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Environmental Noise Assessment

by Sonus

Twin Creek Wind Farm and Energy Storage Facility

Environmental Noise Assessment

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GLOSSARY

A-weighting	Frequency adjustment applied to measured noise levels to replicate the frequency response of the human ear.
Ambient noise level	The noise level of the existing noise sources in the environment (in the absence of the wind farm).
Associated	A landowner with a commercial agreement with the wind farm.
Background noise level	The ambient noise level which excludes intermittent noise sources.
CONCAWE	*The oil companies' international study group for conservation of clean air and water - Europe, The propagation of noise from petrochemical complexes to neighbouring communities (May 1981).*
Day	The period between 7am and 10pm.
dB(A)	A-weighted noise or sound power level in decibels.
EPA	Environment Protection Authority
Equivalent noise level	Energy averaged noise level over a prescribed period of time
Guidelines	*Wind Farms Environmental Noise Guidelines 2021*
IOA Guide	*Institute of Acoustics "A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise" (May 2013)*
ISO 1996-2	*ISO 9613-2:1996 "Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation"*
LA90,10	The A-weighted noise level exceeded for 90% of a 10 minute time period. Represents the background noise level.
Night	The period between 10pm and 7am.
PO4.1	*Performance Outcome 4.1* of the *Interface between Land Uses* section of the South Australian *Planning and Design Code*
Sound power level	A measure of the sound energy emitted from a source of noise.
The Code	South Australian Planning and Design Code
the Policy	*Environment Protection (Commercial and Industrial Noise) Policy 2023*
The Wind Farm	Twin Creek Wind Farm
Weather category 6	Weather category which is most conducive for the propagation of noise, resulting in highest predicted noise levels when using CONCAWE.
WHO	World Health Organisation

WHO Guidelines	*WHO Guidelines for Community Noise*
Worst-case	Conditions resulting in the highest noise level at residences.
WTG	Wind turbine generator comprising a three bladed, upstream facing, horizontal axis turbine mounted on steel towers with a common set of generic design components comprising a foundation, tower, nacelle, hub and blades

EXECUTIVE SUMMARY

An environmental noise assessment has been made of the proposed Twin Creek Wind Farm and Energy Storage Facility. The proposed development is subject to the provisions of the South Australian Planning and Design Code (**the Code**) under the Planning, Development, and Infrastructure Act 2016. The assessment is based upon:

- Up to 42 Wind Turbine Generators (**WTG**), with the Vestas V172-7.2MW as the candidate turbine, with an overall turbine blade tip height up to 220 metres, a hub height of up to 134m and a rotor diameter of up to 172m
- a battery energy storage system (**BESS**) with an indicative capacity of 215MW
- a project substation within the windfarm boundary
- a transmission line and a cut-in terminal substation (which do not include noise sources)

Through the Performance Outcomes of the Code, noise from developments must *not unreasonably impact the amenity of sensitive receivers (or lawfully approved sensitive receivers)*, which can be satisfied by achieving the criteria of the *Environment Protection (Commercial and Industrial Noise) Policy 2023* (the **Policy**).

Clause 22(1) in conjunction with Clauses 9 and 16 exclude wind farm noise from assessment under the general provisions of the Policy. Therefore, WTG noise is to be assessed in accordance with *Wind farms environmental noise guidelines 2021* (the **Guidelines**). The noise from ancillary infrastructure has been assessed against the Policy.

Based upon the land zoning within the Code and the requirements from the Guidelines, the predicted equivalent noise level ($L_{Aeq,10}$), adjusted for tonality in accordance with these guidelines, should not exceed:

- Non-associated Residences
  - 40 dB(A) at relevant receivers, or
  - the background noise ($L_{A90,10}$) by more than 5 dB(A)
- Associated Residences
  - 45 dB(A) at relevant receivers, or
  - the background noise ($L_{A90,10}$) by more than 5 dB(A)

whichever is greater, at all relevant receivers for wind speed from cut-in to rated power of the WTG and each integer wind speed in between.

The goal noise levels for the ancillary infrastructure is set by the policy based upon the designated zones within the Code and the hours of operation. These are as follows:

- Residences within the Rural Zone an average (L_{eq}) noise level of 45 dB(A);
- Residences within the Rural Settlement Zone an average (L_{eq}) noise level of 43 dB(A) and an instantaneous maximum (L_{max}) noise level of 60 dB(A) during the night (10:00pm to 7:00am).

A predictive noise model has been prepared for the proposed wind farm layout and locations of the ancillary infrastructure, which enables noise predictions to be made for each noise source including representative WTG's, transformers and battery storage.

Operational noise of the wind turbine generators has been considered against the requirements of the South Australian EPA Wind farms environmental noise guidelines 2021, as updated in November 2021. The ancillary infrastructure has been assessed against the relevant provisions in the current Environment Protection (Commercial and Industrial Noise) Policy

The predicted noise levels achieve the requirements at all residences, and therefore based upon the assessment, the development is located and designed to minimise hazard or nuisance to adjacent development and land uses.

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1 INTRODUCTION

RES Australia Pty Ltd (**RES Australia**) proposes to develop the Twin Creek Wind Farm and Energy Storage Facility (the **Wind Farm**) within the Mid North area of South Australia. The Wind Farm is approximately 90km north-east of Adelaide and approximately 10km north-east of Kapunda.

The wind farm comprises up to 42 Wind Turbine Generators (**WTGs**) as generally depicted in Appendix A.

Sonus has conducted an environmental noise assessment of the wind farm against the requirements of the South Australian EPA *Wind farms environmental noise guidelines 2021*.

The assessment has been based on the following data:

- the proposed co-ordinates of each WTG as detailed in Appendix B.
- the location and status of residences in the vicinity of the proposed wind farm as detailed in Appendix C.
- background noise monitoring conducted at 7 representative locations, between 31 August to 14 October 2016 and 22 December 2016 to 2 February 2017.

2 PROJECT OVERVIEW

The wind farm is located on the tablelands that form the wide ridgeline associated with Bald Hill and Long Hill situated within the Northern Mount Lofty Ranges.

The landform of the area is defined by numerous ridgelines that run north-south through the site creating a series of parallel ridges, wide open valleys, tablelands and isolated topographic features.

Surrounding the site of the wind farm, the landscape is dominated by grazing with open paddocks defined by fenced boundaries and occasional trees to fence lines and creek lines. The land use that occurs in the open valley floor between the local ridgelines and across the tablelands associated with Bald Hill is more diverse with areas of arable cropping and grazing.

The proposal is for a wind energy facility which will consist of the following components:

- Based on the Vestas V172-7.2MW as the candidate turbine, with an overall turbine blade tip height up to 220 metres, a hub height of up to 134m and a rotor diameter of up to 172m. The final turbine model will be subject to a competitive tender process following development authorisation;
- up to 42 WTGs;
- each WTG has a name plate capacity of up to 7.2MW, with a total installed name plate capacity of up to 270MW;
- associated hard standing areas and access roads;
- operations and maintenance building and compound with associated car parking;
- two electrical substations (one project substation within the windfarm boundary and one cut-in terminal substation;
- a battery energy storage facility with an indicative capacity of 215MW. The facility includes up to 24 containerised energy storage enclosures (which house batteries, inverters, transformers, racking and associated electrical equipment), a control building and switchroom;
- Overhead and underground electrical cable reticulation;
- overhead transmission line for approximately 15 kilometres south-east of the wind farm site and connects to the Robertstown-Tungkillo 275Kv transmission line adjacent the Sturt Highway near Truro;
- temporary construction facilities including a borrow pit and concrete batching plant facilities.

3 LEGISLATION, GUIDEANCE AND STANDARDS

3.1 Planning and Design Code

The proposed development is subject to the provisions of the South Australian Planning and Design Code (**the Code**) under the Planning, Development, and Infrastructure Act 2016.

In accordance with the Code, the Wind Farm is located within a "Rural" Zone. The key noise sensitive receivers are located predominately within a "Rural" Zone, with some in the "Rural Settlement" Zone. Although there are other sensitive receivers in other zones, which are in the vicinity of the transmission line and cut-in terminal substation, there are no noise sources associated with this ancillary infrastructure. The zones relative to the Wind Farm and surrounding receivers are shown in Figure 1.

The Code has been reviewed and the provisions considered relevant to the assessment are included in Appendix D.

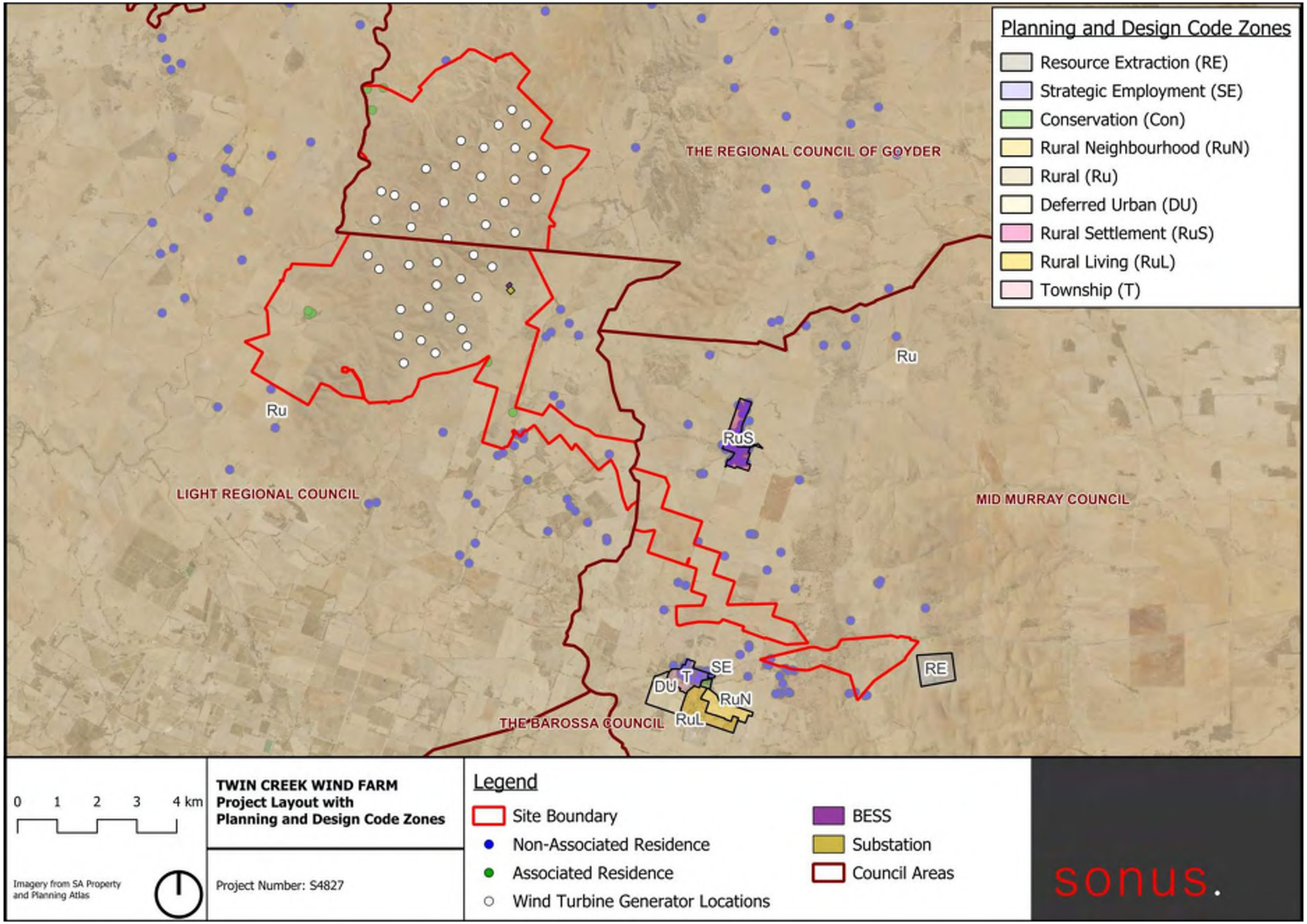

Figure 1: Site Area with Planning and Design Code Zones

3.2 *Environment Protection (Commercial and Industrial Noise) Policy 2023*

Performance Outcome 4.1 (**PO4.1**) of the Interface between Land Uses section of the Code specifically requires noise from developments to *not unreasonably impact the amenity of sensitive receivers (or lawfully approved sensitive receivers)*. The Deemed-to-Satisfy / Designated Performance Feature provision for PO4.1 requires noise that affects sensitive receivers achieves the relevant *Environment Protection (Noise) Policy* (the **Policy**).

Clause 22(1) of the Policy states:

> *If an entity operates a wind farm, the Wind farms environmental noise guidelines 2021, prepared by the Authority, and as in force from time to time, apply.*

Clause 22(1) in conjunction with Clauses 9 and 16 exclude wind farm noise from assessment under the general provisions of the Policy. Therefore, WTG noise is to be assessed in accordance with *Wind farms environmental noise guidelines 2021* (the **Guidelines**). The noise from ancillary infrastructure has been assessed against the Policy.

4 METHODOLOGY

4.1 WTG Noise

4.1.1 Propagation Model

The predictions of environmental noise from the Project have been based on the noise propagation model described by ISO 9613-2:1996 *"Acoustics — Attenuation of sound during propagation outdoors — Part 2: General method of calculation"* (**ISO 1996-2**) and SoundPLAN noise modelling software. ISO 9613-2 is one of the recommended models under the Guidelines for the prediction of wind turbine noise. The noise propagation model considers the following:

- sound power levels and noise source locations
- separation distances between noise sources and residences
- topography of the area
- influence of the ground and air absorption
- meteorological conditions.

ISO 9613-2 provides a methodology for predicting noise levels at sensitive land uses under meteorological conditions favourable to noise propagation. Specifically, the ISO 9613-2 model predicts noise based on the assumption of downwind noise propagation (resulting in higher noise levels) from all WTGs to all noise sensitive receptors simultaneously, therefore representing a conservative approach.

4.1.2 Inputs

Inputs to the noise prediction model are in accordance with the Institute of Acoustics *"A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise"* (May 2013) (**IOA Guide**), which includes the following requirements:

- 10°C temperature
- 70% relative humidity
- intermediate ground absorption (required by the IOA Guide, despite the pastoral nature of the land)
- barrier attenuation of no greater than 2 dB(A) (required by the IOA Guide)
- receiver point located 4m above ground level at the residence (required by the IOA Guide, despite receiver points being at a lower level than this)
- application of a 3 dB(A) correction where a "concave" ground profile exists as defined by the IOA Guide.

The Guidelines specifically reference these inputs as suitable modelling parameters for wind turbines.

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4.1.3 Noise Criteria

Non-Associated Landowners

The following assessment criteria are applied by the Guidelines to landowners without a commercial agreement with the wind farm:

> *The predicted equivalent noise level ($L_{Aeq,10}$), adjusted for tonality in accordance with these guidelines, should not exceed:*
>
> - *35 dB(A) at relevant receivers in localities which are primarily intended for rural living, or*
> - *40 dB(A) at relevant receivers in localities in other zones, or*
> - *the background noise ($L_{A90,10}$) by more than 5 dB(A)*
>
> *whichever is greater, at all relevant receivers for wind speed from cut-in to rated power of the WTG and each integer wind speed in between.*

The EPA has defined the land use principally promoted for each zone in the Code. In accordance with the EPA, the Rural Zone principally promotes “Rural Industry”, and the Rural Settlement zone principally promotes “Residential” land use. Receivers in other zones have not been considered due to the distance from the closest turbine. As neither of the applicable zones principally promote “Rural Living”, the 35 dB(A) base criterion is not applicable to this assessment.

Where the wind farm noise exhibits a tonal characteristic, a 5 dB(A) penalty is to be applied to the predicted or measured noise level.

The results of the correlations and the noise criteria determined using the Guidelines are summarised in Appendix F and Appendix G respectively. Where background noise monitoring has not been conducted at a residence, the lowest measured background noise levels at any monitoring location have been used to derive the criteria. This is a conservative approach.

Associated Landowners

The SA Guidelines note that:

> *The criteria have been developed to minimise the impact on the amenity of premises that do not have an agreement with the wind farm developers.*

To protect the associated landowners from unreasonable interference to their amenity, reference is made to the World Health Organisation (WHO) Guidelines for Community Noise (WHO Guidelines). The WHO guidelines provide recommendations with regard to protecting against:

- sleep disturbance within habitable rooms of residences, and;
- annoyance during the daytime for outdoor areas.

The WHO Guidelines recommend an indoor noise level of 30 dB(A) be achieved to protect against sleep disturbance. The indoor limit of 30 dB(A) equates to an outdoor noise level of 45 dB(A) with windows open for ventilation.

It is proposed that the WHO Guidelines criterion of 45 dB(A) be used as the baseline noise level at associated landowners. Appendix C identifies these landowners by an "Associated" status.

4.2 Ancillary Infrastructure Noise

4.2.1 Propagation Model

A noise model for ancillary infrastructure has been created using the SoundPLAN noise modelling software to predict the resultant noise levels at the sensitive receivers. Predictions have been made using the CONCAWE[1] noise propagation model within the SoundPLAN noise modelling software. The sound propagation model considers the following influences:

- sound power levels and locations of noise sources (including height of sources)
- separation distances between noise sources and receivers
- shielding provided by the ground topography
- influence of the ground and air absorption
- meteorological conditions.

4.2.2 Inputs

The CONCAWE system divides meteorological conditions into six separate "weather categories", which are dependent on the wind speed, wind direction, time of day and level of cloud cover. Weather Category 1 provides the weather conditions associated with the "lowest" propagation of noise, while Weather Category 6 provides "worst-case" (i.e. highest noise level) conditions. Weather Category 4 provides "neutral" weather conditions for noise propagation (that is, conditions which do not account for the effects of temperature inversion or wind on propagation).

This assessment provides noise predictions for CONCAWE Weather Category 6 (worst-case) conditions.

[1] CONCAWE - The oil companies' international study group for conservation of clean air and water – Europe, 'The propagation of noise from petrochemical complexes to neighbouring communities', May 1981.

4.2.3 Noise Criteria

The noise from ancillary infrastructure should achieve the relevant provisions in the current Environment Protection (Commercial and Industrial Noise) Policy. The Policy provides external goal noise levels to be achieved at noise sensitive locations based on the principally promoted land uses of the Code in which the noise source and the noise receivers are located. In this instance, the Policy provides the following goal noise levels:

Residences within the Rural Zone

- an average (L_{eq}) noise level of 52 dB(A) during the day (7:00am to 10:00pm); and
- an average (L_{eq}) noise level of 45 dB(A) during the night (10:00pm to 7:00am);

Residences within the Rural Settlement Zone

- an average (L_{eq}) noise level of 50 dB(A) during the day (7:00am to 10:00pm);
- an average (L_{eq}) noise level of 43 dB(A) during the night (10:00pm to 7:00am); and
- an instantaneous maximum (L_{max}) noise level of 60 dB(A) during the night (10:00pm to 7:00am).

As the Development is anticipated to operate at any time, the night time criterion is the most relevant. The noise from ancillary infrastructure does not vary significantly (when operating) and therefore, the maximum (L_{max}) noise level will be easily achieved where the average (L_{eq}) levels are achieved.

When measuring or predicting noise levels for comparison with the Policy, penalties may be applied to the average goal noise levels for each characteristic of impulse, intermittency, low frequency, modulation, and tone of the noise source. To apply a penalty, the characteristic must be considered dominant in the existing acoustic environment. The application of penalties is discussed further in the Results section of this report.

4.3 Background Noise Monitoring

4.3.1 Noise Monitoring Locations

Background noise monitoring was conducted at 7 locations in the vicinity of the wind farm between 31 August and 14 October 2016 and 22 December 2016 and 2 February 2017. The background noise monitoring was conducted in accordance with the Guidelines.

The monitoring locations are summarised in Table 1

Table 1: Monitoring locations and periods.

Monitoring Location ID	Coordinates (GDA94 Projection MDA54)	
	Easting	Northing
H5	318425	6204359
H18	326591	6204222
H77	324320	6207653
H119	318462	6200062
H122	322874	6198829
H125	324704	6200152
H147	319969	6205165

The noise monitoring equipment was located such that the measured background noise levels are representative of the background noise environment experienced at the dwellings.

Photographs of the monitoring equipment at each location are provided in Appendix E and the monitoring locations are depicted in Figure 2. It is noted that as there are no noise sources associated with the transmission line and cut-in terminal substation, the background noise logging (and therefore Figure 2) is concentrated around the wind farm area.

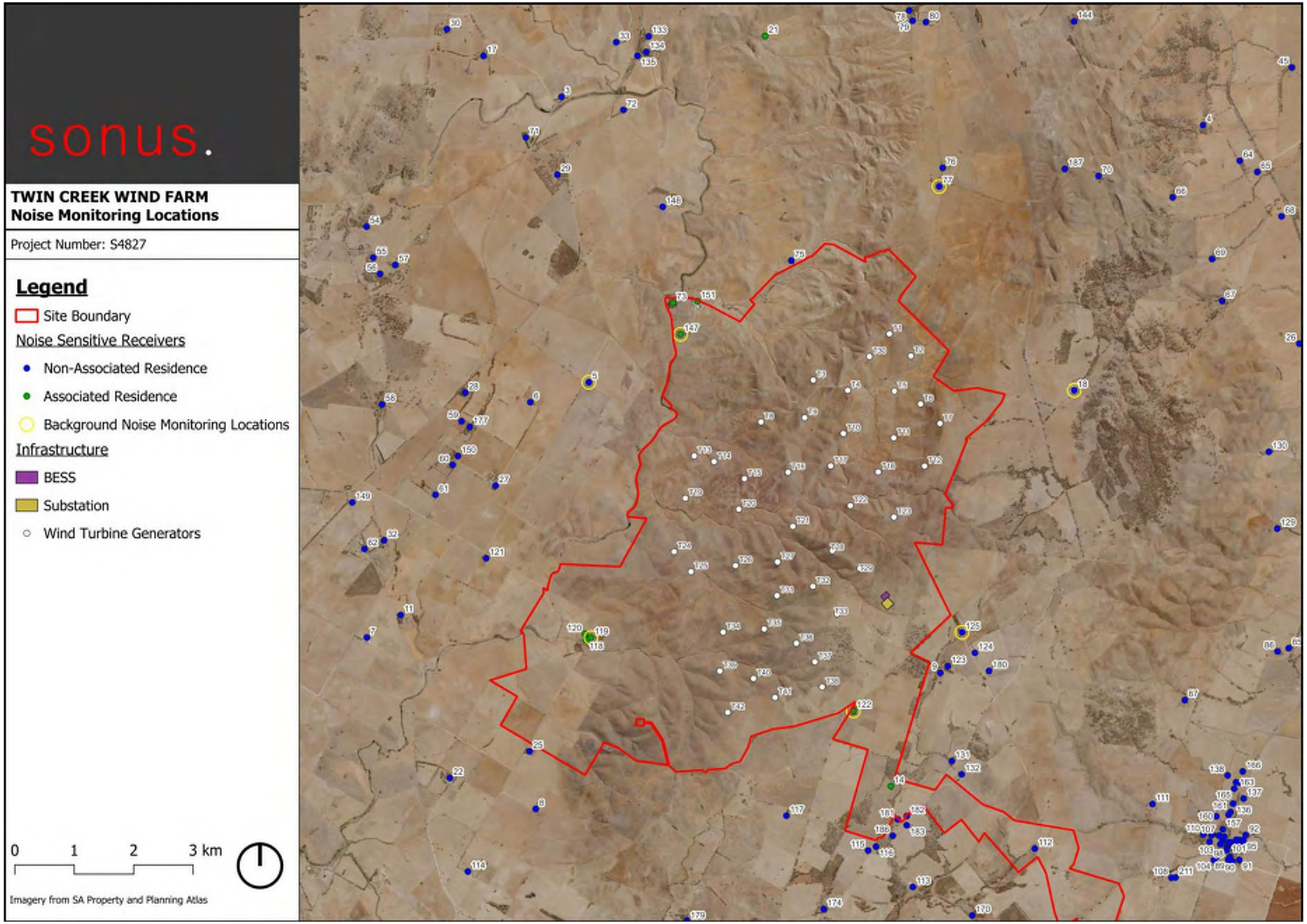

Figure 2: Noise Monitoring Locations

4.3.2 Equipment

The background noise levels were measured using a combination of Rion NL-21 (Type 2) and Rion NL-52 (Type 1) sound level meters, all of which have a noise floor less than 20 dB(A). The sound level meters were calibrated at the beginning and end of the measurement period with a Rion NC-74 Calibrator. All microphones were fitted with weatherproof windshields, with the microphone positioned approximately 1.5 m above ground level.

The wind speed at approximately the microphone height was logged at each location and the rainfall was monitored at two locations, on opposite sides of the wind farm. The rainfall and wind speed data were collected to determine the periods when weather on the microphone may have influenced the measured background noise levels in the vicinity.

4.3.3 Data Collection

The background noise level ($L_{A90,10}$) was measured continuously in 10 minute intervals at each monitoring location over the respective monitoring periods.

During the background noise monitoring period, RES Australia measured the average wind speed and direction at a wind mast located at the wind farm site. The wind data were measured in corresponding 10 minute intervals, at various measurement heights. Table 2 provides details of the wind masts.

Table 2: Wind mast details

Mast ID	Coordinates (GDA94 Projection MDA54)		Measurement Heights (m)
	Easting	Northing	
889	324281	6204237	100, 120 & 140m
61	321699	6201050	40, 50 & 60m

The SA Guidelines specify that the background noise should be correlated with wind speeds at the WTG hub height. The wind speeds at a hub height of 134m have been calculated by RES Australia using measurements at the different anemometer heights.

4.3.4 Data Analysis

Prior to the correlation and analysis, the following data were filtered:

- data points corresponding to any periods of measured rainfall (including the 10 minute periods before and after the recorded period) and/or measured wind speed exceeding 5 m/s at the microphone height for more than 90% of the measurement period;
- data points corresponding to wind speeds below the cut-in (3 m/s) and above the rated power (13 m/s); and,
- data points clearly influenced by extraneous noise sources.

Following the data filtering procedure, the following number of points remained for each of the monitoring locations. As per the Guidelines, a minimum of 2000 data points are required for a valid assessment. Additionally, 500 downwind data points are required, or if this is impractical to collect, the monitoring must continue for up to six weeks. In this case, monitoring was conducted for at least 6 weeks.

Table 3 summarises the number of data points at each monitoring location.

Table 3: Data Points

Monitoring Location ID	Total Measured Data Points	Total Downwind Points	Data Points after Filtering
H5	6000	2188	4593
H18	6000	1827	4877
H77	6308	1221	4364
H119	6234	1243	3947
H122	6324	2176	3913
H125	6324	2373	3516
H147	6324	547	3922

The resultant background noise data for each monitoring location were correlated with the wind speed data measured at the closest wind mast. The correlated noise data were then split into wind speed bins as required by the Guidelines. Each wind speed bin is 1m/s wide and is centred on the integer wind speeds between cut in and rated power. The arithmetic average noise level for each wind speed bins was then determined to give the background noise level at each integer wind speed. The background noise levels for each location following this process are shown in Table 4.

Table 4: Background Noise Levels

Monitoring Location ID	Measured Background Noise Level [dB(A)] Per Hub Height Wind Speed (m/s)										
	3	4	5	6	7	8	9	10	11	12	13
H5	26	27	27	28	28	29	29	30	31	32	32
H18	28	28	28	29	30	32	32	33	33	33	34
H77	30	29	29	29	29	31	34	35	35	36	39
H119	28	28	29	30	30	30	32	34	34	35	36
H122	28	28	28	30	31	31	33	35	36	37	39
H125	27	26	27	27	28	29	31	32	33	34	36
H147	30	31	32	31	31	32	33	34	35	36	37

4.4 Noise Source Levels

The Wind Farm layout comprises up to 42 WTGs, a single site substation (with a total of two transformers), a remote terminal substation and a BESS. Appendix B provides the coordinates of the noise sources.

The assessment has been made based on the Vestas V172 – 7.2MW WTG (with serrated trailing edges and with a hub height of 134 m). The WTGs have a cut-in wind speed of 3 m/s. The rated power wind speed is 13 m/s.

The two transformers at the site substation have been based on units having a rating of up to 150 MVA each. It is understood that there are no noise generating sources as a part of the terminal substation.

As the make and model of the BESS units is yet to be finalised, the noise modelling has been conducted using manufacturer's data for a typical example. For the proposed capacity, 164 battery units and 41 power conversion units have been modelled.

The sound power levels used for the assessment are based on the following:

- Manufacturer's 1/3 octave band sound power level data for the WTG, provided in the document titled: V172-7.2MW Third octave noise emission. The final data are summarised in Appendix H.
- Derived sound power levels for the transformers from the Australian/New Zealand Standard AS/NZS60076.10:2009, Power transformers - Determination of sound levels (IEC 60076-10, Ed. 1(2001) MOD) (summarised in Appendix I).
- Assumed battery and power conversion unit sound power levels, summarised in Appendix I.

5 RESULTS

5.1 WTG Noise

The results from modelling the WTG noise at 13m/s are shown in Figure 3 with noise contours shown at 30 dB(A), 35dB(A), 40dB(A), 45 dB(A) and 50 dB(A). The predictions for all wind speeds against the criteria are given in Appendix J for all houses where the highest predicted noise level was above 25 dB(A). The highest predicted noise level at any house was 43 dB(A) at 122 (associated) for wind speeds between 9 m/s and 13 m/s. the highest not associated prediction is at 9, where the noise level is predicted to be 38 dB(A) for wind speeds between 9 m/s and 13 m/s.

Based upon the assessment, all residences achieve the criteria at all integer hub height wind speeds.

5.2 Ancillary Infrastructure Noise

The noise from the substation and BESS facility has been predicted. The highest predicted noise level from this ancillary infrastructure is 36 dB(A) at 125 (non-associated), which is below the night time criteria for either zone within the area. Though not anticipated, if a penalty were to be applied, the noise level would still be compliant. The predicted noise contours for the noise criteria, are shown in Figure 4. The figure shows that the predicted noise is lower than the criteria at all residences.

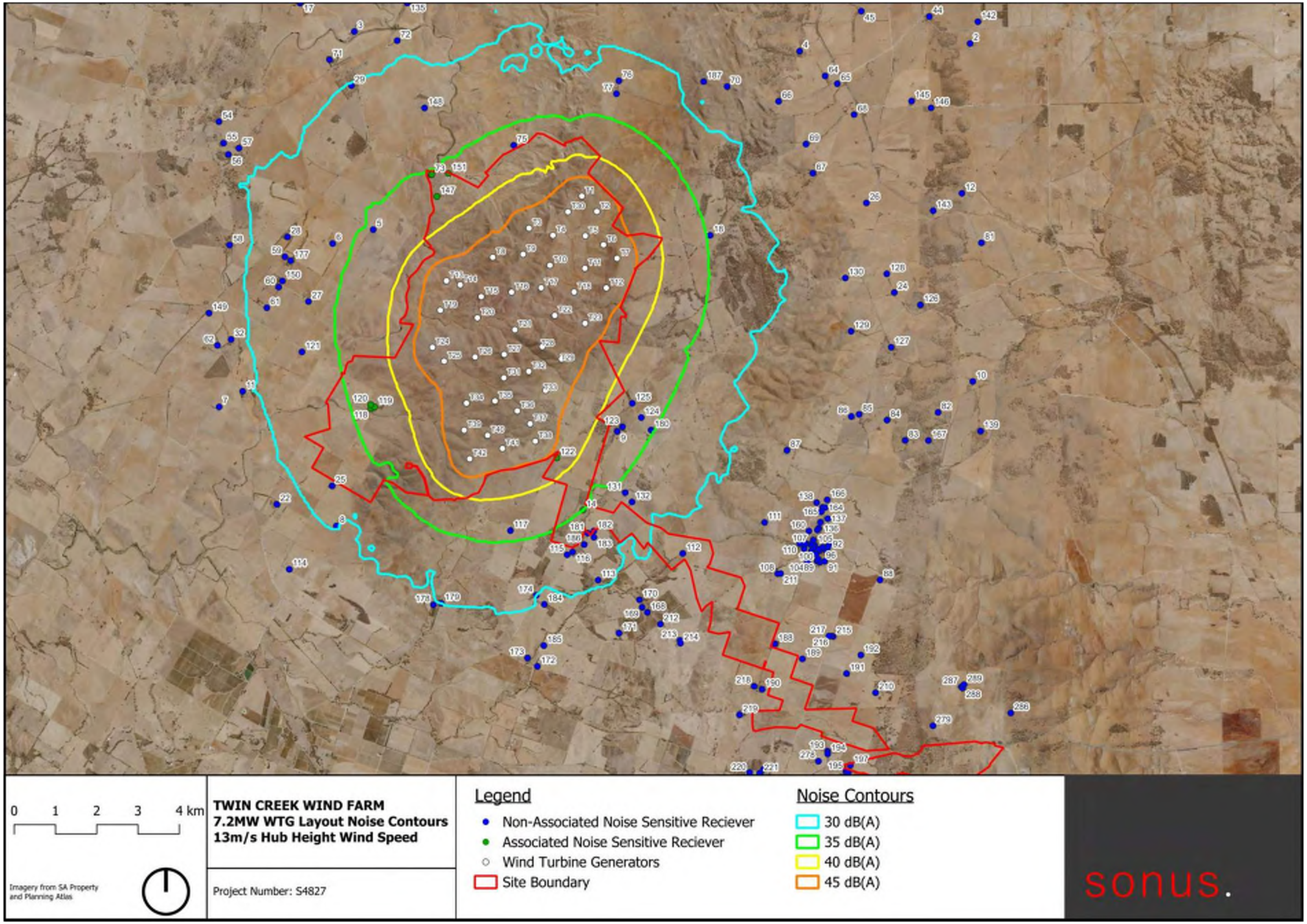

Figure 3: Wind Turbine Generator Noise Contours

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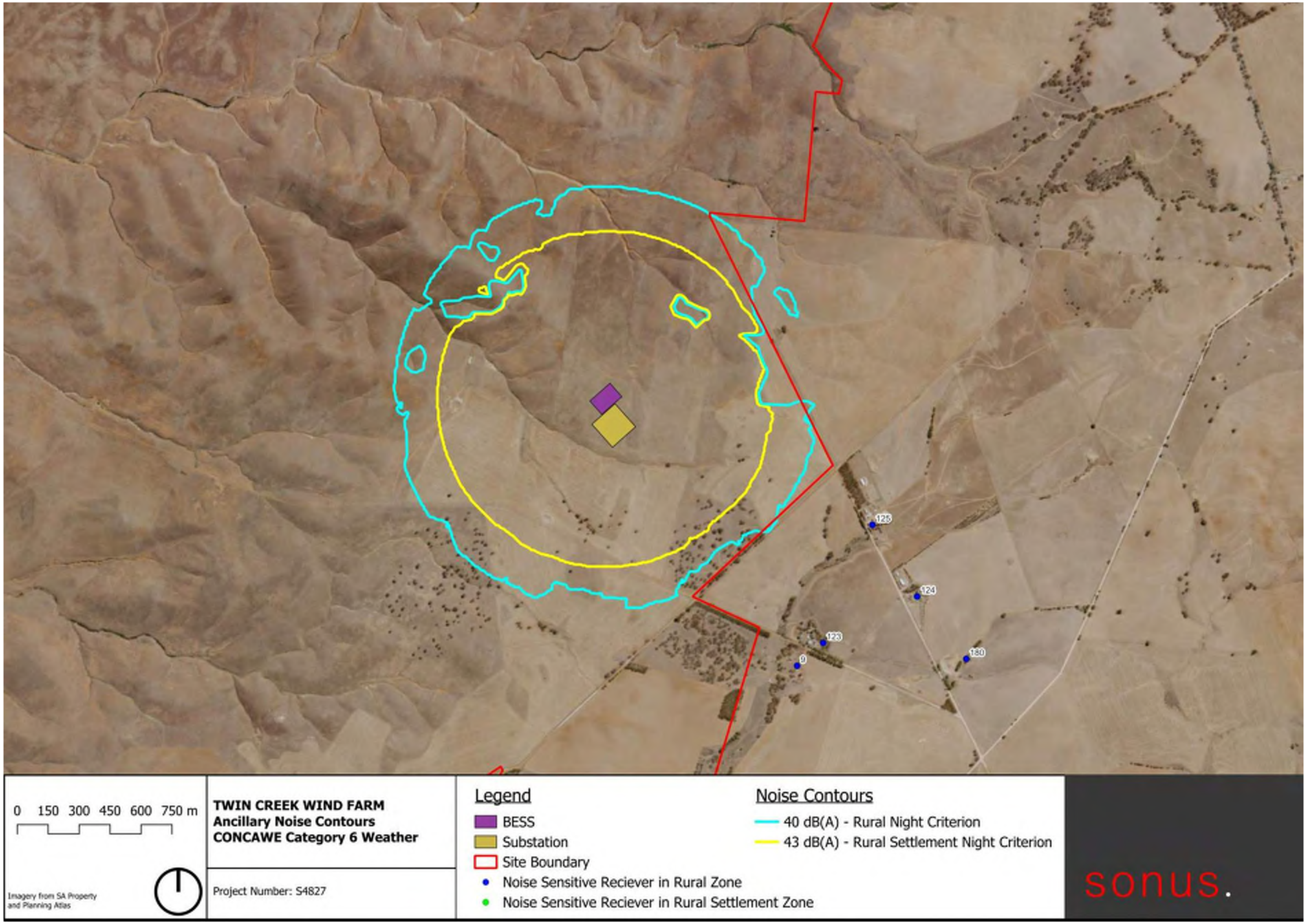

Figure 4: Ancillary infrastructure Noise Contours

6 CONCLUSION

An environmental noise assessment has been made of the proposed Twin Creek Wind Farm. The proposed development is subject to the provisions of the South Australian Planning and Design Code (**the Code**) under the Planning, Development, and Infrastructure Act 2016. The assessment is based upon:

- Up to 42 Wind Turbine Generators, with the Vestas V172-7.2MW as the candidate turbine, with an overall turbine blade tip height up to 220 metres, a hub height of up to 134m and a rotor diameter of up to 172m
- a battery energy storage facility with an indicative capacity of 215MW
- an electrical substation

In addition, there is a transmission line and a cut-in terminal substation, which do not include noise sources.

Operational noise of the wind turbine generators has been considered against the requirements of the EPA's *Wind farms environmental noise guidelines 2021*. The ancillary infrastructure has been assessed against the relevant provisions in the current *Environment Protection (Commercial and Industrial Noise) Policy (2023).*

The predicted noise levels achieve the requirements at all residences, and therefore based upon the assessment, the development is located and designed to minimise hazard or nuisance to adjacent development and land uses with respect to noise.

A final noise assessment will be conducted to confirm compliance with the Guidelines when the final WTG, transformer and battery energy storage facility are available at the procurement stage of the project, with sound power levels provided by the respective manufacturers. The final noise assessment report will be submitted to the relevant authorities prior to the commencement of construction. In addition, noise level monitoring during operation of the wind farm is also typically required by the Environment Protection Authority to confirm ultimate compliance with the Guidelines.

The assessment indicates that the Twin Creek Wind Farm can be readily designed to achieve the requirements of the November 2021 update of the Guidelines. Should the wind farm be granted approval, there will be a review of the final design of the wind farm prior to construction and it is most likely that a condition of approval will require monitoring during operation to confirm ultimate compliance with the Guidelines.

APPENDIX A: PROJECT DESIGN LAYOUT

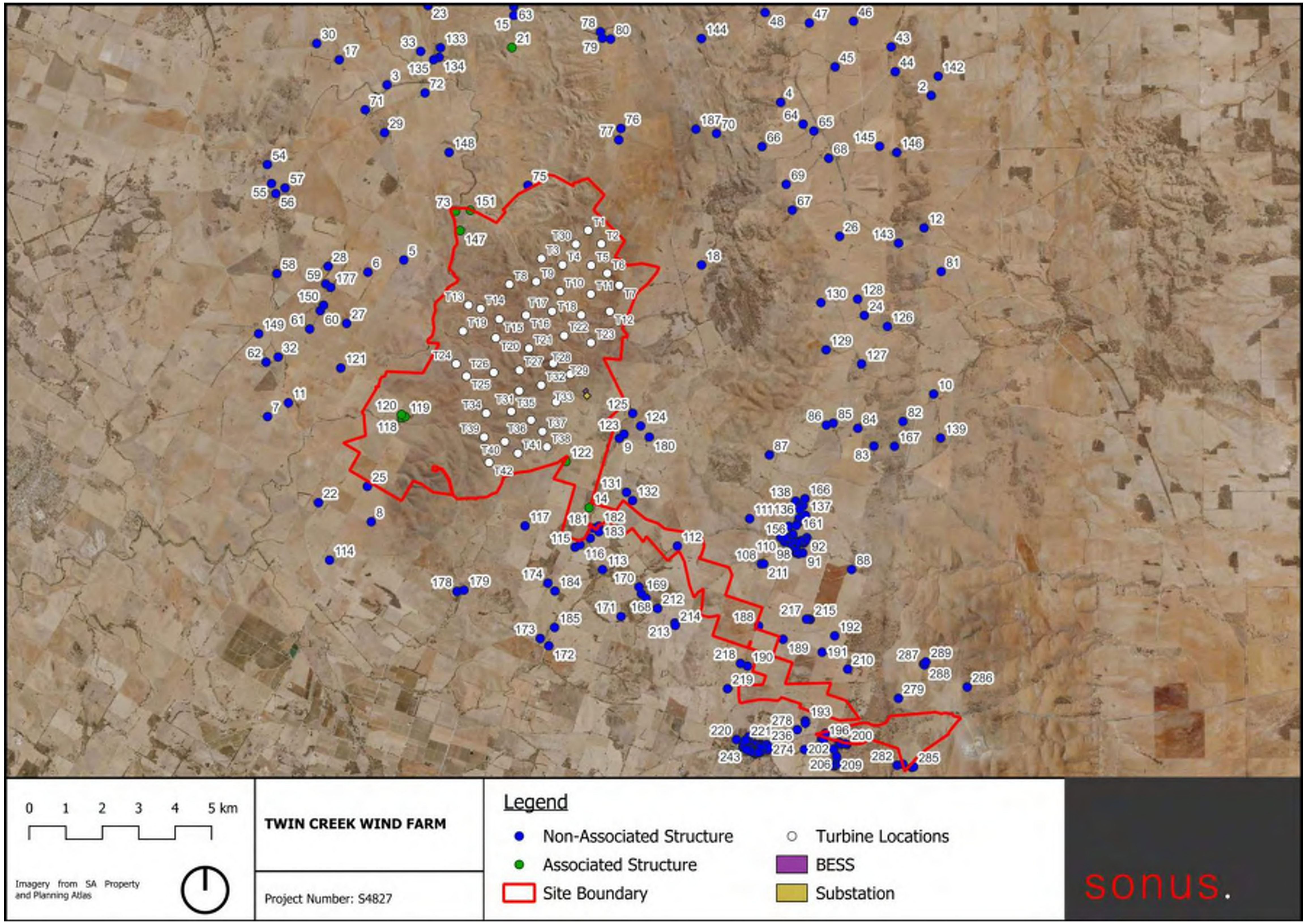

Figure 5: Project Layout

APPENDIX B: PROPOSED WIND FARM LAYOUT AND NOISE SOURCES

Table 5: Turbine Locations

WTG ID	Coordinates (WGS 84 / UTM Zone 54S)	
	Easting	Northing
T1	323482	6205173
T2	323844	6204801
T3	322201	6204396
T4	322781	6204223
T5	323566	6204209
T6	324007	6203993
T7	324334	6203665
T8	321322	6203691
T9	322058	6203763
T10	322708	6203496
T11	323556	6203423
T12	324074	6202948
T13	320199	6203120
T14	320533	6203023
T15	321043	6202736
T16	321778	6202844
T17	322495	6202951
T18	323294	6202849
T19	320050	6202407
T20	320949	6202223
T21	321858	6201934

WTG ID	Coordinates (WGS 84 / UTM Zone 54S)	
	Easting	Northing
T22	322825	6202282
T23	323559	6202089
T24	319861	6201508
T25	320144	6201172
T26	320893	6201273
T27	321600	6201336
T28	322524	6201525
T29	322988	6201226
T30	323145	6204792
T31	321591	6200769
T32	322195	6200924
T33	322603	6200463
T34	320685	6200154
T35	321376	6200207
T36	321917	6199967
T37	322228	6199655
T38	322352	6199232
T39	320630	6199500
T40	321197	6199375
T41	321557	6199056
T42	320763	6198805

Table 6: Ancillary infrastructure Locations

Ancillary infrastructure	Approximate Coordinates (WGS 84 / UTM Zone 54S)	
	Easting	Northing
Battery Energy Storage Facility	323412	6200763
Substation	323450	6200633
Cut-in Terminal Station	333360	6191750

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APPENDIX C: RESIDENCES IN THE VICINITY

Table 7: Residences in the Vicinity

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Predicted Noise Level @13m/s HH Wind Speed [dB(A)]	Compliance	Closest Turbine	Approximate Distance to Closest Turbine (m)	Approximate Direction to Closest Turbine
		Easting	Northing					
14	Associated	323507	6197563	34	Compliant	T38	2000	325
21	Associated	321390	6210185	26	Compliant	T1	5400	155
73	Associated	319843	6205696	35	Compliant	T8	2500	145
118	Associated	318374	6200027	37	Compliant	T24	2100	45
119	Associated	318462	6200062	37	Compliant	T24	2000	45
120	Associated	318362	6200119	37	Compliant	T24	2000	45
122	Associated	322874	6198829	43	Compliant	T38	700	310
147	Associated	319969	6205165	37	Compliant	T8	2000	135
151	Associated	320252	6205722	36	Compliant	T8	2300	150
3	Non-Associated	317966	6209162	28	Compliant	T3	6400	140
5	Non-Associated	318425	6204359	36	Compliant	T13	2200	125
6	Non-Associated	317441	6204023	34	Compliant	T13	2900	110
7	Non-Associated	314690	6200064	30	Compliant	T24	5400	75
8	Non-Associated	317532	6197178	30	Compliant	T42	3600	65
9	Non-Associated	324339	6199469	38	Compliant	T33	2000	300
11	Non-Associated	315260	6200442	30	Compliant	T24	4700	75
15	Non-Associated	321443	6211068	26	Compliant	T1	6200	160
17	Non-Associated	316653	6209849	26	Compliant	T13	7600	150
18	Non-Associated	326591	6204222	35	Compliant	T7	2300	255
19	Non-Associated	319693	6211627	26	Compliant	T1	7500	150
22	Non-Associated	316087	6197701	29	Compliant	T42	4800	75
23	Non-Associated	319090	6211336	26	Compliant	T1	7600	145
25	Non-Associated	317428	6198149	32	Compliant	T42	3400	80
26	Non-Associated	330378	6205007	25	Compliant	T7	6200	255
27	Non-Associated	316856	6202618	33	Compliant	T19	3200	95

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ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Predicted Noise Level @13m/s HH Wind Speed [dB(A)]	Compliance	Closest Turbine	Approximate Distance to Closest Turbine (m)	Approximate Direction to Closest Turbine
		Easting	Northing					
28	Non-Associated	316348	6204184	32	Compliant	T13	4000	105
29	Non-Associated	317896	6207851	30	Compliant	T13	5300	155
30	Non-Associated	316038	6210298	26	Compliant	T13	8300	150
31	Non-Associated	319234	6211695	26	Compliant	T1	7800	145
32	Non-Associated	314980	6201698	29	Compliant	T24	4900	90
33	Non-Associated	318887	6210081	28	Compliant	T3	6600	150
35	Non-Associated	318683	6213276	25	Compliant	T1	9400	150
39	Non-Associated	323271	6212624	25	Compliant	T1	7500	180
51	Non-Associated	320282	6212500	25	Compliant	T1	8000	155
52	Non-Associated	319846	6212278	25	Compliant	T1	8000	155
53	Non-Associated	319737	6212327	25	Compliant	T1	8100	150
54	Non-Associated	314685	6206976	27	Compliant	T13	6700	125
55	Non-Associated	314798	6206455	28	Compliant	T13	6300	120
56	Non-Associated	314913	6206182	29	Compliant	T13	6100	120
57	Non-Associated	315169	6206334	29	Compliant	T13	6000	125
58	Non-Associated	314945	6203986	29	Compliant	T13	5300	100
59	Non-Associated	316285	6203701	31	Compliant	T13	4000	100
60	Non-Associated	316133	6202968	31	Compliant	T19	4000	100
61	Non-Associated	315845	6202465	31	Compliant	T24	4100	105
62	Non-Associated	314649	6201555	29	Compliant	T24	5200	90
63	Non-Associated	321440	6211313	26	Compliant	T1	6500	160
66	Non-Associated	328249	6207469	26	Compliant	T2	5100	240
67	Non-Associated	329079	6205727	27	Compliant	T7	5200	245
68	Non-Associated	330079	6207149	25	Compliant	T2	6700	250

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Predicted Noise Level @13m/s HH Wind Speed [dB(A)]	Compliance	Closest Turbine	Approximate Distance to Closest Turbine (m)	Approximate Direction to Closest Turbine
		Easting	Northing					
69	Non-Associated	328912	6206433	27	Compliant	T2	5300	250
70	Non-Associated	327001	6207829	27	Compliant	T2	4400	225
71	Non-Associated	317366	6208478	28	Compliant	T13	6100	150
72	Non-Associated	319006	6208941	29	Compliant	T3	5600	145
75	Non-Associated	321830	6206405	37	Compliant	T3	2000	170
76	Non-Associated	324379	6207966	32	Compliant	T1	2900	200
77	Non-Associated	324320	6207653	33	Compliant	T1	2600	200
78	Non-Associated	323818	6210616	28	Compliant	T1	5500	185
79	Non-Associated	323873	6210441	28	Compliant	T1	5300	185
80	Non-Associated	324097	6210418	27	Compliant	T1	5300	185
87	Non-Associated	328452	6199011	26	Compliant	T23	5800	300
108	Non-Associated	328227	6196021	25	Compliant	T38	6700	300
109	Non-Associated	328868	6196628	25	Compliant	T38	7000	290
110	Non-Associated	328765	6196749	25	Compliant	T38	6900	290
111	Non-Associated	327910	6197263	26	Compliant	T38	5900	290
112	Non-Associated	325928	6196512	29	Compliant	T38	4500	305
113	Non-Associated	323876	6195866	30	Compliant	T38	3700	335
114	Non-Associated	316390	6196126	28	Compliant	T42	5100	60
115	Non-Associated	323124	6196480	31	Compliant	T38	2900	345
116	Non-Associated	323256	6196546	31	Compliant	T38	2800	340
117	Non-Associated	321750	6197065	36	Compliant	T41	2000	355
121	Non-Associated	316698	6201396	33	Compliant	T24	3200	90
123	Non-Associated	324465	6199580	37	Compliant	T33	2100	295
124	Non-Associated	324921	6199805	36	Compliant	T29	2400	305

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Predicted Noise Level @13m/s HH Wind Speed [dB(A)]	Compliance	Closest Turbine	Approximate Distance to Closest Turbine (m)	Approximate Direction to Closest Turbine
		Easting	Northing					
125	Non-Associated	324704	6200152	38	Compliant	T29	2000	300
129	Non-Associated	330007	6201895	25	Compliant	T7	5900	285
130	Non-Associated	329866	6203188	25	Compliant	T7	5600	275
131	Non-Associated	324533	6197985	34	Compliant	T38	2500	300
132	Non-Associated	324698	6197761	33	Compliant	T38	2800	300
133	Non-Associated	319433	6210179	28	Compliant	T3	6400	155
134	Non-Associated	319393	6209917	27	Compliant	T3	6200	155
135	Non-Associated	319245	6209852	28	Compliant	T3	6200	150
138	Non-Associated	329172	6197743	25	Compliant	T38	7000	280
148	Non-Associated	319669	6207310	32	Compliant	T3	3900	140
149	Non-Associated	314445	6202336	29	Compliant	T24	5500	100
150	Non-Associated	316224	6203117	31	Compliant	T19	3900	100
158	Non-Associated	328914	6196750	25	Compliant	T38	7000	290
159	Non-Associated	328900	6196737	25	Compliant	T38	7000	290
165	Non-Associated	329283	6197521	25	Compliant	T38	7100	285
168	Non-Associated	325069	6195084	28	Compliant	T38	5000	325
169	Non-Associated	324942	6195205	28	Compliant	T38	4800	325
170	Non-Associated	324876	6195388	29	Compliant	T38	4600	325
171	Non-Associated	324384	6194580	28	Compliant	T38	5100	335
172	Non-Associated	322403	6193774	27	Compliant	T42	5300	340
173	Non-Associated	322166	6193978	27	Compliant	T42	5000	345
174	Non-Associated	322377	6195495	30	Compliant	T41	3700	345
177	Non-Associated	316423	6203609	32	Compliant	T13	3800	95
178	Non-Associated	319884	6195267	29	Compliant	T42	3600	15

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Predicted Noise Level @13m/s HH Wind Speed [dB(A)]	Compliance	Closest Turbine	Approximate Distance to Closest Turbine (m)	Approximate Direction to Closest Turbine
		Easting	Northing					
179	Non-Associated	320076	6195303	30	Compliant	T42	3600	10
180	Non-Associated	325159	6199502	35	Compliant	T33	2700	290
181	Non-Associated	323623	6197004	33	Compliant	T38	2600	330
182	Non-Associated	323772	6197057	33	Compliant	T38	2600	325
183	Non-Associated	323773	6196905	33	Compliant	T38	2700	330
184	Non-Associated	322571	6195278	29	Compliant	T41	3900	345
185	Non-Associated	322560	6194278	28	Compliant	T42	4900	340
186	Non-Associated	323539	6196728	33	Compliant	T38	2800	335
187	Non-Associated	326433	6207948	28	Compliant	T1	4100	225
212	Non-Associated	325385	6194799	27	Compliant	T38	5400	325
213	Non-Associated	325861	6194403	26	Compliant	T38	6000	325
214	Non-Associated	325870	6194335	26	Compliant	T38	6000	325

APPENDIX D: PLANNING AND DESIGN CODE

PART 4 – GENERAL DEVELOPMENT POLICIES

Infrastructure and Renewable Energy Facilities

Desired Outcome (DO)

DO 1 *Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.*

Performance Outcome	Deemed-to-Satisfy Criteria / Designated Performance Feature
General Land Use Compatibility	
PO 1.1 Development is located and designed to minimise hazard or nuisance to adjacent development and land uses.	DTS/DPF 1.1 None are applicable.

Interface between Land Uses

Desired Outcome (DO)

DO 1 *Development is located and designed to mitigate adverse effects on or from neighbouring and proximate land uses.*

Performance Outcome	Deemed-to-Satisfy Criteria / Designated Performance Feature
General Land Use Compatibility	
PO 1.2 Development adjacent to a site containing a sensitive receiver (or lawfully approved sensitive receiver) or zone primarily intended to accommodate sensitive receivers is designed to minimise adverse impacts.	DTS/DPF 1.2 None are applicable.
Activities Generating Noise or Vibration	
PO 4.1 Development that emits noise (other than music) does not unreasonably impact the amenity of sensitive receivers (or lawfully approved sensitive receivers).	DTS/DPF 4.1 Noise that affects sensitive receivers achieves the relevant Environment Protection (Noise) Policy criteria.

APPENDIX E: PHOTOGRAPHS OF EQUIPMENT AT MONITORING LOCATIONS

Figure 6: Noise logging equipment at location H5

Figure 7: Noise logging equipment at location H18

Figure 8: Noise logging equipment at location H77

Figure 9: Noise logging equipment at location H119

Figure 10: Noise logging equipment at location H122

Figure 11: Noise logging equipment at location H125

Figure 12: Noise logging equipment at location H147

APPENDIX F: BACKGROUND MONITORING CORRELATIONS

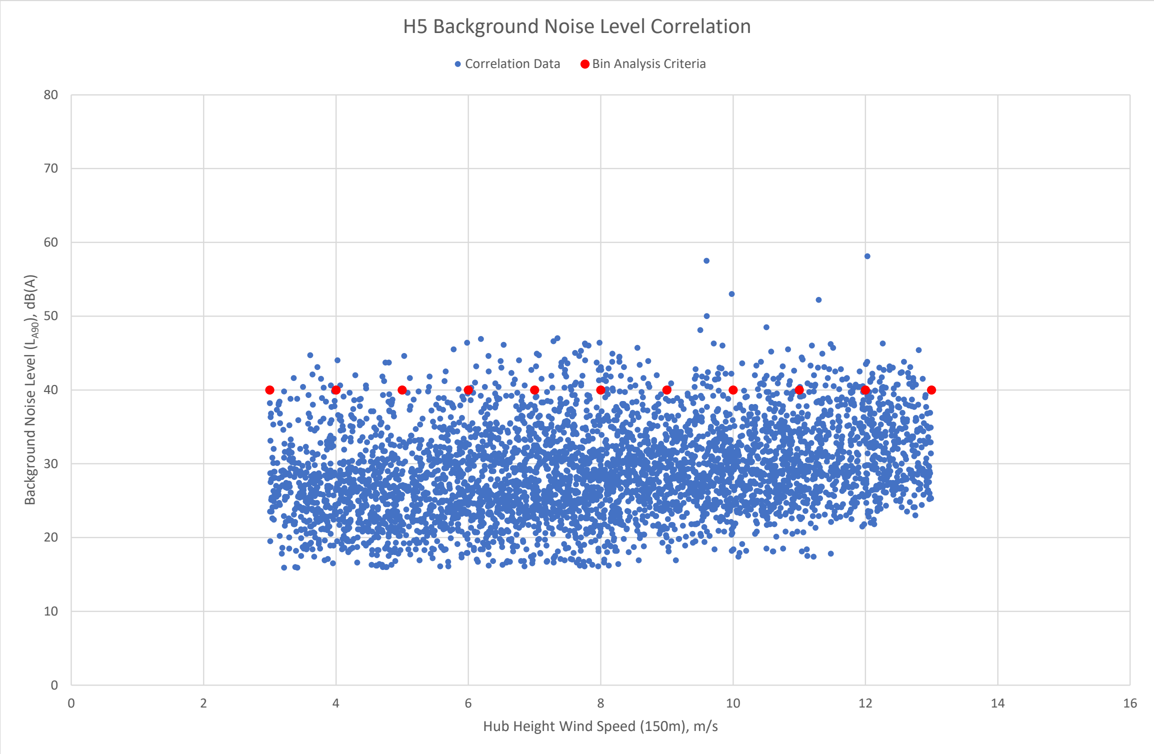

Figure 13: H5 Background Noise Level Correlations

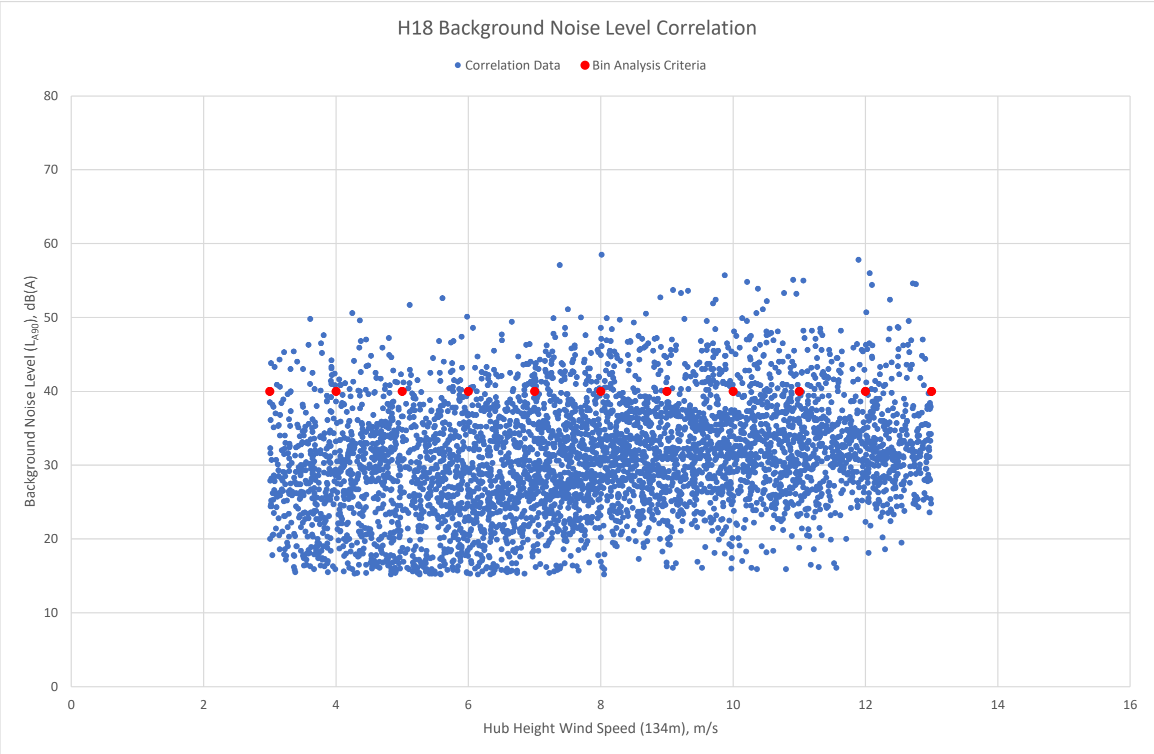

Figure 14: H18 Background Noise Level Correlations

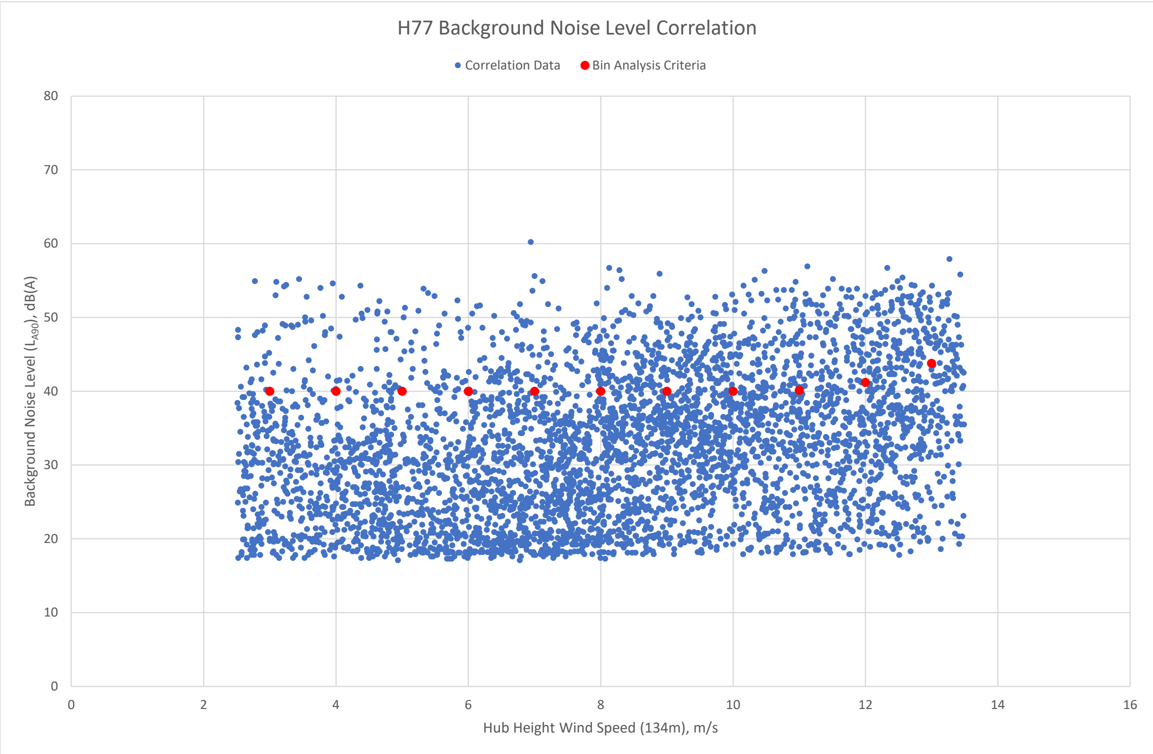

Figure 15: H77 Background Noise Correlation

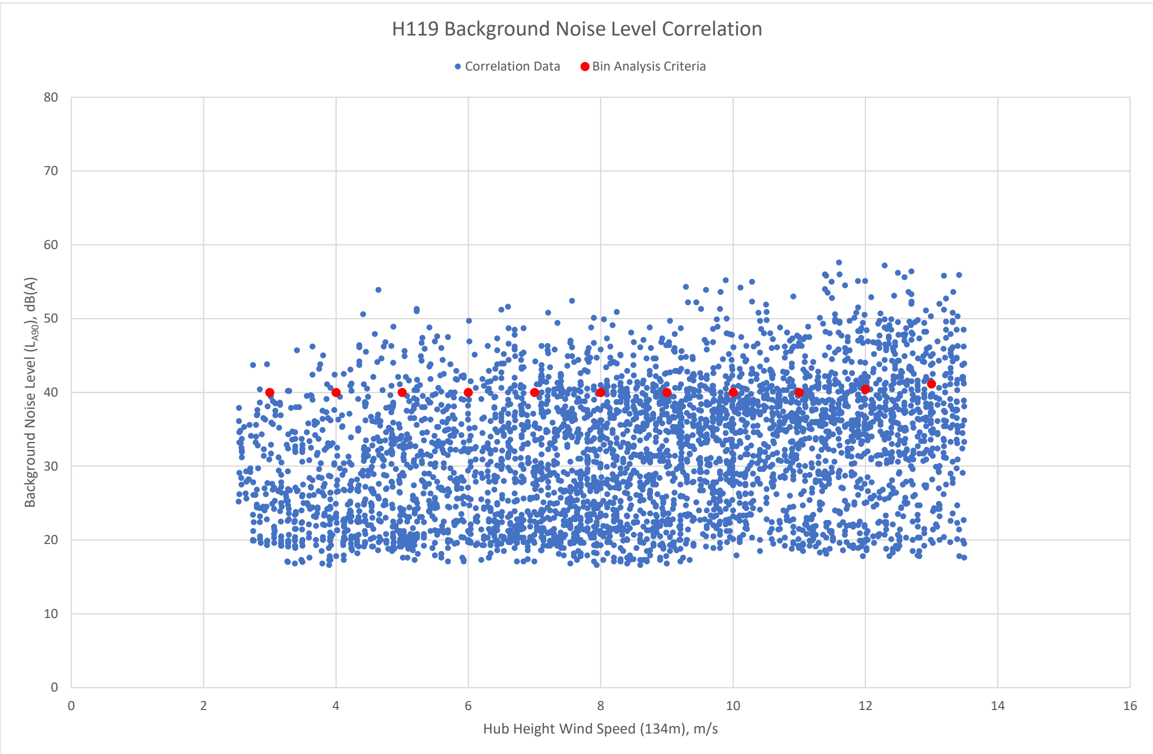

Figure 16: H119 Background Noise Correlations

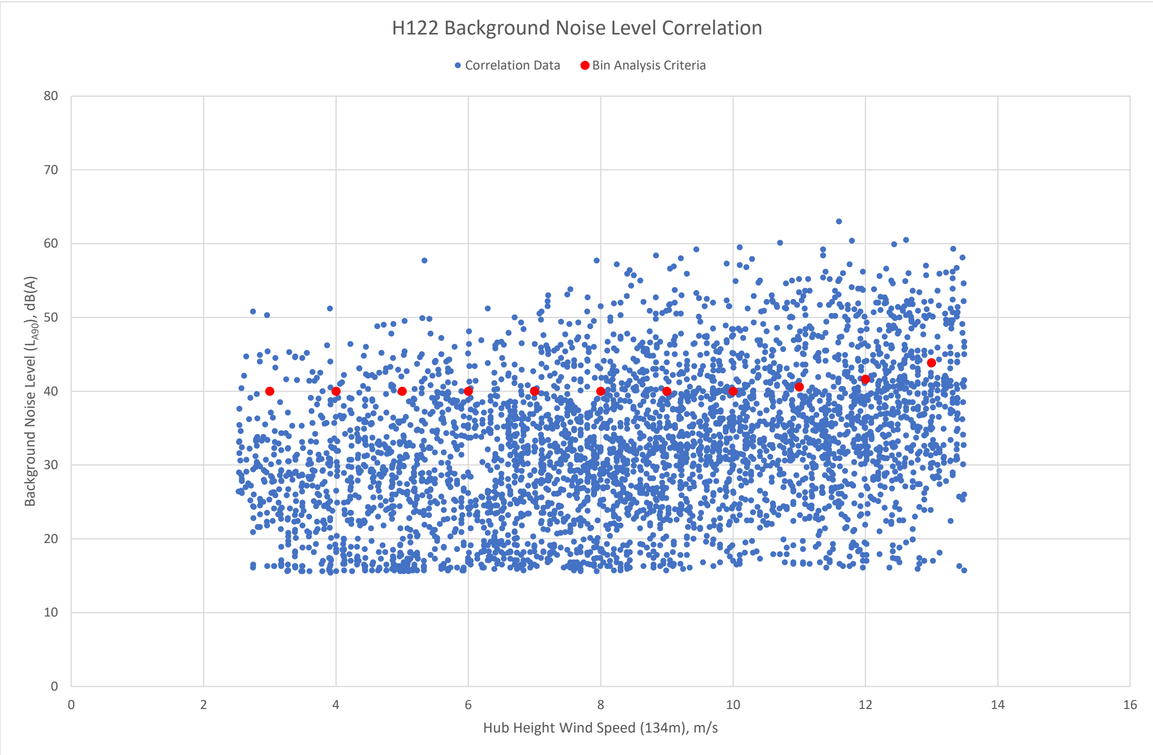

Figure 17: H122 Background Noise Correlations

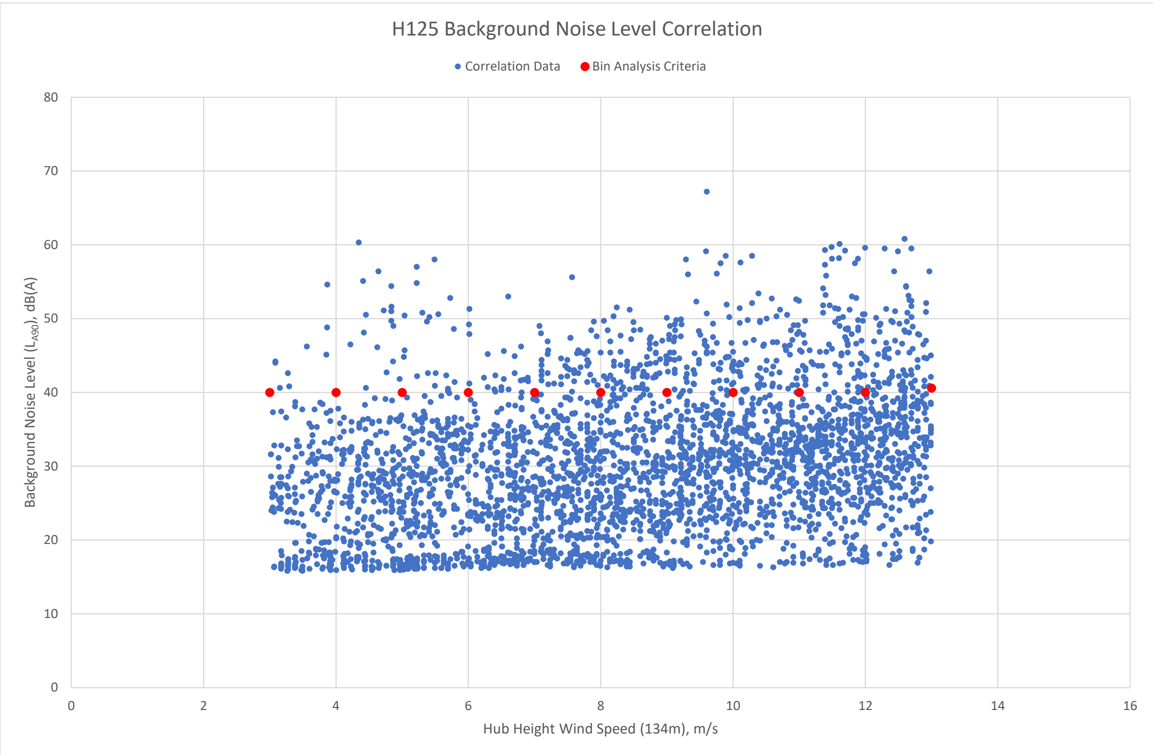

Figure 18: H125 Background Noise Correlations

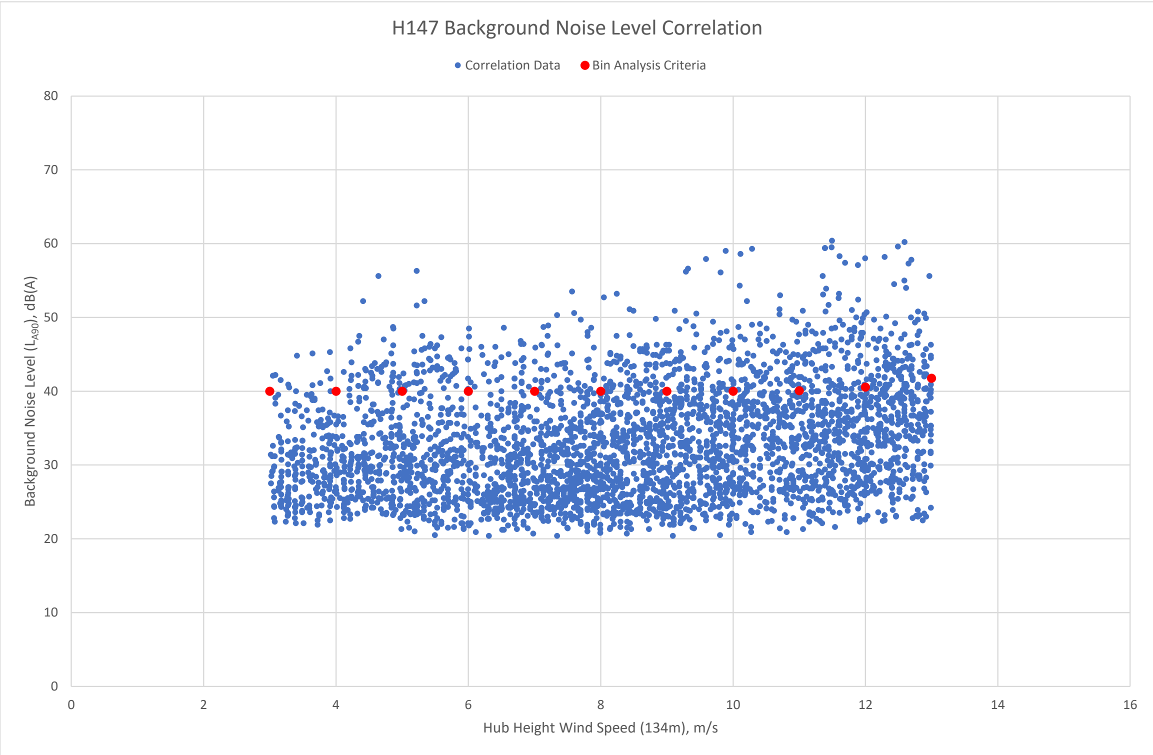

Figure 19: H147 Background Noise Correlations

APPENDIX G: ASSESSMENT CRITERIA

Table 8: Assessment Criteria

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria [dB(A)] for each integer hub height wind speed (m/s).										
		Easting	Northing	3	4	5	6	7	8	9	10	11	12	13
14	Associated	323507	6197563	45	45	45	45	45	45	45	45	45	45	45
21	Associated	321390	6210185	45	45	45	45	45	45	45	45	45	45	45
73	Associated	319843	6205696	45	45	45	45	45	45	45	45	45	45	45
118	Associated	318374	6200027	45	45	45	45	45	45	45	45	45	45	45
119	Associated	318462	6200062	45	45	45	45	45	45	45	45	45	45	45
120	Associated	318362	6200119	45	45	45	45	45	45	45	45	45	45	45
122	Associated	322874	6198829	45	45	45	45	45	45	45	45	45	45	45
147	Associated	319969	6205165	45	45	45	45	45	45	45	45	45	45	45
151	Associated	320252	6205722	45	45	45	45	45	45	45	45	45	45	45
3	Non-Associated	317966	6209162	40	40	40	40	40	40	40	40	40	40	40
5	Non-Associated	318425	6204359	40	40	40	40	40	40	40	40	40	40	40
6	Non-Associated	317441	6204023	40	40	40	40	40	40	40	40	40	40	40
7	Non-Associated	314690	6200064	40	40	40	40	40	40	40	40	40	40	40
8	Non-Associated	317532	6197178	40	40	40	40	40	40	40	40	40	40	40
9	Non-Associated	324339	6199469	40	40	40	40	40	40	40	40	40	40	40
11	Non-Associated	315260	6200442	40	40	40	40	40	40	40	40	40	40	40
15	Non-Associated	321443	6211068	40	40	40	40	40	40	40	40	40	40	40
17	Non-Associated	316653	6209849	40	40	40	40	40	40	40	40	40	40	40
18	Non-Associated	326591	6204222	40	40	40	40	40	40	40	40	40	40	40
19	Non-Associated	319693	6211627	40	40	40	40	40	40	40	40	40	40	40

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ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria [dB(A)] for each integer hub height wind speed (m/s).										
		Easting	Northing	3	4	5	6	7	8	9	10	11	12	13
22	Non-Associated	316087	6197701	40	40	40	40	40	40	40	40	40	40	40
23	Non-Associated	319090	6211336	40	40	40	40	40	40	40	40	40	40	40
25	Non-Associated	317428	6198149	40	40	40	40	40	40	40	40	40	40	40
26	Non-Associated	330378	6205007	40	40	40	40	40	40	40	40	40	40	40
27	Non-Associated	316856	6202618	40	40	40	40	40	40	40	40	40	40	40
28	Non-Associated	316348	6204184	40	40	40	40	40	40	40	40	40	40	40
29	Non-Associated	317896	6207851	40	40	40	40	40	40	40	40	40	40	40
30	Non-Associated	316038	6210298	40	40	40	40	40	40	40	40	40	40	40
31	Non-Associated	319234	6211695	40	40	40	40	40	40	40	40	40	40	40
32	Non-Associated	314980	6201698	40	40	40	40	40	40	40	40	40	40	40
33	Non-Associated	318887	6210081	40	40	40	40	40	40	40	40	40	40	40
35	Non-Associated	318683	6213276	40	40	40	40	40	40	40	40	40	40	40
39	Non-Associated	323271	6212624	40	40	40	40	40	40	40	40	40	40	40
51	Non-Associated	320282	6212500	40	40	40	40	40	40	40	40	40	40	40
52	Non-Associated	319846	6212278	40	40	40	40	40	40	40	40	40	40	40
53	Non-Associated	319737	6212327	40	40	40	40	40	40	40	40	40	40	40
54	Non-Associated	314685	6206976	40	40	40	40	40	40	40	40	40	40	40
55	Non-Associated	314798	6206455	40	40	40	40	40	40	40	40	40	40	40
56	Non-Associated	314913	6206182	40	40	40	40	40	40	40	40	40	40	40

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria [dB(A)] for each integer hub height wind speed (m/s).										
		Easting	Northing	3	4	5	6	7	8	9	10	11	12	13
57	Non-Associated	315169	6206334	40	40	40	40	40	40	40	40	40	40	40
58	Non-Associated	314945	6203986	40	40	40	40	40	40	40	40	40	40	40
59	Non-Associated	316285	6203701	40	40	40	40	40	40	40	40	40	40	40
60	Non-Associated	316133	6202968	40	40	40	40	40	40	40	40	40	40	40
61	Non-Associated	315845	6202465	40	40	40	40	40	40	40	40	40	40	40
62	Non-Associated	314649	6201555	40	40	40	40	40	40	40	40	40	40	40
63	Non-Associated	321440	6211313	40	40	40	40	40	40	40	40	40	40	40
66	Non-Associated	328249	6207469	40	40	40	40	40	40	40	40	40	40	40
67	Non-Associated	329079	6205727	40	40	40	40	40	40	40	40	40	40	40
68	Non-Associated	330079	6207149	40	40	40	40	40	40	40	40	40	40	40
69	Non-Associated	328912	6206433	40	40	40	40	40	40	40	40	40	40	40
70	Non-Associated	327001	6207829	40	40	40	40	40	40	40	40	40	40	40
71	Non-Associated	317366	6208478	40	40	40	40	40	40	40	40	40	40	40
72	Non-Associated	319006	6208941	40	40	40	40	40	40	40	40	40	40	40
75	Non-Associated	321830	6206405	40	40	40	40	40	40	40	40	40	40	40
76	Non-Associated	324379	6207966	40	40	40	40	40	40	40	40	40	40	40
77	Non-Associated	324320	6207653	40	40	40	40	40	40	40	40	40	41	44
78	Non-Associated	323818	6210616	40	40	40	40	40	40	40	40	40	40	40
79	Non-Associated	323873	6210441	40	40	40	40	40	40	40	40	40	40	40

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria [dB(A)] for each integer hub height wind speed (m/s).										
		Easting	Northing	3	4	5	6	7	8	9	10	11	12	13
80	Non-Associated	324097	6210418	40	40	40	40	40	40	40	40	40	40	40
87	Non-Associated	328452	6199011	40	40	40	40	40	40	40	40	40	40	40
108	Non-Associated	328227	6196021	40	40	40	40	40	40	40	40	40	40	40
109	Non-Associated	328868	6196628	40	40	40	40	40	40	40	40	40	40	40
110	Non-Associated	328765	6196749	40	40	40	40	40	40	40	40	40	40	40
111	Non-Associated	327910	6197263	40	40	40	40	40	40	40	40	40	40	40
112	Non-Associated	325928	6196512	40	40	40	40	40	40	40	40	40	40	40
113	Non-Associated	323876	6195866	40	40	40	40	40	40	40	40	40	40	40
114	Non-Associated	316390	6196126	40	40	40	40	40	40	40	40	40	40	40
115	Non-Associated	323124	6196480	40	40	40	40	40	40	40	40	40	40	40
116	Non-Associated	323256	6196546	40	40	40	40	40	40	40	40	40	40	40
117	Non-Associated	321750	6197065	40	40	40	40	40	40	40	40	40	40	40
121	Non-Associated	316698	6201396	40	40	40	40	40	40	40	40	40	40	40
123	Non-Associated	324465	6199580	40	40	40	40	40	40	40	40	40	40	40
124	Non-Associated	324921	6199805	40	40	40	40	40	40	40	40	40	40	40
125	Non-Associated	324704	6200152	40	40	40	40	40	40	40	40	40	40	41
129	Non-Associated	330007	6201895	40	40	40	40	40	40	40	40	40	40	40
130	Non-Associated	329866	6203188	40	40	40	40	40	40	40	40	40	40	40
131	Non-Associated	324533	6197985	40	40	40	40	40	40	40	40	40	40	40

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ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria [dB(A)] for each integer hub height wind speed (m/s).										
		Easting	Northing	3	4	5	6	7	8	9	10	11	12	13
132	Non-Associated	324698	6197761	40	40	40	40	40	40	40	40	40	40	40
133	Non-Associated	319433	6210179	40	40	40	40	40	40	40	40	40	40	40
134	Non-Associated	319393	6209917	40	40	40	40	40	40	40	40	40	40	40
135	Non-Associated	319245	6209852	40	40	40	40	40	40	40	40	40	40	40
138	Non-Associated	329172	6197743	40	40	40	40	40	40	40	40	40	40	40
148	Non-Associated	319669	6207310	40	40	40	40	40	40	40	40	40	40	40
149	Non-Associated	314445	6202336	40	40	40	40	40	40	40	40	40	40	40
150	Non-Associated	316224	6203117	40	40	40	40	40	40	40	40	40	40	40
158	Non-Associated	328914	6196750	40	40	40	40	40	40	40	40	40	40	40
159	Non-Associated	328900	6196737	40	40	40	40	40	40	40	40	40	40	40
165	Non-Associated	329283	6197521	40	40	40	40	40	40	40	40	40	40	40
168	Non-Associated	325069	6195084	40	40	40	40	40	40	40	40	40	40	40
169	Non-Associated	324942	6195205	40	40	40	40	40	40	40	40	40	40	40
170	Non-Associated	324876	6195388	40	40	40	40	40	40	40	40	40	40	40
171	Non-Associated	324384	6194580	40	40	40	40	40	40	40	40	40	40	40
172	Non-Associated	322403	6193774	40	40	40	40	40	40	40	40	40	40	40
173	Non-Associated	322166	6193978	40	40	40	40	40	40	40	40	40	40	40
174	Non-Associated	322377	6195495	40	40	40	40	40	40	40	40	40	40	40
177	Non-Associated	316423	6203609	40	40	40	40	40	40	40	40	40	40	40

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria [dB(A)] for each integer hub height wind speed (m/s).										
		Easting	Northing	3	4	5	6	7	8	9	10	11	12	13
178	Non-Associated	319884	6195267	40	40	40	40	40	40	40	40	40	40	40
179	Non-Associated	320076	6195303	40	40	40	40	40	40	40	40	40	40	40
180	Non-Associated	325159	6199502	40	40	40	40	40	40	40	40	40	40	40
181	Non-Associated	323623	6197004	40	40	40	40	40	40	40	40	40	40	40
182	Non-Associated	323772	6197057	40	40	40	40	40	40	40	40	40	40	40
183	Non-Associated	323773	6196905	40	40	40	40	40	40	40	40	40	40	40
184	Non-Associated	322571	6195278	40	40	40	40	40	40	40	40	40	40	40
185	Non-Associated	322560	6194278	40	40	40	40	40	40	40	40	40	40	40
186	Non-Associated	323539	6196728	40	40	40	40	40	40	40	40	40	40	40
187	Non-Associated	326433	6207948	40	40	40	40	40	40	40	40	40	40	40
212	Non-Associated	325385	6194799	40	40	40	40	40	40	40	40	40	40	40
213	Non-Associated	325861	6194403	40	40	40	40	40	40	40	40	40	40	40
214	Non-Associated	325870	6194335	40	40	40	40	40	40	40	40	40	40	40

APPENDIX H: VESTAS V172-7.2MW SOUND POWER LEVELS

	Sound Power Levels [dB(A)] for each hub height wind speed												
Frequency	**3 m/s**	**4 m/s**	**5 m/s**	**6 m/s**	**7 m/s**	**8 m/s**	**9 m/s**	**10 m/s**	**11 m/s**	**12 m/s**	**13 m/s**	**14 m/s**	**15 m/s**
6.3 Hz	22.2	21.9	18.7	20.4	24.7	28.4	30.0	30.5	31.2	32.6	33.1	32.9	32.3
8 Hz	28.5	28.3	25.5	27.4	31.6	35.3	36.8	37.3	38.0	39.2	39.6	39.5	38.9
10 Hz	34.5	34.4	31.9	34.0	38.2	41.8	43.3	43.7	44.4	45.4	45.8	45.6	45.2
12.5 Hz	40.2	40.1	38.0	40.2	44.3	47.9	49.5	49.8	50.4	51.3	51.6	51.5	51.0
16 Hz	45.9	45.8	44.1	46.0	50.1	53.7	55.2	55.5	56.0	56.8	57.1	57.0	56.6
20 Hz	51.3	51.2	49.8	51.9	55.9	59.1	60.6	60.9	61.3	62.0	62.2	62.1	61.7
25 Hz	56.7	56.6	55.5	57.4	61.4	64.5	66.0	66.2	66.6	67.2	67.4	67.2	66.9
31.5 Hz	61.6	61.6	60.7	62.8	66.8	69.5	71.0	71.2	71.5	72.0	72.2	72.1	71.8
40 Hz	66.1	66.0	65.4	67.8	71.7	74.5	76.0	76.1	76.4	76.8	76.9	76.8	76.6
50 Hz	70.0	70.0	69.6	72.2	76.1	79.0	80.5	80.6	80.8	81.2	81.3	81.2	81.0
63 Hz	73.4	73.4	73.2	76.1	80.0	83.1	84.5	84.6	84.8	85.0	85.1	85.0	84.8
80 Hz	76.2	76.3	76.3	79.4	83.3	86.5	87.9	88.0	88.1	88.3	88.4	88.3	88.2
100 Hz	78.5	78.6	78.8	82.2	86.0	89.4	90.8	90.9	91.0	91.1	91.1	91.1	90.9
125 Hz	80.3	80.4	80.7	84.4	88.1	91.7	93.1	93.1	93.2	93.3	93.3	93.3	93.2
160 Hz	81.7	81.7	82.1	86.0	89.7	93.5	94.8	94.9	94.9	95.0	94.9	94.9	94.8
200 Hz	82.5	82.6	83.1	87.1	90.8	94.7	96.0	96.0	96.1	96.1	96.1	96.0	96.0
250 Hz	83.4	83.5	84.1	87.7	91.4	95.4	96.7	96.7	96.7	96.7	96.7	96.6	96.6
315 Hz	83.9	84.0	84.7	88.3	92.0	95.6	96.9	96.9	96.9	96.8	96.8	96.8	96.8
400 Hz	84.5	84.5	85.3	88.6	92.2	95.7	97.1	97.0	97.0	97.0	96.9	96.9	96.9
500 Hz	84.7	84.8	85.5	88.8	92.4	95.5	96.8	96.8	96.8	96.7	96.7	96.7	96.7
630 Hz	84.6	84.7	85.4	88.7	92.2	95.4	96.6	96.6	96.6	96.5	96.5	96.5	96.6
800 Hz	84.2	84.2	84.9	88.2	91.7	94.8	96.1	96.1	96.0	96.0	96.0	96.0	96.1
1 kHz	83.4	83.4	84.1	87.3	90.8	93.9	95.1	95.1	95.1	95.1	95.1	95.1	95.2
1.25 kHz	82.3	82.2	82.9	86.0	89.5	92.6	93.8	93.8	93.8	93.8	93.8	93.9	93.9
1.6 kHz	80.8	80.8	81.3	84.4	87.9	90.9	92.1	92.1	92.1	92.2	92.2	92.3	92.4
2 kHz	79.0	78.9	79.4	82.4	85.9	88.9	90.1	90.1	90.1	90.2	90.3	90.3	90.4
2.5 kHz	76.9	76.8	77.1	80.1	83.5	86.5	87.7	87.7	87.7	87.8	88.0	88.0	88.1
3.15 kHz	74.4	74.2	74.4	77.3	80.7	83.7	84.9	84.9	85.0	85.1	85.3	85.4	85.5
4 kHz	71.6	71.4	71.4	74.2	77.6	80.6	81.7	81.8	81.9	82.1	82.3	82.4	82.5
5 kHz	68.5	68.2	68.0	70.7	74.1	77.0	78.2	78.2	78.4	78.7	78.9	79.0	79.1
6.3 kHz	65.0	64.6	64.3	66.8	70.2	73.1	74.3	74.3	74.5	74.9	75.2	75.3	75.4
8 kHz	61.1	60.8	60.2	62.6	65.9	68.9	70.0	70.1	70.3	70.8	71.1	71.2	71.3
10 kHz	57.0	56.5	55.7	58.0	61.3	64.2	65.3	65.5	65.7	66.3	66.7	66.8	66.9
12.5 kHz	52.4	52.0	50.9	53.0	56.3	59.2	60.3	60.5	60.8	61.4	61.9	62.0	62.1
16 kHz	47.6	47.0	45.7	47.7	50.9	53.9	54.9	55.1	55.5	56.2	56.7	56.9	56.9
Total	94.6	94.6	95.2	98.6	102.2	105.6	106.9	106.9	106.9	106.9	106.9	106.9	106.9

APPENDIX I: ANCILLARY INFRASTRUCTURE SOUND POWER LEVELS

Table 9: Transformer sound power levels.

Transformer Rating	SWL (dB(A)) for each Octave Band Centre Frequency							Total SWL (dB(A))
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	
150 MVA	76	84	91	94	86	83	76	**96**
300 MVA	80	88	95	98	90	87	80	**101**

Table 10: BESS and PCS Sound Power Levels

1/3 Octave Band Centre Frequency (Hz)	Battery Sound Power Level per Unit (dB(A))	Power Conversion Sound Power Level per Unit (dB(A))
50	53	58
63	59	54
80	63	59
100	68	64
125	77	63
160	80	65
200	78	66
250	75	72
315	75	78
400	77	90
500	77	81
630	79	80
800	82	82
1000	82	77
1250	82	77
1600	80	77
2000	79	76
2500	77	78
3150	75	82
4000	72	72
5000	69	85
6300	65	80
8000	59	77
10000	56	76
Total	**91**	**94**

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APPENDIX J: WIND TURBINE GENERATOR PREDICTED NOISE LEVELS

Table 11: Wind Turbine Generator Predictions

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria and Predictions [dB(A)] for each integer hub height wind speed (m/s).																					
				3		4		5		6		7		8		9		10		11		12		13	
		Easting	Northing	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction
14	Associated	323507	6197563	45	22	45	22	45	22	45	26	45	29	45	33	45	34	45	34	45	34	45	34	45	34
21	Associated	321390	6210185	45	< 20	45	< 20	45	< 20	45	< 20	45	21	45	24	45	25	45	25	45	26	45	26	45	26
73	Associated	319843	6205696	45	23	45	23	45	23	45	27	45	30	45	34	45	35	45	35	45	35	45	35	45	35
118	Associated	318374	6200027	45	24	45	24	45	25	45	28	45	32	45	36	45	37	45	37	45	37	45	37	45	37
119	Associated	318462	6200062	45	25	45	25	45	25	45	29	45	32	45	36	45	37	45	37	45	37	45	37	45	37
120	Associated	318362	6200119	45	24	45	24	45	25	45	28	45	32	45	36	45	37	45	37	45	37	45	37	45	37
122	Associated	322874	6198829	45	31	45	31	45	31	45	35	45	38	45	42	45	43	45	43	45	43	45	43	45	43
147	Associated	319969	6205165	45	24	45	25	45	25	45	29	45	32	45	36	45	37	45	37	45	37	45	37	45	37
151	Associated	320252	6205722	45	23	45	23	45	24	45	27	45	31	45	35	45	36	45	36	45	36	45	36	45	36
3	Non-Associated	317966	6209162	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	27	40	27
5	Non-Associated	318425	6204359	40	23	40	23	40	24	40	27	40	31	40	34	40	36	40	36	40	36	40	36	40	36
6	Non-Associated	317441	6204023	40	21	40	21	40	22	40	25	40	29	40	32	40	34	40	34	40	34	40	34	40	34
7	Non-Associated	314690	6200064	40	< 20	40	< 20	40	< 20	40	21	40	25	40	28	40	29	40	29	40	30	40	30	40	30
8	Non-Associated	317532	6197178	40	< 20	40	< 20	40	< 20	40	22	40	25	40	29	40	30	40	30	40	30	40	31	40	31
9	Non-Associated	324339	6199469	40	25	40	25	40	26	40	29	40	33	40	36	40	38	40	38	40	38	40	38	40	38
11	Non-Associated	315260	6200442	40	< 20	40	< 20	40	< 20	40	21	40	25	40	28	40	30	40	30	40	30	40	30	40	30
15	Non-Associated	321443	6211068	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	25	40	26	40	26	40	26	40	26	40	26
17	Non-Associated	316653	6209849	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	25	40	26	40	26	40	26	40	26	40	26
18	Non-Associated	326591	6204222	40	22	40	22	40	22	40	26	40	29	40	33	40	34	40	34	40	34	40	34	40	34
19	Non-Associated	319693	6211627	40	< 20	40	< 20	40	< 20	40	< 20	40	20	40	24	40	25	40	25	40	25	40	25	40	25
22	Non-Associated	316087	6197701	40	< 20	40	< 20	40	< 20	40	20	40	24	40	27	40	29	40	29	40	29	40	29	40	29
23	Non-Associated	319090	6211336	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	24	40	26	40	26	40	26	40	26	40	26
25	Non-Associated	317428	6198149	40	< 20	40	< 20	40	< 20	40	23	40	27	40	30	40	32	40	32	40	32	40	32	40	32

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ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria and Predictions [dB(A)] for each integer hub height wind speed (m/s).																					
		Easting	Northing	3		4		5		6		7		8		9		10		11		12		13	
				Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction
26	Non-Associated	330378	6205007	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	25	40	25	40	25	40	25	40	25
27	Non-Associated	316856	6202618	40	20	40	20	40	21	40	24	40	28	40	32	40	33	40	33	40	33	40	33	40	33
28	Non-Associated	316348	6204184	40	< 20	40	< 20	40	< 20	40	23	40	26	40	30	40	31	40	31	40	31	40	32	40	32
29	Non-Associated	317896	6207851	40	< 20	40	< 20	40	< 20	40	21	40	25	40	29	40	30	40	30	40	30	40	30	40	30
30	Non-Associated	316038	6210298	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	24	40	26	40	26	40	26	40	26	40	26
31	Non-Associated	319234	6211695	40	< 20	40	< 20	40	< 20	40	< 20	40	20	40	24	40	25	40	25	40	25	40	26	40	26
32	Non-Associated	314980	6201698	40	< 20	40	< 20	40	< 20	40	21	40	24	40	28	40	29	40	29	40	29	40	29	40	29
33	Non-Associated	318887	6210081	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	26	40	27	40	28	40	28	40	28	40	28
35	Non-Associated	318683	6213276	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	25	40	25	40	25	40	25	40	25
39	Non-Associated	323271	6212624	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	24	40	24	40	24
51	Non-Associated	320282	6212500	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	24	40	25	40	25
52	Non-Associated	319846	6212278	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	24	40	24	40	24
53	Non-Associated	319737	6212327	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	24	40	25	40	25
54	Non-Associated	314685	6206976	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	27	40	27
55	Non-Associated	314798	6206455	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	27	40	28	40	28	40	28	40	28	40	28
56	Non-Associated	314913	6206182	40	< 20	40	< 20	40	< 20	40	20	40	24	40	27	40	29	40	29	40	29	40	29	40	29
57	Non-Associated	315169	6206334	40	< 20	40	< 20	40	< 20	40	20	40	24	40	27	40	29	40	29	40	29	40	29	40	29
58	Non-Associated	314945	6203986	40	< 20	40	< 20	40	< 20	40	20	40	24	40	27	40	29	40	29	40	29	40	29	40	29
59	Non-Associated	316285	6203701	40	< 20	40	< 20	40	< 20	40	23	40	26	40	30	40	31	40	31	40	31	40	31	40	31
60	Non-Associated	316133	6202968	40	< 20	40	< 20	40	< 20	40	23	40	26	40	30	40	31	40	31	40	31	40	31	40	31
61	Non-Associated	315845	6202465	40	< 20	40	< 20	40	< 20	40	23	40	26	40	30	40	31	40	31	40	31	40	31	40	31
62	Non-Associated	314649	6201555	40	< 20	40	< 20	40	< 20	40	20	40	24	40	28	40	29	40	29	40	29	40	29	40	29
63	Non-Associated	321440	6211313	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	24	40	26	40	26	40	26	40	26	40	26
66	Non-Associated	328249	6207469	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	24	40	26	40	26	40	26	40	26	40	26
67	Non-Associated	329079	6205727	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	25	40	26	40	26	40	26	40	26	40	26

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria and Predictions [dB(A)] for each integer hub height wind speed (m/s).																					
				3		4		5		6		7		8		9		10		11		12		13	
		Easting	Northing	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction
68	Non-Associated	330079	6207149	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	24	40	25	40	25
69	Non-Associated	328912	6206433	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	25	40	26	40	26	40	26	40	27	40	27
70	Non-Associated	327001	6207829	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	25	40	27	40	27	40	27	40	27	40	27
71	Non-Associated	317366	6208478	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	27	40	28	40	28	40	28	40	28	40	28
72	Non-Associated	319006	6208941	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	27	40	28	40	28	40	28	40	28	40	28
75	Non-Associated	321830	6206405	40	24	40	24	40	24	40	28	40	32	40	35	40	36	40	36	40	36	40	36	40	36
76	Non-Associated	324379	6207966	40	< 20	40	< 20	40	< 20	40	23	40	27	40	30	40	32	40	32	40	32	40	32	40	32
77	Non-Associated	324320	6207653	40	< 20	40	< 20	40	20	40	24	40	28	40	31	40	32	40	32	40	32	41	33	44	33
78	Non-Associated	323818	6210616	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	28	40	28
79	Non-Associated	323873	6210441	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	26	40	27	40	28	40	28	40	28	40	28
80	Non-Associated	324097	6210418	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	27	40	27
87	Non-Associated	328452	6199011	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	25	40	26	40	26	40	26	40	26	40	26
108	Non-Associated	328227	6196021	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	25	40	25	40	25	40	25	40	25
109	Non-Associated	328868	6196628	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	24	40	25	40	25
110	Non-Associated	328765	6196749	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	24	40	25	40	25
111	Non-Associated	327910	6197263	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	24	40	26	40	26	40	26	40	26	40	26
112	Non-Associated	325928	6196512	40	< 20	40	< 20	40	< 20	40	20	40	24	40	28	40	29	40	29	40	29	40	29	40	29
113	Non-Associated	323876	6195866	40	< 20	40	< 20	40	< 20	40	22	40	25	40	29	40	30	40	30	40	30	40	31	40	31
114	Non-Associated	316390	6196126	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	26	40	27	40	28	40	28	40	28	40	28
115	Non-Associated	323124	6196480	40	< 20	40	< 20	40	< 20	40	23	40	27	40	30	40	31	40	31	40	31	40	31	40	31
116	Non-Associated	323256	6196546	40	< 20	40	< 20	40	< 20	40	23	40	26	40	30	40	31	40	31	40	31	40	31	40	31
117	Non-Associated	321750	6197065	40	24	40	24	40	24	40	28	40	31	40	35	40	36	40	36	40	36	40	36	40	36
121	Non-Associated	316698	6201396	40	21	40	21	40	21	40	25	40	28	40	32	40	33	40	33	40	33	40	33	40	33
123	Non-Associated	324465	6199580	40	25	40	25	40	25	40	29	40	33	40	36	40	37	40	37	40	37	40	37	40	37
124	Non-Associated	324921	6199805	40	24	40	24	40	24	40	28	40	31	40	35	40	36	40	36	40	36	40	36	40	36

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria and Predictions [dB(A)] for each integer hub height wind speed (m/s).																					
		Easting	Northing	3		4		5		6		7		8		9		10		11		12		13	
				Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction
125	Non-Associated	324704	6200152	40	25	40	25	40	26	40	29	40	33	40	36	40	38	40	38	40	38	40	38	41	38
129	Non-Associated	330007	6201895	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	25	40	25	40	25	40	25	40	25
130	Non-Associated	329866	6203188	40	< 20	40	< 20	40	< 20	40	< 20	40	20	40	24	40	25	40	25	40	25	40	25	40	25
131	Non-Associated	324533	6197985	40	22	40	22	40	22	40	26	40	29	40	33	40	34	40	34	40	34	40	34	40	34
132	Non-Associated	324698	6197761	40	21	40	21	40	21	40	25	40	28	40	32	40	33	40	33	40	33	40	33	40	33
133	Non-Associated	319433	6210179	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	27	40	27
134	Non-Associated	319393	6209917	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	27	40	27
135	Non-Associated	319245	6209852	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	28	40	28
138	Non-Associated	329172	6197743	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	24	40	25	40	25
148	Non-Associated	319669	6207310	40	< 20	40	< 20	40	< 20	40	23	40	27	40	30	40	32	40	32	40	32	40	32	40	32
149	Non-Associated	314445	6202336	40	< 20	40	< 20	40	< 20	40	20	40	24	40	28	40	29	40	29	40	29	40	29	40	29
150	Non-Associated	316224	6203117	40	< 20	40	< 20	40	< 20	40	23	40	26	40	30	40	31	40	31	40	31	40	31	40	31
158	Non-Associated	328914	6196750	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	25	40	25	40	25
159	Non-Associated	328900	6196737	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	24	40	25	40	25
165	Non-Associated	329283	6197521	40	< 20	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	24	40	24	40	24	40	25	40	25
168	Non-Associated	325069	6195084	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	27	40	28	40	28	40	28	40	28	40	28
169	Non-Associated	324942	6195205	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	27	40	28	40	28	40	28	40	28	40	28
170	Non-Associated	324876	6195388	40	< 20	40	< 20	40	< 20	40	< 20	40	24	40	27	40	29	40	29	40	29	40	29	40	29
171	Non-Associated	324384	6194580	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	26	40	28	40	28	40	28	40	28	40	28
172	Non-Associated	322403	6193774	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	27	40	27
173	Non-Associated	322166	6193978	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	27	40	27
174	Non-Associated	322377	6195495	40	< 20	40	< 20	40	< 20	40	21	40	25	40	29	40	30	40	30	40	30	40	30	40	30
177	Non-Associated	316423	6203609	40	< 20	40	< 20	40	< 20	40	23	40	27	40	30	40	32	40	32	40	32	40	32	40	32
178	Non-Associated	319884	6195267	40	< 20	40	< 20	40	< 20	40	21	40	24	40	28	40	29	40	29	40	29	40	29	40	29
179	Non-Associated	320076	6195303	40	< 20	40	< 20	40	< 20	40	22	40	25	40	29	40	30	40	30	40	30	40	30	40	30

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ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Criteria and Predictions [dB(A)] for each integer hub height wind speed (m/s).																					
				3		4		5		6		7		8		9		10		11		12		13	
		Easting	Northing	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction	Criteria	Prediction
180	Non-Associated	325159	6199502	40	23	40	23	40	23	40	27	40	30	40	34	40	35	40	35	40	35	40	35	40	35
181	Non-Associated	323623	6197004	40	21	40	21	40	21	40	25	40	28	40	32	40	33	40	33	40	33	40	33	40	33
182	Non-Associated	323772	6197057	40	21	40	21	40	21	40	25	40	28	40	32	40	33	40	33	40	33	40	33	40	33
183	Non-Associated	323773	6196905	40	20	40	20	40	21	40	24	40	28	40	32	40	33	40	33	40	33	40	33	40	33
184	Non-Associated	322571	6195278	40	< 20	40	< 20	40	< 20	40	21	40	24	40	28	40	29	40	29	40	29	40	29	40	29
185	Non-Associated	322560	6194278	40	< 20	40	< 20	40	< 20	40	< 20	40	23	40	26	40	28	40	28	40	28	40	28	40	28
186	Non-Associated	323539	6196728	40	< 20	40	20	40	20	40	24	40	28	40	31	40	33	40	33	40	33	40	33	40	33
187	Non-Associated	326433	6207948	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	27	40	27
212	Non-Associated	325385	6194799	40	< 20	40	< 20	40	< 20	40	< 20	40	22	40	26	40	27	40	27	40	27	40	27	40	27
213	Non-Associated	325861	6194403	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	25	40	26	40	26	40	26	40	26	40	26
214	Non-Associated	325870	6194335	40	< 20	40	< 20	40	< 20	40	< 20	40	21	40	25	40	26	40	26	40	26	40	26	40	26

APPENDIX K: ANCILLARY INFRASTRUCTURE PREDICTED NOISE LEVELS

Table 12: Ancillary infrastructure Predictions at closest Residences

ID Code	Associated or Non-Associated	Coordinates (WGS 84 / UTM Zone 54S)		Predicted Noise Level [dB(A)]	Zone	Night Criterion [dB(A)]
		Easting	Northing			
9	Non-Associated	324339	6199469	34	Rural	45
123	Non-Associated	324465	6199580	34	Rural	45
124	Non-Associated	324921	6199805	33	Rural	45
125	Non-Associated	324704	6200152	36	Rural	45
180	Non-Associated	325159	6199502	30	Rural	45

Shadow Flicker Assessment & Blade Glint Assessment

by DNV

TWIN CREEK WIND FARM

Shadow Flicker Assessment and Blade Glint Assessment

RES Australia Pty Limited

Report No.: 10461810-AUMEL-R-01-F
Date: 10 January 2025
Status: Final

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Task and objective:

Wind Farm Shadow Flicker and Blade Glint Assessment

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A	08 Dec 2023	Initial issue – DRAFT	ET	NB	JJ
B	08 Feb 2024	Update to consider revised turbine layout and respond to customer comments	ET	NB	JJ
C	2024-04-19	Update in response to customer comments	ET	NB	NB
D	2024-09-27	Update in response to customer comments	ET	JV	NB
E	2024-10-30	Final status	ET	JV	NB
F	2025-01-10	Update to consider revised site boundary	ET	JV	NB
G	2025-01-10	Final status	ET	JV	NB

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EXECUTIVE SUMMARY

DNV has been commissioned by RES Australia Pty Limited ("the Customer") to independently assess the expected annual shadow flicker durations in the vicinity of the proposed Twin Creek Wind Farm ("the Project") in South Australia. The results of this assessment are described in this document.

Background and methodology

DNV has assessed the expected annual shadow flicker durations for the Project in accordance with the Draft National Wind Farm Development Guidelines [1] (Draft National Guidelines). The methodology used in this study has been informed by these guidelines and various standard industry practices.

The Draft National Guidelines [1] recommend limits of 30 hours per year on the theoretical shadow flicker duration, and 10 hours per year on the actual shadow flicker duration.

A Project layout consisting of up to 42 wind turbines with a proposed rotor diameter of up to of 172 m and hub height of 134 m, resulting in an upper tip height of 220 m, has been modelled. Twenty dwellings in the area surrounding the Project have been considered for this assessment. Eight of these dwellings are associated dwellings.

DNV has previously conducted a shadow flicker assessment for the Project site, as reported in DNV report 170894-AUME-R-01 Twin Creek Shadow Flicker Assessment Issue G dated 26 June 2017 [2] ("the previous shadow flicker assessment"), based on a different turbine layout and configuration. The turbine layout considered in the previous shadow flicker assessment was comprised of up to 51 turbines, with a rotor diameter of 136 m and hub height of 112 m.

The theoretical shadow flicker durations at dwellings in the vicinity of the Project have been determined using a purely geometric analysis. The actual shadow flicker duration likely to be experienced at each dwelling has also been predicted by estimating the possible reduction in shadow flicker due to turbine orientation and cloud cover.

Assessment results

The results of the shadow flicker assessment are summarised in Section 5.

Based on this assessment, one associated dwelling is expected to experience theoretical and actual shadow flicker durations that exceed the limits recommended by the Draft National Guidelines. However, DNV understands that this dwelling (dwelling 122) is currently owned by the Customer and is planned to be demolished prior to construction of the Project. No other dwelings are predicted to experience shadow flicker at a level of intensity that is likely to cause annoyance.

The results of the previous shadow flicker assessment predicted that one dwelling (dwelling 147) would receive theoretical shadow flicker above a moderate level of intensity, but below the recommended limit of 30 hours per year. This dwelling is no longer predicted to experience shadow flicker above a moderate level of intensity due to changes to the proposed turbine layout and configuration. However, dwelling 147 may experience shadow flicker below a moderate level of intensity, but is one of 10 dwellings that may experience some shadow flicker at intensity levels below that which is covered by the Guidelines.

The effects of blade glint have not been quantified in this study as the Draft National Guidelines [1] do not provide any quantification methodology. The guidelines, however, recommend that the

Customer ensures that the turbine blades used have a surface finish with a low reflectivity to avoid occurrences of blade glint. The customer has advised DNV that a non-reflective finish will be applied to the wind turbine blades.

[redacted]

1 INTRODUCTION

RES Australia Pty Limited ("the Customer") has commissioned DNV to independently assess the expected annual shadow flicker durations in the vicinity of the proposed Twin Creek Wind Farm ("the Project") in South Australia. The results of this work are reported here.

This assessment evaluates the shadow flicker durations in the vicinity of the Project for the current proposed turbine layout [3] and configuration in general accordance with the Draft National Wind Farm Development Guidelines (Draft National Guidelines) prepared by the Environment Protection and Heritage Council (EPHC) in July 2010 [1], as well as standard industry practices [4, 5, 6].

DNV has previously conducted a shadow flicker assessment for the Project site, as reported in DNV report 170894-AUME-R-01 Twin Creek Shadow Flicker Assessment Issue G dated 26 June 2017 [2], based on a different turbine layout and configuration.

2 DESCRIPTION OF THE SITE AND PROJECT

2.1 The site

The Project is located in South Australia, approximately 5.5 km south of Eudunda and 74 km northeast of Adelaide. An overview of the site location is presented in Figure 2.

The site is characterised by undulating terrain and predominantly consists of land cleared for agriculture with relatively sparse vegetation. The digital elevation model (DEM) used to define the terrain at the site was created from a high resolution LiDAR DEM [7] for the immediate site area, and SRTM1 data [8] for the extended site area.

2.2 The project

2.2.1 Proposed wind farm layout

The Project is composed of up to 42 wind turbines [3]. A map of the site with the proposed turbine layout is shown in Figure 3, and the coordinates of the proposed turbine locations are given in Table 2.

DNV has modelled the shadow flicker based on the Vestas V172-7.2MW as the candidate turbine with a rotor diameter of 172 m and a hub height of 134 m, such that the upper tip height of the turbine is 220 m [3]. The final turbine model will be subject to a competitive tender process following development authorisation.

2.2.1 Shadow receptor locations

A list of 279 receptors surrounding the Project was provided to DNV by the Customer [9, 10, 11, 12, 13].Twenty dwellings have been identified as having the potential to experience shadow flicker, and these have been considered in this assessment. Buildings identified as sheds or ruins have been omitted from the analysis.

The coordinates of these 20 dwellings are presented in Table 3.

Out of the 20 dwellings identified:

- eight are associated dwellings
- twelve are not associated.

The remaining 259 receptors are at locations that are considered unlikely to be impacted by shadow flicker of an intensity typically considered sufficient to cause annoyance, as discussed further in Sections 3.1 and 4.1.

It should be noted that the scope of the current work has not included a comprehensive survey of sensitive land uses and building locations in the area, and so DNV is relying on the information provided by the Customer.

3 REGULATORY REQUIREMENTS

3.1 Shadow flicker

The South Australian Planning and Design Code (SA Planning Code) published by the Government of South Australia [14] includes the following policy (Performance Outcome 3.4 – Interface between Land Uses):

> *"Development that incorporates moving parts, including windmills and wind farms, are located and operated to not cause unreasonable nuisance to nearby dwellings and tourist accommodation caused by shadow flicker."*

However, the SA Planning Code does not discuss a methodology for assessing shadow flicker or allowable shadow flicker durations.

The Draft National Guidelines [1] recommend that the modelled theoretical shadow flicker duration should not exceed 30 hours per year, and that the actual or measured shadow flicker duration should not exceed 10 hours per year. The guidelines also recommend that the shadow flicker duration at a dwelling be assessed by calculating the maximum shadow flicker occurring within 50 m of the centre of a dwelling.

These limits are assumed to apply to a single dwelling, and it is noted that there is no requirement under the Draft National Guidelines to assess shadow flicker durations at locations other than in the vicinity of dwellings.

The Draft National Guidelines also provide background information, a proposed methodology, and a suite of assumptions for assessing shadow flicker durations in the vicinity of a wind farm.

The impact of shadow flicker is typically only significant up to a distance of around 10 rotor diameters from a turbine [5, 6] or approximately 1200 m to 1900 m for modern wind turbines (which typically have rotor diameters of 120 m to 190 m). Beyond this distance limit the shadow is diffused such that the variation in light levels is not likely to be sufficient to cause annoyance. This issue is discussed in the Draft National Guidelines where it is stated that:

> *"Shadow flicker can theoretically extend many kilometres from a wind turbine. However, the intensity of the shadows decreases with distance. While acknowledging that different individuals have different levels of sensitivity and may be annoyed by different levels of shadow intensity, these guidelines limit assessment to moderate levels of intensity (i.e., well above the minimum theoretically detectable threshold) commensurate with the nature of the impact and the environment in which it is experienced."*

The Draft National Guidelines therefore suggest a distance equivalent to 265 times the maximum blade chord as an appropriate limit, which corresponds to approximately 1000 m to 1600 m for modern wind turbines (which typically have maximum blade chord lengths of 4 m to 6 m).

For the purposes of this assessment, DNV has considered the guidance and recommendations given in the Draft National Guidelines and standard industry practices in relation to shadow flicker, and the design parameters of the candidate turbine that has a rotor diameter of 172 metres and blade chord length of 4.5 m.

3.2 Blade glint

Blade glint involves the regular reflection of the sun off rotating turbine blades. Its occurrence depends on a combination of circumstances arising from the orientation of the nacelle, angle of the blade and the angle of the sun. The reflectiveness of the surface of the blades is also important. Blade glint is not generally a problem for modern wind turbines [1].

A methodology for the quantification of blade glint impacts as well as a regulatory limit are not provided by the Draft National Guidelines [1]. However, the Draft National Guidelines suggest that the Customer ensures the blades of the wind turbines have a finish with low reflectivity.

In relation to blade glint, guidance from the Draft National Guidelines [1] states that:

> *"Blade glint can be produced when the sun's light is reflected from the surface of wind turbine blades. Blade glint has potential to annoy people.*
>
> *All major wind turbine blade manufacturers currently finish their blades with a low reflectivity treatment. This prevents a potentially annoying reflective glint from the surface of the blades and the possibility of a strobing reflection when the turbine blades are spinning. Therefore the risk of blade glint from a new development is considered to be very low.*
>
> *Proponents should ensure that blades from their supplier are of low reflectivity."*

4 ASSESSMENT METHODOLOGY

4.1 Shadow flicker

4.1.1 Overview

Shadow flicker may occur under certain combinations of geographical position and time of day, when the sun passes behind the rotating blades of a wind turbine and casts a moving shadow over neighbouring areas. When viewed from a stationary position, the moving shadows cause periodic flickering of the light from the sun, giving rise to the phenomenon of 'shadow flicker'.

The effect is most noticeable inside buildings, where the flicker appears through a window opening. The likelihood and duration of the effect depends upon a number of factors, including:

- the direction of the property relative to the turbine
- the distance from the turbine (the further the observer is from the turbine, the less pronounced the effect will be)
- the wind direction (the shape of the shadow will be determined by the position of the sun relative to the blades which will be oriented to face the wind)
- the turbine height and rotor diameter
- the time of year and day (the position of the sun in the sky)
- the weather conditions (cloud cover reduces the occurrence of shadow flicker).

Example photographs of wind turbines and associated shadows which have the potential to cause flicker are shown in Figure 1 below.

Figure 1 Examples of wind turbine shadows

4.1.2 Theoretical modelled duration

The theoretical number of hours of shadow flicker experienced annually at a given location can be calculated using a geometrical model which incorporates the sun path, topographic variation over the site area, and wind turbine details such as rotor diameter and hub height.

The wind turbines have been modelled assuming they are spherical objects, which is equivalent to assuming that the rotors of the turbines are disks that are always oriented perpendicular to the sun-turbine vector. This assumption will mean the model calculates the maximum duration for which there is potential for shadow flicker to occur, up to a specified distance limit.

In line with the methodology proposed in the Draft National Guidelines, DNV has assessed the shadow flicker at the surveyed house locations and has determined the highest shadow flicker duration within 50 m of each of the provided house location.

Shadow flicker has been calculated at dwellings at heights of 2 m, to represent ground floor windows, and 6 m, to represent second floor windows. The shadow receptors are simulated as fixed points, representing the worst-case scenario, as real windows at the receptor may be facing a particular direction less affected by shadows cast from the turbines. The shadow flicker calculations for dwelling locations have been carried out with a temporal resolution of 1 minute. The shadow flicker map was generated using a temporal resolution of 5 minutes and a spatial resolution of 10 m to reduce computational requirements to acceptable levels.

The model also makes the following assumptions and simplifications:

- there are clear skies every day of the year
- the plane of rotation of the blades of the turbines is always perpendicular to the direction of the line of sight from the location of interest to the sun
- the turbine blades are always rotating, inherently assuming continuous wind flow across the site.

The first two of these items are addressed in the calculation of the predicted actual shadow flicker duration as described in Section 4.1.3. The third item is not considered but is unlikely to have a significant impact on the results. The settings used to execute the model can be seen in Table 3.

4.1.2.1 Shadow flicker above a moderate level of intensity (10D distance limit)

As part of the shadow flicker assessment, it is necessary to make an assumption regarding the maximum length of a shadow cast by a wind turbine that is likely to cause annoyance due to shadow flicker (the zone of influence of shadows). The UK wind industry and planning guidelines in the UK suggest that a distance of 10 rotor diameters (10D) may be appropriate [5, 6], while the Draft National Guidelines suggest a distance equivalent to 265 times the maximum blade chord (265C) as an appropriate distance.

The determination of the distance of 265C for the zone of influence of shadows suggested by the Draft National Guidelines is provided in Appendix E.7 of [1], and explains that the distance of 10D for the zone of influence of shadows was actually the basis for the derivation of the distance of 265C at the time of publication of the Draft National Guidelines.

DNV notes that the recommendation of a distance of 265C can only be found in the Draft National Guidelines and the Queensland State Government planning guidance State Code 23 [15], and that standard practice in the European wind industry is to still consider a distance of 10D for the zone of influence of shadows [4, 16]. In at least one instance, DNV has also observed evidence of shadow flicker at or beyond 10D from wind turbines. Although the level of annoyance caused by shadow flicker can be subjective, this demonstrates the potential for its effects to extend to at least a distance of 10D, regardless of the durations of these shadow flicker occurrences. This is supported by the following reports [6, 16]. As such, DNV typically considers the greater of the 10D and 265C distances for shadow flicker assessments.

For the current assessment, DNV has assumed that shadow flicker of a moderate level of intensity or above will occur up to a distance of approximately 10D from the wind farm and has therefore applied a maximum shadow length of 10D, which corresponds to a distance limit of 1720 m.

4.1.2.2 Shadow flicker below a moderate level of intensity (15D distance limit)

Beyond the 10D distance limit described in Section 4.1.2.1, it is assumed that any shadow flicker experienced will be below a "moderate level of intensity" and unlikely to cause annoyance. However, it is recognised that different people have different levels of sensitivity to shadow flicker and may therefore be affected by shadow flicker intensities below the moderate level of intensity assumed by this distance limit.

To account for this possibility, and although not suggested by the Draft National Guidelines [1], DNV has also assessed the shadow flicker for an increased distance limit of 15 times the rotor diameter (15D), or 2580 m, to include the potential for occurrences of shadow flicker below a moderate level of intensity. Therefore, in this assessment, shadow flicker below a moderate level of intensity is assumed to occur beyond a distance of 10D and up to a distance of approximately 15D from the wind farm.

4.1.2.3 Typical modelled shadow flicker results

To illustrate typical results, an indicative shadow flicker map for a turbine located in a flat area is shown in Figure 4. The geometry of the shadow flicker map can be characterised as a butterfly shape, with the four protruding lobes corresponding to slowing of solar north-south travel around the summer and winter solstices for morning and evening. The lobes to the north of the indicative turbine location result from the summer months and conversely the lobes to the south result from the winter months. The lobes to the west result from morning sun while the lobes to the east result from evening sun. When the sun is low in the sky, the length of shadows cast by the turbine increases, increasing the area around the turbine affected by shadow flicker.

4.1.2.4 Factors affecting duration

The theoretical shadow flicker duration calculated as described in Section 4.1.2 overestimates the annual number of hours of shadow flicker experienced at a specified location for several reasons, including:

1. The wind turbine will not always be oriented such that its rotor is in the worst-case position (i.e., perpendicular to the sun-turbine vector). Any other rotor orientation will reduce the area of the projected shadow and hence the shadow flicker duration. The wind speed frequency distribution or wind rose at the site can be used to determine probable turbine orientation and to calculate the resulting reduction in shadow flicker duration.
2. The occurrence of cloud cover has the potential to significantly reduce the number of hours of shadow flicker. Cloud cover measurements recorded at nearby meteorological stations may be used to estimate probable levels of cloud cover and to provide an indication of the resulting reduction in shadow flicker duration.

3. Aerosols (moisture, dust, smoke, etc.) in the atmosphere have the ability to influence shadows cast by a wind turbine. The length of the shadow cast by a wind turbine is dependent on the degree that direct sunlight is diffused, which is in turn dependent on the amount of dispersants (humidity, smoke, and other aerosols) in the path between the light source (sun) and the receiver.
4. The modelling of the wind turbine rotor as a sphere rather than individual blades results in an overestimation of the shadow flicker duration. Turbine blades are of non-uniform thickness with the thickest part of the blade (maximum chord) close to the hub and the thinnest part (minimum chord) at the tip. Diffusion of sunlight, as discussed above, results in a limit to the maximum distance that a shadow can be perceived. This maximum distance will also be dependent on the thickness of the turbine blade, and the human threshold for perception of light intensity variation. As such, a shadow cast by the blade tip will be shorter than the shadow cast by the thickest part of the blade.
5. The analysis does not consider that when the sun is positioned directly behind the wind turbine hub, there is no variation in light intensity at the receiver location and therefore no shadow flicker.
6. The presence of vegetation or other physical barriers around a shadow receptor location may shield the view of the wind turbine, and therefore reduce the incidence of shadow flicker.
7. Periods where the wind turbine is not in operation due to low winds, high winds, or for operational and maintenance reasons will also reduce the annual shadow flicker duration.

4.1.3 Predicted actual duration

As discussed in Section 4.1.2.4, there are a number of factors which may reduce the incidence of shadow flicker that are not taken into account in the calculation of the theoretical shadow flicker duration. An attempt has been made to quantify the likely reduction in shadow flicker duration due to cloud cover and, therefore, produce a prediction of the actual shadow flicker duration likely to be experienced at a receptor.

Cloud cover is typically measured in 'oktas', effectively eighths of the sky covered with cloud. DNV has obtained data from the following Bureau of Meteorology (BoM) stations:

- Kapunda (023307), located approximately 14 km west of the centre of the site [17]
- Nuriootpa Department of Primary Industries and Regions (PIRSA) office (023373), located approximately 19 km south of the centre of the site [18]
- Mount Crawford Forest Headquarters (023763), located approximately 45 km south of the centre of the site [19]
- Rosedale (Turretfield Research Centre) (023343), located approximately 34 km southwest of the centre of the site [20]
- Edinburgh RAAF (023083) located approximately 60 km southwest of the centre of the site [21].

The number of oktas of cloud cover visible across the sky at these stations is recorded twice daily, at 9 am and 3 pm, and the observations are provided as monthly averages. After averaging the 9 am and 3 pm observations for the stations considered, the results indicate that the average monthly cloud cover in the region ranges between 39% and 64%, and the average annual cloud cover is approximately 53%. This means that on an average day, 53% of the sky in the vicinity of the wind farm is covered with clouds. Although it is not possible to definitively calculate the effect of cloud cover on shadow flicker duration, a reduction in the shadow flicker duration proportional to the amount of cloud cover is a reasonable assumption.

Similarly, turbine orientation can have an impact on the shadow flicker duration. The shadow flicker duration is greatest when the turbine rotor plane is approximately perpendicular to a line joining the sun and an observer, and a minimum when the rotor plane is approximately parallel to a line joining the sun and an observer. A wind direction frequency distribution derived from data collected by an on-site mast has been provided by the Customer [22] and used to estimate the reduction in shadow flicker duration due to rotor orientation. The measured wind rose is shown overlaid on the indicative shadow flicker map in Figure 4. An assessment of the likely reduction in shadow flicker duration due to variation in turbine orientation was conducted on an annual basis.

It should be noted that the method prescribed by the Draft National Guidelines for assessing actual shadow flicker duration recommends that only reductions due to cloud cover, and not turbine orientation, be included. However, DNV considers that the additional reduction due to turbine orientation is appropriate as the projected area of the turbine, and therefore the expected shadow flicker duration, is reduced when the turbine rotor is not perpendicular to the line joining the sun and dwelling. Due to limitations in the availability of suitable cloud cover data, the methodology used in this assessment also deviates somewhat from the method recommended by the Draft National Guidelines for assessing the reduction in shadow flicker due to cloud cover. However, considering the available cloud cover data, the approach described above is deemed to provide a reasonable estimate of the likely impact of cloud cover on the shadow flicker duration.

No attempt has been made to account for vegetation or other shielding effects around each shadow receptor in calculating the shadow flicker duration. Similarly, turbine shutdown has not been considered.

4.2 Blade glint

Blade glint involves the regular reflection of sun off rotating turbine blades. Its occurrence depends on a combination of circumstances arising from the orientation of the nacelle, angle of the blade and the angle of the sun. The reflectiveness of the surface of the blades is also important. Blade glint is not generally a problem for modern wind turbines.

In order for blade glint not to be an issue for the wind farm, it is recommended that the turbine blades are coated with a non-reflective paint.

As discussed in Section 3.2, the Draft National Guidelines [1] do not provide a methodology for the quantification of blade glint impacts.

5 ASSESSMENT RESULTS

5.1 Shadow flicker

5.1.1 Shadow flicker above a moderate level of intensity (10D distance limit)

A shadow flicker assessment was carried out at all provided dwelling locations, or 'receptors', as outlined in Table 2.

The theoretical and predicted actual shadow flicker durations at all dwellings identified to be affected by shadow flicker above a moderate level of intensity, based on the modelling parameters discussed in Section 4.1, are presented in Table 4. The maximum predicted shadow flicker durations within 50 m of these receptors are also presented in this table. Furthermore, the results are shown in the form of shadow flicker maps in Figure 5 and Figure 6. The shadow flicker values presented in these maps represent the worst case between the results at 2 m and 6 m above ground for each modelled grid point.

Based on DNV's modelling, one associated dwelling (dwelling 122) is predicted to experience shadow flicker of at least a moderate level of intensity, which is expected to occur up to a distance of around 10D from the wind farm as discussed in Section 4.1.2.1.

The results show that the shadow flicker durations at dwelling 122 exceed the recommended limits outlined in the Draft National Guidelines [1], as well as standard industry practices. The dwelling is predicted to experience theoretical shadow flicker durations above the recommended limit of 30 hours per year within 50 m of the dwelling. When considering the likely reduction due to cloud cover and rotor orientation, the shadow flicker is predicted to be above the recommended limit of 10 hours per year within 50 m of the dwelling. However, given that the dwelling is currently owned by the Customer, who has informed DNV that it is unoccupied and planned to be demolished prior to construction of the Project [23], there is no potential for the shadow flicker at this location to cause annoyance. No other dwelings are predicted to experience shadow flicker at a level of intensity that is likely to cause annoyance.

Table 1 Theoretical and predicted actual annual shadow flicker duration

House ID[1,4]	Status	Easting[1] [m]	Northing[1] [m]	Contributing turbines	Theoretical annual[2]				Predicted actual annual[2,3]			
					At dwelling [hr/yr]		Max within 50 m [hr/yr]		At dwelling [hr/yr]		Max within 50 m [hr/yr]	
					2 m	6 m	2 m	6 m	2 m	6 m	2 m	6 m
122[5]	Associated	322874	6198829	T38 T41	**99.1**	**99.1**	**127.2**	**127.2**	24.1	24.1	32.0	32.0
	Recommended duration limits				***30 hr/yr***				***10 hr/yr***			

Note:

1. *Coordinate system: MGA zone 54, GDA94 datum.*
2. *Zone of influence of shadows assumed to extend to a distance of 10 times the rotor diameter following standard wind industry practice* [5, 6, 4]. *Dwellings in Table 2 for which there is no shadow flicker up to a distance of 10 times the rotor diameter have been omitted from this table.*
3. *Considering likely reductions in shadow flicker duration due to cloud cover and turbine orientation.*
4. *Buildings identifed by the Customer as sheds or ruins have been omitted from this assessment.*
5. *Buildings identified as unoccupied* [23].

5.1.2 Shadow flicker below a moderate level of intensity (15D distance limit)

Beyond the 10D distance limit, it is assumed that any shadow flicker experienced will be below a moderate level of intensity and thus unlikely to cause annoyance. However, it is recognised that different people have different levels of sensitivity to shadow flicker and may therefore be affected by shadow flicker below a moderate level of intensity that may occur beyond this distance limit. To account for this possibility, and although not part of the methodology outlined in the Draft National Guidelines, DNV has also assessed the shadow flicker impacts for the Project using an extended distance for the zone of influence of shadows intended to capture the occurrences of shadow flicker below a moderate level of intensity.

For the purpose of this assessment, to account for shadow flicker below a moderate level of intensity, the distance limit has been increased by 50% (to 15D). The results of the assessment indicate the possibility for shadow flicker below a moderate level of intensity to occur within 50 m of 10 dwellings (dwelling 9, 18, 118, 119, 120, 123, 124, 125, 131 and 147). Four of these dwellings are associated dwellings (being dwellings 118, 119, 120 and 147).

Although there is no requirement under the Draft National Guidelines to consider shadow flicker below a moderate level of intensity, the shadow flicker experienced at these dwellings may cause annoyance in some circumstances. DNV recommends that the Customer considers the results of this assessment and uses them to inform discussions with landowners.

5.1.3 Comparison to previous assessment

DNV has previously conducted a shadow flicker assessment for the Project site [2], based on a different turbine layout and configuration. The turbine layout in the previous shadow flicker assessment was comprised of up to 51 turbines, with a rotor diameter of 136 m and hub height of 112 m. The methodology used in the previous assessment used a maximum shadow length of 1360 m, which is 360 m less than the distance limit applied for the current configuration, due to the smaller turbine dimensions under consideration. The previous shadow flicker assessment did not model the potential for shadow flicker below a moderate level of intensity beyond the 10D limit.

The previous shadow flicker assessment [2] reported that a single dwelling (dwelling 147) was predicted to experience shadow flicker above a moderate level of intensity, but the theoretical durations were predicted to be below the recommended limit of 30 hours per year. Dwelling 147 is no longer predicted to experience shadow flicker above a moderate level of intensity due to changes to the proposed turbine layout. However, as discussed in Section 5.1.2 above, receptor 147 is one of 10 dwellings that may experience some shadow flicker below a moderate level of intensity. Receptor 147 is an associated dwelling.

5.1.4 Mitigation options

If required, the effects of shadow flicker may be reduced through a number of mitigation options such as the removal or relocation of turbines, the use of smaller turbines, installation of screening structures or planting of trees to block shadows cast by the turbines, or the use of turbine control strategies (or shadow flicker protection systems) which shut down turbines when shadow flicker is likely to occur.

DNV notes that, since the modelled shadow flicker durations at all potentially occupied dwellings are below the limits specified in the Draft National Guidelines [1] for shadow flicker above a moderate level of intensity, it is not expected that mitigation will be required.

5.2 Blade glint

As discussed in Section 3.2, blade glint is not expected to be an issue for the Project given that the Customer has advised that a non-reflective finish will be applied to the wind turbine blades.

6 CONCLUSIONS

A shadow flicker assessment was carried out at all provided dwelling locations in the vicinity of the Project. For this assessment, DNV has considered a layout consisting of up to 42 candidate turbines, each with a rotor diameter of 172 m and a hub height of 134 m, resulting in a turbine upper tip height of 220 m. The results of the shadow flicker assessment based on this layout configuration are summarised in Table 4.

Based on the modelling conducted by DNV, one associated dwelling is predicted to experience theoretical and actual shadow flicker durations that exceed the limits recommended by the Draft National Guidelines. However, DNV understands that this dwelling is currently owned by the Customer and is planned to be demolished prior to construction of the Project. No other dwellings are predicted to experience shadow flicker at a level of intensity that is likely to cause annoyance.

Blade glint is not expected to be an issue for the Project given that the customer has advised that a non-reflective finish will be applied to the wind turbine blades.

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7 REFERENCES

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Table 2 Proposed turbine layout for the Project site [3]

Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation[2] [m]
T1	323482	6205173	448
T2	323844	6204801	439
T3	322201	6204396	449
T4	322781	6204223	442
T5	323566	6204209	424
T6	324007	6203993	442
T7	324334	6203665	481
T8	321322	6203691	385
T9	322058	6203763	413
T10	322708	6203496	445
T11	323556	6203423	413
T12	324074	6202948	459
T13	320199	6203120	349
T14	320533	6203023	340
T15	321043	6202736	361
T16	321778	6202844	393
T17	322495	6202951	418
T18	323294	6202849	413
T19	320050	6202407	339
T20	320949	6202223	350
T21	321858	6201934	402
T22	322825	6202282	412
T23	323559	6202089	429
T24	319861	6201508	345
T25	320144	6201172	338
T26	320893	6201273	372
T27	321600	6201336	415
T28	322524	6201525	436
T29	322988	6201226	430
T30	323145	6204792	457
T31	321591	6200769	408
T32	322195	6200924	440
T33	322603	6200463	423
T34	320685	6200154	367
T35	321376	6200207	387
T36	321917	6199967	418
T37	322228	6199655	411
T38	322352	6199232	408
T39	320630	6199500	386
T40	321197	6199375	392
T41	321557	6199056	408
T42	320763	6198805	409

Note:

1. *Coordinate system: MGA zone 54, GDA94 datum* [3].
2. *Estimated from a digital elevation model provided by the customer* [8].

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Table 3 Location of dwellings assessed for potential shadow flicker in this report [3, 11, 10, 12, 13]

Dwelling ID	Landowner status	Easting[1] [m]	Northing[1] [m]	Distance to nearest turbine [m]	Nearest turbine ID
5	Not associated	318425	6204359	2164	T13
9	Not associated	324339	6199469	2001	T33
14	Associated	323507	6197563	2030	T38
18	Not associated	326591	6204222	2324	T7
73	Associated	319843	6205696	2491	T8
75	Not associated	324320	6207653	2043	T3
77	Not associated	324320	6207653	2618	T1
117	Not associated	321750	6197065	2000	T41
118	Associated	318374	6200027	2099	T24
119	Associated	318469	6200071	2000	T24
120	Associated	318362	6200119	2044	T24
122[3]	Associated	322874	6198829	659	T38
123	Not associated	324465	6199580	2061	T33
124	Not associated	324921	6199805	2399	T29
125	Not associated	324704	6200152	2024	T29
131	Not associated	324533	6197985	2512	T38
147	Associated	319969	6205165	2001	T8
151	Associated	320251	6205722	2296	T8
181	Not associated	323623	6197004	2565	T38
182	Not associated	323771	6197057	2597	T13

Note:
1. *Coordinate system: MGA zone 54, GDA94 datum.*
2. *Buildings identifed by the Customer as sheds or ruins have been omitted from this assessment.*
3. *Buildings identified as unoccupied.*

Table 4 Shadow flicker model settings for theoretical shadow flicker calculation

Model setting	
Shadow distance limit (10D)	1720 m
Year of calculation	2037
Minimum elevation of the sun	3°
Time step	1 min (5 min for map)
Rotor modelled as	Sphere (disk for turbine orientation reduction calculation)
Sun modelled as	Disk
Offset between rotor and tower	None
Receptor height (single storey)	2 m
Receptor height (double storey)	6 m
Locations used for determining maximum shadow flicker within 50 m of each dwelling	8 points evenly spaced (every 45°) on 25 m and 50 m radius circles centred on the provided house location

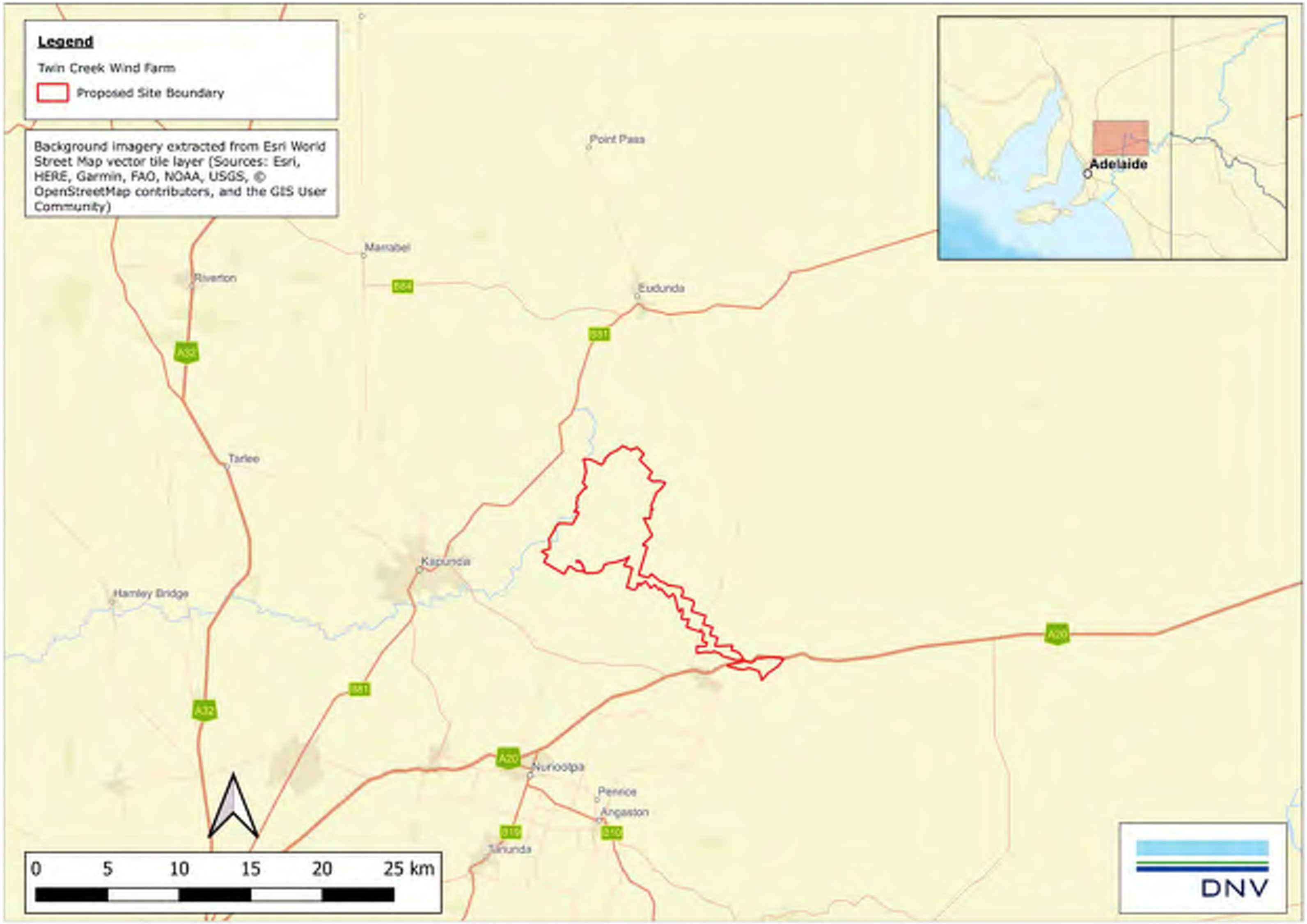

Figure 2 Location of the Project

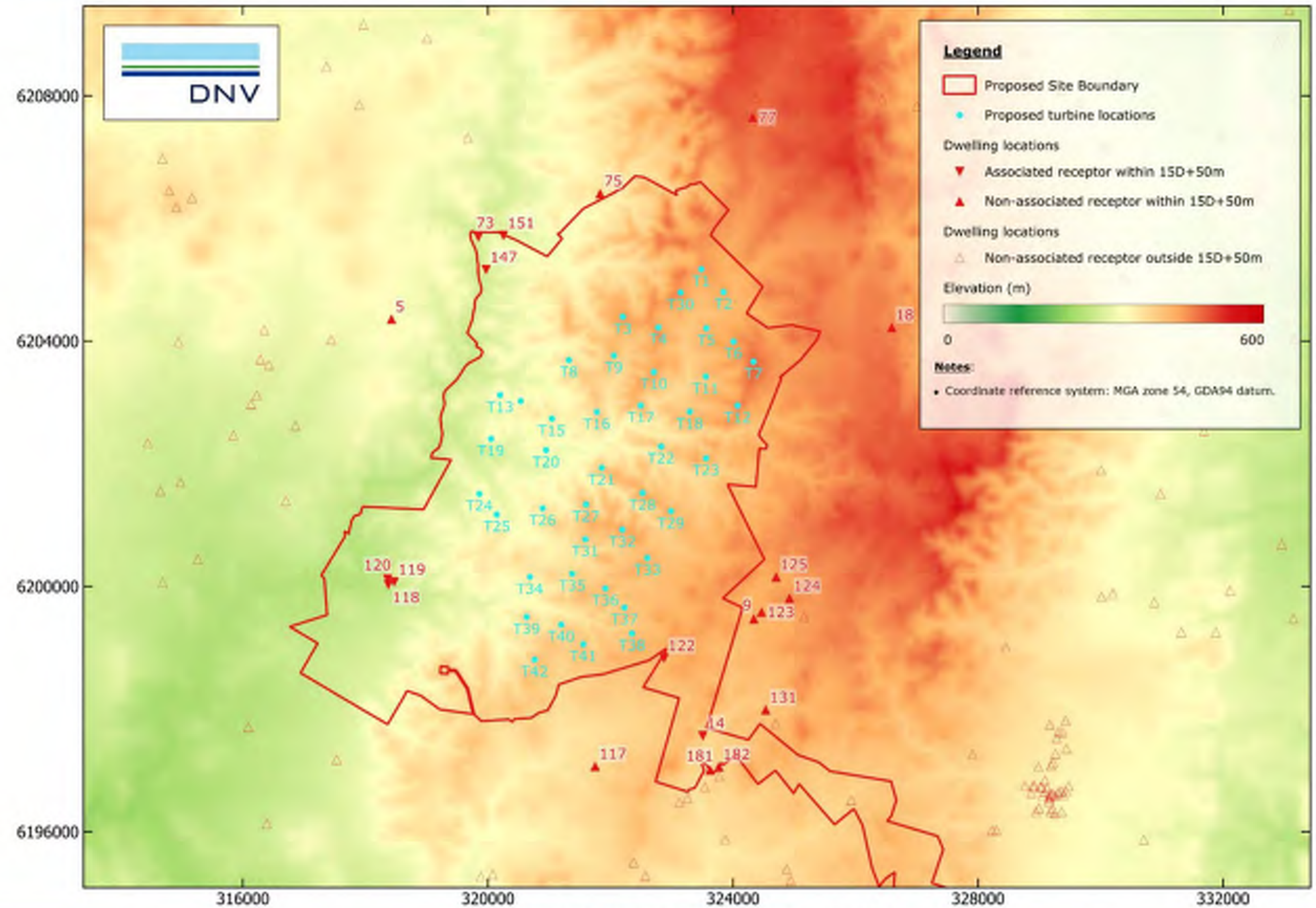

Figure 3 Elevation map of the Project

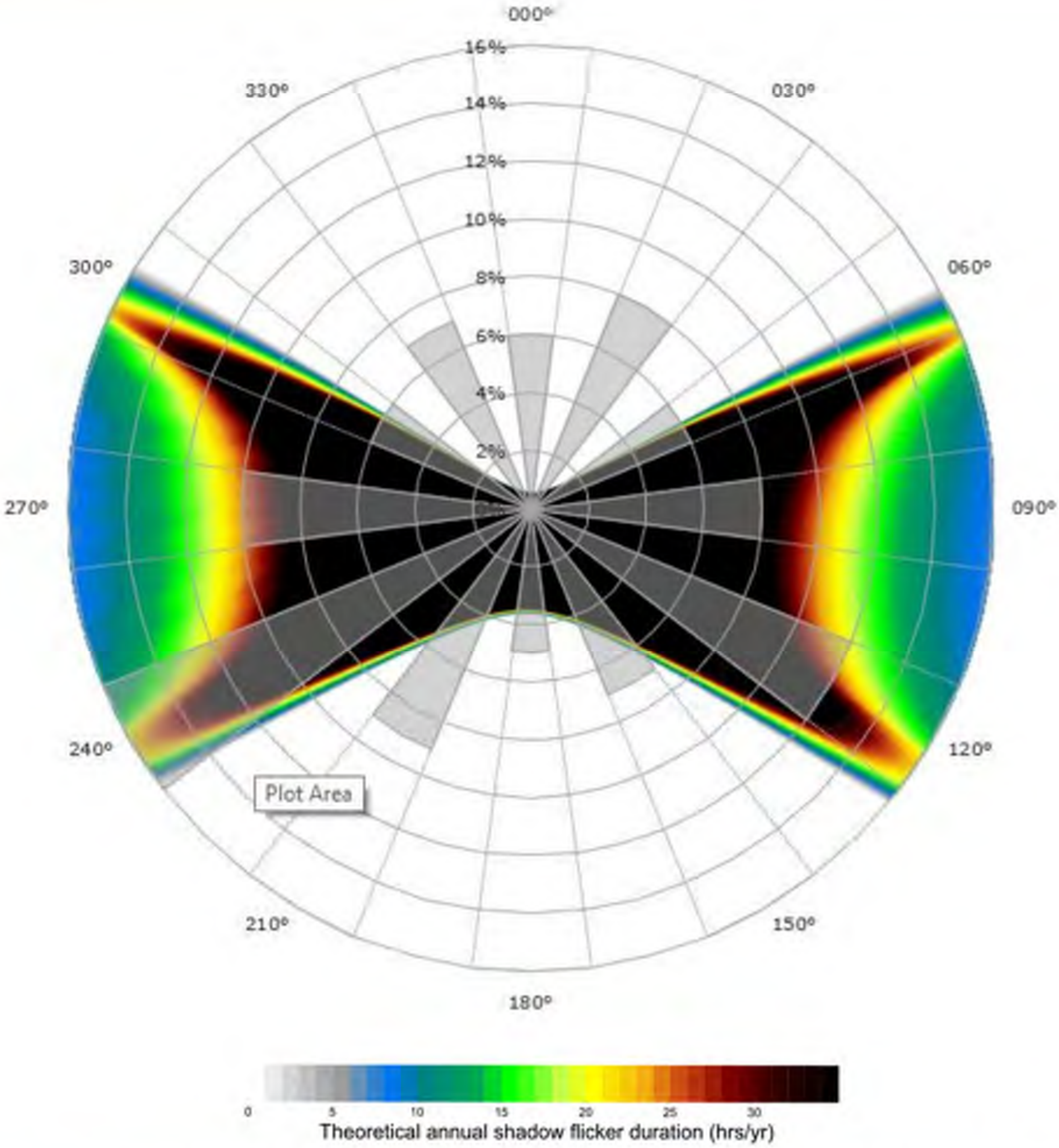

Figure 4 Indicative shadow flicker map and wind direction frequency distribution

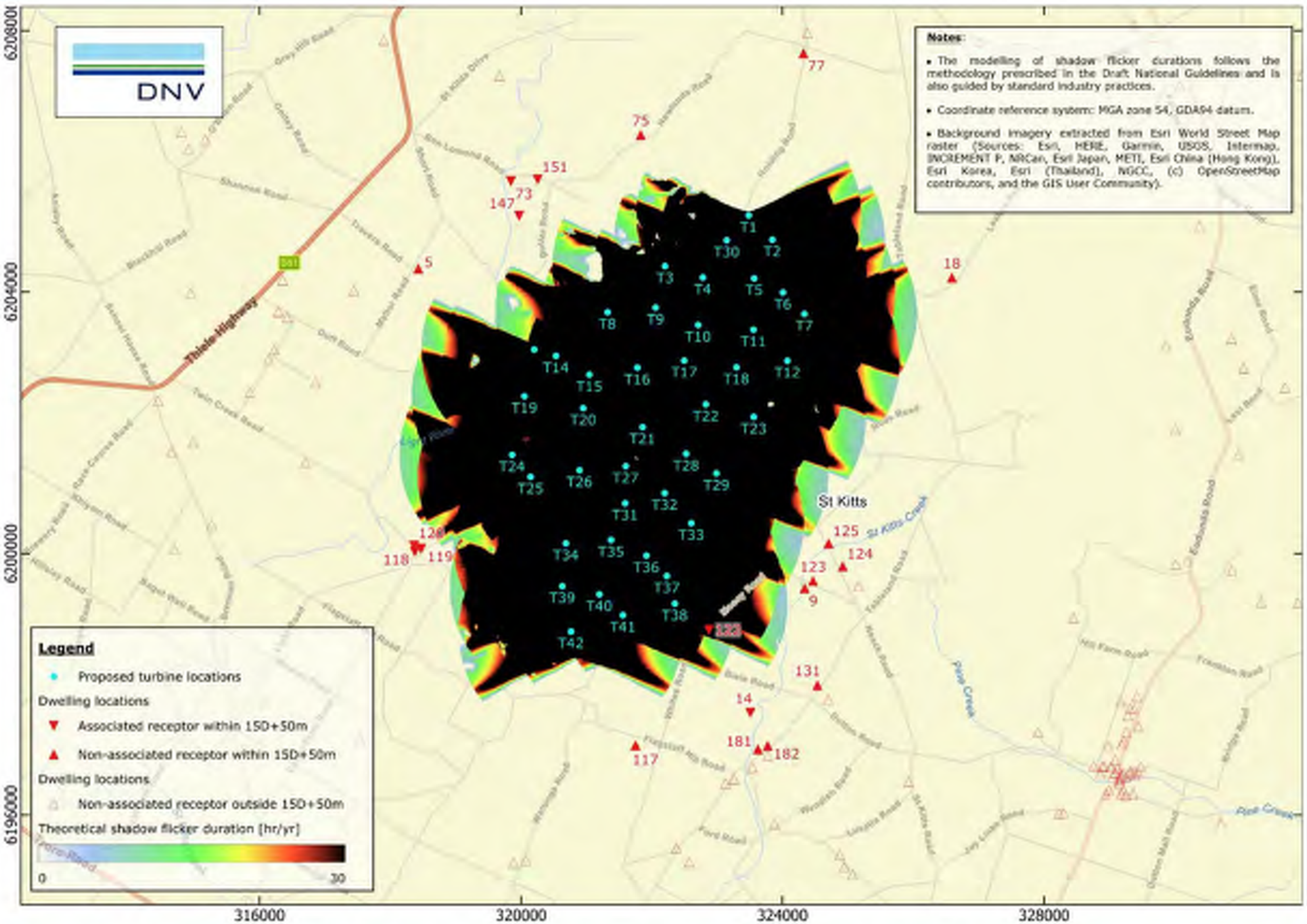

Figure 5 Theoretical annual shadow flicker duration map

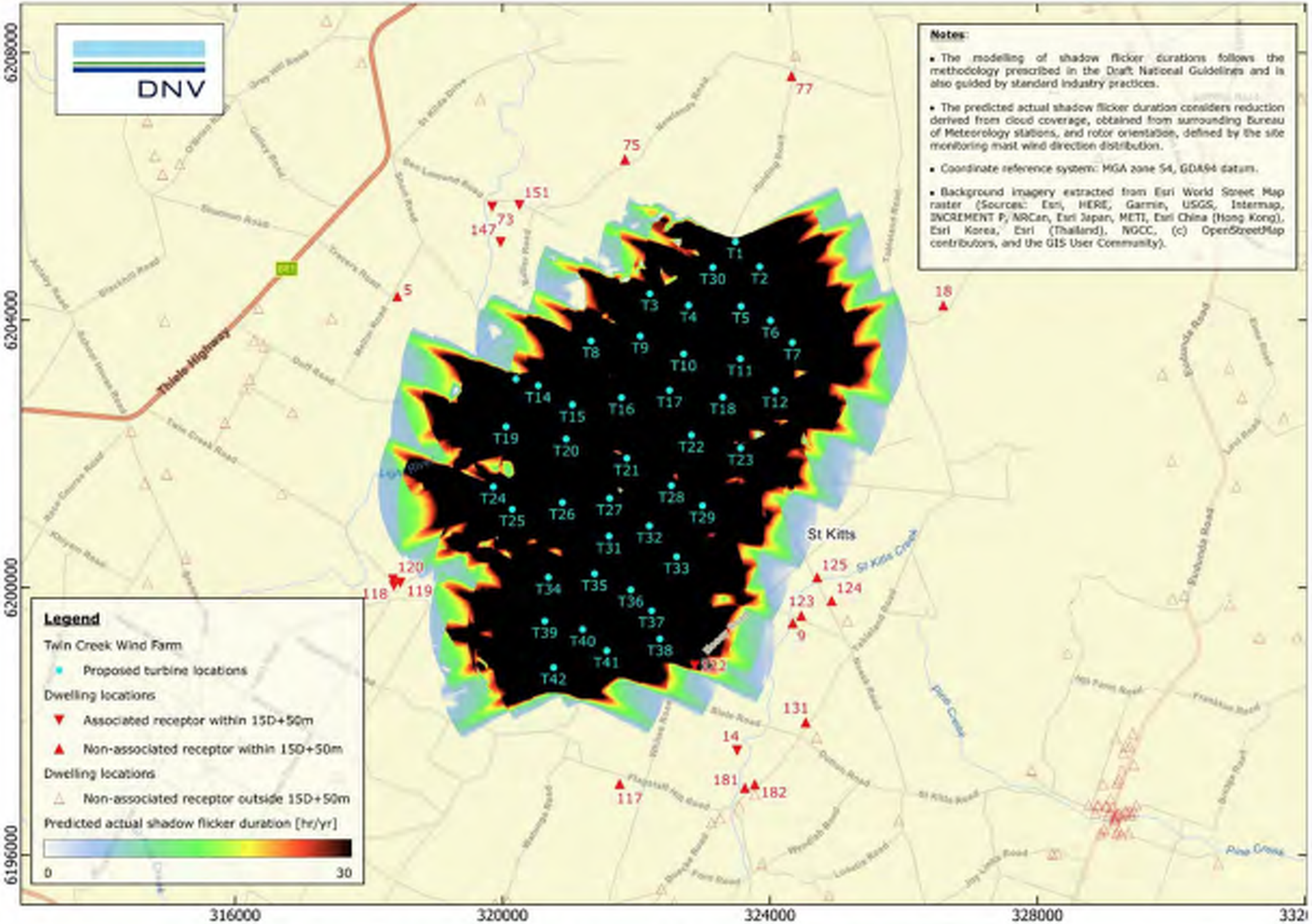

Figure 6 Predicted actual annual shadow flicker duration map

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EMI Assessment

by DNV

TWIN CREEK WIND FARM

EMI Assessment

RES Australia Pty Limited

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RES Consultancy Agreement, dated 28 September 2023

Objective: Twin Creek Wind Farm EMI Assessment

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A	2024-01-05	First issue - DRAFT	E Tomlinson	N Brammer	T Gilbert
B	2024-02-13	Update to consider revised turbine layout and respond to customer comments	E Tomlinson	N Brammer	J Jobin
C	2024-09-27	Update in response to customer comments	E Tomlinson	N Brammer	N Brammer
D	2024-10-16	Update in response to customer comments	E Tomlinson	N Brammer	N Brammer
E	2024-10-30	Final status	E Tomlinson	N Brammer	N Brammer
F	2025-01-10	Update to consider revised site boundary	E Tomlinson	J Villalba	N Brammer
G	2025-01-10	Final status	E Tomlinson	J Villalba	N Brammer

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EXECUTIVE SUMMARY

DNV has been commissioned by RES Australia Pty Limited ("the Customer") to independently assess potential electromagnetic interference (EMI) impacts associated with the development and operation of the proposed Twin Creek Wind Farm ("the Project") in South Australia. The results of the EMI assessment are described in this document.

Background and methodology

DNV has assessed the potential EMI impacts for the Project in accordance with the South Australian Planning and Design Code [1] and Draft National Wind Farm Development Guidelines [2]. The methodology used in this study has been informed by these guidelines and various standard industry practices.

A Project layout consisting of up to 42 wind turbines with a rotor diameter of 172 m and tip height of 220 m has been considered. These dimensions represent the maximum overall tip height within the maximum rotor and tower hub height dimensions.

There are 220 identified dwellings within 5 km of the Project; buildings identified as sheds or ruins have been omitted from the analysis.

DNV has previously conducted an EMI assessment for the Project site, as reported in DNV report 170894-AUME-R-02-E Twin Creek EMI Assessment dated 26 June 2017 [3] ("the previous EMI assessment"), based on a different turbine layout and configuration. The turbine layout considered in the previous EMI assessment was comprised of up to 51 turbines, with a rotor diameter of 136 m and tip height of 180 m.

Outcomes of the assessment

The results of the EMI assessment are summarised in the table at the end of this section.

Turbines at the Project may interfere with point-to-area style services such as mobile phone signals, radio broadcasting, and terrestrial television broadcasting, particularly in areas with poor or marginal signal coverage. Dwellings within approximately 5-10 km of the Project that are currently receiving signals from the Adelaide television broadcast transmitter may experience interference to that service. Feedback received from BAI Communications, suggest that impacts to signals from the Adelaide broadcast transmitter are likely, but no viewers are expected to be affected. If interference to these services is experienced, a range of options are available to rectify difficulties.

Interference to the FM radio signal broadcast by the nearby Flow FM transmitter at Kapunda may also be experienced near the edges of the signal coverage area to the northwest of the Project. However, Flow FM have advised that the areas at risk of interference may also receive signals from other nearby broadcast transmitters. It is understood that Flow FM is currently undertaking further assessment into the potential for interference and seeking advice from other parties to establish an understanding of how any impact to the FM radio signals from the Kapunda transmitter may be mitigated.

Interference to fixed point-to-point links passing over the Project boundaries is considered unlikely as there are no turbines located within the calculated exclusion zones for those links.

Since it is not possible to determine the potential EMI impacts on point-to-multipoint links and emergency services without obtaining further information from the relevant operators, DNV has consulted with organisations operating services that may be affected by the Project. SA Power

Networks previously raised concerns regarding their point-to-multipoint link that crosses the site. DNV have modelled an exclusion zone based on the second Fresnel zone for the link, and SA Power Networks have confirmed that the interference zone applied is sufficient. There are no turbines located within the exclusion zones set by DNV. DNV has also reviewed the point-to-multipoint link locations provided by SWOOP, who provide wireless internet services to residents in the vicinity of the Project, and has identified potential for interference to some link paths. DNV understands that the Customer is intending to engage with SWOOP to develop technical solutions aimed at minimising potential interference to those links.

Feedback received from the Bureau of Meteorology (the Bureau) indicates that there is a potential for the Project to materially impact on the operation of their Buckland Park radar and the associated weather monitoring and prediction services. DNV understands that the Customer has commenced discussions with the Bureau in relation to measures that may be deployed to minimise the potential impact on Bureau infrastructure. Discussions to date indicate that the installation of automatic weather stations and automatic rain stations if/as required would be incorporated as part of the Customer's commitment to the Project.

Potential EMI impacts on other services considered in this assessment, including trigonometrical stations, survey marks, CB radio, and satellite television and internet services are not expected or are considered to be minor.

DNV

Summary of EMI assessment results for the proposed Project

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Radio-communication towers	There are no towers within 2 km of proposed turbine locations	-	None	None required
Fixed point-to-point links	11 links crossing Project boundary, operated by: South Australian Water Corporation (SA Water) Spark Infrastructure SA (No2) Pty Limited (SA Power Networks) South Australian Government Radio Network NBN Co Limited Optus Mobile Pty Limited Wan Solutions Pty Ltd (SWOOP) **All links:** Turbines are not present in any of the potential diffraction zones	**SA Water, NBN Co:** Interference unlikely **Optus, SA Power Networks:** No concerns raised	Unlikely to cause interference	If required - reroute affected links, install additional towers, replace affected links with alternative technologies
Fixed point-to-multipoint links	254 assignments within 75 km of Project boundary 16 base stations within 20 km of Project boundary, operated by: South Australian Water Corporation (SA Water) The Barossa Council Bureau of Meteorology Barossa Valley Golf Club Inc. Spark Infrastructure SA (No2) Pty Limited (SA Power Networks) Telstra Limited	**SA Water, Barossa Council, Telstra, Bureau of Meteorology:** No concerns raised **SA Power Networks:** Satisfied with DNV modelled interference zones	**Other links:** Unlikely to cause interference	If required – reroute affected links, install additional towers, replace affected links with alternative technologies
Other licence types	**Point-to-area style communications:** see findings for emergency services, mobile phones, radio broadcasting, and television broadcasting	-	-	-

Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Emergency services	**Point-to-point links:** 1 South Australian Government Radio Operator link crossing boundary **Point-to-area style communications:** unlikely to be affected	**South Australian Country Fire Service, St John Ambulance Australia Incorporated, Australian Federal Police:** No concerns raised **Other operators:** No response received to date	**Point-to-point links:** Unlikely to cause interference **Point-to-area style communications:** Unlikely to cause interference	**Point-to-point links:** as for point-to-point links **Point-to-area style communications:** if required – increase signal strength from affected tower or alternative towers, install signal repeater, install additional tower
Meteorological radar	Nearest radar: 58 km from Project	Potential for material interference to Buckland Park radar	Likely to cause interference to Buckland Park radar	To be determined through consultation with the Bureau of Meteorology
Trigonometrical stations	**Trigonometrical stations:** 55 stations within 20 km of the Project boundary, unlikely to be affected	No concerns raised	Unlikely to cause interference	None required
Citizen's band radio	Unlikely to be affected	Consultation not considered necessary	Unlikely to cause interference	None required
Mobile phones	Unlikely to be affected in areas with good coverage, may experience interference in areas with marginal coverage	No concerns raised	Low likelihood of interference	To be determined through consultation with the relevant operators, if required
Wireless internet	**Wireless broadband service providers:** mobile phone networks, NBN Co **NBN:** available as a fixed wireless and satellite service **Wan Solutions Pty Ltd (SWOOP)**: wireless internet service	**Wireless broadband service providers:** No concerns raised **NBN Co:** No concerns raised regarding turbines NBN Co have requested information on any planned wind farm operated radiofrequency transmission equipment in order to assess the potential for interference **SWOOP:** Potential for interference	**Wireless broadband services**: see findings for mobile phones **NBN:** Unlikely to cause interference **SWOOP:** Potential for interference	**Wireless broadband services:** as for mobile phones **NBN:** none required **SWOOP:** If required – reroute affected links, install additional towers, replace affected links with alternative technologies

Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Satellite television and internet	**Geostationary satellites:** signals from satellites providing services intended for both Australian and international audiences are unlikely to be affected. **Low Earth orbit (LEO) satellites:** Starlink signals are unlikely to be obstructed at any of the nearby dwellings	Consultation with operators not considered necessary	**Geostationary satellites:** unlikely to cause interference **LEO satellites:** unlikely to cause interference	**Geostationary satellites:** none required **LEO satellites:** none required
Radio broadcasting	**FM signals:** may experience interference in close proximity to turbines **FM signals from Flow FM Kapunda transmitter:** may experience interference in areas with marginal reception to the northwest of the Project **AM signals:** Unlikely to be affected **Digital radio signals:** Project is outside the intended coverage area	FM signals: Potential for interference to signals from Flow FM Kapunda transmitter AM and digital radio signals: Consultation with operators not considered necessary	**FM signals:** Potential for interference to signals from Flow FM Kapunda transmitter **AM signals:** Unlikely to cause interference **Digital radio signals:** None	**FM signals:** Flow FM have been reconsulted. If required, mitigation strategies are to be determined through further consultation. **AM signals:** if required – install higher-quality antenna at affected location **Digital radio signals:** none required
Television broadcasting	May experience interference in areas with poor or marginal reception **Adelaide transmitter:** *'good' coverage in the Kapunda region surrounding the site with areas to the east and northeast of the site receiving poor to no coverage.* 7 dwellings in potential interference zone	Interference analysis suggests signals are likely to be affected, but no residents will be impacted. Rectification of any interference is expected to form part of the Project.	Low likelihood of interference	If required – re-align antenna at affected dwelling to existing tower, re-direct antenna to alternative tower, install more directional or higher gain antenna, change location of antenna, install cable or satellite television, install relay transmitter

1 INTRODUCTION

RES Australia Pty Limited ("the Customer") has commissioned DNV to independently assess the potential electromagnetic interference (EMI) related impacts associated with the proposed Twin Creek Wind Farm ("the Project") in South Australia. The results of this work are reported here.

In accordance with the South Australian Planning and Design Code (SA Planning Code) prepared by the Government of South Australia [1] and the National Wind Farm Development Guidelines – Draft (Draft National Guidelines) prepared by the Environment Protection and Heritage Council (EPHC) in July 2010 [2], this assessment investigates the potential EMI impact of the Project on:

- fixed point-to-point links
- fixed point-to-multipoint links
- radiocommunication assets belonging to emergency services
- meteorological radars
- trigonometrical stations
- Citizen's band (CB) radio and mobile phones
- wireless internet
- satellite television and internet
- broadcast radio and television.

"Radiocommunications" is used as a broad term in this report to encompass all services that rely on microwave or radio frequency electromagnetic waves to transfer information, including those listed above.

DNV has previously conducted an EMI assessment for the Project site, as reported in DNV report 170894-AUME-R-02-E Twin Creek EMI Assessment dated 26 June 2017 [3], based on a different turbine layout and configuration. The turbine layout considered in the previous EMI assessment was comprised of up to 51 turbines, with a rotor diameter of 136 m and tip height of 180 m.

2 DESCRIPTION OF THE SITE AND PROJECT

2.1 The site

The proposed Project site is located in South Australia, approximately 74 km northeast of Adelaide and 5.5 km south of Eudunda. The site is characterised by undulating terrain and predominantly consists of land cleared for agriculture with relatively sparse vegetation.

2.2 The Project

2.2.1 Proposed wind farm layout

The Project is proposed to consist of up to 42 wind turbines [4]. A map of the site with the proposed turbine layout is shown in Figure 1, and the coordinates of the proposed turbine locations are presented in Table 3.

2.2.2 Dwelling locations

The locations of dwellings in the vicinity of the Project have been provided by the Customer [5, 6]. Buildings identified by the Customer as sheds or ruins have been omitted from this assessment [7, 8, 9].

For the purposes of this assessment, DNV has evaluated the potential for EMI-related impacts at identified dwellings within 5 km of the Project boundary. The locations of identified dwellings more than 5 km from the Project boundary have also been shown, where available, but impacts at these dwellings have not been considered. There are 220 dwellings located within 5 km of the Project boundary, 9 of which are associated with the Project. The coordinates of these dwellings are presented in Table 4, and the dwellings and Project boundary considered in this assessment are shown in Figure 1.

DNV has not carried out a detailed and comprehensive survey of building locations in the area and is relying on information provided by the Customer. For the purposes of this assessment, DNV has assumed that all listed dwellings are inhabited, except where indicated otherwise in Table 4.

3 REGULATORY REQUIREMENTS

There are two sets of guidelines that are potentially relevant to the assessment of electromagnetic interference impacts for wind farms in South Australia.

Performance Outcome 8.1 – Interface between Land Uses (General Development Policies) of the SA Planning Code [1] states that developments in rural or remote areas should not *"unreasonably diminish or result in the loss of existing communication services due to electrical interference"*.

However, although the SA Planning Code notes the importance of minimising EMI related impacts, it does not provide a detailed methodology for assessing these impacts.

The EPHC, in conjunction with Local Governments and the Planning Ministers' Council released a draft version of the National Wind Farm Development Guidelines in July 2010 (Draft National Guidelines) [2]. The Draft National Guidelines cover a range of issues across the different stages of wind farm development.

In relation to EMI, the Draft National Guidelines provide advice and methodologies to identify likely affected parties, assess EMI impacts, consult with affected parties and develop mitigation steps to address the likely EMI impacts.

DNV considers that the recommendations of the Draft National Guidelines meet, if not exceed, the policy in the SA Planning Code, and therefore the Draft National Guidelines have been used to inform the methodology adopted for this assessment.

4 EMI CAUSED BY THE PHYSICAL PRESENCE OF WIND TURBINES

4.1 Assessment approach

If not properly designed, wind farms have the potential to interfere with radiocommunication services. Two services that are most likely to be affected are television broadcast signals and fixed point-to-point signals. Terrestrial broadcast signals are commonly used to transmit domestic television, while point-to-point links are used for line-of-sight connections for data, voice, and video. The interference mechanisms are different for each of these and, hence, there are different ways to avoid interference.

The Customer has asked DNV to complete this assessment based upon a layout provided for the Project consisting of up to 42 wind turbines, as outlined in Table 3.

