

Silverton Wind Farm: Barrier Range Dragon Population Monitoring 2020

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Contents

Sumi	mary		1
1.	Intro	oduction	2
	1.1	Project background	2
	1.2	Purpose	2
	1.3	Relationship to other plans	3
2.	Meth	nods	5
	2.1	Survey for Barrier Range Dragon	5
	2.2	Data analysis	7
	2.3	Roadside habitat inspection	7
3.	Resu	llts	8
	3.1	Survey results February 2020	8
	3.2	Comparison with previous survey results	, 11
	3.3	Roadside habitat inspection	. 12
4.	Disc	ussion	. 14
Refe	rence	S	. 16
Appe	ndice	5	. 17
Арре	ndix '	1 Mapping and survey sites	. 18
Арре	ndix	2 Historical weather data	. 20

Tables

Table 1	GPS co-ordinates of Barrier Range Dragon survey sites	5
Table 2	Habitat characteristics of 16 survey sites	6
Table 3	Results of February 2019 survey for Barrier Range Dragons at Silverton Wind Farm	.10
Table 4	Comparison of 2018, 2019 and 2020 mean Barrier Range Dragon counts for all count	
	sites	.11

Figures

Figure 1 Location of study area	4
Figure 2 Box-plot showing difference in mean Barrier Range Dragon abundance between	
survey years	12
Figure 3 Sediment in culvert outlet adjacent road leading to turbine 22	13
Figure 4 Sediment in culvert inlet adjacent road leading to turbine 22.	13
Figure 5 Barrier Range Dragon survey effort - Overview	19



Summary

Biosis Pty Ltd was commissioned by GE Renewable Energy to undertake Barrier Range Dragon *Ctenophorus mirrityana* population monitoring at the Silverton Wind Farm. The survey forms part of a three year investigation in partial fulfilment of a monitoring and adaptive management approach outlined in the Barrier Range Dragon Management Plan (BRDMP) (Biosis 2018a). The purpose of Barrier Range Dragon monitoring is to provide understanding of the on-going values of management actions to be implemented on behalf of the species. In turn, this will allow adaptive management to be based on good empirical evidence of responses by the species. At the conclusion of the first three years of monitoring, results of the investigations will be thoroughly reviewed to ascertain the status of the Barrier Range Dragon population and the nature of its responses to operation of the wind farm and to management actions set out in the BRDMP.

This report presents the results of Barrier Range Dragon population monitoring undertaken in February 2020 – the second of ongoing surveys to be undertaken from 2019-2021, inclusive. These survey findings will be compared to baseline survey data obtained in 2018.

Population monitoring results 2020

Barrier Range Dragons were detected at 14 of the 16 survey sites and on 33 of the 64 survey counts. The combined results of all counts at all sites include records of 34 adult male, 27 adult female and one juvenile Barrier Range Dragons. This is compared with 71 adult male, 75 adult female and seven juvenile lizards recorded in 2018 surveys. Visual analysis of data using a box-plots revealed that the difference in lizard numbers observed between years was significant lower. However, this difference does not necessarily reflect an actual population decline caused by wind farm operation, due to the likely influence of environmental irregularity on population numbers between years.

Conclusions

- During the 2020 surveys for Barrier Range Dragons the species was detected at all but two survey locations where individuals had been recorded in each of 2018 and 2019 surveys.
- There is inter-annual variation in Barrier Range Dragon abundance on the site. However, interpretation of this variation is potentially confounded by the influence of inter-annual climatic variation on lizard activity.
- Absolute numbers of Barrier Range Dragons displayed a significant decline compared to the previous two years of monitoring.
- The present survey results should be compared against the results of future surveys to determine how lizard populations are responding to sustained operation of the wind farm and to management actions for the species.



1. Introduction

1.1 Project background

Silverton Wind Farm is located approximately 5 kilometres north of Silverton and 25 kilometres northwest of Broken Hill in the far west of NSW (Figure 1). The Silverton Wind Farm was approved by the then Minister for Planning in May 2009. The Wind Farm was declared to be a critical infrastructure project under the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), as an energy generating development with the capacity to generate at least 250MW.

