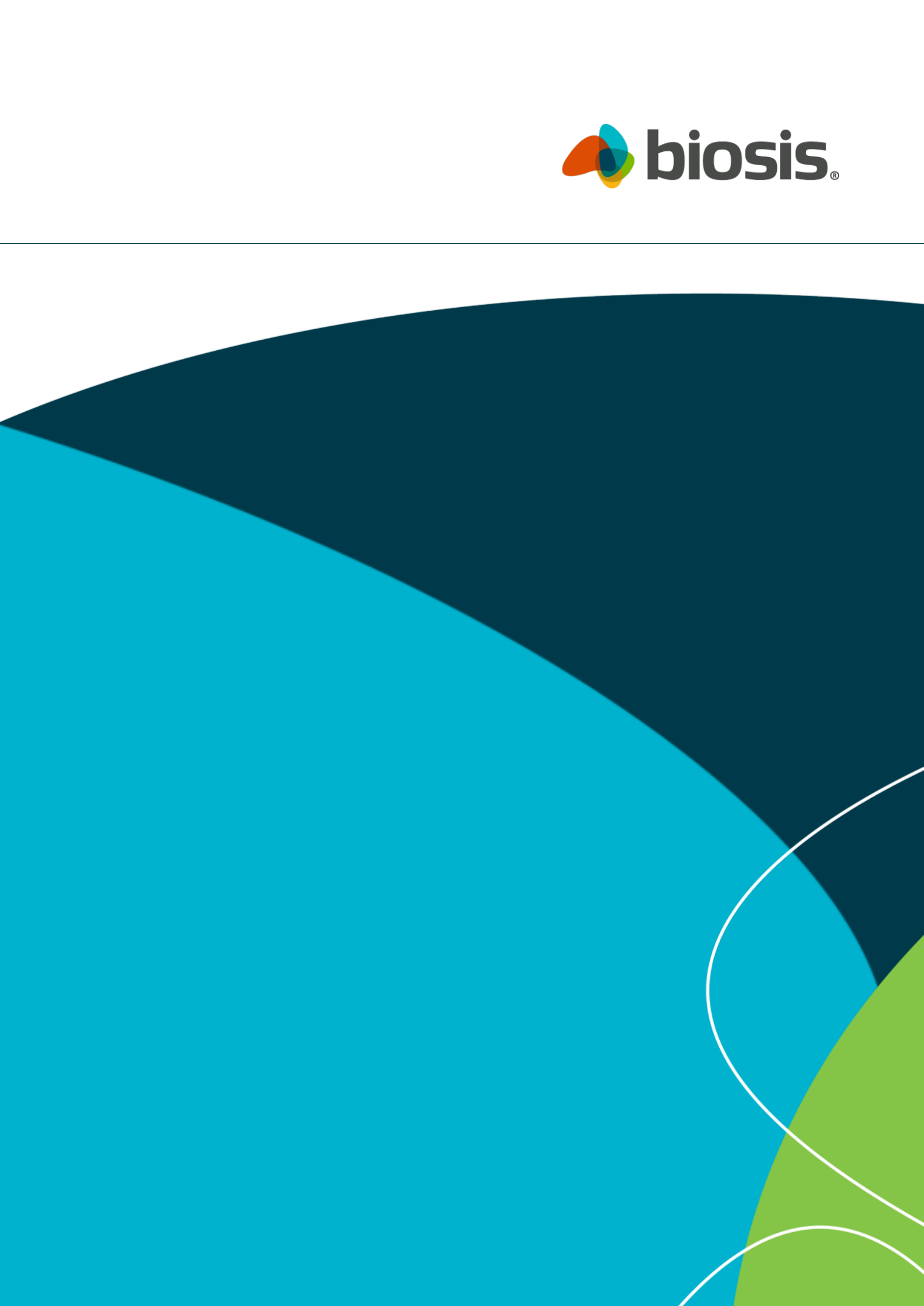

Bird & bat adaptive management plan for Silverton Wind Farm

Prepared for GE Renewable Energy Onshore Wind - Projects and Services

05 May 2018

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Contents

1 Introduction

This Bird and Bat Adaptive Management Plan (BBAMP) for Silverton Wind Farm has been prepared in response to items in condition 17 and 19 of schedule 3 of the third modification of the project approval ('condition 17 and 19 of schedule 3 of the MOD 3 project approval') which was issued by the Planning Assessment Commission of NSW on the 22 December 2016 as well as the Statement of Commitments and Section 9.3 of the Environmental Assessment Main Report Part 2 undertaken by NGH Environmental in 2008. The relevant details of condition 17 and 19 of schedule 3 of the MOD 3 project approval are presented in the box below. This BBAMP should be read in conjunction with the Operations Environmental Management Plan (OEMP) which forms part of a set of documents known as the Service Plans.

Condition 17 and 19 of schedule 3 of the MOD 3 project approval is as follows:

Condition 17, Schedule 3

The Proponent must:

(b) ensure wind turbines are located as far as possible, but at least 200 metres, from raptor nests unless the Secretary agrees otherwise;

(e) minimise:

- impacts on the Barrier Range Dragon;
- impacts on threatened bird and bat populations;
- the clearing of native woodland vegetation and fauna habitat, in particular spinifex habitat,
- standing dead trees and woody habitat and high biodiversity value vegetation communities;

Condition 19, Schedule 3

Prior to the construction of any wind turbines, the Proponent must prepare a Bird and Bat Adaptive Management Plan for the project in consultation with OEH to the satisfaction of the Secretary. This program must include:

(a) baseline data on threatened and 'at risk' bird and bat species and populations in the locality that could potentially be affected by the project;

(b) a detailed description of the measures that would be implemented on site for minimising bird and bat strike during the project, including:

- locating turbines as far as possible away from any raptor nests;
- minimising the availability of raptor perches;
- prompt carcass removal;
- controlling pests;
- using best practice methods for bat deterrence; and
- adaptive management of turbines to reduce mortality; and

(c) trigger levels for further investigation of the potential impacts of the project on particular bird or bat species or populations, and the potential implementation of measures to enhance or protect these species or populations in the locality; and

(d) a detailed program to monitor and report on the effectiveness of these measures, and any bird or bat strikes on site.

Following the Secretary's approval, the Proponent must implement the Bird and Bat Adaptive Management Plan, and incorporate it into the Biodiversity Management Plan.

[OEH = Office of Environment and Heritage]

This plan is set out to meet the requirements of the conditions as follows:

- **Section 2** is provided to meet requirements of Condition 19 of schedule 3 of the MOD 3 (a)
- **Section 3** is provided to meet requirements of Condition 17 b) and Condition 19 of schedule 3 of the MOD 3 (b)
- **Section 4** is provided to meet requirements of Condition 19 of schedule 3 of the MOD 3 (c) re trigger levels for potential impacts
- **Section 5** is provided to meet requirements of Condition 19 of schedule 3 of the MOD 3 (d)
- **Section 6** is provided to meet requirements of Condition 19 of schedule 3 of the MOD 3 (c) re potential measures to enhance or protect relevant species.

GE Renewable Energy Onshore Wind – Projects and Services will contract a Certified Environmental Practitioner (contract qualified ecologist) to oversee implementation of this plan.

In its response to conditions 17 and 19 of schedule 3 of the MOD 3 project approval, the BBAMP also address SOC55 (previously SOC46) in the updated Statement of Commitments.

SOC55 (SOC46) Design and implement an adaptive management monitoring program to document bird and bat mortalities, remove carcasses and assess the effectiveness of controls. If the results of assessment demonstrate that further mitigation is required, further turbine ridge habitat modification and enhancement of off-site habitats would be undertaken.

In its response to conditions 17 and 19 of schedule 3 of the MOD 3 project approval, the BBAMP also addresses Section 9.3 of the Environmental Assessment – Main Report – Part 2.

9.3 MONITORING AND ADAPTIVE MANAGEMENT

Monitoring and adaptive management mechanisms will be in place to reduce the operational impacts of the Proposal, should unforeseen impacts result. The Proposal has a degree of flexibility to address unforeseen impacts. Specific management responses will be determined by the nature and extent of impacts, but could include adjustments to the turbines and associated infrastructure or to offsite areas; for example, to install visual screening offsite or habitat enhancement away from turbine locations.

The CEMP and OEMP will employ adaptive management in response to monitoring results and other inputs. Due to the level of detail and site specific investigation required, monitoring programs will not be designed prior to project consent.

However, an indicative program is outlined below to assess the impact of the operational Proposal on birds and bats.

9.3.1 Example: bird and bat impact monitoring

Monitoring methods and data standards for dead bird searches, indirect disturbance impact assessment and habitat avoidance studies will be based on protocols in the Interim Standards for Assessing the Risks to Birds from Wind Farms in Australia (Brett Lane and Associates 2005).

In the case of bird and bat mortality, threshold mortality rates for threatened or sensitive bird and bat species would be determined for three monitoring periods (first six months, first two years, ongoing). The thresholds will trigger a management response, which will vary depending on the nature and extent of the impact.

The OEMP will contain details of a three-tiered monitoring program for bird and bat mortalities and habitat utilisation impacts:

1. First six months of operation

– An intensive period of monitoring required because birds and bats are in the process of habituating to the new

development, and sensitive species may experience higher levels of mortality during this period

– During this period all turbine sites will be surveyed to determine variation in impact over the study area. Surveys may include monthly dead bird searches, bird utilisation surveys, observation of avoidance/diversion behaviour and targeted surveys for species of concern (such as raptors)

– Reporting will examine the impacts on potentially vulnerable species (such as threatened species, waterbirds and raptors)

2. First two years of operation

– Monitoring to assess mortality rates and trends over several seasons and longer term changes to local species abundance, habitat use patterns and possibly breeding success, directed by the results of previous monitoring

– The surveys may be limited to representative or higher risk turbine sites, based on the results of previous monitoring.

– Reporting will examine the impacts on potentially vulnerable species (such as threatened species, waterbirds and raptors)

3. Ongoing monitoring

– Mortality inspection and reporting to be continued for the life of the wind farm, at intervals determined by the results of previous monitoring. The inspection regime may be linked to turbine inspection and maintenance cycles.

Mortalities of any significant species will be reported to DECC.

[DECC: Department of Environment and Climate Change]

2 Baseline information

Information in this section is provided to meet requirements of Condition 19 of schedule 3 of the MOD 3 (a).

Pre-construction surveys for birds and bats at the site of Silverton Wind Farm were undertaken in accordance with *Survey guidelines for Australia's threatened birds. Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2010a) and *Survey guidelines for Australia's threatened bats. Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2010b). As noted in those guidelines, the surveys were designed to determine presence or the probability of presence of various species. They were not designed to establish or assess species abundance or other measures such as quantified flight rates of different species.

Raptor nest mapping and bat observations identified in the below studies undertaken by NGH Environmental (2016; 2018a; b) have been consolidated and identified in the maps at Appendix 4 and Appendix 5.

- Environmental Assessment – Biodiversity Assessment (dated March 2008)
- Baseline bird surveys – pre-construction:
- Spring / Summer Study 2016
- Autumn / Winter Study 2017
- Spring Study 2017
- Autumn Study 2018

The methods used for all baseline surveys are set out in Appendix 6. The cumulative results of the baseline surveys have informed the current plan and its adaptive framework for management of the wind farm, particularly in respect of the risk assessment process set out below. The baseline investigations have documented species of birds and bats at the site and the risk assessment has been applied to them. Further monitoring of the operational wind farm will be undertaken as part of the BACI design of these investigations (see below). The adaptive approach will permit application of the risk assessment process to address any identified new or altered risks for known species or for any additional species found to be using the site.

Bat calls were recorded by NGH Environmental (2016) using automated bat call detectors. The principal objective of that work was to determine the composition of the local bat fauna. Species abundance or flight frequencies cannot be determined from bat calls because there is no known correlation between bat calls and bat activity. Further, as noted by Law *et al.* (2015), natural and sampling variability in detected bat calls tends to be very high with night-to-night variation due to minor weather variables alone being a substantial variable.

Pennay (2017) recommended the inclusion of two additional species of threatened bats in the assessment because it is possible that they might occur at the site of Silverton Wind Farm. They are Corben's Long-eared Bat *Nyctophilus corbeni* and Bristle-faced Freetail Bat *Mormopterus eleryi*.

Ecology and Heritage Partners (undated maps) have documented a small number of additional threatened passerine birds from the site and its environs.

Investigations of the presence and locations of bird and bat species at Silverton Wind Farm site have been established as a Before-After-Control-Impact (BACI) design. It is important that bird and bat surveys continue once the wind farm becomes operational and that the survey methods used prior to construction are continued using the same methods so that results from before- and after construction are appropriately comparable. The survey and study methods are set out in Appendix 6. Surveys prior to construction of the facility include Before and Control components. Studies after commissioning of the wind farm provide After, Control and Impact components. The BACI design is intended to be able to measure changes that may result

from operation of the wind farm. Annual reviews of the results of the BACI studies will be used to refine the adaptive framework of this BBAMP for management of the wind farm.

The NGH surveys for birds and bats have been undertaken at a series of point locations that provide a sample of habitats and environments for birds and bats. Hence, the results they provide are point locations at which relevant species were detected. Their results (NGH Environmental 2016; 2018a; b) show that species of birds and bats 'of concern' have been recorded widely distributed across the site. There is potential that collision risk for various species may differ between turbines and this will continue to be monitored as part of investigations of both bird and bat utilisation (i.e. continuation of baseline monitoring) and of bird and bat collisions, as set out in this plan. In accordance with the adaptive management framework, responsive actions will be implemented as necessary. We note, that the international and Australian literature includes a number of studies of raptors that have demonstrated that presence and even rates of utilisation are poor predictors of collision risk (Madders & Whitfield 2006; de Lucas *et al.* 2008; Ferrer *et al.* 2012; Hull et al. 2013).

NGH Environmental (2016, 2018b) provided methods and qualitative assessment of risk for listed threatened and migratory species of birds and bats known from the site and its environs. They included Rainbow Bee-eater as a species listed as migratory under the EPBC Act. It is no longer listed under that provision of the Act.

NGH Environmental (2016) also applied the risk assessment to additional species of raptors and some bats that are not threatened. Risk assessment for these additional species was undertaken particularly because it is considered that their flight behaviours may put them at a greater risk of collisions than most other taxa.

NGH Environmental (2016, 2018b) developed and applied a risk matrix for individual species of birds and bats that incorporates probability that the wind farm might alienate birds or bats from habitats at the wind farm and the likelihood that particular species might collide with turbines. Risks were ranked as Low; Medium or High on the basis of a set of defined likelihood and consequence factors. The risk assessment applied by NGH Environmental (2016, 2018b) indicates that collision or barotrauma due to interaction by birds or bats with turbines represents a greater risk than does the possibility that the wind farm might alienate birds or bats from their habitats or that it might present a barrier to their movements. Empirical evidence from operational wind farms in Australia supports this approach, as collisions by some species certainly occur, but there is no known documentary evidence for wind farm infrastructure resulting in alienation of Australian species of birds or bats. For that reason, this Plan is substantially concentrated on management to reduce effects of turbine collisions.

It is important to note that the assessment of turbine collision risk relates to the probability that particular species may collide with turbines. It is not an indication of the likelihood that collisions might represent a significant impact on the population of any species.

The risk matrix used by NGH (2016, 2018b), with three risk levels: Low, Moderate and High, assigned based on the likelihood, is replicated as Table 1, below.

Table 1 Risk matrix [from NGH (2016)]

Likelihood	Consequence			
	Insignificant	**Minor**	**Moderate**	**Significant**
Rare	Low	Low	Moderate	High
Unlikely	Low	Low	Moderate	High
Possible	Low	Moderate	High	High
Probable	Moderate	High	High	High

Descriptions of likelihood and consequence factors for birds and bats, as used by NGH (2016), are set out in Table 2.

Table 2 Likelihood and consequence descriptors used in the NGH risk matrix

Likelihood	Description	Consequence	Description
Rare	An impact may occur only in unusual circumstances	**Insignificant**	Impact on species not detectable in the short term
Unlikely	An impact might occur at some time	**Minor**	Impact may cause non-significant changes to local abundance of some species
Possible	An impact could occur during most circumstances	**Moderate**	Impacts may cause significant changes to local abundance of species
Probable	An impact is expected to occur in most circumstances	**Significant**	Impacts may be significant at a population scale

Table 3 uses the NGH Environmental (2018b) revised collision risk assessment applied to listed threatened and migratory bird and bat species, including species from all sources noted above, that are considered to have potential to use the site and to the non-threatened species included in the assessment of NGH Environmental (2018b).

The risk assessment is qualitative (i.e. it is not quantitative in the manner of mathematical collision-risk modelling) and is indicative about potential risk for particular taxa. It has been used to determine three categories of taxa that are considered to be at a level of risk (listed species, non-threatened raptor species; and other non-threatened species) during operation of the wind farm. For this reason, the triggers in this BBAMP apply to *any* taxa in those categories regardless of current predictions of risk.

This BBAMP is applicable to all the taxa listed in Table 3. It also applies to any species subsequently found to occur at the site and that are listed as:

- threatened or migratory under provisions of the EPBC Act;
- threatened on schedules of the NSW *Biodiversity Conservation Act* 2016; and,
- non-threatened species of 'at-risk' birds and bats that were not previously known or predicted for the site and/or have not been the subject of a risk assessment.

For the purpose of this plan, these are collectively termed 'species of concern'.

Table 3 Qualitative assessment of turbine collision risk for birds & bats at Silverton Wind Farm

EPBC = *Environment Protection & Biodiversity Conservation Act* 1999; BAC = *Biodiversity Conservation Act* 2016

Species		Conservation status	Collision risk
Birds			
Freckled Duck	*Stictonetta naevosa*	Vulnerable BCA	Moderate
Black Kite	*Milvus migrans*		High
Square-tailed Kite	*Lophoictinia isura*		Moderate
Black-breasted Buzzard	*Hamirostra melanosternon*	Vulnerable BCA	High

Species		Conservation status	Collision risk
Collared Sparrowhawk	*Accipiter cirrocephalus*		Low
Little Eagle	*Hieraaetus morphnoides*	Vulnerable BCA	High
Wedge-tailed Eagle	*Aquila audax*		High
Spotted Harrier	*Circus assimilis*	Vulnerable BCA	High
Brown Falcon	*Falco berigora*		High
Nankeen Kestrel	*Falco cenchroides*		Moderate
Grey Falcon	*Falco hypoleucos*	Endangered BCA	Moderate
Pink Cockatoo	*Lophocroa leadbeateri*	Vulnerable BCA	Moderate
White-throated Needletail	*Hirundapus caudacutus*	Migratory EPBC	Moderate
Rufous Fieldwren	*Calamanthus campestris*	Vulnerable BCA	Low
Redthroat	*Pyrrholaemus brunneus*	Vulnerable BCA	Low
Pied Honeyeater	*Certhionyx variegatus*	Vulnerable BCA	Moderate
Painted Honeyeater	*Grantiella picta*	Vulnerable BCA	Moderate
White-fronted Chat	*Epthianura albifrons*	Vulnerable BCA	Low
Hooded Robin (SE form)	*Melanodryas cucullata*	Vulnerable BCA	Low
Varied Sittella	*Daphoenositta chrysoptera*	Vulnerable BCA	Low
Dusky Woodswallow	*Artamus cyanopterus*	Vulnerable BCA	Low
Diamond Firetail	*Stagonopleura guttata*	Vulnerable BCA	Moderate
Bats			
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*	Vulnerable BCA	High
Gould's Wattled Bat	*Chalinolobus gouldii*		Moderate
Little Pied Bat	*Chalinolobus picatus*	Vulnerable BCA	Moderate
Corben's Long-eared Bat	*Nyctophilus corbeni*	Vulnerable EPBC & BCA	Low
Inland Forest Bat	*Vespadelus baverstocki*	Vulnerable BCA	High
Bristle-faced Freetail Bat	*Mormopterus eleryi*	Endangered BCA	Low
White-striped Freetail Bat	*Tadarida australis*		High

3 Significant impact & trigger levels

Information in this section is provided to meet requirements of Condition 19 of schedule 3 of the MOD 3 (c) in relation to trigger levels for potential impacts.

3.1 Guiding principles for determining significance of impacts

While the most desirable outcome for Silverton Wind Farm is that it will operate without any negative effect on birds and bats, it is recognised that some impact is likely to occur.

The overarching objective will be that the wind farm does not have a significant impact on the viability of the population of any species. It is worth noting that density dependence is an important ecological concept of relevance for consideration of effects on viability of wildlife populations. In essence, the size of any natural population is regulated by availability of resources to support it. This will include food, breeding sites, roost sites, mating opportunities, etc. all of which in combination represent 'habitat' for the species in question. Where an impact removes habitat the population will be reduced as a direct consequence. However, where the key resources for the species are not reduced and the population is otherwise stable, the mortality of one individual makes resources available to another whose survival prospects are improved and the net result is that the size of the population is not altered. Construction and operation of Silverton Wind Farm will have little impact on resource availability for most species of birds and bats and mortalities due to turbine collisions can be expected to function in accordance with density dependence with little influence on the equilibrium of affected populations.

Various guidelines published by the Commonwealth for application of the EPBC Act offer some principles of value in consideration of impacts on populations. Significant impact guidelines for threatened and migratory species listed under the EPBC Act are contained in *Matters of National Environmental Significance: Significant impact guidelines 1.1 Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth of Australia 2013), which also provides criteria for what might constitute a 'significant impact'. However, the criteria are not quantifiable in numbers of individual animals and only two of the species of concern for Silverton Wind Farm are listed under the EPBC Act.

The *EPBC Act Policy Statement 2.3 Wind Farm Industry* (Commonwealth of Australia 2009) provides some further explanation and examples relative to potential effects of the wind industry. The following excerpt is useful in its indication that the risk should be considered as proportional to the population size of particular species:

> *"An activity that affects, or is likely to affect, a small number of individuals usually would not be expected to have a significant impact on the species as a whole. However, when a species or community is in small numbers nationally, or its distribution or habitat is limited, or if the habitat has particular importance for the species, the activity could have a significant impact. In general, this would apply to species or communities that are most at risk of extinction and are, as such, listed as critically endangered or endangered.*
>
> *An action is likely to have a significant impact on a species listed as vulnerable where it significantly affects an important population of that species. An example might be where a wind farm is proposed on an island or headland, or near a wetland, that has a key breeding population of a bird species listed as vulnerable. The breeding frequency and success rate for that species would also be relevant considerations."*

None of the species of concern at Silverton Wind Farm are covered by *Draft referral guideline for 14 birds listed as migratory species under the EPBC Act* (Commonwealth of Australia 2015a), nonetheless it is provides further

guidance in that it considers that a significant impact would entail mortalities equalling or exceeding 1% of the population of a species and that further investigation would be required if it equalled or exceeds 0.1% of the population.

The Commonwealth guidance documents clearly indicate that the level of impact that may be significant is based on the measure of change that may be experienced by the population of a threatened or migratory species. This 'population' approach is ecologically meaningful as it responds appropriately to the population sizes of different species. Ideally, it would be possible to consider a number of turbine collision mortalities for a particular species as a proportion of its entire population and determine numbers and frequency of collisions that would warrant management response(s) according to whether they represent an ecologically important influence on the population's viability (Smales 2017). That approach requires good estimates for the population sizes of relevant species. However, accurate population estimates are not available for any of the species of concern for Silverton Wind Farm.

At present there is little published information about rates of bird and bat fatalities at Australian wind farms. The only published peer-review information is from two Tasmanian wind farms with a combined total of 62 turbines that were monitored for different periods but over a total span of eight years (Hull *et al.* 2013; Hull & Cawthen 2013). They detected 245 bird carcasses and 54 bat carcasses during a total of 12,908 searches. It is important to note that due to sampling methods their detection rates do not equate to total numbers of collision fatalities that may have occurred. Nonetheless, extrapolating from their samples it appears unlikely that total collision fatalities represent significant impacts on the population viability of any species.

It is considered to be extremely unlikely that bird and bat fatalities due to collisions by any species at Silverton Wind Farm will be sufficient to represent a significant impact on the species overall population (e.g. to equal or exceeding 1% of the population of any species).

Baseline and post-construction studies of birds and bats at Silverton Wind Farm are aimed at detecting changes in distribution, abundance and activity (collectively termed 'utilisation') of these groups. Multiple variables external to operation of the wind farm, including land management practices, weather and climate are all likely to affect the local utilisation by birds and bats and the levels of collision mortalities of this fauna at other large wind energy facilities in Australia suggests that they are routinely too low and rare to be detectable by utilisation studies. For that reason, the discussion below about trigger levels for management response(s) at Silverton Wind Farm are defined by numbers of mortalities that may be actually detected by carcass searches, rather than by the indirect measures obtainable from utilisation studies. Nonetheless, the BACI bird and bat utilisation monitoring will remain important as a means to assess whether changes in species composition occur after the wind farm becomes operational and will be analysed to ascertain whether changes in utilisation by any species can be discerned.

3.2 Trigger levels for management responses to bird & bat collisions at Silverton Wind Farm

In the absence of population estimates for bird and bat species at Silverton Wind Farm, it is necessary to determine levels of collision mortality that represent levels that will trigger management responses measured by numbers of detected bird and bat collisions with turbines. As outlined above, the significance of any collision mortalities that may occur will differ according to the abundance and population dynamics, as well as the level of threat, for various taxa. Collision mortalities that might occur for any given species can be expected to fall into one of two levels depending upon the number and frequency at which they occur:

1. The number of collisions per annum is low and is unlikely to have any meaningful ecological effect on the local population

2. The number of collisions per annum represents a low, but uncertain potential to result in a negative effect on the local population

If the number and frequency of any detected collision mortalities is low and is unlikely to have any meaningful ecological effect on the local population (i.e. it does not exceed level 1, above), no action is required.

Triggers for responsive management actions will apply where the number of collisions per annum represents a low, but uncertain potential to result in a negative effect on the local population (level 2, above). The response is thus precautionary as it will be implemented at levels substantially below numbers of fatalities that are considered likely to represent a significant impact on the viability of the overall population of any species.

Defined trigger levels are set out below. For consistency, trigger levels are similar to those that have been adopted in other recently approved BBAMPs for wind energy in N.S.W. (e.g. White Rock Wind Farm (Brett Lane & Associates 2017)). The levels will be used, if required, as triggers for implementation of adaptive management aimed at reducing impacts to a level below the set trigger levels.

Trigger levels are for numbers of bird and bat fatalities detected during carcass searches (see Section 5, below). It is important to note that the number of fatalities detected by searches will almost certainly not represent the total number of animals killed because searches rarely detect all carcasses and because some carcasses will be removed by scavengers before they can be found. These effects are well known and there is an existing science for determining estimates of total mortalities from numbers of mortalities detected during searches (e.g. Huso *et al.* 2017). While estimation of total numbers of collision fatalities is important and will be undertaken for Silverton Wind Farm, the small numbers of collisions that generally occur at wind farms in Australia most often result in estimates of total mortality with very large confidence intervals (usually using 95% C. I.). For that reason, extrapolated estimates of total mortality do not provide a sound basis for use as trigger levels.

NGH Environmental (2016) allocated predicted risk of collisions for a range of bird and bat species, primarily for threatened species, but also including all raptors and some non-threatened taxa believed to be at high risk. That information, updated to include some additional species, is replicated as Table 3 (Section 2) of the current plan. Experience at the operational wind farm will tell whether additional species are at risk of collisions. Trigger levels are set here for three groups of species according to their differing conservation status and their relative natural abundance. The trigger levels will apply for all taxa that may use the site, regardless of whether they are included in Table 3, and for any species that are listed as threatened in future. For the purposes of this plan the following trigger levels will apply:

Listed threatened species

A trigger-level impact will occur where any carcass; featherspot; or injured individual of a single threatened species is found under or close to a wind turbine during any mortality search or incidentally by wind farm personnel.

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

Non-threatened raptor species

A trigger-level impact will occur where more than three carcasses or featherspots of a single non-threatened raptor species are detected during carcasses searches in any two consecutive months.

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

Other non-threatened species (including species listed as migratory but not threatened)

A trigger-level impact will occur where more than four carcasses or featherspots of a single non-threatened species are detected during formal searches and/or incidentally in the period of any two consecutive months.