For the purpose of the EMI assessment, a candidate turbine with a rotor diameter of 172 m, an upper tip height of 220 m, and a lower tip height of 48 m has been considered. These dimensions represent the maximum tip height and rotor diameter under consideration for the Project. The results generated based on this turbine configuration will be conservative for all turbine configurations with dimensions that remain inside the turbine envelope by satisfying all of the following criteria:

- a rotor diameter of 172 m or less
- an upper tip height of 220 m or less
- a lower tip height of 48 m or more.

The Draft National Guidelines recommend that a radial distance of 50 km to 60 km from the centre of a wind farm would normally capture all of the potentially affected services in the area. However, the methodology for assessing the potential radiocommunications interference used in this assessment is to locate all of the radiocommunication towers within approximately 75 km of the proposed Project, and then assess the radiocommunication licences attached to these towers. This reduces the likelihood that radiocommunication links crossing the Project are inadvertently excluded from the assessment.

To conduct the EMI assessment, information regarding radiocommunications licences in the vicinity of the Project was obtained from a copy of the Australian Communications and Media Authority (ACMA) Register of Radiocommunications Licences (RRL) database dated 20 September 2023 [10].

Other services with the potential to experience interference from the Project have also been identified, and the potential for interference to those services assessed. These services include meteorological radars, trigonometrical stations, CB radio and mobile phones, wireless internet, broadcast radio, satellite television and internet, and broadcast television.

The Draft National Guidelines recommend that consultation with the relevant operators be undertaken if a turbine is located within 2 km of a radiocommunication site, within the second Fresnel zone of a point-to-point link, or within 250 nautical miles of an aeronautical or meteorological radar site. DNV has consulted with organisations operating services that may be impacted by the development and operation of the Project, to disseminate basic information on the Project and request responses from the organisations regarding whether they foresee any potential EMI-related impacts on their operations and services. The organisations that have been contacted and all responses received to date are summarised in Table 12. Consultation with these operators has been undertaken in three stages:

1. Consultation was conducted in May 2021 as part of the previous EMI assessment with all identified organisations based on a turbine layout consisting of up to 51 turbines with a rotor diameter of 136 m and an upper tip height of 180 m ("the previous turbine layout and dimensions").

2. Further consultation was conducted in December 2023 with those organisations that had expressed concerns or had not previously responded to the consultation undertaken in May 2021, based on a turbine layout consisting of up to 42 turbines with a rotor diameter of 172 m and an upper tip height of 220 m ("the interim turbine layout and dimensions"). It was not considered necessary to re-engage with operators who had indicated that they did not expect impacts based on the previous turbine layout and dimensions and where the potential for interference was not expected to be sensitive to changes in the layout or dimensions.

3. Turbine 30 in the interim turbine layout and dimensions was subsequently relocated to be clear of all interference zones modelled by DNV. As a result, consultation with the relevant operators was repeated in January 2024, based on the turbine layout and dimensions considered in this assessment ("the current turbine layout and dimensions", consisting of up to 42 turbines with a rotor diameter of 172 m and an upper tip height of 220 m).

The organisations that have been contacted and all responses received to date are summarised in Table 12.

The radiocommunication licences and services with potential to experience EMI-related impacts from the proposed Project are considered in the following sections. Each section contains a brief overview of the relevant technology, followed by an assessment of the identified licences and services in the area around the Project and the expected potential for interference. Details of any feedback obtained from the service operators and potential mitigation options are also included where appropriate.

4.2 Radiocommunication towers

Wind turbines located close to radiocommunication sites have the potential to cause interference through near-field effects or reflection or scattering of the signals. According to the Draft National Guidelines [2], the near-field zone for a transmission tower can vary from several metres to approximately 720 m depending on the service type. The Draft National Guidelines therefore recommend that any radiocommunication site within 1 km of a proposed turbine location be considered as having the potential to be impacted by near-field effects. The potential for a turbine to cause reflection or scattering of signals also depends on a number of factors, including the service type, the required signal-to-noise ratio for the service, and the distances between the user, transmission tower, and turbine. Since there is no single criterion for potential impact on radiocommunication services due to near-field effects and reflection or scattering, the Draft National Guidelines recommend consulting with the service operator if any turbine is to be located within 2 km of a radiocommunication site.

4.2.1 Locations of radiocommunication towers and potential for interference

From the ACMA RRL database, there are 1693 radiocommunication towers within a nominal 75 km of the Project boundary. The locations of these radiocommunication towers relative to the Project are shown in Figure 2.

There are no radiocommunication towers located within 2 km of the proposed turbine locations. The nearest tower is located approximately 4 km east of the nearest proposed turbine location. Therefore, it is not expected that the Project will cause interference to the radiocommunications associated with that tower through near-field effects or reflection or scattering of the signals.

4.3 Fixed licences of point-to-point type

Point-to-point links are often used for line-of-sight connections for data, voice, and video. Such links often exist on mobile phone and television broadcast towers. The frequency of common microwave signals varies from approximately 1 GHz to 30 GHz.

Wind turbines can potentially cause interference to point-to-point microwave links and, in some cases, point-to-point ultra high frequency (UHF) links through three mechanisms: diffraction of the signal, reflection or scattering of the signal, and near-field effects. It is generally possible to design around these issues as the link paths and potential interference zones for these signals can be determined.

4.3.1 Locations of point-to-point links and potential for interference

DNV has analysed the registered licences for each radiocommunication tower according to the ACMA RRL database to determine the transmission paths of the licenced links. For this analysis, DNV has used a wider and more conservative frequency range of 0 GHz to 50 GHz.

Each individual link was given a unique identifier or "Assignment ID" so that it could be readily distinguished. This Assignment ID was taken as either the Device Registration ID (for spectrum licences associated with the use of certain frequency band within a particular geographic area) or the EFL ID (for apparatus licences associated with the use of a particular device).

The links paths associated with the analysed towers are shown in Figure 3. It can be seen that not all of the identified transmission towers have a fixed licence of point-to-point type transmission vector. Some towers have no active licences associated with them, and some towers are used solely for point-to-area style transmissions, such as some emergency services towers.

There are 11 point-to-point links over five link paths recorded in the ACMA RRL database that pass over the proposed Project boundary, operated by Spark Infrastructure SA (No 2) Pty Limited (SA Power Networks), NBN Co Limited, Optus Mobile Pty Limited, Wan Solutions Pty Ltd (SWOOP), South Australian Water Corporation (SA Water) and the South Australian Government Radio Network. The details of the links are provided in Table 5, and the link paths are shown in greater detail in Figure 4 based on information obtained from the ACMA RRL database, provided by the link operators, and extracted from aerial or satellite imagery.

The potential interference mechanisms and interference zones established by DNV for these links are described in Sections 4.3.1.1, 4.3.1.2, and 4.3.1.3. Feedback obtained from the operators of the links is summarised in Section 4.3.2.

4.3.1.1 Interference caused by diffraction

The potential for interference to a fixed point-to-point link through diffraction or obstruction of the signal can usually be avoided by keeping clear of an exclusion zone of circular cross-section around the link path from the transmitter to the receiver [2, 11, 12], typically defined in terms of the Fresnel zones for the link. The *n*th Fresnel zone is comprised of all points for which, if the signal travelled in a straight line from the transmitter to the point and then to the receiver, the additional length compared to the straight transmitter-receiver path equals $\frac{n-\lambda}{2}$, where λ = wavelength.

The radius of the *n*th Fresnel zone varies along the length of the signal, and is given by:

$$R_{Fn} = \sqrt{\frac{n\lambda d_1 d_2}{D}}$$

where d_1 is the distance from the transmitter
d_2 is the distance from the receiver
D is the distance from the transmitter to receiver, such that $d_1+d_2 = D$

To avoid interference to point-to-point links caused by signal diffraction, wind turbines, including the blades, should be kept outside of an exclusion zone based on either the second Fresnel zone as recommended in [11], or potentially 60% of the first Fresnel zone for links below 1,000 MHz with a clear line of sight as suggested in [13] (although DNV understands that this zone is under review by the authors of that document). For each of the links crossing the proposed Project boundary, DNV has established a diffraction exclusion zone based on the second Fresnel zone for that link.

It is common practice to have multiple Assignment IDs for the same physical link to cover practicalities such as licensing for sending or receiving signals. Accordingly, the second Fresnel zone for each link has been calculated based on the Assignment ID with the lowest frequency.

The potential diffraction exclusion zones in the horizontal plane are shown in Figure 4. Each exclusion zone includes the rotor radius for turbines with a 172 m rotor diameter, and an additional buffer to account for potential inaccuracies in the radiocommunication tower locations. The size of the uncertainty buffer for the SA Water link is based on the deviations between the tower locations provided by the operator and given in the ACMA RRL database, and the apparent locations determined from aerial or satellite imagery. For all other point-to-point links a standard buffer of 25 m has been applied to account for potential inaccuracies in the tower locations given in the ACMA RRL database.

As shown in Figure 4, there are no turbines located within the diffraction exclusion zone for the point-to-point links passing over proposed Project site. Therefore, it is not expected that the Project will cause interference to the point-to-point links through diffraction of the signals.

4.3.1.2 Interference caused by reflection or scattering

Interference due to reflection or scattering of a fixed point-to-point link can occur when the signal produced by the transmitting antenna is reflected, scattered, or re-radiated by an intervening object into the corresponding receiver antenna. If the reflected or scattered signal is sufficiently strong that the ratio of the direct signal to the indirect signal is lower than the required carrier-to-interference (C/I) ratio, or protection ratio, for the link, the link performance can be degraded. The extent to which an object such as a wind turbine will reflect or scatter electromagnetic waves is characterised by its radar cross section (RCS) [11].

Reference [11] describes a methodology for calculating the C/I ratio that might be expected at a receiver in the presence of a reflected or scattered signal from a wind turbine at a specified location. By evaluating the C/I ratio for incremental changes in the distances between the transmitter, receiver, and wind turbine, and comparing this to the required C/I ratio, a potential interference zone can be defined.

DNV considers that the transmission towers for all of the point-to-point link crossing the Project boundary are sufficiently far from the proposed turbine locations to avoid reflection or scattering effects. Therefore, it is not expected that the Project will cause interference to the point-to-point links through reflection or scattering of the signals.

4.3.1.3 Interference caused by near-field effects

The potential for interference to fixed point-to-point links caused by near-field effects can generally be avoided by keeping clear of the near-field zone for the transmitting or receiving antenna. Within the near-field zone, local inductive and capacitive effects are significant and it is difficult to predict the potential impacts of other objects on the transmitted or received signal. Although the near-field distance typically varies with direction relative to the link path, for most practical purposes the near-field zone can be approximated as a sphere centred on the transmitting or receiving antenna.

Reference [11] presents an equation for estimating the radius of the near-field zone for a point-to-point link from the properties of the transmitting or receiving antenna.

DNV considers that the transmission towers for all of the point-to-point link crossing the Project boundary are sufficiently far from the proposed turbine locations to avoid near-field effects. Therefore, it is not expected that the Project will cause interference to the point-to-point links through near-field effects.

4.3.2 Stakeholder consultation

DNV has contacted the operators of the point-to-point links crossing the proposed Project boundary to determine the likelihood that the proposed Project will cause interference to their operations and services through diffraction, reflection or scattering, or near-field effects.

Responses have been received from NBN Co, Optus Mobile, SA Water and SA Power Networks, as summarised in Table 12. NBN Co and Optus have indicated that they do not expect their point-to-point links to be impacted by turbines at the Project.

SA Water have previously expressed concerns regarding the potential for turbines at the Project to interfere with their point-to-point link crossing the Project site. SA Water previously advised that the Customer proceed at their own risk, and that "any impact on the SA Water point-to-point link post construction will be the responsibility of the wind farm developer/owner to remedy". The interim turbine layout has since been reviewed by SA Water who have advised that impacts are unlikely provided that the current exclusion zone is maintained. DNV recommends that turbines at the Project be kept outside the second Fresnel zone for the SA Water point-to-point link in order to minimise the potential for interference. DNV notes that the current turbine layout and dimensions respect the modelled exclusion zone, and so further consultation with SA Water was not considered necessary.

Consultation with SWOOP and the South Australian Government Radio Network in relation to their point-to-point links was not considered necessary, as these links cross the Project boundary far from the proposed turbine locations, as shown in Figure 4.

4.3.3 Mitigation options

In the event that interference to point-to-point links is experienced after the Project is operational, mitigation options would need to be confirmed through consultation with the relevant operators but may include upgrading the equipment for the affected links, re-routing links via an existing or new tower, or replacing links with alternative communication technologies.

4.4 Fixed licences of point-to-multipoint type

Fixed licences of the point-to-multipoint type are a variation of the point-to-point type. The difference between them is administrative. A point-to-point licence permits communication between two static sites, where the locations of the sites are detailed in the ACMA RRL database. A point-to-multipoint licence allows communication between one or more static sites and multiple points or between the points, and is usually licensed for a defined operational area.

Administratively, the ACMA RRL database details the location of the static station for a fixed licence of the point-to-multipoint type but does not include the remote stations that communicate with the static station. Hence, the paths of the transmission vectors are not readily identifiable.

4.4.1 Locations of point-to-multipoint licences and potential for interference

From the ACMA RRL database, DNV has identified 258 point-to-multipoint Assignment IDs within approximately 75 km of the proposed Project boundary. These licences are shown in Figure 5. The details of the licence holders as given in the ACMA RRL database are provided in Table 6.

There are 6 point-to-multipoint base stations within 20 km of the Project boundary, operated by Spark Infrastructure (No2) Pty Limited (SA Power Networks), Telstra, South Australian Water Corporation (SA Water), Barossa Valley Golf Club, The Barossa Council and the Bureau of Meteorology. There are also several point-to-multipoint base stations located more than 20 km from the Project.

Wind turbines can cause interference to point-to-multipoint links through the same mechanisms as described for point-to-point links in Section 4.3.1. As such, there may be potential for interference to point-to-multipoint links if those links cross the Project near the turbines. However, as it is not possible to know the link paths in a point-to-multipoint network without obtaining further information about the locations of each station in the network, DNV has consulted with the relevant operators, as discussed in Section 4.4.2.

As part of the previous EMI assessment, DNV contacted the operators of potentially affected point-to-multipoint licences to seek feedback on whether their services are likely to be affected by the Project. Responses received at the time highlighted that SA Power Networks operate a fixed link that crosses the site boundary near the turbine locations and could therefore be impacted. The feedback received from SA Power Networks and the potential for interference to their link is discussed in further detail in Section 4.4.2.

4.4.2 Stakeholder consultation

DNV has contacted the operators of potentially affected base stations identified within approximately 60 km of the Project, to determine the likelihood that the proposed Project will cause interference to their operations and services.

Responses based on the previous layout and dimensions have been received from several operators, as summarised in Table 12. No concerns have been raised by Telstra, the Bureau of Meteorology and SA Water regarding potential impacts to their fixed point-to-multipoint links.

Barossa Council have advised that the point-to-multipoint links associated with their licence to the south of the Project are all directed away from the wind farm and therefore are not expected to be impacted.

As a result of the consultation process, SA Power Networks has advised that they operate a fixed link which crosses the Project site between their point-to-multipoint base station at Mt Rufus (Site ID 24227) and an electrical substation at Kapunda. The path of this link is shown in Figure 6.

DNV has established a diffraction exclusion zone for the link based on the second Fresnel zone for the minimum operating frequency, plus the rotor radius for turbines with a 172 m rotor diameter and an additional buffer to account for potential inaccuracies in the tower locations, as described in Section 4.3.1.1. The size of the uncertainty buffer for the SA Power Networks link is based on the deviations between the tower locations provided by the operator and given in the ACMA RRL database, and the apparent locations determined from aerial or satellite imagery.

The potential exclusion zone for the SA Power Networks link passing over the proposed Project site is also shown in Figure 6, and it can be seen that there are no turbines located within the exclusion zone.

SA Power Networks have commented on the current turbine layout and dimensions provided and confirmed that they are satisfied with an exclusion zone based on the second Fresnel zone, and that they do not expect their link to be impacted by turbines located outside this zone. This exclusion zone is respected in the current turbine layout.

The current turbine layout and dimensions have been provided to other relevant operators for their review and feedback, but no further responses have been received to date.

4.4.3 Mitigation options

In the event that interference to point-to-multipoint links is experienced after the Project is operational, mitigation options would need to be confirmed through consultation with the relevant operators but may include re-routing the affected links via an existing or new tower, installing additional towers, or replacing the links with alternative communications technologies.

4.5 Other licence types

Besides fixed point-to-point and point-to-multipoint licences, other licence types recorded in the ACMA RRL database include spectrum licences that permit a range of radiocommunications in a specific geographic area and frequency band, private mobile radio and public telecommunications service (PTS) licences, television and radio broadcasting licences, amateur apparatus licences, and aeronautical licences for ground to aircraft communications.

4.5.1 Locations of other licences and potential for interference

DNV has identified a number of other licences in the ACMA RRL database within 75 km of the proposed Project boundary. The locations of these licences and number of associated Assignment IDs for each licence type are shown in Figure 7 and Table 7.

Most of the licences identified can be broadly described as base to mobile station or point-to-area style communications, including commercial and private mobile telephony and radio and television broadcasting. These licence types are generally not affected by the presence of wind turbines any more than other effects such as terrain, vegetation, and other forms of signal obstruction.

The potential for interference to emergency services signals and commercial mobile telephony signals is discussed further in Sections 4.6 and 4.11 respectively, while the potential for interference to radio and television broadcasting services is considered in Sections 4.14 and 4.15.

A number of aeronautical licences, and radiodetermination licences which may be used for aircraft navigation, have been identified. DNV understands that potential impacts to these services have been considered as part of an aviation impact assessment study.

The results of the previous EMI assessment were broadly similar to the current results regarding other licence types. However, the turbine dimensions used in the current EMI assessment have increased and therefore the likeliness of interference may be greater.

4.6 Emergency services

Licence types operated by emergency services such as state ambulance, police, fire, and rescue services typically comprise fixed point-to-point link and mobile radio communications.

4.6.1 Locations of emergency services licences and potential for interference

DNV has reviewed the ACMA RRL database to identify emergency services with licences for radiocommunication assets operating in the vicinity of the Project. The groups identified are listed in Table 8 along with their contact details. The nearest licence is associated with a tower located approximately 9 km from the Project boundary.

The potential for the turbines at the Project to interfere with emergency services point-to-point links crossing the proposed Project site is discussed in Section 4.3.

All other licences operated by emergency services in the vicinity of the Project are mobile telephony licences used for mobile radio and paging systems, or maritime radiocommunication licences that are restricted to coastal areas. As discussed in Section 4.5, mobile telephony systems are generally not affected by the presence of wind turbines any more than other forms of signal obstruction. Reference [13] provides general guidance regarding the potential for interference with mobile radio systems, and suggests that a clearance of 500 m from the tower is sufficient to avoid significant impacts to these systems. Other references recommend that turbines be kept outside of clearance zones ranging from a distance of 200 m to 1200 m from the tower for point-to-area style services [14].

Given the distance of the emergency services mobile telephony licences from the Project, DNV considers it unlikely that the Project will cause interference to mobile radio and paging systems operated by emergency services.

4.6.2 Stakeholder consultation

DNV has contacted the operators of potentially affected licences identified within approximately 60 km of the Project, to seek feedback on any potential impact that the Project could have on their operations and services. Responses have been received from several operators, as summarised in Table 12, and no concerns have been raised to date.

4.6.3 Mitigation options

Potential mitigation options for impacts to emergency services point-to-point links crossing the Project boundary are discussed in Section 4.3.1.

If localised interference to mobile radio or paging system signals is experienced, this can often be mitigated by the user moving a short distance to a new or higher location to receive a clearer signal or by using an external antenna to improve the signal reception. Other mitigation options may include increasing the signal strength from the affected tower or alternative towers, or installing a signal repeater or additional tower on the opposite side of the Project.

4.7 Aircraft navigation systems and radar

DNV understands that a separate aviation impact study has been undertaken to assess the impact of the Project on nearby aviation navigation systems and radar.

4.8 Meteorological radar

The Bureau of Meteorology ("the Bureau") operates a network of weather radars across Australia consisting of high-resolution Doppler radars and standard weather watch or weather surveillance radars. Operation of the Bureau's part-time wind finding radar installations ceased in August 2019 [15].

Standard weather watch radars emit pulsed microwave radiation and use reflections or "echoes" of that radiation from water particles in the atmosphere to detect rain and storm activity. Doppler radar installations operate in the same way but are also able to measure the speed of the moving water particles, and therefore can provide information about wind speed and direction [16, 17].

While the uninhibited operation of meteorological radars may not be as critical as aviation radar, there are implications for public safety if severe weather is not predicted or if its approach is masked due to EMI. Because radar installations monitor the current weather situation over a wide area, the information they provide can be used to indicate the possibility and approach of severe storms, tropical cyclones, and flooding events. Wind profile measurements are also used to ensure the safe and economical operation of aircraft and provide an important source of data for the Bureau's general weather forecasting system.

The optimal coverage area for a weather radar generally extends approximately 200 km from the radar installation at a height of around 3000 m [18, 19], and approximately 100 km at a height of 1000 m [19]. Therefore, wind farms can theoretically impact on weather radar operations when located within several hundred kilometres of an installation. However, due to the curvature of the earth and intervening terrain, the range at or near ground level is generally less.

The World Meteorological Organisation (WMO) currently states that wind turbines should not be located within 5 km of a meteorological radar site, due to the high potential for complete or partial blockage of the radar signal and subsequent loss of weather data [20, 21]. For wind farms located between 5 km and 20 km of a radar, the WMO recommends consultation and analysis to assess the likelihood of turbines causing reflection or scattering of the radar signals or interfering with Doppler velocity measurements. At distances of between 20 km and 45 km, the presence of a wind farm may produce radar echoes or signal clutter that can cause loss of data or be mistaken for rain. Significant impacts are generally not expected for wind farms located more than 45 km from a meteorological radar, since in most cases the turbine will be below the radar scan line of sight. However, the WMO notes that these guidelines are only applicable to typical radar installations in flat terrain and may need to be modified for higher-powered radars or specific situations.

DNV notes that previous advice received from the Bureau also suggests that there may be potential for interference to meteorological radar operations from wind farms over much greater distances than indicated by the WMO guidelines, depending on the relative elevations of the radar and the wind farm and the intervening terrain.

According to the Draft National Guidelines, operators of weather radars within 250 nautical miles (463 km) of the proposed Project should be consulted [2].

4.8.1 Locations of meteorological radars and potential for interference

DNV has identified that the Bureau operates eight weather radars within 250 nautical miles of the proposed Project, with the closest radar located approximately 59 km southwest of the Project at Buckland Park. The locations of these radars are shown in Figure 8 and the details of each radar are given in Table 9.

Although the distance between the Project and the nearest Bureau radar is greater than the distances at which the WMO suggests impact may occur, consultation with the Bureau, as discussed in Section 4.8.2, is ongoing in order to determine the potential for interference.

4.8.2 Stakeholder consultation

DNV has contacted the Bureau regarding the Project, as recommended by the Draft National Guidelines, to seek feedback on whether interference to their operations and services is likely.

The current turbine layout and dimensions have been provided to the Bureau for their review and feedback. The response received from the Bureau indicates that the Project has potential to materially impact the operation of their radar at Buckland Park. Specifically, analysis undertaken by the Bureau has suggested that turbines at the Project have the potential to be visible on the first three scan angles for the Buckland Park radar. Therefore, there is a high potential for interference with weather monitoring and predictions from the Buckland Park radar facility.

4.8.3 Mitigation options

DNV understands that the Customer has commenced discussions with the Bureau in relation to measures that may be deployed to minimise the potential impact on Bureau infrastructure. Discussions to date indicate that the installation of automatic weather stations and automatic rain stations (specific number to be determined in conjunction with the Bureau as the Project progresses) if/as required would be incorporated as part of the Customer's commitment to the Project.

4.9 Trigonometrical stations

A trigonometrical station, also known as a trig point or a trig beacon, is an observation mark used for surveying or distance measuring purposes.

Some trig points may host surveying equipment such as Global Positioning System (GPS) antennas and electronic distance measuring (EDM) devices. EDM devices measure the distance from the trig point to the target object by means of a beam of known velocity which is reflected back to the unit from the target object. Most EDM devices require the target object to be highly reflective and, accordingly, a reflective prism is placed on the target object being surveyed.

The effective range of EDM devices depends on the wavelength bands used. Light wave and infrared systems have an effective range of 3 km to 5 km, and could be intercepted or obstructed by the presence of turbines. However, the potential for impact is considered low as it is likely to be possible to relocate the target to obtain an unobstructed view of the trig point. Microwave systems can measure distances up to 150 km, but such systems are not limited by the line of sight or affected by visibility [22].

Global navigation satellite system (GNSS) technology is also commonly used for surveying and distance measurements, as it enables users to accurately determine their geographic location using positioning and timing information received from satellite signals. Geoscience Australia currently operates several GNSS networks across Australia, including the Australian Regional GNSS Network (ARGN) and the AuScope GNSS network [23]. The ARGN is comprised of 20 permanent GNSS Continuously Operating Reference Stations (CORS) which provide the geodetic framework for the spatial data infrastructure in Australia and its territories. Eight stations from the ARGN form the Australian Fiducial Network (AFN) [24], through which the Geocentric Datum of Australia (GDA) is defined. The ARGN also provides information for the measurement of geological processes and contributes data to the International GNSS Service. Additional geospatial information aimed at enhancing the accuracy and resolution of the National Geospatial Reference System is provided by the AuScope GNSS network of around 100 CORS strategically distributed across the country, and several private and state-based GNSS CORS networks. GNSS stations are typically equipped with EDM devices and GPS receivers, and transmit data to Geoscience Australia or the relevant state authority via phone lines, internet, or satellite communications.

4.9.1 Locations of trigonometrical stations and potential for interference

According to Geoscience Australia [25], there are 55 trig points within 20 km of the Project boundary. Two trig points, Bald Hill and 6729/1004, are located inside the Project boundary and are both approximately 1.5 km east of the nearest proposed turbine location. The details of these trig points are provided in Table 10 and their locations are illustrated in Figure 9. There are many survey marks within 2 km of the Project boundary [26] as shown in Figure 9. The closest survey mark is located 116 m northeast of the nearest turbine.

DNV has reviewed the primary geodetic network of Australia [27] and observed that the Project is located within the high-density trilateration region. Trilateration depends on distances measured from trigonometrical stations of known positions, baselines and heights, with a high degree of accuracy, to determine the location of the site being surveyed.

The closest GNSS station is located approximately 26 km north of the Project, at Robertstown [28]. Due to the significant distance between the Project and the GNSS station, it is considered unlikely that the Project will cause interference to the GNSS network.

4.9.2 Stakeholder consultation

Although it is unlikely that the trig points in close proximity to the Project host EDM devices or other equipment that may be subject to EMI, DNV has contacted Geoscience Australia and the South Australian Land Services Group to inform them of the Project, and seek feedback regarding whether interference to their systems is possible. Responses have been received from both operators, based on the previous turbine layout and dimensions as summarised in Table 12, and no concerns have been raised.

Further consultation with Geoscience Australia and the South Australian Land Services Group is not considered necessary.

4.10 Citizen's band radio

Citizen's band radio, also known as CB radio, is a class-licensed two-way, short distance communication service that can be used by any person in Australia for private or work purposes. It is commonly used in rural areas for emergency communications, road safety information, communication between recreational travellers, and general conversation. The class licence implies that all users of the CB radio operate within the same frequency range on a shared basis and no individual licence is required.

The CB radio service can be used for voice communication activities, telemetry, and telecommand applications. The radio service operates on two frequency bands, namely the high frequency (HF) band between 26.965 MHz and 27.405 MHz and the ultra-high frequency (UHF) band between 476.425 MHz and 477.400 MHz.

The HF CB radio service was legalised in Australia in the 1970s as a temporary move to switch to UHF CB over the following five years, and transmits signals in either AM (amplitude modulation) or SSB (single side band) transmission mode. The actual range over which the signal is transmitted depends on the antenna used, the terrain, and the interference levels. Over the last decade, the use of the HF CB radio service has declined and has been replaced by UHF CB radio service.

The UHF CB radio service is unique in Australia and uses the FM (frequency modulation) transmission mode. It provides clear communication over 5–20 km and is less susceptible to power line noise. However, the UHF CB radio service requires a clear line-of-sight for a strong signal and is easily hindered by hilly terrain and forested areas. Even in the absence of physical obstructions, UHF CB radio signals generally cannot travel beyond the effective radio horizon, which depends on elevation, antenna height, weather, and atmospheric conditions. If located on a hilltop, CB radio signals can be transmitted over at least 50 km. However, under normal conditions on flat ground, signal range is typically limited to around 5 km. CB repeater stations are often set up on hilltops by community groups and commercial organisations to transmit signals from one channel to another.

No individual or organisation owns or has the right to use a channel exclusively. However, out of the 40 channels available, some of them will be allocated to emergency, telemetry, or repeater inputs.

4.10.1 Locations of CB radio devices and potential for interference

Since users of CB radio services do not require a licence, there is no record of users of the service and their locations and the channels are shared among the users and the repeater stations without a right of protection from interference. Given the limitations of UHF radio signals, CB radio services are typically only intended for local or short-range communications. CB radio signals passing through the Project are likely to be intercepted by existing obstructions such as terrain and vegetation, and there is little evidence in the literature to suggest that wind turbines pose a particular risk of interference to these systems. Therefore, the impact of the Project on CB radio services is expected to be minimal.

4.10.2 Mitigation options

If interference to CB radio signals is experienced, simple steps such as moving a short distance to a new or higher location until the signal strength improves may help to mitigate the impact. CB radio users can also increase their signal range and improve reception by switching their equipment to a higher power setting, using a longer antenna, or increasing the antenna mounting height.

4.11 Mobile phones

Mobile phone networks typically operate at frequencies of either between 700 and 900 MHz, or between 1800 MHz and 2600 MHz, however some new services may operate at up to 3500 MHz. At such frequencies, signals may be affected by physical obstructions such as buildings and wind turbines. However, mobile phone networks are designed to operate in such conditions and in most cases, if there is sufficient mobile network coverage and signal strength, the presence of wind turbines is unlikely to cause any interference.

In rural areas, the mobile network coverage may be more susceptible to physical obstructions due to the large distance between the phone towers and the mobile phone user. In that case, it is theoretically possible that wind turbines could cause some interference to the signal. However, there is little evidence in the literature of wind turbines interfering with mobile phone signals, and DNV notes that previous advice received from mobile phone network operators in Australia has generally indicated that they do not expect wind farm developments to interfere with their services provided that appropriate clearances from the mobile phone towers are maintained.

4.11.1 Availability of mobile phone services and potential for interference

DNV has reviewed the locations of mobile phone towers in the vicinity of the proposed Project. The locations of these towers are shown in Figure 11. The nearest mobile phone tower is located approximately 4 km east of the closest turbine.

Mobile phone network coverage maps have been obtained for Optus, Telstra, and Vodafone.

Figure 12 shows the Optus Mobile network coverage for the Project area [29]. The map shows outdoor 4G coverage at most locations in the vicinity of the Project, with some areas within the site boundary and immediately to the east requiring an external antenna to receive 4G coverage.

Figure 13 shows the Telstra network coverage for the Project area [30]. The map shows 4G coverage in the vicinity of the Project, although some areas within the site and predominantly to the east and southeast of the site appear to have no coverage.

Figure 14 shows the Vodafone network coverage for the Project area [31]. Most areas within the vicinity of the Project receives 4G coverage. There are areas towards the northeast, surrounding Neales Flat, which receive no Vodafone coverage. Although the coverage map also shows areas where Vodafone 3G coverage is available, this service was turned off in January 2024.

In general, for areas with good coverage, interference to mobile phone signals is unlikely. However, for areas where the reception is likely to be marginal, such as those where an external antenna is required, the possibility for interference exists if a wind turbine intercepts the signal between a mobile phone and the tower.

4.11.2 Stakeholder consultation

DNV has contacted Optus, Telstra, and Vodafone to inform them of the proposed Project and to seek feedback on any potential impact that the Project could have on their services. Responses have been received from all operators, based on the previous turbine layout and dimensions as summarised in Table 12, and no concerns have been raised to date. Further consultation with these operators in relation to potential impacts on their mobile phone services is not considered necessary.

4.11.3 Mitigation options

As noted above, interference with mobile phone signals is considered unlikely. If localised interference is experienced by mobile phone users, mitigation options may include the user moving a short distance to a new or higher location until the signal improves, or using an external antenna to improve the signal reception. For interference over a larger area, or in cases where it would not be possible or practical for the user to change their location, mitigation options relating to alteration or additions to infrastructure would need to be discussed with the mobile phone service provider.

4.12 Wireless internet

Wireless internet services in Australia include wireless broadband provided by mobile phone network operators and other internet service providers, and fixed wireless or satellite internet services through the National Broadband Network (NBN).

Previous feedback received from the Customer suggested that residents in the vicinity of the Project experience poor wireless internet coverage [32], however it is not clear what service these residents are currently using. Residents who have marginal wireless internet coverage may be more susceptible to interference from the wind farm, depending on the technology type, and the relative positions of the infrastructure of the internet service provider, the wind farm, and the residents. The potential for impact to wireless broadband internet services and fixed wireless internet services is discussed in Sections 4.12.1 and 4.12.2 respectively.

4.12.1 Wireless broadband services

Wireless broadband services allow the user to connect to the internet without the need for a phone line or cable connection. The wireless signals may operate by line of sight between a base station and the user's antenna as part of a point-to-multipoint network, or may use point-to-area style transmissions such as mobile phone networks.

4.12.1.1 Availability of wireless broadband services and potential for interference

Residents in the vicinity of the Project may use wireless broadband services provided by Optus, Telstra, and Vodafone. These wireless broadband services use the same networks as mobile phone services, and therefore the comments made in Section 4.11.1 are applicable here. Specifically, there is a low theoretical potential for interference in areas with marginal reception if a wind turbine intercepts the signal between a receiver and the tower.

Feedback received from the Customer as part of the previous EMI assessment suggests that residents in the vicinity of the Project currently experience poor wireless internet coverage [33], however it is not clear what service these residents are currently using. Residents who have marginal wireless internet coverage may be more susceptible to interference from the wind farm, depending on the technology type, and the relative positions of the infrastructure of the internet service provider, the wind farm, and the residents.

The Customer has also indicated that some residents may be utilising wireless internet services provided by local company Beam Barossa [32], now trading as SWOOP. However, as SWOOP does not appear to hold any radiocommunication licences in the vicinity of the Project. Consultation with SWOOP, as discussed in Section 4.12.1.2, has been conducted in order to determine the potential for interference.

4.12.1.2 Stakeholder consultation

DNV has contacted Telstra, Optus, and Vodafone as discussed in Section 4.11.2, to seek feedback on any potential impact that the Project could have on their services. Responses have been received from all operators, based on the previous turbine layout and dimensions as summarised in Table 12, and no concerns have been raised to date. Further consultation with these operators in relation to potential impacts on their wireless internet services is not considered necessary.

DNV has also contacted SWOOP to seek further information regarding their services and customers in the vicinity of the Project, and feedback on whether there is potential for the Project to cause interference to their services. As a result of the consultation process, SWOOP (formerly Beam Barossa and Wan Solutions Pty Ltd) has advised that they operate point-to-multipoint links which cross the Project site and have raised concerns about the potential for interference. These links are used to provide wireless internet services to residents in the vicinity of the Project. DNV has reviewed the link locations provided by SWOOP and has identified potential for interference to some link paths.

4.12.1.3 Mitigation options

As noted above, interference with wireless broadband services is considered unlikely. If interference to the wireless broadband services provided by mobile phone networks occurs, the mitigation options given in Section 4.11.3 may be applicable. Specifically, localised interference can often be rectified by the user moving a short distance or using an external antenna to improve signal reception. For interference over a larger area, or in cases where it would not be possible or practical for the user to change their location, mitigation options relating to alteration or additions to infrastructure would need to be discussed with the relevant service provider.

If interference to SWOOP signals is experienced at nearby dwellings, mitigation options would need to be confirmed through consultation with SWOOP. DNV understands that the Customer is intending to engage with SWOOP to develop technical solutions aimed at minimising potential interference to the SWOOP point-to-multipoint links which cross the Project site.

4.12.2 National Broadband Network

The NBN is a national wholesale broadband access network, which consists of fixed line, fixed wireless, and satellite internet services.

NBN fixed line services use wired connections to provide internet signals directly to the user. This technology is typically only available in urban areas and is not expected to be affected by wind farm developments.

NBN fixed wireless services are available in many rural and regional areas. The signals operate by line of sight between an NBN tower and the user's antenna, with a maximum range of 14 km [34]. Consequently, the signals may be affected by physical obstructions such as terrain, vegetation, and wind turbines [35].

For rural and remote users in areas that are not able to receive fixed line or fixed wireless services, NBN satellite internet signals are available from the NBN Sky Muster I and II satellites.

4.12.2.1 Availability of NBN services and potential for interference

The NBN website [36] indicates that the network is currently available as a fixed wireless and satellite internet service in the area surrounding the Project. It is therefore likely that some residents are currently accessing the internet via the NBN and that the network will also be available to other residents in the vicinity of the Project in the near future. The locations of NBN fixed wireless internet towers within 75 km of the Project boundaries are shown in Figure 11, and a map of NBN service coverage in the vicinity of the Project is shown in Figure 15.

The NBN fixed wireless towers servicing the Project area are located at Truro, Eudunda and Kapunda. Based on the relative positions of these towers and the nearby dwellings, and the fixed wireless coverage areas shown in Figure 15, it is unlikely that turbines at the Project will intercept the line of sight between these towers and nearby dwellings.

DNV understands that NBN Co is planning to extend the fixed wireless coverage range for some towers from 14 km to 29 km [37]. The nearest NBN fixed wireless internet tower is located approximately 2 km from the Project, at Truro, and there is another NBN tower located within 6 km of the Project at Eudunda. If the coverage from these towers is extended and residents in the vicinity of the Project begin receiving fixed wireless internet signals prior to the construction of the Project, there may be potential for interference to the NBN fixed wireless service in the future. However, the assessment presented here is based on the current network availability, as shown in Figure 15, which suggests that interference to NBN fixed wireless internet services is unlikely.

The potential for interference to satellite internet signals from the NBN Sky Muster I and II satellites is considered in Section 4.13.

4.12.2.2 Stakeholder consultation

DNV has contacted NBN Co to seek feedback on whether there is potential for the Project to cause interference to their services. NBN Co have advised that the proposed turbine locations do not pose any physical threat of interference with the NBN signals received at dwellings surrounding the Project. It is also noted that there are no current NBN Co customer dwellings within the Project boundary. DNV recommends further engaging with NBN Co prior to the construction of the Project, to identify any changes to the NBN wireless internet coverage areas in the vicinity of the Project and to confirm the potential for impacts to this service.

NBN Co has requested that the customer provides details on any planned radiofrequency transmission equipment, once this information is available, in order for any potential for interference from that equipment to be assessed. DNV recommends that the Customer engages with NBN Co prior to the construction of the Project, once the details of any radiofrequency transmission equipment are known, to allow NBN Co to determine the potential for interference and to establish an understanding of how any impacts can be mitigated.

4.13 Satellite television and internet

In some rural or remote areas, television and internet access can only be provided through satellite signals. There are two types of satellite that are typically used to provide commercial telecommunication services: geostationary satellites and low Earth orbit (LEO) satellites.

4.13.1 Geostationary satellite communication services

Geostationary satellites orbit the earth directly above the equator, at a height of 35,786 km above the Earth's surface [38]. At this altitude, the satellites travel at the same rate as the Earth's rotational speed and therefore appear to remain stationary at the same point in the sky relative to an observer at a fixed location. Additionally, due to their high altitude, each satellite can view (and therefore provide coverage to) a large portion of the Earth's surface. Geostationary orbits are typically used for weather monitoring satellites that continually observe a specific area of the Earth and for satellites that provide telecommunication services, since the satellite dish or antenna used on Earth to receive and transmit signals can be permanently pointed to the correct location in the sky. Both satellite television and satellite internet services are currently available in Australia via geostationary satellites.

Satellite television signals are delivered via a geostationary communication satellite to a satellite dish connected to a set-top box. Satellite television signals are typically transmitted to the user's antenna in one of two frequency bands: the C-band between 4 GHz and 8 GHz, or the Ku-band between 12 GHz and 18 GHz. Signals in the C-band are susceptible to interference due to radio relay links, radar systems, and other devices operating at a similar frequency. Signals in the Ku-band are most likely to be affected by rain which acts as an excellent absorber of microwave signals at this frequency. The main geostationary satellites that transmit Australian free-to-air or subscription television channels are the Optus C1, D1, and D3 satellites and the Intelsat 19 satellite [39, 40].

In the case of internet services provided by geostationary satellites, the user's computer is connected to a satellite modem which is in turn linked to a satellite dish or antenna mounted on the building roof. When the user accesses the internet, a request is sent to the operation centre of the satellite internet provider via the satellite antenna. Data is then sent back to the user's computer via the same path as shown in the figure below. Satellite internet signals are typically transmitted in the Ku-band, as for satellite television, or the Ka-band, with frequencies ranging from 26.5 GHz to 40 GHz. Like signals in the Ku-band, signals in the Ka-band are susceptible to deterioration caused by moisture in the air, but newer satellites contain technologies that help to minimise the loss of signal quality associated with rain and other weather conditions. The main geostationary satellites for providing satellite internet in Australia are the IPSTAR (THAICOM-4) and Optus D2 satellites, and the NBN Sky Muster I and II satellites.

Two-way connection to the internet via satellite [41]

4.13.1.1 Locations of geostationary satellite vectors and potential for interference

Due to marginal coverage of some communication services, some residents in the vicinity of the Project may use satellite television and internet.

A number of satellites transmit television and internet signals that can be received in Australia. Although only a small number of satellites are likely to be providing services specifically intended for Australian audiences, DNV has considered the line of sight to dwellings in the vicinity of the Project from all theoretically viewable satellites.

The analysis has shown that satellite signals to dwellings in the vicinity of the Project are not expected to be intercepted by turbines.

4.13.2 Low Earth orbit satellite communication services

Satellites in LEO occupy heights between 160 km and 1000 km above the Earth's surface [38]. At these altitudes, the satellites travel significantly faster than the Earth's rotational speed and typically complete a full orbit in approximately 90 minutes. Unlike geostationary satellites, LEO satellites do not have to follow a particular path around the Earth and their orbits are usually tilted with respect to the equator. However, due to their low altitude, each satellite can only observe or communicate with a small portion of the Earth's surface at a time and this, together with their fast movement across the sky, can limit the usefulness of LEO satellites in some situations.

For telecommunication applications, satellites in LEO offer lower latency and better performance than geostationary satellites, due to the reduced distance for the signal to travel. However, using a single LEO satellite to provide telecommunication services is often impractical due to the relatively small coverage area and significant effort required to track the satellite from the ground. To compensate for this, LOE satellites used for telecommunications usually operate as part of a large network or "constellation" of multiple satellites that work together to provide continuous coverage to large areas simultaneously. As satellites within the constellation move through the field of view of a satellite dish on Earth, the dish detects and connects to the satellite with the strongest signal and then automatically switches over to another satellite as the first moves out of view. Nevertheless, these services may be sensitive to physical obstructions such as terrain, vegetation, buildings, and other structures such as wind turbines, which can unexpectedly interrupt the signal from the connected satellite and cause the service to temporarily drop out until a new satellite can be found.

4.13.2.1 Availability of low Earth orbit services and potential for interference

Starlink is the only LEO satellite internet service currently available to customers in Australia. The current Starlink LEO constellation consists of several thousand satellites orbiting the Earth at height of approximately 550 km [42], although this may increase to tens of thousands of satellites in the future. Starlink offers two classes of satellite dish to users of their services: a standard dish that is considered suitable for most residential applications, and a high performance dish which has a wider field of view (enabling it to connect to more satellites, even in the presence of obstructions), a higher gain antenna, and improved performance under extreme environmental conditions [43, 44].

In the southern hemisphere, Starlink satellite dishes currently require a relatively clear view of the sky within a field of view of 100° tilted towards the south, with a minimum elevation angle of 25° above the southern horizon [45]. Although some obstructions can be tolerated, the impact of these obstacles will depend on their apparent size, their distance and direction relative to the satellite dish, and the proportion of the sky already obstructed. Potential obstacles below an elevation angle of 25° in the south, 40° in the east and west, and 40° in the north (allowing for locations where no tilt of the satellite dish is required) will not pose any obstruction to the field of view. However, as more satellites are launched and join the Starlink constellation, it is expected that the required angle of tilt towards the south will reduce until dishes can be pointed directly upwards, with elevation angles above the horizon of 40° in all directions [46], and the service will become less sensitive to obstructions due to the increased number of visible satellites at each location.

DNV has considered the potential for turbines at the Project to obstruct Starlink signals received at nearby dwellings, based on the relative locations of the dwelling and the nearby turbines, the elevations of the dwellings and turbines, and a turbine tip height of 220 m.

At all dwellings in the vicinity of the Project, the turbines are expected to be below an elevation angle of 25° above the horizon in all directions. Therefore, based on this analysis, it is not expected that turbines at the Project will obstruct Starlink signals for any nearby dwellings.

4.14 Radio broadcasting

Radio stations typically broadcast using one of two forms of transmission: either amplitude modulation (AM) or frequency modulation (FM). In Australia, AM radio operates in the medium wave (MW) band at frequencies between 520 kHz and 1610 kHz, while FM radio operates in the very high frequency (VHF) band between 87.5 MHz and 108 MHz.

4.14.1 AM radio

AM radio signals are diffracted by the ground as they propagate, such that they follow the curvature of the earth, and are also reflected or refracted by the ionosphere at night. This means that AM radio waves are able to travel significant distances under the right conditions. Due to their long wavelength, they can readily propagate around physical obstructions on the surface of the earth (such as wind turbines), however they do not propagate easily through some dense building materials such as brick, concrete, and aluminium.

The distance over which AM radio signals can travel means that the signal may be weak and susceptible to interference by the time it reaches a receiver. Some of the possible sources of interference to AM radio waves include changes in atmospheric conditions, signals from distant AM broadcasters operating on a similar frequency, electrical power lines, and electrical equipment including electric motors.

However, as noted above, the presence of physical obstructions such as turbines is unlikely to cause significant interference to AM radio signals. Due to the long wavelength of the signal, interference is only likely in the immediate vicinity of a turbine [47].

4.14.1.1 Locations of AM transmitters and potential for interference

The locations of AM broadcast transmitters in the vicinity of the Project were determined from the ACMA Broadcast Transmitter Database [48], and are shown in Figure 16.

It is unlikely that any permanent AM radio receivers will be located sufficiently close to the Project to be affected by interference to the radio signals from the turbines.

4.14.1.2 Mitigation options

In the event that localised interference to AM radio signals is experienced, this can potentially be rectified by installing a high-quality antenna or amplifier at the affected residence.

4.14.2 FM radio

FM radio signals are better suited to short range broadcasting. Unlike lower frequency signals (such as AM signals), they are not reflected or refracted off the ionosphere. Instead, the waves are slightly refracted by the atmosphere and curve back towards the earth, meaning they can propagate slightly beyond the visual horizon. However, FM radio signals may be blocked by significant terrain features. FM radio stations therefore tend to have only local coverage, which means that signals are less susceptible to interference from distant FM broadcasters. FM signals are also less susceptible to interference from changes in atmospheric conditions and electrical equipment than AM signals.

FM radio signals are susceptible to interference from buildings and other structures, although they are less vulnerable than higher frequency signals. Interference to FM signals can occur by two mechanisms: reflection or scattering of the radio waves, or physical obstruction and attenuation of the broadcast signal.

Reflection or scattering of radio waves by physical structures such as wind turbines can reduce the signal strength at a receiver or can cause multi-path errors through reception of a reflected signal in addition to the primary signal from the transmitter. This can result in hissing, fluttering, or distortion being heard by the listener [49]. However, this type of interference is typically only experienced in the immediate vicinity (within several tens of metres) of a wind turbine, where the signal-to-noise ratio is low [47, 50].

Wind turbines located close to an FM transmitter may also present a physical obstruction to the radio signal. If the line-of-sight between the transmitter and a radio receiver is blocked by a turbine, this can cause a noticeable decrease in signal quality or may lower the signal strength below the threshold of the receiver's sensitivity [49]. In these situations, the attenuation of the signal may be as great as 2.5 dB in the direction of the obstructing wind turbine. However, this type of interference is generally only a problem near the edges of the FM signal coverage area, where the broadcast signal is already weak. For commercial FM broadcast signals, physical obstruction of the signal may occur if the turbines are located within approximately 4 km of the transmitter [51].

4.14.2.1 Locations of FM transmitters and potential for interference

The locations of FM broadcast transmitters in the vicinity of the Project were determined from the ACMA Broadcast Transmitter Database [48], and are shown in Figure 16.

The closest FM broadcast transmitter is located at Kapunda approximately 3.9 km from the nearest wind turbine (turbine 12) and is operated by Flow FM. Given the relatively small distance between the broadcast transmitter and the site, it is possible that the FM radio signals from this tower could be influenced by the Project. The location of the broadcast transmitter in relation to the Project and the sector in which physical obstruction of the signal may occur is shown in Figure 17 and Figure 18. Since the transmitter is located to the southeast of the proposed turbine locations, the potential interference sector extends to the northwest of the Project site.

The extents of the coverage areas for rural mono reception, assuming a fixed antenna height of 1.5 m, and car radio reception from the Flow FM broadcast transmitters at Kapunda, Maitland, and Hallett are shown in Figure 17 and Figure 18 respectively. These coverage maps were provided by Flow FM as part of the consultation process described in Section 4.14.2.2. The regions with the highest potential to experience interference to signals from the Kapunda transmitter lie at the edges of the signal coverage area to the northwest of the Project site, at distances of approximately 35-40 km from the site for fixed antennas and approximately 40-50 km for car radios.

Some residents at the edges of the Kapunda rural mono coverage area are also within the coverage area for the Maitland broadcast transmitter, which may mitigate any interference experienced in these regions. However, there is no alternative signal available for residents to the northwest of the Project site around the towns of Saddleworth and Auburn, and so there is increased potential for interference to cause problems in these areas.

Due to the considerable overlap between the car radio coverage areas for the Kapunda, Maitland, and Hallett broadcast transmitters, it is unlikely that interference arising from the Project will be a problem for car radio reception.

4.14.2.2 Stakeholder consultation

DNV has previously contacted the operator of the nearby FM broadcast transmitter, Flow FM, to inform them of the proposed Project and to seek feedback on any potential impact that the Project could have on their services.

The response received from Flow FM, based on the previous turbine layout and dimensions, indicated that the turbines at the Project have the potential to cause interference to the FM radio signals broadcast from their Kapunda transmitter, which is located to the east of the Project site. However, at the time, Flow FM advised that the areas to the west and northwest of the Project site may also receive signals broadcast by their Maitland and Hallett transmitters. Coverage maps for the radio signals from the Kapunda, Maitland, and Hallett transmitters were provided by Flow FM, and have been used by DNV to identify the areas with the greatest potential to experience interference to the signal from the Kapunda transmitter as discussed in Section 4.14.2.1.

The interim turbine layout and dimensions has been provided to Flow FM for their review and feedback. Flow FM have expressed further concerns, particularly given the location of the turbines in the line of sight between the townships of Kapunda and Marrabel. Flow FM also highlighted that signal strengths at Kapunda are already very marginal and have the potential to be degraded further by the presence of wind turbines. It is understood that Flow FM is undertaking further assessment into the potential for interference and seeking advice from other parties regarding potential mitigation options. The Customer is also intending to undertake further engagement with Flow FM, to establish an understanding of how any impact to the FM radio signal from the Kapunda transmitter may be mitigated.

4.14.2.3 Mitigation options

As noted above, there is potential for interference to FM radio signals from the Flow FM broadcast transmitter at Kapunda. If interference is experienced, mitigation options would need to be confirmed through consultation with Flow FM. Mitigation options may include installing high-quality antennas and/or amplifiers at affected residences, increasing the broadcast signal strength from the Kapunda transmitter or the nearby Maitland or Mt Bryan transmitters, moving the Kapunda transmitter to a new location more than 4 km from any turbine, or installing a signal repeater on the opposite side of the Project.

4.14.3 Digital radio

Digital radio services were introduced in metropolitan licence areas in Australia in July 2009. The digital radio services offered use an updated version of the digital audio broadcasting (DAB) digital radio standard, DAB+, to broadcast digital radio to Adelaide, Brisbane, Perth, Melbourne, and Sydney [52]. Digital radio broadcasts in Australia operate in the VHF band at frequencies between 174 MHz and 230 MHz, and therefore tend to have only local coverage within the visual horizon.

The UK telecommunications regulator Ofcom [49] states that "*In contrast [to FM signals], the signal format used for DAB digital radio is designed to offer high levels of robustness in difficult conditions and it is not materially affected by reflections. FM and DAB reception can be affected where a structure blocks signals and both may cease to function if signals are reduced below a certain threshold*". DNV has therefore concluded that DAB signals are not affected by reflection or scattering from physical structures in the same way as FM signals, and so digital radio broadcasts are generally not susceptible to interference from wind farm developments. However, interference may be experienced if the line-of-sight between a DAB transmitter and a radio receiver is blocked by a wind turbine.

4.14.3.1 Availability of digital radio services and potential for interference

According to the digital radio coverage search function available on the Digital Radio Plus website [53], the Project is outside the intended service area for digital radio broadcasts. Since it is therefore unlikely that residents in the vicinity of the Project are currently receiving digital radio signals, it is not expected that the Project will cause interference to these services.

4.15 Terrestrial television broadcasting

Terrestrial television is broadcast in Australia by a number of networks, both public and commercial. As of December 2013, all television broadcasts in Australia are now digital broadcasts [54]. Digital television (DTV) signals are typically more robust in the presence of interference than analogue television signals, and are generally unaffected by interference from wind turbines. DNV has experience in situations where dwellings were able to receive adequate DTV reception in an area of adequate signal strength where the DTV signal was passing through a wind farm.

The susceptibility of DTV signals to interference from wind turbines is discussed further in Section A.1 of Appendix A.

4.15.1 Availability of DTV broadcasting and potential for interference

The locations of DTV broadcast transmitters in the vicinity of the Project were determined from the ACMA Broadcast Transmitter Database [54], and are shown in Figure 16. The main DTV transmitter used by residents in the vicinity of the Project is the Adelaide transmitter. The Adelaide transmitter is located 74 km southwest of the site.

The coverage map for the Adelaide broadcast transmitter is reproduced in Figure 19. Coverage surrounding the site is predominantly good to variable, with dwellings to the east and northeast of the site receiving poor to no coverage.

While residents to the northeast of the site may receive signals from the Eudunda transmitter, which is located approximately 6 km north of the site, coverage from this transmitter does not extend to within 5 km of the proposed turbine locations. Therefore, the potential for impacts to signals from the Eudunda transmitter received at nearby dwellings has not been considered in this assessment.

4.15.1.1 Interference caused by large scale effects

For broadcast signals, large scale interference can generally be avoided by placing the wind turbines at some distance from the transmitter. Broadcast transmitters may be either relay or primary transmitters. Relay transmitters are more commonly found in rural areas. Primary transmitters are higher power and are more commonly located near large urban areas. A clearance of at least 1 km is recommended for relay transmitters, while a clearance of at least 6 km is recommended for primary transmitters [12].

The closest DTV transmitter to the Project is the Eudunda relay transmitter, which is approximately 12 km north of the nearest turbine. Therefore, it is considered unlikely that the Project will cause large scale interference to signals from this transmitter.

4.15.1.2 Interference caused by reflection or scattering

Although DTV signals are generally unlikely to be susceptible to interference from wind turbines in areas of adequate coverage, interference could be encountered in areas where coverage is marginal and antennas at dwellings may receive a reflected signal from a turbine that is of sufficient power to interfere with the signal received directly from the transmitter. Based on the coverage maps for the area around the Project, it is possible that some areas could be deemed to have marginal reception and interference could be encountered.

Due to the lack of an accurate theoretical scattering model, DNV has not performed detailed scatter calculations to predict DTV interference. Instead, dwellings that have increased potential to receive back-scattered or forward-scattered signals from a turbine at the Project (assuming an antenna with a sufficiently narrow beam width and sufficiently high front-to-back ratio is being used) have been highlighted using the 'keyhole' approach described in Section A.3 of Appendix A, with a forward-scatter distance of 5 km and a back-scatter distance of 500 m.

The results of the analysis can be seen in Table 11 and Figure 19. The dwellings most likely to be susceptible to interference include those within the possible interference zone, as summarised in Table 1. Two of the dwellings are located within the north of the proposed site boundary and the remaining five dwellings are immediately north and northeast of the proposed site boundary.

Note that if the signal received at a dwelling from the transmitter is sufficiently weak, or an antenna with insufficient directional discrimination is installed (i.e., a low gain or omni-directional antenna), interference may still occur at dwellings outside of the identified interference zones. Circumstances under which interference may occur outside the interference zones typically established using the 'keyhole' approach are discussed further in Section A.2 of Appendix A. In particular, although DNV has considered the potential for interference to DTV signals at dwellings within 5 km of the proposed turbine locations, previous advice received from BAI Communications, who are responsible for broadcasting of national public television services in Australia, has indicated that interference to DTV broadcasting may be experienced at distances of up to 10 km from turbines. For comparison, Figure 19 shows the area within 10 km of the proposed turbine locations. DNV has contacted BAI Communications, as discussed in section 4.15.2 and Table 12, to confirm the potential for interference to DTV signals received at dwellings outside the 'keyhole' interference zones.

Table 1 Number of dwellings located within potential interference zones for digital television broadcast transmitters in the vicinity of the Project

DTV broadcast transmitter	Number of dwellings in potential interference zone	Signal coverage in potential interference zone
Adelaide	7 (2 associated dwellings)	Predominantly variable to good coverage, with areas in the far northeast of the interference zone receiving poor to no coverage

The method used here to assess the potential interference to television signals from the Project represents a simplified approach which is expected to capture locations where interference is most likely to occur. This simplified analysis is deemed appropriate in most cases as the implications of potential television interference are typically low. If reception difficulties are encountered, there are a number of mitigation options available as discussed in further detail in Section 4.15.3.

4.15.2 Stakeholder consultation

DNV has contacted BAI Communications, who are responsible for broadcasting of national public television services in Australia, to inform them of the proposed Project and seek feedback on any potential impact that the Project could have on DTV signals in the surrounding area.

BAI Communications has conducted an assessment of the potential for the turbines at the Project to interfere with DTV signals from the Eudunda, Angaston, and Mt Lofty (Adelaide) transmitters [55]. The method used by BAI Communications involved modelling the reflection or scattering of DTV signals from the wind turbines, and identifying locations within 10 km of the Project where the resulting C/I ratio for a directional antenna oriented towards the transmitter of interest would be less than required for adequate signal reception.

From the results of their modelling, BAI Communications have advised that they do not expect the Project to cause interference to DTV signals from the Eudunda and Angaston transmitters. Although the modelling suggested that Mt Lofty (Adelaide) services may be affected by the proposed wind farm, BAI Communications noted that, based on satellite and aerial imagery, there are no buildings located within the predicted interference zones for the Adelaide transmitter and therefore none of the viewers are expected to be impacted. However, in the event that interference to DTV signals is experienced by residents, BAI Communications have advised that they expect any necessary mitigation to be undertaken as part of the Project.

The results of the modelling conducted by BAI Communications for the Adelaide DTV transmitter are compared to the DTV coverage map and the interference zones established by DNV in Figure 20. Figure 20 shows that the areas predicted by BAI Communications to be at greatest risk of experiencing interference to signals from the Adelaide transmitter are located within the site boundary, close to the proposed turbine locations. Compared to the interference zones established by DNV using the 'keyhole' approach described in Section 4.15.1.1, the results obtained by BAI Communications indicate that the overall area in which impacts to DTV signals could be experienced is smaller than the areas modelled by DNV. Based on the locations of nearby buildings provided by the Customer, there are no dwellings located within the areas modelled by BAI Communications as being at risk of experiencing interference to signals from the Adelaide DTV transmitter.

4.15.3 Mitigation options

In the event that DTV interference is experienced at nearby dwellings as a result of the Project, potential mitigation options may include:

1. Realigning the user's television antenna more directly towards their existing transmitter.
2. Tuning the user's antenna into alternative sources of the same television signal or a substitute signal.
3. Installing a more directional or higher gain antenna at the affected dwelling.
4. Relocating the antenna to a less affected position.
5. Installing cable or satellite television at the affected dwelling.
6. Installing a television relay transmitter.

In the event of significant interference in the backscatter region, realigning the antenna or installing a more directional antenna should ensure a stronger signal from the transmitter since the backscattered signal will originate from a different direction. However, the effectiveness of this mitigation may be reduced if there is no clear line of sight from the antenna to the transmitter. In these cases, it may be more effective to move the antenna to a location where there is a clearer line of sight to the transmitter or to tune the antenna into an alternative or substitute signal (if one is available).

In the case of forward scatter, the antenna will be pointed towards both the original and scattered signal and hence a more aligned or directional antenna may not alleviate a forward scatter issue.

Alternative mitigation measures to resolve issues caused by forward scatter could include tuning the antenna into an alternative signal (if one is available) or installing cable or satellite television at the affected dwelling. However, as noted in [56], DVB-T reception quality may not be substantially affected in the forward scatter region.

The ITU [57] identified that the receiver height can also affect interference. In areas that are relatively flat and free of vegetation, reflections can enhance or decrease the received signal strength relative to the free path signal strength. The ITU found that the received signal strength may not increase monotonically with receiver height. In other words, lowering the receiver height can improve reception in some cases.

In the event that terrestrial DTV reception cannot be improved, satellite television represents another potential amelioration option. Satellite based television comprises of both free to air and subscription-based broadcasts. Residents in areas which are unable to receive DTV through their normal television antenna due to local interference, terrain, or distance from the transmitter in their area may be eligible to access the Australian Government funded Viewer Access Satellite Television (VAST) service [58].

5 CONCLUSIONS

Broadcast towers and transmission paths around the Project were investigated to determine if EMI would be experienced as a result of the development and operation of the Project. The Project will involve the installation of up to 42 wind turbine generators. DNV has considered a turbine geometry that will be conservative for turbine configurations with dimensions satisfying all of the following criteria: a rotor diameter of 172 m or less and an upper tip height of 220 m or less.

The results of this assessment, including feedback obtained from relevant stakeholders, are summarised in Table 2. It is noted that the Project has the potential to cause interference to meteorological radar operations, digital television signals received at dwellings in the vicinity of the Project, and FM radio broadcasts to the northwest of the Project.

Turbines at the Project may interfere with point-to-area style services such as mobile phone signals, radio broadcasting, and terrestrial television broadcasting, particularly in areas with poor or marginal signal coverage. Dwellings within approximately 5-10 km of the Project that are currently receiving signals from the Adelaide television broadcast transmitter may experience interference to those services. Feedback received from BAI Communications suggest that impacts to signals from the Adelaide broadcast transmitter are likely, but no viewers are expected to be affected. If interference to these services is experienced, a range of options are available to rectify difficulties.

Interference to the FM radio signal broadcast by the nearby Flow FM transmission tower may be experienced near the edges of the signal coverage area to the west and northwest of the Project. However, Flow FM advised that the areas at risk of interference may also receive signals from other nearby broadcast towers. Flow FM have been contacted regarding the current turbine layout and dimensions, and have expressed further concerns about the potential for interference to signals from their FM transmitter at Kapunda. It is understood that Flow FM is undertaking further assessment into the potential for interference and is seeking advice from ACMA to establish an understanding of how any impact to the FM radio signal from the Kapunda transmitter may be mitigated.

Since it is not possible to determine the potential EMI impacts on point-to-multipoint links and emergency services without obtaining further information from the relevant operators, DNV has consulted with organisations operating services that may be affected by the Project. SA Power Networks previously raised concerns regarding their point-to-multipoint link that crosses the site. DNV have modelled an exclusion zone based on the second Fresnel zone for the link, and SA Power Networks have confirmed that the interference zone applied is sufficient. There are no turbines located within the exclusion zones set by DNV. DNV has also reviewed the point-to-multipoint link locations provided by SWOOP, who provide wireless internet services to residents in the vicinity of the Project, and has identified potential for interference to some link paths. DNV understands that the Customer is intending to engage with SWOOP to develop technical solutions aimed at minimising potential interference to those links.

Feedback received from the Bureau of Meteorology (the Bureau) indicates that there is a potential for the Project to materially impact on the operation of their Buckland Park radar and the associated weather monitoring and prediction services. DNV understands that the Customer has commenced discussions with the Bureau in relation to measures that may be deployed to minimise the potential impact on Bureau infrastructure. Discussions to date indicate that the installation of automatic weather stations and automatic rain stations if/as required would be incorporated as part of the Customer's commitment to the Project.

Potential EMI impacts on other services considered in this assessment, including trigonometrical stations, survey marks, CB radio and satellite television are not expected or are considered to be minor.

Table 2 Summary of EMI assessment results for the proposed Project

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Radio-communication towers	There are no towers within 2 km of proposed turbine locations	-	None	None required
Fixed point-to-point links	11 links crossing Project boundary, operated by: South Australian Water Corporation (SA Water) Spark Infrastructure SA (No2) Pty Limited (SA Power Networks) South Australian Government Radio Network NBN Co Limited Optus Mobile Pty Limited Wan Solutions Pty Ltd (SWOOP) **All links:** Turbines are not present in any of the potential diffraction zones	**SA Water, NBN Co:** Interference unlikely **Optus, SA Power Networks:** No concerns raised	Unlikely to cause interference	If required - reroute affected links, install additional towers, replace affected links with alternative technologies
Fixed point-to-multipoint links	254 assignments within 75 km of Project boundary 16 base stations within 20 km of Project boundary, operated by: South Australian Water Corporation (SA Water) The Barossa Council Bureau of Meteorology Barossa Valley Golf Club Inc. Spark Infrastructure SA (No2) Pty Limited (SA Power Networks) Telstra Limited	**SA Water, Barossa Council, Telstra, Bureau of Meteorology:** No concerns raised **SA Power Networks:** Satisfied with DNV modelled interference zones	**Other links:** Unlikely to cause interference	If required – reroute affected links, install additional towers, replace affected links with alternative technologies
Other licence types	**Point-to-area style communications:** see findings for emergency services, mobile phones, radio broadcasting, and television broadcasting	-	-	-
Emergency services	**Point-to-point links:** 1 South Australian Government Radio Operator link crossing boundary **Point-to-area style communications:** unlikely to be affected	**South Australian Country Fire Service, St John Ambulance Australia Incorporated, Australian Federal Police:** No concerns raised **Other operators:** No response received to date	**Point-to-point links:** Unlikely to cause interference **Point-to-area style communications:** Unlikely to cause interference	**Point-to-point links:** as for point-to-point links **Point-to-area style communications:** if required – increase signal strength from affected tower or alternative towers, install signal repeater, install additional tower

Table 2 Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Meteorological radar	Nearest radar: 58 km from Project	Potential for material interference to Buckland Park radar	Likely to cause interference to Buckland Park radar	To be determined through consultation with the Bureau of Meteorology
Trigonometrical stations	**Trigonometrical stations:** 55 stations within 20 km of the Project boundary, unlikely to be affected	No concerns raised	Unlikely to cause interference	None required
Citizen's band radio	Unlikely to be affected	Consultation not considered necessary	Unlikely to cause interference	None required
Mobile phones	Unlikely to be affected in areas with good coverage, may experience interference in areas with marginal coverage	No concerns raised	Low likelihood of interference	To be determined through consultation with the relevant operators, if required
Wireless internet	**Wireless broadband service providers:** mobile phone networks, NBN Co **NBN:** available as a fixed wireless and satellite service **Wan Solutions Pty Ltd (SWOOP)**: wireless internet service	**Wireless broadband service providers:** No concerns raised **NBN Co:** No concerns raised regarding turbines NBN Co have requested information on any planned wind farm operated radiofrequency transmission equipment in order to assess the potential for interference **SWOOP:** Potential for interference	**Wireless broadband services**: see findings for mobile phones **NBN:** Unlikely to cause interference **SWOOP:** Potential for interference	**Wireless broadband services:** as for mobile phones **NBN:** none required **SWOOP:** If required – reroute affected links, install additional towers, replace affected links with alternative technologies
Satellite television and internet	**Geostationary satellites:** signals from satellites providing services intended for both Australian and international audiences are unlikely to be affected. **Low Earth orbit (LEO) satellites:** Starlink signals are unlikely to be obstructed at any of the nearby dwellings	Consultation with operators not considered necessary	**Geostationary satellites:** unlikely to cause interference **LEO satellites:** unlikely to cause interference	**Geostationary satellites:** none required **LEO satellites:** none required

Table 2 Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Radio broadcasting	**FM signals:** may experience interference in close proximity to turbines **FM signals from Flow FM Kapunda transmitter:** may experience interference in areas with marginal reception to the northwest of the Project **AM signals:** Unlikely to be affected **Digital radio signals:** Project is outside the intended coverage area	FM signals: Potential for interference to signals from Flow FM Kapunda transmitter AM and digital radio signals: Consultation with operators not considered necessary	**FM signals:** Potential for interference to signals from Flow FM Kapunda transmitter **AM signals:** Unlikely to cause interference **Digital radio signals:** None	**FM signals:** Flow FM have been reconsulted. If required, mitigation strategies are to be determined through further consultation. **AM signals:** if required – install higher-quality antenna at affected location **Digital radio signals:** none required
Television broadcasting	May experience interference in areas with poor or marginal reception **Adelaide transmitter:** *'good' coverage in the Kapunda region surrounding the site with areas to the east and northeast of the site receiving poor to no coverage.* 7 dwellings in potential interference zone	Interference analysis suggests signals are likely to be affected, but no residents will be impacted. Rectification of any interference is expected to form part of the Project.	Low likelihood of interference	If required – re-align antenna at affected dwelling to existing tower, re-direct antenna to alternative tower, install more directional or higher gain antenna, change location of antenna, install cable or satellite television, install relay transmitter

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APPENDIX A – TELEVISION INTERFERENCE CAUSED BY REFLECTION OR SCATTERING OF SIGNALS

A.1 Susceptibility of DTV signals to reflection or scattering

The United Kingdom telecommunications regulator Ofcom [49] states the following with regard to interference to DTV reception:

> *"Digital television signals are much better at coping with signal reflections, and digital television pictures do not suffer from ghosting. However a digital receiver that has to deal with reflections needs a somewhat higher signal level than one that has to deal with the direct path only. This can mean that viewers in areas where digital signals are fairly weak can experience interruptions to their reception should new reflections appear... reflections may still affect digital television reception in some areas, although the extent of the problem should be far less than for analogue television."*

DNV has drawn two conclusions from this report:

- Firstly, that DTV is very robust and does not suffer from ghosting. In most cases DTV signals are not susceptible to interference from wind farm developments.
- Secondly, that areas of weak DTV signal can experience interruptions to their reception should new reflections appear, such as those from nearby wind turbines.

For television broadcast signals, which are omni-directional or point-to-area signals, interference from wind turbines is dependent on many factors including:

- the proximity of turbines to the television broadcast transmitter
- the proximity of turbines to receivers (dwellings)
- the location of turbines in relation to dwellings and television broadcast transmitters
- the rotor blade material, rotor speed, and rotor blade direction (always into the wind)
- the properties of the receiving antenna (e.g., type, directionality, and height)
- the location of the television receiver in relation to terrain and other obstacles
- the frequency and power of the television broadcast signal.

A.2 Forward and back scatter of DTV signals

Wind turbines can cause interference to DTV signals by introducing reflections that may be received by the antenna at a dwelling, in addition to the signal received directly from the transmitter, which causes multipath errors. A wind turbine has the potential to scatter electromagnetic waves carrying DTV signals both forward and back.

Forward scatter can occur when the transmitter, one or more turbines, and receiver are almost aligned as shown in Figure A.1. The forward scatter region in this case is characterised by a shadow zone of reduced signal strength behind the turbine, where direct and scattered signals can be received, with the blade rotation introducing a rapid variation in the scattered signal [56]. Both of these effects can potentially degrade the DTV signal quality.

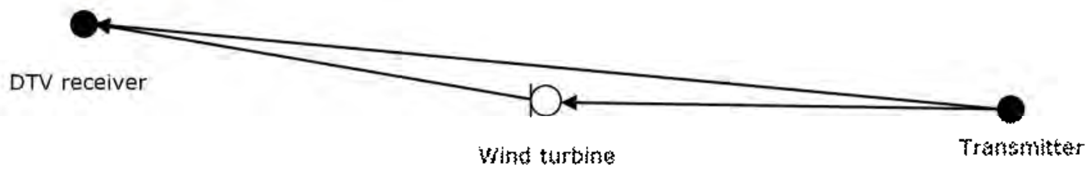

Figure A.1 Forward scatter signal path for DTV signals

Back scatter from wind turbines occurs when DTV signals are reflected from turbine towers and blades onto a receiver as shown in Figure A.2. The reflected signals are attenuated, time-delayed and phase-shifted (due to a longer path from transmitter to receiver) compared to the original signal. The reflected signals are also time-varying due to the rotation of the blades and vary with wind direction. The resultant signal at the receiver includes the original signal (transmitter to receiver) and a series of time-varying multipath signals (transmitter-turbine-receiver).

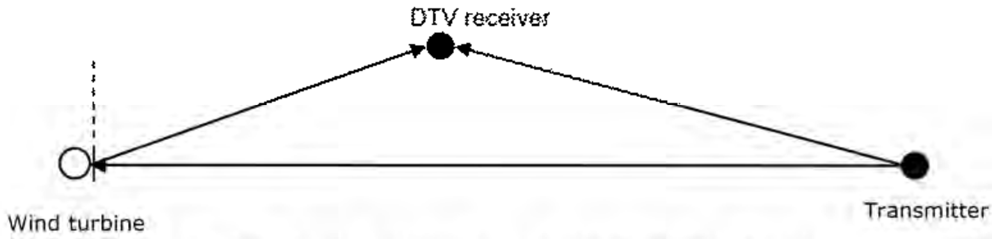

Figure A.2 Back scatter signal path for DTV signals

Interference to DTV signals from wind turbines can potentially occur in both the forward and backward scatter region. The effect of a turbine on a DTV signal can be different depending on the scattering region where the receiver is located [56].

According to Ofcom [49], the forward scatter region does not typically extend further than 5 km for the worst combination of factors [12, 59]. Interference may extend beyond 5 km if the dwellings are screened from the broadcast transmitter, but do have line-of-sight to the turbines [49]. The shape of this region, assuming a relatively high gain, directional antenna, can be represented by a circular segment with an azimuthal range of approximately ±15° to ±20°, corresponding to the beam width of the antenna. If a lower gain or omni-directional antenna is being used, this region is likely to be larger.

Back scattered signals arrive at the dwelling delayed relative to the source signal from the broadcast transmitter. The back scatter region generally does not extend further than 500 m [12, 49], assuming a high gain, directional antenna that has a relatively high front-to-back ratio (meaning the signal received by the front of the antenna is much higher than that received from the back). If an antenna with a lower front-to-back ratio, or an omni-directional antenna is used, this region is likely be larger.

The combination of the forward and back scatter regions, as shown in Figure A.3, resembles a keyhole.

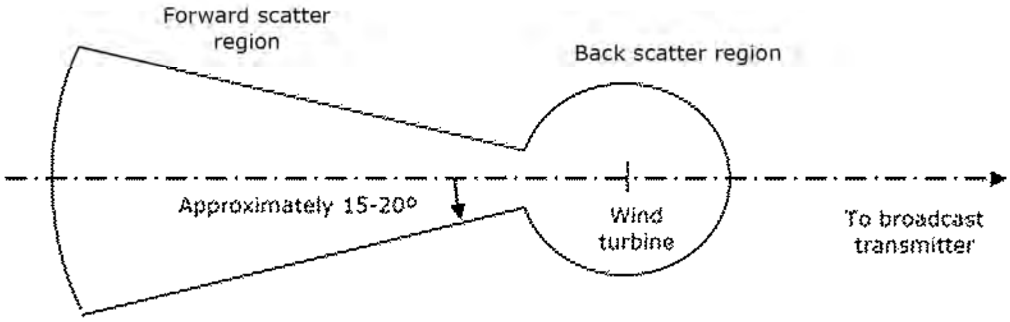

Figure A.3 Potential television interference zones around a wind turbine

Television interference mechanisms rely on many factors (as previously mentioned) and are complex to calculate. Previous experience has shown that even after great effort has been put into performing such calculations, they tend to have limited accuracy, and would require field validation after the wind farm is operational.

In Australia, DTV signals are transmitted using the DVB-T (Digital Video Broadcasting – Terrestrial) standard. The International Telecommunication Union (ITU) Recommendation BT.1893 [60] states the following in regards to the forward scatter region for DVB-T signals:

> *"In most of the situations where the impact of a wind farm to DVB-T reception quality was analyzed, the threshold C/N [carrier-to-noise] ratios obtained were similar to those expected in environments with the absence of wind farms. More precisely, in the forward scattering region of the wind turbines, where the transmit antenna, one or more turbines and the receive antenna are lined-up (±60° behind the wind turbine), the DVB-T reception quality may not be affected though further work of analysis is needed in order to confirm this point, especially in the vicinity of 0°."*

In other words, wind turbines are not generally expected to affect DVB-T DTV signals in the forward scatter region. However, the ITU [57] also highlight that in the case where there is significant blockage of the direct signal, but clear line-of-sight to one or more turbines, interference to the reception of the DTV signal is possible. Results of studies reported by the ITU also suggest that interference may be more likely in areas where the existing DTV signal is already weak or degraded [57].

With regards to back scattering, the ITU states:

> *"In the case of the backscattering region, in those situations where the scattered signals from wind turbines are significant in amplitude and variability, the threshold C/N ratio necessary for quasi error free (QEF) condition is higher."*

In other words, the C/N ratio needs to be higher in the presence of significant back scatter to achieve the same QEF condition as is the case without the presence of turbines, which effectively means that interference is more likely to occur as coverage quality decreases.

A.3 Theoretical models for wind turbine scattering estimation

Various theoretical scatter models to predict scatter of terrestrial television signals have been proposed, some dating back to the late 1970s. A review of these models, as well as a comparison against empirical data has been reported in [61]. This comparison with empirical data found:

> *"…none of the analyzed methods seems to be accurate enough to provide realistic estimations of the signal scattered by the wind turbines. In conclusion, a more complete scattering model is needed in order to provide more practical estimations of the scattered signals and evaluate their potential impact on the broadcasting services."*

Notably, the scattering model proposed by the ITU to specifically address DTV signals [60], was found to be the most inaccurate, and does not provide signal estimations in the forward scattering zone of the blades. Additionally, DNV notes that it only applies to a single wind turbine rather than a wind farm as a whole.

As an alternative to signal scattering models, it is common practice to identify those dwellings or areas that are most likely to experience potential television interference based on likely forward and back scatter regions. As introduced above and shown in Figure A.3, this is often referred to as the 'keyhole' approach and is an established technique for predicting where terrestrial television interference is most likely, based on a number of assumptions regarding receiving antenna characteristics. The approach involves combining multiple keyhole shaped areas that are placed over each turbine location [49]. The combination of these areas forms a region where there is an increased likelihood of interference to television signals occurring.

LIST OF TABLES

Table 3 Proposed turbine layout for the Project [4]

Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation[2] [m]	Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation[2] [m]
T1	323482	6205173	452	T22	322825	6202282	408
T2	323844	6204801	443	T23	323559	6202089	431
T3	322201	6204396	449	T24	319861	6201508	347
T4	322781	6204223	447	T25	320144	6201172	340
T5	323566	6204209	428	T26	320893	6201273	373
T6	324007	6203993	445	T27	321600	6201336	418
T7	324334	6203665	481	T28	322524	6201525	437
T8	321322	6203691	382	T29	322988	6201226	431
T9	322058	6203763	412	T30	323145	6204792	462
T10	322708	6203496	443	T31	321591	6200769	410
T11	323556	6203423	412	T32	322195	6200924	438
T12	324074	6202948	460	T33	322603	6200463	428
T13	320199	6203120	349	T34	320685	6200154	367
T14	320533	6203023	345	T35	321376	6200207	390
T15	321043	6202736	364	T36	321917	6199967	422
T16	321778	6202844	393	T37	322228	6199655	412
T17	322495	6202951	423	T38	322352	6199232	413
T18	323294	6202849	412	T39	320630	6199500	383
T19	320050	6202407	343	T40	321197	6199375	391
T20	320949	6202223	353	T41	321557	6199056	409
T21	321858	6201934	400	T42	320763	6198805	411

1. Coordinate system: MGA zone 54, GDA94 datum.
2. Base elevations have been determined by DNV based on publicly available SRTM1 data.

Table 4 Dwellings within 5 km of the proposed Project boundary [5, 62, 7, 9]

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Status	Distance to nearest turbine [km]
3	317966	6209162	Non-associated	6.4
5	318425	6204359	Non-associated	2.2
6	317441	6204023	Non-associated	2.9
7	314690	6200064	Non-associated	5.4
8	317532	6197178	Non-associated	3.6
9	324339	6199469	Non-associated	2.0
11	315260	6200442	Non-associated	4.7
14	*323507*	*6197563*	*Associated*	*2.0*
15	321443	6211068	Non-associated	6.2
18	326591	6204222	Non-associated	2.3
21	*321390*	*6210185*	*Associated*	*5.4*
22	316087	6197701	Non-associated	4.8
27	316856	6202618	Non-associated	3.2
28	316348	6204184	Non-associated	4.0
29	317896	6207851	Non-associated	5.3
32	314980	6201698	Non-associated	4.9
33	318887	6210081	Non-associated	6.6
55	314798	6206455	Non-associated	6.3
56	314913	6206182	Non-associated	6.1
57	315169	6206334	Non-associated	6.0
58	314945	6203986	Non-associated	5.3
59	316285	6203701	Non-associated	4.0
60	316133	6202968	Non-associated	4.0
61	315845	6202465	Non-associated	4.1
62	314649	6201555	Non-associated	5.2
63	321440	6211313	Non-associated	6.5
66	328249	6207469	Non-associated	5.1
67	329079	6205727	Non-associated	5.2
69	328912	6206433	Non-associated	5.3
70	327001	6207829	Non-associated	4.4
71	317366	6208478	Non-associated	6.1
72	319006	6208941	Non-associated	5.6
73	*319843*	*6205696*	*Associated*	*2.5*
75	321830	6206405	Non-associated	2.0
76	324379	6207966	Non-associated	2.9
77	324320	6207653	Non-associated	2.6
78	323818	6210616	Non-associated	5.5
79	323873	6210441	Non-associated	5.3
80	324097	6210418	Non-associated	5.3
86	330014	6199830	Non-associated	6.7
87	328452	6199011	Non-associated	5.8
88	330707	6195869	Non-associated	9.0
89	329182	6196326	Non-associated	7.4
90	329251	6196299	Non-associated	7.5
91	329366	6196323	Non-associated	7.6
92	329477	6196741	Non-associated	7.5
93	329375	6196658	Non-associated	7.5
94	329394	6196597	Non-associated	7.5
95	329439	6196657	Non-associated	7.5
96	329316	6196623	Non-associated	7.4
97	329248	6196582	Non-associated	7.4

Table 4 Dwellings within 5 km of the proposed Project boundary [5, 62, 7, 9] (continued)

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Status	Distance to nearest turbine [km]
98	329163	6196530	Non-associated	7.3
99	329163	6196557	Non-associated	7.3
100	329174	6196594	Non-associated	7.3
101	329184	6196620	Non-associated	7.3
102	329214	6196373	Non-associated	7.4
103	328993	6196382	Non-associated	7.2
104	328943	6196320	Non-associated	7.2
105	329118	6196714	Non-associated	7.2
106	329158	6196489	Non-associated	7.3
107	329020	6196732	Non-associated	7.1
108	328227	6196021	Non-associated	6.7
109	328868	6196628	Non-associated	7.0
110	328765	6196749	Non-associated	6.9
111	327910	6197263	Non-associated	5.9
112	325928	6196512	Non-associated	4.5
113	323876	6195866	Non-associated	3.7
114	316390	6196126	Non-associated	5.1
115	323124	6196480	Non-associated	2.9
116	323256	6196546	Non-associated	2.8
117	321750	6197065	Non-associated	2.0
118	*318374*	*6200027*	*Associated*	*2.1*
119	*318470*	*6200072*	*Associated*	*2.0*
120	*318362*	*6200119*	*Associated*	*2.0*
121	316698	6201396	Non-associated	3.2
122	*322874*	*6198829*	*Associated*	*0.7*
123	324465	6199580	Non-associated	2.1
124	324921	6199805	Non-associated	2.4
125	324704	6200152	Non-associated	2.0
130	329866	6203188	Non-associated	5.6
131	324533	6197985	Non-associated	2.5
132	324698	6197761	Non-associated	2.8
133	319433	6210179	Non-associated	6.4
134	319393	6209917	Non-associated	6.2
135	319245	6209852	Non-associated	6.2
136	329263	6197269	Non-associated	7.2
137	329442	6197354	Non-associated	7.3
138	329172	6197743	Non-associated	7.0
144	326589	6210431	Non-associated	6.1
147	*319969*	*6205165*	*Associated*	*2.0*
148	319669	6207310	Non-associated	3.9
149	314445	6202336	Non-associated	5.5
150	316224	6203117	Non-associated	3.9
151	*320252*	*6205722*	*Associated*	*2.3*
152	329320	6196662	Non-associated	7.4
153	329222	6196619	Non-associated	7.4
154	329050	6196585	Non-associated	7.2
155	329084	6196649	Non-associated	7.2
156	329037	6196731	Non-associated	7.1
157	329091	6196837	Non-associated	7.2
158	328914	6196750	Non-associated	7.0
159	328900	6196737	Non-associated	7.0

Table 4 Dwellings within 5 km of the proposed Project boundary [5, 62, 7, 9] (continued)

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Status	Distance to nearest turbine [km]
160	328983	6197055	Non-associated	7.0
161	329223	6197127	Non-associated	7.2
162	329189	6197081	Non-associated	7.2
163	329315	6197629	Non-associated	7.1
164	329376	6197622	Non-associated	7.2
165	329283	6197521	Non-associated	7.1
166	329427	6197811	Non-associated	7.2
168	325069	6195084	Non-associated	5.0
169	324942	6195205	Non-associated	4.8
170	324876	6195388	Non-associated	4.6
171	324384	6194580	Non-associated	5.1
172	322403	6193774	Non-associated	5.3
173	322166	6193978	Non-associated	5.0
174	322377	6195495	Non-associated	3.7
177	316423	6203609	Non-associated	3.8
178	319884	6195267	Non-associated	3.6
179	320076	6195303	Non-associated	3.6
180	325159	6199502	Non-associated	2.7
181	323623	6197004	Non-associated	2.6
182	323772	6197057	Non-associated	2.6
183	323773	6196905	Non-associated	2.7
184	322571	6195278	Non-associated	3.9
185	322560	6194278	Non-associated	4.9
186	323539	6196728	Non-associated	2.8
187	326433	6207948	Non-associated	4.1
188	328156	6194319	Non-associated	7.6
189	328827	6193956	Non-associated	8.4
190	327849	6193219	Non-associated	8.1
191	329897	6193600	Non-associated	9.4
192	330243	6194049	Non-associated	9.4
193	329437	6191717	Non-associated	10.3
195	329883	6191224	Non-associated	11.0
197	329987	6191376	Non-associated	11.0
198	330371	6191129	Non-associated	11.4
199	330424	6191076	Non-associated	11.5
200	330575	6191066	Non-associated	11.6
201	330532	6191090	Non-associated	11.5
202	330214	6190939	Non-associated	11.4
203	330462	6190513	Non-associated	11.9
204	330420	6190543	Non-associated	11.9
205	330236	6190480	Non-associated	11.8
206	330272	6190519	Non-associated	11.8
207	330182	6190514	Non-associated	11.7
209	330290	6190746	Non-associated	11.6
211	328296	6196025	Non-associated	6.8
213	325861	6194403	Non-associated	6.0
214	325870	6194335	Non-associated	6.0
215	329570	6194498	Non-associated	8.6
216	329530	6194510	Non-associated	8.6
217	329469	6194508	Non-associated	8.5
218	327658	6193293	Non-associated	8.0

Table 4 Dwellings within 5 km of the proposed Project boundary [5, 62, 7, 9] (continued)

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Status	Distance to nearest turbine [km]
219	327302	6192599	Non-associated	8.3
220	327546	6191204	Non-associated	9.6
221	327813	6191195	Non-associated	9.7
222	327884	6191280	Non-associated	9.7
223	327845	6191144	Non-associated	9.8
224	327814	6191146	Non-associated	9.8
225	327926	6191067	Non-associated	9.9
226	327891	6191081	Non-associated	9.9
227	328051	6191084	Non-associated	9.9
228	328176	6191074	Non-associated	10.0
229	328105	6191058	Non-associated	10.0
230	328221	6191050	Non-associated	10.1
231	328227	6191071	Non-associated	10.1
232	328289	6191043	Non-associated	10.1
233	328285	6191021	Non-associated	10.1
234	328259	6190995	Non-associated	10.1
235	328202	6191014	Non-associated	10.1
236	328378	6191064	Non-associated	10.2
237	327895	6191019	Non-associated	9.9
238	327736	6191073	Non-associated	9.8
239	327771	6191057	Non-associated	9.8
240	327724	6190994	Non-associated	9.8
241	327772	6190979	Non-associated	9.9
242	327781	6190978	Non-associated	9.9
243	327794	6190972	Non-associated	9.9
244	327806	6190972	Non-associated	9.9
245	327823	6190964	Non-associated	9.9
246	327863	6190961	Non-associated	9.9
247	327800	6191000	Non-associated	9.9
248	327778	6191009	Non-associated	9.9
249	327827	6190995	Non-associated	9.9
250	327751	6191015	Non-associated	9.8
251	327880	6190979	Non-associated	9.9
252	327917	6190967	Non-associated	10.0
253	327918	6190931	Non-associated	10.0
254	327932	6190959	Non-associated	10.0
255	328046	6190889	Non-associated	10.1
256	328050	6190919	Non-associated	10.1
257	328084	6190905	Non-associated	10.1
258	328113	6190894	Non-associated	10.1
259	328141	6190886	Non-associated	10.2
260	328136	6190860	Non-associated	10.2
261	328044	6190850	Non-associated	10.1
262	328057	6190809	Non-associated	10.2
263	328086	6190833	Non-associated	10.2
264	328100	6190829	Non-associated	10.2
265	327999	6190852	Non-associated	10.1
266	327962	6190865	Non-associated	10.1
267	327909	6190891	Non-associated	10.0
268	327878	6190901	Non-associated	10.0
269	327935	6190882	Non-associated	10.0

Table 4 Dwellings within 5 km of the proposed Project boundary [5, 62, 7, 9] (continued)

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Status	Distance to nearest turbine [km]
270	327824	6190926	Non-associated	9.9
271	328179	6190855	Non-associated	10.2
272	328198	6190850	Non-associated	10.2
273	328216	6190866	Non-associated	10.2
274	328416	6190927	Non-associated	10.3
275	328439	6190984	Non-associated	10.3
276	328206	6190972	Non-associated	10.1
277	327791	6191184	Non-associated	9.7
278	329216	6191476	Non-associated	10.4
279	331991	6192334	Non-associated	11.9
280	328154	6190849	Non-associated	10.2
281	329412	6190930	Non-associated	10.9
282	331957	6190500	Non-associated	13.0
284	332360	6190441	Non-associated	13.3
286	333877	6192644	Non-associated	13.3
287	316133	6202968	Non-associated	11.9

1. Associated dwellings are indicated by *underlined italic text*. Buildings identifed by the Customer as sheds or ruins have been omitted from this assessment [7].
2. Buildings identified as unoccupied [62].
3. Coordinate system: MGA zone 54, GDA94 datum.

Table 5 Details of point-to-point links crossing the proposed Project

Link no.	Licence number	Assignment ID	Frequency [Hz]	Licence owner
1	10728740/2	10446494	8059020000	NBN Co Limited Level 13 100 Arthur Street North Sydney NSW 2060
		10446495	8059020000	
		10446496	7747700000	
		10446497	7747700000	
2	10728741/2	10446500	8118320000	
		10446501	8118320000	
		10446502	7807000000	
		10446503	7807000000	
3	12016951/1	10446520	8059020000	
		10446521	8059020000	
		10446522	7747700000	
		10446523	7747700000	
4	12016952/1	10446525	8118320000	
		10446526	8118320000	
		10446527	7807000000	
		10446528	7807000000	
5	10146165/2	2352217	11305000000	Optus Mobile Pty Limited LTE TXN 1 Lyonpark Road Macquarie Park NSW 2113
		2352218	11305000000	
		2352219	10815000000	
		2352220	10815000000	
6	12104725/1	10766996	11485000000	
		10766997	11485000000	
		10766998	10995000000	
		10766999	10995000000	
7	12104726/1	10767001	11485000000	
		10767002	11485000000	
		10767003	10995000000	
		10767004	10995000000	
8	1805925/1	858793	11545000000	South Australian Government Radio Network GPO Box 464 Adelaide SA 5001
		858794	11545000000	
		858795	11055000000	
		858796	11055000000	
9	1181233/1	752337	414150000	South Australian Water Corporation SA Water GPO Box 1751 (C/- Hamish Reid) Adelaide SA 5001
		752338	414150000	
		752339	404700000	
		752340	404700000	
10	1987207/1	1004790	460362500	Spark Infrastructure SA (No2) Pty Limited SA Power Networks GPO Box 77 (C/- Louise Watts) Adelaide SA 5001
		1004791	460362500	
		1004792	450862500	
		1004793	450862500	

Table 5 Details of point-to-point links crossing the proposed Project (continued)

Link no.	Licence number	Assignment ID	Frequency [Hz]	Licence owner
11	10357208/3	5115708	11665000000	Wan Solutions Pty Ltd PO Box 1064 Nuriootpa SA 5355
		5115709	11665000000	
		5115710	11175000000	
		5115711	11175000000	
		5115712	11625000000	
		5115713	11625000000	
		5115714	11135000000	
		5115715	11135000000	

Table 6 Details of point-to-multipoint licences within 75 km of the proposed Project

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
9756428	141794	11856200/1	-34.8501	138.7362	62	ADELAIDE MONITORING SERVICES PTY LTD
9756431	141794	11856200/1	-34.8501	138.7362	62	Adelaide Monitoring Services Pty. Ltd. PO Box 2072 MAGILL NORTH SA 5072
825044	501670	1509414/1	-34.8590	138.6122	68	Adelaide Cemeteries Authority PO Box 294 ENFIELD PLAZA SA 5085
825047	501670	1509414/1	-34.8590	138.6122	68	
1289159	501781	1142622/1	-34.1040	139.8673	71	Australian Vintage Ltd Qualco Vineyard PO Box 3 RAMCO SA 5322
1289162	501781	1142622/1	-34.1040	139.8673	71	
824016	501154	1506275/1	-34.4319	138.9683	11	Barossa Valley Golf Club Inc. PO Box 322 NURIOOTPA SA 5355
824019	501154	1506275/1	-34.4319	138.9683	11	
792872	305318	1325983/1	-34.5698	138.6490	42	Barry Farmer Virginia Farm Produce P.O. Box 38 VIRGINIA SA 5120
792875	305318	1325983/1	-34.5698	138.6490	42	
1306050	135941	1180111/1	-34.5444	139.1930	14	Bureau of Meteorology GPO Box 1289 MELBOURNE VIC 3001
1306053	135941	1180111/1	-34.5444	139.1930	14	
2803144	10006281	10272320/1	-33.9993	138.9095	33	
2803147	10006281	10272320/1	-33.9993	138.9095	33	
1306018	405152	1145023/1	-34.2015	138.5970	41	
1306021	405152	1145023/1	-34.2015	138.5970	41	
1305787	23428	434009/1	-34.7243	138.9279	41	
1305790	23428	434009/1	-34.7243	138.9279	41	
2803140	10006279	10272319/1	-33.9292	138.8145	44	
2803143	10006279	10272319/1	-33.9292	138.8145	44	
2505507	10004933	10214946/1	-33.9306	138.6773	51	
2505510	10004933	10214946/1	-33.9306	138.6773	51	
1305749	24472	433980/1	-33.9013	138.6113	57	
1305752	24472	433980/1	-33.9013	138.6113	57	
1306871	23452	1505641/1	-34.8828	138.8713	59	
1306874	23452	1505641/1	-34.8828	138.8713	59	
2498971	10004867	10213228/1	-34.9315	139.0317	59	
2498974	10004867	10213228/1	-34.9315	139.0317	59	
1306481	304390	1322463/1	-34.8833	138.7592	64	
1306484	304390	1322463/1	-34.8833	138.7592	64	
1306040	134199	1148674/1	-34.9222	138.6803	71	
1306043	134199	1148674/1	-34.9222	138.6803	71	

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Table 6 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
824996	501643	1509217/1	-34.5827	139.6109	43	CONDO & SON PTY LT & TRUSTEE FOR CONDO FAMILY TRUST
824999	501643	1509217/1	-34.5827	139.6109	43	SWAN PRODUCE PO Box 334 BROOKLYN PARK SA 5032
4233597	501183	10533103/1	-33.8201	138.6135	64	Clare Golf Club Inc.
4233600	501183	10533103/1	-33.8201	138.6135	64	Clare Golf Club Inc. PO Box 86 CLARE SA 5453
4463437	100209	10563439/1	-34.6973	138.6158	54	Department of Defence Director Defence Spectrum Office D DSO APW-GF-173, Anzac Park West PO Box 7953 CANBERRA BC ACT 2610
4463440	100209	10563439/1	-34.6973	138.6158	54	
1270333	100206	1136256/1	-34.7108	138.6253	54	
1270336	100206	1136256/1	-34.7108	138.6253	54	
1252145	22977	100384/1	-34.7324	138.6478	55	
1252148	22977	100384/1	-34.7324	138.6478	55	
1265214	22977	99849/1	-34.7324	138.6478	55	
1265217	22977	99849/1	-34.7324	138.6478	55	
1265629	22977	100374/1	-34.7324	138.6478	55	
1265632	22977	100374/1	-34.7324	138.6478	55	
1265633	22977	100378/1	-34.7324	138.6478	55	
1265636	22977	100378/1	-34.7324	138.6478	55	
1265637	22977	100379/1	-34.7324	138.6478	55	
1265640	22977	100379/1	-34.7324	138.6478	55	
1265641	22977	100389/1	-34.7324	138.6478	55	
1265644	22977	100389/1	-34.7324	138.6478	55	
1265645	22977	100391/1	-34.7324	138.6478	55	
1265648	22977	100391/1	-34.7324	138.6478	55	
1265649	22977	100392/1	-34.7324	138.6478	55	
1265652	22977	100392/1	-34.7324	138.6478	55	
1265653	22977	100394/1	-34.7324	138.6478	55	
1265656	22977	100394/1	-34.7324	138.6478	55	
1267630	22977	493573/1	-34.7324	138.6478	55	
1267633	22977	493573/1	-34.7324	138.6478	55	
1267626	52733	493559/1	-34.7319	138.6398	55	
1267629	52733	493559/1	-34.7319	138.6398	55	
1265218	22971	99850/1	-34.7160	138.5345	61	
1265221	22971	99850/1	-34.7160	138.5345	61	
1267622	22971	493558/1	-34.7160	138.5345	61	
1267625	22971	493558/1	-34.7160	138.5345	61	
5678205	23109	10737766/1	-34.9494	138.7159	72	Direct-Mix Concrete Pty Ltd Attention: Concrete Operations Manager PO Box 232 Torrensville Plaza SA 5031
5678208	23109	10737766/1	-34.9494	138.7159	72	
5692444	23109	10739289/1	-34.9494	138.7159	72	
5692445	23109	10739289/1	-34.9494	138.7159	72	

Table 6 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
761637	304555	1191804/1	-34.0936	139.8616	71	GD & AR Bald Pty Ltd ATF Bald Family Trust PO Box 78 WAIKERIE SA 5330
761640	304555	1191804/1	-34.0936	139.8616	71	
795677	501003	1329006/1	-34.6117	138.8373	34	Gawler Golf Club PO Box 278 GAWLER SA 5118
795681	501003	1329006/1	-34.6117	138.8373	34	
824087	501221	1506533/1	-33.8187	138.5972	65	Jim Barry Wines Pty Ltd PO Box 321 CLARE SA 5453
824090	501221	1506533/1	-33.8187	138.5972	65	
3853864	10010699	10465819/1	-34.8858	139.5713	64	LACTON PTY LTD 127 Gilles Street ADELAIDE SA 5000
3853867	10010699	10465819/1	-34.8858	139.5713	64	
792593	305281	1325708/1	-35.0100	139.2379	66	Rin-Pra Produce Pty Ltd P.O. Box 437 MURRAY BRIDGE SA 5253
792596	305281	1325708/1	-35.0100	139.2379	66	
2616609	22170	10235310/1	-34.9248	138.5988	75	SOUTH AUSTRALIAN GOVERNMENT RADIO NETWORK GPO Box 464 ADELAIDE SA 5001
2616612	22170	10235310/1	-34.9248	138.5988	75	
2616613	22170	10235311/1	-34.9248	138.5988	75	
2616616	22170	10235311/1	-34.9248	138.5988	75	
2616617	22170	10235312/1	-34.9248	138.5988	75	
2616620	22170	10235312/1	-34.9248	138.5988	75	
2616621	22170	10235313/1	-34.9248	138.5988	75	
2616624	22170	10235313/1	-34.9248	138.5988	75	
2616625	22170	10235314/1	-34.9248	138.5988	75	
2616628	22170	10235314/1	-34.9248	138.5988	75	
2616629	22170	10235315/1	-34.9248	138.5988	75	
2616632	22170	10235315/1	-34.9248	138.5988	75	
1000002	9023070	1985221/1	-34.0989	139.8535	70	Samuel Smith and Son Pty Ltd Yalumba Winery Oxford Landing Estate PMB 31 WAIKERIE SA 5330
1000005	9023070	1985221/1	-34.0989	139.8535	70	

Table 6 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
1311921	9007183	9847149/1	-34.4891	139.1840	8	South Australian Water Corporation SA Water Adelaide 15 GPO Box 1751 (C/- Hamish Reid) ADELAIDE SA 5001
1311924	9007183	9847149/1	-34.4891	139.1840	8	
752357	24263	1181236/1	-34.1849	139.0717	9	
752362	24263	1181236/1	-34.1849	139.0717	9	
752353	24182	1181235/1	-34.5718	139.0058	22	
752356	24182	1181235/1	-34.5718	139.0058	22	
1311959	9002223	9847152/1	-34.3924	138.7185	27	
1311962	9002223	9847152/1	-34.3924	138.7185	27	
911058	9002222	1936788/1	-34.2746	138.6864	30	
911061	9002222	1936788/1	-34.2746	138.6864	30	
752365	24275	1181237/1	-33.9648	139.0628	33	
752368	24275	1181237/1	-33.9648	139.0628	33	
864043	137591	1901960/1	-34.7332	139.0808	36	
864046	137591	1901960/1	-34.7332	139.0808	36	
825410	501790	1510402/1	-34.6029	138.7608	37	
825413	501790	1510402/1	-34.6029	138.7608	37	
957730	501790	1964490/1	-34.6029	138.7608	37	
957733	501790	1964490/1	-34.6029	138.7608	37	
781543	23422	1235783/1	-34.7261	138.9273	41	
781546	23422	1235783/1	-34.7261	138.9273	41	
970852	23422	1970916/1	-34.7261	138.9273	41	
970858	23422	1970916/1	-34.7261	138.9273	41	
7679617	10023416	11206626/1	-34.6329	138.6469	47	
7679620	10023416	11206626/1	-34.6329	138.6469	47	
7679621	10023416	11206626/1	-34.6329	138.6469	47	
7679624	10023416	11206626/1	-34.6329	138.6469	47	
7679625	10023416	11206626/1	-34.6329	138.6469	47	
7679628	10023416	11206626/1	-34.6329	138.6469	47	
7679629	10023416	11206626/1	-34.6329	138.6469	47	
7679632	10023416	11206626/1	-34.6329	138.6469	47	
7679633	10023416	11206626/1	-34.6329	138.6469	47	
7679636	10023416	11206626/1	-34.6329	138.6469	47	
7679637	10023416	11206626/1	-34.6329	138.6469	47	
7679640	10023416	11206626/1	-34.6329	138.6469	47	
824701	501499	1508463/1	-34.0525	138.6005	48	
824704	501499	1508463/1	-34.0525	138.6005	48	
908991	23437	1935045/1	-34.8499	139.1336	48	
908994	23437	1935045/1	-34.8499	139.1336	48	
6697170	23437	10945867/1	-34.8499	139.1336	48	
6697171	23437	10945867/1	-34.8499	139.1336	48	
779517	24293	1232337/1	-33.9322	138.6769	51	
779520	24293	1232337/1	-33.9322	138.6769	51	
7777211	10023760	11217449/1	-34.6729	138.6000	53	
7777212	10023760	11217449/1	-34.6729	138.6000	53	
825218	501742	1509914/1	-34.7537	138.7191	53	
825221	501742	1509914/1	-34.7537	138.7191	53	
868767	9008662	1906921/1	-34.7568	138.7160	54	
868770	9008662	1906921/1	-34.7568	138.7160	54	
825532	501838	1510884/1	-34.7611	138.7108	54	
825535	501838	1510884/1	-34.7611	138.7108	54	
830888	9004223	1564380/1	-34.8326	138.8069	56	

Table 6 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
830891	9004223	1564380/1	-34.8326	138.8069	56	
7679641	10023417	11206626/1	-34.7170	138.5778	58	
7679644	10023417	11206626/1	-34.7170	138.5778	58	
7679645	10023417	11206626/1	-34.7170	138.5778	58	
7679648	10023417	11206626/1	-34.7170	138.5778	58	
7679649	10023417	11206626/1	-34.7170	138.5778	58	
7679652	10023417	11206626/1	-34.7170	138.5778	58	
7679653	10023417	11206626/1	-34.7170	138.5778	58	
7679656	10023417	11206626/1	-34.7170	138.5778	58	
7679657	10023417	11206626/1	-34.7170	138.5778	58	
7679660	10023417	11206626/1	-34.7170	138.5778	58	
7679661	10023417	11206626/1	-34.7170	138.5778	58	
7679664	10023417	11206626/1	-34.7170	138.5778	58	
1696532	23452	10054185/1	-34.8828	138.8713	59	
1696533	23452	10054185/1	-34.8828	138.8713	59	
1740361	23452	10065205/1	-34.8828	138.8713	59	
1740362	23452	10065205/1	-34.8828	138.8713	59	
749223	502494	1148259/1	-34.8358	138.7469	60	
749226	502494	1148259/1	-34.8358	138.7469	60	
825223	501743	1509915/1	-34.8650	138.7749	61	
825227	501743	1509915/1	-34.8650	138.7749	61	
823252	500680	1503652/1	-34.0217	139.6843	61	
823255	500680	1503652/1	-34.0217	139.6843	61	
831191	500680	1564623/1	-34.0217	139.6843	61	
831194	500680	1564623/1	-34.0217	139.6843	61	
917372	134025	1940403/1	-34.7698	138.5826	62	
917375	134025	1940403/1	-34.7698	138.5826	62	
917380	134025	1940404/1	-34.7698	138.5826	62	
917383	134025	1940404/1	-34.7698	138.5826	62	
1400554	134025	9898303/1	-34.7698	138.5826	62	
1400555	134025	9898303/1	-34.7698	138.5826	62	
5068288	134025	10659812/1	-34.7698	138.5826	62	
5068289	134025	10659812/1	-34.7698	138.5826	62	
971878	305774	1971357/1	-34.8744	138.7716	62	
971881	305774	1971357/1	-34.8744	138.7716	62	
779525	205783	1232338/1	-33.8186	138.6467	62	
779528	205783	1232338/1	-33.8186	138.6467	62	
1311964	500963	9847151/1	-34.9946	138.9109	69	
1311965	500963	9847151/1	-34.9946	138.9109	69	
3567221	500963	10411886/1	-34.9946	138.9109	69	
3567222	500963	10411886/1	-34.9946	138.9109	69	
932093	23114	1950797/1	-34.9469	138.7142	72	
932096	23114	1950797/1	-34.9469	138.7142	72	
1696540	23114	10054183/1	-34.9469	138.7142	72	
1696541	23114	10054183/1	-34.9469	138.7142	72	
4144404	23538	10518234/1	-35.0643	139.0676	73	
4144407	23538	10518234/1	-35.0643	139.0676	73	
7679665	10023418	11206626/1	-34.9023	138.5958	73	
7679668	10023418	11206626/1	-34.9023	138.5958	73	
7679669	10023418	11206626/1	-34.9023	138.5958	73	
7679672	10023418	11206626/1	-34.9023	138.5958	73	

Table 6 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
7679673	10023418	11206626/1	-34.9023	138.5958	73	
7679676	10023418	11206626/1	-34.9023	138.5958	73	
7679677	10023418	11206626/1	-34.9023	138.5958	73	
7679680	10023418	11206626/1	-34.9023	138.5958	73	
7679681	10023418	11206626/1	-34.9023	138.5958	73	
7679684	10023418	11206626/1	-34.9023	138.5958	73	
7679685	10023418	11206626/1	-34.9023	138.5958	73	
7679688	10023418	11206626/1	-34.9023	138.5958	73	
1311935	22346	9847157/1	-34.8653	138.5016	75	
1311938	22346	9847157/1	-34.8653	138.5016	75	
1706231	22346	10058433/1	-34.8653	138.5016	75	
1706232	22346	10058433/1	-34.8653	138.5016	75	
6800896	24227	10956909/1	-34.3153	139.1270	3	Spark Infrastructure SA (No2) Pty Limited SA Power Networks GPO Box 77 (C/- Louise Watts) ADELAIDE SA 5001
6800899	24227	10956909/1	-34.3153	139.1270	3	
6800900	24227	10956974/1	-34.3153	139.1270	3	
6800903	24227	10956974/1	-34.3153	139.1270	3	
2367734	10003327	10172964/1	-34.4389	138.4903	49	
2367737	10003327	10172964/1	-34.4389	138.4903	49	
10849322	24293	1938723/2	-33.9322	138.6769	51	
10849325	24293	1938723/2	-33.9322	138.6769	51	
10849346	24293	1982086/2	-33.9322	138.6769	51	
10849349	24293	1982086/2	-33.9322	138.6769	51	
806485	35742	1424275/1	-34.7359	138.7133	52	
806488	35742	1424275/1	-34.7359	138.7133	52	
829174	35742	1515225/1	-34.7359	138.7133	52	
829177	35742	1515225/1	-34.7359	138.7133	52	
904905	35742	1931977/1	-34.7359	138.7133	52	
904908	35742	1931977/1	-34.7359	138.7133	52	
955376	35742	1963427/1	-34.7359	138.7133	52	
955379	35742	1963427/1	-34.7359	138.7133	52	
810662	23530	1430093/1	-34.9291	139.0347	58	
810665	23530	1430093/1	-34.9291	139.0347	58	
829198	23530	1515470/1	-34.9291	139.0347	58	
829201	23530	1515470/1	-34.9291	139.0347	58	
1725435	23530	10062782/1	-34.9291	139.0347	58	
1725438	23530	10062782/1	-34.9291	139.0347	58	
794437	23121	1327662/1	-34.9746	138.7092	75	
794440	23121	1327662/1	-34.9746	138.7092	75	
806493	23121	1424279/1	-34.9746	138.7092	75	
806496	23121	1424279/1	-34.9746	138.7092	75	
806541	23121	1424407/1	-34.9746	138.7092	75	
806544	23121	1424407/1	-34.9746	138.7092	75	
811295	23121	1430655/1	-34.9746	138.7092	75	
811298	23121	1430655/1	-34.9746	138.7092	75	

Table 6 Details of point-to-multipoint licences within 75 km of the proposed Project (continued)

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
707365	24227	90627/1	-34.3153	139.1270	3	TELSTRA LIMITED Telstra - Radio Transport Engineering Locked Bag 3501 BRISBANE QLD 4001
707368	24227	90627/1	-34.3153	139.1270	3	
707371	24205	90628/1	-34.6692	139.4544	38	
707374	24205	90628/1	-34.6692	139.4544	38	
790742	24205	1323924/1	-34.6692	139.4544	38	
790745	24205	1323924/1	-34.6692	139.4544	38	
823356	24468	1503775/1	-33.8490	138.5956	63	
823359	24468	1503775/1	-33.8490	138.5956	63	
699764	23514	81351/1	-35.0437	139.4663	75	
699765	23514	81351/1	-35.0437	139.4663	75	
895129	9011554	1924213/1	-34.4762	138.9853	15	THE BAROSSA COUNCIL PO Box 867 NURIOOTPA SA 5355
895132	9011554	1924213/1	-34.4762	138.9853	15	
4322775	10012445	10544666/1	-34.6359	138.7322	42	TRINITY COLLEGE GAWLER INC
4322778	10012445	10544666/1	-34.6359	138.7322	42	TRINITY COLLEGE GAWLER INC PO Box 131 GAWLER SA 5118

Table 7 Details of other licences identified within 75 km of the proposed Project

Licence category	Licence type	Number of assignment IDs
1800 MHz Band	Spectrum	10811
2 GHz Band	Spectrum	9437
2.3 GHz Band	Spectrum	6960
2.5 GHz Band	Spectrum	2138
2.5 GHz Mid Band Gap	Spectrum	88
26 GHz Band	Spectrum	90
3.4 GHz Band	Spectrum	17552
700 MHz Band	Spectrum	4935
800 MHz Band	Spectrum	4341
AWL - FSS Only	Spectrum	22
AWL - Standard	Spectrum	26
Aeronautical Assigned System	Aeronautical	58
Amateur Beacon	Amateur	11
Amateur Repeater	Amateur	81
Ambulatory - Initial	Land Mobile	6
Ambulatory System	Land Mobile	818
CBRS Repeater	Land Mobile	10
Commercial Radio	Broadcasting	7
Commercial Television	Broadcasting	19
Community Broadcasting	Broadcasting	6
Earth Receive	Earth Receive	76
Fixed Earth	Earth	53
Fixed Receive	Fixed Receive	4
HF Domestic Service	Broadcasting	1
Land Mobile System - > 30MHz	Land Mobile	1998
Land Mobile System 0-30MHz	Land Mobile	138
Limited Coast Assigned System	Maritime Coast	38
Limited Coast Marine Rescue	Maritime Coast	15
Narrowband Area Service station(s)	Broadcasting	7
Narrowcasting Service (Fixed Tax)	Broadcasting	3
Narrowcasting Service (LPON)	Broadcasting	43
Narrowcasting Service Station(s)	Broadcasting	2
National Broadcasting	Broadcasting	14
PABX Cordless Telephone Service	Land Mobile	2
PMTS Class B	PTS	666
PMTS Class B (935-960 MHz)	PTS 900 MHz	1016
Paging System - Exterior	Land Mobile	35
Paging System - Interior	Land Mobile	2
Radiodetermination	Radiodetermination	37
Retransmission	Broadcasting	35
Scientific Assigned	Scientific	7

Table 8 Emergency services with radiocommunication assets in the vicinity of the proposed Project

Emergency service	Contact details	Distance from closest site to Project boundary [km]
Australian Maritime Safety Authority	Australian Maritime Safety Authority GPO Box 2181 Attn: Response Division Administration, Client ID 20000768 Canberra ACT 2601	69
Australian Federal Police	Australian Federal Police Attn T&I Eileen Ferber PO Box 401 Canberra ACT 2601	75
South Australian Country Fire Service	South Australian Country Fire Service GPO Box 2468 Adelaide SA 5001	9
St. John Ambulance Australia Incorporated	St. John Ambulance Australia Incorporated Technical Services 601-609 Blackburn Road Notting Hill VIC 3168	14
South Australia Police	South Australia Police GPO Box 1539 ADELAIDE SA 5001	72
South Australian State Emergency Service	South Australian State Emergency Service State Emergency Service West Region GPO Box 2706 Adelaide SA 5001	68
The Australian Volunteer Coast Guard Association Inc	The Australian Volunteer Coast Guard Association Inc SA Squadron PO Box 60 Semaphore SA 5019	70
The South Australian Sea Rescue Squadron Inc	The South Australian Sea Rescue Squadron Inc PO Box 267 Glenelg SA 5045	73
Wireless Institute Civil Emergency Network SA INC	Wireless Institute Civil Emergency Network SA INC Wicen SA Inc PO Box 600 Modbury SA 5092	70

Table 9 Bureau of Meteorology radar sites in the vicinity of the proposed Project

Site ID	Site name	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]
306141	Met Bureau Site cnr Shellgrit & Applebee Rds Buckland Park	-34.6170	138.4684	59
23280	Met Site Mount Terrible Range Road West Sellicks Hill	-35.3296	138.5025	118
10019217	Mildura Radar off Sturt Highway Cullulleraine	-34.2871	141.6077	223
502339	Bureau of Meteorology site Mildura Airport	-34.2352	142.0861	267
141677	Meteorological Office Mildura Airport Mildura	-34.2353	142.0873	267
10012512	Wimmera Radar Pullut West Road Pullut	-35.9977	142.0134	312
23944	Meteorology Radar Site Airport Mount Gambier	-37.7478	140.7746	397
25514	Range G Transceiver Site Woomera	-31.1492	136.8005	405

Table 10 Trigonometrical stations in the vicinity of the proposed Project

Station name	Datum	Latitude [GDA94]	Longitude [GDA94]	Distance to Project boundary [km]
6628/23502	GDA94	-34.4991	138.9510	18
6628/47819	GDA94	-34.5079	138.9806	18
6629/ 1083	GDA94	-34.2483	138.8477	17
6629/ 1085	GDA94	-34.2508	138.9505	9
6629/ 1086	GDA94	-34.2458	138.9984	5
6629/ 1088	GDA94	-34.2490	139.0012	5
6629/ 1111	GDA94	-34.4969	138.9988	16
6629/ 1112	GDA94	-34.4977	138.9429	18
6629/ 1113	GDA94	-34.4975	138.9451	18
6629/ 1139	GDA94	-34.2528	138.8832	14
6629/ 1357	GDA94	-34.2893	138.9999	3
6629/ 1358	GDA94	-34.2901	138.9996	3
6629/ 1359	GDA94	-34.2777	138.9694	6
6629/ 1360	GDA94	-34.2795	138.9674	6
6629/ 1361	GDA94	-34.2618	138.9643	7
6629/ 1362	GDA94	-34.2478	138.8986	13
6629/ 1363	GDA94	-34.2526	138.8837	14
6629/ 1364	GDA94	-34.2483	138.8500	17
6629/ 1381	AGD66, AGD84, GDA94	-34.3550	138.8718	13
6629/ 1382	GDA94	-34.3535	138.8735	13
6629/ 1383	GDA94	-34.4372	138.9255	13
6629/ 1384	GDA94	-34.4369	138.9254	13
6629/ 1385	GDA94	-34.4796	138.9725	16
6629/ 1386	GDA94	-34.4796	138.9723	16
6629/ 1387	GDA94	-34.2502	138.9508	9
6629/ 1389	GDA94	-34.4977	138.9428	18
6629/ 1391	GDA94	-34.4975	138.9452	18
6629/ 1660	GDA94	-34.4832	138.9910	16
6629/ 3418	GDA94	-34.4976	138.9584	18
6629/ 3462	GDA94	-34.4612	138.9813	13
6728/ 1817	GDA94	-34.5069	139.0286	15
6728/ 3365	GDA94	-34.5142	139.0441	15
6728/ 3416	GDA94	-34.5101	139.0584	14
6729/ 1003	AGD66, AGD84, GDA94	-34.2267	139.0882	5
6729/ 1004	AGD66, AGD84, GDA94	-34.3394	139.0341	Within the boundary
6729/ 1005	AGD66, AGD84, GDA94	-34.3871	139.0970	2
6729/ 1104	GDA94	-34.4755	139.0215	13
6729/ 1191	GDA94	-34.3733	139.0044	4

Table 10 Trigonometrical stations in the vicinity of the proposed Project (continued)

Station name	Datum	Latitude [GDA94]	Longitude [GDA94]	Distance to Project boundary [km]
6729/ 1192	GDA94	-34.3721	139.0029	4
6729/ 1193	GDA94	-34.3322	139.0021	0.6
6729/ 1196	GDA94	-34.4568	139.0020	13
6729/ 1197	GDA94	-34.4578	139.0022	13
6729/ 1532	GDA94	-34.4657	139.0259	12
6729/ 1951	GDA94	-34.4860	139.0304	13
6729/ 1970	GDA94	-34.4893	139.0555	12
Bald Hill	AGD66	-34.3394	139.0341	Within the boundary
Belvidere	AGD66, AGD84, GDA94	-34.4294	138.9026	14
Brownlow	AGD84, GDA94	-34.2098	139.2437	16
Julia	AGD84, GDA94	-34.0994	139.0218	19
Light	AGD66, AGD84, GDA94	-34.3021	138.8356	16
Long Ridge	AGD84, GDA94	-34.4940	139.3443	17
Mons	AGD66, AGD84, GDA94	-34.5858	139.1932	19
Penrice	AGD66, AGD84, GDA94	-34.4907	139.0412	13
Rufus	AGD66, AGD84, GDA94	-34.3166	139.1260	3
Waterloo	AGD66, AGD84, GDA94	-34.2034	138.9645	11
6628/23502	GDA94	-34.4991	138.9510	18
6628/47819	GDA94	-34.5079	138.9806	18

Table 11 Dwellings with increased potential to experience EMI to DTV from television broadcast transmitters

Dwelling ID	Easting[2] [m]	Northing[2] [m]	Located in potential interference zone
			Adelaide
70	327001	6207829	X
75	321830	6206405	X
76	324379	6207966	X
77	324320	6207653	X
147	*319969*	*6205165*	*X*
151	*320252*	*6205722*	*X*
187	326433	6207948	X

1. Coordinate system: MGA zone 54, GDA94 datum.
2. Associated dwellings are indicated by *underlined italic text*. Buildings identifed by the Customer as sheds or ruins have been omitted from this assessment.

Table 12 Summary of service operators contacted by DNV and responses received to date

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
1	Fixed point-to-point link: one link crossing the Project, no turbines in the exclusion zones set by DNV Fixed point-to-multipoint: 4 km from site boundary	South Australian Water Corporation (SA Water) 170894-AUME-L-01	Response received by email on 10 November 2016, based on previous turbine layout and dimensions: *"It would appear that this could impact our PTP link between Mt Kitchener & Eudunda bases (site ID 24263)* *If we were to have interference, Approx. 4 critical pump station/tank sites would be impacted."* Response received by email on 17 November 2016, based on previous turbine layout and dimensions: *"...we are concerned that the proposed installation of wind turbines at the proposed location may adversely impact our PTP radio link between our radio facilities at Mt Kitchener and Eudunda. Upon reviewing the Google Earth data originally submitted to us, it would appear that our radio path will be dissected by the turbines.* *As a ACMA radio licence holder, we are entitled to operate on our allocated frequencies unimpeded and without interference. We are not in a position to suggest whether or not the proposed development of the wind farm could or would impact our operations with any degree of certainty. Therefore it is our position that... [the developer] must engage a subject matter expert in the field of RF propagation to provide an expert opinion and report into this. This report should document opinion on the likelihood of interference posed to our allocated frequencies and recommend any mitigating measures that should take place to prevent interference. The completed report should then be submitted to SA Water for further review."* Response received by email on 24 January 2017 (following submission of draft EMI Assessment report), based on previous turbine layout and dimensions: *"...whilst we acknowledge your EMI Assessment draft report and the conclusions you have drawn from the findings, SA Water normally do not provide approvals or acceptance on locations of wind turbines in relation to SA Water infrastructure.* *We advise that you proceed at your own risk, and any impact on the SA Water point to point link post construction will be the responsibility of the wind farm developer/owner to remedy."* Response received by email on 4 December 2023, based on the interim turbine layout and dimensions:

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
			"As long as the exclusion zone is maintained so the radio path… between Eudunda Tank and Mt Kitchener repeater is not impeded it should be ok." **Further consultation based on the current turbine layout and dimensions is not considered necessary**
2	FM broadcasting: 3.9 km from nearest turbine	W & L Phillips Pty Limited (Flow FM) 170894-AUME-L-02	Response received by email on 2 December 2016, based on previous turbine layout and dimensions: *"I think as you suggest that coverage in some of the weaker areas from Mt Rufus [Kapunda] will get coverage from one of the other transmitters in most cases."* Response received by email on 21 December 2023, based on the interim turbine layout and dimensions: *"We will need some further time to garner feedback from our industry about the nature of projects and specifically reports from others about the impact of wind turbines and proximity to FM broadcasts. In addition, we are seeking clarification from ACMA about our Kapunda and SA Lower Mid North licensing…* *…Our concern [is] the location of all 42 turbines with the nearer turbines being at 3.8 kilometres and the base terrain ranging from 470 metres to 420 metres… the nearest turbines with added towers and blades would be higher than the 540 metres plus 25 metres tower position for our electrical centre on antennas.* *All turbines are closely aligned between a key aperture of Kapunda and Marrabel townships… Kapunda is very marginal in barely receiving rural mono or 54 dBu and given other electronic noise considerations is a concern given a possible addition of wind turbines. Generally, commercial services in key population or urban centres are 66 dBu.* *There may be options to move forward your proposal but it would require confirmation from ACMA about improved licensing for Flow and a commitment from Twin Creek Wind Farm to fund engineering, infrastructure and subsequent antenna changes if ACMA approved licensing. We also note that ACMA has projects waiting engineering for us and other broadcasters with waiting delays up to 5 years.* *We are happy to discuss this further once we receive industry and ACMA responses to our questions and would be happy to electronically meet to discuss."*

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
3	Fixed point-to-point links: 4 links crossing the Project, no turbines the exclusion zones set by DNV Spectrum (wireless internet): 12 km from nearest turbine	NBN Co Limited 170894-AUME-L-03	Response received by email on 15 April 2024 based on the current turbine layout and dimensions: *"...I have reviewed the data provided based on the updated turbine locations of the proposed wind farm.* *The wind farm turbine locations are within scattered existing nbn wireless coverage boundaries. However, none of the proposed wind tower locations pose any risk of introducing a physical obstruction to the RF Path Profiles or boresight paths of existing nbn microwave links. It is also noted no current nbn connected customer premises are within the wind farm boundary so there are also no intrusions into RF paths between customer locations and their connected nbn eNB...* *...Of potential greater concern is any impact from wind farm operated RF transmission equipment impacting nbn licensed spectrum.* *Therefore, please provide information on any planned RF transmission equipment planned to be installed so a potential interference impact can be assessed. This information should include as a minimum, the operating transmission frequencies and transmit power, channel bandwidths, antenna types and their radiation patterns as well as their exact location with antenna height, boresight azimuth and tilt (either mechanical or electrical tilt).* *...We confirm that NBN Co Spectrum Pty Ltd (nbn Spectrum) has a number of spectrum licenses within 75 km of the proposed Twin Creek Wind Farm.* *nbn has strict obligations to provide internet services to the community, and this area has been determined as a FW service area where the footprint of this service is now in place.* *nbn will be forced to consider its position as part of the planning should there be an interference issue.* *If the Application is amended before it is lodged, we request that we are sent any amended Application so we can determine whether we have any objections to the amended Application..."*

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
4	Fixed point-to-multipoint:40 km from nearest turbine Meteorological radar: 60 km from the site	Bureau of Meteorology 170894-AUME-L-06	<u>Response received by email on 14 December 2016, based on the interim turbine layout and dimensions:</u> *"Noting that:* *No Bureau radar is within 20 to 30 km of the proposed Twin Creek wind farm. The closest Bureau radars to the proposed wind farm is approximately 58km away at Buckland Park (S-band), at least 2x the range at which the WMO suggests an impact study is required [at the time of this response]...* *Recommendation* *Given that Buckland Park radar is within 2x the range of the proposed WMO guidelines [at the time of this response] and straight-line propagation puts the wind farm at about 0.2 degrees above the horizon (the effective angle will actually be higher due to atmospheric refraction). Buckland Park radar will observe clutter at higher elevation angles due to the wind farm and radar side-lobe scatter. Buckland Park radar will most likely be affected by the location of the proposed Twin Creek wind farm. The Bureau would prefer if this wind farm is located at a greater distance from Buckland Park radar in order to mitigate interference, namely clutter and Doppler mode false artefacts."* <u>Response received by email on 2 February 2017 (following confirmation that all proposed radar locations are more than 60 km from the Buckland Park radar), based on previous turbine layout and dimensions:</u> *"The Bureau is rather cautious regarding the wind farm's location and the effect it will have on Buckland Park radar's contiguous performance beyond the wind farm, towards the border region. ...whilst the proposed site meets WMO recommendations [at the time of this response] The Bureau strives to provide the best possible performance of our radar network for all stakeholders throughout the country.* *...The Bureau would be happy with the proposed turbine locations as it now stands."* <u>Response received by email on 12 January 2024 based on the current turbine layout and dimensions:</u> *"Our analysis shows that at least three scans of the Adelaide weather radar (Buckland Park) will be impacted by the proposed Twin Creek WF and as such this wind farm is categorised as extreme-risk.* *The Business solution of the Bureau will be in contact with you on further steps that both sides may consider to manage the risk on the weather radar network of the Bureau."*

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
			<u>Response received by email on 14 February 2024 based on the current turbine layout and dimensions:</u> *"...The assessment found that any wind farm built at the proposed Twin Creek site would pose a high risk of interference to a segment of the Adelaide (Buckland Park) weather radar. This high-risk rating is due to the following factors:* - *The proximity to a meteorological radar that serves a capital city (Adelaide),* - *Turbines with a 220 m tip height will potentially affect a segment of the Adelaide radar,* - *The Morgan township, with a population of around 500, lies behind the Twin Creek wind farm and will most likely lose weather radar coverage from the Adelaide (Buckland Park) radar (Figure 1)....* *... The proximity of the Twin Creek wind farm to the Buckland Park radar (62 km) is likely to compromise the Bureau's ability to evaluate the severity of thunderstorms in the wind farm area...* *... We would like to continue the conversation and work with you to minimise and manage the impacts of the Twin Creek wind farm project on the regional radar service..."*
5	Fixed point-to-multipoint: 54 km from nearest turbine	Department of Defence 170894-AUME-L-07	<u>Response received by email on 8 December 2023 based on the interim turbine layout and dimensions:</u> *"From spectrum point of view, the wind farm has very little impact on Defence assets. If we get any interference in future that will be reported to regulator."* **Further consultation based on the current turbine layout and dimensions is not considered necessary**

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
6	Fixed point-to-point link: one link crossing the Project, no turbines in the exclusion zones set by DNV Fixed point-to-multipoint: one identified link crossing the Project, no turbines in the exclusion zone set by DNV Fixed point-to-multipoint: 3 km from nearest turbine	Spark Infrastructure SA (No2) Pty Limited (SA Power Networks) 170894-AUME-L-08	<u>Response received by email on 18 November 2016, based on previous turbine layout and dimensions:</u> *"Based on our radio designers review they have plotted some of the turbines on a map and have found that they are in the path of our link between Mt Rufus to Kapunda substation. They are located roughly 6 km along the path and they have run a path calculation (attached) showing the effect of the proposed 180m turbines on our path. The obstruction will attenuate the radio considerably and the actual path effect is very hard to predict since the rotational obstruction is impossible to model.* *Bottom line is that we expect this will impact the reliability of the path between Mt Rufus and Kapunda substation. Which is critical to our operation of the Electricity Distribution business."* <u>Response received by email on 9 January 2017 (following suggestion that an exclusion zone based on the second Fresnel zone be applied), based on previous turbine layout and dimensions:</u> *"Thanks for your response to our concerns regarding our path between Mt Rufus and Kapunda.* *I have had a look through your proposal and an exclusion zone of the second Fresnel zone would be adequate to ensure the reliability of our path."* <u>Response received by email on 29 February 2024 based on the current turbine layout and dimensions:</u> *"... we can confirm there will be no adverse effect to our radio link..."*

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
7	Fixed point-to-multipoint: 3 km from nearest turbine PTMS/spectrum (mobile phone): 5 km from nearest turbine Land mobile system: 5 km from the nearest turbine	Telstra Corporation Limited – consulted in relation to assets licenced to Telstra and the South Australian Government Radio Network 170894-AUME-L-09	<u>Response received by email on 23 November 2016, based on previous turbine layout and dimensions:</u> *"...a desk top study has been undertaken of the area and nearby telecommunications infrastructure.* *Based on the provided information relating to the proposed wind farm on rural land in the Twin Creek area South of Eudunda, between Kapunda and Frankton, SA, results of Radio rayline analysis investigation reveals that there is no potential for undue interference from the proposed wind farm.* *Also, results of Optic & Copper cable investigation reveals that there is no cable within 1.22Km of any of the proposed location of the Wind Turbines.* *Telstra has no objection to this development in relation to the proposed wind farm subject to [the developer] confirming its agreement to the conditions and matters set out in this letter.* *Telstra requires [the developer] to notify of any additional turbines, or any change to the proposed location of the Wind Turbine, so that impacts on Telstra's Network can be re-assessed.* *Telstra will require the protection of/relocation of its fixed telecommunications infrastructure that may be impacted by activities on this site. To minimise risk of liability due to any damage, the DialBeforeYouDig 1100 Inquiry number should be contacted to obtain location of Telstra plant before commencement of construction work."* <u>Response received by email on 10 April 2024, based on current turbine layout and dimensions:</u> *"...Telstra requires the developer to confirm its agreement to the conditions and matters set out below:* *1) There are no expected impacts to Telstra's Mobile network due to this wind farm based on the turbine locations provided.* *2) Based on the turbine locations provided and information regarding Telstra's existing point to point radio links obtained from Waypoint and maprad.io, the proposed wind farm should not impact on any of Telstra's existing point to*

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
			point radio links. *3) A detailed analysis of the full power coordination impact (Low Frequency Induction (LFI) and/or Earth Potential Rise (EPR)) of the wind farm development is required. This includes location of the wind farm switch yard, the route and potential of any associated HV transmissions lines and the LFI and EPR impact on any Telstra plant they may affect.* *4) It is recommended that you contact Before You Dig Australia, so you are aware of the underground assets in the area. They will provide you with the location of Telstra's as well as any other utilities' underground assets…* *The developer also confirms its role as the proponent and ultimate owner of the proposed wind farm and that it has the authority to ensure that the conditions set out above are implemented and complied with. If the agreement of any other person or entity is required to ensure the conditions set out in this letter are complied with, the developer undertakes to obtain that agreement in writing and to provide it to Telstra prior to lodging a development application for the wind farm.* *If the proposed plans and specifications of the development are altered or amended, Telstra reserves the right to request further conditions and amendments to the development…"*
8	Fixed point-to-multipoint: 15 km from nearest turbine	The Barossa Council 170894-AUME-L-10	Response received by telephone on 4 December 2023: The Barossa Council operate both P2MP licences and relay transmitters near the wind farm. The links associated with the point-to-multipoint licence are all directed south of the site at Nuriootpa, away from the wind farm. The coverage areas for the relay transmitters are localised in and around Angaston, to address a lack reception from Adelaide caused by terrain. Therefore, the wind farm is not expected to impact on either service.

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
9	Emergency service, land mobile system: 74 km from nearest turbine	Australian Federal Police 170894-AUME-L-11	Response received by email on 01 February 2024, based on the current turbine layout and dimensions: *"I can confirm that all equipment from Radio point of view in SA has now been decommissioned. We have transitioned onto the SAGRN radio network with only one site left in our Airport office site. We are expecting this site to be shut down in the coming months as well. I do not see any issues as part of this plan from our perspective."*
10	Emergency service, land mobile system: 19 km from the nearest turbine	South Australian Country Fire Service 170894-AUME-L-12	Response received by email on 28 October 2016, based on previous turbine layout and dimensions: *"I have reviewed the proposal, CFS doesn't see any potential issue pertaining to the HF site, Para Wirra National Park, site ID 23048."* **Further consultation not considered necessary**
11	Emergency service, land mobile system: 15 km from the nearest turbine	St John Ambulance Australia Incorporated 170894-AUME-L-13	Response received by email on 10 November 2016, based on previous turbine layout and dimensions: *"...we have reviewed it and could not identify any obvious impact to St John assets."* **Further consultation not considered necessary**
12	Trigonometrical stations, two within the site boundary, the closest station is 1.5 km from the closest turbine Global Navigational Satellite System (GNSS) stations, 22 km from the site boundary	Geoscience Australia 170894-AUME-L-13	Response received by email on 5 December 2016, based on previous turbine layout and dimensions: *"Geoscience Australia does not see foresee any impact to our trigonometrical stations, Global Navigational Satellite System stations, equipment, facilities or services associated with the proposed Twin Creek Wind Farm."* **Further consultation not considered necessary**

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
13	Survey marks: two points within the Project boundaries	South Australia Land Services Group 170894-AUME-L-15	Response received by email on 25 October 2016, based on previous turbine layout and dimensions: *"Departmental Trig Points and Permanent Survey Marks are non-communicative assets and so will not be affected at all by electromagnetic interference...* *The marks you have listed are generally outside of the proposed wind farm boundary and so will be unaffected by potential construction works and the one inside the boundary appears to be sufficiently clear of the proposed turbine localities.* *There are four survey marks along Ben Lomond Rd that runs through the centre portion of the site. The mark numbers are 6729/1606, 6729/1607, 6729/2060 and 6729/2059, although I have estimated that the turbine locations are just south of Ben Lomond Rd so these marks may not be affected either. However, if these marks are to be disturbed in any way by construction of the wind farm turbines, please arrange for my office to be contacted before they are moved or destroyed."* **Further consultation not considered necessary**
14	Fixed point-to-point links: 3 links crossing the Project boundary, no turbines in exclusion zone set by DNV PTMS/spectrum (mobile phone): 4 km from the nearest turbine	Optus Mobile Pty Ltd 170894-AUME-L-16	Response received by email on 31 November 2016, based on previous turbine layout and dimensions: *"We have reviewed this proposal and conclude it will not impact either our mobile network or microwave link network."* **Further consultation not considered necessary**
15	PTMS/spectrum (mobile phone): 4 km from the nearest turbine	Vodafone Australia Pty Limited 170894-AUME-L-17	Response received by email on 14 November 2016, based on previous turbine layout and dimensions: *"Having spoken with both our radio access and transmission teams Vodafone confirm that we have no plant in the area of interest and as a result would not expect the Twin Creek development to impact our network operation."* **Further consultation not considered necessary**

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
16	DTV broadcasting: 6 km from the site	BAI Communications 10461810-AUMEL-L-05-A	<u>Response received by email on 31 January 2024, based on the current turbine layout and dimensions:</u> *"BAI Communications has done a study on the proposed wind farm located in Southern South Australia. The impact on three digital television broadcast facilities were studied. The results show that the only one DTV broadcast facility is predicted to be impacted (Mt Lofty DTV services) by the proposed wind turbines, but none of the viewers are predicted to be impacted due to the scatter interference effects of the wind farm. However, if there is any impact, remediation that is required to rectify DTV degradation to the viewers, is expected to form part of the wind farm project.* *… The broadcast sites that have been identified to provide coverage around the area of the wind farm are… Mt Lofty… Eudunda… Angaston…* *BAI has conducted field tests on existing wind farms in the past for the impact on FM services. The field test measurements concluded that FM radio had some minor reflections observed but these would not be expected to cause any noticeable effect on reception. Thus, this report will not consider further impacts on FM broadcast…* ***Conclusion*** *BAI have modelled the proposed Twin Creek wind turbines to assess how they will affect DTV services broadcast from Mt Lofty, Eudunda and Angaston sites in ATDI. Interference analysis concluded that Eudunda and Angaston DTV services will not be affected by the presence of wind farms in the current configuration. Furthermore, interference analysis predicts that Mt Lofty DTV services are affected by the proposed wind farms, but none of the viewers are predicted to be impacted. Whilst there are no persons predicted to be impacted by the wind farm, any degradation of DTV services caused by the wind farm development would be expected to be rectified as part of the project."*

Table 12 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site to proposed site boundary or turbine	Operator name and DNV reference	Response received to date
17	Wireless internet services and fixed point to point links in the vicinity of the site Fixed point-to-point link: 1 link crossing the Project boundary, no turbines in exclusion zone set by DNV	SWOOP (formerly Beam Barossa and Wan Solutions Pty Ltd)	Response received by email on 9 April 2024, based on the current turbine layout and dimensions: *"We have confirmed that indeed there will be potential interference to Swoop assets and we are still in the process of identifying which transmission links will be affected."* Response received by email on 22 April 2024, based on the current turbine layout and dimensions: *"...Please see attached an overlay of our links...* *...There are also 5GHz point to multipoint access points servicing 30+ customers in the West and South-West..."* Response received by email on 11 June 2024, based on the current turbine layout and dimensions: *"Please find attached KMZ of the Swoop customers fed from the RUF site. You can assume that there is currently direct line of site from RUF to the customer pins and will require around 3 metres of clearance on the beamwidth...* *... Please note that at no point in time can the line of sight be impeded or the link will experience a down event..."*

LIST OF FIGURES

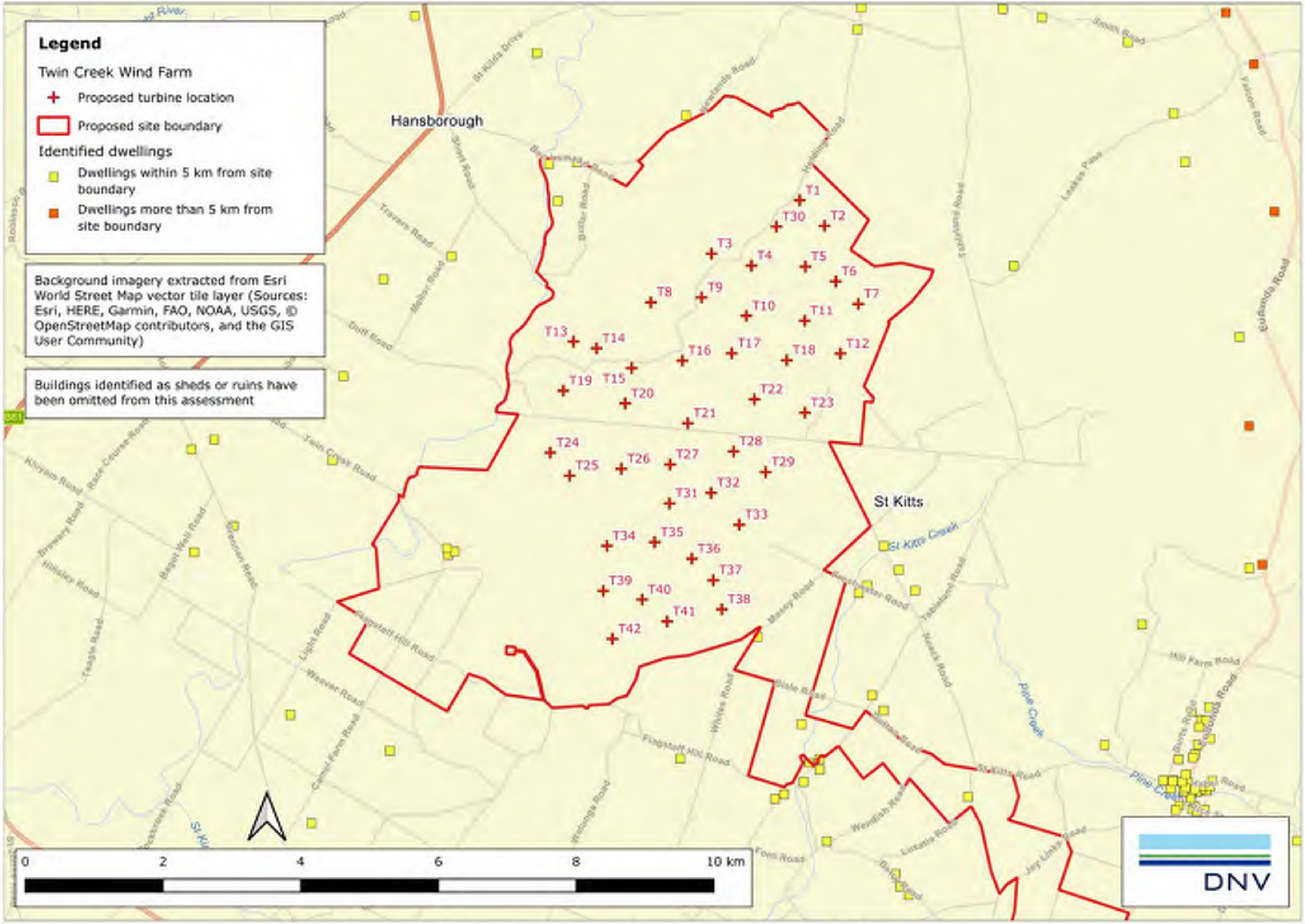


Figure 1 Map of the proposed Project, showing proposed boundary, turbine locations, and locations of nearby dwellings

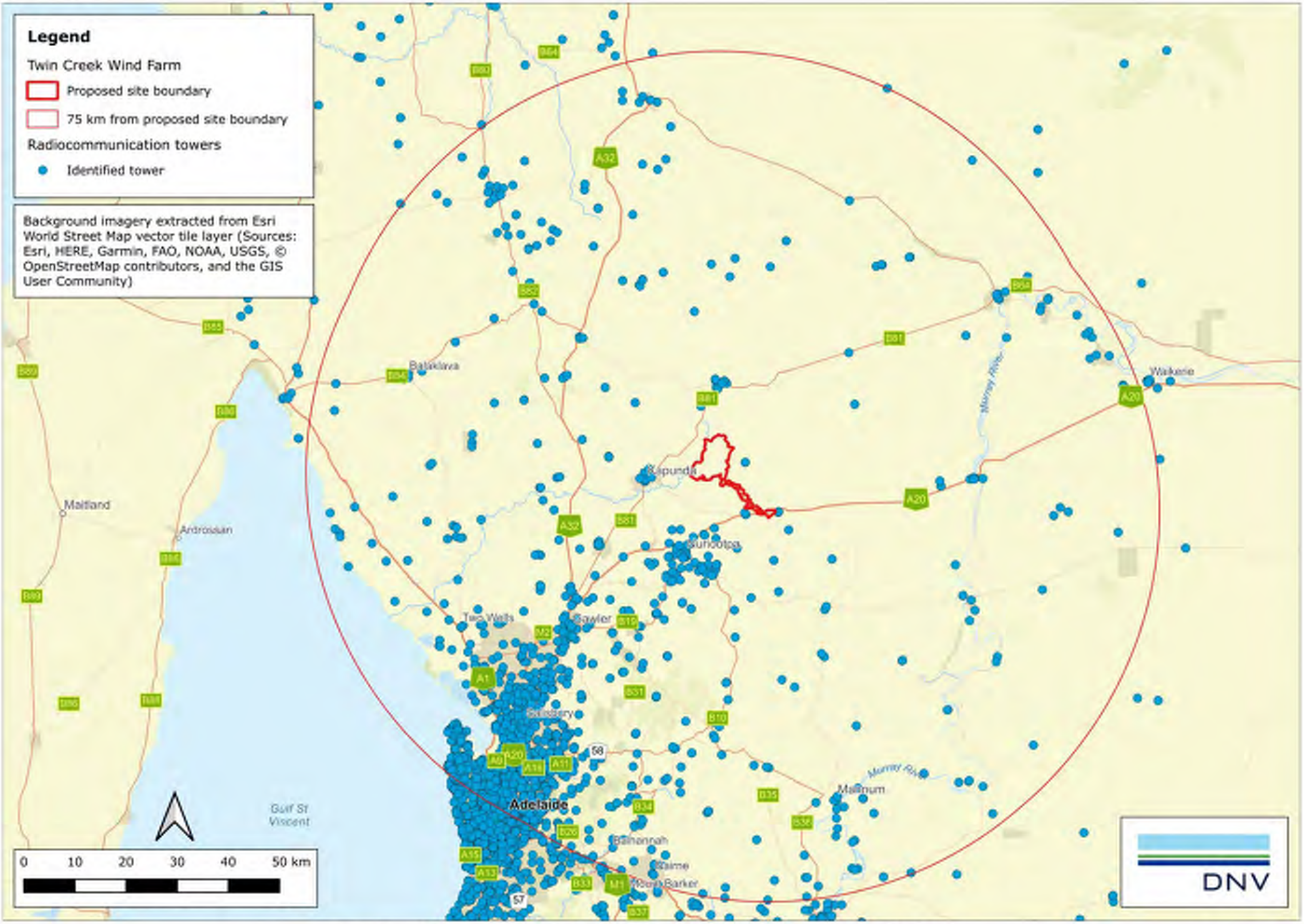


Figure 2 Location of the proposed Project and identified nearby radiocommunication sites

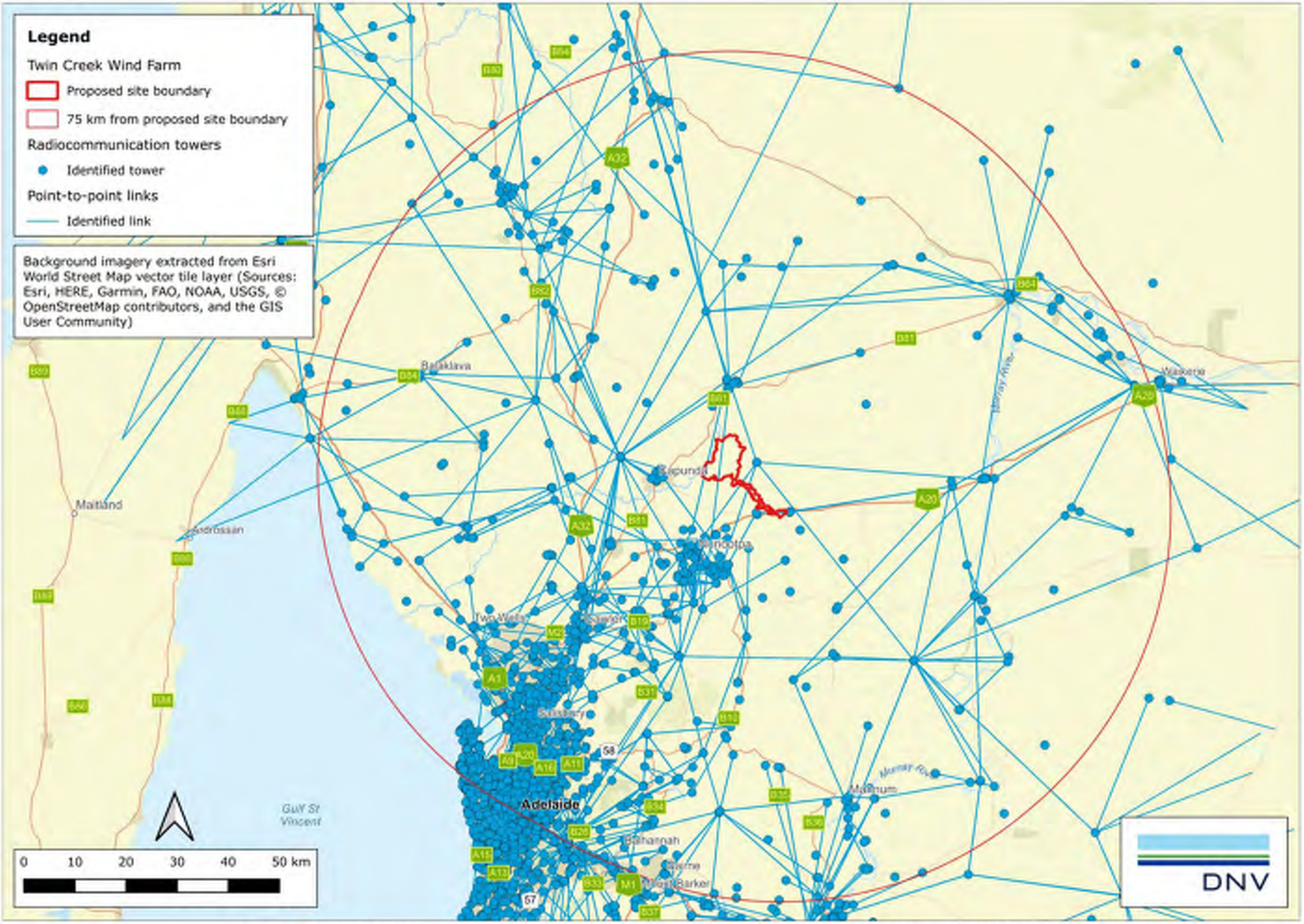


Figure 3 Identified transmission vectors for fixed licences of point-to-point type in the vicinity of the proposed Project

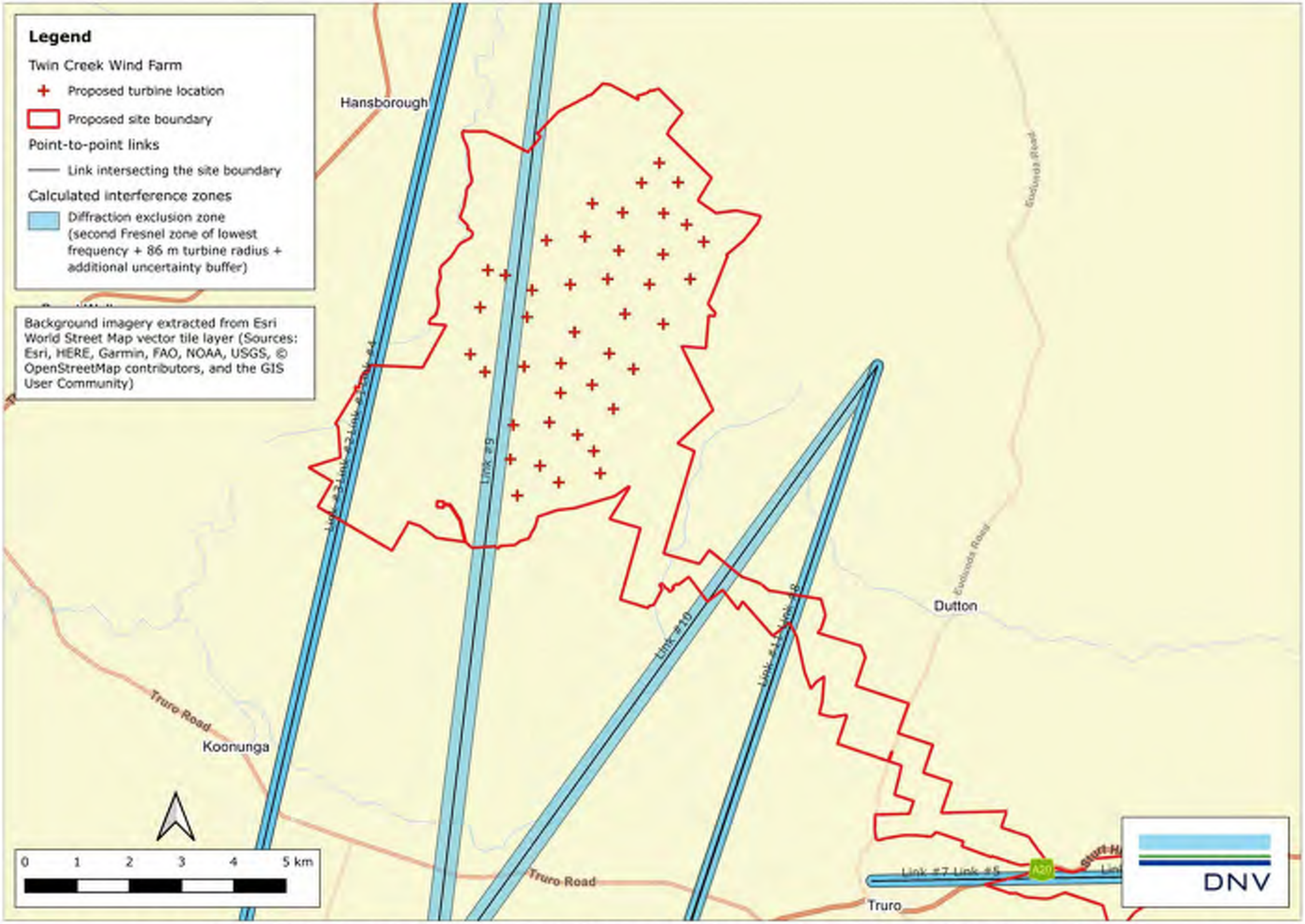


Figure 4 Identified point-to-point radiocommunication vectors crossing the proposed Project and calculated interference zones

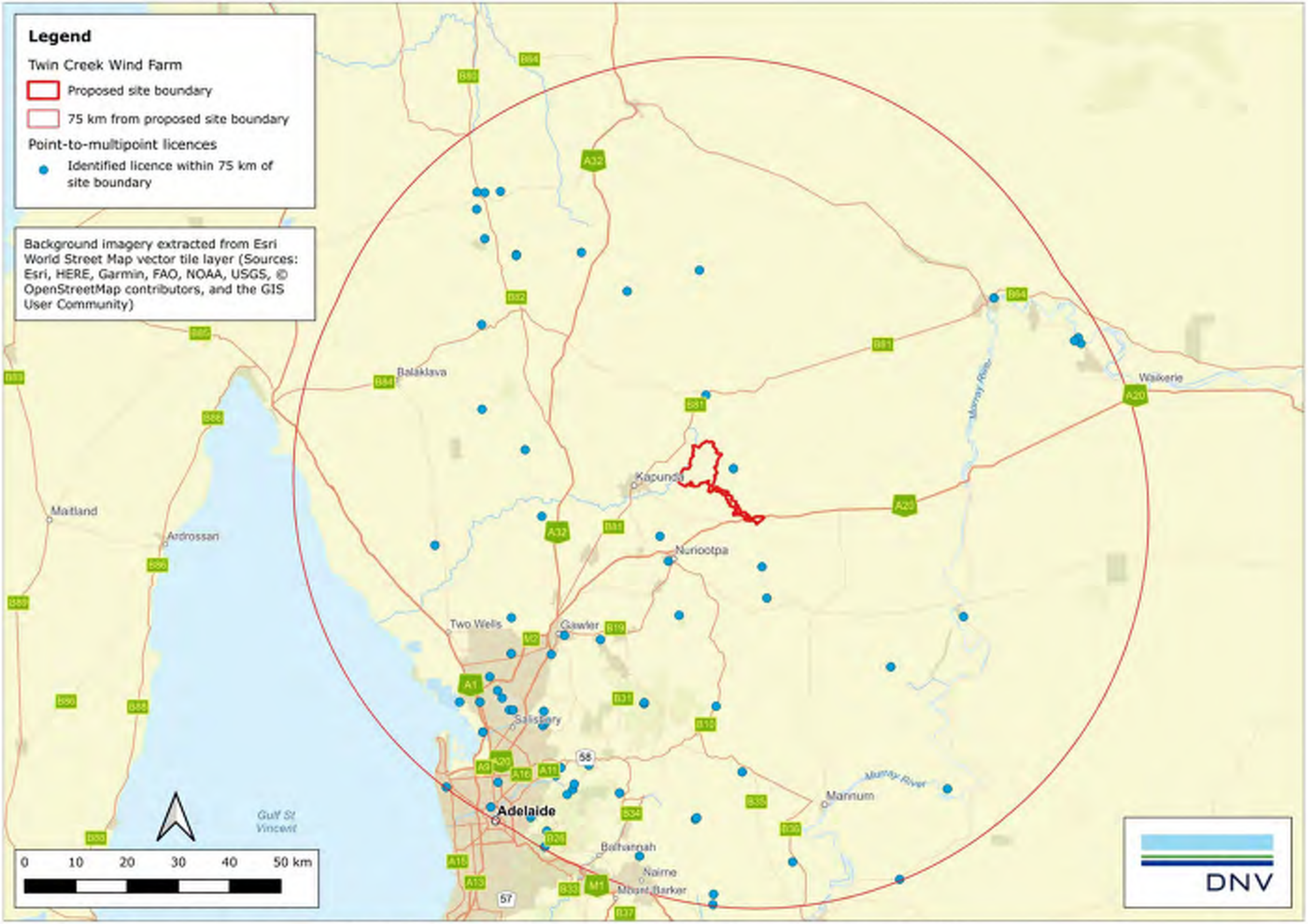


Figure 5 Location of point-to-multipoint licences in the vicinity of the proposed Project

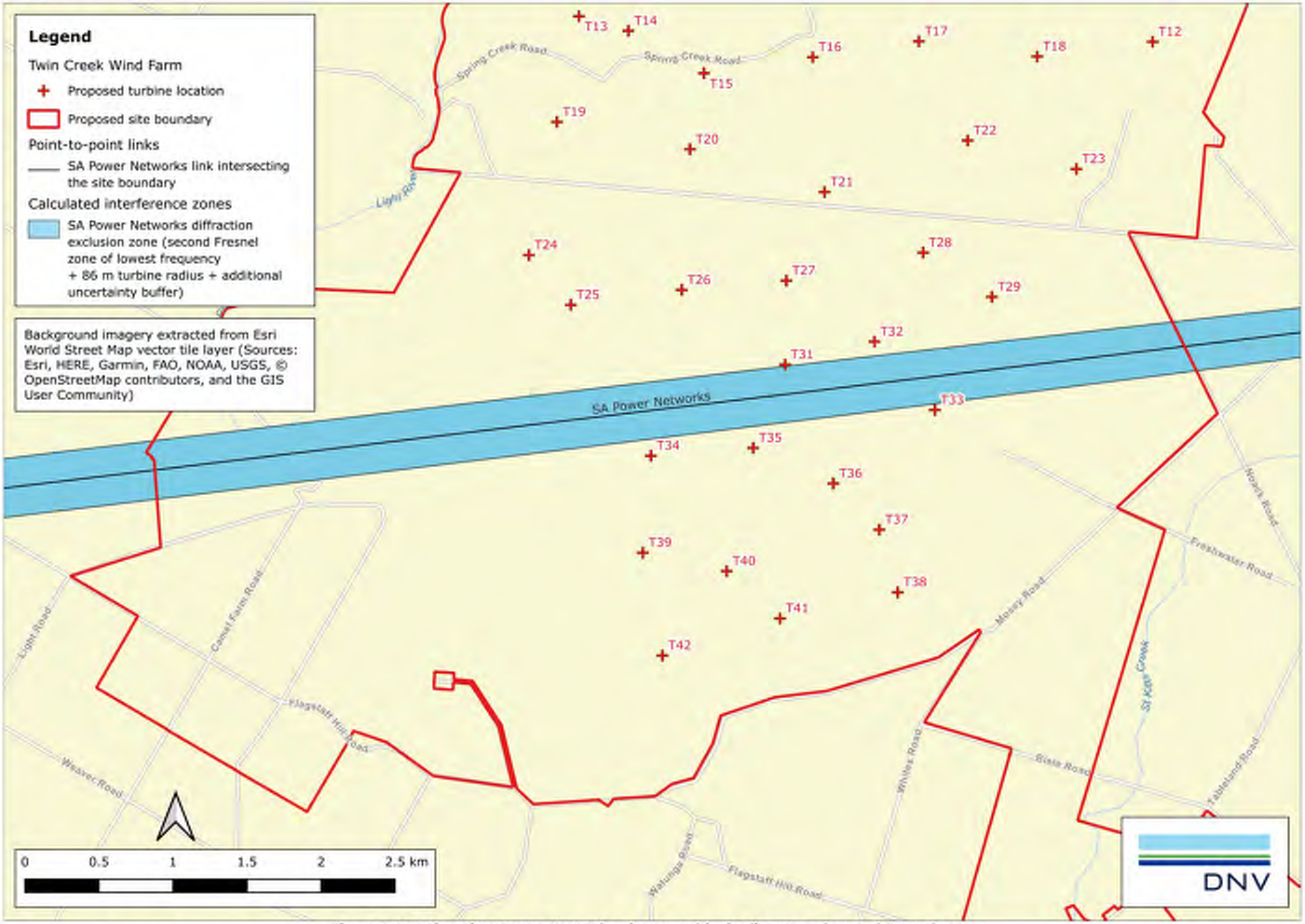


Figure 6 Location of SA Power Network point-to-multipoint licence and second Fresnel zone

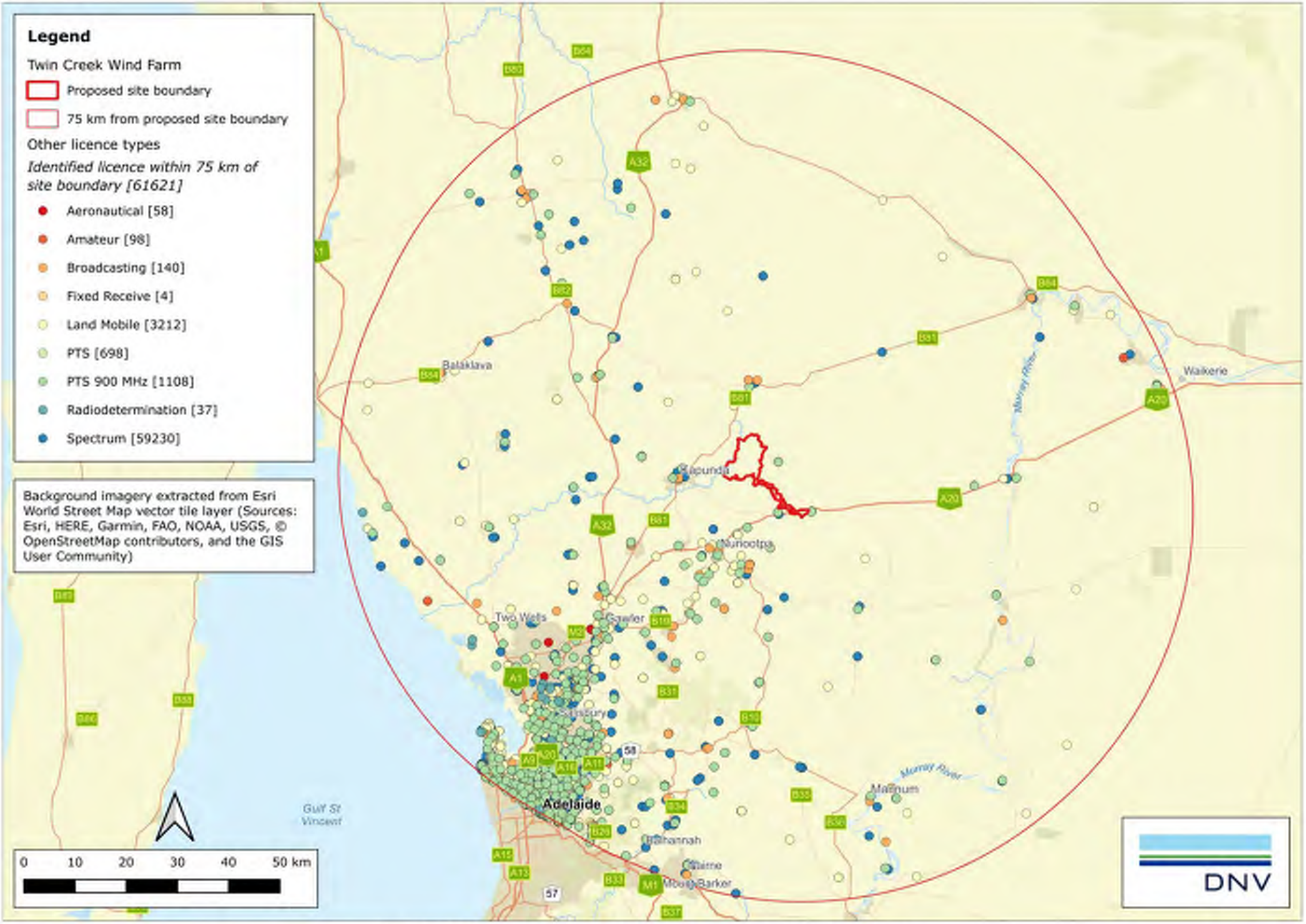


Figure 7 Location of other licence types within 75km of the proposed Project

Figure 8 Location of meteorological radar sites within 250 nautical miles of the proposed Project

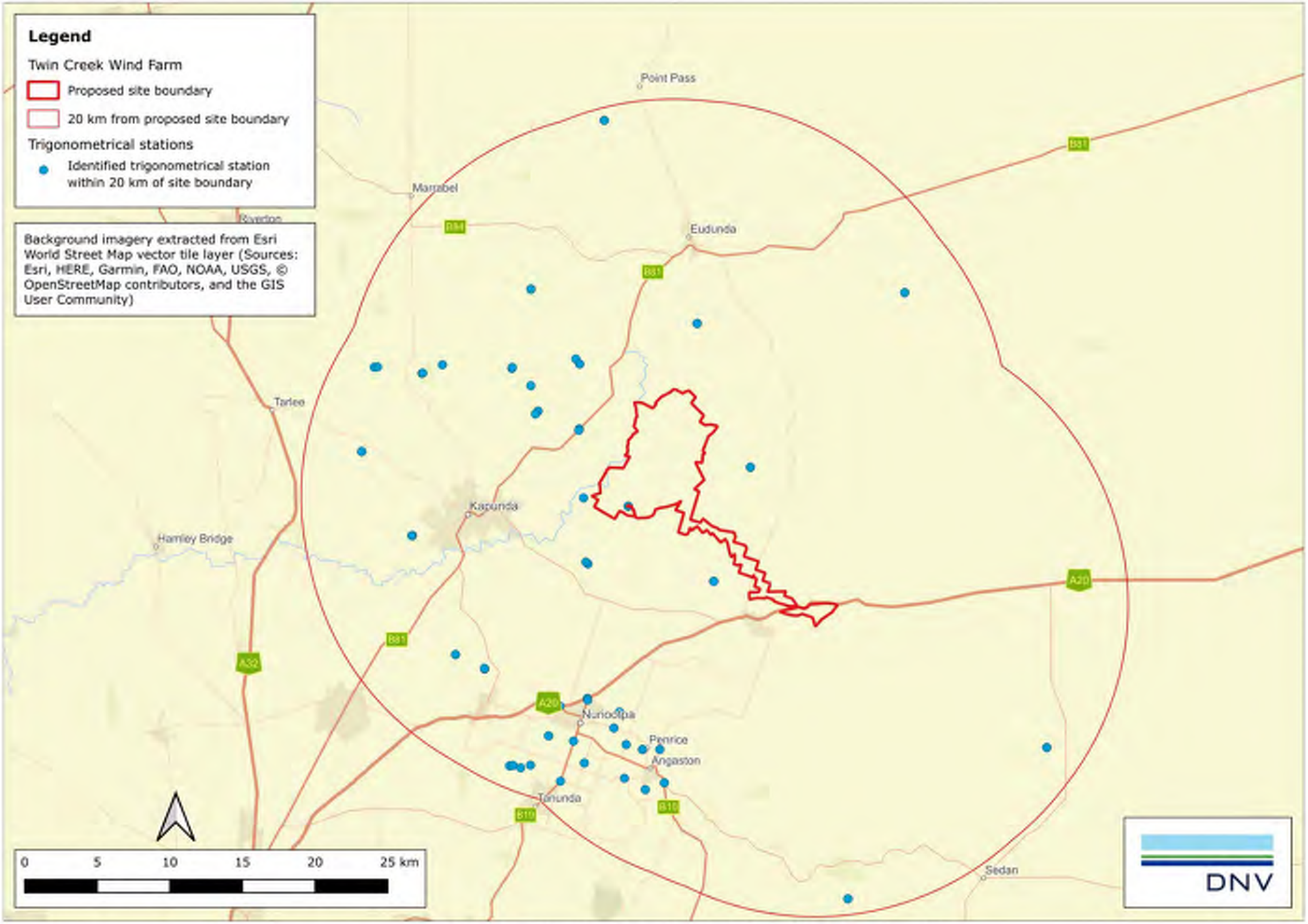


Figure 9 Location of trigonometrical stations within 20 km of the proposed Project