Project and Concept Approval was granted in May 2009, pursuant to Part 3A of the EP&A Act. Further modification (Modification 3) was then approved in December 2016 in accordance with Clause 8J (8) of the *Environmental Planning and Assessment Regulation 2000* and the transitional arrangements of the EP&A Act. Approval was granted for the modifications to the project approval (08_022 MOD 3) and concept approval (08_0022MOD2) subject to the conditions set out in the instrument of approval (Notice of Modification Project Approval 08_022 under the EP&A Act. The detailed project history and compliance with conditions of consent is outlined in the Silverton Wind Farm Biodiversity Adaptive Management Plan (BAMP) (Biosis 2018b)

Condition 18(c) of the Project Approval requires that prior to the commencement of construction, the Proponent must prepare a Biodiversity Management Plan for the project, which includes a Barrier Range Dragon Management Plan BRDMP (Biosis 2018a) for the site. The BRDMP was developed to satisfy that condition, and as applicable at the time of preparing the plan, Statement of Commitments (2009) 26 and 29 for the operational phase of the wind farm.

In partial fulfilment of the monitoring and adaptive management approach outlined in the BRDMP, population monitoring of Barrier Range Dragons at Silverton Wind Farm will be undertaken as part of an initial three year investigation. The purpose of the Barrier Range Dragon monitoring is to provide understanding of the on-going values of management actions to be implemented on behalf of the species. In turn, this will allow adaptive management to be based on good empirical evidence of responses by the species. At the conclusion of the first three years of monitoring, results of the investigations will be thoroughly reviewed to ascertain the status of the Barrier Range Dragon population and the nature of its responses to operation of the wind farm and to management actions set out in the BRDMP. Changes in numbers and distribution of Barrier Range Dragons, as determined by the population monitoring program, will provide the primary metrics of response by the species to the wind farm and to management measures set out in the BRDMP. This will provide performance indicators as required by condition 18(c) of Notice of Modification Project Approval under the EP&A Act.

This plan has been developed in consultation with:

- Department of Planning and Environment
- Office of Environment and Heritage
- GE Renewable Energy

1.2 Purpose

This document provides the survey results of the 2020 Barrier Range Dragon population monitoring across Silverton Wind Farm. These survey results will be compared to baseline population data obtained from surveys undertaken in 2018 (Biosis 2018a), year 1 monitoring survey data obtained in 2019 (Biosis 2019), and



ultimately, to future surveys (i.e., 2021), to ascertain the nature of the species response to operation of the wind farm and to management actions set out in the BRDMP.

1.3 Relationship to other plans

This Barrier Range Dragon Population Monitoring report is to be read in conjunction with the BRDMP (Biosis 2018a), which provides an overview of the management of Barrier Range Dragons across the Silverton Wind Farm. The specific management actions, monitoring and adaptive management responses in relation to Barrier Range Dragon management are described in the implementation section of the Biodiversity Adaptive Management Plan BAMP (Biosis 2018b). The overarching BAMP provides a cohesive document that details the methods, actions, monitoring and reporting identified for the Barrier Range Dragon Management Plan, Goat Management Plan (Biosis 2018c), Porcupine Grass Sparse Woodland Recovery Plan (Biosis 2018d) and Vegetation Management Plan (Biosis 2018e), into one cohesive implementation document. This allows for an integrated approach to on-ground monitoring and management of biodiversity at the Silverton Wind Farm site.





2. Methods

2.1 Survey for Barrier Range Dragon

The year-two Barrier Range Dragon survey was undertaken between 10 and 15 February 2020, inclusive. February was chosen because it is the same time of year that baseline population data were collected in 2018 (Biosis 2018a). Consistently surveying at the same time of year is important to ensure that time of year does not influence between-year results. Furthermore, late summer is a suitable time of year to survey for arid zone reptiles because temperatures are sufficiently high for lizards to be active and they are generally readily observable.

A total of 16 survey sites were selected in 2018, at commencement of the overall program. Sites were chosen to represent a sample of the following:

- A. Natural rock outcrops with a complex of exposed bedrocks and loose fractured boulders of varying sizes that offered multiple potential basking and refuge microsites.
- B. A mixture of naturally outcropping rocks and rocks that have been artificially moved, aggregated or turned out of the ground during wind farm construction.
- C. Entirely artificial aggregations of rocks such as batters of roads and turbine hardstands created during wind farm construction.