In line with other approved BBAMPs in N.S.W., trigger levels will not apply to any introduced species.

The decision-making process shown in Figure 1 will be implemented where a trigger-level has been reached for a species of concern.

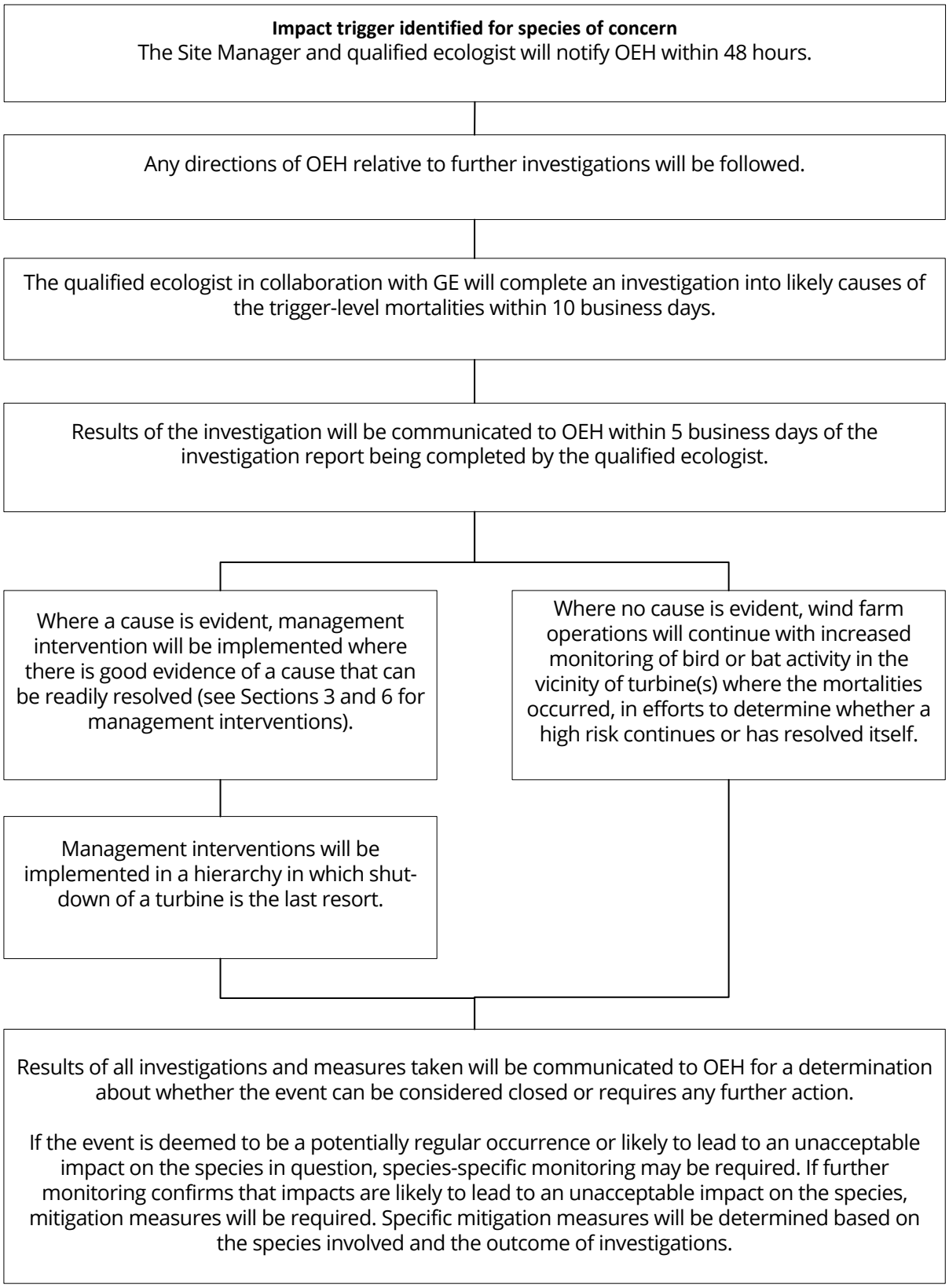

Figure 1 Measures to be implemented in the event of reaching a trigger-level

4 Monitoring strikes & effectiveness of impact minimisation

Information in this section is provided to meet requirements of Condition 19 of schedule 3 of the MOD 3 (d).

Assessment against trigger levels will require a program for monitoring collisions in a sample of years. This will entail a regime of searches for dead birds and bats under turbines.

The following important principles have guided the design of studies described here:

- To the extent possible, they should be simple and minimise extraneous variables.
- In order to maximise their potential to meet stated objectives, they should obtain the largest sample sizes that are practicable.
- They must be able to be implemented without significantly compromising the routine operation and management of the wind farm.

The monitoring program set out here is designed to provide information about trigger levels and to inform estimates of total annual numbers of collisions, with associated confidence intervals, for all bird and bat species of concern.

4.1 Monitoring of turbine collisions

4.1.1 Carcass search method

Purpose-trained dogs have been shown to be highly efficient at detecting carcasses (Mathews *et al.* 2013) and have been used for this purpose at a number of wind farms in in Australia. Using purpose-trained dogs obviates the need for formal transects to be established in the search zones as dogs use scent to detect carcasses and are permitted to roam to do so. Every dog will be fitted with a GPS tracking device while undertaking searches. GPS tracks will be downloaded and maintained for future reference and used for analyses of search effort and coverage. GIS maps showing routes taken by dogs will be made available to OEH on request. The use of trained dogs is the preferred method for searches and will be used, provided appropriately trained dogs and handlers are available. Dog handler(s) must have demonstrated capacity to identify bird and bat species of western NSW.

However, if the use of dogs is not practicable at the Silverton site the alternative is to use people. Human observers will search by walking transects through the search zones. Searches by people will be undertaken by ecologists with demonstrated capacity to identify bird and bat species of western NSW. Transects will be spaced 6 metres apart, or as near to 6 metres as is practical and observers will thus search the ground for 3 metres either side of each transect. Each observer will carry a hand-held GPS unit and record transects they walk. GPS tracks will be downloaded and maintained for future reference and used for analyses of search effort and coverage. GIS maps showing transects walked will be made available to OEH on request.

4.1.2 Fall zone and estimation for unsearchable zones

Hull and Muir (2010) provide the sizes of likely fall zones for different turbines and sizes of birds and bats based on ballistics theory. They note that distance from the base of a turbine is an important factor in dispersion of carcasses and that with increased distance the density of carcasses decreases. They provide modelled fall zones and radii for percentages of expected distribution for two size classes of birds and one for small bats. Huso and Dalthorp (2014) compared five estimators for the relationship of carcass density to distance from modern wind turbines. For all five estimators tested they found that density approached zero at about 70 metres horizontal distance from the turbine base.

The greatest capacity to detect carcasses is obtained from intensive searches of defined areas of the potential fall zones and the most valid estimates of mortality come from distance-based carcass-density models (Huso and Dalthorp 2014). Because the densities of carcasses diminish with horizontal distance from a turbine, searching of large areas including the outer extremities of potential fall zones were shown by those authors to add little to detection rates but to add very substantially and disproportionally to search effort. Hence, intensive searches of the portion of the fall zone in which the majority of carcasses will be found are the most effective and appropriate. The great majority of birds and bats that may be involved in turbine collisions at Silverton Wind Farm are expected to be found within a radius of 70 metres of the bases of turbines.

The immediate areas around many turbines at Silverton Wind Farm include drop-offs and highly dissected rocky ground. Searches of the entire 70 metre radius under turbines by people or by handlers and dogs would entail substantial occupational health and safety risks. This is common to many wind farms internationally and Huso and Dalthorp (2014) and Huso *et al.* (2017) provide sound methodology for extrapolation from areas under turbines that are able to be searched safely. Each turbine at Silverton Wind Farm has an approach road and a hardstand of approximately 2300 square metres area. These clear areas will be readily searchable and searching them under all turbines in a given search regime (see 5.1.3, below) will introduce a uniformity to the search regime that would not otherwise be available. Therefore the search program will be confined to coverage of these clear areas out to a distance of 70 metres from the base of each turbine. Under the majority of turbines the access road passes alongside the turbine and the searchable zone will thus extend out to a 70-metre distance in two directions along the road. Where a turbine is situated at the end of a road, the 70-metre distance will extend only along that distance of the approach road. The extent of the 70-metre radius from the base of each turbine will be permanently marked on relevant roadsides. Current peer-review methods will be used to extrapolate from the numbers of carcasses detected within the defined searchable areas under turbines to provide an estimate of the number of carcasses likely to have fallen within the entire fall-zone under each turbine.

4.1.3 Turbines to be searched

Searches will be undertaken at all 58 turbines during an initial period that will encompass the first six months from November 2018 to April 2019, inclusive. This period covers the annual duration of heightened activity by bats and the breeding season of many birds. Subsequently, and in order to maximise capacity to provide statistically meaningful sample sizes and because collisions with turbines are likely to be infrequent events for the species of concern, carcass searching will be carried out under half of the total complement of 58 turbines. The selected 29 turbines will be searched over two consecutive months, 15 in one month, 14 the next and these will be allocated proportional to the total number of turbines situated within different vegetation zones, but otherwise will be selected at random. This may be varied if searches during the initial six months indicate that particular turbines represent significantly higher risk than others. Pre-construction bird surveys do not provide data sufficient to indicate 'higher-risk' zones but if searches during the initial six months do indicate higher risk associated with particular turbines, then such turbines will preferentially be included in the selection of turbines for on-going monitoring. The selection of turbines to be searched will be made at completion of the first six months of monitoring and will then be used throughout the remainder of the study.

4.1.4 Search duration and frequency

The regime of carcass searching will run for two years and will commence when all turbines are commissioned and become operational at the wind farm. At the completion of the first year of the monitoring program results will be collated and an interim report will be prepared. The results will be provided to OEH and in collaboration with OEH a determination will be made about any changes to search duration and/or frequency that might be made to improve effectiveness of the monitoring program. At the conclusion of the two year program and after analyses of results, a review will be undertaken in collaboration with OEH to determine whether any further monitoring is warranted.

It is likely (but uncertain at present) that carcasses of bats and small birds will be scavenged quickly at the site. Carcass persistence trials will be undertaken during the course of the study (see below), particularly to inform analyses required to extrapolate from numbers of carcasses detected to estimate total number of collisions. In order for the search regime to accommodate the likelihood of rapid scavenging, a relatively short period between initial searches is important.

A primary purpose of the search regime is to ascertain the frequency at which collisions occur. This is necessary for use in extrapolation to estimate total fatality rates. A three-day interval between two searches in each search cycle is designed to provide good capacity to determine frequency of collisions, because there is a high probability that a carcass found on day four must have collided in the preceding three days.

In each month when a turbine is to be searched, one search will be undertaken followed by a second search three days later. The frequency of carcass searches may be altered from the regime set out here if results of carcass persistence trials (see Section 5.1.6, below) indicate the value of doing so. The regime may be altered only if approval is first obtained from OEH.

4.1.5 Carcass & data collection & management

During all searches, all species of birds and bats detected as carcasses or as bird featherspots, will be recorded on a data pro forma designed for the purpose (see Appendices). Ideally, data will be collected on-site using electronic tablets which will maximize efficiency in data management. A featherspot is any collection of five or more feathers found grouped together in a manner that suggests a bird has died at the location. All information, including metadata for each turbine search will also be recorded irrespective of whether a carcass is found during a given search. All data will be entered into a single (backed-up) database to be maintained by the wind farm operator. Raw data will be available to relevant regulatory authorities on request.

On finding a carcass, it will be photographed in situ and its location will be logged using a portable GPS device. Carcasses of all taxa, whether species of concern or not, will be collected, labelled with relevant data details and frozen to permit any necessary investigations of cause of death and/or for use in future searcher efficiency or persistence trials. A freezer for this purpose will be available on-site. At the conclusion of the overall investigation, all specimens will be made available to the Australian Museum.

Retrieved carcasses of common species may be used later for scavenger trials and as the presence of human scent may influence scavenging rates, it is best to avoid direct human contact. Therefore, to avoid human scent being imparted to a carcass, and for health and safety reasons, gloves must be worn when handling bird and bat carcasses.

Table 4 Turbine carcass search regime

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
Engage dog-handler or human observer team(s) with experience at undertaking carcass searches at wind farms.	Prior to the commissioning of the wind farm; ongoing	Use human observers where a dog handler team is not available	Provide the company details and names of contractors to OEH	GE & contracted qualified ecologist	Determine the best method for conducting carcass searches in the Silverton Wind Farm environment	Demonstrate consideration of both dog handler or human observer search options
Train dog-handler / human observer teams on how to undertake the carcass searches and collect the requisite information	Prior to the commissioning of the wind farm; ongoing	N/A	N/A	GE & contracted qualified ecologist	Ensure the search team is inducted and qualified to conduct carcass searches in the Silverton Wind Farm environment	Record the date of induction
Undertake turbine collision carcass searches at 29 turbines (15 turbines in one month, 14 turbines in the next month) using a dog-handler team or human observers	Over two-month cycle. In each month when a turbine is to be searched, one search will be undertaken followed by a second search three days later. Commencing post-construction and at commissioning of all wind turbines. Operating for two years	Use human observers where a dog handler team is not available	Carcass search/mortality raw data will be provided with annual reports	GE to appoint search team. Qualified ecologist to oversee searches. GE & qualified ecologist to prepare & submit reports	Determine the number of carcasses found. These will be used in conjunction with the results of the carcass persistence trails to determine estimated annual strike rate	Documented number of carcasses detected for each species. Documented search frequency and effort.
Collection, recording, storage & carcass disposal	On discovery of any featherspot or collision carcass	N/A	As above	All personnel who detect carcasses	Reduce the instance of carcasses attracting raptors by disposal or storage of carrion for further investigation	Using turbine mortality data sheet

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
Review carcass search regime	After first full year of operation	Refine program if necessary in light of first year results.		GE; contracted qualified ecologist; OEH	Document all findings in annual report and review with OEH and ecologist	Submission of report to OEH
A freezer will be available for the purpose of storing bird and bat carcasses	Prior to the commissioning of the wind farm and on-going	Freezer must be large enough to accommodate large birds such as eagles	N/A	GE	Allow the Australian Museum the opportunity to conduct an autopsy of the carcasses as required	Correspondence with Australia Museum
Apply for a permit under the *Biodiversity Conservation Act 2016* to collect and store bird and bat carcasses	Prior to the commissioning of the wind farm and on-going	Permit must be updated regularly to include the all searchers, qualified ecologist(s) and wind farm personnel who find carcasses while on site.	Any reporting conditions attached to the permit must be followed	GE; contracted qualified ecologist	Permission to collect and store carcasses in order to reduce the instance of carcasses attracting raptors by disposal or storage of carrion for further investigation and determine strike rates	Timely permit application to OEH under the *Biodiversity Conversation Act 2016*
Identify and collect all dead bird and bat carcasses upon discovery and complete data sheets for each carcass collected	During turbine collision carcass searches and for any birds and bats found incidentally by site personnel	Any species that cannot be identified on site will be lodged with the Australian Museum for identification using reference specimens. This may be particularly applicable to feather spots.	A carcass search/mortality report will be provided annually to OEH as part of Annual Bird & Bat Management Report	Contracted qualified ecologist	Document all bird and bat carcass discoveries for the purpose of further investigation and to determine whether trigger levels have been reached	Completed turbine mortality data sheets for all collected bird and bat carcasses, logged in the annual report

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
Appropriately label and store bird and bat carcasses	During turbine collision carcass searches and for any birds and bats found incidentally by site personnel	Specimens must be kept until positively identified to species and be made available for OEH officers on request and be made available to the Australian Museum prior to disposal	Develop a database of carcasses collected on the wind farm site, noting whether they have been retained, disposed of or donation	Contracted qualified ecologist	Allow for species identification, review by OEH and the Australian Museum the opportunity to conduct an autopsy of the carcasses as required prior to disposal	Documented notification correspondence to OEH and the Australian Museum

4.1.6 Carcass persistence trials

Carcasses of bird and bats that collide with turbines may be removed by scavengers or will ultimately disappear due to decomposition. Carcass persistence affects the detection of dead bats that collide with turbines and consequently influences estimation of the total number of fatalities for each species.

Trials to determine persistence time of carcasses are required to derive correction factors necessary to estimate total fatalities from the results of the carcass searches. Two persistence trials will be undertaken in each year of the monitoring regime, one in each of spring and autumn.

Remote cameras will be used to record persistence of carcasses placed on-site for the purpose. Carcasses for the trials will be sourced from bird and bat carcasses found at the site or from other local sources, such as roadkills. It is vital that species used are representation of the bird and bat fauna of Silverton Wind Farm. Carcasses used for trials will be individually marked to ensure they are not confused with collision carcasses. Individual marking allows trial carcasses to be identified if they are simply moved by scavengers. Radio-frequency identification (RFID) microchips inserted into carcasses will be used to provide individual identification. Cameras used for the purpose will be set to take a photograph every hour (day and night) and also when triggered by movement and infrared. This method has been demonstrated in Victoria to be highly efficient and substantially reduces potential influence on scavengers as may occur when human observers visit frequently to check carcasses. Cameras are deployed and left to operate for the duration of the trial and this entails substantially less effort than having people check carcasses daily. Cameras have the additional advantage of recording the precise time of carcass removal and the species of scavenger that removes a carcass. As a result of the precise documentation of the time of carcass removal there is no need to estimate the period of carcass persistence which is required when carcasses are checked only at an intervals of several days. Censored analysis will be required when carcasses persist beyond the trial period (Klein & Moschberger 2003).

The field of view of cameras is limited and scavengers can simply move a carcass out of that view. In order to check for this, each trial will commence approximately one week before the next routine search for carcasses.

In each trial, a total of 10 carcasses of birds and 10 carcasses of bats will be distributed under 20 randomly-chosen turbines across the wind farm. Each trial will be run for up to one month, but cameras will be checked after two weeks to check on their operation and at that point the trial may be terminated if the carcass has been removed or a second carcass may be placed to increase the sample size of the trial.

The results of these trials will permit average carcass persistence times to be determined. The resulting persistence rates will be used in analyses to estimate total numbers of collisions.

Table 5 Carcass persistence trials

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
Implement scavenger trials	One trial in each of spring & autumn in each of two years. Each trial to run for 30 days	Scavenger trial may need to be adjusted/adapted following field trials Alternative carcass substitutes may need to be sourced depending on availability	Collect and maintain all data associated with the persistence trials	Contracted qualified ecologist	To determine the rate that bird and bat carcasses are being scavenged by predators. These will be used in conjunction with the results of the carcass searches in order to calculate the estimated number of collisions	Completed carcass persistence trial data sheets, calculation of average persistence times and estimated total number of collisions

4.1.7 Searcher efficiency trials

Searchers do not routinely find all carcasses, so it is necessary to ascertain the efficiency of searches in order to determine and apply appropriate correction factors for carcasses missed to inform estimation of total collision mortality for species of concern.

The efficiency of each dog or person undertaking searches will be determined by the use of blind trials. Without the prior knowledge of searchers, a known number of bat carcasses will be placed within search plots prior to routine searches. Carcasses will be placed in sufficient numbers, at a range of turbines and over sufficient time to permit the rate of carcass detection to be adequately determined. After the trial the person who placed the carcasses will collect any that has not been detected and document whether any have been scavenged to ensure accuracy of the searcher efficiency trial. The number and type of carcasses found during the searcher efficiency trials will be compared with the known number of and type of carcasses placed under the turbines.

Two searcher efficiency trials will be undertaken for each searcher in each year of the monitoring regime, one in each of spring and autumn.

Carcasses for the trials will be sourced from bird and bat carcasses found at the site or from other local sources such as roadkills. It is vital that species used are representation of the bird and bat fauna of Silverton Wind Farm. Carcasses used for the purpose should be marked to ensure they are not confused with previously undetected collision carcasses, but in a manner that does not draw the attention of the searcher.

At any time that new search personnel or dogs are employed to undertake searches the rate of their detection ability must also evaluated by a searcher efficiency trail as detailed here.

Table 6 Searcher efficiency trials

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
Undertake searcher efficiency trials	One trial in each of spring & autumn in each of two years	As required when any new people or dogs are employed for searches	Collect and maintain all data associated with the searcher efficiency trials	Contracted qualified ecologist	Determine the efficiency of searchers in order to confirm the validity of the turbine carcass search regime	Trial dates and findings are recorded and reported in the annual report, and used to assist in the review of the monitoring program

4.1.8 Incidental finds of bird and bat carcasses

It is possible that during the life of the wind farm, birds and bat carcasses will be discovered incidentally by site personnel. Therefore, all site personnel will be trained on procedures for the event in which they encounter dead or injured birds and bats. Upon incidental discovery, carcasses and featherspots must be photographed *in situ*. However, the carcass or featherspot must be left where it was found in order not to introduce bias to detection rates of the official search regime. Any member of the site personnel who finds a carcass of a bird or bat must complete the relevant carcass data sheet (see Appendices). Copies of carcass data sheets must be available on site for use by all site staff.

Table 7 Requirements for the incidental discovery of carcasses

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
Training of site personnel on procedures for bird and bat carcasses found incidentally	Prior to the commissioning of the wind farm and ongoing	N/A	All incidentally found carcasses and featherspots will be reported to OEH as part of Annual Bird & Bat Management Report	All site personnel; contracted qualified ecologist	Site personnel are inducted to understand the procedures regarding carcass discovery and the possible ramifications for not following this procedure	Inductions have been completed for all site personnel and date of attendance has been recorded.
Photography of incidentally encountered bird and bat carcasses; completion of relevant data form	On discovery of any featherspot or collision carcass	N/A	As above	All personnel who incidentally detect carcasses	Ensure detailed data and photos are captured and recorded	Completed dead or injured bird/bat data sheet, also recorded in the annual report

4.2 Analyses of results

Trigger levels for all species of concern will be determined directly from results of collision mortality searches.

Estimates of the annual total number of collision mortalities for all species of concern will be undertaken using current best-practice science to account for searched areas; carcass persistence times and searcher efficiency rates. Along with the estimates, 95% confidence intervals will be determined as a measure of variance around the estimates. Current best-practice (2017) for these analyses are provided by Huso *et al.* (2017) (see also Huso and Dalthorp 2014; and Dalthorp *et al.* 2017). The analyses will be undertaken by a biometrician with a thorough understanding of the relevant science. In Australia, Symbolix Pty Ltd has developed relevant mathematical algorithms and has experience in provision of appropriate analyses.

A report, including results and analyses, for each of the two years of the study will be prepared and provided to OEH using the below calculation.

Trigger levels will be quantified as the (1) mean number of detected strikes per species per turbine per annum and (2) total estimated number of strikes per species per turbine per annum, with 95% confidence interval. Values for (2) calculated using all the necessary factors such as proportion of turbines searched; portion of fall-zones searched, search frequency; average carcass persistence time; searcher efficiency rates etc.

Table 8 Analyses of results

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
Determine collision results relative to trigger levels	Following each search cycle	N/A	Report to OEH within 2 working days if a trigger level for any threatened species is reached	GE; contracted qualified ecologist	Determine whether a trigger level has been reached, and if so initiate the Decision Making Framework process at Figure 1	Results exceeded trigger levels have been reported to OEH within 48 hours Other results have been reported within 10 business days
Calculate mean rates of searcher efficiency and carcass persistence, relevant for all species of concern	Within 3 months of the completion of monitoring, including trials for the year, in year of the monitoring program	N/A	Provide as inputs to subsequent analyses	Contracted qualified ecologist; statistician to analyze data	Determine mean searcher efficiency and carcass persistence rates for use in calculations of overall collision estimates	Results have been reported to OEH within 10 business days
Use mean scavenge and searcher efficiency rates in combination with the results of mortality searches to estimate total mortality of all species of concern detected in carcass searches at the wind farm, along with associated 95% confidence intervals.	Within 3 months of the completion of monitoring, including trials for the year, in year of the monitoring program	N/A	Results to be provided to OEH in Annual Bird & Bat Management Report	GE; contracted qualified ecologist	Determine whether a trigger level has been reached, and if so initiate the Decision Making Framework process at Figure 1	Results exceeded trigger levels have been reported to OEH within 48 hours Other results have been reported within 10 business days

4.3 Reporting

Requirements for reporting of results and actions pertaining to this BBAMP are as set out in relevant sections above. GE Renewable Energy Onshore Wind - Projects and Services will be responsible for submission of all relevant reports.

4.4 Injured birds and bats

Injured birds and bats may be encountered during carcass searches or incidentally. Handling injured birds and bats requires specialist skill as there is the risk of injury to both animals and people and there is potential for disease transmission in some cases. Injured birds and bats will only be handled by person(s) authorised under the *Biodiversity Conservation Act 2016*. To reduce the risk associated with Australian Bat Lyssavirus, any injured bats must be handled only by people who have up-to-date rabies vaccination (an appropriate level of antibodies for the rabies virus, based on vaccination, is considered to offer the best available protection against Australian Bat Lyssavirus). The details of any injured birds and bats found will be recorded on a dead or injured bird and bat data sheet (see Appendices).

Prior to implementation of this plan, arrangements must be made with a conveniently located veterinary surgery to ensure that arrangements are in place for acceptance and treatment of any injured birds or bats. As options for treatment of injured wildlife may change over the life of the wind farm, an arrangement must be kept current and current telephone numbers for the surgery and for WIRES Wildlife Rescue must be readily available to all site personnel (e.g. on their mobile phones). Where an injured animal can be readily captured it should be placed into a tied calico bag or a box and kept in a quiet and dark location while it is transported to a veterinarian for treatment. In the event that an injured animal cannot be readily captured site personnel should telephone WIRES Wildlife Rescue (current telephone number is 1300 094 737) for assistance.

A data sheet must be completed as per Section 5.1.8 *Incidental finds of bird or bat carcasses* for any injured bird or bat suspected to have collided with a wind turbine (see Appendices).

Table 9 Requirements for injured birds and bats

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
Ensure only appropriately qualified, trained and vaccinated personnel are engaged to handle injured bats and birds	Appropriate trained staff or contractor to be engaged prior to the commissioning of the wind farm and on-going		N/A	Contracted qualified ecologist; person(s) authorised under *Biodiversity Conservation Act 2016*	Ensure injured wildlife is appropriately care for by qualified staff or contractors by appointing a contractor or inducting staff appropriately	Provide a list of qualified staff and contractors to OEH
Liaise with local veterinary practitioner in preparation for incidence of injured wildlife	Prior to the commissioning of the wind farm and on-going	Veterinarian may be required to euthanize some injured birds and bats	N/A	GE; contracted qualified ecologist	Ensure injured wildlife is appropriately care for a veterinarian as required	Provide a list of engaged veterinarians to OEH

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
Train site personnel on procedures for dealing with injured birds and bats found incidentally	Prior to the commissioning of the wind farm and on-going	N/A	N/A	Contracted qualified ecologist to provide appropriate training	Site Personnel are inducted to understand the procedures regarding injured wildlife and the possible ramifications for not following this procedure	Inductions have been completed for all site personnel and date of attendance has been recorded. A list of qualified staff has been provided to OEH
Complete data sheets for any injured birds and bats found	Injured bats and birds may be found at any time during high intensity or general intensity turbine collision carcass searches or incidentally	N/A	N/A	Contracted qualified ecologist	Ensure all injured birds and bats are reported and action taken is recorded using the dead or injured bat/bird data sheet	Provide a log of all complete data sheets in the annual report

5 Management to minimise impacts on birds and bats

Information in this section is provided to meet requirements of Conditions 17 b) and 19 of schedule 3 of the MOD 3 (c) in relation to potential measures to enhance or protect species of concern.

5.1 Turbine locations relative to raptor nests

Condition 17 b) of schedule 3 of the MOD 3 project approval requires turbines are located as far far as possible, but at least 200 metres from raptor nests.The condition pertaining to distance from any raptor nests was applied during the design phase of the wind farm when siting of turbines was determined. The immediate environs of a nest will have a greater frequency of flights by breeding birds than the wider airspace and siting of turbines away from those zones is a precautionary measure intended to reduce the incidence of flights that may be at increased risk of collision with turbines. Pre-construction surveys located a single Wedge-tailed Eagle nest and the closest turbines (T10 and T11) are sited more than one kilometre to its north-west. Pre-construction surveys have not detected nests of any other raptors.