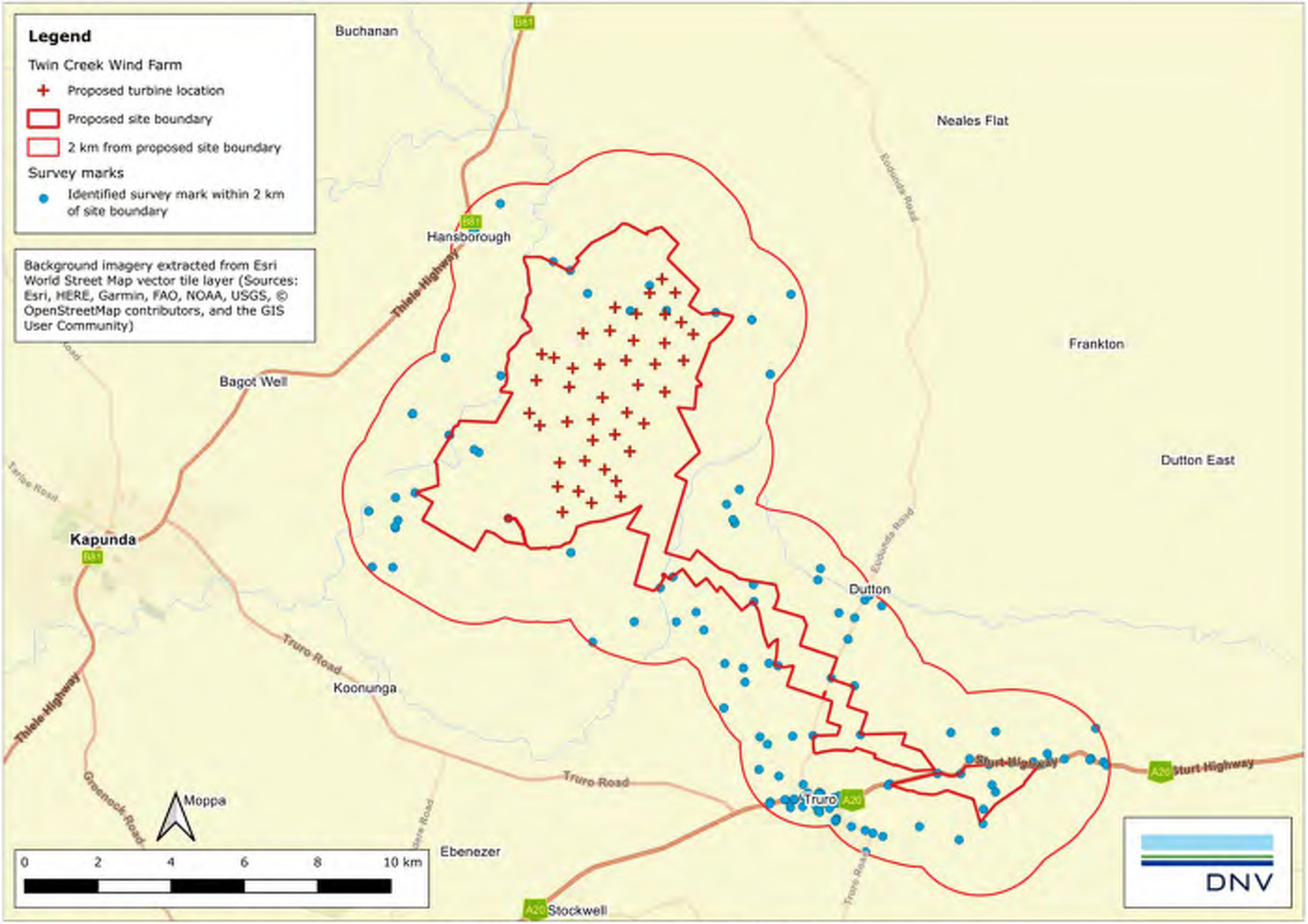


Figure 10 Location of survey marks within 2 km of the proposed Project

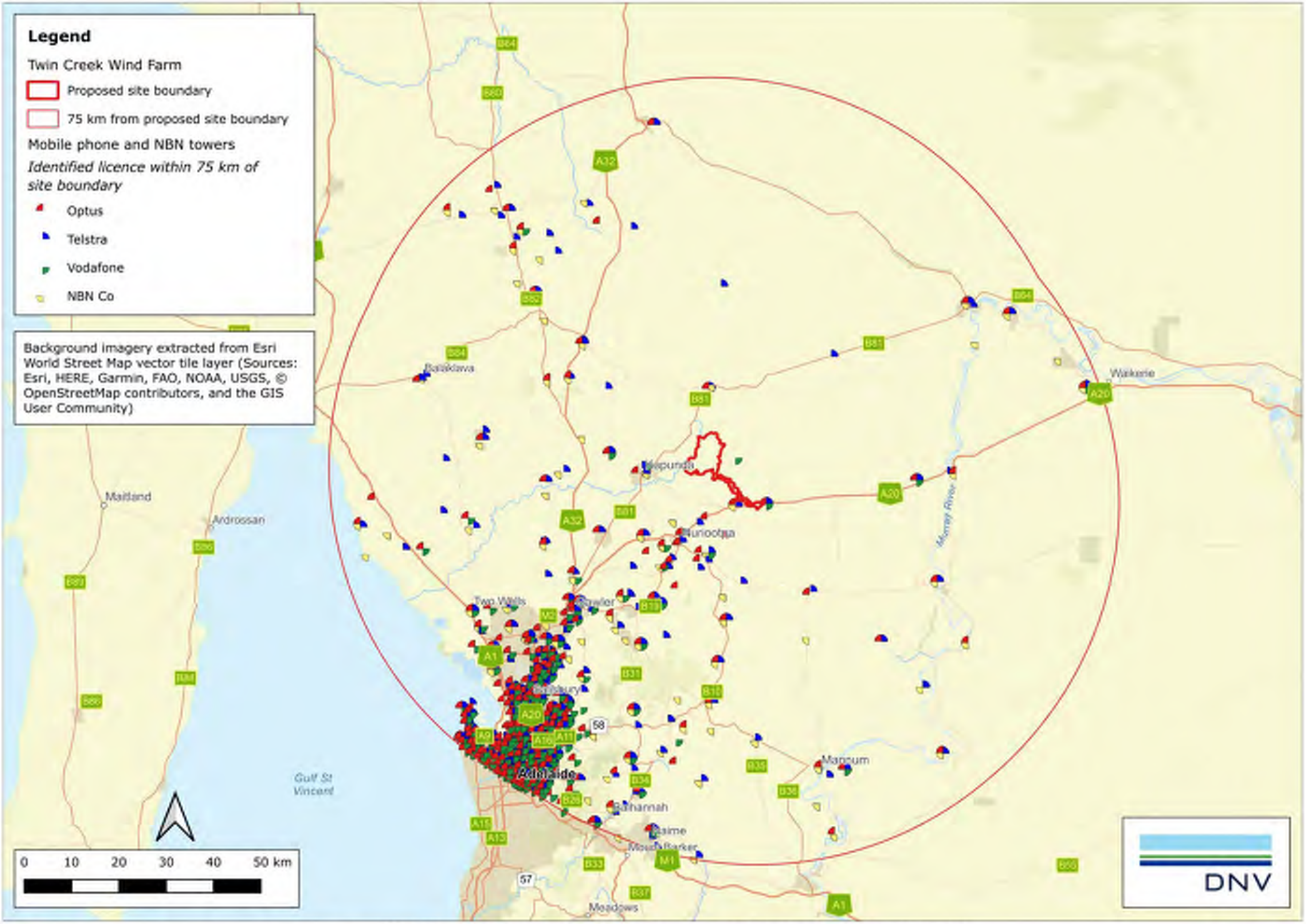
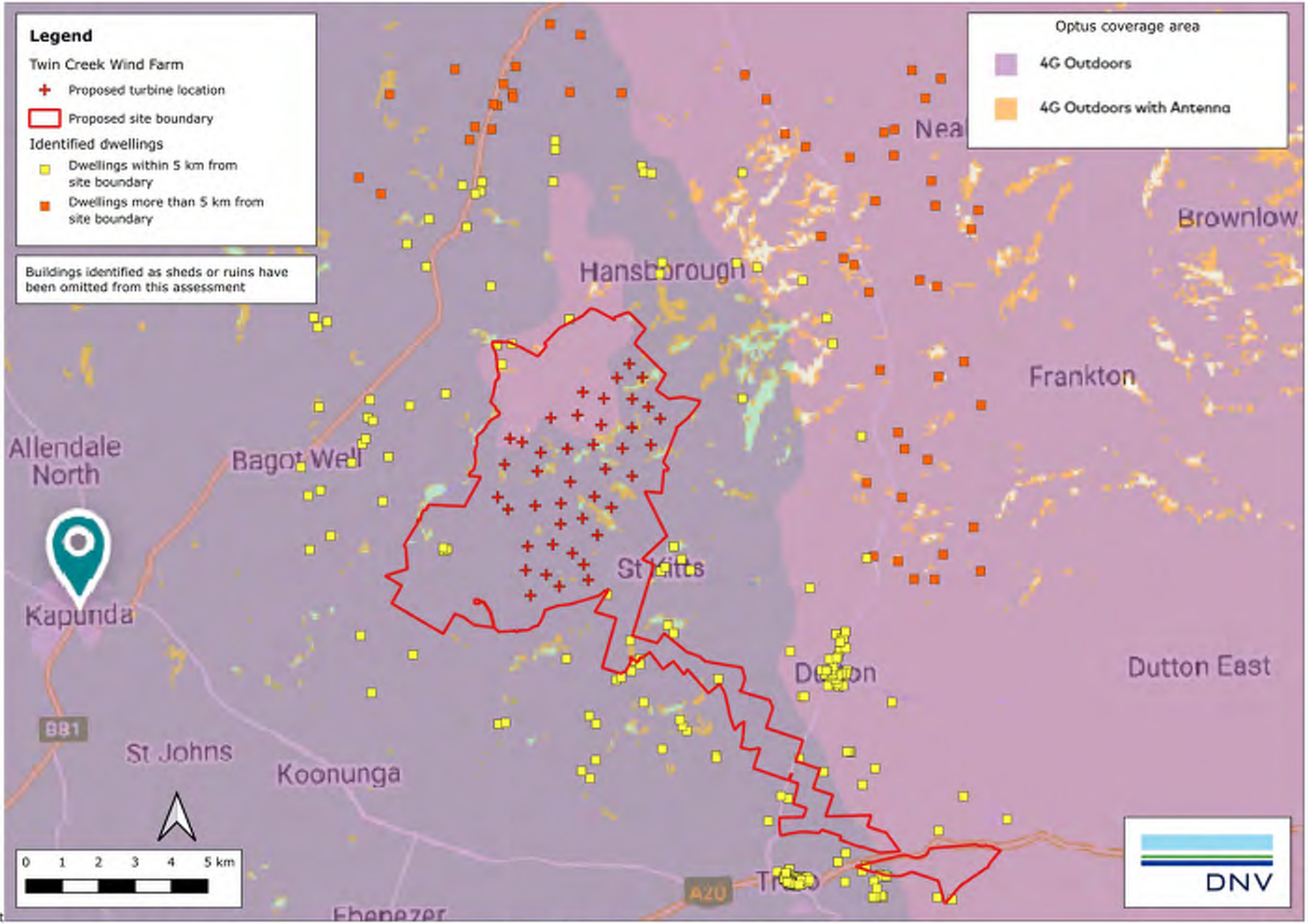
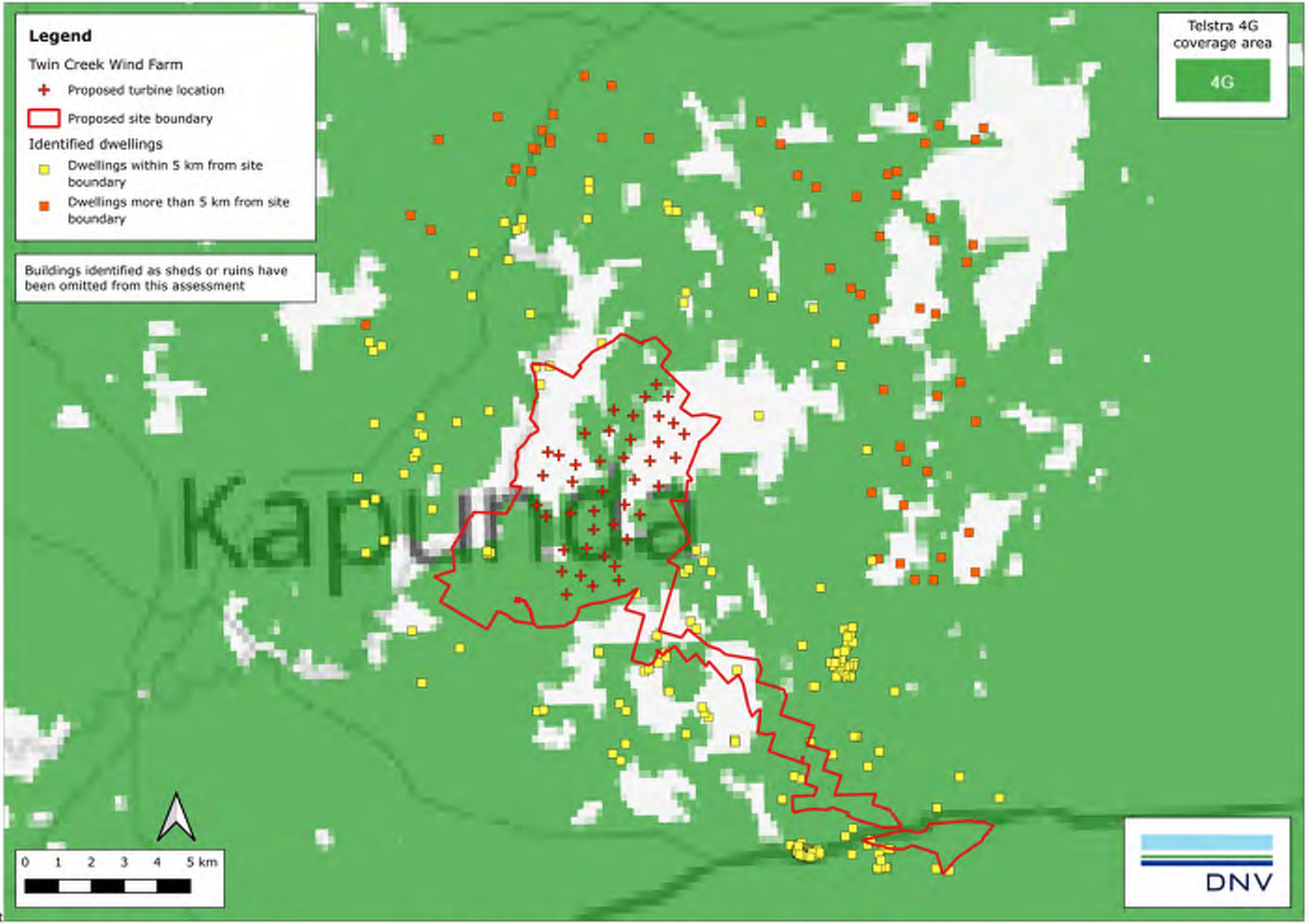


Figure 11 Location of mobile phone and NBN towers within 75 km of the proposed Project



Project

Figure 12 Optus Mobile 4G network coverage for the proposed Project



Project

Figure 13 Telstra 4G network coverage for the proposed Project

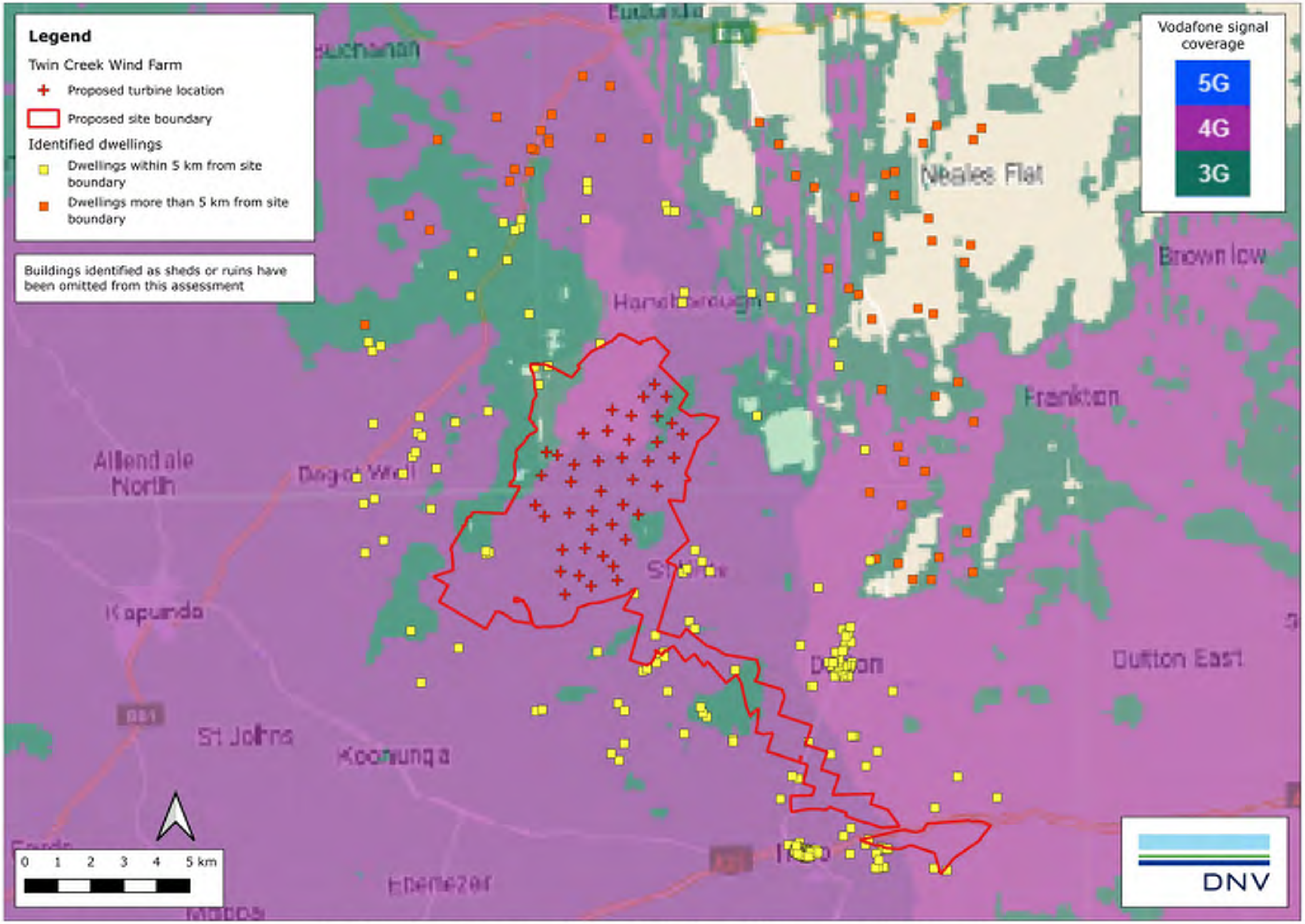


Figure 14 Vodafone network coverage (Apple iPhone 15 Pro handset) for the proposed Project

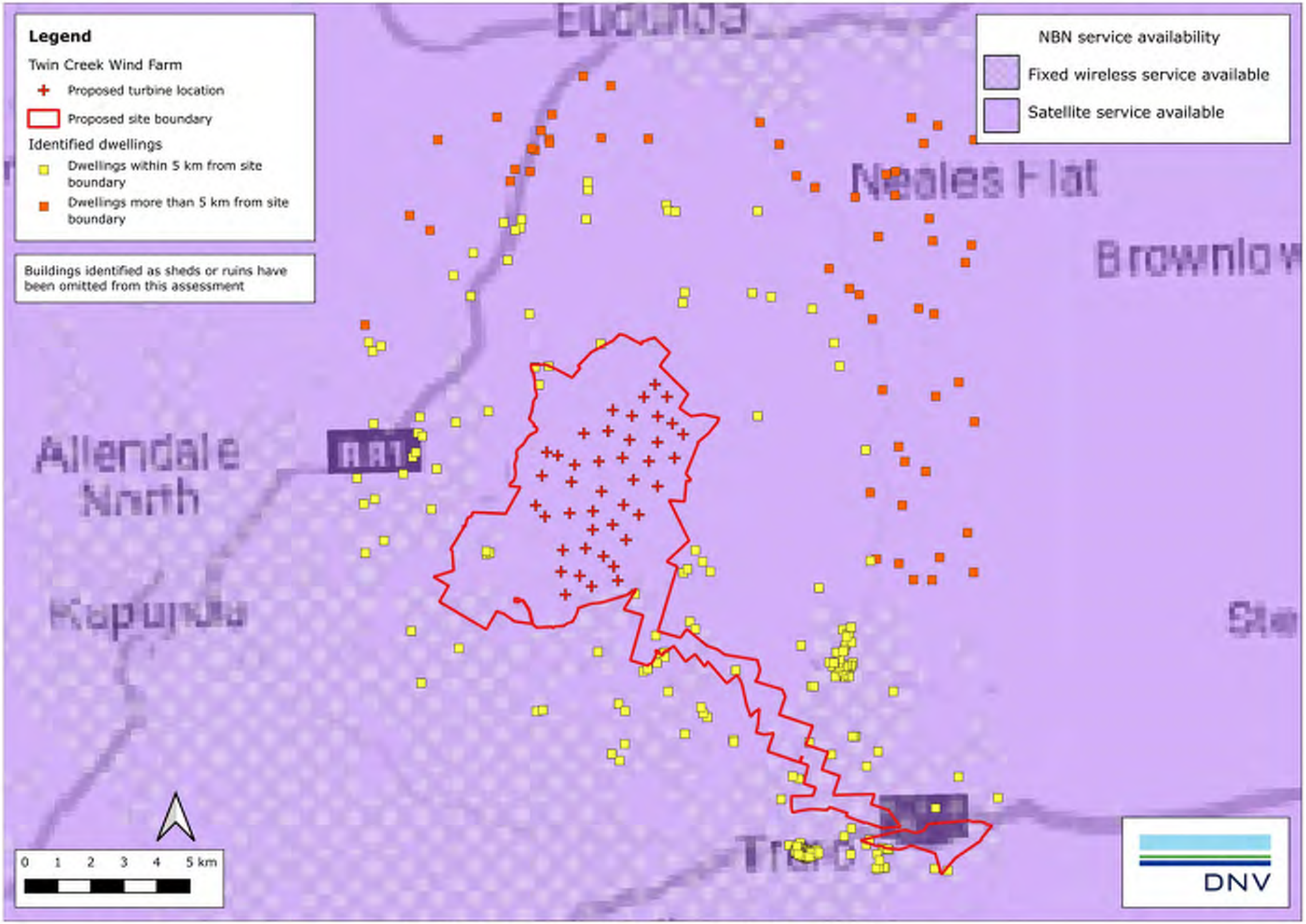


Figure 15 NBN internet coverage in the vicinity of the proposed Project

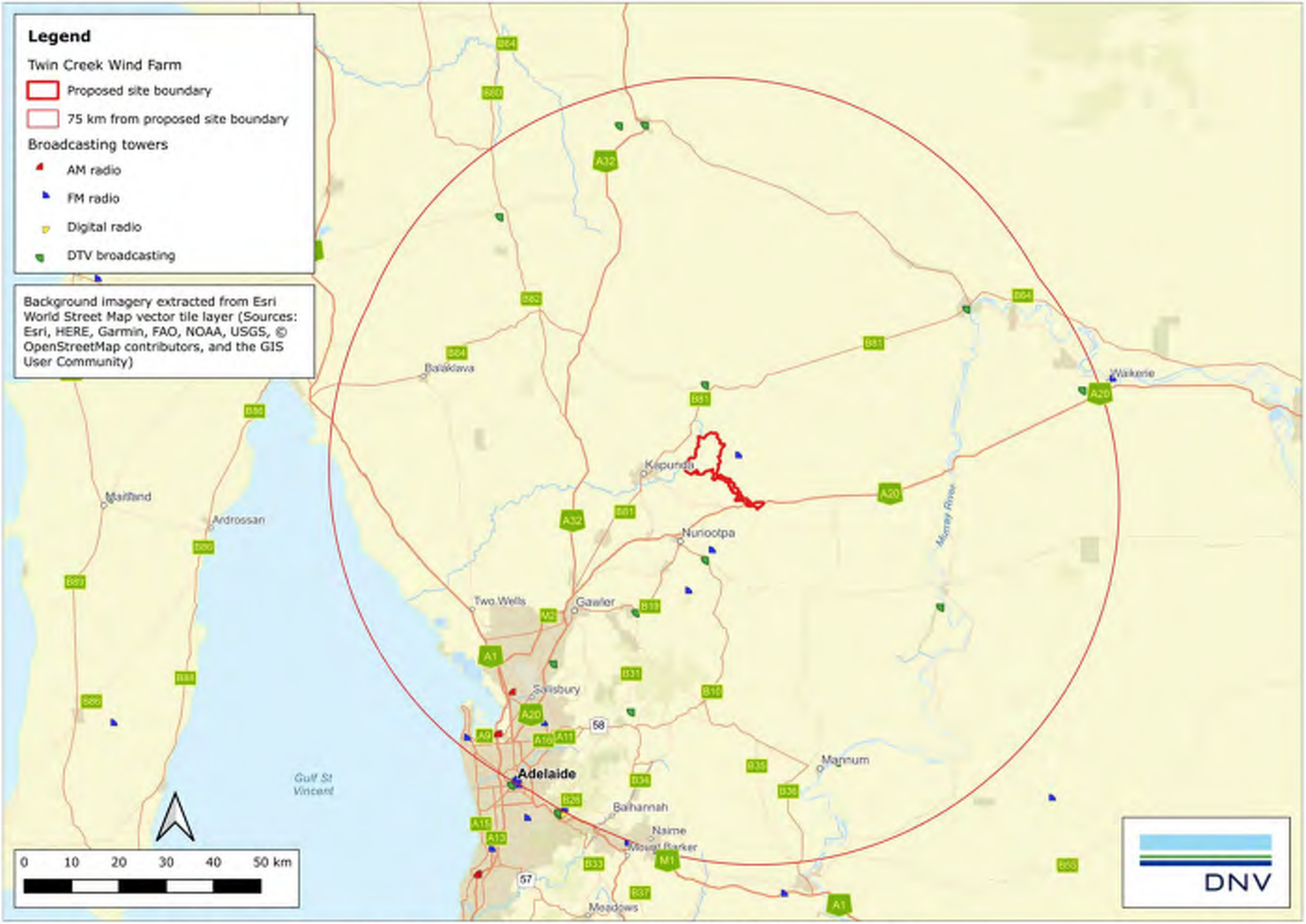


Figure 16 Location of broadcast transmitters in the vicinity of the proposed Project

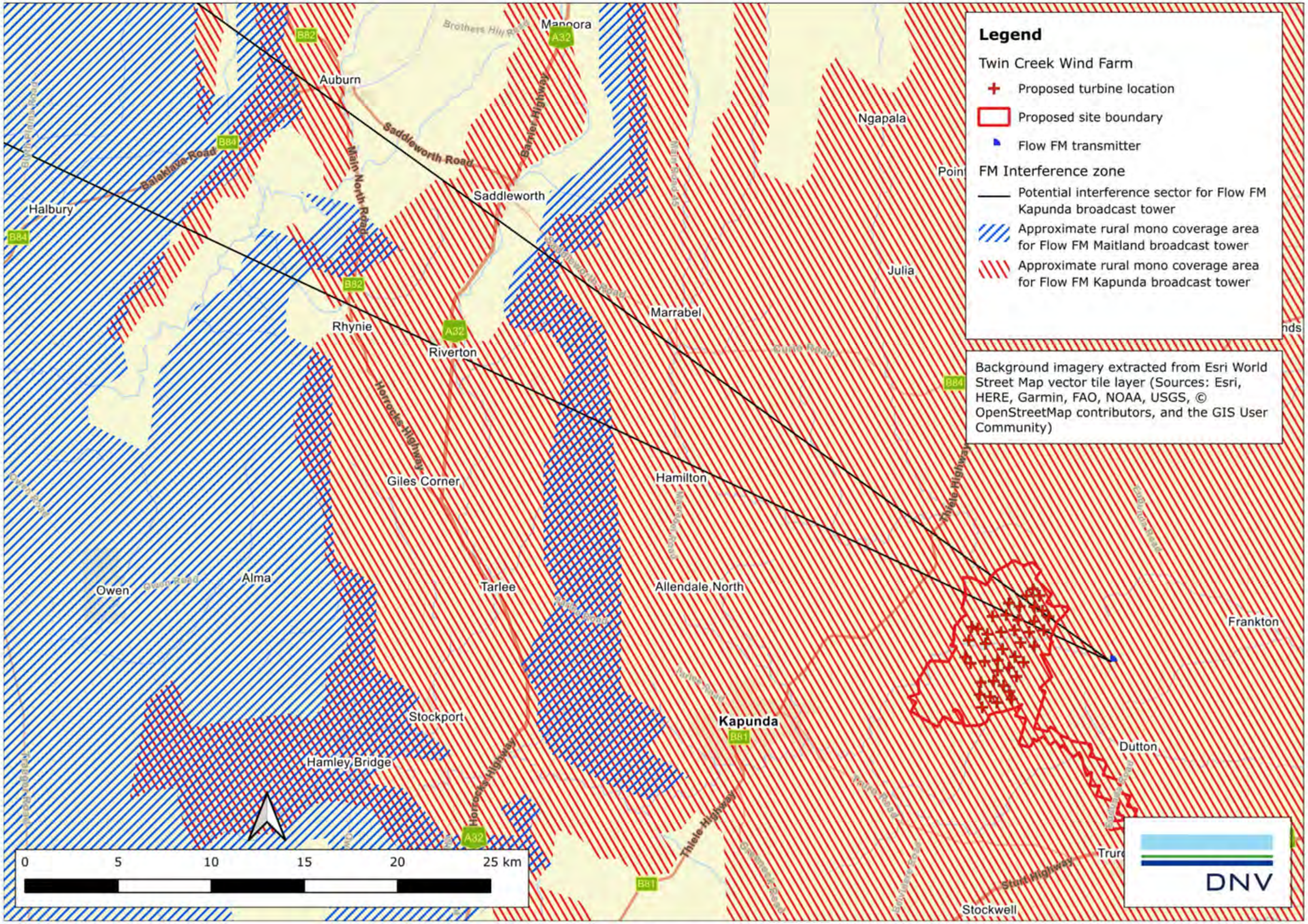


Figure 17 Flow FM signal coverage (rural mono reception) for the proposed Project

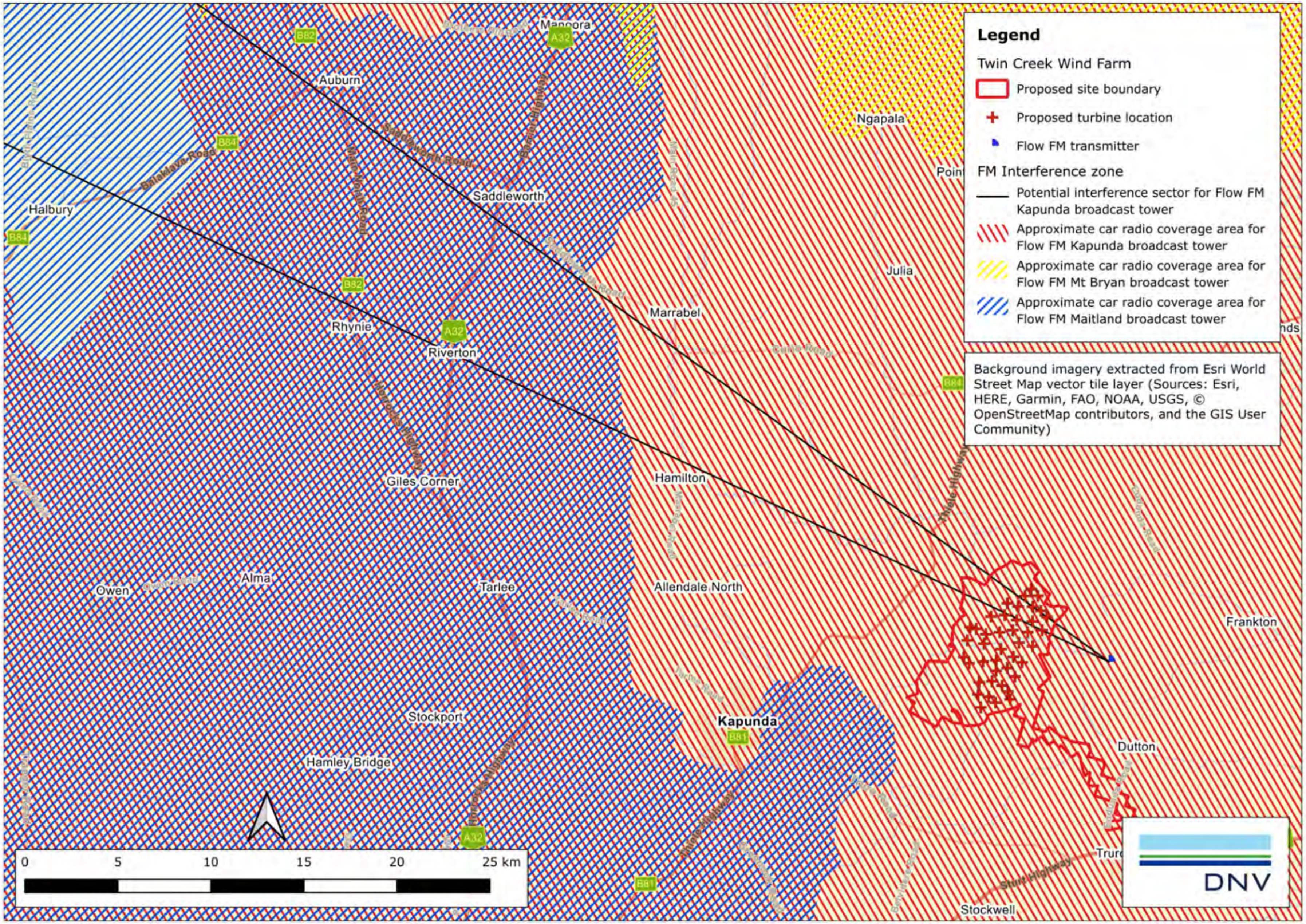


Figure 18 Flow FM signal coverage (car radio reception) for the proposed Project

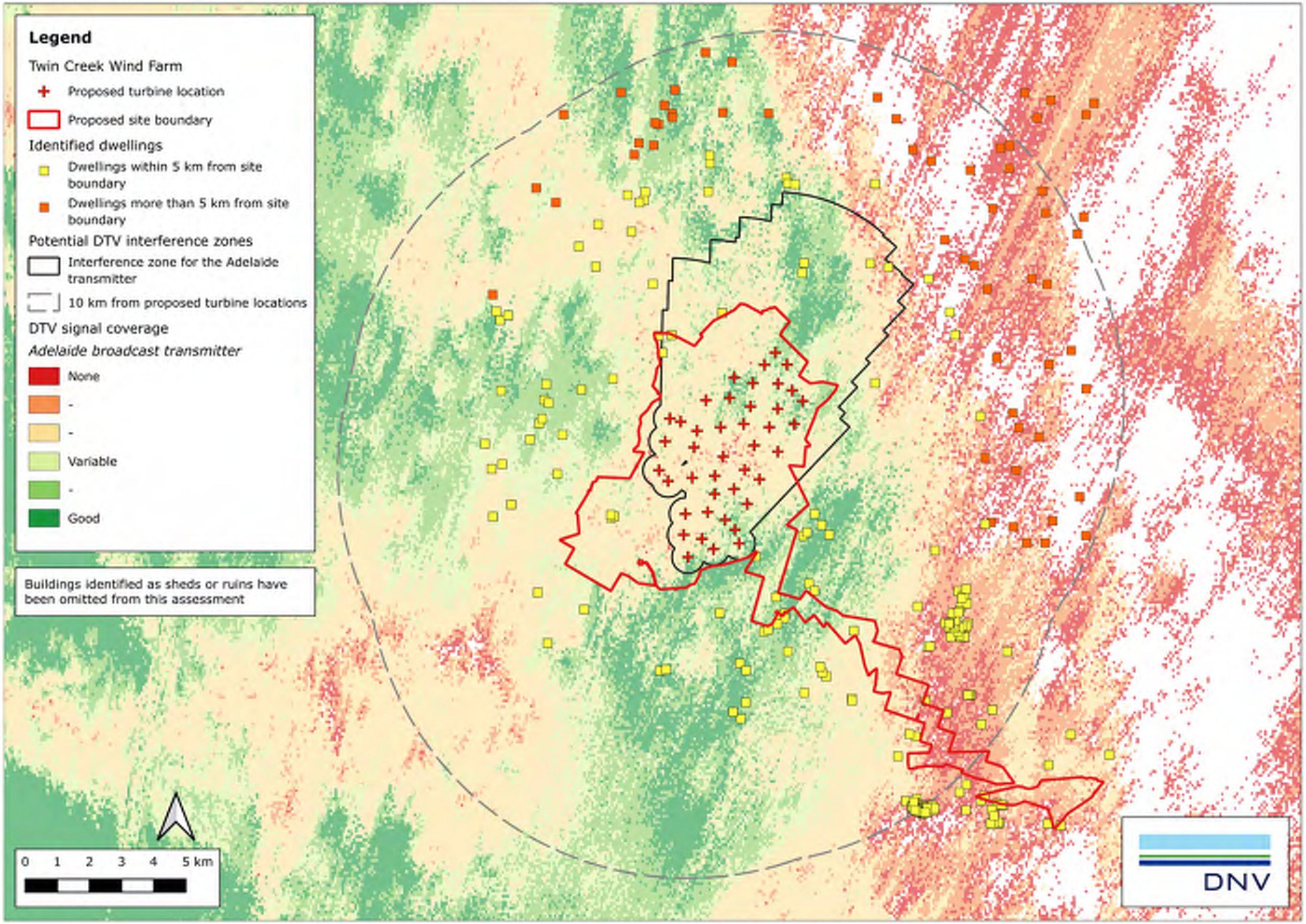


Figure 19 Potential television EMI zones for the Adelaide broadcast transmitter from the proposed Project

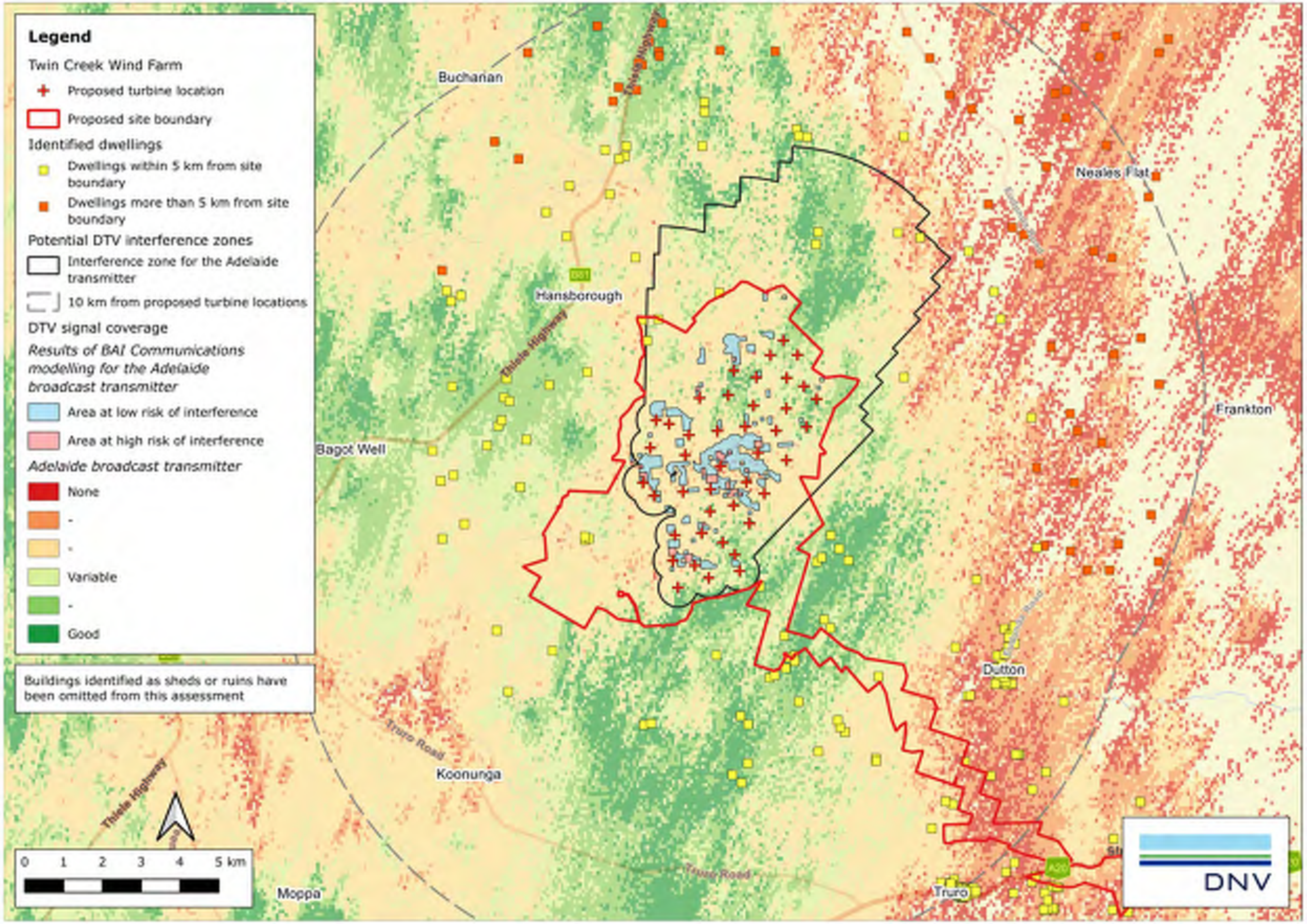


Figure 20 Results of BAI Communications modelling of potential television EMI zones for the Adelaide broadcast transmitter from the proposed Project

About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimising the performance of a wind farm, analysing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.

Landscape Character and Probable Visual Effect Assessment

by Wax Design & Dr Brett Grimm

Landscape Character and Probable Visual Effect Assessment

Twin Creek Wind Farm Project
RES Australia Pty Ltd

Prepared for RES Australia Pty Ltd
By Warwick Keates and Dr Brett Grimm

7 January 2025

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REVISION	DATE	AUTHOR(s)	REVIEWER
H	07/01/2025	WK and BG	CS / WK
G	29/10/2024	WK and BG	CS / WK
F	30/09/2024	WK and BG	CS / WK
E	7/05/2024	WK and BG	CS / WK
D	11/04/2024	WK and BG	CS / BG / WK
C	04/04/2024	WK and BG	CS / BG / WK
B	12/02/2024	WK and BG	CS / BG / WK
A	16/01/2024	WK and BG	CS / BG / WK

Wind Turbine Layout Reference	PAUStwc64
Site Boundary Reference	Site_Boundary_20241213

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01 Scope of Assessment

1.0 Scope of Assessment

1.1 Introduction

This report has been prepared by Warwick Keates of WAX Design in association with Dr Brett Grimm of Brett Grimm Landscape Architect for RES Australia Pty Ltd (RES) to assess the potential visual impact of the proposed Twin Creek Wind Farm project (the Project). This report aims to evaluate the existing landscape character, identifies viewpoints for the visual impact assessment and provides a discussion around the degree of visual change that is likely to result from the introduction of the proposed wind farm and associated infrastructure into the existing landscape character of the locality.

The Landscape and Visual Impact Assessment (LVIA) comprises two separate assessments, a landscape character assessment and a visual impact assessment; these are interrelated processes as described in the Guidelines for Landscape and Visual Impact Assessment[1]. The landscape character assessment described in this report considers the existing character of the landscape and the site locality. The site locality is the area around the Project from which the wind turbines and associated infrastructure are likely to be visible in the landscape, as described in section 1.3. The visual impact assessment considers the likely effect of the proposed development on the physical landscape, which may give rise to changes in its character and the resultant effects on visual amenity.

The potential visual impact was assessed using the Grimke matrix methodology that involves on-site assessments, GIS modelling, consultation with relevant stakeholders and interested parties through RES, the preparation of photomontages and a detailed visual impact assessment to illustrate the predicted visual effect of the Project within the defined locality. The visual impact assessment forms the second stage of the LVIA process.

1.2 Project Description

RES Australia Pty Ltd (RES) has an active Development Plan Consent (422/E003/17) for an earlier iteration of the Twin Creek Wind Farm and Energy Storage Project, proposed in the Mid-North of South Australia. The approved development is a 185MW wind farm comprising up to 51 wind turbines (3.6MW and up to 180 metre tip height) and an associated 215 MW battery energy storage system. Since obtaining the planning consent in October 2019, RES has undertaken further design development in an evolving energy market.

To take advantage of the growth in wind turbine technology, RES has reviewed the approved wind farm and seeks to optimise the Twin Creek Wind Farm and Energy Storage Project, particularly in terms of overall generating capacity and the number, size, and capacity of wind turbine generators. RES has considered options available to amend the current planning consent to achieve variations to the project and has resolved that the alterations resulting from the optimisation warrant the submission of a new development application. Against this background, RES have sought and obtained sponsorship of the Department for Energy and Mining for the development of the Twin Creek Wind Farm and Energy Storage Project to occur as essential infrastructure pursuant to Section 131 of the Planning, Development and Infrastructure Act, 2016.

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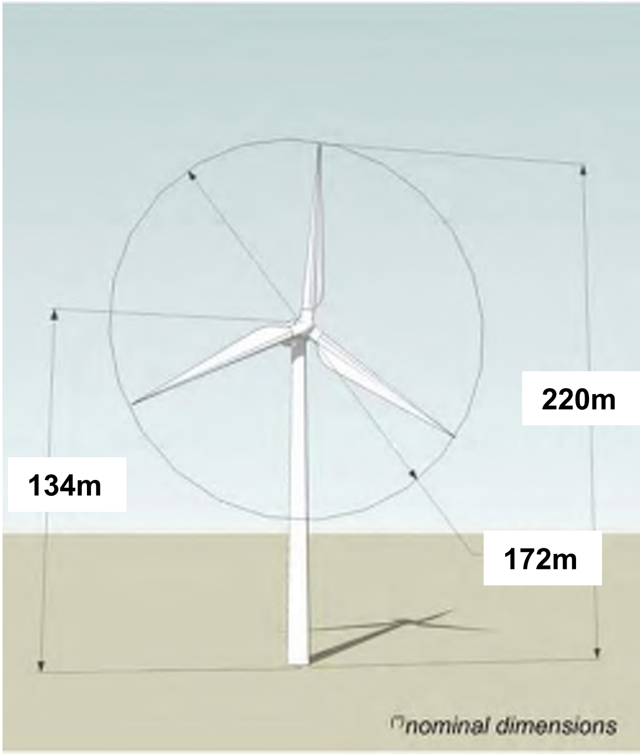
[1] *Swanwick, C. (2013). Guidelines for Landscape and Visual Impact Assessment. 3rd ed. United Kingdom: Landscape Institute and Institute of Environmental Management and Assessment.*

In summary, the variations between the Twin Creek Wind Farm and Energy Storage Project granted planning consent and the optimised proposal are as follows:

	Approved Project	**Optimised Project**
Number of WTG	Up to 51	Up to 42
WTG individual Generating Capacity	3.6MW	Up to 7.2MW
Overall Generating Capacity	185MW	Up to 270MW
Height of WTG	180m tip height	Up to 220m tip height
Battery Energy Storage Capacity	215MW indicative storage capacity	215MW indicative storage capacity
Substation(s)	2 Substations (1 project substation within the windfarm boundary and 1 cut-in terminal substation)	2 Substations (1 project substation within the windfarm boundary and 1 cut-in terminal substation)
Point of Connection	ElectraNet 275kV powerline (Robertstown to Tungkillo) via a cut-in terminal substation	ElectraNet 275kV powerline (Robertstown to Tungkillo) via a cut-in terminal substation, east of Truro.

The Optimised Project will consist of the following components:

- Up to 42 Wind Turbines Generators (WTG)
- Overall height of turbines would be up to 220 metres at the blade tip
- Associated hard standing areas and access roads
- Operations and maintenance building and compound with associated car parking
- Two electrical substations
- Battery energy storage
- Overhead and underground electrical cable reticulation
- Temporary construction facilities, including a borrow pit and concrete batching plant facilities.



1.3 Site Locality

A 20 kilometre regional site locality surrounding the project site has been defined for assessment purposes and is based on research and previous experience in defining thresholds for scale and identification of visual effect. Most notably, Thomas Matrix[2] and Bishop (2002)[3] have provided guidance on this matter. Also, the extent of the site locality has been reviewed against the Zone of Theoretical Visual Influence (ZTVI) mapping. This mapping provides a reference of the extent to which the Project is likely to be visible in the landscape and defines the viewshed resulting from the local topography (excluding vegetation and built form screening). Additional site assessments validate the regional context and viewshed.

The landscape character assessment of the proposed wind farm consists of written descriptions and photographic surveys of the surrounding locality to articulate the character of the existing landscape that surrounds the site in relation to the local (0-3km), sub-regional (3-10km) and regional (>10km) landscapes. This is followed by a discussion of the probable visual effect that is anticipated to occur across the regional landscape as well as within the infrastructure corridors associated with the proposed project. The landscape character and visual assessment provides the basis on which to measure the suitability of the development in relation to the visual impact within the regional area (20km) and in regard to the relevant provisions of the development plan.

Recognition of the potential visual impact of a layout design is implicit in the design process. This includes early reference to the Planning and Design Code (the Code) land use and zoning overlays and relevant guidance reports.

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[2] *Sinclair, G. (2001). The Potential Visual Impact of Wind Turbines in relation to distance: An approach to the environmental assessment of planning proposals. E.I.Services*

[3] *Bishop, I. (2003). Determination of thresholds of visual impact: the case of the wind turbines: Environment and Planning B: Planning and Design: 707-718*

02 Introduction

2.1 Visual Assessment Approach

The LVIA methodology aims to provide an objective, reliable, credible, replicable, and measurable analysis of the potential visual impact when considered against the existing character of the landscape.

The process for the visual assessment is based on the recommendations of John Ginivanand Planning SA (2002)[4] and considers the visual assessment regarding the Primary Landscape Character Assessment and Detailed Visual Effect Assessment (excluding Qualitative Subjective Assessment).

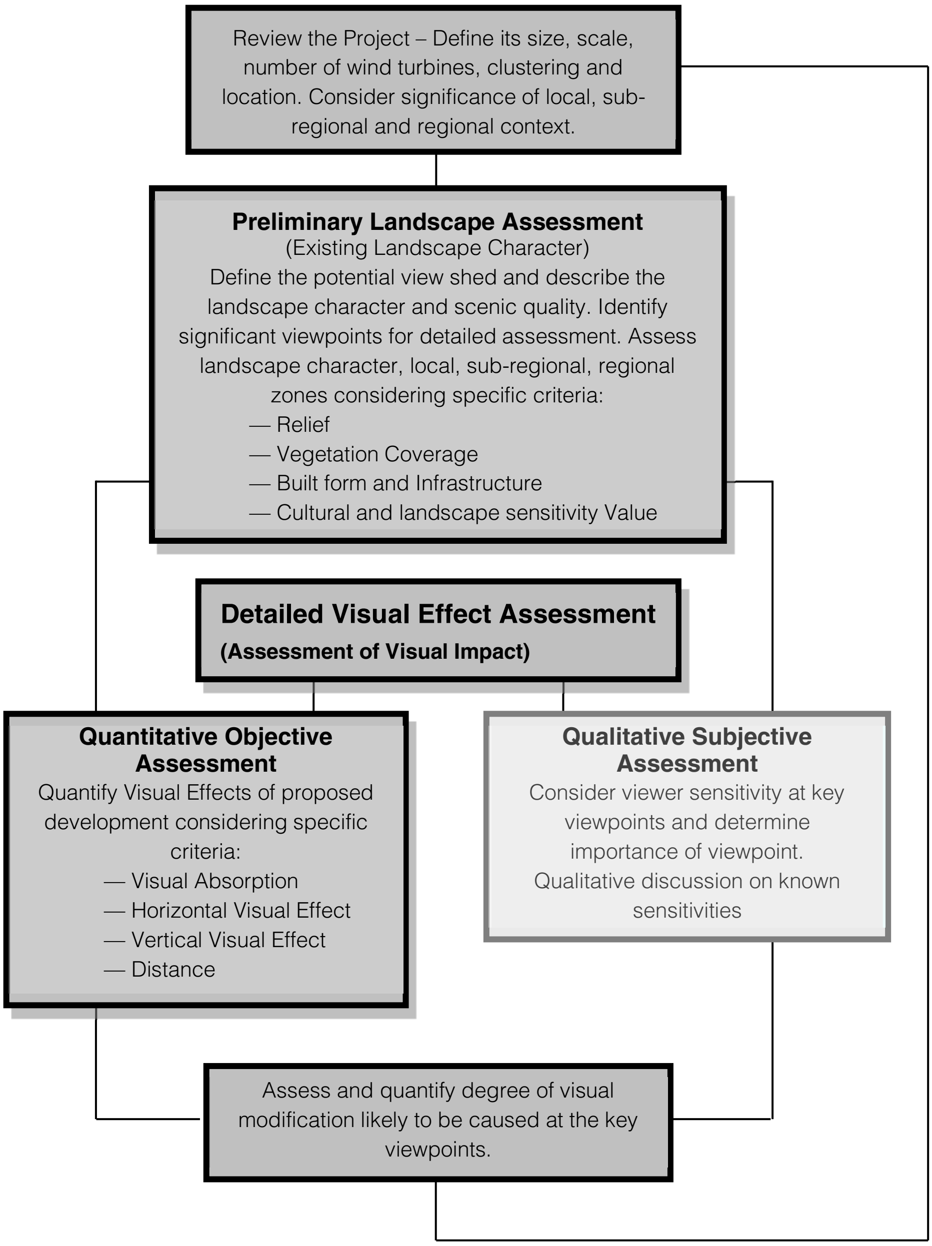

Figure 1: Detailed Visual Assessment Process

[4] *Planning South Australia (2002). Advisory Notice Planning- Draft for Consultation 21 Wind Farms. S.A Adelaide*

2.2 Guidance and Best Practice

Currently, there is no formalised standard visual assessment methodology at local, state or federal government levels. While various guidelines and frameworks have been produced, they do not provide a definitive methodology or technique to be applied. For the visual assessment of the Twin Creek Wind Farm to follow a 'best practice' approach, the assessment methodology has been defined with reference to the following documents:

- Planning and Design Code and Planning, Development and Infrastructure Act (2016)
- Wind Farm Development Guidelines for Developers and Local Government Planners (2014), Central Local Government Region of South Australia[5];
- Planning Guidelines for Development of Wind Energy Facilities (Department of Transport and Planning, September 2023)
- Solar Energy Facilities Design and Development Guidelines (Department of Environment, Land, Water and Planning, August 2019)
- Environment Protection and Heritage Council (2010) National Wind Farm Development Guidelines;
- Siting and Designing Wind Farms in the Landscape (version2)(2014) Scottish Natural Heritage;
- Grimm, B (2009). Quantifying the Visual Effects of Wind Farms; A Theoretical Process in an Evolving Australian Visual Landscape. PhD Thesis Adelaide University;
- Australian Wind Energy Association and Australian Council of National Trusts (2007) Wind Farms and Landscape Values: National Assessment Framework;
- Visual Landscape Planning in Western Australia. (2007). A manual for evaluation, assessment, siting and design, Western Australian Planning Commission;
- Best Practice Guidelines for the Implementation of Wind Energy Projects in Australia (2006);
- Lothian, A. (2008). Scenic perceptions of the visual effects of wind farms on South Australian landscapes. Geographical Research, 46:2, 196 – 207;
- Swanwick, C. (2013). Guidelines for Landscape and Visual Impact Assessment. 3rd ed. United Kingdom: Landscape Institute and Institute of Environmental Management and Assessment;
- South Australian Wind Farms Planning Bulletin (2002).

2.3 Methodology

The LVIA is based on two assessment stages with reference to the Guidelines for Landscape and Visual Impact Assessment and set out in Section 6.

- Stage 1: Landscape Character Assessment identifies and assesses the importance of landscape characteristics and the existing landscape quality.
- Stage 2: The Visual Assessment aims to quantify the extent to which the development is visible and define the degree of visual change and the associated visual impacts using GIS mapping, photomontages, site observations and the Grimke Matrix.

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[5] *Source online (2015). http://www.lga.sa.gov.au/webdata/resources/files/2012.32%20-%20Windfarm%20Development%20Guidelines%20-%20Final%20Report.pdf. [Accessed 08 September 2015].*

02 Introduction

The completed Landscape Character Assessment and Visual Impact Assessment are used to draw several observations and conclusions about the magnitude of the likely visual effects of the proposed development on the site locality.

Figure 2 outlines a detailed description of each process conducted within the methodology.

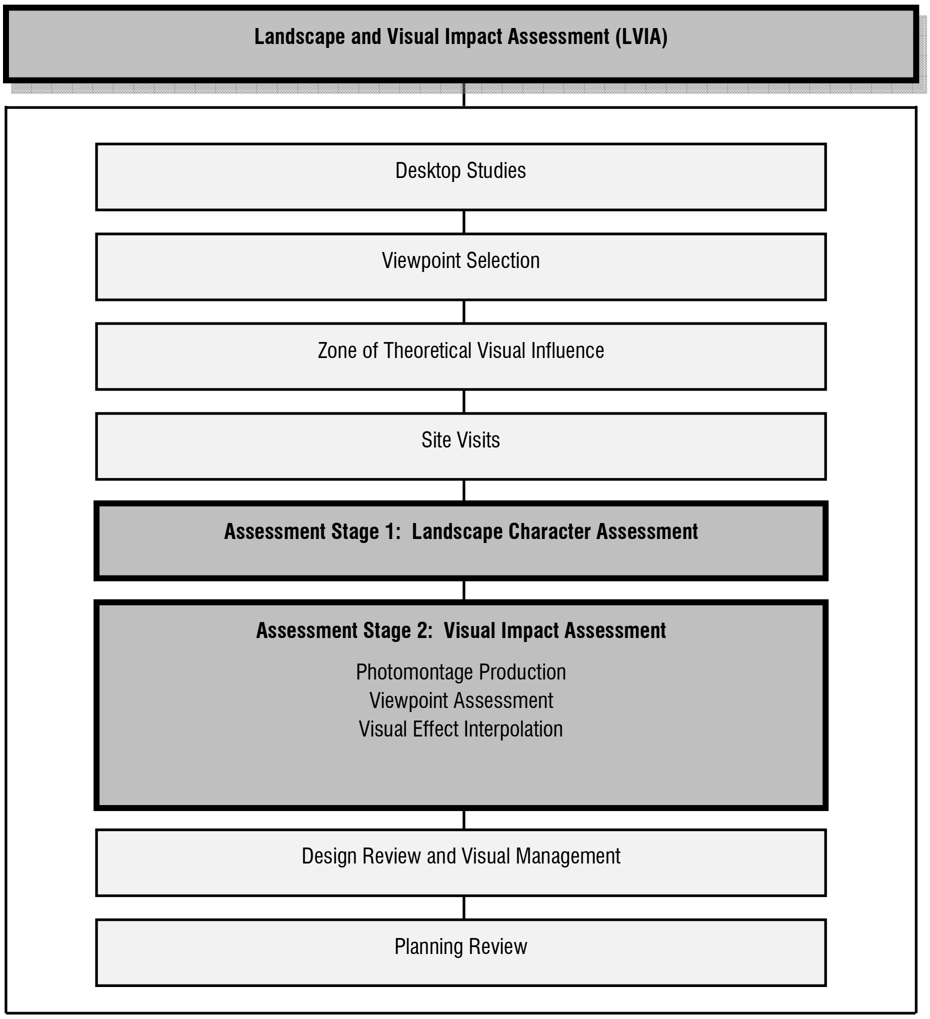

Figure 2: LVIA – Two Assessment Stages and Associated Tasks.

<u>Desktop Studies</u>

The landscape character assessment for the Optimised Project includes a review of the Approved Project documentation, location and infrastructure associated with the Approved Project and comparison against the Optimised Project. Analysis of GIS maps, landscape photography, aerial photographs and supporting literature was reviewed to establish a broad comprehension of the scope of the Optimised Project and the existing landscape character.

<u>Viewpoint Selection</u>

Viewpoint selection for the Optimised Project was reviewed by WAX Design and BGLA as part of a site visit on 26 September 2023 and in response to updated Zone of Theoretical (ZTVI) mapping. The original viewpoints for the Approved Project, selected in 2016, were reviewed against the Optimised Project to confirm locations from which a detailed visual assessment of the potential visual effect can be made as part of the Stage 2 assessment. The viewpoints selected are representative of the locality, publicly accessible, adjacent to areas of private land ownership and where a large proportion of the wind farm and associated infrastructure is visible.

Viewpoints provide a selection of locations that capture the regional extent of the viewshed. Consequently, the detailed visual assessment will provide a relative quantification of probable effects surrounding the proposed development site.

Zone of Theoretical Visual Influence (ZTVI)

In order to gain an appreciation of the potential visual effect of both the Approved Project and the Optimised Project, ZTVI maps have been produced and overlaid for comparison. The mapping illustrates where and how many wind turbines may be seen within the landscape. The maps quantify the extent to which the wind turbines are likely to be seen, considering a maximum blade tip height of 220m and a hub height of up to 134m for the Optimised Project.

The analysis uses a digital terrain model and computer-generated models of the wind turbines to illustrate how many individual turbines would be visible from any location around the wind farm within the 20-kilometre regional landscape assessment area. It should be noted that the ZTVI does not consider the impact of local vegetation and buildings or localised landforms as it is based on a combination of 5 and 10 metre contour data set. This means that theoretically, the visual impact of the wind turbines is evaluated within a landscape devoid of any screening vegetation or other features and represents a 'worst case' scenario.

The site assessment confirmed and qualified the ZTVI mapping with reference to vegetation screening and local landforms not depicted by the ZTVI.

Assessment Stage 1: Landscape Character Assessment – Optimised Project

A review of the Approved Project assessment was undertaken including identification and description of the existing landscape character (considering areas of defined landscape quality determined by topographic form, land use, and vegetation associations, including patterning, colouration and textural relief). In addition, special landscape features and settlements were revisited. Mapping and photographic surveys was undertaken, and written commentary used to describe the locality and existing landscape character and any significant changes between the assessment of the Approved Project and the Optimised Project.

The landscape character assessment for the Optimised Project was undertaken on 26 September 2023 to enable the project team to develop a comprehensive understanding of the existing landscape character and any changes that may have occurred since 2016.

Seven (7) viewpoints were reviewed and identified for detailed visual assessment, GPS coordinates, base photography, and qualitative description of existing landscape character within the locality was recorded.

02 Introduction

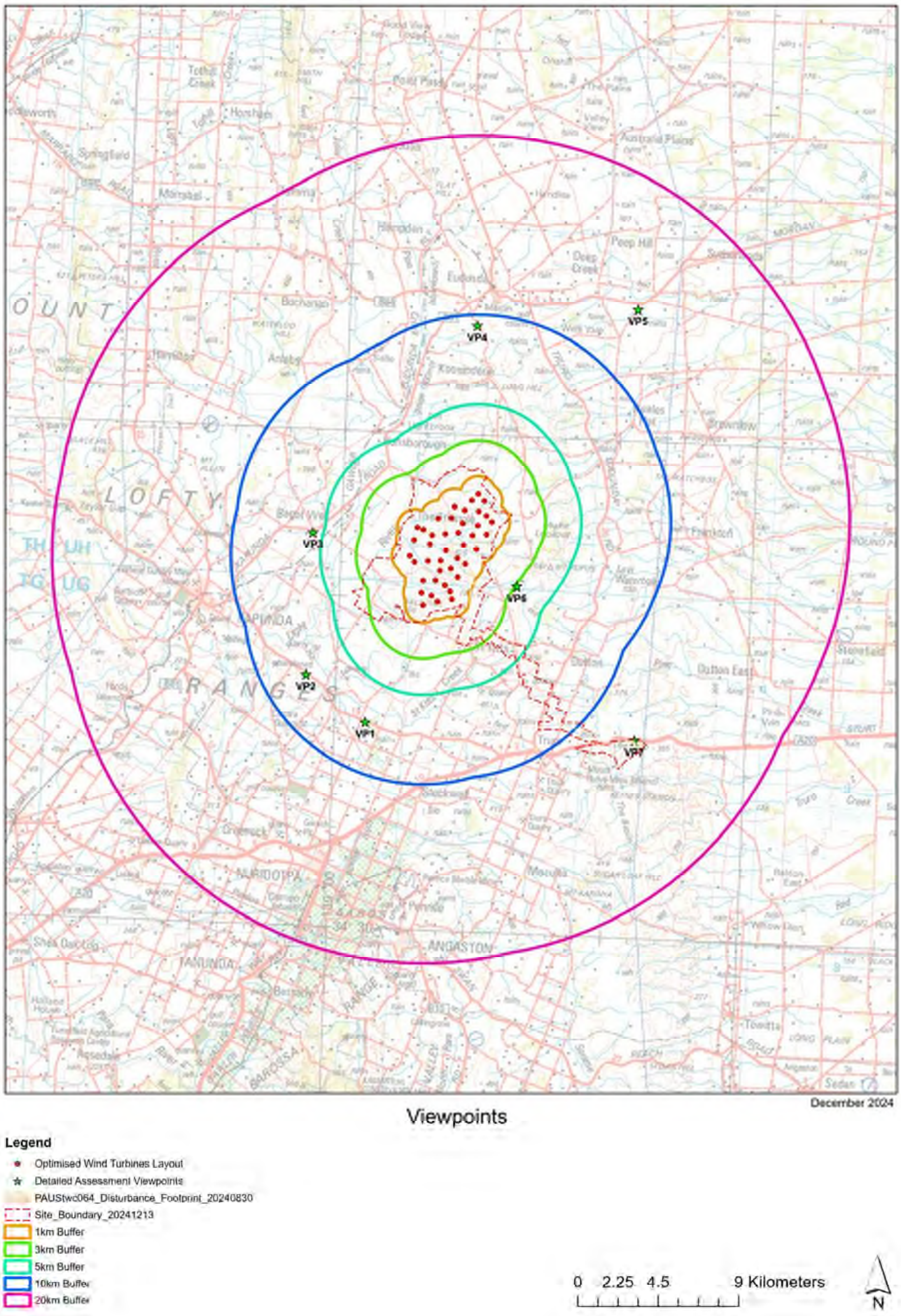

Figure 3: Viewpoint Locations

Assessment Stage 2: Photomontage Production

Photomontages of the Optimised Project from each viewpoint were produced. The photomontages represent a 120-degree horizontal field of view with a 50mm lens digital equivalent photo capture. This has been proven to represent the human binocular field of view. Details of the methodology used to produce the photomontages are described in Appendix B and represent a best practice approach with reference to 'Photography and photomontage in landscape and visual impact assessment' (2011) Landscape Institute (advice note 01/11).

For the purposes of the photomontage production, a neutral off-white colour was used to represent the wind turbines. This colour selection was made to reflect the proposed colour of the turbines (RAL 7035, Light Grey) while allowing for variations in local light and environmental conditions. As part of the photomontage compositing process in Photoshop ™, adjustments were made to the contrast and luminosity levels of the wind turbine render. These adjustments were made to ensure the proposed wind turbines are visible in the photomontage. It is important to note that the adjustments made to the photomontages do not alter the assessment process, as all findings are validated by on-site observations and measurements.

WAX Design and BGLA confirmed the accuracy of the photomontages during a second site visit on 27 October 2023. The combined photomontage assessment and on-site review ensures that issues typically associated with photographic simulations, such as image compression and distortion, are mitigated by assessing and measuring the visual effect in the existing landscape using GPS and a bearing compass. This enables the photomontages to be ground-truthed for positional correctness and scale. Any minor distortion to the edge of the 120 degrees provided by the horizontal field extent and 2-dimensional image representations are reflected relatively in the simulated modelling overlay.

The photomontage images were used to inform the detailed viewpoint assessment.

Assessment Stage 2: Visual Impact Assessment

The assessment of the visual impact includes the production of photomontages to assist in quantifying and qualifying the potential visual effect. The viewpoints identified as part of the preliminary assessment stages were measured using a series of landscape and visual criteria. The assessment results were then mapped and interpolated to demonstrate the likely visual impact of the Optimised Project across the regional landscape.

The Stage 2 assessment was undertaken on 27 October 2023. Site conditions were clear, providing good visibility and extending several kilometres throughout the landscape character zone.

The viewpoint assessment of the Optimised Project uses a combination of visual assessment measurements and descriptive text. This comprises site observations with reference to prepared photomontages and a detailed assessment of the baseline landscape character and resulting visual impact.

Initially, the baseline landscape character for each viewpoint was assessed considering the following:

- Relief (the complexity of the land that exists as part of the underlying landscape character);
- Vegetation Cover (the extent to which vegetation is present and the potential to screen and filter views);
- Infrastructure and Built Form (the impact of development on landscape and visual character); and
- Cultural Sensitivity (existing cultural overlays, planning designations and any identified listing of heritage items and local sensitivities to landscape, such as scenic drives/ viewpoints and frequency of views high main routes between townships etc.).

A numerical value was generated for the existing landscape relative to each viewpoint. This value formed the baseline assessment value. This baseline value was modified by the impact of the development on the landscape, which informs the degree of visual effect.

Following the landscape character assessment, each viewpoint was then assessed against the following visual effects:

- Percentage of landscape absorption (the landscape's ability to absorb and screen the development form);
- Horizontal visual effect (percentage spread of the development in the field of view);
- Vertical visual effect (vertical scale of the development as a percentage of the existing landscape scale within the field of view); and
- Distance of visual effect (distance between viewpoint and development).

The landscape character and visual effect measurements were combined to produce a quantified value for the degree of visual change that resulted from the Project at each viewpoint (refer to Appendix E for detailed assessment criteria and matrix methodology).

Assessment Stage 2: Visual Effect Interpolation

The findings of the visual impact assessment for each viewpoint were used to provide a percentage value to describe the degree of visual change. Each viewpoint was cartographically mapped in GIS, and the values were used in a weighted interpolation. The ZTVI was overlayed onto the visual effect interpolation map to define the extent of visibility. The combination of visual effect interpolation and ZTVI provided a map of the likely visual impact experienced in the regional locality as a result of the Optimised Project. The map provides a representation of the relativity of the possible experience of visual effect.

Planning and Design Code Review

A review of the landscape and visual impacts of the development from a planning context was also undertaken. The planning review included a review of the relevant frameworks and provisions of the Planning and Design Code.

In particular, the potential visual impact of the development has been reviewed and discussed against the relevant desired character statements with specific reference to landscape and visual considerations resulting from the development of the Optimised Project.

The Landscape Character Assessment for the project includes reviews of the project documentation, the proposed development location and the infrastructure associated with the proposed development. Analysis of GIS maps, landscape photography, aerial photographs and supporting literature were also reviewed to establish a broad comprehension of the scope of the proposed wind farm and the existing landscape character.

2.4 Limitations and Exclusions

The scope of work and assessment is based on the visual effect of the proposed wind farm and its associated infrastructure. The assessment methodology aims to provide a quantified measurement of the degree of visual change.

The scope of work has been undertaken as a collaborative assessment between Warwick Keates and Dr Brett Grimm. The qualitative GrimKe assessment of the landscape was also reviewed and discussed on site to ensure that a balanced opinion was reached.

Limited reference was made to the potential response or sensitivity of the viewer to landscape changes from each viewpoint assessed and how this influences the perception of the visual effect. The degree of viewer sensitivity remains the personal preference of the viewer as to whether the visual change is positive or negative.

Accordingly, public perception surveys for each viewpoint do not form part of this process, and the degree of visual change was considered within the context of the existing landscape character with consideration of community evaluations of the regional cultural value, scenic quality and the capacity of the landscape to accommodate the physical visual change, not the degree of perceived change.

Furthermore, the assessment is based on the landscape character at a specific point in time and is limited in changes that may occur through regional development and on changes in landuse over time.

03 Landscape Character Assessment

3.1 The Site Locality

The Optimised Project is located approximately 90 kilometres northeast of Adelaide. The subject land is on the tablelands that form the wide ridgeline associated with Bald Hill and Long Hill in the Northern Mount Lofty Ranges. The site is located between the townships of Kapunda, Eudunda and Truro.

The locality can be defined by five distinct landscape character areas that largely follow the four cardinal directions (north, east, south, and west). To the south of the subject land is the Northern Barossa Valley, which has a denser level of development and high quality agricultural landscape with a variety of visual interest created by the smaller lot sizes and variety of land uses (grazing, vineyards, animal husbandry). The Western Pastoral Lands and ridgelines stretch along the western edge of the subject locality and are defined by a more open agricultural landscape with rolling ridgelines. The subject locality itself and to the north are the Central Tablelands; these are characterised by rolling landforms and valleys associated with the Northern Mount Lofty Ranges and have a typically open grass grazing land use with minimal vegetation. To the east of the subject locality is Mount Rufus and associated north/south ridgelines which transition further east into the Western Murray River Plains, the ridgeline associated with Mount Rufus forms a distinct division between the subject locality and the Murray River Plains.

The Murray Plains represent expansive grazed/pastoral landscape depicted by low lying landform with limited vegetative cover of scale or significance.

Figure 4: View of the land use and land forms typical for the locality

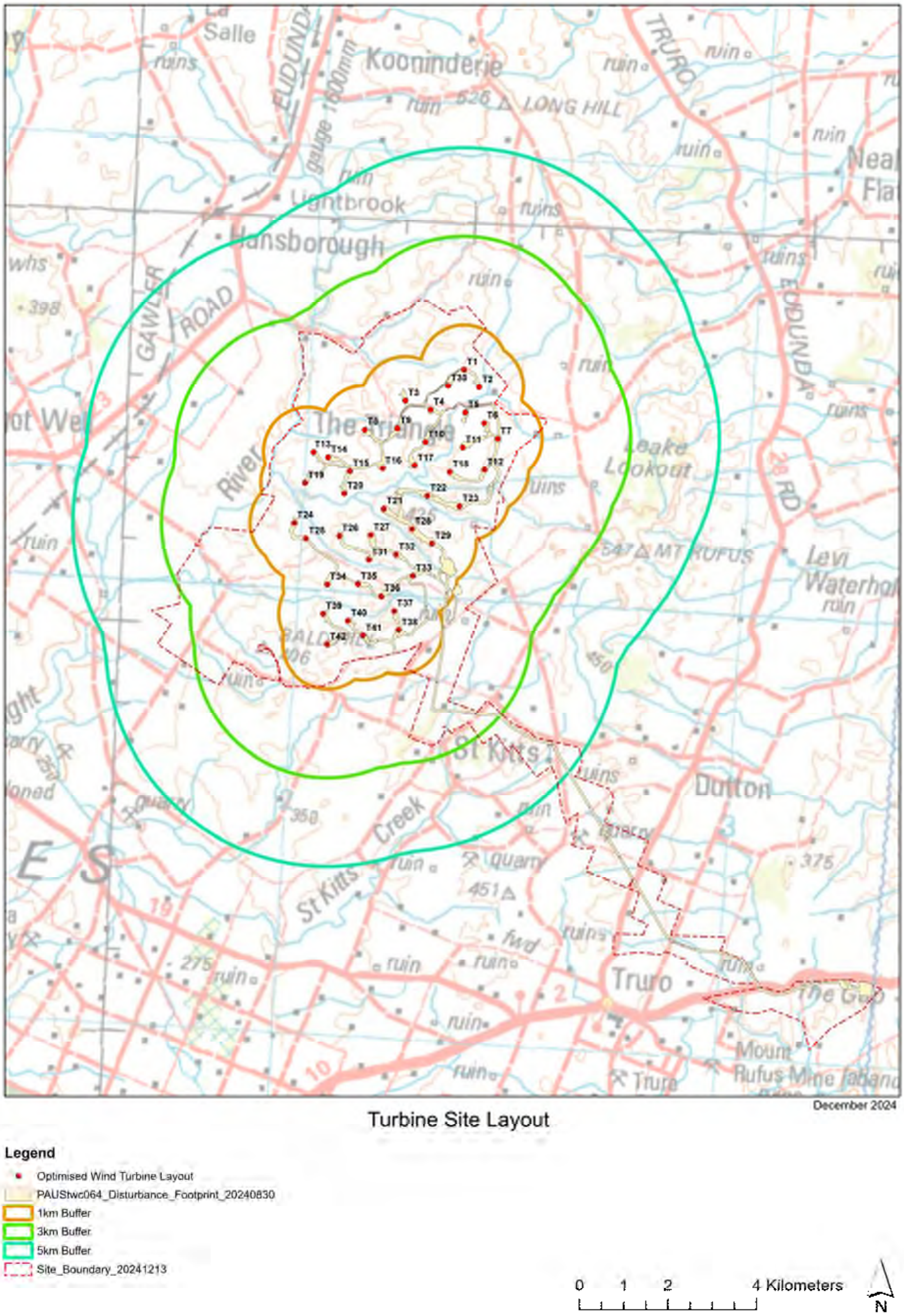

Figure 5: Proposed site location

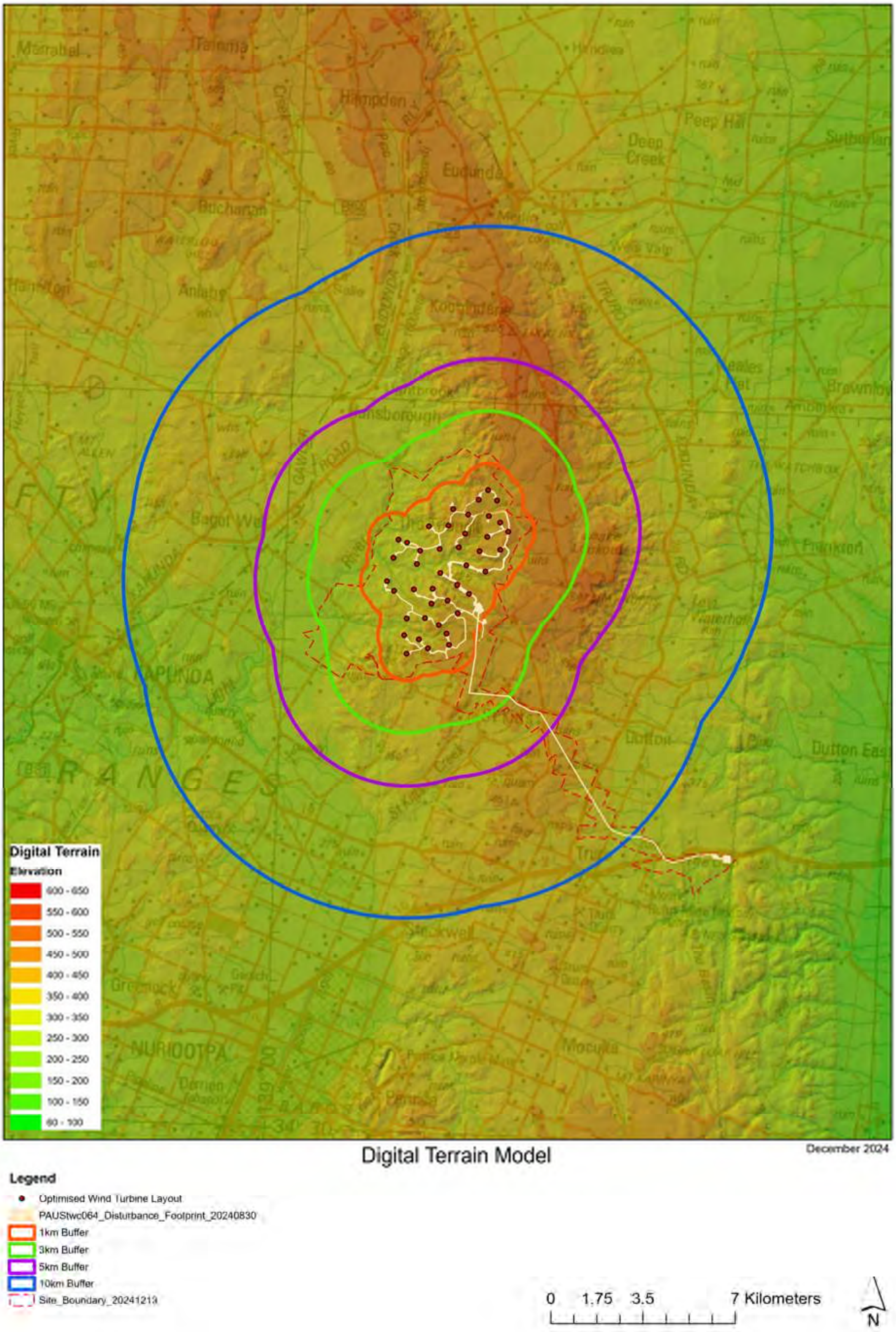

Figure 6: Topographic digital terrain model (10m contours)

3.2 Land Use and Land Cover

The land cover associated with the locality of the development site reflects various agricultural land uses, including arable and pastoral practices, and is consistent across the locality with little variation in scale or function. The landscape surrounding the site is dominated by grazing with open paddocks defined by fenced boundaries and occasional trees to fence lines and creek lines. The land use that occurs on the open valley floor between the local ridgelines and across the tablelands associated with Bald Hill is more diverse, with areas of arable cropping and grazing.

This land cover creates a patchwork character to the landscape with changes in colour and texture as a result of the different agricultural practices. Typically, the land cover and associated vegetation are low lying with limited visual screening to the west, south and north. Areas to the east associated with the Mount Rufus ridgelines and the northern outskirts of Nuriootpa possess more extensive tree cover. Vineyards are a notable visual element creating a defined pattern to the northern outskirts of Nuriootpa, emphasising the landscape qualities of the Barossa Valley.

3.3 Landform and Geomorphology

The landform of the area is defined by numerous ridgelines that run north-south through the site, creating a series of parallel ridges, wide open valleys, tablelands and isolated topographic features. The progressive geological faulting and folding processes that have formed the Southern Flinders Ranges and Northern Mount Lofty Ranges dominate the area, creating numerous undulating ridges and escarpments.

The site is dominated by the prominent geomorphology of the Light Ranges and the northern extent of the Barossa Ranges that create north/south orientated ridgelines. Further south of the project site, the ridgelines decrease in height and become more fragmented, creating isolated hills and promontories, which produce an elevated, undulating landscape.

East is an expansive low lying landscape associated with the Murray Plains. This open landscape character creates distant east and southeast views from elevated locations such as Mount Rufus.

To the west are the ridges and valleys formed by the Nain Ranges, Greenock Ranges and Light Ranges, which create overlapping north/south landforms of an approximate 100-200m vertical variance to the valleys in between, which is typical of the area.

To the north, the geomorphology of the landscape increases in scale and complexity with more prominent and more widely spaced ridges and valleys, particularly in relation to the Tothill and Scrubby Ranges and the Belalie Plain. These landforms continue in a north/south direction before transitioning into the more dramatic topography of the Southern Flinders Ranges.

3.4 Landscape Character Units

To understand how and to what degree the Project will produce a visual effect in the existing landscape, an assessment to identify landscape character units has been undertaken, as is shown in Figure 7. This assessment identified several landscape character areas within the site locality that contain similar landscape qualities in relation to land use, topography, vegetation, visual patterning, texture and scale.

The regional landscape context surrounding the project contains five (5) landscape character areas, which are;

Northern Barossa Valley

Western Pastoral Lands and Ridgelines

Central Tablelands

Mount Rufus Ridgeline

Western Murray River Plains

03 Landscape Character Assessment

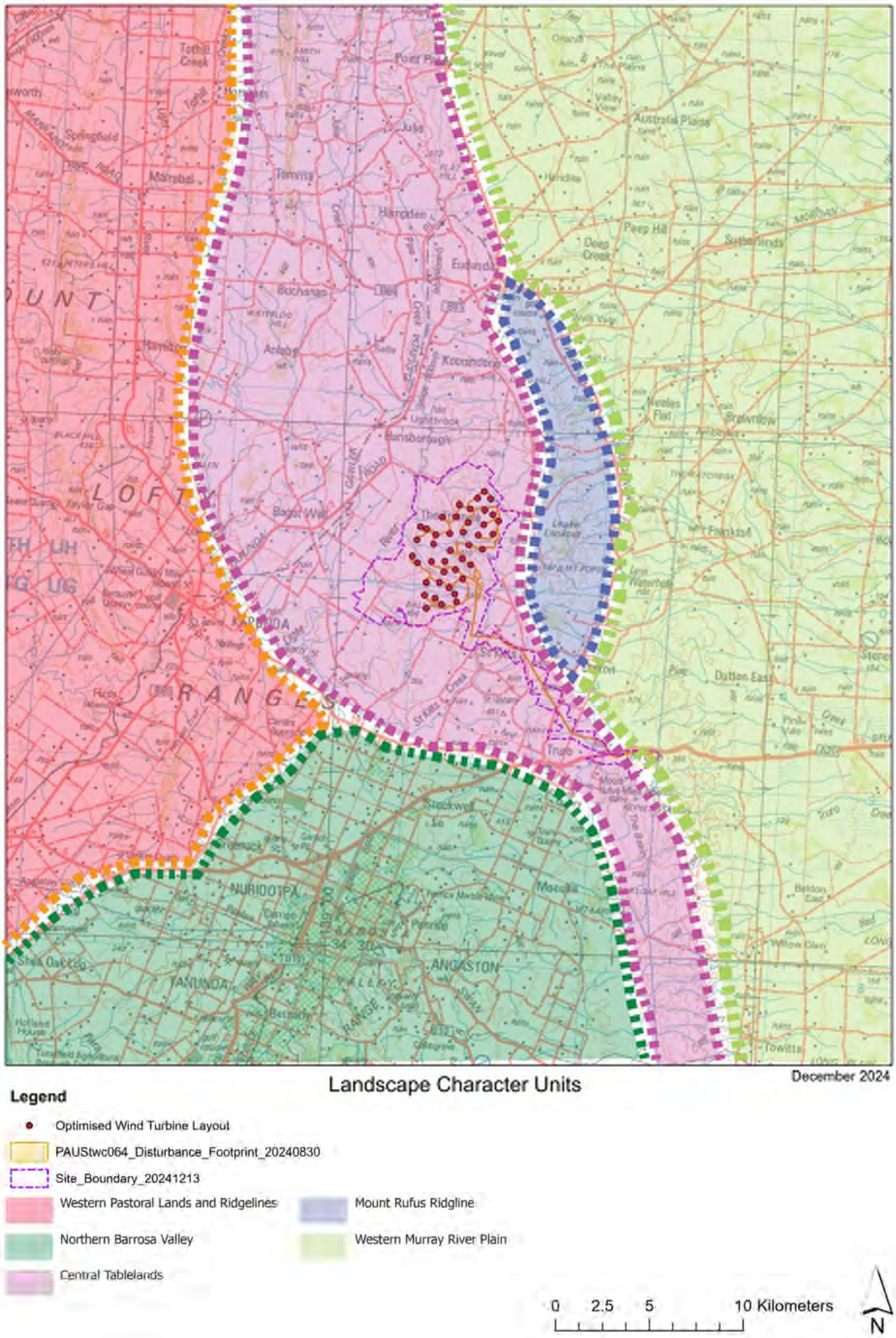

Figure 7: Landscape character units

3.4.1 Northern Barossa Valley

The northern edge of the Barossa Valley forms a defined landscape character south of the proposed wind farm site and is defined by the townships of Nuriootpa, Stockwell and Greenock.

With the largest population, Nuriootpa demonstrates the more urban nature of these townships, resulting in several commercial and industrial buildings on the outskirts of town and an increased density of residential development in and around the town.

The cadastral overlay of the landscape character reflects the historical 80 acre agricultural pattern creating a defined patchwork of paddocks, vegetated field boundaries and tree groups that cover the gently rolling landscape and topography of the area. The land use is predominantly agricultural including vineyards, grazing, cropping and various areas of animal husbandry interspersed with rural living properties and single storey dwellings on large rural land parcels. This combination of topography, extensive belts of vegetation and land use creates an attractive rural landscape.

The low lying topography of this area creates an open visual character to the north that is framed by vegetation and distant ridgelines to the east and west associated with the Northern Mount Lofty Ranges and Southern Mount Lofty Ranges respectively. Localised embankments and residential development coupled with vegetation along field boundaries restrict the potential for long distance views towards the north.

The northern ridgeline associated with Bald Hill defines the northern edge of the Barossa Valley. The well vegetated landscape character and defined field boundaries of the Barossa is replaced with a rolling grazed landscape with isolated pockets of trees, fencing and agricultural buildings.

This landscape character unit reflects the Barossa Valley Character Preservation District, which provides legislative recognition and protection of the district's special character

Figure 8: Views north from Wolf Blass Winery along Kapunda-Truro Road

Between the township of Nuriootpa and Stockwell, along the Kapunda-Truro Road, is the Wolf Blass Winery. This represents a tourist location and industrial/agricultural production. Views from this location are largely screened towards the project site and enclosed by belts of vegetation associated with the existing field patterns. The land cover is predominantly vineyards with rural living and single storey development on large land parcels.

The existing vegetation consists of large stands of eucalypts across the valley floor and results in a series of dense landscape screens that limit visibility down to 30 metres east and west along the Sturt Highway Road corridor and to a maximum of 100 metres across existing field boundaries. The enclosed visual character means that views of the project site are largely screened.

3.4.2 Western Pastoral Lands and Ridgelines

To the west of the proposed project site is a ridgeline associated with the Greenock and Nain Range, which creates a defined elevated topographic feature that connects the towns of Greenock and Kapunda. The elevated, undulating landscape character around St John's and Koonunga creates defined viewpoints with expansive views over significant distances to the north and northeast towards the project site.

The township of Kapunda is located on the southwestern edge of the locality. The arrangement of the township in relation to the Greenock Range results in the town being orientated to the western slope of the ranges. The town's orientation results in limited views overlooking the ridgeline to the east towards the proposed wind farm. The alignment of the streets creates an internalised visual character with single storey dwellings orientated towards the main street.

Between the townships of Kapunda and Eudunda, and the edge of the Greenock and Nain Ranges is the Waterloo Plain which is defined by low lying rolling hills, grazing and cropping and isolated dwellings or structures associated with agricultural practices. The settlement pattern of the plain is larger than that of the Northern Barossa Valley, with a more uniform land use, creating less visual contrast within the landscape.

Along the southern section of the Kapunda-Morgan Road, the local topography and tree groups along the roadside screen the subject land, allowing only glimpsed views. Further north towards Eudunda, the topography provides more panoramic views of the Project Site, particularly between the Kapunda-Morgan Road and Bagot Well Road.

Further to the west, the visual character of the locality is contained by the ridgeline associated with the Greenock, Light and Nain Range. The Heysen Trail traverses this portion of the Northern Mount Lofty Ranges. However, the distance from the proposed development, which is approximately 15 kilometres away coupled with, local landforms and vegetative cover restrict views of the project site from the trail.

Figure 9: Enclosed views in the township of Kapunda

3.4.3 Central Tablelands

The landscape character associated with the locality immediately surrounding the proposed wind farm development is defined by numerous undulating landforms forming a broad raised tableland between Bald Hill, at the northern edge of the Barossa Valley, towards Eudunda. The undulating landforms rise approximately twenty to thirty metres in elevation above the underlying valley plain, creating a visual complexity of prominent landforms and wide gullies. The land cover is defined by an open grazed field pattern, which is almost entirely devoid of vegetation except for isolated trees to some tree groups in parts of the landscape.

The elevated landforms have defined rolling escarpments that create topographic screens, reducing views to other areas. This is particularly prevalent along Camel Farm Road and from several properties located within the area.

Figure 10: The Central Tablelands looking east along Twin Creek Road

The landscape character is defined to the north by a series of north-south ridgelines with wider valleys. These include the ridgeline that is defined by Long Hill to the east and Waterloo Hill to the west. The interaction of the ridgelines, undulating landscape forms and wide valleys create a visually complex landscape character. The increased topographic complexity results in a degree of visual fragmentation towards the proposed wind farm. Screening occurs as a result of the interaction of local landforms and the alignment of the road corridors and fields that traverse the landscape.

The township of Eudunda is orientated in an east-west direction across the topography of the Southern Mount Lofty escarpment, which defines the edge of Murray Plains to the east. The defined orientation of the town and local ridgelines, particularly to the west and south, limit views from within the town and provide a degree of visual enclosure. The ZTVI mapping indicates that the township is contained within a defined viewshed and that the visual impact associated with the proposed development will not be experienced within the township or from surrounding residential areas.

3.4.4 Mount Rufus Ridgeline

The Truro Road defines the eastern landscape character zone that runs for the full extent of the locality, extending from Eudunda south towards Dutton and Truro. The landscape character to the north/east of the proposed development site is defined by widely separated north/south ridgelines. The separated ridgelines and wide valley form an enclosed visual character with views contained by local topography and features associated with the valley floor. The land cover to the lower lying area of the ridgeline is typical of the locality with grazing and cropping practices occurring across the landscape.

Figure 11: Views east to Mt Rufus ridgeline

The prominent ridgeline formed by Long Hill and Mount Rufus is associated with the edge of the Murray Plains to the east. There are defined areas of vegetation associated with creek lines, field boundaries and remnant vegetation groups clustered around rocky outcrops that occur at the edge of the ridgelines. Dense vegetation occupies land surrounding Leake Lookout and Mt Rufus, providing visual amenity and an enclosed landscape character.

The Federation Lavender Trail runs north/south between Truro and Eudunda; the trail is located predominately through farmland and away from the main roadways. Most of the trail runs along the eastern side of the Mount Rufus ridgelines, ensuring that the topography, local landforms and vegetative cover restrict the view of the proposed wind farm for most of the trail within the locality. The Leake lookout (not accessible by public road) is a stopping point along this trail; it has not been considered in this assessment. However, the lookout and the Lavender trail are considered to be consistent with the relativity of visual experience depicted in the interpolation mapping. It is assumed there will be a visual effect on the Lavender trail. However, the potential visual impact of which will vary dependent on distance between the wind turbines and the trial, and localised topographic and vegetation screening.

The township of Truro is located to the southeast along Truro Road. The township is defined by the east-west orientation of the main street that runs through the centre of the town. The settlement pattern and built form create a series of low rise buildings that face onto the road alignment. The topographic form on which the town is located creates a defined valley with views to the surrounding areas, which are contained by local ridgelines, belts of vegetation, isolated dwellings, and rural buildings.

The underlying topography of the town is interrelated to the Mt Rufus Ridgeline and the Central Tablelands landscape, providing a transitional landscape with localised rolling ridgelines limiting distant views. The visual containment of the town extends for several hundred metres north and south from the main street road corridor and for similar distances east-west along the corridor itself.

3.4.5 Western Murray River Plains

Further to the east, the topography of the landscape diminishes significantly and extends across the Murray Plains east towards the Murray River. The portion of the Murray Plains that is included as part of this landscape character unit is the western edge of the Murray Plains. The low lying landscape character of the Plains allows expansive views to the east over significant distances with limited variation in topography. The landscape is defined by the rural agricultural landscape typical of the area with small clusters of vegetation associated with field boundaries and creek lines within the landscape.

Figure 12: Views east looking over the Murray Plains

3.4.6 St Kitts

Within the locality is the settlement of St Kitts. Historically, the area is recognised for numerous early Lutheran settlement buildings, including a school and two churches.

St Kitts was settled in the 1850s and 1860s by immigrant Sorbs or Wends who had migrated from Saxony (then part of Prussia, now mostly in western Poland).

The area has several heritage overlays, and many of the buildings in the area are registered. A separate assessment has been undertaken by DASH Architects to assess the impact on the heritage values of the area.

This area is also defined by localised vegetation that surrounds some of the dwellings, providing relief to the built form within the locality. The majority of dwellings are on the lower side of local ridgelines reducing visual prominence and expanse of views both as notable elements and as a receptor of the broader landscape.

04 Zone of Theoretical Visual Influence

4.1 Zone of Theoretical Visual Influence (ZTVI)

The Zone of Theoretical Visual Influence (ZTVI) mapping provides an illustration of where the Optimised Project may be seen within the landscape. The mapping quantifies the extent and number of wind turbines which are likely to be seen within the wider landscape.

The ZTVI mapping is developed in GIS using 10m contour data that has been provided for a 20 kilometres radius of the project site. The ZTVI represents a 'worst case' scenario as it does not incorporate vegetation, built form or localised screening effects, which are assessed onsite.

Two ZTVI maps were produced. One map is based on the entire wind turbine using a blade tip height of 220 metres. The second was based on a wind turbine hub with a height of 134 metres.

The on site assessment of the existing landscape indicates that there is a substantial tree canopy structure to the south surrounding the northern outskirts of the Barossa Valley (Nuriootpa). This vegetation limits and, in some cases, removes the extensive views to the north that are indicated in the ZTVI mapping.

Both the ZTVI tip and hub height maps for the Optimised Project demonstrate a similar degree of visibility. The mapping indicated that the visibility is defined within 5-10 kilometres of the wind turbines. At distances beyond 10 kilometres, the potential screening within the locality of the wind turbines reduces potential visual effects.

Of particular note are the following;

- The screening provided by the north-south ridgelines of Mount Rufus and Bald Hill reduces the visibility of the wind turbines to the east.
- Screening and visual fragmentation of the wind turbines to the north, particularly from the Bluff Ranges and the south.
- Reduced visibility of the wind farm from Tothill Valley due to local ridgelines and the Tothill Ranges
- Higher visibility to the south, although the mapping does not take account of existing vegetation.
- Higher visibility west of the project site

04 Zone of Theoretical Visual Influence

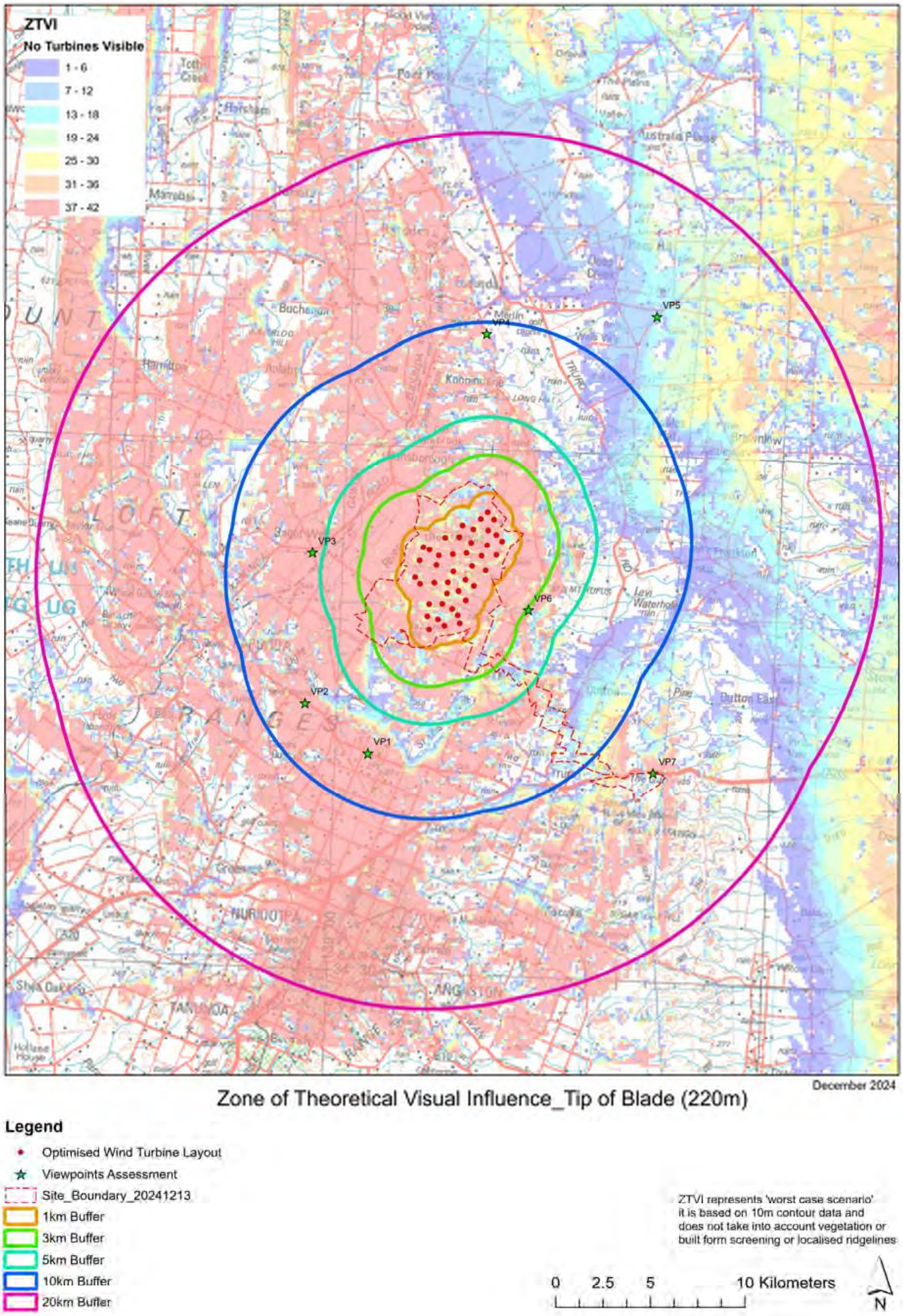

Figure 13: Optimised Project ZTVI map for the Twin Creek Wind Farm based on 220 metre turbine tip of blade height

04 Zone of Theoretical Visual Influence

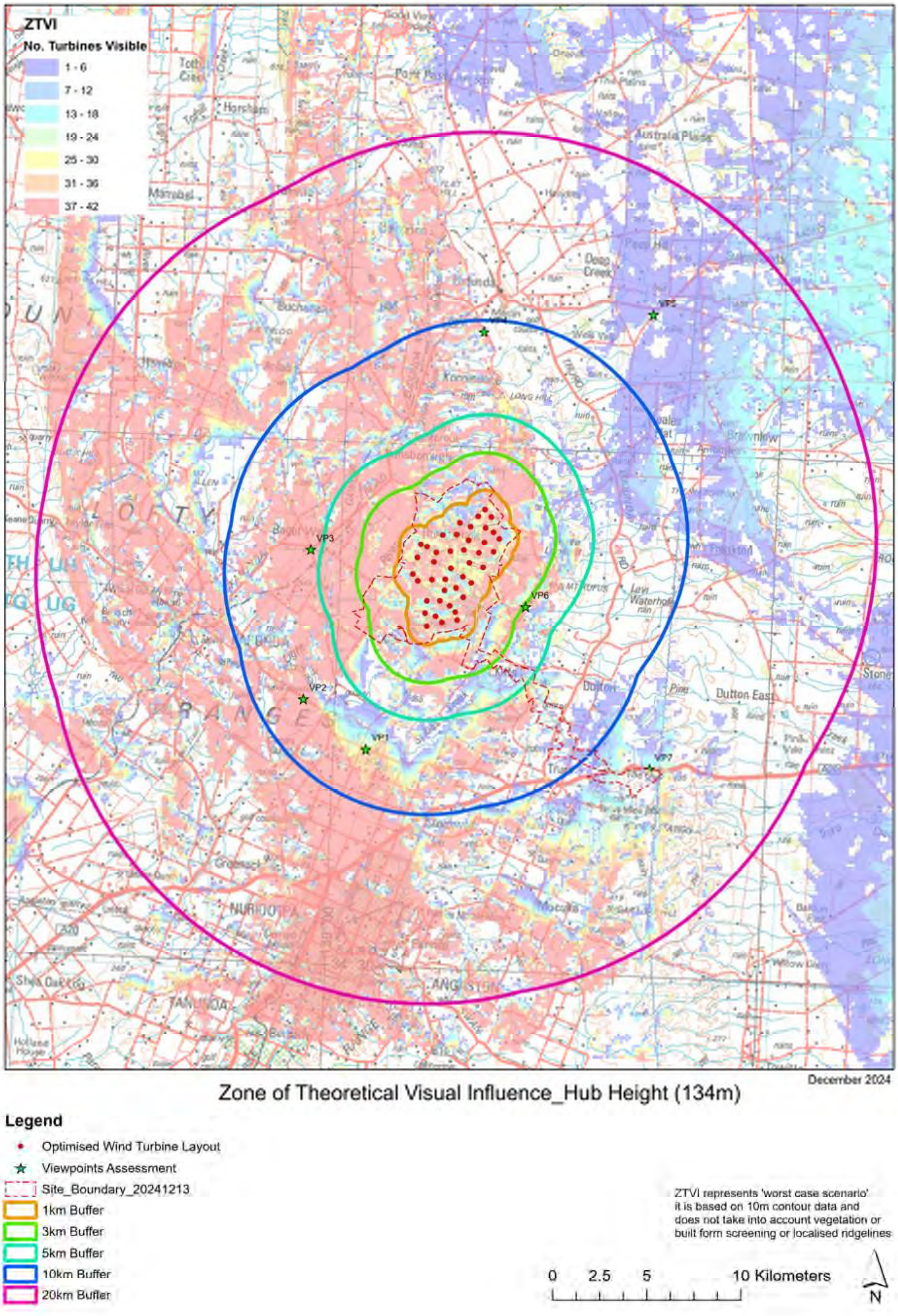

Figure 14: Optimised Project ZTVI map for the Twin Creek Wind Farm based on 134 metre turbine hub height

05 Visual Impact Assessment

5.1 Visual Assessment Scope

The visual impact assessment of the Optimised Project was based on 42 wind turbines, and the site locality, as described in the landscape character assessment, was to a radius of 20 kilometres of the proposed development.

The visual impact assessment considered key aspects of the existing landscape, such as relief, vegetation, built form and infrastructure, and cultural and scenic landscape values from each of the seven selected viewpoints. These key aspects from each viewpoint were scored out of 5 to produce an assessment value out of 20. This enabled a baseline landscape value to be calculated from which the visual impact was measured in relation to the degree of visual change likely to occur as a result of the introduction of the proposed development into the existing landscape character.

The visual effect was assessed using a set of criteria that considered factors such as the degree of landscape absorption, horizontal and vertical effects and distance to the development from each viewpoint.

The visual effect was then expressed as a coefficient and applied to the baseline landscape value to produce a measurement of the likely degree of visual change, that is to say, the extent to which the Project is predicted to alter the existing landscape.

5.2 Visual Impact Assessment

Using the visual assessment matrix as described in Appendix E, the potential degree of visual change and resulting visual impact of each viewpoint was measured and evaluated against the following criteria:

- Baseline Landscape Value is expressed as a value between 4 and 20;
- Visual Assessment Value is expressed as a value between 4 and 20;
- Coefficient of Visual Impact is calculated as a decimal fraction of the visual assessment value;
- Relative Value of Visual Impact is calculated as the baseline landscape character multiplied by the coefficient and
- Degree of Visual Change is expressed as the visual impact divided by the landscape character assessment range represented as a percentage.

The visual assessment also includes a description of the viewpoint context in relation to the landscape character that surrounds the viewpoint and the potential visual impact. This assessment is supported by photomontages of the development and wireframe illustrations of the relative wind turbine positions.

For clarity and legibility of the report, all reference images, maps and photomontages have been extracted to Appendix A, C and D and reproduced at A3 to enable them to be studied while reviewing the associated text for each viewpoint.

The viewpoints selected for the visual impact assessment are shown in Table 1 are:

VP01 Kapunda-Truro Road, Ebenezer (north - regional)

VP02 Kaunda-Truro Road, Koonunga (northeast - regional)

VP03 Intersection of Bagot Well Road and Kapunda-Eudunda Road, Bagot Well (east – sub-regional)

VP04 Tablelands Road, south of Eudunda (south–regional)

VP05 Von Reiben Road, east of Eudunda (southwest–regional)

VP06 Tablelands Road, south of Mount Rufus (west-regional)

VP07 Sturt Highway, east of Truro (northwest-regional)

Ref.	Viewpoint	Longitude	Latitude	Distance to nearest WTG	View Direction
VP01	Kapunda-Truro Road, Ebenezer	317919	6192096	8.41km	25°
VP02	Kaunda-Truro Road, Koonunga	314453	6194570	8.62km	40°
VP03	Intersection of Bagot Well Road and Kapunda-Eudunda Road, Bagot Well	314383	6202506	5.22km	85°
VP04	Tablelands Road, south of Eudunda	322870	6214541	8.9km	180°
VP05	Von Reiben Road, east of Eudunda	331788	6215965	13.3km	220°
VP06	Tablelands Road, south of Mount Rufus	325931	6200154	2.64km	300°
VP07	Sturt Highway, east of Truro	332988	6191953	13.6km	310°

Table 1: Summary of Viewpoint location information

05 Visual Impact Assessment

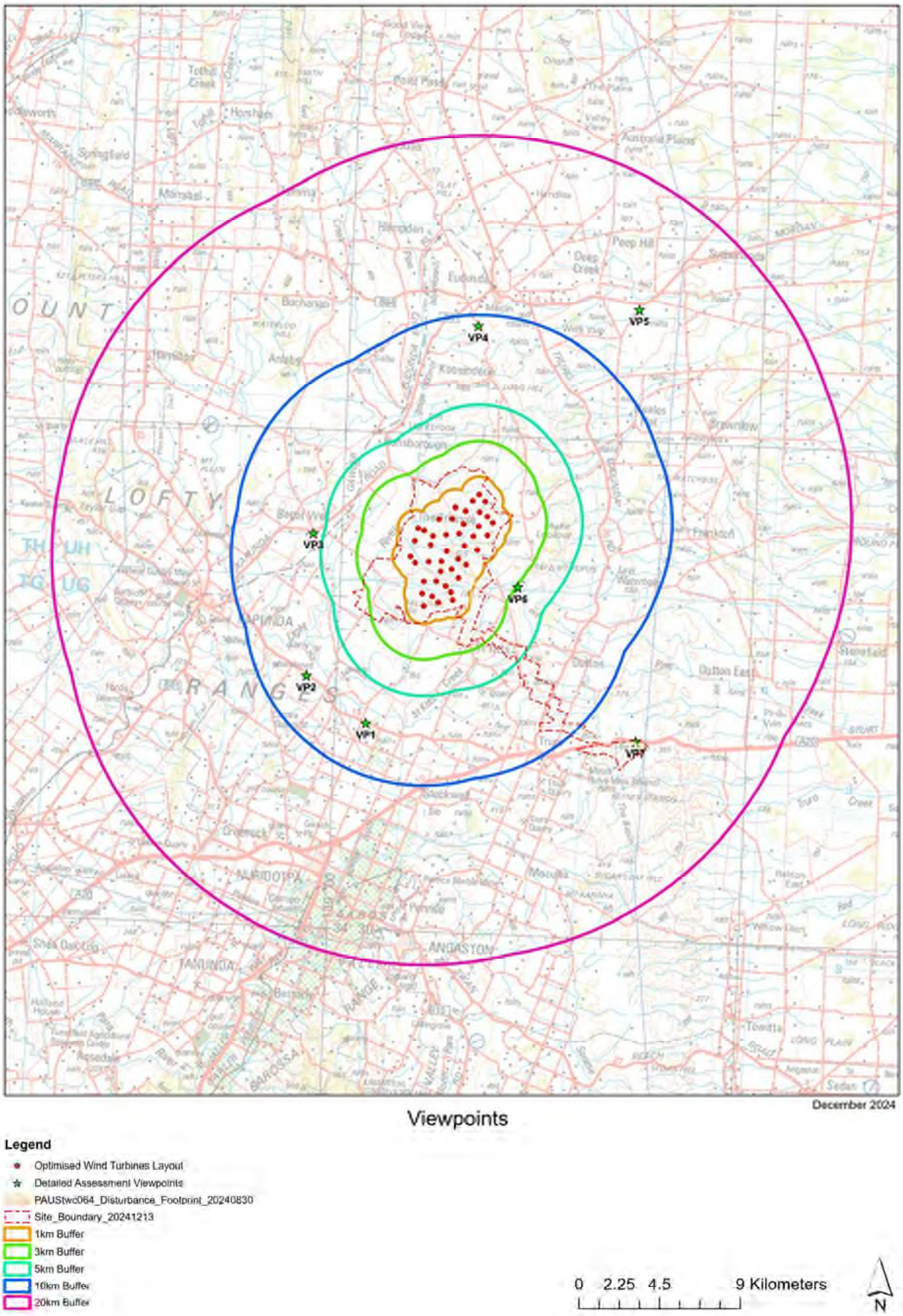

Figure 15: Viewpoint Locations

5.2 Viewpoint 1: Kapunda-Truro Road, Ebenezer

Viewpoint Context

Viewpoint 1 is located on the southern edge of the proposed wind farm along the east-west orientated Kapunda-Truro Road close to the intersection with Belvedere Road. This road corridor is the closest sealed and most frequently travelled road south of the project site. Viewpoint 1 is located 1 kilometre away from the Yatara Farm, which is listed as a State Heritage Place (reference Heritage no: 13331). The viewpoint is typical of the landscape character of the northern Barossa Valley and represents the probable visual effect that will be experienced within this locality.

The low-lying valley floor supports a mixture of arable practices, grazing and vineyards, which are typical of this locality. This productive landscape includes a range of farm buildings and ancillary structures scattered through the landscape associated with the predominately agricultural land use. Extensive belts of vegetation provide localised landscape amenity, and the rising landform of the Greenhill Ranges provides a degree of visual enclosure within the locality. The ridgelines associated with Bald Hill and St Kitts form a visual envelope and represent the extent of the viewshed to the north of the viewpoint.

Figure 16: Viewpoint 1: Kapunda-Truro Road, Ebenezer

Figure 17: Digital Overlay showing all Turbines: Viewpoint 1

Figure 18: Absorption Capacity Calculations: Viewpoint 1

Viewpoint Assessment

Table 2: Detailed Visual Assessment for Viewpoint 1

Assessment	Value	Description
Relief	2	Negligible local foreground variation with limited to moderate subregional to regional background topographic form
Vegetation Coverage	3	Sporadic foreground vegetation of mature scale that enhances the landscape qualities
Infrastructure and Built Form	4	Limited development form, associated to farming frost fans and rural dwellings. Primarily a rural agricultural landscape
Cultural and Landscape Value	3	On the fringe of the Northern Barossa Valley landscape character unit as described in Section 3 hence has an higher level of association to the cultural vineyard landscapes.
Baseline Landscape	12	
Landscape Absorption	3	The ridgeline and mature vegetation coverage to the north provide moderated landscape absorption capacity, which is calculated to be 44%.
Horizontal	1	The horizontal visual effect is created between turbines 13 and 38, which equates to 21 degrees or 18% of the field of view.
Vertical	4	The vertical visual effect is created by turbine 42, which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 117m at a distance of 4095m. The variance in elevation created by turbine 42 is 345m at a distance of 7289m. Hence, the turbines create a 63% proportion increase in vertical scale.
Distance	2	The closest turbine is turbine 42, which is 7.3km to the north
Visual Effect	10	
Coefficient	0.5	
Degree of Visual Change	30%	12x0.5= 6 Landscape visual effect 6/20= Degree of visual change

Description of potential visual impact

The local ridgelines associated with Bald Hill and St Kitts provide a visual screen behind which the Optimised Project is located.

The proposed wind farm layout produces a concentrated cluster of wind turbines located on the northern horizon line formed by the local topography of Bald Hill that extends north from the viewpoint. The visual effect created by the Optimised Project will result in two distinct visual effects.

Several wind turbines appear above the ridgeline, forming prominent visual elements with large sections of the towers, nacelles, and blades visible on and above the ridgeline. This includes turbines T37 to T42.

These prominent wind turbines form distinct visual elements within the landscape within a narrow field of view. The blades of other wind turbines are visible low on the horizon, creating intermittent and dynamic visual effects as the blades appear and disappear rotating behind the horizon.

The visual effect can be described as a cluster of infrastructure elements punctuating the northern horizon line of the locality. The visual effect in the landscape is visible over a brief period along the road corridor rather than being visually expansive or impactful over a wider area.

The extent of the existing tree canopy and the scale of the vegetation within the locality provide a degree of visual mitigation. The wind turbines are likely to be seen located more distantly behind the existing vegetation cover. Further to the south, the vegetation screening increases, and the visibility of the Optimised Project becomes limited, particularly in relation to the Barossa Valley.

The height of the wind turbines in the landscape does not dominate the vegetation or the elevation of the underlying topography, and there is a comparative visual scale. Consequently, the potential visual impact of the wind turbines is likely to be offset by the existing vegetation and wooded rural landscape character.

The combination of wind turbine layout and local topography results in the proposed development producing a single dynamic visual element located along a portion of the ridgeline that marks the northern extent of the Northern Barossa Valley landscape unit.

5.3 Viewpoint 2: Kapunda-Truro Road, Koonunga

Viewpoint Context

Viewpoint 2 is located southwest of the proposed development along the Kapunda-Truro Road on the rise of a local ridgeline. The viewpoint location is typical of the transitioning landscape between the edge of the northern Barossa Valley and the western pastoral lands and ridgelines. This viewpoint represents the visual effect that may be experienced by visitors and from dwellings to the south-west of the proposed development, particularly from elevated properties along Brewery Road and to the eastern edge of Kapunda.

The elevation of the viewpoint provides panoramic views of the tablelands on which the wind farm is located, forming a distinct viewshed and horizon line to the locality. The progressive agricultural development of the locality has resulted in a cleared landscape with little vegetation to the ridgelines. The open field boundaries and absence of tree coverage are typical to landscape areas to the northeast from this viewpoint.

Isolated tree groups exist in the low lying areas around the tablelands and increase in intensity to the south as a result of the landscape character associated with the Barossa Valley. Further to the north are a series of defined ridgelines that mark the Northern Mount Lofty Ranges and the elevated parallel ridgelines that are typical throughout the mid- north. The open landscape character, distant ridgelines and vegetative qualities of the northern edge of the Barossa Valley provide a degree of visual amenity across the landscape.

Figure 19: Viewpoint 2; Kapunda-Truro Road, Koonunga

Figure 20: Digital Overlay showing all Turbines: Viewpoint 2

Figure 21: Absorption Capacity Calculations: Viewpoint 2

Viewpoint Assessment

Table 3: Detailed Visual Assessment for Viewpoint 2

Assessment	Value	Description
Relief	3	Limited local foreground variation with limited to moderate subregional to regional background topographic form
Vegetation Coverage	2	More scattered vegetation surrounding properties. The view is comprised mainly by low lying crops.
Infrastructure and Built Form	4	Visual presence of a borrow pit (disused quarry) and man-made dams within the landscape.
Cultural and Landscape Value	3	Tablelands landscape character has local cultural values for its scenic qualities. Relative high frequency of views on the Truro to Kapunda transport corridor.

Baseline Landscape	12	
Landscape Absorption	4	Limited landscape absorption due to the elevated viewpoint and limited vegetation screening such that the absorption capacity is calculated to be 22%.
Horizontal	2	The horizontal visual effect is created between turbines 38 and 13, which equates to 27 degrees or 23% of the horizontal field of view.
Vertical	5	The vertical visual effect is created by turbine 42, which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 130m at a distance of 9861m. The variance in elevation created by turbine 42 is 328m at a distance of 7610m. Hence, the turbines create a greater than 100% proportion increase in vertical scale.
Distance	2	Turbine 42 is the closest turbine at a distance of 7.61km
Visual Effect	13	
Coefficient	0.65	
Degree of Visual Change	39%	12x0.65= 7.8 Landscape visual effect 7.8/20= Degree of visual change

Description of potential visual impact

The proposed wind farm will likely create a distinct visual effect within the rural landscape in terms of the compact nature of the wind turbine cluster and absence of land form or vegetation screening. The 42 wind turbines are visible as a cluster of large infrastructure elements within the landscape.

The wind turbines will be uniformly visible across the plateau formed by Spring Hill and the central tablelands. The height and arrangement of the wind turbines will appear consistent and located in a narrow field of view, with small gaps appearing as part of the wind turbine layout.

Most of the wind turbines are likely to be visible on or just behind the existing horizon line formed by the local topography and the regional landscape character. The towers, nacelles and blades will be seen as a dynamic array of significant infrastructure elements. Most of the wind turbines will be clearly visible, with little mitigation in terms of screening provided by the topography or vegetation within the locality.

The visibility and resulting visual effect of the wind turbines is likely to be prominent. However, the visual impact will appear uniform, with no single wind turbine appearing more significant in scale or visual dominance than any other. In this regard, the entire wind farm produces the visual effect without particular visual prominence or variance associated with specific wind turbines, outliers or clusters.

The elevation of the wind turbines behind the local ridgelines visually disrupts the underlying horizon line of the locality, particularly to the south and east.

The height of the wind turbines and base elevation will be consistent, and the spread of the wind turbines across the rural landscape will be uniform. As such, the resulting visual effect, while prominent, will be legible, and the wind farm is likely to be experienced as a single collection of infrastructure elements in the landscape.

5.4 Viewpoint 3: Intersection of Bagot Well Road and Kapunda-Eudunda Road, Bagot Well

Viewpoint Context

Viewpoint 3 is located to the western side of the proposed development at the intersection of Bagot Well Road and the Kapunda-Eudunda Road (Thiele Highway). The viewpoint is located adjacent to the Old School House, which is listed as a local heritage place. The viewpoint represents the landscape character of the central tablelands and the typical landscape associated with the eastern edge of Greenock Ranges and the lower lying undulating landscape between the ranges and tablelands.

This viewpoint represents the anticipated visual effect experienced from the northern outskirts of Kapunda as well as the Kapunda-Eudunda Road and from elevated residential properties to the southwestern side of the wind farm.

The land cover transitions from the dense field boundary and vegetated character of the Barossa Valley in the southeast to an open pastoral landscape with larger fields used for grazing and some arable cropping. The belts of vegetation that exist across the low lying areas create a more defined vegetation pattern that follows the field boundaries and creek lines. The elevation of the ridgeline and escarpment formed by the local topography associated with Mount Rufus is mainly devoid of vegetation and forms a defined viewshed.

The topography of the tablelands encloses the visual character, particularly the lower-lying landscape areas along the road corridor. The layered hills and hummocks associated with the tablelands form a complex terrain with numerous ridges, prominent topographic forms, and shallow gullies. The diversity of visual character is reinforced by the colouration of the land cover as well as the temporal light qualities of the escarpment, which creates an additional degree of visual interest.

Figure 22: Viewpoint 3; Intersection of Bagot Well Road and Kapunda-Eudunda Road, Bagot Well

Figure 23: Digital Overlay showing all Turbines: Viewpoint 3

Figure 24: Absorption Capacity Calculations: Viewpoint 3

Viewpoint Assessment

Table 4: Detailed Visual Assessment for Viewpoint 3

Assessment	Value	Description
Relief	3	Negligible foreground topographic variation with moderate subregional to regional background elevated punctuated forms
Vegetation Coverage	3	Sporadic mature vegetation following creek lines and cadastral boundaries to the foreground, which frames views.
Infrastructure and Built Form	4	Scattered farm dwellings that are typically isolated from view by vegetation and not of a scale to deter from the underlying agricultural land use.
Cultural and Landscape Value	2	Central Tablelands landscape with transient views along the Kapunda- Truro Road, which is a major arterial road between townships
Baseline Landscape	12	
Landscape Absorption	5	The elevated location of the turbines on the leading edge of the sub-regional ridgeline with limited foreground topography and vegetation means that the landscape has minimal capacity to absorb the visual effect from this viewpoint. The absorption capacity is calculated to be 18%.
Horizontal	2	The horizontal visual effect is created between turbines 42 and 1, which equates to 46 degrees or 38% of the horizontal field of view.
Vertical	5	The vertical visual effect is created by turbine 42, which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 134m at a distance of 7452m. The variance in elevation created by turbine 42 is 268m at a distance of 5570m.

		Hence, the turbines create a greater than 100% proportion increase in vertical scale.
Distance	3	Turbine 24 is the closest turbine at a distance of 5.6km
Visual Effect	15	
Coefficient	0.75	
Degree of Visual Change	45%	12x0.75= Landscape visual effect 9/20= Degree of visual change

Description of potential visual impact

The viewpoint is located on the main arterial road between Kapunda and Eudunda. The frequency of the vehicle movements along the road corridor reflects the sensitivity and possible visual frequency that will be experienced and the potential visual effects of the proposed wind turbine within the landscape.

The proposed wind farm will form a cluster of infrastructure elements within the landscape. The elevation of the wind turbines creates a degree of uniformity in the visual effect in terms of the vertical alignment of the nacelles, blade tip heights and sweep of the blades.

No single turbine appears as a prominent visual element. However, T 42 appears as a slight outlier to the overall arrangement of the wind turbines to the south.

The overall height of the wind turbines will be seen as a proportional increase in the scale being prominent elements elevated above the existing horizon. The existing escarpment does provide visual relief due to its sharp contrast with the tablelands landscape.

The visual effect is contained within a tight field of view, and the complexity and arrangement of the wind turbines are likely to be perceived easily from a single view. That is to say, the Optimised Project does not create a panoramic visual impact across the locality, and the potential visual effect associated with the wind farm is experienced from a contained field of view.

The potential for sequential or combined visual effects resulting from separated clusters or linear wind turbine arrangements is not experienced, and the proposed wind farm will be seen as a single infrastructure element within the locality.

The arrangement of the wind turbines across the mid-ground and foothills adjacent to the Light River increases the visual effect. The existing topography and landscape character of the locality will be impacted, and rather than being perceived as an open rural landscape, the local ridgeline and mid-ground are likely to be changed by the introduction of the wind turbines.

The Optimised Project is likely to fragment the landscape character. This fragmentation caused by the wind turbines reduces the legibility of the underlaying rural land use, and the wind farm becomes the dominant visual element.

To the outskirts of Kapunda, local ridgelines provide a visual screen particularly from the local road corridors and lower lying areas associated with the Kapunda-Eudunda and Kapunda-Truro Road intersection. The degree of visibility is likely to increase from elevated locations and mainly residential properties to the northern ridgeline of Kapunda. From these viewpoints, the visual effect will be similar to that experienced at Viewpoint 2.

5.5 Viewpoint 4: Tablelands Road, south of Eudunda

Viewpoint Context

Viewpoint 4 is located along Tablelands Road and represents the potential visual effect that will be experienced to the north of the wind farm, particularly around the southern outskirts of Eudunda. The viewpoint is typical of the undulating landscape character of the elevated central tablelands.

The landscape character surrounding the viewpoint is defined by an open agricultural landscape of grazing and cropping and a general absence of vegetation apart from a few isolated trees. Numerous hills and localised ridgelines create a defined undulating landscape character typical of the locality. From the viewpoint and other surrounding areas, views extend south across local ridgelines with more expansive panoramic views to the east and west.

To the west, views extend as far as the north-south ridgeline of the Greenock Range, some 40 kilometres away, and east towards the Southern Mt Lofty Ranges escarpment, with the Murray Plains forming a distant landscape on the horizon.

Figure 25: Viewpoint 4; Tablelands Road, south of Eudunda

Figure 26: Digital Overlay showing all Turbines: Viewpoint 4

Figure 27: Absorption Capacity Calculations: Viewpoint 4

Viewpoint Assessment

Table 5: Detailed Visual Assessment for Viewpoint 4

Assessment	Value	Description
Relief	3	The elevated viewing area associated with the Mt Rufus ridgeline provides a moderate local to sub-regional variation in topography with limited regional variation as it flattens into the Western Pastoral lands.
Vegetation Coverage	1	Limited to grazing and crops
Infrastructure and Built Form	5	Limited presence of infrastructure within the field of view.
Cultural and Landscape Value	2	Elevated views are present on the outskirts of Eudunda. Views would be associated with the experience on walking trails within the area.
Baseline Landscape	11	
Landscape Absorption	3	The undulating forms of the Mt Rufus ridgeline provide moderate absorption screening of 44%
Horizontal	1	The horizontal visual effect is created between turbines 13 and 7, which equates to 22 degrees or 18% of the horizontal field of view.
Vertical	5	The vertical visual effect is created by turbine 3, which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 25m at a distance of 2524m. The variance in elevation created by turbine 3 is 173m at a distance of 10180m. Hence, the turbines create an 88% proportional increase in vertical scale.
Distance	1	Turbine 1 is the closest turbine at a distance of 9.42km
Visual Effect	10	
Coefficient	0.5	
Degree of Visual Change	28%	11x0.5= Landscape visual effect 5.5/20= Degree of visual change

Description of potential visual impact

The wind turbines form a distinct cluster of elements set just behind the ridgeline to the south. The uniform layout creates a dispersed visual effect along the horizon line. The wind turbines will appear layered in front and behind each other. Similar to other viewpoints, the layering of and rotation of the wind turbine blades will increase the complexity of the visual effect.

The visual effect of the Optimised Project is concentrated in a narrow field of view within the broader rural landscape of the locality. The location of the viewpoint and the offset distance of the proposed development means that from more elevated locations to the north of the wind farm, the proposed visual effect is limited.

The wind turbines are likely to be seen as a distinct cluster of infrastructure elements set low on the horizon line formed by the undulating landscape of the locality.

Sections of the wind turbine towers, several nacelles and blades will be seen above the ridgeline, creating a dynamic visual effect. Several wind turbines to the west will be screened by local landforms, particularly T13, T14, T19, T24, T25, T34 and T39.

Overall, the visual impact will be seen as a concentrated visual effect located within a single field of view and set low on the visual envelope of the locality formed by the topography of Spring Hill.

While the wind farm and associated turbines will be notable elements within the locality, the compact layout and screening provided by the surrounding topography limits the visibility and potential visual effects. In this regard, the visual effect is notable but limited to a narrow field of view.

5.6 Viewpoint 5: Von Reiben Road, east of Eudunda

Viewpoint Context

Viewpoint 5 is located on Von Reiben Road, some 16 kilometres north-east of the proposed development. The viewpoint represents the potential visual effect with a degree of visual change that will be experienced to the northeast and east of the proposed development in relation to regional locations across the Murray Plains.

The low lying character of the viewpoint is typical of the Murray Plains with extensive views across the rural landscape of the plains. The underlying land cover is typical of the area, consisting of cropping and grazing with scattered belts of vegetation following field boundaries or creeks.

To the southwest is the elevated escarpment associated with Mount Rufus and Long Hill with the township of Eudunda to the west. Prominent topographical features such as Mt Rufus are visible along the horizon line. These landforms produce a defined undulating ridgeline in front of the proposed development.

Figure 28: Viewpoint 5; Von Reiben Road, east of Eudunda

Figure 29: Digital Overlay showing all Turbines: Viewpoint 5

Figure 30: Absorption Capacity Calculations: Viewpoint 5

Viewpoint Assessment

Table 6: Detailed Visual Assessment for Viewpoint 5

Assessment	Value	Description
Relief	3	There is limited foreground topographic variation with moderate subregional to regional.
Vegetation Coverage	2	Scattered copse planting of mature trees within paddocks and along creek lines and cadastral boundaries
Infrastructure and Built Form	4	Unsealed road corridor provides a dominant element to the foreground within the field of view—also, scattering of homestead ruins.
Cultural and Landscape Value	2	The Murray River plain landscape is expansive, with limited culturally sensitive elements of significance present within

		the proximity of the viewpoint. However, this particular viewpoint is located close to the Eudunda Morgan Road, which is an arterial road with a greater frequency of occupation and, hence, visitation and views.
Baseline Landscape	11	
Landscape Absorption	1	The eastern edge of the Mt Rufus ridgeline provides substantial absorption screening of 90%
Horizontal	1	The horizontal visual effect is created between turbines 13 and 38, which equates to 13 degrees or 11% of the horizontal field of view.
Vertical	1	The vertical visual effect is created by turbine 30, which has the greatest elevation from this viewpoint. The existing landscape topographic variation is recorded as 200m at a distance of 7406m. The variance in elevation created by turbine 3 is 378m at a distance of 15,052m. The vertical visual effect of the turbines is proportionate to the landscape scale; hence, the tips of the blades are not seen to increase the scale. The scale provides minor to negligible vertical effects.
Distance	1	Turbine 1 is the closest turbine at a distance of 13.72km
Visual Effect	4	
Coefficient	0.2	
Degree of Visual Change	11%	11x0.2= Landscape visual effect 2.2/20= Degree of visual change

<u>Description of visual impact</u>

The visual effect to the north is limited due to the local screening provided by ridgelines in the locality. The wind turbines are glimpsed as a series of minor visual elements on the ridge line that is formed by the underlying topography of the region.

Visual effects result from the appearance of the blades rotating behind the ridge line. This creates a limited but dynamic visual effect in the landscape. The majority of the turbines, turbine towers, hubs and nacelles will be screened by the local ridgeline, which creates a defined visual enclosure around the proposed wind farm.

The orientation of Von Rieben Road means that the visibility increases when travelling south and the Optimised Project is directly aligned with the road corridor. However, this visibility and visual effect remains limited, with only a few blades visible above the ridge line.

The potential for a slight visual effect is likely to be experienced from locations to the east of the proposed development. The visual effect is created by the flicking visibility of the wind turbine blades as they appear above and disappear behind the ridgeline. It is anticipated that with varying climatic conditions, the degree of visibility will be further reduced, and from other locations to the east of the development, the wind farm may be completely screened.

5.7 Viewpoint 6: Tablelands Road, south of Mount Rufus

Viewpoint Context

Viewpoint 6 is located on Tablelands Road, south of Mt Rufus, and represents the potential visual effect that will be experienced from locations to the eastern edge of the wind farm development site. The viewpoint is located on one of the many locally elevated hills that form the transitional landscape character between the central tablelands and the Mt. Rufus ridgeline.

The locality of the viewpoint represents the landscape amenity that is provided by the undulating rural landscape and the combination of extensive vegetation belts, isolated trees, open arable land, isolated farm dwellings and panoramic views to distant ridgelines. Further to the south are several heritage properties that provide a degree of cultural significance to the landscape character and locality of the area. While the landscape represents a modified agricultural land use, the combination and arrangement of landscape and built form elements provides a degree of visual amenity and scenic value.

The elevation and isolated tree cover of the agricultural landscape results in panoramic views to the southwest and, to a lesser extent, the north. Views to the east are contained by local ridgelines associated with Mt Rufus and the southern extent of the ridgelines that continue towards the Barossa Valley. The rolling landscape contains belts of vegetation that increase in frequency and prominence towards the edge of the Barossa Valley and further to the south. Further to the east are the distant ranges and topographic forms such as Bald Hill, which define the horizon line and visual envelope of the locality.

Figure 31: Viewpoint 6; Tablelands Road, south of Mount Rufus

Figure 32: Digital Overlay showing all Turbines: Viewpoint 6

Figure 33: Absorption Capacity Calculations: Viewpoint 6

Viewpoint Assessment

Table 7: Detailed Visual Assessment for Viewpoint 6

Assessment	Value	Description
Relief	2	From this viewpoint, the landscape is perceived to have limited foreground mid-ground and background.
Vegetation Coverage	2	Limited sporadic trees in linear bands associated with cadastral boundaries and fence lines
Infrastructure and Built Form	4	Scattered farm dwellings are evident in the foreground to mid-ground
Cultural and Landscape Value	2	Views from this locality provide reference to typical intermittent views along the Mt Rufus ridgeline, which has the Lavender Trail traversing through the landscape.
Baseline Landscape	10	
Landscape Absorption	5	The western edge of the Mt Rufus ridgeline provides limited/minor absorption screening of 15% due to the tableland landscape character being relatively devoid of undulations.
Horizontal	4	The horizontal visual effect is created between turbines 42 and 2, which equates to 79 degrees or 66% of the horizontal field of view.
Vertical	5	The vertical visual effect is created by turbine 23, which has the greatest elevation from this perspective. The existing landscape topographic variation is recorded as 13m at a distance of 1023m. The variance in elevation created by turbine 23 is 171m at a distance of 3133m. Hence, the turbines create a proportional increase in vertical scale more significant than 100%.

Distance	4	Turbine 23 is the closest turbine at a distance of 3.14km
Visual Effect	18	
Coefficient	0.9	
Degree of Visual Change	45%	10x0.9= Landscape visual effect 9/20= Degree of visual change

Description of potential visual impact

The proposed development is located within a defined locality, which is represented by local ridgelines to the north, the edge of the tablelands to the east, local ridge lines, the rolling landscape to the south, and the rising foothills around Mount Rufus.

This contained locality is dominated by the scale of the proposed wind farm development. Within the locality, there are no landscape elements, topography, or land use that offset the vertical scale of the wind turbines. This increases the visibility and potential visual effects.

The visual effect from Viewpoint 6 is substantial. The extent and spread of the turbines within the landscape will create a panoramic visual effect. The wind turbine array extends north and south across the rural landscape.

The wind turbines are set across the midground, and the locality defines the broader landscape of the plateau and central tablelands. The arrangement of the wind turbines provides a uniform array of individual infrastructure elements.

However, the lower lying location of several turbines to the west increases the visual complexity as turbine heights vary across the horizontal visual effect.

While limited, the degree of overlap and visual complexity is still evident. The height of the wind turbines is significant within the locality of the viewpoint, and there is little opportunity for mitigation from the existing topography or vegetation.

The wind turbines will likely appear as imposed infrastructure elements on the landscape and set against the more distant ridge line of the Southern Mount lofty ranges. Consequently, the backdrop and distant visual character of the locality are interrupted by the infrastructure elements.

The wind turbines are significantly larger than any of the belts of vegetation or isolated trees that surround the viewpoint. The height of the wind turbines extends across the horizon line and the backdrop of the regional landscape.

There is a distinct separation between the mid-ground locality in which the turbines are situated and the distant background formed by the ridge lines that defines the visual envelope of the regional locality.

5.8 Viewpoint 7:Sturt Highway, east of Truro

Viewpoint Context

Viewpoint 7 is located 5 kilometres outside Truro along the Sturt Highway. The viewpoint represents the anticipated visual effect that will be experienced to the southeast of the wind farm. The Sturt Highway provides an entrance gateway into the township of Truro.

Vehicles travelling along this highway can travel up to 100 kilometres per hour. The existing landscape character of the viewpoint is typical of the local area, with rolling undulating landforms predominantly grazed, defining the land use character.

The landscape is punctuated by isolated trees that produce notable visual landscape markers. There is little screening within the wider landscape.

The topography of Mount Rufus and the extension of the north-south ridgeline form the dominant landscape feature, which defines the horizon line and contains the field of view.

Figure 34: Viewpoint 7; Sturt Highway, east of Truro

Figure 35: Digital Overlay showing all Turbines: Viewpoint 7

Figure 36: Absorption Capacity Calculations: Viewpoint 7

Viewpoint Assessment

Table 8: Detailed Visual Assessment for Viewpoint 7

Assessment	Value	Description
Relief	3	Limited foreground complexity in variation with moderate mid-ground to background
Vegetation Coverage	2	Limited sporadic copse or isolated planting of mature trees retained in paddocks
Infrastructure and Built Form	4	Sturt Highway is present in the foreground but has a limited impact on the perspective view. Distant transmission line evident
Cultural and Landscape Value	3	Sturt Highway corridor and outskirts or Truro. Hence, the frequency of views would be greatest along this corridor as a transient experience of the regional landscape.
Baseline Landscape	12	
Landscape Absorption	1	The southwestern ridgelines associated with Mt Rufus provide substantial absorption screening of 84%
Horizontal	2	The horizontal visual effect is created between turbines 42 and 2, which equates to 25 degrees or 21% of the horizontal field of view.
Vertical	1	The vertical visual effect of the turbines is proportionate to the landscape scale; hence, the tip of the blades are not seen to increase the scale. The scale provides negligible vertical effect.
Distance	1	Turbine 38 is the closest turbine at a distance of 12.86km
Visual Effect	5	
Coefficient	0.25	
Degree of Visual Change	15%	12x0.25= Landscape visual effect 3/20= Degree of visual change

Description of potential visual impact

The turbines are seen as a distant cluster of elements located just below a series of ridgelines that define the complex topography of the local area. The undulating ridgelines modify the degree of visibility with the nacelle and blades on a number of wind turbines being visible, particularly the turbines along the eastern edge of the Optimised Project.

The Mount Rufus ridge is visible as a prominent landscape element from the viewpoint. The topographic significance and visual character of this element are retained. The presence of existing remnant vegetation on the ridgeline and scattered trees provides an additional screening that will reduce the visual effect.

Due to the compact nature of the layout, distance from the viewpoint, as well as the interrelationship of the undulating ridgelines and local topography, result in a limited visual effect that is characterised by glimpsed views of wind turbine blades and a limited number of nacelles.

Potential visual impacts on the surrounding landscape and Barossa Valley to the east remain limited due to the contained visual character that is formed by the local topography and isolated vegetation groups.

5.9 Optimised Project Summary of Visual Impacts

The visual assessment of the seven viewpoints demonstrates that various visual impacts will be experienced within the local, sub-regional and regional landscapes surrounding the Optimised Project. Typically, the visual effect associated with the proposed wind farm will occur within a modified agricultural landscape that is contained by defined topographic and landscape features to the north, south, east and west. The resulting landscape character creates a defined locality in which various visual effects are likely to be experienced.

The two tables below illustrate the degree of visual change recorded at each of the viewpoints and a description of the potential visual impacts associated with the degree of visual change. Of note are the key factors that will affect the visual impact which occurs at each viewpoint and in the wider landscape. They include:

- Existing landscape character value and the presence or absence of topographic screening or significant vegetation
- The degree of landscape absorption provided by the existing landscape character
- Panoramic and scenic qualities of the landscape
- Horizontal and vertical visual effects produced by the proposed wind farm

As shown in Table 2, there is a notable variation in the measured visual impacts, ranging from slight to the northeast and southeast, moderate to the north and south and substantial to the east and west.

The existing landscape character remains consistent with a measure value range of 10 to 12. This reflects the uniformity of the existing rural landscape character of the area in relation to land use, topography and vegetation cover. More significant is the screening and mitigation provided by the local topography and vegetation in relation to the degree of visual change throughout the locality that surrounds the Optimised Project.

Viewpoints	Relief	Vegetation Coverage	Infrastructure	Cultural/Landscape Value	Landscape Character	Landscape Absorption	Horizontal	Vertical	Distance	Visual Assessment	Degree of Visual Change
Viewpoint 1	2	3	4	3	12	3	1	4	2	10	30%
Viewpoint 2	3	2	4	3	12	4	2	5	2	13	39%
Viewpoint 3	3	3	4	2	12	5	2	5	3	15	45%
Viewpoint 4	3	1	5	2	11	3	1	5	1	10	28%
Viewpoint 5	3	2	4	2	11	1	1	1	1	4	11%
Viewpoint 6	2	2	4	2	10	5	4	5	4	18	45%
Viewpoint 7	3	2	4	3	12	1	2	1	1	5	15%

Table 9: Summary of Visual Impacts Optimised Project

The following table is a summary of the classifications described in the GrimKe matrix, which provides additional information on the potential visual impact used to describe each viewpoint.

Percentage of Visual Change	Descriptive of Visual Impact	Descriptors – appearance in the central vision field	Comments
80-100%	**Extreme**	Commanding, controlling the view	Extreme change in view: change very prominent involving total obstruction of existing view or change in character and composition of the landscape and view through loss of key elements or addition of new or uncharacteristic elements which significantly alter underlying landscape visual character and amenity. The sensitivity of the underlying landscape character to change is unable to accommodate or mitigate the introduction of development, and the visual effect is highly adverse.
60-80%	**Severe**	Standing out, striking, sharp, unmistakable, easily seen	Severe change in view involving the obstruction of existing views or alteration to underlying landscape visual character through the introduction of new elements. Change may be different in scale and character from the surroundings and the wider setting or a severe change in the context of the existing landscape character. Resulting in a perceived adverse visual effect and an increase in proportional change to the underlying landscape visual character.
40-60%	**Substantial**	Noticeable, distinct, catching the eye or attention, clearly visible, well defined	Substantial change in view: which may involve partial obstruction of existing view or alteration of underlying landscape visual character and composition through the introduction of new elements. Composition of the view will alter however the sensitivity of the underlying landscape character to change low, and it provides opportunities for mitigation, management and absorptions of the visual effect. View character may be partially changed through the introduction of features.
20-40%	**Moderate**	Visible, evident, obvious	Moderate change in view: change will be distinguishable from the surroundings while composition, and underlying landscape visual character will be retained. The sensitivity of the existing landscape to change is low.

Percentage of Visual Change	Descriptive of Visual Impact	Descriptors – appearance in the central vision field	Comments
0-20%	**Slight**	Lacking sharpness of definition, not obvious, indistinct, not clear, obscure, blurred, indefinite	Very slight change in view: change barely distinguishable from the surroundings. Composition and character of view substantially unaltered.

Table 10: Classification of Visual Impacts

The landscape assessment and ZTVI highlight the enclosed visual character of the locality. The ridgelines associated with the Nain Ranges, Greenock Ranges and Light Ranges and the northern extent of the Barossa Ranges form a defined visual envelope to the southwest and west, which extends northwest and combines with the topography of the Tothill Ranges to create a defined visual envelope around the proposed wind farm.

To the east and extending north, the ridge associated with Mount Rufus and Bald Hill visually encloses the locality, and to the south, local landforms and extensive belts of vegetation associated with the northern edge of the Barossa Valley provide extensive visual screening. Within this visually contained existing landscape character, the layout of the Optimised Project forms a single cluster of 42 wind turbines.

The landscape and visual impact assessment, with reference to ZTVI mapping, demonstrates that the degree of visibility will be experienced within a contained viewshed. The layout of the proposed wind turbines is likely to result in a single cluster of large infrastructure elements that form a concentrated visual effect in the rural landscape.

Travelling through the landscape, the underlying topography of the surrounding ranges modifies views towards the proposed wind farm. The visibility of the proposed development changes due to the screening effects provided by the adjacent hills and ridgelines or areas of existing vegetation.

The visual assessment undertaken from the seven selected viewpoints demonstrates that a variety of visual impacts will be experienced within the local (0-3km), sub-regional (3-10km) and regional (>10km) landscapes that surround the proposed wind farm site. To the north and south and from a distance of greater than five kilometres, the visual effect associated with the proposed development will result in wind turbines being seen behind local ridgelines and landforms. In these locations, the potential visual effect is likely to result from sections of the hub and blades visible above the local topography and vegetation.

The potential visual effect reduces over distance, with the visual assessment recording the visual effect as slight at a distance of more than ten kilometres, particularly to the northeast. This reflects the different landscape characters around the proposed development site and the significant landscape absorption and screening created by ridgelines and vegetation in the locality.

To the south, the distance between the proposed wind farm and the Barossa Valley significantly mitigates the visual effect and removes the potential visual impact that the Optimised Project may have on the Barossa Valley Character Preservation Zone and the associated areas of higher landscape amenity and cultural value.

Viewed from the east and west, the proposed wind turbines are likely to be visible and situated on the elevated topography of the Central Tablelands. The scale of the proposed development in relation to the topography and landform of the underlying landscape character is prominent due to the number of wind turbines and the height of the towers and blades in the landscape.

Within five kilometres of the proposed wind farm, the screening provided by local ridgelines and vegetation belts is limited, and the majority of the wind turbines are experienced as visually prominent elements in the rural landscape, producing a degree of visual change of 45%, which is described as substantial. This substantial visual effect alters the underlying visual character within these defined local areas and composition of the landscape through the introduction of new elements. Views will be altered, but the sensitivity of the underlying landscape character to change is considered low.

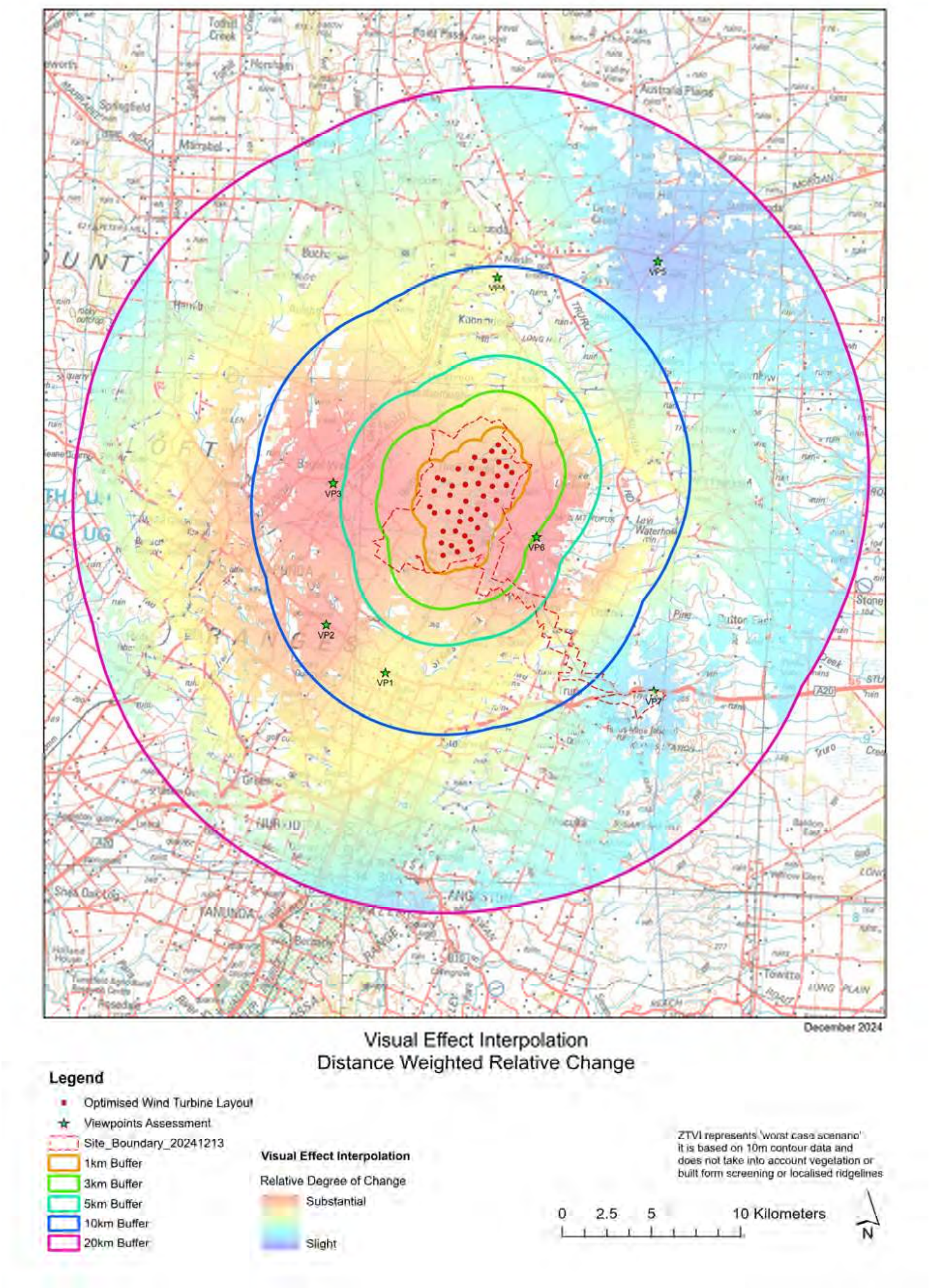

Figure 37: Optimised Project summary of viewpoint visual effect

From sub-regional locations, the topography and landscape character of the locality produce numerous visual screens that fragment or remove the visual effects of the proposed wind turbines. The landscape screening, increased visual absorption, and greater distance between the viewpoint and the wind turbines reduce the visual effect, resulting in a degree of visual change that ranges from 28% to 39% and is described as moderate.

The resulting visual change will be distinguishable from the surroundings, while the composition and underlying visual character of the landscape will remain.

Beyond ten kilometres, the degree of visual change reduces significantly, and the topography and vegetation of the locality provide increased levels of screening. From regional locations, the degree of change is reduced to a range of 11% to 15%, particularly to the northeast and southwest and is described as slight.

Although the Visual Effect Interpolation map shows moderate and substantial visual effects on the edges of the townships of Nuriootpa and Kapunda, the local topography, built form and vegetation around the towns provide significant screening. Within the surrounding towns of Nuriootpa, Kapunda, Eudunda and Truro, there are restricted views towards the proposed development. This is due to several factors, including the location of the towns in valleys or on hillsides facing away from the subject land, the local topography, and stands of vegetation which screen the proposed development, resulting in limited or no visual effect.

5.11 Substations and Transmission line Visual Effect Assessment

In addition to the visual effect of the wind turbines, an assessment was undertaken to understand the anticipated visual effect of the proposed substations and transmission line. This included supplementary illustrative imagery of viewpoints 6 and 7 and the production of an additional viewpoint 9 that shows the proposed terminal substation. The production of these images made a number of assumptions in regards to the final design of the infrastructure elements, including:

- The proposed transmission poles are constructed from steel or spun concrete monopoles up to 35 metres high and spaced approximately 275 – 375 metres apart (exact locations of poles to be confirmed during detailed design)
- The terminal substation is based on elevations provided and
- The finished floor level (FFL) of the substation is based on a midpoint of the surrounding topography (this may be more or less based on the final design development).

Furthermore, the photomontages for Viewpoints 6, 7 and 9 are modelled using 10m contour terrain data. This limitation in data may result in the exclusion of some local landforms or topographical changes less than 10m, which could otherwise further enhance localised screening. Variances in the topographic scale of >10 metres could proportionally provide substantial landscape absorption, of the proposed substation and transmission.

For these reasons, the infrastructure elements of the development and the potential visual effect are assessed in this section and are not incorporated into sections 5.1 to 5.9.

5.12 Site Substation, Control Buildings and Operational Maintenance Compound

The proposed wind farm will require one on-site substation, including switching yards, associated electrical infrastructure, control buildings, battery storage, staff facilities and a car park.

The substation/switching yard will be located on the southeastern edge of the site near wind turbine T29. The substation has been located to provide a short distance to the grid connection, thus reducing the extent of landscape impacted by ancillary infrastructure components. This will, however, increase the proportional visual effects surrounding Viewpoint 6 as the transmission line will extend the infrastructure from south to southwest.

The site compound and substation will be partially visible from Viewpoint 6. The scale of the on-site substation will be considerably less conspicuous than the turbines as it is proposed to be positioned in a lower-lying area adjacent to T29 at an approximate distance of 2.7 kilometres from Viewpoint 6, with local landforms screening most of the development.

The substation/switching yard compound will comprise the following;

- One permanent 175kV grid connection
- One control building
- Operations and maintenance building and compound with associated car parking
- Concrete batching plant within the compound (during construction)
- Battery energy storage facility
- Construction compound and material lay down area (during construction)

The substation will be located 2.5 kilometres west of Tablelands Road and will be accessed from Mosey Road. From Tablelands Road and other local tracks, the substation will create a visual contrast to the rural character of the landscape, reinforcing the perceived land use changes that will occur with the introduction of the proposed wind farm.

The vertical scale of the substation gantry (approximately 20m) is likely to produce a higher degree of visibility within the locality of the substation. The change in elevation between Viewpoint 6 and the substation location is 60m, which, in terms of the scale of the proposed gantry (20m), will limit the degree of visual effect. In addition, the gantry and towers are proposed to be lattice structures, partially reducing the visual mass and form.

While the visual effect of the substation in relation to the overall effect of the wind farm is limited, from local viewpoints around Tablelands Road, the degree of visual change within the rural landscape will slightly increase, and the substation will be a noticeable development form.

To mitigate the potential visual effect of the onsite substation and operational maintenance compound, it is proposed that landscape treatments be provided where possible to the perimeter of the substation compound. The landscape treatment would be a combination of local provenance screening tree groups and shrubs suitable for the conditions in which the infrastructure associated with the wind development is located.

Any screening will need to be undertaken in line with electrical code best practice. Planting should be grouped rather than linear to reflect the vegetation patterns in the area.

Tree species could include Allocasuarina verticillata, Pittosporum angustifolium, Melaleuca lanceolata, and Santalum acuminatum or others to be determined. These trees will provide elevated canopies of 6 to 10m, which would be proportionate to the ancillary infrastructure depending on the distance of view and proximity of planting. The shrub species could include Acacia paradoxa, Acacia euthycarpa, Cassinia uncata, or others to be determined. Planted in a double row at 0.5 to 1m centres of the shrubs would create a 2 to 3m screen to the boundary of the substation, providing screening to the local area.

From more distant views of the lattice tower, the gantry will become recessive, limiting the visual presence and effect of the onsite substation infrastructure. While the lattice construction of the gantry will not remove the visual effect completely, this visually permeable form of construction will mitigate, to a certain degree, the potential visual impact of the infrastructure associated with the substation.

5.13 Transmission Line and Substation Connection to Existing 275kv

As part of the infrastructure provision of the Optimised Project, an overhead transmission line is proposed to link the onsite substation with the existing ElectraNet transmission corridor. The proposed 275kV transmission line is aligned to traverse the southwest tablelands towards the Murray Plains landscape character zone. The alignment is to the south of the Mount Rufus character area and northeast of the Barossa zone. Visual effects are mitigated from key culturally sensitive areas and townships of Nuriootpa and Truro.

The landscape assessment undertaken in Section 5 indicates that the existing landscape character is formed by several distinct landscape and topographic areas. These landscape character areas will produce various visual contexts in which the transmission line is proposed to be located.

The infrastructure corridor will travel southeast of the site for approximately 15.5 kilometres. The proposed transmission line is anticipated to be supported by spun concrete poles up to 35 metres high and spaced approximately 275 – 375 metres apart; this will produce a fragmented visual effect across the existing rural landscape.

It is only from locations adjacent to the proposed transmission line and over relatively short distances (less than 300 to 400m) that the visual effect increases. While the poles produce individual visual effects, the uniformity and repetitive pattern of the entire development ensures that the transmission line is seen within the context of the wider agricultural landscape. As a result, the proposed transmission will be seen as 'another piece' of infrastructure, no more significant than the existing stobie poles and existing transmission infrastructure within the landscape.

The terminal substation connecting the transmission line to the existing 275kv line is proposed to be located adjacent to the Sturt Highway, approximately 15 kilometres southeast of the proposed wind farm development and approximately 6 kilometres east of Truro. This piece of infrastructure will comprise a benched level pad, lattice towers, gantries and electrical wiring, all contained within a site compound surrounded by palisade fencing.

Further detailed design will be required to appreciate how this compound will be positioned on the landscape and the potential cut and fill to create a benched level pad for construction, drainage and maintenance access within the site. Figure 38 illustrates the substation locations and transmission line alignment.

It is anticipated that there is likely to be a degree of visual impact resulting from the development of the Optimised Project and the alignment of the proposed transmission line around St Kitts. While not directly impacting the locality of the heritage buildings, there is a likelihood of a successive visual effect on views to the east created by the proposed wind turbines and transmission line.

The proposed wind farm is likely to be seen as a series of blades and nacelles positioned low on the surrounding visual envelope to the east. While the transmission line will form notable visual elements to the locality of St Kitts and the associated heritage buildings and ruins. The spacing of the poles will require some detailed design analysis to investigate key sight lines and visual management opportunities.

Further information in relation to specific impacts on the heritage buildings and overlays is discussed in the Heritage Impact Assessment (HIA) prepared by DASH Architects.

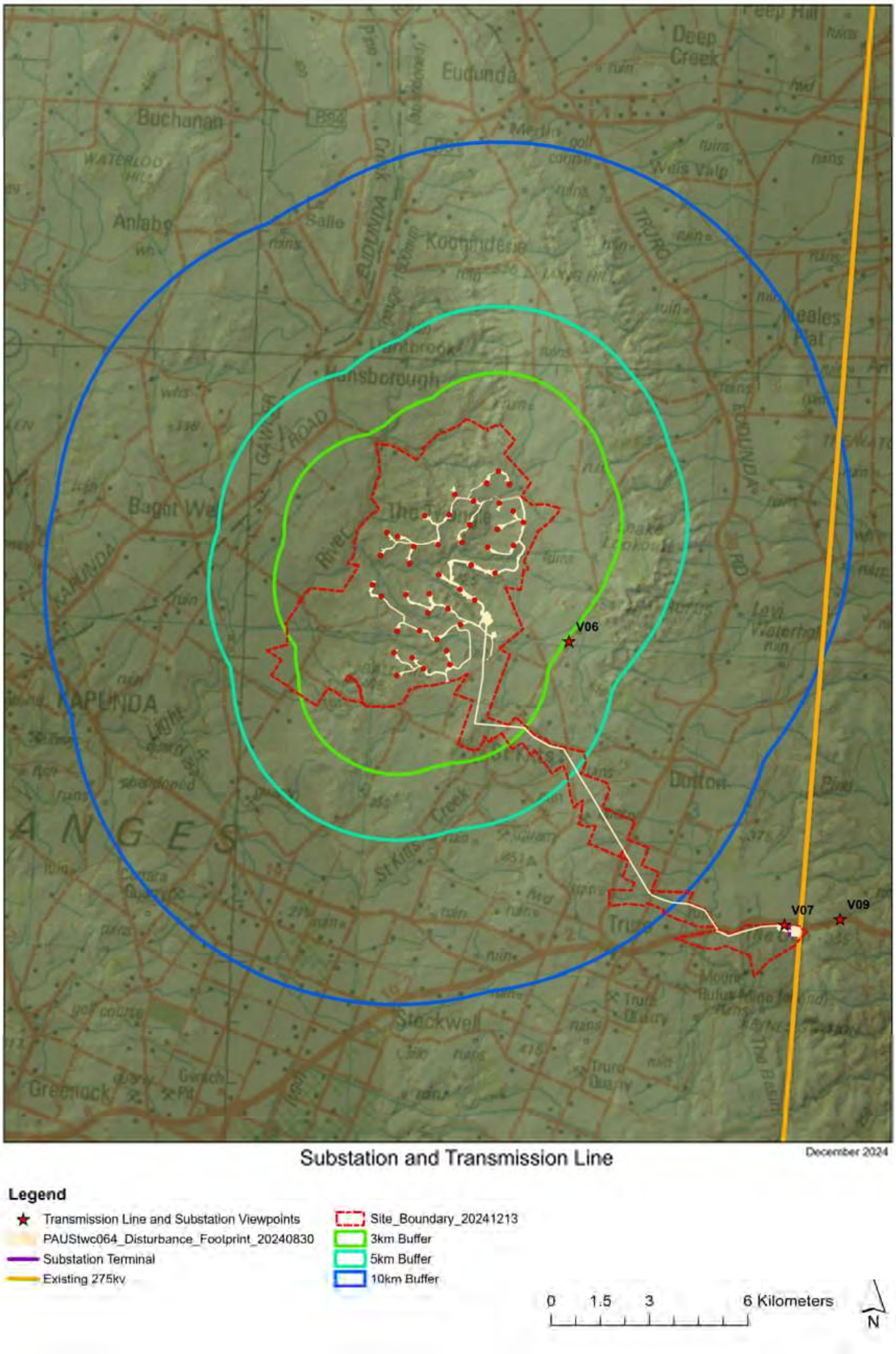

Figure 38: Substations and Transmission Line

5.14 Probable Visual Effect Discussion for Substations and Transmission

The following discussion provides a reference to the likely visual effects created by the substations and transmission lines relating to the assessed viewpoints that are likely to experience visual change. In addition, Viewpoint 9 has been developed and assessed to illustrate the potential visual effect surrounding this locality of the proposed development.

Viewpoint 6: Tablelands Road, south of Mount Rufus

Partial views of the onsite substation and the transmission line east of the turbine cluster are likely to be experienced from this viewpoint. The location of the substation relative to the local topography provides a degree of screening, with small sections of the infrastructure likely to be visible from this viewpoint. The transmission line, due to its monopole design, relative scale and positioning within the landscape and topography, creates a fragmented visual effect within the landscape.

The assessed visual impacts will only slightly increase due to the presence of the substation and transmission line.

Figure 39: Viewpoint 6; Tablelands Road, south of Mount Rufus

Figure 40: Viewpoint 6 Photomontage

Figure 41: Digital Overlay showing all Infrastructure and Turbines: Viewpoint 6

Viewpoint 7: Sturt Highway, east of Truro

Viewpoint 7 will experience an increased visual effect. The 275kV transmission line will create an infrastructure corridor connecting the wind farm to the existing ElectraNet transmission line. The transmission line will be seen within the Sturt Highway corridor on the southern side of the road within proximity to the viewpoint.

The proposed transmission line is anticipated to be supported by spun concrete monopoles up to 35m high, which will produce a fragmented visual effect across the existing rural landscape. The scale of the poles will be relatively large in the foreground; however, they will be dispersed, which limits the degree of visual mass. A local ridge to the northwest of the view will screen a proportion of the transmission line as it crosses the road corridor.

The transmission line is likely to create an increased visual effect from viewpoint 7 due to the adjacency of this viewpoint to the proposed transmission corridor. It is only from locations adjacent to the proposed transmission line and over relatively short distances (less than 300 to 400m) that the visual effect increases. In other locations along this road corridor and within the locality, the visual effect is decreased due to distance and the presence of the existing transmission corridor, which is of a similar or greater scale.

Figure 42: Viewpoint 7; Sturt Highway, east of Truro

Figure 43: Viewpoint 7 Photomontage

Figure 44: Digital Overlay showing all Infrastructure and Turbines: Viewpoint 7

Viewpoint 9: Sturt Highway, east of Terminal Substation

Viewpoint 9 is located east of the terminal substation along the Sturt Highway. Due to its proximity to Viewpoint 7, the viewpoint landscape character can be described similarly (refer to section 5.8). From Viewpoint 9, the proposed wind farm will be slightly visible due to the local ridgelines.

The intersection of the 275kV transmission line to the 275kV ElectraNet corridor is located south of the Sturt Highway. When viewed from close proximity, the terminal substation will be a dominant visual element in the locality. There is likely to be an increase in the concentration of infrastructure elements experienced within the landscape due to its connection to two transmission lines.

The visual effect of the terminal substation is increased due to its close proximity to the Sturt Highway. However, due to the road alignment, which curves both before and after this location, local ridges and stands of vegetation along the road corridor, the substation will only be visible when travelling along a limited section of the Highway.

To mitigate the potential visual effect of the substation along the road corridor, landscape treatments could be provided where possible to the perimeter of the substation in line with the considerations described in section 5.12. Any screening will need to be undertaken in line with electrical code best practices to avoid potential supply disruption.

Further refining the benching level of the development during the detailed design phase could allow the development to sit lower in the landscape and increase the effectiveness of landscape screening treatments.

Figure 45: Viewpoint 9; Sturt Highway, east of Truro

Figure 46: Viewpoint 9 Photomontage

Figure 47: Digital Overlay showing all Infrastructure and Turbines: Viewpoint 9

Figure 48: Digital illustration showing established landscape screening: Viewpoint 9

5.15 Access tracks

As part of the proposed development, a series of compacted gravel tracks will be required to access the turbine locations off public access roads. On-site access tracks to have a minimum width of 5.5m with all disturbance during construction occurring within the disturbance footprint. Surrounding land adjacent to final access tracks will be restored, revegetated and/or returned to former grazing uses.

Wherever possible, the proposal will utilise existing access track and road connections. In addition, the form, materiality and colour of the new tracks will be in keeping with other tracks and roads in the area. While the proposed tracks will appear as new development, post-construction, they will not appear out of character within the wider rural landscape. The track surface will be crushed rock sourced either on site or from a local supplier. Over time, the track material is likely to weather and will be subject to revegetation to the track edges, which will further reduce the associated visual effect.

Finally, the visibility of the tracks needs to be assessed relative to the other development forms associated with the wind farm proposal. The proportional effect of the tracks will always be a secondary or partial visual element when considered against the degree of visual change produced by wind turbines. In this regard, the visual effect of the track is described as negligible and will progressively diminish over time.

5.16 Underground cable routes

The undergrounding of cable as part of the proposed development limits visual impact. Trenching will be typically between 0.25 and 0.55m wide by 1 m deep (minimum). All trenches will be backfilled to meet existing surface levels, limiting associated visual impacts, and should be considered in context with the access tracks and overall visual effect of the entire development. Cable trenches will predominantly be located immediately adjacent to access tracks, avoiding additional site and visual impacts associated with separate trenching.

The absence of significant vegetation areas of vegetation within the anticipated cable routes means that the potential vegetation clearance will be limited, and the resulting visual effect will be negligible.

06 Review of Planning Policy

6.1 Introduction

The Planning and Design Code (the Code) has been used to assess the suitability of the Optimised Project in relation to the anticipated effect on the landscape and visual character of the relevant Zones and Overlays and the General Provisions relating to Infrastructure and Renewable Energy Facilities and the potential management of the visual impacts.

6.2 Proposed Development

The proposed development is located within the Rural Zone of the Planning and Design Code (version 2023 .16 dated 9 November 2023). A number of Overlays apply to various allotments (sections) (but not all land parcels) within the project area, including:

Zone:	Rural
Overlays:	• Dwelling Excision • Heritage Adjacency • Hazards (Flooding - Evidence Required) Hazards (Bushfire – Regional) Hazards (Bushfire – General) Environment and Food Production Area • Key Outback and Rural Routes • Limited Land Division • Native Vegetation Murray-Darling Basin • State Heritage Place • Water Resources Resource Extraction Protection Area
Local Variations:	Minimum Site Area (Minimum site area is 200 ha) Minimum Dwelling Allotment Size (Minimum dwelling allotment size is 36 ha)

6.3 Planning Zone

Zone - Rural	
DO 1	A zone supporting the economic prosperity of South Australia primarily through the production, processing, storage and distribution of primary produce, forestry and the generation of energy from renewable sources.

Zone - Rural	
PO 1.1	The productive value of rural land for a range of primary production activities and associated value adding, processing, warehousing and distribution is supported, protected and maintained
DTS/DPF 1.1	Development comprises one or more of the following: (s) Renewable energy facility
PO 9.1	Renewable energy facilities and ancillary development minimise significant fragmentation or displacement of existing primary production.

Desired Outcome (DO) of the Rural Zone clearly envisages generation of energy from renewable sources, which would include wind farms. Renewable energy facilities and the associated infrastructure are an envisaged land use in DTS/DPF 1.1. PO 9.1 requires that renewable energy facilities and ancillary development minimise significant fragmentation or displacement of existing primary production. While the turbines represent large pieces of infrastructure, the wind farm has limited impact on the existing rural land use, and the footprint of each wind turbine and the associated infrastructure is relatively small when compared with the total site area.

The visual assessment (Section 5) highlights that the underlying landscape character that surrounds the Optimised Project is not affected by the development, and the environmental qualities associated with the rural landscape will remain.

6.4 Planning Overlays

The following provides a summary of the Desired Outcome(s) of the Overlays that may apply to some (or all) of the subject land. As discussed in the Development Assessment Report by MasterPlan, not all of these Overlays will be applicable to the assessment of the proposed development.