All sites were adjacent to wind farm roads both for ease of access and to permit monitoring of the potential effects of roads on the species. The GPS location of each survey site was recorded for the purposes of future monitoring. The site overview and locations of all survey sites are shown on maps in Appendix 1. GPS co-ordinates for each site are listed in Table 1.

Site	Easting	Northing
1	530627	6489369
2	530787	6489085
3	529747	6488968
4	531089	6487956
5	530858	6487848
6	531418	6487346
7	531188	6486984
8	531093	6486731
9	529399	6485563
10	528220	6484368
11	528262	6483465
12	522865	6483628
13	522797	6483931
14	522797	6483976
15	522058	6481599
16	523980	6482600
15	523980	6482600

Table 1 GPS co-ordinates of Barrier Range Dragon survey sites



Thirteen survey sites are outside of the Area 7 Goat Fence and three are inside it (see also Biosis 2018b). The dominant vegetation community within the Area 7 Goat Fence is Porcupine Grass Sparse Woodland Community. Goat density is managed within the fenced area according to the Goat Management Plan (Biosis 2018c) for the purpose of protecting that community. A small number of survey sites for Barrier Range Dragons were chosen within that area to permit the effects of goat management on the species to be monitored.

The basic habitat type (according to the three types of rocky environments outlined above) and whether they are inside or outside of the Goat Fence are set out in Table 2, below. In addition, the presence and abundance of goat scats was documented for each site. This was not quantified but was recorded as a relative and qualitative value (low / medium / high) allowing comparison between survey sites.

Site	Location	Rocky habitat type	2020 presence & relative abundance of goat scats
1	Outside Goat Fence	В	Low
2	Outside Goat Fence	А	Low
3	Outside Goat Fence	А	Medium
4	Outside Goat Fence	А	Medium
5	Outside Goat Fence	С	Low
6	Outside Goat Fence	А	Low
7	Outside Goat Fence	В	Low
8	Outside Goat Fence	А	Low
9	Outside Goat Fence	В	High
10	Outside Goat Fence	В	High
11	Outside Goat Fence	В	Low
12	Inside Goat Fence	В	Not present
13	Inside Goat Fence	В	Not Present
14	Inside Goat Fence	В	Not present
15	Outside Goat Fence	В	Low
16	Outside Goat Fence	А	High

Table 2 Habitat characteristics of 16 survey sites

The following meteorological data were recorded for each survey:

- Air temperature
- Humidity
- Average wind speed
- Percentage cloud cover
- Time of survey start and finish

Surveys of Barrier Range Dragons at selected sites took the form of standardised timed counts of dragons. Each survey was carried out by two experienced herpetologists. Each count was for 25 minutes (50 personminutes). For safety reasons the two team members remained within visual distance of each other during counts, but each took a separate random path such that they were not likely to observe the same individual Barrier Range Dragons. During the surveys, observers paused frequently and used binoculars to scan habitat for dragons. The survey design using timed random meander was chosen rather than using defined area surveys because the habitat for the species was not continuous at all sites and because, while all habitat could be scanned from a distance, at some sites it was precipitous and too dangerous to access directly.



During four days of surveys each site was surveyed on four occasions. This permitted the mean number of dragons observed at each site over the duration of the entire survey to be determined. The time of day of counts at each site was varied and all sites were counted during both morning and afternoon. Surveys were not commenced during the hottest part of the day between 1300 and 1500 hrs when surface temperatures of many rocks exceeded 50°C and it was evident that dragons were less active and less observable.

In each count the total number of adult Barrier Range Dragons of each sex and the number of juveniles, were documented. Adult males and females are readily distinguished on the basis of very different colouration. Juveniles were distinguished from adults based on their smaller size.

2.2 Data analysis

Comparison of absolute and mean numbers of Barrier Range Dragons recorded during all counts are compared with results of counts from 2018 and 2019. Results of survey data between years was also compared visually using box-plots.