It is possible that raptors of various species may build nests within 200 metres of a turbine during the operational life of the wind farm. Wind farm operations personnel will be provided with training in the identification of potential raptor nests. If a potential raptor nest is detected within 200 metres of a turbine, a qualified ecologist will be called in to confirm identity of the nesting species and to ascertain whether the nest location represents heightened risk to a threatened species. If so, OEH will be notified and a strategy to reduce risk will be determined. Shut-down of turbines will be a last resort, but may be used in the short-term where the nest is particularly close to a turbine and heightened risk is likely to resolve itself once the nesting event finishes.

5.2 Minimising raptor perch sites

The earliest wind farms used turbines with lattice towers that provided multiple perching opportunities for raptors and this attraction to those turbines was implicated in high rates of turbine collisions. As with all modern turbines, the towers to be used at Silverton Wind Farm are monopoles that offer no perching opportunities for raptors or other bird species.

Poles and wires of overhead powerlines can also provide perching and nesting sites for raptors. Silverton Wind Farm has been designed with the majority of power transmission in underground lines. Where overhead powerlines are necessary, power poles have been chosen for their design aimed at restricting opportunities for raptors to use them as perches. This is of value to operation of the wind farm in minimising the risk of birds or their nests resulting in power outages.

Trees and other features provide natural perching sites for raptors. Maps prepared by EHP (undated) show two raptor perches, one each in proximity of turbines T06 and T39. It is not known whether these perches are used more frequently than any others, but from the variety of raptor species identified in the vicinity, there can be no doubt that raptors will use multiple natural sites as perches. It is not considered to be appropriate to remove natural perches or to otherwise actively attempt to discourage birds from using natural perches.

It is possible that raptors of various species may frequent favoured perch locations within 200 metres of a turbine during the operational life of the wind farm. Wind farm operations personnel will be provided with training in the basic identification of raptor species. In the event that a potentially favoured raptor perch site is

detected within 200 metres of a turbine, a qualified ecologist will be called in to confirm identity of the species and to ascertain whether the perch location represents heightened risk to a threatened species. If so, OEH will be notified and a strategy to reduce risk will be determined. Removal of the perch site may be considered if it is a dead tree and there is considered to be a reasonable likelihood of reducing risk by doing so.

5.3 Large animal carcass removal

The timely removal of carcasses of livestock and other larger animals, such as destroyed feral species, from the wind farm may help reduce the incidence of collision with turbines by raptors that routinely feed on carrion and may be attracted to carcasses. Note that carcasses of birds and bats that may have resulted from collisions with turbines are not to be removed as part of this process.

A carcass removal program will be implemented for the life of the wind farm and will apply to any carcass other than those of birds and bats, found anywhere within the wind farm site. All site personnel (staff and contractors) will be inducted into a reporting procedure that will apply during all wind farm operations, including collision carcass searches (see below). The wind farm will implement a routine for removal and burial of any carcass within 48 hours of its discovery. Any program of feral animal control on the wind farm will include the removal of all carcasses from the wind farm site (see also Silverton Wind Farm Goat Management Plan). The wind farm has legal agreements that cover specific areas including all its infrastructure, roads and hardstand areas. This condition is enforceable on land areas covered by those agreements. The wind farm operator will make all efforts to work collaboratively with adjacent land managers, including, where achievable, entry into formal agreements to provide for co-operative and coordinated detection and removal of large animals carcasses from the area within 200 metres of all turbines.

Table 10 Large animal carcass removal requirements

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
The wind farm operator will provide information to all staff and contractors on the procedure to follow after discovering a carcass	During daily turbine maintenance and service	N/A	N/A	GE	Site Personnel are inducted to understand the procedures regarding carcass removal and the possible ramifications for not following this procedure	Inductions have been completed for all site personnel and date of attendance has been recorded.

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
The wind farm operator will implement a program of carcass removal and burial.	During daily turbine maintenance and service	Specific livestock carcass search and removal may need to be implemented in the event that a high concentration of eagle activity near a turbine indicates they may be at heightened risk.	N/A	GE	Remove carcasses within 48 hours of discover to reduce the incidence of feeding on carrion by raptors	Date of discovery and date of removal are recorded in a Carrion Data Log. Any exceedance of 48 hours is investigated via incident report and internal audit. These data logs are included in the report to OEH and DPE
Feral animal control programs.	As part of any feral animal management control program	Specific carcass searches may need to be implemented during any program of feral predator or herbivore control undertaken on the wind farm or its immediate environs.	N/A	GE; pest animal control contractor	Remove carcasses as soon as possible by engaging a relevant pest control expert within 48 hours of discovery	Date of discovery and date of removal are recorded in a Carrion Data Log. Any exceedance of 48 hours is investigated via incident report and internal audit. These data logs are included in the report to OEH and DPE

5.4 Pest animal control

Pest animal control will be undertaken as part of routine environmental management of the wind farm and land managed by the wind farm operator. Control of all pest species will be carried out in accordance with NSW legislation, policy and strategies administered by the Department of Primary Industries. Section 3.3 provides detail of the requirements for removal of carcasses, including those of any pest species that may attract large raptors into the close proximity of turbines (see also Silverton Wind Farm Goat Management Plan).

Control of rabbits around wind turbines is a specific action that may minimise collision risk because rabbits are primary prey for large raptors. A pest animal control program will be implemented for the life of the wind farm. All site personnel (staff and contractors) will be inducted into a procedure for reporting the location of any rabbit warren or other site of high rabbit density. The wind farm operator will be responsible for its

obligatory requirements for control of pest animals on all land for which it has legal responsibility. The wind farm has legal agreements that cover specific areas including all its infrastructure, roads and hardstand areas. This condition is enforceable on land areas covered by those agreements. The wind farm operator will make all efforts to work collaboratively with adjacent land managers, including, where achievable, entry into formal agreements to provide for co-operative and coordinated detection and removal of large animals carcasses from the area within 200 metres of all turbines.

Table 11 Pest animal control requirements

Action	Timing /Frequency	Adaptive Management	Reporting	Responsible Party	Objective	Measure
The wind farm operator will implement a program of pest control. A pest animal contractor will be engaged as required.	During all wind farm operations.	Specific or increased control measures will be instigated as required according to fluctuating densities of pest animals.	N/A	GE; pest animal control contractor.	Work with leaseholders to reduce the incidence of rabbits and other pests	Documented correspondence with leaseholders and land managers
The wind farm operator will inform all personnel & contractors of the procedure to follow on detection of a warren or high density of rabbits on wind farm land.	During all wind farm operations.	N/A	N/A	GE	Site personnel are inducted to understand the procedures regarding pest control and the possible ramifications for not following this procedure	Inductions have been completed for all site personnel and date of attendance has been recorded.

5.5 Deterrence of bats from turbines

The reasons that bats may fly in close proximity to wind turbines are not fully understood, however bats do collide with the blades of turbines and barotrauma, in which respiratory collapse occurs due to air pressure differentials in close proximity to rotor blades, has also been reported. The incidence of barotrauma has been questioned since it was first reported but that question appears to remain unresolved at present.

Some species of bats are attracted to concentrations of insect prey that can occur near artificial lights. Turbines at Silverton Wind Farm will not be lit and they will not have aviation warning lighting. Artificial lighting will thus not be a cause of attraction of bats to turbines at the wind farm.

Some techniques intended to deter bats from approaching wind turbines have been tried overseas. They include methods using radar, ultrasonic bat calls, thermal imaging and acoustic sensors. Some of these are designed to provide automated detection of bat collisions rather than to provide actual deterrence of bats.

The great majority of them are experimental and they have not been widely applied to commercial wind energy facilities and there is no body of peer-reviewed rigorous evidence for their performance. At present a 'best practice' mechanism for deterrence of bats in Australian environments is not available.

It is notable that many of the bats species that have been subjects of particular concern in North America and Europe are long-distance migrants and large numbers of collisions documented for some of them appear to relate to high concentrations and specific periods when these species are on migration passage using defined routes. The majority of bat species of concern for Silverton Wind Farm are not known to undertake long-distance migrations and most of them are believed to be year-round residents. Evidence from seasonality of records suggests that Yellow-rumped Sheathtail Bats may be largely absent from southern Australia in the first months of each year, but that they are present during the latter half of the year (Aitken 1975; Churchill 1998). They may thus migrate between the north and south of the continent, however, unlike some northern hemisphere species, there are no known defined migratory pathways where Australian bat species may be at increased risk of collisions and Silverton Wind Farm is certainly not known to be on any such route.

It is possible that reduction of bat collisions can be achieved by the use of low wind speed turbine curtailment, although at present no information is available about response to wind speed by Australian species of bats. Overseas investigations (e. g. Martin *et al.* 2013) have found that a variety of bats concentrate their flight activities during periods of low wind speed (i.e. at wind speeds of between approximately 0 and 7 metres per second). Subject to confirmation of technical requirements by the turbine manufacturer, consideration may be given to programming turbines so that rotor blades will remain feathered and not rotate during periods of the night when wind speeds are below those at which turbines generate electricity (i.e. at wind speeds of between approximately 0 and 3 metres per second).

5.6 Adaptive management of turbines to reduce collisions

Management measures specifically aimed at reducing specific risks at provided in each subsection above.

Within three months of the completion of each year of all activities set out in this BBAMP, a report will be prepared and submitted to OEH. The report will provide results of all investigations and studies related to effects of Silverton Wind Farm on bird and bat species of concern. In collaboration with OEH, the results will be considered to determine whether any changes to processes or management actions are required. Any such changes will be focussed on improvements to reduce impacts on bird and bat species of concern, specifically, in the event that detected collisions with turbines by any such species have reached or exceeded trigger levels set out here.

Silverton Wind Farm is in an environment different from the great majority of wind energy facilities in Australia that are located within more intensive cropping and grazing agricultural areas. It is not feasible to foresee what potential factors might lead to an unexpectedly high level of collisions by any species.

Appropriate mitigation measures can be prepared only if a cause, or causes, of ecologically significant impacts on the relevant species is known. If a cause is not readily apparent then investigation of the reason(s) for the impact must be undertaken prior to proposal of a mitigation strategy. Advice from OEH will be sought with regard to design and implementation of any such investigations and of an ultimate mitigation strategy, if required. OEH will be notified within two working days of determination by GE or the contracted qualified ecologist that a trigger level for any species of concern is detected. Liaison with OEH will commence to determine a strategy aimed at reducing the incidence of collisions as soon as is practical thereafter.

Any mitigation strategy will be tailored to the needs of the particular species affected and will be formulated if and when the nature and cause(s) of the impact are known. It will be submitted to OEH and will be implemented when approved.

Broad categories of potential causes of heighten collision risk may include the following:

- Agricultural practices, such as feeding of grain to stock, that may result in concentrations of birds in proximity of turbines
- Control of pest animals and management of stock and large animal carcasses
- Possible seasonal attraction of bats to turbines
- Seasonal nesting or roosting in proximity of turbines
- Periodic environmental conditions such as localised high densities of natural food sources or availability of surface water.

If a trigger level of collisions is detected and it can be attributed to a cause such as one of these, then an appropriate management action may be feasible. Land management practices can be altered or short-term management of turbines may be able to be implemented. Shut-down of turbines will be last resort, but may be used in the short-term if a particular turbine is involved and the cause is likely to resolve itself, for example once a nesting event finishes.

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Appendices

Appendix 1: Turbine mortality survey data sheet

Survey details:			
Date:		Observers:	
Start time:		Finish time:	
Turbine ID:			
Survey methodology (please tick):			
Dog ID			
Human observers			
Incidental (Any bird or bat turbine mortality observed outside a routine survey)			
Ground visibility (circle): *High* *Moderate* *Poor*			
Was entire search area covered? *Yes / No*		NOTE: If not, estimate area covered as a percentage (%) of total search area:	
Survey limitations (e.g. long grass, any areas that were inaccessible/not surveyed and why):			
Weather details (please circle):			
Temperature:			
Precipitation: *Fine* *Showers* *Rain*			
Wind strength: *Calm* *Breeze* *Moderate* *Strong*			
Wind direction:		Cloud cover (%):	
Turbine bird and bat mortality record:			
Dead/injured bird or bat recorded? *Yes / No*	If yes, record total number:	Bird and Bat carcass / injury datasheet completed? *Yes / No*	Photographs taken? *Yes / No*
Additional notes			

Appendix 2: Dead or injured bird / bat data sheet

This datasheet must be completed for every dead / injured bird or bat found during high- and general-intensity turbine mortality surveys. This datasheet should also be completed for any dead /injured bird or bar recorded incidentally (i.e. not during routine surveys).

Each dead bird or bat (including feather spots) must be removed upon discovery and placed into a clearly labelled plastic bag with the date, time, location (GPS coordinates) and turbine number, as required for species identification.

Date and location:				
Date:		Observer/s:		
Time animal was found:				
Turbine ID:		Easting/Northing of carcass:		
Detection:				
Survey method (circle):	*Dog search*	*Human search intensity*	*Incidental*	NOTE: turbine survey datasheet must also be completed.
Distance of carcass / injured animal from observer when first detected:				
Describe ground visibility within a 1 m radius of where carcass / injured animal was found:				
Carcass / injured animal photographed? *Yes / No*		Photo and camera details (e.g. camera number, photo numbers, location of saved photos):		
Weather details at time of detection (please circle):				
Temperature:				
Precipitation:	*Fine*	*Showers*	*Rain*	
Wind strength:	*Calm*	*Breeze*	*Moderate*	*Strong*
Wind direction:		Cloud cover (%):		
Carcass / injured animal information and condition:				
Species (if unknown closest taxonomic group, e.g. raptor, bat):				
Age (circle):	*Unknown*	*Adult*	*Juvenile*	
Sex (circle):	*Unknown*	*Male*	*Female*	
Condition (circle):	*Dead (carcass)*	*Injured but alive*	*Feather spot (≥ 10 feathers)*	
Degree of decay (circle):	*Fresh*	*More than a week old*	*Very old or highly decayed*	
Describe location and type of any injuries evident:				

Describe evidence of scavenging, if any:
Notes / additional information:

Appendix 3. Carcass persistence trial: carcass deployment data sheet

This carcass deployment sheet must be completed for each turbine used in the scavenger trial.

Survey and turbine details:					
Date:			Observers:		
Time:					
Turbine ID:					
Ground visibility (circle): *High* *Moderate* *Poor*					
Description of ground visibility (e.g. grass height, rock cover):					
Carcass deployment record:					
Carcass type	Unique carcass identifier:	Direction from turbine base:	Distance from turbine base:	Easting / northing:	Notes:
Additional notes:					

Appendix 4: Consolidated Bird Observation Map

T35
T33
T34
T32
T31
T29
T30
T44
T28
T43
T42
T45
T40
T27
See Map 1b
See Map 1c
See Map 1d

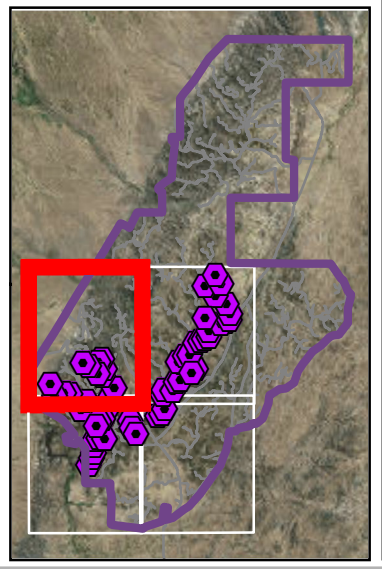
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Map 1a
Bird Observations
Silverton Wind Farm - South

Legend
- Silverton Wind Farm boundary
- Turbine locations
- Access tracks

Threatened Birds
- Hooded Robin (south-eastern form)
- Rufous Fieldwren
- Varied Sittella

At-risk Birds
- Nankeen Kestrel
- Wedge-tailed Eagle



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Metres

Scale at A3 is 1:27,000

Map publish date: 15/08/2017

Baseline data provided to Ecology and Heritage Partners courtesy of WGA / Baseline data collected by NGH Environmental in 2012 and updated in 2013 and 2016

ecology & heritage partners

9381_SilvertonWF_BirdObs_MB 15/08/2017 melsley

Appendix 5: Consolidated Bat Observation Map

T35
T34
T33
T32
T31
T29
T30
T44
T28
T43
T42
T45
T40
T27
See Map 1b
See Map 1c
See Map 1d

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

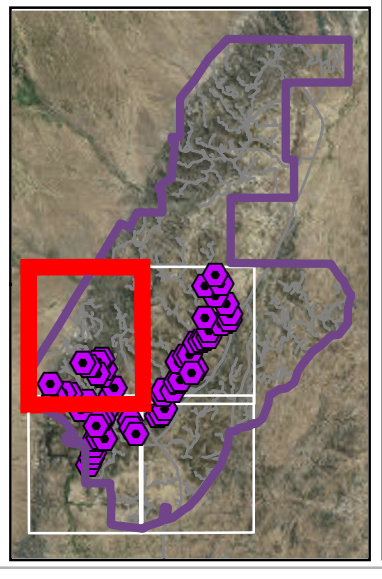
Map 2a
Bat Observations
Silverton Wind Farm - South

Legend

- Silverton Wind Farm boundary
- Turbine locations
- Access tracks

At-risk Bats

- Inland Free-tailed Bat
- Lesser Long-eared Bat



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Metres

Scale at A3 is 1:27,000

Map publish date: 15/08/2017

ecology & heritage partners

Baseline data provided to Ecology and Heritage Partners courtesy of WGA / Baseline data collected by NGH Environmental in 2012 and updated in 2013 and 2016

9381_SilvertonWF_BatObs_MB 15/08/2017 melsley

Appendix 6: Baseline bird and bat survey methods; risk assessment & results

1 May 2018

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Dear Adam,

RE – Silverton Wind Farm – Bird and Bat Baseline Surveys - Summary of all results combined (our project ref: 16-412)

Please find below a summary of the combined results of the four seasons of bird and bat baseline surveys, conducted at Silverton Wind Farm from December 2016 through to and including the final survey in March 2018.

The aim of this letter is to advise you of notable records from the surveys including observations of listed threatened species, as well as records of 'at risk' species observed to be flying at or above the rotor swept area (RSA) height) within the wind farm site.

If you have any questions, please contact me on the number below. I would be pleased to discuss any aspect of this project with you further.

Yours sincerely,

Managing Director
NGH Environmental Pty Ltd
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SURVEY METHODS TIMING, EFFORT & PERSONNEL

SURVEY METHODS & EFFORT

The detailed survey methodology is described in detail in the Bird and Bat Survey Methods document (NGH 2017), accompanying this results summary. The general methods undertaken for this Autumn 2018 survey included the following elements:

- Passerine bird surveys
- Raptor surveys
- Bat detector surveys
- Bat trapping study (one-off trapping program conducted as part of the Spring 2017 survey)

The survey effort is described in detail in the Bird and Bat Survey Methods document (NGH 2017), accompanying this results summary (and shown in the Survey Effort Figure at Appendix A). Of note, the surveys included the following:

- 29 Passerine surveys (10 Control and 19 Impact sites). This level of survey effort remained constant across the entire survey program with the same sites visited each of the four seasonal survey occasions.
- 19 Raptor surveys (8 Control and 11 Impact sites). This level of survey effort remained constant across the entire survey program with the same sites visited each of the four seasonal survey occasions.
- Bat detector sites. The overall level of survey effort undertaken during each seasonal survey undertaken differed slightly. Specifically, the first two survey occasions (Summer 2016 and Autumn/Winter 2017) were generally equivalent in terms of overall survey effort (i.e. Summer 2016 involved the use of 8 detector sites and Autumn/Winter 2017 involved 9 detector sites). The survey effort undertaken during the two subsequent surveys (Spring 2017 and Autumn 2018) was substantially increased to address the comments received from the OEH Expert (Michael Pennay) in relation to the scope of the bat surveys conducted. The revised survey effort for the bat surveys included a total of 20 detector sites (including 3 located at monitoring masts MM1, MM2 and MM3 and which involved the use paired detectors to record calls at ground level and at RSA level (with the microphone attached to a pulley on the mast tower and set at an elevation of approximately 65 m). A full description of the bat detector survey effort and locations over the course of the baseline monitoring program is provided in Section 3.2. This includes a description of the number of detectors that have been established at replicated sites from the first two survey occasions (Summer 2016 and Autumn/Winter 2017), as well as a description of the habitat type, unit pairing, and deployment as either control/impact recording units (to detail overall survey stratification).

  Please note that for the Spring 2017 survey, two of the sites, BD13 and BD14 and for the Autumn 2018 survey, one site, BD11, no results were obtained due to equipment malfunctions (such as feral goats chewing on the microphone cables, and windy conditions that caused the SD memory card to become full on the first night of recording).

SURVEY TIMING

The Silverton Wind Farm bird and bat baseline surveys were completed across four seasons as described below:

- Summer 2016 (12th to 14th December 2016 inclusive).
- (late) Autumn/Winter 2017 (29th May to 2 June 2017 inclusive).
- Spring 2017 (bird surveys were conducted from 10th to 12th October 2017 inclusive and bat surveys were conducted from 22nd to 30th November 2017 inclusive).
- (early) Autumn 2018 - conducted from 19th to 28th March 2018 (inclusive).

SURVEY PERSONNEL

The survey personnel over the four seasonal surveys varied however to the greatest extent possible, involved using the same key NGH staff to keep consistency across the surveys.

The analysis of the bat call files was completed by suitably qualified professionals including Greg Richards for the first two surveys (Summer 2016 and Autumn/Winter 2017), and Glenn Hoye for the second two survey occasions (Spring 2017 and Autumn 2018). Glenn Hoye was also responsible for undertaking a targeted trapping surveys for microbats as part of the Spring 2017 survey.

The staff used in the surveys are all suitably experienced in conducting field surveys, and have adequate experience in the identification of bird species. The names and organisation of each staff field team leader for each survey occasion is included in each of the seasonal summary results letter.

RESULTS OF THE COMBINED BASELINE SURVEYS

BIRD SURVEYS

Records of threatened species within the site

Records of threatened bird species made within the site included a total of 26 separate records and included a total of nine (9) threatened species, all of which are listed as Vulnerable under the NSW *Biodiversity Conservation Act 2016.* The Hooded Robin *Melanodryas cucullata cucullata* was the most frequently recorded species, accounting for 15 of the 26 threatened species records, and was observed in three of the four survey periods (wasn't recorded during the first Summer 2016 survey).

With regard to threatened species that may also be considered "at risk" from the wind farm development, three threatened raptor species were recorded at the site over the duration of the baseline survey program, including the Black-breasted Buzzard *Hamirostra melanosternon,* Little Eagle, *Hieraaetus morphnoides* and Spotted Harrier *Circus assimilis.* All three of these species were recorded only during the Summer 2016 period, with the latter two species including only a single individual record, whilst a record of a single individual was made on two separate occasions of the Black-breasted Buzzard.

The other listed threatened species recorded at the site are not regarded as being "at risk' from the wind farm project given these are mostly small woodland birds that generally fly close to the ground (at or within the canopy), or, in the case of the Freckled Duck (*Stictonetta naevosa)*, spends the majority of its time within the water body and generally only disperses from these habitats when the waterbody dries up. As the record of the Freckled Duck was made at Umberumberka Reservoir, which is normally inundated, movements into and out of the reservoir by Freckled Ducks are considered to be infrequent and as such, the wind farm is not expected to place this species at risk.

A revised Risk Assessment has been undertaken and is summarised in the advice letter at Appendix C, and summarised briefly at the end of this document.

A full description of the threatened species records made over the duration of the baseline monitoring program is provided in Table 1 below, and also detailed in the maps of recorded threatened species at Appendix B (includes mapped results for each season, Appendix B.1 and the results for all seasons combined, Appendix B.2).

Table 1 Records of threatened species within the site during the Autumn 2018 survey period

Species	Common Name	Status	Observation Method	No. individuals	Habitat Type	Location (easting/northing Zone 54)
Summer 2016						
Calamanthus campestris	Rufous Fieldwren	V – TSC Act	Opportunistic	1	MDF	0527731 6478012
Circus assimilis	Spotted Harrier	V – TSC Act	Opportunistic	1	MDF	0527600 6478283
Daphoenositta chrysoptera	Varied Sittella	V – TSC Act	Passerine	2	MDF	0525052 6484420 (P19)
			Opportunistic	8	MDF	0528912 6483616
Hamirostra melanosternon	Black-breasted Buzzard	V – TSC Act	Opportunistic	1	MDF	0529276 6488511
			Opportunistic	1	MDF	0527081 6472705
Hieraaetus morphnoides	Little Eagle	V – TSC Act	Opportunistic	1	MDF	0527081 6472705
Pyrrholaemus brunneus	Redthroat	V – TSC Act	Opportunistic	2	BB	0527844 6477735
Autumn/Winter 2017						
Calamanthus campestris	Rufous Fieldwren	V – TSC Act	Opportunistic	1	PG	523290 6482973
Melanodryas cucullata cucullata	Hooded Robin	V – TSC Act	Passerine BUS	1	MDF	528988 6483655 (5P)
			Passerine BUS	2	RR	529672 6485291 (9P)
			Opportunistic	1	RR	531621 6486472
			Opportunistic	4	RR	529758 6485229
			Opportunistic	2	BB	524848 6482126

Species	Common Name	Status	Observation Method	No. individuals	Habitat Type	Location (easting/northing Zone 54)
			Opportunistic	1	BB	524422 6481777
			Opportunistic	3	MDF	521920 6482239
			Opportunistic	4	MDF	521378 6484858
Spring 2017						
Melanodryas cucullata cucullata	Hooded Robin	V – TSC Act	Opportunistic	2	BB	525163 - 6481806
			Opportunistic	2	MDF	524430 - 6479617
			Passerine survey	11	MDF	522525 - 6478315
Artamus cyanopterus cyanopterus	Dusky Woodswallow	V – TSC Act	Opportunistic	1	MDF	521713 – 6484511
Stictonetta naevosa	Freckled Duck	V-TSC Act	Opportunistic	10	RRG	519852 – 6480104
Autumn 2018						
Melanodryas cucullata cucullata	Hooded Robin	V – TSC Act	Opportunistic	2	BB	519744 - 6483872
			Opportunistic	2	BB	519790 - 6483944
			Passerine survey	2	MDF	530248 – 6487210 (P1)
			Opportunistic	1	MDF	0523783 - 6477342

MDF = Mulga Dead Finish (open) woodland
BB = Bluebush shrubland
RR= River Red Gum Woodland
PG = Porcupine Grass (Spinifex) Sparse Woodland

Records of bird species recorded within or above the RSA

Bird species recorded at the site flying within or above the RSA height (i.e. at a height of greater than 40 metres above ground level) during the baseline survey program are presented in Table 2 below. The results include a total of 102 observations across 13 species of birds flying within or above the RSA height during either the surveys.

From the survey observations, it was noted that the Wedge-tailed Eagle (*Aquila audax*) accounted for the majority of the records with a total of 75 (of the 102) records, followed by the Nankeen Kestrel (*Falco cenchroides*) which accounted for nine records.

Of the 13 species recorded at the site, five of these are considered to be "at risk" from wind farm impacts, being all raptor species (i.e. Wedge-tailed Eagle, Nankeen Kestrel, Australian Hobby, Whistling Kite and Black Kite). The other eight species are common species and are not considered to be "at risk" from wind farm impacts.

No listed threatened species were observed within the site flying within or above the RSA height.

A full description of the species recorded flying within or above RSA height over the duration of the baseline monitoring program is provided in Table 2 below, and also detailed in the maps of species recorded at/above RSA provided at Appendix B (includes mapped results for each season, Appendix B.3 and the results for all seasons combined, Appendix B.4).