Dwelling Excision Overlay	**DO 1**	Creation of allotments to accommodate existing habitable dwellings in primary production areas is limited to avoid undermining primary production.
Hazards (Bushfire – General Risk) Overlay	**DO1**	Development, including land division responds to the general level of bushfire risk by siting and designing buildings in a manner that mitigates the threat and impact of bushfires on life and property taking into account the increased frequency and intensity of bushfires as a result of climate change.
	DO2	To facilitate access for emergency service vehicles to aid the protection of lives and assets from bushfire danger

Hazards (Bushfire – Regional) Overlay	**DO1**	Development, including land division responds to the relevant level of bushfire risk and is sited and designed to mitigate the threat and impact of bushfires on life and property taking into account the increased frequency and intensity of bushfires as a result of climate change.
	DO2	To facilitate access for emergency service vehicles to aid the protection of lives and assets from bushfire danger.
Hazards (Flooding – Evidence Required) Overlay	**DO 1**	Development adopts a precautionary approach to mitigate potential impacts on people, property, infrastructure and the environment from potential flood risk through the appropriate siting and design of development.
Heritage Adjacency Overlay	**DO 1**	Development adjacent to State and Local Heritage Places maintains the heritage and cultural values of those Places.
	PO 1.1	Development adjacent to a State or Local Heritage Place does not dominate, encroach on or unduly impact on the setting of the Place.
Key Outback and Rural Routes Overlay	**DO 1**	Safe and efficient movement of vehicle and freight traffic on Key Outback and Rural Routes.
Limited Land Division Overlay	**DO 1**	The long term use of land for primary production is maintained by minimising fragmentation through division of land.
Murray-Darling Basin Overlay	**DO 1**	Sustainable water use in the Murray-Darling Basin area.
Native Vegetation Overlay	**DO 1**	Areas of native vegetation are protected, retained and restored in order to sustain biodiversity, threatened species and vegetation communities, fauna habitat, ecosystem services, carbon storage and amenity values.
State Heritage Place Overlay	**DO 1**	Development maintains the heritage and cultural values of State Heritage Places through conservation, ongoing use and adaptive reuse consistent with Statements of Significance and other relevant documents prepared and published by the administrative unit of the Public Service that is responsible for assisting a Minister in the administration of the Heritage Places Act 1993.
	PO 1.1	The form of new buildings and structures maintains the heritage values of the State Heritage Place.
	PO 1.2	Massing, scale and siting of development maintains the heritage values of the State Heritage Place.

	PO 1.6	New buildings and structures are not placed or erected between the primary and secondary street boundaries and the façade of a State Heritage Place.
Local Heritage Place Overlay	**DO1**	Development maintains the heritage and cultural values of Local Heritage Places through conservation, ongoing use and adaptive reuse.
Water Resources Overlay	**DO 1**	Protection of the quality of surface waters considering adverse water quality impacts associated with projected reductions in rainfall and warmer air temperatures as a result of climate change.
Environment and Food Production Area Overlay	**DO1**	Protection of valuable rural, landscape, environmental and food production areas from urban encroachment.
Resource Extraction Protection Area Overlay	**DO1**	Protection of current and future state significant resource extraction activities by ensuring development has regard to potential environmental and amenity impacts generated by the lawful operation of proximate mines and quarries.

The Code identified several Overlays that required consideration in relation to the Optimised Project particularly the Heritage Adjacency Overlay.

The subject land does not contain any places of State significance as recorded on the South Australian Heritage Register. There are several local heritage places located on properties within the locality of the site of the development and within the St Kitts area, particularly adjacent the transmission line. Subsequently, the Heritage Adjacency Overlay of the Planning and Design Code is applicable to the assessment of the Project.

A Heritage Impact Assessment (HIA) has been prepared by DASH Architects, which considers each of the properties affected by the Heritage Adjacency Overlay. In summary, the HIA concludes that the transmission lines of the Project may be visible within some views from Local Heritage Places, such infrastructure will not dominate, encroach on or unduly impact on the setting of the heritage places, nor adversely impact on their heritage and cultural values. For these reasons the development is considered to be consistent with the relevant provisions of the Heritage Adjacency Overlay of the Planning and Design Code.

6.5 General Provisions – Infrastructure and Renewable Energy Facilities

DO 1	Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.
PO 2.1	The visual impact of above-ground infrastructure networks and services (excluding high voltage transmission lines), renewable energy facilities (excluding wind farms), energy

	storage facilities and ancillary development is minimised from townships, scenic routes and public roads by: a) utilising features of the natural landscape to obscure views where practicable b) siting development below ridgelines where practicable c) avoiding visually sensitive and significant landscapes d) using materials and finishes with low-reflectivity and colours that complement the surroundings e) using existing vegetation to screen buildings f) incorporating landscaping or landscaped mounding around the perimeter of a site and between adjacent allotments accommodating or zoned to primarily accommodate sensitive receivers.
PO 2.2	Pumping stations, battery storage facilities, maintenance sheds and other ancillary structures incorporate vegetation buffers to reduce adverse visual impacts on adjacent land.
PO 2.3	Surfaces exposed by earthworks associated with the installation of storage facilities, pipework, penstock, substations and other ancillary plant are reinstated and revegetated to reduce adverse visual impacts on adjacent land.
PO 8.1	Visual impact of wind turbine generators on the amenity of residential and tourist development is reduced through appropriate separation.
DTS / DPF 8.1	Wind turbine generators are: (a) set back at least 2000m from the base of a turbine to any of the following zones: i. Rural Settlement Zone ii. Township Zone iii. Rural Living Zone iv. Rural Neighbourhood Zone (b) set back at least 1500m from the base of the turbine to non-associated (non-stakeholder) dwellings and tourist accommodation
PO 8.2	The visual impact of wind turbine generators on natural landscapes is managed by: (a) designing wind turbine generators to be uniform in colour, size and shape

	(b) coordinating blade rotation and direction (c) mounting wind turbine generators on tubular towers as opposed to lattice towers.

In relation to the potential visual effects of the proposed wind farm, DO 1, PO 2.1, PO 2.2, PO 2.3, PO 8.1, DTS / DPF 8.1 and PO 8.2 are considered relevant, and a discussion is provided to explain how the Optimised Project achieves the listed requirements of the General Provisions – Infrastructure and Renewable Energy Facilities.

While the wind farm will create a visual change in the existing landscape character of the locality, the proposed layout for the wind farm aims to minimise impact on landscapes that have greater scenic value or natural character. Typically, wind turbines are set back several hundred metres from these areas.

PO 8.1 and DTS / DPF 8.1 are achieved, and the visual impact of wind turbines on the amenity of residential and tourist development is reduced through appropriate separations. In relation to the required setback, a buffer distance of 2,700 metres is required from any land zoned for Township, Rural Settlement, Rural Living, or Rural Neighbourhood based on a maximum turbine height (base to tip of the blade) of 220 m. The siting of wind turbines as currently proposed meets DTS/DPF 8.1(a).

Based on metadata associated with shapefiles provided by RES, dwellings within the 1500 m buffer are understood to be associated with the Optimised Project, thereby meeting DTS/DPF 8.1(b).

PO 8.2 is achieved as the operational rotation, design and material finish of individual turbines will be consistent to ensure that all wind turbines express a degree of uniformity in terms of colour, size, shape and movement. In addition, the wind turbines will consist of tubular towers, which is sought by DTS/DPF 8.1(c).

In relation to spacing, the turbines are located approximately 600 to 800 metres apart. The spacing, while not regular, is consistent. The resulting positional consistency of the wind turbines responds to the undulating topography and local ridgelines that run across the site and results in a layout which responds directly to the underlying landforms.

RES will undertake the landscaping of substations, maintenance sheds and, where appropriate, other ancillary structures to mitigate the potential visual effect and satisfy PO 2.2. RES will also undertake remediation works to surfaces exposed by earthworks associated with the installation of storage facilities, access tracks, substations and other ancillary plants and revegetate to reduce adverse visual impacts on adjacent land to satisfy PO 2.3.

07 State Wide Landscape Scenic Quality Values

7.1 Review of State Wide Landscape Scenic Quality Values

To present a wider understanding of the landscape value associated with the existing landscape and the impact of the proposed development, a review has been undertaken of a research study conducted by Dr Andrew Lothian in relation to landscape character, landscape value and the potential visual change created by wind farms.

7.2 State Wide Landscape Scenic Quality Values

Referring to Lothian (2000)[6], the biophysical landscape character of the Southern Flinders Ranges, Mid North Plains and surrounding region has been classified as agricultural plains, low ranges/ hills and main ranges, Figure 49.

The assessment process conducted by Lothian (2000) measured public scenic beauty perception values of South Australian Landscapes. Scenes were rated out of 10.

The mean ratings for scenes within the Southern Agricultural Province were;

- Main High Ranges 6
- Agricultural Hills and low ranges 5
- Plain (Coastal) 4

In addition, scenes were assessed with regard to land use and physical characteristics such as vegetation type and coverage, topographic variance, and the presence of water. Crops and pastures occupy the majority of the southern agricultural province. The mean of these scenes was 4.36. To be more specific, scenes of crops and pastures with ridgelines had a mean of 4.53, whereas flat terrain recorded a mean of 3.97, and coastal areas had a median range of 6-6.99.

The agricultural landscape of the Northern Mount Lofty Ranges received a moderate ranking in terms of scenic quality. Figure 50 illustrates the landscape quality variance of South Australia and the proposed location of the Twin Creek Wind Farm and represents landscape quality values of 5 to 6.

A subsequent study was conducted by Lothian (2008)[7], the objective of which was to measure the scenic perceptions and visual effects of wind farms in the landscape. Using the South Australian landscape quality assessment as a baseline reference, the potential sensitivity of wind farms in particular geographic localities was interpolated in the study.

The findings of the 2008 study reported that scenes with a scenic quality of less than 5.1 would be improved by the presence of a wind farm. The trend correlation between existing landscape quality and visual sensitivity to wind farm developments is derived from an existing landscape quality rating of 5.1, at which point a lower-valued landscape will not be devalued by the presence of a wind farm. In fact, the development has the potential to add qualities such as scale, form and a dynamic visual element within a modified and often denuded landscape.

In the case of the Project, the existing landscape quality is extremely diverse, with areas of scenic value as well areas that are impacted significantly by industrial infrastructure. Consequently, the visual effect of the proposed wind farm may potentially be improved by the presence of a wind farm, while other locations may be impacted. As such, Lothian's findings are provided for information purposes only.

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6 *Lothian, A. (2000) Landscape Quality Assessment of South Australia. Department of Geographical & Environmental Studies. University of Adelaide. PhD*

7 *Lothian, A.(2008). Visual Impact Assessment of Wind Farms in South Australia. Geographical Research, 46/2, 196 - 207*

07 State Wide Landscape Scenic Quality Values

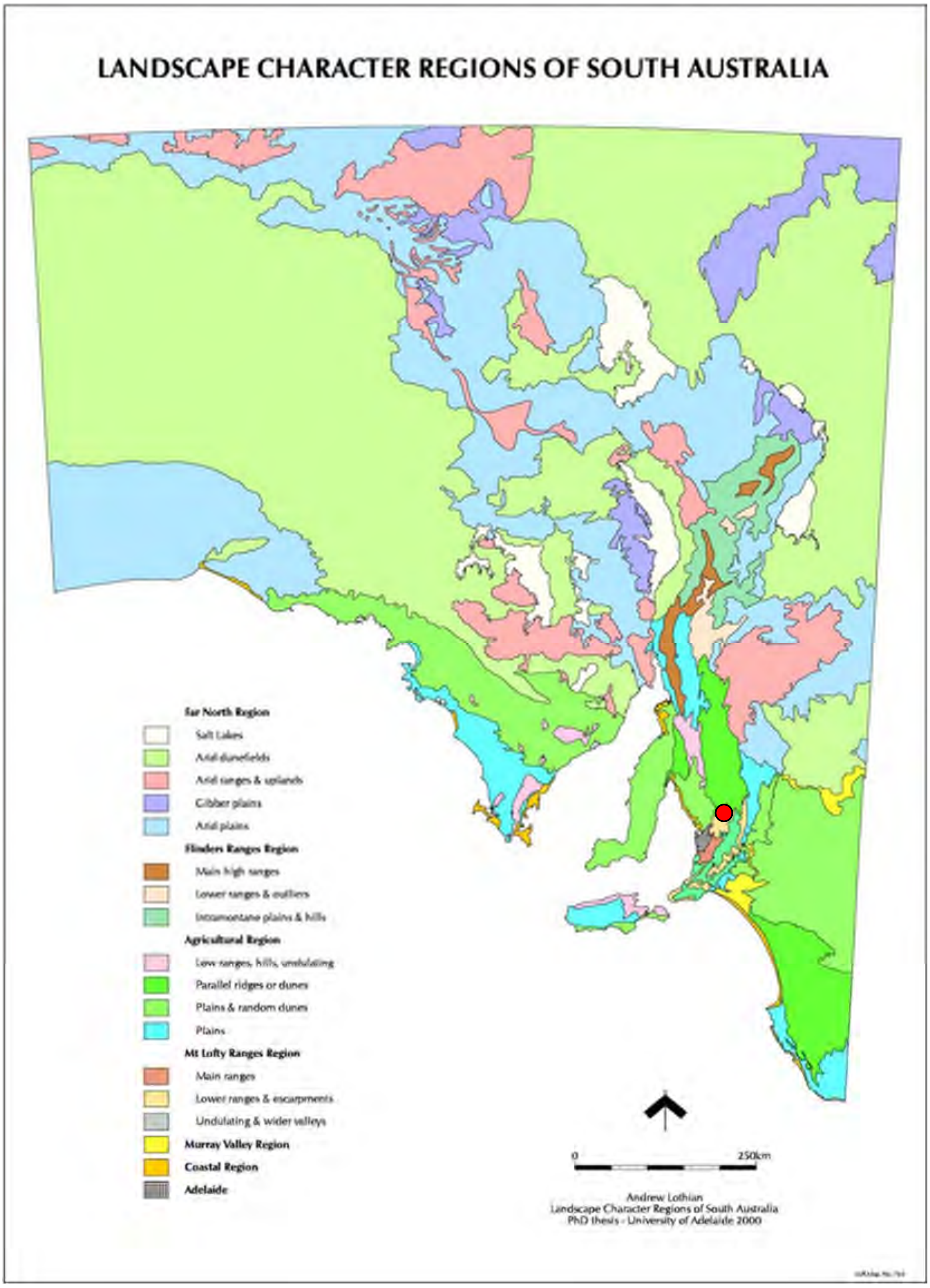

Figure 49: Landscape Character Regions of South Australia (Lothian, 2000 with red dot indicating wind farm location)

07 State Wide Landscape Scenic Quality Values

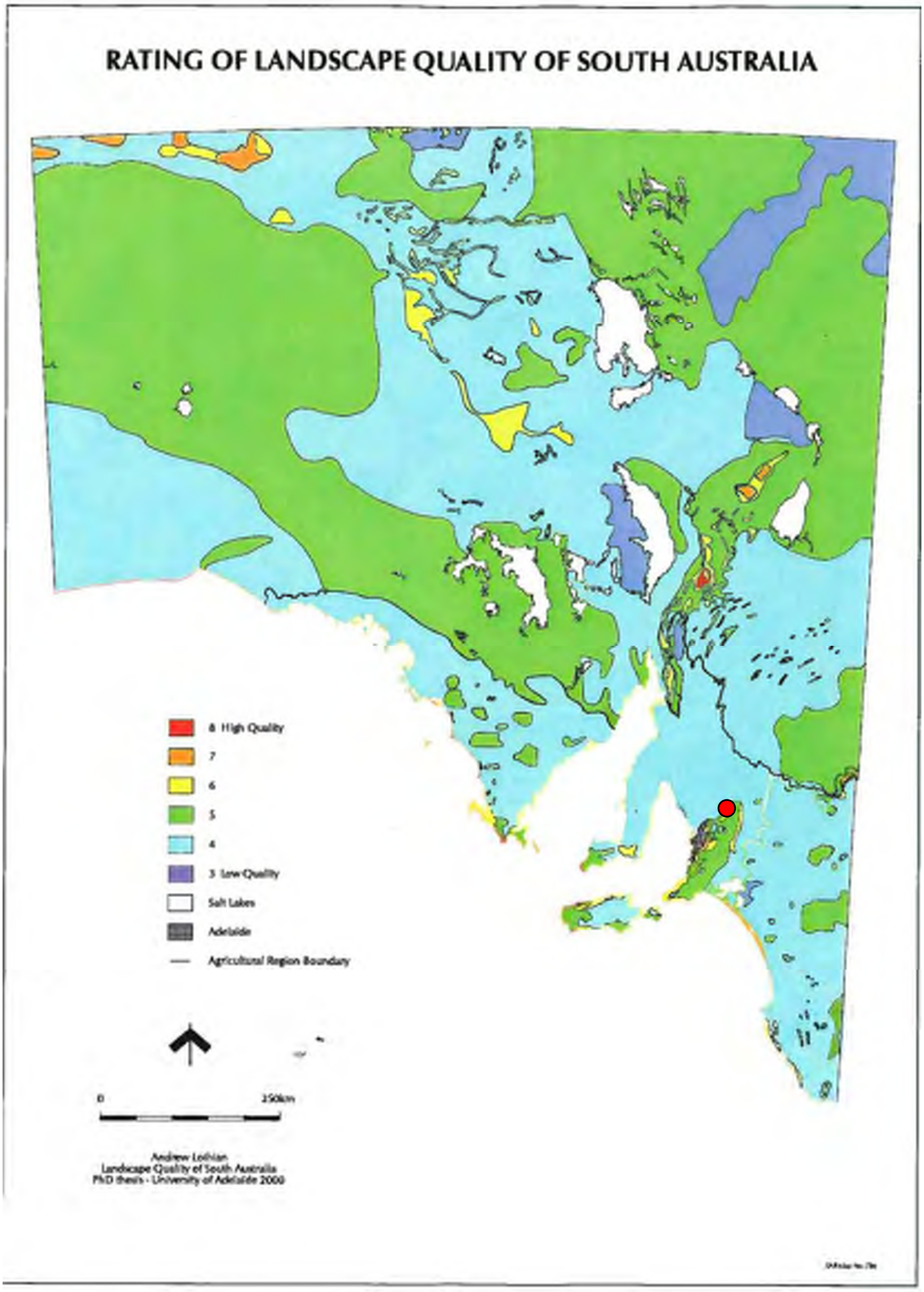

Figure 50: Landscape Quality of South Australia (Lothian, 2000 with red dot indicating wind farm location)

08 Cumulative Visual Effect

8.1 Description of Cumulative Visual Effect

Cumulative visual effects can be defined as the additional changes caused by a proposed development in conjunction with similar developments[8] in the landscape or site locality or as the combined effect of a set of developments taken together. The following assessment has considered the cumulative effects of other existing and potential development in the regional locality of the Twin Creek Wind Farm.

To understand the degree of cumulative visual effect, the following descriptions have been provided to depict the different types of cumulative visual effects.

Combined Visibility:
When a proposed wind farm is located within a visible distance of existing developments, the observer from a particular viewpoint may be able to see more than one form of development.

Succession:
When the observer has to turn to see the various developments from the same viewpoint. The developments cannot be seen at the same time; they are in a different arc of view. However, the cumulative visual impact will have a degree of perceptive value.

Sequential Effects:
When the observer has to move or travel through the landscape to view the various developments within the same field of view. Sequential effects should be assessed for travel along regularly used routes (major roads). Different degrees of sequential effect will be evident.

Frequent Effects:
Frequent sequential effects occur when the developments appear within the same field of view regularly with short periods in between. The speed of travel and distance between large-scale infrastructure developments will be determinants of the significance of the effect.

8.2 Discussion of Cumulative Visual Effect

Throughout the wider regional landscape context of the Northern Mount Lofty Ranges and Mid North, wind farms exist or are proposed as clustered developments increasing and decreasing in visual prominence as a result of each wind farm's layout and location rather than as a combined cumulative visual effect. The absence of visual presence of existing or proposed wind farms in the regional locality around the Twin Creek Wind Farm means that any cumulative visual effect would be described as sequential. At the time of the assessment the consultant team are aware of the Waterloo Wind Farm being the closest wind farm development.

The distance between the Twin Creek Wind Farm and the expanded Waterloo Wind Farm is 28 kilometres at its nearest point. At this distance, the visual effect is negligible, and the ability to view both wind farms in the same view is limited, if possible at all, particularly due to the underlying topography and vegetation of the locality. Furthermore, the Zone of Theoretical Visual Influence (ZTVI) illustrates the enclosed nature of the Twin Creek locality, which limits the perceived sequential visual experience of the Twin Creek Wind Farm and other wind farms in the area.

The potential sequential cumulative visual effect is negligible and will not impact on the underlying character of the landscape or elevate the visual effect of the Twin Creek proposal.

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[8] http://www.snh.org.uk/pdfs/strategy/cumulativeeffectsonwindfarms.pdf *[Accessed 01 September 2015]*

09 Viewer Sensitivity

The assessment of the Twin Creek Wind Farm (Optimised Layout) considers the visual effect of the wind farm from various locations having regard to the existing landscape quality and the degree of visual change on the existing environment. It does not measure the extent to which a viewer's response or sensitivity to landscape changes and how this influences the perception of visual effect.

The Wind Farms Planning Bulletin Planning SA (2002) identifies potential viewers and the possible sensitivity that may be experienced by the public, ranging from the eco-tourist, who may experience a devaluing of the landscape, to members of the local community, who might stand to benefit from the development. However, the Planning Bulletin also concedes that "Given the potential impact on the visual amenity of an area, a diverse range of public response can be expected".

Fundamental to the viewer's sensitivity is the degree to which visual change is perceived or experienced and whether this is seen as a positive or negative visual effect. Therefore, it is likely that local residents, who are most familiar with the landscape, will experience a greater degree of change than occasional visitors to the area. However, whether the change is perceived as positive or negative will depend on the viewer's opinions. It is evident that many people like the look of turbines, considering them sculptural and majestic or positive signs of climate change action, while some view them as an industrial blight.

By contrast, most tourists may perceive no change and see the wind farm as part of the existing visual environment.

The truth may be that within all user groups, be they locals, tourists, walkers or weekenders, a spectrum of opinions can be expected based on differing views on the receiving landscape, the visual appeal of turbines and renewable energy. The final level of viewer sensitivity becomes the personal preference of the viewer as to whether the visual change is positive or negative, as an assessment of social or demographic groups can only be subjective, it does not form part of this discussion.

10 Conclusion

The landscape assessment indicates that the Twin Creek Wind Farm (Optimised Project) will be developed in a modified rural landscape with a defined visual character. The topography of the Nain Ranges, Greenock Ranges, Light Ranges, Barossa Ranges and Mount Rufus create a visual envelope to the north, east and west of the proposed development farm. To the south, local landforms and the existing belt of vegetation associated with the Barossa Valley limit the visibility of the Project.

Throughout the regional locality around the Optimised Project, the existing land use is agricultural, with small woodland pockets of vegetation. Within this visually contained rural landscape, the proposed layout of the Optimised Project will form a compact cluster of 42 wind turbines with a maximum tip height of 220 metres.

The potential visual effect is likely to be most notable from the east and west within the local to subregional 5 kilometre locality. The proposed wind turbines will be situated on the ridges and elevated plateau of the Central Tablelands. The wind turbines appear in the landscape as prominent visual elements elevated on the central tablelands, with the vertical scale of the wind turbines likely to appear larger than the scale of the underlying topography.

From local and sub-regional locations within five kilometres of the Optimised Project, the potential screening and visual mitigation provided by local ridgelines and vegetation belts is limited, and the majority of the wind farm is visible. The resulting visual effect produces a degree of visual change that will be consistently in the order of 45%, which is described as substantial, with the visual character of the locality being altered by the introduction of the wind turbines into the rural landscape. However, the sensitivity of the underlying landscape to change is low due to the agricultural character.

Across the sub-regional landscape, between five and ten kilometres, local ridgelines and tree belts create defined visual screens that reduce and remove the visual effects of the proposed wind turbines. The combination of topography and vegetation provides additional visual mitigation, and the degree of visual change reduces to a range of 28% to 39% and is described as moderate, increasing to substantial.

At distances of over ten kilometres within the regional locality, the degree of visual change reduces significantly to a range of 11% to 15%, particularly to the northeast and southwest and is described as slight.

The associated infrastructure, substations, and transmission lines will provide localised impacts to their immediate site localities. These visual effects will be limited to shorter distances (contained viewsheds) to the east and southeast. There will be no visual effect on the township of Truro. Transient experiences will be witnessed along local roads within the southeast of the regional landscape, with a small section of the Sturt Highway being impacted by the substation terminal.

The visual assessment and visual effect interpolation mapping illustrates the relationship between distance and visual effect and the significance of local ridgelines in reducing the visibility of the proposed wind farm in the wider locality. The visual effect is represented as bands of visual change radiating from the proposed wind farm. The consistency of the existing landscape character means that distance and visual absorption are the dominant variables in mitigating the visual effect.

10 Conclusion

Although the visual effect is likely to be substantial within the local to subregional area, the containment of the effect can be attributed to the visual character of the landscape coupled with the uniformity of the agricultural character. The visual effects are contained within a defined locality, and the proposed Twin Creek Wind Farm can be accommodated without significantly altering the underlying landscape character.

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Landscape Character and Probable Visual Effect Assessment: Appendices

Twin Creek Wind Farm Project

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7 January 2025

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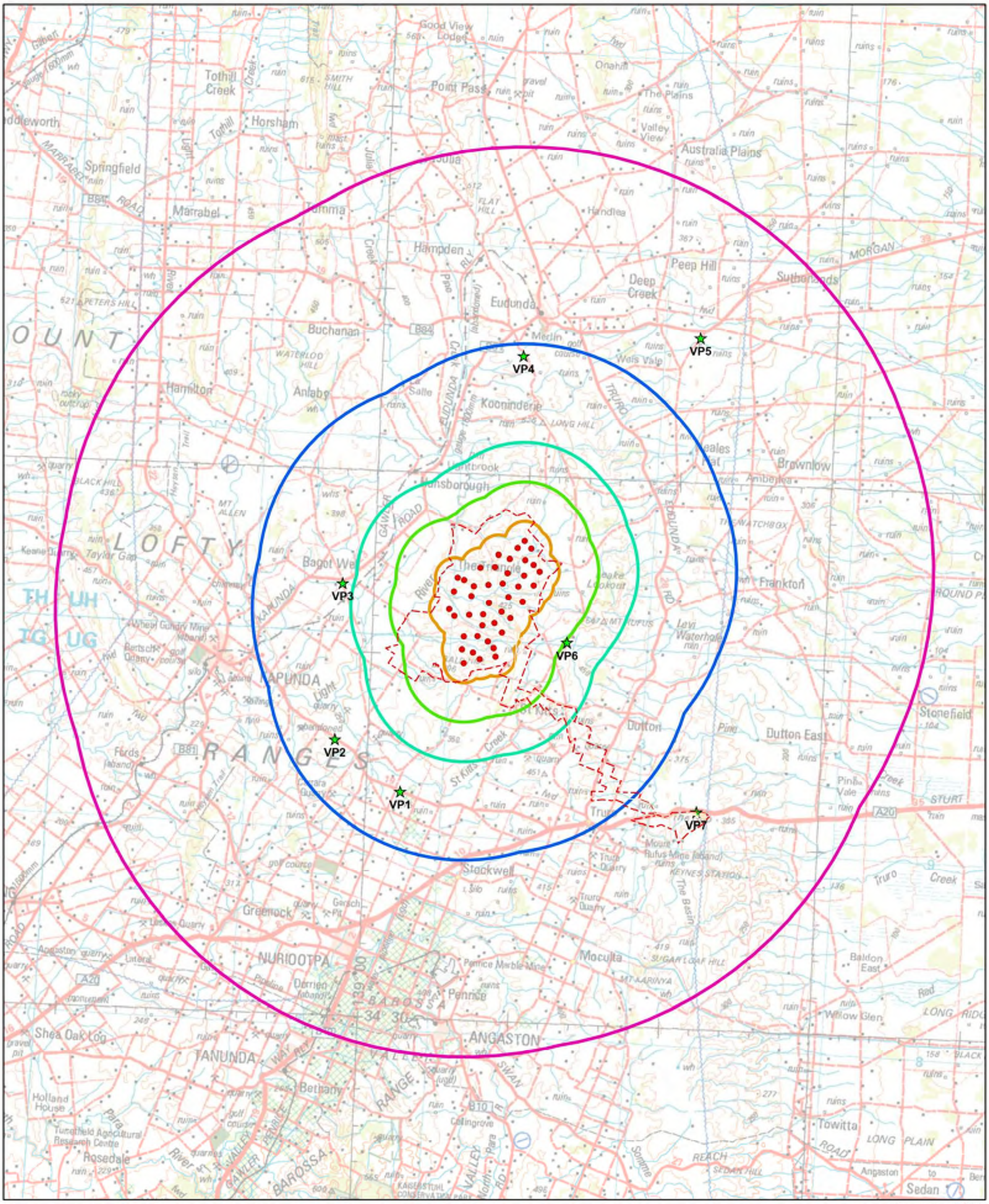
REVISION	DATE	AUTHOR	REVIEWER
D	07/01/2025	BG/WK	CS/WK
C	29/10/2024	BG/WK	CS/WK
B	30/09/2024	BG/WK	CS/WK
A	11/04/2024	BG/WK	CS/WK

Appendix A
Assessment Mapping



December 2024

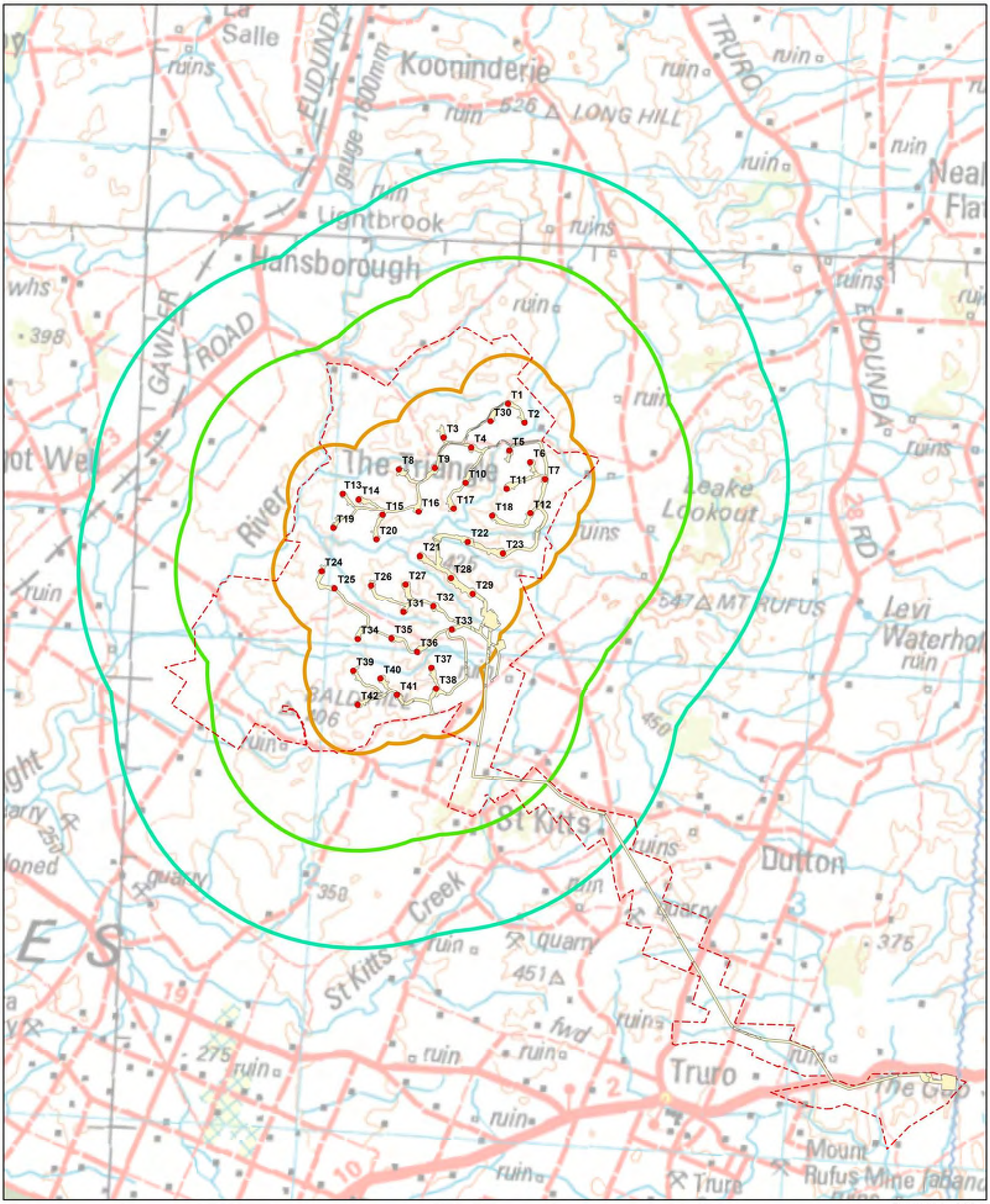
Viewpoints

Legend

- Optimised Wind Turbines Layout
- Detailed Assessment Viewpoints
- PAUStwc064_Disturbance_Footprint_20240830
- Site_Boundary_20241213
- 1km Buffer
- 3km Buffer
- 5km Buffer
- 10km Buffer
- 20km Buffer

0 2.25 4.5 9 Kilometers

N



December 2024

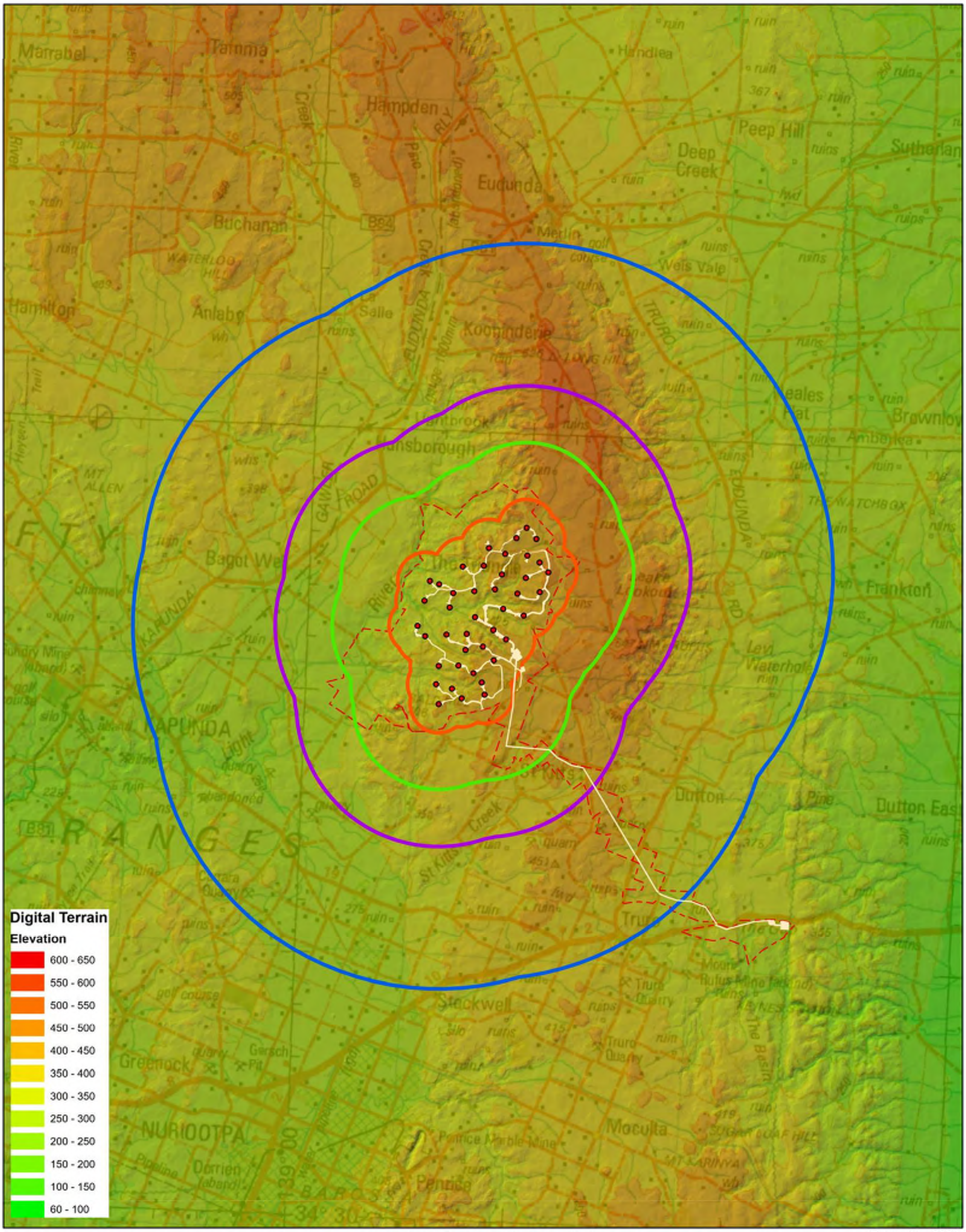
Turbine Site Layout

Legend

- Optimised Wind Turbine Layout
- PAUStwc064_Disturbance_Footprint_20240830
- 1km Buffer
- 3km Buffer
- 5km Buffer
- Site_Boundary_20241213

0 1 2 4 Kilometers

N



Digital Terrain Model

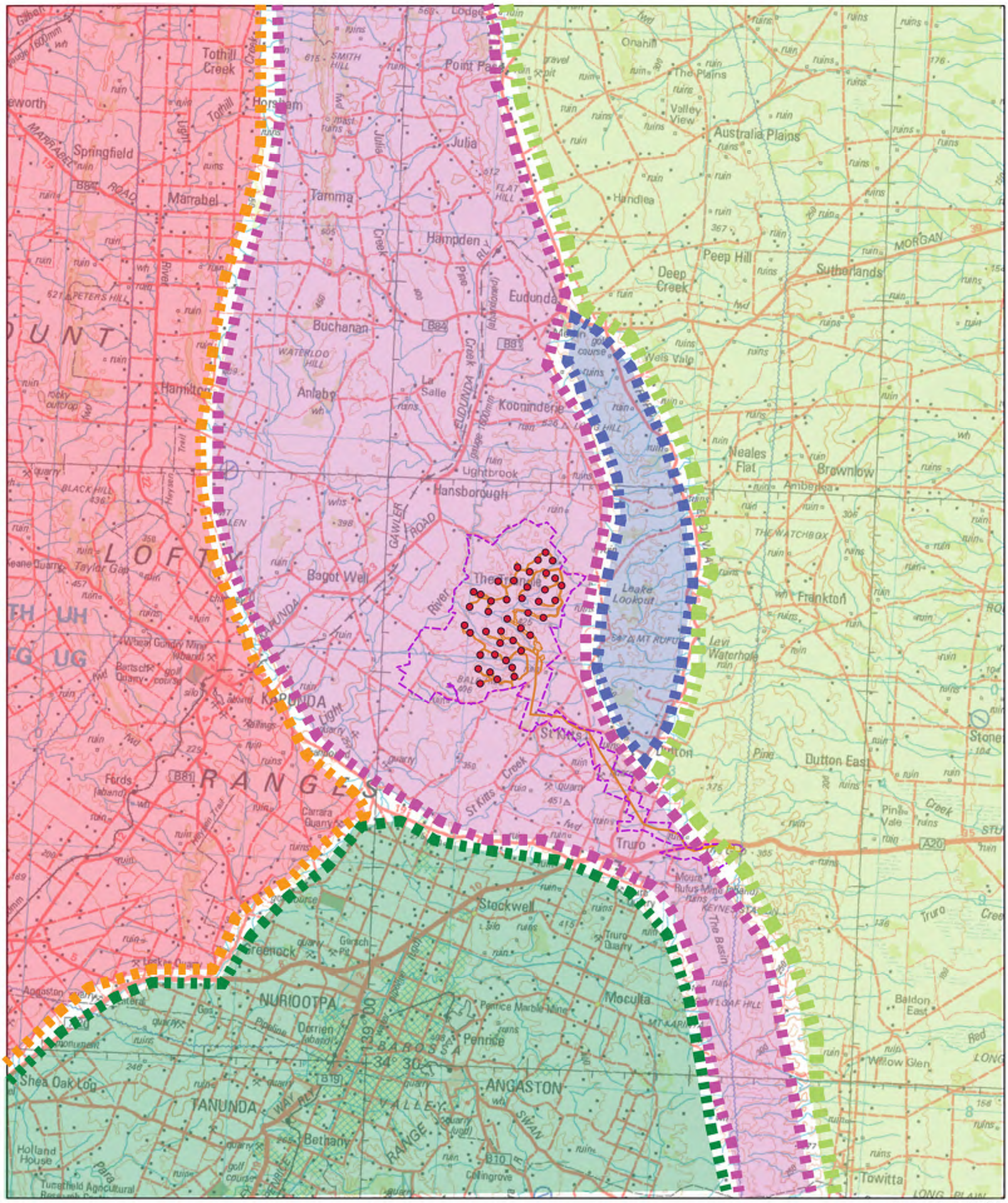
December 2024

Legend

- Optimised Wind Turbine Layout
- PAUStwc064_Disturbance_Footprint_20240830
- 1km Buffer
- 3km Buffer
- 5km Buffer
- 10km Buffer
- Site_Boundary_20241213

0 1.75 3.5 7 Kilometers

N



December 2024

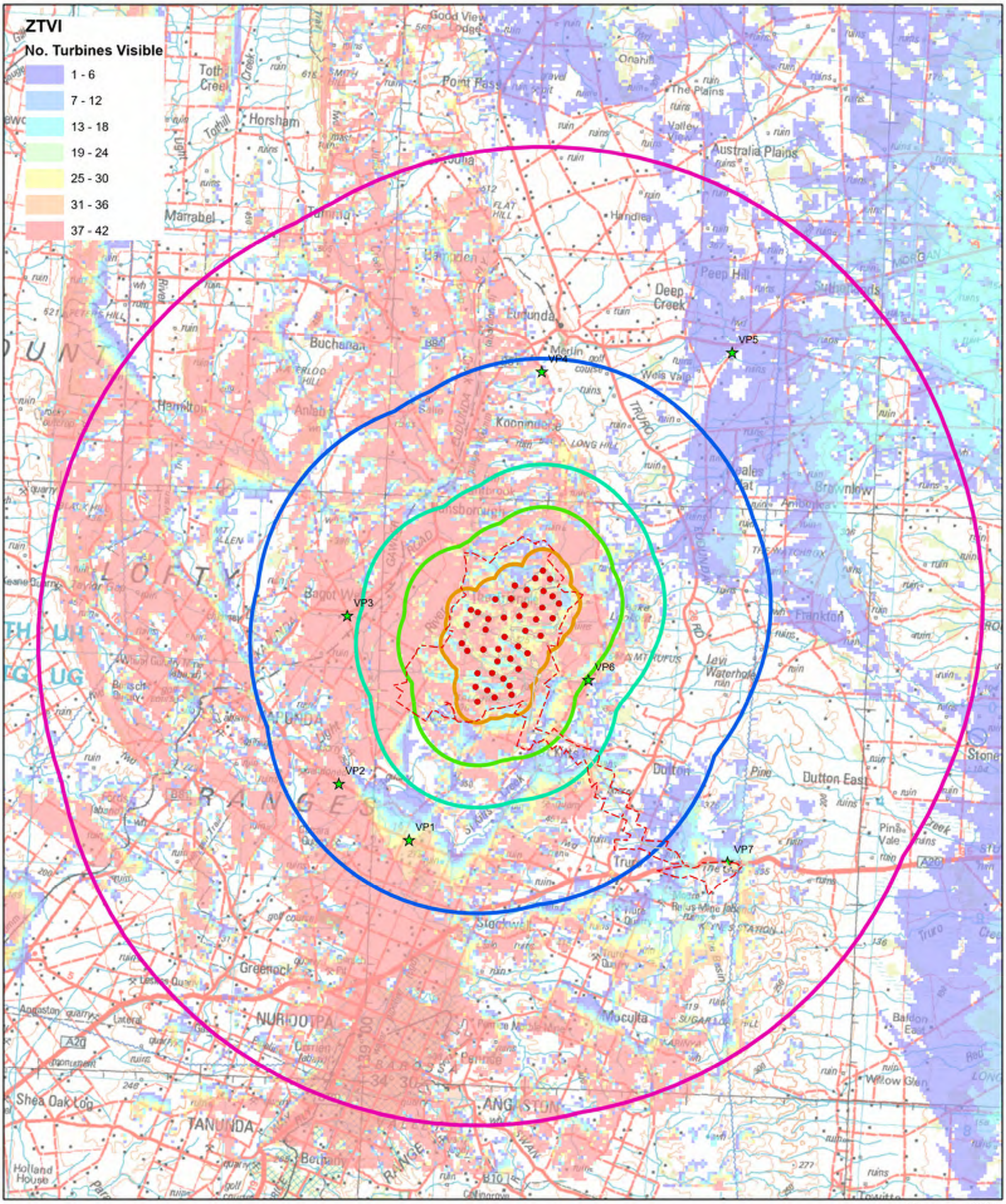
Landscape Character Units

Legend

- Optimised Wind Turbine Layout
- PAUStwc064_Disturbance_Footprint_20240830
- Site_Boundary_20241213
- Western Pastoral Lands and Ridgelines
- Northern Barrosa Valley
- Central Tablelands
- Mount Rufus Ridgline
- Western Murray River Plain

0 2.5 5 10 Kilometers

N



December 2024

Zone of Theoretical Visual Influence_Hub Height (134m)

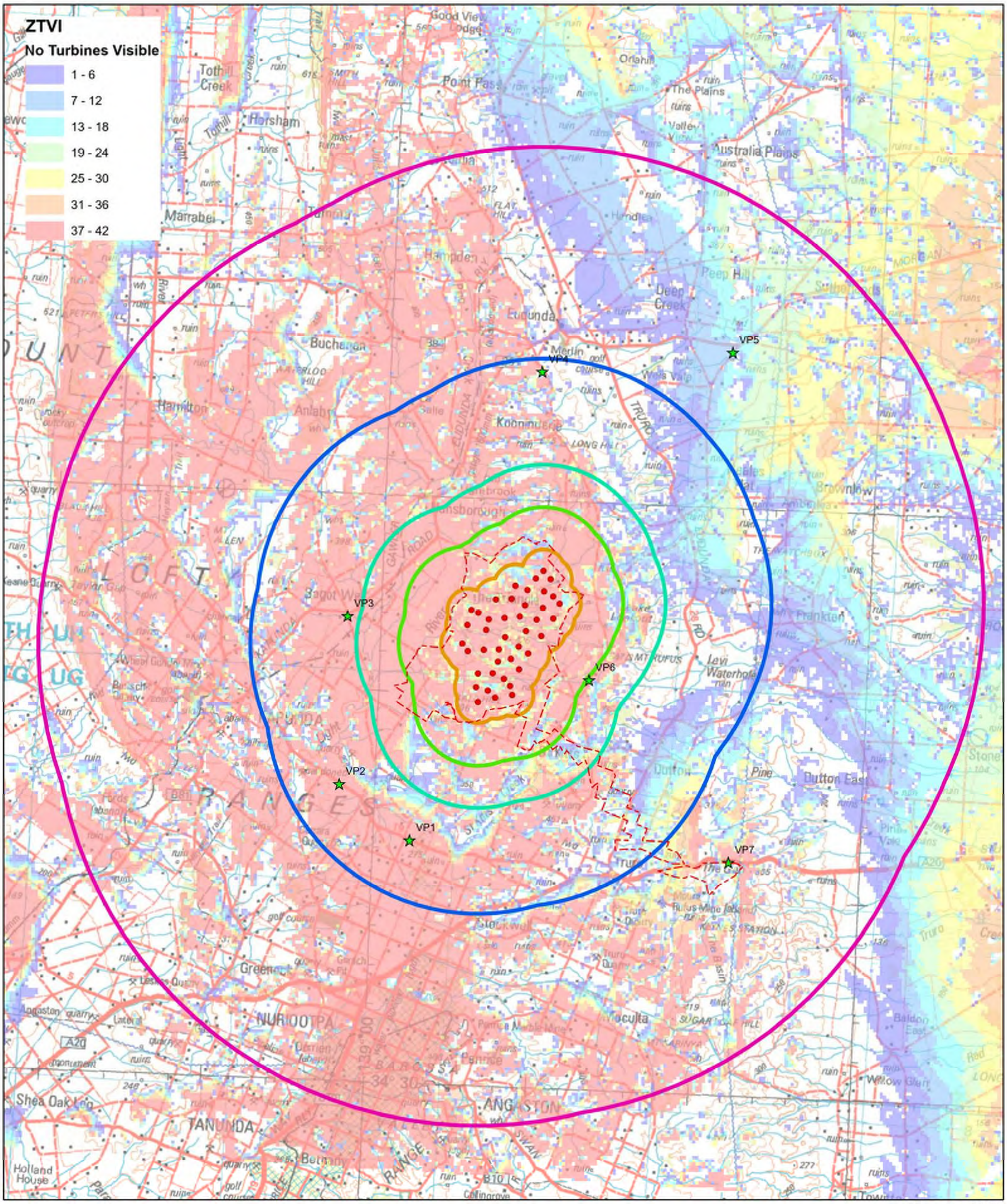
Legend

- Optimised Wind Turbine Layout
- Viewpoints Assessment
- Site_Boundary_20241213
- 1km Buffer
- 3km Buffer
- 5km Buffer
- 10km Buffer
- 20km Buffer

ZTVI represents 'worst case scenario' it is based on 10m contour data and does not take into account vegetation or built form screening or localised ridgelines

0 2.5 5 10 Kilometers

N



December 2024

Zone of Theoretical Visual Influence_Tip of Blade (220m)

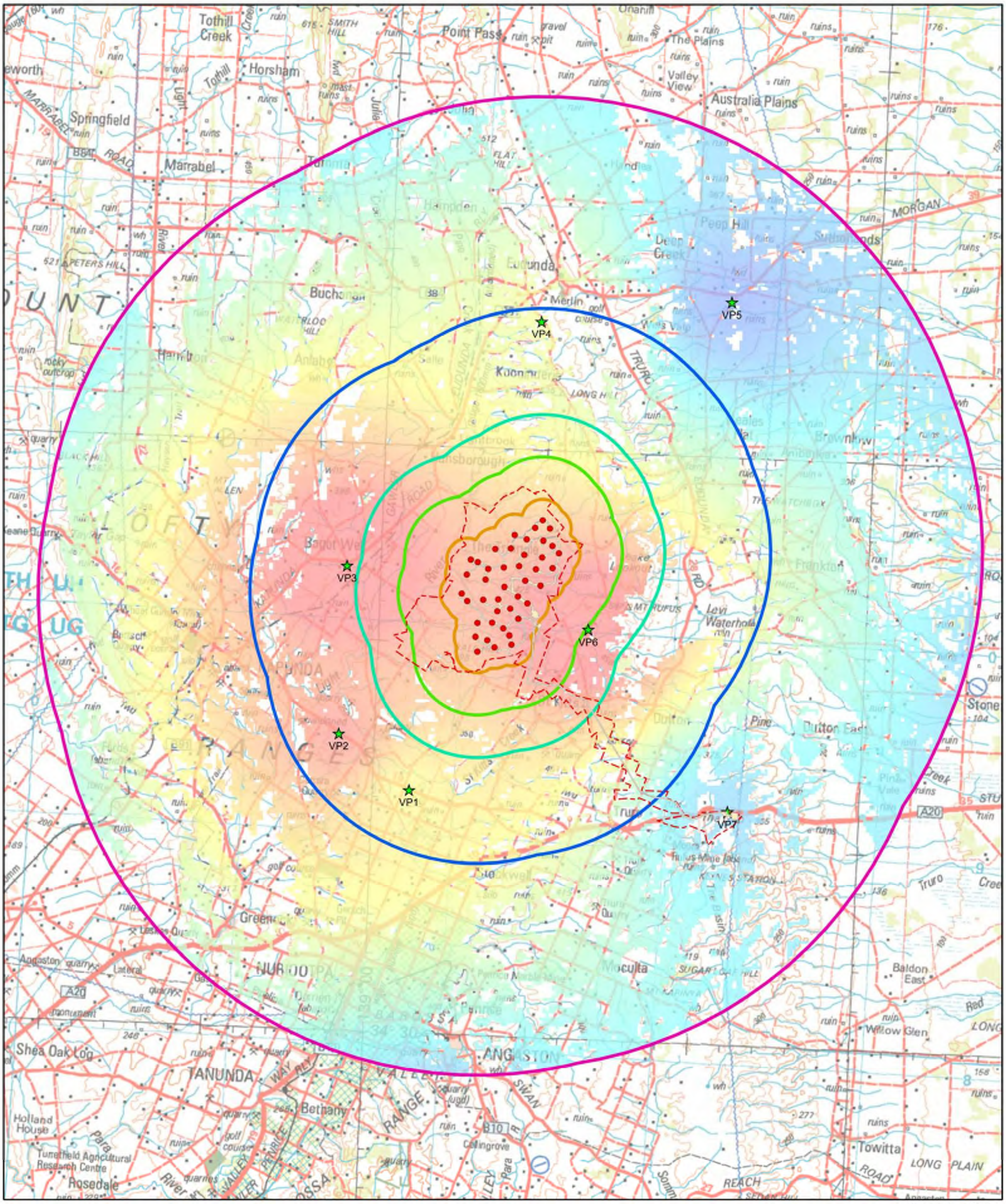
Legend

- Optimised Wind Turbine Layout
- Viewpoints Assessment
- Site_Boundary_20241213
- 1km Buffer
- 3km Buffer
- 5km Buffer
- 10km Buffer
- 20km Buffer

ZTVI represents 'worst case scenario'
it is based on 10m contour data and
does not take into account vegetation or
built form screening or localised ridgelines

0 2.5 5 10 Kilometers

N



December 2024

Visual Effect Interpolation
Distance Weighted Relative Change

Legend

- Optimised Wind Turbine Layout
- Viewpoints Assessment
- Site_Boundary_20241213
- 1km Buffer
- 3km Buffer
- 5km Buffer
- 10km Buffer
- 20km Buffer

Visual Effect Interpolation

Relative Degree of Change

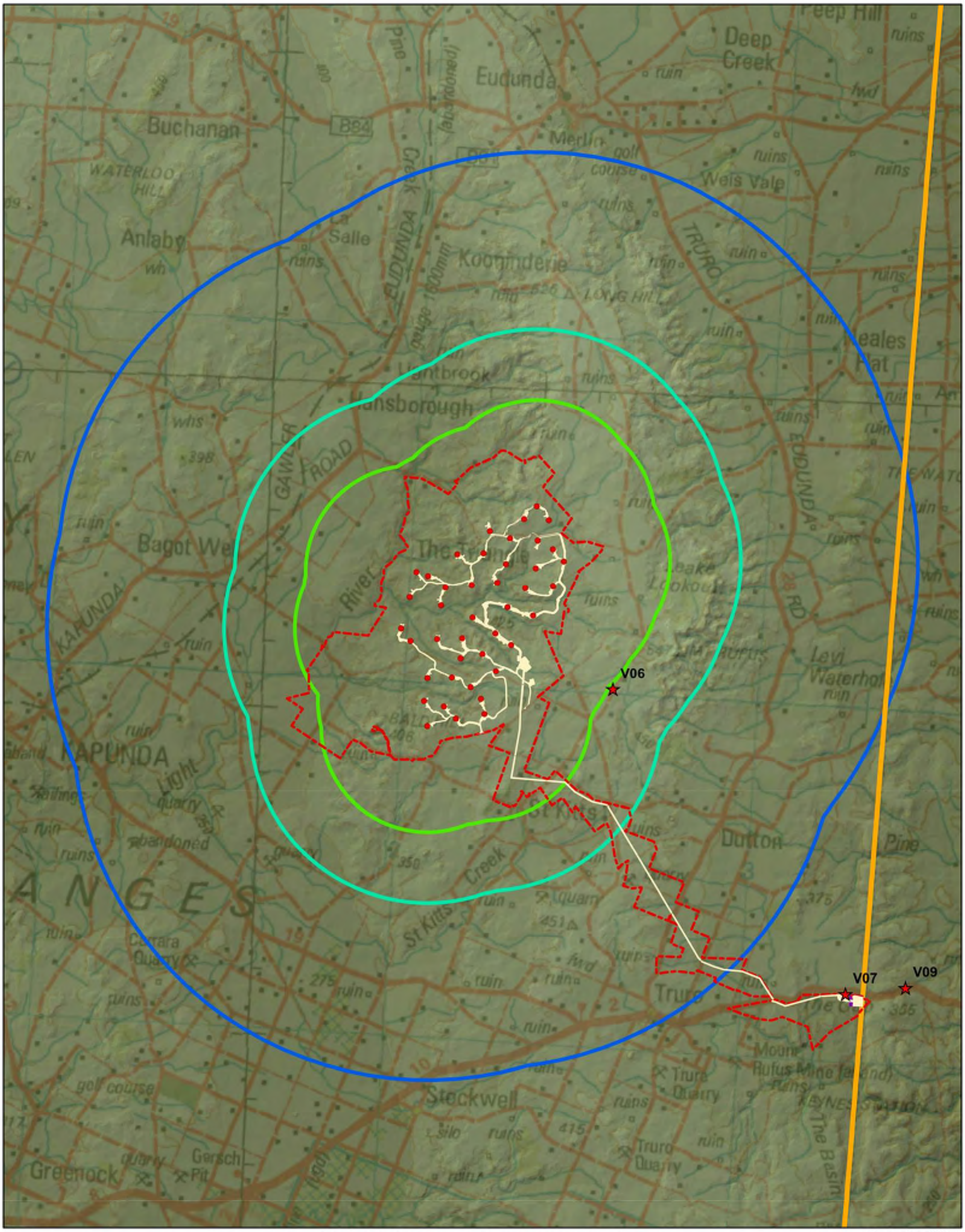
Substantial

Slight

ZTVI represents 'worst case scenario' it is based on 10m contour data and does not take into account vegetation or built form screening or localised ridgelines

0 2.5 5 10 Kilometers

N



Substation and Transmission Line

December 2024

Legend

- Transmission Line and Substation Viewpoints
- PAUStwc064_Disturbance_Footprint_20240830
- Substation Terminal
- Existing 275kv
- Site_Boundary_20241213
- 3km Buffer
- 5km Buffer
- 10km Buffer

0 1.5 3 6 Kilometers

N

Appendix B

Photographic Methodology (produced by Convergen)

The method consists of 6 stages. The following summarises the stages;

1. Viewpoints are identified using a Zone of Theoretical Visibility map, site assessment and in consultation with the client and residents in the area. The viewpoints are selected to represent the worse case scenario i.e. the maximum number of turbines visible within the field of view. The locations of viewpoints are typically representative of the regional landscape character units or identified by residents. The locations represent a diverse range of views from around the wind farm at a variety of directions and distances.

2. Photos are taken onsite using a 32mm lens digital SLR camera (50mm equivalent analogue). Numerous research papers have concluded that this is most representative of the human eye for depth of field. Photos are taken on a mounted tripod and the height recorded to eye level. In addition the elevation of the viewpoint is recorded Above Sea Level (ASL) using the barometric measure on a handheld GPS device. The weather and time of day are also recorded to enable computer model rectification in stage 4 and 6 of the process.

3. The centre of the field of view is equated onsite using a bearing compass and GPS to the projected centre of the development. A field of view of 60 degrees to either side of centre is established onsite to provide the full 120 degrees. The extent of the field of view is recorded and evaluated onsite using the GPS and bearing compass. 6 photos are taken for each viewpoint with 1/3 overlap of each to enable photo stitching. The bearing to centre of each photo is recorded to enable cross reference to the next phase of developing a computer model. During the site photography numerous fixed known visual markers are recorded with a GPS location and bearing from the viewpoint. These markers provide reference points within the computer modelling for due diligence.

4. To generate the panoramic photographs the individual photographs are stitched together using PTGui software.

5. The next stage of the process involves the computer generation of a wire frame perspective view of the wind farm, which incorporates the topography from each viewpoint. Using the Wind Farmer™ software the wire frame is produced using a digital terrain model with 10 metre contour intervals. This creates the topography and positions the turbines at the correct coordinates and elevation within the wire frame. The correct field of view is established by matching the viewing centre of the view angle to the camera and lens used for the photography with the wire frame. This ensures that the image size and angle of view of the wire line matches the photos taken. The wire line is then superimposed on the stitched panoramic photograph and matched in accordance to reference markers and landscape features.

6. A second site visit is conducted with the preliminary wire lines to certify the correct locations of the turbines using a GPS and bearing compass. Minor alterations are marked up on the drafts to mitigate the effects of photographic warping to the periphery of the stitched panorama. Ground truthing the turbine locations, provides rigour to the process. Typically if any amendments are required they are within 1-5 degrees.

7. Once the wire frame and photograph have been lined up the rendered image of the turbines are created. The rendered model is created in Wind Farmer™ using the correct sun angle for the date and time of the day that the photograph was taken. The rendered model is exported to Photoshop™ for final matching with the photograph. The rendered image is edited, masking turbines or parts their off that are screened by vegetation and other elements to the foreground. Additional visual effects are applied to match the lighting effects of shadow imposed by vegetation etc.

Viewing of Photomontages

Given that the objectives of photography and photomontage are to produce printed images of a size and resolution sufficient for use in assessment work in the field, the exact dimensions of these images will depend on the characteristics of the field of view.

All photographs, whether printed or digitally displayed, have a unique, correct viewing distance - that is, the distance at which the perspective in the photograph correctly reconstructs the perspective seen from the point at which the photograph was taken. The correct viewing distance is stated for all printed or digitally displayed photographs and photomontages, together with the size at which they should be printed.

The viewing distance and the horizontal field of view together determine the overall printed image size.
Photographs and photomontages should be printed or published digitally at an appropriate scale for comfortable viewing at the correct distance, noting the limitations of the printing process particularly with regards to colour and resolution. Guidance is provided on viewing the image in order to best represent how the proposal would appear if constructed, such as the required viewing distance between the eye and the printed image. Panoramic images should be curved so that peripheral parts of the image are viewed at the same intended viewing distance. The ‘before’ photograph and the ‘after’ photomontage should be presented on the same page and/or at the same scale to allow comparison if practicable.

References

Landscape Institute Photography and photomontage in landscape and visual impact assessment (March 2011)

Landscape Institute and IEMA (2002) Guidelines for landscape and visual impact assessment (2nd ed). London: Spon.

Scottish Natural Heritage (2006) Visual representation of windfarms: good practice guidance. Inverness: Scottish Natural Heritage. SNH report no. FO3 AA 308/2

Appendix C

Photomontages and Turbine Locations

Used in the GrimKe visual assessment and referred to in sections 5.2 – 5.9 of the Landscape Character and Probable Visual Effect Report

VIEWPOINT 1: KAPUNDA-TRURO ROAD, EBENEZER

2023 BASE PHOTOGRAPHY

WIRE LINE

VIEWPOINT 1: KAPUNDA-TRURO ROAD, EBENEZER

PHOTOMONTAGE

VIEWPOINT 2: KAPUNDA-TRURO ROAD, KOONUNGA

2023 BASE PHOTOGRAPHY

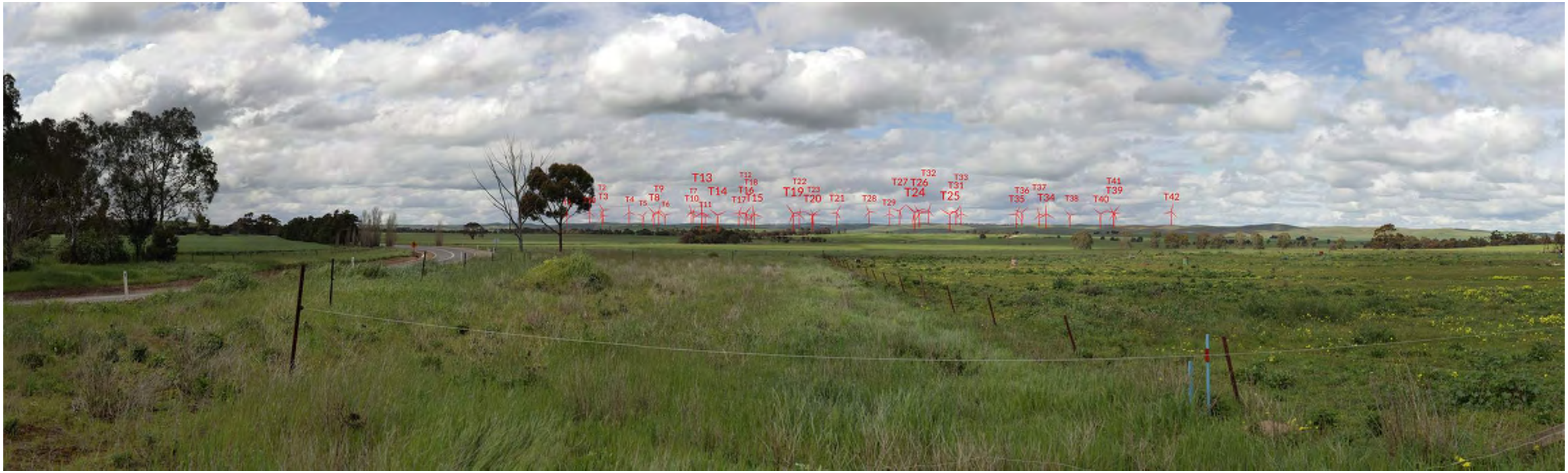
WIRE LINE

VIEWPOINT 2: KAPUNDA-TRURO ROAD, KOONUNGA

PHOTOMONTAGE

VIEWPOINT 3: INTERSECTION OF BAGOT WELL ROAD AND KAPUNDA-EUDUNDA ROAD, BAGOT WELL

2023 BASE PHOTOGRAPHY



WIRE LINE

VIEWPOINT 3: INTERSECTION OF BAGOT WELL ROAD AND KAPUNDA-EUDUNDA ROAD, BAGOT WELL

PHOTOMONTAGE

VIEWPOINT 4: TABLELANDS ROAD, SOUTH OF EUDUNDA

2023 BASE PHOTOGRAPHY

WIRE LINE

VIEWPOINT 4: TABLELANDS ROAD, SOUTH OF EUDUNDA

PHOTOMONTAGE

VIEWPOINT 5: VON REIBEN ROAD, EAST OF EUDUNDA

2023 BASE PHOTOGRAPHY

WIRE LINE

VIEWPOINT 5: VON REIBEN ROAD, EAST OF EUDUNDA

PHOTOMONTAGE

VIEWPOINT 6: TABLELANDS ROAD, SOUTH OF MOUNT RUFUS

2023 BASE PHOTOGRAPHY

WIRE LINE

VIEWPOINT 6: TABLELANDS ROAD, SOUTH OF MOUNT RUFUS

PHOTOMONTAGE

Appendix D

Supplementary Photomontages with Substations and Transmission Line

Additional photomontages produced to discuss the probable visual effect of the associated infrastructure and referred to in sections 5.11 – 5.16 of the Landscape Character and Probable Visual Effect Report

VIEWPOINT 7: STURT HIGHWAY, EAST OF TRURO

2023 BASE PHOTOGRAPHY

WIRE LINE

VIEWPOINT 7: STURT HIGHWAY, EAST OF TRURO

PHOTOMONTAGE

VIEWPOINT 9: STURT HIGHWAY, EAST OF TRANSMISSION SUBSTATION

2017 BASE PHOTOGRAPHY

WIRE LINE

VIEWPOINT 9: STURT HIGHWAY, EAST OF TRANSMISSION SUBSTATION

PHOTOMONTAGE

Appendix E
GrimKe Assessment Matrix

The GRIMKE Matrix has been based on the WAX (2006) and HASSELL Matrix (2005), and with reference to The Visual Management System (VMS) produced by Litton (1968) primarily used for the U.S. Forest Service (1973) and the US Bureau of Land Management (1980). These models are based on a professional consultant (Landscape Architect) quantifying potential changes to landscape composition through “forms, lines, colours and textures and their interrelationships”1. Other factors such as compositional qualities, dominance, variety, animation and sensitivity to potential receptors are also considered.

The extent of visual impact was identified on site, using a GPS with a Wide Area Augmentation System (WAAS) that provides positional accuracy to within 3 metres.i Using the GPS, the location and extent of the development was plotted as 'waypoints', using longitude and latitude, elevation and distances to provide geographic referenced data. The surrounding area was then surveyed with the GPS and a SILVAii bearing compass to calculate the bearing and distance between the viewpoint and the subject area. This methodology was used to assess where the development is in the landscape and whether it is visible.

The GrimKe Matrix considers two key aspects in terms of understanding visual impact and the resulting visual assessment. The initial assessment is a quasi-objective measurement, where a landscape architect considers the landscape character of the site and particularly in relation of this landscape to the viewpoints that have been selected as part of the assessment criteria. Each viewpoint is then assessed in terms of:

- Relief (the complexity of the land that exists as part of the underlying landscape character)
- Vegetation Cover (the extent to which vegetation is present and its potential to screen and filter views)
- Infrastructure and Built Form (the impact of development on landscape and visual character)
- Cultural and Landscape Value (quantification of recognised planning overlays)

Assessing each viewpoint and the regional context (cultural and landscape value) a quantified value is generated for landscape character. This value then forms the baseline assessment value, which will be modified by the impact of the development within the landscape, which in turn will be measured as part of the visual assessment.

This two-tiered assessment methodology ensures the degree of visual impact is assessed against a quantified landscape character value enabling, the GrimKe Matrix to accurately quantify the degree of visual impact that is experienced as a result of implementing the development.

The assessment considers the landscape as three distinct zones based on the distance from the proposed development. The three zones were defined as; local (0-1km), sub-regional (1-5km) and regional (5-30km). (Planning South Australia, 2002). Specific landscape characters are also identified to provide a complete assessment of the landscape context.

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[1] *Daniel, T C & Vining, J (1980) p49*

1. Landscape Character Assessment

1.1 Relief

This is an assessment of the landscape complexity in terms of the underlying topography. The relationship of relief assists in defining the landscape and the visual character of an area. This is relevant in terms of the position and elevation of a proposed development within the landscape and the viewpoint.

The topography is assessed both on site (from each viewpoint) and as part of a desktop review (topography mapping). The assessment considers the topographical complexity in terms of local, sub-regional and regional. Within each zone an assessment is made of the topography and the complexity of landscape features.

The assessment is concerned with landscape complexity and how it impacts on the visual character. The assessment considers landform patterns, dominant elements and other distinguishing topographical features that will impact on the visual context.

Relief (expressed as percentage)	Value	Description of Landscape Relief
80-100%	5	Substantial landscape relief. The landscape possesses significant topographic variations, features and prominent elements creating a dynamic landscape context.
60-79%	4	Increasing relief. Due to the scale of the topography and frequency of features.
40-59%	3	Moderate relief. Medium level of change to the landscape. Occasional landscape features and topographic variation.
20-39%	2	Limited relief. Small amount of topographic variation in the landscape.
0-19%	1	No or minor relief within the landscape. The landscape is considered feature less, without noticeable elements or patterns.

1.2 Vegetation Coverage

Vegetation coverage is a measurement of the extent, character and frequency of vegetation that exists at each viewpoint and within the local, sub-regional and regional zones. The extent of vegetation provides the potential for screening and to reduce the visual effect of development. Conversely, a lack of vegetation results in an increase in the visual significance of a development.

This measurement responds to the potential visual absorption of the landscape as measured by the visual matrix. Again, this assessment considers the dominant vegetation patterns within each zone and in relation to each viewpoint.

Vegetation Coverage (expressed as percentage)	Value	Description of Vegetation Coverage
80-100%	5	Natural or non-harvested commercial forests. Significant areas of treed vegetation creating an arboreal landscape.
60-79%	4	Bushland or woodlands. Major areas of

		vegetation that define the landscape character of an area
40-59%	3	Tree groups, copse, screens, shelter belts. Defined areas of vegetation creating a layered landscape character.
20-39%	2	Sporadic trees producing a punctuated vegetation character.
0-19%	1	No trees scrub or low ground cover. Limited vegetation cover.

1.3 Infrastructure and Built Form

This assessment considers the interrelationship of landscape character and human development. The assessment considers how development and infrastructure can create a counterpoint to the existing landscape character (vegetation and topography). Alternatively, development within the landscape may assist with the assimilation of development.

Infrastructure and Built Form (expressed as percentage)	**Value**	**Description of Infrastructure and Built Form**
0-19%	5	No objects within the landscape. The landscape has a high natural or remote rural character.
20-39%	4	Isolated objects in the landscape. Single elements with limited visual impact on the landscape. Small farm building, telephone towers or houses.
40-59%	3	Small clusters of development. Increasing presence of development within the landscape.
60-79%	2	Medium scale linear infrastructure or development. More significant development within the landscape. Minor roads, culverts, warehouses, transmission lines and residential areas.
80-100%	1	Large scale infrastructure. The landscape is significantly affected by development. Freeways, power stations and opencast mining

1.4 Cultural Sensitivity Value

The cultural and landscape value assessment is a survey of the regional area around the development up to 20 kilometres. The measurement considers the recognised cultural, heritage, natural and social overlays that exist within the landscape. This assessment is predominantly a desktop survey and only measures recognised designations.

The measurement is then represented as a percentage based of the area of designation compare to the area occupied by the regional zone.

The landscape value is the aggregate value from each of the assessment criteria. Either, as a value for each viewpoint or as a baseline value for the landscape surrounding the development. This Landscape Value in then used to assess the percentage of visual change created by the introduction of development within the landscape.

Cultural and Landscape (expressed as percentage)	Value	Description of Cultural and Landscape Value
80-100%	5	Majority of regional zone is affected by planning designations or overlays. Highly valued culture, natural and social landscape.
60-79%	4	Planning designations impacts a significant area of the regional zone. Valued culture, natural and social landscape
40-59%	3	Moderate impact from planning designations. Valued community or social landscape
20-39%	2	Limited effect
0-19%	1	None to negligible effect of planning designations

1.5 Landscape Character Assessment

The aggregate of relief, vegetation, infrastructure and cultural sensitivity values determines the base line landscape character value. The following table summarises the definition of Landscape Character Values

Landscape Character Value	Value	Description of Landscape Relief
16-20	High	Landscape quality is of high value with significant areas of scenic quality provided by varied topography, large areas of natural beauty and obvious presence of cultural sensitivity to change.
12-16	Moderate to increasing	Moderate to increasing landscape character value experienced through a layered landscape of natural qualities, scenic beauty and cultural sensitivity.
8-12	Moderate	Moderate landscape character value experienced by small clusters of natural landscape and cultural sensitivity.
4-8	Limited	Limited landscape character value experienced. The landscape is monotonous with little visual interest through topography or vegetation and heavily modified.

2. Visual Assessment

Each viewpoint was then assessed with respect to the following aspects of visual effect

— Percent of landscape absorption (the landscape’s ability to absorb and screen the development form).

— Horizontal visual effect (percentage spread of the development in the field of view).

— Vertical visual effect (height of the development as a percentage of the field of view).

— Distance of visual effect (distance between viewpoint and development).

Using the following GRIMKE matrix formula, the development was quantified and aggregated to provide an assessment of the visual effect for each viewpoint.

2.1 Percent of Visual Absorption (PVA)

This is an assessment of the landscape's ability to absorb or screen the visual effect. Due to the comprehension of the landscape and wind farm development being holistic, the area that is visually affected includes the space between the turbines.

Using photomontages of the proposed development and Adobe Photoshop™ the amount to which the landscape screens the development is described as a percent of pixel absorption. Foreground contrasting pixels are selected within the vertical and horizontal extents of the development (area A), figure 6. This area is divided by the total area occupied by the development within the active field of view (area B) and expressed as a percentage of visual absorption. The assessment takes into consideration, visual sky lining and screening from existing vegetation and other physical forms.

Figure 1 Photo with wire line model draped on top. Courtesy Wind Farm Developments (2004)

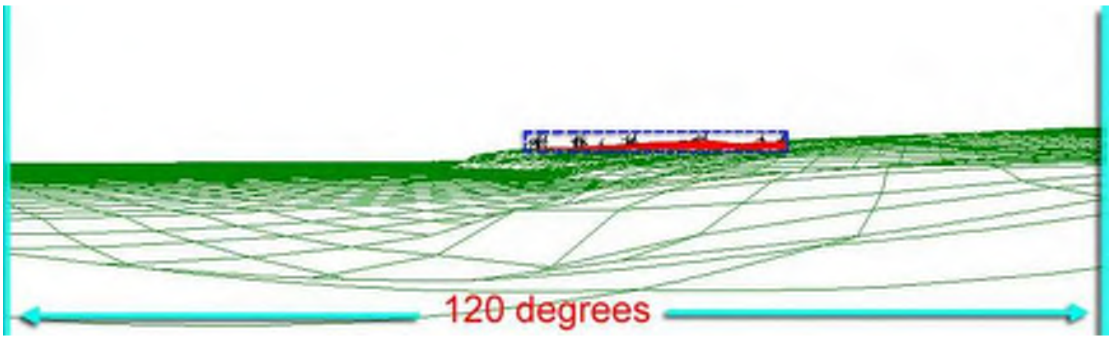


Figure 2 Wire line of showing extent of photomontage. Adapted from Wind Farm Development (2004)

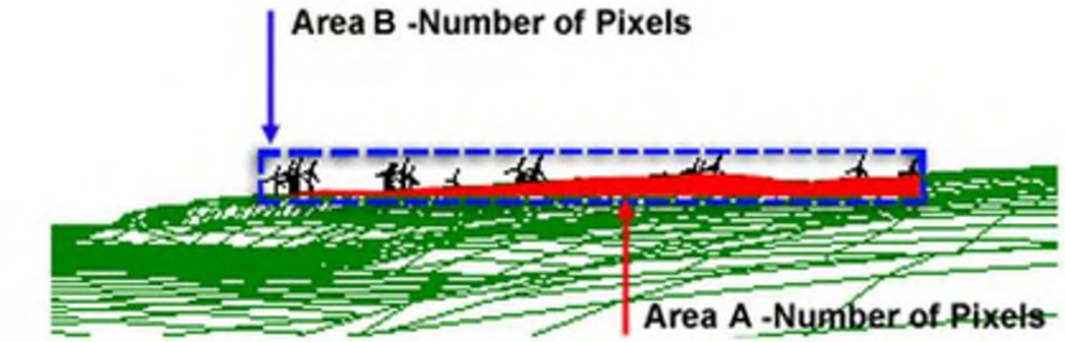


Figure 3 Detailed view of the landscape absorption (area A) and development extents (area B).

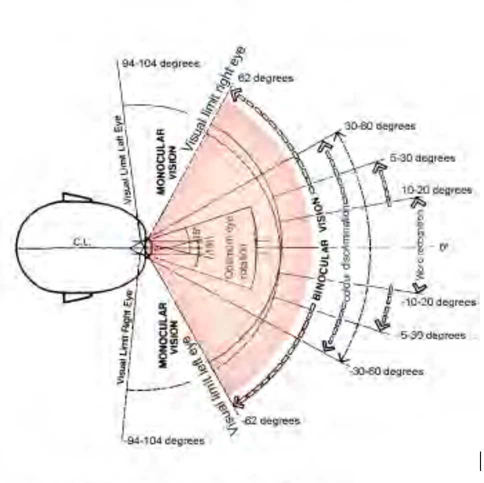
Adapted from Wind Farm Development (2004)

Percent of Visual Absorption (expressed as percentage of change)	Value	Description of Visual Absorption
80-100%	1	Substantial landscape absorption capacity. The landscape possesses sufficient vegetation and topography to screen any effect of the development, maintaining the visual character.
60-79%	2	Increasing absorption capacity. Due to the scale of the topography and density of vegetation the landscape is able to screen the development.
40-59%	3	Moderate absorption capacity. Medium level of change to the landscape. The landscape is less able to absorb change due to the scale, distance and extent of the development.
20-39%	4	Limited absorption. The development is noticeable within the landscape; however through vegetation and topography the landscape fragments and filters views of the development.
0-19%	5	No or minor absorption within the landscape. The development is considered to be prominent within the visual landscape.

2.3 Horizontal Visual Effect (HVE)

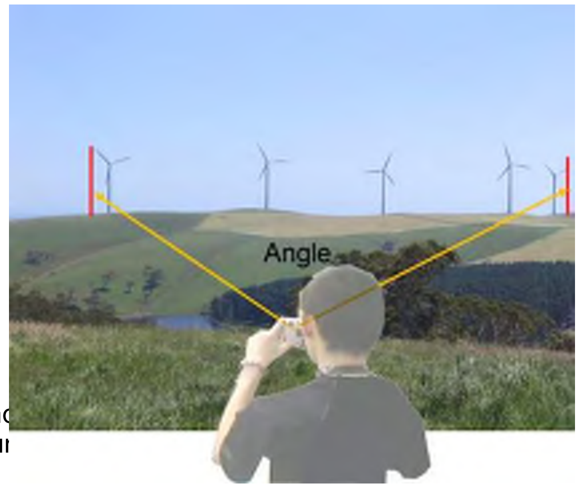
The field of vision (FOV) experienced by the human eye is described as an angle of 200-208 degrees horizontallyiii. This field of view includes the peripheral (monocular) vision, which is described as 40 degrees to each eye; within this zone colour and depth of field are not registered. For the purposes of the assessment the angle of peripheral vision has been subtracted from the field of view producing a binocular, 'active field of view' of 120 degrees.

Using this fixed visual reference, an assessment of the possible impact of development within this measurable area is undertaken. The centre of the development is established and an angle of 60 degrees each side is defined. The overall assessment is made of the entire development, rather than of the individual objects that may form the proposal. The angle is measured using a GPS and a bearing compass with known waypoints (geographic coordinates). Using GPS the extent of the horizontal visual field is calculated by the difference in bearing between the widest waypoints from a particular viewpoint. This measurement of effect is then described as a percentage of the 120 degrees active field of view



VISUAL FIELD IN HORIZONTAL PLANE

the binc
measur



Degree of Horizontal Visual Impact (expressed as an angle of impact and percentage of change)	Value	Description of Visual Modification
80-100% of the panorama measure at 120˚FOV)	5	Substantial horizontal visual impact. Visual impact throughout the entire active field of view.
60-80% of the panorama measure at 120˚FOV)	4	Increasing visual effect. A large proportion of the active field of view is affected.
40-60% of the panorama Measure at 120˚FOV	3	Moderate visual effect.
20-40% of the panorama measure at 120˚FOV)	2	Limited effect. The visual impact is a small part of the active field of view.
0-20% of the panorama measure at 120˚FOV)	1	No or minor visual effect.

2.4 Vertical Visual Effect (VVE)

The vertical visual effect evaluates the proportional scale of the development with reference to the vertical character of the existing landscape, as seen within the field of view of the assessed viewpoints.

The process of assessment is undertaken in 3 stages:

Stage 1:

The first stage of the process is to determine the vertical scale of the existing landscape. The baseline landscape scale is calculated using the photomontage viewpoint elevation (A) as a known reference height. The elevation of the viewpoint is recorded using a GPS. Using contour data, a second value (B) is recorded representing the highest topographic elevation within the field of view. Finally, the horizontal distance (C) between the viewpoint and the highest topographic feature is recorded. The vertical angle of view α_1 is then given as:

$\alpha_1 = \tan^{-1}((B-A)/C)$

as shown in Figure 6 below.

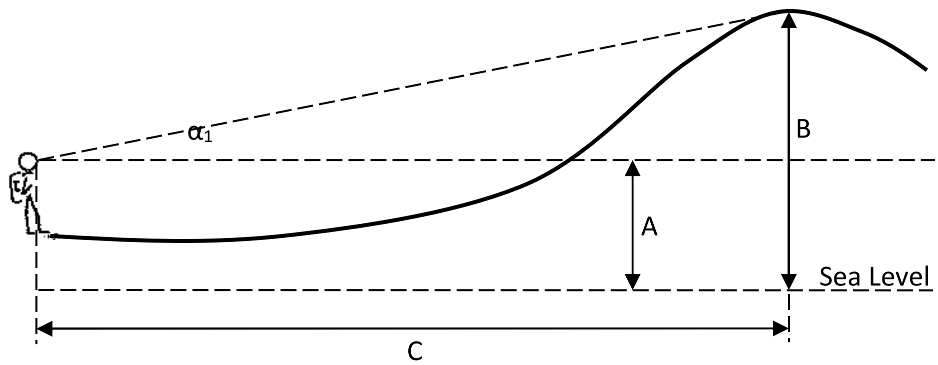


Figure 6: Vertical Scale of Existing Landscape

Stage 2:

The second stage of the process is to determine the vertical scale of the landscape modification, namely that of the apparent maximum turbine tip height as viewed from the viewpoint. Using the known turbine height (E), ground elevation (F) and its distance from the viewpoint (G), the vertical angle of view α_2 is then given by:

$\alpha_2 = \tan^{-1}((E+F - A)/G)$

as shown in Figure 7 below.

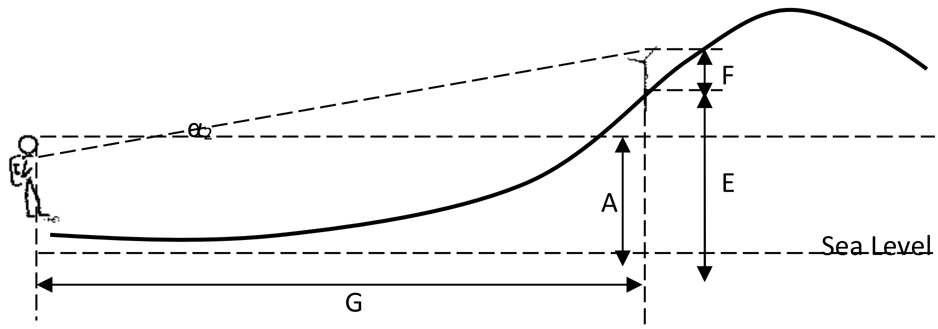


Figure 7: Vertical Scale of Landscape Modification

Stage 3:

The final stage of the process is to determine the overall proportion of the vertical scale of the development with reference to the existing landscape scale by taking the ratio of the two angles α_2 and α_1. Depending on the relative size of the vertical angles of view occupied by the existing and modified landscapes respectively, the ratio α_2 / α_1 will determine the nature and scale of the visual impact.

Depending on the relative scale of the angle of view occupied by the landscape and/or the development, the two vertical angles will depict whether there will be an increase in vertical visual impact created by the development ($\alpha_2 / \alpha_1 > 1$) or conversely the visual effect will be experienced as a vertical visual effect relative to the existing landscape scale ($\alpha_2 / \alpha_1 < 1$).

The vertical visual effect assessment will result in one of the following conditions:

- an increase in the overall vertical visual effect experienced from the viewpoint as a result of the combined vertical visual effect of the existing landscape character and the proposed development, or;

- a limited vertical visual effect as a result of the scale of the development being less than the existing landscape vertical scale when assessed from a viewpoint. This may be created by backdrop landforms or large ravines, valleys depicting a scale that within the field of view is greater than the development.

Either, the turbines or parts of the turbines are seen above ridgelines or landforms within the field of view and the effect will result in an increase in vertical visual effect, or the viewpoint contains large escarpments or deep valleys within the field of view and the vertical scale of the proposed wind turbines are likely to be seen as a proportion of the existing landscape scale resulting in a limited vertical visual effect.

In the first case (i.e. where $\alpha_2 / \alpha_1 > 1$), the proportional vertical visual impact should be assessed using Table 1 below. In the second case, the proportional vertical visual impact is considered minor and is assigned a value of 1.

Table 1 Proportional Vertical Visual Effect in existing landscape scale ($\alpha_2 / \alpha_1 > 1$)

Vertical Visual Impact (expressed as percentage increase ($\alpha_2 / \alpha_1 - 1$) x 100)	Value	Description of Visual Modification
80-100%	5	Substantial visual impact.
60-80%	4	Increasing visual impact
40-60%	3	Moderate visual impact.
20-40%	2	Limited impact
0-20%	1	No or minor visual impact within the landscape.

2.5 Distance of Visual Effect

This is a measurement of how visual impact is modified by distance. The effect of scale, topography, vegetation and weather, changes with distance, and in turn changes the degree of visual effect. The distance to the development from each viewpoint is recorded using the GPS. Standing onsite at each viewpoint the exact distance can be calculated by selecting the closest waypoint function (all the turbine locations are stored as waypoints in the GPS).

The distance categories outlined in the table below have been based on empirical research University of Newcastle (2002), Sinclair (2001), Bishop (2002).

Location of Development (from viewpoint)v	Value	Description
0 to 4 km (80-100%)	5	Adjacent: Dominant impact due to large scale, movement, proximity and number
4 to 8 km (60-80%)	4	Foreground: Major impact due to proximity: capable of dominating landscape
8 to 13 km (40-60%)	3	Middle ground: Clearly visible with moderate impact: potentially intrusive
13 to 18 km (20-40%)	2	Distant middle ground: Clearly visible with moderate impact becoming less distinct
18 km and greater (0-20%)	1	Background: Less distinct: size much reduced

2.6 Landscape Absorption Assessment

The aggregate of landscape absorption, horizontal and vertical effects and distance values determines the base visual impact value form the viewpoint. The following table summarises the definition of Visual Impact values

Visual Impact Value	Value	Description of Landscape Relief
16-20	High	High visual impact within the field of view
12-16	Moderate to increasing	Moderate to increasing visual impact within the field of view
8-12	Moderate	Moderate visual impact within the field of view
5-8	Limited	Limited visual impact within the field of view

3. Degree of Visual Impact (Percentage of Visual Change)

Degree of Visual Impact

The degree of Visual Impact is expressed as a coefficient of visual change to the baseline Landscape Value (general or viewpoint specific). This calculation directly expresses the effect of the development on the landscape, the change to the visual character and the reciprocal visual impact.

- Baseline Landscape Character : express as a value between 4 and 20)
- Coefficient of Visual Impact : calculated as the 20 divided by visual assessment value

Calculation of degree of Visual Impact

Coefficient x landscape character value expressed as a percentage = Visual Impact on Landscape Character

Example:

(a) Visual Impact Assessment

Horizontal visual effect	3
Vertical visual effect	1
Absorption capacity	3
Distance	2
Total visual effect	**9 (0.45)**

9/20 equated to a coefficient of ***0.45***

(b) Landscape Character Assessment

Relief	3
Vegetation coverage	3
Infrastructure built form	2
Cultural landscape overlays	2
Total landscape character	**10**

(c) 10 x 0.45 = 4.5

(d) 4.5/20 = 0.225

(e) 0.225 x 100 = 22.5% Visual Change to the Landscape

3.1 Final Aggregated Visual Effect

Percentage Value of Visual Change	Descriptive Qualification of Visual Effect	Comments
80-100%	Extreme	Extreme change in view: change very prominent involving total obstruction of existing view or change in character and composition of view through loss of key elements or addition of new or uncharacteristic elements which significantly alter underlying landscape visual character and amenity

60-80%	Severe	Severe change in view involving the obstruction of existing views or alteration to character through the introduction of new elements. Change may be different in scale and character from the surroundings and the wider setting. Resulting in a perceived increase in proportional change to the underlying landscape visual character.
40-60%	Substantial	Substantial change in view: which may involve partial obstruction of existing view or alteration of character and composition through the introduction of new elements. Composition of the view will alter. View character may be partially changed through the introduction of features.
20-40%	Moderate	Moderate change in view: change will be distinguishable from the surroundings whilst composition and underlying landscape visual character will be retained.
0-20%	Slight	Very slight change in view: change barely distinguishable from the surroundings. Composition and character of view substantially unaltered.

Appendix F
Glossary[2]

[2] *Visual Analysis of Windfarms Good Practice Guidance, Scottish Natural Heritage (2005)*

Active Field of View:	The field of view excluding peripheral vision, which is described as 40° to each eye, within this zone colour, shapes and forms are not registered. The active field of view removes the angle of peripheral vision from the field of view producing an angle of 120 - 160°
Assessment (landscape):	An umbrella term for description, classification and analysis of landscape.
Depth of Field:	The distance between the nearest point (viewpoint) and farthest objects (visual envelope) which is visible within the field of view.
Element:	A component part of the landscape or visual composition.
Effect (landscape or visual):	These occur as a broad culmination of one or more impacts, incorporating professional judgement to extrapolate and/or generalise on the nature of these.
Horizontal Visual Effect:	This term is used to describe the field of view occupied by the visible part of a wind farm.
Impact (landscape or visual):	Impacts occur to a particular element of the environment and they can be described factually by the nature and degree of change.
Landscape:	Human perception of the land conditioned by knowledge and identity with a place.
Landscape character:	The distinct and recognizable pattern of elements that occurs consistently in a particular type of landscape, and how people perceive this. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement. It creates the particular sense of place of different areas of the landscape.
Landscape feature:	A prominent eye-catching element, for example, wooded hilltop, isolated trees or grain silo.
Mitigation:	Measures, including any process, activity or design to avoid, reduce, remedy or compensate for adverse landscape and visual impacts of a development project.
Panorama:	A view, covering a wide field of view.
Photomontage:	A visualisation based on the superimposition of an image onto a photograph for the purpose of creating a realistic representation of proposed or potential changes to a view. These are now mainly generated using computer software.
Sensitivity:	The extent to which a landscape or visual composition can accommodate of a particular type and scale without adverse effects on its character or value.
Visual Amenity:	The value of a particular area or view in terms of what is seen.
Visual Envelope:	Extent of potential visibility to or from a specific area, viewpoint or feature.

Appendix G
Endnotes

[i] The GPS used was a Garmin X12 which differential-ready 12 parallel channel receiver continuously tracks and uses up to twelve satellites to compute and update a position

[ii] The SILVA precision M80 with a parallax free prismatic magnification-bearing compass. A magnetic bearing compass with a ± 0.5˚ from true magnetic course.

[iii] Pirenne, M.H. (1967). Vision and the Eye. London: Chapman and Hall

[iv] Panero, J. & Zelnik, M. (1979) Human Dimension & Interior Space- A source Book of Design Reference Standards. The Architectural Press Ltd. London.

[v] The distance zones have been developed Sinclair Thomas Matrix, which has cited field observations of the visual extents. The classification zones have been based on projected 90-100m high turbines.

Aviation Impact Assessment

by Aviation Projects

January 2025

AVIATION IMPACT ASSESSMENT

TWIN CREEK WIND FARM

Prepared for MasterPlan (on behalf of RES Australia Pty Ltd)

AVIATION PROJECTS

DOCUMENT CONTROL

Document Title: Twin Creek Wind Farm – Aviation Impact Assessment

Reference: 101808-04

Prepared by: J Bell \ L Wang

Reviewed by: P White

Released by: J Bell \ L Wang

REVISION HISTORY

Version	*Description*	*Transmitted*	*Reviewed by*	*Date*
0.1	First draft	09 October 2023	MasterPlan/RES	13 October 2023
0.2	Second draft	27 October 2023	MasterPlan/RES	14 November 2023
0.3	Third draft – update to ALA in vicinity	14 November 2023	MasterPlan/RES	November 2024
0.4	Update to WTG 30 and site boundary	31 January 2024	MasterPlan/RES	19 March 2024
1.0	Final Version	16 April 2024	MasterPlan/RES	19 April 2024
1.1	Final re-issued			
1.2	Final re-issued	24 September 2024		
1.3	Updated Final	07 January 2025		

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AVIATION PROJECTS

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ACRONYMS

AAAA	Aerial Application Association of Australia
AC	Advisory Circular
AFAC	Australasian Fire and Emergency Services Council
AGL	above ground level
AHD	Australian Height Datum
AIA	aviation impact assessment
AIP	Aeronautical Information Package
AIS	aviation impact statement
ALA	aircraft landing area
ALARP	as low as reasonably practicable
AMSL	above mean sea level
ARP	Aerodrome Reference Point
AS	Australian Standards
AsA	Airservices Australia
ATSB	Australian Transport Safety Bureau
BoM	Bureau of Meteorology
CAAP	Civil Aviation Advisory Publications
CAO	Civil Aviation Orders
CAR	Civil Aviation Regulation (1988)
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation (1998)
CFIT	controlled flight into terrain
CNS	communications, navigation and surveillance
CTAF	common traffic advisory frequency
DAH	Designated Airspace Handbook
EIS	environmental impact statement
ERC-H	en-route chart high
ERC-L	en-route chart low
ERSA	En Route Supplement Australia
GA	general aviation

ICAO	International Civil Aviation Organization
IFR	instrument flight rules
IMC	instrument meteorological conditions
LGA	local government area
LSALT	lowest safe altitude
MOC	minimum obstacle clearance
MOS	Manual of Standards
MSA	minimum sector altitude
NASAG	National Airports Safeguarding Advisory Group
NASF	National Airports Safeguarding Framework
NDB	non-directional (radio) beacon
OLS	obstacle limitation surface
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations
PSR	primary surveillance radar
RAAF	Royal Australian Air Force
RFDS	Royal Flying Doctor Service
RPT	regular public transport
RSR	route surveillance radar
SSR	secondary surveillance radar
VFR	visual flight rules
VFRG	visual flight rules guide
VMC	visual meteorological conditions
WMTs	wind monitoring towers
WTGs	wind turbine generators

UNITS OF MEASUREMENT

ft	feet	(1 ft = 0.3048 m)
km	kilometres	(1 km = 0.5399 nm)
m	metres	(1 m = 3.281 ft)
nm	nautical miles	(1 nm = 1.852 km)

DEFINITIONS

Definitions of key aviation terms are included in **Annexure 2**

NOTES

Nil

EXECUTIVE SUMMARY

Introduction

Res Australia Pty Ltd (RES – the Proponent) is proposing to develop the Twin Creek Wind Farm, located approximately 9 km east-northeast of the town of Kapunda, 14.5 km northeast of the town of Nuriootpa and 77 km northeast of the City of Adelaide, in the Mid-North region of South Australia.

RES obtained planning consent in 2019 for a 3.6MW wind farm consisting of up to 51 wind turbine generators (WTGs) with a tip height of 180 m above ground level (AGL), as well as associated energy storage and transmission infrastructure (the approved Project). Since consent was granted, RES have developed an optimised configuration (the Project), consisting of up to 42 wind turbine generators, (WTG) each with a proposed capacity of 7.2MW, and height of up to 220m AGL, a Battery Energy Storage System (BESS) with 215MW indicative storage capacity and associated transmission and connection infrastructure. MasterPlan is assisting RES with town planning advice and technical studies and has requested Aviation Projects to provide an aviation impact assessment of the Project.

This report, Aviation Impact Assessment (AIA), has been prepared to support a new development application by the Proponent for the optimised Project.

The AIA has been prepared in response to the Civil Aviation Safety Regulations 1998, associated Manuals of Standards and other guidance material provided by CASA, the National Airports Safeguarding Framework (NASF) Guideline D: *Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers,* and specific requirements as advised by Airservices Australia.

This AIA assesses the potential aviation impacts associated with the Project and provides aviation safety advice in respect of relevant requirements of air safety regulations and procedures and informs and documents consultation with relevant aviation agencies.

This AIA report includes an Aviation Impact Statement (AIS) and a qualitative risk assessment to determine the need for obstacle lighting and marking.

Project description

The Twin Creek wind farm will comprise the following infrastructure relevant to this aviation impact assessment:

- Up to 42 wind turbines with a maximum overall height (tip height) of up to 220 m above ground level (AGL)
- The highest proposed wind turbine is WTG7 with a ground elevation of 486.1 m Australian Height Datum (AHD) (with 5 m buffer) and overall height of 706.1 m AHD (2317 ft AMSL)
- Associated power storage and transmission infrastructure, including an overhead transmission line connecting to the existing grid via a cut-in terminal substation, east of Truro.

Conclusions

Based on a comprehensive analysis and assessment detailed in this report, the following conclusions were made:

Certified airports

1. The Project is not located within 30 nm of any certified aerodrome, and therefore will not affect any Procedures for Air Navigation Services - Aircraft Operations PANS-OPS surfaces or obstacle limitation surfaces.

Aircraft Landing Areas (ALAs)

2. There are no active verified or ALAs located within 3 nm of the Project, including the transmission line. There is one unverified ALA identified within 3 nm of the Project, however is not anticipated to be affected by the Project.

Air Routes and Lowest Safe Altitude

3. The Project will not affect any route or grid lowest safe altitude.

Aviation Facilities

4. The Project will not penetrate any protection areas associated with aviation facilities.

Radar

5. Due to the distance and intervening terrain between the Project and the primary and secondary radar facilities located at Adelaide airport, it is anticipated there will be no impact to radar facilities. Airservices Australia may conduct a simple assessment on the potential impact of the Project on the Adelaide airport primary radar facility.

Aviation Impact Statement (AIS)

6. Based on the Project WTG layout and maximum blade tip height of up to 220 m AGL, the blade tip elevation of the highest WTG will not exceed 706.1 m AHD (2317 ft AMSL), and:

    a) is not located within 30 nm of any certified aerodrome and will not affect any terminal instrument flight procedures

    b) will not penetrate any OLS surfaces

    c) will not have an impact on nearby designated air routes

    d) will not have an impact on the grid LSALT of 3400 ft established in ERC Low and 3800 ft established in ERC High

    e) will not have an impact on operational airspace

    f) is wholly contained within Class G airspace

    g) is outside the clearance zones associated with civil aviation navigation aids and communication facilities.

Obstacle lighting risk assessment

7. Aviation Projects has undertaken a safety risk assessment of the Project and concludes that the proposed WTGs will not require obstacle lighting to maintain an acceptable level of safety to aircraft

Consultation

8. Refer to Section 5 for detailed responses from relevant aviation stakeholders.

Summary of key recommendations

A summary of the key recommendations of this AIA is set out below.

The full list of recommendations and associated details are provided in Section 11 'Recommendations' at the end of this report.

1. 'As constructed' details of the coordinates and elevations of the WTGs should be provided to Airservices Australia, using the Vertical Obstruction Data form (https://www.airservicesaustralia.com/wp-content/uploads/ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf to the following email address: vod@airservicesaustralia.com
2. The Proponent should consider engaging with local aerial agricultural operators and aerial firefighting operators during construction in developing procedures for such aircraft operations in the vicinity of the Project site.
3. Details of the final wind farm layout should be provided to local and regional aircraft operators prior to construction so they can plan their operations accordingly.
4. Overhead transmission lines and/or supporting poles associated with the Project that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial agriculture operators and marked in accordance with Part 139 Manual of Standards (MOS) Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8) where applicable.

1. INTRODUCTION

1.1. Situation

RES is planning the development of the optimised Twin Creek Wind Farm (the Project) in the Mid-North region of South Australia, approximately 77 km northeast of the City of Adelaide. The Project is proposed to consist of up to 42 wind turbine generators (WTGs) with a maximum tip height of up to 220 m above ground level (AGL).

This AIA assesses the potential aviation impacts, provides aviation safety advice in respect of relevant requirements of air safety regulations and procedures, and informs and documents consultation with relevant aviation agencies.

This AIA report includes an Aviation Impact Statement (AIS) and a qualitative risk assessment to determine the need for obstacle lighting and other applicable mitigation.

1.2. Purpose and Scope

The purpose and scope of work is to prepare an AIA for consideration by Airservices Australia, CASA and Department of Defence and support a development application to be submitted to the State Commission Assessment Panel under the Planning, Development and Infrastructure Act 2016.

The AIA specifically responds to the following key legislation, approvals, and guidance material:

- Government of South Australia, PlanSA, Planning and Design Code, Version 2023.13
- Civil Aviation Safety Authority, Civil Aviation Safety Regulations 1998 (CASR) and associated material
- NASF Guideline D: Managing the Risk to aviation safety of wind turbine installations (wind farms)/Wind Monitoring Towers
- Other specific requirements as advised by Airservices Australia.

1.3. Methodology

Aviation Projects conducted the task in accordance with the following methodology:

1. Confirm the scope and deliverables with the Proponent (or representative)
2. Review client material
3. Review relevant regulatory requirements and information sources
4. Prepare a draft AIA and supporting technical data
5. Prepare an AIS and a qualitative risk assessment to determine need for obstacle lighting and marking
6. Identify risk mitigation strategies that provide an acceptable alternative to night lighting. The risk assessment was completed following the guidelines in *ISO 31000:2018 Risk Management – Guidelines*
7. Consult with relevant Councils (if required), Part 173 procedure designers (if required) and aerodrome operators of the nearest aerodrome/s to seek endorsement of the proposal to change instrument procedures (if applicable)
8. Consult/engage with stakeholders to negotiate acceptable outcomes (if required)

9. Finalise the AIA report.

1.4. Aviation Impact Statement (AIS)

The AIS included in this report (see Section 6) includes the following specific requirements as advised by Airservices Australia:

Aerodromes:

- Specify all certified aerodromes that are located within 30 nm (55.56 km) of the project site
- Nominate all instrument approach and landing procedures at these aerodromes
- Review the potential effect of the Project operations on the operational airspace of the aerodrome(s)

Air Routes:

- Nominate air routes published in ERC-L & ERC-H which are located near/over the project site and review potential impacts of Project operations on aircraft using those air routes
- Specify two waypoint names located on the routes which are located before and after the obstacles

Airspace:

- Nominate the airspace classification – A, B, C, D, E, G etc where the project site is located

Navigation/Radar:

- Nominate radar navigation systems with coverage overlapping the site.

1.5. Material reviewed

Material provided by the Proponent for preparation of this assessment include:

- Project GIS, Site_Boundary_20231213.shp, received by email 10 January 2024
- Project GIS, Infrastructure, infrastructures_paustwc064_unlocked_20231220.kml, received by email 10 January 2024
- Project GIS, *Twin Creek Preliminary Site Layout 20231011.kmz*, received by email 13 October 2023
- WTG location and elevation, *Turbine Layout PAUStwc060 (Coordinates, Elevation & Dimensions)*.xlsx, received by email 06 September 2023

2. BACKGROUND

2.1. Site overview

The closest townships to the wind farm include Truro, located approximately 10 km southeast of the nearest proposed WTG location, Eudunda, approximately 11 km north of the nearest WTG, and Kapunda, approximately 12 km west of the nearest proposed WTG location. The City of Adelaide is located approximately 77 km southwest of the Project Area.

The Project is located across three Local Government Areas, the Regional Council of Goyder, Light Regional Council and Mid-Murray Council.

An overview of the Project Area relative to nearby townships, as well the Sturt and Thiele highways is provided in Figure 1 (source: RES, Google Earth).

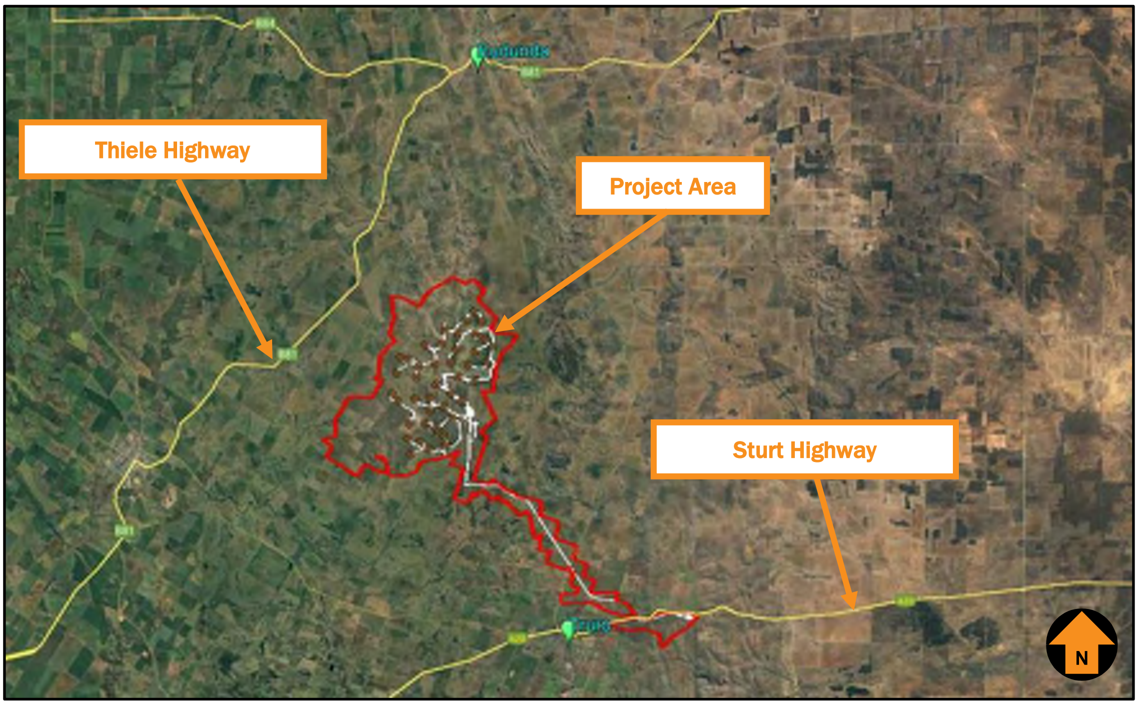

Figure 1 Project Site Overview

2.2. Project description

The Twin Creek wind farm is proposed to include the development of wind turbines with a tip height of up to 220 m AGL. The Project also includes 1 substation within the Project boundary, an overhead transmission line connecting to the existing grid via cut-in substation east of Truro, and up to 215MW indicative Battery Energy Storage System (BESS).

The layout of WTGs and the transmission line route is shown in Figure 2 (Source, RES, Google Earth).

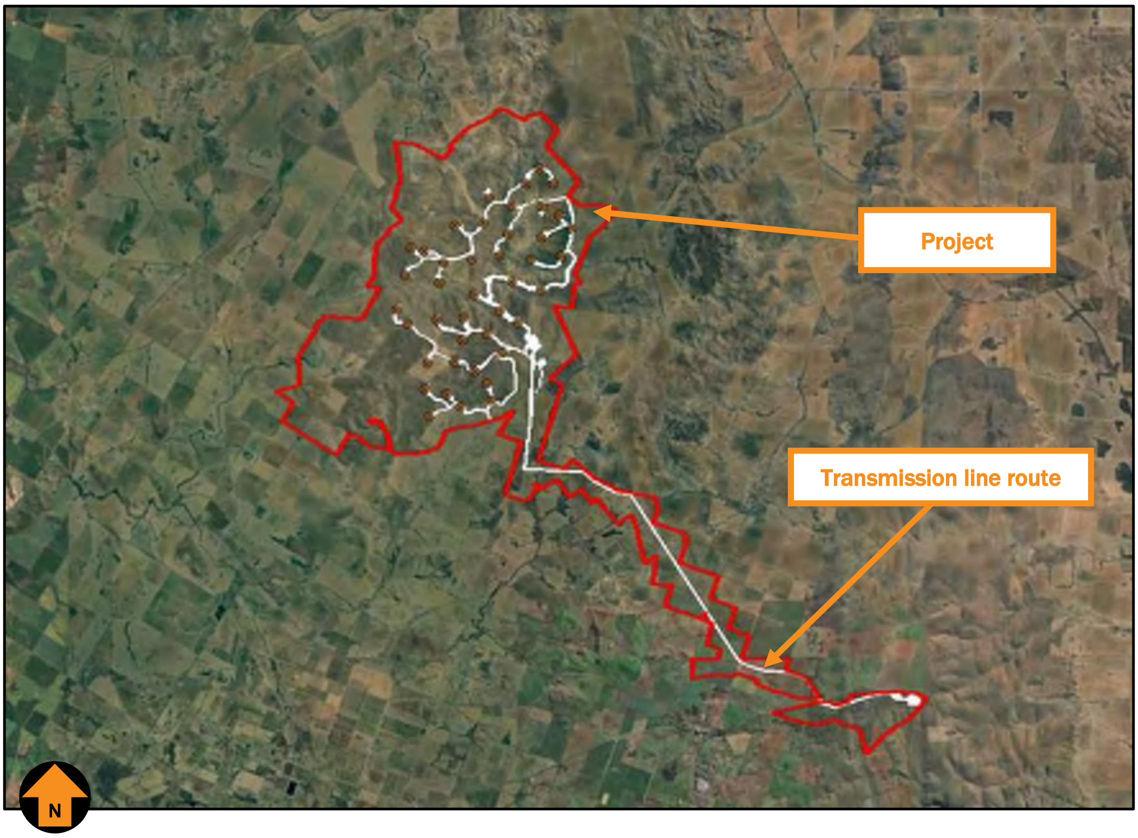

Figure 2 Project Layout

Table 1 shows the location(s) and site elevation(s) for each proposed WTG site. Site elevation for each WTG site has been provided by RES, with a 5 m buffer applied to each WTG site for this assessment. The WTG location responsible for the maximum Project height is highlighted.

The maximum Project height is identified as:

- WTG7, with a maximum tip height of 706.1 m AHD (2317 ft AMSL)

Table 1 WTG location and elevation

WTG ID	*Easting (m)*	*Northing (m)*	*Site elevation (m AHD)*	*+ 5 m buffer*	*Tip height m AGL*	*Maximum Height m AHD*	*Maximum Height (ft AMSL)*
1	323482	6205173	447.6	452.6	220	672.6	2207
2	323844	6204801	439	444	220	664	2179
3	322201	6204396	448.4	453.4	220	673.4	2209
4	322781	6204223	442.3	447.3	220	667.3	2189
5	323566	6204209	424.1	429.1	220	649.1	2130
6	324007	6203993	441.4	446.4	220	666.4	2186

WTG ID	Easting (m)	Northing (m)	Site elevation (m AHD)	+ 5 m buffer	Tip height m AGL	Maximum Height m AHD	Maximum Height (ft AMSL)
7	324334	6203665	481.1	486.1	220	706.1	2317
8	321322	6203691	384.6	389.6	220	609.6	2000
9	322058	6203763	412.3	417.3	220	637.3	2091
10	322708	6203496	444.7	449.7	220	669.7	2197
11	323556	6203423	412.4	417.4	220	637.4	2091
12	324074	6202948	458.2	463.2	220	683.2	2242
13	320069	6203120	335.4	340.4	220	560.4	1839
14	320581	6202968	348.9	353.9	220	573.9	1883
15	321043	6202736	361.4	366.4	220	586.4	1924
16	321778	6202844	392.6	397.6	220	617.6	2026
17	322495	6202951	417.7	422.7	220	642.7	2109
18	323294	6202849	412.7	417.7	220	637.7	2092
19	320050	6202407	338.8	343.8	220	563.8	1850
20	320949	6202223	349.5	354.5	220	574.5	1885
21	321858	6201934	402.2	407.2	220	627.2	2058
22	322825	6202282	411.9	416.9	220	636.9	2090
23	323676	6202324	438.7	443.7	220	663.7	2178
24	319861	6201508	344.5	349.5	220	569.5	1869
25	320144	6201172	338	343	220	563	1847
26	320893	6201273	372	377	220	597	1959
27	321600	6201336	414.8	419.8	220	639.8	2099
28	322524	6201525	435.6	440.6	220	660.6	2167
29	322988	6201226	430.3	435.3	220	655.3	2150
30	323145	6204792	457	462	220	682	2238
31	321451	6200769	384.4	389.4	220	609.4	1999
32	322195	6200924	440	445	220	665	2182
33	322603	6200463	423.4	428.4	220	648.4	2127
34	320685	6200154	367.1	372.1	220	592.1	1943
35	321376	6200207	386.6	391.6	220	611.6	2007
36	321917	6199967	418.3	423.3	220	643.3	2111

WTG ID	Easting (m)	Northing (m)	Site elevation (m AHD)	+ 5 m buffer	Tip height m AGL	Maximum Height m AHD	Maximum Height (ft AMSL)
37	322228	6199655	410.6	415.6	220	635.6	2085
38	322352	6199232	407.6	412.6	220	632.6	2076
39	320630	6199500	386.5	391.5	220	611.5	2006
40	321197	6199375	391.7	396.7	220	616.7	2023
41	321557	6199056	408.4	413.4	220	633.4	2078
42	320763	6198805	408.9	413.9	220	633.9	2080

2.3. Wind monitoring tower description

A wind monitoring tower (WMT) is installed in the northern part of the Project Area with a height of 101 m AGL. The WMT is temporary and is anticipated to be decommissioned prior to the construction of the wind farm.

3. EXTERNAL CONTEXT

This chapter explores the federal, state, and local planning context that may impact the Project. Each section will explore and respond to the planning context to identify any conflict between the Project and applicable planning requirements.

3.1. South Australian Government – planning context

Development consent was provided in October 2019 for the Twin Creek Wind Farm and Energy Storage Project consisting of 51 WTGs up to 180 m AGL tip height. RES intends to submit a new development application to the State Commission Assessment Panel for the (optimised) Project under the Planning, Development and Infrastructure Act 2016.

Crown Sponsorship has been granted by the Department for Energy and Mining for the development of the Twin Creek Wind Farm and Energy Storage Project to occur as essential infrastructure.

The Project will be subject to the South Australian Planning and Design Code, made under the Planning, Development and Infrastructure Act 2016.

The Code divides development into categories based on its classification under the Code as either:

a) accepted development

b) deemed-to-satisfy development

c) restricted development

d) performance assessed

Relevant to the development of renewable energy facilities is the performance outcome specified in the Infrastructure and Renewable Energy Facilities General Development Policy PO 4.1:

> *Infrastructure and renewable energy facilities and ancillary development located and operated to not adversely impact maritime or air transport safety, including the operation of ports, airfields and landing strips.*

This aviation assessment will examine the impact of the Project on air transport safety. There are no Airport-related overlays applicable to the Project Area.

3.2. National Airports Safeguarding Framework

The National Airports Safeguarding Advisory Group (NASAG) was established by Commonwealth Department of Infrastructure and Transport to develop a national land use planning framework called the National Airports Safeguarding Framework (NASF). The purpose of the NASF is to enhance the current and future safety, viability, and growth of aviation operations at Australian airports through:

- the implementation of best practice in relation to land use assessment and decision making in the vicinity of airports
- assurance of community safety and amenity near airports
- better understanding and recognition of aviation safety requirements and aircraft noise impacts in land use and related planning decisions
- the provision of greater certainty and clarity for developers and landowners

- improvements to regulatory certainty and efficiency
- the publication and dissemination of information on best practice in land use and related planning that supports the safe and efficient operation of airports.

NASF Guideline D: *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers*, provides guidance to State/Territory and local government decision makers, airport operators and developers of wind farms to jointly address the risk to civil aviation arising from the development, presence and use of wind farms and WMTs.

The methodology for preparing the risk assessment is contained in the NASF Guideline D Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation.

The risk assessment will have regard to all potential aviation activities within the vicinity of the Project site including recreation, commercial, civil (including for agricultural purposes) and military operations.

NASF Guideline D strongly encourages consultation with aviation stakeholders in the early stages of wind farm development planning, including with aerodrome owners and operators, regional aircraft operators and CASA and Airservices.

3.3. Aircraft operations at non-controlled aerodromes

Advisory Circulars (ACs) provide advice and guidance from CASA to illustrate a means, but not necessarily the only means, of complying with the Regulations, or to explain certain regulatory requirements. Advisory Circular (AC) 91-10 v1.1 *Operations in the vicinity of non-controlled aerodromes* provides guidance for pilots flying at or in the vicinity of non-controlled aerodromes, with respect to CASR 91.

A conventional circuit pattern and heights are provided in AC 91-10 v1.1. The standard circuit consists of a series of flight paths known as *legs* when departing, arriving or when conducting circuit practice. Illustrations of the standard aerodrome traffic circuit procedures provided in AC 91-10 v1.1. are shown in Figure 3 and Figure 4.

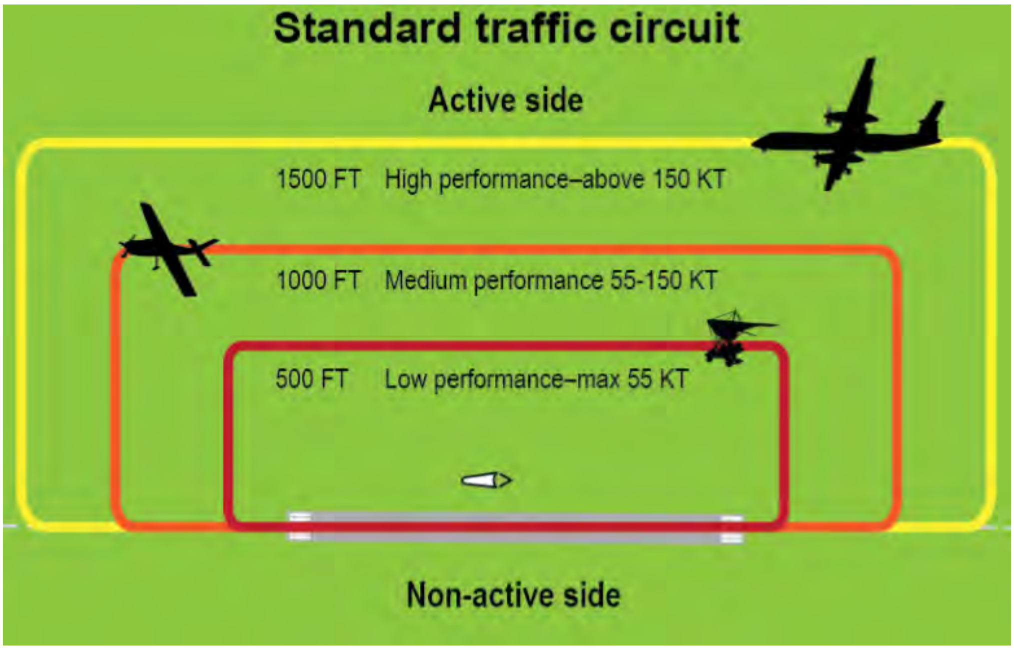

Figure 3 Lateral and vertical separation in the standard aerodrome traffic circuit

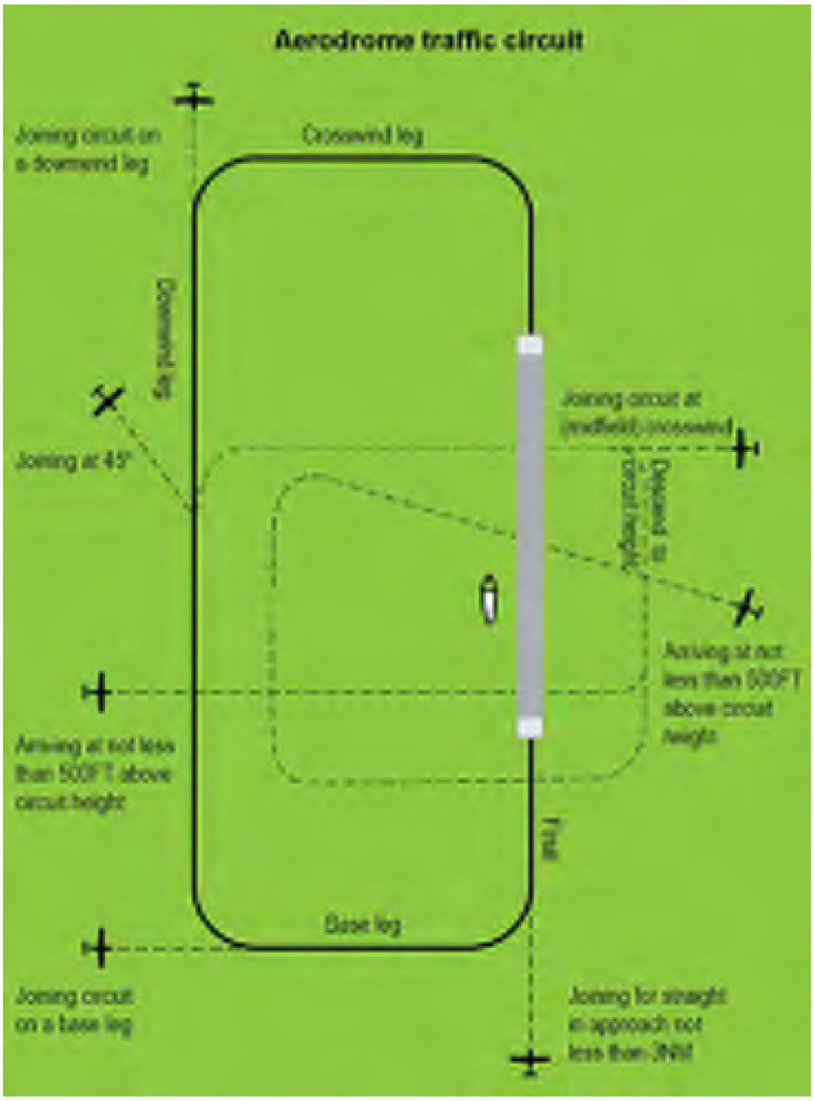

Figure 4 Aerodrome standard traffic circuit, showing arrival and joining procedures

AC 91-10 v1.1. paragraph 7.10 makes reference to a distance that is “normally” well outside the circuit area and where no traffic conflict exists, which is at least 3 nm (5556 m). The paragraph is copied below:

> *7.10 Departing the circuit area*
>
> *7.10.1 Aircraft should depart the aerodrome circuit area by extending one of the standard circuit legs or climbing to depart overhead. However, the aircraft should not execute a turn to fly against the circuit direction unless the aircraft is well outside the circuit area and no traffic conflict exists. This will normally be at least 3 NM from the departure end of the runway, but may be less for aircraft with high climb performance. In all cases, the distance should be based on the pilot’s awareness of traffic and the ability of the aircraft to climb above and clear of the circuit area.*

3.4. Rules of flight

3.4.1. Flight under Day Visual Flight Rules (VFR)

According to Aeronautical Information Publication (AIP) the meteorological conditions required for visual flight in the applicable (Class G) airspace at or below 3000 ft AMSL or 1000 ft AGL whichever is the higher are: 5000 m visibility, clear of clouds and in sight of ground or water.

Civil Aviation Safety Regulation (1998) 91.267 (Minimum height rules—other areas) prescribes the minimum height for flight. Generally speaking, and unless otherwise approved, aircraft are restricted to a minimum height of 500 ft AGL above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas, and 1000 ft AGL over built up areas (within a horizontal radius of 600 m of the point on the ground or water immediately below the aeroplane).

These height restrictions do not apply if through stress of weather or any other unavoidable cause it is essential that a lower height be maintained.

Flight below these height restrictions is also permitted in certain other circumstances.

3.4.2. Night VFR

With respect to flight under the VFR at night, Civil Aviation Safety Regulations (1998) 91.277 requires that the pilot in command of an aircraft flying VFR at night must not fly below the following heights (unless during take-off and landing operations, within 3 nm of an aerodrome, or with an air traffic control clearance):

a) *the published lowest safe altitude for the route or route segment (if any);*

b) *the minimum sector altitude published in the authorised aeronautical information for the flight (if any);*

c) *the lowest safe altitude for the route or route segment;*

d) *1,000 ft above the highest obstacle on the ground or water within 10 nautical miles ahead of, and to either side of, the aircraft at that point on the route or route segment;*

e) *the lowest altitude for the route or route segment calculated in accordance with a method prescribed by the Part 91 Manual of Standards for the purposes of this paragraph.*

3.4.3. Instrument Flight Rules (Day or night) (IFR)

According to CASR 91, flight under the instrument flight rules (IFR) requires an aircraft to be operated at a height clear of obstacles that is calculated according to an approved method.

3.5. Aircraft operator characteristics

Aircraft operations in the vicinity of the Project area are likely to be mostly private and recreational aircraft including powered and glider aircraft associated with the Adelaide Soaring club at Gawler aerodrome and Adelaide University Gliding Club at Stonefield gliding aerodrome, aerial application aircraft and military aircraft operating in designated restricted airspace overhead and adjacent the Project Area.

Air transport operations are generally conducted under the instrument flying rules (IFR), while aerial work and private and recreational activities are likely to be conducted under visual flying rules (VFR).

Operations conducted under VFR are required to remain in visual meteorological conditions (VMC) (at least 5,000 m horizontal visibility at a similar height of the wind turbines) and clear of the highest point of the terrain by 500 ft vertical distance and 300 m horizontal distance. In visual meteorological conditions (VMC), the wind turbines will likely be sufficiently conspicuous to allow adequate time for pilots to avoid the obstacles. VFR operators will most likely avoid the Project Area once wind turbines are erected.

IFR and Night VFR (which are required to conform to IFR applicable altitude requirements) aircraft operations are addressed in Section 6.

3.6. Military operations

There may be some high-speed low-level military jet aircraft and helicopter operations conducted in the area, in restricted airspace overhead the Project Area, at a minimum height of 3500 ft AMSL.

3.7. Aerial application operations

Aerial application operations including such activities as fertiliser, pest and crop spraying are generally conducted under day VFR below 500 ft AGL; usually between 6.5 ft (2 m) and 100 ft (30.5 m) AGL.

The standard response from the Aerial Application Association of Australia in relation to wind farms has been included in Section 3.8 (below) for reference. Objections to windfarms are generally related to large scale wind farm projects in active areas of agriculture located in the vicinity of aerial agriculture operations.

There may be aerial application operations associated with fertiliser, pest and crop spraying in the area.

3.8. Aerial Application Association of Australia (AAAA)

In previous consultation with the AAAA, Aviation Projects has been directed to the AAAA Windfarm Policy (dated March 2011) which states in part:

> *As a result of the overwhelming safety and economic impact of wind farms and supporting infrastructure on the sector, AAAA opposes all wind farm developments in areas of agricultural production or elevated bushfire risk.*
>
> *In other areas, AAAA is also opposed to wind farm developments unless the developer is able to clearly demonstrate they have:*
>
> > *1. consulted honestly and in detail with local aerial application operators;*
> >
> > *2. sought and received an independent aerial application expert opinion on the safety and economic impacts of the proposed development;*
> >
> > *3. clearly and fairly identified that there will be no short or long term impact on the aerial application industry from either safety or economic perspectives;*
> >
> > *4. if there is an identified impact on local aerial application operators, provided a legally binding agreement for compensation over a fair period of years for loss of income to the aerial operators affected; and*
> >
> > *5. adequately marked any wind farm infrastructure and advised pilots of its presence.*

AAAA had developed National Windfarm Operating Protocols (adopted May 2014). These protocols note the following comments:

> *At the development stage, AAAA remains strongly opposed to all windfarms that are proposed to be built on agricultural land or land that is likely to be affected by bushfire. These areas are of critical safety importance to legitimate and legal low-level operations, such as those encountered during crop protection, pasture fertilisation or firebombing operations.*
>
> *However, AAAA realises that some wind farm proposals may be approved in areas where aerial application takes place. In those circumstances, AAAA has developed the following national operational protocols to support a consistent approach to aerial application where windfarms are in the operational vicinity.*

The protocols list considerations for developers during the design/build stage and the operational stage, for pilots/aircraft operators during aircraft operations and discusses economic compensation. NASF Guideline D is included in the Protocols document as Appendix 1, and AAAA Aerial Application Pilots Manual – excerpts on planning are provided as Appendix II.

This AIA has been prepared in consideration of the National Windfarm Operating Protocols, noting there are no known aerial application operations associated with fertiliser, pest and crop spraying in the area.

3.9. Local aerial application operators

Aerial application operators consulted in previous studies undertaken by Aviation Projects have stated that a wind farm would, in all likelihood, prevent aerial agricultural operations in that particular area, but that properties adjacent to the wind farm would have to be assessed on an individual basis.

Aerial application operators generally align their positions with the AAAA policies.

Based on previous studies undertaken by Aviation Projects, and subject to the results of consultation with AAAA and any further consultation with local aerial application operators, it is reasonable to conclude that safe aerial application operations would still be possible on properties within the Project site and neighbouring the Project site, by implementing recommendations provided in this report.

The use of helicopters enables aerial application operations to be conducted in closer proximity to obstacles than would be possible with fixed wing aircraft due to their greater manoeuvrability.

It is possible that fixed wing aerial agriculture operations will be conducted in the vicinity of the Project.

3.10. Aeromedical services – Royal Flying Doctor Service

Royal Flying Doctor Service (RFDS) and other emergency services operations are generally conducted under the IFR, except when arriving/departing a destination that is not serviced by instrument approach aids or procedures.

Most emergency aviation services organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained.

RFDS have previously indicated to Aviation Projects that wind farm development more than 3 nm from an aerodrome to be used for RFDS operations is not a concern.

3.11. Aerial firefighting

Aerial firefighting operations (firebombing in particular) are conducted under Day VFR, sometimes below 500 ft AGL. Under certain conditions visibility may be reduced/limited by smoke/haze.

Most aerial firefighting organisations have formal risk management programs to assess the risks associated with their operations and implement applicable treatments to ensure an acceptable level of safety can be maintained. For example, pilots require specific training and approvals, additional equipment is installed in the aircraft, and special procedures are developed.

The Australasian Fire and Emergency Services Council (AFAC) has developed a national position on wind farms, their development and operations in relation to bushfire prevention, preparedness, response and recovery, set out in the document titled *Wind Farms and Bushfire Operations*, version 3.0, dated 25 October 2018.

Of specific interest in this document is the section extracted verbatim from under the 'Response' heading, copied below:

> *Wind farm operators should be responsible for ensuring that the relevant emergency protocols and plans are properly executed in an emergency event. During an emergency, operators need to react quickly to ensure they can assist and intervene in accordance with their planned procedures.*
>
> *The developer or operator should ensure that:*
>
> - *liaison with the relevant fire and land management agencies is ongoing and effective*
> - *access is available to the wind farm site by emergency services response for on-ground firefighting operations*
> - *wind turbines are shut down immediately during emergency operations – where possible, blades should be stopped in the 'Y' or 'rabbit ear' position, as this positioning allows for the maximum airspace for aircraft to manoeuvre underneath the blades and removes one of the blades as a potential obstacle.*
>
> *Aerial personnel should assess risks posed by aerial obstacles, wake turbulence and moving blades in accordance with routine procedures.*

Fixed wing aerial firefighting operations may be conducted in the vicinity of the Project.

4. INTERNAL CONTEXT

4.1. Wind farm description

The Twin Creek wind farm will comprise of up to 42 WTGs with a maximum height of up to 220 m AGL tip height, together with associated infrastructure.

The Project will be located on rural cropping and pastoral land.

The main permanent wind farm components of the proposed Project will include the following:

- A maximum of 42 WTGs with a maximum tip height of up to 220 m AGL
- Hard standing areas for WTG construction
- Access tracks
- Battery Energy Storage System (BESS)
- On-site substation and terminal substation located east of Truro
- Overhead cabling and unground cabling as required (linking WTGs to site sub-station)

Design elements are subject to detailed design over the course of development.

Figure 5 and Figure 6 show the general nature of the Project area. These locations are generally representative of the nature of Project area for all proposed WTG sites.

Figure 5 Southern Project Area

Figure 6 Photo facing southeast towards northwest Project Area

4.2. Wind turbine generator (WTG) description

The maximum blade tip height of the proposed wind turbines will be up to 220 m AGL.

Figure 7 demonstrates the Project layout identifying the highest proposed wind turbine WTG-7 (source: RES, Google Earth).

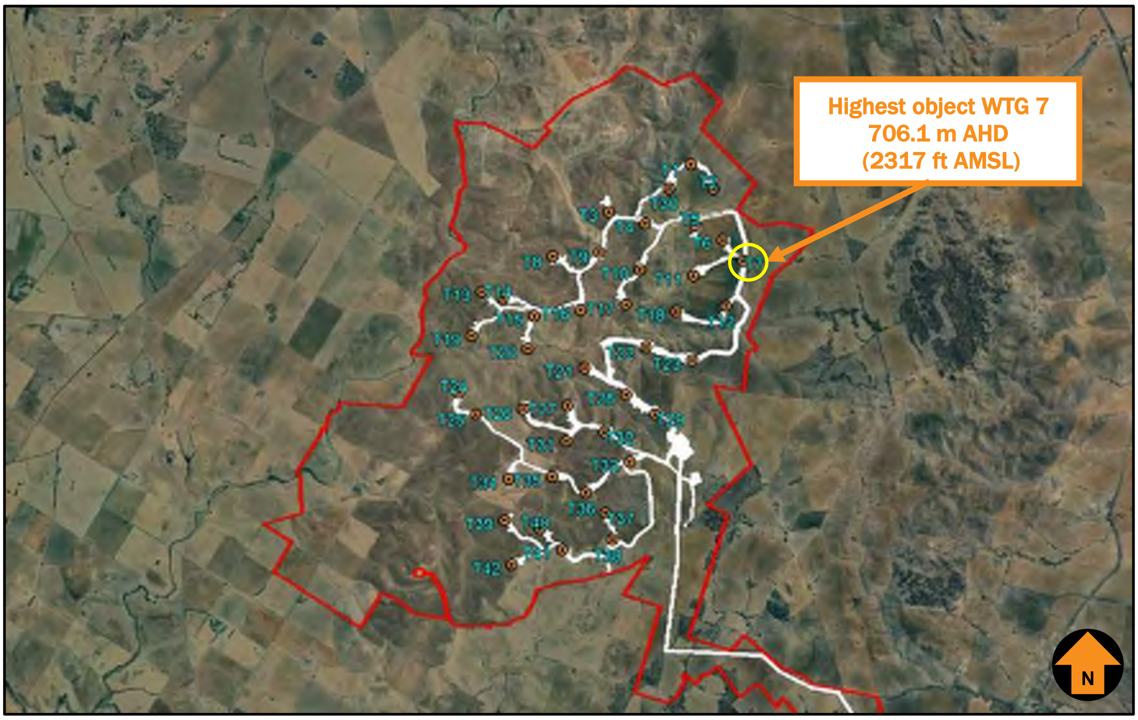

Figure 7 Proposed WTG locations and highest elevation WTG (WTG-7)

4.3. Grid transmission

The Project will connect to the ElectraNet 275kV powerline via a cut-in terminal substation east of the town of Truro.

It is understood the WTGs will be connected via underground cables, with an overhead transmission line connecting the wind farm from the on-site substation to the ElectraNet 275kV powerline.

Figure 8 and Figure 9 show the configuration of the grid transmission infrastructure (Source, RES, Drawing No. 03498-RES-MAP-DR-TE-015)

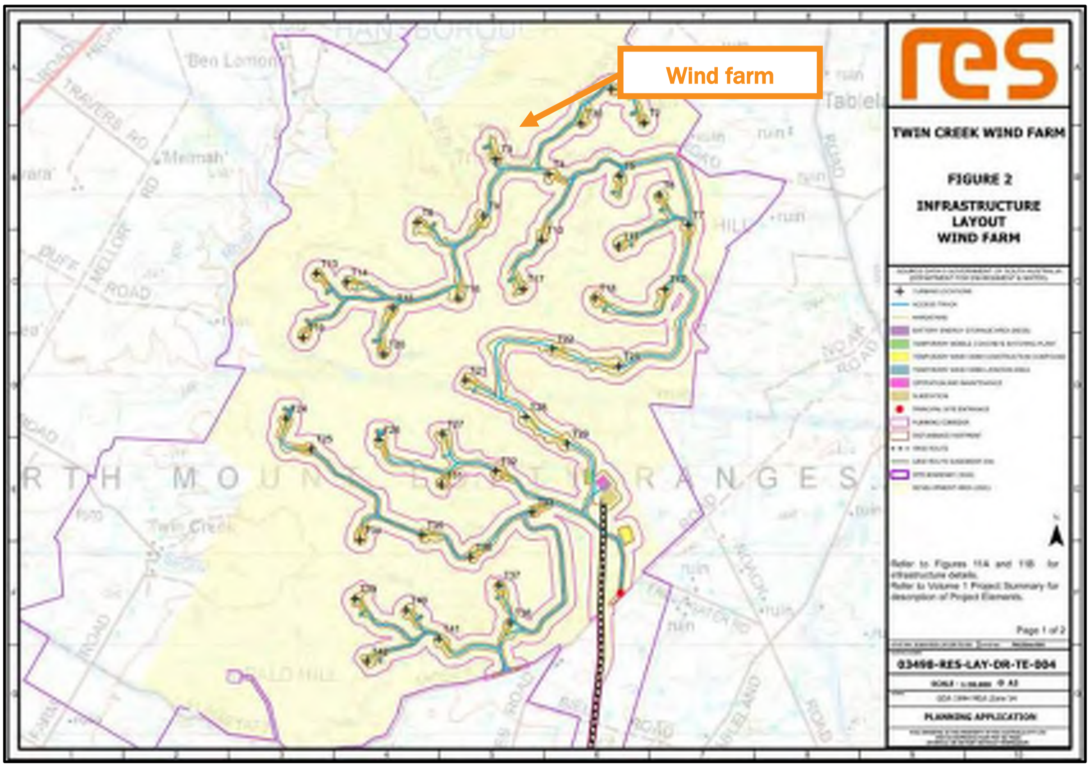

Figure 8 Transmission line route (Part 1)

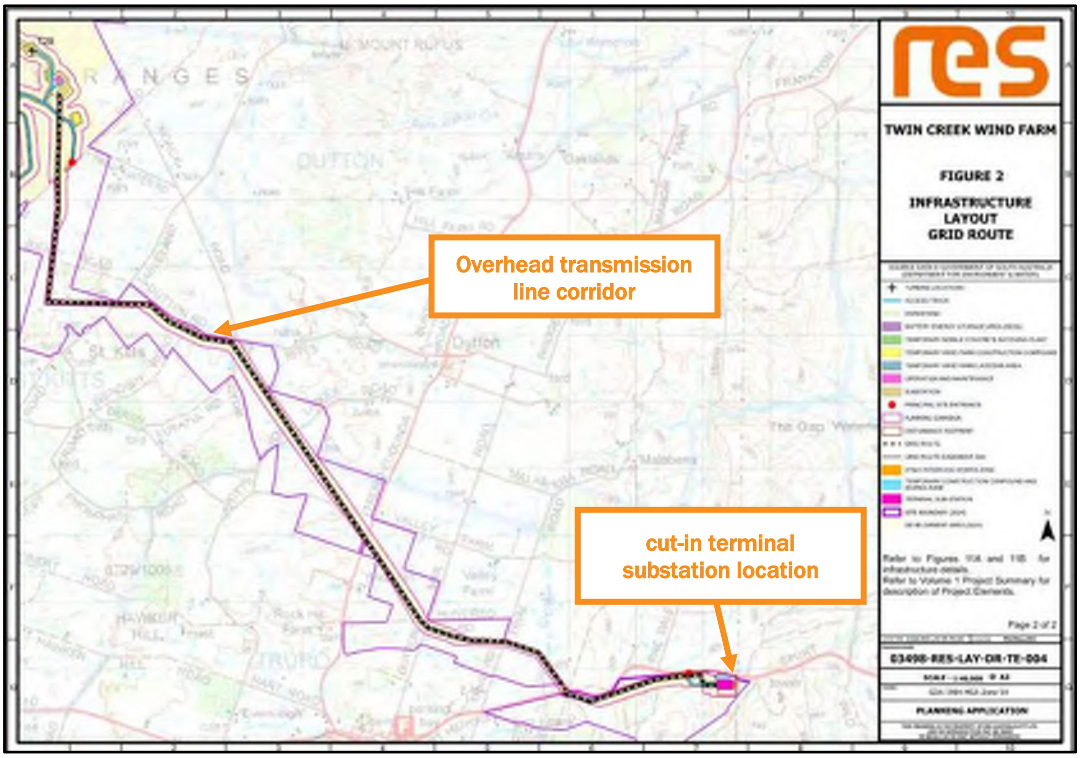

Figure 9 Transmission line route (Part 2)

5. CONSULTATION

The following list of stakeholders were identified as requiring consultation:

- Airservices Australia
- Royal Flying Doctor Service
- Department of Defence
- Adelaide Soaring Club
- Stonefield Gliding aerodrome
- Regional aircraft operators

Details and results of the consultation activities are provided in Table 2.

Table 2 Stakeholder consultation details

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Action Proposed*
Airservices Australia	27 October 2023	19 December 2023, by Alex Blight Airspace Development & Protection Coordinator	*I refer to your request for an Airservices assessment of the proposed Twin Creek Wind Farm.* ***Airspace Procedures*** *With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 706.1m (2317ft) AHD the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedures at any aerodromes.* *Note: procedures not designed by Airservices were not considered in this assessment.* *Communications/Navigation/Surveillance (CNS) Facilities* *We have assessed the proposed activity to the above specified height for any impacts to Airservices Precision/Non-Precision Navigation Aids, Anemometers, HF/VHF/UHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links and have no objections to it proceeding.* ***Air Traffic Control (ATC) Operations***	Submit tall object notification form once development reaches maximum height.

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
			There are no additional instructions or concerns from our ATC. *Summary* *It is our view that the proposed activity does not impact Airservices designed airspace procedures, CNS facilities or ATC operations at any aerodrome.* *This advice remains valid for any future time extensions if there is no change to the location and height of the proposed activity for a period of 12 months.* *Vertical Obstacle Notification* *This proposed wind farm is more than 30m (99ft) AGL.* *Please follow the below notification process:* *1. Complete the Vertical Obstacle Notification Form: ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf (airservicesaustralia.com)* *2. Submit completed form to: VOD@airservicesaustralia.com as soon as the development reaches the maximum height.*	

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Action Proposed*
			For further information regarding the reporting of tall structures, please contact the VOD team: • *Phone - (02) 6268 5622* • *Email - VOD@airservicesaustralia.com* • *Or refer to: Civil Aviation Safety Regulation Part 175 — Airservices and You - Airservices (airservicesaustralia.com)*	
Department of Defence	27 October 2023	16 April 2024	*Thank you for referring the Twin Creek Wind Farm Project to the Department of Defence (Defence) for comment. Defence understands that this proposed wind farm will consist of a total of 42 wind turbines (of up 220m above ground level) with the highest turbine being 486 m AHD (2317 ft AMSL) located approximately 9 km east-northeast of the town of Kapunda, South Australia.* *Defence has assessed the proposal with respect to any impact on the safety of military flying operations and possible interference to Defence communications and radars. Defence can advise that it has no concerns with the Twin Creek Wind Farm at this time.* *Air Services Australia (ASA) is responsible for recording the location and height of tall structures.*	Report details of the Project to Airservices Australia.

Agency/Contact	*Activity/Date*	*Response/ Date*	*Issues Raised During Consultation*	*Action Proposed*
			The information is held in a central database managed by ASA and relates to the erection, extension or dismantling of tall structures, RAAF requirements are: *a. 30 metres AGL, that are within 30 kilometres of an aerodrome, and* *b. 45 metres AGL elsewhere.* *In accordance with Advisory Circular 139.E-01 – Reporting of tall structures, Defence requests that the applicant is to provide Defence and Air Services Australia (ASA) "as constructed" details for the proposed structures so that they can be marked on aeronautical charts.* *The details can be emailed to Defence at land.planning@defence.gov.au and ASA at vod@airservicesaustralia.com* *Should you wish to discuss the content of this advice further, please contact Matt Williams at land.planning@defence.gov.au*	
Adelaide Soaring Club	14 November 2023	No response	N/A	N/A
Adelaide University Flying Club	14 November 2023	No response	N/A	N/A

Agency/Contact	Activity/Date	Response/ Date	Issues Raised During Consultation	Action Proposed
Aerotech	10 January 2024	Phone discussion Mid-North base manager 11 January 2024	No concern with proposed wind farm, except preference is for all WMTs to be marked to increase visibility during the day.	

6. AVIATION IMPACT STATEMENT

6.1. Overview

The NASF Guideline D: *Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation* provides information to proponents and planning authorities to help identify any potential safety risks posed by WTG and wind monitoring installations from an aviation perspective.

Potential safety risks include (but are not limited to) impacts on flight procedures and aviation communications, navigation, and surveillance (CNS) facilities which require assessment by Airservices Australia.

To facilitate these assessments all wind farm proposals submitted to Airservices Australia must include an Aviation Impact Statement (AIS).

This analysis considers the aeronautical impact of the WTGs on the following:

- The operation of nearby certified aerodromes
- The operation of nearby aircraft landing areas (uncertified aerodromes)
- Grid and air route Lowest Safe Altitudes (LSALTS)
- Airspace protection
- Aviation facilities
- Radar installations
- Local aircraft operations.

6.2. Nearby certified aerodromes

The area of 30 nm (56 km) from a certified airport's aerodrome reference point (ARP) is used to identify possible constraints from the Project.

The 30 nm radius represents the 25 nm minimum sector altitude (MSA) for aerodromes with terminal instrument flight procedures. The 25 nm MSA minimum altitude is determined by assessing obstacles within 30 nm of the reference point.

There are no proposed WTG sites located within 30 nm (55.56 km) of any certified aerodrome. Edinburgh airfield (YPED) is located approximately 30.6 nm from the nearest proposed WTG to the aerodrome reference point (ARP).

The nearest certified aerodromes to the Project (from the closest WTG) are:

- Edinburgh (YPED) – 30.6 nm southwest
- Parafield (YPPF) – 35 nm southwest
- Adelaide (YPAD) – 45 nm southwest

The location of the Project Area relative to the nearest certified aerodromes shown in Figure 10 (Source: RES, Google Earth).

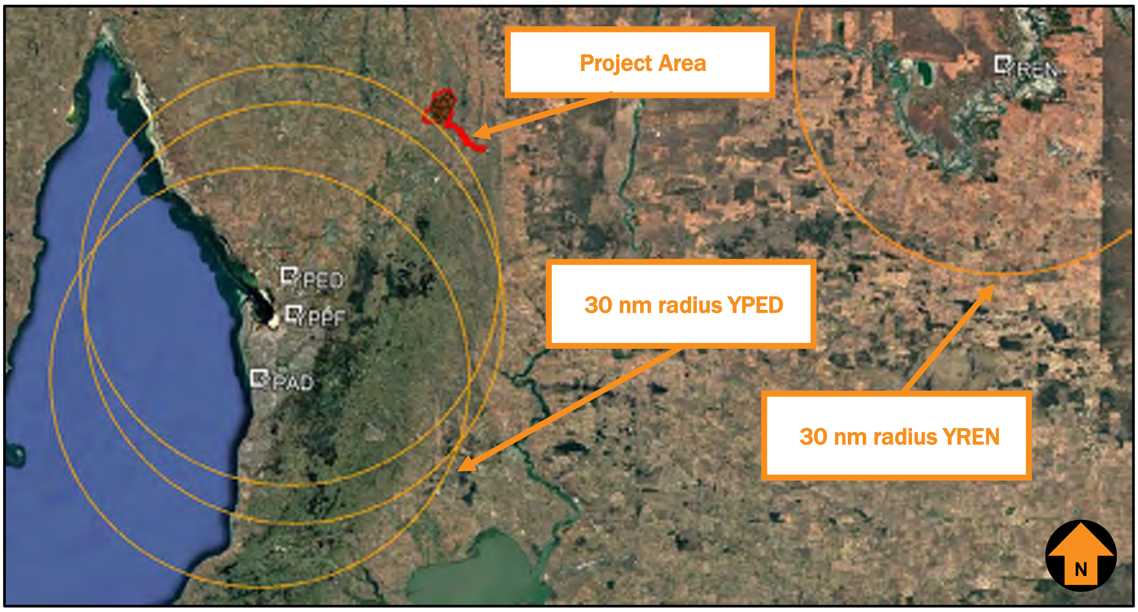

Figure 10 Project location in relation to certified aerodromes

The WTGs are not located within 30 nm of any certified aerodrome and therefore will not affect any certified aerodrome's terminal instrument flight procedures or obstacle limitation surface.

6.3. Nearby aircraft landing areas (ALAs)

As a guide, an area of interest within a 3 nm radius of an aircraft landing area (ALA – uncertified aerodrome) is used to assess potential impacts of proposed developments on aircraft operations at or within the vicinity of the ALA.

A search of various aviation datasets was undertaken to identify ALAs in the vicinity of the Project. The aviation datasets used are:

- OzRunways - which sources its data from Airservices Australia (AIP). The aeronautical data provided by OzRunways is approved under CASA CASR Part 175.
- Australian Government National Map online.

As a guide, an area of interest within a 3 nm radius of an ALA is used to assess the potential impacts of proposed developments on aircraft operations at or within the vicinity of the ALA. There are no specified obstacle protection surfaces established for ALAs, and a 3 nm radius from an ALA generally represents the distance beyond which normal aircraft operations that are anticipated to occur at ALAs would not be adversely affected.

An ALA (YVAF) was previously located in the vicinity of the Project transmission line corridor. The ALA is still currently identified in OzRunways, with a note attached to the published information stating the property has been sold and the ALA is closed. This ALA is not considered in this assessment.

Figure 11 shows the location of the nearest verified ALAs in relation to the Project. A 3nm radius from each ALA is shown. (Source, RES, Google Earth, OzRunways)

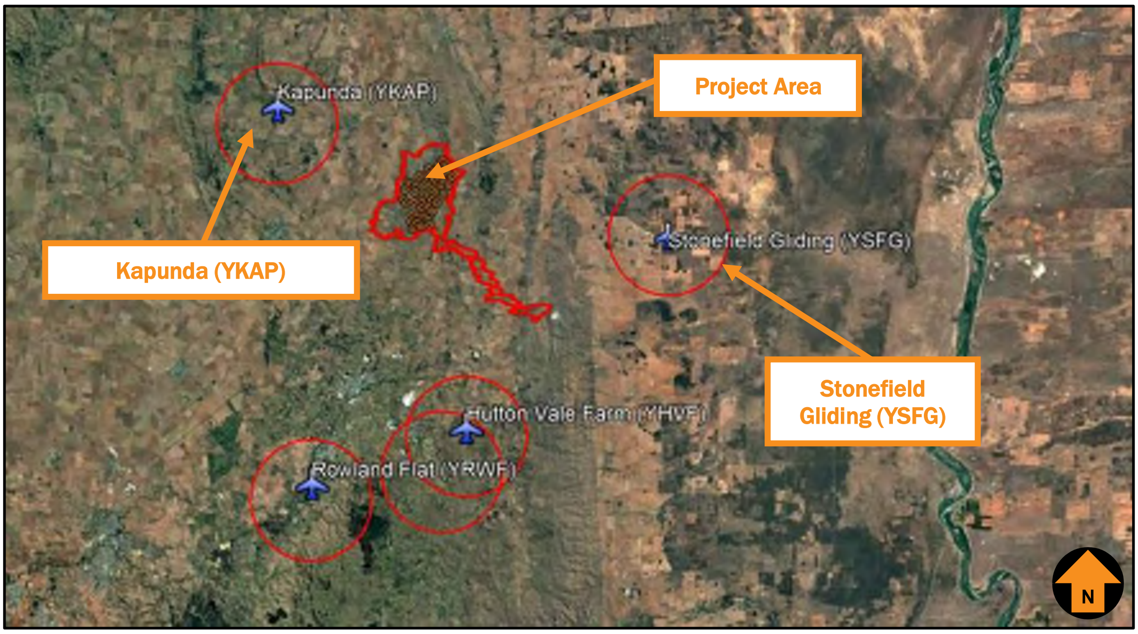

Figure 11 verified ALAs in relation to Project Area

An ALA was identified on topographic base map west of the Project site at 4641 Thiele Hwy, Hansborough. A wind direction indicator is visible on the ALA on recent Google Earth imagery. The ALA is located within 3 nm of several WTGs. The ALA has a single unsealed runway which is approximately 700 m long and aligned NNE-SSW, meaning the approach and departure tracks for both runway directions are not in line with the Project.

The nearest WTG is located approximately 4.7 km (2.6 nm) southeast of the runway. The runway is located more than the maximum conceivable distance that wake turbulence from a WTG would affect an aircraft, which is conservatively assumed to be 16 times rotor diameter (2560 m).

Figure 12 shows the unverified ALA in relation to the Project, with a 3 nm radius from the centroid of the ALA and a 1 nm nominal circuit pattern shown.

Due to the runway orientation in relation to the Project, and no WTGs being located which would impact on a circuit pattern to the east of the runway, it is anticipated that the Project would not impact on the accessibility and operation of aircraft at the ALA.

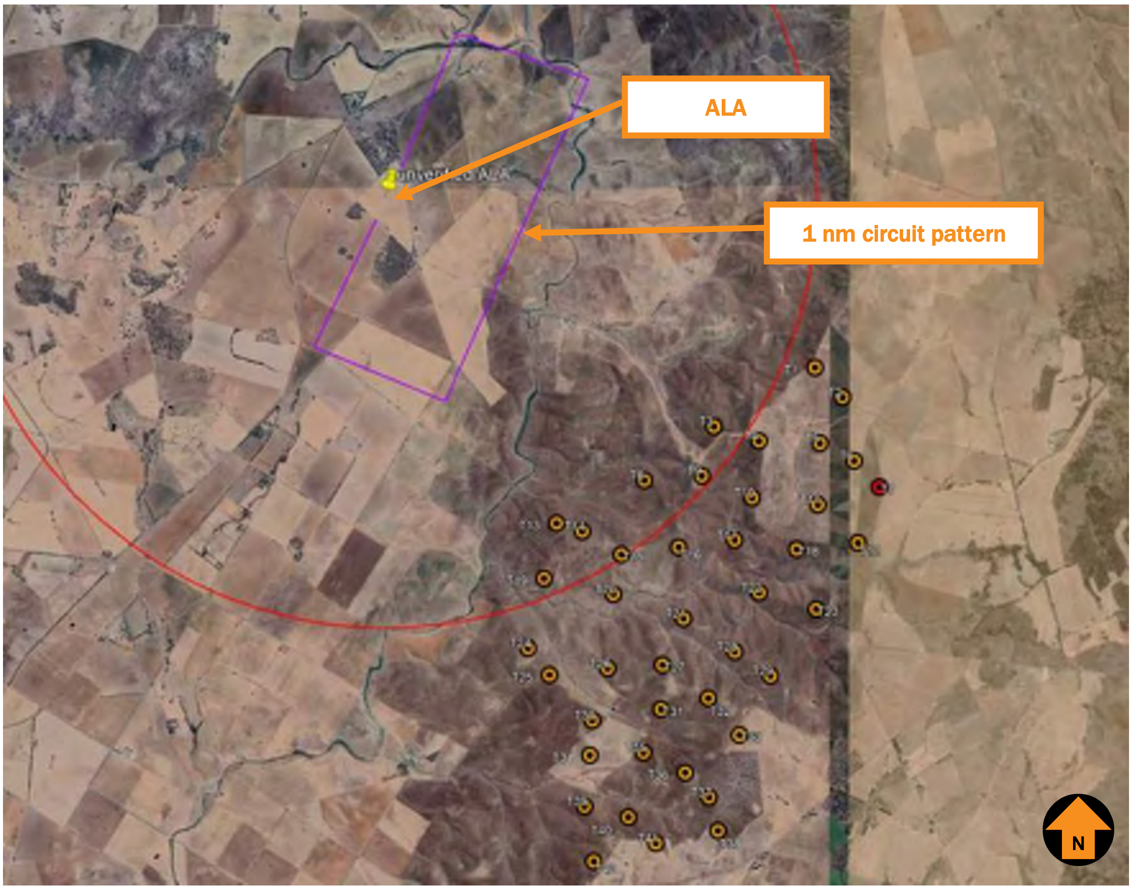

Figure 12 unverified ALA west of Project

6.4. Air routes and LSALT

MOS 173 requires that the published lowest safe altitude (LSALT), for a particular airspace grid or air route, provides a minimum of 1000 ft clearance above the controlling (highest) obstacle within the relevant airspace grid or air route tolerances.

Grid LSALTs are specified for grid squares formed by the parallels and meridians at 1° intervals for low-level charts and 2° intervals for the high-level chart applicable to the Project Area.

The proposed WTGs are located in a grid identified in the EnRoute Chart – Low. (ERCL 7) The grid LSALT applicable to the proposed WTG locations is 3400 ft AMSL. The Project is located in the vicinity of one low-level air route, W325, between the VOR located at Adelaide airport (AD VOR) and waypoint RUSSL.

Figure 13 provides the low-level air routes and grid LSALTs in proximity to the Project site (source: ERC Low National, RES).

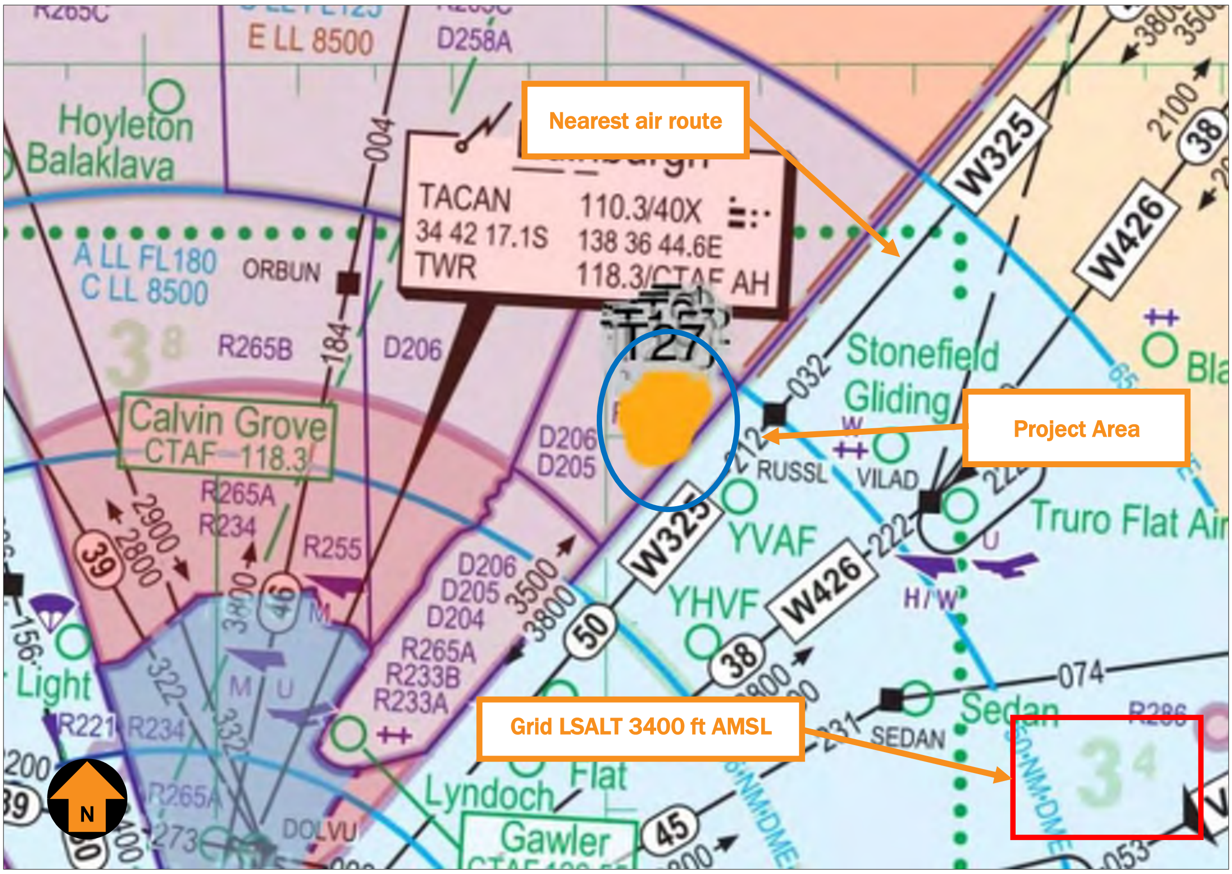

Figure 13 Low-level air routes and Grid LSALT in relation to the Project site

The Project is identified in a grid in the EnRoute Chart – High (ERC H3 South). The applicable grid LSALT is 3800 ft AMSL. The Project is in the vicinity of one high-level air route, Q32, between waypoints BORLI and KAMBI. There is no route LSALT specified for Q32, meaning the grid LSALT of 3800 ft AMSL applies.

Figure 14 provides the high-level air routes and grid LSALT in proximity to the Project site (source: ERC High 3, RES).

An impact analysis of the LSALTs applicable to the Project Area is provided in Table 3, based on the maximum Project height of 706.1 m AHD (2317 ft AMSL).

There will be no impact to any grid or route LSALT caused by the Project, based on the proposed WTG configuration.

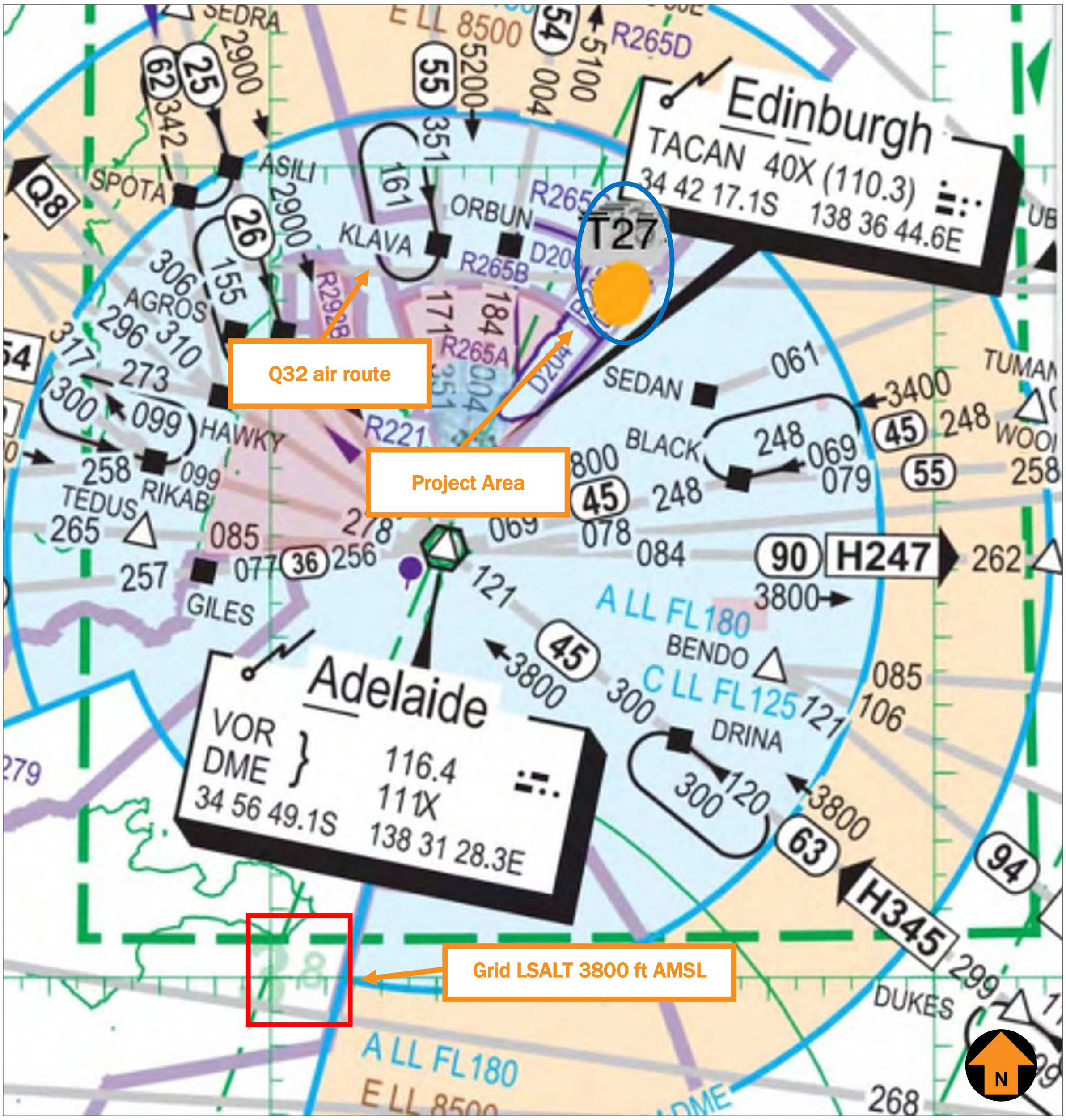

Figure 14 High-level air routes and Grid LSALT in relation to the Project site

Table 3 LSALT analysis

Air route	*Waypoint pair*	*LSALT (ft AMSL)*	*Protection surface (ft AMSL)*	*Impact on airspace design*	*Potential solution*	*Impact on aircraft ops*
W325 (ERCL)	AD VOR - RUSSL	3500/3800	2500/2800	Nil – maximum Project height	N/A	N/A

Air route	Waypoint pair	LSALT (ft AMSL)	Protection surface (ft AMSL)	Impact on airspace design	Potential solution	Impact on aircraft ops
				below surface by 183 ft/483 ft		
Q32	BORLI-KAMBI	Grid – 3800	2800	Nil – maximum Project height below surface by 483 ft	N/A	N/A
Grid (ERCL)	N/A	3400	2400	Nil – maximum Project height below surface by 83 ft	N/A	N/A
Grid (ERCH)	N/A	3800	2800	Nil – maximum Project height below surface by 483 ft	N/A	N/A

6.5. Airspace Protection

The Project site is located outside controlled airspace (wholly within Class G uncontrolled airspace). The Project is located within the lateral limits of the following Restricted Areas associated with military flying activities from Edinburgh air base:

- **R265E** – Edinburgh Military Flying (3500 – 4500 ft AMSL) – NOTAM activation (Controlling authority FLTCDR 453SQN Edinburgh
- **R265F** – Edinburgh Military Flying (lower limit 4500 ft AMSL) – NOTAM activation (Controlling authority FLTCDR 453SQN Edinburgh

The Project is also located within the lateral limits of Danger Areas 205 and 206, associated with gliding operations by the Adelaide Soaring Club from Gawler aerodrome. The Danger Areas are activated by NOTAM (likely associated with gliding events).

Figure 15 shows the Project site in relation to the lateral limits of the restricted and danger Areas (Source, RES, OzRunways)

A restricted area prohibits the operation of aircraft in the airspace unless the pilot in command has an approval for the flight from the Controlling Authority of the restricted area. Danger areas are established around areas where hazardous operations are likely to take place, however aircraft are not specifically prohibited from operating in that area.

The maximum Project height will be below the minimum height of the restricted areas. The Project is not anticipated to affect the function of the restricted and danger areas.

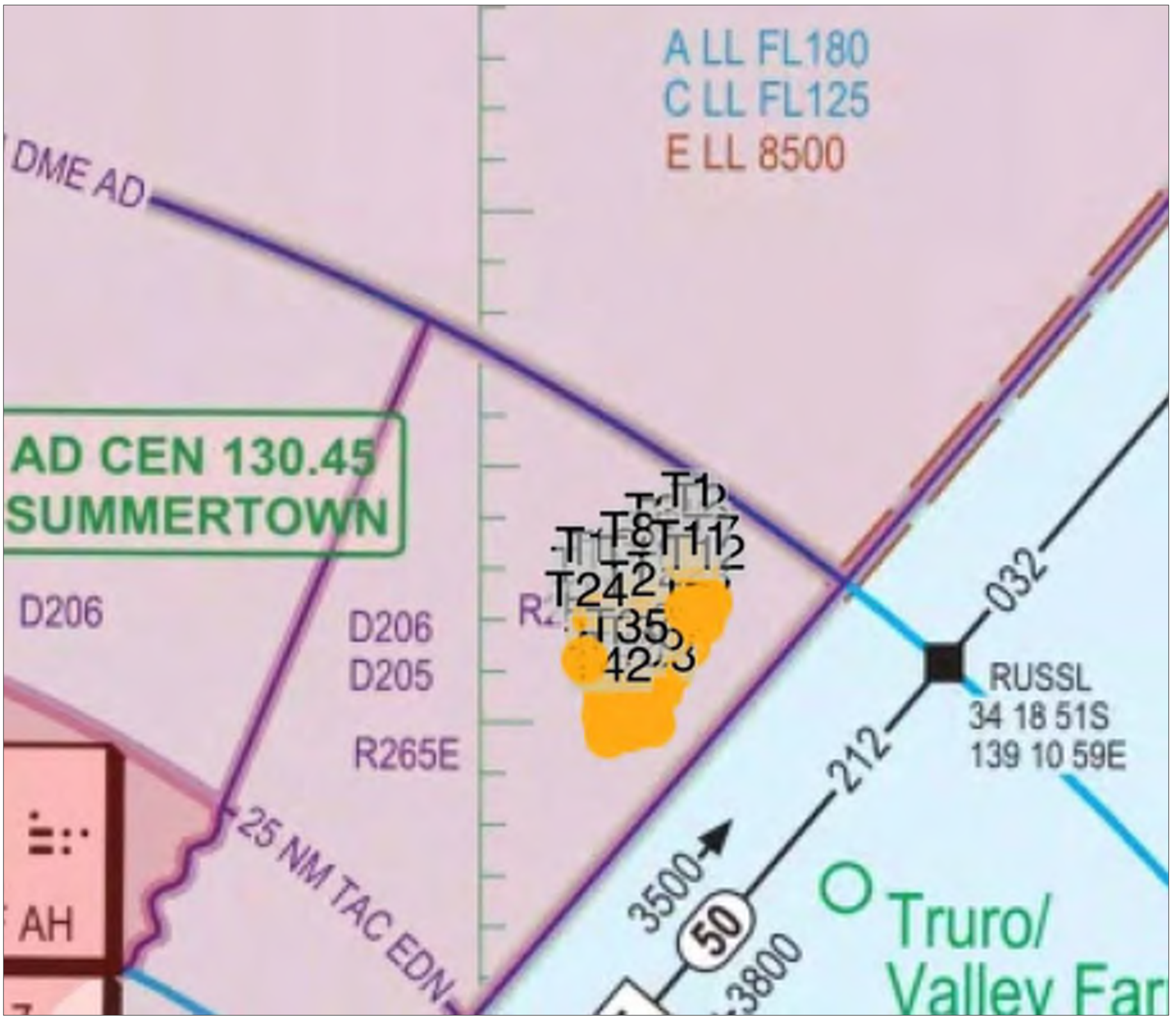

Figure 15 Project in relation to Danger and Restricted Areas

6.6. Aviation facilities – Communication, Navigation and Surveillance Systems (CNS)

NASF Guideline G (Protection Aviation Facilities - Communication, Navigation and Surveillance (CNS)) and Part 139 MOS 2019 specify the area where development of buildings and structures has the potential to cause unacceptable interference to CNS facilities.