2.3 Roadside habitat inspection

Roadside habitat for Barrier Range Dragons was mapped during the 2018 baseline surveys and is shown on maps in Appendix 1. Habitat was considered to exist whether the rocks were natural outcrops and scree or had been placed artificially. Habitat was considered to exist wherever there was the following combination of characteristics occurring immediately adjacent to roads:

• Aggregations of rocks where a large proportion of rocks were between approximately 30 cm and one metre in diameter

- Aggregations were within approximately 20 metres of the edge of the road surface
- The aggregation consisted of at least 30 metres of continuous length beside the road

During the surveys undertaken in February 2020, the areas mapped as suitable habitat during 2018 were inspected to review the suitability as habitat for Barrier Range Dragon using the above characteristics.



3. Results

3.1 Survey results February 2020

The results of all surveys are shown in Table 3. Barrier Range Dragons were detected at 14 of the 16 survey sites and on 33 of the 64 survey counts.

Weather conditions during the week of surveys were ideal for observing Barrier Range Dragons, which were active throughout all but the hottest, early afternoon parts of each day. Air temperatures during surveys ranged from 18 to 36 degrees C. Sunny conditions prevailed during the majority of most counts, with cloud cover of up to 70 percent on a very few occasions. Examination of climate data from the Bureau of Meteorology (Broken Hill Airport) (Appendix 2) showed that mean monthly maximum (MMM) temperatures were not substantially different from October to December however the MMM was noticeably lower during the months of January and February 2020 when compared to previous years. Mean monthly rainfall recorded in the twelve months prior to the 2020 surveys was substantially lower than rainfall levels recorded preceding the 2018 and 2019 surveys (Appendix 2).

The value of replicate counts is demonstrated by the fact that at all fourteen sites where dragons were observed at least one of the counts did not observe dragons. Overall, there was little variation in numbers of dragons detected between sites, which ranged from 0 to 5 for a given 25 minute survey. The greatest number of dragons were recorded at sites 3, 10 and 12.

The majority of dragons were observed basking on rocks and a smaller number were detected sheltering in rock crevices. While a few Barrier Range Dragons were observed on large bedrocks, it appeared that they generally prefer to use scree of jumbled and broken rocks, often around the edges and immediately downslope of outcropping bedrocks, rather than bedrocks themselves. In this respect, results of the survey concur with the finding of NGH Environmental (2008) and Biosis (2018a) that percentage cover of rocks between 251-500 mm in size was important for the species.

The mean and range of the number of individuals observed at each site are also shown in Table 3. These values provide a continuation of baseline data against which to compare results of future surveys during operation of Silverton Wind Farm. Overall, the numbers of dragons observed during 'am' (surveys that commenced prior to 1200 hrs) and 'pm' (surveys that commenced after 1500 hrs) did not differ substantially.

Overall, the density of dragons varied little and there was no obvious indication of substantial differences in numbers of dragons according to the three basic habitat types; sites with different values for goat scats; and, sites within and outside of the Goat Fence. It should be noted that the maximum number of Barrier Range Dragons recorded in any one count is the measure most likely to reflect the absolute number of individuals inhabiting the site, albeit that it should not be taken as a true census. The mean number has been calculated and is shown in Table 3 for the primary purpose of comparison with results of surveys in past and future years.

While goat scats were present at most sites, their density was very variable over any given rock outcrop and we were not able to determine whether any relationship might exist between specific locations where dragons were found and locations of goat scats. In addition, at many locations scats of Euros *Macropus robustus* were also present and variable in their densities. There was no apparent correlation between documented levels of goat scats and numbers of Barrier Range Dragons.



Vegetation cover was anecdotally observed to have declined at the count sites when compared to similar times of the previous years, suggesting that grazing pressure and low rainfall had contributed to a change in habitat structure that is potentially impacting upon dragon abundance.

The combined results of all counts at all sites include records of 34 adult male and 27 adult female Barrier Range Dragons. As each site was surveyed four times it is very likely that these totals include multiple records of some individuals. The records may not represent the true adult sex ratio of the species as females are more cryptically coloured than males and they may have been less readily observed. The survey method was not designed to counter any potential biases in records of males and females.

One juvenile Barrier Range Dragon was observed during a survey at site 8. This demonstrates that the species successfully bred during the preceding spring/summer months, as it did in each of 2018 and 2019. However, the number of juveniles detected has dropped from seven in 2018 and two in 2019.