Table 2 Birds recorded within or above RSA height

Species	Date	Survey Site	Impact/Control	Location		Height
Summer 2016						
Wedge-tailed Eagle	12/12/2016	48R	Impact	520990	6479811	400
Wedge-tailed Eagle	12/12/2016	4R	Impact	521169	6479880	100
Nankeen Kestrel	12/12/2016	21R	Control	525502	6482821	50
Wedge-tailed Eagle						100-600
Wedge-tailed Eagle	13/12/2016	46R	Impact	521895	6484114	200
Wedge-tailed Eagle						30 - 200
Wedge-tailed Eagle	13/12/2016	47R	Impact	522554	6484220	80
Wedge-tailed Eagle						100 – 200
Wedge-tailed Eagle						80 – 800
Wedge-tailed Eagle						150
Nankeen Kestrel	13/12/2016	44R	Control	521241	6484976	80
Wedge-tailed Eagle	13/12/2016	7P	Impact	522056	6484120	80
Wedge-tailed Eagle	13/12/2016	OPP	outside impact zone	523401	6479513	100
Wedge-tailed Eagle	13/12/2016	28R	Control	525426	6475777	200
Wedge-tailed Eagle	13/12/2016	23P	Impact	522525	6478315	50
Black Kite						50
Black Kite	14/12/2016	2P	Impact	528049	6482961	40 - 100
Wedge-tailed Eagle	14/12/2016	45R	Control	522948	6487688	200
Black-Faced Woodswallow						100 - 200
Australian Raven	14/12/2016	1P	Impact	531161	6487105	50
Unknown Raptor	14/12/2016	33R	Impact	526032	6480126	100 - 300
Autumn/Winter 2017						
Wedge-tailed Eagle	30/05/2017	8R	Impact	527616	6481250	150

Species	Date	Survey Site	Impact/Control	Location		Height
Wedge-tailed Eagle	30/05/2017	21R	Control	525514	6482888	100
Wedge-tailed Eagle						50
Wedge-tailed Eagle						>600
Wedge-tailed Eagle	30/05/2017	43R	Impact	519868	6482291	600
Wedge-tailed Eagle						100-400
Wedge-tailed Eagle						100-400
Wedge-tailed Eagle						200-300
Wedge-tailed Eagle	30/05/2017	48R	Impact	520995	6479809	200
Wedge-tailed Eagle						40-80
Wedge-tailed Eagle	30/05/2017	16P	Impact	527351	6481125	50
Wedge-tailed Eagle	30/05/2017	19P	Impact	525030	6484444	50
Wedge-tailed Eagle	30/05/2017	38P	Impact	520983	6479967	100
Wedge-tailed Eagle	30/05/2017	OPP	outside impact zone	525189	6483347	150 - 200
Wedge-tailed Eagle	31/05/2017	3R	Impact	528784	6483755	200
Wedge-tailed Eagle	31/05/2017			528784	6483755	300-500
Wedge-tailed Eagle	31/05/2017	25R	Impact	524214	6480217	150
Wedge-tailed Eagle	31/05/2017	29R	Control	527401	6479513	100
Wedge-tailed Eagle	31/05/2017	44R	Control	521232	6484971	300 – 500
Wedge-tailed Eagle						100 – 300
Wedge-tailed Eagle						300 – 400
Wedge-tailed Eagle						250
Wedge-tailed Eagle						250
Wedge-tailed Eagle	31/05/2017	45R	Control	522950	6487687	50 - 200
Wedge-tailed Eagle						50 - 300
Wedge-tailed Eagle						100
Little Corella	31/05/2017	32P	Impact	526347	6480130	40
Wedge-tailed Eagle	1/06/2017	6R	Impact	528912	6483616	100 - 300
Wedge-tailed Eagle						50
Wedge-tailed Eagle						50
Wedge-tailed Eagle	1/06/2017	46R	Impact	521890	6484116	400
Wedge-tailed Eagle	1/06/2017	47R	Impact	522554	6484219	400
Wedge-tailed Eagle						100 – 300
Wedge-tailed Eagle						400
Wedge-tailed Eagle	1/06/2017	41P	Impact	522176	6484229	100
Spring 2017						
Wedge-tailed Eagle	10/10/2017	21R	Control	525514	6482888	60
Nankeen Kestrel	11/10/2017	33R	Impact	525983	6480147	40
Wedge-tailed Eagle	12/10/2017	31P	Control	527926	6477830	30-50
Tree Martin	10/10/2017	17P	Control	528338	6481026	60
Nankeen Kestrel	10/10/2017	4R	Impact	528784	6483755	60
Wedge-tailed Eagle	10/10/2017	7P	Impact	528049	6482961	200
Raven sp.						80
Black-faced Cuckoo-shrike						80

Species	Date	Survey Site	Impact/Control	Location		Height
Nankeen Kestrel	10/10/2017	9P	Impact	529672	6485291	100
Wedge-tailed Eagle	12/10/2017	30P	Control	527157	6479156	50
Tree Martin	12/10/2017	41P	Impact	522176	6484229	80
Nankeen Kestrel	11/10/2017	11P	Impact	530603	6488157	100
Wedge-tailed Eagle	11/10/2017	21R	Control	525514	6482888	60
Wedge-tailed Eagle	11/10/2017	39P	Control	521143	6484756	50
Wedge-tailed Eagle	12/10/2017	43R	Impact	519868	6482291	50
Autumn 2018						
Wedge-tailed Eagle	23/03/2018	3-R	Impact	528784	6483755	10-100
Nankeen Kestrel	22/03/2018	6-R	Impact	528912	6483616	30-50
Nankeen Kestrel	22/03/2018	10-R	Impact	528877	6484015	50-100
Nankeen Kestrel	23/03/2018	2-P	Impact	529554	6488781	20-100
Australian Magpie	21/03/2018	11-P	Control	530603	6488157	30-80
Wedge-tailed Eagle	21/03/2018	21-R	Impact	525514	6482888	100-50
Wedge-tailed Eagle	n/r	25-R	Impact	524214	6480217	150-200
Wedge-tailed Eagle	n/r			524214	6480217	150-200
Wedge-tailed Eagle	23/03/2018	28-R	Control	525426	6475777	50-100
Wedge-tailed Eagle	22/03/2018	29-R	Control	527401	6479513	0-150
Galah	22/03/2018	17-P	Control	528338	6481026	50
Australian Raven						50
Galah	21/03/2018	20-P	Control	525195	6484056	60
Black Kite	21/03/2018	30-P	Control	527158	6479157	80
Wedge-tailed Eagle	22/03/2018	31-P	Impact	527926	6477830	100
Whistling Kite	21/03/2018	36-P	Impact	523485	6481778	50
Wedge-tailed Eagle						50
Wedge-tailed Eagle	27/03/2018	37-P	Impact	520346	6482029	90
Little Corella	27/03/2018	38-P	Impact	520983	6479967	200
Wedge-tailed Eagle						200
Wedge-tailed Eagle	22/03/2018	44-R	Control	521232	6484971	50
Wedge-tailed Eagle						50
Wedge-tailed Eagle						50
Australian Hobby						50
Wedge-tailed Eagle	21/03/2018	45-R	Control	522950	6487687	100
Wedge-tailed Eagle						100
Wedge-tailed Eagle						100
Wedge-tailed Eagle						200
Wedge-tailed Eagle	20/03/2018	46-R	Impact	521890	6484116	60
Wedge-tailed Eagle	27/03/2018	48-R	Impact	520995	6479809	75
Wedge-tailed Eagle						400

BAT SURVEYS

Results of bat detector surveys

In summarising these results at least nine species (and potentially up to 11 species – depending on whether calls attributed to a bat call complex (i.e. *Scotorepens eleryi* and *S. greyi* which have indistinguishable calls from each other) involved only one or both of the species included in the complex). Of these, three threatened species (all listed as Vulnerable under NSW legislation) have been identified from the site including the Yellow-bellied Sheathtail-bat (*Saccolaimus flaviventris*), and (possibly) the Inland Forest Bat (*Vespadelus baverstocki*), and the Corben's Long-eared Bat (*Nyctophilus corbeni*), although with the latter two species, the calls could not reliably be distinguished from other similar species calls. As noted in the November 2017 results that included the one-off trapping survey, the Inland Forest Bat was successfully captured whilst the Little Forest Bat was not, indicating that at least a portion of the recorded calls from this complex could be reasonably attributed to the threatened Inland Forest Bat. For the Corben's Long-eared Bat, this species was not captured whilst the common Lesser Long-eared Bat was captured, suggesting that the recorded calls from this complex were more likely to be attributable to the common Lesser Long-eared Bat (although the presence of the threatened Corben's Long-eared Bat cannot be completely discounted).

In addition to the above threatened species, the White-striped Freetail-bat (*Austronomus australis*) was also recorded at the site. Whilst being relatively common, this species is considered to be potentially at risk from wind farm projects given it is a known high-flying species.

Overall, the species records were generally similar across each season.

A full description of the threatened bat species records made over the duration of the baseline monitoring program is provided in Table 3 below, and also detailed in the maps of recorded threatened species at Appendix B (includes mapped results for each season, Appendix B.1 and the results for all seasons combined, Appendix B.2).

Table 3 Records of threatened and at risk species within the site during the Autumn 2018 survey period

Species	Common name	Date	Unit/ Site	Habitat Type	Location	
					Easting	Northing
Summer 2016						
(possible) *Saccolaimus flaviventris*	Yellow-bellied Sheathtail-bat	14/12/2016	AE-3	RRG	521091	6479805
Vespadelus vulturnus/baverstocki	Little Forest Bat/Inland Forest Bat	13/12/2016	AE-3	RRG	521091	6479805
		14/12/2016	AE-3	RRG	521091	6479805
		12/12/2016	AE-2	RRG	520606	6479831
Austronomus australis	White-striped Free-tailed Bat	14/12/2016	AE-3	RRG	521091	6479805
Autumn/Winter 2017						
Austronomus australis	White-striped Free-tailed Bat	29/05/2017	AE-5a	MDF	527430	6478140
		30&31/05/2017	AE-5b	MDF	527943	6481253
Vespadelus vulturnus/baverstocki	Little Forest Bat/Inland Forest Bat	29/05/2017	AE-5a	MDF	527430	6478140
		30/05/2017	AE-5b	MDF	527943	6481253
Spring 2017						
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	27/11/2017	BD8	MDF	527119	6481682
Vespadelus vulturnus/baverstocki	Little Forest Bat/Inland Forest Bat	25/11/2017	BD3B*	MDF	524804	6479164
		26/11/2017	BD4	MDF	520223	6481895
		26/11/2017	BD6	MDF	527817	6478249
		26/11/2017	BD7	MDF	524861	6478557
		27/11/2017	BD9	RRG	521205	6479912

Species	Common name	Date	Unit/ Site	Habitat Type	Location	
					Easting	Northing
		28/11/2017	BD9	RRG	521205	6479912
		29/11/2017	BD9	RRG	521205	6479912
		23/11/2017	BD11	RRG	531026	6485664
		23/11/2017	BD12	RRG	531742	6486712
		24/11/2017	BD12	RRG	531742	6486712
		26/11/2017	BD12	RRG	531742	6486712
Nyctophilus corbeni/N. geoffroyi	Corben's Long-eared Bat / Lesser Long-eared Bat	25/11/2017	BD1B*	MDF	528820	6489036
		24/11/2017	BD2B*	MDF	520505	6482347
		25/11/2017	BD4	MDF	520223	6481895
		26/11/2017	BD4	MDF	520223	6481895
		27/11/2017	BD5	MDF	521022	6480512
		23/11/2017	BD6	MDF	527817	6478249
		25/11/2017	BD6	MDF	527817	6478249
		24/11/2017	BD7	MDF	524861	6478557
		25/11/2017	BD7	MDF	524861	6478557
		26/11/2017	BD7	MDF	524861	6478557
		27/11/2017	BD7	MDF	524861	6478557
		27/11/2017	BD8	MDF	527119	6481682
		26/11/2017	BD9	RRG	521205	6479912
		27/11/2017	BD9	RRG	521205	6479912
		28/11/2017	BD9	RRG	521205	6479912
		29/11/2017	BD9	RRG	521205	6479912
		23/11/2017	BD11	RRG	531026	6485664
		24/11/2017	BD11	RRG	531026	6485664
		25/11/2017	BD11	RRG	531026	6485664
		23/11/2017	BD12	RRG	531742	6486712
		24/11/2017	BD12	RRG	531742	6486712
		25/11/2017	BD12	RRG	531742	6486712
		26/11/2017	BD12	RRG	531742	6486712
		23/11/2017	BD16	MRM	530081	6483083
		23/11/2017	BD17	PG	522262	6485286
		26/11/2017	BD18	PG	521872	6484140
		25/11/2017	BD19	PG	522810	6485362
		26/11/2017	BD19	PG	522810	6485362
		25/11/2017	BD20	PG	522912	6484350
Autumn 2018						
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat	25/03/2018	BD10	RRG	522814	6479798
Austronomus australis	White-striped Free-tailed Bat	22/03/2018	BD1B*	MDF	528820	6489036
		25/03/2018	BD4	MDF	520223	6481895
		25/03/2018	BD8	MDF	527119	6481682
		24/03/2018	BD9	MDF	521205	6479912
		22/03/2018	BD16	MDF	530081	6483083
		22/03/2018	BD17	PG	522262	6485286
Vespadelus baverstocki/V.vulturnus	Inland Forest Bat/Little forest Bat	24/03/2018	BD6	MDF	527817	6478249
		23/03/2018	BD9	RRG	521205	6479912
		24/03/2018	BD9	RRG	521205	6479912

Species	Common name	Date	Unit/ Site	Habitat Type	Location	
					Easting	Northing
		25/03/2018	BD9	RRG	521205	6479912
		26/03/2018	BD9	RRG	521205	6479912
		23/03/2018	BD10	RRG	522814	6479798
		24/03/2018	BD10	RRG	522814	6479798
		25/03/2018	BD10	RRG	522814	6479798
		26/03/2018	BD10	RRG	522814	6479798
		23/03/2018	BD12	RRG	531742	6486712
		24/03/2018	BD12	RRG	531742	6486712
		25/03/2018	BD12	RRG	531742	6486712
		26/03/2018	BD12	RRG	531742	6486712
Nyctophilus corbeni/N. geoffroyi	Corben's Long-eared Bat / Lesser Long-eared Bat	19/03/2018	BD2B*	MDF	520505	6482347
		25/03/2018	BD5	MDF	521022	6480512
		23/03/2018	BD6	MDF	527817	6478249
		24/03/2018	BD6	MDF	527817	6478249
		25/03/2018	BD6	MDF	527817	6478249
		26/03/2018	BD6	MDF	527817	6478249
		24/03/2018	BD7	MDF	524861	6478557
		25/03/2018	BD7	MDF	524861	6478557
		26/03/2018	BD7	MDF	524861	6478557
		25/03/2018	BD8	MDF	527119	6481682
		26/03/2018	BD8	MDF	527119	6481682
		23/03/2018	BD9	RRG	521205	6479912
		24/03/2018	BD9	RRG	521205	6479912
		25/03/2018	BD9	RRG	521205	6479912
		26/03/2018	BD9	RRG	521205	6479912
		23/03/2018	BD10	RRG	522814	6479798
		24/03/2018	BD10	RRG	522814	6479798
		25/03/2018	BD10	RRG	522814	6479798
		26/03/2018	BD10	RRG	522814	6479798
		23/03/2018	BD12	RRG	531742	6486712
		24/03/2018	BD12	RRG	531742	6486712
		25/03/2018	BD12	RRG	531742	6486712
		26/03/2018	BD12	RRG	531742	6486712
		21/03/2018	BD15	MRM	531012	6487843
		22/03/2018	BD16	MRM	530081	6483083
		21/03/2018	BD17	PG	522262	6485286
		23/03/2018	BD17	PG	522262	6485286
		22/03/2018	BD20	PG	522912	6484350

*Unit Mounted at top of Met Mast
MDF = Mulga Dead Finish (open) woodland
MRM = Mulga/Red Mallee Shrubland
RRG = River Red Gum Woodland
PG = Porcupine Grass (Spinifex) Sparse Woodland

OVERALL SUMMARY OF SURVEY EFFORT AND RESULTS

The bird and bat baseline surveys conducted over four seasons at the Silverton Wind Farm site have now been completed. This has involved four seasonal surveys conducted since December 2016. The bird surveys have been repeated consistently (i.e. same sites) over all four survey occasions, and includes a total of 48 survey sites completed each survey occasion. The bat surveys were modified in October 2017 to address comments made by OEH (and their appointed expert Michael Pennay), and consequently, only the Spring 2017 and Autumn 2018 surveys conducted since then have used the same repeated survey sites. With regard to consistency and repeatability across the four survey occasions, some sites were sampled across both Summer 2016 and Winter 2017, as well as carried across into the Spring 2017 and Autumn 2018 surveys. These include:

- Site BD4 (previously labelled A4-B for Summer 2016, and labelled SM1 in Winter 2017 survey)
- Site BD8 (previously labelled A1-A for Summer 2016, and labelled AE-5b in Winter 2017 survey)

Some sites were sampled across both Summer 2016 and Winter 2017, as well as carried across into the Spring 2017 and Autumn 2018 surveys, but were moved slightly to ensure they were clearly in either the control or impact zone (but not in between). These sites were re-established generally in a similar habitat type as the previous surveys, and include:

- Site BD9 (previously labelled A2-A for Summer 2016, and labelled AE-2 in Winter 2017 survey. This site was relocated approx. 2.5 km East to be in Control Zone, but staying within River Red Gum Woodland habitat along edge of Umberumberka Reservoir. Results are therefore considered sufficiently comparable).
- Site BD10 (previously labelled A4-A for Summer 2016, and labelled AE-3 in Winter 2017 survey. This site was relocated approx. 2 km East to be in Impact Zone, but staying within River Red Gum Woodland habitat along rocky creeks along a tributary of Umberumberka Reservoir. Results are therefore considered sufficiently comparable).
- Site BD11 (previously labelled A1-B for Summer 2016, and labelled AE-1 in Winter 2017 survey. This site was relocated approx. 500 m to be in Control Zone, but staying within River Red Gum Woodland habitat. Results are therefore considered sufficiently comparable.
- Site BD12 (previously labelled A3-B for Summer 2016, and labelled AE-4 in Winter 2017 survey. This site was relocated approx. 500 m to be in Impact Zone, but staying within River Red Gum Woodland habitat. Results are therefore considered sufficiently comparable.

In addition, some sites established during either (but not both) the previous Summer 2016 and Winter 2017 surveys were re-used into the Spring 2017 and Autumn 2018 surveys. These include

- Site BD6 (previously AE-5a for Winter 2017 survey but not established for the Summer 2016 survey)

It is acknowledged that at some of these sites the level of survey effort (i.e. number of nights deployed) was not always consistent, this was due in part to unit malfunctions as well as access and weather issues at that time (which meant some units had to be collected early before creeks became impassable with the onset of heavy rain). Since the survey protocol was improved and submitted to OEH for acceptance, the subsequent Spring 2017 and Autumn 2018 surveys have been conducted at the same sites and with the same level of survey effort.

The results of the surveys indicate that the site supports a number of threatened bird species, however, many of the threatened species recorded at the site were on only one survey occasion with only the Rufous Fieldwren and Hooded Robin recorded on two or more survey occasions. The Hooded Robin was the most frequently recorded threatened species, accounting for 15 of the 26 threatened species records made at the site. The site was also found to support a number of threatened bat species, including the Yellow-bellied Sheathtail-bat, Inland Forest Bat and Corben's Long-eared Bat. Of these, only the Inland Forest Bat was recorded on all four survey occasions (and was also successfully captured during the Spring 2017 trapping survey). The Corben's Long-eared Bat was only recorded during the last two survey occasions (Spring 2017 and Autumn 2018), although it was recorded at a number of different sites, however this species was not captured, and it is possible that the related Lesser Long-eared Bat (*Nyctophilus geoffroyi*) which was captured, accounts for most or all of the recorded calls analysed.

River Red Gum Woodland habitats accounted for most of the calls recorded, followed by the Mulga Dead Finish Habitat, whilst detectors set-up in other habitats (i.e. Mulga/Red Mallee Shrubland and Porcupine Grass (Spinifex) Sparse Woodland yielded comparatively fewer results.

The findings of the four seasonal surveys have also been considered in the context of the Bird and Bat Risk Assessment for the Silverton Wind Farm (NGH 2016), and a re-evaluation of the risk status of bird and bat species has been completed based on these results. A summary letter of the updated risk assessment is included at Appendix C of this letter. In summarising this updated risk assessment, the review found that the overall risks to birds and bats is generally lower than the previous 2016 assessment due to around 15 m more ground clearance of the minimum RSA (at 45 m) of the GE 3.43-130 turbine model, compared to the parameters used in the original BBRA, and that one species (Square-tailed Kite) was downgraded from 'high' risk of collision to 'moderate', whilst another species (Inland Forest Bat) was upgraded from 'moderate' to 'high'. The total number of 'high' risk species remains at nine, and includes: Wedge-tailed Eagle, Little Eagle, Black Kite, Brown Falcon, Spotted Harrier, Black-breasted Buzzard, Yellow-bellied Sheathtail Bat, White-striped Freetail Bat, Little Forest Bat.

Several of the high risk species are listed as threatened in NSW (Little Eagle, Black-breasted Buzzard, Yellow-bellied Sheathtail Bat, Little Forest Bat), whilst other (non-high-flying) threatened species recorded on site during baseline surveys (e.g. Dusky Woodswallow, Hooded Robin, Redthroat, Rufous Fieldwren and Varied Sitella) are not likely to encounter the RSA and are not species considered to be at risk of collision. The most appropriate vehicle for addressing and managing risks to birds and bats from operational wind farms is through the Adaptive Bird and Bat Management Plan (i.e. monitoring).

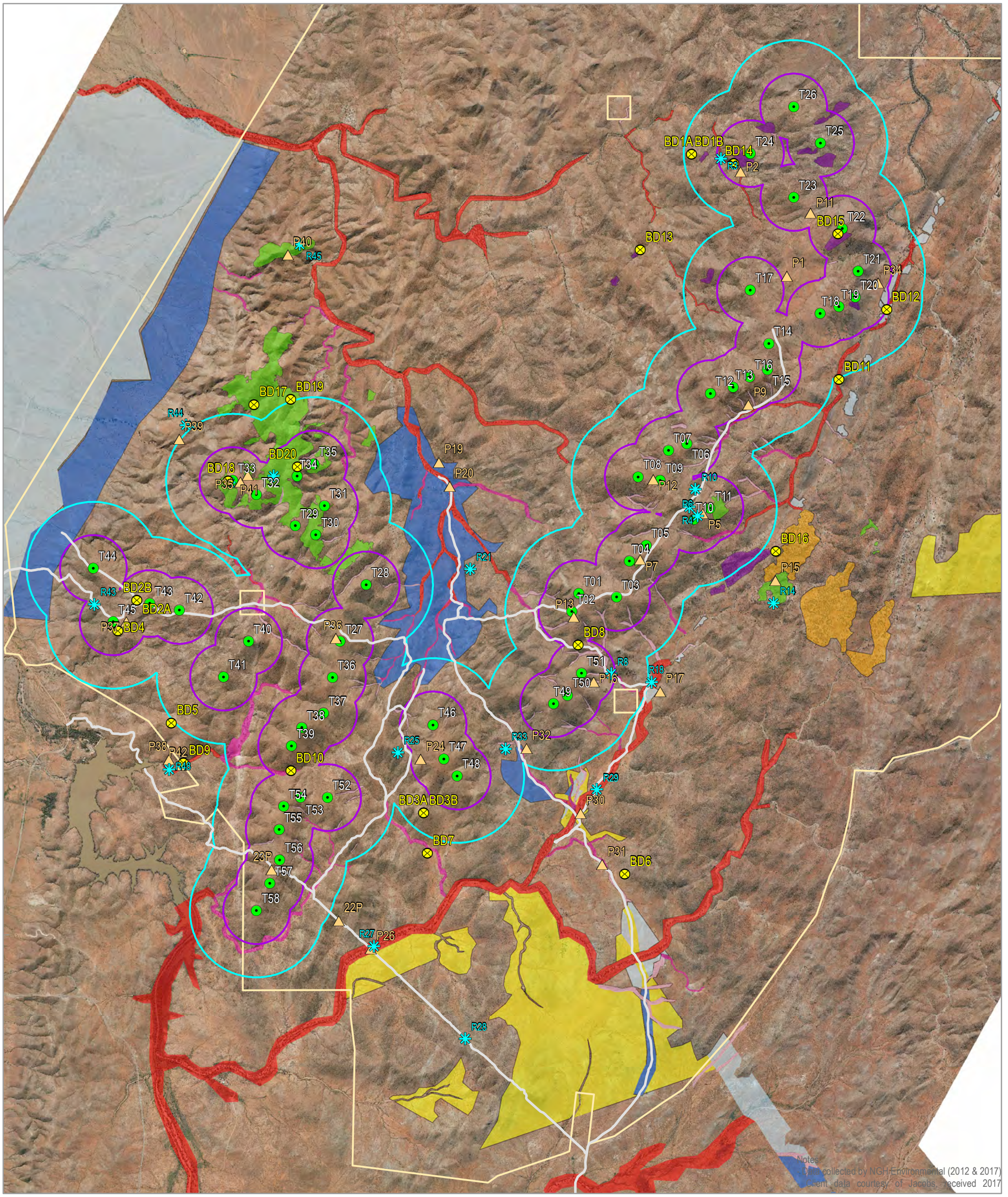
With regard to the provision of the baseline survey data, the location of the survey sites and key survey findings (threatened and at-risk species) is provided in the figures at Appendix A and Appendix B. A full copy of the data set is provided (electronically in Microsoft Excel format) with this letter, and includes the following data:

- Summary details of bird survey sites
- Bird species master lists for all four survey occasions (separately)
- Threatened bird species list (four seasons combined)
- Birds observed at/above RSA master list (four seasons combined)
- Threatened and at-risk bat species list (four seasons combined)

Also provided electronically with this summary review letter is a copy of all relevant GIS shapefiles.

Also provided for ease of reference is the accepted Bird and Bat Survey Methods Document for Silverton Wind Farm which provides further detail and justification on the suitability of the overall survey program employed for the baseline data collection (Appendix D).