There are no aviation CNS located in the vicinity of any WTGs, and the Project will not penetrate any protection areas associated with CNS facilities as specified in Part 139 MOS 2019 and the National Airports Safeguarding Framework.

6.7. Radar

Airservices Australia currently requires an assessment of the potential for wind turbine generators to affect radar line of sight.

With respect to aviation radar facilities, the closest radar to the Project Area is the Adelaide Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR) which are located at Adelaide Airport approximately 45 nm (83 km) southwest of the nearest proposed WTG.

EUROCONTROL guidelines for assessing the potential impact on wind turbines and WMTs on radar surveillance sensors stipulate the following assessment requirements:

Primary Surveillance Radar (PSR)

Zone 1 0-500 m: Not permitted

Zone 2 500 m – 15 km: Detailed assessment

Zone 3: Further than 15 km but within maximum instrumented range and in radar line of sight: Simple assessment

Zone 4: Anywhere within maximum instrumented range but not in radar line of sight or outside the maximum instrumented range: No assessment

Secondary Surveillance Radar (SSR)

Zone 1: 0-500 m: Not permitted

Zone 2 500 m – 16 km but within maximum instrumented range and in radar line of sight: Detailed assessment

Zone 4: Further than 16 km or not in radar line of sight: No assessment

(Zone 3 is not established for secondary surveillance radar)

Due to the distance and terrain profile of the Project Area from the facilities, it is anticipated that the Project will not impact the Adelaide Primary and Secondary Surveillance Radar facilities.

Airservices Australia has confirmed that the proposed Project does not impact Airservices designed airspace procedures, CNS facilities or ATC operations at any aerodrome.

Note: Route Surveillance Radar (RSR) and Secondary Surveillance Radar (SSR) is the same radar system.

6.8. Consultation

An appropriate and justified level of consultation was undertaken with relevant parties. Refer to Section 5 for details of the stakeholders and a summary of the consultation.

6.9. AIS Summary

Based on the Project WTG layout and maximum blade tip height of up to 220 m AGL, the blade tip elevation of the highest WTG associated with both proposed WTG configurations, will not exceed 706.1 m AHD (2317 ft AMSL) and:

- will not penetrate any certified aerodrome's obstacle limitation surfaces
- is not located within 30 nm of and will not affect any certified aerodrome's terminal instrument flight procedures
- will not have an impact on nearby designated air routes
- will not have an impact on the grid LSALT established in ERC High and ERC Low

- will not have an impact on operational airspace
- is wholly contained within Class G airspace
- is outside the clearance zones associated with civil aviation navigation aids and communication facilities.

6.10. ALA analysis summary

There are no verified active ALAs located within 3 nm of the Project. There is one unverified ALA identified within 3 nm of the Project, however is not anticipated to be affected by the Project due to the distance and orientation of the runway in relation to the WTGs.

6.11. Assessment recommendations

Based on the information contained within this section and the analysis conducted, the following recommendations are made:

- Consultation should be undertaken with Airservices Australia to assess potential impacts of the Project (undertaken during this assessment)
- Consult with Adelaide University Gliding Club and Adelaide Soaring Club at Stonefield gliding and Gawler aerodromes to determine if there will be potential safety issues for aircraft operations to the aerodromes if the Project was developed (undertaken during this assessment)
- Department of Defence should be consulted to identify any potential impacts from the Project on military operations.

An appropriate and justified level of consultation was undertaken with relevant parties. Refer to Section 5 for details of the stakeholders and a summary of the consultation.

7. HAZARD LIGHTING AND MARKING

Based on the risk assessment set out in Section 9 it is concluded that aviation lighting is not required for WTGs.

For completeness, relevant lighting standards and guidelines are summarised in Annexure 3.

8. ACCIDENT STATISTICS

This section establishes the external context to ensure that stakeholders and their objectives are considered when developing risk management criteria, and that externally generated threats and opportunities are properly taken into account.

8.1. General aviation operations

The general aviation (GA) activity group is considered by the Australian Transport Safety Bureau (ATSB) to be all flying activities that do not involve commercial air transport (activity group), which includes scheduled (RPT) and non-scheduled (charter) passenger and freight type. It may involve Australian civil (VH–) registered aircraft, or aircraft registered outside of Australia. General aviation/recreational encompasses:

- Aerial work (activity type). Includes activity subtypes: agricultural mustering, agricultural spreading/spraying, other agricultural flying, photography, policing, firefighting, construction – sling loads, other construction, search and rescue, observation and patrol, power/pipeline surveying, other surveying, advertising, and other aerial work.
- Own business travel (activity type).
- Instructional flying (activity type). Includes activity subtypes: solo and dual flying training, and other instructional flying.
- Sport and pleasure flying (activity type). Includes activity subtypes: pleasure and personal transport, glider towing, aerobatics, community service flights, parachute dropping, and other sport and pleasure flying.
- Other general aviation flying (activity type). Includes activity subtypes: test flights, ferry flights and other flying.

8.2. ATSB occurrence taxonomy

The ATSB uses a taxonomy of occurrence sub-type. Of specific relevance to the subject assessment are terms associated with **terrain collision**. Definitions sourced from the ATSB website are provided below:

- **Collision with terrain**: Occurrences involving a collision between an airborne aircraft and the ground or water, where the flight crew were aware of the terrain prior to the collision.
- **Controlled flight into terrain (CFIT):** Occurrences where a serviceable aircraft, under flight crew control, is inadvertently flown into terrain, obstacles, or water without either sufficient or timely awareness by the flight crew to prevent the event.
- **Ground strike:** Occurrences where a part of the aircraft drags on, or strikes, the ground or water while the aircraft is in flight, or during take-off or landing.
- **Wirestrike:** Occurrences where an aircraft strikes a wire, such as a powerline, telephone wire, or guy wire, during normal operations.

8.3. National aviation occurrence statistics 2010-2019

The Australian Transport Safety Bureau (ATSB) recently published a summary of aviation occurrence statistics for the period 2010-2019 (AR-2020-014, Final - 29 April 2020).

According to the report, there were no fatalities in high or low capacity RPT operations during the period 2010-2019. In 2019, 220 aircraft were involved in accidents in Australia, and a further 154 aircraft involved in serious incidents (an incident with a high probability of becoming an accident). In 2019 there were 35 fatalities from 22 fatal accidents. There have been no fatalities in scheduled commercial air transport in Australia since 2005.

Of the 326 fatalities recorded in the 10-year period, almost two thirds (174 or 53.68%) occurred in the general aviation segment. On average, there were 1.51 fatalities per aircraft associated with a fatality in this segment. The fatalities to aircraft ratio ranges from 1.09 to 177:1. Whilst it can be inferred from the data that the majority of fatal accidents are single person fatalities, it is reasonable to assert that the worst credible effect of an aircraft accident in the general aviation category will be multiple fatalities.

A breakdown of aircraft and fatalities by general aviation sub-categories is provided in Table 4 (source: ATSB).

Table 4 Number of fatalities by General Aviation sub-category – 2010 to 2019

Sub-category	*Aircraft assoc. with fatality*	*Fatalities*	*Fatalities to aircraft ratio*
Aerial work	37	44	1.18:1
Instructional flying	11	19	1.72:1
Own business travel	3	5	1.6:1
Sport and pleasure flying	53	94	1.77:1
Other general aviation flying	11	12	1.09:1
Totals	115	174	1.51:1

Figure 16 refers to Fatal Accident Rate by operation type per million departures over the 6-year period (source: ATSB). Note the rates presented are not the full year range of the study (2010–2019). This was due to the availability of exposure data (departures and hours flown) which was only available between these years. According to the ATSB report, the number of fatal accidents per million departures for GA aircraft over the 6-year reporting period ranged between 6.6 in 2014 and 4.9 in 2019.

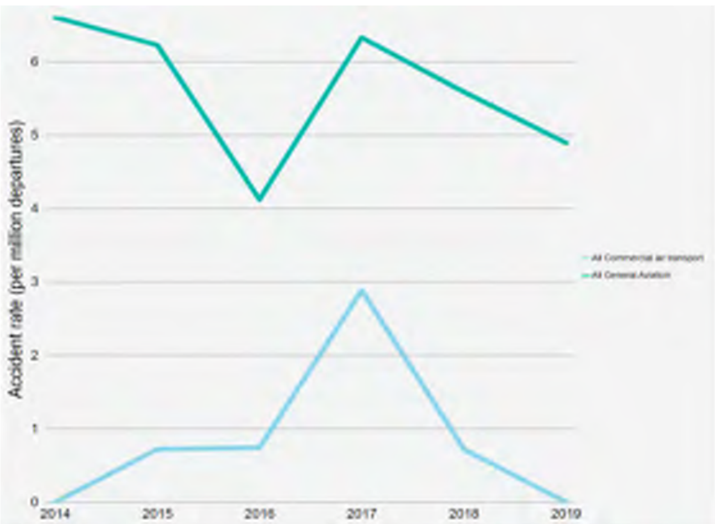

Figure 16 Fatal Accident Rate (per million departures) by Operation Type

In 2018, there were 9 fatal accidents and 9 fatalities involving GA aircraft, resulting in a rate of 5.6 fatal accidents per million departures and 7.7 fatal accidents per million hours flown.

In 2019, there were 1,760,000 landings, and 1,320,000 hours flown by VH-registered general aviation aircraft in Australia, with 8 fatal accidents and 17 fatalities. Based on these results, in 2019 there were 4.9 fatal accidents per million departures and 6.4 fatal accidents per million hours flown. A summary of fatal accidents from 2010-2019 by GA sub-category is provided in Table 5 (source: ATSB).

Table 5 Fatal accidents by GA sub-category – 2010 -2019

Sub-category	*Fatal accidents*	*Fatalities*
Agricultural spreading/spraying	13	13
Agricultural mustering	11	12
Other agricultural	1	1
Survey and photographic	5	10
Search and rescue	2	2
Firefighting	2	2
Other aerial work	3	4
Instructional flying	11	19
Own business travel	3	5
Sport and pleasure flying	53	94
Other general aviation flying	11	12
Total	115	174

Over the 10-year period, no aircraft collided with a WTG or a WMT in Australia.

Of the 20,529 incidents, serious incidents and accidents in GA operations in the 10-year period, 1,404 (6.83%) were terrain collisions.

The underlying fatality rate for GA operations discussed above is considered tolerable within Australia's regulatory and social context.

8.4. Worldwide accidents involving wind farms

Worldwide since aviation accident statistics have been recorded, there have been a total of 4 aviation accidents involving a wind farm (i.e. where WTGs were erected). To provide some perspective on the likelihood of a VFR aircraft colliding with a WTG, a summary of the 4 accidents and the relevant factors applicable to this assessment is incorporated in this section.

Based on the statistics set out in the Global Wind Energy Council (GWEC) report 2016, there were 341,320 WTGs operating around the world at the end of 2016. In 2019, approximately 60.4 GW of wind power had been installed worldwide.

Based on the Australia's Clean Energy Council statistics there were 102 wind farms in Australia at the end of 2019. Aviation Projects has researched public sources of information, accessible via the world wide web, regarding aviation safety occurrences associated with wind farms. Occurrence information published by Australia, Canada, Europe (Belgium, Denmark, France, Germany, Norway, Sweden and The Netherlands), New Zealand, the United Kingdom and the United States of America was reviewed.

The 4 recorded aviation accidents involving a wind farm are summarised as follows:

- One accident, which resulted in 2 fatalities, occurred in Palm Springs in 2001. This accident involved a wind farm but was not caused by the wind farm. The cause of the accident was the inflight separation of the majority of the right canard and all of the right elevator resulting from a failure of the builder to balance the elevators per the kit manufacturer's instructions. The accident occurred above a wind farm, and the aircraft struck a WTG on its descent and therefore the cause of the accident was not attributable to the wind farm and not applicable to this AIA.
- Two accidents involving collision with a WTG were during the day, as follows:
  - One accident occurred in Melle, Germany in 2017 as the result of a collision with a WTG mounted on a steel lattice tower at a very low altitude during the day with good visibility and no cloud. The accident resulted in one fatality. If the tower was solid and painted white, as is standard on contemporary wind farms, then it more than likely would have been more visible than if it were to be equipped with an obstacle light which in all likelihood would not have been operating during daylight with good visibility conditions.
  - One accident occurred in Plouguin, France in 2008 when the pilot decided to descend below cloud in an attempt to find the destination aerodrome. The aircraft was flying in conditions of significantly reduced horizontal visibility in fog where the top of the WTGs were obscured by cloud. The WTGs became visible too late for avoidance manoeuvring and the aircraft made contact with two WTGs. The aircraft was damaged but landed safely. No fatalities were recorded.
  - In both of the above cases, it is difficult to conclude that obstacle lighting would have prevented the accidents.
- One fatal accident, near Highmore, South Dakota in 2014 occurred at night in Instrument Meteorological Conditions (IMC).

There is one other accident mentioned in a database compiled by an anti-wind farm lobby group (wind-watch.org), which suggests a Cessna 182 collided with a WTG near Baraboo, Wisconsin, on 29 July 2000. The NTSB database records details of an accident involving a Cessna 182 that occurred on 28 July 2000 in the same area. For this particular accident, NTSB found that the probable cause of the accident was VFR flight into IMC encountered by the pilot and exceeding the design limits of the aircraft. A factor was flight to a destination alternate not performed by the pilot. No mention in the NTSB database is made of WTGs or a wind farm.

A summary of the 4 accidents is provided in Table 6.

Table 6 Summary of accidents involving collision with a WTG

ID	Description	Date	Location	Fatalities	Flight rules	WTG height	Obstacle lighting	Cause of accident	Relevant to obstacle lighting at night
1	Diamond DA320-A1 D-EJAR Collided with a WTG approximately 20 m above the ground, during the day in good visibility. The mast was grey steel lattice, rather than white, although the blades were painted in white and red bands.	02 Feb 2017	Melle, Germany	1	Day VFR No cloud and good visibility	Not specified	Not specified	Not specified	Not applicable

ID	Description	Date	Location	Fatalities	Flight rules	WTG height	Obstacle lighting	Cause of accident	Relevant to obstacle lighting at night
2	The Piper PA-32R-300, N8700E, was destroyed during an impact with the blades of a WTG, at night in IMC. The wind farm was not marked on either sectional chart covering the accident location; however, the pilot was reportedly aware of the presence of the wind farm.	27 Apr 2014	10 miles south of Highmore, South Dakota	4	Night IMC Low cloud and rain	420 ft AGL overall	Fitted but reportedly not operational on the WTG that was struck	The NTSB determined the probable cause(s) of this accident to be the pilot's decision to continue the flight into known deteriorating weather conditions at a low altitude and his subsequent failure to remain clear of an unlit WTG. Contributing to the accident was the inoperative obstacle light on the WTG, which prevented the pilot from visually identifying the WTG.	An operational obstacle light may have prevented the accident.

ID	Description	Date	Location	Fatalities	Flight rules	WTG height	Obstacle lighting	Cause of accident	Relevant to obstacle lighting at night
3	Beechcraft B55 The pilot was attempting to remain in VMC by descending the aircraft through a break in the clouds. The pilot, distracted by trying to visually locate the aerodrome, flew into an area of known presence of WTGs. After sighting the WTGs he was unable to avoid them. The tip of the left wing struck the first WTG blade, followed by the tip of the right wing striking the blade of a second WTG. The pilot was able to maintain control of the aircraft and landed safely.	04 Apr 2008	Plouguin, France	0	Day VFR The weather in the area of the WTGs had deteriorated to an overcast of stratus cloud, with a base between 100 ft to 350 ft and tops of 500 ft.	328 ft AGL hub height, 393 ft AGL overall	Not specified	This pilot reported having been distracted by a troubling personal matter which he had learned of before departing for the flight. The wind farm was annotated on aeronautical charts.	Not applicable

ID	Description	Date	Location	Fatalities	Flight rules	WTG height	Obstacle lighting	Cause of accident	Relevant to obstacle lighting at night
4	VariEze N25063 The aircraft collided with a WTG following in-flight separation of the majority of the right canard and all of the right elevator.	20 July 2001	Palm Springs, USA	2	Day VFR	N/A	N/A	The failure of the builder to balance the elevators per the kit manufacturer's instructions. The cause of this accident is not attributable to the wind farm.	Not applicable

9. RISK ASSESSMENT

A risk management framework is comprised of likelihood and consequence descriptors, a matrix used to derive a level of risk, and actions required of management according to the level of risk.

The risk assessment framework used by Aviation Projects and risk event description is provided in Annexure 4.

9.1. Risk Identification

The primary risk being assessed is that of aviation safety associated with the height and location of WTGs proposed by the Project.

Based on an extensive review of accident statistics data (see summary in Section 8 above) and stakeholders who were consulted during the preparation of this AIA (see Section 5), 5 identified risk events associated with WTGs relate to aviation safety or potential visual impact, and are listed as follows:

1. potential for an aircraft to collide with a WTG, controlled flight into terrain (CFIT) (related to aviation safety).
2. potential for a pilot to initiate manoeuvring in order to avoid colliding with a WTG resulting in collision with terrain (related to aviation safety).
3. potential for the hazards associated with the Project to invoke operational limitations or procedures on operating crew (related to aviation safety).
4. Potential effect of obstacle lighting on neighbours (related to potential visual impact).

It should be noted that according to guidance provided by the Commonwealth Department of Infrastructure Transport, Regional Development, Communications and the Arts (Airspace and Air Traffic Management Risk Management Policy Statement). and in line with generally accepted practice, the risk to be assessed should primarily be associated with passenger transport services. The risk being assessed herein is primarily associated with smaller aircraft likely to be flying under the VFR, and so the maximum number of passengers exposed to the nominated consequences is likely to be limited.

The four risk events identified here are assessed in detail in the following section.

9.2. Risk Analysis, Evaluation and Treatment

For the purpose of considering applicable consequences, the concept of worst credible effect has been used. Untreated risk is first evaluated, then, if the resulting level of risk is unacceptable, further treatments are identified to reduce the residual level of risk to an acceptable level.

A summary of the level of risk associated with the Project, under the proposed treatment regime, with specific consideration of the effect of obstacle lighting, is provided in Table 7 through to Table 9.

Table 7 Aircraft collision with wind turbine generator (WTG)

Risk ID:	1. **Aircraft collision with wind turbine generator (WTG) (CFIT)**

Discussion

An aircraft collision with a WTG would result in harm to people and damage to property. Property could include the aircraft itself, as well as the WTG.

There have been 4 reported occurrences worldwide of aircraft collisions with a component of a WTG structure since the year 2000 as discussed in Section 8. These reports show a range of situations where pilots were conducting various flying operations at low level and in the vicinity of wind farms in both IMC and VMC. No reports of aircraft collisions with wind farms in Australia have been found.

In consideration of the circumstances that would lead to a collision with a WTG:

1. GA VFR aircraft operators generally don't individually fly a significant number of hours in total, let alone in the area in question
2. Military aircraft are likely to operate overhead the Project Area within the designed airspace of Restricted Areas R265E and R265F. These restricted areas have a minimum vertical limit of 3500 ft and 4500 ft AMSL respectively
3. There is a very small chance that a pilot, suffering the stress of weather, will continue into poor weather conditions (contrary to the rules of flight) rather than divert away from it, is not aware of the wind farm, will not consider it or will not be able to accurately navigate around it.
4. If the aircraft was flown through the wind farm, there is still a very small chance that it would hit a WTG.

Refer to the discussion of worldwide accidents in Section 8.

There may be aerial application operations during the day in the vicinity of the Project site.

There are no known aerial application operations conducted at night in the vicinity of the Project site.

If a proposed object or structure will be 100 m or more AGL, details of the relevant proposal must be referred to CASA for CASA to determine, in writing:

(a) whether the object or structure will be a hazard to aircraft operations

(b) whether it requires an obstacle light that is essential for the safety of aircraft operations.

CASA don't have the regulatory authority to mandate obstacle lighting as the Project is clear of the obstacle limitation surfaces (OLS) of any aerodrome.

CASA generally may recommend obstacle lighting for objects over 200 m AGL.

Consequence

If an aircraft collided with a WTG, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.

Consequence	Catastrophic

Untreated Likelihood

There have been 4 reports of aircraft collisions with WTGs worldwide, which have resulted in a range of consequences, where aircraft occupants sustained minor injury in some cases and fatal injuries in others (see Section 8). Similarly, aircraft damage sustained ranged from minor to catastrophic. One of these accidents

resulted from structural failure of the aircraft before the collision with the WTG. Only two relevant accidents occurred during the day, and only one resulted in a single fatality. It is assessed that collision with a WTG resulting in multiple fatalities and damage beyond repair is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.	
Untreated Likelihood	Possible
Current Treatments (without lighting) • The Project site is not located within 30 nm of any certified aerodrome • The Project site is clear of the obstacle limitation surfaces (OLS) of any certified aerodrome. • There are no WTGs proposed to be located within 3 nm of any active aircraft landing area (ALA) • Aircraft flying at night are required to maintain at least the established LSALT with at least 1000 ft clearance over the highest obstacle except within 3 nm of the aerodrome during landing and take-off operations. • Aircraft are restricted to a minimum height of 500 ft (152.4 m) AGL above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas. The proposed WTGs will be a maximum of 220 m (723 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 67.6 m (223 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). • In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5,000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs. • The WTGs will be coloured light grey which should be visible to pilots during the day. • The 'as constructed' details of WTGs are required to be notified to Airservices Australia so that the location and height of all WTGs can be noted on aeronautical maps and charts. • Because the Project WTGs are proposed to be above 100 m AGL, there is a statutory requirement to report the WTGs to CASA and notified to Airservices Australia prior to construction. CASA will review the Project for potential hazards to aircraft operations.	
Level of Risk The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8 (Unacceptable).	
Current Level of Risk	8 - Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Recommended Treatments The following treatments which can be implemented which will provide an acceptable level of safety:	

• Details of the Project should be communicated to local and regional aircraft operators (refer to **Section 5**) prior to construction to heighten their awareness of its location and so that they can plan their operations accordingly (regional aircraft operators will be consulted with during this aviation impact assessment).	
Residual Risk With the implementation of the Recommended Treatments listed above, the likelihood of an aircraft collision with a WTG resulting in multiple fatalities and damage beyond repair will be **Unlikely**, and the consequence remains **Catastrophic**, resulting in an overall risk level of **7 - Tolerable.** The level of risk with the implementation of the Recommended Treatments is considered **As Low As Reasonably Practicable (ALARP).** **It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a Project WTG without obstacle lighting on the WTGs.**	
Residual Risk	7 - Tolerable

Table 8 Harsh manoeuvring leading to controlled flight into terrain

<table>
<tr><td>Risk ID:</td><td colspan="2">2. Harsh manoeuvring leads to controlled flight into terrain (CFIT)</td></tr>
<tr><td colspan="3">Discussion

An aircraft colliding with terrain as a result of manoeuvring to avoid colliding with a WTG would result in harm to people and damage to property.

There are a few ground collision accidents resulting from manoeuvring to avoid wind farms, but none in Australia, and all were during the day.

The Project is clear of the OLS of any aerodrome.

Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built up areas.

The proposed WTGs will be a maximum of 220 m (723 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 67.6 m (223 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft).

Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs.

Aircraft are restricted to a minimum height of 304.8 m (1000 ft) above obstacles within 10 nm of the aircraft in visual flight at night and potentially even higher during instrument flight (day or night).

Aircraft authorised to intentionally fly below 152.4 m (500 ft) AGL (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities.

Assumed risk treatments
The WTGs will be coloured light grey and should be visible during the day.
The ‘as constructed’ details of WTGs are required to be notified to Airservices Australia so that the location and height of WTGs can be noted on aeronautical maps and charts.
Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTG to CASA.</td></tr>
<tr><td colspan="3">Consequence

If an aircraft collided with terrain, the worst credible effect would be multiple fatalities and damage beyond repair. This would be a Catastrophic consequence.</td></tr>
<tr><td colspan="2" align="right">Consequence</td><td>Catastrophic</td></tr>
<tr><td colspan="3">Untreated Likelihood

There are a few ground collision accidents resulting from manoeuvring to avoid WTGs, but none in Australia, and all were during the day (see Section 8). It is assessed that a ground collision accident following manoeuvring to avoid a WTG is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.</td></tr>
<tr><td colspan="2" align="right">Untreated Likelihood</td><td>Possible</td></tr>
<tr><td colspan="3">Current Treatments (without lighting)
The Project site is clear of the obstacle limitation surfaces (OLS) of any aerodrome.</td></tr>
</table>

• Aircraft are restricted to a minimum height of 152.4 m (500 ft) above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas. • Aircraft flying at night are required to maintain at least the established LSALT with at least 1000 ft clearance over the highest obstacle except within 3 nm of the aerodrome during landing and take-off operations • The proposed WTGs will be a maximum of 220 m (723 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 67.6 m (223 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). Nevertheless, the minimum visibility of 5000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs. • Aircraft authorised to intentionally fly below 152.4 m AGL (500 ft) (day) or below safety height (night) are operated in accordance with procedures developed as an outcome of thorough risk management activities. • The WTGs are typically coloured white, typical of most WTGs operational in Australia, so they should be visible during the day. • The 'as constructed' details of WTGs are required to be notified to Airservices Australia so that the location and height of wind farms can be noted on aeronautical maps and charts. • Since the WTGs will be higher than 100 m AGL, there is a statutory requirement to report the WTGs to CASA.

Level of Risk The level of risk associated with a Possible likelihood of a Catastrophic consequence is 8.	
Current Level of Risk	8 – Unacceptable
Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Recommended Treatments The following treatments which can be implemented which will provide an acceptable level of safety: • Details of the Project should be communicated to local and regional aircraft operators (refer to Section 5) prior to construction to heighten their awareness of its location and so that they can plan their operations accordingly (regional aircraft operators will be consulted with during this aviation impact assessment). • Ensure details of the Project WTGs have been communicated to Airservices Australia prior to construction, for publication in relevant aeronautical publications.	
Residual Risk	

With the implementation of the Recommended Treatments listed above, the likelihood of an aircraft collision with a WTG resulting in multiple fatalities and damage beyond repair will be Unlikely, and the consequence remains Catastrophic, resulting in an overall risk level of 7 - Tolerable. The level of risk with the implementation of the Recommended Treatments is considered As Low As Reasonably Practicable (ALARP). **It is our assessment that there will be an acceptable level of aviation safety risk associated with the potential for an aircraft collision with a Project WTG without obstacle lighting on the WTGs.**	
Residual Risk	7 - Tolerable

Table 9 Effect of the Project on operating crew

Risk ID:	3. Effect of the Project on operating crew	
Discussion Introduction or imposition of additional operating procedures or limitations can affect an aircraft's operating crew. There are no known aerial application operations conducted at night in the vicinity of the Project site.		
Consequence The worst credible effect a wind farm could have on flight crew would be the imposition of operational limitations, and in some cases, the potential for use of emergency procedures. This would be a Minor consequence.		
	Consequence	Minor
Untreated Likelihood The imposition of operational limitations is unlikely to occur, but possible (has occurred rarely), which is classified as Possible.		
	Untreated Likelihood	Possible
Current Treatments (without lighting) • The Project site is clear of the obstacle limitation surfaces (OLS) of any certified aerodrome. • Aircraft flying at night are required to maintain at least the established LSALT with at least 1000 ft clearance over the highest obstacle except within 3 nm of the aerodrome during landing and take-off operations • Aircraft are restricted to a minimum height of 500 ft (152.4 m) AGL above the highest point of the terrain and any object on it within a radius of 300 m in visual flight during the day when not in the vicinity of built-up areas. The proposed WTGs will be a maximum of 220 m (723 ft) at the top of the blade tip. The rotor blade at its maximum height will be approximately 67.6 m (223 ft) above aircraft flying at the minimum altitude of 152.4 m AGL (500 ft). • In the event that descending cloud forces an aircraft lower than 500 ft (152.4 m) AGL, the minimum visibility of 5,000 m required for visual flight during the day should provide adequate time for pilots to observe and manoeuvre their aircraft clear of WTGs. • The WTGs will be coloured light grey and should be visible to pilots during the day. • The 'as constructed' details of WTGs are required to be notified to Airservices Australia so that the location and height of all WTGs can be noted on aeronautical maps and charts. • Because the Project WTGs are proposed to be above 100 m AGL, there is a statutory requirement to report the WTGs to CASA and notified to Airservices Australia prior to construction. CASA will review the Project for potential hazards to aircraft operations and may recommend the use of obstacle lighting, however this will not be mandatory.		

Level of Risk The level of risk associated with a Possible likelihood of a Minor consequence is 5.	
Current Level of Risk	5 - Tolerable
Risk Decision A risk level of 5 is classified as Tolerable: Treatment action possibly required to achieve ALARP - conduct cost/benefit analysis. Relevant manager to consider for appropriate action.	
Risk Decision	Accept, conduct cost benefit analysis
Recommended Treatments Given the current treatments and the limited scale and scope of flying operations conducted within the immediate vicinity of the Project, there is likely to be little additional safety benefit to be gained by installing obstacle lighting. The following treatment, which can be implemented at little cost, will provide an additional margin of safety: • Ensure details of the Project WTGs have been communicated to Airservices Australia, and local and regional aerodrome and aircraft operators prior to construction.	
Residual Risk Notwithstanding the current level of risk is considered **Tolerable,** the additional Recommended Treatments listed above will enhance aviation safety. The likelihood remains **Possible**, and consequence remains **Minor**. In the circumstances, the risk level of 5 is considered **ALARP.** **It is our assessment that there is an acceptable level of aviation safety risk associated with the potential for operational limitations to affect aircraft operating crew, without obstacle lighting on the Project WTGs.**	
Residual Risk	5 – Tolerable

Table 10 Effect of obstacle lighting on neighbours

Risk ID:	*4.* Effect of obstacle lighting on neighbours

Discussion

This scenario discusses the consequential impact of a decision to install obstacle lighting on the wind farm.

Installation and operation of obstacle lighting on WTGs can have an effect on neighbours' visual amenity and enjoyment, specifically at night and in good visibility conditions.

Details of the relevant proposal (for objects 100 m AGL or above) must be referred to CASA for CASA to determine, in writing:

(a) whether the object or structure will be a hazard to aircraft operations

(b) whether it should be lit with obstacle light(s) that is essential for the safety of aircraft operations.

In general, objects outside an OLS and above 200 m would be recommended by CASA to have obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.

The Project is not located within the River Murray International Dark Sky Reserve.

Consequence

The worst credible effect of obstacle lighting specifically at night in good visibility conditions would be:

- Moderate site impact, minimal local impact, important consideration at local or regional level, possible long-term cumulative effect. Not likely to be decision making issues. Design and mitigation measures may ameliorate some consequences.

This would be a Moderate consequence.

Consequence	Moderate

Untreated Likelihood

The likelihood of moderate site impact, minimal local impact is Almost certain - the event is likely to occur many times (has occurred frequently).

Untreated Likelihood	Almost certain

Current Treatments

If the WTGs will be higher than 150 m (492 ft) AGL, they must be regarded as obstacles unless CASA assess otherwise. In general, objects outside an OLS and above 200 m may be recommended by CASA to have obstacle lighting unless CASA, in an aeronautical study, assesses it is shielded by another lit object or it is of no operational significance.

Level of Risk

The level of risk associated with an Almost certain likelihood of a Moderate consequence is 8.

Current Level of Risk	8 - Unacceptable

Risk Decision A risk level of 8 is classified as Unacceptable: Immediate action required by either treating or avoiding risk. Refer to executive management.	
Risk Decision	Unacceptable
Recommended Treatments Not installing obstacle lighting would completely remove the source of the impact. As per the above safety risk assessment, the provision of lighting for the WTGs and WMTs is not considered necessary to provide an acceptable level of safety. If CASA or a planning authority decide that obstacle lighting is required there are impact reduction measures that can be implemented to reduce the impact of lighting on surrounding neighbours, including: • reducing the number of WTGs with obstacle lights • specifying an obstacle light that minimises light intensity at ground level • specifying an obstacle light that matches light intensity to meteorological visibility • mitigating light glare from obstacle lighting through measures such as baffling. These measures are designed to optimise the benefit of the obstacle lights to pilots while minimising the visual impact to residents within and around the Project site. Consideration may be given to activating the obstacle lighting via a pilot activated lighting system. An option is to consider using Aircraft Detection Lighting Systems (referred in the United States Federal Aviation Administration Advisory Circular AC70/7460-1L CHG1 – *Obstruction Marking and Lighting*). Such a system would only activate the lights when an aircraft is detected in the near vicinity and deactivate the lighting once the aircraft has passed. This technology reduces the impact of night lighting on nearby communities and migratory birds and extends the life expectancy of obstruction lights.	
Residual Risk Not installing obstacle lights would clearly be an acceptable outcome to those potentially affected by visual impact. If lighting is required, consideration of visual impact in the lighting design should enable installation of lighting that reduces the impact to neighbours. The likelihood of a **Moderate** consequence remains **Likely**, with a resulting risk level of **7 – Tolerable**. **It is our assessment that visual impact from obstacle lights can be negated if they are not installed.** If obstacle lights are to be installed, they can be designed so that there is an acceptable risk of visual impact to neighbours.	
Residual Risk	7 - Tolerable

10. CONCLUSIONS

The key conclusions of this AIA are summarised as follows:

10.1. Project description

The Project will comprise the following:

- Up to a maximum of 42 WTGs with a maximum overall height (tip height) of up to 220 m AGL
- The highest WGT has a ground elevation of 486.1 m AHD (with 5 m buffer) and an overall height of 706.1 m AHD (2317 ft AMSL)
- Associated power storage and transmission infrastructure, including an overhead transmission line connecting to the existing grid via a cut-in terminal substation, east of Truro.

The Project is located within the Regional Council of Goyder, Light Regional Council and Mid-Murray Council LGA.

10.2. Aviation Impact Statement

Based on the Project WTG layout and maximum blade tip height of up to 220 m AGL, the blade tip elevation of the highest WTG will not exceed 706.1 m AHD (2317 ft AMSL) and:

- is not located within 30 nm of any certified aerodrome and will not affect any terminal instrument flight procedures
- will not penetrate any OLS surfaces
- will not have an impact on nearby designated air routes
- will not have an impact on the grid LSALT
- will not have an impact on operational airspace
- is wholly contained within Class G airspace
- is outside the clearance zones associated with civil aviation navigation aids and communication facilities.

10.3. ALA analysis summary

There are no active verified ALAs located within 3 nm of the Project. Truro Valley farm ALA (YVAF) was located less than 1 km from the Project transmission line corridor, however this ALA has been noted as closed on OzRunways and is currently being used for cropping.

Gawler and Stonefield Gliding aerodromes are not located in close proximity to the Project and there is no impact anticipated to the normal departure and arrival procedures for gliders at those aerodromes.

An unverified ALA was identified west of the Project, approximately 4.7 km (2.6 nm) northwest of the nearest WTG site. The ALA is located beyond the maximum wake turbulence impacts anticipated for WTGs, and the Project is located well clear of a 1 nm circuit pattern on the eastern side of the runway. Aircraft operations and accessibility to the ALA are not anticipated to be affected by the Project.

10.4. Aircraft operator characteristics

Aircraft operators flying in vicinity of the Project may include private and recreational (including gliding) activities. Aerial firefighting and aerial application operations may be possible in the vicinity of the Project Area. Military aircraft are likely to operate overhead the Project within restricted areas R265E and 265F, with minimum vertical limits of 3500 ft and 4500 ft AMSL respectively.

There are no regular high-capacity air transport operations that would be conducted in the immediate vicinity of the Project Area.

10.5. Hazard marking and lighting

The following conclusions apply to hazard marking and lighting:

- With respect to CASR Part 139 Division 139.E.1 Notifying potential hazards 139.165, the proposed WTGs must be reported to CASA. WTGs should be marked in accordance with Part 139 MOS 2019 Chapter 8 Division 10 section 8.110.
- CASA will review the proposed WTG development and may make a recommendation for obstacle lighting, however this would not be mandatory.
- With respect to marking of WTGs, a light-grey colour has been selected as the colour for the WTGs. It is considered that this will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents.

10.6. Summary of risks

A summary of the level of residual risk associated with the Project with the Recommended Treatments implemented, is provided in Table 11.

Table 11 Summary of Residual Risks

Identified Risk	*Consequence*	*Likelihood*	*Risk*	*Actions Required*
Aircraft collision with wind turbine generator (WTG)	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project WTGs to local and regional operators.
Avoidance manoeuvring leads to ground collision	Catastrophic	Unlikely	7	Acceptable without obstacle lighting (ALARP). Communicate details of the Project WTGs to local and regional operators.
Effect on crew	Minor	Possible	5	Acceptable without obstacle lighting (ALARP) Communicate details of the Project WTGs to local and regional operators.
Effect of obstacle lighting on neighbours	Moderate	Likely	7	Acceptable without obstacle lighting (ALARP)

11. RECOMMENDATIONS

Recommended actions resulting from the conduct of this assessment are provided below.

Notification and reporting

1. Details of WTGs exceeding 100 m AGL must be reported to CASA *as soon as practicable after forming the intention to construct or erect the proposed object or structure,* in accordance with CASR Part 139.165(1)(2).

2. 'As constructed' details of WTG coordinates and elevation should be provided to Airservices Australia, by submitting the form at this webpage: https://www.airservicesaustralia.com/wp-content/uploads/ATS-FORM-0085_Vertical_Obstruction_Data_Form.pdf to the following email address: vod@airservicesaustralia.com

3. Any obstacles above 100 m AGL (including temporary construction equipment) should be reported to Airservices Australia NOTAM office until they are incorporated in published operational documents. With respect to crane operations during the construction of the Project, a notification to the NOTAM office may include, for example, the following details:

    a. The planned operational timeframe and maximum height of the crane; and

    b. Either the general area within which the crane will operate and/or the planned route with timelines that crane operations will follow.

4. Details of the wind farm should be provided to local and regional aircraft operators prior to construction in order for them to consider the potential impact of the wind farm on their operations.

5. To facilitate the flight planning of aerial application operators, details of the Project, including the 'as constructed' location and height information of WTGs, WMTs and overhead transmission lines should be provided to landowners so that, when asked for hazard information on their property, the landowner may provide the aerial application pilot with all relevant information

Lighting of WTGs

6. Aviation Projects has assessed that installing obstacle lights on WTGs is not required to maintain an acceptable level of safety to aircraft.

Micrositing

7. The potential micrositing of the WTGs has been considered in the assessment with the estimate of the overall maximum height being based on the highest ground level within 100 m of the WTG positions. Providing the micrositing is within 100 m of the WTGs, it is likely to not result in a change in the maximum overall blade tip height of the Project. No further assessment is likely to be required from micrositing and the conclusions of this AIA would remain the same.

Overhead transmission line

8. Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial application operators and marked in accordance with Part 139 MOS 2019 Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8).

Triggers for review

9. Triggers for review of this risk assessment are provided for consideration:

    a. prior to construction to ensure the regulatory framework has not changed

b. following any significant changes to the context in which the assessment was prepared, including the regulatory framework

c. following any near miss, incident or accident associated with operations considered in this risk assessment.

ANNEXURES

1. References
2. Definitions
3. CASA regulatory requirements – Lighting and Marking
4. Risk Framework

ANNEXURE 1 – REFERENCES

References used or consulted in the preparation of this report include:

- Airservices Australia, Aeronautical Information Package; including AIP Book, Departure and Approach Procedures and En Route Supplement Australia dated 05 September 2024
- Airservices Australia, Designated Airspace Handbook, effective 13 June 2024
- Government of South Australia, PlanSA, Planning and Design Code, Version 2023.13
- Civil Aviation Safety Authority, Civil Aviation Safety Regulations 1998 (CASR)
- Civil Aviation Safety Authority, Advisory Circular (AC) 91-10 v1.1: *Operations in the vicinity of non-controlled aerodromes*, dated November 2021
- Civil Aviation Safety Authority, Manual of Standards Part 173 – Standards Applicable to Instrument Flight Procedure Design, version 1.8, dated August 2022
- Civil Aviation Safety Authority, *Part 139 (Aerodromes) Manual of Standards 2019*, Version F2020L00931 dated 13 August 2020
- Civil Aviation Safety Authority, Advisory Circular 139.E-01 v1.0—Reporting of Tall Structures, dated December 2021
- Civil Aviation Safety Authority, Advisory Circular (AC) 139.E-05 v1.1 Obstacles (including wind farms) outside the vicinity of a CASA certified aerodrome, October 2022
- Department of Infrastructure and Regional Development, Australian Government, National Airport Safeguarding Framework, Guideline D *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* dated July 2012
- International Civil Aviation Organization (ICAO) Doc 8168 Procedures for Air Navigation Services—Aircraft Operations (PANS-OPS)
- ICAO Standards and Recommended Practices, Annex 14—Aerodromes
- OzRunways, aeronautical navigation charts extracts, dated September 2024
- Standards Australia, ISO 31000:2018 *Risk management – Guidelines*

ANNEXURE 2 – DEFINITIONS

Term	*Definition*
Aerial Agricultural Operator	Specialist pilot and/or company who are required to have a commercial pilot's licence, an agricultural rating and a chemical distributor's licence
Aerodrome	A defined area on land or water (including any buildings, installations, and equipment) intended to be used either wholly or in part for the arrival, departure, and surface movement of aircraft.
Aerodrome facilities	Physical things at an aerodrome which could include: a. the physical characteristics of any movement area including runways, taxiways, taxilanes, shoulders, aprons, primary and secondary parking positions, runway strips and taxiway strips; b. infrastructure, structures, equipment, earthing points, cables, lighting, signage, markings, visual approach slope indicators.
Aerodrome reference point (ARP)	The designated geographical location of an aerodrome.
Aeronautical Information Publication (AIP)	Details of regulations, procedures, and other information pertinent to the operation of aircraft
Aeronautical Information Publication En-route Supplement Australia (AIP ERSA)	Contains information vital for planning a flight and for the pilot in flight as well as pictorial presentations of all licensed aerodromes
Civil Aviation Safety Regulations 1998 (CASR)	Contain the mandatory requirements in relation to airworthiness, operational, licensing, enforcement.
Instrument meteorological conditions (IMC)	Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling, less than the minimum specified for visual meteorological conditions.
Manual of Standards (MOS)	The means CASA uses in meeting its responsibilities under the Act for promulgating aviation safety standards
National Airports Safeguarding Framework (NASF)	The Framework has the objective of developing a consistent and effective national framework to safeguard both airports and communities from inappropriate on and off airport developments.
Obstacles	All fixed (whether temporary or permanent) and mobile objects, or parts thereof, that are located on an area intended for the surface movement of aircraft or that extend above a defined surface intended to protect aircraft in flight.

Term	Definition
Runway	A defined rectangular area on a land aerodrome prepared for the landing and take-off of aircraft.
Runway strip	A defined area including the runway and stopway, if provided, intended: a. to reduce the risk of damage to aircraft running off a runway; and b. to protect aircraft flying over it during take-off or landing operations.
Safety Management System	A systematic approach to managing safety, including organisational structures, accountabilities, policies and procedures.

ANNEXURE 3 – CASA REGULATORY REQUIREMENTS – LIGHTING AND MARKING

In considering the need for aviation hazard lighting and marking, the applicable regulatory context was determined.

The Civil Aviation Safety Authority (CASA) regulates aviation activities in Australia. Applicable requirements include the Civil Aviation Regulations 1988 (CAR), Civil Aviation Safety Regulations 1998 (CASR) and associated Manual of Standards (MOS) and other guidance material. Relevant provisions are outlined in further detail in the following section.

Civil Aviation Safety Regulations 1998, Part 139—Aerodromes

CASR 139.165 requires the owner of a structure (or proponents of a structure) that will be 100 m or more above ground level to inform CASA. This must be given in written notice and contain information on the proposal, the height and location(s) of the object(s) and the proposed timeframe for construction. This is to allow CASA to assess the effect of the structure on aircraft operations and determine whether the structure will be hazardous to aircraft operations.

Manual of Standards Part 139—Aerodromes

Chapter 9 sets out the standards applicable to Visual Aids Provided by Aerodrome Lighting.

Section 9.30 provides guidance on Types of Obstacle Lighting and Their Use:

1. *The following types of obstacle lights must be used, in accordance with this MOS, to light hazardous obstacles:*
    a. *low-intensity;*
    b. *medium-intensity;*
    c. *high-intensity;*
    d. *a combination of low, medium or high-intensity.*
2. *Low-intensity obstacle lights:*
    a. *are steady red lights; and*
    b. *must be used on non-extensive objects or structures whose height above the surrounding ground is less than 45 m.*
3. *Medium-intensity obstacle lights must be:*
    a. *flashing white lights; or*
    b. *flashing red lights; or*
    c. *steady red lights.*

    Note CASA recommends the use of flashing red medium-intensity obstacle lights.

4. *Medium-intensity obstacle lights must be used if:*
    a. *the object or structure is an extensive one; or*

b. *the top of the object or structure is at least 45 m but not more than 150 m above the surrounding ground; or*

c. *CASA determines in writing that early warning to pilots of the presence of the object or structure is desirable in the interests of aviation safety.*

Note For example, a group of trees or buildings is regarded as an extensive object.

5. *For subsection (4), low-intensity and medium-intensity obstacle lights may be used in combination.*

6. *High-intensity obstacle lights:*

   a. *must be used on objects or structures whose height exceeds 150 m; and*

   b. *must be flashing white lights.*

7. *Despite paragraph (6) (b), a medium-intensity flashing red light may be used if necessary, to avoid an adverse environmental impact on the local community.*

Sections 9.31 (8) and (9) provide guidance on obstacle lighting specific to wind farms:

8. *Subject to subsection (9), for wind turbines in a wind farm, medium-intensity obstacle lights must:*

   a. *mark the highest point reached by the rotating blades; and*

   b. *be provided on a sufficient number of individual wind turbines to indicate the general definition and extent of the wind farm, but such that intervals between lit turbines do not exceed 900 m; and*

   c. *all be synchronised to flash simultaneously; and*

   d. *be seen from every angle in azimuth.*

   Note: This is to prevent obstacle light shielding by the rotating blades of a wind turbine and may require more than 1 obstacle light to be fitted.

9. *If it is physically impossible to light the rotating blades of a wind turbine:*

   a. *the obstacle lights must be placed on top of the generator housing; and*

   b. *a note must be published in the AIP-ERSA indicating that the obstacle lights are not at the highest position on the wind turbines.*

10. *If the top of an object or structure is more than 45 m above:*

   a. *the surrounding ground (ground level); or*

   b. *the top of the tallest nearby building (building level); then the top lights must be medium-intensity lights, and additional low-intensity lights must be:*

   c. *provided at lower levels to indicate the full height of the structure; and*

   d. *spaced as equally as possible between the top lights and the ground level or building level, but not so as to exceed 45 m between lights.*

Advisory Circular 139.E-01 v1.0—Reporting of Tall Structures

In Advisory Circular (AC) 139.E-01 v1.0—Reporting of Tall Structures, CASA provides guidance to those authorities and persons involved in the planning, approval, erection, extension or dismantling of tall structures so that they may understand the vital nature of the information they provide.

Airservices Australia has been assigned the task of maintaining a database of tall structures. RAAF and Airservices Australia require information on structures which are:

a) 30 metres or more above ground level—within 30 kilometres of an aerodrome; or

b) 45 metres or more above ground level elsewhere for the RAAF, or

c) 30 m or more above ground level elsewhere for Airservices Australia.

The purpose of notifying Airservices Australia of these structures is to enable their details to be provided in aeronautical information databases and maps/charts etc used by pilots, so that the obstacles can be avoided.

The proposed WTGs must be reported to Airservices Australia. This action should occur once the final layout after micrositing is confirmed and prior to construction.

International Civil Aviation Organisation

Australia, as a contracting State to the International Civil Aviation Organisation (ICAO) and signatory to the Chicago Convention on International Civil Aviation (the Convention), has an obligation to implement ICAO's standards and recommended practices (SARPs) as published in the various annexes to the Convention.

Annex 14 to the Convention — *Aerodromes, Volume 1,* Section 6.2.4 provides SARPs for the obstacle lighting and marking of WTGs, which is copied below:

> *6.2.4 Wind turbines*
>
> *6.2.4.1 A wind turbine shall be marked and/or lighted if it is determined to be an obstacle.*
>
> *Note 1. — Additional lighting or markings may be provided where in the opinion of the State such lighting or markings are deemed necessary.*
>
> *Note 2. — See 4.3.1 and 4.3.2*
>
> *Markings*
>
> *6.2.4.2 Recommendation. — The rotor blades, nacelle and upper 2/3 of the supporting mast of wind turbines should be painted white, unless otherwise indicated by an aeronautical study.*
>
> *Lighting*
>
> *6.2.4.3 Recommendation. — When lighting is deemed necessary, in the case of a wind farm, i.e. a group of two or more wind turbines, the wind farm should be regarded as an extensive object and the lights should be installed:*
>
> > *a) to identify the perimeter of the wind farm;*
> >
> > *b) respecting the maximum spacing, in accordance with 6.2.3.15, between the lights along the perimeter, unless a dedicated assessment shows that a greater spacing can be used;*
> >
> > *c) so that, where flashing lights are used, they flash simultaneously throughout the wind farm;*
> >
> > *d) so that, within a wind farm, any wind turbines of significantly higher elevation are also identified wherever they are located; and*
> >
> > *e) at locations prescribed in a), b) and d), respecting the following criteria:*

i) for wind turbines of less than 150 m in overall height (hub height plus vertical blade height), medium-intensity lighting on the nacelle should be provided;

ii) for wind turbines from 150 m to 315 m in overall height, in addition to the medium-intensity light installed on the nacelle, a second light serving as an alternate should be provided in case of failure of the operating light. The lights should be installed to assure that the output of either light is not blocked by the other; and

iii) in addition, for wind turbines from 150 m to 315 m in overall height, an intermediate level at half the nacelle height of at least three low-intensity Type E lights, as specified in 6.2.1.3, should be provided. If an aeronautical study shows that low-intensity Type E lights are not suitable, low-intensity Type A or B lights may be used.

Note. — The above 6.2.4.3 e) does not address wind turbines of more than 315 m of overall height. For such wind turbines, additional marking and lighting may be required as determined by an aeronautical study.

6.2.4.4 Recommendation. — The obstacle lights should be installed on the nacelle in such a manner as to provide an unobstructed view for aircraft approaching from any direction.

6.2.4.5 Recommendation. — Where lighting is deemed necessary for a single wind turbine or short line of wind turbines, the installation should be in accordance with 6.2.4.3 e) or as determined by an aeronautical study.

As referenced in Section 6.2.4.3(e)(iii), Section 6.2.1.3 is copied below:

6.2.1.3 The number and arrangement of low-, medium- or high-intensity obstacle lights at each level to be marked shall be such that the object is indicated from every angle in azimuth. Where a light is shielded in any direction by another part of the object, or by an adjacent object, additional lights shall be provided on that adjacent object or the part of the object that is shielding the light, in such a way as to retain the general definition of the object to be lighted. If the shielded light does not contribute to the definition of the object to be lighted, it may be omitted.

As referenced in Section 6.2.4.3(b), Section 6.2.3.15 is copied below:

6.2.3.15 Where lights are applied to display the general definition of an extensive object or a group of closely spaced objects, and

a) low-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 45 m; and

b) medium-intensity lights are used, they shall be spaced at longitudinal intervals not exceeding 900 m.

Section 4.3 Objects outside the OLS states the following:

4.3.1 Recommendation.— Arrangements should be made to enable the appropriate authority to be consulted concerning proposed construction beyond the limits of the obstacle limitation surfaces that extend above a height established by that authority, in order to permit an aeronautical study of the effect of such construction on the operation of aeroplanes.

4.3.2 Recommendation. — In areas beyond the limits of the obstacle limitation surfaces, at least those objects which extend to a height of 150 m or more above ground elevation should be regarded *as obstacles, unless a special aeronautical study indicates that they do not constitute a hazard to aeroplanes.*

Note. — This study may have regard to the nature of operations concerned and may distinguish between day and night operations.

ICAO Doc 9774 Manual on Certification *of Airports* defines an aeronautical study as:

An aeronautical study is a study of an aeronautical problem to identify potential solutions and select a solution that is acceptable without degrading safety.

Light characteristics

If obstacle lighting is required, installed lights should be designed according to the criteria set out in the applicable regulatory material and taking CASA's recommendations into consideration in the case that CASA has reviewed this risk assessment and provided recommendations.

The characteristics of the obstacle lights should be in accordance with the applicable standards in Part 139 MOS 2019.

The characteristics of low and medium intensity obstacle lights specified in Part 139 MOS 2019, Chapter 9, are provided below.

Part 139 MOS 2019 Chapter 9 Division 4 – Obstacle Lighting section 9.32 outlines Characteristics of Low Intensity Obstacle Lights.

1. *Low-intensity obstacle lights must have the following:*
   - a. *fixed lights showing red;*
   - b. *a horizontal beam spread that results in 360-degree coverage around the obstacle;*
   - c. *a minimum intensity of 100 candela (cd);*
   - d. *a vertical beam spread (to 50% of peak intensity) of 10 degrees;*
   - e. *a vertical distribution with 50 cd minimum at +6 degrees and +10 degrees above the horizontal;*
   - f. *not less than 10 cd at all elevation angles between –3 degrees and +90 degrees above the horizontal.*

   Note: The intensity requirement in paragraph (c) may be met using a double-bodied light fitting. CASA recommends that double-bodied light fittings, if used, should be orientated so that they show the maximum illuminated surface towards the predominant, or more critical, direction of aircraft approach.

2. *To indicate the following:*
   - a. *taxiway obstacles;*
   - b. *unserviceable areas of the movement area; low-intensity obstacle lights must have a peak intensity of at least 10 cd.*

Part 139 MOS 2019 Chapter 9 Division 4 – Obstacle Lighting section 9.33 outlines Characteristics of Medium Intensity Obstacle Lights.

1. *Medium-intensity obstacle lights must:*

a. *be visible in all directions in azimuth; and*

b. *if flashing — have a flash frequency of between 20 and 60 flashes per minute.*

2. *The peak effective intensity of medium-intensity obstacle lights must be 2 000 ☐ 25% cd with a vertical distribution as follows:*

    a. *for vertical beam spread — a minimum of 3 degrees;*

    b. *at -1-degree elevation — a minimum of 50% of the lower tolerance value of the peak intensity;*

    c. *at 0 degrees elevation — a minimum of 100% of the lower tolerance value of the peak intensity.*

3. *For subsection (2), vertical beam spread means the angle between 2 directions in a plane for which the intensity is equal to 50% of the lower tolerance value of the peak intensity.*

4. *If, instead of obstacle marking, a flashing white light is used during the day to indicate temporary obstacles in the vicinity of an aerodrome, the peak effective intensity of the light must be increased to 20 000 ± 25% cd when the background luminance is 50 cd/m^2 or greater.*

Visual impact of night lighting

Annex 14 Section 6.2.4 and Part 139 MOS 2019 Chapter 9.31 (8)(9) are specifically intended for WTGs and recommends that medium intensity lighting is installed.

Generally accepted considerations regarding minimisation of visual impact are provided below for consideration in this aeronautical study:

- To minimise the visual impact on the environment, some shielding of the obstacle lights is permitted, provided it does not compromise their operational effectiveness;
- Shielding may be provided to restrict the downward component of light to either, or both, of the following:
    - such that no more than 5% of the nominal intensity is emitted at or below 5 degrees below horizontal; and
    - such that no light is emitted at or below 10 degrees below horizontal;
- If a light would be shielded in any direction by an adjacent object or structure, the light so shielded may be omitted, provided that such additional lights are used as are necessary to retain the general definition of the object or structure.
- If flashing obstacle lighting is required, all obstacle lights on a wind farm should be synchronised so that they flash simultaneously; and
- A relatively small area on the back of each blade near the rotor hub may be treated with a different colour or surface treatment, to reduce reflection from the rotor blades of light from the obstacle lights, without compromising the daytime visibility of the overall WTG.

Marking of WTGs

ICAO Annex 14 Vol 1 Section 6.2.4.2 recommends that the rotor blades, nacelle and upper 2/3 of the supporting mast of the WTGs should be painted a shade of white, unless otherwise indicated by an aeronautical study.

It is generally accepted that a shade of white colour will provide sufficient contrast with the surrounding environment to maintain an acceptable level of safety while lowering visual impact to the neighbouring residents.

Overhead transmission lines

Overhead transmission lines and/or supporting poles that are located where they could adversely affect aerial application operations should be identified in consultation with local aerial application operators and marked in accordance with Part 139 MOS 2019 Chapter 8 Division 10 section 8.110 (7) and section 8.110 (8):

> *8.110 Marking of hazardous obstacles*
>
> *(7) Hazardous obstacles in the form of wires or cables must be marked using 3-dimensional coloured objects attached to the wire or cables. Note: Spheres and pyramids are examples of 3-dimensional objects.*
>
> *(8) The objects mentioned in subsection (7) must:*
>
> > *(a) be approximately equivalent in size to a cube with 600 mm sides; and*
> > *(b) be spaced 30 m apart along the length of the wire or cable.*

ANNEXURE 4 – RISK FRAMEWORK

A risk management framework is comprised of likelihood and consequence descriptors, a matrix used to derive a level of risk, and actions required of management according to the level of risk.

The risk assessment framework used by Aviation Projects has been developed in consideration of ISO 31000:2018 *Risk management—Guidelines* and the guidance provided by CASA in its Safety Management System (SMS) for Aviation guidance material, which is aligned with the guidance provided by the International Civil Aviation Organization (ICAO) in Doc 9589 *Safety Management Manual*, Third Edition, 2013. Doc 9589 is intended to provide States (including Australia) with guidance on the development and implementation of a State Safety Programme (SSP), in accordance with the International SARPs, and is therefore adopted as the primary reference for aviation safety risk management in the context of the subject assessment.

Section 2.1 of the ICAO Doc 9589 *The concept of safety* defines safety as follows [author's underlining]:

> *2.1.1 Within the context of aviation, safety is "the state in which the possibility of harm to persons or of property damage is reduced to, and maintained at or below, an acceptable level through a continuing process of hazard identification and safety risk management."*

Likelihood

Likelihood is defined in ISO 31000:2018 as the chance of something happening. Likelihood descriptors used in this report are as indicated in Table 1.

Table 1 Likelihood Descriptors

No	Descriptor	Description
1	Rare	It is almost inconceivable that this event will occur
2	Unlikely	The event is very unlikely to occur (not known to have occurred)
3	Possible	The event is unlikely to occur, but possible (has occurred rarely)
4	Likely	The event is likely to occur sometimes (has occurred infrequently)
5	Almost certain	The event is likely to occur many times (has occurred frequently)

Consequence

Consequence is defined as the outcome of an event affecting objectives, which in this case is the safe and efficient operation of aircraft, and the visual amenity and enjoyment of local residents.

Consequence descriptors used in this report are as indicated in Table 2.

Table 2 Consequence Descriptors

No	Descriptor	People Safety	Property/Equipment	Effect on Crew	Environment
1	Insignificant	Minor injury – first aid treatment	Superficial damage	Nuisance	No effects or effects below level of perception
2	Minor	Significant injury – outpatient treatment	Moderate repairable damage – property still performs intended functions	Operations limitation imposed. Emergency procedures used.	Minimal site impact – easily controlled. Effects raised as local issues, unlikely to influence decision making. May enhance design and mitigation measures.
3	Moderate	Serious injury - hospitalisation	Major repairable damage – property performs intended functions with some short-term rectifications	Significant reduction in safety margins. Reduced capability of aircraft/crew to cope with conditions. High workload/stress on crew. Critical incident stress on crew.	Moderate site impact, minimal local impact, and important consideration at local or regional level, possible long-term cumulative effect. Not likely to be decision making issues. Design and mitigation measures may ameliorate some consequences.
4	Major	Permanent injury	Major damage rendering property ineffective in achieving design functions without major repairs	Large reduction in safety margins. Crew workload increased to point of performance decrement. Serious injury to small number of occupants. Intense critical incident stress.	High site impact, moderate local impact, important consideration at state level. Minor long-term cumulative effect. Design and mitigation measures unlikely to remove all effects.
5	Catastrophic	Multiple Fatalities	Damaged beyond repair	Conditions preventing continued safe flight and landing. Multiple deaths with loss of aircraft	Catastrophic site impact, high local impact, national importance. Serious long-term cumulative effect. Mitigation measures unlikely to remove effects.

Risk matrix

The risk matrix, which correlates likelihood and consequence to determine a level of risk, used in this report is shown in Table 3.

Table 3 Risk Matrix

		CONSEQUENCE				
		INSIGNIFICANT 1	MINOR 2	MODERATE 3	MAJOR 4	CATASTROPHIC 5
LIKELIHOOD	ALMOST CERTAIN 5	6	7	8	9	10
	LIKELY 4	5	6	7	8	9
	POSSIBLE 3	4	5	6	7	8
	UNLIKELY 2	3	4	5	6	7
	RARE 1	2	3	4	5	6

Actions required

Actions required according to the derived level of risk are shown in Table 4.

Table 4 Actions Required

8-10	**Unacceptable Risk**	Immediate action required by either treating or avoiding risk. Refer to executive management.
5-7	**Tolerable Risk**	Treatment action possibly required to achieve As Low As Reasonably Practicable (ALARP) - conduct cost/benefit analysis. Relevant manager to consider for appropriate action.
0-4/5	**Broadly Acceptable Risk**	Managed by routine procedures, and can be accepted with no action.

AVIATION PROJECTS

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Native Vegetation Clearance Data Report

by Umwelt

Native Vegetation Clearance

Twin Creek Wind Farm and Energy Storage Project Data Report

Clearance under the Native Vegetation Regulations 2017

14/01/2025

Prepared by E. West – Umwelt (Australia) Pty Ltd

Twin Creek Wind Farm and Energy Storage Native Vegetation Clearance Data Report

Prepared by Umwelt (Australia) Pty Ltd for MasterPlan Pty Ltd

Project Number: 31699

Disclaimer

CITATION: Umwelt (2024) Native Vegetation Clearance Twin Creek Wind Farm and Energy Storage Native Vegetation Clearance Data Report. Report to MasterPlan Pty Ltd. Umwelt (Australia) Pty Ltd, Adelaide.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
R01	J. Skewes (NVC Accredited Consultant) and E. West	15/02/2024	A. Derry	14/02/2024
R02	E. West	20/09/2024	A. Derry	28/09/2024
R03	E. West	14/10/2024	T. How (NVC Accredited consultant)	18/10/2024
R04	E. West	14/10/2024	A. Derry	11/11/2024
R05	E. West	09/01/2025	A. Derry	09/01/2025
R06	E. West	14/01/2025	A. Derry	14/01/2025

Cover photograph: *Juncus* spp. and *Cyperus* spp. Sedgeland within the Development Area.

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Glossary and Abbreviations

BAM	Bushland Assessment Method
BDBSA	Biological Database of South Australia (maintained by DEW)
BUS	Bird Utilisation Survey
CEMP	Construction Environmental Management Plan
DA	Development Application
DCCEEW	Department of Climate Change, Energy, the Environment and Water (Commonwealth)
DEW	Department for Environment and Water (South Australia)
Development Area	The area outlined in Figure 2.1
DIT	Department for Infrastructure and Transport (South Australia)
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
ha	Hectare(s)
IBRA	Interim Biogeographical Regionalisation of Australia
INTG	Iron-grass Natural Temperate Grassland
km	Kilometre(s)
kV	Kilovolt
LSA Act	*Landscapes South Australia Act 2019*
m	Meter(s)
MBC	Mallee Bird Community
MDD	Murray Darling Depression
MNES	Matters of National Environmental Significance
MW	MegaWatt
NatureMaps	Initiative of DEW that provides a common access point to maps and geographic information about South Australia's natural resources in an interactive online mapping format
NPW Act	*National Parks and Wildlife Act 1972*
NV Act	*Native Vegetation Act 1991*
NVC	Native Vegetation Council
PBTL	Pygmy Blue-tongue Lizard
PBGW	Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia
PMST	Protected Matters Search Tool (under the EPBC Act; maintained by DCCEEW)
Project	Twin Creek Wind Farm Energy and Storage Project
RES	RES Australia Pty Ltd (the proponent)
SA	South Australia(n)
Search Area	5 km buffer of the Development Area
SEB	Significant Environmental Benefit

Site Boundary	The land detailed in Appendix 1
sp.	Species
spp.	Species (plural)
ssp.	Sub-species
STAM	Scattered Tree Assessment Method
TBS	Total Biodiversity Score
TCWF	Twin Creek Wind Farm
TEC	Threatened Ecological Community
TL	Transmission Line
WTG	Wind Turbine Generator
var.	Variety (a taxonomic rank below that of species and subspecies, but above that of form)

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1. APPLICATION INFORMATION

Details of the native vegetation clearance applicant are summarised in Table 1.1 with a summary of the proposed clearance provided in Table 1.2.

Table 1.1 Application Details

Applicant:	**RES Australia Pty Ltd**		
Key contact:	Roberta Magoba (Development Project Manager) Mobile: +61 (0) 478 079 331 Email: roberta.magoba@res-group.com		
Landowner:	The Applicant has contractual arrangements in place with the land holders to undertake the Project on the land.		
Site Address:	Various land holders see Appendix 1		
Local Government Area:	Goyder Light Mid Murray	**Hundred:**	Julia Creek Kapunda Belvidere Dutton Jellicoe
Title ID:	Title IDs are provided in Appendix 1	**Parcel ID**	Parcel IDs are provided in Appendix 1

Table 1.2 Summary of the Proposed Clearance

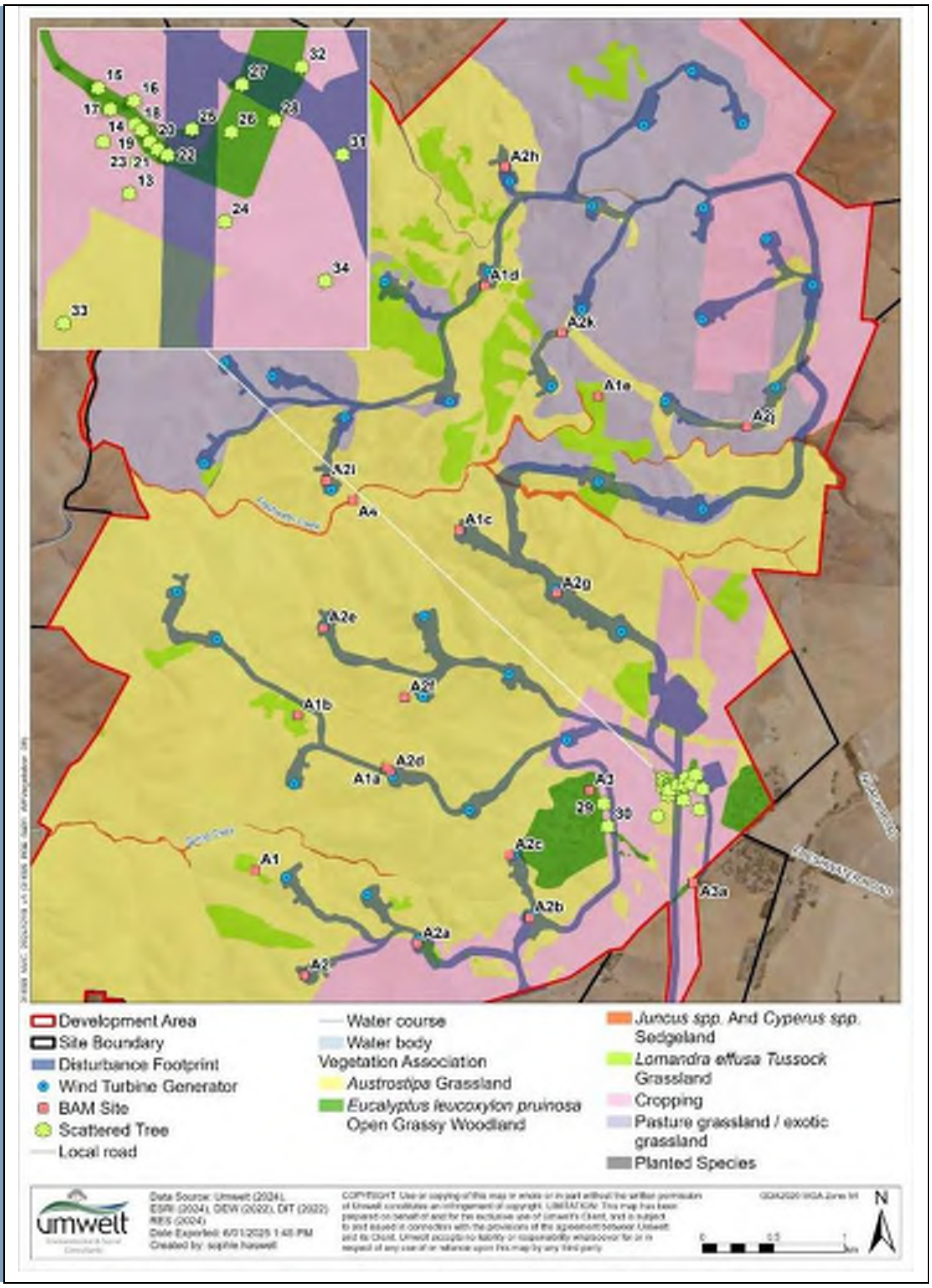
Purpose of clearance:	Clearance required for the construction of up to 42 wind turbine generators (WTGs) and associated infrastructure such as hard stands, access tracks, two substations and transmission line.
Native Vegetation Regulation:	Regulation 12, Schedule 1 clauses 33 (New building) and 34 (Infrastructure).
Description of the vegetation under application:	**Vegetation associations**

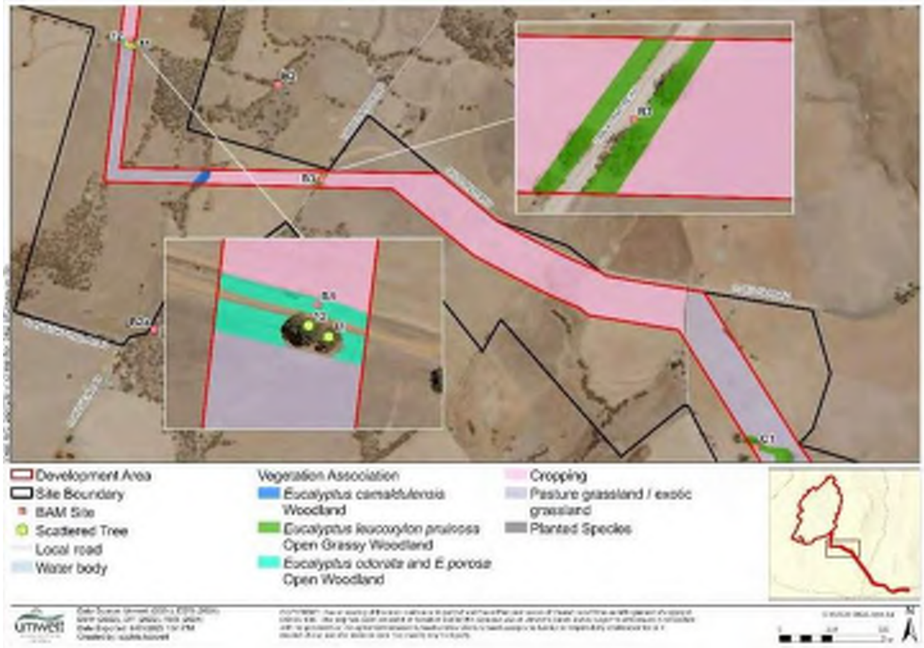
Vegetation association	Description	Location
A1	*Lomandra* spp. Tussock Grassland	Wind Farm
A2	*Austrostipa* spp. Grassland	Wind Farm
A3	*Eucalyptus leucoxylon pruinosa* Open Woodland	Wind Farm
A4	*Juncus spp.* and *Cyperus* spp. Sedgeland	Wind Farm
B1	*Eucalyptus odorata* and *E. porosa Open* Woodland	Transmission Line (TL) Route
B2	*E. camaldulensis* Woodland	TL Route
B3	*E. leucoxylon pruinosa* Open Woodland	TL Route
C1	*E. leucoxylon pruinosa* Open Woodland	TL Route
D1	*Austrostipa* spp. Grassland	TL Route
E1	*E. leucoxylon pruinosa* Open Woodland	TL Route
E2	*E. odorata* and *E. porosa* Open Woodland	TL Route

<table>
<tr><td></td><td>
<table>
<tr><td>E3</td><td>Lomandra effusa and Austrostipa sp. Grassland</td><td>TL Route</td></tr>
</table>
Scattered trees
A total of 35 scattered trees, which includes:

Five Eucalyptus porosa (Mallee Box)
28 Eucalyptus leucoxylon pruinosa (Inland Blue-gum)
Two Eucalyptus odorata (Peppermint Box).

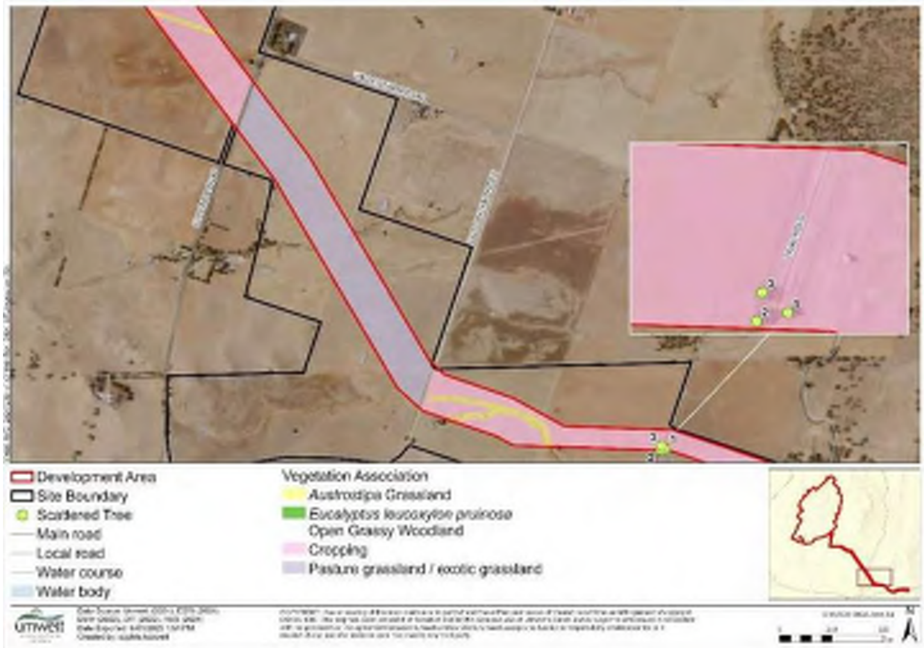
</td></tr>
<tr><td>Total proposed clearance – area (ha) and/or number of trees:</td><td>A total of 176.78 ha and 35 scattered trees are proposed to be cleared.</td></tr>
<tr><td>Level of clearance:</td><td>Level 4</td></tr>
<tr><td>Overlay (Planning and Design Code):</td><td>Native Vegetation Overlay</td></tr>
<tr><td>Map of proposed clearance area:</td><td>Maps of proposed clearance area (show as a minimum; property boundary and proposed clearance area).</td></tr>
</table>

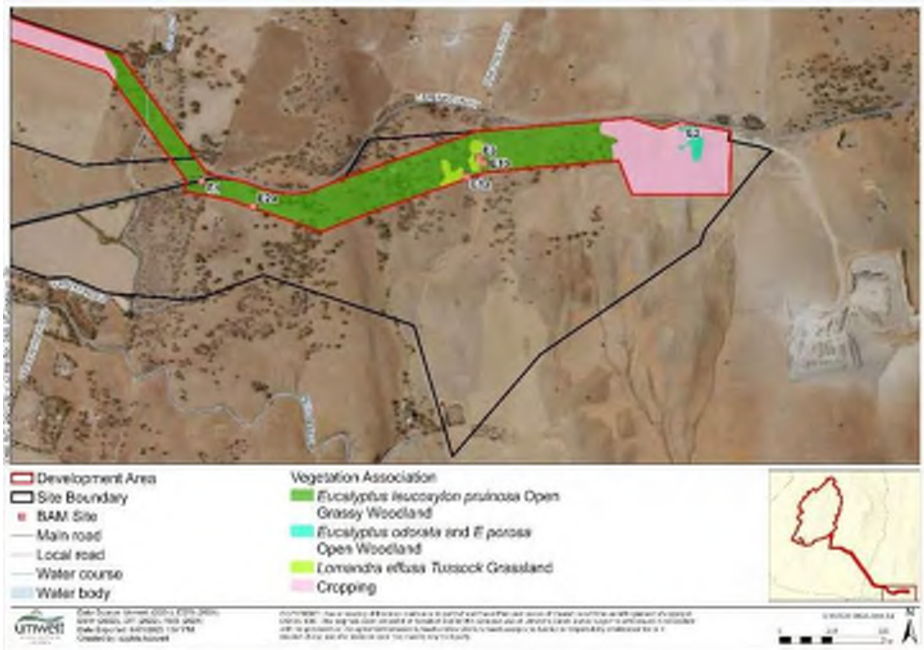

Development Area
Site Boundary
Disturbance Footprint
Wind Turbine Generator
BAM Site
Scattered Tree
Local road
Water course
Water body
Vegetation Association
Austrostipa Grassland
Eucalyptus leucoxylon pruinosa Open Grassy Woodland
Juncus spp. And Cyperus spp. Sedgeland
Lomandra effusa Tussock Grassland
Cropping
Pasture grassland / exotic grassland
Planted Species



Development Area
Site Boundary
BAM Site
Scattered Tree
Local road
Water body
Vegetation Association
Eucalyptus camaldulensis Woodland
Eucalyptus leucoxylon pruinosa Open Grassy Woodland
Eucalyptus odorata and E porosa Open Woodland
Cropping
Pasture grassland / exotic grassland
Planted Species

Development Area
Site Boundary
BAM Site
Scattered Tree
Main road
Local road
Water course
Water body
Vegetation Association
Austrostipa Grassland
Eucalyptus leucoxylon pruinosa Open Grassy Woodland
Cropping
Pasture grassland / exotic grassland
Planted Species





Mitigation Hierarchy:

a) Avoidance – outline measures taken to avoid clearance of native vegetation

All stages of the project design have been undertaken considering vegetation mapping, threatened ecological community mapping and the known locations of threatened species populations. Whilst every effort has been made to avoid sensitive areas where possible, such as locating turbines outside of *Lomandra* spp. grasslands and Peppermint Box grassy woodlands, engineering and landscape constraints mean that clearing of native vegetation cannot be completely avoided. The clearance areas showcase the worst-case scenario. That is, calculation of areas required for clearance of vegetation for the Wind Turbine Generators (WTG) and ancillary infrastructure associated with the construction of the TL route has been overstated and overcalculated. For example, the SEB calculated for the TL Route has assumed clearance of vegetation with the entire corridor, however, this is not the intended construction methodology. The poles and infrastructure required for the TL will be micro-sited to avoid vegetation included scattered trees resulting in partial clearance. This micro-siting also applies to WTG hard stands areas, access tracks and associated infrastructure (i.e. construction compound). To enable opportunities for avoidance as the project progresses through detailed design, a micrositing corridor (shown on the RES plans and is shown in Appendix 6).

b) Minimization – if clearance cannot be avoided, outline measures taken to minimize the extent, duration and intensity of impacts of the clearance on biodiversity to the fullest possible extent (whether the impact is direct, indirect or cumulative).

During the final design of the development, the infrastructure will be micro-sited to minimise native vegetation clearance. Clearance has been reduced to the smallest extent possible, given the design and specification constraints for the wind farm. The following measures have been taken to minimise native vegetation clearance and associated direct and indirect impacts:

- Existing farm tracks and council roads will be utilised where possible.
- Wherever possible, the location of infrastructure in grasslands that are in poor condition, currently being impacted by weeds and grazing.
- Micro siting of infrastructure wherever possible, particularly to avoid scattered trees.
- A Construction Environmental Management Plan (CEMP) aims to highlight the minimization measures for this Project. Some of these include, but are not limited to:
    - Limit vegetation clearing to that required for construction and safety and where possible, retain established trees and native shrub under storeys.
    - All vegetation clearing or disturbance is approved and undertaken in compliance with permits and/ or site management plans.
    - Tree pruning instead of removal where possible
    - Provide an induction for all project team members for identification and management of protected flora and fauna prior to the commencement of works, particularly Pygmy-blue Tongue Lizards, Iron-grass (*Lomandra* spp.) and Peppermint Box (*Eucalyptus odorata*).
    - Accurately and clearly mark out the edge of clearing and trees/vegetation to be retained including hollow trees, significant species, riparian zones.
    - Identify, retain and protect old or mature trees (alive or dead) which are in close proximity to the corridor by marking out/fencing.
    - Clearly identify buffer areas around protected species, including existing wedge tailed eagle nests
    - Fence or mark buffer areas around protected species prior to the commencement of works.
    - Controls in place to minimise disturbance to flora and fauna are maintained and effective.
    - Disturbed/ exposed areas are stabilised and revegetated progressively.
    - Cease work immediately if any previously unknown threatened flora species are encountered
    - Vegetation clearing methods shall be conducted in a manner that encourages natural regeneration of rootstock, minimises land disturbance and maintains soil stability and line clearance.
    - Avoid the removal of trees with hollows (alive or dead.) Where removal cannot be avoided, maintain the tree intact (as far as possible) and place it on the ground in adjoining vegetation.
    - Vegetation clearing methods shall be conducted in a manner that encourages natural regeneration of rootstock, minimises land disturbance and maintains soil stability and line clearance.

c) Rehabilitation or restoration – outline measures taken to rehabilitate ecosystems that have been degraded, and to restore ecosystems that

	have been degraded, or destroyed by the impact of clearance that cannot be avoided or further minimized, such as allowing for the re-establishment of the vegetation. Clearance for the Wind Farm footprint and TL Route poles will be permanent, and no rehabilitation will occur within those areas. However, areas between the TL Route poles will not be cleared. The following rehabilitation methods will be implemented: - Disturbed/ exposed areas are stabilised and revegetated progressively. Revegetation of areas beside access tracks and hardstands both during and following construction. Species selection will most likely be with a native seed mix/pasture seed mix. Often oversown with a sterile rye grass to ensure soil stabilisation. - Wherever practical, trenches will be backfilled immediately upon cable installation in accordance with the Construction Environmental Management Plan, with measures adopted to slow stormwater flows and to prevent the scouring of open trench or disturbed ground prior to revegetation. - Storing cleared vegetation and/ or topsoil containing seed bank for re-establishment after construction has been completed - Vegetation clearing methods shall be conducted in a manner that encourages natural regeneration of rootstock, minimises land disturbance and maintains soil stability and line clearance - Where removal of trees cannot be avoided, maintain the tree intact (as far as possible) and place it on the ground in adjoining vegetation. ***d) Offset – any adverse impact on native vegetation that cannot be avoided or further minimized should be offset by the achievement of a significant environmental benefit that outweighs that impact.*** The proponent aims to offset part of the clearance with an on-ground SEB Area (Offset Area). The Offset Area protects three vegetation associations, 21.174 hectares of Peppermint Box Grassy Woodland (in varying conditions) and 4.197 ha of River Red Gum Riparian Open Woodland. The vegetation associations and Unit Biodiversity Score (UBS) are listed below: - A1 (Peppermint Box open Grassy Woodland) UBS 39.05 – 14.019 ha - A2 (Peppermint Box Grassy Woodland) UBS 90.66 – 7.155 ha - A3 (River Red Gum Riparian Open Woodland) UBS 27.35 – 4.197 ha. Peppermint Box Grassy Woodland is listed as a nationally threatened ecological community (TEC) under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). BAM site A2 meets the condition class B TEC requirements in its current condition, the implementation of the Offset Area management plan will assist in significantly improving its condition. The management plan also aims to improve the condition of A1 (currently condition Class C, patches amendable to rehabilitation). The Offset Area would also contribute to the total area under conservation management in the area. Approximately 6% of the of Mopami EA contains native vegetation and only 2% is within the Reserve System. Therefore, the Offset Area significantly contributes to the management of native vegetation in the region. The balance amount will be paid into the fund.
SEB Offset proposal	Payment of **$4,108,821.03** (includes administration fee and GST) and **5652.07** SEB points

2. PURPOSE OF THE CLEARANCE

The Native Vegetation Data Report for the proposed optimised layout utilises a worst-case scenario in relation to clearance and the required SEB offset. That is, calculation of areas required for clearance of vegetation for the wind turbine generators and ancillary infrastructure, along with the infrastructure associated with construction of the Transmission Line (TL) Route has been overstated and overcalculated. By way of example, the SEB calculated for the TL Route has assumed clearance of vegetation within the entire corridor, however this is not the intended construction methodology. The poles and infrastructure required for the TL Route will be micro-sited to avoid vegetation, including scattered trees, and would not require complete clearance. This micro-siting also applies to the Wind Turbine Generator (WTG) hard stand areas, the access tracks and infrastructure areas (i.e. construction compounds). During the final design of the development, the infrastructure will be micro-sited to minimise native vegetation clearance. The finalised clearance and SEB will then be reviewed by the Native Vegetation Council for approval.

2.1. Description

Umwelt (Australia) Pty Ltd (Umwelt) (formerly EBS Ecology) has been engaged by MasterPlan Pty Ltd on behalf of RES Australia Pty Ltd (RES) to prepare a Native Vegetation Council (NVC) Data Report for the proposed Twin Creek Wind Farm (TCWF) Energy and Storage Project (the Project). RES proposes to develop the Twin Creek Wind Farm and Energy Storage Project within the Mid - North area of South Australia (SA). The site of the proposed development includes the area comprising the project infrastructure, as well as the proposed 275 kilovolt (kV) transmission line. The TL Route extends approximately 15 kilometres (km) south-east of the site and connects to the Robertstown - Tungkillo 275 kV transmission line adjacent the Sturt Highway near Truro.

2.2. Background

The proposed TCWF is located approximately 90 km northeast of Adelaide and is situated within the northern hills of the Mount Lofty Ranges. The Development Area is dominated by ridgelines in the north and plains or undulating hills in the south.

Land use within the area is predominantly agricultural (e.g. grazing for sheep and cattle). Native vegetation has previously been extensively cleared, with most of the Project footprint containing derived grasslands in varying condition. Woodland vegetation is generally restricted to creek lines and within small patches, or as scattered remnant trees. The general region is open, low hills with occasional rocky outcrops that fall away to low foot slopes and deep, eroded drainage channels at regular intervals. Vegetation cover is dominated by grasses and perennial herbaceous forbs, remnant woodland primarily comprised of *Eucalyptus leucoxylon* subsp. *pruinosa* (South Australian Blue-gum) and *Eucalyptus porosa* (Mallee Box). Patches of *Eucalyptus odorata* (Peppermint Box) also occur in the TL Route and the species was also found scattered across the site.

2.3. General Location Map

The site of the proposed development is approximately 90 km north-east of Adelaide and between the townships of Kapunda, Eudunda and Truro (Figure 2.1) It is located within two Landscape Management Regions, Northern and Yorke and Murraylands and Riverland, three Local Government Areas, Goyder, Light and Mid Murray and two Interim Biogeographic Regionalisation for Australia (IBRA) Associations, Rufus and Mopami (Figure 2.2).

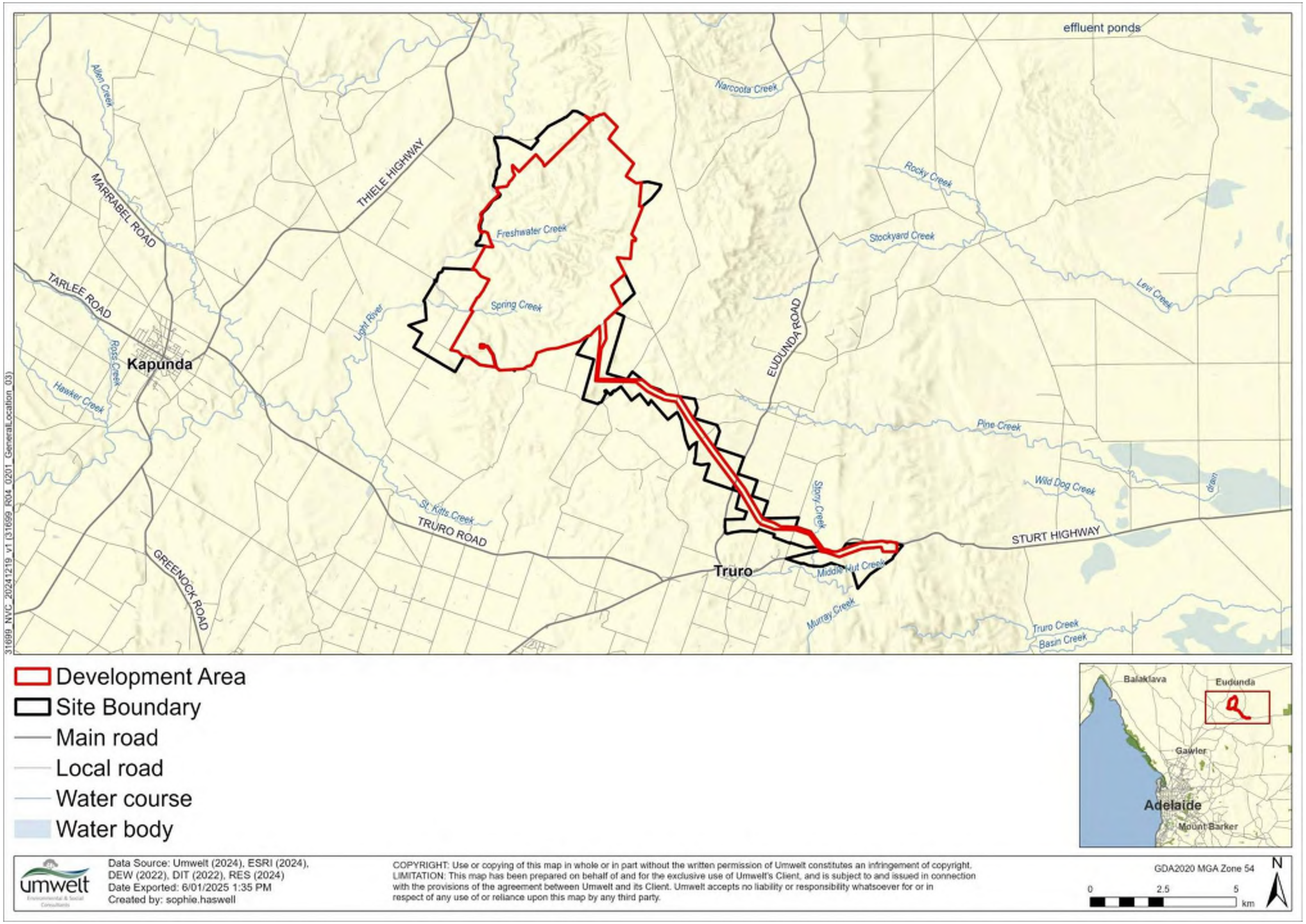


Figure 2.1 General location of the Twin Creek Wind Farm

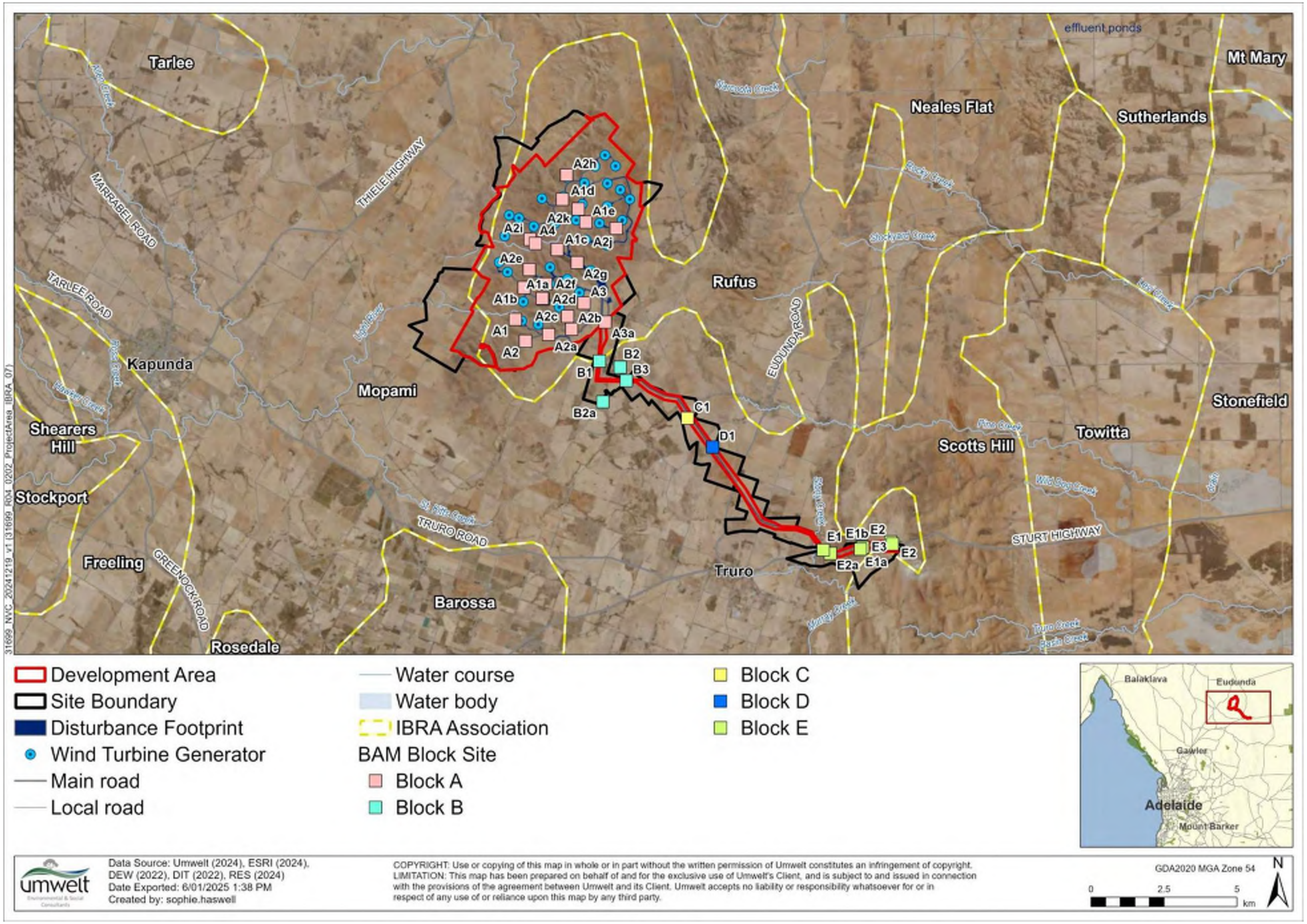


Figure 2.2 Interim Biogeographic Regionalisation for Australia (IBRA) Associations and different Blocks across the Development Area

2.4. Details of the Proposal

The site of the development has two components the Wind Farm (includes WTG and associated infrastructure) and the Transmission Line (TL). The optimised proposed design for the TCWF will consist of the following components:

- an overall WTG blade tip height up to 220 meters (m), a hub height of up to 134 m and a rotor diameter of up to 172 m
- up to 42 WTG
- each WTG has a capacity of up to 7.2 MegaWatt (MW), with a total installed generating capacity of up to 270 MW
- associated hard standing areas and access roads
- operations and maintenance building and compound with associated car parking
- two electrical substations (one project substation within the windfarm boundary and one cut-in terminal substation)
- a battery energy storage facility with an indicative capacity of 215 MW
- overhead and underground electrical cable reticulation
- overhead TL for approximately 15 km from the on-site substation to the existing overhead Robertstown – Tungkillo transmission line east of Truro
- temporary construction facilities including a borrow pit and concrete batching plant facilities.

This is highlighted in more detail in Table 2.1 and basic infrastructure shown in Figure 2.3.

Table 2.1 Project specifications

Component	Description
Project Layout	Up to 42 WTG and associated infrastructure. Each WTG with a name plate capacity of up to 7.2 MW, and a total installed name plate capacity of up to 270 MW.
Wind Turbines	Maximum height (to blade tip) – up to 220 m Rotor radius – up to 86 m Hub Height – up to 134 m Foundations – approximately 6m pedestal, 25 m sub-surface and 4m deep (exact footing dimensions are subject to engineering).
WTG laydown and Hardstand area	An average area of approximately 85 m x 45 m for foundation, laydown and crane hardstand areas - plus three 19 m x 7.5 m crane assist pads (exact dimensions are subject to engineering). Hardstand areas will be required adjacent to the base of each turbine to enable the assembly and erection of the WTG components. The shape and area will vary depending on the construction approach and the site conditions at each WTG location.
External Electrical Transformers	A pad mounted enclosed transformer (kiosk) located at the base of each turbine. Approximate dimensions (2 m long x 2 m wide x 1.5 m high).
Site Access	On-site access tracks a minimum width of 5.5m to accommodate construction activities and cranes. The main access tracks will provide access to the WTG sites and will be designed to take the weight of WTG transport and construction vehicles, and the crane used to erect the turbines. These will be located to align with existing property access tracks where possible.

Component	Description
	Some sections of the access tracks may be wider to accommodate overtaking areas and turning circles.
Underground electrical cabling	Approximate total length 99 km. Trenches – typically approximately 0.5m width and approximately 1m deep (minimum). Approximately 15 m impact area for a single cable alignment +approximately 5 m per cable in parallel. The exact dimensions will depend on the installation method used by the contractor.
Overhead 275 kV Transmission Line	Approximate length 15km. The TL would be constructed with steel or spun concrete poles up to 35 m high and spaced approximately 275–375 m apart (or wider should terrain enable). At the terminal substation the 275 kV transmission towers will comprise lattice towers approximately 60 m high to tee into the existing transmission line. Exact dimensions are subject to detailed design.
Substation, Battery Energy Storage Facility, and Operations and Maintenance Facilities	Two substations (1 project substation with the windfarm boundary and 1 cut-in terminal substation). Proposed operation and maintenance area 125 m x 65 m (~0.8 ha) Proposed substation 150 m x 150 m (~2.2 ha) Proposed battery storage area 87 m x 130 m (~1.1 ha)
Temporary Construction Compounds and Concrete Batching Plants	A temporary construction compound 100 m x 150 m (~1.5 ha) A temporary laydown area 100 m x 50 m (~0.5 ha) A temporary concrete batching plant 80 m x 131 m (~1.1 ha) A temporary construction compound adjacent to the terminal station (~1.47 ha).
Public Road Improvements	Access routes for all over-dimensional vehicles will be limited to those specified in the Traffic Impact Assessment. Roads and intersections will be upgraded to meet load and safety standards as agreed in the Traffic Management Plan. All public roads will be left in good repair following construction as agreed in the Traffic Management Plan. All access routes will be subject to DIT and Council agreement.

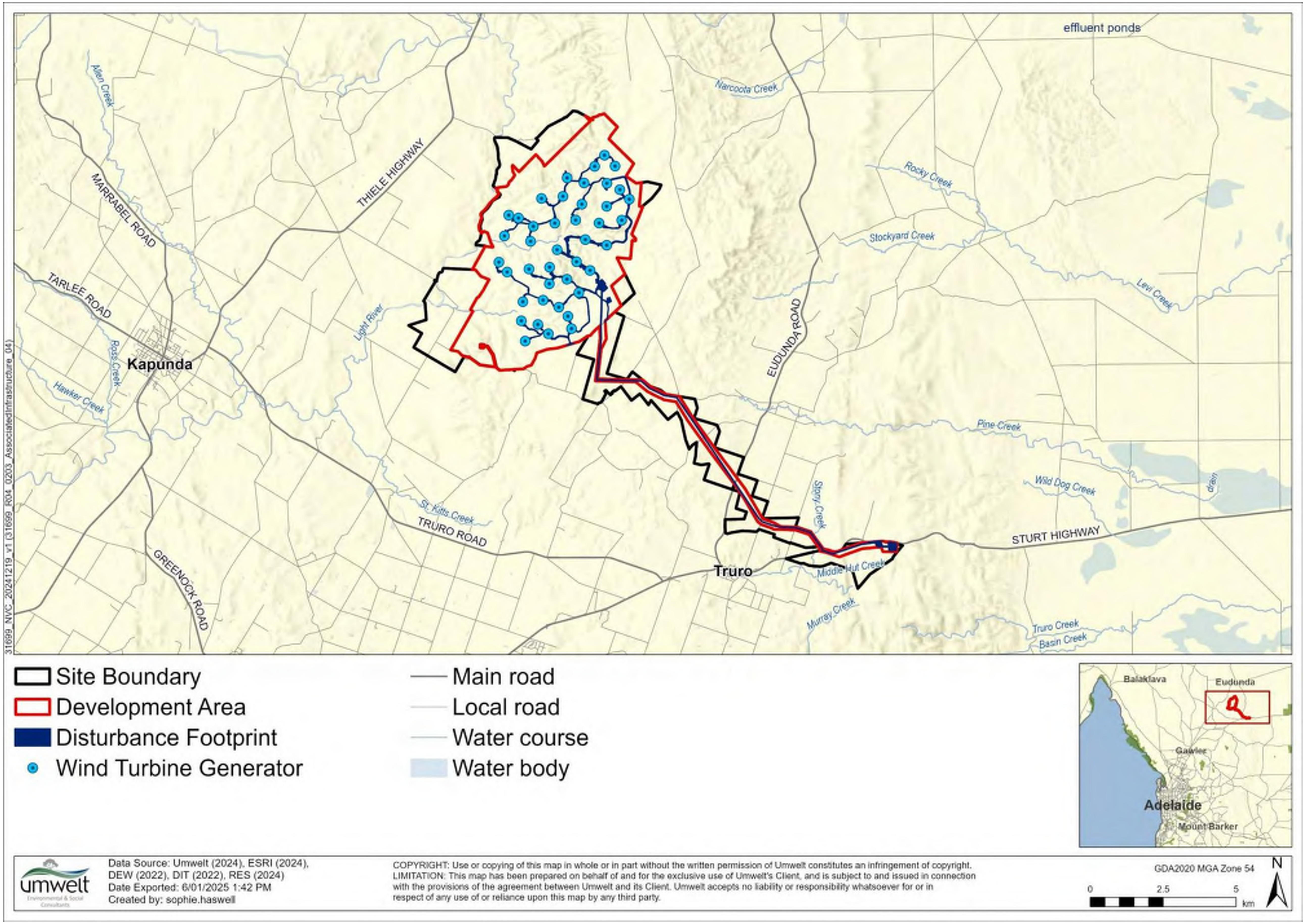


Figure 2.3 The Twin Creek Wind Farm Development Area and Associated Infrastructure

2.5. Approvals Required *or* Obtained

2.5.1. Native Vegetation Act 1991

This data report is supplied in support of the application and fulfils the requirements of the *Native Vegetation Act 1991* (NV Act) to clear native vegetation.

2.5.2. Planning, Development and Infrastructure Act 2016

Approval is required under the *Planning, Development and Infrastructure Act 2016* (PDI Act), and this report has been prepared to accompany the Development Application (DA). Provisions relating to Regulated or Significant Trees do not apply for this Project.

2.5.3. Environment Protection and Biodiversity Conservation Act 1999

Matters of National Significance are likely to be impacted by this Project, including up to three nationally listed threatened fauna species and a Threatened Ecological Community (TEC). A significant impact self-assessment should be undertaken for all Matters of National Environmental Significance (MNES) which may be impacted by the Project. If impacts are considered significant to any MNES, an EPBC Referral to the Commonwealth Government under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) will be required, which may impose conditions on Project approval. RES has committed to undertaking an EBPC Referral for this Project.

2.5.4. National Parks and Wildlife Act 1972 (NPW Act) (e.g., flora collection permit)

All flora surveys conducted as part of the native vegetation clearance application were undertaken by Umwelt under Permit / License to Undertake Scientific Research K25613-23.

2.5.5. Landscape South Australia Act 2019

A permit to transport Declared weeds on a public road may be required for this Project.

A total of 11 weed species listed as Declared species under the *Landscape South Australia Act 2019* (LSA Act) were identified within the Development Area, this includes:

- *Allium triquetrum* (Three-cornered Garlic)
- *Asparagus asparagoides* f. (Bridal Creeper)
- *Chondrilla juncea* (Skeleton Weed)
- *Cynara cardunculus* ssp. *flavescens* (Artichoke Thistle)
- *Echium plantagineum* (Salvation Jane)
- *Marrubium vulgare* (Horehound)
- *Olea europaea* ssp. (Olive)
- *Reseda lutea* (Cut-leaf Mignonette)
- *Rosa canina* (Dog Rose)
- *Rosa* sp. (Wild Rose/Briar)
- *Solanum elaeagnifolium* (Silver-leaf Nightshade).

A permit to transport Declared weeds on a public road is likely to be required for this Project if topsoil is to be removed from the site. Land holders have a responsibility to control Declared weeds on their property.

2.5.6. *Aboriginal Heritage Act 1988*

Approval will be required if any sites, objects or remains are uncovered during the works. If any sites, objects or remains are uncovered during the works, measures detailed in the project Cultural Heritage Management Plan (CHMP) will be followed and implemented.

2.6. Native Vegetation Regulation

The proposed clearance is suggested to be assessed under Regulation 12 and Schedule 1 *clauses 33 (New dwelling or building) and 34 (Infrastructure)*.

33 — New dwelling or building.

Clearance of vegetation required in order to erect a building or structure or other facility that is ancillary to a building, provided that any development authorisation required by or under the **Development Act 1993* has been obtained.

*Superseded by the PDI Act.

34 — Infrastructure

1. Clearance of vegetation—
   (a) incidental to the construction or expansion of a building or infrastructure where the Minister has, by instrument in writing, declared that the Minister is satisfied that the clearance is in the public interest; or
   (b) required in connection with the provision of infrastructure or services to a building or proposed building, or to any place, provided that any development authorisation required by or under the **Development Act 1993* has been obtained.

   *Superseded by the PDI Act.

2.7. Development Application information (if applicable)

The proposed development is within the Rural Zone of the Planning and Design Code (version 2023.16 dated 9 November 2023). A total of 14 Overlays apply to various allotments (sections) (but not all land parcels) within the Development Area (Table 2.2).

A detailed assessment against all of the relevant planning policy has been undertaken by MasterPlan, which is contained in Volume 2 of the Development Application documents.

Table 2.2 The overlays that apply to across the Development Area

Overlay	
Environmental	Water Resources
	Native Vegetation
	Environment and Food Production Area
	Murray-Darling Basin
Hazards	Flooding – Evidence Required
	Bushfire – Regional Risk
	Bushfire – General Risk
Heritage	Heritage Adjacency
	Local Heritage Place
	State Heritage Place
Land Division	Dwelling Excision

Overlay	
	Limited Land Division
Road and Rail	Key Outback and Rural Routes
Rural and Primary Production	Resource Extraction Protection Area

3. METHODOLOGY

3.1.1. Protected Matters Search Tool report

A PMST report was generated on 12 September 2024 to identify flora, fauna and TECs listed under the EPBC Act as threatened or migratory (DCCEEW 2024). Only species and TECs identified in the PMST report as known to occur within the Search Area were assessed for their likelihood of occurrence within the Development Area.

Species identified as known to occur were entered into the scoresheets for the purposes of calculating the threatened fauna score, conservation significance score and SEB obligations of the clearance. Species assessed as unlikely to occur in the Development Area may be removed from the calculations by the Native Vegetation Council (NVC) during the clearance approvals process.

Those species that are listed in Appendix 3 of the Scattered Tree Assessment Manual (NVC, 2020b) as ‘scattered tree using wildlife’ have been entered in the STAM scoresheet.

3.1.2. Biological Database of South Australia data extract

A data extract from the Biological Database of South Australia (BDBSA) was obtained from the DEW to identify flora and fauna species that have been recorded within 5 km of the Development Area (data extracted 31/10/2023; DEW 2023a. **Recordset number: DEWNRBDBSA231031-4**).

The BDBSA is comprised of an integrated collection of species records from the South Australian Museum, conservation organisations, private consultancies, Birds SA, Birdlife Australia, and the Australasian Wader Study Group, which meet the DEW’s standards for data quality, integrity and maintenance. Only species with records since 1995 and a spatial reliability of less than 1 km were assessed for their likelihood of occurrence.

All threatened fauna identified by the BDBSA extract were entered into the scoresheets for the purposes of calculating the threatened fauna score, conservation significance score and SEB obligations of the clearance. Species assessed as unlikely to occur in the Development Area may be removed from the calculations by NVC during the clearance approvals process.

3.2. Flora assessment

The flora assessment was undertaken by NVC Accredited Consultant J. Carpenter and Ecologists E. West, S. Greer and D. Hoadley from 30 October to 1 November 2023. A second field survey was undertaken by NVC Accredited Consultant J. Skewes and Ecologist E. West from 10 to 12 January 2024 in accordance with the Bushland Assessment Method (BAM) and Scattered Tree Assessment Method (STAM) (NVC, 2020a and NVC, 2020b).

3.2.1. Bushland Assessment Method

The BAM is derived from the Nature Conservation Society of South Australia’s Bushland Condition Monitoring methodology (Croft *et al.* 2007, 2008a, 2008b, 2009; Milne and Croft 2012; Milne and McCallum 2012). The BAM is used to assess areas of native vegetation requiring clearance and calculate the SEB requirements.

Details of site selection/stratification and assessment protocols, and the biodiversity value components assessed and the factors that influence these components are outlined in the *Bushland Assessment Manual* (NVC 2020a).

The Conservation Significance Scores were calculated from direct observations of flora and direct and historical observations of fauna species of conservation significance. All fauna identified as known or likely to occur in the Protected Matters Search Tool (PMST), and fauna with Biological Database of South Australia (BDBSA) records since 1995 and with a spatial reliability of less than 1 km, within 5 km of the Development

Area, were included in the BAM scoresheets. Species determined as unlikely to occur within the Development Area will be removed from the calculations by the Native Vegetation Branch during the clearance assessment process if the finding is supported. Marine and/or wetland species were omitted from the scoresheets given the Development Area is terrestrial.

Two species have been discounted from the BAM scoresheets. This includes wetland species *Rostratula australis* (Australian Painted Snipe) and *Tringa nebularia* (Common Greenshank). No wetlands are located within the Development Area and the nearest water bodies where these species may reside is within the Murray River approximately 38 km east of the Development Area. Although drainage lines and water bodies exist within the Development Area, these areas are seasonally inundated and do not provide a permanent source of water or habitat for these species.

As the *Eucalyptus camaldulensis* Woodland was inaccessible at the time of the field survey, areas nearby were surveyed instead. The top and the bottom of the creek were assessed to get an average score (BAM sites B2 and B2a).

Benchmark communities were chosen based on the Nature Conservation Society of South Australia's Bushland Condition Monitoring Methodology Northern and York (Croft *et al.* 2007, 2008a, 2008b, 2009; Milne and Croft 2012; Milne and McCallum 2012).

3.2.2. Scattered Tree Assessment Method

The STAM is derived from the *Scattered Tree Clearance Assessment in South Australia: Streamlining, Guidelines for Assessment and Rural Industry Extension* report (Cutten and Hodder 2002). The STAM is suitable for assessing scattered trees in the following instances:

- Individual scattered trees (i.e., canopy does not overlap). The spatial distribution of trees may vary from approaching what would be considered their original distribution (pre-European) through to single isolated trees in the middle of a paddock; or
- Dead trees (when a dead tree is considered native vegetation); or
- Clumps of trees (contiguous overlapping canopies) if the clump is small (approximately <0.1 ha); and

For both scattered trees and clumps:

- The ground layer comprises wholly or largely of introduced species
- Some scattered colonizing native species may be present, but represent <5% of the ground cover
- The area around the trees consists of introduced pasture or crops.

Details of the scattered tree Point Scoring System are outlined in the *Scattered Tree Assessment Manual* (NVC 2020b).

The numbers of uncommon and threatened scattered trees using fauna species, entered into the Scattered Tree Scoresheet, were calculated by cross-referring the BDBSA data extract and the lists of Scattered Trees using fauna in the *Scattered Tree Assessment Manual* (NVC 2020). The resource use of each species identified was considered when determining each tree's suitability for threatened fauna species (e.g., species that only use hollows in scattered trees were only assigned to scattered trees containing hollows).

3.2.3. Provisional List of Threatened Ecosystems

The *Provisional List of Threatened Ecosystems* (Department for Environment and Heritage, 2005) was reviewed to determine whether any vegetation associations impacted meet the criteria for listing as a threatened ecosystem at the state level.

3.3. Fauna Assessment

A desktop assessment was undertaken to determine the potential for any threatened fauna species and Threatened Ecological Communities (TECs) to occur within the Development Area. This included species listed under both the EPBC Act and the NPW Act.

The search was undertaken by applying a 5 km buffer around the Development Area, referred to as the Search Area. The following databases were searched to obtain records of threatened species:

- PMST Report generated by the Department of Climate Change, Energy, Environment and Water (DCCEEW) to identify any MNES that may or are known to occur in the Search Area.
- BDBSA Data extract obtained from the Department for Environment and Water (DEW) that identifies the location of historical records of flora and fauna in the Search Area.

3.3.1. Field Survey

Fauna surveys were conducted in conjunction with the flora assessments in 2023 and 2024 within the Development Area. Weather conditions during the survey were favourable, based on the season that the survey was undertaken.

All native and exotic fauna species opportunistically encountered (directly observed, or tracks, scats, burrows, nests, and other signs of presence) during the native vegetation clearance assessment were recorded during the 2023 and 2024 survey. Potential fauna refuge sites, such as hollows, were noted as an indication of availability of suitable habitat. Particular attention was paid to identifying habitat for threatened species identified in the desktop assessment. For each opportunistic fauna observation, the species, number of individuals, GPS location, detection methodology (sight, sound, or sign) and habitat were recorded.

Pygmy Blue-tongue Lizard

Two independent field surveys were undertaken within the Disturbance Footprint across the Development Area. The first survey was undertaken by four EBS Ecologists (J. Carpenter, S. Greer, C. Panozzo and J. Jantke) from 18 to 22 March 2024. The second field survey was undertaken by three EBS Ecologists (E. West, C. Panozzo and S. Bulling) from 8 to 12 April 2024. All surveyors were highly experienced in undertaking PBTL surveys.

Survey timing was planned for early autumn to enable maximum visibility in grassland vegetation (i.e. low grass and exotic pasture cover).

The survey method was consistent with the Survey guidelines for Australia’s threatened reptiles: Guidelines for detecting reptiles listed as threatened under the EPBC Act (DSEWPaC 2011).

Bird and Bat Monitoring

Bird and bat monitoring was undertaken by EBS Ecology four times per year (one survey per season) starting in July (winter) 2020 and concluding in April (autumn) 2022 for a total of eight surveys. Morning (AM) and afternoon (PM) bird surveys were undertaken at 16 dedicated point count sites during each survey period, for a total of 255 surveys or 127.5 hours of bird survey work (EBS 2020, EBS 2021, EBS 2021a, EBS 2021b, EBS 2021c, EBS 2022).

3.3.2. Likelihood of occurrence

Threatened species and TECs that were identified by the desktop assessment were assessed for their likelihood of occurrence in the Development Area. All species with historical records since 1995 with a spatial reliability of <1 km and species listed as ‘known to occur’ by the PMST report were assessed.

The assessment was based on recency or records, habitat preferences and the results of the field survey, with criteria for the likelihood of occurrence described in Appendix 5. Marine, wetland were not assessed, as the clearance does not impact these or associated habitats.

Table 3.1 Criteria for the Likelihood of Occurrence of Threatened Species within the Development Area

Likelihood	Criteria
Highly Likely/Known	Recorded in the last 10 years, the species does not have highly specific niche requirements, the habitat is present and falls within the known range of the species distribution or The species was recorded as part of field surveys.
Likely	Recorded within the previous 20 years, the area falls within the known distribution of the species and the area provides habitat or feeding resources for the species.
Possible	Recorded within the previous 20 years, the area falls inside the known distribution of the species, but the area provides limited habitat or feeding resources for the species. Recorded within 20–40 years, survey effort is considered adequate, habitat and feeding resources present, and species of similar habitat needs have been recorded in the area.
Unlikely	Recorded within the previous 20 years, but the area provides no habitat or feeding resources for the species, including perching, roosting or nesting opportunities, corridor for movement or shelter. Recorded within 20–40 years; however, suitable habitat does not occur, and species of similar habitat requirements have not been recorded in the area. No records despite adequate survey effort.

3.3.3. Limitations

Flora and fauna records were retrieved from the PMST and BDBSA extract. The BDBSA only includes verified flora and fauna records submitted to DEW or partner organisations. It is recognized that information is imperfectly captured, and it is possible that significant species may occur in the Development Area that are not reflected by database records. Although much of the BDBSA data has been through a variety of validation processes, the lists may contain errors and should be used with caution. DEW gives no warranty that the data is accurate or fit for any particular purpose of the user or any person to whom the user discloses the information.

3.3.4. Spatial Data Limitations

All spatial data has been captured or converted to the following coordinate reference system.

Datum: Geocentric Datum of Australia 2020 (GDA2020).

Projection: Map Grid of Australia 2020 (MGA2020), Zone 54.

All location coordinates listed in this report are expressed using this system. Spatial data converted from other coordinate reference systems may have accuracy limitations.

4. ASSESSMENT OUTCOMES

4.1. Vegetation Assessment

4.1.1. General Description of the Vegetation, the Site and Matters of Significance

A total of 12 native vegetation associations have been mapped across the Development Area (Table 4.1). An additional three VA have been mapped across the Development Area (Figure 4.1). However, these associations do not form part of the application as they are not protected under the NV Act, this includes, Cropping, Pasture grassland / exotic grassland and Planted species.

The wind farm area consisted mainly of *Austrostipa* and *Lomandra* grasslands in varying condition, interspersed by cropping land. Native vegetation was scattered along the TL Route as most of the land is used for cropping. Due to the sparseness of remnant vegetation across the Development Area, vegetation has been split into numerous blocks (Block A–E). The Development Area is dominated by ridgelines deeply dissected by drainage lines and creeks. Larger creeks within the proposed wind farm area include Freshwater Creek, Spring Creek and Light River. The landform of the TL Route consists of more plains to the northwest with smaller undulating hills towards the southeast end. Drainage lines and creeks are also scattered across this part of the Development Area.

The closest conservation reserves (managed by DEW) to the proposed Twin Creek Wind Farm footprint are Kaiserstuhl Conservation Park (approximately 25 km south) and Brookfield Conservation Park (approximately 32 km east). Three existing Heritage Agreements under the NV Act are situated 4 km south (Heritage Agreement No.287) and 6 km east of the Development Area (Heritage Agreement numbers 677 and 1314).

Table 4.1 Overall summary of vegetation associations

Vegetation association	Description	Total Area in Development Area (ha)	Clearance Area (ha)	Location
A1	*Lomandra* spp. Tussock Grassland	156.50	7.68	Wind Farm
A2	*Austrostipa* spp. Grassland	1,959.98	147.02	Wind Farm
A3	*Eucalyptus leucoxylon pruinosa* Open Woodland	48.05	1.25	Wind Farm
A4	*Juncus* spp. and *Cyperus* spp. Sedgeland	26.28	1.03	Wind Farm
B1	*E. odorata* and *E. porosa Open* Woodland	0.13	0.07	TL Route
B2	*E. camaldulensis* Woodland	0.39	0.27	TL Route
B3	*E. leucoxylon pruinosa* Open Woodland	0.19	0.12	TL Route
C1	*E. leucoxylon pruinosa* Open Woodland	1.71	0.31	TL Route
D1	*Austrostipa* spp. Grassland	5.05	1.75	TL Route
E1	*E. leucoxylon pruinosa* Open Woodland	41.21	15.88	TL Route
E2	*E. odorata* and *E. porosa* Open Woodland	1.21	1.21	TL Route
E3	*Lomandra effusa* and *Austrostipa* sp. Grassland	1.64	0.19	TL Route
	Total clearance (ha)	**3,672.33**	**176.78**	

4.1.2. Details of the vegetation associates/scattered trees proposed to be impacted

Details of vegetation under the application are described in Table 4.2 to Table 4.13**.** Details of Scattered Trees under application are described in Table 4.14**.**

Table 4.2 **Summary of vegetation association A1**

<table>
<tr><td>Vegetation association</td><td colspan="5">Lomandra spp. Tussock Grassland</td></tr>
<tr><td>Benchmark Community</td><td colspan="5">NA 3.2 Grasslands</td></tr>
<tr><td>BAM sites</td><td colspan="5">A1, A1a, A1b, A1c, A1d and A1e</td></tr>
<tr><td colspan="6"> 
Direction of photo: West, photo point: -34.3295, 139.0471, survey period: October 2023
Direction of photo: South, photo point: -34.293, 139.0662, survey period: January 2024</td></tr>
<tr><td rowspan="3">General description</td><td colspan="5">The condition of the Lomandra Grasslands varied across Block A. Dominance from one Lomandra species (Lomandra effusa (Scented Iron grass)). Most of these sites were impacted from grazing and weed incursions.</td></tr>
<tr><td colspan="2">Over storey</td><td>Mid storey</td><td colspan="2">Under storey</td></tr>
<tr><td colspan="2">NA</td><td>NA</td><td colspan="2">Lomandra effusa (Scented-Mat-rush)
Enneapogon nigricans (Black-head Grass)
Austrostipa nitida (Balcarra Spear-grass)
Austrostipa elegantissima (Rusty Spear-grass)
Convolvulus angustissimus (Narrow-leaf Bindweed)
Vittadinia gracilis (Woolly New Holland Daisy)
*Briza maxima (Large Quaking-grass)
*Carthamus lanatus (Saffron Thistle)
*Moraea setifolia (Thread Iris)</td></tr>
<tr><td>Threatened species or community</td><td colspan="5"><u>Threatened Ecological Communities</u>
This community classifies as a State (Provisional List of Threatened Ecosystems of SA) Endangered community. This community may also classify as the EPBC protected Iron-grass Natural Temperate Grassland (INTG) of South Australia. However, due to the dry conditions in October broad leaf herbs were limited with some species difficult to ID due to unidentifiable features. It is likely that this patch represents condition class C (indicative patches that are degraded but could be rehabilitated to the listed TEC).
<u>Threatened species observed in this vegetation:</u>
• Black Falcon (Falco subniger): NPW Act: Rare
• Blue-winged Parrot (Neophema chrysostoma): EPBC Act VU, NPW Act V
• Peregrine Falcon (Falco peregrinus macropus): NPW Act: Rare
• Pygmy Blue-tongue Lizard (Tiliqua adelaidensis): EPBC Act EN, NPW Act E.
<u>Additional threatened fauna records:</u>
• Elegant Parrot (Neophema elegans elegans): NPW Act: Rare.
• Southern Whiteface (Aphelocephala leucopsis leucoposis): EPBC Act: VU.</td></tr>
<tr><td>Landscape context score</td><td>1.19</td><td>Vegetation Condition Score</td><td>31.53</td><td>Conservation significance score</td><td>1.40</td></tr>
<tr><td>Unit biodiversity Score</td><td>52.53</td><td>Area (ha)</td><td>7.68</td><td>Total biodiversity Score</td><td>403.37</td></tr>
</table>

** Denotes exotic species.*

Table 4.3 Summary of vegetation association A2

Vegetation association	***Austrostipa* Grassland**
Benchmark Community	NA 3.2 Grasslands
BAM sites	A2, A2a, A2b, A2c A2d, A2e, A2f, A2g, A2h, A2i A2j and A2k


Direction of photo: South, **photo point:** -34.3332, 139.0688, **survey period**: October 2023
Direction of photo: Southeast, **photo point:** -34.3085, 139.064, **survey period**: January 2024.

General description	Grasslands across Block A consisted of varying conditions. Native grass species such as *Austrostipa* and *Enneapogon* were dominant. Herbaceous forbs were also scattered throughout these grasslands. Weeds were common and dominance varied across the block. Infestations of Declared weeds such as *Solanum elaeagnifolium* (Silver- leaf Nightshade) and *Marrubium vulgare* (Horehound) were also common along the northern end of the Block A.		
	Over storey	**Mid storey**	**Under storey**
	NA	NA	*Aristida behriana* (Brush wiregrass) *Austrostipa nitida* (Balcarra Spear-grass) *Convolvulus angustissimus* (Narrow-leaf Bindweed) *Enneapogon nigricans* (Black-head Grass) *Lomandra effusa* (Scented-Mat-rush) *Ptilotus spathulatus* (Pussy-tails) *Vittadinia gracilis* (Woolly New Holland Daisy) **Solanum elaeagnifolium* (Silver- leaf Nightshade) **Marrubium vulgare* (Horehound) **Carthamus lanatus* (Saffron Thistle) **Moraea setifolia* (Thread Iris)
Threatened species or community	**<u>Threatened species observed in this vegetation:</u>** • Black Falcon (*Falco subniger*): NPW Act: Rare • Blue-winged Parrot (*Neophema chrysostoma*): EPBC Act VU, NPW Act V • Peregrine Falcon (*Falco peregrinus macropus*): NPW Act: Rare • Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*): EPBC Act EN, NPW Act E. **<u>Additional threatened fauna records:</u>** • Elegant Parrot (*Neophema elegans elegans*): NPW Act: Rare. • Southern Whiteface (*Aphelocephala leucopsis leucoposis*): EPBC Act: VU.		

Landscape context score	1.19	**Vegetation Condition Score**	20.68	**Conservation significance score**	1.10
Unit biodiversity Score	27.07	**Area (ha)**	147.02	**Total biodiversity Score**	3,979.44

** Denotes exotic species.*

Table 4.4 Summary of vegetation association A3

<table>
<tr><td>Vegetation association</td><td colspan="3">Eucalyptus leucoxylon pruinosa Open Woodland</td></tr>
<tr><td>Benchmark Community</td><td colspan="3">NA 3.1 Woodlands with an Open Grassy Understorey</td></tr>
<tr><td>BAM sites</td><td colspan="3">A3 and A3a</td></tr>
<tr><td colspan="4">
Direction of photo: South, photo point: -34.3251, 139.0735, survey period: October 2023.</td></tr>
<tr><td rowspan="3">General description</td><td colspan="3">Over storey dominated by Eucalyptus leucoxylon pruinosa (Inland South Australian Blue Gum) with scattered E. odorata (Peppermint Box). No mid storey and understorey dominated by a variety of grass species (both exotic and native).</td></tr>
<tr><td>Over storey</td><td>Mid storey</td><td>Under storey</td></tr>
<tr><td>Eucalyptus leucoxylon pruinosa (Inland South Australian Blue Gum)
Eucalyptus odorata (Peppermint Box)</td><td>NA</td><td>Aristida behriana (Brush wiregrass)
Austrostipa spp. (Spear-grass)
Calocephalus citreus (Lemon Beauty-heads)
Rytidosperma sp. (Wallaby-grass)
Vittadinia cuneata (Fuzzy New Holland Daisy)
*Hordeum sp.
*Carthamus lanatus (Saffron Thistle)
*Moraea setifolia (Thread Iris)
*Bromus rubens (Red Brome)</td></tr>
<tr><td>Threatened species or community</td><td colspan="3">The State Rare Black Falcon was observed within the vegetation, additional threatened fauna records that may utilise this vegetation are listed below.
<u>Additional threatened fauna records:</u>
• Blue-winged Parrot (Neophema chrysostoma): EPBC Act VU, NPW Act V
• Diamond Firetail (Stagonopleura guttata) EPBC Act: VU, NPW Act: V
• Elegant Parrot (Neophema elegans elegans): NPW Act: Rare
• Peregrine Falcon (Falco peregrinus macropus): NPW Act: Rare
• Pygmy Blue-tongue Lizard (Tiliqua adelaidensis): EPBC Act EN, NPW Act E
• Satin Flycatcher (Myiagra inquieta): NPW Act: Rare.
• South-eastern Hooded Robin (Melanodryas cucullata cucullata) EPBC Act: EN, NPW Act: R
• Southern Whiteface (Aphelocephala leucopsis leucoposis): EPBC Act: VU.
• White-winged Chough (Corcorax melanorhamphos): NPW Act: Rare</td></tr>
</table>

Landscape context score	1.19	**Vegetation Condition Score**	45.93	**Conservation significance score**	1.10
Unit biodiversity Score	60.12	**Area (ha)**	1.25	**Total biodiversity Score**	75.15

** Denotes exotic species.*

Table 4.5 Summary of vegetation association A4

<table>
<tr><td>Vegetation association</td><td colspan="5">Juncus spp. and Cyperus spp. Sedgeland</td></tr>
<tr><td>Benchmark Community</td><td colspan="5">NA 7.2 Common Reed &/ or Bulrush Dominated Sedgelands</td></tr>
<tr><td>BAM Sites</td><td colspan="5">A4</td></tr>
<tr><td colspan="6">
Direction of photo: Southwest, photo point: -34.3065, 139.0559, survey period: January 2024.</td></tr>
<tr><td rowspan="3">General description</td><td colspan="5">Dominance from numerous sedge species such as Juncus spp. Cyperus spp. Schoenoplectus pungens and a mixture of native and exotic aquatic forbs such as Cotula coronopifolia, with dense mats of algae (Chara sp.). Evidence of disturbance by livestock.</td></tr>
<tr><td>Over storey</td><td colspan="2">Mid storey</td><td colspan="2">Under storey</td></tr>
<tr><td>NA</td><td colspan="2">NA</td><td colspan="2">Cyperus gymnocaulos (Spiny Flat-sedge)
Juncus kraussii (Sea Rush)
Juncus pallidus (Pale Rush)
Mimulus repens (Creeping Monkey-flower)
Schoenoplectus spp. (Club-rush)
Triglochin striata (Streaked Arrowgrass)
Distichlis distichophylla (Emu-grass)
* Solanum elaeagnifolium (Silver-leaf Nightshade)
* Cotula coronopifolia (Water Buttons)</td></tr>
<tr><td>Threatened species or community</td><td colspan="5">No threatened flora or fauna observed within this vegetation.
No suitable habitat for threatened species.</td></tr>
<tr><td>Landscape context score</td><td>1.19</td><td>Vegetation Condition Score</td><td>64.22</td><td>Conservation significance score</td><td>1.00</td></tr>
<tr><td>Unit biodiversity Score</td><td>76.43</td><td>Area (ha)</td><td>1.03</td><td>Total biodiversity Score</td><td>78.72</td></tr>
</table>

** Denotes exotic species.*

Table 4.6 Summary of vegetation association B1

Vegetation association	***Eucalyptus odorata and E. porosa Open Woodland***
Benchmark Community	NA 3.1 Woodlands with an Open Grassy Understorey
BAM Sites	B1

Direction of photo: Southwest, photo point: -34.3065, 139.0559, survey period: January 2024.

General description

Due to the linear nature of the site, diversity of the over and mid-storey is minimal with dominance from mallee species such as *Eucalyptus porosa* and *E. odorata*. The understorey was diverse, with a mixture of sedges, grasses, and herbaceous forbs.

Over storey	Mid storey	Under storey
Eucalyptus porosa (Mallee box) *Eucalyptus odorata* (Peppermint Box)	NA	*Dianella revoluta* var. *revoluta* (Black-anther Flax-lily) *Aristida behriana* (Brush Wire-grass) *Austrostipa* spp. (Spear-grass) *Vittadinia cuneata* var. (Fuzzy New Holland Daisy) *Leiocarpa websteri* (Narrow Plover-daisy) **Scabiosa atropurpurea* (Pincushion) **Salvia verbenaca* var. (Wild Sage) **Avena barbata* (Bearded Oat)

Threatened species or community

Does not classify as TEC Peppermint Box Grassy Woodland (PBGW) and no threatened fauna or flora species were observed. Threatened fauna that could potentially use this vegetation are listed below.

Threatened fauna records

- Black Falcon (*Falco subniger*): NPW Act: Rare
- Blue-winged Parrot (*Neophema chrysostoma*): EPBC Act VU, NPW Act V
- Diamond Firetail (*Stagonopleura guttata*) EPBC Act: VU, NPW Act: V
- Elegant Parrot (*Neophema elegans elegans*): NPW Act: Rare
- Peregrine Falcon (*Falco peregrinus macropus*): NPW Act: Rare
- Plumed Egret (Ardea intermedia plumifera): NPW Act: Rare
- Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*): EPBC Act EN, NPW Act E
- Satin Flycatcher (*Myiagra inquieta*): NPW Act: Rare.
- South-eastern Hooded Robin (*Melanodryas cucullata cucullata*) EPBC Act: EN, NPW Act: R
- Southern Whiteface (*Aphelocephala leucopsis leucoposis*): EPBC Act: VU.

	• White-winged Chough (*Corcorax melanorhamphos*): NPW Act: Rare				
Landscape context score	1.17	**Vegetation Condition Score**	38.65	**Conservation significance score**	1.10
Unit biodiversity Score	49.74	**Area (ha)**	0.07	**Total biodiversity Score**	3.48

** Denotes exotic species.*

Table 4.7 Summary of vegetation association B2

Vegetation association	***Eucalyptus camaldulensis* (River Red Gum) Woodland**
Benchmark Community	NA 7.1 Riparian Woodlands
BAM Sites	B2 and B2a

Site: B2, direction of photo: south, photo point: -34.3452, 139.0865, survey period: October 2023.

Site: B2a, direction of photo: north, photo point: -34.3558, 139.0798, survey period: October 2023.

General description

These woodlands consisted of *Eucalyptus camaldulensis* (River Red Gum) with a mid storey of *Allocasuarina verticillata* (Drooping Sheoak). The under storey consisted of both native and exotic grasses and forbs.

Over storey	Mid storey	Under storey
Eucalyptus camaldulensis (River Red Gum)	*Allocasuarina verticillata* (Drooping Sheoak)	*Themeda triandra* (Kangaroo Grass) *Juncus* sp. (Rush) *Austrostipa eremophila* (Rusty Spear-grass) *Dianella revoluta* var. *revoluta* (Black Anther Flax Lily) **Avena barbata* (Bearded Oat) **Plantago lanceolata* var. (Ribwort) **Allium triquetrum* (Three-cornered Garlic) **Scabiosa atropurpurea* (Pincushions)

Threatened species or community

No threatened flora or fauna species were observed. Fauna that could potentially utilise the vegetation is listed below.

Threatened fauna records

- Black Falcon (*Falco subniger*): NPW Act: Rare
- Blue-winged Parrot (*Neophema chrysostoma*): EPBC Act VU, NPW Act V
- Diamond Firetail (*Stagonopleura guttata*) EPBC Act: VU, NPW Act: V
- Elegant Parrot (*Neophema elegans elegans*): NPW Act: Rare
- Peregrine Falcon (*Falco peregrinus macropus*): NPW Act: Rare
- Satin Flycatcher (*Myiagra inquieta*): NPW Act: Rare.
- South-eastern Hooded Robin (*Melanodryas cucullata cucullata*) EPBC Act: EN, NPW Act: R
- Southern Whiteface (*Aphelocephala leucopsis leucoposis*): EPBC Act: VU.
- White-winged Chough (*Corcorax melanorhamphos*): NPW Act: Rare

Landscape context score	1.17	**Vegetation Condition Score**	34.31	**Conservation significance score**	1.10

Unit biodiversity Score	44.15	**Area (ha)**	0.27	**Total biodiversity Score**	11.92

** Denotes exotic species.*

Table 4.8 Summary of vegetation association B3

<table>
<tr><td>Vegetation association</td><td colspan="3">Eucalyptus leucoxylon pruinosa Open Woodland</td></tr>
<tr><td>Benchmark Community</td><td colspan="3">NA 2 Open Forests & Woodlands with a mid-dense Shrub & Grassy Understorey</td></tr>
<tr><td>BAM Sites</td><td colspan="3">B3</td></tr>
<tr><td colspan="4">
Direction of photo: South, photo point: 139.0887, -34.3494, survey period: October 2023.</td></tr>
<tr><td rowspan="3">General description</td><td colspan="3">Overstorey dominated by Eucalyptus leucoxylon pruinosa (Inland South Australian Blue Gum) with scattered E. odorata (Peppermint Box). Mid storey absent, and understorey dominated by a variety of native and exotic grass species.</td></tr>
<tr><td>Over storey</td><td>Mid storey</td><td>Under storey</td></tr>
<tr><td>Eucalyptus leucoxylon ssp. pruinosa (Inland South Australian Blue-gum)
E. porosa (Mallee Box)</td><td>NA</td><td>Rytidosperma sp. (Wallaby-grass)
Einadia nutans ssp. (Climbing Saltbush)
Atriplex semibaccata (Berry Saltbush)
Austrostipa scabra (Rough Spear-grass)
Austrostipa sp.
Einadia nutans ssp. (Climbing Saltbush)
*Scabiosa atropurpurea (Pincushion)
*Asparagus asparagoides f. (Bridal Creeper)
*Rosa Canina (Dog Rose)</td></tr>
<tr><td>Threatened species or community</td><td colspan="3">No threatened flora or fauna species were observed. Fauna that could potentially utilise the vegetation is listed below.
<u>Threatened fauna records</u>
• Black Falcon (Falco subniger): NPW Act: Rare
• Blue-winged Parrot (Neophema chrysostoma): EPBC Act VU, NPW Act V
• Diamond Firetail (Stagonopleura guttata) EPBC Act: VU, NPW Act: V
• Elegant Parrot (Neophema elegans elegans): NPW Act: Rare
• Peregrine Falcon (Falco peregrinus macropus): NPW Act: Rare
• Pygmy Blue-tongue Lizard (Tiliqua adelaidensis): EPBC Act EN, NPW Act E
• Satin Flycatcher (Myiagra inquieta): NPW Act: Rare.
• South-eastern Hooded Robin (Melanodryas cucullata cucullata) EPBC Act: EN, NPW Act: R</td></tr>
</table>

	• Southern Whiteface (*Aphelocephala leucopsis leucoposis*): EPBC Act: VU • White-winged Chough (*Corcorax melanorhamphos*): NPW Act: Rare.				
Landscape context score	1.17	**Vegetation Condition Score**	25.96	**Conservation significance score**	1.10
Unit biodiversity Score	33.41	**Area (ha)**	0.12	**Total biodiversity Score**	4.01

** Denotes exotic species.*

Table 4.9 Summary of vegetation association C1

<table>
<tr><td>Vegetation association</td><td colspan="3">Eucalyptus leucoxylon pruinosa Open Woodland</td></tr>
<tr><td>Benchmark Community</td><td colspan="3">NA 2 Open Forests & Woodlands with a mid-dense Shrub & Grassy Understorey</td></tr>
<tr><td>BAM sites</td><td colspan="3">C1</td></tr>
<tr><td colspan="4">
Direction of photo: south, photo point: -34.4022, 139.1757, survey period: October 2023.</td></tr>
<tr><td rowspan="3">General description</td><td colspan="3">The vegetation was in poor condition due to historical clearance and dominance of weed species such as Avena barbata (pictured above). Numerous Lomandra species (L. collina, L. effusa and L. multiflora etc.) were present within this VA along with other native forbs, however, their density was low.</td></tr>
<tr><td>Over storey</td><td>Mid storey</td><td>Under storey</td></tr>
<tr><td>Eucalyptus leucoxylon ssp. pruinosa (Inland South Australian Blue-gum)</td><td>Allocasuarina verticillata (Drooping Sheoak)
Bursaria spinosa ssp. spinosa (Sweet Bursaria)</td><td>Lomandra spp. (Mat-rush)
Chrysocephalum apiculatum (Common Everlasting)
Ptilotus spathulatus (Pussy-tails)
*Avena barbata (Bearded Oat)
*Bromus diandrus (Great Brome)
*Echium plantagineum (Salvation Jane)</td></tr>
<tr><td>Threatened species or community</td><td colspan="3">No threatened flora or fauna species were observed. Fauna that could potentially utilise the vegetation is listed below.
<u>Threatened fauna records</u>
Black Falcon (Falco subniger): NPW Act: Rare
Blue-winged Parrot (Neophema chrysostoma): EPBC Act VU, NPW Act V
Diamond Firetail (Stagonopleura guttata) EPBC Act: VU, NPW Act: V
Elegant Parrot (Neophema elegans elegans): NPW Act: Rare
Peregrine Falcon (Falco peregrinus macropus): NPW Act: Rare
Pygmy Blue-tongue Lizard (Tiliqua adelaidensis): EPBC Act EN, NPW Act E
Satin Flycatcher (Myiagra inquieta): NPW Act: Rare.
South-eastern Hooded Robin (Melanodryas cucullata cucullata) EPBC Act: EN, NPW Act: R</td></tr>
</table>

	• Southern Whiteface (*Aphelocephala leucopsis leucoposis*): EPBC Act: VU • White-winged Chough (*Corcorax melanorhamphos*): NPW Act: Rare.				
Landscape context score	1.15	**Vegetation Condition Score**	21.94	**Conservation significance score**	1.10
Unit biodiversity Score	27.75	**Area (ha)**	0.31	**Total biodiversity Score**	8.60

** Denotes exotic species.*

Table 4.10 Summary of vegetation association D1

<table>
<tr><td>Vegetation association</td><td colspan="5">Austrostipa spp. Grassland</td></tr>
<tr><td>Benchmark Community</td><td colspan="5">NA 2 in MDBSA Open Forest/Woodlands with Mid dense shrub and Grassy understorey</td></tr>
<tr><td>BAM Sites</td><td colspan="5">D1</td></tr>
<tr><td colspan="6">
Direction of photo: North, photo point: -34.3699, 139.1216, survey period: January 2024.</td></tr>
<tr><td rowspan="3">General description</td><td colspan="5">A large patch of Austrostipa grassland scattered across two properties and along Valley Farm Road. This grassland was in good condition with dominance from Austrostipa blackii (Crested Spear-grass)</td></tr>
<tr><td>Over storey</td><td colspan="2">Mid storey</td><td colspan="2">Under storey</td></tr>
<tr><td>NA</td><td colspan="2">NA</td><td colspan="2">Austrostipa blackii (Crested Spear-grass)
Rytidosperma sp. (Wallaby-grass)
Convolvulus angustissimus (Narrow-leaf Bindweed)
Aristida behriana (Brush Wire-grass)
Euphorbia drummondii
Maireana enchylaenoides (Wingless Fissure-plant)
*Avena barbata
*Vulpia sp.
*Salvia verbenaca var.</td></tr>
<tr><td>Threatened species or community</td><td colspan="5">No threatened species were observed within this vegetation. Threatened fauna that are likely to utilise this vegetation is listed below.
• Black Falcon (Falco subniger): NPW Act: Rare
• Blue-winged Parrot (Neophema chrysostoma): EPBC Act VU, NPW Act V
• Peregrine Falcon (Falco peregrinus macropus): NPW Act: Rare
• Pygmy Blue-tongue Lizard (Tiliqua adelaidensis): EPBC Act EN, NPW Act E.
• Elegant Parrot (Neophema elegans elegans): NPW Act: Rare.
• Southern Whiteface (Aphelocephala leucopsis leucoposis): EPBC Act: VU.</td></tr>
<tr><td>Landscape context score</td><td>1.15</td><td>Vegetation Condition Score</td><td>11.53</td><td>Conservation significance score</td><td>1.10</td></tr>
<tr><td>Unit biodiversity Score</td><td>14.59</td><td>Area (ha)</td><td>1.75</td><td>Total biodiversity Score</td><td>25.53</td></tr>
</table>

** Denotes exotic species.*

Table 4.11 Summary of vegetation association E1

<table>
<tr><td>Vegetation association</td><td colspan="3">Eucalyptus leucoxylon pruinosa Open Woodland</td></tr>
<tr><td>Benchmark Community</td><td colspan="3">NA 2 Open Forests & Woodlands with a mid-dense Shrub & Grassy Understorey</td></tr>
<tr><td>BAM Sites</td><td colspan="3">E1, E1a and E1b</td></tr>
<tr><td colspan="4">
Direction of photo: south, photo point: -34.4022, 139.1757, survey period: October 2023.</td></tr>
<tr><td rowspan="3">General description</td><td colspan="3">Over storey dominated by Eucalyptus leucoxylon pruinosa (Inland South Australian Blue Gum) with scattered E. odorata (Peppermint Box). No mid storey and understorey dominated by a variety of grass species (both exotic and native).</td></tr>
<tr><td>Over storey</td><td>Mid storey</td><td>Under storey</td></tr>
<tr><td>Eucalyptus leucoxylon ssp. pruinosa (Inland South Australian Blue-gum)
E. porosa (Mallee Box)</td><td>NA</td><td>Aristida behriana (Brush Wiregrass)
Einadia nutans ssp. (Climbing Saltbush)
Rytidosperma sp. (Wallaby-grass)
Salsola australis (Buckbush)
Vittadinia gracilis (Woolly New Holland Daisy)
*Hordeum sp.
*Cynara cardunculus ssp. flavescens (Artichoke Thistle)
*Marrubium vulgare (Horehound)
*Moraea setifolia (Thread Iris)</td></tr>
<tr><td>Threatened species or community</td><td colspan="3">The State Rare Maireana rohrlachii (Rohrlach’s Bluebush) was observed within this vegetation. No threatened fauna species was observed. Threatened species that may utilise this habitat are listed below.
<u>Threatened fauna records</u>
• Black Falcon (Falco subniger): NPW Act: Rare
• Blue-winged Parrot (Neophema chrysostoma): EPBC Act VU, NPW Act V
• Diamond Firetail (Stagonopleura guttata) EPBC Act: VU, NPW Act: V
• Elegant Parrot (Neophema elegans elegans): NPW Act: Rare
• Peregrine Falcon (Falco peregrinus macropus): NPW Act: Rare
• Pygmy Blue-tongue Lizard (Tiliqua adelaidensis): EPBC Act EN, NPW Act E
• Satin Flycatcher (Myiagra inquieta): NPW Act: Rare.
• South-eastern Hooded Robin (Melanodryas cucullata cucullata) EPBC Act: EN, NPW Act: R
• Southern Whiteface (Aphelocephala leucopsis leucoposis): EPBC Act: VU
• White-winged Chough (Corcorax melanorhamphos): NPW Act: Rare.</td></tr>
</table>

Landscape context score	1.18	**Vegetation Condition Score**	36.20	**Conservation significance score**	1.11
Unit biodiversity Score	47.46	**Area (ha)**	15.88	**Total biodiversity Score**	753.75

** Denotes exotic species.*

Table 4.12 Summary of vegetation association E2

<table>
<tr><td>Vegetation association</td><td colspan="3">Eucalyptus odorata and E. porosa Open Woodland</td></tr>
<tr><td>Benchmark Community</td><td colspan="3">MDBSA 9.1 Woodlands with an Open Grassy Understorey</td></tr>
<tr><td>BAM Sites</td><td colspan="3">E2</td></tr>
<tr><td colspan="4">
Direction of photo: south, photo point: -34.4007 139.1861, survey period: October 2023.</td></tr>
<tr><td rowspan="3">General description</td><td colspan="3">This open woodland consisted of scattered E. porosa (Mallee Box) trees with no mid-storey and an understorey consisting of grasses (both native and exotic). Avena barbata (Bearded Oat) had a high cover rating followed by Bromus diandrus (Great Brome). Due to the large cover of weeds and the degraded over and mid-storey this vegetation association had a low condition score.</td></tr>
<tr><td>Over storey</td><td>Mid storey</td><td>Under storey</td></tr>
<tr><td>Eucalyptus porosa (Mallee Box)</td><td>NA</td><td>Maireana brevifolia (Short-leaf Bluebush)
Austrostipa sp.
Einadia nutans ssp. (Climbing Saltbush)
Rytidosperma sp. (Wallaby-grass)
Salsola australis (Buckbush)
*Avena barbata (Bearded Oat)
*Echium plantagineum (Salvation Jane)
*Scabiosa atropurpurea (Pincushion)
*Asteriscus spinosus (Golden Pallensis)</td></tr>
<tr><td>Threatened species or community</td><td colspan="3">The State Rare Maireana rohrlachii (Rohrlach's Bluebush) was observed within this vegetation. No threatened fauna species was observed. Threatened species that may utilise this habitat are listed below.
<u>Threatened fauna records</u>
• Black Falcon (Falco subniger): NPW Act: Rare
• Blue-winged Parrot (Neophema chrysostoma): EPBC Act VU, NPW Act V
• Diamond Firetail (Stagonopleura guttata) EPBC Act: VU, NPW Act: V
• Elegant Parrot (Neophema elegans elegans): NPW Act: Rare
• Peregrine Falcon (Falco peregrinus macropus): NPW Act: Rare
• Pygmy Blue-tongue Lizard (Tiliqua adelaidensis): EPBC Act EN, NPW Act E
• Satin Flycatcher (Myiagra inquieta): NPW Act: Rare.
• South-eastern Hooded Robin (Melanodryas cucullata cucullata) EPBC Act: EN, NPW Act: R
• Southern Whiteface (Aphelocephala leucopsis leucoposis): EPBC Act: VU</td></tr>
</table>

	• White-winged Chough (*Corcorax melanorhamphos*): NPW Act: Rare.				
Landscape context score	1.18	**Vegetation Condition Score**	22.05	**Conservation significance score**	1.14
Unit biodiversity Score	29.66	**Area (ha)**	1.21	**Total biodiversity Score**	35.89

** Denotes exotic species.*

Table 4.13 Summary of vegetation association E3

<table>
<tr><td>Vegetation association</td><td colspan="5">Lomandra effusa and Austrostipa sp. Grassland</td></tr>
<tr><td>Benchmark Community</td><td colspan="5">MDBSA 9.1 Woodlands with an Open Grassy Understorey</td></tr>
<tr><td>BAM Sites</td><td colspan="5">E3</td></tr>
<tr><td colspan="6">
Direction of photo: south, photo point: 139.1754, -34.402, survey period: October 2023.</td></tr>
<tr><td rowspan="3">General description</td><td colspan="5">This Lomandra grassland was in low condition with very limited native species diversity.</td></tr>
<tr><td>Over storey</td><td colspan="2">Mid storey</td><td colspan="2">Under storey</td></tr>
<tr><td>NA</td><td colspan="2">NA</td><td colspan="2">Lomandra effusa (Scented Mat-rush)
Austrostipa spp. (Spear-grass)
Aristida behriana (Brush wire-Grass)
Enneapogon nigricans (Black-head Grass)
*Avena barbata (Bearded Oat)
*Hordeum sp.
*Trifolium sp.</td></tr>
<tr><td>Threatened species or community</td><td colspan="5"><u>Threatened Ecological Communities</u>
This community classifies as a State (Provisional List of Threatened Ecosystems of SA) Endangered community. This community may also classify as the EPBC protected Iron-grass Natural Temperate Grassland (INTG) of South Australia. However, due to the dry conditions in October broad leaf herbs were limited with some species difficult to identify due to lack of distinguishable features (i.e. flowering or fruiting bodies). It is likely that this patch represents condition class C (indicative patches that are degraded but could be rehabilitated to the listed ecological community). Threatened fauna species that may utilise the vegetation is listed below.
<u>Threatened fauna</u>
• Black Falcon (Falco subniger): NPW Act: Rare
• Blue-winged Parrot (Neophema chrysostoma): EPBC Act VU, NPW Act V
• Elegant Parrot (Neophema elegans elegans): NPW Act: Rare.
• Peregrine Falcon (Falco peregrinus macropus): NPW Act: Rare
• Pygmy Blue-tongue Lizard (Tiliqua adelaidensis): EPBC Act EN, NPW Act E.
• Southern Whiteface (Aphelocephala leucopsis leucoposis): EPBC Act: VU.</td></tr>
<tr><td>Landscape context score</td><td>1.18</td><td>Vegetation Condition Score</td><td>9.19</td><td>Conservation significance score</td><td>1.40</td></tr>
<tr><td>Unit biodiversity Score</td><td>15.18</td><td>Area (ha)</td><td>0.19</td><td>Total biodiversity Score</td><td>2.88</td></tr>
</table>

** Denotes exotic species.*

Table 4.14 Details of the Scattered Trees Proposed to be Impacted

Tree #	Tree spp.	No. of trees	Height (m)	Hollows	Diameter (cm)	Canopy dieback (%)	Total Biodiversity Score	General comments
Mopami IBRA Association								
1	*Eucalyptus porosa*	1	4.2	0	17.5	5	0.55	Small mallee tree in good condition
2	*E. porosa*	1	5.5	0	25.5	10	1.18	Large mallee tree in good condition
3	*E. porosa*	1	6	0	69	80	1.34	Large mallee tree in poor condition
4	*E. leucoxylon pruinosa*	1	10.1	3 small	91	25	3.94	Large tree in good condition
5	*E. leucoxylon pruinosa*	1	9	0	77	15	2.55	Large tree in good condition
6	*E. leucoxylon pruinosa*	1	9	1 large 5 small	107	50	3.82	Large tree in good condition
7	*E. leucoxylon pruinosa*	1	6.5	3 small	134	5	4.34	Large tree in good condition
8	*E. leucoxylon pruinosa*	2	2.5	0	13	8	0.55	Small tree with little habitat value
9	*E. leucoxylon pruinosa*	1	11	1 medium	70	25	3.63	Large tree in good condition
10	*E. leucoxylon pruinosa*	1	9	10 small 3 med	57	25	2.61	Large tree in good condition
11	*E. porosa*	1	5.5	0	35	5	1.99	Medium size mallee tree in good condition
12	*E. porosa*	1	7	2 small	66	8	4.64	Large tree in good condition
Rufus IBRA Association								
13	*E. leucoxylon pruinosa*	1	9	1 large 3 med. 2 small	108	40	4.05	Large tree with good habitat value
14	*E. leucoxylon pruinosa*	1	6.5	2 large 1 med. 2 small	115	30	3.84	Large tree with good habitat value
15	*E. leucoxylon pruinosa*	1	10.3	2 large 1 med. 3 smalls	123	15	6.48	Large tree with good habitat value
16	*E. leucoxylon pruinosa*	1	10	1 large 1 med. 2 small	76	5	4.60	Large tree with good habitat value
17	*E. leucoxylon pruinosa*	1	10	3 med 1 small	109	2	6.51	Large tree with good habitat value

Tree #	Tree spp.	No. of trees	Height (m)	Hollows	Diameter (cm)	Canopy dieback (%)	Total Biodiversity Score	General comments
18	*E. odorata*	1	10	1 large 2 med.	72	2	6.85	Large tree with good habitat value
19	*E. leucoxylon pruinosa*	1	8.2	2 large 1 med. 1 small	86	20	4.00	Large tree with good habitat value
20	*E. leucoxylon pruinosa*	1	8.2	1 large 1 med. 3 small	78	15	3.96	Large tree with good habitat value
21	*E. leucoxylon pruinosa*	1	8.5	1 large 5 med. 5 small	124	10	6.07	Large tree with good habitat value
22	*E. leucoxylon pruinosa*	1	9	3 med 3 small	83	10	4.41	Large tree with good habitat value
23	*E. leucoxylon pruinosa*	1	7	1 large 1 small	89	30	3.53	Large tree with good habitat value
24	*E. leucoxylon pruinosa*	1	8	2 large 1 med. 1 small	97	70	2.37	Large tree in poor condition
25	*E. leucoxylon pruinosa*	1	13	3 large 2 small	106	20	8.76	Large tree with good habitat value
26	*E. odorata*	1	10.5	1 large	60	30	4.58	Medium sized tree in good condition
27	*E. leucoxylon pruinosa*	1	11	4 large 2 small	70	15	4.36	Large tree with good habitat value
28	*E. leucoxylon pruinosa*	1	10	3 large 1 small	78	60	3.28	Large tree in poor condition
29	*E. leucoxylon pruinosa*	1	6.5	0	150	3	4.10	Large tree is good condition
30	*E. leucoxylon pruinosa*	1	9	3 small 2 med. 2 large	170	15	7.23	Large tree is moderate condition
31	*E. leucoxylon pruinosa*	1	12	3 small 1 med. 1 large	88	2	6.68	Large tree is good condition
32	*E. leucoxylon pruinosa*	1	11	3 med. 3 large	111	15	6.42	Large tree is good condition
33	*E. leucoxylon pruinosa*	1	9	1 small 1 med. 3 large	93	40	3.80	Large tree is moderate condition
34	*E. leucoxylon pruinosa*	1	8	1 med. 3 large	39	50	1.25	Large tree is moderate condition

4.1.3. Site map showing areas of proposed impact

Native vegetation assessed as part of this application and the proposed impact of the Project are shown in Figure 4.1 to Figure 4.6.

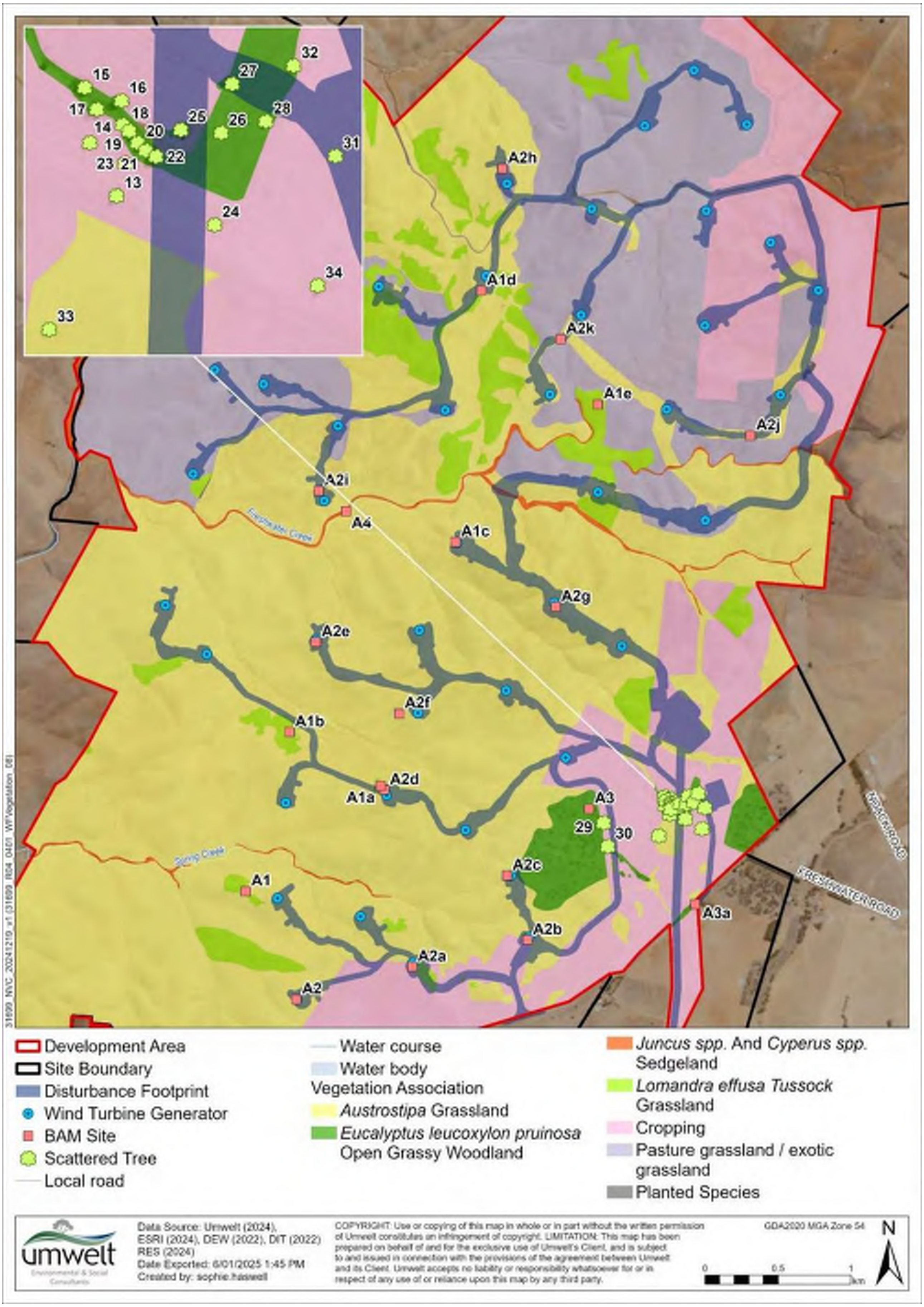


Figure 4.1 Vegetation Associations and Scattered Trees impacted by Development Area

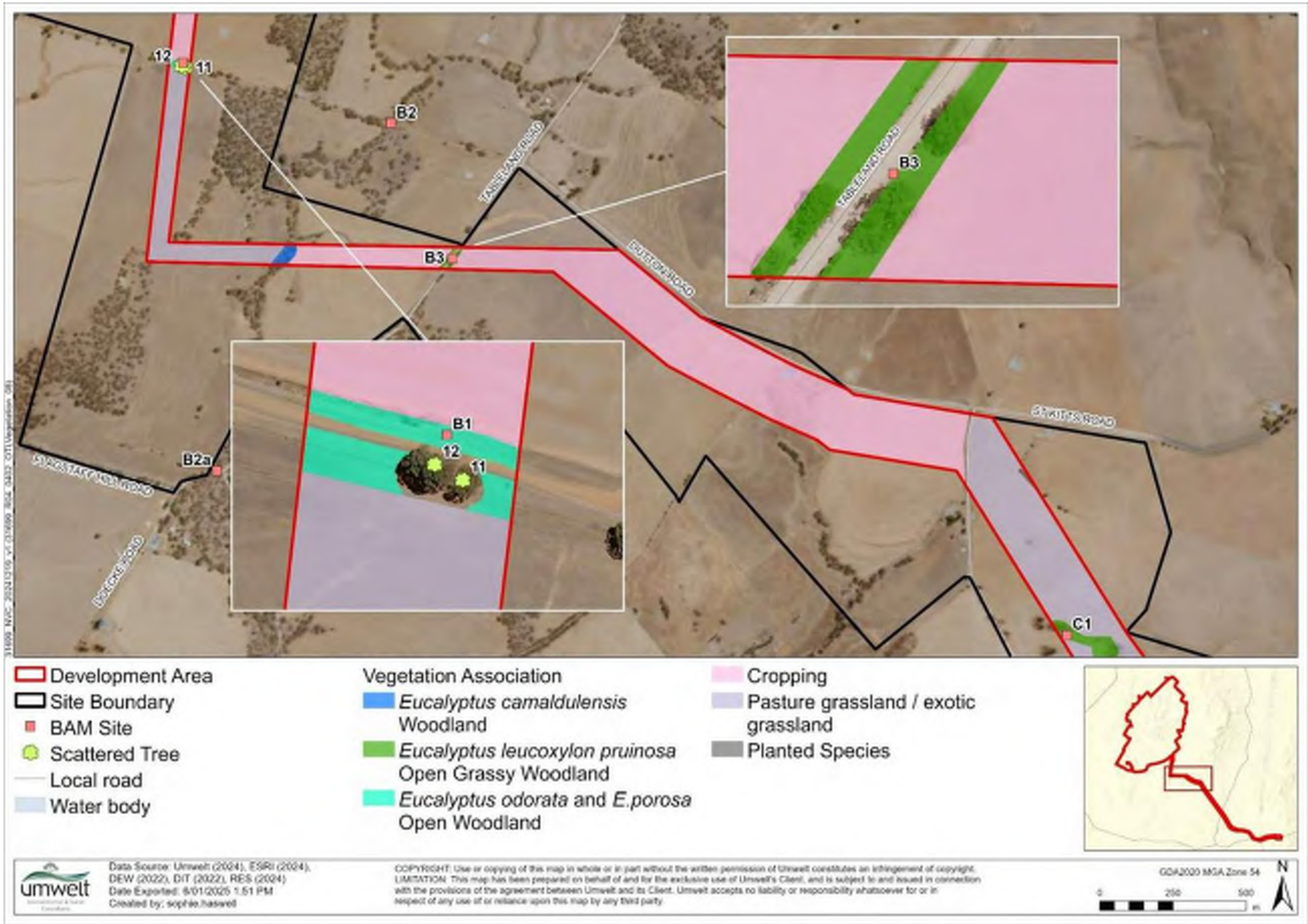


Figure 4.2 **Native Vegetation Impacted by the Transmission Line Route (Map 1 of 4)**

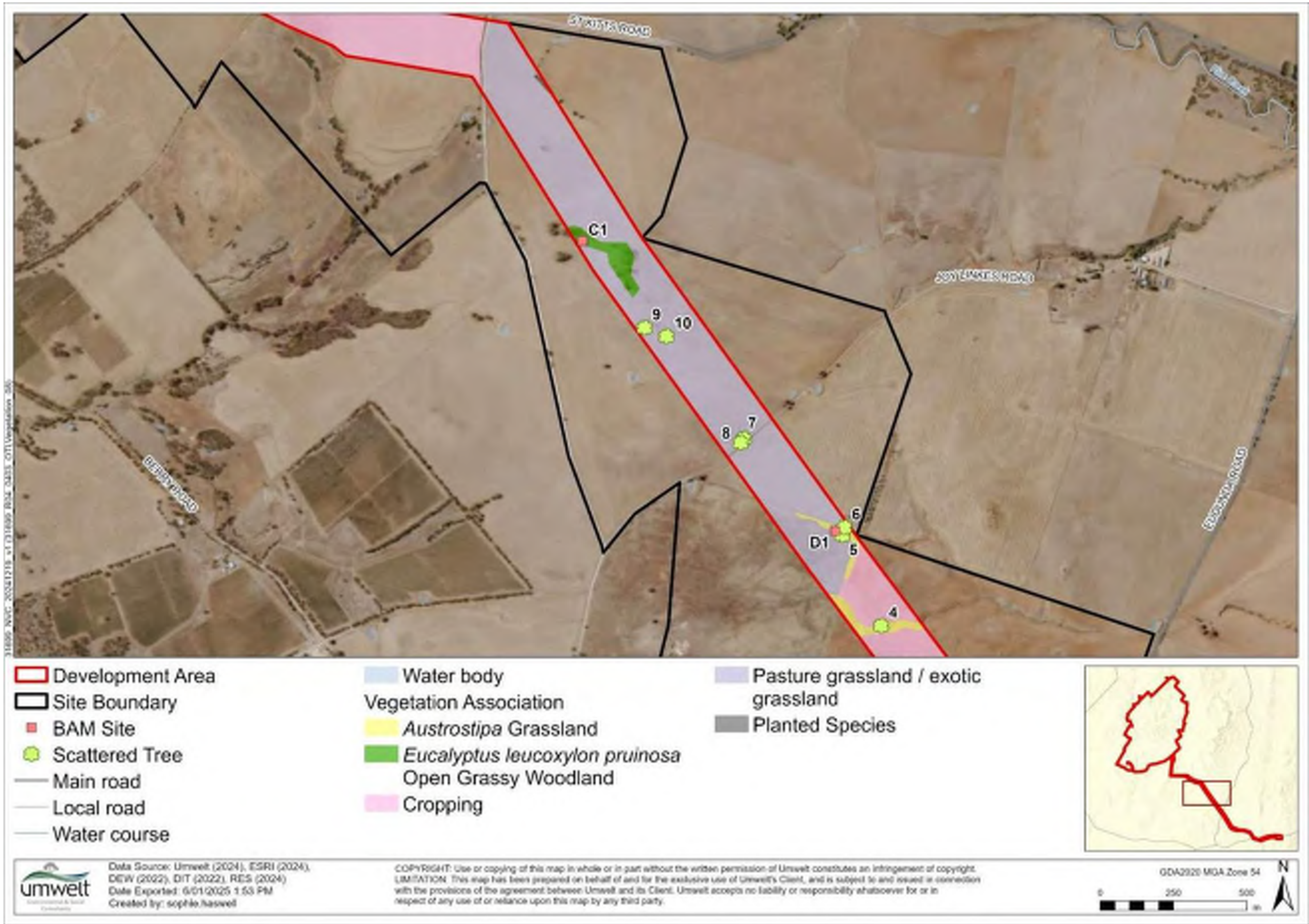


Figure 4.3 Native vegetation impacted by the Transmission Line Route (Map 2 of 4)

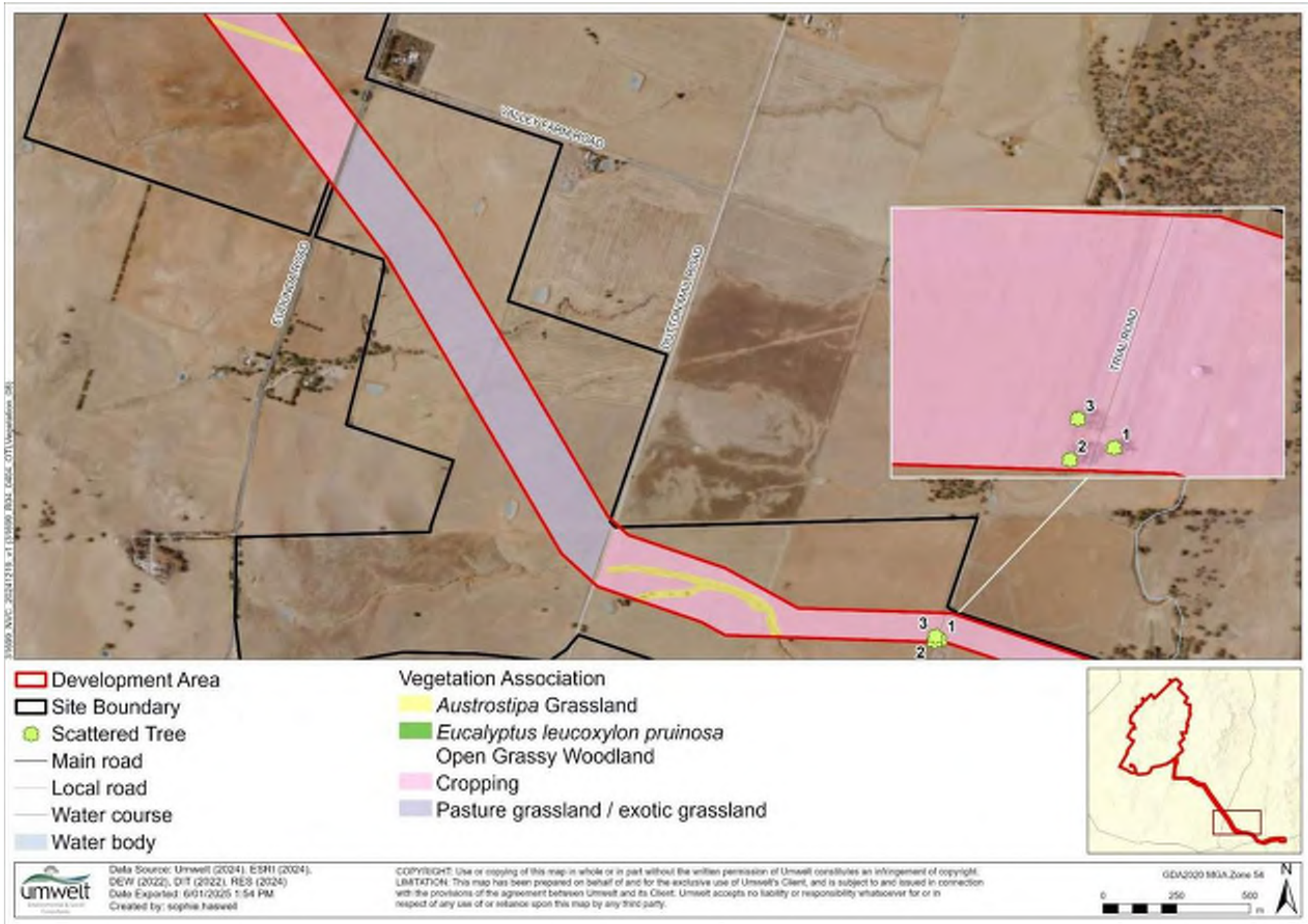


Figure 4.4 **Native vegetation impacted by the Transmission Line Route (Map 3 of 4)**

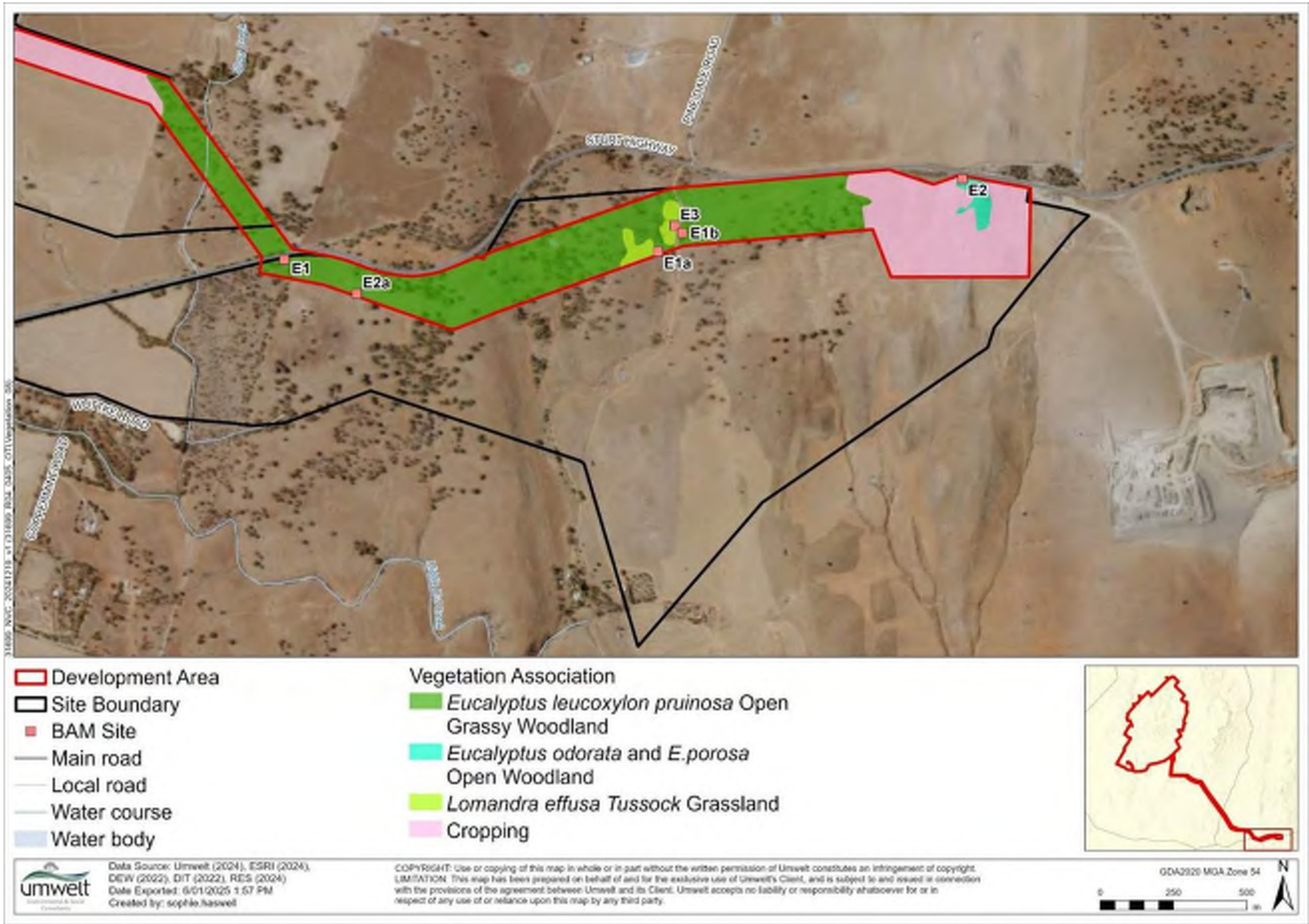


Figure 4.5 **Native vegetation impacted by the Transmission Line Route (Map 4 of 4)**

4.2. Threatened Ecological Communities

The database searches indicated that four TECs might occur:

- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia
- Iron-grass Natural Temperate Grassland of South Australia
- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions
- Plains Mallee Box Woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregions.