	Results of timed Barrier Range Dragon counts at selected survey sites														
	10-F	eb	11-F	eb	12-	Feb	13-	Feb	14-	Feb	15-	Feb	BRD obs	served pe	er count
Site	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	Mean	Min	Мах
1		1	0			1	1						0.75	0	1
2		0	0			0	1						0.25	0	1
3		0	5			1	2						2	0	5
4			1			2	2	0					1.25	0	2
5			2	2				0			3		1.75	0	3
6				0	0			0			0		0	0	0
7				1	0			2			0		0.75	0	2
8				2	2					1	0		1.25	0	2
9				1	0		3			0			1	0	3
10				4	0		2	2					2	0	4
11		2		1	0		0						0.75	0	2
12	4		0			2		2					2	0	4
13	3		2			0		0					1.25	0	3
14	0		1			0		4					1.25	0	4
15		0	0		0	0							0	0	0
16		0		0	0		1						0.25	0	1
Mean number															
of BRD per count	2.33	0.5	1.22	1.38	0.25	0.75	1.5	1.25		0.5	0.75				

Table 3Results of February 2019 survey for Barrier Range Dragons at Silverton Wind Farm



3.2 Comparison with previous survey results

Surveys for Barrier Range Dragons during 2020 at Silverton Wind Farm, reported here, found Barrier Range Dragons at fourteen of the sixteen survey locations compared to baseline surveys and 2019 in which dragons were detected at all sixteen of the survey locations and individuals were generally readily observed at each survey site. Total Barrier Range Dragon counts for 2020 (n = 66) decreased compared to 2019 (n = 98) and were less than half that of 2018 (n = 153). Barrier Range Dragons were not detected on 31 of the 64 counts in 2020, compared with a non-detection on 21 of the 64 counts in 2019 and 13 of the 64 counts in 2018. Site 3 yielded the highest number of Barrier Range Dragons in 2020 with five individuals recorded in a single count compared to both 2018 and 2019 where six individuals were recorded in a single count during each survey. During 2018 and 2019 the highest number of dragons recorded during a count occurred at site 9 with 11 and seven individuals observe respectively.

Of the 16 sites surveyed in 2020, 14 had a lower mean lizard count than those surveyed in 2018. Mean dragon counts increased at sites 5 and 12 compared to 2018. A comparison of mean Barrier Range Dragon count data across the three surveys years is presented in Table 4.

Mean BRD observed per count												
Survey site	2018 (baseline)	2019 (year 1)	2020 (year 2)	Difference (2018 vs 2020)	Difference (2019 vs 2020)							
1	3.3	1.5	0.8	-2.6	-0.8							
2	1.8	0.3	0.3	-1.6	-0.1							
3	3.3	2	2	-1.3	0							
4	3.3	1	1.3	-2.1	0.3							
5	1.5	1.5	1.8	0.3	0.3							
6	1	2.5	0	-1	-2.5							
7	0.8	0.8	0.8	-0.1	-0.1							
8	2	1	1.3	-0.8	0.3							
9	6.5	3.3	1	-5.5	-2.3							
10	5	2.3	2	-3	-0.3							
11	1.8	1.8	0.8	-1.1	-1.1							
12	1.5	2	2	0.5	0							
13	1.3	2.3	1.3	-0.1	-1.1							
14	2.3	0.8	1.3	-1.1	0.5							
15	3.8	1.3	0	-3.8	-1.3							
16	1	0.5	0.3	-0.8	-0.3							

Table 4Comparison of 2018, 2019 and 2020 mean Barrier Range Dragon counts for all count
sites.





Figure 2 Box-plot showing difference in mean Barrier Range Dragon abundance between survey years.

3.3 Roadside habitat inspection

All roadside habitat mapped during 2018 still maintained suitable characteristics to be considered habitat for the Barrier Range Dragon. This included areas at which Barrier Range Dragons were recorded during surveys and whilst driving around the wind farm. Suitable roadside habitat with records where formal surveys occurred were survey sites 1, 2, 3, 4, 5, 7, 8, 13 and 16. Other Barrier Range Dragon observations made outside of formal surveys occurred at roadside habitat near Turbines 7 and 36.