APPENDIX A MAP OF SURVEY EFFORT



BIRD AND BAT BASELINE MONITORING SURVEY EFFORT

Silverton Wind Farm

- Turbine locations
- Wind Farm Site
- Existing tracks
- Impact zone (500m)
- Control zone (1km)

Survey effort
- Passerine survey
- Raptor survey
- Bat detector survey sites

Vegetation types
- Black Bluebush Shrubland (ID153)
- Black Oak Woodland
- Bluebush Shrubland (ID155)
- Chenopod
- Chenopod – Red Mallee Woodland/Shrubland (VEG2)
- Mulga - Dead finish (ID123)
- Mulga/Red Mallee Shrubland (VEG1)
- Porcupine Grass sparse woodland (ID359)
- Prickly wattle Shrubland (ID136)
- River Red Gum on rocky creeks
- River Red Gum woodland (ID41)

0 0.5 1 2 Kilometers

A3 @ 1:55000
Ref: 16-412
Author: JB 01/05/2018

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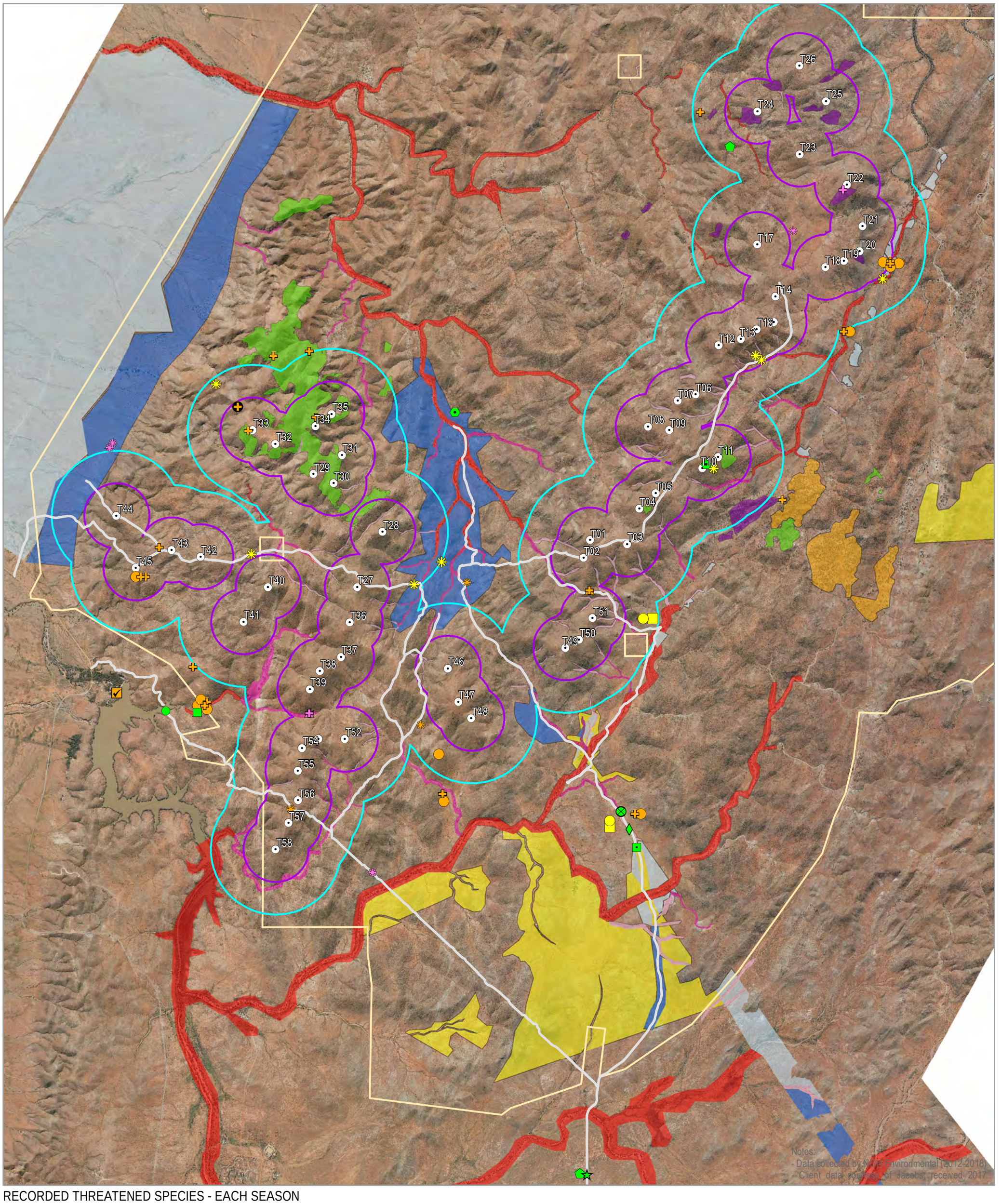
APPENDIX B RESULTS FIGURES

B.1 RECORDED THREATENED SPECIES – EACH SEASON



RECORDED THREATENED SPECIES - EACH SEASON

Silverton Wind Farm

Turbine locations
Wind Farm Site
Existing tracks
Impact zone (500m)
Control zone (1km)

Summer 2016
- Little Forest Bat/Inland Forest Bat
- White-striped Free-tailed Bat
- Yellow-bellied Sheathtail-bat
- Black-breasted Buzzard
- Little Eagle
- Redthroat
- Rufous Fieldwren
- Spotted Harrier
- Varied Sittella

Spring 2017
- Corben's/Lesser Long-eared Bat
- Little Forest Bat/Inland Forest Bat
- Yellow-bellied Sheathtail-bat
- Dusky Woodswallow
- Freckled Duck
- Hooded Robin

Autumn/Winter 2017
- Little Forest Bat/Inland Forest Bat
- White-striped Free-tailed Bat
- Hooded Robin
- Rufous Field-wren

Autumn 2018
- Corben's/ Lesser Long-eared Bat
- Inland Forest Bat/Little forest Bat
- Yellow-bellied Sheathtail-bat
- Hooded Robin

Vegetation types
- Black Bluebush Shrubland (ID153)
- Black Oak Woodland
- Bluebush Shrubland (ID155)
- Chenopod
- Chenopod – Red Mallee Woodland/Shrubland (VEG2)
- Mulga - Dead finish (ID123)
- Mulga/Red Mallee Shrubland (VEG1)
- Porcupine Grass sparse woodland (ID359)
- Prickly wattle Shrubland (ID136)
- River Red Gum on rocky creeks
- River Red Gum woodland (ID41)

0 0.5 1 2 Kilometres

A3 @ 1:56000
Ref: 16-412
Author: JB 27/04/2018

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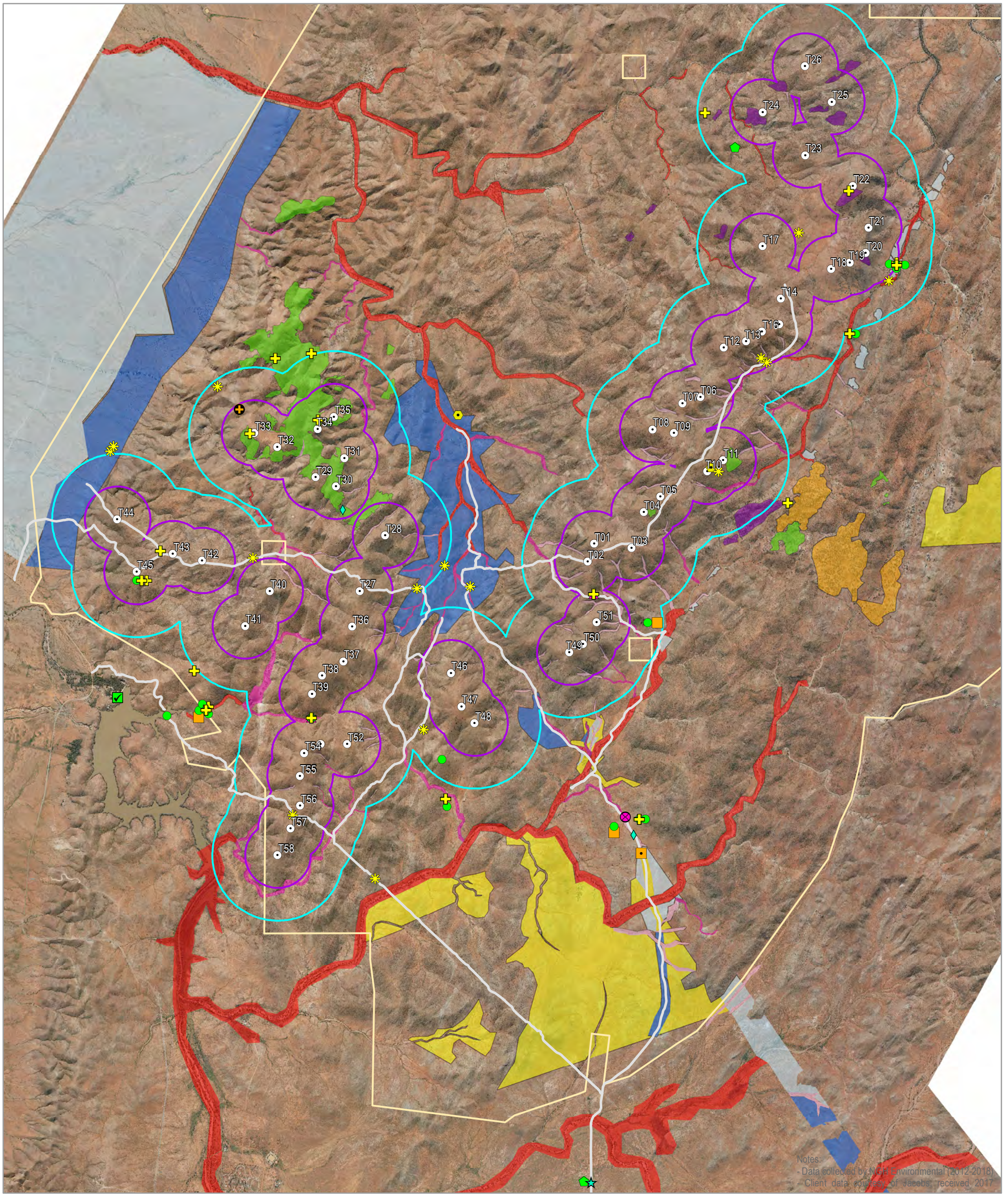
B.2 RECORDED THREATENED SPECIES – ALL SEASONS COMBINED



RECORDED THREATENED SPECIES - ALL SEASONS COMBINED

Silverton Wind Farm

- Turbine locations
- Wind Farm Site
- Existing tracks
- Impact zone (500m)
- Control zone (1km)

Threatened species
- Corben's / Lesser Long-eared Bat
- Little Forest Bat/Inland Forest Bat
- White-striped Free-tailed Bat
- Yellow-bellied Sheathtail-bat
- Black-breasted Buzzard
- Dusky Woodswallow
- Freckled Duck
- Hooded Robin
- Little Eagle
- Redthroat
- Rufous Fieldwren
- Spotted Harrier
- Varied Sittella

Vegetation types
- Black Bluebush Shrubland (ID153)
- Black Oak Woodland
- Bluebush Shrubland (ID155)
- Chenopod
- Chenopod – Red Mallee Woodland/Shrubland (VEG2)
- Mulga - Dead finish (ID123)
- Mulga/Red Mallee Shrubland (VEG1)
- Porcupine Grass sparse woodland (ID359)
- Prickly wattle Shrubland (ID136)
- River Red Gum on rocky creeks
- River Red Gum woodland (ID41)

0 0.5 1 2 Kilometres

A3 @ 1:56000
Ref: 16-412
Author: JB 27/04/2018

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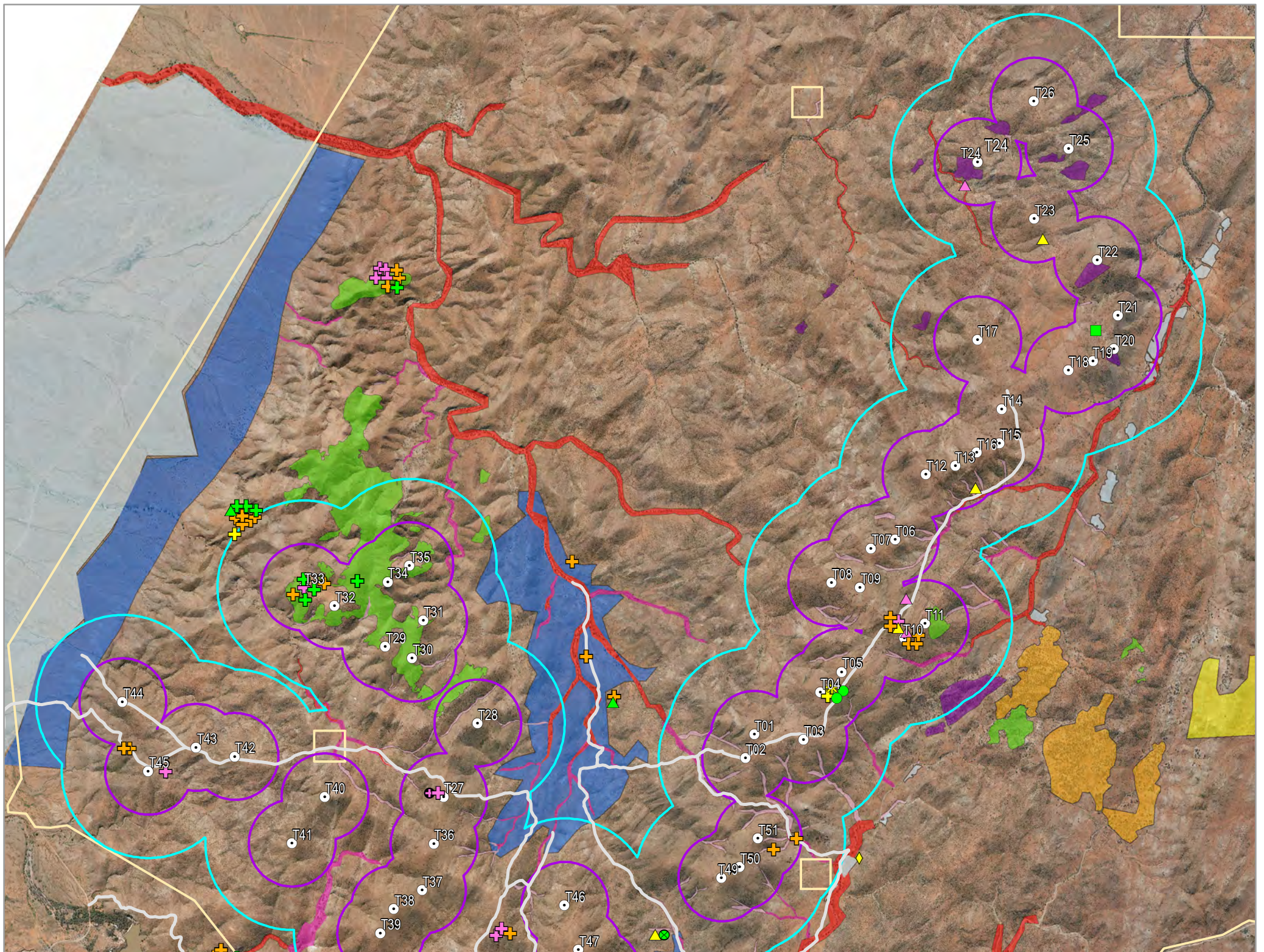
B.3 BIRDS OBSERVED AT/ABOVE RSA – EACH SEASON



BIRDS OBSERVED AT/ABOVE RSA - EACH SEASON

Silverton Wind Farm

- Turbine locations
- Wind Farm Site
- Existing tracks
- Impact zone (500m)
- Control zone (1km)

Summer 2016
- Black Kite
- Black-Faced Woodswallow
- Nankeen Kestrel
- Unknown Raptor
- Wedge-tailed Eagle

Autumn/Winter 2017
- Wedge-tailed Eagle

Spring 2017
- Black-faced Cuckoo-shrike
- Nankeen Kestrel
- Tree Martin
- Wedge-tailed Eagle

Autumn 2018
- Australian Hobby
- Black Kite
- Nankeen Kestrel
- Wedge-tailed Eagle
- Whistling Kite

Vegetation types
- Black Bluebush Shrubland (ID153)
- Black Oak Woodland
- Bluebush Shrubland (ID155)
- Chenopod
- Chenopod – Red Mallee Woodland/Shrubland (VEG2)
- Mulga - Dead finish (ID123)
- Mulga/Red Mallee Shrubland (VEG1)
- Porcupine Grass sparse woodland (ID359)
- Prickly wattle Shrubland (ID136)
- River Red Gum on rocky creeks
- River Red Gum woodland (ID41)

0 0.5 1 2 Kilometres

A3 @ 1:53000
Ref: 16-412
Author: JB 27/04/2018

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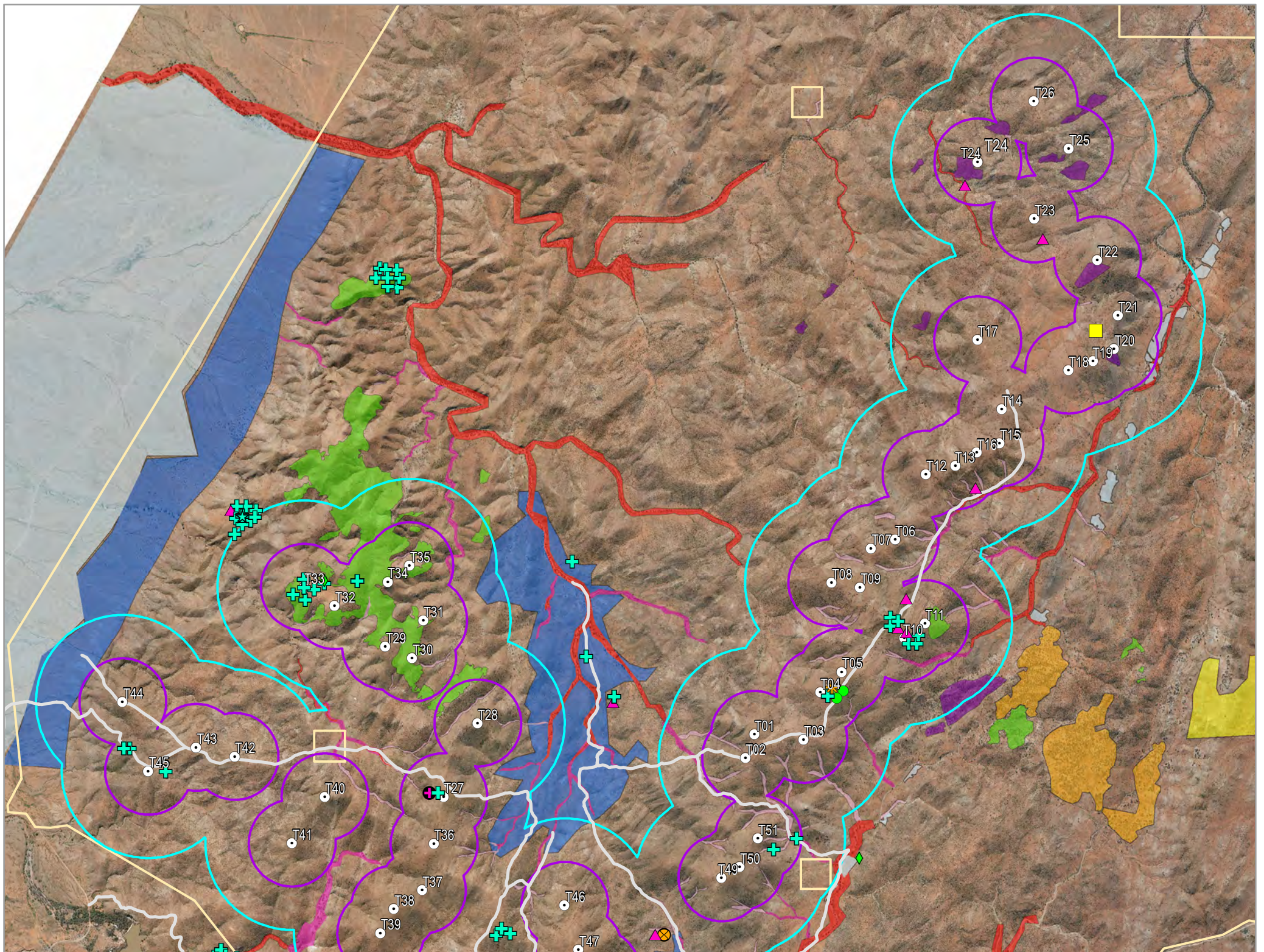
B.4 BIRDS OBSERVED AT/ABOVE RSA – ALL SEASONS COMBINED



BIRDS OBSERVED AT/ABOVE RSA - ALL SEASON COMBINED

Silverton Wind Farm

- Turbine locations
- Wind Farm Site
- Existing tracks
- Impact zone (500m)
- Control zone (1km)

Species
- Australian Hobby
- Black Kite
- Black-Faced Woodswallow
- Black-faced Cuckoo-shrike
- Nankeen Kestrel
- Tree Martin
- Unknown Raptor
- Wedge-tailed Eagle
- Whistling Kite

Vegetation types
- Black Bluebush Shrubland (ID153)
- Black Oak Woodland
- Bluebush Shrubland (ID155)
- Chenopod
- Chenopod – Red Mallee Woodland/Shrubland (VEG2)
- Mulga - Dead finish (ID123)
- Mulga/Red Mallee Shrubland (VEG1)
- Porcupine Grass sparse woodland (ID359)
- Prickly wattle Shrubland (ID136)
- River Red Gum on rocky creeks
- River Red Gum woodland (ID41)

0 0.5 1 2 Kilometres

A3 @ 1:53000
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APPENDIX C REVISED RISK ASSESSMENT SUMMARY

1 May 2018

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Dear Adam,

RE – Silverton Wind Farm – revised Bird and Bat Risk Assessment (Our Ref: 16-412)

A Bird and Bat Risk Assessment (BBRA 2016) was undertaken in 2016 for Silverton Wind Farm, based on a 'worse-case scenario' of a mix of turbine parameters from a range of models being considered. Construction is nearing completion at Silverton Wind Farm and the turbine model has been chosen. Baseline bird and bat surveys have been underway at Silverton Wind Farm over the last two years with a total of four surveys undertaken during 2016, 2017 and 2018.

NSW Department of Planning and Environment (DPE) have requested that the BBRA 2016 be reviewed in light of the new information (turbine parameters and site-specific bird data) before the Bird and Bat Adaptive Management Plan (BBAMP) is finalised. This revision of risk begins overleaf and was undertaken by our Senior Ecologist Bianca Heinze, who conducted the BBRA 2016.

Yours sincerely,

Nick Graham-Higgs
Managing Director

Ph 0427 260 819

NGH Environmental

1 INTRODUCTION AND BACKGROUND

1.1 PROJECT BACKGROUND

A Bird and Bat Risk Assessment was undertaken in 2016 to identify any new risks arising from proposed changes to the approved layout. These changed involved different turbine models being considered for the project and, as a result, a revised layout including fewer turbines. The BBRA 2016 noted a number of limitations, including (NGH Environmental 2016): *"Lack of site-specific bird utilisation data for the Silverton Wind Farm site, necessitating extrapolation from other parts of Australia and reliance on assumptions."* (p.15). Further, the BBRA 2016 was based on a 'worse-case scenario', with the most extreme parameters of the several turbine models under consideration being used as the rotor-swept area (RSA).

Construction is nearing completion at Silverton Wind Farm and the turbine model and its' parameters are now known. The turbine model used at Silverton Wind Farm is General Electric GE 3.43-130. The specifications of this turbine were provided by AGL and are given in Table 1-1.

Table 1-1 Specifications of the turbine model used at Silverton Wind Farm

WTG model	GE 3.43-130
Size (MW)	3.43
Rotor diameter (m)	130
Hub height (m)	110
Maximum tip height (m)	175
Ground clearance (m)	45
Rotor-swept area (m^2)[1]	13,273

Baseline bird and bat surveys

Baseline bird and bat surveys have been underway at Silverton Wind Farm (SWF) over the last two years. Four surveys have been undertaken:

- Summer 2016.
- Autumn-winter 2017.
- Spring 2017.
- Autumn 2018.

Assumptions underpinning the BBRA 2016 can now be updated using site-specific data obtained during these surveys. The DPE have requested that the BBRA 2016 be updated before the Bird and Bat Adaptive Management Plan (BBAMP) is finalised.

1.2 APPROACH OF THIS ASSESSMENT

This assessment provides a review and/or revision of the BBRA 2016 based on the bird data gathered at the site across differing vegetation communities as well as seasonal and weather conditions. Note: the risks associated with habitat resources on site and turbine layout have not changed substantially and therefore have not been reviewed herein (this relates to Section 3.1 and 3.3 of NGH Environmental 2016).

[1] This parameter calculated by NGH Environmental

2 RISK REVIEW

2.1 TURBINE PARAMETERS

The specifications for the turbine model used at SWF are given in Table 1-1 above. Key considerations in relation to collision risks are:

- The lowest height above the ground that the rotor passes (i.e. the 'ground clearance' or 'minimum RSA').
- The total level of the RSA from lowest to highest points.

The BBRA 2016 was based on a ground clearance of 29.5 m and a high point of 180 m. Birds and bats flying between around 29 m and 180 m height would potentially be within the RSA. Generally, the lower the minimum RSA, the more frequently birds would be expected to encounter it. The BBRA 2016 considered that birds may be affected by the wake of moving blades within 10m of the RSA. The BBRA 2016 found a minimum clearance of 9.5 m of vegetation in the Porcupine Grass – Red Mallee – Gum Coolibah woodland, which affected 15 turbines. The GE 3.43-130 has a much higher ground clearance than previously assumed at 45 m. Comparing this to the maximum vegetation heights, the minimum clearance between the RSA and the vegetation canopy is at least 25 m for the Porcupine Grass – Red Mallee – Gum Coolibah woodland, and in some vegetation types, more than 40 m. The majority of birds travel below this height during the majority of their flights (NGH Environmental unpubl.). In summary, the turbines at SWF do not pose an automatic risk to all birds travelling above the canopy at woodland sites.

Table 2-1 Maximum height levels of vegetation on slopes and ridges where turbines are proposed and comparison of RSA clearance and risk for the BBRA 2016 (NGH Environmental 2016) and turbines used at SWF

Vegetation community	Maximum vegetation height (m) **	Minimum clearance between canopy and turbines	
		BBRA 2016: 29.5 m	SWF (turbines used): 45 m
Porcupine Grass – Red Mallee- Gum Coolibah Hummock Grassland / Low Sparse Woodland	20	9.5	25
Black Oak Woodland	15	14.5	30
Mulga-Dead Finish on Stony Hills	15	14.5	30
Undescribed Community 1: Mulga / Red Mallee shrubland	15	14.5	30
Bluebush shrubland	2	~ 27	43

2.2 SPECIES RISK ASSESSMENT

2.2.1 Methods

The species risk assessment uses a risk matrix of likelihood of collision and consequence of collision. The consequence builds in considerations of population impact. It must be emphasised that a 'high risk' species does not necessarily infer a high risk to the population should a collision occur. Table 2-2 shows the risk matrix used in the BBRA 2016 and herein. For example, a high-risk species may have a 'probable' likelihood of collision with a 'minor' consequence – such as Wedge-tailed Eagle. But also, a high-risk species may have a 'rare' likelihood of collision with a 'significant' consequence – such as a critically endangered species.

Table 2-2 Risk matrix with three risk levels: Low, Moderate and High, assigned based on the likelihood and consequence

Likelihood	Consequence			
	Insignificant	**Minor**	**Moderate**	**Significant**
Rare	Low	Low	Moderate	High
Unlikely	Low	Low	Moderate	High
Possible	Low	Moderate	High	High
Probable	Moderate	High	High	High

When considering how best to manage high risk species, consideration of likelihood is an important factor. For example, it would be relatively futile to invest a large quantity of resources to attempt to reduce the likelihood of a 'rare' rated species colliding with a turbine. In this situation, it would be best to consider how to manage the consequence of such an occurrence.

In contrast, there may be scope to manage (i.e. reduce) the likelihood of a species with a 'probable' rating. One such example is removing carcasses around turbines to reduce the likelihood of Wedge-tailed Eagles foraging in the vicinity and therefore encountering blades. Table 2-3 provides the descriptions of likelihood and consequence ratings.

Table 2-3 Descriptions of likelihood and consequence ratings.

Likelihood	Description	Consequence	Description
Rare	An impact may occur only in unusual circumstances	**Insignificant**	Impact on species not detectable in the short term
Unlikely	An impact might occur at some time	**Minor**	Impact may cause non-significant changes to local abundance of species
Possible	An impact could occur during most circumstances	**Moderate**	Impacts may cause significant changes to local abundance of species
Probable	An impact is expected to occur in most circumstances	**Significant**	Impacts may be significant at a population scale

2.2.2 Species assessed

Each species subject to a risk assessment in the BBRA 2016 was reviewed, and one added (in bold):

1. Wedge-tailed Eagle.
2. Little Eagle.
3. Black Kite.
4. Brown Falcon.
5. Nankeen Kestrel.
6. Collared Sparrowhawk.
7. Spotted Harrier.
8. Black-breasted Buzzard.
9. Square-tailed Kite.
10. Grey Falcon.
11. White-throated Needletail.
12. Pink Cockatoo.
13. Diamond Firetail.
14. Pied Honeyeater.
15. Painted Honeyeater.
16. Rainbow Bee-eater.
17. White-fronted Chat.
18. **Freckled Duck (added).**
19. Yellow-bellied Sheathtail Bat.
20. Inland Forest Bat.
21. Little Pied Bat.
22. White-striped Freetail Bat.
23. Gould's Wattled Bat

Where there was new relevant information to consider (e.g. from surveys or due to RSA height change), the risk assessment has been provided in Appendix A, with new information and changes to the assessment highlighted.