Vegetation in the Development Area has been assessed against the definitions of each TEC identified in Table 4.15**.** The assessment found that two TECs occur within the Development Area.

Table 4.15 Assessment of the Presence of Threatened Ecological Communities in the Development Area

Threatened Ecological Community	Conservation Status	Definition	Assessment
Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia (PBGW)	Critically Endangered	The PBGW is restricted to SA and consists of an open to dense woodland dominated by *Eucalyptus odorata* and typically occurs with other tree species including *E. leucoxylon*, *E. microcarpa* or *E. porosa.* Canopy height comprises low trees, 5-10m tall with an understorey comprised of diverse grasses and herbs including *Austrostipa* sp.*, Lomandra* sp. and *Acacia pycnantha.* (DEWHA 2008b; Turner 2012). This TEC can be categorised under three different condition classes (A, B and C), based on remnant patch size and native species diversity and composition. Class C does not make up the TEC but is of sufficient biodiversity value to target for restoration (DEWR 2007; Turner 2012).	**Absent** – no relevant vegetation in the Development Area.
Iron-grass Natural Temperate Grassland of South Australia (INTG)	Critically Endangered	INTG is endemic to SA and consists of tussock-forming perennial grasses, Iron-grasses (*Lomandra effusa* and/or *L. multiflora* ssp. *dura)* and a low presence (<10%) of trees and tall shrubs (DEWR 2007; Turner 2012). This TEC can be categorised under three different condition classes (A, B and C), based on patch size, native species diversity and composition, and tussock density. Class A and Class B, make up this TEC, while Class C does not make up the TEC but is of sufficient biodiversity value to target for restoration (DEWR 2007; Turner 2012, DEWHA 2008b).	**Present** – relevant vegetation in the Development Area. Areas surveyed during the 2023 and 2024 survey only classified as condition class C. However, due to the abnormally dry spring conditions in 2023, broad leaf herbaceous forbs were hard to detect.
Mallee Bird Community (MBC) of the Murray Darling Depression Bioregion	Endangered	A fauna community found in the Murray Darling Depression (MDD) bioregion comprising an assemblage of 20 bird species that are dependent on the mallee vegetation that characterises the bioregion. Criteria for listing includes being within the MDD, containing at least 5 ha dominated by mallee habitats and at least three MBC bird species recorded within 20 km in the last 10 years (DAWE 2021a).	**Absent** – TL route within the MDDB. However, no suitable mallee vegetation was assessed within the impact area.
Buloke Woodlands of the Riverina and	Endangered	Woodland communities where Buloke (*Allocasuarina luehmannii*) is the dominant or	**Absent** – no relevant vegetation present

Threatened Ecological Community	Conservation Status	Definition	Assessment
Murray-Darling Depression Bioregions		co-dominant tree species. Co-dominant species include *Callitris gracilis, Callitris glaucophylla, Eucalyptus largiflorens, Eucalyptus leucoxylon* ssp. *pruinosa* and *Eucalyptus microcarpa.* In SA, the community is only known from the Bordertown district (Cheal, Lucas, & Macaulay 2011).	within the Development Area.

4.3. Threatened Species Assessment

4.3.1. Threatened flora

One threatened flora species was recorded during both surveys (2023 and 2024):

- *Maireana rohrlachii* (Rohrlach's Bluebush): NPW Act Rare.

A patch of 28 individuals of *Maireana rohrlachii* (Rohrlach's Bluebush) were within the Development Area (Figure 4.7).

The database searches identified 23 threatened flora species that may occur in the Search Area, of which 10 were assessed as possible, likely or highly likely to occur in the Development Area. These species are listed in Table 4.16 and species with BDBSA records area mapped in Figure 4.8**.** The full likelihood of occurrence assessment for all species is provided in Appendix 5.

Table 4.16 Likelihood of occurrence of threatened flora species identified in the desktop assessment. The data source and threat levels are described in the table footer

Scientific Name	Common Name	Conservation status		Data Source	PMST occurrence/ BDBSA Sighting (year)	Likelihood of Occurrence in Development Area
		EPBC Act	NPW Act			
Acacia glandulicarpa	Hairy-pod Wattle	VU	E	1	May	Unlikely
Acacia iteaphylla	Flinders Ranges Wattle		R	2	2002	Possible
Acacia menzelii	Menzel's Wattle	VU	V	1	May	Unlikely
Acacia spilleriana	Spiller's Wattle	EN	E	1	May	Unlikely
Austrostipa breviglumis	Cane Spear-grass		R	2	2011	**Likely**
Caladenia argocalla	White-beauty Spider-orchid	EN	E	1	Likely	Unlikely
Caladenia concolor	Crimson Spider-orchid	VU		1	May	Unlikely
Caladenia tensa	Greencomb Spider-orchid	EN		1	Likely	Unlikely
Cryptandra campanulata	Long-flower Cryptandra		R	2	2015	**Likely**
Dodonaea procumbens	Trailing Hop-bush	VU	V	1	Likely	Unlikely
Dodonaea subglandulifera	Peep Hill Hop-bush	EN	E	1	Likely	Possible
Eucalyptus behriana	Broad-leaf Box		R	2	2018	**Likely**
Euphrasia collina subsp. *osbornii*	Osborn's Eyebright	EN	V	1	May	Unlikely
Maireana excavata	Bottle Fissure-plant		V	2	2022	**Likely**

Scientific Name	Common Name	Conservation status		Data Source	PMST occurrence/ BDBSA Sighting (year)	Likelihood of Occurrence in Development Area
		EPBC Act	NPW Act			
Maireana rohrlachii	Rohrlach's Bluebush		R	2, 3	2017	**Highly Likely/ Known**
Olearia pannosa subsp. *pannosa*	Silver Daisy-bush	VU	V	1	Likely	Unlikely
Pterostylis xerophila	Desert Greenhood	VU	V	1	May	Unlikely
Ptilotus erubescens	Hairy-tails		R	2	2017	**Likely**
Rumex dumosus	Wiry Dock		R	2	2011	**Likely**
Sclerolaena muricata var. *villosa*	Five-spine Bindyi		R	2	2017	**Likely**
Senecio macrocarpus	Large-fruit Fireweed	VU	V	1	May	Unlikely
Swainsona behriana	Behr's Swainson-pea		V	2	2011	Unlikely
Swainsona pyrophila	Yellow Swainson-pea	VU	R	1	May	Unlikely

Conservation status

EPBC Act: (*Environment Protection and Biodiversity Conservation Act 1999*). NPW Act (*National Parks and Wildlife Act 1972*). Conservation Codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. ssp.: the conservation status applies at the sub-species level. Mi: listed as migratory under the EPBC Act. Ma: listed as marine under the EPBC Act.

Source of Information

1. EPBC Act Protected Matters Report (DCCEEW 2024) – 5 km buffer applied to Development Area.
2. Biological Database of South Australia data extract (DEW 2023a) – 5 km buffer applied to Development Area.
3. Recorded during the 2023/24 field survey.

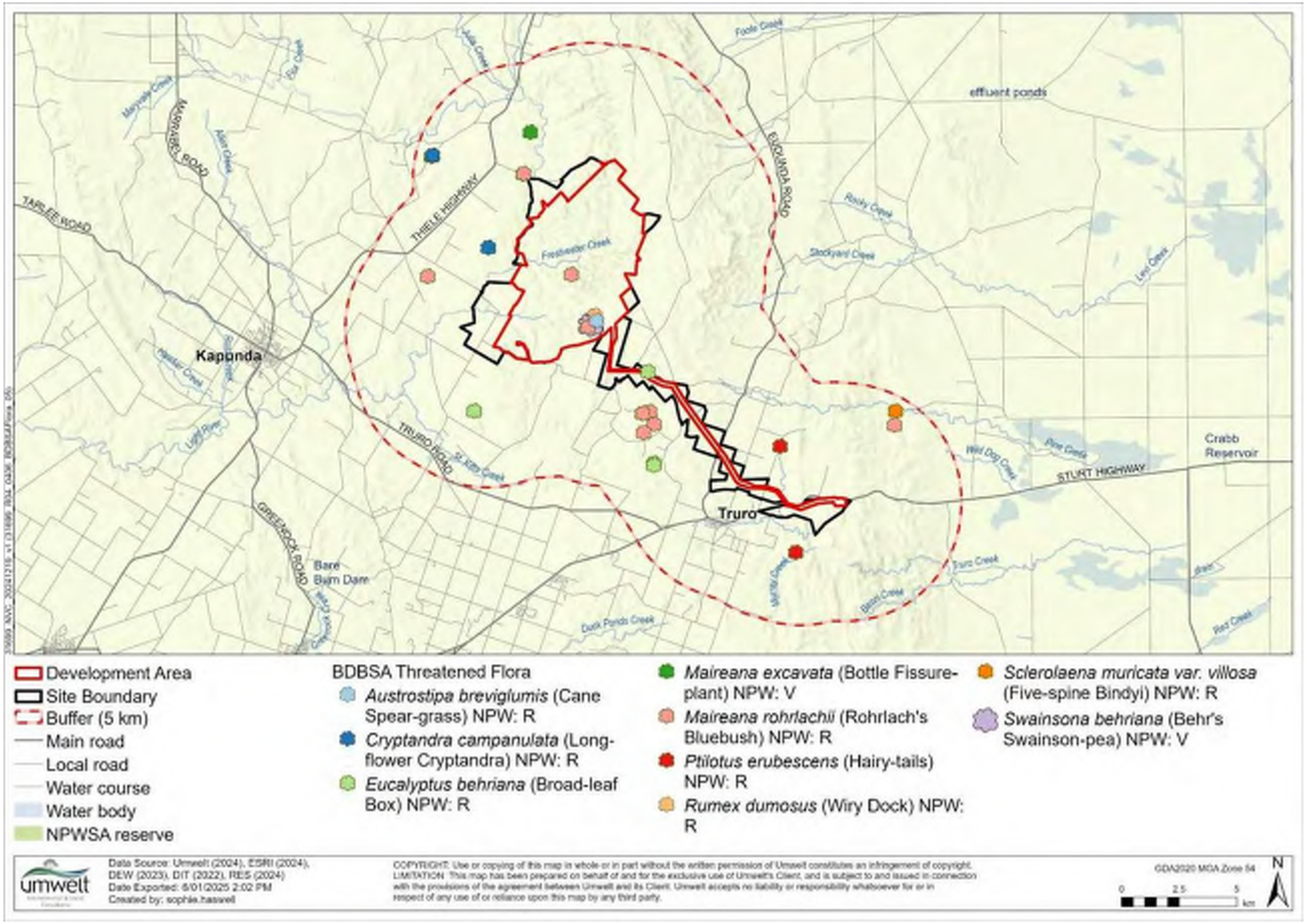


Figure 4.6 NPW Act Listed Threatened Flora Records within 5 km of the Development Area

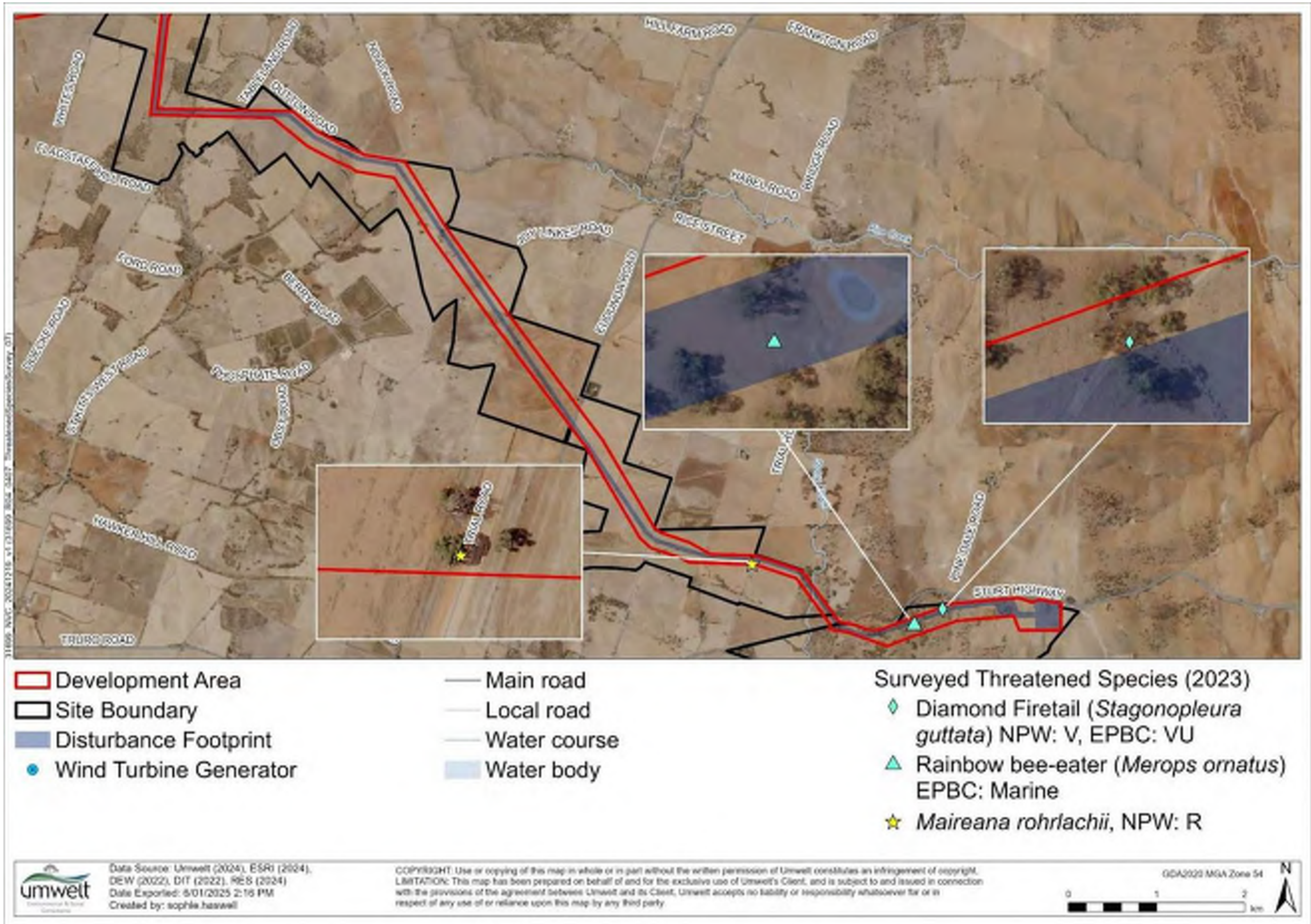


Figure 4.7 **Threatened Flora and Fauna Observed During the 2023/2024 Surveys**

4.3.2. Threatened fauna

The database searches identified 29 threatened fauna species (one amphibian, one fish, one mammal, 24 birds and two reptiles), which may occur in the Search Area. Four species were assessed as likely to occur within the Development Area, this includes:

- White-winged Chough (*Corcorax melanorhamphos*) – NPW Act: Rare
- Restless Flycatcher (*Myiagra inquieta*) – NPW Act: Rare
- Southern Whiteface (*Aphelocephala leucopsis leucopsis*) – EBPC Act: Vulnerable
- South-eastern Hooded Robin (*Melanodryas cucullata cucullata*) – EPBC Act: Endangered and State Rare.

All threatened fauna species are listed in Table 4.17 and species with BDBSA records area mapped in Figure 4.6. The full likelihood of occurrence assessment for all species is provided in Appendix 5.

2024 surveys

Three threatened fauna species (two birds and one reptile) were recorded during the survey:

- Two Rainbow Bee-eaters were observed resting on a tree in *Eucalyptus leucoxylon pruinosa* Open Woodland (Figure 4.7).
- Four Diamond Firetails were seen foraging on the ground along the eastern end of the TL Route within *Eucalyptus leucoxylon pruinosa* Open Woodland (Figure 4.7).
- A total of 200 PBTL were observed within the Disturbance Footprint (Appendix 7).
- Black Falcon was observed flying over vegetation in A3.

Historical surveys

- Three individual Blue-winged Parrots were observed flying over vegetation Associations 1 and 2: *Lomandra effusa* grasslands and *Austrostipa* sp. grassland (respectively). It is believed that Blue-winged Parrots utilise these vegetation associations for foraging (EBS 2017) (Figure 4.8).
- Black Falcon and Peregrine Falcon were observed during a Bird Utilisation Survey (BUS) in 2021 and 2022, respectively.

Table 4.17 Threatened species identified as Known to occur (DCCEEW 2024). This also includes species that have been observed within the Development Area

Scientific Name	Common Name	Conservation status		Data Source	PMST Occurrence/ BDBSA Last Sighting (year)	Likelihood of Occurrence in Development Area
		EPBC Act	NPW Act			
AMPHIBIANS						
Litoria raniformis	Southern Bell Frog	VU	V	1		Unlikely
AVES						
Ardea intermedia plumifera	Plumed Egret		R	2	2010	Unlikely
Amytornis striatus howei	Murray Mallee Striated Grasswren	EN	R	1	May	Unlikely
Aphelocephala leucopsis	Southern Whiteface	VU		1	Known	Possible
Botaurus poiciloptilus	Australasian Bittern	EN	E	1	May	Unlikely
Calidris acuminata	Sharp-tailed Sandpiper	VU, Mi (W)		1	May	Unlikely

Scientific Name	Common Name	Conservation status		Data Source	PMST Occurrence/ BDBSA Last Sighting (year)	Likelihood of Occurrence in Development Area
		EPBC Act	NPW Act			
Calidris ferruginea	Curlew Sandpiper	CE, Mi (W)	E	1	May	Unlikely
Corcorax melanorhamphos	White-winged Chough		R	2	2011	**Likely**
Falco hypoleucos	Grey Falcon	VU	R	1	Likely	Unlikely
Falco peregrinus macropus	Peregrine Falcon		R	2, 4	2009	**Known**
Falco subniger	Black Falcon		R	2, 3, 4	1999	**Known**
Gallinago hardwickii	Latham's Snipe	VU, Mi (W)	R	1	May	Unlikely
Grantiella picta	Painted Honeyeater	VU	R	1	Likely	Possible
Leipoa ocellata	Malleefowl	VU	V	1	Likely	Unlikely
Lophochroa leadbeateri leadbeateri	Major Mitchell's Cockatoo (eastern)	EN		1	May	Unlikely
Melanodryas cucullata cucullata	South-eastern Hooded Robin	EN	R	1, 2	Known/2015	**Likely**
Merops ornatus	Rainbow Bee-eater	Ma		3,4	May	**Known**
Myiagra inquieta	Restless Flycatcher		R	2	1999	**Likely**
Neophema chrysostoma	Blue-winged Parrot	VU	V	1, 2, 4	Known/2011	**Known**
Neophema elegans elegans	Elegant Parrot		R	2	1999	Possible
Pedionomus torquatus	Plains-wanderer	CE	E	1	May	Unlikely
Polytelis anthopeplus monarchoides	Regent Parrot (eastern)	VU	V	1	Likely	Unlikely
Rostratula australis	Australian Painted Snipe	EN	E	1	Known	Unlikely
Stagonopleura guttata	Diamond Firetail	VU	V	1,2,3	Known/2018	**Known**
Tringa nebularia	Common Greenshank	EN, Mi (W)		1	Likely	Unlikely
FISH						
Galaxias rostratus	Flathead Galaxias	CE		1	Likely	Unlikely
MAMMALS						
Pteropus poliocephalus	Grey-headed Flying-fox	VU	R	1	May	Unlikely

Scientific Name	Common Name	Conservation status		Data Source	PMST Occurrence/ BDBSA Last Sighting (year)	Likelihood of Occurrence in Development Area
		EPBC Act	NPW Act			
REPTILES						
Aprasia pseudopulchella	Flinders Ranges Worm-lizard	VU		1	Likely	Possible
Tiliqua adelaidensis	Pygmy Blue-tongue Lizard	EN	E	1,2,3,4	Known/2021	**Known**

Conservation status

EPBC Act: (*Environment Protection and Biodiversity Conservation Act 1999*). **NPW Act** (*National Parks and Wildlife Act 1972*). **Conservation Codes**: **CE**: Critically Endangered. **EN/E**: Endangered. **VU/V**: Vulnerable. **R**: Rare. **ssp.**: the conservation status applies at the sub-species level. **Mi**: listed as migratory under the EPBC Act. **Ma**: listed as marine under the EPBC Act.

Source of Information

1. EPBC Act Protected Matters Report (DCCEEW 2024) – 5 km buffer applied to Development Area.
2. Biological Database of South Australia data extract (DEW 2023a) - 5 km buffer applied to Development Area.
3. Recorded during the 2023/24 field survey.
4. Recorded during the previous field surveys.

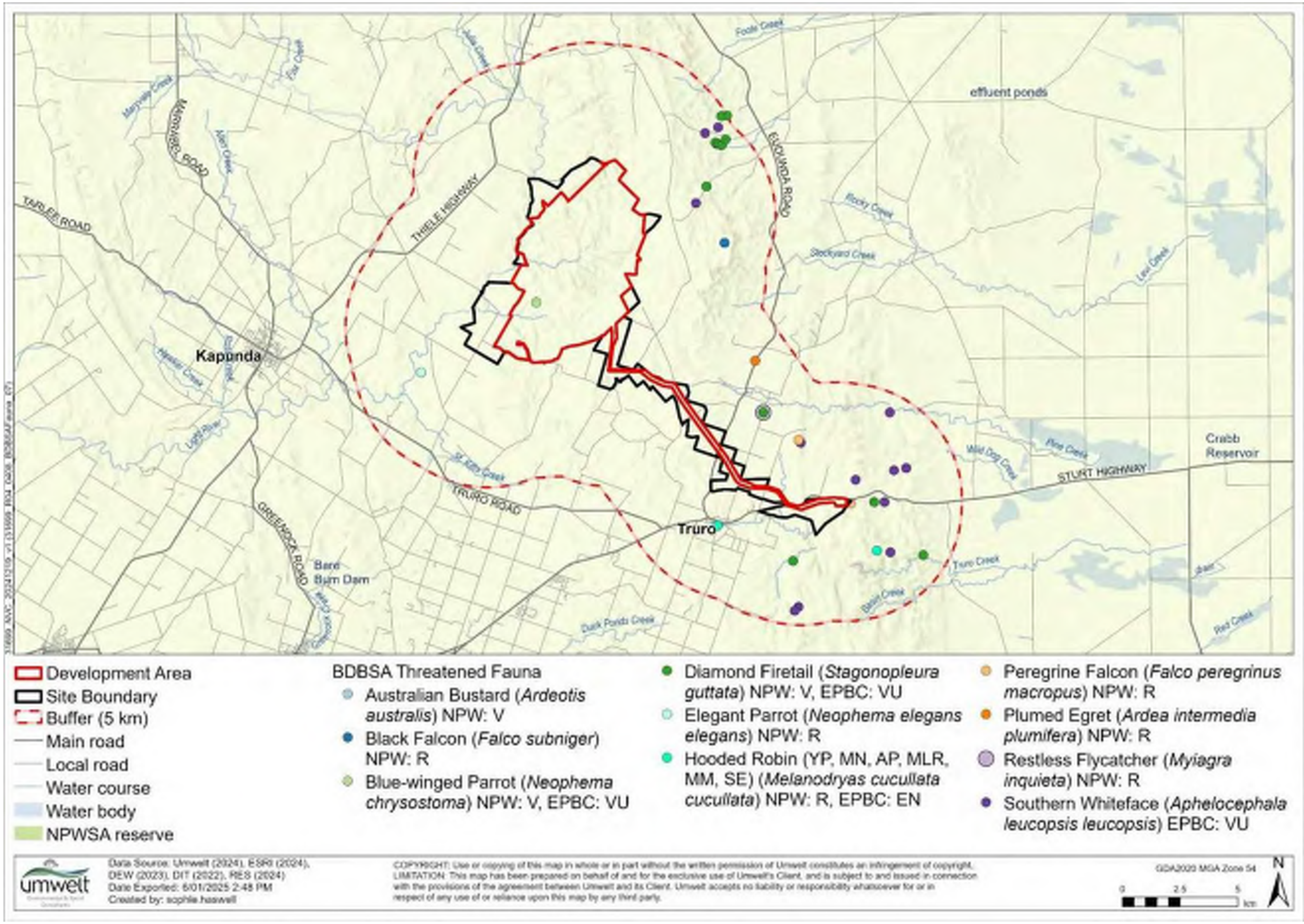


Figure 4.8 NPW Act Listed Threatened Fauna Records within 5 km of the Development Area Since 1995

4.4. Cumulative Impacts

When exercising a power or making a decision under Division 5 of the Native Vegetation Regulations 2017, the NVC must consider the potential cumulative impact, both direct and indirect, that is reasonably likely to result from a proposed clearance activity.

Direct Clearance

To calculate the impact to native vegetation, all infrastructure associated with TCWF, including WTG sites, access tracks, cable routes and a construction compound has been mapped in ArcGIS and overlaid onto native vegetation association information. This includes all associated infrastructure and construction areas, such as turbine site hardstands, crane hardstands, stockpiles, batter slopes and construction compounds/laydown areas (Disturbance Footprint).

A worst-case scenario complete clearance of the Disturbance Footprint along the TL Route (approximately 50 m width) has been assumed as part of this clearance application.

Indirect Clearance

- Construction and operation of the TCWF has the potential to cause indirect impacts to native vegetation associated with construction machinery, dust, weeds, herbicide use, altered hydrology/stormwater drainage and potentially changes to local grazing regimes/levels. These impacts will be minimised and managed through construction and operation management plans. Examples of indirect clearance mitigation is addressed Section 4.5 below.

4.5. Addressing the Mitigation Hierarchy

When exercising a power or making a decision under Division 5 of the Native Vegetation Regulations 2017, the NVC must have regard to the mitigation hierarchy. The NVC will also consider, with the aim to minimize, impacts on biological diversity, soil, water and other natural resources, threatened species or ecological communities under the EPBC Act or listed species under the NPW Act.

a) Avoidance – outline measures taken to avoid clearance of native vegetation

All stages of the project design have been undertaken considering vegetation mapping, threatened ecological community mapping and the known locations of threatened species populations. Whilst every effort has been made to avoid sensitive areas where possible, such as locating turbines outside of *Lomandra* spp. grasslands and Peppermint Box grassy woodlands, engineering and landscape constraints mean that clearing of native vegetation cannot be completely avoided. The clearance areas showcase the worst-case scenario. That is, calculation of areas required for clearance of vegetation for the Wind Turbine Generators (WTG) and ancillary infrastructure associated with the construction of the TL route has been overstated and overcalculated. For example, the SEB calculated for the TL Route has assumed clearance of vegetation with the entire corridor, however, this is not the intended construction methodology. The poles and infrastructure required for the TL will be micro-sited to avoid vegetation included scattered trees resulting in partial clearance. This micro-siting also applies to WTG hard stands areas, access tracks and associated infrastructure (i.e. construction compound). To enable opportunities for avoidance as the project progresses through detailed design, a micrositing corridor (shown on the RES plans as a planning corridor) has been prepared and is shown in Appendix 6.

b) Minimization – if clearance cannot be avoided, outline measures taken to minimize the extent, duration and intensity of impacts of the clearance on biodiversity to the fullest possible extent (whether the impact is direct, indirect or cumulative).

During the final design of the development, the infrastructure will be microsited to mimise native vegetation clearance. Clearance has been reduced to the smallest extent possible, given the design and specification constraints for the Project. The following measures have been taken to minimise native vegetation clearance and associated direct and indirect impacts:

- Existing farm tracks and council roads will be utilised where possible.
- Wherever possible, the location of infrastructure in grasslands that are in poor condition, currently being impacted by weeds and grazing
- Micro siting of infrastructure wherever possible, particularly to avoid scattered trees
- A Construction Environmental Management Plan (CEMP) aims to highlight the minimization measures for this Project. Some of these include, but are not limited to:
  - Limit vegetation clearing to that required for construction and safety and where possible, retain established trees and native shrub under storeys.
  - All vegetation clearing or disturbance is approved and undertaken in compliance with permits and/ or site management plans.
  - Tree pruning instead of removal where possible.
  - Provide an induction for all project team members for identification and management of protected flora and fauna prior to the commencement of works, particularly Pygmy-blue Tongue Lizards, Iron-grass (*Lomandra* spp.) and Peppermint Box (*Eucalyptus odorata*).
  - Accurately and clearly mark out the edge of clearing and trees/vegetation to be retained including hollow trees, significant species, riparian zones.
  - Identify, retain and protect old or mature trees (alive or dead) which are in close proximity to the corridor by marking out/fencing.
  - Clearly identify buffer areas around protected species, including existing wedge tailed eagle nests.
  - Fence or mark buffer areas around protected species prior to the commencement of works.
  - Controls in place to minimise disturbance to flora and fauna are maintained and effective.
  - Disturbed/ exposed areas are stabilised and revegetated progressively.
  - Cease work immediately if any previously unknown threatened flora species are encountered
  - Vegetation clearing methods shall be conducted in a manner that encourages natural regeneration of rootstock, minimises land disturbance and maintains soil stability and line clearance.
  - Avoid the removal of trees with hollows (alive or dead.) Where removal cannot be avoided, maintain the tree intact (as far as possible) and place it on the ground in adjoining vegetation.
  - Vegetation clearing methods shall be conducted in a manner that encourages natural regeneration of rootstock, minimises land disturbance and maintains soil stability and line clearance.

c) ***Rehabilitation or restoration – outline measures taken to rehabilitate ecosystems that have been degraded, and to restore ecosystems that have been degraded, or destroyed by the impact of clearance that cannot be avoided or further minimized, such as allowing for the re-establishment of the vegetation.***

Clearance for the Wind Farm footprint and TL Route poles will be permanent, and no rehabilitation will occur within those areas. However, areas between the TL Route poles will not be cleared. The following rehabilitation methods will be implemented:

- Disturbed/ exposed areas are stabilised and revegetated progressively. Revegetation of areas beside access tracks and hardstands both during and following construction. Species selection will most likely be with a native seed mix/pasture seed mix. Often oversown with a sterile rye grass to ensure soil stabilisation.
- wherever practical, trenches will be backfilled immediately upon cable installation in accordance with the CEMP, with measures adopted to slow stormwater flows and to prevent the scouring of open trench or disturbed ground prior to revegetation.
- Storing cleared vegetation and/ or topsoil containing seed bank for re-establishment after construction has been completed.

- Vegetation clearing methods shall be conducted in a manner that encourages natural regeneration of rootstock, minimises land disturbance and maintains soil stability and line clearance.
- Where removal of trees cannot be avoided, maintain the tree intact (as far as possible) and place it on the ground in adjoining vegetation.

d) ***Offset* – any *adverse impact on native vegetation that cannot be avoided or further minimized should be offset by the achievement of a significant environmental benefit that outweighs that impact.***

The proponent aims to offset part the clearance with an on-ground SEB Area (Offset Area).

The Offset Area protects three vegetation associations, 21.174 hectares of Peppermint Box Grassy Woodland (in varying conditions) and 4.197 hectares of River Red Gum Riparian Open Woodland. The vegetation associations are listed below:

- A1 (Peppermint Box open Grassy Woodland) UBS 39.05 – 14.019 ha
- A2 (Peppermint Box Grassy Woodland) UBS 90.66 – 7.155 ha
- A3 (River Red Gum Riparian Open Woodland) UBS 27.35 – 4.197 ha.

Peppermint Box Grassy Woodland is listed as a nationally TEC under the EPBC Act. BAM site A2 meets the condition class B TEC requirements in its current condition, the implementation of this management plan will assist in significantly improving its condition. The Offset Area management plan also aims to improve the condition of A1 (currently condition Class C, patches amendable to rehabilitation). The Offset Area would also contribute to the total area under conservation management in the area. Approximately 6% of the of Mopami EA contains native vegetation and only 2% is within the Reserve System. Therefore, the Offset Area significantly contributes to the management of native vegetation in the region.

The balance amount will be paid into the fund. The NVC will only consider an offset once avoidance, minimization and restoration have been documented and fulfilled. The *SEB Policy* explains the biodiversity offsetting principles that must be met.

4.6. Principles of Clearance (Schedule 1, *Native Vegetation Act 1991*)

The Native Vegetation Council will consider Principles 1(b), 1(c) and 1(d) when assigning a level of Risk under Regulation 16 of the Native Vegetation Regulations. The Native Vegetation Council will consider all the Principles of clearance of the Act as relevant, when considering an application referred under the Planning, Development and Infrastructure Act 2016. The clearance is assessed against the Principles of Clearance as set out in Table 4.18.

Table 4.18 Assessment Against the Principles of Clearance

Principle of clearance	Considerations
Principle 1(a) – it comprises a high level of diversity of plant species	**Relevant information**

Vegetation association	# Native	# Introduced	Plant Diversity score
A1*	13	10	14
A2*	9	9	11
A3	13	9	18
A4	14	10	28
B1	17	7	21
B2*	10	14	13
B3	7	4	12
C1	11	7	10
D1	6	6	6
E1*	13	6	11
E2	9	7	12

<table>
<tr><th>Principle of clearance</th><th>Considerations</th></tr>
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E3	5	4	6

** Averaged score*

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Assessment against the principles

Seriously at Variance

A4 and B1

At Variance

A1, A2, A3, B2, B3, C1, E1, E2

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Moderating factors that may be considered by the NVC

The total area of each vegetation association in the Development Area compared to the clearance area is shown in Table 4.1

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<tr><td>**Principle 1(b) – significance as a habitat for wildlife**</td><td>

Relevant information

Three threatened fauna species were recorded during the 2023/2024 field survey:

- Black Falcon (Falco subniger) – NPW Act: R.
- Diamond Firetail (*Stagonopleura guttata*) – EPBC: VU, NPW Act: V
- Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*) – EPBC: EN, NPW Act: E
- Rainbow Bee-eater (*Merops ornatus*) – EPBC: Ma

Historical threatened fauna species was recorded during previous Umwelt surveys:

- Blue-winged Parrot (*Neophema chrysostoma*) – EPBC: VU, NPW Act: V.
- Black Falcon (*Falco subniger*) – NPW Act: R
- Peregrine Falcon (*Falco peregrinus macropus*) -NPW Act: Rare.

Two other species have been assessed as “Known to occur” based on the PMST, this includes:

- Southern-eastern Hooded Robin (*Melanodryas cucullata cucullata*) – EPBC Act: EN, NPW Act: R. A 2015 record was identified within the Search Area. Suitable habitat does exist within the Development Area. As further explained in Appendix 5, the Hooded Robin prefers woodland of eucalypt, mallee, mulga; coastal heath; semi cleared farmland. As this habitat is present within the Development Area (A3, B1, B2, C1, E1 and E2).
- Southern Whiteface (*Aphelocephala leucopsis*) – EPBC Act: VU. There are no historical records within the area. However, this species has a broad distribution and habitat requirements and likely to disperse across grasslands and woodlands across the Development Area.

Bushland Assessment

Most of the impacted vegetation within the Project consists of grasslands, which does not support a high diversity of species. However, these areas are known habitat for the Pygmy Blue-tongue Lizard and possible habitat for the Flinders Ranges Worm Lizard.

Woodland trees provide hollows and shelter refuge for certain species, specifically large birds of prey such as Wedge-tailed Eagles. Four known nests were observed within A3. Areas that support a high diversity of species are large, connected patches of woodland, particularly along the TL Route, which includes E1 and E2.

Vegetation association	Threatened fauna score	Unit biodiversity score
A1*	0.1	52.53
A2*	0.1	27.07
A3	0.1	60.12
A4	0.0	76.43
B1	0.1	49.74
B2*	0.1	44.15
B3	0.1	33.41
C1	0.1	27.75
D1	0.1	14.59

</td></tr>
</table>

Principle of clearance	Considerations
	<table><tr><td>E1*</td><td>0.1</td><td>47.46</td></tr><tr><td>E2</td><td>0.1</td><td>29.66</td></tr><tr><td>E3</td><td>0.1</td><td>15.18</td></tr></table> ** Averaged score* **Scattered Tree Assessment** Biodiversity score for scattered trees outlined in Table 4.14. All scattered trees received a fauna score of 1.8.
	Assessment against the principles All scattered trees are *Seriously at Variance*. All vegetation associations are Seriously at Variance except A4.
	Moderating factors that may be considered by the NVC *Impact significance* It is uncertain whether the clearance of 19.11 ha of woodland will lead to a long-term decrease in population for the Diamond Firetail. However, a referral to DCCEEW will be a part of the process for TCWF. It is unlikely that the clearance will fragment a population as large patches of connecting woodland exist outside of the Development Area. Similarly for Blue-winged Parrots and Rainbow Bee-eaters, large amounts of suitable habitat exist outside of the Development Area. The clearance is unlikely to result in invasive species becoming established, as numerous weed species already exist and are widespread within the area. PBTL surveys were undertaken during March and April 2024. A total of 453 PBTL were identified, of which 200 PBTL were located within the Disturbance Footprint (refer to Appendix 7) and likely to be impacted by the Project. Currently, it is not known whether this Project will have a significant impact on PBTL. A Significant Impact Assessment under the provisions of the EPBC Act will form part of the referral process. *Non-essential habitat* Given the high level of impact from weeds, fragmentation and historical clearing, the vegetation under application is unlikely to represent essential habitat for any threatened fauna species. *Common species* All species recorded in the Development Area on fauna surveys are species that are commonly found in grasslands and woodlands. The Development Area does include habitat features essential for maintaining local populations, such as hollow trees and a reduction in impacts to these have been considered during the design phase.

<table>
<tr><th>Principle of clearance</th><th>Considerations</th></tr>
<tr><td rowspan="3">Principle 1(c) – plants of a rare, vulnerable or endangered species</td><td>
<u>Relevant information</u>

One State Rare flora species was identified within the Development Area:
Maireana rohrlachii (Rohrlach's Bluebush). There were two BAM sites that included this species. A total of 28 individuals were identified within a patch of native vegetation on Trial Road (Figure 4.7). Scattered individuals were recorded in VA E1 (individuals not counted).
Species listed as likely or possible within the Development Area have not been observed. Most native vegetation across the Development Area is dominated by grassy and herbaceous species and dominance of weed species, with ground layer vegetation sparse to absent. As the Development Area is continuously grazed, there is little chance of threatened forb species, such as orchids, persisting under such conditions.

<table>
<tr><th>Vegetation association</th><th>Threatened flora score</th></tr>
<tr><td>A1*</td><td>0</td></tr>
<tr><td>A2*</td><td>0</td></tr>
<tr><td>A3</td><td>0</td></tr>
<tr><td>A4</td><td>0</td></tr>
<tr><td>B1</td><td>0</td></tr>
<tr><td>B2*</td><td>0</td></tr>
<tr><td>B3</td><td>0</td></tr>
<tr><td>C1</td><td>0</td></tr>
<tr><td>D1</td><td>0</td></tr>
<tr><td>E1*</td><td>0.04</td></tr>
<tr><td>E2</td><td>0.04</td></tr>
<tr><td>E3</td><td>0</td></tr>
</table>
* Averaged score
</td></tr>
<tr><td>
<u>Assessment against the principles</u>

At Variance
E1 and E2
</td></tr>
<tr><td>
<u>Moderating factors that may be considered by the NVC</u>

Impact significance
These shrubs are already fragmented by a road and are impacted by weeds. It is unlikely that the removal of these shrubs will have a significant impact on this species.

Numbers of plants to be cleared
All plants will be cleared based on the current design. It is likely that > 1% of the plants will be affected.

Significant benefit
N/A
</td></tr>
<tr><td>Principle 1(d) – the vegetation comprises the whole or part of a plant community that is Rare, Vulnerable or</td><td>
<u>Relevant information</u>

A State (Provisional List of Threatened Ecosystems of SA) Endangered community was observed in Block A (A1) and Block E (E3). This community may also classify as the EPBC protected Iron-grass Natural Temperate Grassland (INTG) of South Australia. However, due to the dry conditions during the 2023 October survey, broad leaf herbs were limited with some species difficult to identify due to a lack of distinguishable features such as flowering or fruiting bodies. It is likely that this patch represents condition class C (indicative patches that are degraded but could be rehabilitated to the listed ecological community).
</td></tr>
</table>

<table>
<tr><th>Principle of clearance</th><th>Considerations</th></tr>
<tr><td rowspan="3">endangered</td><td>
<table>
<tr><th>Vegetation association</th><th>Threatened community score</th></tr>
<tr><td>A1*</td><td>1.3</td></tr>
<tr><td>A2*</td><td>0</td></tr>
<tr><td>A3</td><td>0</td></tr>
<tr><td>A4</td><td>0</td></tr>
<tr><td>B1</td><td>0</td></tr>
<tr><td>B2*</td><td>0</td></tr>
<tr><td>B3</td><td>0</td></tr>
<tr><td>C1</td><td>0</td></tr>
<tr><td>D1</td><td>0</td></tr>
<tr><td>E1*</td><td>0</td></tr>
<tr><td>E2</td><td>0</td></tr>
<tr><td>E3</td><td>1.3</td></tr>
</table>
* Averaged score</td></tr>
<tr><td><u>Assessment against the principles</u>
Seriously at Variance
A1 and E3</td></tr>
<tr><td><u>Moderating factors that may be considered by the NVC</u>
Impact significance
It is unlikely that the clearance of these VAs will lead to a long-term effect on the plant community. These patches of Lomandra are already isolated at patchy due to the long history of clearance and grazing within the area. The vegetation is also largely impacted by weeds (both Declared and environmental).
Area of impact
A total of 158.14 ha of Lomandra Tussock Grasslands are mapped across the Development Area. Of that 158.14 ha, 7.87 ha will be impacted by the proposed clearance (4.97% of that community in the Development Area).
Condition of the vegetation
The condition of the vegetation is not representative of a remnant vegetation due to large incursions of weeds and impacts from grazing.</td></tr>
<tr><td rowspan="3">Principle 1(e) – it is significant as a remnant of vegetation in an area which has been extensively cleared</td><td><u>Relevant information</u>
The Development Area contains one IBRA Subregion (Broughton) and two associations (Rufus and Mopami). The Broughton subregion has been heavily cleared for agriculture, generally with scattered patches of vegetation remaining in areas unsuitable for farming.
<table>
<tr><th>Subregion</th><th>Remnancy</th><th>Association</th><th>Remnancy</th></tr>
<tr><td rowspan="2">Broughton</td><td rowspan="2">10%</td><td>Rufus</td><td>9%</td></tr>
<tr><td>Mopami</td><td>6%</td></tr>
</table>
Total Biodiversity Score (TBS) – 5528.89</td></tr>
<tr><td><u>Assessment against the principles</u>
Seriously at Variance
All vegetation within the Development Area. Remnancy is 3-10% and TBS IS >500.</td></tr>
<tr><td><u>Moderating factors that may be considered by the NVC</u>
N/A. The condition of vegetation varies across the Development Area. Vegetation varies from poor to good condition.</td></tr>
</table>

Principle of clearance	Considerations
Principle 1(f) – it is growing in, or in association with, a wetland environment	**Relevant information** No wetlands are present within the Development Area.
	Assessment against the principles N/A
	Moderating factors that may be considered by the NVC N/A
Principle 1(g) – it contributes significantly to the amenity of the area in which it is growing or is situated	**Relevant information** The northern agricultural region has a long history of clearing. The existing vegetation occurs scattered across private property and roadsides. Most of the vegetation is situated on private property. In a few areas, grassland and woodland vegetation occurs alongside public roads. These woodland areas are frequented by the public and in relatively good condition and are likely to provide amenity to the area. The Project will become a highly visible component of the landscape once complete, although remote from any areas accessible to the general public. The Mid North Region Plan (a volume of the SA Planning Strategy) identifies and encourages wind farm development within the Mid North region.
	N/A
	Moderating factors that may be considered by the NVC N/A

Principles of Clearance (h-m) will be considered by comments provided by the local NRM Board or relevant Minister. The Data Report should contain information on these principles where relevant and where sufficient information or expertise is available.

4.7. Risk assessment

The *Guide for applications to clear native vegetation* (Native Vegetation Council, 2020b) sets out how the risk level of a clearance application is assessed. This is summarised in Table 4.19. This table indicates that this Project is a Level 4 clearance, due the Total Biodiversity Score being greater than 250.The summary of the clearance and risk assessment is summarised in Table 4.20**.**

Table 4.19 Risk assessment for native vegetation clearance applications in the agricultural regions of South Australia

	Patches – clearance	Trees – clearance	Escalating matters Clearance assessment will be raised to the next level if;
Level 1	0.05 ha or less	5 trees or less	The site contains a listed species or contains a threatened community under either the NP&W Act or EPBC Act Or Clearance of any trees of the specified circumference.
	And clearance does not involve any trees with a trunk circumference measured at 1 m above the ground of (for multi stemmed trees, measure the largest trunk/stem): 50 cm or more.		
Level 2	>0.05 ha to 0.5 ha	6–20 trees	Clearance is seriously at variance with Principle of Clearance 1(b), 1(c) or 1(d).
Level 3	Total Biodiversity Score of less than or equal to 250		Clearance is seriously at variance with Principle of Clearance 1(b), 1(c) or 1(d).
Level 4	Total Biodiversity Score of greater than 250		

Table 4.20 Summary of clearance and risk assessment

Total clearance	No. of trees	35
	Area (ha)	176.78
	Total biodiversity Score	5,382.74
Seriously at variance with principle 1(b), 1(c) or 1 (d)		1(b), 1(c) and 1(d)
Risk assessment outcome		Level 4

5. CLEARANCE SUMMARY

Clearance summary tables for the clearance application are shown in Table 5.1 for vegetation associations and Table 5.2 for scattered trees. The summary tables indicate the SEB points and SEB payment obligations of the clearances.

The total SEB obligations of the clearance are summarised in Table 5.3.

Table 5.1 Clearance summary and total Significant Environmental Benefit (SEB) obligations for vegetation associations impacted by the Project

Impact type	Block	Site	Species diversity score	Threatened Ecological community Score	Threatened plant score	Threatened fauna score	UBS	Area (ha)	TBS	Loss factor	Loadings	Reductions	SEB Points required	SEB payment	Admin Fee
	A	1	14	1.3	0	0.1	53.41		410.16	1	0	0	430.67	$298,245.53	$16,403.50
	A	1a	14	1.3	0	0.1	51.69		396.95	1	0	0	416.80	$292,998.61	$16,114.92
	A	1b	14	1.3	0	0.1	51.26		393.65	1	0	0	413.34	$285,626.79	$15,709.47
	A	1c	18	1.3	0	0.1	66.68	7.68	512.08	1	0	0	537.68	$374,764.32	$20,612.04
	A	1d	10	1.3	0	0.1	22.49		172.73	1	0	0	181.37	$126,141.95	$6,937.81
	A	1e	16	1.3	0	0.1	69.62		534.67	1	0	0	561.41	$397,163.32	$21,843.98
	A	**1 Mean**	**14**	**1.3**	**0**	**0.1**	**52.53**		**403.37**	**1**	**0**	**0**	**423.55**	**$295,823.42**	**$16,270.29**
	A	2	12	1	0	0.1	27.44		4032.22	1	0	0	4235.93	$3,021,973.67	$166,208.55
Wind Farm	A	2a	12	1	0	0.1	16.46		2420.53	1	0	0	2541.56	$1,809,390.93	$99,516.50
	A	2b	8	1	0	0.1	28.5		4189.38	1	0	0	4398.85	$3,210,421.50	$176,573.18
	A	2c	8	1	0	0.1	28.12		4133.52	1	0	0	4340.20	$3,070,449.75	$168,874.74
	A	2d	14	1	0	0.1	36.47		5362.40	1	0	0	5630.52	$3,958,075.48	$217,694.15
	A	2e	8	1	0	0.1	24.65	147.02	3624.59	1	0	0	3805.82	$2,590,163.10	$142,458.97
	A	2f	16	1	0	0.1	47.28		6951.26	1	0	0	7298.83	$4,967,436.09	$273,208.98
	A	2g	6	1	0	0.1	15.3		2249.85	1	0	0	2362.34	$1,646,547.69	$90,560.12
	A	2h	14	1	0	0.1	22.38		3290.88	1	0	0	3455.43	$2,382,636.50	$131,045.01
	A	2i	14	1	0	0.1	31.58		4642.45	1	0	0	4874.57	$3,281,161.16	$180,463.86
	A	2j	10	1	0	0.1	24.32		3574.94	1	0	0	3753.68	$2,666,728.85	$146,670.09

Impact type	Block	Site	Species diversity score	Threatened Ecological community Score	Threatened plant score	Threatened fauna score	UBS	Area (ha)	TBS	Loss factor	Loadings	Reductions	SEB Points required	SEB payment	Admin Fee
	A	2k	14	1	0	0.1	22.32		3281.26	1	0	0	3445.32	$2,452,801.86	$134,904.10
	A	**2 Mean**	**11**	**1**	**0**	**0.1**	**27.07**		**3979.44**	**1**	**0**	**0**	**4178.59**	**$2,921,482.22**	**$160,681.52**
	A	3	12	1	0	0.1	53.64		67.05	1	0	0	70.40	$50,331.62	$2,786.24
	A	3a	24	1	0	0.1	66.60	1.25	83.24	1	0	0	87.41	$63,531.14	$3,494.21
	A	**3 Mean**	**18**	**1**	**0**	**0.1**	**60.12**		**75.15**	**1**	**0**	**0**	**78.91**	**$56,931.38**	**$3,131.23**
	A	**4**	**28**	**1**	**0**	**0.1**	**76.43**	**1.03**	**78.72**	**1**	**0**	**0**	**82.66**	**$56,006.78**	**$3,080.37**
	B	**1**	**21**	**1**	**0**	**0.1**	**49.74**	**0.07**	**3.48**	**1**	**0**	**0**	**3.66**	**$2,695.39**	**$148.25**
	B	2	12	1	0	0.1	43.86		11.84	1	0	0	12.44	$9,056.94	$498.13
	B	2a	14	1	0	0.1	44.44	0.27	12.00	1	0	0	12.6	$9,175.69	$504.66
	B	**2 Mean**	**13**	**1**	**0**	**0.1**	**44.15**		**11.92**	**1**	**0**	**0**	**12.52**	**$9,116.32**	**$501.40**
	B	**3**	**12**	**1**	**0**	**0.1**	**33.41**	**0.12**	**4.01**	**1**	**0**	**0**	**4.21**	**$3,104.11**	**$170.73**
	C	**1**	**10**	**1**	**0**	**0.1**	**27.75**	**0.31**	**8.60**	**1**	**0**	**0**	**9.03**	**$6,808.23**	**$374.45**
TL Route	**D**	**1**	**6**	**1**	**0**	**0.1**	**14.59**	**1.75**	**25.53**	**1**	**0**	**0**	**26.80**	**$19,482.18**	**$1,071.52**
	E	1	6	1	0	0.1	57.44		912.22	1	0	0	957.83	$614,712.29	$33,809.18
	E	1a	14	1	0	0.1	44.11	15.88	700.49	1	0	0	735.52	$456,668.91	$25,116.79
	E	1b	14	1	0.04	0.1	40.84		648.53	1	0	0	680.96	$422,792.38	$23,253.58
	E	**1 Mean**	**11**	**1**	**0.01**	**0.1**	**47.46**		**753.75**	**1**	**0**	**0**	**791.44**	**$498,057.86**	**$27,393.18**
	E	**2**	**12**	**1**	**0.04**	**0.1**	**29.66**	**1.21**	**35.89**	**1**	**0**	**0**	**37.69**	**$23,229.21**	**$1,277.61**
	E	**3**	**6**	**1.3**	**0**	**0.1**	**15.18**	**0.19**	**2.88**	**1**	**0**	**0**	**3.03**	**$1,880.00**	**$103.40**

Impact type	Block	Site	Species diversity score	Threatened Ecological community Score	Threatened plant score	Threatened fauna score	UBS	Area (ha)	TBS	Loss factor	Loadings	Reductions	SEB Points required	SEB payment	Admin Fee
						TOTAL	**478.09**	**176.78**	**5,382.74**				**5,652.07**	**3,894,617.09**	**$214,203,94**

Table 5.2 Clearance summary and total Significant Environmental Benefit (SEB) obligations for Scattered Trees impacted by the Project

Tree Number	Number of Trees	Fauna Habitat Score	Threatened Flora Score	Total Biodiversity Score	Loss Factor	SEB Points Required	SEB Payment (includes admin fee)
1	1	1.8	0	0.55	1	0.58	$447.31
2	1	1.8	0	1.18	1	1.23	$948.42
3	1	1.8	0	1.34	1	1.41	$1,081.54
4	1	1.8	0	3.94	1	4.13	$3,177.26
5	1	1.8	0	2.55	1	2.68	$2,060.14
6	1	1.8	0	3.82	1	4.02	$3,085.73
7	1	1.8	0	4.34	1	4.56	$3,501.34
8	2	1.8	0	0.55	1	0.57	$441.25
9	1	1.8	0	3.6	1	3.82	$2,931.60
10	1	1.8	0	2.61	1	2.74	$2,107.92
11	1	1.8	0	1.99	1	2.09	$1,602.52
12	1	1.8	0	4.64	1	4.87	$3,742.92
13	1	1.8	0	4.05	1	4.26	$3,016.48
14	1	1.8	0	3.84	1	4.03	$2,856.28
15	1	1.8	0	6.48	1	6.80	$4,817.47
16	1	1.8	0	4.6	1	4.83	$3,423.13
17	1	1.8	0	6.51	1	6.83	$4,842.33
18	1	1.8	0	6.85	1	7.20	$5,098.51
19	1	1.8	0	4	1	4.20	$2,976.77
20	1	1.8	0	3.96	1	4.16	$2,945.11
21	1	1.8	0	6.07	1	6.37	$4,516.79
22	1	1.8	0	4.41	1	4.63	$3,280.25
23	1	1.8	0	3.53	1	3.71	$2,627.11
24	1	1.8	0	2.37	1	2.49	$1,764.96
25	1	1.8	0	8.76	1	9.20	$6,520.98
26	1	1.8	0	4.58	1	4.81	$3,407.08
27	1	1.8	0	4.36	1	4.58	$3,243.48
28	1	1.8	0	3.28	1	3.44	$2,440.72
29	1	1.8	0	4.10	1	4.31	$3,052.24
30	1	1.8	0	7.23	1	7.59	$5,376.63
31	1	1.8	0	6.68	1	7.01	$4,970.05
32	1	1.8	0	6.42	1	6.74	$4,775.19
33	1	1.8	0	3.80	1	3.99	$2,828.22
34	1	1.8	0	1.25	1	1.31	$928.00
Total	**35**			**138.28**		**145.19**	**$104,835.71**

Table 5.3 Summary of the total SEB obligations of the clearance

	Total Biodiversity score	Total SEB points required	SEB Payment	Admin Fee	Total Payment
Application	5,382.74	5,652.07	$3,894,617.09	$214,203.94	$4,108,821.03
Economies of Scale Factor			**0.5**		
Rainfall (mm)			**Differs across the Development Area**		

6. SIGNIFICANT ENVIRONMENTAL BENEFIT

A Significant Environmental Benefit (SEB) is required for approval to clear under Division 5 of Part 2 of the Native Vegetation Regulations 2017. The NVC must be satisfied that as a result of the loss of vegetation from the clearance, a SEB will result in a positive impact on the environment that is over and above the negative impact of the clearance.

ACHIEVING A SEB

It is likely that the proponent will achieve the SEB by payment into the Native Vegetation Fund. However, the establishment of a new SEB area on land owned by the proponent will also be investigated.

Options for achieving SEB are:

- ☒ Establish a new SEB Area on land owned by the proponent.
- ☐ Use SEB Credit that the proponent has established.
- ☐ Apply to have SEB Credit assigned from another person or body.
- ☐ Apply to have an SEB to be delivered by a Third Party.
- ☒ Pay into the Native Vegetation Fund.

PAYMENT SEB

The SEB Policy states that if a SEB is required as a result of an approved activity undertaken under the Regulations, the applicant has a choice of either providing an on-ground SEB or a Payment SEB. However, if a proposed clearance will have an offset obligation of greater than 150 SEB Points required, the NVC will first request that a reasonable attempt be made to identify an on-ground SEB before a payment will be accepted.

The total SEB required to offset the clearance of **176.78** ha of native vegetation and **35** scattered trees is **5,652.07** SEB points or **$4,108,821.03** (including administration fee and GST).

The Proponent will be looking at establishing an on-ground SEB Area which is owned by the Proponent. This detail is outlined below, and the SEB Management Plan is attached in Appendix 7.

The on-ground SEB Area will offset a total of **188.34** SEB gain points. The balance amount will be paid into the Native Vegetation Fund, the total amount left to offset the clearance is **5,463.73 SEB points.**

If a proponent proposes to achieve the SEB by paying into the Native Vegetation Fund, summary information must be provided on the amount required to be paid and the manner of payment:

7. ON-GROUND SEB AREA

Details about the St Kitts SEB Area for the Twin Creek Wind Farm are summarised in Table 7.1.

Table 7.1 SEB Area details

Ownership:	RES Australia Pty Ltd		
Site Address:	188 Whites Road, St Kitts.		
Local Government Area:	Light Regional Council	Hundred:	Belvidere
Title ID:	5476 305 5485 289 5569 233	Parcel ID	H160100 S190 F16260 A500 H160100 S239
Landscape Board	Northern and Yorke	Total SEB Offset Area (ha)	25.371
SEB Points	188.34		

7.1. General description of the vegetation, the site and matters of significance

The St Kitts Offset Area occurs within a property that was purchased by RES Australia in June 2021. The total property size is ~153 ha. The Offset Area is typical of land which has historically been used for stock grazing.

There are no encumbrances or easements on the Title and the land is zoned Rural, with the following Overlays:

- Environment and Food Production Area
- Hazards (Bushfire – General)
- Heritage Adjacency
- Hazards (Flooding – Evidence Required)
- Native Vegetation
- Water Resources.

The St Kitts Offset Area is located within the Flinders Lofty Block IBRA Bioregion within the Broughton IBRA Subregion and the Mopami Environmental Association (EA). The Mopami EA contains approximately 6% (4,257 ha) remnant native vegetation, of which 2% (110 ha) is formally conserved.

The closest conservation reserves (managed by DEW) to the proposed Twin Creek Wind Farm footprint are Kaiserstuhl Conservation Park (approximately 25 km south) and Brookfield Conservation Park (approximately 32 km east). Three existing Heritage Agreements under the NV Act are situated 4 km south (Heritage Agreement No.287) and 6 km east of the Development Area (Heritage Agreement numbers 677 and 1314).

The Offset Area site is characterised by low hills with a 440 metre (m) maximum elevation in the southern area. A River Red Gum (*Eucalyptus camaldulensis*) lined creek runs north south in the eastern side of the Offset Area with the elevation dropping to 380–390 m in this area. However, grazing has resulted in a depauperate understorey, lacking the pre-European diversity of grass, forb and herbaceous species, and instead proliferating in pasture weed species. The site is long unburnt, with no known fire history impacting the site.

The Offset area is 25.371 ha in size and consists of predominantly Peppermint Box (*Eucalyptus odorata*) Low Grassy Woodland grading to River Red Gum Open Grassy Woodland in the riparian zone. The overstorey of the woodland is relatively intact with the understorey dominated by introduced grasses and herbs. One small dam occurs within the southern section of the Woodland area; however, it will be excluded from the Offset Area. This dam will be fenced so that stock can still access it. A fenced dam is also located adjacent to the northern section; however, it has access through an open gate on the western side, from the cropping land.

The Offset area protects three Vegetation Associations (VAs), 21.174 ha of Peppermint Box Grassy Woodland (in varying conditions) and 4.197 hectares of River Red Gum Riparian Open Woodland. The Vegetation Associations are listed below:

- A1 (Peppermint Box open Grassy Woodland) UBS 39.05 – 14.019 ha
- A2 (Peppermint Box Grassy Woodland) UBS 90.66 – 7.155 ha
- A3 (River Red Gum Riparian Open Woodland) UBS 27.35 – 4.197 ha.

Peppermint Box Grassy Woodland is listed as a nationally TEC under the EPBC Act. BAM site A2 meets the condition class B TEC requirements in its current condition, the implementation of this management plan will assist in significantly improving its condition. The management plan also aims to improve the condition of A1 (currently condition Class C, patches amendable to rehabilitation). The Offset Area would also contribute to the total area under conservation management in the area. Approximately 6% of the of Mopami EA contains native vegetation and only 2% is within the Reserve System. Therefore, the Offset Area significantly contributes to the management of native vegetation in the region.

Additionally, the Offset Area provides some connectivity between patches and corridors of vegetation within an environment where extensive clearance has occurred. The southern portion adjoins a neighbouring patch of vegetation, and the drainage line area continues through the neighbouring property.

The area retains an intact mature overstorey stratum and is amenable to rehabilitation.

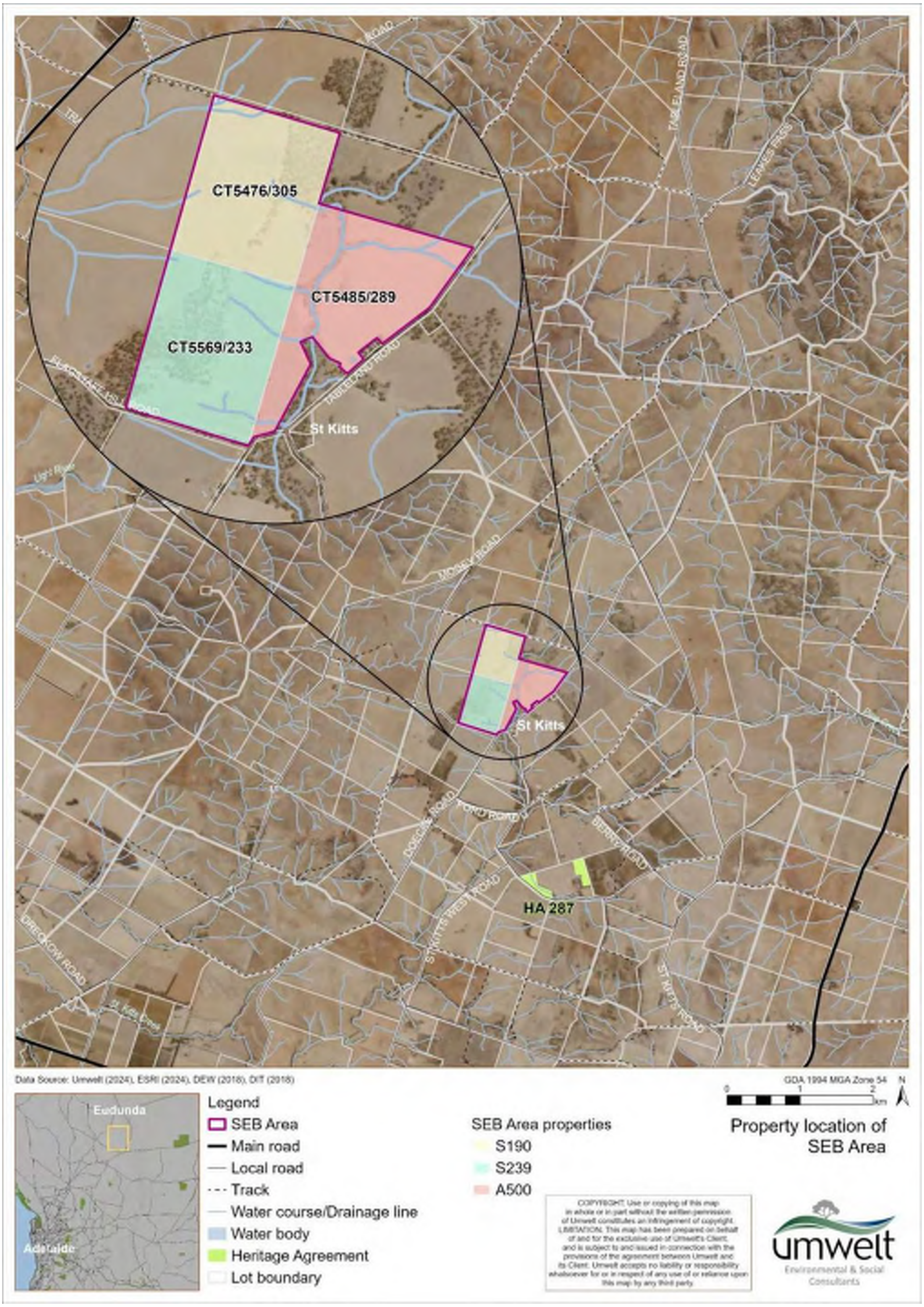

Figure 7.1 Property location of SEB Area

7.2. Description of the vegetation

Vegetation mapped in the SEB Area are visualized in and described in Table 7.2 to Table 7.4.

Table 7.2 Vegetation Association A1

Vegetation Association	Peppermint Box (*E. odorata*) Low Open Woodland over mixed native grass and exotic weedy understorey in fair condition.


Easting: 323568, Northing: 6197957 (direction of photo not provided)

General description	Peppermint Box (*E. odorata*) Low Open Woodland over mixed native grass and exotic weedy understorey in poor to fair condition. Site consists of widely scattered large remnant Peppermint Box trees intermixed with no observable regeneration. A native shrub mid-stratum is entirely absent from the site and the ground cover varies from moderate condition native grassland to weed dominated.
Threatened species or community	No threatened flora or fauna was observed within the VA. This VA has been classified as a condition Class C Peppermint Box Grassy Woodland TEC (not protected under the EPBC Act). A total of eight threatened species were identified as potentially ustilising the BDBSA records and PMST Report: • Blue-winged Parrot (*Neophema chrysostoma*): EPBC Act VU, NPW Act V • Diamond Firetail (*Stagonopleura guttata*) EPBC Act: VU, NPW Act: V • South-eastern Hooded Robin (*Melanodryas cucullata cucullata*) EPBC Act: EN, NPW Act: R • Southern Whiteface (*Aphelocephala leucopsis leucoposis*) EPBC Act: VU • White-winged Chough (*Corcorax melanorhamphos*): NPW Act: R.

Landscape context score	1.15	**Vegetation Condition Score**	30.34	**Conservation significance score**	1.10
UBS Gain Score	7.05	**Area (ha)**	14.019	**SEB Points**	98.81

Table 7.3 Vegetation Association A2

<table>
<tr><td colspan="1">Vegetation Association</td><td colspan="5">Peppermint Box (E. odorata) Low Open Woodland over Spear Grass (Austrostipa spp.) and introduced grasses.</td></tr>
<tr><td colspan="6">
Easting: 323568 Northing: 6197957 (no direction provided)</td></tr>
<tr><td>General description</td><td colspan="5">Site consists of widely scattered large remnant Peppermint Box trees intermixed with various age classes of naturally regenerated single stemmed Peppermint Box. A native shrub mid-stratum is absent from the site except for several singular shrubs (i.e. Rhagodia parabolica). The ground cover varies from moderate condition native grassland to weed dominated.
No significant infestations of woody weeds or serious environmental weeds were recorded within this community, except for a singular Bridal Creeper (Asparagus asparagoides) plant and scattered Dog Rose (Rosa canina). The remaining weed species are common weeds that occur throughout the region including introduced grasses, Soursob (Oxalis pes-caprae) and Wild Sage (Salvia verbenaca).</td></tr>
<tr><td>Threatened species or community</td><td colspan="5">No threatened flora or fauna was observed within the VA. This VA has been classified as a condition Class B Peppermint Box Grassy Woodland TEC (protected under the EPBC Act).
A total of eight threatened species were identified as potentially ustilising the BDBSA records and PMST Report:
• Blue-winged Parrot (Neophema chrysostoma): EPBC Act VU, NPW Act V
• Diamond Firetail (Stagonopleura guttata) EPBC Act: VU, NPW Act: V
• South-eastern Hooded Robin (Melanodryas cucullata cucullata) EPBC Act: EN, NPW Act: R
• Southern Whiteface (Aphelocephala leucopsis leucoposis) EPBC Act: VU
• White-winged Chough (Corcorax melanorhamphos): NPW Act: R</td></tr>
<tr><td>Landscape context score</td><td>1.17</td><td>Vegetation Condition Score</td><td>51.66</td><td>Conservation significance score</td><td>1.50</td></tr>
<tr><td>UBS Gain Score</td><td>8.84</td><td>Area (ha)</td><td>7.155</td><td>SEB Points</td><td>63.22</td></tr>
</table>

Table 7.4 Vegetation Association A3

<table>
<tr><td>Vegetation Association</td><td colspan="5">River Red Gum (E. camaldulensis var. camaldulensis) Open Woodland over mixed native grasses and weedy species</td></tr>
<tr><td colspan="6">
Easting: 323531.42, Northing: 6197305.35 (no direction provided).</td></tr>
<tr><td>General description</td><td colspan="5">Riparian area including the creekline and banks ~25 m either side. Riparian zone exhibited a similar mix of native and weedy species to the Grassy Woodland (Site 1 and 2) but the overstorey was dominated by River Red Gum (E. camaldulensis). Several significant weed species were recorded within this area including Dog Rose (Rosa canina) and a singular large African Boxthorn (Lycium ferocissimum). Some areas of old erosion were present as well as a section of active gully erosion.
The southern boundary fence across the creekline, to a neighbouring a property which is not managed for agriculture (pers. comms with current property manager), showed a significant improvement in understorey condition, structure and species diversity, including species such as Acacia pycnantha, Bursaria spinosa and Themeda triandra.</td></tr>
<tr><td>Threatened species or community</td><td colspan="5">No threatened flora or fauna were observed within this VA. This VA does not qualify as a TEC.
A total of eight threatened species were identified as potentially ustilising the BDBSA records and PMST Report:
• Blue-winged Parrot (Neophema chrysostoma): EPBC Act VU, NPW Act V
• Diamond Firetail (Stagonopleura guttata) EPBC Act: VU, NPW Act: V
• South-eastern Hooded Robin (Melanodryas cucullata cucullata) EPBC Act: EN, NPW Act: R
• Southern Whiteface (Aphelocephala leucopsis leucoposis) EPBC Act: VU
• White-winged Chough (Corcorax melanorhamphos): NPW Act: R.</td></tr>
<tr><td>Landscape context score</td><td>1.17</td><td>Vegetation Condition Score</td><td>21.25</td><td>Conservation significance score</td><td>1.10</td></tr>
<tr><td>UBS Gain Score</td><td>6.27</td><td>Area (ha)</td><td>4.197</td><td>SEB Points</td><td>26.31</td></tr>
</table>

Figure 7.2 Vegetation associations and BAM sites within the Offset Area

7.2.1. Photo log

Figure 7.3 **Active erosion was recorded at several locations within the River Red Gum creekline**

Figure 7.4 **Neighbouring property creekline with denser understorey shrubs, native grasses, rushes and sedges**

Figure 7.5 **One large Boxthorn was recorded within the River Red Gum creekline**

Figure 7.6 **Isolated Bridal Creeper was recorded within the Peppermint Box Woodland**

7.3. Future management issues

The following management issues may arise within the SEB Area in the future.

7.3.1. Weeds

Environmental weeds are an ongoing threat to all ecosystems where disturbance and seed dispersal potential occurs. Riparian environments provide perfect conditions for the establishment of weeds spreading easily along pathways and waterways and taking advantage of the heightened nutrient availability from runoff, and water availability (Croft *et al*. 2007). Within the Offset Area, twenty-one (21) weed species were recorded during the field survey, including three declared weeds and two environmental weeds (weed threat rating >3). It is likely that additional weed species may be present within the reserve, but not observed during the survey due to survey timing.

7.3.2. Pest animals

Pest animals present an ongoing management threat to all natural areas, where they reduce survivorship of native fauna, and impact on native vegetation through grazing. Within the Offset Area one species of pest animal, rabbit (*Oryctolagus cuniculus*), was observed during the field survey. It is likely that additional pest animal species, such as foxes (*Vulpes vulpes*) and feral cat (*Felis cattus*) would occur within the Offset Area.

7.3.3. Inappropriate grazing pressure

Stock grazing is currently undertaken within the majority of the site with no grazing occurring in the northern section woodland in recent times. Sections of new and replacement fencing will be required to ensure stock grazing is prevented in the future. Rabbits were observed on the site, and there was some evidence of diggings. Currently there is very little cover for rabbits provided by a shrub layer, however with the

Figure 7.7 Management issues across the SEB Area

7.4. Flora and fauna assessment

The PMST report generated on the 17 of September 2024, identified 2 TEC, 29 threatened species (10 flora and 19 fauna species) and 9 migratory species that may occur within 5 km of the Offset Area (Appendix 8), An additional NatureMaps (DEW 2024) identified an additional five species that may occur within 5 km of the Offset Area.

The following threatened flora species occur within woodland and open woodland and suitable habitat may exist in the Offset Area; this includes:

- *Dodonaea procumbens* (Trailing Hop-bush) – EPBC Act and NPW Act: Vulnerable
- *Dodonaea subglandulifera* (Peep Hill Hop-bush) - EPBC Act and NPW Act: Endangered
- *Senecio macrocarpus* (Large-fruit Fireweed) - EPBC Act and NPW Act: Endangered
- *Austrostipa breviglumis* (Cane Spear-grass) – NPW Act: Rare
- *Eucalyptus behriana* (Broad-leaf Box) – NPW Act: Rare
- *Maireana rohrlachii* (Rohrlach's Bluebush) – NPW Act: Rare
- *Rumex dumosus* (Wiry Dock) – NPW Act: Rare.

Of the 20 threatened fauna species species, five of these species are likely to have foraging or breeding habitat within the Offset Area. This includes:

- South-eastern Hooded Robin (*Melanodryas cucullata cucullata*) – EPBC Act: Endangered and NPW Act: Rare
- Diamond Firetail (*Stagonopleura guttata*) – EPBC Act and NPW Act: Vulnerable
- Southern Whiteface (*Aphelocephala leucopsis*) – EPBC Act: Vulnerable
- Blue-winged Parrot (*Neophema chrysostoma*) – EPBC Act and NPW Act: Vulnerable
- White-winged Chough (*Corcorax melanorhamphos*) – NPW Act: Rare.

A full description of suitable habitat for these species is outlined in Appendix 5.

Figure 7.8 NatureMaps threatened flora records (DEW 2024)

Figure 7.9 NatureMaps threatened fauna records (DEW 2024)

7.5. Environmental benefits

A total of five goals have been outlined in the management plan, this includes:

- Reduce the weed species across the Offset Area.
- Increase natural regeneration, species diversity and native grass cover across the Offset Area.
- Prevent and manage new infestation of non-native plants or animals.
- Prevent stock grazing.
- Rehabilitate and stabilise erosion gullies.

These goals will aim to improve the condition the existing vegetation back to its pre-European form. This will result in the establishment of the threatened TEC Peppermint Box Grassy Woodlands. Revegetation will form a large part of this management plan and will include the planting of State threatened species such as:

- *Dianella longifolia* (Pale Flax-lily) – State Rare
- *Cullen parvum* (Scurf-pea) – State Vulnerable.

7.6. Summary Table

Block	Site	Vegetation Association	UBS	UBS Gain Score	Area (ha)	SEB points provided
A	1	*Eucalyptus odorata* open woodland over *Austrostipa* sp. and *Rytidosperma* sp. grassy understorey.	39.05	7.05	14.019	98.81
A	2	*Eucalyptus odorata* open woodland over *Austrostipa* sp. and *Rytidosperma* sp. grassy understorey.	90.66	8.84	7.155	63.22
A	3	*Eucalyptus camaldulensis* dominant riparian habitat with occasional *E. odorata*	27.35	6.27	4.197	26.31
				Total	25.371	188.34

The Management Plan for the proposed SEB area is attached in the appendices.

A Native Vegetation Management Plan is required as part of the Conditions of Consent for clearance.

The Management Plan should be provided at the time of submitting the application to clear vegetation, however it can be lodged during the assessment process if required but must be received before a decision can be made by the NVC in relation to the associated clearance. The Simple and Complex SEB Management Plan template and Template Instructions are found under Tools for Accredited Consultants.

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9. APPENDICES

9.1. Appendix 1 – Wind farm and grid connection infrastructure land parcels supplied by MasterPlan on the 16/12/2024

Allotment/ Section	Volume[1]	Folio	Number	Infrastructure	Local Government Area
A15	Vol 5293	Fol 926	F158976	T3 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
A12	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
A13	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
A14	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
A16	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
A17	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
A18	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
S220	Vol 5293	Fol 927	H160300	T1, T2 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S219	Vol 5293	Fol 927	H160300	T30 Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S218	Vol 5293	Fol 927	H160300	Access Track, Planning Corridor, Cables	Regional Council Of Goyder
S236	Vol 5293	Fol 928	H160300	T6 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S237	Vol 5293	Fol 928	H160300	T7 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S239	Vol 5293	Fol 928	H160300	T11, T12 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S240	Vol 5293	Fol 928	H160300	T23 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S238	Vol 5293	Fol 928	H160300	No Infrastructure Planned	Regional Council Of Goyder
S122	Vol 5293	Fol 930	H160300	T13, T14 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S127	Vol 5293	Fol 930	H160300	T15, T20 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S124	Vol 5293	Fol 930	H160300	T16 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S128	Vol 5293	Fol 930	H160300	T19 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S125	Vol 5293	Fol 930	H160300	T21 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder

[1] All references Certificates of Title (CT) with Volume and Folio, unless otherwise stated. CR refers to Crown Record

Allotment/ Section	Volume[1]	Folio	Number	Infrastructure	Local Government Area
S126	Vol 5293	Fol 930	H160300	Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S123	Vol 5293	Fol 930	H160300	Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S121	Vol 5293	Fol 930	H160300	No Infrastructure Planned	Regional Council Of Goyder
S129	Vol 5293	Fol 930	H160300	No Infrastructure Planned	Regional Council Of Goyder
S232	Vol 5293	Fol 931	H160300	T4, T10 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S235	Vol 5293	Fol 931	H160300	T5 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S233	Vol 5293	Fol 931	H160300	T17, T22 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S234	Vol 5293	Fol 931	H160300	T18 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
A3	Vol 5293	Fol 933	F158974	Access Track, Planning Corridor, Cables	Regional Council Of Goyder
A10	Vol 5293	Fol 934	F158975	T8 Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
A11	Vol 5293	Fol 934	F158975	T9 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
A4	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A5	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A6	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A7	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A8	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A9	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A104	Vol 5390	Fol 991	F199397	Access Track, Planning Corridor, Cables	Light Regional Council
A105	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A91	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
Q99	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
Q100	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
Q101	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
Q102	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
Q103	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A92	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A93	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A94	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A95	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council

Allotment/ Section	Volume[1]	Folio	Number	Infrastructure	Local Government Area
A96	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A97	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A98	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
S105	Vol 5531	Fol 405	H160100	No Infrastructure Planned	Light Regional Council
S103	Vol 5531	Fol 406	H160100	No Infrastructure Planned	Light Regional Council
S271	Vol 5618	Fol 687	H160100	T31, T32 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S284	Vol 5618	Fol 688	H160100	Access Track, Construction Compound And Material Laydown Area, Planning Corridor, 275kv Line, Cables	Light Regional Council
S283	Vol 5618	Fol 688	H160100	No Infrastructure Planned	Regional Council Of Goyder
S272	Vol 5618	Fol 689	H160100	T28, T29 Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
S249	Vol 5618	Fol 690	H60100	No Infrastructure Planned	Light Regional Council
S285	Vol 5618	Fol 691	H160100	Access Track, Site Entrance, Planning Corridor, 275kv Line, Cables.	Light Regional Council
S273	Vol 5618	Fol 692	H160100	T33 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S278	Vol 5618	Fol 693	H160100	Access Track, Battery Energy Storage Facility, Concrete Batching Plant Area, Operation And Maintenance Facilitiesm 33kv/275kv Substation, Planning Corridor, 275kv Line, Cables	Light Regional Council
S255	Vol 5618	Fol 694	H160100	T39 Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
S250	Vol 5618	Fol 694	H160100	No Infrastructure Planned	Light Regional Council
S251	Vol 5618	Fol 694	H160100	No Infrastructure Planned	Light Regional Council
S254	Vol 5618	Fol 694	H160100	No Infrastructure Planned	Light Regional Council
Ag	Vol 5618	Fol 694	R2497	No Infrastructure Planned	Light Regional Council
S263	Vol 5618	Fol 695	H160100	T24 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S265	Vol 5618	Fol 696	H160100	T25 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S269	Vol 5618	Fol 697	H160100	T27 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S279	Vol 5618	Fol 698	H160100	No Infrastructure Planned	Light Regional Council
S258	Vol 5618	Fol 699	H160100	T40 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S270	Vol 5618	Fol 700	H160100	T35 Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
S267	Vol 5618	Fol 701	H160100	T26 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S257	Vol 5618	Fol 702	H160100	No Infrastructure Planned	Light Regional Council

Allotment/ Section	Volume[1]	Folio	Number	Infrastructure	Local Government Area
S268	Vol 5618	Fol 703	H160100	T34 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
Q91	Vol 5618	Fol 704	F217083	No Infrastructure Planned	Light Regional Council
Q92	Vol 5618	Fol 704	F217083	No Infrastructure Planned	Light Regional Council
A569	Vol 5618	Fol 705	F176641	No Infrastructure Planned	Light Regional Council
A91	Vol 5618	Fol 706	F199399	Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
A102	Vol 5618	Fol 707	F214685	No Infrastructure Planned	Light Regional Council
A571	Vol 5618	Fol 708	F176643	No Infrastructure Planned	Light Regional Council
A20	Vol 5625	Fol 166	F217158	T36, S37 Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
A23	Vol 5625	Fol 166	F217158	T38 Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
A22	Vol 5625	Fol 166	F217158	T41 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
A24	Vol 5625	Fol 166	F217158	T42 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
A21	Vol 5625	Fol 166	F217158	Access Track, Planning Corridor, Cables	Light Regional Council
A25	Vol 5625	Fol 166	F217158	No Infrastructure Planned	Light Regional Council
A572	Vol 5826	Fol 797	F176644	No Infrastructure Planned	Light Regional Council
A1	Vol 5878	Fol 290	F160535	No Infrastructure Planned	Regional Council Of Goyder
S241	Vol 5964	Fol 335	H160300	No Infrastructure Planned	Regional Council Of Goyder
S242	Vol 5964	Fol 335	H160300	Access Track, Planning Corridor, Cables	Regional Council Of Goyder
S243	Vol 5964	Fol 335	H160300	Access Track, Planning Corridor, Cables	Regional Council Of Goyder

Allotment/ Section	Volume	Folio	Number	Infrastructure	Local Government Area
S581	Vol 5146	Fol 519	H160100	275kv Overhead Line	Light Regional Council
S290	Vol 5264	Fol 963	H160100	275kv Overhead Line	Light Regional Council
S314	Vol 5274	Fol 160	H160100	275kv Overhead Line	Light Regional Council
Q94	Vol 5304	Fol 717	F163638	275kv Overhead Line	Mid Murray Council
S221	Vol 5315	Fol 264	H121100	275kv Overhead Line	Mid Murray Council
A1	Vol 5322	Fol 638	D44123	275kv Overhead Line	Mid Murray Council
Q101	Vol 5360	Fol 970	F174415	275kv Overhead Line	Mid Murray Council
S87	Vol 5460	Fol 955	H120600	275kv Overhead Line	Mid Murray Council
S190	Vol 5476	Fol 305	H160100	275kv Overhead Line	Light Regional Council
A500	Vol 5485	Fol 289	F16260	275kv Overhead Line	Light Regional Council
S38	Vol 5485	Fol 579	H120600	275kv Overhead Line	Mid Murray Council
S36	Vol 5485	Fol 733	H120600	275kv Overhead Line	Mid Murray Council

Allotment/ Section	Volume	Folio	Number	Infrastructure	Local Government Area
A99	Vol 5486	Fol 561	D48414	275kv Overhead Line	Light Regional Council
S34	Vol 5503	Fol 860	H120600	275kv Overhead Line	Mid Murray Council
S37	Vol 5517	Fol 458	H120600	275kv Overhead Line	Mid Murray Council
S286	Vol 5552	Fol 876	H160100	No Infrastructure Planned	Light Regional Council
S239	Vol 5569	Fol 233	H160100	No Infrastructure Planned	Light Regional Council
S83	Vol 5616	Fol 778	H120600	275kv Overhead Line	Mid Murray Council
S85	Vol 5616	Fol 778	H120600	275kv Overhead Line	Mid Murray Council
S319	Vol 5616	Fol 778	H160100	275kv Overhead Line	Light Regional Council
S287	Vol 5663	Fol 19	H160100	275kv Overhead Line	Light Regional Council
S51	Vol 5812	Fol 749	H120600	275kv Overhead Line	Mid Murray Council
A110	Vol 5947	Fol 941	D65818	275kv Overhead Line	Mid Murray Council
S218	Vol 5950	Fol 567	H121100	275kv Overhead Line	Mid Murray Council
A1	Vol 6124	Fol 753	D36071	275kv Overhead Line	Light Regional Council
Q118	Vol 6157	Fol 823	F174416	275kv Overhead Line	Mid Murray Council
A910	Vol 6221	Fol 131	D119571	275kv Overhead Line Terminal Substation, Access Track, Vegetative Screening, Electrical Infrastructure	Mid Murray Council
A397	Vol 6288	Fol 554	D132059	275kv Overhead Line	Mid Murray Council
Q392	Vol 6288	Fol 558	D132058	275kv Overhead Line	Mid Murray Council
Q386	Vol 6290	Fol 429	D132328	275kv Overhead Line	Mid Murray Council

9.2. Appendix 2 – Flora species recorded by the field survey

Introduced	Scientific Name	Common Name	Conservation Status	
			EPBC Act	NPW Act
	Acacia acinacea	Wreath Wattle		
	Acacia argyrophylla	Silver Mulga-bush		
	Acacia pycnantha	Golden Wattle		
*	*Aira* sp.	Hair-grass		
*	*Allium triquetrum*	Three-cornered Garlic		
	Allocasuarina verticillata	Drooping Sheoak		
*	*Arctotheca calendula*	Cape Weed		
	Aristida behriana	Brush Wire-grass		
*	*Asparagus asparagoides f.*	Bridal Creeper		
	Asperula conferta	Common Woodruff		
*	*Asphodelus fistulosus*	Onion Weed		
*	*Asteriscus spinosus*	Golden Pallensis		
	Atriplex semibaccata	Berry Saltbush		
	Atriplex vesicaria	Bladder Saltbush		
	Austrostipa blackii	Crested Spear-grass		
	Austrostipa drummondii	Cottony Spear-grass		
	Austrostipa eremophila	Rusty Spear-grass		
	Austrostipa nitida	Balcarra Spear-grass		
	Austrostipa nitida	Balcarra Spear-grass		
	Austrostipa nodosa	Tall Spear-grass		
	Austrostipa scabra ssp.	Rough Spear-grass		
	Austrostipa sp.	Spear-grass		
*	*Avena barbata*	Bearded Oat		
*	*Avena barbata*	Bearded Oat		
*	*Avena* sp.	Oat		
	Boerhavia dominii	Tar-vine		
*	*Brassica tournefortii*	Wild Turnip		
*	*Briza maxima*	Large Quaking-grass		
*	*Bromus diandrus*	Great Brome		
*	*Bromus hordeaceus* ssp. *hordeaceus*	Soft Brome		
*	*Bromus rubens*	Red Brome		
	Bromus sp.	Brome		
	Bursaria spinosa ssp.	Bursaria		
	Calocephalus citreus	Lemon Beauty-heads		
*	*Carex divisa*	Divided Sedge		
*	*Carthamus lanatus*	Saffron Thistle		
	Chloanthaceae sp.			
	Chloris truncata	Windmill Grass		
*	*Chondrilla juncea*	Skeleton Weed		
	Chrysocephalum apiculatum	Common Everlasting		
*	*Cirsium vulgare*	Spear Thistle		
*	*Citrullus* sp.	Wild Melon		

Introduced	Scientific Name	Common Name	Conservation Status	
			EPBC Act	NPW Act
	Convolvulus angustissimus	Narrow-leaf Bindweed		
	Convolvulus angustissimus ssp.	Narrow-leaf Bindweed		
	Convolvulus remotus	Grassy Bindweed		
	Convolvulus sp.	Bindweed		
*	*Cotula coronopifolia*	Water Buttons		
	Cymbopogon ambiguus	Lemon-grass		
*	*Cynara cardunculus* ssp. *flavescens*	Artichoke Thistle		
	Cyperus gymnocaulos	Spiny Flat-sedge		
	Cyperus vaginatus	Stiff Flat-sedge		
	Dianella revoluta var. *revoluta*	Black Anther Flax Lily		
	Distichlis distichophylla	Emu-grass		
	Dysphania pumilio	Small Crumbweed		
*	*Echium plantagineum*	Salvation Jane		
	Einadia nutans ssp.	Climbing Saltbush		
	Enchylaena tomentosa var.	Ruby Saltbush		
	Enchylaena tomentosa var. *tomentosa*	Ruby Saltbush		
	Enneapogon intermedius	Tall Bottle-washers		
	Enneapogon nigricans	Black-head Grass		
*	*Eragrostis minor*	Small Stink-grass		
*	*Erodium botrys*	Long Heron's-bill		
*	*Erodium botrys*	Long Heron's-bill		
*	*Erodium cicutarium*	Cut-leaf Heron's-bill		
	Erodium sp.	Heron's-bill/Crowfoot		
	Eucalyptus camaldulensis ssp.	River Red Gum		
	Eucalyptus leucoxylon ssp. *pruinosa*	Inland South Australian Blue Gum		
	Eucalyptus odorata	Peppermint Box		
	Eucalyptus porosa	Mallee Box		
	Euphorbia drummondii group			
	Glycine sp.	Glycine		
	Goodenia pinnatifida	Cut-leaf Goodenia		
*	*Heliotropium europaeum*	Common Heliotrope		
*	*Holcus lanatus*	Yorkshire Fog		
	Isolepis cernua	Nodding Club-rush		
	Juncus kraussii	Sea Rush		
	Juncus pallidus	Pale Rush		
*	*Medicago* sp.	Medic		
	Mimulus gracilis	Slender Monkey-flower		
*	*Polypogon monspeliensis*	Annual Beard-grass		
*	*Rorippa nasturtium-aquaticum*	Watercress		
	Rytidosperma sp.	Wallaby-grass		
*	*Salvia verbenaca* var.	Wild Sage		
	Schenkia australis	Spike Centaury		

Introduced	Scientific Name	Common Name	Conservation Status	
			EPBC Act	NPW Act
	Schoenoplectus pungens	Spiky Club-rush		
	Schoenoplectus tabernaemontani	River Club-rush		
*	*Solanum elaeagnifolium*	Silver-leaf Nightshade		
*	*Sonchus oleraceus*	Common Sow-thistle		
	Triglochin striata	Streaked Arrowgrass		

Conservation Status: EPBC Act (*Environment Protection and Biodiversity Conservation Act 1999*). **NPW Act**: South Australia (*National Parks and Wildlife Act 1972*). **Conservation codes: CE**: Critically Endangered. **EN/E**: Endangered. **VU/V**: Vulnerable. **R**: Rare.

9.3. Appendix 3 – Fauna species recorded by the field survey

Introduced	Scientific Name	Common Name	'Scattered Tree' – Using Wildlife	Conservation Status	
				EPBC Act	NPW Act
AVES					
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	LC (common)		
	Alauda arvensis arvensis	Eurasian Skylark			
	Anas gracilis gracilis	Grey Teal	LC (common)		
	Anas superciliosa	Pacific Black Duck	LC (common)		
	Anthus australis australis	Australian Pipit			
	Aquila audax audax	Wedge-tailed Eagle	LC (common)		
	Ardea pacifica	White-necked Heron	MN: Near threatened (uncommon) MM: Rare		
	Artamus cyanopterus	Dusky Woodswallow	MN: Near threatened (uncommon) MM: LC (common)		
	Chenonetta jubata	Australian Wood Duck	LC (common)		
	Cincloramphus cruralis	Brown Songlark			
	Climacteris picumnus	Brown Treecreeper	Near threatened (uncommon)		
	Corvus coronoides	Australian Raven	MN: LC (common) MM: Near threatened (uncommon)		
	Corvus mellori	Little Raven	LC (common)		
	Corvus sp.	Crows			
	Coturnix pectoralis	Stubble Quail			
	Dacelo novaeguineae novaeguineae	Laughing Kookaburra	LC (common)		
	Eolophus roseicapilla	Galah	LC (common)		
	Epthianura albifrons	White-fronted Chat			
	Falco berigora berigora	Brown Falcon	LC (common)		
	Falco cenchroides cenchroides	Nankeen Kestrel	LC (common)		
	Gavicalis virescens	Singing Honeyeater	LC (common)		
	Glossopsitta concinna	Musk Lorikeet	MN: Near threatened (uncommon) MM: LC (common		
	Grallina cyanoleuca cyanoleuca	Magpielark	LC (common)		
	Gymnorhina tibicen	Australian Magpie	LC (common)		
	Hirundo neoxena neoxena	Welcome Swallow			
	Manorina flavigula	Yellow-throated Miner	LC (common)		
	Merops ornatus	Rainbow Bee-eater	LC (common)		
	Ocyphaps lophotes lophotes	Crested Pigeon	LC (common)		
	Pardalotus striatus	Striated Pardalote	LC (common)		

Introduced	Scientific Name	Common Name	'Scattered Tree' – Using Wildlife	Conservation Status	
				EPBC Act	NPW Act
	Parvipsitta porphyrocephala	Purple-crowned Lorikeet	Near threatened (uncommon)		
	Passer domesticus domesticus	House Sparrow			
	Petrochelidon ariel	Fairy Martin			
	Petrochelidon nigricans	Tree Martin	LC (common)		
	Platycercus elegans	Crimson Rosella	MN: LC (common) MM: Near threatened (uncommon)		
	Psephotus haematonotus	Red-rumped Parrot	LC (common)		
	Ptilotula penicillata	White-plumed Honeyeater	LC (common)		
	Rhipidura leucophrys leucophrys	Willie Wagtail	LC (common)		
	Stagonopleura guttata	Diamond Firetail	MN: VU MM: VU		
	Sturnus vulgaris vulgaris	Common Starling			
	Tachybaptus novaehollandiae novaehollandiae	Australasian Grebe			
REPTILIA					
	Tiliqua adelaidensis	Pygmy Bluetongue Lizard		EN	E
	Tiliqua scincoides	Eastern Blue-tongue lizard			
MAMMALIA					
	Lasiorhinus latifrons	Southern Hairy-nosed Wombat			
	Macropus robustus	Euro Wallaby			
	Macropus fuliginosus	Western grey Kangaroo			
*	*Vulpes vulpes*	Red Fox			

Conservation Status: EPBC Act (*Environment Protection and Biodiversity Conservation Act 1999*). **NPW Act**: South Australia (*National Parks and Wildlife Act 1972*). **Conservation codes: CE**: Critically Endangered. **EN/E**: Endangered. **VU/V**: Vulnerable. **R**: Rare. *Denotes introduced species. MN: Mid North, MM: Murray Mallee. LC: Least Concern (Common), NT: Near threatened (Uncommon).

9.4. Appendix 4 – Scattered Trees Photo File

Photo 1 **Tree 1 (*Eucalyptus porosa*)**

Photo 2 **Tree 2 (*Eucalyptus porosa*)**

Photo 3 **Tree 3 (*Eucalyptus porosa*)**

Photo 4 **Tree 4 (*Eucalyptus leucoxylon pruinosa*)**

Photo 5 **Tree 5 (*Eucalyptus leucoxylon pruinosa*)**

Photo 6 **Tree 6 (*Eucalyptus leucoxylon pruinosa*)**

Photo 7 **Tree 7 (*Eucalyptus leucoxylon pruinosa*)**

Photo 8 **Tree 8 (*Eucalyptus leucoxylon pruinosa*) – 2 in group**

Photo 9 **Tree 9 (*Eucalyptus leucoxylon pruinosa*)**

Photo 10 **Tree 10 (*Eucalyptus leucoxylon pruinosa*)**

Photo 11 **Tree 11 (*Eucalyptus porosa*)**

Photo 12 **Tree 12 (*Eucalyptus porosa*)**

Photo 13 **Tree 13 (*Eucalyptus leucoxylon pruinosa*)**

Photo 14 **Tree 14 (*Eucalyptus leucoxylon pruinosa*)**

Photo 15 **Tree 15 (*Eucalyptus leucoxylon pruinosa*)**

Photo 16 **Tree 16 (*Eucalyptus leucoxylon pruinosa*)**

Photo 17 **Tree 17 (*Eucalyptus leucoxylon pruinosa*)**

Photo 18 **Tree 18 (*Eucalyptus leucoxylon pruinosa*)**

Photo 19 **Tree 19 (*Eucalyptus leucoxylon pruinosa*)**

Photo 20 **Tree 20 (*Eucalyptus leucoxylon pruinosa*)**

Photo 21 **Tree 21 (*Eucalyptus leucoxylon pruinosa*)**

Photo 22 **Tree 22 (*Eucalyptus leucoxylon pruinosa*)**

Photo 23 **Tree 23 (*Eucalyptus leucoxylon pruinosa*)**

Photo 24 **Tree 24 (*Eucalyptus leucoxylon pruinosa*)**

Photo 25 **Tree 25 (*Eucalyptus leucoxylon pruinosa*)**

Photo 26 **Tree 26 (*Eucalyptus odorata*)**

Photo 27 **Tree 27 (*Eucalyptus leucoxylon pruinosa*)**

Photo 28 **Tree 28 (*Eucalyptus leucoxylon pruinosa*)**

Photo 29 **Tree 29 (*Eucalyptus leucoxylon pruinosa*)**

Photo 30 **Tree 30 (*Eucalyptus leucoxylon pruinosa*)**

Photo 31 **Tree 31 (*Eucalyptus leucoxylon pruinosa*)**

Photo 32 **Tree 32 (*Eucalyptus leucoxylon pruinosa*)**

Photo 33 **Tree 33 (*Eucalyptus leucoxylon pruinosa*)**

Photo 34 **Tree 34 (*Eucalyptus leucoxylon pruinosa*)**

9.5. Appendix 5 – Likelihood of Occurrence Assessment

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
Flora							
Acacia glandulicarpa	Hairy-pod Wattle	VU		1	May occur	Discontinuous, occurring in the Burra Gorge, Hanson and Bordertown areas, S.A. Red Mallee (*Eucalyptus socialis*). Grows in open scrub vegetation and shrubland on hard, alkaline red duplex soils on rocky hillside Associated with *E. brachycalyx* and *Callitris gracilis* (Davies 1986) Whibley and Symon (1992).	**Unlikely** – no historical records and not observed during field surveys.
Acacia iteaphylla	Flinders Ranges Wattle		R	2	2002	Endemic to South Australia and found on northern Eyre Peninsula eastward to the Flinders Ranges and northern Mount Lofty Ranges growing on hillsides amongst rocky outcrops or in valleys along rocky creek banks. Widely planted & naturalised elsewhere and widespread in the Mt Lofty Ranges region (DEWNR 2023a).	**Possible** – historical record. Suitable habitat within the Development Area. Not observed during field survey. Unlikely to be naturally occurring (i.e. planted or naturalized from planted specimens).
Acacia menzelii	Menzel's Wattle	VU		1	May occur	Endemic to South Australia and found in a small area in the Murray region near Monarto and in the Flinders Ranges. Occurs in open scrub, often associated with *Eucalyptus socialis* and *Eucalyptus incrassata*, on grey-brown calcareous loamy soils (DEWNR 2023b).	**Unlikely** – no historical records and not observed during field surveys.
Acacia spilleriana	Spiller's Wattle	EN		1	May occur	Restricted to the North Mt Lofty Ra., S.A., from Burra Hill S to Tarlee. Grows on rocky hills, commonly along watercourses (B.R Maslin).	**Unlikely** – no historical records and not observed during field surveys.

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
Austrostipa breviglumis	Cane Spear-grass		R	2	2011	Found in the Flinders Ranges and the Mount Lofty Ranges in South Australia growing in hills and ridges on sandy loam soils (DEWNR 2023c).	**Likely** – historical record. Suitable habitat within the Development Area. Not observed during field survey.
Caladenia argocalla	White-beauty Spider-orchid	EN		1	Likely to occur	S.A. (Lofty Ranges, Barossa Valley, Murray region); 200–350 m altitude. Highly localised and rare; previously more widely distributed and common (once abundant around Adelaide), but now restricted to relict patches of vegetation. Found growing among shrubs and grass on sheltered slopes in open forest in freely draining, fertile loam (D.L Jones).	**Unlikely** – no historical records and not observed during field surveys. Development Area highly degraded due to cropping, grazing and incursion of weeds.
Caladenia concolor	Crimson Spider-orchid	VU		1	May occur	The Crimson Spider-orchid flowers in August to late October and grows in sclerophyll forest on clay loams and gravelly soil. This species also occurs in dry eucalypt forest, heathland and closed scrub and grassland.	**Unlikely** – no historical records and not observed during field surveys. Development Area highly degraded due to cropping and grazing.
Caladenia tensa	Greencomb Spider-orchid	EN		1	Likely to occur	S.A. (E mallee area), Vic. (Little Desert, Big Desert); 80–200 m altitude. Locally common; growing among shrubs and tussocks in woodland dominated by yellow gum and Rottnest Island Pine (*Callitris preissii*) in freely draining, red-brown, sandy loam; also, among spinifex in mallee communities on poor, sandy soil; less commonly in Black Box woodland and Buloke woodland in heavy soil (D.L Jones).	**Unlikely** – no historical records and not observed during field surveys. Development Area highly degraded due to cropping and grazing.
Cryptandra campanulata	Long-flower Cryptandra		R	2	2015	This Cryptandra grows in shallow soil over rocks, mostly in grassland but also heath and shrubland, and occurs in the southern Flinders Ranges and the northern Mount Lofty Ranges (Kellerman 2020).	**Likely** – historical record. Suitable habitat within the Development Area. Not observed during field survey.
Dodonaea procumbens	Trailing Hop-bush	VU		1	Likely to occur	This species grows in low-lying, often winter wet areas in woodland, low open forest, heathland and grasslands, on sands and clays (Duretto 1999)	**Unlikely** – no historical records and not observed during field surveys. Development Area highly

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
							degraded due to cropping and grazing.
Dodonaea subglandulifera	Peep Hill Hop-bush	EN		1	Likely to occur	Endemic to South Australia and found on the east side of the Mount Lofty Ranges and on Yorke Peninsula, growing on low hills on loamy soils associated with rocky outcrops in open woodland, open shrubland and mallee (Moritz and Bickerton 2010).	**Possible** – no historical records and not observed during field surveys. Suitable habitat exists along the TL Route.
Eucalyptus behriana	Broad-leaf Box		R	2	2018	Found on southern Eyre Peninsula, southern Flinders Ranges, northern Mount Lofty Ranges and upper South-east in South Australia, growing on heavy soils in slight depressions or in gently undulating terrain (G.W Chippendale).	**Likely** – historical record. Suitable habitat within the Development Area. Not observed during field survey.
Euphrasia collina subsp. *osbornii*	Osborn's Eyebright	EN		1	May occur	Confined to South Australia in the Upper South-East, Kangaroo Island (Dudley Peninsula), Fleurieu, Yorke and Eyre Peninsulas, and in the Flinders Ranges apparently as far north as Burra in the Mid North. Recorded mainly from the mallee (*Eucalyptus*) woodlands common throughout most of its range. In higher parts of the Mount Lofty Ranges, it occurs in heathy openings in wet sclerophyll forest (W.R (Bill) Barker).	**Unlikely** – no historical records and not observed during field surveys. Development Area highly degraded due to cropping and grazing.
Maireana excavata	Bottle Fissure-plant		V	2	2022	Found in south-eastern S.A. Grows in heavy soil (Wilson, P, G 1999a).	**Likely** – historical record. Suitable habitat within the Development Area. Not observed during field survey.
Maireana rohrlachii	Rohrlach's Bluebush		R	2, 3	2017	Found from northern Eyre Peninsula, S.A. Usually growing in loamy soils (Wilson, P, G 1999b).	**Known** – this species was observed scattered throughout the Development Area.
Olearia pannosa subsp. *pannosa*	Silver Daisy-bush	VU		1	Likely to occur	Endemic to South Australia and found scattered in the southern part using on roadsides and with few individuals (SSCC 2018).	**Unlikely** – no historical records and not observed during field surveys.

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
							Development Area highly degraded due to cropping and grazing.
Prasophyllum pallidum	Pale Leek-orchid	VU		1	Likely to occur	S.A. (S Flinders Ranges, Mt Lofty Ranges, Adelaide Hills and N Fleurieu Peninsula); 200–400 m altitude. Relatively widespread, but disjunct; found growing in grassy forest and heathy forest in freely draining loam (Jones 2018).	**Unlikely** – no historical records and not observed during field surveys. Development Area highly degraded due to cropping and grazing.
Pterostylis xerophila	Desert Greenhood	VU		1	May occur	The Desert Greenhood is endemic to inland south-eastern Australia, where it occurs in Victoria and South Australia, in the Murray-Darling Depression, Eyre-York Block, Gawler, and Great Victoria Desert IBRA bioregions (sensu DEH 2000). In South Australia, P. xerophila occurs in dry woodland on fertile red loamy soils (Bates & Weber 1990), on or around granite or quartzite rock outcrops (Jessop & Toelken 1986). Species commonly found in areas where P. xerophila occurs on the Eyre Peninsula include Broombush Melaleuca uncinata, Ridge-fruited Mallee Eucalyptus incrassata, Beaked Red Mallee Eucalyptus socialis and/or Narrow-leaf Red Mallee Eucalyptus leptophylla (Pobke 2007).	**Unlikely** – no historical records and not observed during field surveys. Development Area highly degraded due to cropping and grazing.
Ptilotus erubescens	Hairy-tails		R	2	2017	Found mainly in the southern Flinders Ranges and Mount Lofty Ranges in South Australia with an isolated destruction near Bordertown, growing fertile soil in grassy woodland (Seeds of South Australia 2018).	**Likely** – recent record and suitable habitat within the Development Area.
Rumex dumosus	Wiry Dock		R	2	2011	West to the Eyre Peninsula of SA. In grasslands and disturbed grassy areas; mostly on clayey soils (SSCC 2018).	**Likely** – historical record. Suitable habitat within the Development Area. Not observed during field survey.
Sclerolaena muricata var. *villosa*	Five-spine Bindyi		R	2	2017	South-eastern S.A. Common on overgrazed or overstocked areas on heavier soils and occasionally	**Likely** – historical record. Suitable habitat within the

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
						naturalized in coastal and Tableland districts (SSCC 2018).	Development Area. Not observed during field survey.
Senecio macrocarpus	Large-fruit Fireweed	VU		1	May occur	Occurs from Ardrossan in southeast South Australia southeast to Yan Yean in south-central Victoria, with an outlier recently collected at Gundaroo in New South Wales. There are a few old records from Tasmania, but it is now presumed extinct in that state. Grows in low-lying areas on basalt-derived clay or clay-loam soils, in grassland, sedgeland and woodland (Thompson 2011).	**Unlikely** – no historical records and not observed during field surveys. Development Area highly degraded due to cropping and grazing.
Swainsona behriana	Behr's Swainson-pea		V	2	May occur	Once found in the Mount Lofty Ranges and the lower South-east, growing on light or occasionally heavy soils in moist grassland and woodland. Now only found in the northern and eastern side of the Mount Lofty Ranges (SSCC 2018).	**Unlikely** – no historical records and not observed during field surveys. Development Area highly degraded due to cropping and grazing.
Swainsona pyrophila	Yellow Swainson-pea	VU		1	2011	Found in South Australia in Eyre Peninsula with a few records from Yorke Peninsula and the Murray region. Native. Very rare in South Australia. The Yellow Swainson-pea grows in mallee scrub on sandy or loamy soil and is usually found to germinate only after fire and subsequent rain (Jeanes 1996; Tonkinson & Robertson 2010a).	**Possible** – historical record. Suitable habitat within the Development Area. Not observed during the field survey.
Fauna							
Actis hypoleucos	Common Sandpiper	Mi (W)		1	May occur	Found along all coastlines of Australia and in many areas inland, the Common Sandpiper is widespread in small numbers. The population when in Australia is concentrated in northern and western Australia Inhabit in Salt-water and fresh-water ecosystems.	**Unlikely** – no suitable habitat within the Development Area.
Amytornis striatus howei	Murray Mallee Striated Grasswren	EN		1	May occur	In SA, Striated Grasswren subspecies *howei* occur in the Murray Mallee region where they now occur patchily through the Riverland Biosphere Reserve. Only occasionally sightings have been recorded, located in	**Unlikely** – no historical records and not observed during field surveys. No suitable mallee habitat

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
						reliable reserves including Gluepot and Calperum reserves and Danggali Conservation Park (DCCEEW 2024b).	located within the Development Area.
Aphelocephala leucopsis leucopsis	Southern Whiteface	VU		1	Known to occur	Occurs in semi-arid woodlands, mallee, mulga, dry-country scrublands. Southern Whiteface favour habitat with low tree densities and an herbaceous understory litter cover. They live in a wide range of open woodlands and shrublands which are dominated by acacia, mallee, mulga and eucalyptus species (DCCEEW 2024b).	**Possible** – no historical records and not observed on site. However, suitable habitat does exist within this Development Area.
Aprasia pseudopulchella	Flinders Ranges Worm-lizard	VU		1	Likely to occur	Known from the FR of SA, extending south to the western slopes and northern and central MLR. The species inhabits open woodland, native tussock grassland, riparian habitats, and rocky isolates, preferring stony or clay soils with a stony / rocky surface, but has also been found sheltering in soil beneath sones and rotting stumps (Commonwealth Government, 2008). The Flinders Ranges Worm-lizard is known from the Flinders Ranges of South Australia, extending south to the western slopes and northern and central Mount Lofty Ranges. It occurs in open woodland, native tussock grassland, riparian habitats and rocky isolates (DEWHA 2008b).	**Possible** – no historical records and not observed on site. However, suitable habitat does exist within this Development Area.
Apus pacificus	Fork-tailed Swift	Mi (Ma)		1	Likely to occur	In South Australia the Fork-tailed Swift is widespread from the Victorian border west to the Spencer Gulf. It is also common in coastal parts of Eyre Peninsula as far west as Franklin Island, off Streaky Bay and north to 32° S. There have been a few recently published records beyond these bounds, such as in Flinders Ranges and the Lake Eyre Drainage Basin from Billa Kallina Station, Lake Eyre South and Marree. Sightings have also been recorded north to Moorayepe and east to Innamincka and Moomba (Higgins 1999). They mostly occur over dry or open habitats, including	**Unlikely** – the Development Area is outside of this species normal distribution.

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
						riparian woodland and tea-tree swamps, low scrub, heathland or saltmarsh. They are also found at treeless grassland and sandplains covered with spinifex, open farmland and inland and coastal sand-dunes. The sometimes occur above rainforests, wet sclerophyll forest or open forest or plantations of pines (Higgins 1999).	
Ardea intermedia plumifera	Plumed Egret		R	2	2010	Inhabits flooded areas with short emergent vegetation such as rice fields, cattle pastures, sewage farms and saltwater lakes.	**Unlikely** – a recent record however not suitable habitat within the Development Area.
Botaurus poiciloptilus	Australasian Bittern	EN		1	May occur	Occurs in coastal and sub coastal SE South Australia in or over water in tall reedbeds, sedges, rushes, lignum and occasionally in saltmarsh (Pizzey and Knight, 2007). Occurs in freshwater wetlands and, rarely, in estuaries or tidal wetlands, favouring areas with tall dense, vegetation (DCCEEW 2024b).	**Unlikely** – no historical records and not observed during field surveys. The Development Area is northern SA and outside normal distribution for this species.
Calidris acuminata	Sharp-tailed Sandpiper	VU, Mi (W)		1	May occur	Inhabits tidal mudflats, salt marshes and shallow fresh, brackish or saline wetlands and flood waters (Pizzey and Knight 2007). Movements occur during the non-breeding period where birds appear to be dispersive, moving to temporary or flooded wetlands and leaving them when they dry. On migration, they forage and roost on rocky and sandy beaches, freshwater habitats and inland saltwater habitats (DCCEEW 2024b).	**Unlikely** – no historical records and not observed during field surveys. No suitable habitat located within the Development Area.
Calidris ferruginea	Curlew Sandpiper	CE, Mi (W)		1	May occur	In Australia, Curlew Sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including	**Unlikely** – no historical records and not observed during field surveys. The Development Area is northern SA and outside normal distribution for this species.

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
						around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (DCCEEW 2024b). Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons. They occur in both fresh and brackish waters (Morcombe 2021).	
Calidris melanotos	Pectoral Sandpiper	Mi (W)		1	May occur	In South Australia (SA), the Pectoral Sandpiper is found mostly in the south-east, from north to the Murray River and west to Yorke Peninsula (Higgins & Davies 1996). In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. (Higgins & Davies 1996).	**Unlikely** – no historical records and not observed during field surveys. No suitable habitat located within the Development Area.
Corcorax melanorhamphos	White-winged Chough		R	2	1999	Found in open forests and woodlands, preferring wetter areas with lots of leaf litter	**Likely** – This species is likely to utilise the woodland habitat within the Development Area.
Falco hypoleucos	Grey Falcon	VU		1	Likely to occur	The species occurs in arid and semi-arid Australia, including the Murray-Darling Basin, Eyre Basin, central Australia and WA. Preferred habitat includes lightly treed inland plains, sand ridges and pastoral plains. (Pizzey and Knight 2007). This species is mainly found where annual rainfall is less than 500 mm and is essentially confined to the arid and semi-arid zones at all times. The species frequents timbered lowland plains, particularly acacia shrublands that are crossed by tree-lined water courses (Schoenjahn 2018).	**Unlikely** – No historical records and not observed during field surveys. No suitable habitat located within the Development Area.
Falco peregrinus macropus	Peregrine Falcon		R	2, 4	2009/2022	Found across most habitats and well adapted to the urban environment.	**Known** – species was observed during a BUS in 2022.

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
Falco subniger	Black Falcon		R	2, 4	1999/2021	Found along tree-lined watercourses, mainly in arid and semi-arid areas.	**Known** – species was observed during a BUS in 2021.
Galaxias rostratus	Flathead Galaxias	CE		1	May occur	The flathead galaxias inhabits a variety of habitats including billabongs, lakes, swamps and rivers, with a preference for still or slow flowing waters. The species has a preference for schooling in midwater	**Unlikely** – No historical record. Although rivers and draining lines exist within the Development Area, they do not provide suitable habitat for this species.
Gallinago hardwickii	Latham's Snipe	VU, Mi (W)		1	May occur	Latham's Snipe is a non-breeding visitor to south-eastern Australia, including the Adelaide plains, MLR and EP. They usually inhabit open, freshwater wetlands with low, dense vegetation (DCCEEW 2024b).	**Unlikely** – No historical records and not observed during field surveys. Development Area is outside of normal distribution for this species.
Grantiella picta	Painted Honeyeater	VU		1	Likely to occur	Sparsely distributed from southern Victoria and south-eastern SA to far northern QLD and eastern Northern Territory Forest, woodland, dry scrub, often with abundant mistletoe. (Birdlife International 2021). Forest, woodland, dry scrub, often with abundant mistletoe. Dependent on mistletoe berries (Morecombe eGuide 2020).	**Possible** – No historical records and not observed during field surveys. Suitable habitat may occur in the woodland vegetation within the Development Area.
Leipoa ocellata	Malleefowl	VU		1	Likely to occur	In SA, the Malleefowl is distributed from the south-east, north to the Murray-Mallee region and west to Streaky Bay. Occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or native pine Callitris woodlands, Acacia shrublands, or coastal heathlands (Benshemesh 2007). Inhabits semi-arid regions of southern Australia. In SA, the Malleefowl is distributed from the south-east, north to the Murray-Mallee region and west to Streaky Bay. Occupies shrublands and low woodlands that are dominated by mallee vegetation. It also occurs in other habitat types including eucalypt or	**Unlikely** – No historical records and not observed during field surveys. No suitable habitat located within the Development Area.

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
						native pine Callitris woodlands, Acacia shrublands, or coastal heathlands. (Benshemesh 2007).	
Litoria raniformis	Southern Bell Frog	VU		1	May occur	Three distinct groups of records in SA. One group is located in the far south-east of the state, one group along the Murray River from Victoria to the coast, and a small group in the Mt Lofty Ranges. This species is found mostly amongst emergent vegetation, including *Typha* sp. (bullrush), *Phragmites* sp. (reeds) and *Eleocharis* sp. (sedges), in or at the edges of still or slow-flowing water bodies This species occurs in: clays or well-watered sandy soils; open grassland, open forest, and ephemeral and permanent non-saline marshes and swamps; steep-banked water edges (like ditches and drains) and gently graded edges containing fringing plants; and formerly, areas of high altitudes (DCCEEW 2024b).	**Possible** – No historical records and not observed during field surveys. However suitable habitat may exist in VA A4 (*Juncus* sedgeland).
Lophochroa leadbeateri leadbeateri	Major Mitchell's Cockatoo (eastern)	EN		1	May occur	The Major Mitchell's Cockatoo occurs only in Australia, where it usually inhabits semi-arid and arid regions, mainly inland, but in some coastal areas. They usually inhabit dry woodlands in arid and semi-arid areas, where eucalypts or acacias dominate the vegetation. They require old trees which support hollows that are large enough to be suitable for nesting in (Birdlife Australia 2024).	**Unlikely** – No historical records and not observed during field surveys. No suitable habitat located within the Development Area.
Melanodryas cucullata cucullata	South-eastern Hooded Robin	EN	R	1, 2	2015 Known to occur	Utilises woodland of eucalypt, mallee, mulga; coastal heath; semi cleared farmland. Sub-populations in SA are recorded from the Barossa, Monarto, Onkaparinga River, Ashbourne, Port Willunga areas as well as isolated records from elsewhere in the hills and Fleurieu. Requires large remnants (>50 ha) with open areas, young eucalypts or shrubs for nesting and numerous perches for foraging (DEH, 2008). Occurs across south-eastern Australia, most of NSW, VIC and south-eastern SA. South-eastern subspecies found in	**Likely** – Recent record and suitable habitat within the Development Area.

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
						Eucalypt woodland and mallee and Acacia shrubland (Willson and Bignall 2009).	
Merops ornatus	Rainbow Bee-eater	Ma		3		The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located near permanent water.	**Known -** this species was observed during the field survey in 2024.
Motacilla cinerea	Grey Wagtail	Mi (T)		1	May occur	European and Asian species. Migrates south in winter, usually to Indonesia and NG. Rarely reaches Australia, but when it does, favors habitat near freshwater streams, also mown grass, ploughed land or near sewage ponds. (Carter 1993)	**Unlikely** – no recent records and no suitable habitat within the Development Area.
Motacilla flava	Yellow Wagtail	Mi (T)		1	May occur	The Yellow Wagtail M flava is considered a regular visitor to marshes of northern Australia between August and April, overflying normal wintering grounds (Johnstone 1982).	**Unlikely** – no recent records and no suitable habitat within the Development Area.
Myiagra cyanoleuca	Satin Flycatcher	Mi (T)		1	May occur	In South Australia, they are occasionally recorded, mostly in the lower south-east, occasionally as far north as Naracoorte (Blakers et al. 1984). There have been six records at scattered sites in the area from Langhorne Creek, west to eastern Kangaroo Island and north to Sandy Creek. Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.	**Unlikely** – no recent records and no suitable habitat within the Development Area.
Myiagra inquieta	Restless Flycatcher		R	2	1999	Open forests, woodlands and farmland	**Likely** – Suitable habitat exits across entire Development Area
Neophema chrysostoma	Blue-winged Parrot	VU	V	1,2,4	2011	This species mainly occurs in Tasmania and Victoria, particularly in southern Victoria and the midlands and	**Known** – this species was observed during the

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
					Known to occur	eastern areas of Tasmania however sparser populations are also found in western New South Wales and eastern South Australia, extending to south-west Queensland and occasionally into the Northern Territory. Prefers grasslands and grassy woodlands but will inhabit a range of habitats from coastal, sub-coastal and inland areas, right through to semi-arid zones (Birdlife Australia 2024).	baseline flora and fauna survey in 2015.
Neophema elegans elegans	Elegant Parrot		R	2	1999	Open forests, woodlands, mallee mulga and salt marsh	**Possible** – woodland may provide suitable habitat in Development Area.
Pedionomus torquatus	Plains-wanderer	CE		1	May occur	The Plains-wanderer occurs at scattered sites in NSW and Victoria and more marginal habitat in QLD and SA. Inhabits sparse, treeless, lowland native grasslands with approximately 50% bare ground, most vegetation less than 5 cm in height, with some widely-spaced plants up to 30 cm high (DAWE, 2021b). Present in very small numbers in SE South Australia occurring in sparse, treeless native grasslands and/or low shrubland (Pizzey and Knight 2007).	**Unlikely** – No historical records and not observed during field surveys. No suitable habitat located within the Development Area.
Polytelis anthopeplus monarchoides	Regent Parrot (eastern)	VU		1	Likely to occur	The eastern Regent Parrot occurs in the lower Murray-Darling basin region of South Australia, New South Wales and Victoria. The Regent Parrot breeds almost entirely in River Red Gum forest and woodland, and all known breeding colonies are located along the Murray River. Typically occur within 100 km of the River in non-breeding season and can forage in mallee habitats (Baker-Gabb & Hurley 2011).	**Unlikely** – No historical records and not observed during field surveys. No suitable habitat located within the Development Area.
Pteropus poliocephalus	Grey-headed Flying-fox	VU		1	May occur	Grey-headed Flying-foxes forage up to 40 km from their roost at Botanic Park each night. Food plants are typically planted trees, both native and exotic, which provide fruit or a rich source of nectar (DCCEEW 2024b).	**Unlikely** – No historical records and not observed during field surveys. No suitable habitat located

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
							within the Development Area.
Rostratula australis	Australian Painted Snipe	EN		1	Known to occur	Occurs in shallow freshwater (occasionally brackish) wetlands, both ephemeral and permanent, such as lakes, swamps, claypans, inundated or waterlogged grassland/saltmarsh, dams, rice crops, sewage farms and bore drains, rushes and reeds, low scrub, *Muehlenbeckia* spp. (lignum), open timber or samphire (DCCEEW 2024b).	**Unlikely** – No historical records and not observed during field surveys. No permanent source of water within the Development Area.
Stagonopleura guttata	Diamond Firetail	VU	V	1, 2, 3	2018 Known to occur	Diamond firetails occur in eucalypt, acacia or casuarina woodlands, open forests and other lightly timbered habitats, including farmland and grassland with scattered trees (Higgins et al. 2007). They prefer areas with relatively low tree density, few large logs, and little litter cover but high grass cover (Antos et al. 2008).	**Known** – this species was observed during the field survey.
Tiliqua adelaidensis	Pygmy Blue-tongue Lizard	EN	E	1, 3, 4	Known to occur	Fragmented populations known from across the mid-north of SA, with unknown population size. Occurs in a variety of habitats, ranging from highly degraded grasslands to grasslands of high biodiversity, sparse to moderate coverage, preferably on lower slopes. The species uses empty spider burrows (trapdoor, wolf spider) as refuges and basking sites and requires these to occur in moderate abundance in the landscape. Historically (pre-1992), the species was found in chenopod and mallee scrublands with compacting or crusty sand soils associated with hollow mallee lignotubers and near surface limestone sheets (Duffy et al. 2012).	**Known** – this species was observed during the historical field surveys and 2024 survey.
Tringa nebularia	Common Greenshank	EN, Mi (W)		1	2021 Likely to occur	This species is found in a wide variety of inland wetlands and sheltered coastal habitats of varying salinity. It occurs in sheltered coastal habitats, typically with large mudflats and saltmarsh, mangroves or seagrass. Habitats include embayment's, harbours, river estuaries, deltas and lagoons and are recorded	**Unlikely** – No historical records and not observed during field surveys. No suitable habitat located

Scientific name	Common name	Conservation status		Source of information	Last sighting (year)/ PMST Occurrence	Habitat Preferences	Likelihood of occurrence within Development Area
		Aus	SA				
						less often in round tidal pools, rock-flats and rock platforms. The species uses both permanent and ephemeral terrestrial wetlands, including swamps, lakes, dams, rivers, creeks, billabongs, waterholes and inundated floodplains, claypans and salt flats. It will also use artificial wetlands, including sewage farms and saltworks dams, inundated rice crops and bores (Higgins & Davies 1996).	within the Development Area.

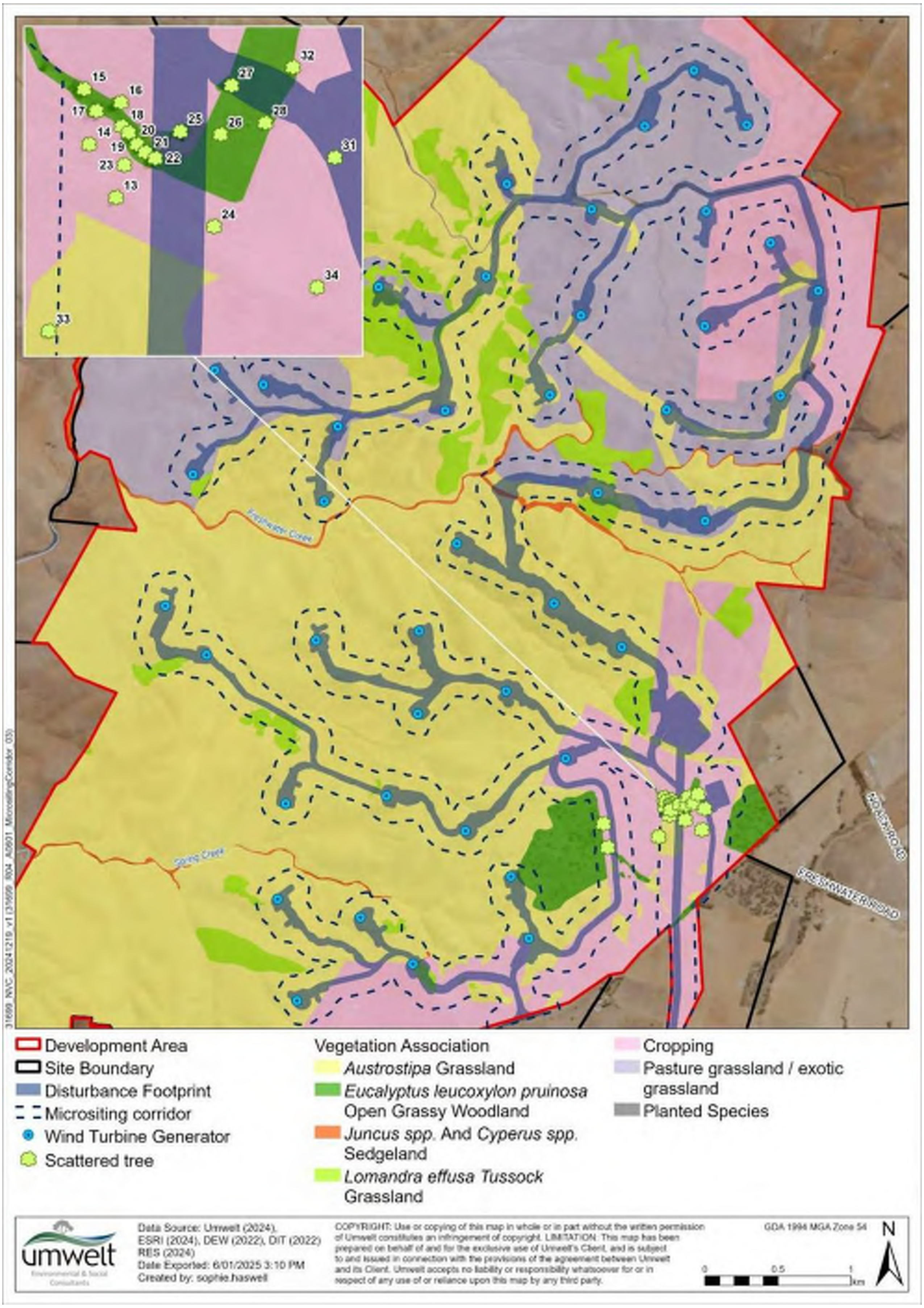
Conservation status

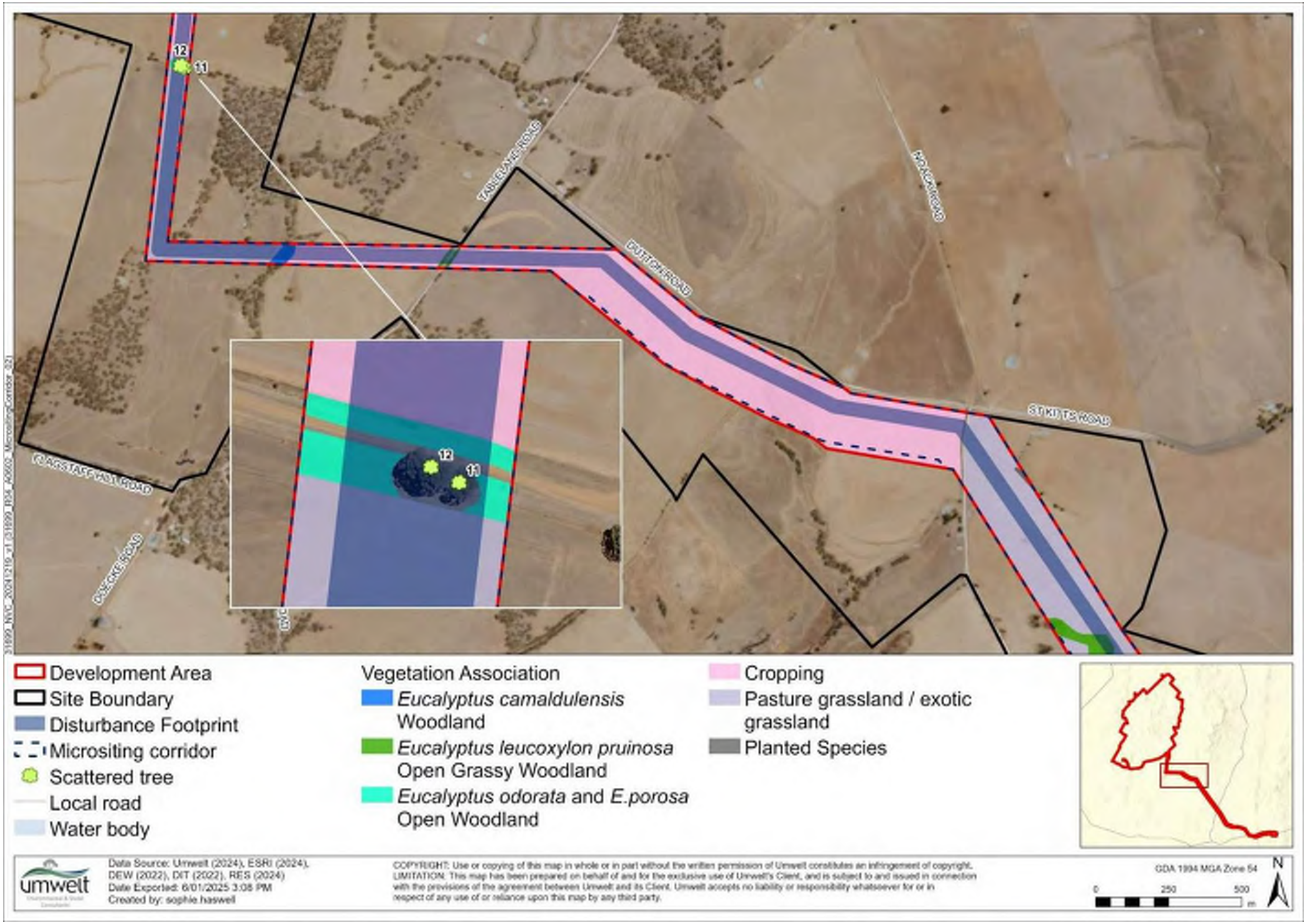
EPBC Act (*Environment Protection and Biodiversity Conservation Act 1999*). **NPW Act** (*National Parks and Wildlife Act 1972*). **Conservation Codes**: **CE**: Critically Endangered. **EN/E**: Endangered. **VU/V**: Vulnerable. **R**: Rare. **ssp.**: the conservation status applies at the sub-species level. **Mi**: listed as migratory under the EPBC Act. **Ma**: listed as marine under the EPBC Act.

Source of Information

1. EPBC Act Protected Matters Report (DCCEEW 2024) – 5 km buffer applied to Development Area.
2. Biological Database of South Australia data extract (DEW 2023a) - 5 km buffer applied to Development Area.
3. Observed during the field survey.
4. Observed during previous EBS surveys (2015 – 2017).

9.6. Appendix 6 – Micrositing corridor within the Development Area





12
11
TABLE HILL ROAD
DUTTON ROAD
ST KITTS ROAD
FLAGSTAFF HILL ROAD
Development Area
Site Boundary
Disturbance Footprint
Micrositing corridor
Scattered tree
Local road
Water body
Vegetation Association
Eucalyptus camaldulensis Woodland
Eucalyptus leucoxylon pruinosa Open Grassy Woodland
Eucalyptus odorata and E.porosa Open Woodland
Cropping
Pasture grassland / exotic grassland
Planted Species
Data Source: Umwelt (2024), ESRI (2024), DEW (2022), DIT (2022), RES (2024)
Date Exported: 6/01/2025 3:08 PM
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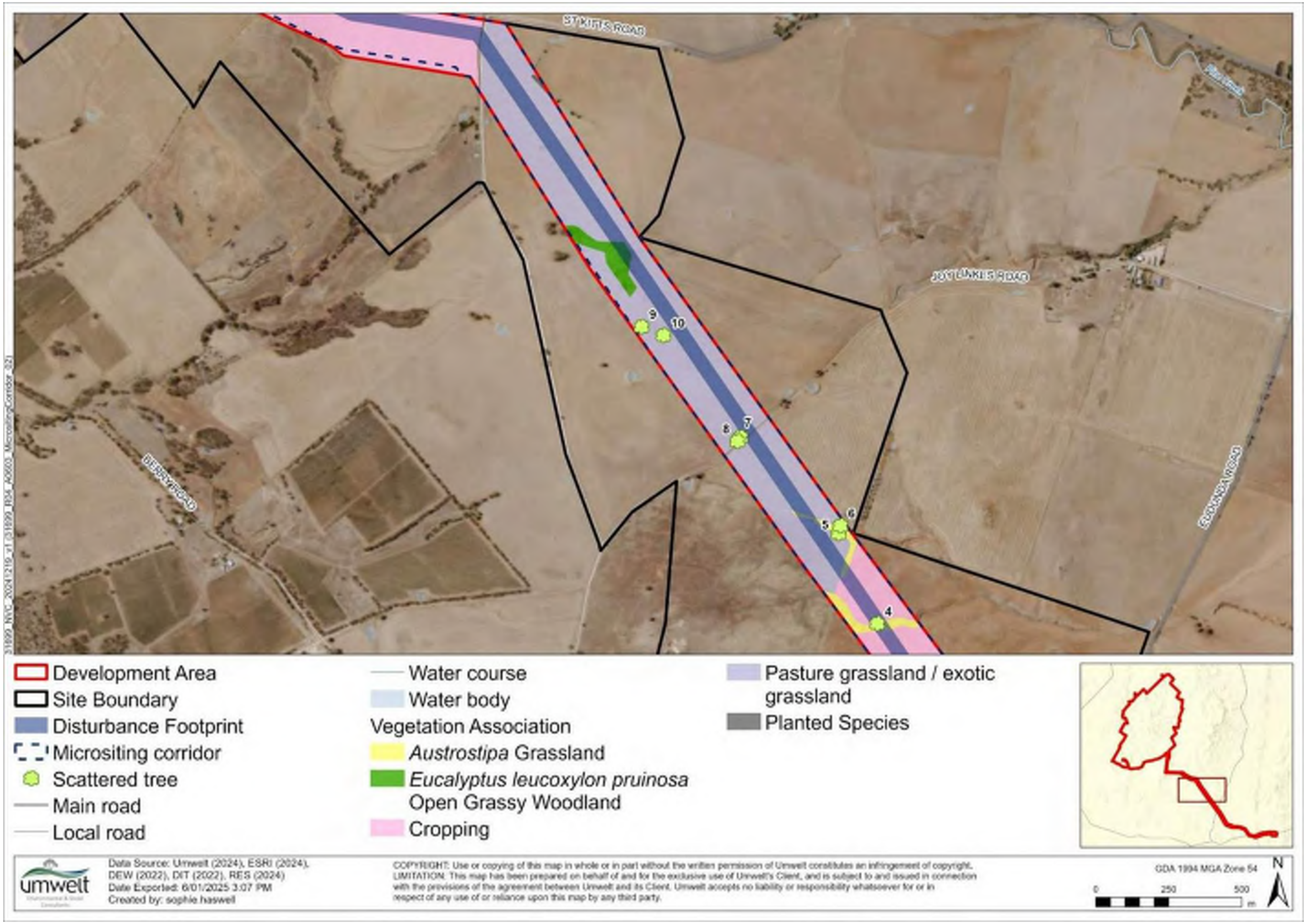

ST KITTS ROAD
JOY LINKE'S ROAD
9
10
8
7
5
6
4
Development Area
Site Boundary
Disturbance Footprint
Micrositing corridor
Scattered tree
Main road
Local road
Water course
Water body
Vegetation Association
Austrostipa Grassland
Eucalyptus leucoxylon pruinosa Open Grassy Woodland
Cropping
Pasture grassland / exotic grassland
Planted Species
Data Source: Umwelt (2024), ESRI (2024), DEW (2022), DIT (2022), RES (2024)
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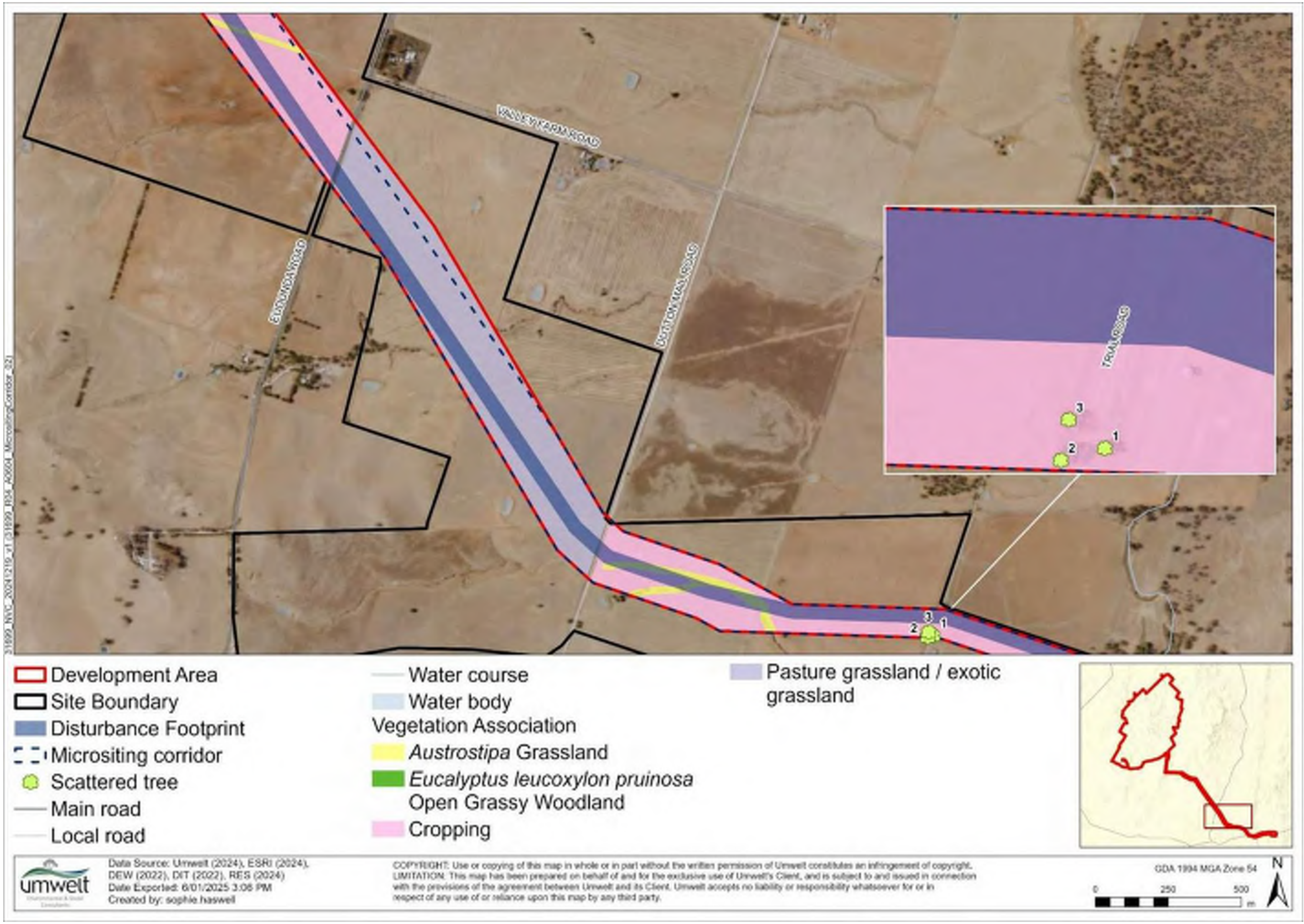

3
1
2
Development Area
Site Boundary
Disturbance Footprint
Micrositing corridor
Scattered tree
Main road
Local road
Water course
Water body
Vegetation Association
Austrostipa Grassland
Eucalyptus leucoxylon pruinosa Open Grassy Woodland
Cropping
Pasture grassland / exotic grassland
Data Source: Umwelt (2024), ESRI (2024), DEW (2022), DIT (2022), RES (2024)
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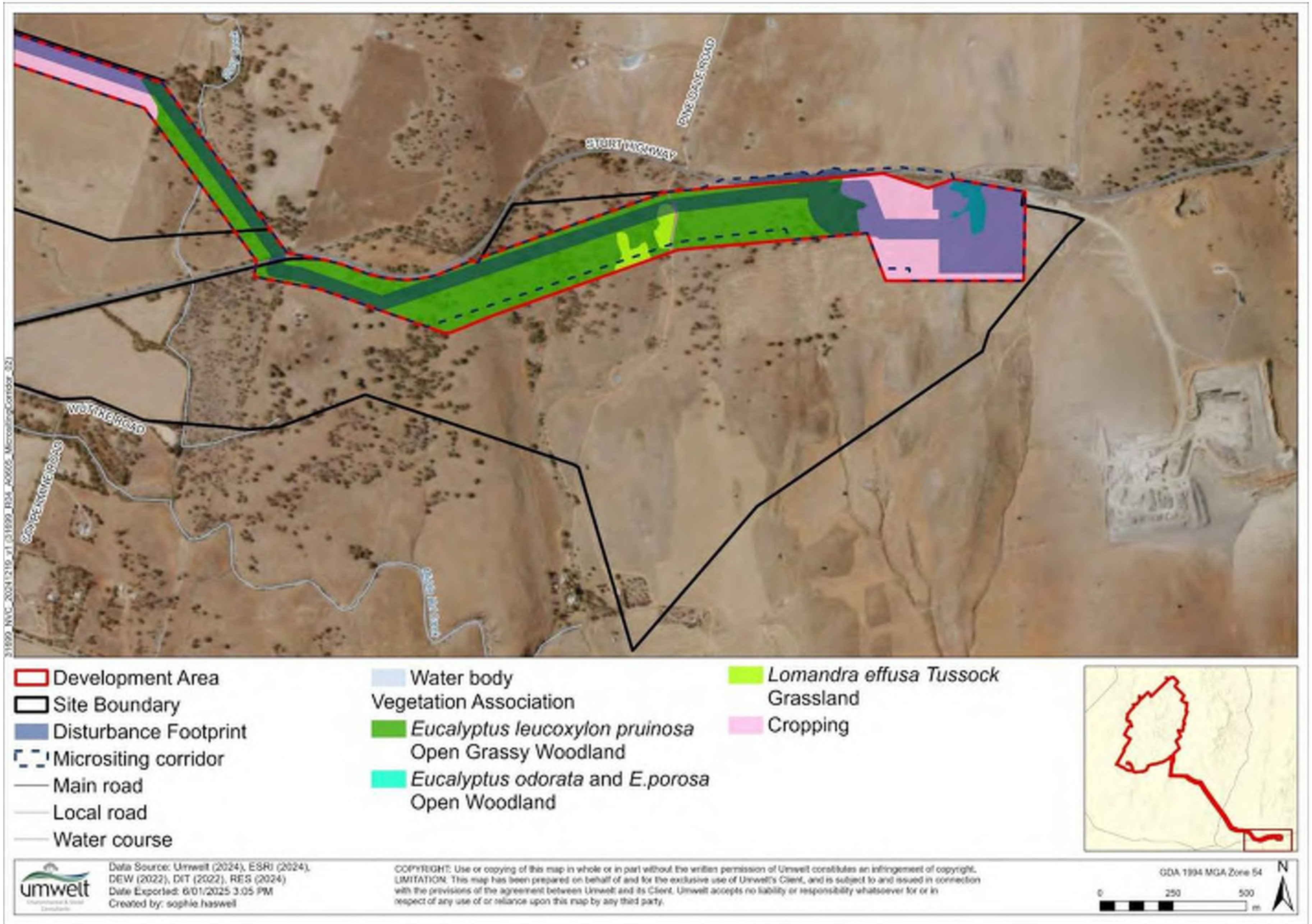
STURT HIGHWAY
Development Area
Site Boundary
Disturbance Footprint
Micrositing corridor
Main road
Local road
Water course
Water body
Vegetation Association
Eucalyptus leucoxylon pruinosa Open Grassy Woodland
Eucalyptus odorata and *E.porosa* Open Woodland
Lomandra effusa Tussock Grassland
Cropping
Data Source: Umwelt (2024), ESRI (2024), DEW (2022), DIT (2022), RES (2024)
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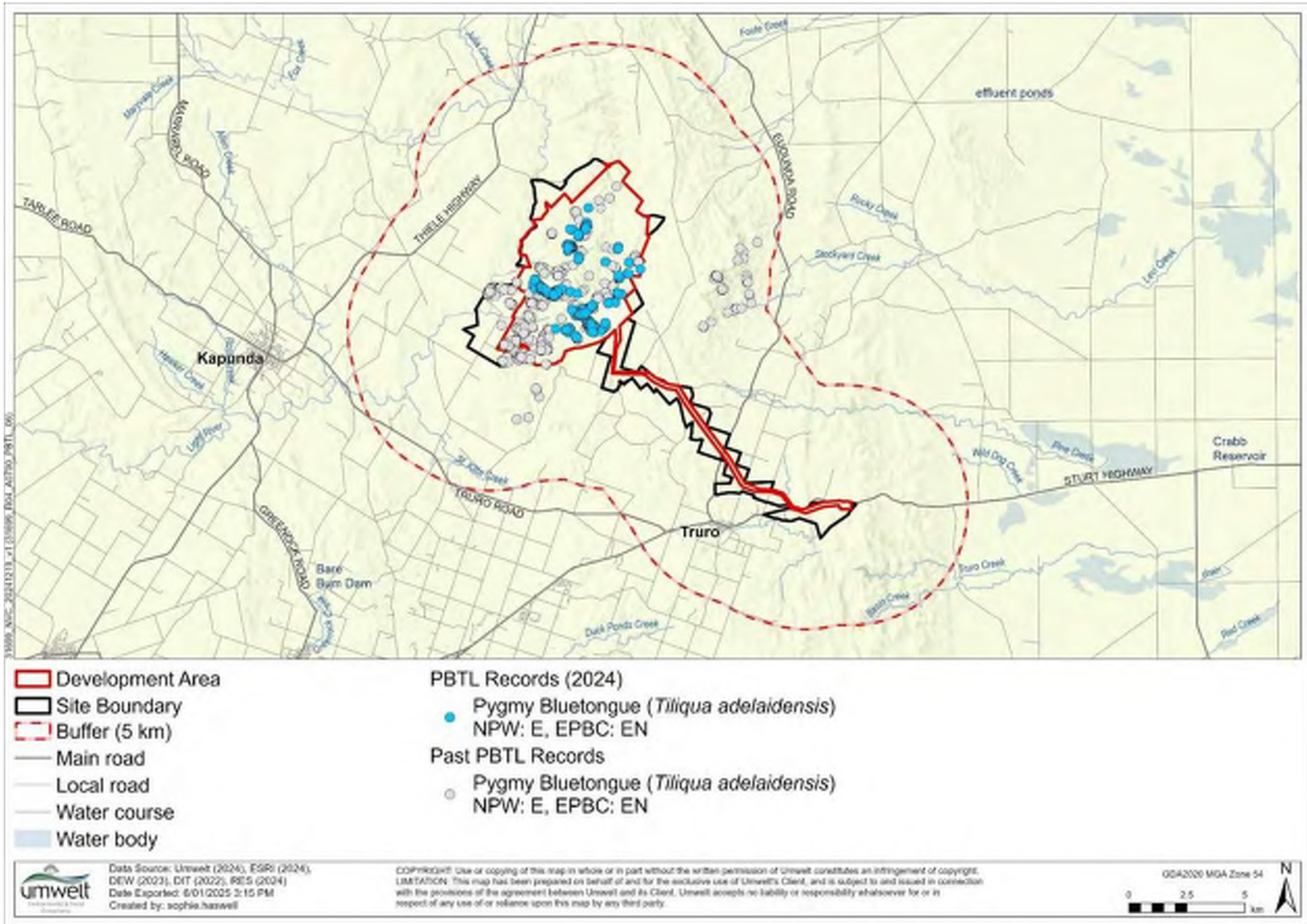
9.7. Appendix 7 – Pygmy Blue-tongue Lizard Records Located within the Development Area (2016, 2017 and 2024 Records)



9.8. Appendix 8 – SEB Management Plan PMST Report

Summary

Matters of National Environment Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance (Ramsar	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	2
Listed Threatened Species:	29
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at https://www.dcceew.gov.au/parks-heritage/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	15
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None
Habitat Critical to the Survival of Marine Turtles:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have

State and Territory Reserves:	1
Regional Forest Agreements:	None
Nationally Important Wetlands:	None
EPBC Act Referrals:	5
Key Ecological Features (Marine):	None
Biologically Important Areas:	None
Bioregional Assessments:	None
Geological and Bioregional Assessments:	None

Details

Matters of National Environmental Significance

Listed Threatened Ecological Communities [Resource Information]

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.
Status of Vulnerable, Disallowed and Ineligible are not MNES under the EPBC Act.

Community Name	Threatened Category	Presence Text	Buffer Status
Iron-grass Natural Temperate Grassland of South Australia	Critically Endangered	Community likely to occur within area	In feature area
Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia	Critically Endangered	Community likely to occur within area	In feature area

Listed Threatened Species [Resource Information]

Status of Conservation Dependent and Extinct are not MNES under the EPBC Act.
Number is the current name ID.

Scientific Name	Threatened Category	Presence Text	Buffer Status
BIRD			
Aphelocephala leucopsis Southern Whiteface [529]	Vulnerable	Species or species habitat known to occur within area	In feature area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat likely to occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago hardwickii			
Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area
Grantiella picta			
Painted Honeyeater [470]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Leipoa ocellata			
Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Melanodryas cucullata cucullata			
South-eastern Hooded Robin, Hooded Robin (south-eastern) [67093]	Endangered	Species or species habitat likely to occur within area	In feature area
Neophema chrysostoma			
Blue-winged Parrot [726]	Vulnerable	Species or species habitat known to occur within area	In feature area
Pedionomus torquatus			
Plains-wanderer [906]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
Polytelis anthopeplus monarchoides			
Regent Parrot (eastern) [59612]	Vulnerable	Species or species habitat may occur within area	In feature area
Rostratula australis			
Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area	In feature area
Stagonopleura guttata			
Diamond Firetail [59398]	Vulnerable	Species or species habitat known to occur within area	In feature area
FISH			
Galaxias rostratus			
Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow [84745]	Critically Endangered	Species or species habitat may occur within area	In buffer area only
FROG			
Litoria raniformis			
Southern Bell Frog,, Growling Grass Frog, Green and Golden Frog, Warty Swamp Frog, Golden Bell Frog [1828]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
MAMMAL			
Pteropus poliocephalus			
Grey-headed Flying-fox [186]	Vulnerable	Foraging, feeding or related behaviour may occur within area	In buffer area only
PLANT			
Acacia menzelii			
Menzel's Wattle [9218]	Vulnerable	Species or species habitat may occur within area	In feature area
Caladenia argocalla			
White-beauty Spider-orchid [54991]	Endangered	Species or species habitat may occur within area	In buffer area only
Caladenia tensa			
Greencomb Spider-orchid, Rigid Spider-orchid [24390]	Endangered	Species or species habitat likely to occur within area	In feature area
Dodonaea procumbens			
Trailing Hop-bush [12149]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Dodonaea subglandulifera			
Peep Hill Hop-bush [11956]	Endangered	Species or species habitat may occur within area	In feature area
Euphrasia collina subsp. osbornii			
Osborn's Eyebright [3684]	Endangered	Species or species habitat may occur within area	In feature area
Olearia pannosa subsp. pannosa			
Silver Daisy-bush, Silver-leaved Daisy, Velvet Daisy-bush [12348]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Prasophyllum pallidum			
Pale Leek-orchid [20351]	Vulnerable	Species or species habitat may occur within area	In feature area
Senecio macrocarpus			
Large-fruit Fireweed, Large-fruit Groundsel [16333]	Vulnerable	Species or species habitat may occur within area	In feature area
Swainsona pyrophila			
Yellow Swainson-pea [56344]	Vulnerable	Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
REPTILE			
Aprasia pseudopulchella Flinders Ranges Worm-lizard [1666]	Vulnerable	Species or species habitat likely to occur within area	In feature area
Tiliqua adelaidensis Pygmy Blue-tongue Lizard, Adelaide Blue-tongue Lizard [1270]	Endangered	Species or species habitat known to occur within area	In feature area

Listed Migratory Species [Resource Information]

Scientific Name	Threatened Category	Presence Text	Buffer Status
Migratory Marine Birds			
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area	In feature area
Migratory Terrestrial Species			
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area	In feature area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area	In feature area
Myiagra cyanoleuca Satin Flycatcher [612]		Species or species habitat may occur within area	In feature area
Migratory Wetlands Species			
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area	In feature area
Calidris acuminata Sharp-tailed Sandpiper [874]	Vulnerable	Species or species habitat may occur within area	In feature area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area	In feature area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area	In feature area

Scientific Name	Threatened Category	Presence Text	Buffer Status
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]	Vulnerable	Species or species habitat may occur within area	In feature area

NATIVE VEGETATION MANAGEMENT PLAN

SEB Area Reference Name: St Kitts Offset Area

Registered Proprietor:

Period of Management Plan: 2027-2037

Plan authored by: J. Skewes and Dr T. How (Umwelt (Australia))

Native Vegetation Council
GPO Box 1047 (08) 8303 9777
Adelaide SA 5001 nvc@sa.gov.au

TABLE OF CONTENTS

1 RECITAL

1) In this Plan, unless the contrary intention appears –

   a) "Native fauna" means an animal or animals of a species indigenous to South Australia

   b) “Significant Environmental Benefit (SEB) Area” means an area of land that is protected and managed for conservation to provide a significant environmental benefit to offset the impacts of clearance of native vegetation that has been approved or may be approved sometime in the future

   c) "Owner" means the person who has executed this Agreement as the proprietor of the land containing the SEB Area and includes all successors in title and occupiers of the land. Where two or more persons are named as the Owner the rights and liabilities under this Agreement will pass to all such persons jointly and each of them severally

   d) “the Act” means the *Native Vegetation Act 1991*

   e) Words and phrases defined in the Act, shall for the purposes of this Agreement have the meanings defined in that Act.

2) This Management plan commences upon approval from the Native Vegetation Council (NVC) and may not be varied or terminated except by a written Agreement signed by both the NVC and the Owner.

3) This management plan is binding on, and enforceable against all owners and subsequent owners of the land described in Section 2 and remains operational in perpetuity or until it is rescinded by mutual agreement of the NVC and the Owner.

4) The obligations described in this management plan specifically apply to the land delineated as the “SEB Area” in Section 2.4.

5) The Owner shall notify the NVC if any activity on the land is likely to result in damage to the environment or biodiversity assets of the area or if there is any breach or potential breach of this Management Plan.

6) The NVC, any agent of the NVC or any employee or contractor of the Crown, authorised by the NVC may, at any reasonable time, having first notified the landholder (notice provision to be confirmed):

   a) enter the SEB Area for the purpose of inspecting the land or any fence on the land

   b) enter the SEB Area for the purposes of monitoring the conservation values and condition of the native vegetation and Native fauna protected by this Agreement.

7) If the Owner is in breach of this Management plan, the NVC may by notice in writing served on the Owner, specify the nature of the breach and require the Owner to remedy the breach within a reasonable period of time specified in the notice.

2 SEB OFFSET AREA

2.1 Landowner and Location Details

<table>
<tr><td rowspan="1">Property name</td><td colspan="2">188 Whites Road, St Kitts</td></tr>
<tr><td rowspan="2">Registered owner</td><td colspan="2">Name: RES Australia Pty Ltd</td></tr>
<tr><td colspan="2">Postal address: Suite 6.01 Level 6, 165 Walker Street, North Sydney, NSW 2060.</td></tr>
<tr><td rowspan="4">Offset site manager / provider contact</td><td colspan="2">Name: Roberta Magoba</td></tr>
<tr><td rowspan="2">Postal address: Suite 6.01 Level 6, 165 Walker Street, North Sydney, NSW 2060.</td><td>Phone: 0478 079 331</td></tr>
<tr><td>Mobile: 0478 079 331</td></tr>
<tr><td colspan="2">Email: roberta.magoba@res-group.com</td></tr>
</table>

<table>
<tr><td>Landscape Board region[1]</td><td>Northern and Yorke</td><td>Local government area</td><td>Light Regional Council</td></tr>
<tr><td>IBRA[2] region</td><td>Flinders Lofty Block</td><td>Total Offset area (ha)</td><td>25.371</td></tr>
<tr><td>IBRA sub-region</td><td>Broughton</td><td>SEB points (total, if applicable)</td><td>188.34</td></tr>
<tr><td>IBRA association(s)</td><td colspan="3">Mopami</td></tr>
</table>

2.2 Land Parcels

Parcels whole or in part which comprise the Offset area

Title	Volume	Folio	Parcel ID	Hundred
CT	5476	305	H160100 S190	Belvidere
CT	5485	289	F16260 A500	Belvidere
CT	5569	233	H160100 S239	Belvidere

[1] Landscape SA region, see https://landscape.sa.gov.au/
[2] IBRA = Interim Biogeographic Regionalisation of Australia

2.3 Introduction and Offset Area Description

Background/reason for establishing the Offset Area (e.g. give brief details of clearance application, credit application or grant project)
RES Australia Pty Ltd (RES; the Proponent) is developing the Twin Creek Wind Farm (TCWF; the Project) near Kapunda in the Mid North of South Australia (SA), approximately 90 kilometres (km) northeast of Adelaide. RES has sought and gained development authorisation (in 2019 – Development Application 422/E003/17) and approval for the clearance of native vegetation associated with Twin Creek Wind Farm on the 15th of December 2017 under Regulation 5(1)(d). Various extensions were granted to meet the NVC approval conditions (including the provision of the Native Vegetation Management Plan for the SEB Offset area). Since 2017, RES has undertaken further design development in an evolving energy market. To take advantage of the growth in wind turbine technology, RES have reviewed the approved wind farm and have optimised the Twin Creek Wind Farm and Energy Storage Project, particularly in terms of overall generating capacity, number, size and capacity of wind turbine generators. This new optimised Project has undergone extensive re-designs to mitigate impact to native vegetation and threatened species. RES has submitted a new development application for the optimised layout and prepared a new Native Vegetation Data Report. This NVC Data Report is anticipated to be lodged in October 2024 (Umwelt 2024). The Proponent purchased a ~153 ha property, '188 Whites Road, St Kitts' in 2021, which has been selected as an option to establish a portion (25.371 ha) of the on-ground SEB required for the Project (hereafter the 'Offset Area)'. The total SEB required to offset the clearance of 176.78 ha of native vegetation and 35 scattered trees results in a total of **5,652.07 SEB points** or **$4,108,821.03** into the NV fund. The Proponent plans to offset 188.34 SEB gain points with the Offset Area and the remaining will be paid into the NV fund.

Current and past land use history and events impacting the site/s (e.g. grazing, cropping, previous clearance, known fires; also list any existing covenants, caveats or agreements)
The total property size purchased by the Proponent is ~153 ha, of which 25.371 ha will be put aside for the Offset Area. The Offset Area is typical of land which has historically been used for stock grazing. The area retains an intact overstorey stratum of Peppermint Box trees (*E. odorata*) and Red Gum trees (*E. camaldulensis*) (in the creekline), however grazing has resulted in a depauperate understorey, lacking the pre-European diversity of grass, forb and herbaceous species, and instead proliferating in pasture weed species. The site is long unburnt, with no known fire history impacting the site.

General description of the features within the Offset Area (e.g. wetlands/creeks, soils, aspect, topography and rainfall)
The Interim Biogeographical Regionalisation of Australia (IBRA) identifies geographically distinct bioregions based on common climate, geology, landform, native vegetation, and species information. The bioregions are further refined into subregions and environmental associations (Thackway and Cresswell 1995). The St Kitts Offset Area is located within the Flinders Lofty Block IBRA Bioregion within the Broughton IBRA Subregion and the Mopami Environmental Association (EA). The Mopami EA contains approximately 6% (4,257 ha) remnant native vegetation, of which 2% (110 ha) is formally conserved. The Offset Area site is characterised by low hills with a 440 metre (m) maximum elevation in the southern area. A River Red Gum (*Eucalyptus camaldulensis*) lined creek runs north south in the eastern side of the Offset Area with the elevation dropping to 380-390 m in this area. The Offset Area is 25.371 ha in size and consists of predominantly Peppermint Box (*Eucalyptus odorata*) Low Grassy Woodland grading to River Red Gum Open Grassy Woodland in the riparian zone. The site is partially fenced and has a long history of stock grazing with adjacent areas cropped. The overstorey of the woodland is relatively intact with the understorey dominated by introduced grasses and herbs. One small dam occurs within the southern section of the woodland area, however, it will be excluded from the Offset Area and be fenced such that stock can still access it.

A fenced dam is also located adjacent to the northern section; however, it has access through an open gate on the western side, from the cropping land. This dam is not included in the Offset Area.

Scattered native understorey species occur within the Offset Area, with a higher abundance and diversity recorded in the northern section of the Offset, especially on the protected south-facing slope. The mid-storey is virtually non-existent and little regeneration was recorded across the site.

Summary of the conservation significance of the Offset Area
The Offset Area protects 21.174 ha of Peppermint Box Grassy Woodland and 4.197 ha of River Red Gum Riparian Open Woodland. Peppermint Box Grassy Woodland is listed as a nationally threatened ecological community (TEC) under the *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). BAM site A2 meets the condition class B TEC requirements in its current condition, the implementation of this management plan will assist in significantly improving its condition. The management plan also aims to improve the condition of A1 (currently condition Class C, patches amendable to rehabilitation). The Offset Area would also contribute to the total area under conservation management in the region. Approximately 6% of the of Mopami EA contains native vegetation and only 2% is within the Reserve System. Therefore, the Offset Area significantly contributes to the management of native vegetation in the region. Site condition was scored using the Bushland Assessment Methodology (BAM) and scoring system derived from the Nature Conservation Society of South Australia's (NCSSA) Bushland Condition Monitoring (BCM) methodology (Croft et al, 2005-2009; Milne & McCallum [2012]; Milne & Croft [2012)]. Scoring uses a selection of key ecological attributes in relation to a Benchmark 'pre-European' community from which the vegetation association is derived. These measures provide scores assessing vegetation cover, conservation value and landscape context which combine to provide a Unit Biodiversity Score (UBS) (per hectare). BAM A1 (Peppermint Box Grassy Woodland) UBS 39.05 – 14.019 ha BAM A2 (Peppermint Box Open Grassy Woodland) UBS 90.66 – 7.155 ha BAM A3 (River Red Gum Riparian Open Woodland) UBS 27.35 – 4.197 ha

Summary of the conservation significance of the Offset Area
Additionally, the Offset Area provides some connectivity between patches and corridors of vegetation within an environment where extensive clearance has occurred. The southern portion adjoins a neighbouring patch of vegetation and the drainage line area continues through the neighbouring property. The area retains an intact mature overstorey stratum and is amenable to rehabilitation.

2.4 Offset Area Map

Figure 1 shows the property that is owned by RES Australia whilst Figure 2 shows the location of the Offset Area, the vegetation associations and BAM sites.