At the road leading up to turbine 22, survey site 5, there is an area of sediment build-up shown in Figure 3 and Figure 4. This is occurring where the road has been built up over a drainage line with a culvert built in. At the inlet and outlet of the culvert sediment build-up is smothering rocks within the drainage line. The dust storms and rain that occurred in the weeks and days before surveys were undertaken are highly likely to have contributed to the amount of sediment as sediment build up was observed both close to and away from wind farm infrastructure. This was observed particularly in areas where water pooled after heavy rain occurred on 9 April 2020. Remediation to remove sediment within this drainage line and culvert should occur and ongoing monitoring to determine if further mitigation works are necessary.





Figure 3 Sediment in culvert outlet adjacent road leading to turbine 22.

Figure 4 Sediment in culvert inlet adjacent road leading to turbine 22.





4. Discussion

At the outset it is worth noting that, while the initial monitoring of the present investigation was undertaken in 2018 and is referred to as 'baseline', the very great majority of the wind farm had been constructed at that time. All wind farm roads and earthworks and movements of rocks for the purposes of creating turbine hardstands and for underground electricity cabling at and near Barrier Range Dragon monitoring sites had been completed. Those physical changes to habitats for the species associated with the wind farm have thus not altered since 'baseline' conditions were documented during monitoring in 2018.

Overall, Barrier Range dragons were observed less frequently in the 2020 survey than they were in both the 2018 and 2019 surveys. This being second year of monitoring data with which to compare to baseline surveys provides greater insight into the status of the species with the Silverton Wind Farm site. Whilst examining population changes over a period of three years offers a relatively small sample size, it is clear following analysis of data collected across the three years of survey that the species has exhibited a decline in abundance across most of the count locations. However, these results when compared with climatic trends and observations on site also raise larger questions about the population dynamics of the Barrier Range Dragon and its ongoing response to climatic pressures (i.e. low rainfall years). Therefore, attempts to detect actual demographic changes as a result of wind farm operation or management actions would appear to require information from long-term data.

Analysis of weather records across survey years from the Broken Hill Airport weather station indicate that in the 12 months prior to the 2020 monitoring survey rainfall was substantially lower than in the previous year. Levels during this period were the lowest recorded during the now three year survey period. Count sites were anecdotally observed to have declined in overall vegetation cover and persistence of small to medium shrubs when compared to observations during previous years of survey. Large trees along river and creek beds on site were also observed to have defoliated or presenting an apparently reduced canopy cover. Annual variation in rainfall levels through its effects on vegetation growth has been shown to drive alterations in abundances and community structure of arid zones dragons (Dickman, Letnic, & Mahon 1999). The period of particularly dry weather that has been observed of the 12 months prior to this 2020 survey period has created an increased amount of natural pressure on the Barrier Range Dragon population of Silverton Wind Farm. Therefore, consideration must be given to this climatic trend when interpreting comparisons between results in this 2020 monitoring report and the previously conducted surveys.

Dragon observations have significantly decreased over the period since monitoring began however, as noted above, no alterations to the physical nature of rocky habitats has occurred since 2018, and the principal environmental variable that has affected the region over the past two years has been a substantial decrease in rainfall. The potential for the outlined rainfall trend to confound assessment of any impact of wind farm activities on this population of Barrier Range Dragon poses a challenge for the interpretation of results given the overarching context.

Surveys completed in 2020 recorded Barrier Range Dragons at 14 of the 16 count locations, whereas previously dragons had been recorded at all 16 of the count locations during both baseline surveys and 2019 monitoring. Dragons were not recorded at sites 6 and 15. Both of which have been classified during initial habitat assessments as rocky habitat type B, which is described in Section 2.1 of this report. It is unlikely that the lack of dragon observations at these sites during 2020 survey is due to the unsuitability of rocky habitat type B. There are a total of nine of the sixteen count site that comprise rocky habitat type B. Failure to detect the species at these two sites during the 2020 survey may be because those sites offer lower quality habitat refuge for the species during periods of notably drier weather, or for other currently unknown reasons.