The consequence rating for only two species was updated and upgraded due to a change in their listing: Pink Cockatoo and Diamond Firetail. These are threatened species listed as Vulnerable under the NSW *Biodiversity Conservation Act 2017* but were not assessed as such in the BBRA 2016. All other changes relate to the likelihood of collision. Changes have been due to either information collected during baseline surveys (e.g. flight height data) or increased minimum height of the RSA, or both. The primary information used from baseline surveys was:

- Presence/absence.
- Frequency of species observation.
- Records above minimum RSA height (45 m) plus 10 m buffer (i.e. greater than 35 m above ground).

Table 2-4 provides a summary of the risk assessment review, showing likelihood and risk (consequence has not been shown as it remains unchanged for the majority of species). There have been changes to the risk assessment for:

- Little Eagle.
- Square-tailed Kite.
- Grey Falcon.
- Pink Cockatoo.
- Diamond Firetail.
- Inland Forest Bat.
- Little Pied Bat.
- Gould's Wattled Bat.

Table 2-4 Summary of collision 'likelihood' and 'risk' of assessed species, showing both BBRA 2016 results and those of this review

Species	Conservation status	BBRA 2016 Lower RSA at 29.5 m		Revision Lower RSA at 45 m		Change	Reason for change
		Likelihood	Risk	Likelihood	Risk		
Wedge-tailed Eagle		Probable	High	Probable	High	None	
Little Eagle	Vulnerable NSW	Probable	High	Possible	High	Likelihood downgrade Risk equivalent	Survey information
Black Kite		Probable	High	Probable	High	None	
Brown Falcon		Probable	High	Probable	High	None	
Nankeen Kestrel		Probable	Moderate	Probable	Moderate	None	
Collared Sparrowhawk		Unlikely	Low	Unlikely	Low	None	
Spotted Harrier	Vulnerable NSW	Possible	High	Possible	High	None	
Black-breasted Buzzard	Vulnerable NSW	Possible	High	Possible	High	None	
Square-tailed Kite	Vulnerable NSW	Possible	High	Unlikely	Moderate	Likelihood downgrade Risk downgrade	RSA height
Grey Falcon	Endangered NSW	Unlikely	Moderate	Rare	Moderate	Likelihood downgrade Risk equivalent	RSA height
White-throated Needletail	Migratory - national	Probable	Moderate	Probable	Moderate	None	
Pink Cockatoo	Vulnerable NSW	Rare	Low	Rare	Moderate[2]	Consequence upgrade Risk upgrade	Conservation status
Diamond Firetail	Vulnerable NSW	Rare	Low	Rare	Moderate[2]	Consequence upgrade Risk upgrade	Conservation status
Freckled Duck	Vulnerable NSW	-	-	Rare	Moderate	New assessment	Recorded near site during baseline surveys
Pied Honeyeater	Vulnerable NSW	Rare	Moderate	Rare	Moderate	None	
Painted Honeyeater	Vulnerable NSW	Rare	Moderate	Rare	Moderate	None	
Rainbow Bee-eater	Migratory - national	Rare	Low	Rare	Low	None	
White-fronted Chat	Vulnerable NSW	Rare	Low	Rare	Low	None	
Yellow-bellied Sheathtail Bat	Vulnerable NSW	Possible	High	Possible	High	None	

[2] Pink Cockatoo has been listed as a threatened species since the BBRA. Diamond Firetail was not assessed as a threatened species in the BBRA, despite being listed as Vulnerable. Consequence of collision upgraded from 'minor' to 'moderate', leading to a risk rating upgrade from 'low' to 'moderate'. Likelihood remained unchanged at 'rare'.

Species	Conservation status	BBRA 2016 Lower RSA at 29.5 m		Revision Lower RSA at 45 m		Change	Reason for change
Inland Forest Bat	Vulnerable NSW	Rare	Moderate	Possible	High	Likelihood upgrade Risk upgrade	Survey information
Little Pied Bat	Vulnerable NSW	Unlikely	Moderate	Rare	Moderate	Likelihood downgrade Risk equivalent	Survey information
White-striped Freetail Bat		Probable	High	Probable	High	None	
Gould's Wattled Bat		Probable	High	Possible	Moderate	Likelihood downgrade Risk downgrade	Survey information

2.2.3 Threatened species

The following threatened species were recorded during baseline surveys:

1. Black-breasted Buzzard (V NSW).
2. Dusky Woodswallow (V NSW).
3. Freckled Duck (V NSW).
4. Hooded Robin (V NSW).
5. Little Eagle (V NSW).
6. Redthroat (V NSW).
7. Rufous Field-wren (V NSW).
8. Spotted Harrier (V NSW).
9. Varied Sittella (V NSW).
10. Yellow-bellied Sheathail Bat (V NSW).
11. Inland Forest Bat (V NSW).
12. Corben's Long-eared Bat (V NSW, V C'th).

These species were briefly considered for their likelihood to encounter the RSA, based on habitat and ecology. With the exception of raptors and Freckled Duck, the other threatened species are all encountered low in the landscape or close to the canopy (Dusky Woodswallow) and would not be expected to encounter the RSA at 45 m height. The three species that may encounter the RSA: Black-breasted Buzzard, Freckled Duck, Little Eagle; have been subjected to a risk assessment, reported above.

2.2.4 High risk species

Square-tailed Kite has been downgraded from 'high' risk species to a 'moderate' risk species. With the change in minimum RSA height now well above the vegetation canopy, the likelihood of collision for this species was downgraded from 'possible' to 'unlikely'.

The Inland Forest Bat was upgraded from a 'moderate' risk to a 'high' risk species with the likelihood increasing from 'rare' to 'possible'. There is a great deal of uncertainty about the species' behaviour and flight height is not known. This species was widely recorded during baseline surveys and on this basis, the precautionary principle was applied: an assumption was made that it may encounter the RSA while foraging.

Other 'high' risk species remain unchanged. The nine 'high' risk species are:

1. Wedge-tailed Eagle.
2. Little Eagle.
3. Black Kite.
4. Brown Falcon.
5. Spotted Harrier.
6. Black-breasted Buzzard.
7. Yellow-bellied Sheathtail Bat.

8. White-striped Freetail Bat.
9. Inland Forest Bat

Each of these is a 'high' risk species due to a 'possible' or 'probable' likelihood (rather than due to a severe consequence rating).

3 CONCLUSIONS AND RECOMMENDATIONS

3.1 REVIEW OF PREVIOUS RECOMMENDATIONS

The BBRA 2016 provided a number of recommendations. Those relating to buffer distances and turbine configuration are outside the scope of this review. The recommendation to address species-specific risk (Section 5.2.3 in BBRA 2016) by monitoring 'high' risk species more frequently however does relate to this review.

All 'high' risk species have a high *likelihood* of collision. The most appropriate way to work out whether any particular species is at 'high' risk is to undertake mortality searches for carcasses around operational turbines. These should not be targeted toward a particular species but rather attempt to locate all carcasses present during a search. Increasing the frequency of monitoring toward any particular species is likely to skew the results of monitoring, which is to be avoided as much as possible.

Species, or group-specific management actions to reduce the likelihood of collisions should be undertaken in response to an actual mortality event (or pre-determined trigger, such as multiple mortalities of one species). Examples of suitable management actions might be to remove carcasses (e.g. goats or stock) around turbines if Wedge-tailed Eagles or other scavenging raptors are being found during mortality searches. The Adaptive Bird and Bat Management Plan would include such considerations.

3.2 CONCLUSION

Using new information including baseline bird and bat surveys and the final turbine model used for Silverton Wind Farm, this review has found:

- Overall risks to birds and bats to be generally lower due to around 15 m more ground clearance of the minimum RSA (at 45 m) of the GE 3.43-130 turbine model, compared to the parameters of the BBRA 2016.
- When discussing 'high' risk species, it is important to distinguish those with a higher likelihood of collision from those with a higher consequence of collision.
- One species downgraded from 'high' risk of collision (Square-tailed Kite) to 'moderate', and another species upgraded from 'moderate' to 'high' (Inland Forest Bat). The total number of 'high' risk species remains nine: Wedge-tailed Eagle, Little Eagle, Black Kite, Brown Falcon, Spotted Harrier, Black-breasted Buzzard, Yellow-bellied Sheathtail Bat, White-striped Freetail Bat, Little Forest Bat.
- The 'high' risk species list is made up of higher flying species (or in the case of Inland Forest Bat, a species with limited information about flight height) that are likely to encounter the RSA during their daily foraging activity, if they occur within the ridgetop turbine zone. Several of these species are listed as threatened in NSW (Little Eagle, Black-breasted Buzzard, Yellow-bellied Sheathtail Bat, Little Forest Bat).
- Other (non-high-flying) threatened species recorded on site during baseline surveys (e.g. Redthroat) are not likely to encounter the RSA and are not species at risk of collision.
- The most appropriate vehicle for addressing and managing risks to birds and bats from operational wind farms is through the Adaptive Bird and Bat Management Plan (i.e. monitoring).

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APPENDIX A REVIEW - SPECIES RISK ASSESSMENT

All species in Appendix B of NGH Environmental (2016) were reviewed. Species for which new information is available or relevant have been included here. Edits are in orange text.

Wedge-tailed Eagle		
Risk factors	Observed at site, including nesting Utilises updrafts around the range when foraging (at blade height) Large-bodied, low manoeuvrability Large home range Male diving displays Prey source present at turbine sites (goats and rabbits) Low reproductive rate	
Discussion	Observed singly and in a pairs soaring over the range and taking flight from within the turbine envelope. Rabbits and goats are local food sources. Rabbit warrens are present on the plains and goat nurseries on rocky outcrops. Important resources are concentrated within the range and adjacent area (habitat of moderate to high importance). Similar habitat is present in other parts of the range although, the proposal would cover an extensive area of preferred habitat. Sedentary, so reduction of habitat area through barrier effect would impact individuals. Wedge-tailed Eagles continue to be observed utilising habitat, foraging and breeding at wind farm sites. Wedge-tailed Eagles have a considerably lower avoidance rate than many other species, at between 90% and 95% (Smales 2009, MacMahon 2010). Although mortalities are generally low in number, this species is consistently recorded in carcass monitoring at wind farms in Australia (NGH Environmental 2012). Regularly recorded in RSA during baseline surveys. Of 102 observations of birds in the RSA plus buffer (i.e. 35 m or higher), 75 were Wedge-tailed Eagle.	
Collision risk	Likelihood: Probable Consequence: Minor	**Risk: High**

Little Eagle	
Risk factors	Observed at site irregularly Utilises updrafts around the range when foraging (at blade height) Large-bodied, low manoeuvrability Large home range Low reproductive rate Threatened species
Discussion	While Little Eagles have not been recorded in the Australian carcass search literature cited herein, it is a medium sized raptor with similar soaring and prospecting foraging behaviour (Aumann 2001) as the Wedge-tailed Eagle and may be similarly at risk from turbines in certain landscape positions. As for Wedge-tailed Eagles, juvenile Little Eagles with turbines near nests would be most at risk. Observed in the study area and there are many records of the species in the ALA. Rabbits are local food sources. Rabbit warrens are present on the plains Important resources are concentrated within the range and adjacent area (habitat of moderate to high importance). Similar habitat is present in other parts of the range although, the proposal would cover an extensive area of preferred habitat. Sedentary, so reduction of habitat area through barrier effect would impact individuals.

	Observed one on occasion during baseline studies and not within RSA.	
Collision risk	Likelihood: Possible Consequence: Moderate	**Risk: High**

Black-breasted Buzzard		
Risk factors	Utilises updrafts around the range when foraging (at blade height) Large-bodied, low manoeuvrability Large home range Low reproductive rate Threatened species	
Discussion	Wide-ranging, sparsely distributed species. There are several records in the locality; mostly observed in wooded habitats and riparian areas. Black-breasted Buzzard observed in the study area and there are many records of the species in the ALA. Rabbits are local food sources.	
Collision risk	Likelihood: Possible Consequence: Moderate	**Risk: High**

Square-tailed Kite		
Risk factors	Utilises updrafts around the range when foraging (at blade height) Large-bodied, low manoeuvrability Large home range Low reproductive rate Threatened species	
Discussion	Wide-ranging, sparsely distributed species. There are several records in the locality; mostly observed in wooded habitats and riparian areas. Square-tailed Kite has not been observed in the study area. Generally forages directly above the canopy. Minimum RSA height has increased to 45 m, with at least 25 m clearance above the highest growing vegetation type on site.	
Collision risk	Likelihood: Unlikely Consequence: Moderate	**Risk: Moderate**

Grey Falcon		
Risk factors	Performs tumbling and diving flight displays Soaring Threatened species (endangered)	
Discussion	There are many records in the locality although species sparsely distributed. Forages using high-speed chase, quartering and high soaring usually over vegetated (including grassland) and riparian areas (Debus 2012). Main prey items are ground-feeding granivores (NSW Scientific Committee (2010). Prey sources present in the wind farm area. Minimum RSA height has increased to 45 m, with at least 25 m clearance above the highest growing vegetation type on site.	
Collision risk	Likelihood: Rare Consequence: Moderate	**Risk: Moderate**

Pink Cockatoo		
Risk factors	Rapid flight at turbine height Flocking Threatened species in NSW (Vulnerable)	
Discussion	Feeds mostly on the ground, on the seeds of native and exotic melons, saltbush, wattles and cypress pines. Normally found in pairs or small groups, though flocks of hundreds may be found where food is abundant (DECC 2007). Observed on site during BA flying with the turbine envelope at blade height. Not observed during baseline surveys. A manoeuvrable flyer. Key habitat is not located within the development envelope. Cockatoos do not feature among regular carcass finds at wind farms (NGH Environmental unpubl. data).	
Collision risk	Likelihood: Rare Consequence: Moderate	**Risk: Moderate**

Diamond Firetail		
Risk factors	Seasonal flock aggregations Threatened species	
Discussion	Sedentary. Feeds predominantly on the ground on grass seeds, in groups from 5 to 150 individuals (Schodde & Tidemann 2007), nesting in pairs or communally in shrubs and small trees. May form large flocks during winter and autumn. Diamond Firetails are considered to have poor dispersal abilities and are likely to be less common away from tree cover. Recorded in study area.	
Collision risk	Likelihood: Rare Consequence: Moderate	**Risk: Moderate**

Rainbow Bee-eater		
Risk factors	Migratory	
Discussion	When migrating may occur in large flocks. Forages by pursuing and catching flying insects, or by aerial sweeping. Considered secure and common in Australia. (SEWPAC 2016). Recorded in study area including during baseline surveys, but not recorded flying above 35 m.	
Collision risk	Likelihood: Rare Consequence: Minor	**Risk: Low**

Freckled Duck	
Risk factors	Migratory Threatened species Waterbirds – awkward flight, night migration
Discussion	Generally, for waterbirds coastal habitats provide drought refugia and inland wetlands are used during wet periods (Wen *et al.* 2016). Freckled Duck is known to retreat to reliable coastal wetlands during dry conditions inland (BirdLife Australia undated). The bird was recorded in spring 2017 at the reservoir – where habitat does not fit descriptions for the species. The region received below average rainfall over winter and spring 2017 (BOM 2018a, b). Freckled Duck may have been utilising the reservoir as drought refugia or as a stop-over between more suitable inland and coastal wetlands.

Freckled Duck		
	Freckled Duck has been recorded utilising wetlands near to an operational wind farm in southern NSW, but has not been recorded within the turbine area. At the same wind farm, there have been no waterbirds recorded amongst carcass search data (NGH Environmental, unpubl.)	
Collision risk	Likelihood: Rare Consequence: Moderate	**Risk: Moderate**

Yellow-bellied Sheathtail Bat		
Risk factors	High-flying, fast flying Migratory	
Discussion	Yellow-bellied Sheathtail Bat was recorded during BA and baseline surveys, albeit with a low number of passes. Fast and high-flying species such as this appear to be less able to avoid obstacles while foraging.	
Collision risk	Likelihood: Possible Consequence: Moderate	**Risk: High**

Inland Forest Bat		
Risk factors	Threatened species Colonial	
Discussion	Little information is available for this species. There are ALA records for this species in the region, e.g. Menindee and Bimbowrie (over the border in SA), although but not in the Broken Hill / Silverton district. Other forest bats fly within the canopy, and their echolocation calls reflect flight in a cluttered environment: steep, fast calls. The call of the Inland Forest Bat is more like the Little Pied Bat (Pennay *et al.* 2004), suggesting the species flies in more open habitat. However, it is unclear whether this is due to the flight height (i.e. flying above the canopy) or the openness of arid land habitat. The Forest Bat complex *(Vespadelus baverstocki/vulturnus)* was one of the most frequently recorded microbat during baseline surveys. It was recorded during all four survey events, and recorded widely spring 2017 and autumn 2018. The likelihood of collision for this species is particular should be reviewed again following operational monitoring.	
Collision risk	Likelihood: Possible Consequence: Moderate	**Risk: Moderate**

Little Pied Bat		
Risk factors	Threatened species Recorded in study area in BA, but not during baseline surveys.	
Discussion	Little is known about Little Pied Bat, however, it appears that the species prefers to forage within the canopy or understorey of vegetation communities. The physiology and the short pulse rate of the bat suggest it is a relatively slow flying and manoeuvrable species (Churchill 2008, Pennay *et al.* 2004).	
Collision risk	Likelihood: Rare Consequence: Moderate	**Risk: Moderate**

Gould's Wattled Bat		
Risk factors	High-flying, fast flying	
Discussion	Gould's Wattled Bat was recorded in study area during BA but not during baseline surveys. This is a sedentary species. Fast and high-flying species such as this appear to be less able to avoid obstacles while foraging. Gould's Wattled Bats are disproportionately represented in available Australian carcass monitoring data (NGH Environmental 2012, Hull 2013)	
Collision risk	Likelihood: Possible Consequence: Minor	**Risk: High**

APPENDIX D BIRD AND BAT BASELINE DATA SURVEY METHODS

Bird and Bat Survey Methods

SILVERTON WIND FARM

NOVEMBER 2017

ngh environmental

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1 INTRODUCTION & PROJECT BACKGROUND

Project Approval for Silverton Wind Farm (including the latest Modification 3 project design proposal) was received in December 2016. Condition 18, of Schedule 3 (Environmental Conditions) of the approval includes:

> *Prior to the construction of any wind turbines, the Proponent must prepare a Bird and Bat Adaptive Management Plan for the project in consultation with OEH to the satisfaction of the Secretary. This program must include:*
>
> *(a) baseline data on threatened and 'at risk' bird and bat species and populations in the locality that could potentially be affected by the project;*

The key aims of the baseline surveys is to gather adequate baseline data on the existing bird and bat species composition prior to commencement of construction of the wind farm (i.e. pre-impact data). This data will be required for future comparisons to be made to detect changes in the species use (including changes in activity patterns such as avoidance) of the site post-construction and during operation of the wind farm.

This report provides a single consolidated outline of the methods adopted for the overall Silverton Wind Farm Bird and Bat Baseline Data Collection program. This Baseline Program will be used as an appendix to the Bird and Bat Adaptive Management Strategy.

Also included in this letter (**Appendix B**) are summary responses to the main recommendations made in the OEH Expert Report (Michael Pennay, 2017). The responses should be read in conjunction with the survey methods proposed in this document and the supporting survey effort plan accompanying this document. This revised approach seeks to address the concerns raised by OEH, including the recommendations made in the OEH Expert Report in relation to the bat survey component, as well as having consideration to the relevant survey guideline documents, including the commonwealth's *Survey guidelines for Australia's threatened bats* (DWEHA 2010), and the NSW *Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities* (DEC 2004).

2 OVERVIEW OF TYPES OF SURVEYS TO BE CONDUCTED

The Silverton Wind Farm Bird and Bat Baseline Data Surveys have, include the following broad survey types:

1. Bird Utilisation Surveys
2. Raptor Surveys
3. Bat Surveys

The specific methods to be employed for each of the above survey types is detailed further below.

2.1 SURVEY STRATIFICATION

This bird and bat (baseline) survey design has been based on the BACI principle (Before, After, Control, Impact). The baseline surveys are to be completed before commencement of construction of the turbines, and therefore forms the *Before* component of the overall bird and bat surveys. The survey design also includes both *Control* and *Impact* areas as defined below. The *After* component will be covered by ongoing monitoring post commencement of operation, and will be managed under the Bird and Bat Adaptive Management Plan (BBAMP, developed and implemented by others).

Based on previous baseline and ongoing monitoring surveys from other wind farms (and using Boco Rock Wind Farm as the primary example), *Impact* and *Control* zones will be established as follows:

- *Impact Zone* is defined as the entire area within a 500m radius around each turbine location.
- *Control Zone* is defined as all areas located more than 1,000m from each turbine (as shown on the attached survey locations plan, based on the latest available information on turbine placements as per the GE-Catcon layout, which proposes 58 turbine sites).

An additional layer of the survey stratification is the seasonality of the surveys to account for possible changes in bird and bat species occurrences and habitat use throughout the year based on seasonal influences.

To account for seasonal difference, the baseline surveys will be conducted over different seasons, including summer, autumn winter and spring. To date, a summer survey (December 2016), and a combined Autumn/Winter period (May/June 2017) have been completed for both bird and bat surveys, and a bird-only Spring survey was undertaken in October 2017. A further bat-only survey will be undertaken in November 2017, as per the survey protocols outlined in this report. A Further bat-only Autumn survey (March 2018) will also be undertaken immediately prior to commencement of operation of turbines to provide further seasonal before impact data for bats. The current status of the bird and bat surveys is also detailed in Tables 3 and 10 of this report.

It is noted that OEH had requested that each survey site would be multiple times during different times of the day. Given the large site area and access difficulties due to lack of existing roads and difficult terrain, this was not possible to achieve during the same seasonal survey. Given the replication of same survey sites at different times of the year (including being conducted at different times of the day between the seasons), as well as the fact that there are numerous sites within the same habitat type (which is relatively homogenous across the majority of the wind farm site – see below for further discussion of stratification based on habitat type), it is believed that there has been sufficient survey effort and replication to account for the majority of species likely to be present at the site, particularly with respect to the differences in utilisation of the main habitat types within the site.

The survey design has also been further stratified to consider bird and bat utilisation within the different habitat types recorded within the broader study area, and informed primarily by the vegetation mapping already completed for the original environmental assessment of the proposed development. The number and location of the Control and Impact survey sites is governed by the overall area of each vegetation type (i.e. habitat availability) present within the study area, and importantly, within both the defined Control and Impact Zones. Accordingly, vegetation types such as the Mulga – Dead Finish will include the greatest number of survey sites as this vegetation type occurs over more than 90% of the overall study area. The breakdown of survey sites within each vegetation type is explained further below in relation to Passerine and Raptor bird groups.

2.2 CONSIDERATION OF STATISTICAL RIGOUR OF APPROACH

To ensure we have developed a survey approach that will collect sufficient data to enable a statistically rigorous evaluation to determine if the operation of the wind farm is having an effect on birds or bats, we have consulted with a statistical expert (Dr Elizabeth Stark, Symbolix Pty Ltd) to examine the overall approach.

With regard to the bird utilisation surveys, Symbolix note that "The survey design and effort undertaken for the baseline surveys appears to be in line with (or better than) the baseline survey effort at other Australian wind farm sites. Provided that post-construction surveys match the timing, location and effort of these baseline surveys the data set should be sufficient to measure before-after patterns and infer if these patterns differ between control and impact sites." (refer to letter of advice included at Appendix C).

With regard to the bat survey component, a detailed summary of the latest methods was not able to be supplied to Symbolix as some of the final methods (i.e. RSA-level monitoring etc) had not yet been finalised to provide a consolidated methods statement for their review and comment. Notwithstanding this, numerous discussions were undertaken with Dr Stark about the general approach undertaken for the bat surveys. Dr Stark noted that the use of bat detectors has very limited application with respect to detecting changes in population abundance as the number of calls files cannot be used as a surrogate for the number of individuals present and contributing to the calls recorded. As such, the data cannot be used reliably to determine whether the wind farm is resulting in a decline in the population abundance of a species. Nevertheless, the use of detectors can be seen as a good measure of presence/absence of species, and can therefore be useful to detect changes/trends in habitat utilisation, from which it can potentially be determined whether the wind farm is resulting in habitat avoidance impacts for a given species.

3 DETAILED SURVEY METHODS

3.1 BIRD UTILISATION SURVEYS

The baseline bird surveys are broadly divided into passerine and raptor surveys, and includes timed point-count utilisation surveys as well as opportunistic observations as described below for each group.

3.1.1 Passerine bird surveys

The passerine[1] bird surveys includes a standardised truncated bird survey involving a 20 minute point count method, with 2 observers stationed at nominated survey sites (see further below for a description of the number and location of survey sites). The observers ensure that they are positioned to have an adequate, clear view of the surrounding landscape (to the greatest extent possible) to maximise the ability of observing all birds within the area. The details recorded during each survey include:

- date, time, site number, GPS co-ordinates, temperature, wind, general habitat description
- Bird observation records, including species, count (number of birds seen if possible), time of observation, distance of bird/s to observer, flight height[2], flight direction, other notes where possible including habitat flown from/to, distance of flight, any other pertinent observation on the sighting

A detailed summary of the survey methods is provided at Appendix D.

3.1.2 Raptor surveys

The raptor[3] bird surveys includes a standardised truncated bird survey including a 30 minute point count method similar to the passerine bird survey, but with an added 10 minutes of observation time to account for the (generally) lower abundance of these species, as well as an added focus on the flight behaviour (including a minor modification to the data sheet for recording height, direction, landscape etc). As with the passerine surveys, the survey team spend a brief amount of time (approx. 15 minutes) together viewing structures of a known height in order to try and calibrate their visual estimation of height.

The selection of site locations for the raptor surveys will utilise the control and impacts sites already described. Areas where a strategic view is afforded (i.e. along ridgetops and not in deep and/or heavily vegetated gullies) have been selected to the greatest extent possible, however, given that certain habitat types (such as the River Red Gum) only occur within the gullies, it was inevitable that some survey sites would require the location to be lower down in the gullies/valleys.

[1] Passerine birds are defined by the arrangement of their toes and are sometimes known as perching birds or, less accurately, as songbirds.

[2] Prior to the commencement of surveys, the survey team will spend a brief amount of time (approx. 15 minutes) together viewing structures of a known height in order to try and calibrate their visual estimation of height.

[3] Raptors are birds of prey and include eagles, hawks, falcons and the like.

3.1.3 Opportunistic Records

During the general driving and walking around the site (including movements into and out of the site from public roads etc) opportunistic records of birds are recorded wherever possible.

3.1.4 Number and location of bird surveys:

A total of 48 sites are included in the survey as follows:

- 29 Passerine (10 Control and 19 Impact sites)
- 19 Raptor (8 Control and 11 Impact sites)

The number of surveys was derived from consideration of the overall area (ha) of the development footprint, as well the variety of different vegetation types where the impacts would occur. The final survey density was then derived by a combination of the overall area of the site, the number of turbines and the total RSA of the development based on the number and design parameter of the turbines, as follows

- Turbine type = GE Turbine (GE 3.43-130) with a diameter of 130m.
- Turbine RSA (single) = 13,273m^2
- Total RSA for Stage 1 (58 Turbines) = 769,834m^2
- Survey Density = one survey site per 16,038m^2 of RSA

The survey density compares favourably with other bird and bat baseline surveys, including/such as Boco Rock Wind Farm which had one survey site per 17,540m^2.

The number and location of the passerine and raptor survey sites are the same as for the Summer 2016 surveys and are described in Tables 1 and 2 below and shown in the Survey Effort figure at Appendix A.2.

3.1.5 Summary of Bird Utilisation Survey Effort

A summary of the overall bird survey effort for the collection of the baseline data is provided below, including a summary of the survey effort within each habitat type across the study area. The same number and location sites has been consistently applied across all survey seasons.

For the habitat types assessed, the following codes are used:

- MD = Mulga Dead Finish (open) woodland
- PG = Porcupine Grass sparse woodland
- RR = River Red Gum riparian woodland
- BB = Bluebush shrubland

Table 1 Passerine bird survey effort

Impact				Control				Total
MDF	PG	RR	BB	MDF	PG	RR	BB	
13	2	3	1	4	2	3	1	29

Table 2 Raptor bird survey effort

Impact			Control			Total
MDF	PG	RR	MDF	PG	RR	
8	2	1	3	2	3	19

The overall stratification of the bird survey design, including the habitat type that each site is located within, as well as the allocation of each site as either a Control Zone or Impact Zone site, is summarised in Table 4.