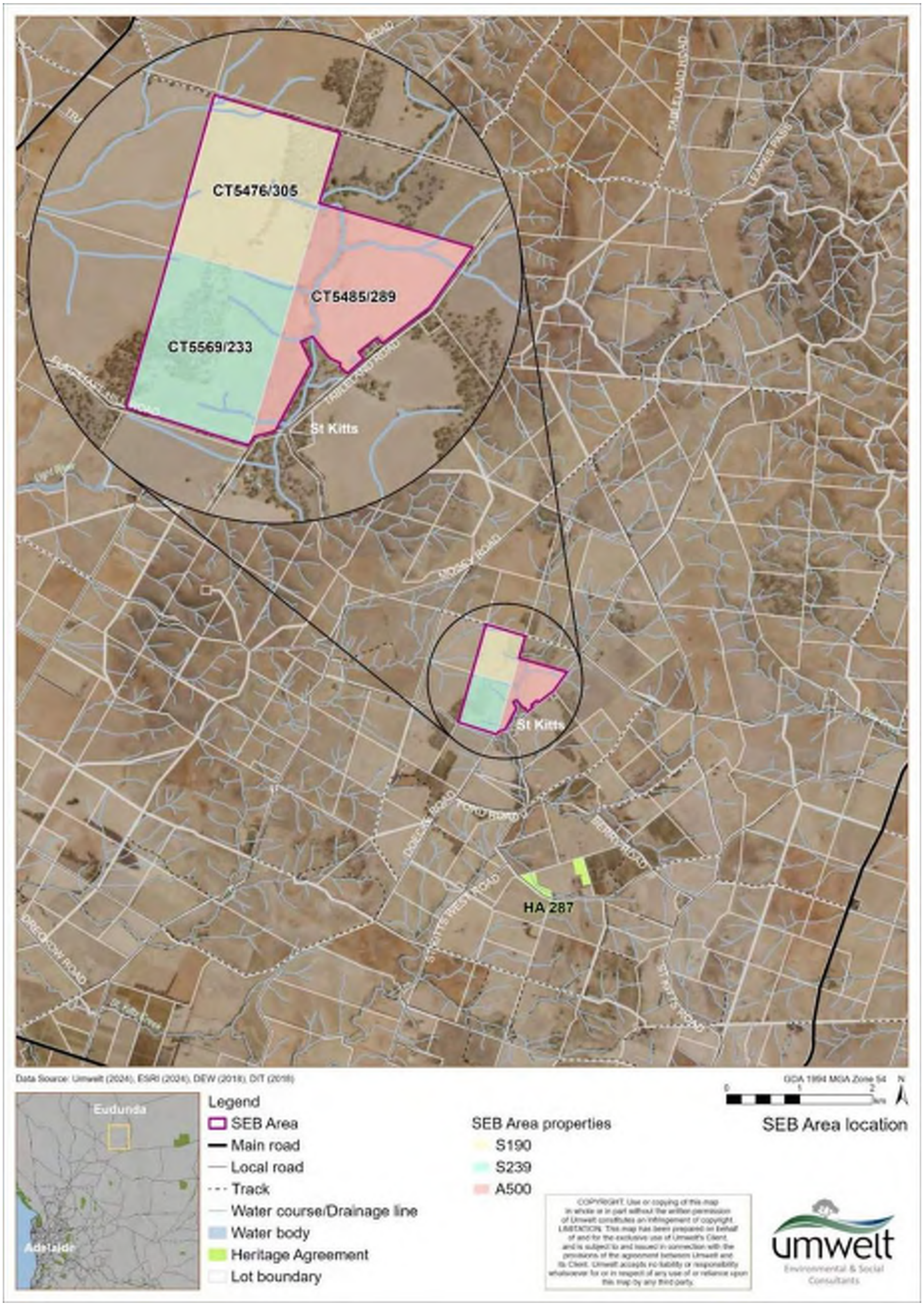


Figure 1. Location of the SEB Area

Figure 2. Offset Area location, vegetation associations and BAM survey site locations

3 BIODIVERSITY

3.1 Pre-European vegetation associations

The dominant original vegetation structure of the Light Region was Mallee Box (*Eucalyptus porosa*) or Peppermint Box (*E. odorata*) Open Grassland, with River Red Gum (*E. camaldulensis*) dominating the riparian areas.

The impacts of clearance for agriculture and long-term grazing, along with weed invasion has compromised the composition and structure of these vegetation associations and significantly reduced native species diversity.

3.2 Existing native vegetation associations and condition

The Offset Area comprises a total of 25.371 hectares of vegetation and 188.34 SEB points as outlined in the following tables. SEB points are calculated from a vegetation assessment undertaken on 6th of August 2021 by Jessica Skewes and Holly Whittenbury, Umwelt (Australia) (formerly EBS Ecology). A plant species list including all native flora observed across the site is given in Appendix 1.

Native vegetation within the Offset Area consists of two broad vegetation associations (Figure 2):

- Peppermint Box (*E.odorata*) Low Grassy Woodland with mixed understorey of native grass and weedy species, with open patches of grassland. Two areas of this community were mapped of two conditions.
- River Red Gum (*E. camaldulensis var. camaldulensis*) Open Woodland over mixed native grasses and weedy species within a drainage line, varying from steep, to gently sloping grassy banks.

The condition of the patches of vegetation varied, however it appears that the same historical land use was applied across the broader area. Vegetation communities weren’t divided further into management zones as the management required across the Offset Area will be similar.

Site Number	Vegetation Association	Area (ha)	SEB pts
1	*Eucalyptus odorata* (Peppermint Box) open woodland over *Austrostipa* sp. (Spear-grass) and *Rytidosperma* sp. (Wallaby Grass)	**14.019**	**98.81**
General description Peppermint Box (*E.odorata*) Low Open Woodland over mixed native grass and exotic understorey in poor to fair condition. Site consists of widely scattered large remnant Peppermint Box trees intermixed with no observable regeneration. A native shrub mid-stratum is entirely absent from the site and the ground cover varies from moderate condition native grassland to weed dominated. No significant infestations of woody weeds or serious environmental weeds were recorded within this community, except for scattered Dog Rose (*Rosa canina*). The remaining weed species are common weeds that occur throughout the region including introduced grasses, Soursob (*Oxalis pes-caprae*) and Wild Sage (*Salvia verbenaca*).			

Figure 3. Representative photo of Peppermint Box woodland showing weedy ground covering

Figure 4. Representative photo of Peppermint Box woodland

Site Number	Vegetation Association	Area (ha)	SEB pts
2	*Eucalyptus odorata* (Peppermint Box) open woodland over *Austrostipa* sp. (Spear-grass) and *Rytidosperma* sp. (Wallaby Grass)	**7.155**	**63.22**

General description

Peppermint Box (*E.odorata*) Low Open Woodland over Spear Grass (*Austrostipa* spp.) and introduced grasses in fair condition.

Site consists of widely scattered large remnant Peppermint Box trees intermixed with various age classes of naturally regenerated single stemmed Peppermint Box. A native shrub mid-stratum is absent from the site except for several singular shrubs (i.e. *Rhagodia parabolica*). The ground cover varies from moderate condition native grassland to weed dominated.

No significant infestations of woody weeds or serious environmental weeds were recorded within this community, except for a singular Bridal Creeper (*Asparagus asparagoides*) plant and scattered Dog Rose (*Rosa canina*). The remaining weed species are common weeds that occur throughout the region including introduced grasses, Soursob (*Oxalis pes-caprae*) and Wild Sage (*Salvia verbenaca*).

Figure 5. Representative photo of Peppermint Box Woodland showing weedy ground covering.

Figure 6. Isolated Bridal Creeper was recorded within the Peppermint Box Woodland.

Site Number	Vegetation Association	Area (ha)	SEB pts
3	*E. camaldulensis var. camaldulensis* (River Red Gum) woodland +/- *E. odorata* (Peppermint Box)	**4.197**	**26.31**

General description

Riparian area including the creekline and banks ~25m either side. Riparian zone exhibited a similar mix of native and weedy species to A1 and A2 but the overstorey was dominated by River Red Gum (*E. camaldulensis*). Several significant weed species were recorded within this area including Dog Rose (*Rosa canina*) and a singular large African Boxthorn (*Lycium ferocissimum*). Some areas of old erosion were present as well as a section of active gully erosion.

The southern boundary fence across the creekline, to a neighboring a property which is not managed for agriculture (pers. comms with current property manager), showed a significant improvement in understorey condition, structure and species diversity, including species such as *Acacia pycnantha*, *Bursaria spinosa* and *Themeda triandra* (Figure 10). The stark difference in condition highlights the improvement potential of this area under management as an offset.

Figure 7. Representative photo of the River Red Gum creekline

Figure 8. One large Boxthorn was recorded within the River Red Gum creekline.

Figure 9. Active erosion was recorded at several locations within the River Red Gum creekline

Figure 10. Neighbouring property creekline with denser understorey shrubs, native grasses, rushes and sedges.

3.3 Threatened flora and fauna

A detailed ecological assessment has not been undertaken for the Offset Area. However, a Protected Matters Search Tool (PMST) report generated on the 17 of September 2024, identified 2 TEC, 29 threatened species (10 flora and 19 fauna species) and 9 migratory species that may occur within 5 km of the Offset Area (Appendix 8). An additional NatureMaps (DEW 2024) identified an additional five species (four flora and one fauna) that may occur within 5 km of the Offset Area.

The following threatened flora species occur within woodland and open woodland and suitable habitat may exist in the Offset Area, this includes:

- *Dodonaea procumbens* (Trailing Hop-bush) – EPBC Act and NPW Act: Vulnerable
- *Dodonaea subglandulifera* (Peep Hill Hop-bush) - EPBC Act and NPW Act: Endangered
- *Senecio macrocarpus* (Large-fruit Fireweed) - EPBC Act and NPW Act: Endangered
- *Austrostipa breviglumis* (Cane Spear-grass) – NPW Act: Rare
- *Eucalyptus behriana* (Broad-leaf Box) – NPW Act: Rare
- *Maireana rohrlachii* (Rohrlach's Bluebush) – NPW Act: Rare
- *Rumex dumosus* (Wiry Dock) – NPW Act: Rare.

Of the 20 threatened fauna species species, five of these species are likely to have foraging or breeding habitat within the Offset Area. This includes:

South-eastern Hooded Robin (Melanodryas cucullata cucullata) – EPBC Act: Endangered and NPW Act: Rare

- Diamond Firetail (*Stagonopleura guttata*) – EPBC Act and NPW Act: Vulnerable
- Southern Whiteface (*Aphelocephala leucopsis*) – EPBC Act: Vulnerable
- Blue-winged Parrot (*Neophema chrysostoma*) – EPBC Act and NPW Act: Vulnerable
- White-winged Chough (*Corcorax melanorhamphos*) – NPW Act: Rare

No species of state or national conservation significance were recorded within the Offset Area during the field survey.

Additional unlisted fauna and flora species are likely to occur within the Offset Area, either as annual species (flora species not identifiable at the time of the survey), permanent residents (small reptiles), or occasional migrants (bird species), but their likelihood is not presented in this report. Restoration works are likely to have positive implications for these more widespread and generalist species.

3.4 Bushland restoration principles

There are various methods used to facilitate bushland restoration in Australia. Generally, the preferred way to undertake bushland restoration is to work from areas of highest quality to areas of lower quality. In order of importance, bushland restoration should be undertaken as follows:

1) Retain existing remnant vegetation
2) Protect existing native vegetation from degradation by managing threats
3) Actively manage degraded vegetation by ongoing weed control and revegetation

Where possible, management should aim to assist in facilitating natural regeneration of species already existing at a site, however, where species diversity is severely lacking after long periods of disturbance, revegetation can be used to re-establish pre-European diversity.

In an area of native vegetation, management should aim to reduce negative impacts of disturbance associated with management actions, and work with seasonal conditions to have the most effective outcome. For example (adapted from Robertson, 2005):

- Pull or grub weeds when soil is moist (i.e., in winter) - this makes it easier, and also enables the weed to be properly removed at the roots.
- Ensure any equipment used by bushland regenerators (including clothing and shoes) is free of weed seeds to prevent spreading weeds into new areas.
- Ensure seedlings are removed at the same time as parent plants.
- Minimise soil disturbance around pulled plants by pressing down soil and covering with leaf litter. Alternatively, remove parts of plant likely to regrow (seeds / fruits/ rhizomes / runners / bulbs), cut remaining plant into small pieces (or mulch), and cover disturbed soil to prevent weed reestablishment (woody weeds only).
- Ensure methods of weed removal are well understood and best practice methods and timing are utilised to maximise effectiveness of control.
- Ensure follow up management is scheduled appropriately to enable a gradual reduction in management requirements over time as bushland condition improves.

4 MANAGEMENT ISSUES AND ACTIONS

Whilst specific management zones haven't been developed, the site is divided into three areas:

- Site 1 (A1) is the area of Peppermint Box Grassy Woodland in the north of the Offset,
- Site 2 (A2) is the Peppermint Box Grassy Woodland in the south
- Site 3 (A3) is the Red Gum creekline on the eastern portion of the Offset (Figure 2).

4.1 Minimum Management Obligations

During the term of this Plan, the Offset Area is dedicated to the conservation of native vegetation and native fauna on the land and, subject to this Plan, shall not be used in a manner inconsistent with that dedication.

The landholder must not undertake, or permit to occur, any activity that is likely to damage, injure or endanger the native vegetation or native fauna on the Offset Area (except as provided for within this Management Plan, or where approved by the NVC).

In particular, the Owner shall not, without the written consent of the Native Vegetation Council, undertake or permit on the Offset Area (except as may be provided for within this Management Plan):

- the clearance of native vegetation
- the planting of exotic vegetation
- the construction of a building or other structure
- fertiliser application or artificial feeding
- cropping or soil disturbance
- dumping of rubbish, unwanted machinery or plant material
- new dams or drainage alterations
- removal of rocks
- removal of standing or fallen timber
- vehicle access beyond that which is required to manage and monitor the biodiversity value of the site
- any other activity that, in the opinion of the NVC, is likely to damage, injure or endanger the native vegetation or habitat of native fauna on the Offset Area.

Grazing

Stock are to be excluded from the Offset Area at all times. The exception to this may be the implementation of an ecologically beneficial grazing strategy within the Peppermint Box Woodland areas. This has not been recommended as a strategy at this stage but may be required in the future. It will be dependent on the annual grass weed load that occurs seasonally. It was difficult to determine the abundance of native grass species / annual grassy weed species across the Offset Area at the time of the assessment. Therefore, it is unclear how beneficial implementing a grazing strategy will be.

It is likely that the southern section of the Peppermint Box Woodland has little native grass cover, as this area shows signs of a much higher grazing pressure. Until grazing has been removed for at least a season, it is an unknown the ratio of native to exotic grass cover will be. It is recommended that the use of a grazing for ecological reasons be reviewed at the end of the first year of this management plan. If deemed appropriate, a grazing strategy will need to be developed and approved by NVC prior to implementation.

Fencing

Fencing must be maintained in a stock proof condition. The Offset Area is partially fenced with high quality stock proof fencing. There is one section of fence that will require replacement, and several sections of new fencing will be required to ensure stock cannot not gain access to the Offset Area (Figure 11).

Controlling pests

The Owner is responsible for the control and, if possible, eradication of declared plant and animal pests pursuant to Section 192 (1) of the *Landscape South Australia Act 2019.* All methods used must minimise off-target damage, minimise soil disturbance and comply with the *Native Vegetation Act 1991* and the *Landscape South Australia Act 2019.* Monitoring should aim to detect any new weeds or pests and management action taken to prevent these from becoming established.

Overabundant native animals

If control of a native species is required due to negative impacts (e.g. excessive kangaroo grazing), it must be conducted under permit from the SA Department for Environment and Water (DEW) where applicable.

Fire prevention

The Owner will take all reasonable steps to prevent fire on their land, provided these steps are not inconsistent with their commitments under this Plan. All works must be compliant with the *Native Vegetation Act 1991* and the *Landscape South Australia Act 2019*.

4.2 Threats - Weeds and Pest Animals

4.2.1 Existing weed management issues

Environmental weeds are an ongoing threat to all ecosystems where disturbance and seed dispersal potential occurs. Riparian environments provide perfect conditions for the establishment of weeds spreading easily along pathways and waterways and taking advantage of the heightened nutrient availability from runoff, and water availability (Croft *et al*. 2007).

Weeds cause a range of environmental and management issues including:

- competition with native vegetation for space, sun, water, nutrients
- smothering native vegetation and preventing recruitment and establishment
- failure of revegetation efforts
- Loss of amenity value.

Within the Offset Area, twenty-one (21) weed species were recorded during the field survey, including three declared weeds and two environmental weeds (weed threat rating >3) (Table 1 and Table 2). It is likely that additional weed species may be present within the reserve, but not observed during the survey due to survey timing.

Woody weeds are scattered in both the Peppermint Box and Riparian habitats. The riparian zone hosts scattered Dog Rose, as well as a single large African Boxthorn, with non-woody weeds such as Artichoke Thistle and introduced grasses occupying the banks. As these infestations are scattered, it is recommended to undertake removal in one stage.

Weed species are rated in a variety of ways depending on their impacts at a national and local scale, and their potential for negative impacts on either the agricultural or natural environment. Declared weeds are those which are listed under the LSA Act and are recognised as being highly invasive and damaging to either agriculture, society, or the natural environment. Environmental weeds are those known to have a high impact on native vegetation and biodiversity, displacing native plants and impacting on habitat values. Within the Bushland Condition Monitoring Manual, weed species are given a rating from 1-5 within each Land Management Region in SA (i.e., N/Y, EP, MDB, SE, SMLR, KI), with higher scores recognising weeds of significance within a region. Generally, weeds with scores above 3 are recognised as posing a threat to native flora and fauna. Landowners have a legal responsibility to control declared weeds on their property.

Table 1. Weed species present that pose a threat to the flora/fauna[5].

Weed species	Common name	Declared (Y/N)	BCM threat rating	Site/s
Arctotheca calendula	Cape Weed	N	2	1, 2
Asparagus asparagoides	Bridal Creeper	Y	5	2
Cynara cardunculus	Artichoke Thistle	N	3	2
[1]*Lycium ferocissimum*	African Boxthorn	Y	4	3
[1]*Oxalis pes-capre*	Soursob	N	3	1, 2, 3
Piptatherum miliaceum	Rice Millet	N	2	2
Rosa canina	Dog Rose	Y	3	1, 2, 3

Table 2. Additional weed species observed on site which pose a lesser management threat.

Weed species	Common name	Declared (Y/N)	BCM threat rating	Site/s
Avena barbata	Bearded Oat	N	2	2
Bromus diandrus	Great Brome	N	1	1, 3
Erodium cicutarium	Storksbill	N	2	1, 2
Heliotropium sp.	Heliotrope	N	1	2
Hypochaeris glabra	Smooth Cat's Ear	N	1	2
Lepidium africanum	Common Peppercress	N	1	2
Malva parviflora	Small-flower Marshmallow	N	1	1
Moraea setifolia	Thread Iris	N	2	1, 2, 3
Rumex obtusifolius	Bitter Dock	N	2	2, 3
Salvia verbenaca	Wild Sage	N	2	1, 2
Scabiosa atropurpurea	Pincushion	N	3	1, 2
Stellaria media	Chickweed	N	1	1
Trifolium sp.	Clover	N	2	2
Vicia sp.	Vetch	N	2	2

Weeds pose an ongoing management challenge, and a variety of management methods are required to control various weed species. Table 3 lists the most important weeds for management within the Offset Area and describes their threat to biodiversity and preferred control methods. Methods of weed control are described in Appendix 3. Refer to Weed Control Handbook for Declared Plants in South Australia (PIRSA, 2024) or seek expert advice for details on recommended herbicide use and application.

Table 3. Offset Area priority weed species summaries

Weed species	Threat	Preferred Control Methods
African Boxthorn (Lycium ferocissimum) Declared	• exerts water stress on surrounding desirable vegetation including large trees • harbours pest animals (foxes, rabbits) • forms dense, impenetrable thickets	• mechanical removal (seedlings) • cut and swab (non-selective) • drill and fill (non-selective)
Artichoke Thistle *(Cynara cardunculus)* Declared	• perennial herb • seedlings germinate year-round, but particularly in autumn after rain • rapid growth in spring • seeds survive up to 5 years in soil	• manual removal of flower heads before seed set • selective herbicide use at rosette stage
Cape Weed (*Arctotheca calendula*)	• herbaceous annual • crowds out native species during growth • competes for nutrients • leaves bare patches once deceased in summer	• improve density of perennial native understorey species to outcompete the weed. • chemical control in creeklines (Site 3) is not recommended due to environmental sensitivity (potential for amphibians and fragile plants). • consider low-toxicity, highly biodegradable herbicide (i.e. Glyphosate) in Site 1 and high elevation areas of Site 2.
Dog Rose *(Rosa canina)*	• large, scrambling shrub with thorns • harbours pest fauna species (rabbits, foxes) and can form dense thickets. • outcompetes natives and can form a dense monoculture in large patches.	• cut and swab larger plants to minimise off target damage • spot spray smaller plants during active growth when healthy leaves are present, and the plant is not stressed. • Glyphosate or Triclopyr are effective options. • be careful of off-target damage during spraying; ensure heavy drip setting of wand nozzles to prevent spray overshooting plant in higher foliage.

Rice Millet (*Piptatherum miliaceum)*	• weed of disturbed areas and degraded woodlands • spread by seed including water, animals or machinery	• spot spray • hand-pull small infestations or individual plants
Sour Sob *(Oxalis pes-capre)*	• competitive weed of disturbed areas and invasive monoculture in bushland • displaces native species	• grubbing (just before flowering) • repeated broad-leaf selective herbicide spray such as Brush-Off (Metsulfuron-Methyl) preferably before flowering.

4.2.2 Future weed management issues

Bushland areas are under continual threat from weed invasion from surrounding and nearby areas. Weeds are dispersed through a landscape by a range of means including animal, wind and water. Future monitoring of the Offset Area will be critical in identifying new weed species in the area as well as additional infestations of known weeds. Once recorded, appropriate control measures will need to be implemented to ensure control of new infestations before they become established and widespread.

There is potential for an increase in weed cover to occur once grazing is removed from the Offset Area. It is recommended that the use of a grazing for ecological reasons be reviewed at the end of the first year of this management plan, dependent on the level of growth and weed species present. Any use of grazing as a weed management tool would require protocols to be implemented to guide stock levels, grazing duration and timing, and would likely be dependent on seasonal parameters. Grazing would primarily be used to reduce introduced grass density and allow native grass and herb species to increase. However, a reasonable abundance of native grass and herb species needs to be present in the area for this strategy to be effective.

4.2.3 Pest animals

Pest animals present an ongoing management threat to all natural areas, where they reduce survivorship of native fauna, and impact on native vegetation through grazing. Within the Offset Area one species of pest animal, rabbit (*Oryctolagus cuniculus*), was observed during the field survey, outlined in Table 4. It is likely that additional pest animal species, such as foxes (*Vulpes vulpes*) and feral cat (*Felis cattus*) would occur within the Offset Area (Table 5).

Agricultural lands provide refuges for animals which are able to exploit resources such as rabbits and foxes. Introduced predators, such as foxes, pose significant threats to any wildlife remaining in the patch, with reduced vegetation and ground shelter (logs and rocks) features minimising the amount of protection native animals can find.

Rabbits are an environmental and agricultural pest. Even small populations pose a threat to the reestablishment of native vegetation, through burrowing, browsing on vegetation (especially fresh regrowth) and causing soil erosion issues. Rabbit populations should be managed prior to undertaking revegetation works to reduce potential negative impacts to success of the program.

Table 4. Pest animal species observed during field assessment

Pest animal species (declared)	Common name	Recorded on site/s (Y/N)	Likely to occur at site/s (Y)	Site/s
Oryctolagus cuniculus	Rabbit	Y (seen)	Y	1,2

Table 5. Pest animal species likely to occur in Offset Area

Pest animal species (declared)	Common name	Recorded on site/s (Y/N)	Likely to occur at site/s (Y)	Site/s
Alauda arvensis arvensis	Eurasian Skylark	N	Y	1,2,3
Columbia livia	Feral pigeon	N	Y	1,2,3
Canis lupus familiaris	Domestic Dog	N	Y	1,2,3
Felis cattus	Feral Cat	N	Y	1,2,3
Lepus capensis	Brown Hare	N	Y	1,2,3
Passer domesticus domesticus	House Sparrow	N	Y	1,2,3
Sturnus vulgaris vulgaris	Common Starling	N	Y	1,2,3

4.3 Other Threats and Issues Impacting, or likely to impact the Offset Area

Threat or Issue	Description of sites / species affected and the severity of impact (where known)
Inappropriate total grazing pressure (e.g. stock access, feral grazing animals and/or kangaroos)	Stock grazing is currently undertaken within the majority of the site with no grazing occurring in the northern section woodland in recent times. Sections of new and replacement fencing will be required to ensure stock grazing is prevented in the future. A small number of Western Grey Kangaroos (*Macropus fuliginosus*) and evidence of scats were observed during the field assessment, and it is likely that grazing by Kangaroos occurs in the Offset Area, however, Kangaroos are likely to be in low numbers, and there were minimal grazing impacts observed at the site. Rabbits were observed on the site, and there was some evidence of diggings. Currently there is very little cover for rabbits provided by a shrub layer, however with the implementation of revegetation, this site may become more suitable for them, and management actions should be considered to remove them from the site.
Artificial water source(s)	Two dams occur within the property. One has been excluded from the Offset Area and is fenced with access from cleared cropping land through a gate. This dam can remain operational without any impact to the Offset Area. The second dam will also be excluded from the Offset Area and requires fencing off and a gate installed to allow access for stock but prevent their access to the adjoining offset Area.
Areas with a lack of native vegetation due to past disturbance	There are several patches within the Offset Area which contain minimal native vegetation, maintaining only some native vegetation in the grassy layer.

Threat or Issue	Description of sites / species affected and the severity of impact (where known)
	One location of gully erosion occurs which is primarily devoid of native vegetation.
Changed hydrology, salinity, acidity or waterlogging	Historic vegetation clearance and agricultural practices have resulted in gully erosion in one location along the creekline. No other water management issues are present within the site.
Inappropriate fire regime	The area doesn't appear to have been burnt for some time. However, given the rural nature of the property and surrounding agricultural land (grazing and cropping), fire management is not regarded as a major threat / issue.
Damage from public access (e.g. use of bike trails, off-road vehicles, rubbish dumping, pollution)	Historically tyres have been used to help stabilise the erosion gully, this appears to be relatively stable and therefore should be left in situ. No other public access issues have been identified.
Disease (e.g. *Phytophthora*)	No.
Buildings	An old, dilapidated building occurs within the Offset Area.

4.4 Management Goals and Objectives

- The goal(s) below outline the intent / desired outcome(s) of managing the Offset Area over the long term.
- The management objectives define the strategies that must be undertaken in the first 10 years to address threats/issues and progress towards achieving the overall goal.
- The targets and indicators of success clarify what is expected to be achieved and/or observable at the site with 10 years of site management.
- Specific actions, methods and monitoring are detailed in later sections.

Goal 1: Reduce weed species cover across the Offset Area
Management objectives: 1.1. Remove African Boxthorn – PRIORITY. 1.2. Remove Bridal Creeper – PRIORITY. 1.3. Remove Dog Rose – PRIORITY. 1.4. Remove Artichoke Thistle. 1.5. Reduce herbaceous and grassy weed prevalence in understorey – i.e., Sour-sob, introduced grasses.
Targets/Indicators of success: • Elimination of woody weeds African Boxthorn, Bridal Creeper and Dog Rose. • Elimination of Artichoke Thistle. • Increased coverage of native grasses in Peppermint Box Woodland (as a result of reduced weed cover, more light infiltration and management to support native grass growth).

Goal 2: Increase natural regeneration, species diversity and native grass cover across the Offset Area.
Management objectives: 2.1. Establish seed bank from existing native vegetation population (local provenance) or engage a suitable contractor to grow local provenance seedlings. 2.2. Prepare sites for revegetation. 2.3. Undertake revegetation in designated areas. 2.4. Monitor / control woody, herbaceous and grassy weeds to reduce shading and increase seed set potential of native species (see 1.5).

Targets/Indicators of success:

- Increased species diversity in ground and mid layers.
- Natural regeneration of revegetated species recorded.
- Increased percentage of native ground cover across Offset Area.
- Recorded increase in natural regeneration of existing species (*E.odorata*).

Goal 3: Prevent and manage new infestations of non-native plants or animals

Management objectives:

3.1. Prevent establishment of new weed species into the Offset Area.

3.2. Control rabbits within Offset Area by undertaking rabbit baiting in conjunction with a local authorised officer.

3.3. Monitor pest animals and control as advised by local authorised officer.

Targets/Indicators of success:

- Any new weed or pest infestations are identified and controlled before becoming established.
- Rabbit population significantly reduced.

Goal 4: Prevent stock grazing

Management objectives:

4.1. Replace or install new fencing within nominated areas to prevent stock grazing.

4.2. Maintain existing good quality fences.

Targets/Indicators of success:

- New fencing completed.
- No stock access to Offset Area (reviewed after Year 1).

Goal 5: Rehabilitate and stabilise erosion gullies

Management objectives:

5.1. Revegetation of highlighted erosion gully.

5.2. Targeted revegetation within Peppermint Box Woodland areas.

Targets/Indicators of success: • Native species cover across erosion gullies. • No active erosion points along creekline. • Increased diversity and abundance of native species within Offset Area.

4.5 Revegetation

Revegetation is a useful tool in areas which have become highly degraded over time and are severely lacking in pre-European diversity of species. Both vegetation associations identified in the Offset Area are highly degraded, with minimal diversity of herbaceous ground layer species, and a completely absent shrub layer.

Revegetation across the site will aim to fill gaps in overstorey species and will also aim to restore diversity into the ground layer vegetation.

Unless otherwise agreed by the NVC, any revegetation must:

- be with species indigenous to the local area;
- use seed or plant material collected from as close as possible to the planting site;
- aim to be representative of the structure and composition of the relevant pre-European vegetation benchmark community.

Benchmark goals are presented for each vegetation association in Table 6.

Table 6. Benchmark vegetation goals

Reveg Site ID	**Area of reveg** (ha)	**Current condition**	**Description of the key structure and composition of the relevant pre-European vegetation benchmark community** (e.g. type of vegetation that should be achieved in the longer term; open / dense / clumped distribution of trees, shrubs or groundcovers)
1 – Grassy Woodland	~4.0	*Poor*	*Eucalyptus odorata* Woodland (10-30% cover) over grassy and herbaceous understorey (20+ species) with sparse shrubs (<5% cover)
2 - Riparian	~0.5	*Poor*	Ephemeral creek woodland, grading from *E. odorata to E. camaldulensis +/- E. leucoxylon* with an open understorey of sedges, grasses and herbs and sparse shrubs.
Vegetation Condition Descriptions: *Excellent – very little or no sign of alien vegetation in the understorey, resembles pre-European condition* *Good – High proportion of native species and native cover in understoery, reasonable representation of pre-European vegetation* *Moderate – Substantial invasion of aliens but native understorey persists (i.e. low proportion of native species but high cover, or high proportion of native species but low cover)*			

Reveg Site ID	Area of reveg (ha)	Current condition	Description of the key structure and composition of the relevant pre-European vegetation benchmark community (e.g. type of vegetation that should be achieved in the longer term; open / dense / clumped distribution of trees, shrubs or groundcovers)
Poor – Understorey consists predominantly of alien species, although a small number of natives persist *Very Poor – Understorey consists only of alien species*			

4.5.1 Methods

Revegetation requires multiple approaches depending on the area of management and desired outcome. Three approaches will be used for revegetation across the Offset Area with the primary objectives to increase species diversity and restore structure to degraded areas.

1) Overstorey – sparse (>20m apart) plantings of overstorey species in open areas of the Peppermint Box Open Woodland.
2) Cluster diversity planting – small, easily managed clumps (~15 x 15 m) of shrub and understorey species, to facilitate reintroduction of native seedbank into the site.
3) Riparian restoration – planting above and around erosion gully to stabilise area

Suggested species to be revegetated

Method - T = Tubestock, M = Machine Direct Seed, H = Hand Direct Seed

Botanical Name	Common Name	Method	Target Density	Area	Planting Notes (e.g., Site ID)
CANOPY					
Eucalyptus odorata	Peppermint Box	T	10-30% cover	1, 2	Sparse plantings in open grassland >10m apart.
E. leucoxylon ssp. *pruinosa*	Inland SA Bluegum	T	Sparse	1, 2	Upper banks as sub-dominant.
Callitris gracilis	Southern Cypress Pine	T	Sparse	1,2	Upper banks, scattered trees. Low density.
SHRUBS					
Acacia acinacea	Wreath Wattle	T	Sparse (<5%)	1,2,3	Clustered plantings.
Bursaria spinosa	Sweet Bursaria	T	Sparse (<5%)	1,2,3	Clustered plantings.

Botanical Name	Common Name	Method	Target Density	Area	Planting Notes (e.g., Site ID)
Cryptandra amara	Long-flowered Cryptandra	T	Sparse (<5%)	1	Clustered plantings.
Cullen parvum / australasicum	Scurf-pea	T	Sparse (<5%)	1	Clustered plantings.
Dodonaea viscosa ssp. *spatulata*	Sticky Hop-bush	T	Sparse (<5%)	1,2,3	Clustered plantings.
Pultenaea largiflorens	Twiggy Bush-pea	T	Sparse (<5%)	3	Clustered plantings.
GROUND LAYER					
Aristida behriana	Brush Wire-grass	T, H	Up to 50% cover (total tussocks)	1,2,3	Clustered plantings. Direct seed in zone 6. Spread seed in bare patches.
Arthropodium fimbriatum/strictum	Nodding / Common Vanilla-lily	T	Up to 30% cover (total herbs)	1,2	Clustered plantings.
Austrostipa sp. *(densiflora, eremophila, gibbosa, nodosa, scabra, multispiculus)*	Spear-grass species	T, H	Up to 50% cover (total tussocks)	1,2,3	Clustered plantings. Direct seed in zone 6. Spread seed in bare patches.
Calostemma purpureum	Pink Garland-lily	T		3	Tolerant bulb, lower banks.
Carex bichenoviana	Notched Sedge	T		3	Creek banks.
Convolvulus remotus	Grassy Bindweed	T, H	<1% cover (twiners)	1,2,3	Clustered plantings.
Cymbopogon ambiguous	Lemon Grass	T, H		3	Upper banks, rocky areas.
Dianella revoluta var. *revoluta / longifolia*	Black-anther Flax-lily or Pale Flax-lily	T	Up to 10% cover (total tall tussocks)	1,2,3	Upper banks and outer zones.

Botanical Name	Common Name	Method	Target Density	Area	Planting Notes (e.g., Site ID)
Enneapogon nigricans	Black-head Grass	T, H	Up to 50% cover (total tussocks)	1,2,3	Clustered plantings. Direct seed in zone 6. Spread seed in bare patches.
Einadia nutans ssp. *nutans*	Climbing saltbush	T	Up to 30% cover (total herbs	1,2,3	Clustered plantings.
Goodenia willisiana	Mallee Goodenia	T	Up to 30% cover (total herbs	1,2	Clustered plantings.
Goodenia pinnatifida	Mother ducks	T	Up to 30% cover (total herbs	1,2	Clustered plantings.
Juncus subsecundus	Finger Rush	T		3	Banks.
Leptorhynchos spp.	Buttons	T	Up to 30% cover (total herbs	1,2	Clustered plantings.
Lomandra densiflora	Soft Tussock Mat-rush	T	Up to 10% cover (total tall tussocks)	1,2	Clustered plantings.
Lomandra effusa	Scented Mat-rush	T	Up to 10% cover (total tall tussocks)	1,2	Clustered plantings.
Oxalis perennans	Native Sorrel	T	Up to 30% cover (total herbs	1,2	Clustered plantings.
Ptilotus spathulatus	Pussy-tails	T	Up to 30% cover (total herbs	1,2	Clustered plantings.
Ptilotus angustifolius	Narrow-leaf yellow Tails	T	Up to 30% cover (total herbs	1, 2	Upper banks and clustered plantings.

Botanical Name	Common Name	Method	Target Density	Area	Planting Notes (e.g., Site ID)
Rytidosperma sp.	Wallaby Grass	T,H		1,2,3	Clustered plantings. Direct seed in zone 6. Spread seed in bare patches.
Teucrium racemosum	Grey Germander	T	Up to 30% cover (total herbs	1,2,3	Clustered plantings.
Themeda triandra	Kangaroo Grass	T, H	Up to 50% cover (total tussocks)	1,2,3	River banks and in revegetation clumps.
Vittadinia spp. *(cuneata, blackii, gracilis)*	New Holland Daisy	T, H	Up to 30% cover (total herbs	1,2,3	Clustered plantings.
Wahlenbergia stricta ssp. *stricta*	Tall bluebell	T, H	Up to 30% cover (total herbs	1, 2	Clustered plantings.

4.5.2 Considerations

Plant supply

All plants should be grown from seed collected on site, or from nearby remnant vegetation. Reputable suppliers within the Adelaide region include:

- Barossa Bush Gardens (Nuriootpa)
- Provenance Indigenous Plants (Salisbury Park)
- Trees For Life (Adelaide)
- Kersbrook Landcare Group (Williamstown).

Costing

All costing is approximate at the time of writing and may vary depending on supplier and availability of stock, as well as final revegetation design.

Component	Description	Approx. cost
Mulch	100mm layer of mulch over ~200m^2 for each accessible cluster planting	\$10 / m^2
Plants (~220 / cluster)	1 overstorey sp. / cluster plus trees at ~20 m spacing in open grassland areas. 1 shrub / 20m^2 (~5 / cluster) 1 ground cover / m^2	\$5-10 / tree seedling \$5-10 / shrub seedling \$2-5 / understorey seedling
Other	Tree guards plus stake Labour Maintenance	\$3 / each -

Preparation and weed control

Revegetation should not commence until adequate site preparation has been undertaken, and resources are available for ongoing care and weed management, at least for the first year after planting, until established. Planting locations should be spot sprayed with a knockdown herbicide taking care to avoid any native plant species.

Timing

Revegetation should be started following 1-2 years of intensive weed control. Removal of woody weeds before initiation of revegetation works allows easier access for initial weed removal and adequate time for preparation of the site for revegetation to be successful. Revegetation should commence in the winter of year two (following at least 12 months of weed control).

4.6 Management Action Implementation

The following table details the implementation of management actions within each of the management areas (Sites 1-3).

Management Action	Methods	Timing
Remove stock	De-stock property until fencing has been completed	At commencement
Initial weed control	All areas; woody weed control: Cut, drill and fill, spot spray, hand pull all woody weed species	Year 1 (Spring)
	All areas: Spot spray revegetation locations	Year 1 / 2 (2 operations)
	Site 3: Spot spray Artichoke thistle	Year 1 (Spring)
Initial pest control	Undertake rabbit baiting around entire Offset Area	Before revegetation begins.
Stock proof fencing	Replace existing along eastern side of Site 2 Install fencing along eastern side of Site 3 and small section in Site 1	Year 1
Seedling propagation / purchase	Purchase tube stock of target species if local stock is available or have then grown by supplier for project using species list provided in section 4.5	1 year prior to revegetation
Ground preparation	Use herbicides spray revegetation locations (2 operations)	Year 1 and 2
	Use auger to dig hole and create bowl for water retention (scattered trees)	Year 2-3
Plant establishment (tubestock)	Plant tubestock, water (especially in drier months) and use corflute tree guard and stakes to protect from grazing and weed encroachment	Year 2-3
Aftercare	Spray and / or hand pull weeds around each plant / cluster 2-3 times per year until plants are established. Remove tree guards after 18 months.	Ongoing after planting (Year 2-3 onwards)
Supplementary replanting	Monitor survival. If success of initial planting is low (<80% within 1 year) methods should be reviewed and replacement planting should be undertaken.	Ongoing after planting (Year 2-3 onwards)
Weed control	Annual weed control to remove any woody weeds or weeds of concern	Annually

4.7 Risk Management and Contingencies

This section identifies the major risks that have a potential to threaten the successful implementation of the Management Plan or the associated on-ground outcomes, the likelihood of such an event occurring (High, Medium and Low) and steps that will be taken to mitigate or address these risks.

Relevant mitigating actions identified here are included in the Action Table

Risk	Likelihood	Mitigating measures or contingency
Revegetation failure	Medium	Ensure thorough weed and pest control at all stages and ensure all major woody weed removal works are undertaken prior to revegetation commencing. Plant early in season to take advantage of winter rainfall. Water plants until established (~12 months). Ensure regular monitoring is undertaken in the first 12-18 months to quickly identify any issues and mitigate or undertake follow up planting.
Incursion of new weed species	Medium	Undertake regular monitoring and remove / treat new weed infestation as soon as possible. Develop a bush care group for the site to maximise likelihood of ongoing and regular maintenance and early detection of issues.

4.8 Action Table

This table lists the 10-year management objectives, associated actions and resources required to achieve the Management Goals. Costs are an approximate guideline only and relate to materials and contractor labour hours required to undertake the necessary work over the course of the 10-year management plan. It is likely that these costs will change over the course of the 10-year plan and should be used as an indication only. Ongoing maintenance costs are likely to be variable depending on success of early weed removal work. Detailed methods are included in the appendices.

10-Year Management Objective	Management Action	Methods	Approx. cost ($) GST excl.	Timing
Goal 1: Reduce weed species cover across the Offset Area	1.1 – 1.4 Remove woody weed species and Artichoke Thistle	Cut and swab (established plants) / drill and fill / basal bark spray. Spot spray small individuals	$10,000	Begin as soon as possible after commencement of plan. Spring / Summer (active growing time)
	1.5 Reduce herbaceous and grassy weed cover	Targeted control of herbaceous and grassy weed species using spot spray / bushcare techniques	$8,000	Annually in early spring
		Preparation of revegetation sites (targeted weed control in patches and establishment of mulch beds in accessible locations)	$6,000	Year 1 and Year 2

10-Year Management Objective	Management Action	Methods	Approx. cost ($) GST excl.	Timing
Goal 2: Increase natural regeneration, diversity, and cover of native species	2.1 Procure tubestock for revegetation	Engage with plant supplier	$5,000	12 months prior to revegetation
	2.2 Prepare sites for revegetation to maximise likelihood of success	Spot spray planting areas	*covered under Action 1.5	Year 1 / 2
	2.3 Undertake revegetation in designated areas	Tubestock planting of overstorey species in open areas Tubestock planting of mid / under storey species in cluster areas	$15,000	Year 2
	2.4 Monitor / control establishment of weeds around revegetation area	Spray out weed species within revegetation areas 2-3 times per year	$5000/year	Annually
Goal 3: Prevent and manage new infestations of	3.1 Prevent establishment of new weed species into Offset Area	Spot spray, grub or cut and swab any new weed infestations	$2500/year	Annually from year 2
	3.2 Control rabbits on site	Implement baiting program around Offset Area.	$3,000 /year	Initially every year but will be dependent on

10-Year Management Objective	Management Action	Methods	Approx. cost ($) GST excl.	Timing
non-native plants or animals				rabbit numbers or evidence of rabbits.
	3.3 Monitor pest animal activity (signs of scats, grazing, burrows, sightings)	Record any signs of the presence of pest animals.	$500 / year	Annually
Goal 4: Prevent stock grazing	4.1 Remove all stock	Remove all stock off entire property until fencing has been complete, stock can then be reintroduced to areas outside the Offset Area.		At commencement
	4.2 Replace or install new fencing within nominated areas to prevent stock grazing	Remove and replace old fencing on edge of Site 2. Install new fencing along eastern edge of Site 3 and small section of Site 2.	$7,000	Year 1
	4.3 Maintain and repair all fences	Inspect and repair fence lines to ensure they are stock proof.		Annually
Goal 5: Rehabilitate	5.1 Revegetate erosion gully	Revegetate section of Red Gum Creek that contains erosion using tubestock.	$9,000	Year 2

10-Year Management Objective	Management Action	Methods	Approx. cost ($) GST excl.	Timing
and stabilise erosion gully		Leave old tyres in situ, revegetate high side of gully and edges of gully to minimise future erosion		

4.9 Works Calendar Summary

Year(s) that each management action is to be carried out in order to achieve the 10-year Management Objectives, plus any monitoring and reporting required.

No.	Action Item	Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Yr 6	Yr 7	Yr 8	Yr 9	Yr 10
1.1 – 1.4	Remove African Boxthorn, Bridal Creeper, Dog Rose and Artichoke Thistle.										
1.5	Reduce herbaceous and grassy weed cover										
2.1	Procure tubestock										
2.2	Preparation of revegetation sites										
2.3	Undertake revegetation works (monitor success and undertake additional revegetation if required)										
2.4	Monitor / control establishment of weeds around revegetation areas										
3.1	Prevent establishment of new weed species into Offset Area										
3.2	Control rabbits										
3.3	Monitor pest animal activity (signs of scats, grazing, burrows, sightings).										
4.1	Remove all stock										
4.2	Replace or install new fencing										
4.3	Maintain and repair all fences										
5.1	Revegetate erosion gully										

4.10 Management Action Map

These maps delineate the location of management issues (e.g. weed infestations, rabbit warrens) and the location of threat management works to be undertaken, and revegetation locations.

Figure 11. Threat management map indicating different management zones.

5 MONITORING AND REPORTING

5.1 Standard Monitoring

Observing, documenting, and analysing the outcomes of management actions are required. If monitoring shows that the goals of this Plan are not being achieved, the owner or the NVC may request a review and update of the Plan. The following standard monitoring data is required:

- Record of management actions undertaken.
- Photographs from at least one representative photographic monitoring site or ‘photo-point’ for each vegetation association (i.e. each ‘site’).
- A map and/or list showing the location of each photo-point and the photo direction.
- Annual photographs showing the same field of view as the first (baseline) photograph at each photo-point.
- Record of dominant species and species of interest occurring in the photographs with notes of key changes compared to the baseline.
- Record of seasonal conditions (e.g., rainfall) to assist with evaluating changes.

5.2 Additional Monitoring

If the number of SEB points generated is >150 points (or if stipulated by the NVC) additional assessments of vegetation condition will be undertaken by an accredited consultant at years 5 and 10 of the Management Plan. The method used will be the NVC’s Bushland or Rangelands Assessment Method as appropriate, unless otherwise approved by the NVC.

5.3 Complimentary Monitoring

If **revegetation, management of threatened species** or an **ecological grazing/burning strategy** are a part of this plan, then the following sections outline the relevant monitoring goals and methods that will be used to guide management and document outcomes.

Monitoring goal/s (e.g. what questions will be answered by monitoring the site?)
1. Is there a reduction in woody weeds across the site? 2. Is there a reduction in weedy ground cover across the site? 3. Is there an increase in natural regeneration of native species across the site? 4. Is there a decrease in rabbit activity? 5. Is there increased native species diversity within the Offset Area? 6. Is there stabilisation of the erosion gully? 7. Is the revegetation program successful?

Ecological indicators

Monitoring goal no.	**Ecological indicators** (what is to be measured/observed)	**Methods** (how measurements/observations will be carried out, timing and recording)
1	Weed abundance and threat rating	BCM Sites (reduction in percentage cover) BAM A1 (reduction in percentage cover) BAM A2 (reduction in percentage cover) BAM A3 (Reduction in percentage cover) Before revegetation starts and in Year 5 and Year 10
2	Weed abundance and threat rating	BCM Sites (reduction in percentage cover) Year 5 and Year 10
3	Photo points	Qualitative assessment of photo points Year 5 and Year 10
3	Indicator 4 – regeneration	BCM Sites (increase in regeneration score) Year 5 and Year 10
4	Reduced activity rating	BCM Sites (increase in plant life form score) Year 5 and Year 10
5	Species diversity score	BCM Site 1 and 2 (increase) BAM A1 (increase) BAM A2 (increase) Year 5 and Year 10
6	Photo point	Qualitative assessment of photopoint Visual inspection Year 5 and Year 10
7	Survival	Count plants surviving each year following revegetation. Keep records.

Evaluation

Ecological indicator	**Year of Plan**	**Target** (e.g. desired state when monitored, possibly in comparison to a baseline, benchmark or control)
Weed abundance and threat rating	2	Significant reduction / elimination of woody weeds across site. All large woody weeds eliminated before revegetation starts (prevent difficulty with accessibility following rehabilitation works)
	5	No mature woody weeds, reduction in weed abundance and threat score and percentage cover for each BCM site. All sites: Very Poor (45) → Moderate (18-25)
	10	No mature woody weeds, reduction in weed abundance and threat score and percentage cover for each BCM site. All sites: Good (11-17) to Very Good (0-10)
Indicator 3 – B: Plant Life Forms	5	BCM Sites (increase in plant life form score) All sites: Moderate (11) → Good (12-14)
	10	BCM Sites (increase in plant life form score) All sites: Excellent (15+)
Indicator 4 - Regeneration	5	BCM Sites (evidence of tree regeneration) All sites: Very poor (0) → Moderate (1) Observation across whole site visible from Photo points
	10	BCM Sites (evidence of multiple species regeneration) All sites: Moderate (1) → Good (2) Also, with regeneration in shrub layer. Observation across whole site visible from Photo points
Indicator 3 – A: Ground Cover	5	BCM Sites have ‘excellent’ rating for groundcover (3-4), however this is dominated by weedy species. *Native: Exotic understorey* score over time. All sites: Native: Exotic Understorey score 2 → 3
	10	BCM Sites have ‘excellent’ rating for groundcover (3-4), however this is dominated by weedy species. Improvement would be indicated by an increase in the *Native: Exotic understorey* score over time. All sites: Native: Exotic Understorey score 3-5
Species diversity score	5	BCM Sites (increased native species diversity) Site 1: Very Poor (1-3) → Poor (4-8)
	10	BCM Sites (increased native species diversity) All sites: Moderate (9-15)
	10	BCM Site 1 and 2 (evidence reduced dieback) Site 1: Indicator 5 (Dieback) – Good Site 2: Indicator 5 (Dieback) – Good

		Site 1: Indicator 6 (Habitat) - Excellent (8-10) Site 2: Indicator 6 (Habitat) - Excellent (8-10) Observation across whole site visible from Photo points
Survival	5	>80% survival after year 1 >70% survival after year 5 (If less than anticipated survival rate at any monitoring period, threats identified and managed, and additional revegetation undertaken if required.
	10	>50% survival rate (depending on species), but evidence of natural regeneration present. If the population is declining without replacement, check for causes (e.g. weed competition, grazing, lack of seed set, low rainfall etc) and give attention to those factors which can be managed (e.g. reduce weeds and grazers).

Roles and responsibilities

Monitoring action	Timing	Person(s) / organisation(s) responsible
New weeds / pests	Annually	Site manager (to delegate)
Bushland Assessment	Years 2, 5 and 10	Accredited consultant
Revegetation monitoring	Each year following revegetation until year 5, and then again in year 10 (presuming revegetation successful)	Site manager / incorporated into Bushland Assessment
Review and, if required, update Management Plan	Year 5 and Year 10	Site manager / consultant

5.4 Reporting and review

Progress reports will be submitted to the NVC each year for the first 3 years and as requested by the NVC thereafter. Reports are to include:

- a description of works undertaken for the previous year for each Management Goal
- standard monitoring data as outlined in Section 5.1, photographs and evaluation of outcomes.

Year 5 and 10 assessment reports will be submitted to the NVC and include:

- summary of works undertaken to date
- an evaluation of the condition of the vegetation compared to the baseline/benchmark including photographs and monitoring data
- a review of whether management actions have achieved the management objectives to the extent expected
- suggested changes to management plan (if required).

Type of report	**Report required to be sent to the NVC? (Y/N)**	**Due dates**	**Person(s) / organisation responsible**
Progress	Y	2028, 2029, 2030	Accredited consultant
Year 5 Assessment	Y	2032	Accredited consultant
Year 10 Assessment	Y	2037	Accredited consultant

6 EXECUTION OF THE PLAN

Offset Area Reference Name: ……………………………………………………….

Signed: .... Date: ....
(“the Decision Date”)

Print Name: ……………………………………………………

☐ **PRESIDING MEMBER, NATIVE VEGETATION COUNCIL**
☐ **DELEGATE TO NATIVE VEGETATION COUNCIL**

Signature of Landowner(s) or seal of Company and authorised signatory:

Signed: .... Date: ....

Print Name: …………………..…………………………………………..

Signed: .... Date: ....

Print Name: ……………………..………………………………………..

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8 APPENDICES

8.1 Appendix 1 – Native flora list from Offset Area

Species list is likely to be larger, however as the survey was undertaken in winter, annual species were not detected and grasses were unable to be identified to species.

Plant Species	**Common Name**
Acaena echinata	Sheep's Burr
Allocasuarina verticillata	Drooping Sheoak
Amyema miquelii	Box Mistletoe
Atriplex semibaccata	Berry Saltbush
Austrostipa sp.	Spear-grass
Bulbine sp.	Bulbine-lily
Bursaria spinosa ssp.	Bursaria
Calostemma purpureum	Pink Garland-lily
Calostemma sp.	Garland-lily
Cassinia laevis ssp*. laevis*	Curry Bush
Chamaescilla corymbosa var. corymbosa	Blue Squill
Enchylaena tomentosa var.	Ruby Saltbush
Erodium crinitum	Blue Heron's-bill
Eucalyptus camaldulensis ssp.	River Red Gum
Eucalyptus odorata	Peppermint Box
Exocarpos cupressiformis	Native Cherry
Geranium retrorsum	Grassland Geranium
Heliotropium sp.	Heliotrope
Lomandra effusa	Scented Mat-rush
Rhagodia parabolica	Mealy Saltbush
Rytidosperma sp.	Wallaby-grass

8.2 Appendix 2 – Native fauna observed during field assessment

Fauna Species	Common Name
Acanthiza chrysorrhoa	Yellow-rumped Thornbill
Aquila audax	Wedge-tailed Eagle
Cacatua galerita	Sulphur-crested Cockatoo
Climacteris picumnus	Brown Treecreeper
Colluricincla harmonica	Grey Shrikethrush
Corvus mellori	Little Raven
Dacelo novaeguineae	Laughing Kookaburra
Daphoenositta chrysoptera	Varied Sittella
Eolophus roseicapilla	Galah
Gymnorhina tibicen	Australian Magpie
Hirundo neoxena	Welcome Swallow
Manorina melanocephala	Noisy Miner
Pachycephala rufiventris	Rufous Whistler
Pardalotus punctatus	Spotted Pardalote
Petrochelidon nigricans	Tree Martin
Phaps chalcoptera	Common Bronzewing
Platycercus elegans	Crimson Rosella
Psephotus haematonotus	Red-rumped Parrot
Ptilotula penicillata	White-plumed Honeyeater
Rhipidura leucophrys	Willie Wagtail

8.3 Appendix 3 – Weed control methods

Weed control methods adapted from *Weed control handbook for declared plants in South Australia*, May 2024 Edition. (PIRSA, 2024)

Control Method	Method details	Uses	Timing
Non-herbicide control methods			
Hand-pull	• Seedlings: hold plant at ground level, pull with one hand while pushing down on soil with other hand to minimize soil disturbance. • Small woody plants: hold stem at ground level, rock back and forth to loosen soil, until plant comes out with roots. • Ensure lignotuber / roots are entirely removed to prevent re-establishment	Suitable for a small number of plants with shallow taproots, seedlings, herbaceous weeds, some grasses.	During winter when soil is soft to remove small woody plants and herbaceous weeds.
Hand-dig and grub	• Dig using a mattock, spade or hoe to dislodge taproot and / or cut it as low as possible in the soil. • Press down disturbed soil and cover with litter • Ensure follow up treatment for any regrowth	Suitable for weeds that have growing points at ground level or below the surface such as bulbs, rhizomes, fibrous roots.	During winter when soil is soft to remove small woody plants and herbaceous weeds.
Mechanical (mowing / slashing / brush-cutting/ ploughing / mulching)	• Cut annual non-native grasses medium-low to remove flowers but preserve leaves. • Do not slash if weed fruits or bulbils are present (avoid spreading seed) • Brush-cut smaller dense infestations and then spot spray (i.e. Phalaris)	For large, dense, or widespread infestations. Particularly useful tool for grasslands to facilitate regrowth of summer flowering native grasses.	Annual plants should be slashed before seeds of non-native grasses form (typically mid-late spring).
Herbicide control methods			
Foliar spray	• Involves spraying the foliage of a target plant before the point of runoff.	Herbaceous plants, shrubs, grasses, vines.	Active growth phase of plant (usually spring / summer).

	• Spot spraying (useful around areas of desired native vegetation) • Boom spraying – using selective herbicides to target species		
Cut-stump method (cut and swab)	• Cut main stem of trunk at base (as close to ground as possible) using chainsaw / axe / brushcutter / machete / secateurs etc. • **Immediately** apply herbicide mixture to cut area to point of runoff	Vines, multi-stemmed shrubs, medium and large trees.	Active growth phase of plant (usually spring / summer).
Stem inject (drill and fill)	• Frill and fill: use a narrow bladed axe to make a horizontal cut the width of the blade (5-7cm) at a 45-degree angle and immediately apply herbicide into cut. • Drill and fill: use a drill (9mm) to drill 45-degree holes around base of tree (~4cm deep depending on thickness of bark) at 5-10cm intervals. Immediately inject herbicide into each hole.	Woody trees and shrubs with a single stem and trunk diameter of 5-10cm or greater.	Active growth phase of plant (usually spring / summer).
Basal bark method	• Apply herbicide mixed with diesel or biodiesel to all sides of every stem from ground up to 30cm on dry stems with no debris.	Saplings and multi-stemmed shrubs and regrowth with a basal diameter of <5cm.	Active growth phase of plant (usually spring) 20–25-degree temperatures when plant isn't stressed.
Pellet or granular soil application	• Apply pellets evenly to soil under target weed, to 30cm beyond canopy drip line. • Apply prior to rain event.	Isolated outlying plants (without desirable vegetation around).	Active growth phase of plant (usually spring / summer).
Other considerations: - Apply herbicide when plants are actively growing - Do not apply when plant is under stress (ie from drought, extreme heat or cold, waterlogging or disease)			

- Do not spray when wet or windy weather is anticipated
- Use only to specifications on label
- Work from areas of higher conservation value to areas of lower value.

Bird and Bat Assessment

by Umwelt

umwelt
Environmental & Social Consultants

BIRD AND BAT ASSESSMENT ADDENDUM

Twin Creek Wind Farm

FINAL

January 2025

BIRD AND BAT ASSESSMENT ADDENDUM

Twin Creek Wind Farm

FINAL

Prepared by
Umwelt (Australia) Pty Limited
on behalf of
MasterPlan Pty Ltd

Project Director:	Alison Derry
Project Manager:	Ella West
Report No.	R05
Date:	January 2025

Environmental & Social Consultants

This report was prepared using Umwelt's ISO 9001 certified Quality Management System.

Acknowledgement of Country

Umwelt would like to acknowledge the traditional custodians of the country on which we work and pay respect to their cultural heritage, beliefs, and continuing relationship with the land. We pay our respect to the Elders – past, present, and future.

Document Status

Rev No.	Reviewer		Approved for Issue	
	Name	Date	Name	Date
R01	E. West	17/11/2023	Dr. M. Louter	17/11/2023
R01	E. West	29/11/2023	A. Derry	23/01/2024
R03	E. West	19/09/2024	A. Derry	25/09/2024
R04	E. West	16/10/2024	Dr. M. Louter	23/10/2024
R05	E. West	09/01/2025	A. Derry	09/01/2025

Glossary and Abbreviation of Terms

BDBSA	Biological Databases of South Australia database search
DRMF	(Australian) Defence Risk Management Framework
DEW	Department for Environment and Water
Development Area	Area outlined **Figure 1.1**
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ha	Hectares
m	Meter(s)
km	Kilometer(s)
kV	KiloVolt(s)
MNES	Matters of National Environmental Significance, as defined under the EPBC Act
MW	Megawatt(s)
NPW Act	*National Parks and Wildlife Act 1972*
PMST	Protected Matters Search tool
Project	Twin Creek Wind Farm
RES	RES Australia Pty Ltd (the proponent)
RSA	Rotor Swept Area (48 m above ground level)
Search Area	a 5 km buffer surrounding the Development Area
sp.	Species (singular)
spp.	Species (plural)
ssp.	Subspecies
the Project	the proposed TCWF
TCWF	Twin Creek Wind Farm
Umwelt	Umwelt (Australia) Pty Ltd (formerly EBS Ecology)
WTG	Wind Turbine Generator

Executive Summary

The proposed Twin Creek Wind Farm (TCWF) is located approximately 90 kilometres (km) north east of Adelaide and is situated within the northern hills of the Mount Lofty Ranges. Umwelt (Australia) Pty Ltd (Umwelt) (formerly EBS Ecology) has been engaged by MasterPlan Pty Ltd on behalf of RES Australia Pty Ltd (RES) to prepare a Bird and Bat Risk Assessment Addendum for the proposed TCWF, as the design of Wind Turbine Generators (WTG) has changed since original risk assessments were undertaken for the Project.

Previously, Umwelt collated two reports that highlighted the bird/bat strike risk assessments across the proposed TCWF, which included data from the 2017 Flora and Fauna Assessment and the 2020 Bird Strike Risk Assessment Update. These previous assessments were based on an approved Project design which was based on up to 51 WTGs with a tip height of up to 180 meters (m) (45 m above ground level).

This Bird and Bat Risk Assessment Addendum is based on an optimised design for the proposed TCWF, which now includes up to 42 WTG with a tip height of up to 220 m and a Rotor Swept Area (RSA) of 48 m above ground level. The data analysed in this report is based on almost three years of survey work (February 2021 to January 2024). The Development Area includes the Wind Farm and the Transmission Line Route (3,672.33).

A risk assessment matrix was used to qualitatively define the risk of the proposed TCWF to common and threatened bird and bat species observed in the Development Area and was guided by the qualitative measures of likelihood and consequence used in the Australian Defence Risk Management Framework. The risk assessment matrix was used to qualitatively define the risk (low, medium, high or extreme) to threatened bird species as listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *National Parks and Wildlife Act 1972* (NPW Act), observed during surveys or defined as “possibly” or “likely” to occur within the Development Area based on desktop database searches (Umwelt 2024). Bird species identified as having performed at-risk-movements (i.e. movements within the RSA) within the Development Area (such as raptors) were also assessed.

A risk assessment matrix was used to define the risk to all bat species identified during previous surveys as occurring within the Development Area, for threatened bats identified as potentially occurring in the region and other bat species determined as Possibly or Likely to occur in the Development Area (EBS 2017 and Umwelt 2024).

Other cumulative impacts such as presence of raptor nests within the Development Area were also included within the risk assessment.

The risk assessment identified that six raptors (Wedge-tailed Eagle, Brown Falcon, Nankeen Kestrel, Peregrine Falcon, Black Falcon, and Little Eagle) have a **medium** risk of collisions with a WTG. Two raptors (Spotted Harrier and Southern Boobook) have a **low** risk of collisions with a WTG.

A total of four threatened bird species were identified as being at a **medium** risk of collisions with a WTG (Southern-eastern Hooded Robin, Blue-winged Parrot, Diamond Firetail and Painted Honeyeater). No robust flight data is currently available for these species, however, due to their threatened status any impact to individuals is likely to have an impact on the local population.

A total of five threatened bird species were identified as having a **low** risk of collisions with a WTG (Southern Whiteface, Rainbow Bee-eater, White-winged Chough, Restless Flycatcher and Elegant Parrot).

Four common bird species (Australia Raven, Little Raven, Pink Galah and Australian Magpie) identified within the Development Area were assessed as having a **low** risk of collisions with a WTG.

The likelihood of collision with a WTG causing mortality was determined as likely for all bat species. As such the overall level of risk of collisions with a WTG or impact due to barotrauma for all bat species was determined as **medium**.

For those bird and bat species considered to have a medium risk level, all efforts have been made to mitigate against potential impact on these species. RES have taken into consideration the 200 m exclusion buffer around woodlands and have adopted this buffer where possible. Similarly, all efforts were made to minimise the impact to Wedge-tailed Eagle nesting sites within these woodlands and RES have taken into consideration the 500 m exclusion buffer around these nests. RES understands that TCWF is likely to require a referral under the EPBC Act.

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Appendices

1.0 Introduction

Umwelt (Australia) (Umwelt) (formerly EBS Ecology) has been engaged by MasterPlan Pty Ltd on behalf of RES Australia Pty Ltd (RES) to prepare a Bird and Bat Risk Assessment Addendum for the proposed Twin Creek Wind Farm (TCWF), as the design of Wind Turbine Generators (WTG) has changed since original risk assessments were undertaken for the Project.

Two previous assessments undertaken by Umwelt (EBS 2017, 2020a) identified the risk levels of birds and bat species colliding with WTGs within the TCWF. The initial assessment (EBS 2017) was based on indicative WTG dimensions of up to 112 m for the tower height and 67 m for the blade lengths with 45 m clearance from the ground and maximum tip height of 180 m. The subsequent assessment (EBS 2020a) reviewed previous data and assessed the impact to birds and bats of up to 51 WTGs with a 180 m maximum blade tip height.

This Bird and Bat Risk Assessment Addendum is based on the new optimised TCWF design, which includes a reduction in the number of WTGs from 51 to 42 (reduction of nine WTG) and an increase in tip height from 180 m to up to 220 m (increase of 40 m), an increase of Rotor Swept Area (RSA) by 3 m (increase from 45 to 48 m above ground level). This report will only assess “at-risk” species which include diurnal birds of prey (raptors) and threatened and common bird species from the last almost three years of survey data.

This includes data from the following field surveys:

- native vegetation assessment and bird utilisation surveys January 2024
- native vegetation assessment and bird utilisation surveys October/November 2023
- bird and bat monitoring survey February and April 2022
- bird and bat monitoring survey February, April, July and October 2021.

1.1 Development Area

The proposed TCWF is located approximately 90 kilometres (km) northeast of Adelaide and is situated within the northern hills of the Mount Lofty Ranges. The Project site is dominated by ridgelines in the north and plains or undulating hills in the south. The Development Area is approximately 3,672.33 ha (includes Wind Farm and the Transmission Line Route) with the main infrastructure area extending approximately 10 km (east to west) and 7.5 km (north to south) (**Figure 1.1**).

Please note, that this report only talks about the Wind Farm component of the Development Area, a 5 km search buffer around the entire Development Area was assessed for this Bird and Bat Assessment (**Appendix B**).

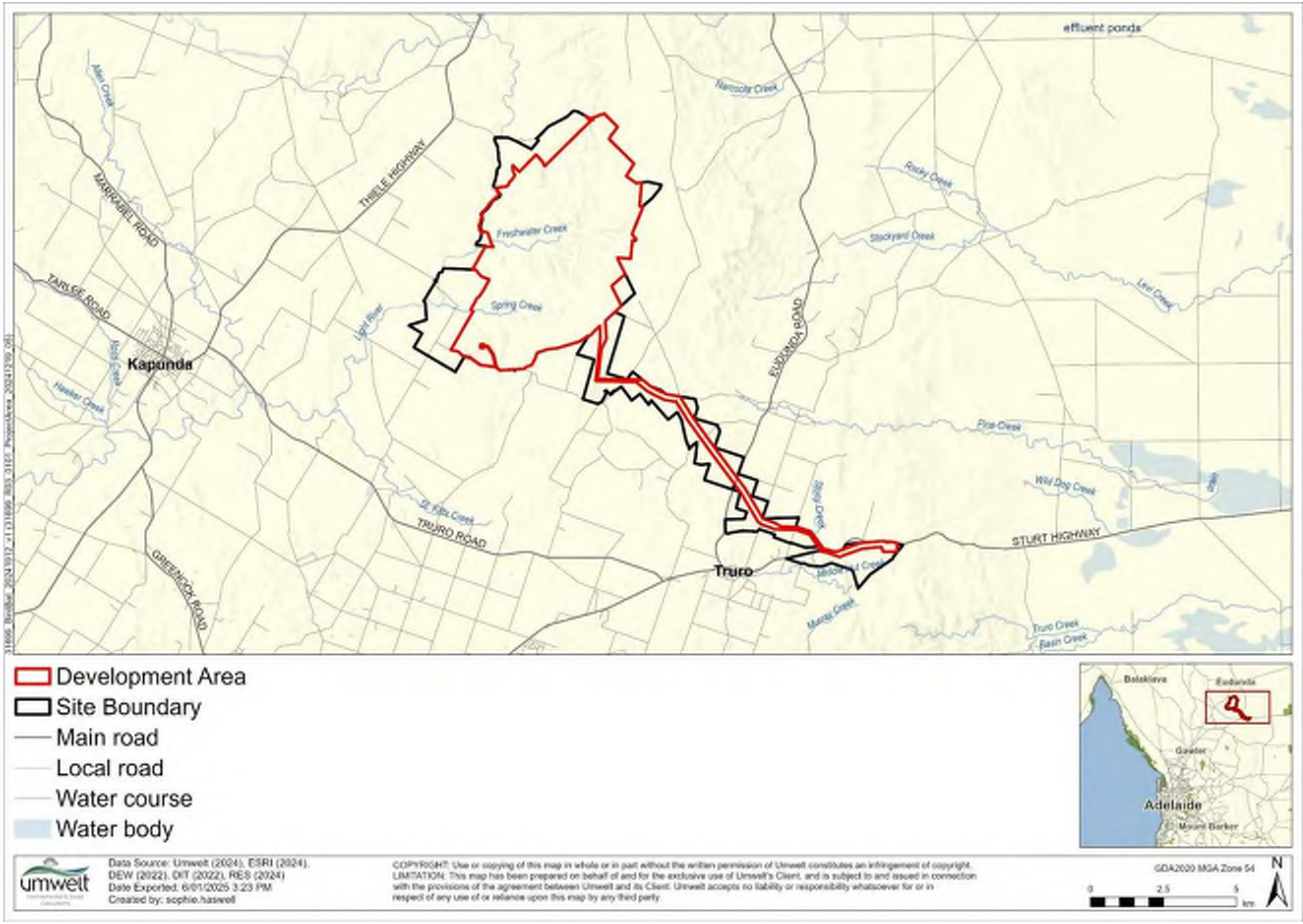

Figure 1.1 Location of the proposed Twin Creek Wind Farm and Transmission Line Route (Development Area)

2.0 Background Information

2.1 Project details

Initial design information for the TCWF was supplied to Umwelt on 6 November 2023 by RES. The optimised design for TCWF incorporates up to 42 WTG, which is a reduction of 9 WTG from the approved project design. The siting of the WTGs as part of the optimised design has been an interactive process and the final design provided to Umwelt in September 2024. (**Table 2.1**).

The Project has been developing since January 2015, where RES sought planning consent for TCWF, which was granted in October 2019. Since then, there have been major developments in wind and turbine technology. To take advantage of the evolution in wind turbine technology, RES has optimised the Project layout for the TCWF. Against this background, RES are seeking development authorisation for the updated design. **Table 2.1** shows a summary of the variations between the approved Project and the optimised Project. The optimised design for the proposed TCWF is presented in **Figure 2.1**.

Table 2.1 Comparison of Project designs

	Approved Project	Optimised Project
Number of WTG	Up to 51	Up to 42
WTG individual Generating Capacity	3.6 Megawatt (MW)	Up to 7.2 MW
Overall Generating Capacity	185 MW	Up to 270 MW
Tip height of WTG	180 m tip height	Up to 220 m tip height
Battery Energy Storage Capacity	215 MW indicative storage capacity	215 MW indicative storage capacity
Substation(s)	2 Substations (1 Project substation within the wind farm boundary and 1 cut-in terminal substation)	2 Substations (1 Project substation within the wind farm boundary and 1 cut-in terminal substation)
Point of Connection	ElectraNet 275 kV powerline (Robertstown to Tungkillo) via a cut-in terminal substation, east of Truro	ElectraNet 275 kV powerline (Robertstown to Tungkillo) via a cut-in terminal substation, east of Truro.

MasterPlan have engaged Umwelt on behalf of RES to provide advice on the potential impact to birds and bats based on the following design changes:

- the reduction in the number of WTG from 51 to up to 42 (reduction of nine WTG)
- the selected WTG tip height from 180 m to up to 220 m (increase of 40 m)
- an increase in the RSA from 45 m to 48 m (increase of 3 m above ground level).

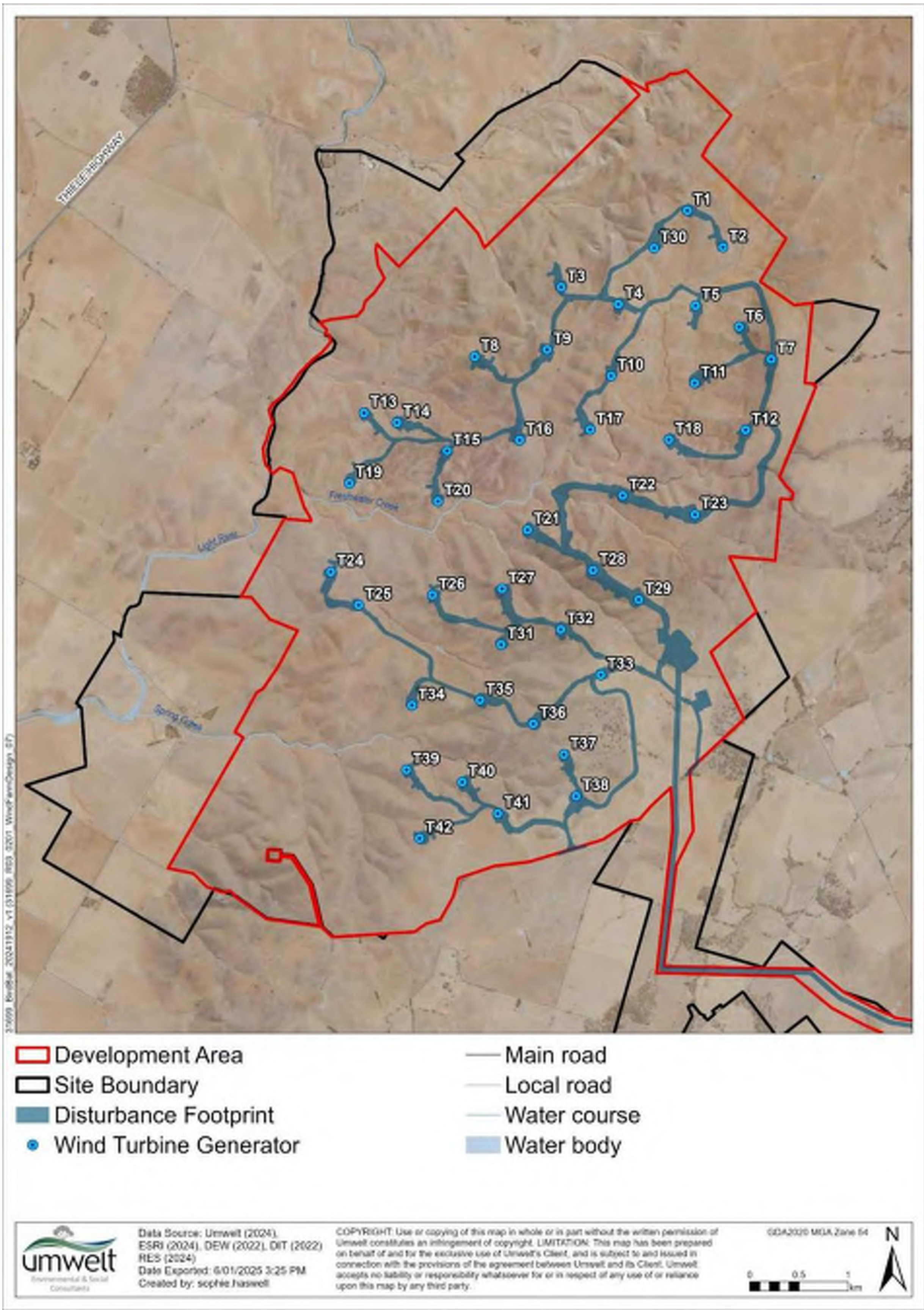

Figure 2.1 Location of the Wind Turbine Generators at Twin Creek Wind Farm

2.2 Current design plans

The optimised proposed design for the TCWF will consist of the following components (supplied to Umwelt in September 2024):

- an overall WTG blade tip height up to 220 m, a hub height of up to 134 m and a rotor diameter of up to 172 m
- up to 42 WTG
- each WTG has a name plate capacity of up to 7.2 MW, with a total installed generating capacity of up to 270 MW
- associated hard standing areas and access roads
- operations and maintenance building and compound with associated car parking
- two electrical substations (one project substation within the windfarm boundary and one cut-in terminal substation)
- a battery energy storage facility with an indicative capacity of 215 MW
- overhead and underground electrical cable reticulation
- overhead Transmission Line for approximately 15 km from the on-site substation to the existing overhead Robertstown – Tungkillo Transmission Line east of Truro
- temporary construction facilities including a borrow pit and concrete batching plant facilities.

2.2.1 Current land use

Land use within the Development Area is predominantly agricultural (e.g., grazing for sheep and cattle). Native vegetation has historically been extensively cleared, with most of the footprint containing grasslands. Woodland vegetation is generally restricted to creek lines and within small patches. The general region is open, low hills with occasional rocky outcrops that fall away to low foot slopes and drainage channels at regular intervals.

Vegetation cover is dominated by grasses and perennial herbaceous forbs, with sparse incidents of remnant woodland primarily comprised of *Eucalyptus leucoxylon* ssp. *pruinosa* (South Australian Blue-gum). Patches of *Eucalyptus odorata* (Peppermint Box) also occur in the transmission line (Umwelt 2024).

2.3 Wind Farm impacts on avifauna

The potential impacts of wind farms on avifauna and bats include:

- rotor strikes (bird mortality)
- barotrauma (bat mortality)
- clearance and degradation of habitat

- acoustic masking
- behavioural avoidance.

2.3.1 Rotor strikes

Bird species that regularly fly at heights that are swept by turbine rotors are prone to rotor strike. This includes raptors, which are one of the most at-risk groups of bird from wind farms due to their flight height, low fecundity and long lifespans (Beston *et al.* 2016), which means that the replacement of struck individuals within the population takes considerable time and energy, and population declines may occur (Dahl *et al*. 2012).

Worldwide, raptors and birds of prey have been extensively documented as a high-risk species for WTG collision (Thaxter *et al.* 2017). In Australia, collisions of raptors with WTG have been documented for Tasmania Wedge-tailed Eagle (*Aquila audax fleayi*) (Hull *et al.* 2015, Pullen 2023), Wedge-tailed Eagle (*Aquila audax*), White-bellied Sea Eagle (*Haliaeetus leucogaster*) (Pullen 2023), Swamp Harrier (*Circus approximans*), Brown Falcon (*Falco berigora*), Black-shouldered Kite (*Elanus axillaris*), Australian Hobby (*Falco longipennis*), Brown Goshawk (*Accipiter fasciatus*), Collared Sparrowhawk (*Accipiter cirrocephalus*), Little Eagle (*Hieraaetus morphnoides*), Nankeen Kestrel (*Falco cenchroides*), Peregrine Falcon (*Falco peregrinus*), Whistling Kite (*Haliastur sphenurus*) and Black Falcon (*Falco subniger*) (Hull *et al* 2013; Maloney *et al.* 2019).

Bird collisions with (seemingly slow-moving) rotor blades occur as a result of the following possible reasons:

- Due to the optics of bird vision, as the bird approaches the spinning blades, the rate the image is transmitted to the bird's brain speeds up until the retina cannot keep up with it, creating a blur (called motion blur) that the bird likely translates as being safe air space (Hodos 2003). Birds could therefore assess this area as safe and risk colliding with the turbine blades.

- Due to birds narrow frontal field of view and expected high use of their lateral field of view for detecting prey, predators and other conspecifics, birds may not observe turbines while undertaking other activities, increasing their risk of collision (May *et al.* 2020).

2.3.2 Barotrauma

Bats succumb to barotrauma at wind farm turbines whereby the rapid air-pressure reduction near moving turbines causes tissue damage to air-containing structures (Baerwald *et al*. 2008). High rates of bat mortality at wind farms have been noted in e United States, Canada, Europe, South America, Africa, Asia and Oceana (Whitby *et al.* 2024)).

In Australia, at Ararat Wind Farm, Victoria 44 bat were carcasses identified within one year of monthly monitoring over 25 turbines (BL&A 2019). The true number of bat mortalities across these 25 turbines would be significantly higher than 44 deaths, as scavenging rates and surveyor error (failed detection during searches) was not accounted for. Bat monitoring at McArthur Wind Farm in south-western Victoria found annual bat mortality per turbine to be 1.41 ± 0.65 and 3.08 ± 1.68 in 2013 and 2014, respectively (AERS 2015).

2.3.3 Clearance and degradation of habitat

The proposed TCWF will result in the direct clearance of habitat for WTG hardstands, access tracks, Transmission Line poles and substations. For the construction of wind farms, some clearance of remnant native vegetation is expected to be required and can contribute to habitat loss, fragmentation and degradation of habitat. In particular, habitat loss is expected to be unfavourable to small passerine species with specific habitat preferences and favourable to large generalist species (Szabo *et al*. 2011). If any hollow bearing trees, are to be cleared, this contributes to the loss of roosting and nesting habitat for bird and bat species with those specific habitat requirements. Furthermore, where native vegetation borders the infrastructure footprint, habitat is at a higher risk of becoming degraded from weed invasion, erosion and other edge effects.

2.3.4 Acoustic masking

The noise associated with a wind farm may have adverse impacts on songbirds (Zwart *et al*. 2016). Acoustic masking caused by wind farm noise may affect the ability of individuals with established territories to deter a rival (Zwart *et al*. 2016). As such, increased time and energy would need be spent for maintaining territories, which could result in reduced breeding success of sedentary territorial bird species (Zwart *et al*. 2016).

2.3.5 Behavioural avoidance

Raptors are known to substantially reduce their presence within an area following the construction of a wind farm. While this reduces the number of individuals that succumb to rotor strike, it may displace pairs from their established territories, which can reduce breeding success. The impact of rotor strike and displacement of individuals is considered to have reduced the breeding success of White-tailed Eagles (*Haliaeetus albicilla*) within occupied territories from 48% before wind farm construction to 22% post construction (Dahl *et al*. 2012). Displacement of raptors at a wind farm also occurred in Wisconsin, United States of America, where a 47% reduction in raptor abundance was recorded following wind farm construction (Garvin *et al*. 2011). At two wind farms in Tasmania, flight tracks and behaviour of Wedge-tailed Eagles were recorded over two years, which demonstrated that Wedge-tailed Eagles had avoidance rates of 81% to 97% higher compared to pre-construction, although this varied between sites and in different weather conditions (Hull & Muir 2013).

2.4 Previous risk assessments

Previously, Umwelt have prepared two reports for the proposed TCWF:

- TCWF Flora and Fauna Assessment (EBS 2017).
- TCWF Bird Strike Risk Assessment Update (EBS 2020a).

An initial risk assessment was conducted as part of the Flora and Fauna Assessment Report (EBS 2017). A second assessment was conducted a part of a Bird Strike Risk Assessment update (EBS 2020a). The WTG dimensions used in the previous risk assessment were as follows:

- A maximum tip of blade height of up to 180 m
- up to 112 m for the tower height

- 67 m for the blade lengths. The risk assessment was based on the lowest extent of a rotating blade tip, which was 45 m from the ground.

The likelihood of a collision event was determined as “unlikely” for two species (Brown Falcon and Wedge-tailed Eagle), “rarely” for four species (Australian Hobby, Black-shouldered Kite, Spotted Harrier and Blue-winged Parrot) and “likely” for Australian Kestrel. Previous assessments were based on knowledge of their size and flight behaviours as well as information about flight behaviour from surveys undertaken at the TCWF site. The consequence of mortality at a species/population level was determined as “minor” for six species (Australian Hobby, Black-shouldered Kite, Brown Falcon, Spotted Harrier, Wedge-tailed Eagle and Blue-winged Parrot) and “insignificant” for Australian Kestrel, a species that is locally common in the area.

The overall level of risk of impacts by WTG was determined as **low** for all species (EBS 2017, 2020a).

3.0 Methods

3.1 Bird and bat monitoring

Bird and bat monitoring was undertaken by Umwelt four times per year (one survey per season) starting in July (winter) 2020 and concluding in April (autumn) 2022 for a total of eight surveys. Morning (AM) and afternoon (PM) bird surveys were undertaken at 16 dedicated point count sites during each survey period, for a total of 255 surveys or 127.5 hours of bird survey work (EBS 2020b, EBS 2021, EBS 2021a, EBS 2021b, EBS 2021c, EBS 2022).

3.2 Risk assessment

A risk assessment was undertaken to determine the potential impact of the proposed wind farm on bird and bat species where the risk element of concern was collision. The risk assessment was performed for raptor species, threatened and common bird species known from the Development Area and those species determined as Possible, Likely and High Likely/Known to occur from the Native Vegetation Data Report (Umwelt 2024).

3.2.1 Assessment of the likelihood of species utilising the Development Area

A PMST Report was generated on the 12 September 2024 to identify threatened fauna that occur within 5 km of the Development Area. A likelihood of occurrence rating was assigned to each threatened bird and bat species identified in the Protected Matters Search Tool (PMST (Department of Climate Change, Energy, the Environment and Water (DCCEEW) 2024). A Biological Databases of South Australia (BDBSA) database search (DEW 2023 Recordset number: DEWNRBDBSA231031-4) was obtained. The BDBSA database search is comprised of an integrated collection of species records from the South Australian Museum, conservation organisations, private consultancies, Birds SA, Birdlife Australia and the Australasian Wader Study Group.

This likelihood of occurrence rating, ‘Highly Likely/Known’, ‘Likely’, ‘Possible’ takes the following criteria into consideration:

- proximity of the records (distance to the Development Area)
- date of the records
- landscape features, vegetation remnancy and vegetation type at the location of the record (taking into consideration similarities within the Development Area)
- knowledge of species’ habitat preferences, causes of decline, and local population trends.

Common bird and bat species that are known to occur in the Development Area and that were assessed as at risk of flying within the RSA of 48 m above ground level were included in the assessment.

Other cumulative impacts that have been taken into account in the risk assessment are the location of known raptor nests within the Development Area. Presence of nests within the Development Area increases the likelihood of an event causing mortality, which can elevate the risk level. Furthermore, the placement of WTG in relation to areas of higher ecological value (such as woodlands) have been taken into account in the risk assessment process, as the placement of WTG in these areas exacerbates the risk to at-risk species (such as woodland bird species) that occupy such areas.

3.2.2 Level of risk

A risk assessment matrix was used to qualitatively define the risk of the proposed TCWF on common and threatened bird and bat species observed in the Development Area and threatened bird species defined as Possible, Likely and High Likely/Known occur within the Development Area (Umwelt 2024). Bird species identified as having performed at-risk movements within the Development Area (such as raptors) were also assessed.

A risk assessment matrix was used to define the risk to all bat species identified during previous surveys as occurring in the Development Area, threatened bats identified and potentially in the region and other bat species determined as Possible, Likely and High Likely/Known occur to occur in the Development Area (Umwelt 2024).

The assessment was guided by the qualitative measures of likelihood and consequence used in the Australian Defence Risk Management Framework (Gaidow and Boey 2005). This framework provides generic guidance on the introduction and ongoing implementation of a risk management process; it may be applied to different activities or operations of any corporate, community or public sector organisation (Gaidow and Boey 2005). The risk assessment matrix considers the risk consequences (impact or magnitude of effect) and likelihood (measured by frequency or probability) of risk occurrence and combines both into the overall level of risk.

The risk assessment methodology used within the Australian Defence Risk Management Framework was adapted to include likelihood and consequence of an event on (1) a species or (2) a local population. Umwelt used the matrix to qualitatively define the risk of a proposed WTG on birds within numerous proposed wind farms located in the mid-north of South Australia and this approach has been accepted (when previously used by Umwelt) by the Environment, Resources and Development Court.

Likelihood was defined as how likely mortality from collision is to occur, and consequence was defined by significance of associated impact on individuals, viability at a local population level, or viability at species level (**Table 3.1**):

- **Categories A to E** were used to define likelihood, ranging from chronic (the event is expected to occur in most circumstances) to rarely (where the event may occur only in exceptional circumstances).
- **Categories 1 to 5** were used to define consequence, where one equated to nil/insignificant (individuals may be affected, but viability of local population was not impacted) and five equated to catastrophic disaster (potential to lead to collapse of a species) (**Table 3.1**).

Table 3.2 outlines the qualitative risk analysis matrix, which summarises four levels of impact: low, medium, high and extreme:

- If the level of risk was determined to be high to extreme, then resulting impact on an individual species and local population may be unacceptable when considered through regulatory approval processes.
- If the level of risk was assessed as medium, then all efforts should be made to mitigate against potential impact on the species.
- If the level of risk was assessed as low, then impact would be restricted to an individual level and impact on a species would be unlikely to affect the viability of a local population.

Table 3.1 Qualitative measures of likelihood and consequence (adopted from AS/NZS 4360:1999, now superseded by AS ISO 31000:2018)

Likelihood (how likely is mortality from collision/barotrauma to occur)		Consequence (Significance of associated impact on species viability)	
Rating	Definition	**Rating**	Definition
Chronic	The event is expected to occur in most circumstances.	**Catastrophic/ Disaster**	Potential to lead to collapse of species.
Frequent	The event probably will occur in most circumstances (e.g., weekly to monthly).	**Major**	Critical event, very likely to have significant impact on species.
Likely	The event should occur at some time (i.e., once in a while).	**Moderate**	Likely to have impact on population, potential to impact on long-term viability under some scenarios.
Unlikely	The event could occur at some time.	**Minor**	May have impact on local population, no impact on species.
Rarely	The event may occur only in exceptional circumstances.	**Insignificant**	Individuals may be affected, but viability of local population not impacted.

Table 3.2 Qualitative Risk Analysis Matrix – Level of Risk (adopted from AS/NZS 4360:1999 [superseded by AS ISO 31000:2018] and HB 143:1999 [superseded by SA SNZ HB 436-2013])

Likelihood	Consequences				
	Insignificant 1	**Minor 2**	**Moderate 3**	**Major 4**	**Catastrophic 5**
A (Chronic)	High	High	Extreme	Extreme	Extreme
B (Frequent)	Medium	High	High	Extreme	Extreme
C (Likely)	Low	Medium	High	Extreme	Extreme
D (Unlikely)	Low	Low	Medium	High	Extreme
E (Rarely)	Low	Low	Medium	High	High

3.3 Limitations

The findings and conclusions expressed by Umwelt are based solely upon information available at the time of the assessment.

Existing flora and fauna records were sourced from the BDBSA. The BDBSA only includes verified flora and fauna records submitted to the Department for Environment and Water or partner organisations. Although much of the BDBSA data has been through a variety of validation processes, the lists may contain errors and should be used with caution.

There is limitation in determining the resulting impact of acceptability and significance with regard to the risk assessment matrix. The risk assessment matrix provides a guide to risk consequences and likelihood of risk occurrences, based on the bird/bat species that were identified at the site and as performing flights considered as 'at-risk' movements.

4.0 Bird and Bat Risk Assessment

The risk assessment was undertaken to determine the potential impact of the proposed Project on bird and bat species, where the risk element of concern (death due to collision/barotrauma) remains unchanged. The WTG dimensions used in this risk assessment are as follows:

- the maximum tip of blade height of up to 220 m
- up to 134 m for the hub height
- up to 86 m for the rotor radius.

The risk assessment was based on the lowest extent of a rotating blade tip being 48 m from the ground. Bird flight data that recorded flight above 48 m above ground level are considered at-risk movements, as this airspace corresponds with the rotor-swept area of the updated WTG design.

4.1 Raptors

Data from 2021, 2022 and 2023 bird surveys at the site shows that eight raptor species are known to utilise the Development Area (**Table 4.1**). Refer **Appendix A** for the locations of raptors within the Development Area since 2021.

Two of these species (Spotted Harrier and the Southern Boobook) have been assessed as having a **low** risk of collisions with a WTG. For the species of which risk was determined as low, individuals may be affected, but the viability of local populations and the species as a whole will not be impacted upon.

All other raptor species have been assessed as having a **medium** risk level. The raptor species that were assessed as having a medium level of risk are potentially being affected at the local population level, but not at the overall species level.

4.2 Threatened species

A total of six threatened species have been assessed as part of this risk assessment. Three threatened bird species are Known to occur within the Development Area, this includes:

- Blue-winged Parrot (*Neophema chrysostoma*) – Nationally and State Vulnerable
- Diamond Firetail (*Stagonopleura guttata*) – Nationally and State Vulnerable
- Rainbow Bee-eater (*Merops ornatus*) – Marine listed species.

An additional three species have been assessed as either Possibly or Likely occurring within the Development Area (Table 4.1), this includes:

- Southern Whiteface (*Aphelocephala leucopsis*) – Nationally Vulnerable
- South-eastern Hooded Robin (*Melanodryas cucullata cucullata*) – Nationally Endangered and State Rare
- Painted Honeyeater (*Grantiella picta*) – Nationally Vulnerable and State Rare.

An additional three State threatened species have been assessed as Likely or Possibly occurring within the Development Area (Table 4.1), this includes:

- White-winged Chough (*Corcorax melanorhamphos*) – State Rare
- Restless Flycatcher (*Myiagra inquieta*) – State Rare
- Elegant Parrot (*Neophema elegans elegans*) – State Rare.

Four of the species (Blue-winged Parrot, Diamond Firetail, Painted Honeyeater and South-eastern Hooded Robin) have been assessed as having a **medium** risk of collisions with a WTG. Although the likelihood of an event causing a mortality is unlikely for these species. If a mortality was to occur, it is likely to have impact on population due to the Nationally and State threatened status of these species.

Five other species (Southern Whiteface, Rainbow Bee-eater, White-winged Chough, Restless Flycatcher, Elegant Parrot) have been assessed as having a **low** risk of collisions with a WTG.

Refer to **Appendix B** for threatened species records within the Development Area.

4.3 Common species

A total of four common bird species (Australian Raven, Little Raven, Pink Galah and Australian Magpie) performed “at-risk” movements within the Development Area in the last two years. Collision for these species is likely, however, the consequence at a population was deemed insignificant. Therefore, these species have been assessed as having a **low** risk level (**Table 4.1**).

Table 4.1 Twin Creek Wind Farm avian risk assessment

Scientific name	Common name	Type	Max flight height (m) (Umwelt observations)	Conservation status		Likelihood of utilising Development Area (Umwelt 2024)	Likelihood of an event causing mortality	Consequence at a species / population level	Level of risk
				Aus	SA				
Raptor species observed in the Development Area									
Aquila audax audax	Wedge-tailed Eagle	Raptor	400			Known	Likely	Minor	Medium
Circus assimilis	Spotted Harrier	Raptor	NA*			Known	Unlikely	Minor	Low
Falco berigora berigora	Brown Falcon	Raptor	150			Known	Likely	Minor	Medium
Falco cenchroides cenchroides	Nankeen Kestrel	Raptor	150			Known	Likely	Minor	Medium
Falco peregrinus	Peregrine Falcon	Raptor	NA*		R	Known	Likely	Minor	Medium
Falco subniger	Black Falcon	Raptor	15		R	Known	Unlikely	Moderate	Medium
Hieraaetus morphnoides	Little Eagle	Raptor	40		V	Known	Unlikely	Moderate	Medium
Ninox boobook	Southern Boobook	Raptor	4			Known	Unlikely	Minor	Low
Nationally threatened birds potentially occurring within the Development Area									
Aphelocephala leucopsis	Southern Whiteface	Woodland bird	NA	VU		Possible	Unlikely	Minor	Low
Melanodryas cucullata cucullata	South-eastern Hooded Robin	Woodland bird	NA	EN	R	Likely	Unlikely	Moderate	Medium
Neophema chrysostoma	Blue-winged Parrot	Woodland bird	NA*	VU	V	Known	Unlikely	Moderate	Medium

Scientific name	Common name	Type	Max flight height (m) (Umwelt observations)	Conservation status		Likelihood of utilising Development Area (Umwelt 2024)	Likelihood of an event causing mortality	Consequence at a species / population level	Level of risk
				Aus	SA				
Stagonopleura guttata	Diamond Firetail	Woodland bird	NA*	VU	V	Known	Unlikely	Moderate	Medium
Merops ornatus	Rainbow Bee-eater	Woodland bird	NA*	Ma		Known	Unlikely	Minor	Low
Grantiella picta	Painted Honeyeater	Woodland bird	NA	VU	R	Possible	Unlikely	Moderate	Medium
State threatened birds assessed as potentially occurring within the Development Area									
Corcorax melanorhamphos	White-winged Chough	Woodland bird	NA*		R	Likely	Unlikely	Minor	Low
Myiagra inquieta	Restless Flycatcher	Woodland bird	NA		R	Likely	Unlikely	Minor	Low
Neophema elegans elegans	Elegant Parrot	Woodland bird	NA		R	Possible	Unlikely	Minor	Low
"At risk" common bird species that occur in the Development Area									
Corvus coronoides	Australian Raven	Woodland bird	350			Known	Likely	Insignificant	Low
Corvus mellori	Little Raven	Woodland bird	100			Known	Likely	Insignificant	Low
Eolophus roseicapilla	Pink Galah	Woodland bird	120			Known	Likely	Insignificant	Low
Gymnorhina tibicen	Australian Magpie	Woodland bird	100			Known	Likely	Insignificant	Low

Aus: *Australia (Environment Protection and Biodiversity Conservation Act 1999).* ***SA:*** *South Australia (National Parks and Wildlife Act 1972).* ***Conservation Codes: EN/E:*** *Endangered.* ***VU/V:*** *Vulnerable.* ***R:*** *Rare.* ***Mi****: Migratory. Ma: Marine – protected in Marine Protected Areas. *opportunistic bird record, no flight data provided. NA: No flight data available, however, known flying behaviour of this species has been used to make the assessment.*

Likelihood definitions (how likely is mortality from collision to occur):

- Chronic – the event is expected to occur in most circumstance
- Frequent - the event probably will occur in most circumstances
- Likely - the event should occur at some time
- Unlikely – the event could occur at some time
- Rarely – the event may occur only in exceptional circumstances.

Consequence definitions (significance of associated impact on species viability):

- Catastrophic disaster – the event has the potential to lead to collapse of species
- Major– critical event, very likely to have significant impact on species
- Moderate– likely to have impact on population, potential to impact on long term viability under some scenarios
- Minor – the event may impact on local population, no impact on species
- Nil/Insignificant - individuals may be affected, but viability of local population not impacted.

Level of risk (as per Table 3.2 **on** Page 11):

- low
- medium
- high
- extreme.

4.4 Bats

Umwelt has assumed that all bat species recorded during the surveys and determined as “likely” to occur within the TCWF are at risk to barotrauma.

There is a possibility of bats flying into the rotor-swept area as they traverse between areas at at-risk heights and between wooded habitats. Being nocturnal, bats need places to roost during the day that provide shelter from the weather and potential predators. Most microbats will roost in tree hollows or under bark. Flight height of bats as they leave their roosting sites and fly between areas may coincide with the revised rotor-swept area of the updated WTG design.

The risk assessment includes assessing eleven bat species (**Table 4.2**):

- Seven bat species are Known to occur at the site (confirmed through AnaBat surveys, EBS 2017).
- Three species determined as Likely occurring at the site, based on desktop assessment results (EBS 2017):

All eleven bat species have been assessed as having a **medium** risk to be impacted by the proposed TCWF.

Table 4.2 Twin Creek Wind Farm bat risk assessment

Scientific name	Common name	Conservation status		Likelihood of utilising Development Area (EBS 2017)	Likelihood of an event causing mortality	Consequence at a species / population level	Level of risk
		Aus	SA				
Bat species (ID AnaBat) identified as occurring within the Development Area							
Austronomus australis	White-striped Freetail-bat			Known	Likely	Minor	Medium
Chalinolobus gouldii	Gould's Wattled Bat			Known	Likely	Minor	Medium
Chalinolobus morio	Chocolate Wattled Bat			Known	Likely	Minor	Medium
Nyctophilus geoffroyi	Lesser Long-eared Bat			Known	Likely	Minor	Medium
Ozimops planiceps	Southern Free-tail Bat			Known	Likely	Minor	Medium
Vespadelus darlingtoni	Large Forest Bat			Known	Likely	Minor	Medium
Vespadelus regulus	Southern Forest Bat			Known	Likely	Minor	Medium
Other bat species determined as potentially occurring within the Development Area							
Saccolaimus flaviventris	Yellow-bellied Sheath-tail Bat		R	Likely	Likely	Minor	Medium
Scotorepens balstoni	Inland Broad-nosed Bat			Likely	Likely	Minor	Medium
Vespadelus vulturnus	Little Forest Bat			Likely	Likely	Minor	Medium

Conservation status**: Aus:** Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). **Conservation Codes: VU/V:** Vulnerable. **R:** Rare.

Likelihood definitions (how likely is mortality from collision to occur):

- Chronic – the event is expected to occur in most circumstance
- Frequent - the event probably will occur in most circumstances
- Likely - the event should occur at some time
- Unlikely – the event could occur at some time
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- Minor – the event may impact on local population, no impact on species
- Nil/Insignificant - individuals may be affected, but viability of local population not impacted.

Level of risk (as per **Table 3.2** on **Page 11**):

- low
- medium
- high
- extreme.

5.0 Discussion

The level of risk was categorised as **medium** for nine bird species listed in **Table 4.1** and **medium** for all bat species listed in **Table 4.2**. The species with medium risk level assessments have a minor consequence at a species / population level. The risk assessment implies that there may be an impact on the local population of these species in the event of collision with a WTG.

For those bird and bat species considered to have a **medium** risk level, all efforts have been made to mitigate against potential impact on these species. RES have taken into consideration the 200 m exclusion buffer around woodlands and have adopted this buffer where possible. Similarly, all efforts were made to minimise the impact to WTE nesting sites within these woodlands with consideration of a 500 m buffer around these nests in the project design.

5.1 EPBC Act listed threatened species

Since in the approval of the TCWF design in 2019, four new bird species relevant to TCWF have been added to the EPBC Act list of threatened species:

- Southern Whiteface (*Aphelocephala leucopsis*) - EPBC Act: Vulnerable
- Blue-winged Parrot (*Neophema chrysostoma*) - EPBC Act: Vulnerable, NPW Act: Vulnerable
- Hooded Robin (*Melanodryas cucullata cucullata*) – EPBC Act: Endangered, NPW Act: Rare
- Diamond Firetail (*Stagonopleura guttata*) – EPBC Act: Vulnerable; NPW Act: Vulnerable.

All four newly listed species are woodland birds, and with the RSA of the updated WTG design being 48 m, the likelihood of these birds experiencing a collision has been reduced compared to the earlier WTG designs. All WTG are located outside of the 500 m buffer from known WTE nests.

5.2 Raptors

A total of six raptors, of which three are State threatened (Peregrine Falcon, Black Falcon and the Little Eagle) have been assessed at a **medium** impact level due to their flight behaviour (particularly while foraging) as they have been frequently recorded flying at heights or likely to fly within RSA of a WTG. Additionally, raptor species listed as a medium risk have been observed in the Development Area occurring near proposed turbine sites (**Figure B.1**). Raptors such as Wedge-tailed Eagles and Peregrine Falcons generally reside and nest in permanent home ranges. As such when these species intersect with wind farm locations there is a higher risk of WTG collision (Smales 2006). Raptors are particularly at risk during their breeding season as they are restricted to a nesting location and individuals are deemed to forage more regularly to feed their young. Given there are four known nest locations of Wedge-tailed Eagles within the proposed TCWF Development Area, Wedge-tailed Eagle have been assessed as having a **medium** risk level. Similarly, a Nankeen Kestrel nest was observed within the woodland during the 2023 surveys. Species observed below the RSA have been assessed as unlikely. However, due to the State threatened status of these species, they have been assessed as a **moderate** consequence (Black Falcon and Little Eagle). As mortality is likely to have impact on population level.

5.3 Woodland species

In general, the potential effects of a wind farm on woodland bird species are related to (1) possible loss of habitat and (2) disturbance and impacts from turbines situated close to woodlands. Direct interaction with turbine blades is assessed as Unlikely for woodland specific bird species (unless otherwise stated in **Table** 4.2), as the WTG height of blades is reduced. Common bird species were assessed for their potential to be impacted at the local population level by the proposed TCWF. Most of the common bird species that occur at wind farms such as Pink Galah and the Australian Magpie tend to forage and nest within wooded areas. The location of WTG 37 (40 m from woodland) may increase the risk of individual mortality. However, it has been assessed that for these common species individuals may be affected, but viability of local population not impacted. Therefore, these were assessed a **low** risk level.

5.4 Bats

All bats were assessed as having a **medium** risk level. Despite not having flight height data for bats, the **medium** risk level is based on the general knowledge of bat movements and on data from the study by Moloney *et al.* (2019). That study recorded mortality events for 13 bat species over 2 years, with some that extended to 3 or 3.5 years. Of the 13 species recorded, seven occur at the TCWF. Bats are more at risk of rotor strike/barotrauma when traversing between patches of woodland. Similar to woodland birds, the proximity of turbines to woodlands within TCWF and the RSA are likely to be the main risk factors for strikes/barotrauma impacts.

5.5 Conclusion

The location of the wind farm relative to bird species that may be present, the layout of the turbines, particular landscape features and the behaviour of bird species influence the likelihood that a bird flying through a wind farm will collide with a turbine (Krijgsveld *et. al* 2009, Erickson *et.al* 2014, Perold *et. al* 2020 and Santos *et al.* 2022). As such, features that increase the risk of birds colliding with turbines (such as placement of turbines near Wedge-tailed Eagle nest and Peregrine Falcon Nest, or placement of turbines near woodlands) should be considered in the design of wind farms. Collision risk models have also been used to determine the risk of collision of large raptors with wind turbines (Murgatroyd *et. al* 2020).

Exclusion buffers have been considered in the planning and design processes of TWCF, in order to reduce the likelihood of impacts to birds in the area proposed for development. In South Australia, exclusion buffers around known raptor nest's locations are currently primarily aimed at reducing the disturbance to raptors during breeding season and when juveniles are near fledging. The risks of collision for raptor species such as the Wedge-tailed Eagle and Peregrine Falcon are considered significant when assessing bird interactions with wind farms, as they conduct regular flights at heights coinciding with turbine rotor-swept areas of operating WTG.

The benefits of exclusion buffers around known nest locations of at-risk bird species are deemed as follows:

- Buffers are generally focussed around areas of high bird activity (e.g., woodland); these are areas where raptor species may potentially nest.
- During the construction of proposed wind farms, raptor species are more likely to be at risk of disturbance from activities conducted within close proximity to nest locations. By implementing

exclusion buffers, disturbance levels to these bird species would be avoided/minimized as much as possible.

- Raptors such as Wedge-tailed Eagles are territorial and typically return to the same area to nest each year. The placement of exclusion buffers around nest locations assists with lessening disturbance levels to this species.

- Juvenile raptors (and juvenile birds in general) are deemed to be more susceptible to collision with WTGs. Newly fledged juveniles would need to learn how to forage on their own and are deemed more naïve and thus less likely to avoid structures such as turbines during this learning process. The implementation of exclusion buffers around known nest sites assists in decreasing the risk of juvenile raptors/birds colliding with WTGs.

6.0 Recommendations

6.1 Design considerations

Based on the risk assessment, Umwelt has recommended to RES that the following exclusion zones be included:

- At a minimum, a 500 m exclusion buffer around Wedged-tailed Eagle nests to mitigate the likelihood of mortality from collision with a WTG.
- At a minimum, a 200 m exclusion buffer around woodland (including patches of scattered trees). This is aimed at minimising disturbance to wooded areas where woodland birds and bats are likely to roost.

These recommendations have been considered as part of the designs where possible.

6.2 EPBC assessment

The following EPBC Act listed threatened species have been assessed in this risk assessment:

- Blue-winged Parrot (*Neophema chrysostoma*) – EPBC Act: Vulnerable
- Diamond Firetail (*Stagonopleura guttata*) – EPBC Act: Vulnerable
- Painted Honeyeater (*Grantiella picta*) – EPBC Act: Vulnerable
- Rainbow Bee-eater (*Merops ornatus*) – EPBC Act: Marine
- South-eastern Hooded Robin (*Melanodryas cucullata cucullata*) – EPBC Act: Endangered
- Southern Whiteface (*Aphelocephala leucopsis*) – EPBC Act: Vulnerable.

The Hooded Robin, Diamond Firetail, Southern Whiteface and Blue-winged Parrot are newly listed species under the EPBC Act (date effective 31 March 2023). It is recommended that an EPBC self-assessment is undertaken to outline whether an ongoing bird monitoring survey will be required.

It is acknowledged by RES, that a EPBC Significant Impact Assessment and a EPBC referral is likely required by DCCEEW, for approval under the EPBC Act.

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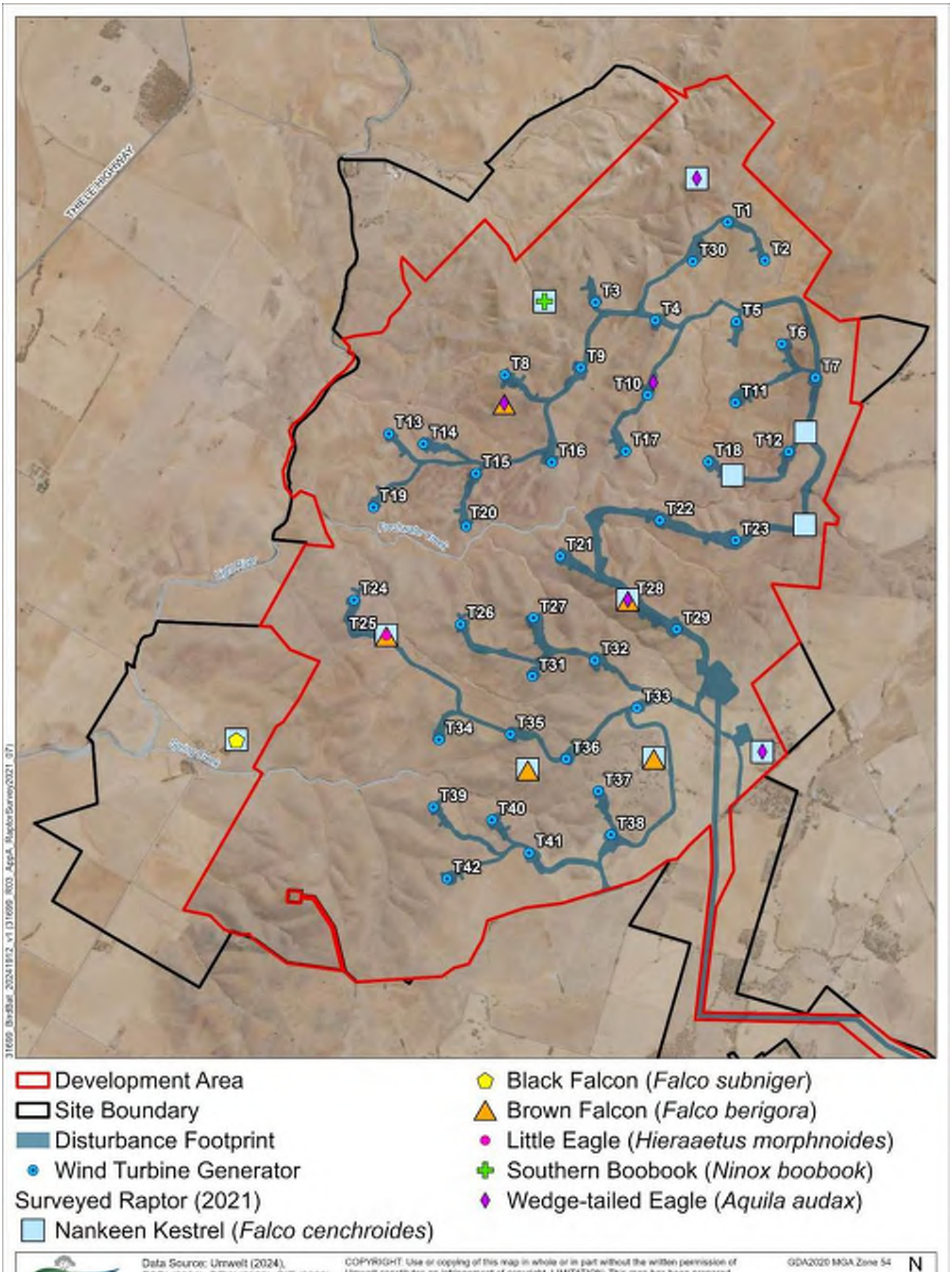
APPENDIX A

Raptors observations within the Development Area during 2021, 2022, 2023 and 2024 surveys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Disturbance Footprint
Wind Turbine Generator
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Black Falcon (Falco subniger)
Brown Falcon (Falco berigora)
Little Eagle (Hieraaetus morphnoides)
Southern Boobook (Ninox boobook)
Wedge-tailed Eagle (Aquila audax)
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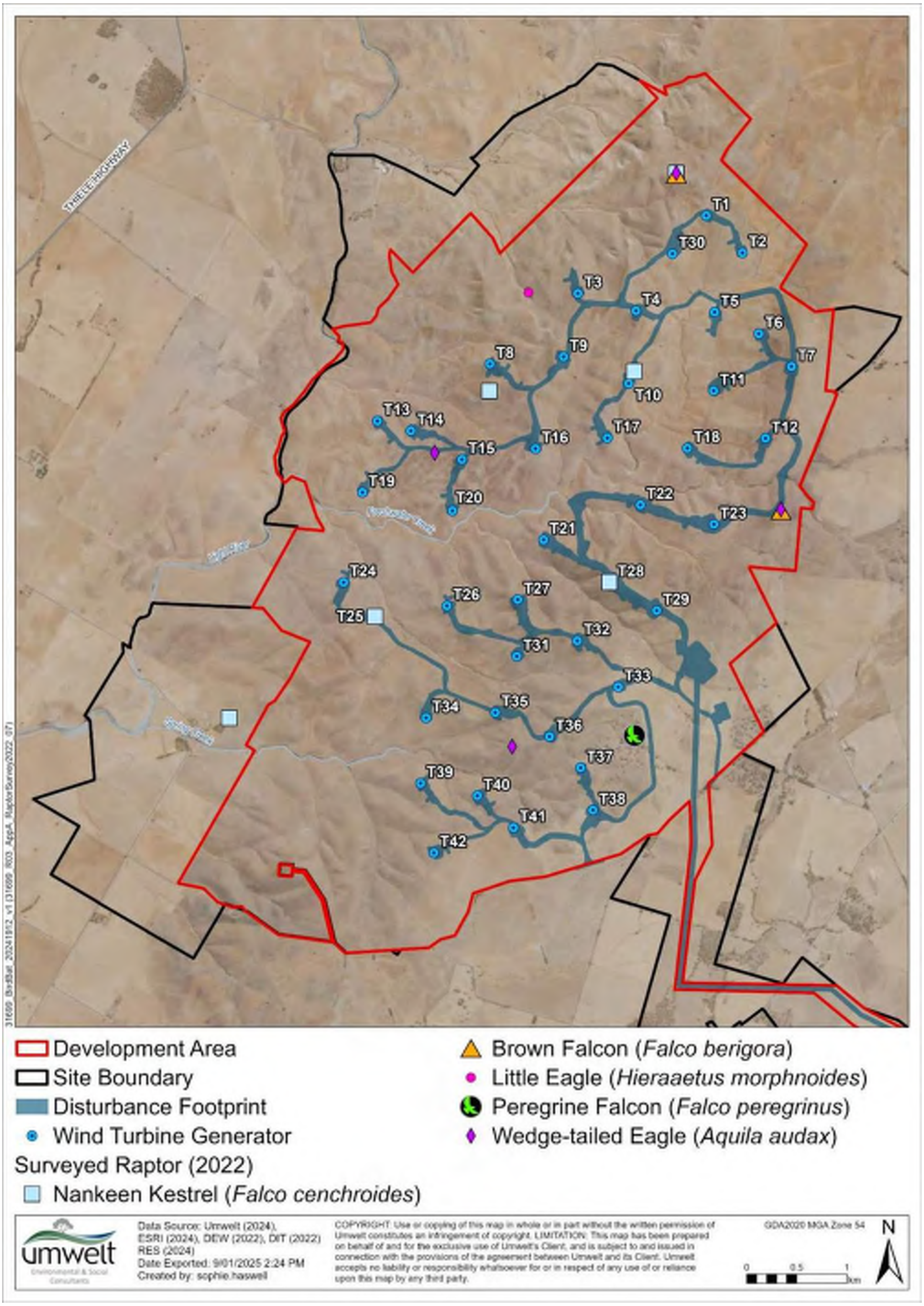

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Disturbance Footprint
Wind Turbine Generator
Surveyed Raptor (2022)
Nankeen Kestrel (*Falco cenchroides*)
Brown Falcon (*Falco berigora*)
Little Eagle (*Hieraaetus morphnoides*)
Peregrine Falcon (*Falco peregrinus*)
Wedge-tailed Eagle (*Aquila audax*)
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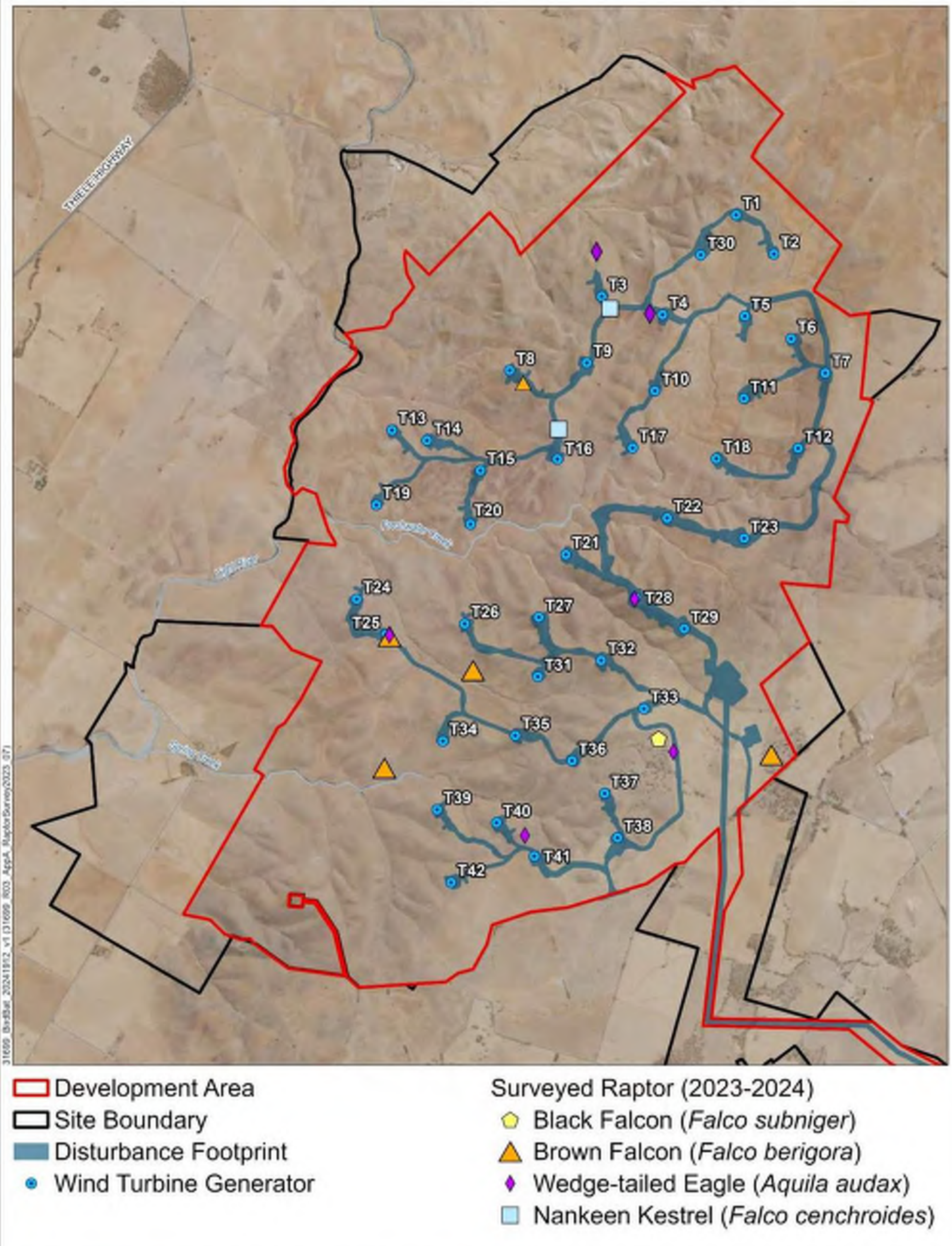

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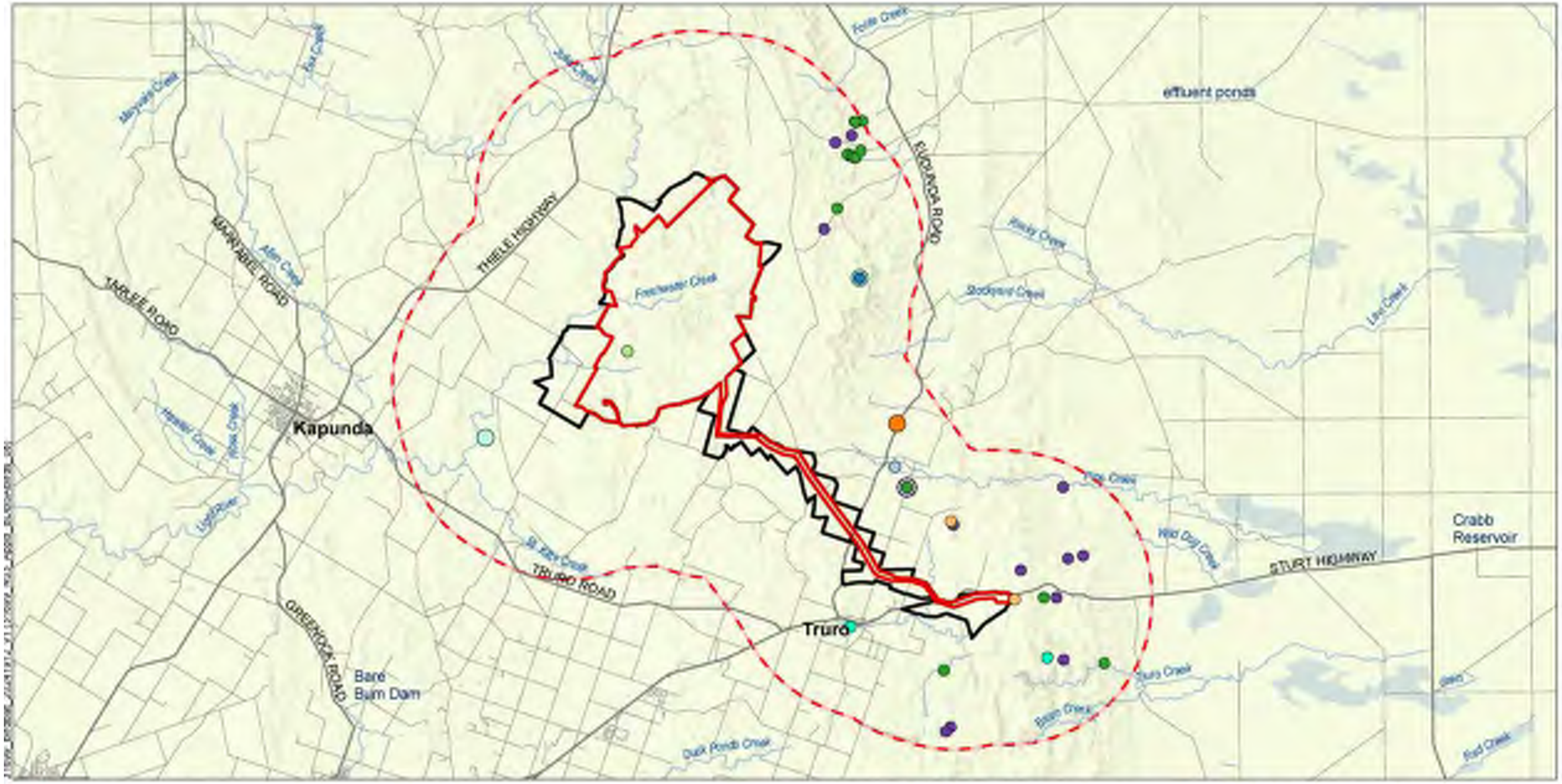
APPENDIX B

Threatened species records within Twin Creek Wind Farm



- Development Area
- Site Boundary
- Buffer (5 km)
- Main road
- Local road
- Water course
- Water body

BDBSA Threatened Birds

- Australian Bustard (*Ardeotis australis*) NPW: V
- Black Falcon (*Falco subniger*) NPW: R
- Blue-winged Parrot (*Neophema chrysostoma*) NPW: V, EPBC: VU
- Diamond Firetail (*Stagonopleura guttata*) NPW: V, EPBC: VU
- Elegant Parrot (*Neophema elegans elegans*) NPW: R
- Hooded Robin (YP, MN, AP, MLR, MM, SE) (*Melanodryas cucullata cucullata*) NPW: R, EPBC: EN
- Peregrine Falcon (*Falco peregrinus macropus*) NPW: R
- Plumed Egret (*Ardea intermedia plumifera*) NPW: R
- Restless Flycatcher (*Myiagra inquieta*) NPW: R
- Southern Whiteface (*Aphelocephala leucopsis leucopsis*) EPBC: VU

umwelt

Data Source: Umwelt (2024), ESRI (2024), DEW (2022), DIT (2022), RES (2024)
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Traffic Impact Assessment

by MFY

RES GROUP

TWIN CREEK WIND FARM AND ENERGY STORAGE FACILITY

TRAFFIC IMPACT ASSESSMENT

January 2025

23-0154

Traffic • Parking • Transport

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DOCUMENT ISSUE

Revision issue	Date	Description	Approved by
Draft 1	20 Oct 2023	Draft for review	SV
Draft 2	2 Nov 2023	For client issue	MLM
Draft 3	14 Feb 2024	Updated traffic route	MLM
Final	15 Feb 2024	Final Report	MLM
Revision A	23 Oct 2024	Amended Plans	MLM
Revision B	17 Jan 2025	Amended Plans	MLM

CONTENTS

1.0 INTRODUCTION

It is proposed to develop a wind farm and energy storage facility on agricultural land adjacent to Twin Creek in the North Mount Lofty Ranges. The subject site spans across Hansborough, Bagot Well and St Kitts. The proposed development will include:

- up to 42 wind turbine generators with the Vestas V172-7.2MW as the candidate turbine, with an overall turbine blade tip height up to 220 metres, a hub height of up to 134m and a rotor diameter of up to 172m;
- a battery energy storage system (BESS) with an indicative capacity of 215MW;
- two electrical substations (one project substation within the windfarm boundary and one cut-in terminal substation).

The proposed development will connect to the proposed cut-in terminal substation facility to be located adjacent Sturt Highway in Truro.

An existing approval for a development on this site includes the installation of up to 51 wind turbines as well as other facilities. The current proposal will have a reduced number of wind turbines which will have larger blades, thus optimising the efficiency of the facility.

MFY has been commissioned to assess the traffic implications associated with the current proposal. This report summarises the traffic investigations that were completed for the purpose of the Development Application. In completing the assessment, the report considers the traffic assessment completed for the original application.

This assessment also includes a preliminary review of the proposed access and traffic route for delivery vehicles during construction, including swept path requirements for over size over mass (OSOM) vehicles which are not within the gazetted OSOM routes. The assessment does not, however, include a heavy vehicle route assessment which may be required to obtain relevant permits during constriction or preparation of a construction traffic management plan. Such documents would typically be prepared post development approval, the requirement for which would be included as a condition.

Additionally, the assessment includes a review of the potential safety implications such as driver distraction on the adjacent roads or impacts to existing road users. Austroads guidelines have been referenced in identifying the relevant safety considerations that may be applicable to the facility.

2.0 EXISTING SITUATION

The subject site is located in the Northern Mount Lofty Ranges to the east of Light River. The site is located within the Light Regional Council and Regional Council of Goyder. The substation site will be located in Truro with frontage to Sturt Highway in the Mid Murray Council area. Figure 1 identifies the subject site and the arterial roads in close proximity to the site.

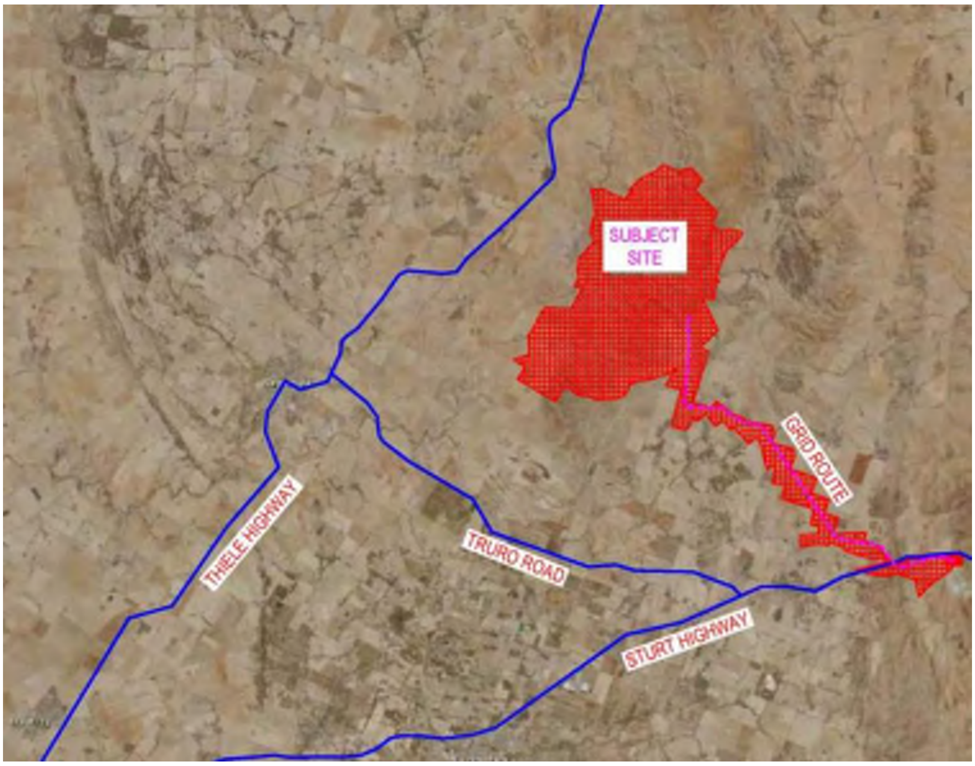

Figure 1: Subject site

2.1 EXISTING ROAD NETWORK

2.1.1 ARTERIAL ROADS

Arterial roads in the vicinity of the subject site include Sturt Highway, Thiele Highway and Truro Road. These roads are in the care and control of the Commissioner of Highways.

Sturt Highway has a posted speed limit of 110 km/h and an average daily traffic volume of 3,900 vehicles. The road has a dual carriageway with sealed shoulders for most of its length but widens to provide for channelised turn lanes at intersections. Sturt Highway is gazetted for use by PBS Level 3B vehicles (road trains).

Thiele Highway has a posted speed limit of 100 km/h and an average daily traffic volume of 1,400 vehicles. It has a dual carriageway with sealed shoulders. The majority of the

Thiele Highway is gazetted for use by PBS Level 3A vehicles (road trains), albeit the section through Kapunda is limited to PBS Level 2A vehicles (B-doubles).

Truro Road has a speed limit of 100km/h and an annual average daily traffic volume of 1,500 vehicles which reduces to 200 vehicles to the east of Belvidere Road. The road has a dual carriageway with adjacent unsealed shoulders and is gazetted for use by PBS Level 3A vehicles between Sturt Highway and Kapunda.

2.1.2 LOCAL ROADS

Bagot Well Road, Camel Farm Road, Flagstaff Hill Road and Mosey Road provide the preferred access route to the subject site. All roads are unsealed and in relatively good condition. The default speed limit of 100km/h applies to these roads, albeit drivers may not adopt such a speed due to the unsealed nature of the road.

The roads vary in width between approximately 6.0m and 8.0m. They provide local access for adjacent farming properties. Existing traffic volumes on the roads are low and would include farm machinery as well as domestic vehicles.

Bagot Well Road crosses St Kitts Creek at a bridge. The road bends in this location which creates a constraint for the swept path of larger vehicles and for two-way traffic movements.

A number of roads were also identified within the subject site. Site investigations confirmed that many of these roads are unmade, with some consisting of only wheel tracks and are gated, therefore restricting public access.

3.0 PROPOSAL

The proposed development will include:

- up to 42 Wind Turbine Generators (WTG), with the Vestas V172-7.2MW as the candidate turbine, with an overall turbine blade tip height up to 220 metres, a hub height of up to 134m and a rotor diameter of up to 172m
- a battery energy storage system (BESS) with an indicative capacity of 215MW
- two electrical substations (one project substation within the windfarm boundary and one cut-in terminal substation).

Figure 2 identifies the proposed wind farm site, including the Terminal substation.

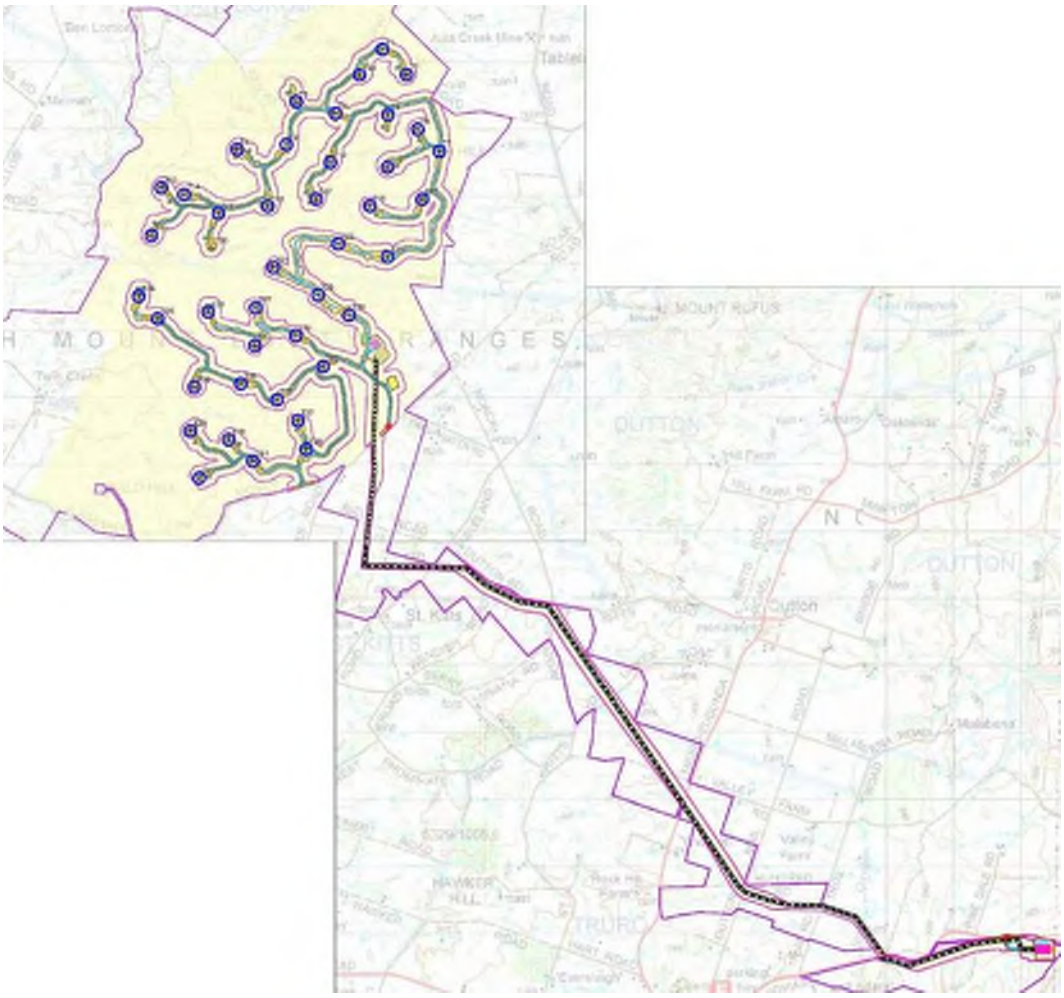

Figure 2: Proposed wind farm and terminal substation

3.1 TURBINE LOCATIONS

The proposed wind turbines will be located within the subject site clear of any road reserve. Figure 3 identifies the span of the blades of the wind turbines and demonstrates that they will be located within the subject land.

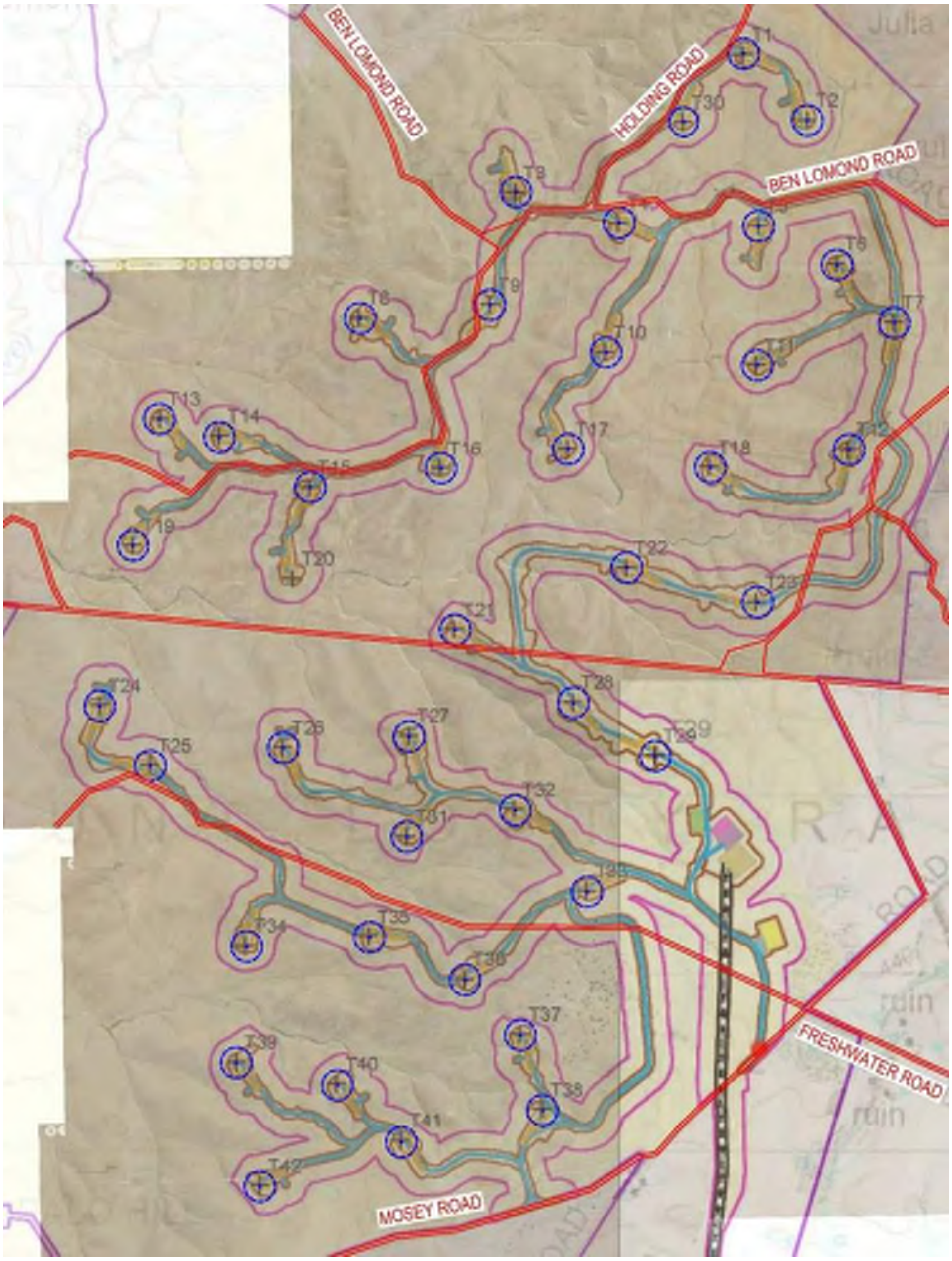

Figure 3: Wind turbines located to ensure space of blades is within the subject land.

3.2 WIND FARM

The proposed wind farm will have two access points on Mosey Road. The access points will be located on either side of Whites Road. The western access point will service the smaller cluster while the eastern access point will service the larger cluster. The proposed access locations will be used for the construction and operational phases of the project. Figure 4 identifies the proposed access locations for the wind farm.

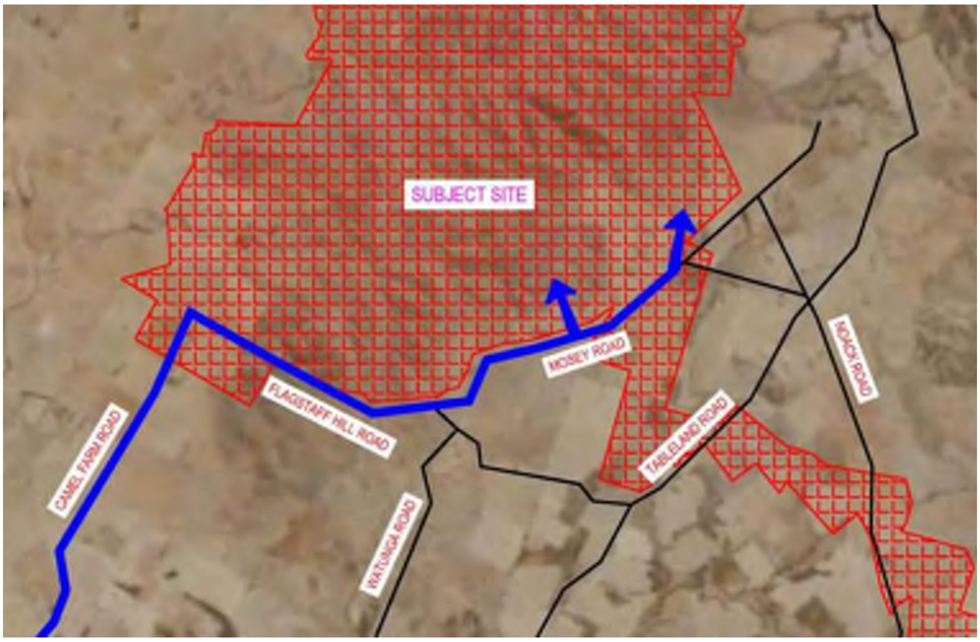

Figure 4: Proposed access points for the wind farm.

A site assessment verified that sightlines at the proposed access locations will meet Safe Intersection Sight Distance (SISD) requirements specified in *"Austroads Guide to Road Design Part 4A – Signalised and Unsignalised Intersections"* (AGRD04A).

Internal driveways will be constructed to provide access to individual turbines and the substation.

3.3 TERMINAL SUBSTATION

The terminal substation will be accessed via Sturt Highway. A new access will be constructed to provide access to the terminal substation, located approximately 200 m west of the proposed substation to ensure that SISD requirements are met in accordance with the requirements in AGRD04A as shown in Figure 5.

Figure 5: Proposed access points for the terminal substation to meet SISD requirements

A driveway will be constructed to provide access to the substation. Typically only domestic vehicles and small trucks will require access to the facility when it is operable and such vehicles will be able to enter and exit the site in a forward direction with turning movements permitted in each direction. The access will also cater for the access of large vehicles if these were required to access the site when it is operating (such as to deliver a component required to repair the substation for example).

3.4 TRURO BYPASS

In assessing access options for the site, consideration has been given to the impact to access for the land which could occur as a result of the potential road project. While the Truro Bypass project is still in the planning phase (and not funded), DIT has issued a high level concept plan which identifies the anticipated route for the road. Figure 6 illustrates the proposed terminal substation location relative to the potential bypass.

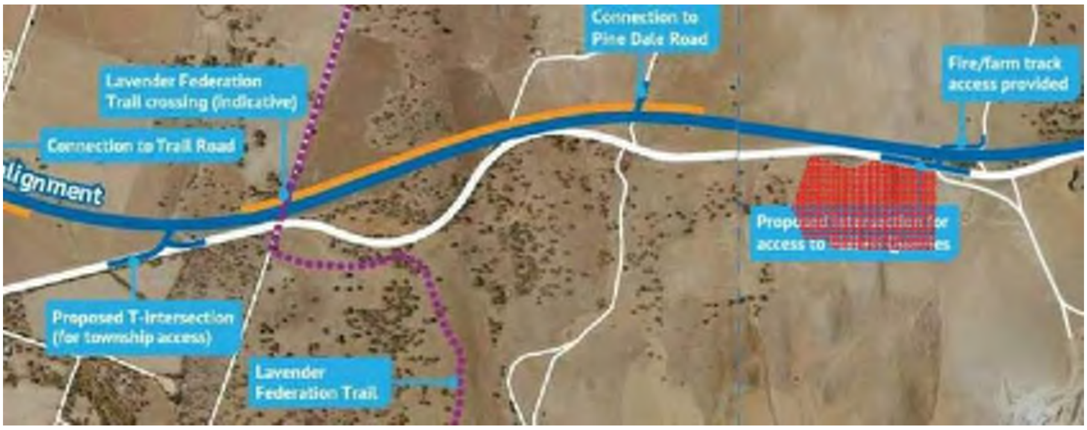

Figure 6: Proposed terminal substation location relative to the potential Truro bypass (credit: DIT)

The location and design of the access will continue to operate safely and efficiently if the Truro Bypass was constructed as per the above concept.

4.0 TRAFFIC SAFETY ASSESSMENT

The proposed wind farm will generate minimal traffic movements. Once operational, vehicles accessing the site will be limited to maintenance vehicles which will have minimal impact on the road network. The potential impact to road safety is minimal given the low volumes. However, it is also important to consider whether the turbines pose a risk to the safety of drivers on the road network.

The existing low traffic volumes reduces any potential for impact associated with distraction potential caused by the proposed turbines. Nonetheless, consideration has been given to the variation to the traffic environment and any associated impacts which could be created by the proposal.

Advice in relation to road safety considerations for location of infrastructure is provided in Austroads “Guide to Road Design – Part 6: Roadside Design, Safety and Barriers” (AGRD06) and “Guide to Road Design - Part 6B: Roadside Environment” (AGRD06B).

The key aspects of road safety consideration for the proposed development are:

- whether the location of the tower presents a risk to drivers due to its proximity to the road; and
- whether the moving blades on the turbine represent a distraction to drivers.

Towers adjacent to publicly accessible roads will be located at least 500 m away. Such a separation would ensure that the towers will be well outside the range to cause an impact to errant vehicles.

With respect to driver distraction, consideration has been given to whether the turbines will be located within the cone of vision of drivers. The cone of vision represents an area adjacent to the road which could be within a driver’s general field of vision. While AGRD06B does not stipulate that an object within the cone of vision will cause a distraction for drivers, removal of an object from the cone of vision will mitigate the risk of driver distraction.

The cone of vision relates to the angle of vision for drivers at any position along a road to the potential point of distraction which, in this instance, is considered to be the blades. The speed of vehicles is also a factor in determining the potential distraction for drivers, with the cone of vision decreasing for higher speeds. The safety factor needs to consider the potential distraction of drivers and the speed of the vehicle. Accordingly, the cone of vision has been assessed at a speed of 80km/h as the cone of vision criteria is greater (and hence compliance with this requirement will be of greater safety benefit).

Appendix A includes plans of the cone of vision assessment for all proposed turbines which would be located in relatively close proximity to a road. The proximity of Turbine T38 to Mosey Road is the closest and has been illustrated in Figure 7.

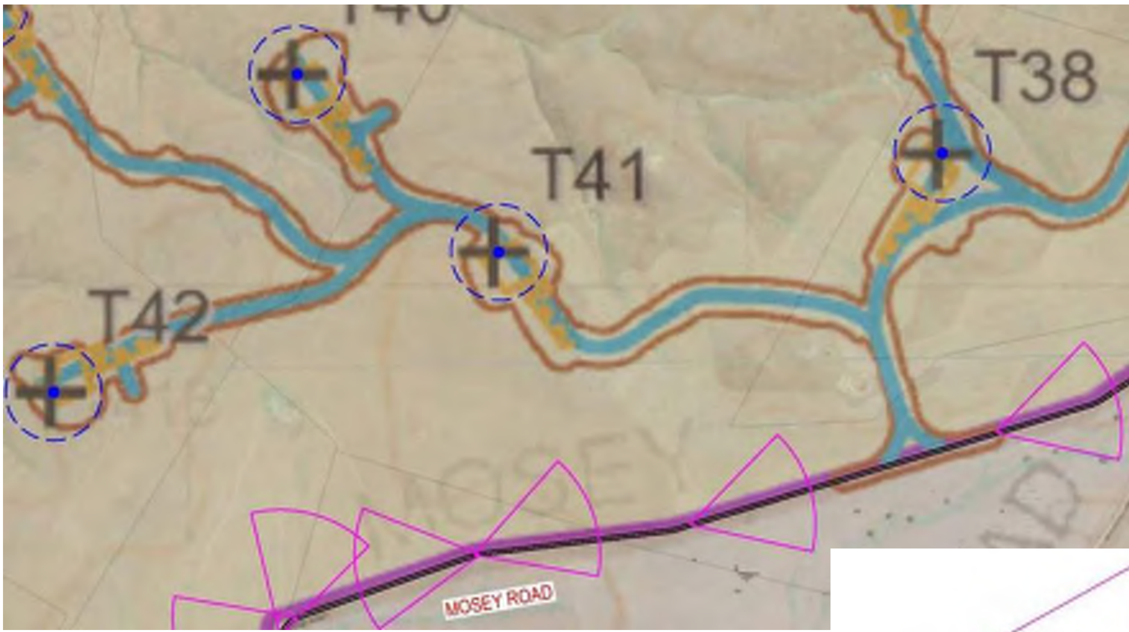

Figure 7: Cone of vision assessment for T38

The above figure confirms that the blade of the turbine will be significantly outside the cone-of-vision, thus mitigating the risk of distraction for drivers. All other turbines will be further from a publicly accessible road and will satisfy these criteria.

5.0 CONSTRUCTION TRAFFIC ACCESS REQUIREMENTS

The subject proposal is unique in that it will generate more traffic during the construction phase than the operation phase. Further, delivery of the wind turbine components, specifically, the blades, will require very large vehicles to be driven under police escort.

Accordingly, consideration has been given to the construction traffic access requirements including the delivery of wind turbine components and construction materials to facilitate the development of the site.

This review considers the route which will be adopted for the OSOM vehicles which will access the site during the construction period and, in particular, the long vehicle which will deliver the turbine blades. General access vehicles, including semi-trailers, could use alternate public road routes during construction.

5.1 WIND TURBINE COMPONENT'S DELIVERY

A range of OSOM vehicles will be required to deliver the components of a wind turbine. It will be important during the detailed construction route assessment to review the turning requirements when the actual delivery vehicle is identified having regard to any specific constraints along the preferred route (such as height restrictions, bridge limitations or specific requirements within townships).

The approved proposal considered the use of Sturt Highway for delivery vehicles to access the site and considered different routes gazetted for OSOM vehicles, depending on the port of origin. Figure 8 identifies the route options from Port Adelaide and Port Pirie.

Figure 8: Proposed route option for OSOM vehicles.

Delivery vehicles will access the site from Sturt Highway via Truro Road as shown in Figure 9.

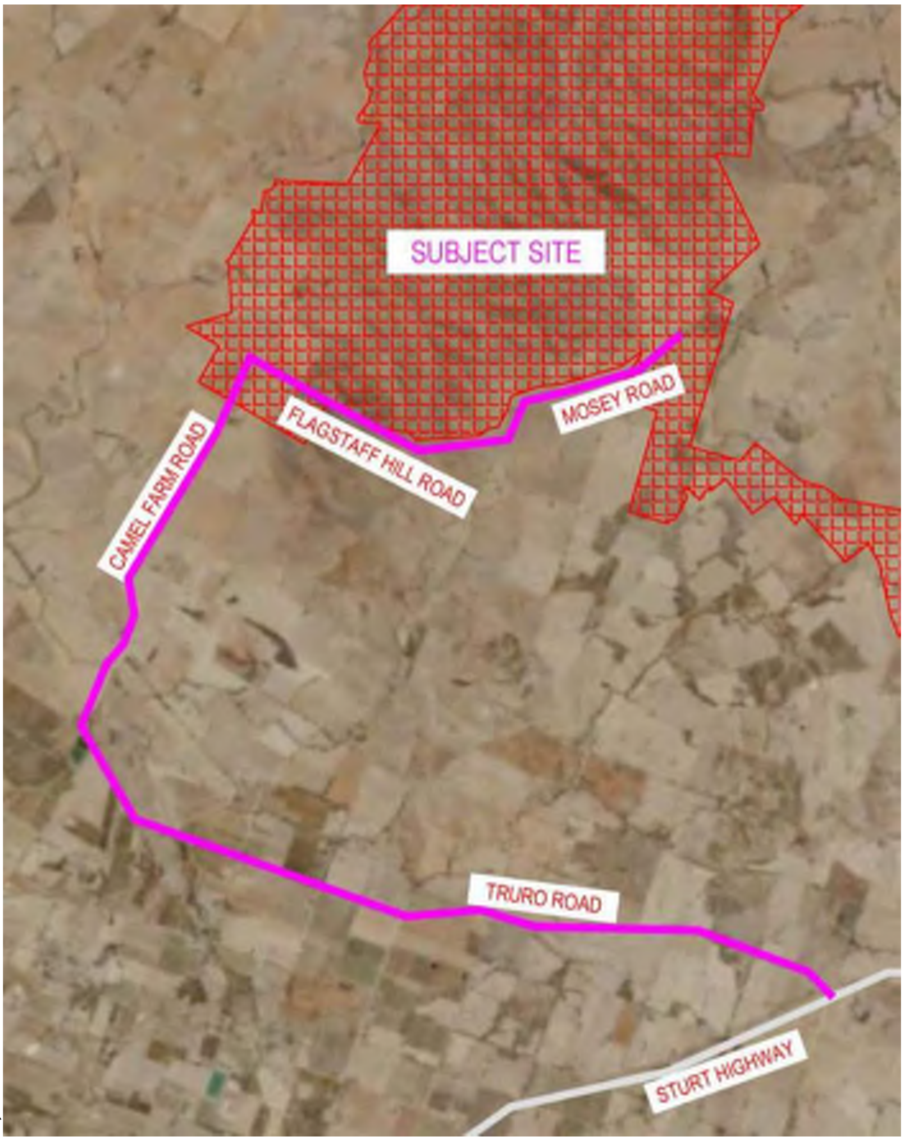

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Figure 9: Proposed OSOM delivery route option.

The site assessment confirmed that the roads along this route are in good condition. The critical scenario is the delivery of the blades which will require a long twin steer vehicle which will be the largest vehicle to access the site during construction. A review of the vehicle has been completed at the following key locations:

- Sturt Highway/Truro Road intersection;
- Truro Road/Bagot Well Road intersection;
- Bagot Well Road/Camel Farm Road intersection;
- Through the bends on Flagstaff Hill Road;
- Bagot Well Road/Mosey Road intersection;
- the bends on Mosey Road; and
- the bridge on Bagot Well Road approximately 900 m north of Truro Road;

The turn paths were prepared using a twin steer semi-trailer which has a variable length trailer. Typically the trailer would be slightly shorter than the blade which would extend over the end of the vehicle. While it is important to review the accessibility once the route and vehicle are confirmed, the following assessment will give guidance to areas where upgrades may be warranted to facilitate vehicle access.

Figure 10 illustrates the vehicle turning at the Sturt Highway/Truro Road intersection.

Figure 10: Vehicle navigating the Sturt Highway/Truro Road intersection

Figure 11 illustrates the turning movements of vehicles at the Truro Road/Bagot Well Road intersection.

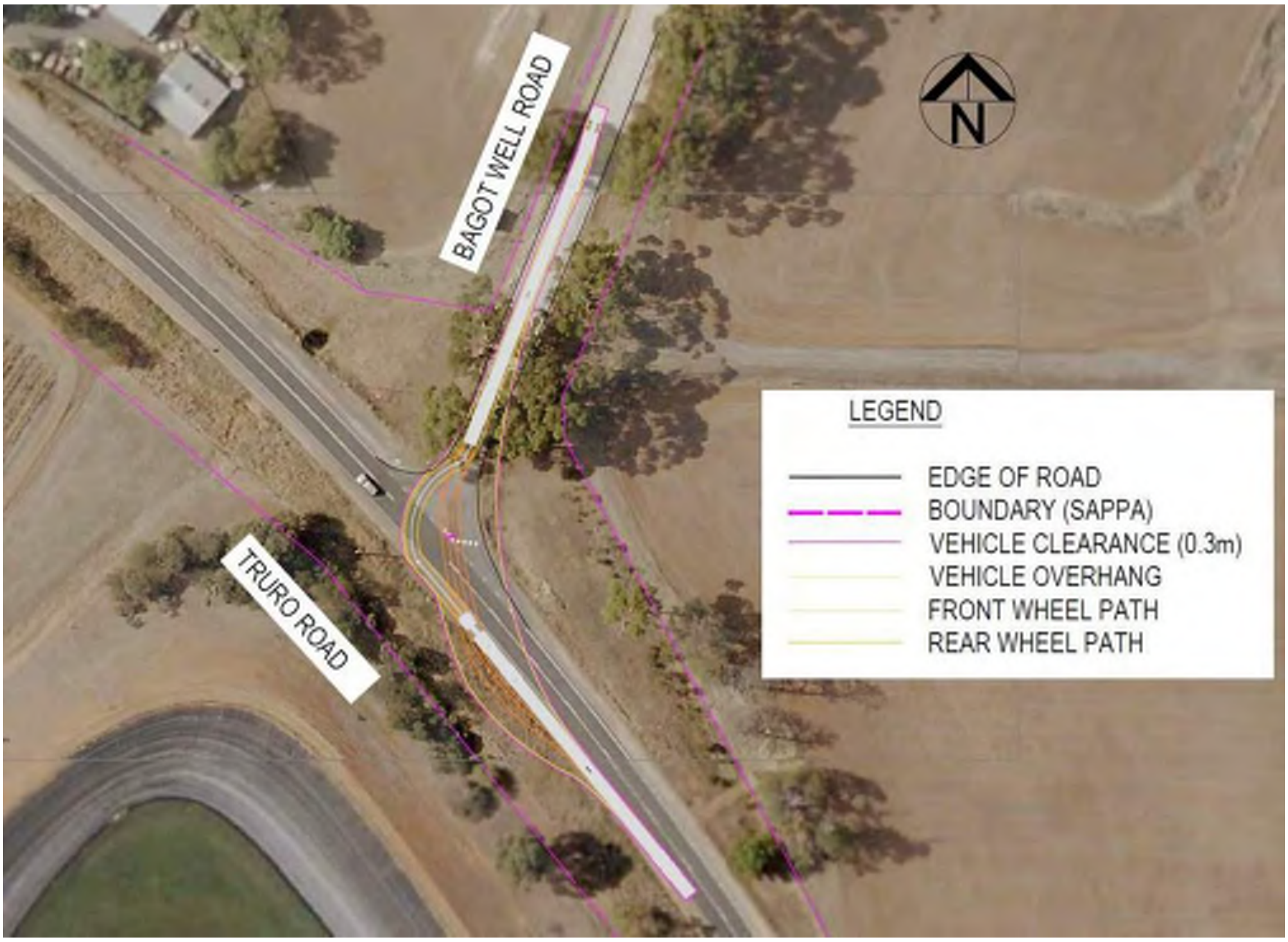


Figure 11: Vehicle navigating the Truro Road/Bagot Well Road intersection

There are trees on either side of Bagot Well Road. The above swept path shows that it would appear the vehicle can navigate between the trees, albeit some pruning may be required where limbs extend across the road.

Figure 12 identifies turning movements at the Bagot Well Road/Camel Farm Road intersection.

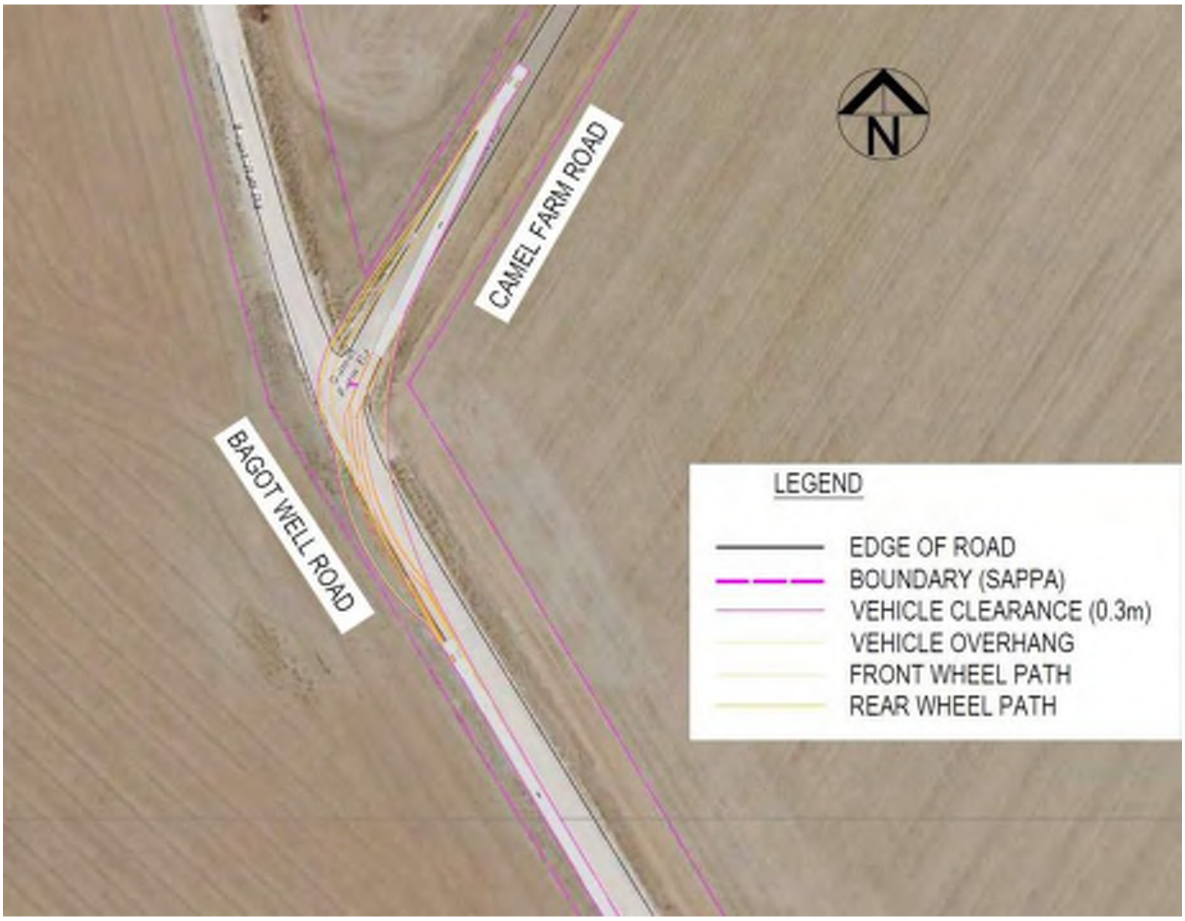


Figure 12: Vehicle navigating the Bagot Well Road/Camel Farm Road intersection

Figure 13 illustrates a vehicle navigating the bends on Flagstaff Hill Road.

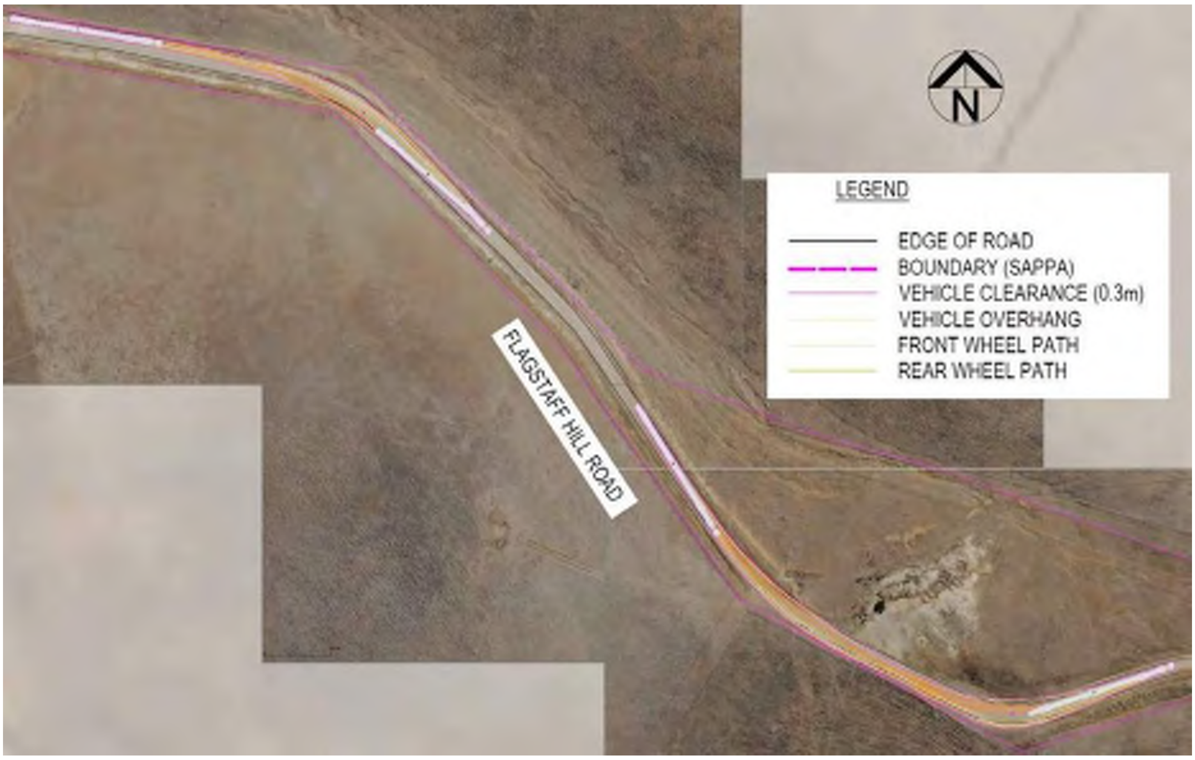


Figure 13: Vehicle navigating the bends on Flagstaff Hill Road

Figure 14 illustrates a vehicle turning at the Bagot Well Road/Mosey Road intersection.

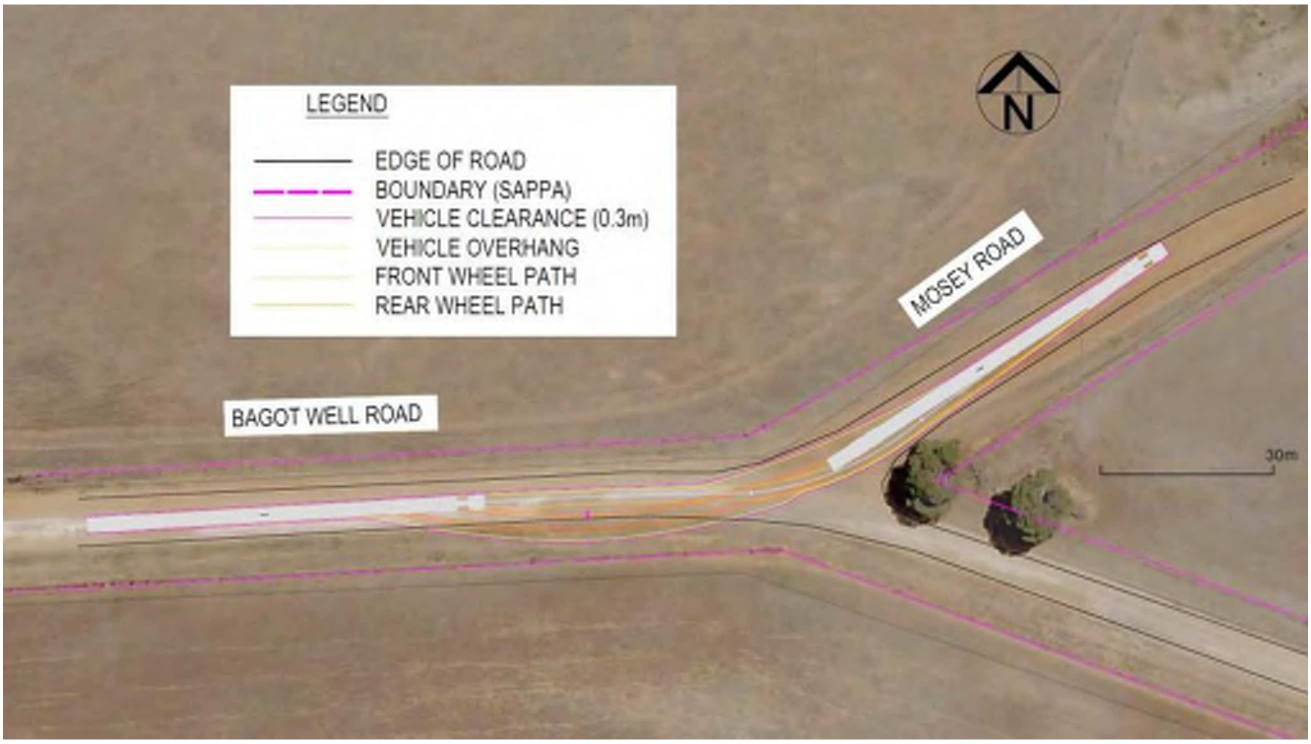


Figure 14: Vehicle navigating the Bagot Well Road/Mosey Road intersection

Figure 15 illustrates a vehicle turning through the bends on Mosey Road.

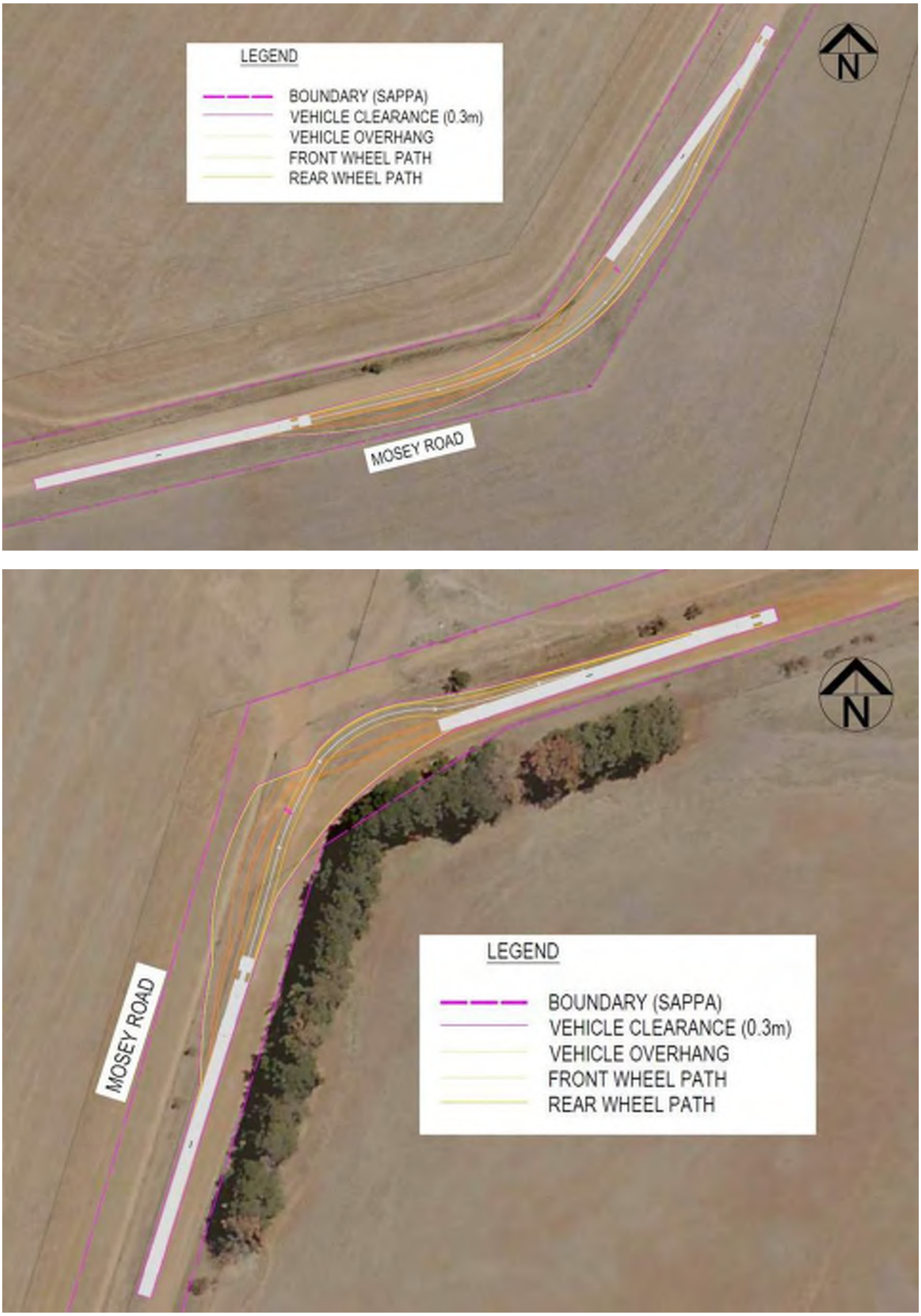


Figure 15: Vehicle navigating the bends on Mosey Road intersection

The above figures illustrate that while there will be some requirements for road pavement widening to accommodate turn paths, the access route would appear to be accommodated within existing road reserve. It would also appear that there would be minimal impact to trees (with some potential trimming required to achieve head-height clearance but no removal of large trees necessary).