The 2020 survey results have demonstrated the value of monitoring population numbers between years, providing a clearer picture of the overall state of the Barrier Range Dragon population dynamics at Silverton Wind Farm. Population numbers have again displayed a significant decline when compared to previous monitoring surveys. Surveys that are to be conducted in 2021 are the final year of monitoring set out for this initial monitoring period as part of the Biodiversity Adaptive Management Plan (Biosis 2018b). Given the decline that has been observed during the two years of monitoring to-date, it is unlikely that one further year of monitoring will be sufficient to clearly determine whether the population responds if rainfall conditions improve over the 12 months prior to the next survey event. Longer term monitoring is likely to be required to effectively determine the response of the population to external stimuli (i.e. low rainfall) that have the potential to confound the assessment of wind farm operational impacts. The present results along with those of 2018 and 2019 will be useful when compared to future monitoring data following surveys in 2021 to determine how the dragon populations are responding to sustained operation of the wind farm and management actions for the species.



References

Biosis 2018a. *Silverton Wind Farm: Barrier Range Dragon Management Plan*, Report for Prepared for GE Renewable Energy. Author: Smales. I. Biosis Pty Ltd. Project No. 26380. Melbourne, VIC.

Biosis 2018b. *Silverton Wind Farm Operational Biodiversity Adaptive Management Plan*, Report to GE Renewable Energy. Woodward. R. Clancy. R. Smales. I.Biosis Pty Ltd. Project no. 26380. Melbourne, VIC.

Biosis 2018c. *Silverton Wind Farm: Goat Management Plan*, Report for GE Renewable Energy. Author: Clancy R. Biosis Pty Ltd, Albury. Project No. 26380.

Biosis 2018d. *Silverton Wind Farm: Porcupine Grass Sparse Woodland Recovery Plan*, Report for GE Renewable Energy. Author: Woodward R. Biosis Pty Ltd, Albury. Project No. 26380.

Biosis 2018e. *Silverton Wind Farm: Vegetation Management Plan*, Report for GE Renewable Energy. Author: Cutler S & Price P, Biosis Pty Ltd, Albury. Project No. 26380.

Biosis 2019. *Silverton Wind Farm: Barrier Range Dragon Population Monitoring 2019*, Report for GE Renewable Energy. Author: Farquhar J. Biosis Pty Ltd, Melbourne. Project No. 29556.

Dickman C, Letnic M, & Mahon PS 1999. 'Population dynamics of two species of dragon lizards in arid Australia: the effects of rainfall', *Oecologia*, 119: 357–366.

NGH Environmental 2008. *Proposed development of Stage 1b & 1c, Silverton Wind Farm, western NSW. Status and distribution of the Tawny Rock Dragon and their habitat*, Report to Silverton Wind Farm Pty. Ltd. Authors: NGH Environmental.



Appendices



Appendix 1 Mapping and survey sites





Legend

	Study area
	Infrastructure
\propto	Roadside BRD habitat

- ★ BRD survey site
- 🛧 Turbine

PGSW structural variants

- Porcupine grass with eucalypts
- Porcupine grass only
- Eucalypts only

Figure 5 Barrier Range Dragon survey effort -Overview





Metres Scale: 1:62,500 @ A3 Coordinate System: GDA 1994 MGA Zone 54



Matter: 31443, Date: 13 March 2020, Checked by: MJ, Drawn by: JPT, Last edited by: Jturner Layout: 31443_F5_BRD_SurveyEffort Location: \bio-data-01\matters\$\31400s\31443\Mapping\ 31443_SummerFauna.aprx



the GIS User Community



Appendix 2 Historical weather data

Mean Maximum Temperature (°C)	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan
2017	36.1	34.3	32.8	24	19.7	16.9	17.7	17.9	23.6	27	29.8	32.2	26
2018	36.8	34.4	30.4	28.5	19.3	15.6	17.4	18.9	21.5	27	28.1	34.6	26
2019	38.3	33.5	30.8	25.7	20.1	16.3	17.5	17.3	23.3	27.8	28.7	35.4	26.2
2020	34.1	30.4											

Rainfall (mm)	Jan	Feb	Mar	Apr	Мау	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
2017	15.6	0	0	20	6.6	3.8	0.2	11.4	2.6	10	24	14.4	108.6
2018	4.8	0.6	0	1.2	5.2	6.4	0.4	6	0	37.4	24.8	9.6	96.4
2010	15 <i>A</i>	1 /	10.2	0	0	5	1 7	0.2	1	0.6	16	0	69
2019	15.4	1.4	19.2	0	0	5	1.2	0.2	1	0.0	10	0	00
2020	0	7.8											7.8