3.1.6 Timing of Bird Surveys

As stated above, to account for seasonal difference, the baseline surveys will be conducted over different seasons, including summer, autumn winter and spring. The table below details the survey timing of the bird surveys (including an indication as to the current status of these surveys as being complete or yet to be undertaken).

Table 3 Seasonal timing of bird surveys

Season	Status
Summer	**Completed (December 2016)**
Autumn*	**Completed (May/June 2017)**
Winter*	**Completed (May/June 2017)**
Spring	**Completed (October 2017)**
Autumn	**Not yet undertaken. Scheduled for March (2018)**

*Autumn and Winter were combined for the bird surveys given the generally low number of birds expected to occur at this time of year. Future surveys are to separate these into distinct seasons. A March 2018 survey will be conducted to add further Autumn data to capture possible migratory species movements at that time of year.

It is expected that the future operational surveys would be conducted at a minimum during each season independently, if not more regularly as determined in the BAMP.

Table 4 Schedule of Survey Sites

Site No	Passerine	Raptor	Control	Impact	HABITAT
1	P			I	MDF
2	P			I	RR
3		R		I	RR
4		R		I	MDF
5	P			I	MDF
6		R		I	MDF
7	P			I	PG
8		R		I	MDF
9	P			I	RR
10		R		I	MDF
11	P			I	MDF
12	P			I	MDF
13	P			I	MDF
14		R	C		PG
15	P		C		PG
16	P			I	MDF
17	P		C		MDF
18		R	C		RR
19	P		C		MDF
20	P		C		RR
21		R	C		MDF
22	P		C		MDF
23	P			I	MDF
24	P			I	MDF
25		R		I	MDF
26	P		C		RR
27		R	C		RR
28		R	C		MDF
29		R	C		RR
30	P		C		RR
31	P		C		BB
32	P			I	BB
33		R		I	MDF
34	P			I	MDF
35	P			I	MDF
36	P			I	MDF
37	P			I	MDF
38	P			I	MDF
39	P		C		MDF
40	P		C		PG
41	P			I	PG
42	P			I	RR
43		R		I	MDF
44		R	C		MDF
45		R	C		PG
46		R		I	PG
47		R		I	PG
48		R		I	MDF
TOTAL	**29**	**19**	**18**	**30**	

3.2 BAT SURVEYS

The bat survey scope has been updated from the completed Summer 2017 and Autumn/Winter 2017 surveys. Specifically, the survey locations have been revised to add new sites to increase the overall survey area covered, and the survey methods have been amended to included bat surveys at the RSA height, as has been discussed with OEH, and recommended by their expert review (M. Pennay, 2017).

The revised bat survey methods are explained further below. It is expected that this updated approach will also form the basis of the future ongoing operational monitoring to be established under the BBAMP.

The specific survey methods to be employed as both once-off and ongoing survey monitoring include a mixture of both trapping and passive call recording. Each survey method and the intended use of that method is described further below.

3.2.1 Trapping

Generally, trapping will not be used as an ongoing survey method. However, given that there have been some difficulties in obtaining conclusive positive species identification for some species, a once-off trapping program is planned to coincide with the use of bat detectors. The physical capture and identification of specimens at the same time that calls are being recorded will enable a more conclusive identification of the species included in the call analyses (described further below).

Specifically, the species of interest with inconclusive call results to date and for which trapping will be targeted include the following:

- Inland Forest Bat *(Vulturnus baverstocki)* or Little Forest Bat (*V. vulturnus*) (or both).
- Bristle-faced free-tailed bat (*Mormopterus eleryi*) or Little broad-nosed bat (*Scotorepens greyi*) (or both).
- Corben's Long-eared Bat (*Nyctophilus corbeni*) or Lesser Long-eared Bat (*N. geoffroyii*) (or both).

Once the species have been confirmed, this survey method is no longer required and would not continue as part of the ongoing operational monitoring of the wind farm.

A total of four trapping sites will be established (and potentially more if time/weather permit). One night of trapping will be conducted at each site. The location of trapping sites will be finalised during the establishment of the bat detectors to identify suitable sites based on the presence of habitat features including hollow-bearing trees (roost/shelter habitat) and water (for foraging habitat). The trapping will occur concurrently with bat detector survey work at the same location/time for comparison of call results with trapping results.

3.2.2 Bat Detectors

The main survey technique to be employed for both the current baseline data collection as well as on an ongoing operational monitoring basis is the use of passive bat call detection units, including both Anabat and Songmeter units, utilising both Zero Crossing Analysis as well as Full Spectrum call file analysis.

The use of call detectors is well established in the current literature, and is a recognised survey technique in both the NSW and Commonwealth survey guidelines (as applicable). Details on the efficacy of this technique does not require further consideration, although it is noted that the use of call file numbers of a species on any particular survey occasion (night), is not regarded as a good surrogate for estimating population abundance (as only a small number of individuals can repeatedly fly around/near a detector yielding a large number of call files, suggesting a much larger number of individuals than what is actually

present). The use of bat detector call recording for determining presence/absence of species, particularly if coupled with a trapping study as described above, is well accepted.

The overall scope and effort, including the total number and rational for siting of call detectors is described further below.

Ground vs RSA level monitoring

A main critique of the work conducted to date for the baseline data collection has been the absence of monitoring of bats flying within the Rotor Sweep Area (RSA). Given that bat species composition and activity levels within the RSA may not be the same as those recorded at ground level, monitoring at RSA is required.

One of the challenges to undertaking monitoring at RSA at the Silverton Wind Farm Project Area is that only existing meteorological monitoring masts (Met Masts) are available for RSA level monitoring. There are no other structures existing or proposed within or near the site that would enable mounting a bat detector unit above a minimum required height of 35 m (lowest point of RSA). We explain further below issues preventing the use of other potential options for RSA level monitoring.

In considering the use of the Met Masts, presently there are only 3 permanent meteorological monitoring masts (Met Masts) within the Stage 1 (58 Turbine) Project Area available for use on an ongoing basis (Masts MM1, MM2 and MM3, refer to the table below).

Other Met Masts that were used in the development of the project are no longer available for a number of reasons, including mainly that the existing previous masts in the Stage 1 project area were established for temporary use only, with the intention that they would eventually be replaced with permanent wind monitoring masts, in different locations. Also some of the masts were established for wind monitoring for other stages of the larger(unapproved) project which at this point in time are not being pursued, and those masts are now located on properties that are not currently signed up to the (approved) project. Consequently, there is no existing agreement between the landowner and the proponent to allow ongoing access to these masts and they will also be removed. Furthermore, the distance from these other four mast sites to the Stage 1 Project Area (more than 10km) means that any data gained from these site may have limited application to the Stage 1 Project Area.

Other opportunities for establishing units at RSA level have been considered (i.e. helium weather balloons), and these were found to be unsuitable for use at an operational wind farm (refer to responses to OEH Expert

The locations of the Met Masts MM1, MM2 and MM3 that are able to be used for the baseline data collection and subsequent operational monitoring are described in Table 5 below and shown also in the Survey Plan accompanying this document.

Table 5 Met Mast locations for RSA level monitoring

MAST	Easting	Northing	General Location	Habitat Type
MM1	528825.6	6489040.8	Impact*	MDF
MM2	520504.6	6482354.9	Impact	MDF
MM3	524804.3	6479164.3	Impact*	MDF

*Note: MM1 and MM3 are located outside the 500 m Impact Zone buffer, but not past the 1km buffer for the Control Zone. As these masts cannot be moved, they have been ascribed as Impact Zone sites.

In summary, all three masts are located within the Impact Zone (noting that masts MM1 and MM3 are located in the *Intermediate Zone;* i.e. the area between the 500m Impact Zone and the 1km buffer for the Control Zone. For the purposes of this survey protocol, these sites be treated as Impact Zone monitoring sites as neither the masts nor the turbines can be moved to allow location entirely within either Control or Impact Zones.

For the RSA-level monitoring, the detectors will be mounted at approximately 65m height. Full-spectrum records (i.e. Anabat Swift or songmeters) will be used for the RSA-level monitoring.

For the bat detector survey sites to be deployed at ground level only (discounting the fixed position of the units to be deployed at about ground-level on met masts MM1, MM2 and MM3), there is greater flexibility in the site selection process. However, site selection for these detectors was still limited by a sufficient amount of available habitat within both the Control and Impact Zone areas of the site to allow a BACI design to operate.

A description of the survey site selection of the ground-only bat detector monitoring, is described further below. The general approach taken in developing this method is as follows:

i) Identify which vegetation communities constitute Priority Habitat to be targeted for sampling
ii) Identify which existing survey sites (from Summer 2016 and Autumn/Winter 2017) are suitable as sites for repeatable ongoing sampling

In taking this approach, we have developed a consolidated list of survey sites that we propose are suitable for use on an ongoing basis. We also make comment below on how the consolidated list of sites meets the requirements for a sufficiently stratified BACI design, how they will meet the recommendations of the OEH Expert Report as well as the requirements of the Commonwealth's *Survey guidelines for Australia's threatened bats* (DEWHA 2010).

We list the (new and revised) survey sites in Table 7. Each site has been allocated a new numbering system to be used from this point forward to avoid any confusion resulting from giving each survey site a number related to the individual Anabat unit. The new numbering will relate to the site location and not the actual bat detector unit number as has happened in the past. This includes going back to the previous Summer 2016 and Autumn/Winter 2017 surveys and revising the map and reports to use this new numbering so that future comparisons between seasons/years at the same site can be more readily made.

Rationale for site selection

Identification of Priority Habitat Areas

As per the comments made in the OEH Expert Report (M. Pennay, 2017), the main focus of survey effort should be toward Priority Habitat Areas. These Priority Habitat Areas are considered to be areas within the suite that provide important habitat features for bats, and include areas of woodland with potential for hollow-bearing trees (important for roosting habitat), as well as areas that support or are in close proximity to water resources (both permanent and ephemeral). Areas that provide a propensity to support both hollow-bearing trees as well as water are considered to be of the highest priority in terms of potential bat habitat.

Note that given the very large size of the site, a detailed hollow-bearing tree survey has not been completed for the project, and as such, the occurrence of hollow-bearing trees as part of a Priority Habitat Area is not based on survey information, but on the likelihood of hollows, inferred from the observed vegetation structure and composition of various vegetation community types mapped across the site.

Note also that whilst some (generally) permanent water resources are known to occur within the project site (mainly Umberumberka Reservoir, and a large farm dam in the southeast corner (at the location of Anabat Unit AE-6 from the Autumn/Winter 2017 survey period)), all potential water resources within the site have not been formally mapped (as either permanent or ephemeral). Whilst it is likely that the larger stream orders are likely to contain water from time to time, including larger pools where water may occur on a more permanent basis, this has not been specifically assessed or mapped. As such, targeting water resources for deployment of bat detectors may not result in consistent repeatable sampling with respect to habitat availability, as a large inundated pool section of a stream in one season/year may be completely dry during other seasons/years.

A summary of the occurrence of Priority Habitat Areas within the site based on the existing vegetation mapping is given in the table below.

Table 6 Identification of Priority Habitat Areas within the site

Vegetation Community Type	Habitat features for bats	Priority Habitat?
Mulga Dead Finish woodland	Contains some limited water resources (a single recorded farm dam as well as ephemeral stream gullies not supporting River Red Gum riparian woodland). Low potential for hollow-bearing trees given dominant tree species is Mulga (*Acacia aneura*) which typically does not readily form hollows. Generally in poor condition with disturbance from grazing/browsing. Given extensive occurrence (circa 90% of total site area), with some potential for hollow-bearing trees and water resources, and likely to be foraging habitat, this habitat type has been identified as Priority Habitat.	Yes
Mulga/Red Mallee shrubland	Generally devoid of any water resources. Some potential for hollows to be present within Red Mallee trees (*Eucalyptus socialis*) that may be used as roost sites. Is limited to some (relatively small) patches in the northeast of the site.	Yes
Porcupine Grass (Spinifex) sparse woodland	The Porcupine Grass spares woodland contains scattered Red Mallee/Gum-barked Coolibah trees (*E. intertexta*), which have been observed to contain smaller spout-hollows which are often favoured by small microbat species. No obvious water resources in these areas.	Yes
Prickly Wattle shrubland	Very small occurrence within site, limited mainly to smaller first and second order drainage lines. May contain some temporary water resources during periods of high rainfall, though pools of water unlikely. Highly unlikely to support any tree hollows.	No
River Red Gum on rocky creeks	Very small occurrence within site, limited mainly to smaller first and second order drainage lines. May contain some temporary water resources during periods of high rainfall, though pools of water unlikely. Contains mature River Red Gum trees, therefore likely to support tree hollows. Note that this vegetation type is regarded as constituting essentially the same habitat type for bats as the River Red Gum Woodland	Yes

	vegetation unit below, typified by large River Red Gum trees along low-lying valley floors and larger gullies.	
River Red Gum woodland	Occurs along large drainage lines, including (generally) third order streams and above. Likely to support ephemeral water resources and also contains mature River Red Gum trees, therefore likely to support hollow-bearing trees.	Yes
Black Bluebush shrubland	This vegetation community is characterised by low shrubs, and generally devoid of mature trees. Although mapped in areas close to River Red Gum riparian zones, this community often commences once the riparian zone influences end, and as such there is very low potential for hollow-bearing trees, and limited water resources (with the drainage gullies where the water occurs likely to support either River Red Gum woodland or Prickly Wattle shrubland). This community does not occur at or near any turbines.	No
Black Oak woodland	This woodland occurs in very small patches, and has not been mapped within the project area as occurring in a patch size greater than a few hectares. Woodland areas may support hollows, but given small sporadic occurrence, no mappable habitat areas of this vegetation community type occurs within the Stage 1 58 turbine project area. As such, it is not possible to survey within this vegetation type within the Impact Zone.	Yes (but doesn't occur within the site)
Bluebush shrubland	This vegetation community is characterised by low shrubs, with only minimal scattered trees, and consequently there is considered to be very low potential for hollow-bearing trees to occur in these areas. Although mapped in areas close to River Red Gum riparian zones, there are no identified water resources within this community (with the nearby drainage gullies likely to support River Red Gum). This community does not occur at or near any turbines.	No
Chenopod (Saltbush) shrubland	This vegetation community is characterised by low shrubs, with only minimal scattered trees, and consequently there is considered to be very low potential for hollow-bearing trees to occur in these areas. This vegetation community occurs in a broad swathe across lands to the south-east of the Project Area, including on lands surrounding ephemeral water courses, but does not extend into (or within 1km of) any of the turbine sites	No
Chenopod – Red Mallee woodland/shrubland	This vegetation community is characterised by a mix of predominantly low shrubs with scattered to continuous Mallee trees. There is some potential for hollows to be present in the Mallee trees which may be used as roost sites. This vegetation community occurs in patches to the east of the Project Area, but does not extend into (or within 1 km of) any of the turbine sites. Also, this community does not appear to support any notable water courses (although very minor unnamed stream order 1 gullies may be present).	Yes (but doesn't occur within the site)

In summarising the table above, the following Priority Habitat Areas are considered to occur at the site:

- Mulga Dead Finish
- Mulga/Red Mallee Shrubland
- Porcupine Grass (Spinifex) sparse woodland

- River Red Gum on rocky creeks
- River Red Gum woodland
- Black Oak Woodland
- Chenopod – Red Mallee Woodland/Shrubland

When considering the appropriate number of survey sites to be established within the Priority Habitat Areas, it is important to note again that this survey program has been designed as a BACI survey with the aims of observing changes over time in the bird and bat species utilisation and associated impacts from operation of the Silverton Wind Farm. As a BACI survey design, it is therefore imperative that all aspects of the proposed survey are repeatable so as to allow collection of data both *Before* and *After* the commencement of operation of the wind farm, as well as to obtain data from both *Control* and *Impact* sites. The OEH Expert Report notes specifically that:

> *at a minimum it would be expected that at least 2 sites (1 impact & 1 control) would be sampled in each high priority community …. There are 5 vegetation communities with trees/shrubs reaching > 5m height. If each of these communities is sampled with a control and impact site the total minimum effort required to produce a meaningful result would be 5 communities x 2 conditions (control/impact) x 2 detectors x 4 nights = 80 detector nights per season. Plus, an additional 8 detector nights for other sites selected to capture spatial variability and other priority areas such as wetlands.*
>
> *As a guide, the Commonwealth threatened bat survey guidelines recommend sampling at a rate of 16 detector nights per 50 ha*

The main issue with compliance the above comment is the (incorrect) assumption that all priority habitat areas occur both within the Control and Impact Zones as established for this survey program. It is noted that the only vegetation communities identified as Priority Habitat Areas and that have been mapped as occurring within both the Impact Zone (i.e. within 500m of a proposed turbine site) and Control Zone (i.e. more than 1km from a proposed turbine), and which support a large enough patch size in each zone to establish at least 2 Control and Impact Zone survey sites include the following:

- Mulga Dead Finish (MDF)
- Mulga/Red Mallee Shrubland (MRM)
- Porcupine Grass (Spinifex) sparse woodland (PG)
- River Red Gum (includes both the River Red Gum Woodland and River Red Gum on Rocky Creeks mapped vegetation units) (RRG).

In order to achieve a properly implemented BACI survey, only these areas of the site can therefore be surveyed on an ongoing basis to allow both Control and Impact site data collection. Based on this scenario, the total extent of habitat of each of these areas within the Impact (and Control) Zones is summarised in Table 8 below.

Identification of existing survey sites suitable for ongoing use as repeatable survey sites

We have reviewed the existing survey sites from the Summer 2016 and Autumn/Winter 2017 survey periods in the context of the comments included in the OEH Expert Report to determine which of these sites are adequate for continued use in the survey program moving forward. In particular, the existing sites to be kept were assessed on the basis of the following criteria:

- Location within either the Impact or Control Zone (i.e. sites located in the “intermediate zone”, being the area >500 m from a proposed turbine, but <1 km where the Control Zone boundary occurs are not to be continued)

- Quality of data already collected (for example, the site SM2 from the Autumn/Winter 2017 survey did not record any bats, and so there is no existing data from this location that would facilitate future comparative analysis that would make this site worthwhile keeping)
- Location in the landscape in terms of achieving adequate coverage of different habitat areas to meet the requirements for a stratified design with sufficient sites to allow a statistically meaningful result

Given the above considerations, the existing survey sites that are proposed to be kept for ongoing monitoring are detailed in Table 7 below.

Table 7 Existing sites to be kept for ongoing monitoring (including sites where a minor relocation is required)

Summer 2016 Site No.	Autumn/Winter 2017 Site No.	Control/Impact site	Habitat Type	Rationale
Retained Sites				
A1-A	n/a (close to paired unit AE-5b)	IMPACT	MDF	Kept as useful for replication and existing baseline data (new site number BD8).
A4-B	SM1	IMPACT	MDF	Kept as useful for replication and existing baseline data (new site number BD4).
n/a	AE-5a	CONTROL	MDF	Kept as useful for replication and existing baseline data (new site number BD6).
A3-B	AE-4	IMPACT	RRG	Kept as useful for replication and existing baseline data (new site number BD12). Next to waterbody and likely HBTs.
Minor Relocated Sites				
A2-A	AE-2	CONTROL	RRG	Previously in "Intermediate Zone". Minor relocation, approx. 150-200 m from current site, to Control Zone (new site number BD9). Next to waterbody and likely HBTs within RRG habitat type.
A4-A	AE-3	IMPACT	RRG	Previously in "Intermediate Zone". Relocation, approx. 2 km E from current site, to Impact Zone (new site number BD10). Next to waterbody and likely HBTs, and remaining within same RRG habitat type.
A1-B	AE-1	CONTROL	RRG	Previously in "Intermediate Zone". Minor relocation approx. 300m from current site to Control Zone (new site number BD11).

				Next to waterbody and likely HBTs.

As can be seen from the table above, there are four (4) existing sites that were found to be suitable to retain for ongoing monitoring. Three (3) of these are located within the MDF habitat type (including two Impact and one Control site), and the fourth is located within the Impact Zone of the RRG habitat type. In addition to these, there are another three (3) sites that, if relocated to nearby areas (but outside of the "Intermediate Zone") would be suitable to retain for ongoing monitoring. All three (3) sites are located within the RRG habitat type, and includes two (2) Control Zone sites and one (1) Impact Zone site.

3.2.3 Final survey sites for ongoing monitoring

Based on the above considerations in terms of the distribution of Priority Habitat Areas, as well as having consideration for the ability to establish survey sites within both Impact and Control Zones (to achieve a BACI design), and in attempting to keep/re-use suitable existing survey sites where possible, we have identified 20 suitable survey sites to be established to achieve a robust stratified design. The proposed survey sites to be implemented from this point in time and going forward are described in Table 8 below, including identification of new site numbering to be used from this point forward.

Table 8 Proposed final survey sites

(New) Survey Site No.	Old Site No. (2016 / 2017)	Proposed Location – Description	Control/Impact site	Habitat Type	Near Water Resource?	Paired Unit
MULGA DEAD FINISH						
BD1A	N/A - New	Met Mast MM1 – Ground mounted unit (mounted @2-3m height	IMPACT^	MDF	No	BD1B & BD13/14
BD1B	N/A - New	Met Mast MM1 – RSA mounted unit (mounted @65m height)	IMPACT^	MDF	No	BD1A & BD13/14
BD2A	N/A - New	Met Mast MM2 – Ground mounted unit (mounted @2-3m height	IMPACT	MDF	No	BD2B & BD5
BD2B	N/A - New	Met Mast MM2 – RSA mounted unit (mounted @65m height	IMPACT	MDF	No	BD2A & BD5
BD3A	N/A - New	Met Mast MM3 – Ground mounted unit (mounted @2-3m height	IMPACT^	MDF	No	BD3B & BD6
BD3B	N/A - New	Met Mast MM3 – RSA mounted unit (mounted @65m height	IMPACT^	MDF	No	BD3A & BD6
BD4	A4-B / SM1	Ground-mounted unit in same location as previous site A4-B/SM1.	IMPACT	MDF	No	BD5 & BD6
BD5	N/A - New	Ground-mounted unit approx. 500m N of bridge over Umberumberka Reservoir	CONTROL	MDF	No	BD4
BD6	n-a / AE-5a	Ground-mounted unit in same location as previous site AE-5a	CONTROL	MDF	No	BD8 & BD3A
BD7	N/A - New	Ground-mounted unit located approx. 1km NE of MM1.	CONTROL	MDF	No	BD1A
BD8	A1-A / AE-5b	Ground-mounted unit located near T51	IMPACT	MDF	No	BD6
RIVER RED GUM WOODLAND						
BD9	A2-A / AE-2*	Ground-mounted unit. Relocation of previous A2-A/AE-2 site approx. 2.5 km E to Control Zone, but staying within RRG along edge of Umberumberka Reservoir	CONTROL	RRG	Yes	BD10
BD10	A4-A / AE-3*	Ground-mounted unit. Relocation of previous A4-A/AE-3 site approx. 2 km E to Impact Zone, but staying within RRG (on rocky creeks) along tributary of Umberumberka Reservoir arm/branch	IMPACT	RRG	Yes	BD9
BD11	A1-B / AE-1*	Ground-mounted unit within RRG. Relocation of previous A1-B/AE-1 site approx. 300m North or 600m south to within Control Zone, but staying within RRG. To be chosen/micro-sited for either/both HBT & pool section	CONTROL	RRG	Potential	BD12

BD12	A3-B / AE-4	Ground-mounted unit within RRG. Re-use of existing site A3-B/AE-4. Micro-sited for either/both HBT & pool section	IMPACT	RRG	Yes*	BD11
MULGA/RED MALLEE SHRUBLAND						
BD13	N/A - New	Ground-mounted unit within small patch of MRM approx. 2 km W of Turbine T23. Micro-sited for HBT if possible	CONTROL	MRM	No	BD14
BD14	N/A - New	Ground-mounted unit within small patch of MRM immediately W of Turbine T24. Micro-sited for HBT if possible	IMPACT	MRM	No	BD13
BD15	N/A - New	Ground-mounted unit within small patch MRM immediately S of Turbine T22. Micro-sited for HBT if possible	IMPACT	MRM	No	BD22
BD16	N/A - New	Ground-mounted unit within small patch MRM approx. 1.5km E of Turbine T10. Micro-sited for HBT if possible	CONTROL	MRM	No	BD21
PORCUPINE GRASS (SPINIFEX) SPARSE WOODLAND						
BD17	N/A - New	Ground-mounted unit within PG, approx 500 m E of bird survey sites R44.	CONTROL	PG	No	BD18
BD18	N/A - New	Ground-mounted unit within PG, near bird survey sites P35/R46 (near Turbine T33).	IMPACT	PG	No	BD17
BD19	N/A - New	Ground-mounted unit within PG, approx 1.5 Km E of bird survey sites R44.	CONTROL	PG	No	BD20
BD20	N/A - New	Ground-mounted unit within PG, near Turbine T34.	IMPACT	PG	No	BD19

*=Sites that are relocated to nearby new sites (but within same habitat type, and generally, moved less than 200m from current location)

^=Sites BD1A/BD1B & BD3A/3B, established on Met Masts MM1 and MM3 respectively, are actually located in the "Intermediate Zone", between the Control and Impact Zone buffers. As the Met Mast cannot be moved, these sites have been ascribed as Impact Zone sites.

BD = Bat Detector

In summarising Table 8 above, we note the following survey stratification is achieved:

- There are a total of three (3) paired units at RSA and ground level. All of these are defined as occurring within the Impact Zone – though noting two of these are in the "Intermediate Zone". There are no other existing structures within the project area that units can be attached to for RSA level monitoring.
- RSA-level detectors will be mounted to permanent met masts at a height of 65m.
- There are a total of eight (8) sites within the Mulga Dead Finish (MDF) habitat type. This includes 5 x Impact sites and 3 x Control Sites.
- There are a total of four (4) sites within the River Red Gum (RRG) habitat type. This includes 2 x Impact sites and 2 x Control Sites. All Impact and Control sites are paired with a nearby detector (generally less than 1 km away) in the same habitat type but within the differing control/impact zone.
- There are a total of four (4) sites within the Porcupine Grass Sparse Woodland (PG) habitat type. This includes 2 x Impact sites and 2 x Control Sites. All Impact and Control sites are paired with a nearby detector (generally less than 1 km away) in the same habitat type but within the differing control/impact zone.
- There are a total of four (4) sites within the Mulga/Red Mallee Shrubland (MRM) habitat type. This includes 2 x Impact sites and 2 x Control Sites. All Impact and Control sites are paired with a detector (although only one can be paired with a detector within about 1 km away, the other survey opportunities for Control and Impact sites in this habitat type prevents pairing with a nearby detector).
- Bat detectors will be micro-sited at each location to be close to a Hollow-bearing Tree (HBT) if present/available, and/or any areas of pooled/standing water if present/available.
- There are a total of six (6) sites that have potential to be located next to a water resource. Two (2) of these are located next to a relatively permanent water source (i.e. Umberumberka Reservoir). The other four (4) sites could potentially be located next to a pool section along the stream gullies in the RRG habitat. However, given the ephemeral nature of these watercourses, it cannot be guaranteed that they will always be located next to available water throughout all seasons and across all years of the monitoring program.
- In total, across the entire study area there 11 Impact and 9 Control sites.
- The project will involve the deployment of a total of 23 Bat Detectors at 20 "sites" (noting that 3 sites will require two paired detectors for RSA and ground-level monitoring at Met Masts)
- Bat detectors at each site will be deployed for a minimum of 4 (consecutive) nights. As such, the total survey effort is 92 detector nights for this and each subsequent survey occasion.
- For paired sites, the same unit type will be used (i.e. Songmeters are to be paired with Songmeters and Anabats are to be paired with Anabats)
- The use of each detector type per site will be determined based on resourcing for the upcoming November survey, however it is expected that full spectrum analysis units will be used for the ground and RSA level monitoring at the Met Masts. Once finalised, the use of each detector type per Met Mast site will become enshrined in the BBAMP. For other ground-only monitoring sites, replication of the unit type for each site will be performed to the greatest extent possible.
- As we (or any other consultant that we know) do not have 23 bat detectors available at any one time, it is likely that the survey period will be divided into 2 x 4 night survey periods, with detectors used in the first 4-night period to be collected and redeployed for the second 4-night period. Therefore, it will be impossible to achieve data collection for all sites at exactly the same time.

In order to confirm the overall level of survey effort, the mapped extent of each community within the project area is summarised in Table 9 below.

Table 9 Summary of survey effort (number of sites per hectare of habitat type)

Vegetation Type	Number of Turbines	Area in Impact Zone (500m radius)	Number of Survey Sites (Impact & Control)	Survey Density (# survey sites / ha)
Mulga Dead Finish	57	2744.05 ha	8	1/343 ha
Mulga/Red Mallee Shrubland	0	23.68	4	1/6 ha
Porcupine Grass (Spinifex) sparse woodland	1	108.57	4	1/27.1 ha
River Red Gum Woodland + River Red Gum on rocky creeks	0	15.36	4	1/3.8 ha
Prickly Wattle Shrubland	0	47.3	0	0.0
Black Bluebush Shrubland	0	4.21	0	0.0
Bluebush Shrubland	0	0.64	0	0.0
Black Oak Woodland	0	0.0	0	0.0
Total	**58**	**2943.81**	**20**	**1/147.2 ha**

3.2.1 Timing of Bat Surveys

As stated above, to account for seasonal difference, the baseline surveys will be conducted over different seasons, including summer, autumn winter and spring. The table below details the survey timing of the bat surveys (including an indication as to the current status of these surveys as being complete or yet to be undertaken).

Table 10 Seasonal timing of bat surveys

Season	Status
Summer	**Completed (December 2016)**
Autumn*	**Completed (May/June 2017)**
Winter*	**Completed (May/June 2017)**
Spring	**Not yet undertaken Scheduled for November 2017)**
Autumn	**Not yet undertaken. Scheduled for March (2018)**

*Autumn and Winter were combined for the bat surveys given the generally low number of birds expected to occur at this time of year. Future surveys are to separate these into distinct seasons.

A March 2018 survey will be conducted to add further Autumn data to capture possible migratory species or other seasonal movements at that time of year.

It is expected that the future operational surveys would be conducted at a minimum during each season independently, if not more regularly as determined in the BAMP.

APPENDIX A SURVEY PLAN

APPENDIX B RESPONSES AGAINST EXPERT REPORT RECOMMENDATIONS

X

OEH (Expert) Recommendation	Response	Responsibility
4.1 RECOMMENDATIONS TO IMPROVE THE RISK ASSESSMENT:		
1. *Mormopterus eleryi* and *Nyctophilus corbeni* should be added to the risk assessment. The site should be surveyed for *Mormopterus eleryi* and *Nyctophilus corbeni* to confirm if present or not.	- The species-specific Risk Assessment table in the BBAMP is to be updated to include consideration of these species. - The baseline surveys (as well as future ongoing operation monitoring surveys) will include consideration of these two species. The current use of bat detectors (as updated for the Spring 2017 survey period) will address the survey requirements for these two species, and the call file analysis (performed by an independent expert) will be briefed to ensure that they are aware that these 2 species are to be considered (including use of appropriate call references for confirming presence/number of calls at the site). This will be supported by a trapping study to be conducted to confirm species identification for those species whose calls are unable to be confidently determined (see response to recommendation 4.2 (1)).	E&HP to update BBAMP NGH to implement baseline data collection and brief expert conducting call file analysis
2. The risk status for all species should be reviewed given 29.5m above ground is not considered 'high' in terms of bat flight for most species. *S. flaviventris*, *M. eleryi*, *C. picatus* forage in and above canopy, they readily fly at 29.5m or above – and should be classified as high risk of collision. *V. baverstocki* and *N. corbeni* are likely to fly above 29.5m at times but most frequently forage within or below canopy height so could probably be classified as moderate risk of collision.	- Noted. The species Risk Assessment table in the BBAMP is to be updated to revise the risk status of relevant species identified by the OEH Expert Report. *NOTE: No (other) change to the baseline data survey methods is specifically required by this recommendation (with the exception of conducting RSA height monitoring as discussed elsewhere to confirm species flying at RSA height)*	E&HP to update BBAMP

3. Emphasis for bat monitoring should focus on representative sampling of sites in, adjoining or near to vegetation communities with trees or water sources (including ephemeral).	A detailed consideration of survey site selection is included in the document above, and describes where and how sites have been selected to achieve stratification across habitats, including achieving both Control and Impact sites. From this, it can be seen that there are a number of sites located in the River Red Gum community, which includes sites next to the Umberumberka Reservoir, as well as section along the larger/higher stream order that are likely to support water from time to time (noting that these streams are predominantly ephemeral and likely to contain water on an infrequent basis. Notes have been included in the updated design to inspect the stream to try and identify areas where larger pools of water are likely to form). An existing farm dam (the only dam known in the Project Area) has also been identified and will be targeted for ongoing monitoring. With regard to hollow-bearing trees, a detailed hollow-bearing tree survey has not been completed for the site. When establishing new survey sites (or minor relocations of existing sites), attempts will be made to find nearby hollow-bearing trees and bat detectors will be deployed at these sites. It is noted that the highest proportion/density of hollow-bearing trees is likely to be within the River Red Gum areas, with only sporadic occurrences outside of these areas in the Porcupine Grass Sparse Woodland (PG) and Mulga Dead Finish (MDF) and Mulga/Red Mallee Shrubland (MRM). Note that it is not possible for all potential habitat types (possibly) containing hollow-bearing trees to be surveyed, due to restrictions associated with establishing both Control and Impact sites. For example the River Red Gum on Rocky Creeks, Black Oak Woodland, and Chenopod – Red Mallee woodland/shrubland do not have any mapped areas extending into the Impact Zone of the site, and therefore cannot be surveyed under a BACI design.	NGH
4.2 RECOMMENDATIONS TO IMPROVE THE SURVEY DESIGN		

1. To strengthen the conclusions of acoustic sampling results. Trapping / netting should be undertaken to confirm; a) if *V. baverstocki* or *V. vulturnus* (or both) are present at the site. b) if *Mormopterus eleryi* or *Scotorepens greyi* (or both) are present at the site. c) if *N. corbeni* is present at the site (*N. geoffroyii* almost certainly is).	Noted. A single trapping study is proposed to be undertaken to confirm which species occur at the site. This will be undertaken concurrently with the Spring bat detection study to confirm species identification in the call analyses. This method is not required on an ongoing basis as part of the BACI design for monitoring of wind farm impacts (it is purely to confirm species identification) and therefore, will only be conducted once and will not be continued as an ongoing survey monitoring technique. Trapping will be completed in late November 2017 and concurrently with the bat detector survey.	NGH
2. To understand bat activity in the rotor sweep area it is recommended paired bat detectors be set to record at lowest rotor sweep height (e.g c. 30-35m) and ground level. Detectors could be mounted on Met towers, turbine towers or other structures. If towers are not available within priority locations tethered helium balloons may be used.	We have 3 available Met Masts for use for mounting bat detectors at RSA level within the Stage 1 (58 Turbine) Project Area (Masts MM1, MM2 and MM3). These are detailed in the survey methods document above. It is noted that all 3 masts are located on ridgelines within the Mulga Dead-Finish habitat type, and are located within the Impact Zone, although 2 of these Masts MM1 and MM3 are located in the Intermediate Zone (>500m but <1 km from turbine location). There are no existing masts or other suitable structures within the Project Area in any habitat type. Other masts located in the project area (SLV1, SLV5 and SLV7) as well as others located outside of the project area (several km's from nearest turbines) that have been investigated for use as well. All of these masts are temporary development masts and are to be decommissioned. The main problem with meeting this requirement in full (i.e. achieving RSA level monitoring in a BACI design and across all Priority Habitat Areas) is the lack of any structure of any type within any other habitat type in the broader Project Area that could be used for monitoring at RSA height. In particular, the main priority habitat area for bats is considered to be within the River Red Gum woodlands which is restricted to the lower-lying gullies. No masts or turbines will be proposed in these habitats that could	

	allow for future ongoing monitoring. Further, only a very small amount of this habitat actually occurs within 500m (i.e. within the Impact Zone) of any turbine. We have also investigated a number of options for establishing RSA level bat detectors, with no suitable outcome achieved. Options considered include towing a large telescopic tower from more than 600 km away, at significant ongoing cost (as it will need to be repeated), but also is limited in that it must remain on flat terrain, and also, has wind speed loadings of 40 km/hr at heights of more than 40 m. The cost and limitations of this method means that it is clearly not feasible as an ongoing monitoring option. Regarding establishing new/additional Met Masts, given there are only 3 permanent met masts in the area (with the previous development masts to be removed), there is no requirement by the client to install additional masts for wind speed monitoring. Further, the cost of such structures mean that it is not a feasible option to build more met masts .when not required With regard to helium balloons – this has been considered however a number of problems are associated with this method at the site. Because the site is typically very windy (hence location for a wind farm), it will be difficult to ensure that the balloons remain at a constant height during strong winds, with the risk that they could be pushed back toward the ground. The other significant issue is the ability to undertake this on an ongoing basis during the operational phase of the windfarm. This method presents a substantial risk to the turbines should a balloon become untethered and float into and become entangled in the rotor blades which could then damage the turbine rotors. Because of these issues, this method has been discounted as a safe and reliable option for repeated use, and if not repeatable, it cannot be used in a BACI design. We have also had discussions with the proponent about the feasibility of installing bat detectors on newly constructed turbines, and prior to their commencement of generating electricity (i.e. fully operational stage). This also has limitations as the blades would need to be mechanically braked (whereas normally they would be free-spinning until the generators are fully operational). The use of these brakes places strain on the	

	rotor gears, as well as increased flex of the blades, and so is only suitable for short periods of time, before it starts to have an impact on the equipment. A period of 4 consecutive nights of full braking of the equipment is potentially too risky to very expensive equipment. It is therefore not likely that this method will be repeatable over time. Further almost all of the turbines (>90%) are located within the same Mulga Dead Finish habitat type, and so this approach would not necessarily solve the problem of having monitoring in other priority habitat areas. The only other habitat types that turbines will be located in are the Bluebush (Saltbush) shrubland, and Porcupine Grass/Spinifex grassland/open woodland. Neither of these are considered Priority Habitat Areas, given the general lack of larger hollow-bearing trees, although it is possible that bats may forage in these parts. If anything, bat use is likely to be higher in the Mulga woodland given the greater structural diversity of the woodland compared to the grassland and shrubland habitats. Based on the above consideration, the obvious key point that becomes apparent in the BACI survey design is *what is achievable as an ongoing and regular monitoring option.* The sites regarded as suitable for bat detection on an ongoing basis are identified in report above, and have been selected on this premise and the limitations outlined above.	
3. If it is impossible to sample in the rotor sweep area for all sites, at a minimum paired sampling of ground based and rotor sweep area detectors should be undertaken and analysed, the results could then be extrapolated to inform ground based sampling.	Noted and agreed. It will not be possible to sample at RSA height in all priority habitat areas. Ground mounted bat detectors will be established in these areas as shown in the proposed survey plan, and results will be extrapolated as proposed in response below on statistical approaches.	NGH
4. The BACI design requires greater clarification;		

a. The metric(s) used should be defined – suggest species occurrence (present or not) and abundance (measured by the surrogate 'activity' defined as total # call passes per species per sample).	To date, we have provided the overall number of call files recorded as well as reported on the number of call files for threatened species. Other species not identified as being threatened or at risk were recorded simply on an occurrence basis. All historic call files could be re-analysed to provide the number of calls per species per sample. It is suggested that this should occur after the trapping study has been conducted to determine species will difficult call interpretation, as stated above.	NGH (with Glenn Hoye to re-analyse data)
b. The thresholds for adaptive management should be explicit, at what point should something happen. Suggest that at a minimum this be if a species occurrence or abundance has declined at an average rate of 3% / yr (this equates to the IUCN criteria of 30% decline over 10 years) that adaptive measures be triggered.	This is a matter to be addressed in the BBAMP. It does not otherwise specifically affect survey method. As stated above, the number of calls per species per sample can be completed and this will provide a base for identifying declines in occurrence or activity.	E&HP
c. The number and stratification of sites should be clearly enunciated. Sites should adequately sample identified priority areas based on risk and representative of the spatial heterogeneity of the site. The number of sites should be informed by statistical power analysis.	The number and stratification of sites is clearly explained in the survey methods document above. Site selection has been based on identification of Priority Habitat Areas, as well as the spatial distribution of these habitats to enable surveying within **both** Control and Impact zones. The overall distribution of bat survey sites across the Project Area is detailed in the survey effort plan (Appendix A). From this, it can be seen that a broad portion of the overall wind farm area is covered. There will be a minimum of 23 bat detector survey sites across the identified priority habitat areas, with detectors to record for 4 nights at each site. A total of 92 detector	NGH

	nights will therefore be achieved. This number is regarded as sufficient to enable adequate statistical analysis.	
d. Sampling of Control and Impact sites should be paired e.g each stratified control site should have a paired site in the same strata in impact zone (unless there is a good experimental design reason why not to) the effort at paired sites should be consistent and matched across seasons.	Noted. All proposed sites have been paired based on either: - RSA level sites are directly paired with a ground-mounted unit in the same location (at Met Masts). - All (other) sites are paired with a Control and an Impact site located in the same habitat and (generally) within about 1 km of each other.	NGH
e. Sites should not be located in indeterminate zones (eg >500m and less than 1km from a turbine) this is just confusing and messy.	Noted, existing sites in these areas will be moved as required to either within the 500m radius line of a turbine for the Impact Zone or beyond the 1 km area for the Control Zone. Note that this is not possible in relation to met masts MM1 and MM3.	
f. Unless there is a good reason to vary site pairs should stay the same across seasons. If the site location varies, at a minimum the strata and CI status should be consistent.	A Total of 4 units will be deployed at the same site as previous surveys, with a further 3 units to be relocated nearby (i.e. within 200m) to an existing site from the previous surveys. It is intended that all proposed survey sites in this document will be repeatedly surveyed during each season from this point in time onward.	
5. Survey effort needs to be consistent and capable of producing statistically meaningful results;	Noted. As stated in the document above, we have consulted with Symbolix on the revised survey and the survey effort and design is considered adequate for determining impacts of the wind farm operation on bat species.	
a. Power analysis should inform the number and duration of sampling to detect trends over a reasonable time. If the effort is less than 2	The revised survey plan will have at least 4 detectors in each habitat type (including at least 2 detectors in either the Control or Impact Zones), and will be deployed for at least 4 nights per season/survey occasion.	

detectors for 4 nights per site /season this will need to be explained in detail.	The overall survey effort will involve 23 detectors deployed for 4 nights each, equating to a total of 92 detector nights. Given this survey effort is to be repeated for each season/survey occasion going forward, this will allow adequate statistical power to identify impacts over time.	
b. The recommended survey effort needs to be clearly enunciated	The updated survey effort is clearly explained in the survey methods document above.	
c. Survey effort should be consistent between site pairs (control /impact) and across seasons so that comparisons can be readily drawn.	The latest survey plan shows that all sites now are sensibly located as pairs in similar habitats but between control and impact zones, and generally are located within about 1 km of each other (noting that a paired site cannot be closer than 500 m to each other, except when paired as a RSA level monitoring site at a Met Mast).	
6. Survey seasons need to be reviewed, lumping of Autumn and Winter together is not satisfactory as it misses the period of highest activity and risk of mortality (March). Suggest that sampling be conducted at a minimum in summer (November – January)[16] and March. Winter and Spring could be conducted separately or as a merged season.	Noted. A survey is proposed for end of November and again in March. On completion of the March survey, all seasons will have been surveyed. For the longer-term operational monitoring, the plan will be to undertake surveys within each distinct season, and will be appropriately timed for conditions to be generally consistent with that seasonal norm. Where possible, surveys will generally be in the middle part of each season, and appropriately timed apart from each other (dependant on other factors such as timing to coincide with known peak periods of activity).	

APPENDIX C SYMBOLIX LETTER OF ADVICE

APPENDIX D DETAILED BIRD SURVEY METHODS

Bird Utilisation Surveys

Purpose:

To quantify which bird species are present, their numbers and activity levels and how they use the site. Data from utilisation surveys will be used to assess whether use of the site by birds changes once turbines have been installed and are functioning and to therefore gauge changes in populations.

Method:

- Surveys are completed through un-truncated point counts.
    - Point counts are not limited to a defined search area and the observer should record all observations when seen.
    - Point counts will be 20 minutes in duration in which bird movements are recorded by continually scanning, noting the numbers of species and approximate distance to each unit. A unit can consist of an individual, or a flock. In the case of a flock, the approximate number should be estimated.
    - Each individual is noted when first sighted; should an individual disappear and a second (or potentially the same) individual appear later, this is noted as a separate sighting.
    - Surveys will be completed between dawn and dusk. The potential for collision can occur at any time a turbine is operating (i.e. 24 hrs / day), therefore bird movements require monitoring throughout the day to determine bird activity across this entire period.
- For each sighting, the following is recorded: time at first sighting, distance to first sighting (in metres), species, number, cue type (observed, heard). Metadata will also be recorded including weather conditions, wind speed and direction.
- For the additional raptor surveys, the height at which the bird is flying will be recorded (using a visual estimate), and the distance of the flight will also be recorded (wherever possible).

Additional Considerations:

As monitoring of wind farms and their potential impacts is a rapidly evolving field, the use of point counts is designed to allow for some flexibility in possible future application of the data.

Surveying of the pre-selected locations are conditional upon access, landholder logistics, and operating constraints.

APPENDIX E SUMMARY OF REVISED SURVEY PLAN AGAINST COMMONWEALTH GUIDELINES

We have considered the proposed survey strategy against the Commonwealth's *Survey guidelines for Australia's threatened bats* (DEWHA, 2010), and provide below a summary of the proposed survey strategy against the requirements set-out in the guidelines.

To begin with, none of the species that have been recorded at the site are nationally listed as threatened under the EPBC Act, and consequently, none of the species recorded at the site are included in the species profiles section of the guidelines which provides species-specific survey methods. Notwithstanding this, the general survey approach (i.e. techniques and effort) within the guidelines for species generally, has been considered in regards to the methods proposed under this survey. We summarise these further below, including a statement as to how the proposed methodology to be employed at Silverton Wind Farm will comply with, or otherwise not be inconsistent with the commonwealth guidelines.

SURVEY TECHNIQUES

The survey techniques listed in the commonwealth guidelines includes the following:

- Direct Capture methods (including use of Harp Traps, Mist Nets, Trip Lines, Hand Netting)
- Echolocation call detection
- Roost Searches
- Radio-tracking
- Chemi-luminescent tagging

Whilst the Guidelines recommend that a combination of both direct capture methods and use of echolocation call detection devices yields the best results, this (NGH) document deals only with the use of echolocation recording devices as a method for efficient ongoing monitoring. Direct capture will be employed on a one-off basis to ensure that species whose calls cannot be confidently identified can be confirmed by direct capture.

GENERAL GUIDELINE NOTES ON SPATIAL/TEMPORAL SAMPLING

Spatial Sampling:

The guidelines note that the number of sampling units within the study area (or strata) should be proportional to its size, a principle referred to as *area-proportionate sampling* (MacNally & Horrocks 2002). The Guidelines also note however, that a linear increase in sample number with area will become impractical at very large study areas.

This is especially the case with Silverton WF as it is a very large site, is difficult to traverse, and is dominated across the majority of the Project Area by a single habitat type (vegetation complex), being the Mulga Dead

Finish. As such, the number of survey sites required at SWF should not be directly proportionate in area compared with the survey density of many other smaller sites with more complex habitats.

Notwithstanding the above, the Guidelines document makes no comment on general survey density (eg number of detectors / ha of impact/site area), although for the species-specific methods, the survey effort is quoted based on a hypothetical site of 50 ha. For both species, the recommended effort is 16 detector nights over a minimum of 4 nights (i.e. 4 detectors set-up for 4 nights each over a 50 ha area). The Project Area (defined by the Impact Zone) is approximately 2943.8 ha. This survey methodology proposes the use of 23 detectors over 4 nights for a total of 92 detector nights. This equates to one detector every 147 ha (for four nights), which compares with the recommended one detector every 12.5 ha (for four nights). However, given the large distances between turbines and that each single turbine has an Impact Area of 78.6 ha (based on 1 km diameter), the recommended density is not considered directly applicable to this project, otherwise, 6 detectors per turbine would be required to achieve a comparable survey density to the guidelines. As an alternative measure, each turbine hardstand is approximately 30 m in diameter, which equates to a total hardstand area of 16.4 ha for the 58 turbines. This equates to one detector every 0.8 ha of hardstand. An alternative measure also is to consider the RSA as a measure of the "impact Area". As mentioned in previous method documents, the turbines will have a blade diameter of 130 m which equates to a total RSA of 13,273m^2 per turbine. This equates to a total of 76.98 ha for the total 58 turbines. Using this as a measure, the survey density would equate to one survey sites per 3.8 ha of RSA which compares favourably with the recommended survey guidelines.

Temporal Sampling:

The Guidelines note that "regular sampling over time is recommended as it will increase the probability that individuals will be detected on at least one occasion." The guidelines also note that repeated sampling over time, however is not always practical/possible and in this instance, "off-study area sampling is another means to address this problem, whereby sampling is conducted in suitable habitat in the area surrounding the study area. This procedure effectively increases the study area, allowing greater spatial sampling, and enhances the probability of detecting individuals with home ranges larger than the core study area. In practice, this will be a useful strategy because temporal replication is often more costly to implement than spatial replication, as additional travel may be required to and from the study area."

Whilst the implementation of the BBAMP will allow for repeated sampling over time (to determine operational impacts of the wind farm), including ongoing sampling (from October 2017 onward) of bats flying within the RSA (at the location of the existing Met Masts to be used).

SURVEY EFFORT

Echolocation call detectors

The Guidelines state that many survey standards recommend that 30–60 minutes of echolocation call survey per night for four to five nights is adequate for inventory surveys, whilst other studies state that recordings must be made across the entire night (de Oliveira 1998; Law et al. 1998; Duffy et al. 2000; Richards 2001). While many bat species are active soon after dusk, it is well known that the data from a stationary detector will rarely detect all species present at a site within one hour after dusk. **For unattended bat detectors:** should be set recording before sunset and stopped after dawn.

The Australasian Bat Society, Inc. (ABS) has produced a document detailing a set of minimum requirements for a transparent and sufficiently comprehensive consultative report of identifications made from acoustic

recordings. These are given in *Recommendations of the Australasian Bat Society Inc. for reporting standards for insectivorous bat surveys using bat detectors*), and have been adopted for these survey guidelines. The recommended survey effort and methods (as relevant to the Silverton WF Project) include:

- A description of the reference library used in the identification process.
- Details of the number of detector hours undertaken during the survey.
- A sample 'time versus frequency' graph of each species identified during the survey. These graphs must be of bats recorded and identified during the survey.
- For species with similar call characteristics, a written description of the characteristics used to distinguish these species must be included in the methods.
- An indication of the proportion of calls identified, i.e. the total number of calls processed and the percentage of these that were identified.
- All the call files from a survey are deposited ultimately with the client or agency.

In addition, this document also provides additional suggestions on survey effort and methods. Of relevance to the Silverton Wind Farm bat monitoring project are the following:

- Typical inventory survey effort should involve detector deployment for at least three complete nights in each major habitat type in the survey area.
- Surveys should be conducted during the warmer months of the year and in good weather conditions.

Note: the Guidelines make no further comment on survey density (eg number of detectors / ha of impact/site area).

In addition to the above, the Guidelines provide species-specific requirements for a number of nationally listed threatened bat species. The species that have previously been recorded at Silverton WF are not included in the identified species of the Guidelines. Notwithstanding this, two species have been considered from this list for consideration of any other relevant survey requirement that should be applied to the Silverton WF baseline survey project. These species and the survey requirements are listed below.

Bare-rumped sheath-tailed bat (Saccolaimus saccolaimus nudicluniatus)

Bat detectors (Anabat or other frequency division, or time-expansion detector; unattended) should be located in forest or woodland and ideally placed several metres above the ground (in trees or on poles), orientated upwards (at least 45°) towards gaps in the vegetation AND at waterholes/dams or in watercourses. Unattended detectors should be left overnight.

Unattended bat detectors to be used for a minimum of 16 detector nights and over a minimum of 4 nights.

Large-eared pied bat (Chalinolobus dwyeri)

Passive acoustic detection. A range of potential roost habitats can be examined by passive detection with unattended recorders placed in the vicinity of mines, caves and rocky outcrop, and also in foraging sites such as vegetation corridors and flyways, sandstone gorges, over watercourses, isolated waterholes and in representative vegetation types. Quality search-phase echolocation calls are diagnostic but these may not be recorded from bats emerging from underground roosts if bat detectors are placed at the entrance. Unattended detectors should be left overnight at multiple locations.

Unattended bat detectors to be used for a minimum of 16 detector nights and over a minimum of 4 nights.

From the above two species, it can be seen that Anabat surveys should be conducted over a minimum of 4 nights and achieve at least 16 detector-nights of sampling. Also, the focus of device location should be toward suitable habitats (though not specifically toward any type of habitat that happens to be present at a site). The surveys to be undertaken at Silverton have/will meet all of the above requirements.

APPENDIX F SUMMARY OF REVISED SURVEY PLAN AGAINST NSW THREATENED SPECIES SURVEY GUIDELINES

We have considered the proposed survey strategy against the NSW Threatened Biodiversity Survey and Assessment: Guidelines for Developments and Activities (DEC 2004), and provide below a summary of the proposed survey strategy against the requirements set-out in the guidelines for bats (noting that these guidelines are more directed toward assessments of impacts rather than ongoing monitoring surveys).

Methods

The guidelines note that some microchiropteran bat species are best identified by their unique ultrasonic echolocation calls (Woodside and Taylor 1985), while others can only be reliably identified by trapping (Helman and Churchill 1986). Therefore, a combination of both ultrasonic detection and trapping is essential as neither method can detect all species (Corben 1989; Parnaby 1992a, b; Duffy *et al.* 2000). Ultrasonic methods are more likely to record high-flying species but trapping methods are needed to detect low intensity echo locators (eg. long-eared bats and the golden-tipped bat) (Corben 1989).

Given the above, the proposed Silverton Wind Farm monitoring surveys are consistent with the recommended approach in that echolocators will be used for longer term monitoring, with a trapping study to be used in Spring to assist in species identification.

Effort

The guidelines note that the following key points with regard to survey effort:

- The location of traps and ultrasonic recorders should be in the areas of greatest potential activity (such as roost sites or near watering points)
- Bats are most active from October to March and sampling should be undertaken during this period (Lumsden and Bennett 1995). In other months, some bats may be active, particularly in northern NSW, however the probability of recording all the species that are present is reduced.
- Three hours of recording immediately after dusk is required to identify 90% of species present. Echolocation call detection should be conducted for a minimum of four hours, however recording for the entire night is recommended.

Each of the above recommendations for survey effort will be met by this Project, with a focus on stratifying survey points in Control and Impact Zones across the main habitat types, including extra survey effort for the River Red Gum Woodland areas regarded as being of primary importance in the landscape to bat habitat. Surveys will occur within the recommended timing of October to March and each detector will be programmed to record all night for four consecutive nights.

The suggested survey methods and effort for bats is defined in the table below (adopted from the NSW guidelines).

Method	**Effort per 100 hectares (or portion thereof) of stratification unit targeting preferred habitat**	**Survey period**
Ultrasonic call recording	Two sound activated recording devices utilised ***for the entire night (a minimum of four hours)***, starting at dusk for two nights	October to March

Based on the above, and adopting the RSA as a surrogate measure for overall site area, the Silverton Project will have a total RSA of 76.98 ha for the total 58 turbines. Using this as a measure, the survey density would equate to one survey site per 3.8 ha of RSA which compares favourably with the recommended survey guidelines of one detector for every 50 ha of the stratification unit.