Figure 16 illustrates a vehicle navigating the bridge on Bagot Well Road approximately 900 m north of Truro Road.

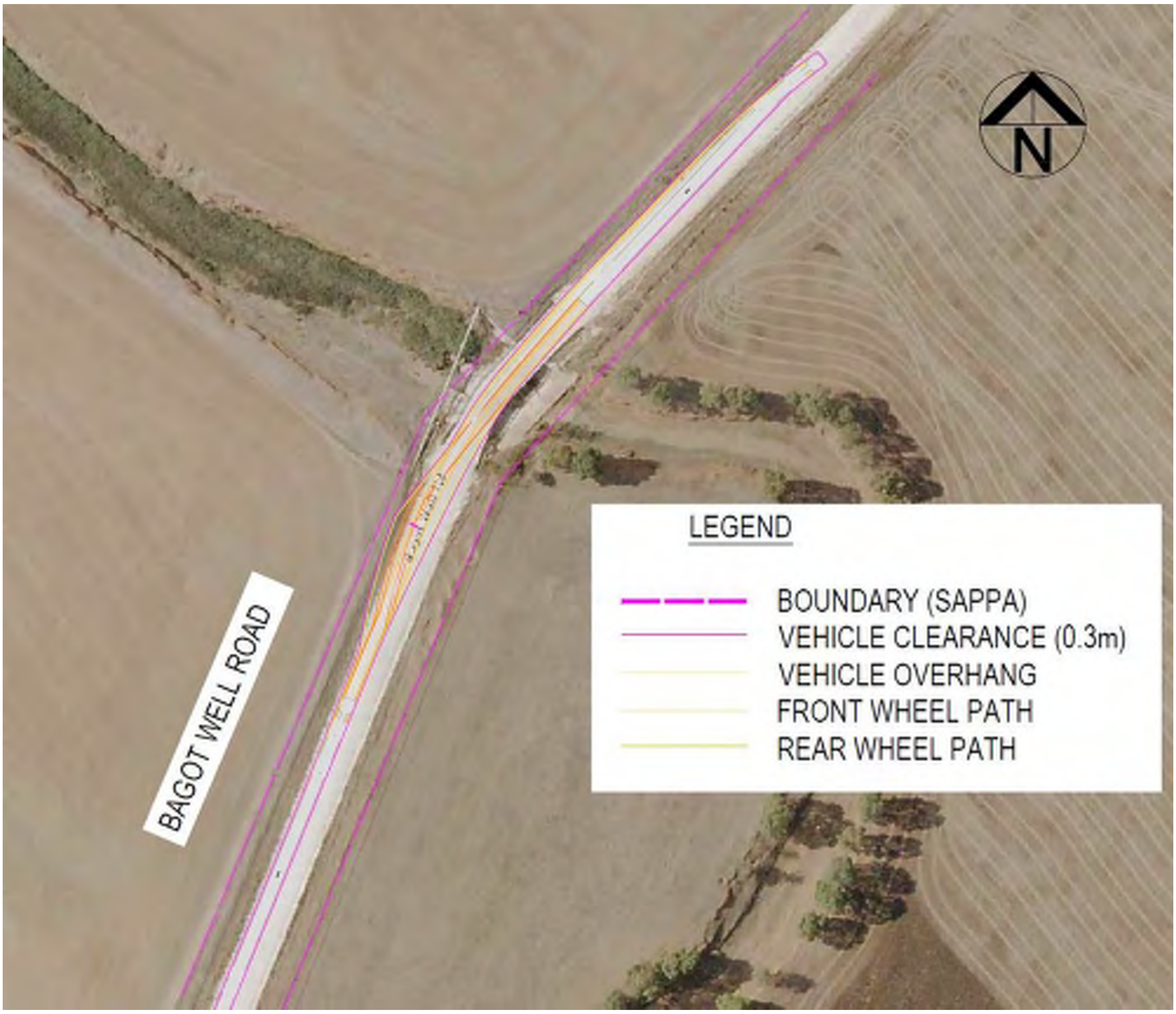


Figure 16: Vehicle traversing the bridge

It can be seen on the above figure that the bridge will need to be widened to accommodate the vehicle, together with a review of the structural integrity of the bridge. A detailed structural assessment of the bridge will be carried out to ascertain the extend of upgrade works required to ensure that it can sustain the OSOM vehicle loads. Upgrades recommended by the structural assessment would be implemented to ensure the bridge support these loads.

Vehicle access to the site of the development will occur from two locations on Mosey Road. Figure 17 illustrates the proposed eastern access location which will form the principal access for the site.

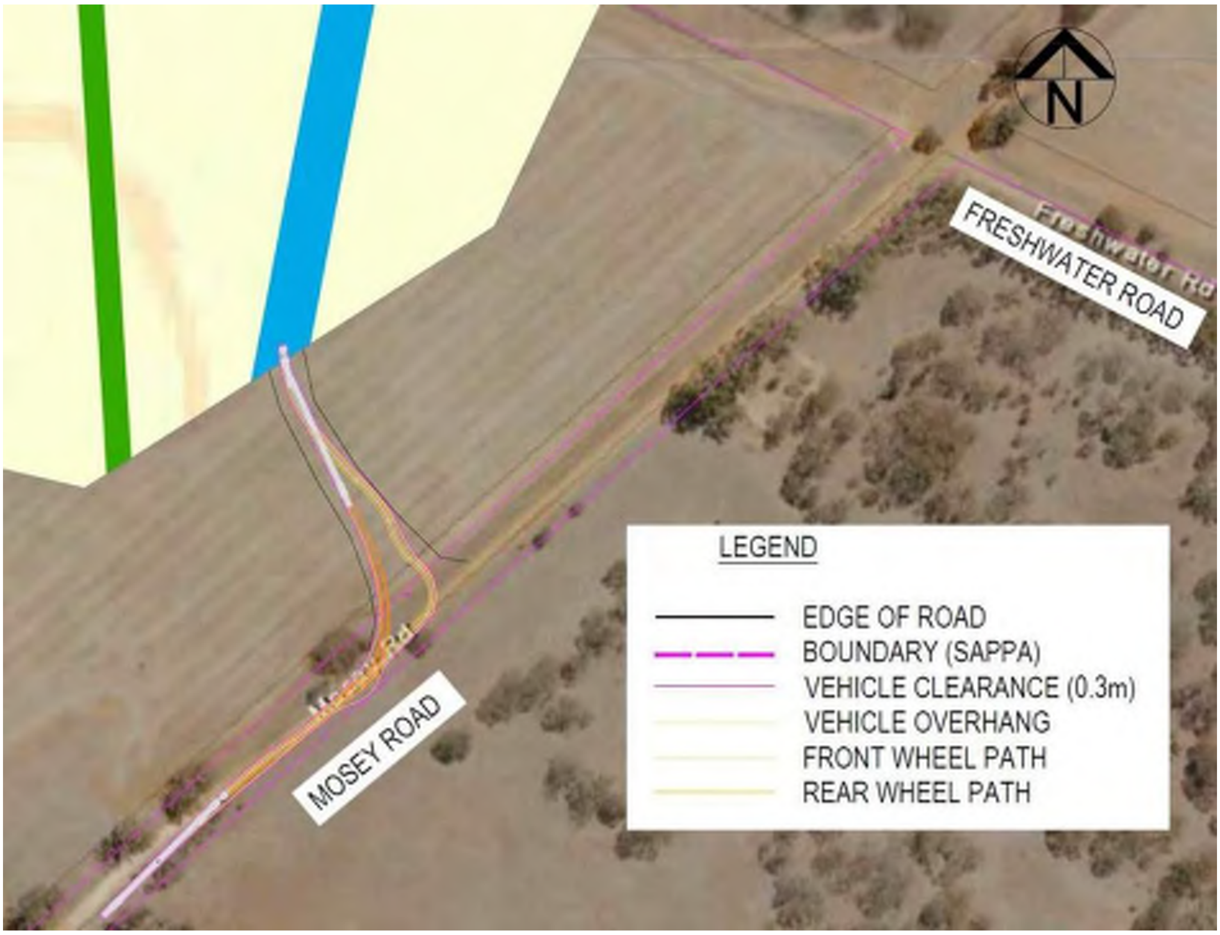


Figure 17: Vehicle accessing via the principal access

Figure 18 illustrates the proposed western access location.

Figure 18: Vehicle accessing via the western access

The proposed route will present a safe and viable option for the use of OSOM vehicles to transport wind turbine parts to the subject site. Minor widening of the pavement will be required at intersections. Upgrades recommended by the structural assessment would be implemented to ensure the bridge support these loads.

While the analysis shows that the modelled vehicle will not impact road features such as trees and SAPN poles or encroach into adjacent private land, the specific delivery vehicles has not been confirmed. A review of the area required to turn should be completed during the construction traffic assessment when further information is available in respect to the vehicle type.

Notwithstanding this assessment, an application to the NHVR accompanied by a Heavy Vehicle Route Assessment will be required for the use of these roads to accommodate the delivery vehicles.

5.2 TERMINAL SUBSTATION COMPONENT DELIVERY

The terminal substation will require the delivery of transformers that are approximately 8.0 m in width and will therefore require the use of OSOM vehicles. It is anticipated that a 25.0 m articulated low loader will be able to transport the transformers.

The vehicle will use the approved OSOM route to access the site via Sturt Highway. The construction access will need to cater for the access of the delivery vehicle. Figure 19 identifies the swept paths of the delivery vehicle at the access.

Figure 19: A 25.0 m articulated low loader vehicle accessing the terminal substation site

The above figure confirms that the low loader will be able to enter and exit the site at the proposed access.

5.3 CONSTRUCTION MATERIALS DELIVERY

The type of vehicles used for the delivery of construction materials is expected to range from rigid vehicles to B-Doubles. General Access Vehicles will likely use alternate routes when accessing the site. B-Doubles will either require a permit or use a gazetted route and hence these vehicles will likely utilise the identified access routes for the development when travelling to and from the site.

A construction traffic management plan will be required by DIT in order for the required permits to be issued. This will include details of the proposed access routes by OSOM vehicles, including proposed timing of component delivery and where police escort is required. Details in respect to temporary road works and traffic control signage will also be required.

5.4 IMPACT TO EXISTING USERS

The subject road network is currently used by large farm machinery. Such vehicles also require a permit to travel on the public road network (if the vehicle is not a general access vehicle) and such movements are managed appropriately. There is minimal impact created as a result of these movements because the volumes on the road are low.

The subject development will provide improvements to the road network to facilitate access for larger vehicles associated with the proposed development. While there will be a higher potential for conflict between large vehicles due to the increased traffic volume on the road, such volumes will be low and will be appropriately managed through vehicle escorts and other traffic control requirements.

The permit, escort and associated signage requirements will be adopted for all heavy vehicle transport movements. A good community engagement strategy/method to keep the community informed should also be established.

6.0 TRAFFIC IMPACT ASSESSMENT

6.1 CONSTRUCTION PHASE

Table 1 identifies the total trips forecast during the period of construction.

Table 1: Traffic generation rates

Material	Estimated Quantity	Vehicle Type	Rate	Two-way Trips
Concrete Materials	34,200 m^3	Semi-trailers	ten m^3 per truck	6,840
Reinforcing Steel	1,700 tonnes	Semi-trailers	ten tonnes per truck	340
Road Base	245,000 tonnes	Semi-trailers	ten tonnes per truck	49,000
Miscellaneous Equipment and Materials	Nominal	Semi-trailers	100 vehicles	200
Tower Sections	Five sections per tower	OSOM	one section per truck	470
Nacelles	Two sections per tower	OSOM	one section per truck	188
Hub	one hub per turbine	OSOM	one hub per truck	94
Blade	Three blades per turbine	OSOM	one blade per truck	282
Transformer	Two transformers	OSOM	one transformer per truck	4
Switchgear and other substation equipment	Nominal	Semi-trailers	120 vehicles	120
Employees	190	Cars/4WD	three persons per vehicle for 396 working days	50,160
Construction Equipment, Plant and Components	Nominal	Various	1,140 vehicles	1,140

Following is a summary of the trips which are anticipated for the entirety of the construction phase:

- 1,038 OSOM vehicle trips;
- 57,640 general access truck trips (up to 19.0 m semi-trailers); and
- 50,160 light vehicles.

The following average daily traffic volumes are anticipated based on an 18-month construction period:

- three OSOM vehicle trips;
- 145 general access truck trips (up to 19.0 m semi-trailers); and
- 125 light vehicle trips

Accordingly, the construction of the proposed development will generate approximately 273 trips per day.

With the exception of the OSOM vehicles for which the route will be fixed, drivers of other vehicles will have various options to access the site depending on their origin. Most drivers will use either Thiele Highway or Sturt Highway to access Truro Road. The additional traffic is low and will not change the nature or function of these arterial roads which have been designed to accommodate such traffic.

Between Truro Road and the site, drivers will use the local road network. The increase in traffic will not change the function of the local road network and subject to approval by Council, mitigation measures will be incorporated into the design to safety cater for all vehicles. Importantly, the increase will only occur for the period of construction and will not have a material impact on the road network.

6.2 OPERATIONAL PHASE

The traffic generated during the operational phase of the development will be limited to maintenance vehicles infrequently visiting the site. There could be instances where large maintenance vehicles will be required on-site, such as for the replacement of the turbine components. In such instances OSOM vehicles will be required and they will use the routes identified in Section 5.2.

7.0 SUMMARY

This report has addressed potential road safety and access requirements associated with the proposed Twin Creek Wind Farm. The traffic impact associated with the operation of the proposed facility will be negligible and will relate to safety for users of the adjacent roads rather than any impact created by traffic associated with the proposal.

A site assessment and analysis of the proposed development confirm that the locations of the turbines will satisfy the criteria for lateral and vertical clearance requirements to mitigate driver distraction on public roads.

Access to the development will be located such that sightline criteria are met and will be designed to accommodate the largest anticipated vehicle. Two access points will be provided to service separate areas of the site where connectivity is constrained by the natural terrain.

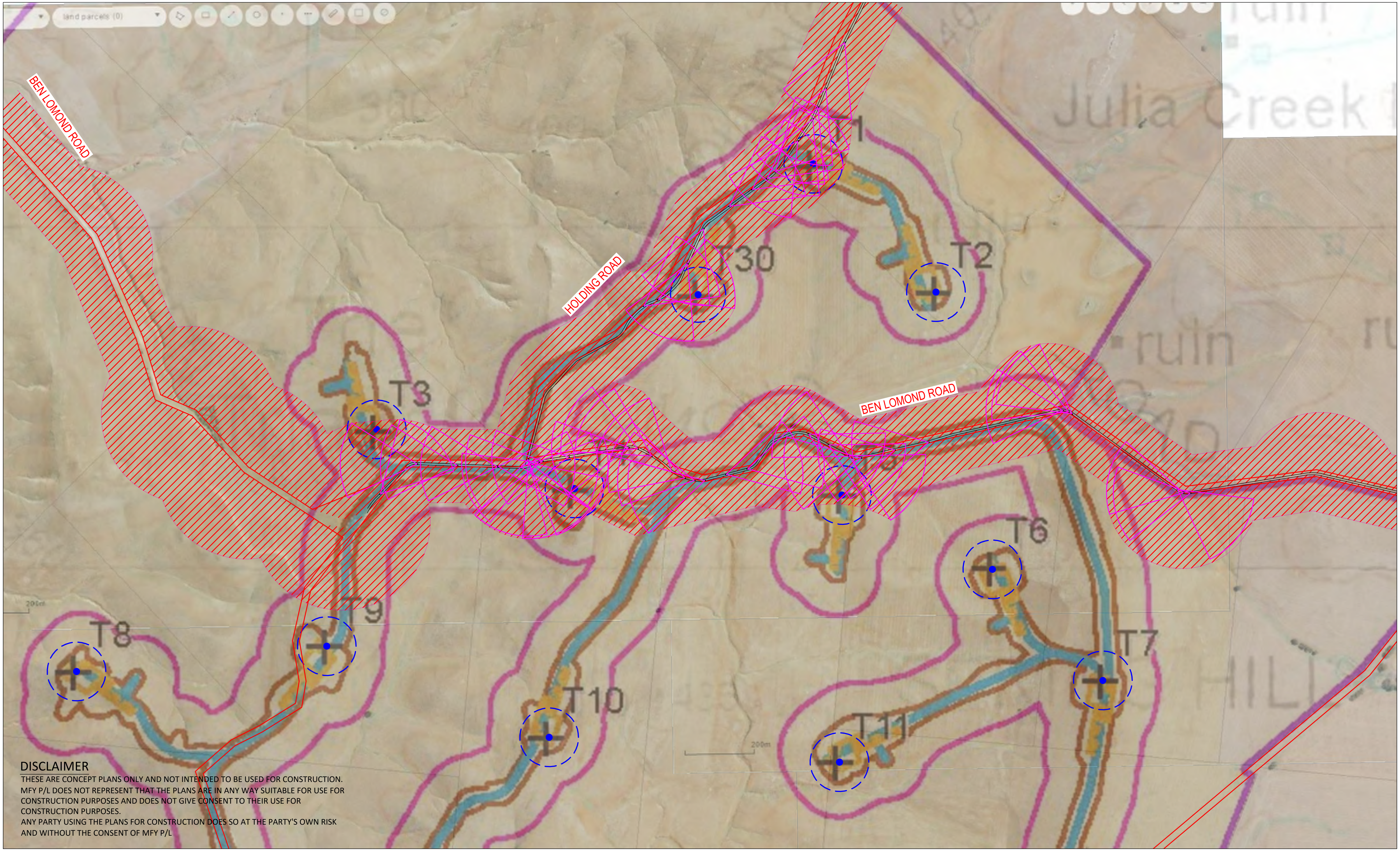
Notwithstanding the negligible impact associated with the operation of the proposal, the delivery turn path requirements for the turbines will be considerable, thus necessitating road infrastructure upgrades to service the site. These upgrades, which would be detailed in the construction traffic management plan, would appear to be accommodated within existing road reserve, although a review of the requirements having regard to the specific delivery vehicle will clarify any temporary construction works required.

The assessment has identified an OSOM route which would facilitate access between Port Adelaide or Port Pirie and the site. The transportation of turbine components will occur on these routes.

There will be a requirement to identify a road connection which can accommodate the OSOM vehicles between the access point(s) for the site and the OSOM route. The route which would be via Truro Road and Bagot Well Road, will require the bridge on Bagot Road to be upgraded to accommodate the design vehicle. A detailed assessment of the agreed access route will identify the infrastructure upgrade requirements to facilitate access to the site.

APPENDIX A

CONE OF VISION ASSESSMENT



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Wind Farm
Twin Creek
Cone Of Vision - Ben Lomond Road & Holding Road

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Date:	17.01.2025	Paper Size:	A3

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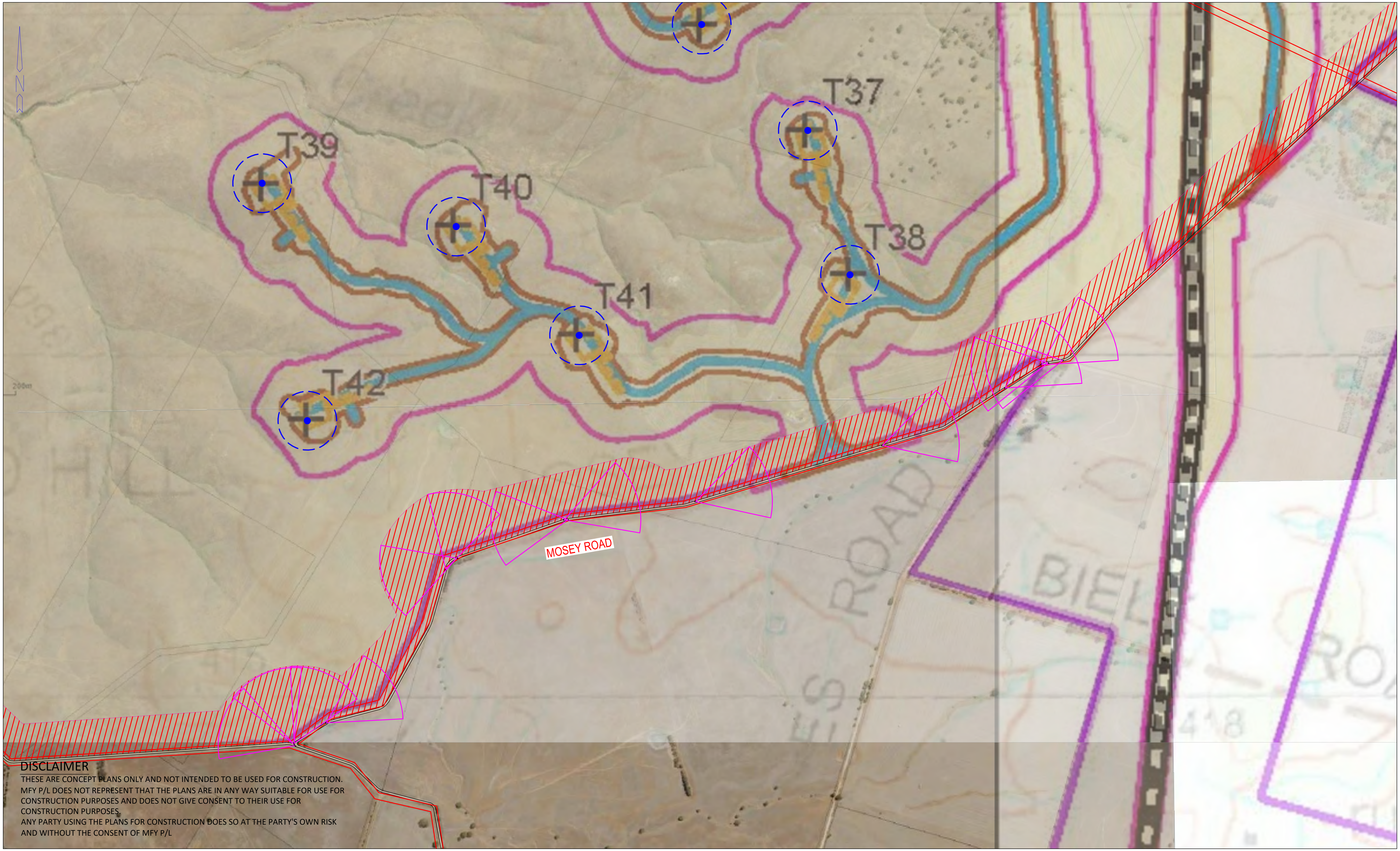

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Wind Farm
Twin Creek
Cone Of Vision - Mosey Road

Drawing:	MFY_230154_04_SH02	Revision:	D
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Date:	17.01.2025	Paper Size:	A3

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Civil, Geology and Hydrology Technical Assessment

by AECOM

Prepared for
RES Australia Pty Ltd
ABN: 55 106 637 754

Twin Creek Wind Farm and Energy Storage Facility - Development Application

Civil, Geology and Hydrology Technical Assessment

13-Jan-2025
Twin Creek Wind Farm and Energy Storage Facility
Doc No. Civil Geo Hydro R001

Twin Creek Wind Farm and Energy Storage Facility - Development Application

Civil, Geology and Hydrology Technical Assessment

Client: RES Australia Pty Ltd

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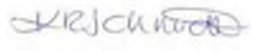
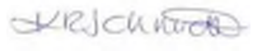
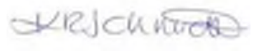
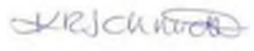
			Name/Position	Signature
A	6-November-2023	Draft	Kylie Schmidt Project Manager	
B	13-Feb-2024	Revised Draft	Kylie Schmidt Project Manager	
0	28-Oct-2024	Final for Use	Kylie Schmidt Project Manager	
1	13-Jan-2025	Final for Use	Kylie Schmidt Project Manager	

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Executive Summary

The following report highlights key issues associated with the Twin Creek Wind Farm and Energy Storage Project (the proposed development). It is noted there are a number of items that will be further addressed during future detailed investigations, design and documentation, including the preparation of a Construction Environmental Management Plan (CEMP).

This report addresses:

- Preliminary Civil design
- Desktop Geotechnical review
- Desktop Hydrology review

The scope of this report has been a desktop review and makes reference to a site visit completed for the earlier development consent that identified many turbine sites are located on areas with rocky outcrops or areas with very thin topsoil. Erosion was observed in the lower valley areas, where stormwater is flowing down through the catchment to the Light River. This highlights the lower lying areas have a high potential for erosion and sedimentation through the ephemeral creek lines which will need to be considered in the stormwater management sections of the CEMP.

1.0 Project Description

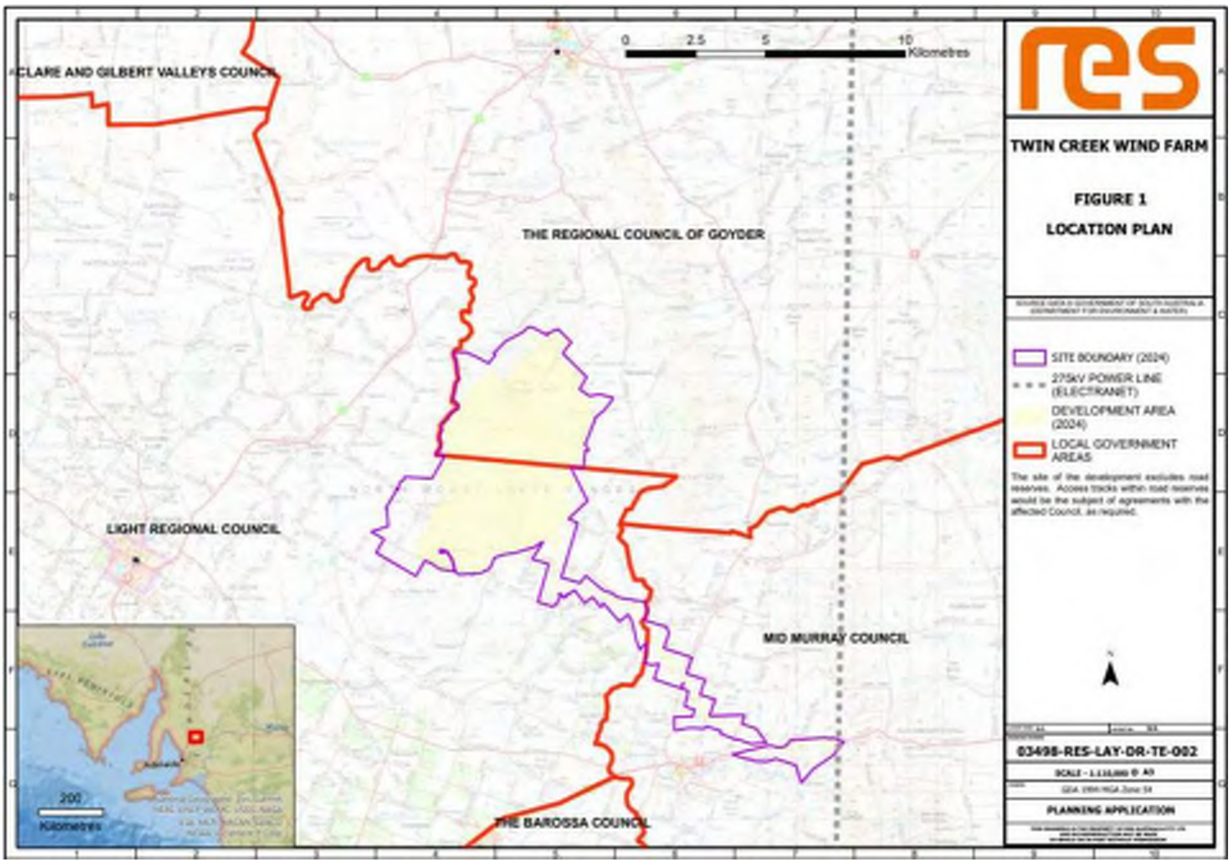
1.1 Introduction

RES Australia Pty Ltd (RES) has an active Development Plan Consent (422/E003/17) for the Twin Creek Wind Farm and Energy Storage Project proposed in the Mid-North of South Australia. The approved development is a 185MW wind farm comprising 51 wind turbines (3.6MW and up to 180 metre tip height) and associated 215 MW battery energy storage system. Since obtaining the planning consent in October 2019, RES has undertaken further design development in an evolving energy market.

To take advantage of the growth in wind turbine technology, RES have reviewed the approved wind farm and have optimised the Twin Creek Wind Farm and Energy Storage Project, particularly in terms of overall generating capacity, number, size and capacity of wind turbine generators. RES has considered options available to amend the current planning consent to achieve variations to the project and has resolved that the alterations resulting from the optimisation warrant the submission of a new development application (this application).

The proposed development is within the Mid - North area of South Australia. The site of the proposed development is approximately 90 kilometres north-east of Adelaide and north-east of Kapunda. The proposed development is located between the townships of Kapunda, Eudunda and Truro detailed below.

Figure 1 Location Plan



1.2 Project Overview

The site of the proposed development includes the area comprising the project infrastructure, as well as the proposed 275kV transmission line. The transmission line extends approximately 15 kilometres south-east of the site and connects to the Robertstown -Tungkillo 275Kv transmission line adjacent the Sturt Highway near Truro.

The proposed development will involve the construction and operation of up to 42 wind turbine generators (WTGs). Each WTG is proposed to have a name plate capacity of 7.2 Megawatts (MW) and a nominal generation capacity of up to 270MW. The proposed development includes a battery energy storage facility (BESS) with an indicative storage capacity of 215MW.

The proposed development is to be located approximately 90 kilometres north-east of Adelaide and between the townships of Kapunda, Eudunda and Truro.

The optimised proposed development will consist of the following components:

- based on the Vestas V172-7.2MW as the candidate turbine, with an overall turbine blade tip height up to 220 metres, a hub height of up to 134m and a rotor diameter of up to 172m. The final turbine model will be subject to a competitive tender process following development authorisation;
- up to 42 Wind Turbines Generators (WTG);
- each WTG has a name plate capacity of up to 7.2MW, with a total nominal installed generation capacity of up to 270MW;
- associated hard standing areas and access roads;
- operations and maintenance building and compound with associated car parking;
- two electrical substations (one project substation within the windfarm boundary and one cut-in terminal substation;
- a battery energy storage facility with an indicative capacity of 215MW;
- Overhead and underground electrical cable reticulation;
- overhead transmission line for approximately 15 kilometres from the on-site substation to the existing overhead Robertstown - Tungkillo transmission line east of Truro;
- temporary construction facilities including a borrow pit and concrete batching plant facilities.

The infrastructure layout for the proposed infrastructure in Appendix A. Design elements are subject to detailed design over the course of development.

2.0 Project Siting/Locality Description

The site is located on the tablelands that form the wide ridgeline associated with Bald Hill and Long Hill situated within the Northern Mount Lofty Ranges.

Landform of the area is defined by numerous ridgelines that run north-south through the site creating a series of parallel ridges, wide open valleys, tablelands and isolated topographic features.

Surrounding the site of the proposed development, the landscape is dominated by grazing with open paddocks defined by fenced boundaries and occasional trees to fence lines and creek lines. The land use that occurs in the open valley floor between the local ridgelines and across the tablelands associated with Bald Hill is more diverse with areas of arable cropping and grazing.

3.0 Introduction

This report has been prepared to provide a preliminary assessment of civil, geology and hydrology for the proposed wind farm and energy storage facility located at Twin Creek approximately 10 km north east of Kapunda, and the transmission line and terminal substation.

The purpose of the preliminary geology and hydrology assessment is to provide a baseline assessment of features that may be impacted by the proposed development or that may impact on the design of the proposed development .

The scope of this desktop civil, geology and hydrology assessment comprised:

- Preliminary access road civil design and proposed siting of substation, construction compounds etc (completed by RES)
- Review of readily available documents, including:
  - Geology maps;
  - Topographic maps;
  - Mineral Resource Potential maps;
  - On-line government databases relating to geology, surface water, registered water bores, mining tenements, historical mine and mineral workings;
  - Selected report books produced by the Department of Mines South Australia;
  - Selected reports regarding the Light River hydrology;
  - Stereo pairs of aerial photographs; and
- A site visit (drive-over) of the windfarm and energy storage facility site by AECOM geotechnical engineer and civil engineer in 2016 and drive-by in 2023.

4.0 Project Description and Preliminary Civil Design

4.1 Project Description

The proposed development and site are described in Sections 1 and 2.

The infrastructure includes up to 42 wind turbine generators (WTG's), access roads, foundations and crane hard standing areas and transformer housings at each turbine, a wind farm substation and control room, communication towers (if required), operation and maintenance (O&M) office/workshop compound, and temporary construction compounds. An indicative 215MW storage capacity battery energy storage system will be located on site.

Underground/overhead electrical cables connecting each turbine will generally be located adjacent to the site access roads. A wind farm substation and transmission line will also be required, with a grid route through to the terminal substation located at the gird connection point.

WTG's will generally be located along ridge lines. Access tracks linking all turbines will be constructed and site access will be gained from a dedicated route via public roads to the site via new or upgraded routes.

During construction, additional temporary infrastructure may include quarries for road base and concrete aggregate, on-site concrete batching plants, water sources for concrete, temporary soil stockpile locations, laydown areas for equipment and construction site compounds with facilities for the workforce.

4.2 Preliminary Civil Design

Preliminary civil design has been completed by RES and is included in Appendix A. This provides an initial preliminary layout and location for:

- Wind Farm access track centrelines and corridors
- Turbine hardstand layout
- Proposed location for substation(s), construction compound, temporary lay down areas and also concrete batch plant

Internal access roads have considered slopes generally to 15% maximum with some very isolated areas up to 18% - these will be further confirmed in future design stages and based on construction and operational requirements. 80 m minimum radius horizontal curves. The location of the infrastructure has considered constraints identified including pygmy blue tongue lizard (PBTL) offset and buffers, wedge tail eagle (WTE) nests, Aboriginal cultural heritage, cultural heritage survey, identified native, endangered or Environment Protection and Biodiversity Conservation Act (EPBC) vegetation. It also considered set back from associated dwellings and public roads/landowners, considered site topography of existing slopes and elevations and a buffer from watercourses.

It is noted that the civil design is preliminary and will be subject to updates during future stages as more site data becomes available and also further construction and operational considerations from contractors during early works.

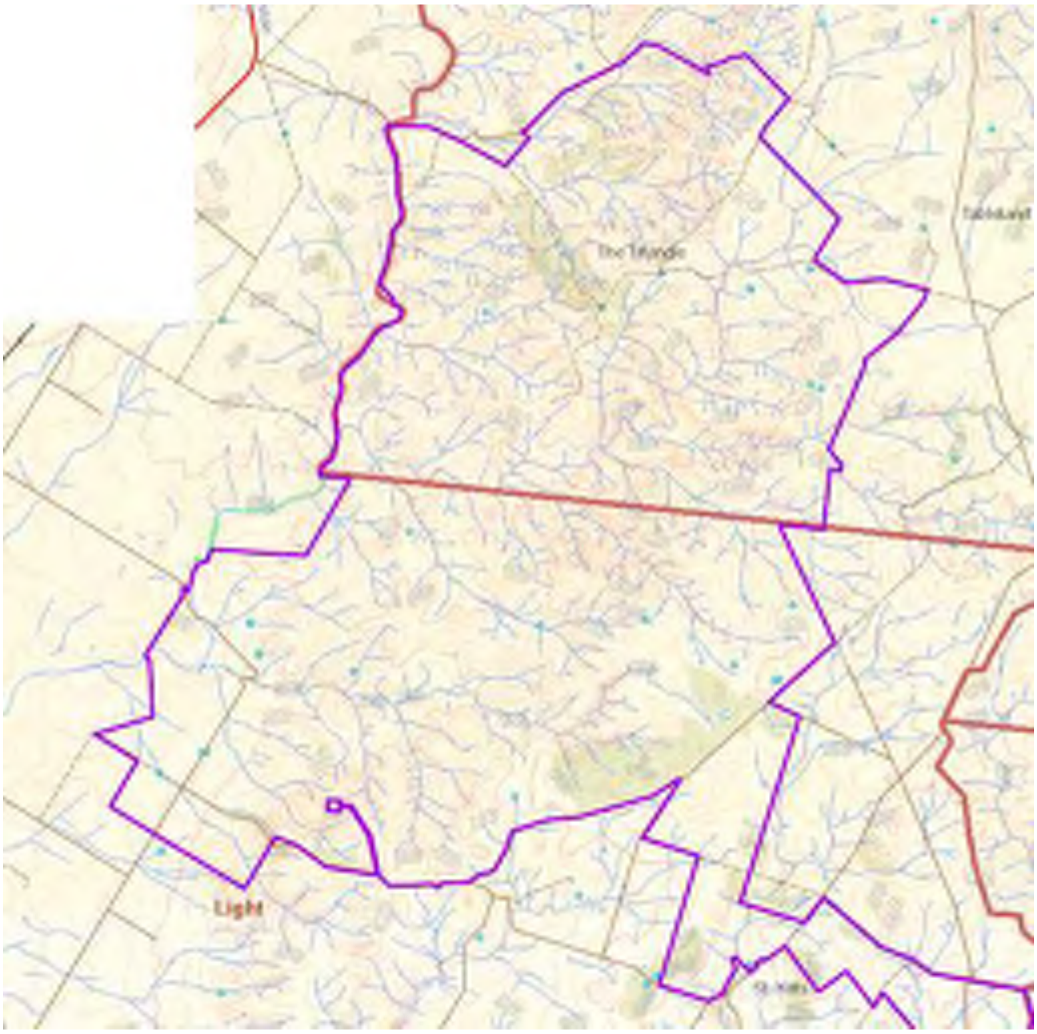
5.0 Hydrology, Hydrogeology and Geology Review

5.1 Surface Features

Wind Farm and Energy Storage

The wind farm and energy storage portion of the site is shown with reference to the topographic base map and contours on NatureMaps map sheet (which includes the 1:50,000 topographic data). The site is located within the North Mount Lofty Ranges, on the eastern side of the Kapunda – Eudunda Road, approximately 10 km from Kapunda and 15 km from Eudunda.

Figure 2 Topographic and surface features (source: NatureMaps)



Note: purple outline is the wind farm and energy storage site boundary, transmission line coming off on the south eastern edge.

The proposed wind turbine locations extend over an area approximately 8.5 km wide in the east-west direction, and about 9 km in the north-south direction, although the overall project boundaries extend considerably further.

The topography of the site is hilly, with numerous incised creek valleys typically draining towards the west into the Light River. The elevation of the Light River near the site varies from about RL 270 m to 290 m AHD, whereas the ridge lines and hills within the project site typically have elevations in the range of about RL 400 m to 450 m AHD.

The hills and ridge tops are generally rounded but become steeper towards the valleys where creeks are incised in relatively steep sided channels. In general, the terrain undulates somewhat more steeply in the southern part of the site.

Rock outcrops are visible throughout the site, ranging from rocky hill tops and ridges, to rocky creek beds. Orange clay typically overlay the rock, with the soil thickness varying up to about 3 m in some creek beds but reducing to close to zero on the hill tops.

At the time of the site visit, vegetation typically comprised low grass with occasional, scattered mature trees. Numerous small farm dams, some windmills and old stone ruins were also present across the site.

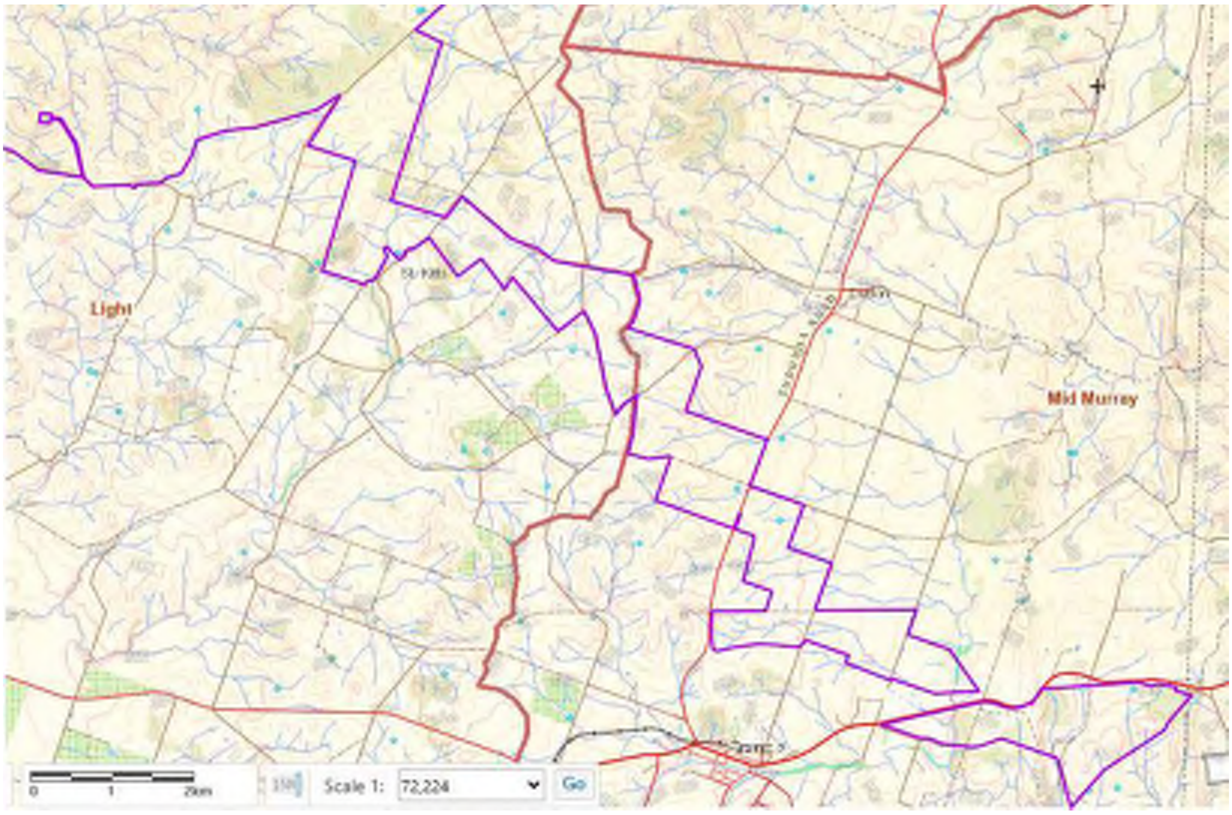
Access tracks across the site appeared to have been constructed from local materials, and typically comprised a mixture of gravel and exposed clay. The main tracks/roads had been sheeted with gravel that resembled local site won crushed/sorted rock. Trafficability was general acceptable for a light 4WD vehicles in dry conditions, but the more clayey tracks were slippery when wet.

No evidence of significant landslides was observed from either the stereo pairs of aerial photographs, or from the areas of the site observed during the walk-over. Considerable erosion and 'wombat holes' were observed in the orange clay, particularly near the creeks, and the wombat holes were also observed during a site visit in May 2023.

Transmission Line and Terminal Substation

The transmission line and terminal substation portion of the site is shown with reference to the topographic base map and contours on NatureMaps map sheet (which includes the 1:50,000 topographic data). The site is located within the North Mount Lofty Ranges, with the transmission line connecting the wind farm and energy storage portion of the site to the ElectraNet 275kV Robertstown to Tungkillo transmission line just over 5km to the east of Truro via a cut in terminal substation. The transmission line crosses the Eudunda Road and also the Sturt Highway.

Figure 3 Topographic and surface features (source: NatureMaps)



Note: purple outline is the wind farm and energy storage site boundary, transmission line coming off on the south eastern edge.

The proposed transmission line crosses topography that is hilly, with numerous incised creek valleys and also crossing Stony Creek close to the Sturt Highway. The elevation ranges from about RL 400 m to 450 m AHD near the wind farm and energy storage portion of the site down to about RL 300m AHD at the terminal substation. Numerous small farm dams are present along the route.

5.2 Regional Hydrology

Wind Farm and Energy Storage

Watercourses within the wind farm and energy storage facility site area are predominantly fed by rainfall and are ephemeral, ceasing to flow in dry weather. The Light River flows along the western boundary of the site, entering from the north western corner and leaving at the south western corner. The Light River has a catchment of approximately 1820 km^2. The majority of the catchment is used for dryland agriculture, with cereal and canola crops as well as livestock grazing.

Freshwater Creek enters the site in the north eastern area, flows in a south westerly direction through the site and contributes the Light River approximately halfway along the western boundary of the site. The catchment for Freshwater Creek is approximately 34.66 km^2 in size with approximately 20 km^2 of the catchment within the site boundary. Spring Creek originates in the south east area of the site, flows west and contributes to the Light River just outside the south west corner of the site. The catchment for Spring Creek is approximately 9.26 km^2.

Other watercourses within the site originate from the ridge on the eastern side of the site and flow through naturally occurring valleys before contributing to the Light River, or Freshwater Creek or Spring Creek. The watercourses throughout the site have catchment sizes ranging from 1 km^2 to over 30 km^2 for Freshwater Creek.

Some small farm dams were noted during the site visit as well as on topographical maps, which will capture some runoff.

Outside of the site boundary, the Julia Creek barite mine that operated between 1925 and 1974 is located upstream of Freshwater Creek. The presence of the mine indicates the potential for naturally occurring increased levels of mineral salts in the groundwater. There is no readily available information regarding mineralisation historically targeted in the mine.

Reference to Location SA and WaterConnect websites indicated the following regarding site hydrology:

- The site is within the surface water catchment of the Light River that flows through to Kapunda, Hamley Bridge and out to sea. There are numerous ephemeral creeks across the site that feed into Spring or Freshwater Creek and into the Light River.
- While the site is not located in a prescribed water resources area, it is noted that the site is located north and outside the Barossa Prescribed Water Resources Area, which covers groundwater, water courses and surface water.
- The site is located in Northern and Yorke Non-Prescribed Surface Water Area, with part of the site located in the Light River Catchment Surface Water Management Zone and Non-Prescribed Surface Water Management Zone (both NFCE CAT1-Low – low competition for resources with low consumptive use and the use of the water resources is uncapped or has not been fully allocated.

The Light River has been subject to water quality monitoring downstream of the site at Mingays waterhole located approximately 4 km south west of the site. The report on water quality by the EPA in 2011 indicated that at Mingays Waterhole that the Light River has marginal water quality at the times of year when low flow occurs. The report also identified that the Light River at this location was permanently wet and saline in autumn and Spring 2011, with nutrient and salinization impacts observed, large sediment deposition, sparse macroinverterbates present and riparian vegetation dominated by introduced species. Another monitoring location is located further downstream at Kapunda.

The Light River is also subject to a River Catchment Plan dated September 2004. This included mapping of the subcatchments. This noted that creeks on the site have poor native watercourse vegetation, or exotic trees. Where the Light River forms the western boundary of the site, it contains native vegetation that should be protected. Downstream there is good native watercourse vegetation.

The Light River Catchment Action Plan 2017 was part of the Four Catchment projects funded by the Australian Government since 2012. The action plan draws together information and feedback from a wide range of community members and summarises the most important features of the catchment and issues faced in managing them. The site is located in the Mid Light River sub-catchment with community issues and priorities summarised in the Action Plan.

The CEMP should consider sediment and erosion control and management, as well as bunding and containment of any fuels stored on site given the stormwater from the site flows to the Light River. These measures will manage the water quality from the construction site and ongoing operation of the wind farm.

Reference should be made to the SA EPA construction guidelines regarding sedimentation and erosion control measures.

Flood modelling available for the Light River is limited to downstream in lower lying areas towards Gawler and the coast. No flood modelling is available for the site. The site lies within a 'Hazards (Flooding – Evidence Required) planning Overlay. This has the desired outcome that development adopts a precautionary approach to mitigate potential impacts on people, property, infrastructure and the environment from potential flood risk through the appropriate siting and design of development.

Transmission Line and Terminal Substation

The proposed transmission line crosses topography that is hilly, with numerous incised creek valleys and also crossing Stony Creek close to the Sturt Highway.

The CEMP should consider sediment and erosion control and management, as well as bunding and containment of any fuels stored on site. These measures will manage the water quality from the construction site and ongoing operation of the transmission line and terminal substation.

Reference should be made to the SA EPA construction guidelines regarding sedimentation and erosion control measures.

5.3 Regional Hydrogeology

Wind Farm and Energy Storage

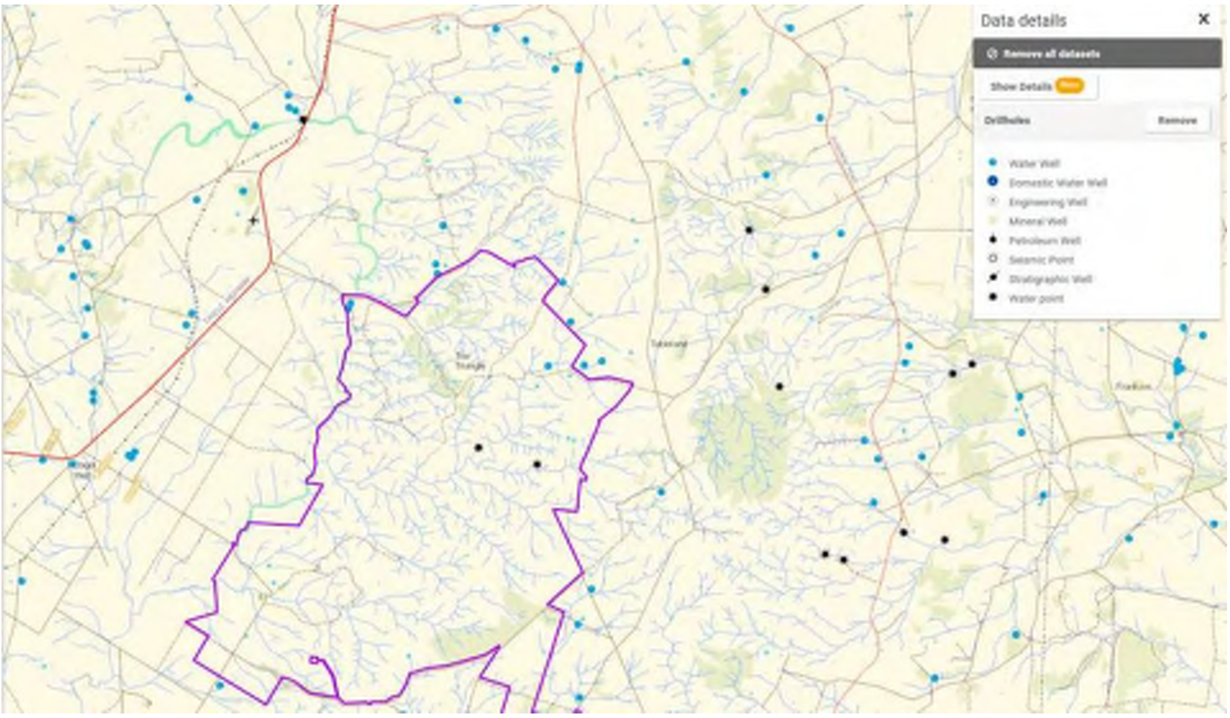
Reference to Location SA and WaterConnect websites indicated that the site is:

- There are numerous ephemeral creeks across the site that feed into Spring or Freshwater Creek and into the Light River influencing groundwater and base flows.
- While the site is not located in a prescribed water resources area, it is noted that the site is located north and outside the Barossa Prescribed Water Resources Area, which covers groundwater, water courses and surface water.
- Fractured Rock aquifer in Cambrian and Precambrian rocks underlies the site, this is expected to have seeps (as observed during the site visit) and a strong connection to rainfall and stormwater flows on site.
- One operational well is present on the site 6729-126, located adjacent to a track running north off of Newlands Road. This is shown to have the use of stock watering, was drilled in 1970 to a depth of 47 m, with a standing water level of 17 m, TDS of 4000 mg/L and yield of 0.3 L/s.
- One well present on the site is 6729-1556, located adjacent to a track running of Ben Lomond Road and approximately 100 m from the Light River. This has no operational status noted in WaterConnect, was drilled in 1996 to 44 m depth, with no standing water level recorded, TDS of 5658 mg/L and yield of 3.7 L/s.
- Operational wells were also located in areas in close proximity to the eastern site boundary including:
  - Three wells near Holding Road being 6729-128, 129, 130 all being shown as operational, drilled in 1955 to 1970, drilled to 35 to 40 m with SWL ranging from 23 to 27 m, TDS ranging from 3000 to 7000 mg/L, yield ranging from 0.3 to 0.5 L/s and all being shown to have the purpose of stock watering.
  - One well was also located just near Noack Road being 6729-274, shown as operational and used for stock watering purpose, drilled in 1975 to 22m with a SWL of 17m, TDS of 1500 mg/L.
  - The groundwater salinity and yields on site or very close by align with the stock watering purpose based on the yields and also the TDS salinities observed.

- Operational wells with higher yields (over 10 L/s) used for irrigation are located close to the Kapunda township approximately 10 km west of the site boundary and approximately 5 km south and south east of the site. Many of these wells are drilled to depths of over 50 m.

Figure 4 Well locations – Wind Farm and Energy Storage

(noting many are abandoned and those operational detailed above)



Note: purple outline is the wind farm and energy storage site boundary, transmission line coming off on the south eastern edge.

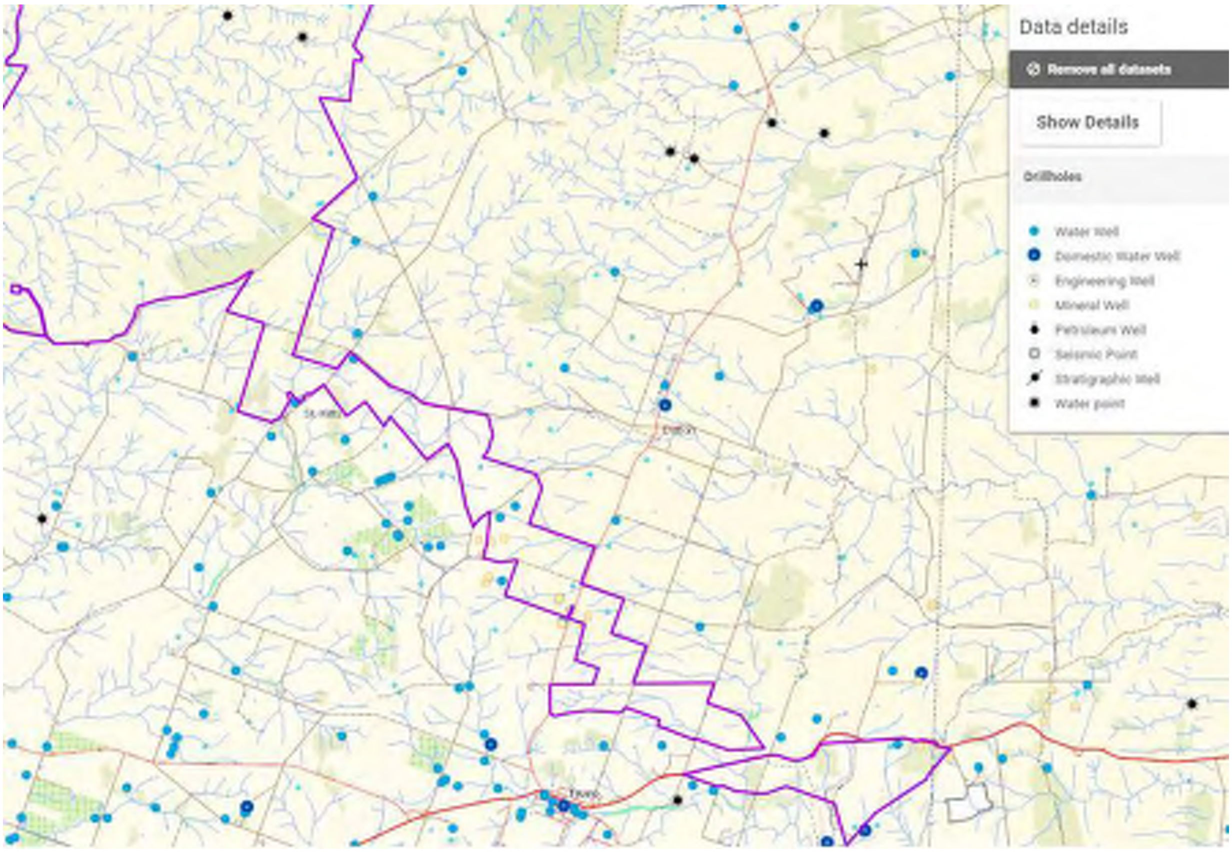
Transmission Line and Terminal Substation

Reference to Location SA and WaterConnect websites indicated that the site is:

- There are numerous ephemeral creeks the transmission line crosses influencing groundwater and base flows.
- The transmission line and terminal substation are not located in a prescribed water resources area, it is noted that the site is located near but outside the Barossa Prescribed Water Resources Area, which covers groundwater, water courses and surface water.
- Fractured Rock aquifer in Cambrian and Precambrian rocks underlies the site, this is expected to have seeps and a strong connection to rainfall and stormwater flows on site.
- Throughout the transmission line route, wells are used for irrigation and stock watering.
- Standing water levels vary with topographic levels and also aquifers drilled to and are observed at 250 to 290 m AHD near the terminal substation and they increase as the topography climbs up following the transmission line to around 420 m AHD near the start of the transmission line and windfarm and energy storage site.

Figure 5 Well locations – Wind Farm and Energy Storage

(noting many are abandoned and those operational detailed above)



Note: purple outline is the wind farm and energy storage site boundary, transmission line coming off on the south eastern edge.

5.4 Regional Geology

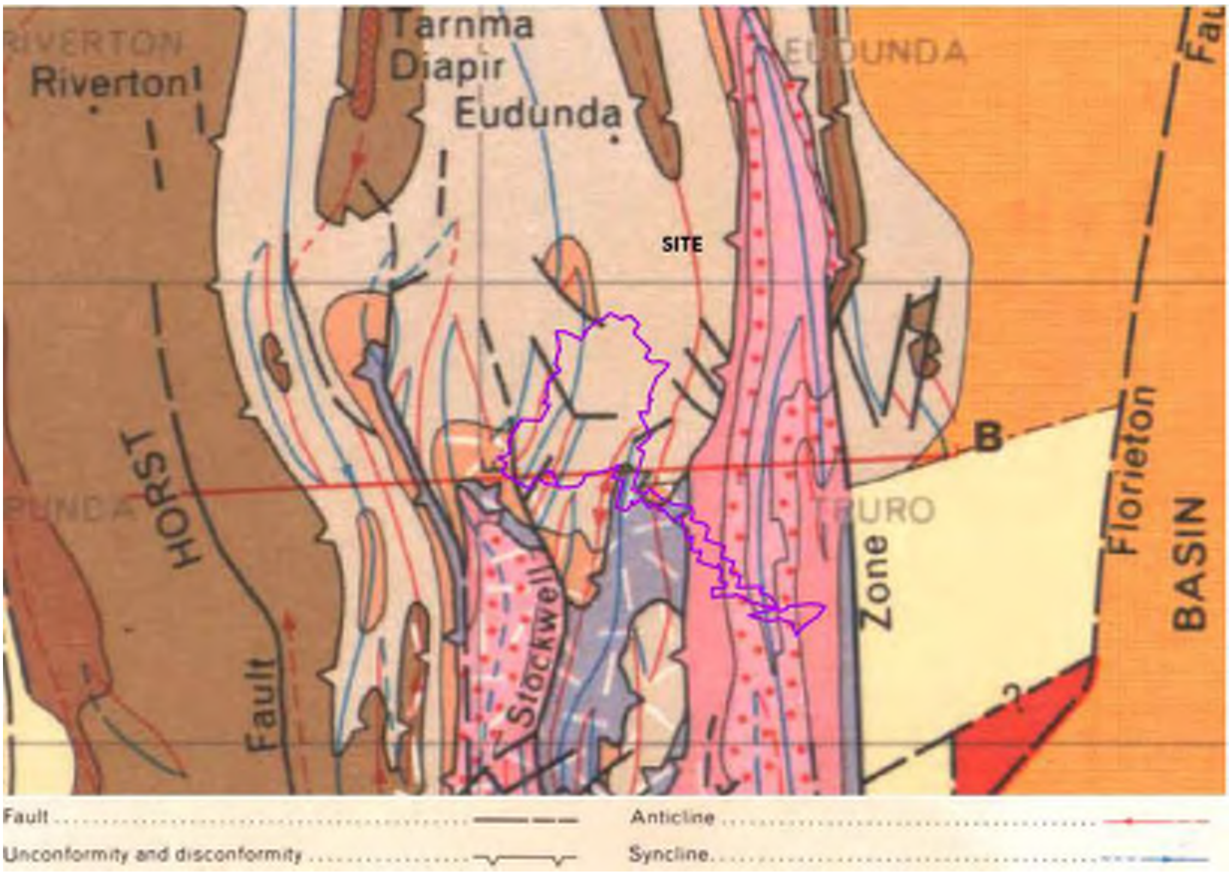
The site is located within the Adelaide Geosyncline, comprising thick sedimentary and minor igneous rocks that were formed during the late Precambrian (between about 1,100 Ma and 600 Ma). These rocks later became folded, metamorphosed, intruded and uplifted (Preiss, 1987).

An approximate sketch of the wind farm site boundary and has been overlaid onto an extract of the tectonic sketch from the Adelaide geology map sheet. The overlay is shown in Figure 6.

The tectonic sketch indicates that the Stockwell fault extends into the southern end of the site, beyond any currently proposed turbine locations. Two other un-named faults (possibly related to splintering at the northern end of the Stockwell fault) are shown trending north-west to south-east through the central parts of the site.

A parallel series of closely spaced anticlines and synclines are shown extending from the Stockwell fault to the un-named fault close to the centre of the site. To the north of this fault, a single syncline is shown trending approximately north-south through the site.

Figure 6 Tectonic sketch (extract from 'Adelaide' 1:250,000 geology sheet)



Note: purple outline is the wind farm and energy storage site boundary, transmission line coming off on the south eastern edge.

A similar overlay of the site boundary has been made on the relevant portion of the SARIG geology database, shown in Figure 6 for the wind farm and energy storage and Figure 7 for the transmission line and terminal substation. A legend of geological units is presented in Table 1.

The geology database indicates that for the main wind farm site:

- In the southern part of the site, which is more heavily folded via a parallel series of synclines and anticlines, the near-surface geology is expected to comprise "Ne – Yerelina Subgroup", comprising siltstone, sandstone and diamictite.
- Through the central part of the site (where the majority of the turbines are proposed) a zone of "Nep – Pepuarta Tillite" is expected, along the axis of the single north-south trending syncline. The tillite is expected to resemble pale grey or greyish green siltstone and sandy siltstone with sparse granule to boulder erratics. Limited structural mapping shown on the "Adelaide" geology sheet suggests that the bedding of the tillite dips towards the axis of the syncline at about 20 degrees on both the eastern and western limbs.
- To both the east and west of the tillite, "Nir - Tarcowie Siltstone" is expected, comprising sandy siltstone.
- A relatively thin band of "Neu – Gumbowie Arkose" (arkosic sandstone) is also expected between the tillite and siltstone on the eastern limb of the syncline.
- In places, these rocks (especially the Tarcowie Siltstone) have been intruded by dykes containing dolerite, microdiorite and porphyrite. These dykes appear to be related to mineralisation that was exploited by the Julia Creek and Newlands mines, where barite was extracted from close the project area.

- Within the northern part of the site, “Nsu - Ulupa Siltstone” flanked by a relatively thin band of “Nsn - Nuccaleena Formation” is expected. The Ulupa Silstone is described as resembling grey green and purple siltstone. The Nuccaleena Formation is expected to comprise white dolomite.
- The proposed BESS facility is located within the Tarcowie Siltstone formation.

The proposed alignment of a new transmission connects the wind farm to the existing Robertstown – Tungkillo Transmission line to the south-east of the wind farm on the Sturt Highway. The line is approximately 16km long and is generally orientated from north-west, at the proposed wind farm, to south-east near the Truro Quarry at Accommodation Hill.

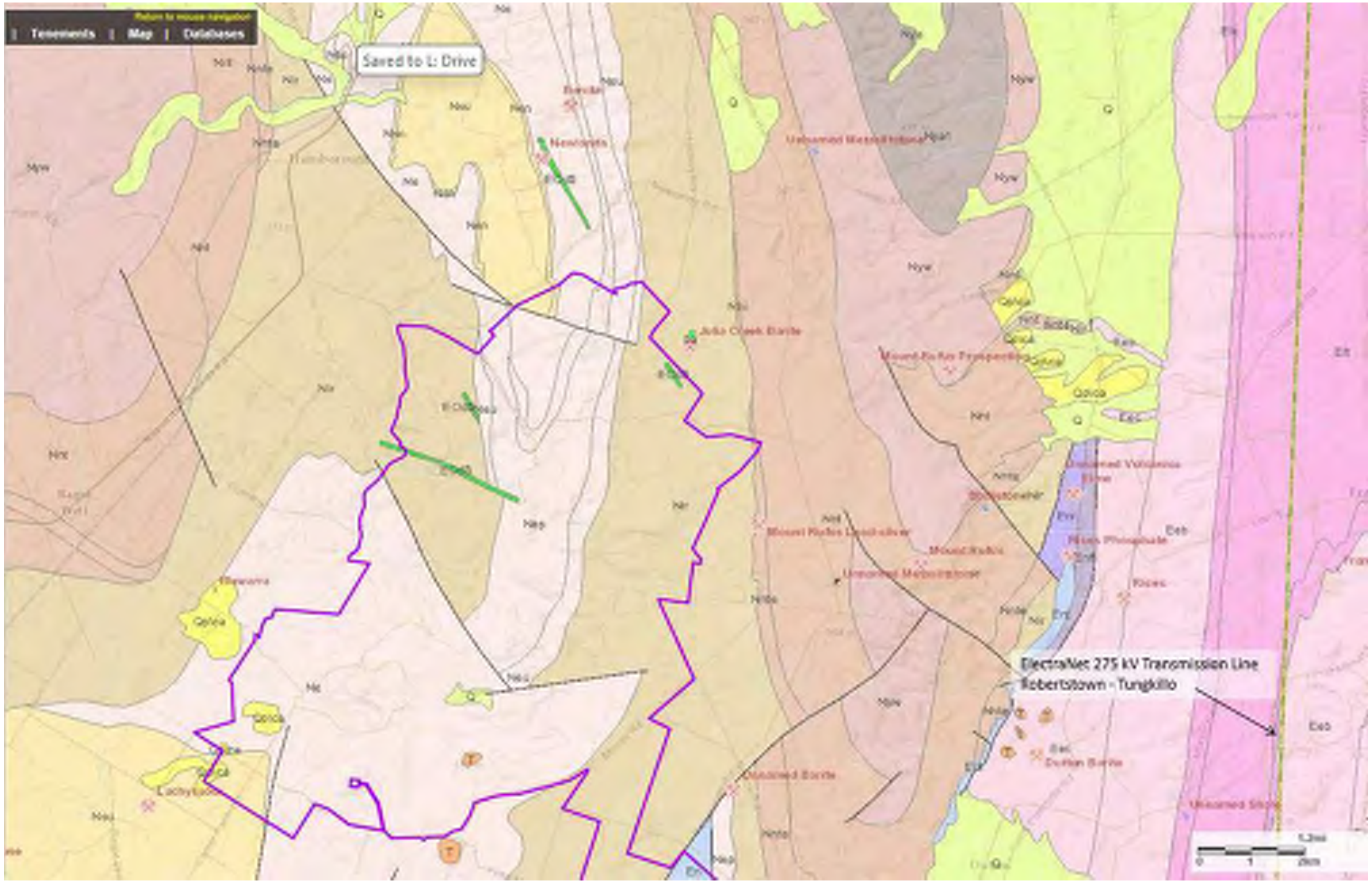
The Proposed transmission line crosses various unnamed faults and several geological formations listed below:

- Nir Tarcowie Siltstone, Siltstone, sandy, flaser bedded.
- En Normanville Group, Carbonate, marine shelf to basinal; shale; minor basal sandstone and felsic to mafic volcanic rock.
- Nep Pepuarta Tillite, Siltstone and sandy siltstone, sparse granule to boulder erratics, pale grey or greyish green, massive or bedded, often calcareous.
- Nsu, Ulupa Siltstone, Siltstone, shale, green-grey and purple.
- Enh Heatherdale Shale, Shale, blue-black, grey, pyritic, calcareous, Limestone, blue-black, pyritic, nodular and phosphatic.
- Eec, Carrickalinga Head Formation, Sandstone, grey, thick bedded, with thinly bedded, muddy, siltstone interbeds.
- Eeb Backstairs Passage Formation, Sandstone, laminated, thick bedded, slumped, crossbedded, with minor siltstone interbeds. Widespread siltstone unit at base.
- Elk Karinya Shale, Shale, siltstone, blue-black, pyritic, laminated, carbonaceous.
- Elt, Tapanappa Formation, Sandstone to greywacke, fine to coarse-grained, dark grey, thick-bedded to laminated. This formation is extracted in the Truro Quarry and produces products for use in the manufacture of Concrete, Asphalt and Pavements.

Rock containing pyrite can often be acid-producing. As such, excavations within the Heatherdale Shale and Karinya Shale should be avoided where possible. If excavations in the Karinya Shale cannot be avoided, then a management plan to control and mitigate potential the effects of potential acidic run off from the cutting and spoil material must be implemented.

A section running east-west slightly to the south of the site is shown in Figure 9, illustrating the rock relationships.

Figure 7 Extracts from SARIG geology database – Wind Farm and Energy Storage



Note: purple outline is the wind farm and energy storage site boundary, transmission line coming off on the south eastern site boundary.

Figure 8 Extracts from SARIG geology database – Transmission Line and Terminal Substation

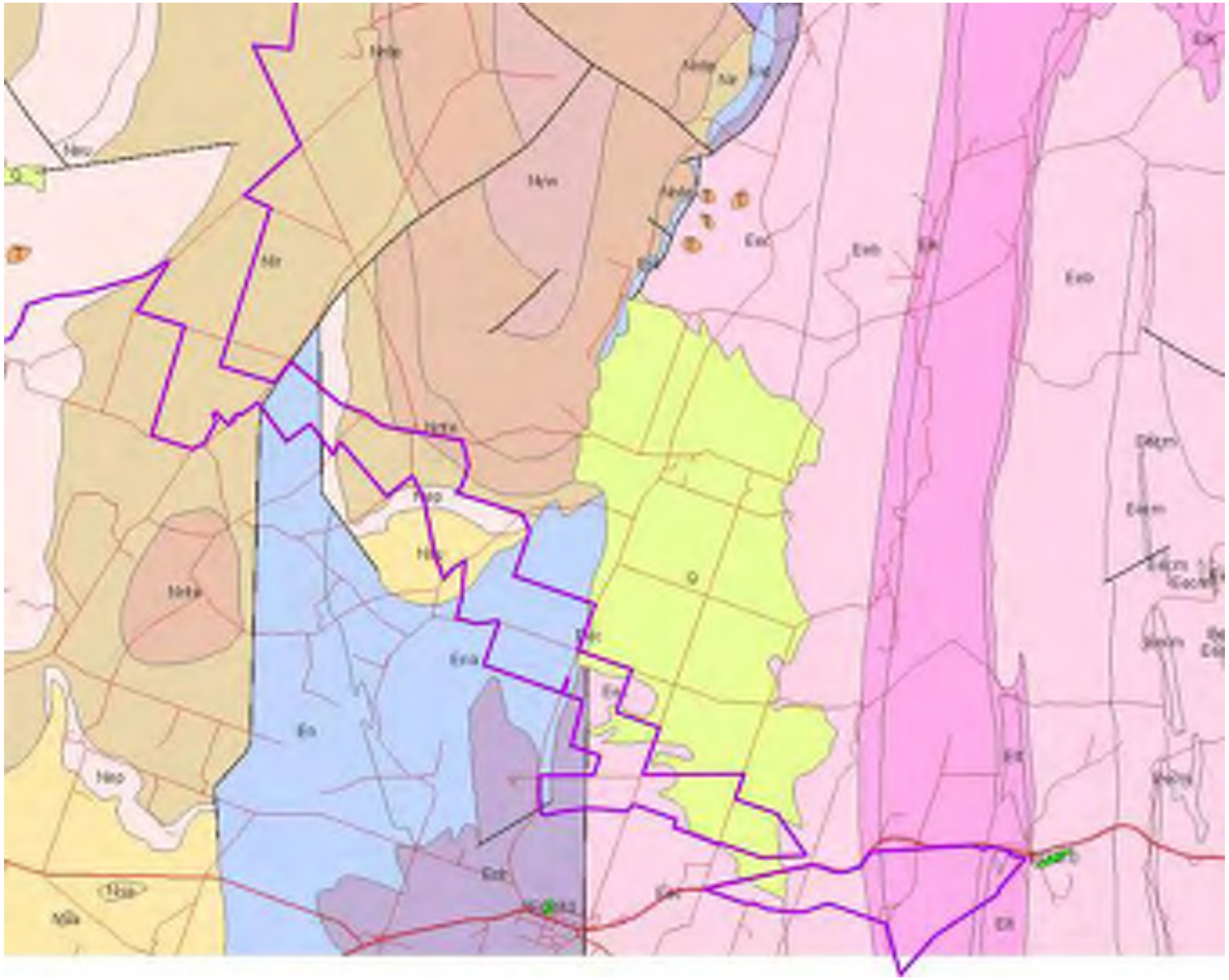
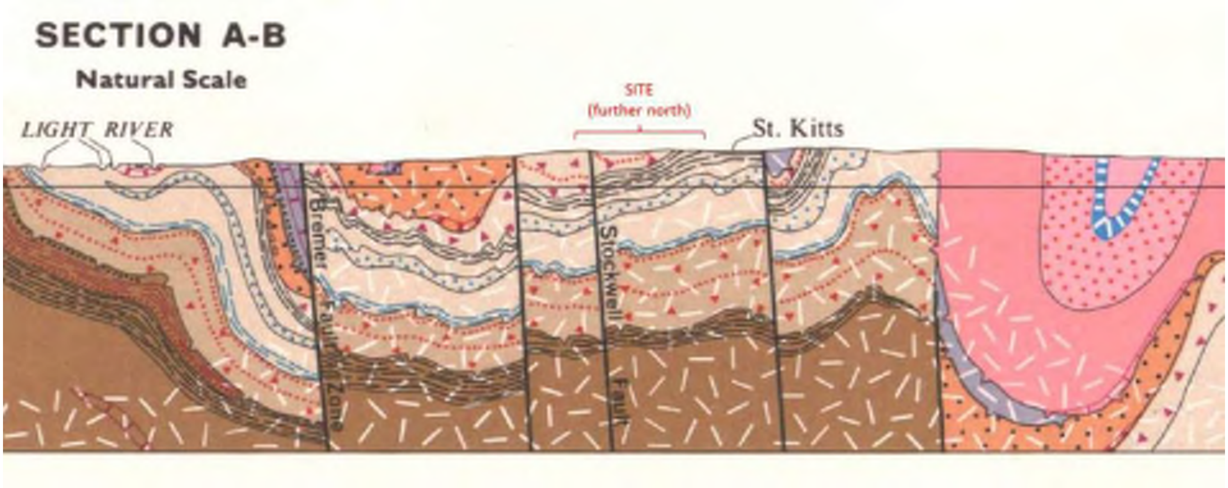


Table 1 Geology Legend

Map unit	Stratigraphic name	Stratigraphic description	Parent name	Age	Min age
Q	Unnamed GIS Unit - see description	Undifferentiated Quaternary rocks	-	PLEISTOCENE-HOLOCENE	Quaternary
Qp\ca	Unnamed GIS Unit - see description	Undifferentiated Pleistocene calcrete	Unnamed GIS Unit - see description	PLEISTOCENE	Pleistocene
T	Unnamed GIS Unit - see description	Undifferentiated Tertiary rocks	-	TERTIARY	Tertiary
Elk	Karinya Shale	Shale, siltstone, blue-black, pyritic, laminated, carbonaceous.	Bollaparudda Subgroup	CAMBRIAN	Toyonian
Elt	Tapanappa Formation	Sandstone to greywacke, fine to coarse-grained, dark grey, thick-bedded to laminated; interbedded with laminated siltstone and thin, sulphidic siltstone and lenticular grit to conglomerate beds. scour-and fill channels, rare cross-bedding.	Bollaparudda Subgroup	CAMBRIAN	Toyonian
Eeb	Backstairs Passage Formation	Sandstone, laminated, thick bedded, slumped, crossbedded, with minor siltstone interbeds. Widespread siltstone unit at base.	Keynes Subgroup	CAMBRIAN	Botomian
Eec	Carrickalinga Head Formation	Sandstone, grey, thick bedded, with thinly bedded, muddy, siltstone interbeds. Minor cross-bedding, ripples, rare trace fossils.	Keynes Subgroup	CAMBRIAN	Cambrian, Early
Nsu	Ulupa Siltstone	Siltstone; shale, green-grey and purple.	Wilpena Group	NEOPROTEROZOIC	Marinoan
Nsn	Nuccaleena Formation	Dolomite, thin, laminated, micritic, with interbedded shale near the top.	Wilpena Group	NEOPROTEROZOIC	Marinoan
Ne	Yerelina Subgroup	Siltstone; sandstone; diamictite.	Umberatana Group	NEOPROTEROZOIC	Marinoan
Neg	Grampus Quartzite	Quartzite, arenaceous, with conglomerate lenses.	Yerelina Subgroup	NEOPROTEROZOIC	Marinoan
Neu	Gumbowie Arkose	Sandstone, arkosic.	Yerelina Subgroup	NEOPROTEROZOIC	Marinoan
Nep	Pepuarta Tillite	Siltstone and sandy siltstone, sparse granule to boulder erratics, pale grey or greyish green, massive or bedded, often calcareous. Minor lenses and interbeds of massive and laminated calcareous sandy siltstone and calcareous sandstone.	Yerelina Subgroup	NEOPROTEROZOIC	Marinoan

Map unit	Stratigraphic name	Stratigraphic description	Parent name	Age	Min age
Nir	Tarcowie Siltstone	Siltstone, sandy, flaser bedded.	Upalinna Subgroup	NEOPROTEROZOIC	Marinoan
Nni	Brighton Limestone	Limestone, massive, oolitic, stromatolitic, ripple marks. Colour from blue-grey at base to reddish-grey at top.	Nepouie Subgroup	NEOPROTEROZOIC	Sturtian
Nnt	Tapley Hill Formation	Siltstone, grey to black, dolomitic and pyritic grading upwards to calcareous, thinly laminated, locally cross-bedded; dolomite, grey, flaggy to massive; limestone conglomerate, intraformational; greywacke.	Nepouie Subgroup	NEOPROTEROZOIC	Sturtian
Nnte	Eudunda Arkose Member	Arkosic siltstone, blue, flaggy and thinly bedded, lenticular	Tapley Hill Formation	NEOPROTEROZOIC	Sturtian
Nyw	Wilyerpa Formation	Siltstone, green. Lower third is fine grained, includes glacial dropstones; middle unit is medium to coarse sandstone; upper unit is siltstone with minor sandstone. Minor diamictite, sandy and pebbly dolomite.	Yudnamutana Subgroup	NEOPROTEROZOIC	Sturtian
Nds	Saddleworth Formation	Mudstone; siltstone; shale, partly carbonaceous.	Bungarider Subgroup	NEOPROTEROZOIC	Torrensian
Ent	Mount Terrible Formation	Arkose, cross-bedded, coarse-grained to conglomeratic, Basal part, fluviatile? pyritic and glauconitic sandstone, minor shale siltstone and dolomite.	Normanville Group	CAMBRIAN	Atdabanian
EOd5	Unnamed GIS Unit - see description	Undifferentiated Delamerian basic igneous rocks	Unnamed GIS Unit - see description	CAMBRIAN-ORDOVICIAN	Ordovician
ba	Unnamed GIS Unit - see description	Barite, undifferentiated.	-	MISCELLANEOUS	-

Figure 9 Geology section (extract from 'Adelaide' 1:250,000 geology sheet)



Observations of the main geological units from the site visit walk-over are summarised below.

Yerelin siltstone/sandstone

A small borrow pit/quarry was observed within the Yerelina siltstone/sandstone near the southern tip of the site, immediately adjacent to Flagstaff Hill Road (approximate coordinates of MGA94 Zone 54 E318705 N6198224). It was inferred that this borrow pit may have been used as a source of gravel to sheet Flagstaff Hill Road. In general the rock fragments remaining at the borrow pit appeared to be slightly to moderately weathered and ranged up to high or very high strength. At the uphill side of the borrow pit, the natural hillside had many rock fragments exposed at the surface that were typically of the order of 100 mm across. Some larger boulders up to about 1 m across were also present in a stockpile, suggesting variability of fracture spacing across the relatively small borrow pit. A photograph of the larger siltstone fragments is presented in Figure 9.

Figure 10 Photograph of borrow pit in Yerelina siltstone/sandstone

Tarcowie siltstone

Dedicated borrow pits were not observed in the Tarcowie siltstone, however, old stone ruins were observed west of Mosey Road, between the Freshwater Road and Noack Road intersections. It was inferred that these stone buildings had been constructed from Tarcowie siltstone, either fossicked from the surface or from excavation of a small nearby dam. The siltstone used in the building construction was typically moderately weathered, grading to slightly weathered and assessed to be of medium to high strength. Photographs of the stone ruins are presented in Figure 10.

Figure 11 Photographs of Tarcowie siltstone used in building construction

Pepuarta tillite

Observations during the site visit was that the tillite generally resembled grey siltstone or fine grained sandstone, with evidence of turbulent bedding and occasional erratics (drop stones), suggesting deposition in a shallow glacial lake. Selected photographs of the tillite are presented in Figure 12.

Where the tillite was only slightly weathered, it appeared to be of high strength. Fracture spacing varied considerably with fracture spacing observed to be of the order of 1 m in places, but less than 100 mm elsewhere. In particular, an exposure in the bed of Freshwater creek (approximate coordinates of MGA94 Zone 54 E321850 N6202232) showed the fracture spacing varying over this range across a very short distance, where a shear zone appeared to be present. A photograph of the exposure is shown in Figure 13, where to the left (west) of the superimposed red line, fracture spacing of about 1 m was present, but to the right (east) fracture spacing of about 100 mm was present. Also visible in Figure 13 is the variation in thickness of the overlying orange clay.

Figure 12 Photographs of Pepuarta Tillite

Figure 13 Photograph of exposure in Freshwater Creek (looking south to south-east)

5.5 Mining at the site

5.5.1 Current Mining Tenements

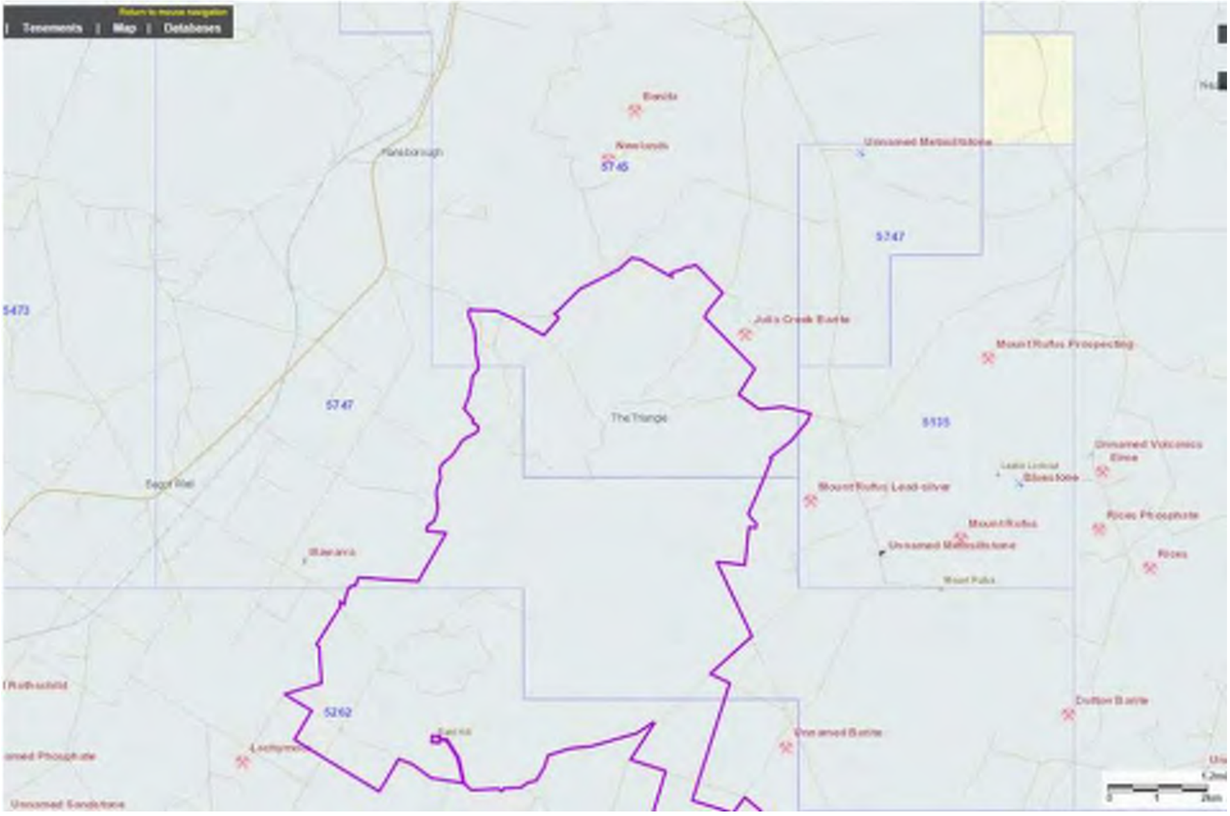
Details of current mining tenements that cover the site were obtained from the South Australia government SARIG website. A plan showing the current mining tenements and approximate site boundaries is shown in

Figure 14 and details available through the SARIG database are summarised in Table 2.

Table 2 Summary of mining tenements

Tenement Number	Tenement Status	Licencees	Commodities Sought	Tenement Start Date	Tenement Expiry Date	Area (km^2)
5135	Active	Maximus Resources Limited	Gold	3/9/2012	2/9/2016	26
5262	Active	Terramin Exploration Pty Ltd	Gold, rare earths, zinc, copper, lead	28/4/2013	27/4/2015*	624
5745	Active	Seesaw Resources Pty Ltd	Silver, rare earths. Zinc, copper, lead	22/2/2016	21/2/2018	128
5747	Active	Seesaw Resources Pty Ltd	Gold, rare earths. Zinc, copper, lead	22/2/2016	21/2/2017	955

Figure 14 Existing mining tenements



Note: purple outline is the wind farm and energy storage site boundary, transmission line coming off on the south eastern edge.

It is noted that a Hallett Resources quarry is located adjacent to the terminal substation located east of the Truro township. It is a Meta - greywacke quarry which is considered to be high strength, hard and durable and the quarry produces products for use in the manufacture of Concrete, Asphalt and Pavements.

5.5.2 Historic mining activities

The SARIG database shows a former mine close to the eastern boundary of the site of Julia Creek Barite.

The SARIG database lists the location coordinates of the mine as 139.091755, -34.277111 or MGA94 Zone 54 E324340, 6205470.

Reference has been made to a South Australian government website (minerals.statedevelopment.sa.gov.au) which states that “numerous mines have been worked in the past but are now abandoned, including: a number of small mines at Julia Creek (72 km northeast of Adelaide) producing 10,500 t of barite between 1925 and 1974”.

Further reference has been made to Mansfield (1950), which indicates that two vertical shafts were dug at the Julia Creek Barite mine. A sketch dated 17/10/1947 indicates that the northern (main) shaft was 68 feet (20.7 m) deep and the southern shaft was 20 feet (6.1 m) deep, with a north-south drive connecting the two shaft and extending further north and south. Advice from Mansfield (Inspector of Mines and Quarries) to the mine operators at the time was to extend the shaft to 100 feet depth and then drive further north and south. A sketch also shows “suggested costeans” running east and west. All of the mapped and suggested mine workings on the sketch were within a radius of approximately 50 m from the shafts.

No records were located describing the mining activities at Julia Creek from after 1950. As such, the final extent of underground mine workings at Julia Creek is not known. Based on the preliminary turbine layout, the closest turbines to the Julia Creek mine (T52 and T60) are more than 600 m or 700 m from the mine. As such, this abandoned mine should not impact on the proposed development.

6.0 Potential Borrow Sources

Reference has been made to the Truro mineral resource potential map sheet layer, accessible via the South Australia Resource Information Gateway digital platform, which does not identify any potential resources within the project boundary suitable for construction of road base, concrete aggregate or road sealing aggregate. Identified deposits of construction aggregates are shown to the east of the site, within the Tapley Hill Formation, which is present running north-south along the alignment of Tablelands Road. A borrow pit was observed adjacent to the intersection of Tablelands Road and Newlands Road, which is beyond the project boundaries, but within the Tapley Hill Formation. Other identified resources of construction aggregate are shown further to the east in the Tapanappa Formation (close to the existing alignment of the Robertstown to Tungkillo 275 kW transmission line).

Nonetheless, based on site observations, it appears that potential borrow pits for unsealed track construction could be sited within the majority of the main geological units (Yerelina siltstone/sandstone, Tarcowie siltstone, Pepuarta tillite). Trials and laboratory testing would be required to more reliably assess the ease of processing and quality of the materials produced from different borrow sources.

It is anticipated that concrete aggregate would be sourced off-site from established quarries with acceptable quality control/assurance.

7.0 Geotechnical Constraints and Opportunities

7.1 Turbine Foundations

Rock is expected to be present either at the surface or at very shallow depth at all turbine locations, which should make anchored footings a viable option for many turbines. However, if the rock is highly fractured or deeply weathered, the anchors may need to be excessively deep and/or the associated overall rock mass may have a low stiffness which would result in excessive deflections of the base of turbine. In such areas gravity footings may be required.

Future geotechnical investigations will be required to assess the condition of the rock at each turbine location.

7.2 Construction Materials

7.2.1 Aggregate

Potential borrow pit sites that are suitable for producing aggregate for unsealed road construction are expected to be readily available throughout the project area. Selecting areas where the rock is more closely fractured but still of high strength should result in reduced effort during excavation and crushing of the aggregate.

Due to the higher quality demands on concrete aggregate, it is expected that off-site sources of concrete will be used.

7.2.2 Water

Whilst a number of farm dams are present throughout the site, the majority appeared small and were located either on ephemeral creeks or hillsides. Many of the dams observed had little or no water. The ability to utilise surface water for construction is therefore expected to be limited to the wetter months of the year.

A number of existing bores are present throughout the project area that are currently used for stock watering or other agricultural purposes. Existing data indicates that they are of low yield of 0.3 to 0.5 L/S and ranged from 1500 mg/L TDS (fresh to brackish) up to 7000 mg/L (saline). It is noted that the existing bore observations noted above were from the 1970's and should be checked on site if on site groundwater is to be considered.

Should the installation and development of new bores be required during construction, a South Australian Government permit (from the Department of Water and Natural Resources) will be required for each new bore.

7.3 Slope Stability

No evidence of significant existing landslides was observed at the site during this study, however, slope stability assessment was beyond the scope of the current study.

If significant thicknesses of new cuts or fills are required for access road construction, the stability of such earthworks must be assessed.

The stability of turbine and transmission line footings in close proximity to steep slopes must also be assessed, particularly where the rock mass is highly fractured or has unfavourably orientated defects.

7.4 Excavatability

The majority of footing excavations for the turbines and transmission line are expected to be in rock, which will require the use of rock excavation techniques, such as hydraulic rock breakers mounted on large excavators. The use of blasting should be avoided however, as it may loosen the rock mass and lower the stiffness of the rock below the footing level.

7.5 Erosion

Considerable erosion of the relatively thin soil cover was observed across the site, especially adjacent to creeks. The soil erosion had resulted in the accumulation of significant quantities of sediment in some creek beds.

Any new excavations that expose the soil profile must be provided with protection from erosion, and mitigation measures such as silt fences may be required down gradient of active earthworks areas to avoid fouling the natural creeks.

7.6 Future Geotechnical Investigations

A staged approach to future geotechnical investigations is recommended, with initial test pitting recommended at each turbine location to assess the near-surface rock strength, weathering, fracture spacing and the orientation of the main rock defects at each proposed turbine site. Similar investigations at key points along proposed access road tracks and at the proposed substation site should also be performed.

Following a review of the test pit results, seismic refraction surveys should be considered at a range of turbine locations, if the option of anchored footings is to be assessed. Seismic surveys should be performed at a selection of sites covering the range of more favourable to less favourable rock foundations conditions observed in the test pits to allow an initial assessment of the feasibility of anchored footings.

Diamond cored boreholes to about 15 m depth should then be performed to better assess the viability of anchored footings at sites that are potentially unsuitable for anchored footings, and at selected sites that cover the different rock types where favourable conditions are predicted.

Intrusive investigations at the terminal substation should include both test pits for shallow sampling and boreholes, and boreholes for transmission line footings.

8.0 References

Department for Environment and Heritage, South Australia (2001) *Truro* 1:50,000 topographic map.

Department of Mines Adelaide (1969) *Adelaide* 1:250,000 geology sheet, Geological Survey of South Australia.

Department for Manufacturing, Innovation, Trade, Resources and Energy (2013) *Truro* 1:50,000 Mineral Resource Potential, Geological Survey of South Australia.

Fleming, PD (1965) *Report on "Newlands" Barytes Deposit Sections 162 and 201 Hundred Julia Creek*. Report Book 60/3, Department of Mines South Australia

Mansfield, LL (1950) *E.A. Linke Bartes* [sic] *Mine – HD. Julia Creek*, Report book 29-3, Department of Mines South Australia

Priess, WV (1987) *The Adelaide Geosyncline Late Proterozoic Stratigraphy, Sedimentation, Palaeontology and Tectonics*, Bulletin 53. Geological Survey of South Australia, Department of Mine and Energy.

South Australian Government
http://minerals.statedevelopment.sa.gov.au/geoscience/mineral_commodities/barite.

9.0 Limitations

AECOM Australia Pty Limited (AECOM) has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of RES and only those third parties who have been authorised in writing by AECOM to rely on the report.

It is based on generally accepted practices and standards at the time it was prepared. No other warranty, expressed or implied, is made as to the professional advice included in this report. It is prepared in accordance with the scope of work and for the purpose outlined in the contract.

The methodology adopted and sources of information used by AECOM are outlined in this the Report.

Where this report indicates that information has been provided to AECOM by third parties, AECOM has made no independent verification of this information unless required as part of the agreed scope of work. AECOM assumes no liability for any inaccuracies in or omissions to that information.

This Report was prepared between 2016 and 2025. The information in this report is considered to be accurate at the date of issue and is in accordance with conditions at the site at the dates sampled. Opinions and recommendations presented herein apply to the site existing at the time of our investigation and cannot necessarily apply to site changes of which AECOM is not aware and has not had the opportunity to evaluate. This document and the information contained herein should only be regarded as validly representing the site conditions at the time of the investigation unless otherwise explicitly stated in a preceding section of this report. AECOM disclaims responsibility for any changes that may have occurred after this time.

This report should be read in full. No responsibility is accepted for use of any part of this report in any other context or for any other purpose or by third parties. This report does not purport to give legal advice. Legal advice can only be given by qualified legal practitioners.

This report contains information obtained by inspection, sampling, testing or other means of investigation. This information is directly relevant only to the points in the ground where they were obtained at the time of the assessment. The borehole logs indicate the inferred ground conditions only at the specific locations tested. The precision with which conditions are indicated depends largely on the uniformity of conditions and on the frequency and method of sampling as constrained by the project budget limitations. The behaviour of groundwater and some aspects of contaminants in soil and groundwater are complex. Our conclusions are based upon the analytical data presented in this report and our experience. Future advances in regard to the understanding of chemicals and their behaviour, and changes in regulations affecting their management, could impact on our conclusions and recommendations regarding their potential presence on this site.

Where conditions encountered at the site are subsequently found to differ significantly from those anticipated in this report, AECOM must be notified of any such findings and be provided with an opportunity to review the recommendations of this report.

Whilst to the best of our knowledge information contained in this report is accurate at the date of issue, subsurface conditions, including groundwater levels can change in a limited time.

Therefore this document and the information contained herein should only be regarded as valid at the time of the investigation unless otherwise explicitly stated in this report.

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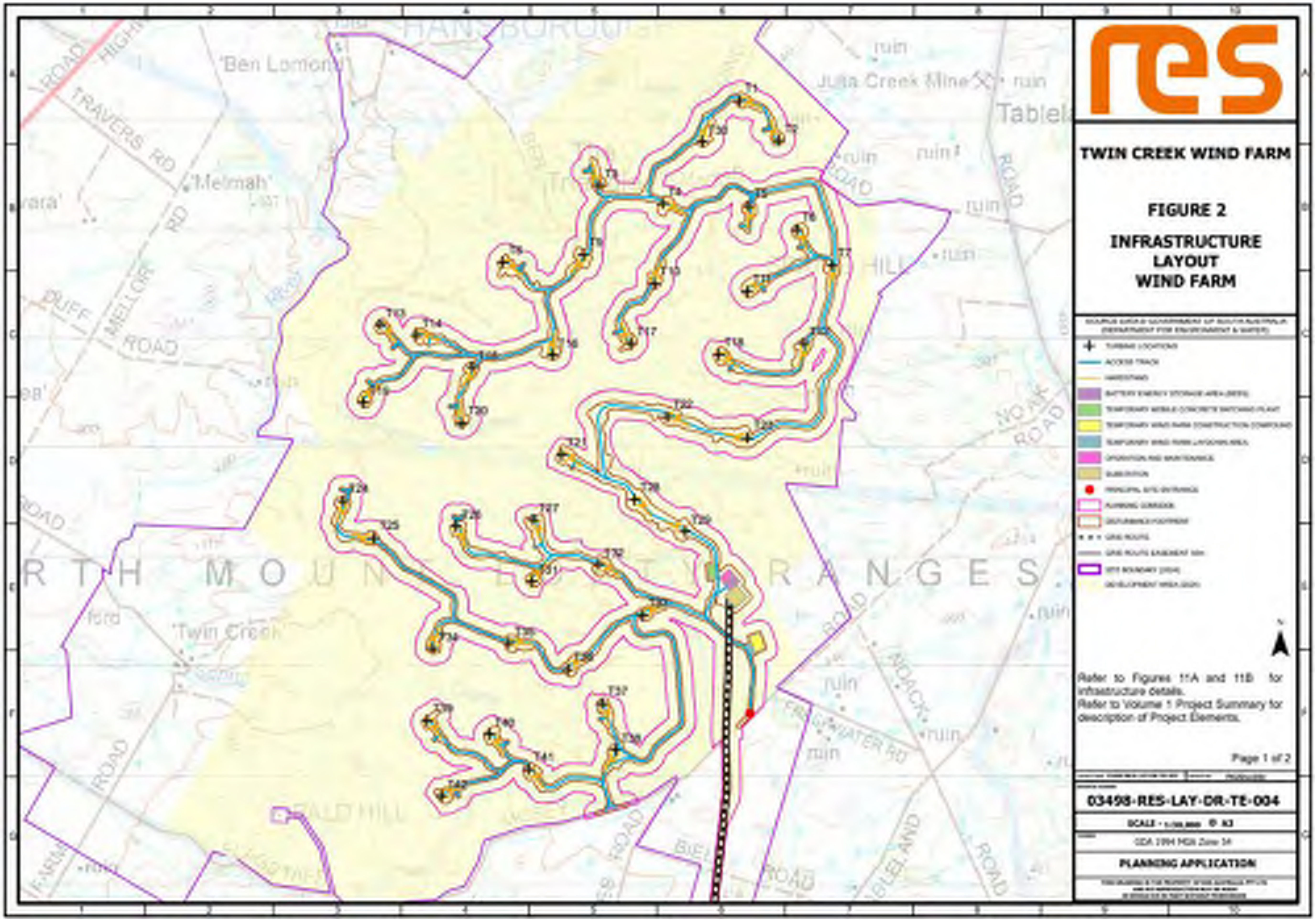
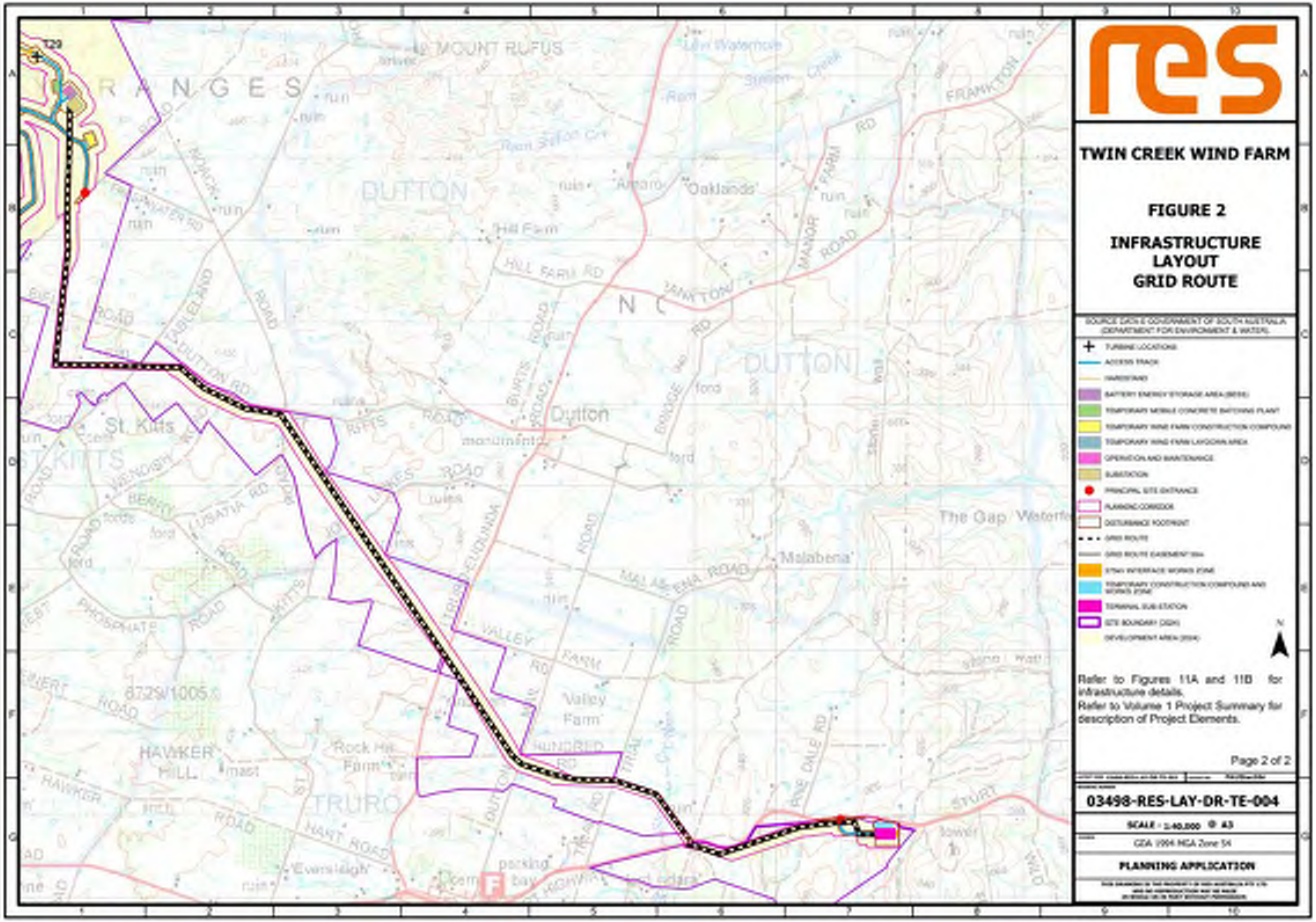
Appendix A

Preliminary Civil Design


TWIN CREEK WIND FARM
FIGURE 2
INFRASTRUCTURE LAYOUT WIND FARM
Refer to Figures 11A and 11B for infrastructure details.
Refer to Volume 1 Project Summary for description of Project Elements.
Page 1 of 2
03498-RES-LAY-DR-TE-004
GDA 1994 MGA Zone 54
PLANNING APPLICATION


res
TWIN CREEK WIND FARM
FIGURE 2
INFRASTRUCTURE LAYOUT GRID ROUTE
Refer to Figures 11A and 11B for infrastructure details.
Refer to Volume 1 Project Summary for description of Project Elements.
Page 2 of 2
03498-RES-LAY-DR-TE-004
SCALE - 1:40,000 @ A3
GDA 1994 MGA Zone 54
PLANNING APPLICATION
MOUNT RUFUS
DUTTON
St. Kitts
Dutton
'Malabena'
The Gap
'Valley Farm'
HAWKER HILL
TRURO
Rock Hill Farm
'Oaklands'
'Hill Farm'

Heritage Impact Assessment

by Dash

Twin Creek Wind Farm and Energy Storage Project 2025

Heritage Impact Assessment

DA193751 Issue D

13.1.25

1.0 Background

In 2019 DASH Architects prepared a Heritage Impact Assessment (HIA) for the proposed Twin Creek wind farm, that traversed the historic settlement of St Kitts. This assessment was undertaken under the now repealed Development Act, and associated Light Regional Council Development Plan. This project was granted Development Plan Consent on 24 October 2019.

The approved application consisted of 51 wind turbines (3.6MW and up to 180m tip height) and associated 215MW battery storage facility connecting into the Robertstown – Tungkillo transmission line east of Truro via a 15km overhead transmission line

The 2019 HIA considered the extent to which the project was visible within the context of Local Heritage Places within the locality, and the extent to which such views materially affected their context (in accord with the relevant Development Plan polices of the day).

This HIA identified that of the 8 Local Heritage places within the vicinity of the project, views of the transmission lines were 'close' for two, and were either 'nil' or 'limited in distance' to the remaining six. The Approval Authority had also requested that the HIA consider the potential visual impacts of the transmission lines on the the *the context / character / setting of the historic St Kitts settlement* itself.

The 2019 HIA found:

> *…while the transmission lines will not be visually consistent with the historic and current character of St Kitts, it is nonetheless consistent with its context, and Desired Character of the Zone.*
>
> *In summary, the proposed visual impacts to the context of the identified heritage places is considered consistent with that envisaged by Council's Development Plan.*

The applicant, RES Australia Pty Ltd has since undertaken further design development of the proposed Wind Farm and Energy Storage Project in response to an evolving energy market and wind turbine technology. The optimised project (subject to this application) differs from the approved project as summarised in the below table.

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Adelaide SA 5000
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www.dasharchitects.com.au
ABN 82 059 685 059

Key changes to the project scope summarised below are the number of Wind Turbine Generators (WTG) and their height. We understand the transmission line pathway, its scale and proximity to nearby heritage places remains unchanged.

	Approved Project	**Current Application**
Number of WTG	Up to 51	Up to 42
WTG individual Generating Capacity	3.6MW	Up to 7.2MW
Overall Generating Capacity	185MW	Up to 270MW
Height of WTG	180m tip height	Up to 220m tip height
Battery Energy Storage Capacity	215MW indicative storage capacity	215MW indicative storage capacity
Substation(s)	2 Substations (1 project substation within the windfarm boundary and 1 cut-in terminal substation)	2 Substations (1 project substation within the windfarm boundary and 1 cut-in terminal substation)
Point of Connection	ElectraNet 275kV powerline (Robertstown to Tungkillo) via a cut-in terminal substation	ElectraNet 275kV powerline (Robertstown to Tungkillo) via a cut-in terminal substation, east of Truro.

2.0 Scope

This 2025 Heritage Impact Assessment will re-assess the updated proposal as a new application against the relevant provisions of the Planning and Design Code.

This assessment is based on the following documentation prepared by RES Australia provided to DASH Architects:

- Figure 2 Preliminary Site Layout Wind Farm: 03498-RES-LAY-DR-TE-004:
  - Page 1 or 2
  - Page 2 of 2

To assist in locating the path of the proposed transmission line, RES Australia also provided a Keyhole Markup Language file (in .kmz format) that overlaid the transmission line development area over Google Earth. This file was particularly useful in locating the proposed transmission line pathway, and was heavily relied upon in preparing this HIA.

An initial review of the project footprint on Plan SA's SA Property and Planning Atlas (SAPPA) mapping indicates that the infrastructure avoided any properties with Local and State Heritage interests (and Overlays). Refer below figure.

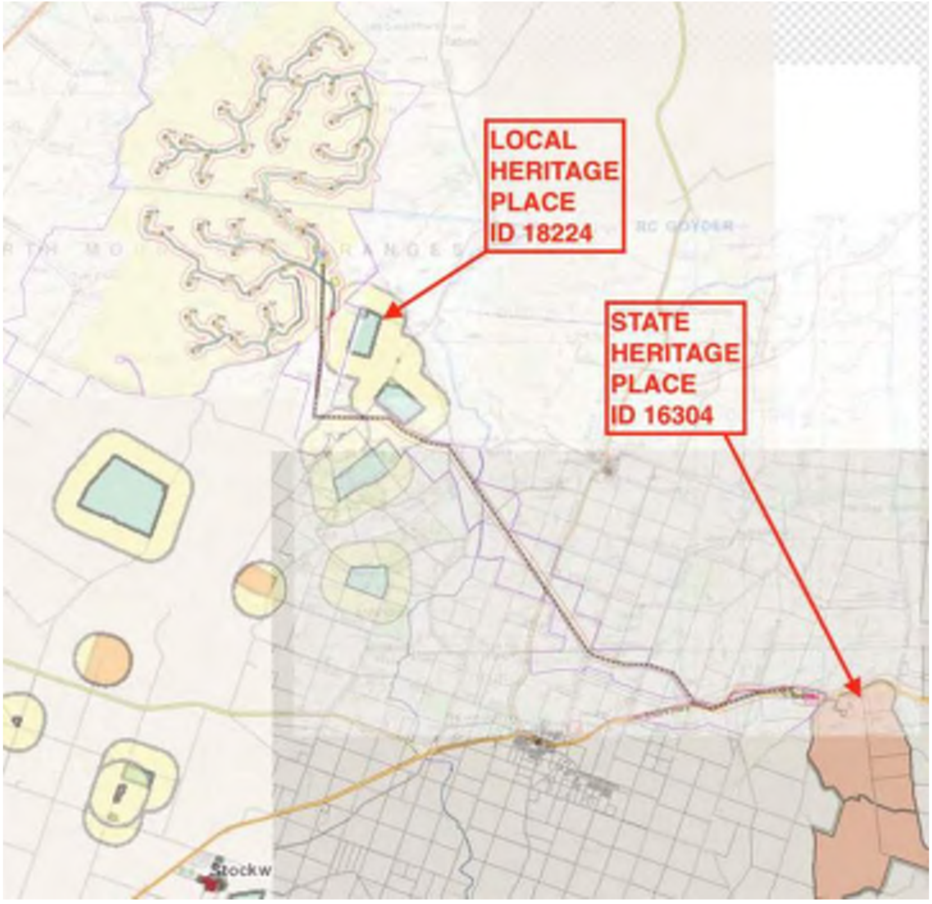

Figure 1: Overlay of project onto SAPPA mapping with spatial mapping of Stage Heritage Overlay (orange), and Local Heritage Overlay (teal) that is avoided by the works.

Despite this, some of the land parcels affected by the proposed developments do retain State and Local Heritage interests as noted below.

2.1 State Heritage Places Overlay

State Heritage ID 16304

- Stone Wall
- Off Sturt Highway, Truro

Figure 2 below is an extract of an overlay of the spatial SAPPA mapping and the proposed works. It clearly shows no works within the orange boundaries of the State Heritage Places Overlay associated with the listed Stone Wall (ID16304).

The proposed transmission line does, however, traverse a land parcel (F174416QP118) that shares a Certificate of Title with the State Heritage Place (CT CT6157/823) and accordingly retains a State Heritage interest.

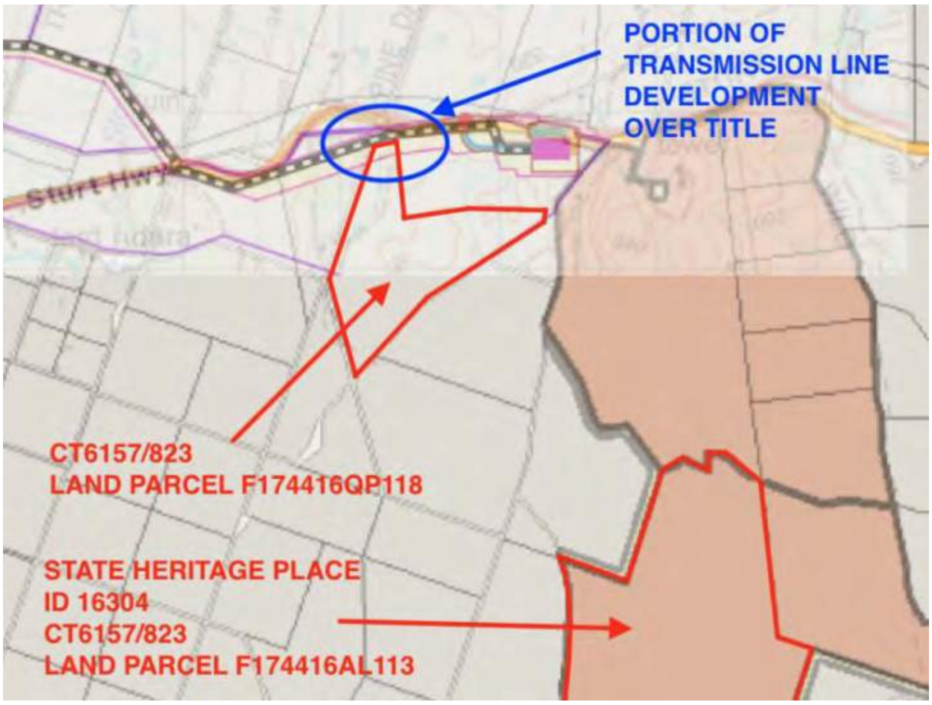

Figure 2: Portion of transmission line over title that has State Heritage interest

Notwithstanding this State Heritage interest, the State Heritage Places Overlay does not apply to land parcel F174416QP118, with the Planning and Design Code's Rules of Interpretation noting:

> <u>*Application of Spatially Based Policies and Rules*</u>
> *Where* [an]*…. Overlay… does not spatially apply to the whole of a site that is subject to a development application, the spatially based rules of the… overlay… are only applicable to the portion of the site to which the… overlay… spatially covers. Reference to the South Australian Property and Planning Atlas* [SAPPA]*… will be made to determine whether* [an]*… overlay is relevant to the site…*

For this reason the State Heritage Places Overlay is not enlivened by the proposed works, and will not be considered by this HIA.

2.2 Local Heritage Places Overlay

<u>Local Heritage ID18224</u>

- Noack's Farm; External form, materials and details of the early farm buildings associated with the initial settlement
- Freshwater Road ST. KITTS

Figure 3 below is another extract of the overlay of the spatial SAPPA mapping and the proposed works. This map similarly shows no works within the teal boundaries of the Local Heritage Place Overlay associated with Noack's Farm (ID 18224).

Again, the transmission line development traverses a land parcel (H16000SE290) that shares a Certificate of Title (CT5264/963) with the Local Heritage Place (located on land parcel H16000SE291) and accordingly retains a Local Heritage interest.

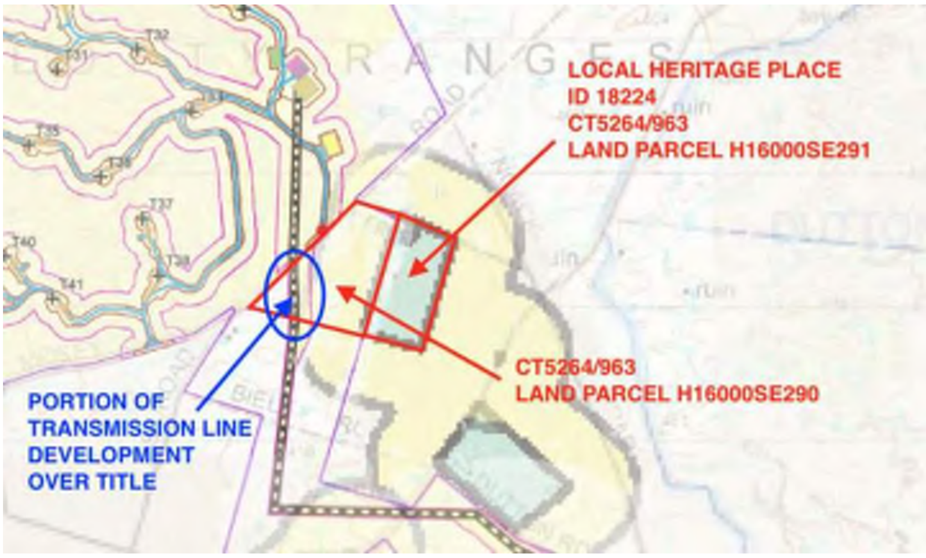

Figure 3: Portion of transmission line over title that has Local Heritage interest.

For the reasons noted above (Section 2.1) the Local Heritage Places Overlay is not enlivened by the transmission line works, and will accordingly not be considered by this HIA.

2.3 Heritage Adjacency Overlay

The transmission line development area traverses the land between the WTGs area and the Terminal Station and passes through Heritage Adjacency Overlays associated with the following Local Heritage Places:

- ID17722: Abandoned Farm Complex
- ID18051: Former St Pauls Lutheran Church
- ID18050: Doecke's Farm

In addition to this, a very small area of the land accommodating the WTGs area encroached within the Heritage Adjacency Overlay of Noack's Farm (ID 18224).

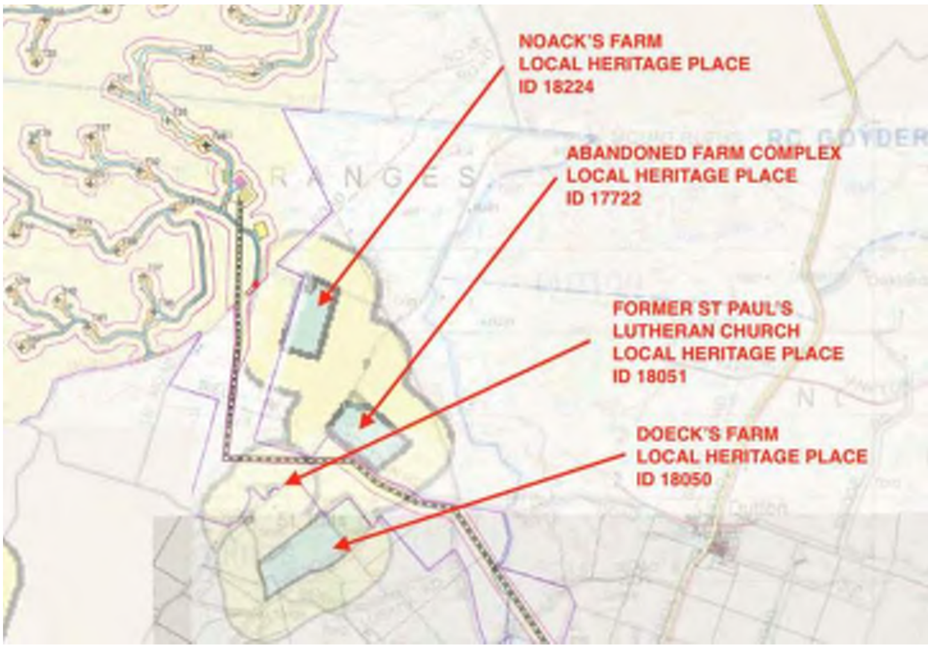

Figure 4: Local Heritage Places affecting the Heritage Adjacency Overlay.

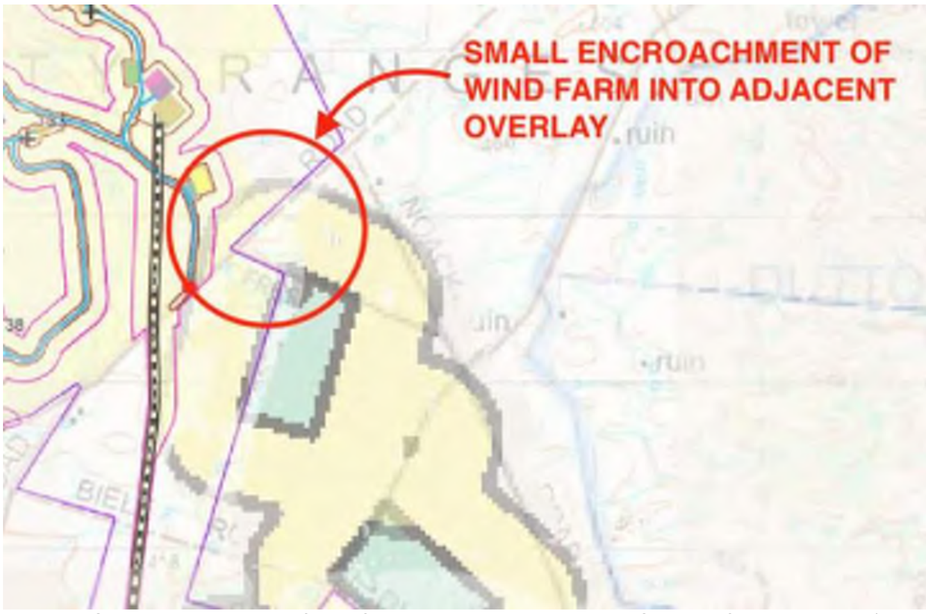

Figure 5: Small encroachment of wind farm into Heritage Adjacency Overlay of Noack's Farm (Local Heritage Place).

2.4 Summary of Scope

For reasons noted above, the scope of this HIA will be limited to the Heritage Adjacency Overlay with regards to the following:

- For the portion of transmission line development over land adjacent the following Local Heritage Places:
  - ID17722: Abandoned Farm Complex

- ID18051: Former St Pauls Lutheran Church
- ID18050: Doecke's Farm

- Portion of the wind farm over land adjacent to the Local Heritage listed Noack's Farm.

3.0 Planning and Design Code

Policy of the Planning and Design Code of particular relevance to this assessment includes:

Heritage Adjacency Overlay
<u>Desired Outcome</u>
DO1 Development adjacent to State and Local Heritage Places maintains the heritage and cultural values of those Places.

<u>Performance Outcomes</u>
PO1.1 Development adjacent to a State or Local Heritage Place does not dominate, encroach on or unduly impact on the setting of the Place.

4.0 Heritage Impact Assessment

4.1 Transmission line

A transmission line is needed to connect the wind farm to the terminal station. This 2025 HIA has assumed that the transmission line infrastructure is the same as that assessed in the 2019 HIA, namely a series of poles constructed with steel or concrete monopoles up to 35m in height, and spaces between 200m and 400m apart (approx), subject to terrain and/or ground conditions.

Figure 6: Typical transmission pole infrastructure

4.1.1 Abandoned Farm Complex

The Local Heritage listed Abandoned Farm Complex is located to the NE corner of the intersection of Duttons and Tablelands Road. The 2004 Heritage Survey of the Light Regional Council provides the following description of the place:

> ***HISTORY AND DESCRIPTION****: An abandoned, but well maintained complex of ironstone farmhouses and outbuildings. Landmark palm trees are in the midst of the buildings.*
>
> *Peter Zwar a farmer acquired Section 304 from George Boback in 1866. In 1880 it was transferred to Andreas Falland and in 1882 to Carl Falland of St. Kitts who changed his name to August Carl Falland. In 1932 Johann Kernich became the owner and then Alwine Kernich. In 1939 the property entered the possession of the Munchenberg family*
>
> ***STATEMENT OF HERITAGE VALUE****: This now abandoned farm complex retains evidence of the stages of development of the farming property, reflecting the growth of agriculture in the area.*

Figure 7: Abandoned Farm Complex 2019

The proposed transmission line is located to the opposite side of Dutton Road, some 300m away. The land upon which the transmission line will traverse is undulating, resulting in some sections likely being elevated higher than the land accommodating the Local Heritage place.

Figure 8: Estimated views of transmission line infrastructure from Abandoned Farm Complex.

Figure 9: Estimated views of transmission line infrastructure from Abandoned Farm Complex.

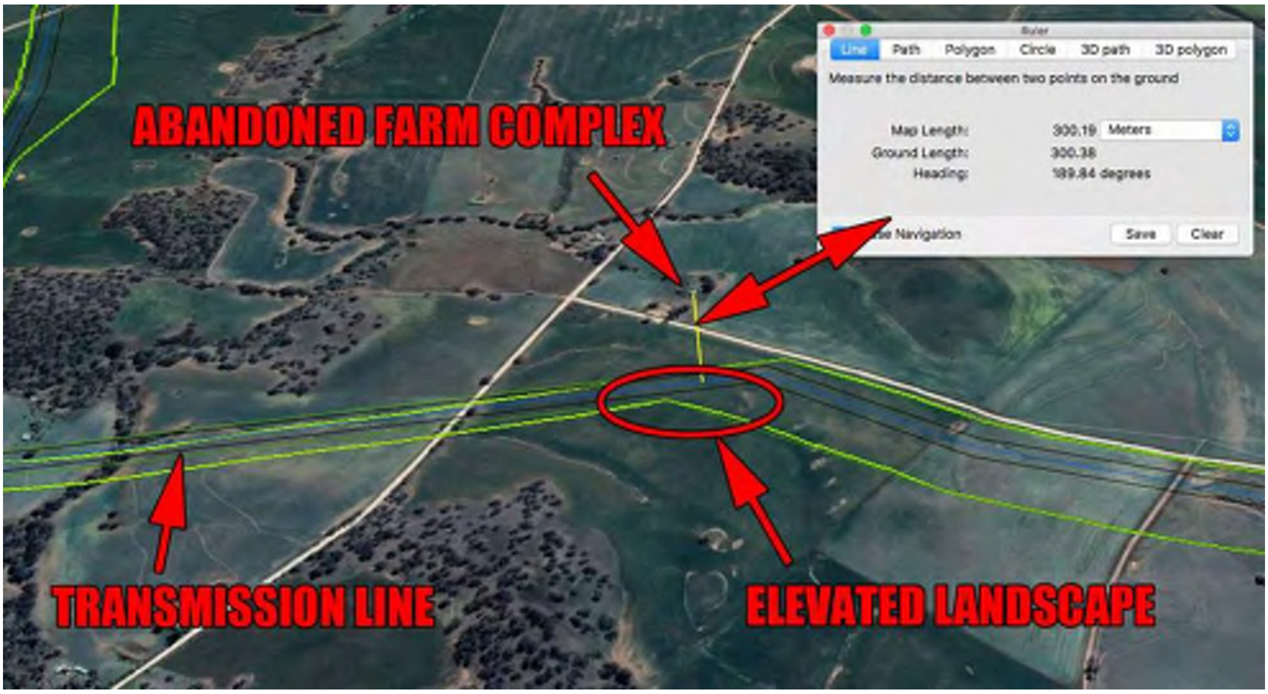

Figure 10: Abandoned Farm Complex Google Earth overlay, with transmission line setout by kmz file provided by applicant.

Being a ruin, the immediate setting of the heritage place is generally devoid of modern incursions. While the proposed transmission lines will be visible within the broader setting of the heritage place, they are not considered to dominate, encroach or unduly impact on its setting as:

- The setting of the ruin is primarily defined by its siting and the property boundaries to the intersection of Duttons and Tablelands road. The transmission lines are located outside of this curtilage
- The infrastructure is located some 300m away from the ruins, on another site across the road
- The heritage values of the abandoned farm complex is the manner that it displays *the stages of development of the farming property, reflecting the growth of agriculture in the area*. The proposed new transmission line infrastructure on the adjacent site, across the road, does not impact on these values.

For these reasons the proposed new transmission lines within the Heritage Adjacency Overlay associated with the Abandoned Farm Complex are considered consistent with DO1 and PO1.1.

4.1.2 Former St Paul's Lutheran Church & Cemetery

The former St Paul's Church and Cemetery is located on the edge of a shallow valley. The 2004 Heritage Survey of the Light Regional Council provides the following description of the place:

***HISTORY AND DESCRIPTION**: The cemetery is a small reserve with nine grave sites marked. It is surrounded by mature pines and gums. The existing grave sites are all aligned on the western edge, facing east. The former church is now converted to a residence, but retains its face dressed ironstone front gable end and pointed arched entry door and side windows. There is a fireplace at the western end and a chimney which protrudes through the western gable.*

A congregation, formed by breaking away from St. Peter's Lutheran Church at St. Kitts, built St. Paul's Church in 1904. At the time of separation there were about 200 people mostly of Wendish or German descent living in the St. Kitts area. Johann Gersch acquired the land upon which the church is sited in 1863, after he had leased it for five years, and he transferred it to Herman Wilhelm Noack in 1886. Hermann Noack, Carl Wilsch, Paul Noack, Carl Noack Andreas Kleinig and Wilhelm Freundt all farmers of St. Kitts acquired the land, Part Section 240, as joint tenants in 1904. It is presumed that they acted as Trustees for the church. The church remained in use until 1949. In 1985 the property was transferred to the ownership of Reuben Noack, a local farmer.

***STATEMENT OF HERITAGE VALUE**: This small rural church building represents Lutheran settlement in the district and indicates the religious differences that arose in the local congregation, and the eventual unification of branches of the Lutheran Church.*

Figure 11: Former St Paul's Lutheran Church and Cemetery 2019

Topography to the north elevates slightly, with land to the west dropping away. The proposed transmission lines will run approximately 400m behind the heritage place. The local rise in topography to the north will obscure some views, however it is possible that sections of the transmission lines will be visible over this.

The immediate environs of the church and cemetery is landscaped with substantial plantings, that will likely obscure much of the immediate views of the transmission lines from the road directly in front of the heritage place. Notwithstanding this, however, some views of the lines will remain through this landscaping, and from vantage points to the side of the heritage place (Figure 14, Figure 15).

Figure 12: Landscape setting of former St Paul's Lutheran Church and Cemetery 2019

Figure 13: Landscape setting of former St Paul's Lutheran Church and Cemetery 2019

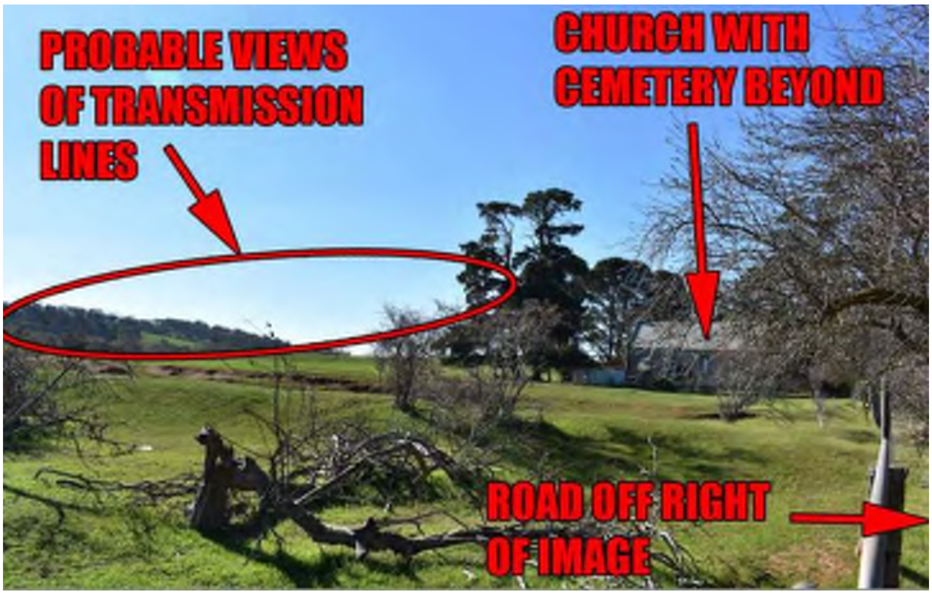

Figure 14: Estimated views of transmission line infrastructure from behind St Paul’s Church.

Figure 15: Estimated views of transmission line infrastructure over crest and through trees of St Paul’s Cemetery.

Figure 16: St Paul's Church and Cemetery Google Earth overlay, with transmission line development area of the kmz file provided by applicant.

The immediate setting of St Paul's Church is to Tablelands Road and the landscaped ground and cemetery within the immediate environs. The landscape behind forms a backdrop to the heritage place, as it does throughout St Kitts.

The proposed transmission lines will likely have minimal visual presence within the immediate setting of St Paul's Church. They will not impact on the manner by which the heritage place *represents Lutheran settlement in the district and indicates the religious differences that arose in the local congregation, and the eventual unification of branches of the Lutheran Church*.

Views of the transmission lines will be largely screened be existing landscaping within the church grounds, and undulating topography. Some views will remain, however they are not considered to dominate, encroach on or unduly impact on the setting of the Place.

For these reasons the proposed new transmission lines within the Heritage Adjacency Overlay associated with the Former St Paul's Lutheran Church and Cemetery are considered consistent with DO1 and PO1.1.

4.1.1 Doecke's Farm

The Local Heritage listed Doecke's Farm is located approximately 1.7km south of the proposed transmission lines. The 2004 Heritage Survey of the Light Regional Council provides the following description of the place:

HISTORY AND DESCRIPTION: *This early complex of timber, pug and pine, and stone buildings is in a ruinous condition, but retains examples of early farming structures including timber supported sheds.*

The Wends, a Slavic people from Lusatia, the area between the Oder and Elbe Rivers in Eastern Germany first settled in the St. Kitts district in 1854 and 1855. They constructed buildings in the Wendish style. This building group demonstrates vernacular construction techniques used in the district.

Heinrich August Edward Meyer, a Lutheran clergyman acquired section 307 in 1861 and it was transferred to Wilhelmina Friederika Meyer in 1874 and then to farmer Andreas Biar in the same year. It remained in the Biar family until 1907. In 1911 Gustav Adolph Doecke of St. Kitts acquired the property and the Doecke family kept it until at least 1961.

STATEMENT OF HERITAGE VALUE: *This farm complex, now abandoned, reflects the settlement in the area by Wendish people and their contribution to the development of agriculture in the area and demonstrates vernacular construction techniques used locally.*

Figure 17: Doecke's Farm 2019

The topography between the site and the transmission lines is undulated, with several crests that would likely obscure all views of the proposed infrastructure from the site.

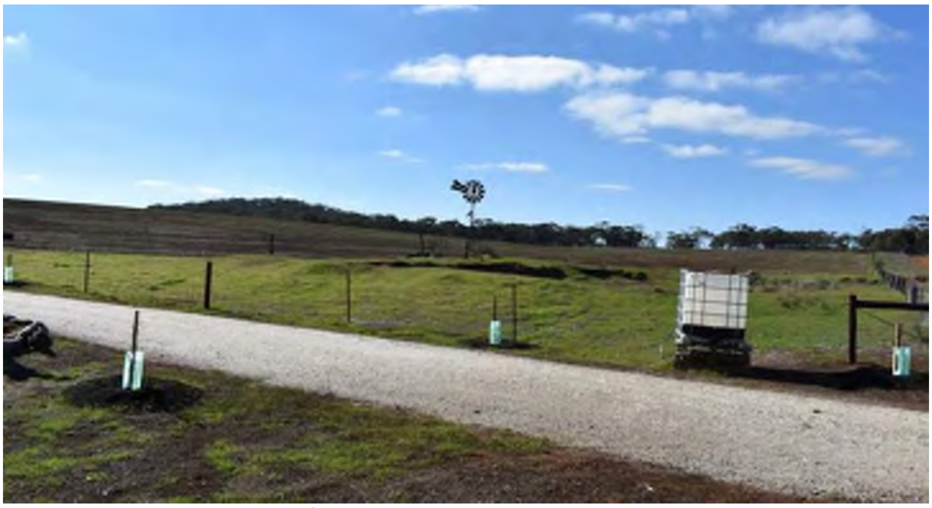

Figure 18: Elevated land looking from Doecke's Farm towards the proposed transmission lines 2019

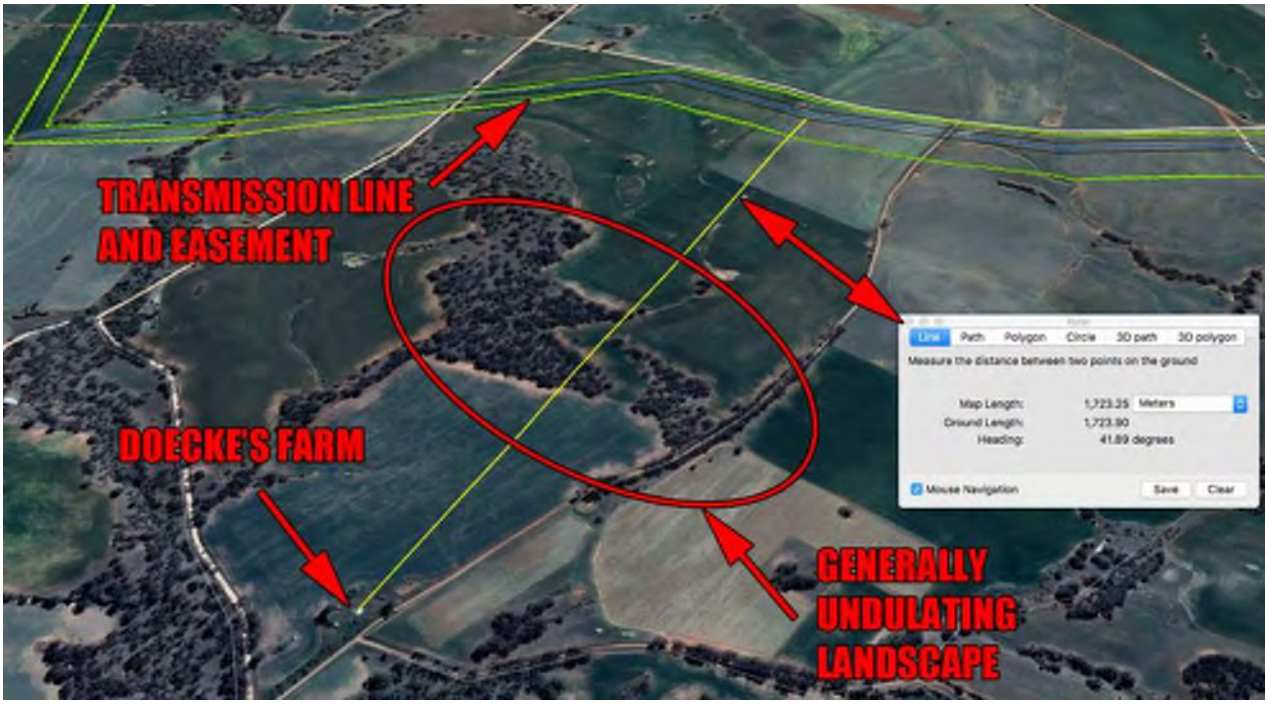

Figure 19: Doecke's Farm Google Earth overlay, with transmission line development area of the kmz file provided by applicant.

While the transmission lines are located within the Heritage Adjacency Overlay of this property, they will be some 1.7km south of the ruins and not generally visible within their setting due to the undulating landscape.

For these reasons the proposed new transmission lines within the Heritage Adjacency Overlay associated with the Doecke's Farm are considered consistent with DO1 and PO1.1.

4.2 Wind Farm

The proposed boundary of the wind farm complex is located approximately 500m away from the Local Heritage Listed Noack's Farm. The 2004 Heritage Survey of the Light Regional Council provides the following description of the place:

> ***HISTORY AND DESCRIPTION:*** *This farm complex consists of early residences, sheds constructed of pug and pine, and stone materials.*
>
> *In 1858 Johann Noack received a Land Grant of Section 291 in the Hundred of Belvidere with a small reserve excluded from the title. In 1888 it was transferred to Johann Noack Jnr of St. Kitts and to Ewald Nathaniel Noack in 1932. In 1965 the property was transferred to Walter Wilhelm Doering, a Noack descendant, and then to Michael John Doering in 1990. As was the case with other early German settlers, Johann Noack intended his property to be self supporting. It had its own blacksmithy, smokehouse for making mettwurst, bacon and ham, a bake oven, dairy with a separator room for producing cream from the milk, vegetable gardens and fruit trees, and later a car shed with a pit. The farm produced cereal crops and the family kept pigs, cows and chickens.*
>
> ***STATEMENT OF HERITAGE VALUE****: This farm complex represents the settlement of the district by German farmers and indicates their tradition of self-sufficiency and use of local building materials, and has been continuously in the hands of the first owner and then his descendants since 1858.*

Figure 20: E14: Noack's Farm.

While a very small portion of the wind farm boundary encroaches into the Heritage Adjacency Overlay of Noack's Farm, there are no WTG's located within this area.

Accurately overlaying the proposal onto the extent of the Heritage Adjacency Overlay is problematic. Figure 5 above, however, suggests that site fencing will likely encroach within this footprint, as well as potentially an access track. Neither of the features will be visible from the Noack's Farm complex buildings due to the undulating topography and landscaping. Even if glimpses were afforded, they would neither *dominate, encroach on or unduly impact on the setting of the Place.*

For these reasons the proposed wind farm within the Heritage Adjacency Overlay associated with the Noack's Farm is considered consistent with DO1 and PO1.1.

5.0 Summary

While the amended proposal for the 2025 Twin Creek Wind Farm and Energy Storage Project differs sufficiently from the approved 2019 scheme to warrant a new application, its layout, and potential impacts to the setting of Heritage Places within the district remains essentially unchanged. Most of the potential heritage impacts associated with the project arise from the proposed transmission lines, which we understand remains generally unchanged from the approved scheme.

What has changed is the planning policy frameworks within which this new application is to be assessed, namely the Planning and Design Code. While there are subtle differences in heritage policy relevant to this application, both the previous Development Plans and the current code seek to mitigate impacts to the setting of heritage places that may adversely affect their respective heritage values.

The most notable change in policy under the new Code is the provision of greater definition on when an impact to the setting of a heritage place may arises through spatial mapping of Heritage Adjacency Overlays. This update has reduced the number of heritage places potentially impacted by the works from eight (as assessed in the 2019 HIA) to four (as assessed in this HIA).

Unsurprisingly, the 2025 assessment of the potential heritage impacts to the setting of these heritage places is also very similar to that undertaken for the 2019 approved scheme. While the proposed transmission lines that connect the wind farm to the terminal station may be visible within some views the relevant Local Heritage Places, such infrastructure will not *dominate, encroach on or unduly impact on the setting of the heritage places*, nor adversely impact on their *heritage and cultural values*.

For these reasons the proposed works are considered consistent with the relevant provisions of the Heritage Adjacency Overlay.

Development Assessment Report

by MasterPlan

Development Assessment Report

Twin Creek Wind Farm & Energy Storage Project

for RES Australia Pty Ltd

January 2025

MASTERPLAN
TOWN + COUNTRY PLANNERS SINCE 1977

Development Assessment Report

Twin Creek Wind Farm & Energy Storage Project

for RES Australia Pty Ltd

January 2025

Development Application: 313/V039/23

Version	Date	Detail	Prepared	Review
Draft 1.1	30 Jan 2024	52975REP04	Julie Jansen	Roberta Magoba, RES
Draft 1.2	14 Feb 2024	52975REP04	Julie Jansen	
Draft	16 Feb 2024	52975REP04	Julie Jansen	Kyra Reznikov, Finlayson; Roberta Magoba RES
Draft 1.3	27 Mar 2024	52975REP04	Julie Jansen	
Draft 1.4	30 Oct 2024	52975REP04	Julie Jansen	RES
Final	21 Nov 2024	52975REP04	Julie Jansen	RES
Final 2	17 Jan 2025	52975REP04	Julie Jansen	Issued

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Contents

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Executive Summary

RES Australia Pty Ltd (RES) proposes to develop a renewable energy facility, known as Twin Creek Wind Farm and Energy Storage Project (the Project), comprising up to 42 wind turbines with an overall generating capacity of up to 270MW and a 251MW battery energy storage system. The Project is to be developed north-east of Kapunda in the mid-north of South Australia, approximately 90 kilometres north-east of Adelaide.

Located on freehold land, the site of the proposed development transverses three Local Government areas. Infrastructure for the project will be developed within the Light Regional Council, Regional Council of Goyder and Mid Murray Council areas.

RES has an active Development Plan Consent (422/E003/17) for an earlier iteration of the Project. The approved development is a 185MW wind farm comprising up to 51 wind turbines (3.6MW and up to 180 metre tip height) and associated 215 MW battery energy storage system.

Since obtaining the planning consent in October 2019, RES has undertaken further design development in an evolving energy market. To take advantage of the growth in wind turbine technology, RES has reviewed the approved wind farm and has optimised the Project, particularly in terms of overall generating capacity, number, size and capacity of wind turbine generators.

RES has considered options available to amend the current planning consent to achieve variations to the Project and has resolved that the alterations resulting from the optimisation warrant the submission of a new development application. RES has sought and obtained crown sponsorship of the Project from the Department for Energy and Mining, for the development to occur as essential infrastructure pursuant to Section 131 of the Planning, Development and Infrastructure Act 2016.

In summary, the variations between the Twin Creek Wind Farm and Energy Storage Project granted planning consent and the optimised proposal are as follows:

Table 1: Comparison of Approved and Proposed Project

	Approved Project	Optimised Project
Number of WTG	Up to 51	Up to 42
WTG individual Generating Capacity	3.6MW	Up to 7.2MW
Overall Generating Capacity	185MW	Up to 270MW
Height of WTG	180m tip height	Up to 220m tip height
Battery Energy Storage Capacity	215MW indicative storage capacity	215MW indicative storage capacity
Substation(s)	2 Substations (1 project substation within the windfarm boundary and 1 cut-in terminal substation)	2 Substations (1 project substation within the windfarm boundary and 1 cut-in terminal substation)
Point of Connection	ElectraNet 275kV powerline (Robertstown to Tungkillo) via a cut-in terminal substation	ElectraNet 275kV powerline (Robertstown to Tungkillo) via a cut-in terminal substation, east of Truro.

The site of the proposed development is located within the Rural Zone, in which renewable energy facilities are expressly envisaged. An assessment of the merits of the proposed development has been undertaken against the relevant provisions of the Planning and Design Code (version 2023.16 dated 9 November 2023[1]). It is considered that the proposed development is not significantly at variance with the Planning and Design Code. The proposed renewable energy project adequately and appropriately addresses potential impacts, particularly those associated with noise, visual amenity, protection of flora and fauna, interface between land uses, European and Aboriginal heritage, bushfire and traffic movements in a manner sought by the relevant policies of the Planning and Design Code.

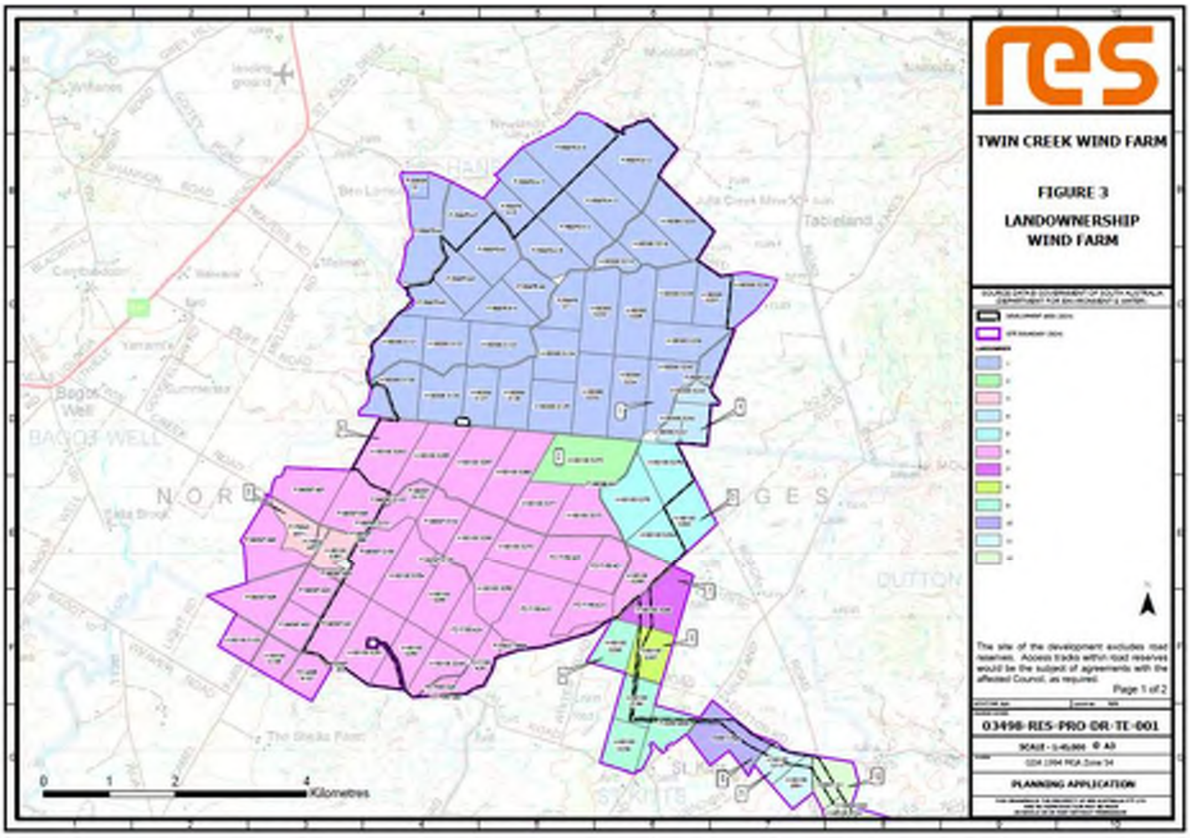
On balance, the proposal is a suitable form of development within the Rural Zone and appropriately addresses potential impacts and thereby warrants the granting of development authorisation.

A summary of the project is contained in **Table 2**:

Table 2: Project Overview

Project Overview	
Applicant	RES Australia Pty Ltd Suite 6.01 Level 6, 165 Walker Street, North Sydney, NSW 2060 Registered ABN 55 106 637 754
Proposed Development	Construction and operation of Twin Creek Wind Farm and Energy Storage Project comprising: up to 42 wind turbine generators (WTGs), comprising a total installed generating capacity of up to 270MW; with each WTG having a name plate capacity of up to 7.2 Megawatts (MW) and total tip height up to 220 metres. The development includes a battery energy storage facility (BESS) with an indicative storage capacity of 215MW; transmission line, substations, operations and maintenance compound, civil works (e.g. access tracks, cabling etc) and temporary facilities (e.g. works compound, laydown areas and mobile concrete batching plant etc). RES is seeking a period of five years in which to substantially commence the proposed development from the operative date of the development authorisation and substantial completion seven years from the operative date of the development authorisation.
Property Location	Various land parcels located between the townships of Kapunda, Eudunda and Truro as identified in extract of Figure 3 – Ownership Plan and defined in **Attachment A**.
Landowners	Various – Refer Volume 1 – Project Summary – Certificates of Title
Land Type	Freehold
Local Government Area	Light Regional Council, Regional Council of Goyder and Mid Murray Council
Development Site Area[2]	Approximately 5,548 hectares within the site boundary; 3,684 hectares within the development area and 380 hectares within the disturbance footprint.
Zoning	Rural Zone
Land Use	Grazing and Cropping

[1] Lodgement date of the development application (DA 313/V039/23) recorded as 9 November 2023 and subsequently the relevant version of the PD Code is 2023.16 dated 9 November 2023
[2] •Refer Section 1.6 of Volume 1 – Project Summary for description of site boundary, development area and disturbance footprint.



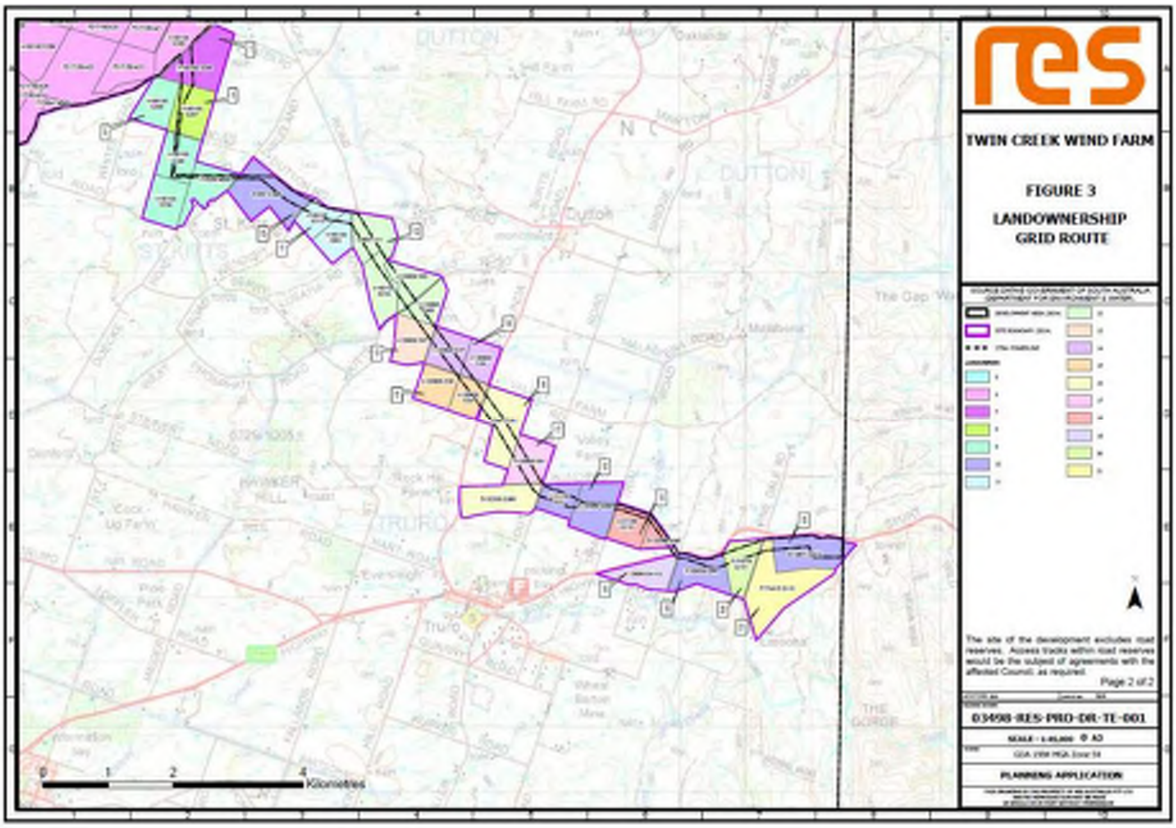


Figure 1: RES Figure 3 (2 pages) - Land Ownership Wind Farm and Grid Route

1 Introduction

MasterPlan SA Pty Ltd was engaged by RES Australia Pty Ltd (RES) to undertake an assessment of the proposed wind farm and energy storage project against the provisions of the Planning and Design Code. This report provides an assessment against the relevant provisions of the Planning and Design Code.

1.1 Document Review

In preparing this report, all relevant investigations have been undertaken including:

- Review of relevant legislation, including the *Planning, Development and Infrastructure Act 2016*.
- Review of the provisions of the Planning and Design Code (version 2023.16 dated 9 November 2023).
- Review of Volume 1 - Project Summary of the development application documents;
- Review the technical assessment reports as contained in Volume 2 - Technical Reports in the development application documentation, as listed below:
  - Landscape Character and Probable Visual Effect Assessment by Wax Design and Dr Brett Grimm
  - Twin Creek Wind Farm Environmental Noise Assessment by Sonus
  - Twin Creek Wind Farm Shadow Flicker and Blade Glint Assessment by DNV
  - Twin Creek Wind Farm EMI Assessment by DNV
  - Aviation Impact Statement by Aviation Projects
  - Traffic Impact Assessment by MFY
  - Twin Creek Wind Farm Civil, Geology and Hydrology by AECOM Australia Pty Ltd (AECOM)
  - Twin Creek Wind Farm Socio-Economic Impact Assessment by Hudson Howells Strategic Management Consultants
  - Heritage Impact Assessment by DASH Architects
  - Native Vegetation Clearance Data Report by Umwelt
  - Bird and Bat Assessment Addendum by Umwelt.

Review of the plans (Volume 3 - Drawings, Maps and Figures) of the development application documents including those listed below:

Table 3: List of Figures and Drawings

Figure No.	Name	Drawing Number
Figure 1	Location Plan	03498_RES-LAY-DR-TE-002
Figure 2	Infrastructure Layout Wind Farm and Grid Route (2 pages)	03498-RES-LAY-DR-TE-004
Figure 3	Landownership Wind Farm andGrid Route (2 pages)	03498-RES-PRO-DR-TE-001
Figure 4	Landownership Wind Farm and Infrastructure Wind Farm	03498-RES-PRO-DR-TE-004
Figure 5	Turbine Locations	03498-RES-LAY-DR-TE-003

Figure No.	Name	Drawing Number
Figure 6	House and Turbine Locations Wind Farm and Grid Route (2 pages)	03498-RES-MAP-DR-TE-004
Figure 7	Turbine Micrositing	03498-RES-LAY-DR-TE-012
Figure 8A	Site and Context Analysis Wind Farm and Grid Route(2 pages)	03498-RES-MAP-DR-TE-010
Figure 8B	Site and Context Analysis Plan Wind Farm and Grid Route (2 pages)	03498-RES-MAP-DR-TE-014
Figure 9	Planning Zones	03498-RES-MAP-DR-TE-011
Figure 10	Design Response Wind Farm and Grid Route (2 pages)	03498-RES-MAP-DR-TE-012
Figure 11A	Construction Operations, Maintenance and Substation Areas	03498-RES-LAY-DR-PT-004
Figure 11B	Terminal Station Site Plan	03498-RES-LAY-DR-PT-007 Rev 1
Figure 12	Typical Operations and Maintenance Area (3 pages)	03498-RES-LAY-DR-PT-005 Rev 1
Figure 13	Typical Temporary Construction Compound	03498-RES-LAY-DR-PT-006 Rev 1
Figure 14	Typical Concrete Batching Plant	03498-RES-LAY-DR-PT-001 Rev 1
Figure 15	Typical Substation and Control Building	03498-RES-UTI-DR-PT-001 Rev 1
Figure 16	Battery Energy Storage Facility	03498-RES-BAT-DR-PT-001 Rev 2
Figure 17	Cable Reticulation Layout	03498-RES-CBL-DR-TE-001
Figure 18	Onsite Cable Trench Typical Sections	03498-RES-GRD-DR-PT-001 Rev 1
Figure 19	Typical Overhead Line Poles	03498-RES-UTI-DR-PT-002 Rev 1
Figure 20	Typical Overhead Line Easement and Vegetation Clearance	03498-RES-UTI-DR-PT-003 Rev 1
Figure 21	Preliminary Track Design	03498-RES-LAY-DR-PT-003 Rev 1
Figure 22	Typical Turbine Foundation	03498-RES-WTG-DR-PT-001 Rev 1
Figure 23	Typical Front and Side Elevation of a Wind Turbine	03498-RES-WTG-DR-TE-004
Figure 24	Typical Crane/Turbine Hardstand	03498-RES-LAY-DR-PT-002 Rev 2

- Review of the Draft Construction Environmental Management Plan contained in Volume 4 of the development application documentation.

In addition to reviewing the abovementioned plans and reports, a site and locality inspection has been undertaken.

1.2 Crown Development

In accordance with Section 131(2)(c) of the *Planning, Development and Infrastructure Act 2016* (the PDI Act), RES is proposing to develop electricity infrastructure, with the electricity proposed to be generated by wind turbine generators and a battery energy storage system, to be distributed to the national grid.

In accordance with the definition of "essential infrastructure" in Section 3(1) of the PDI Act, RES is providing electricity infrastructure, as identified in part (a):

> *essential infrastructure means –*
>
> *infrastructure, equipment, structures, works and other facilities used in or in connection with -*
>
> *(i) the generation of electricity or other forms of energy; or*
> *(ii) the distribution or supply of electricity, gas or other forms of energy; and ...*

In accordance with the requirements of Schedule 6 of the *Planning, Development and Infrastructure (General) Regulations 2017*, a certificate from the Office of the Technical Regulator must be obtained and accompany a development application for electricity generation exceeding 5MW that is connected to the State's electricity system. The battery energy storage system (BESS) of the project will have the capability to meet the Office of the Technical Regulator (OTR) technical requirements by providing Fast Frequency Response (FFR). The Project has the capacity to provide (via one option or in combination):

- 740MW.s of real inertia provided via a synchronous condenser, or
- 127.5MW of fast frequency response (FFR) provided via a battery energy storage system (BESS) with a response time of <250mS, or
- 84.5MW of FFR provided via a BESS with a response time of <150mS,

To support the South Australian network, which will meet the requirements of the OTR. A Certificate of Compliance has been obtained from the Office of the Technical Regulator for the optimised Project.

Electricity proposed to be generated by the wind farm and stored in the BESS will be distributed to the national grid. The South Australian Department for Energy and Mining (state agency) has endorsed the proposed development for the purposes of Section 131 of the PDI Act.

By definition (as contained in Part 7 - Planning and Design Code), the proposed land use is a renewable energy facility.

> *Renewable energy facility: Means land and/or water used to generate electricity from a renewable source such as wind, solar, tidal, hydropower, biomass and/or geothermal.*
>
> *This use may also include:*
>
> *(a) any associated facility for the storage and/or transmission of the generated electricity;*
> *(b) any building or structure used in connection with the generation of electricity.*

1.3 Time in Which to Commence and Complete the Development

RES is seeking a period of five (5) years in which to substantially commence the proposed development from the operative date of the development authorisation and substantial completion seven years from the operative date of the development authorisation.

2 Description of the Proposed Development

The proposed development is described in detail in Volume 1 - Project Summary and on the plans Volume 3 - Drawings, Maps and Figures. In summary the optimised proposed development (this application) will consist of the following components:

- Based on the Vestas V172-7.2MW as the candidate turbine, with an overall turbine blade tip height up to 220 metres, a hub height of up to 134 metres and a rotor diameter of up to 172 metres. The final turbine model will be subject to a competitive tender process following development authorisation.
- Up to 42 Wind Turbines Generators (WTG).
- Each WTG has a name plate capacity of up to 7.2MW, with a total installed generating capacity of the wind farm of up to 270MW.
- Associated hard standing areas and access roads.
- Operations and maintenance building and compound with associated car parking.
- Two electrical substations (one project substation south-east of WTG 29 and one cut-in terminal substation east of Truro).
- A battery energy storage facility with an indicative capacity of 215MW.
- Overhead and underground electrical cable reticulation.
- Overhead transmission line for approximately 15 kilometres from the on-site substation to the existing overhead Robertstown - Tungkillo transmission line east of Truro.
- Temporary construction facilities including a borrow pit and concrete batching plant facilities.

The layout of the proposed development is shown on the plans contained in Volume 3 of the application document and illustrated on the extract below.

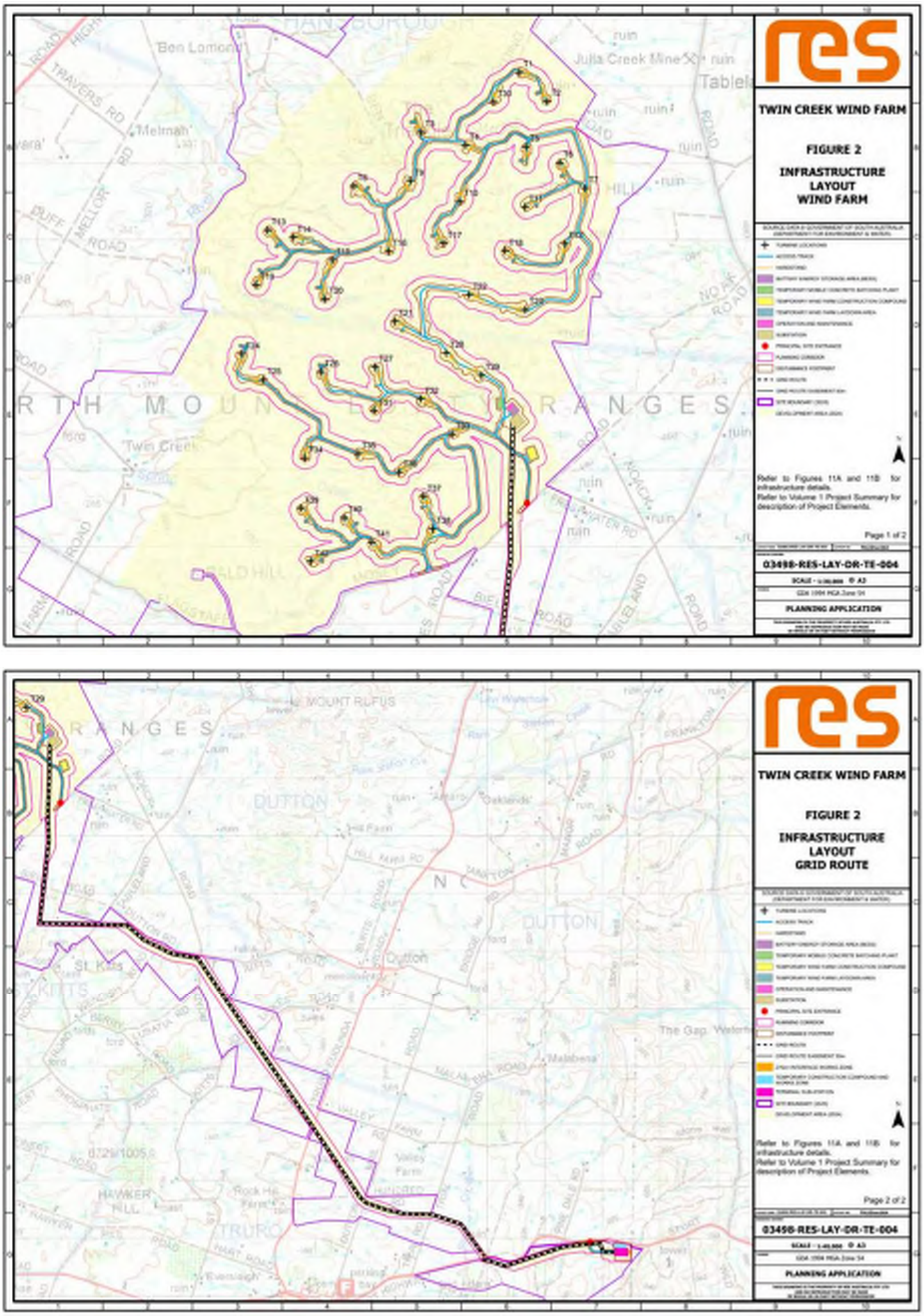


Figure 2: RES Figure 2 - Infrastructure Layout Wind Farm and Grid Route (2 pages)

3 Site and Locality Description

The site of the proposed development is located across three (3) local government areas, being the areas of the Light Regional Council, the Regional Council of Goyder and the Mid Murray Council. Infrastructure including wind turbine generators (WTGs), battery energy storage system (BESS), on-site substation, operations and maintenance compound, temporary construction compound (including temporary concrete batching plant) are located within the areas of the Light Regional Council and Regional Council of Goyder. The transmission line transverses from within the Light Regional Council area into the Mid Murray Council area and terminates with a terminal substation east of Truro.

3.1 Site of Development

The site[3] of the development is often referred to in technical reports (Volume 2 forming part of the development application) by varying terminology such as 'the project boundary' or 'project area' or 'site boundary' or 'development area' may be utilised within the application documentation to describe the development and the site of the development. Whilst the terminology may vary the development is based on the following parameters:

- The “site boundary – wind farm” incorporates all land detailed in **Attachment A**. The “site boundary” is shown on the plans prepared by RES as a purple line (site boundary 2024). The site boundary – wind farm comprises the outer boundary of the land described in all Certificates of Title incorporated in the development, including allotments/sections are not proposed to host project infrastructure but are described on the same Certificates of Title as allotments/sections that are hosting project infrastructure. The land within the site boundary includes landowner associated dwellings, vehicle access routes, driveways and ancillary structures, along with the proposed infrastructure within the ‘development area’.
- The “site boundary – grid route” incorporates land in private ownership along the transmission line (grid route) as detailed in **Attachment A**. The “site boundary” is shown on the plans prepared by RES as a purple line (site boundary 2024) and includes the outer boundary of the allotment/section which comprises transmission line infrastructure, substation and property in the ownership of RES, including land proposed to be utilised for on-ground significant environmental benefit. That is, the site boundary – grid route as illustrated on the plans does not illustrate the entirety of the Certificate of Title boundaries.
- References to the “development area”, which is shown as light yellow shading (and/or dashed black line) on the plans prepared by RES contains the infrastructure of the project, but may not include entire allotments as contained within the “site boundary”, or allotments that are not proposed to host any project infrastructure.
- The terms Grid route and transmission corridor are utilised interchangeably. The transmission corridor incorporates a 50-metre-wide easement within the site boundary.

[3] Site is defined in Part 8 – Administrative Terms and Definitions of the Planning and Design Code as: Means the area of land (whether or not comprising a separate or entire allotment) on which a building is built, or proposed to be built, including the curtilage of the building, or in the case of a building comprising more than 1 separate occupancy, the area of land (whether or not comprising a separate or entire allotment) on which each occupancy is built, or proposed to be built, together with its curtilage.

- Disturbance footprint, which is shown as a brown line on the plans prepared by RES illustrates the maximum area of disturbance of the development within the planning corridor. The disturbance footprint will not extend beyond the planning corridor but may be micro-sited within this corridor.
- Planning corridor, which is shown as a pink line on the plans prepared by RES is a corridor for the location of the infrastructure and micro-siting of that infrastructure. The planning corridor is designed with a base of 100 metres in all directions around the disturbance footprint (with some variations to avoid what have been identified as unbuildable areas (i.e., creeks, lower half of the ridge and the like).
- Micro-siting of wind turbines is based on a 100m radius from turbine centre point, with relevant constraints excluded.

The site of the development with cadastre data is shown on Figure 4 - Land Ownership and Infrastructure Wind Farm and Grid Route of the application documents (Volume 3) and detailed in Volume 1 - Project Summary.

The site boundary of the wind farm is estimated to be encircle approximately 5,548 hectares of the land. Of the total site area, The development area is approximately 3,684 hectares in total, however the majority of this land will not comprise any infrastructure. The disturbance footprint which is proposed to incorporate the development infrastructure is approximately 380 hectares in total. Not all of the disturbance footprint will contain infrastructure and is a worst-case scenario. By way of example, the disturbance footprint incorporates the transmission line entire corridor, however this is corridor would include transmission towers which are separated and not a continuous corridor of infrastructure.

Infrastructure incorporating the on-site substation, energy storage, and operations and maintenance facilities is approximately 5 hectares in area, and is located within Section 278 in Certificate of Title Volume 5618 Folio 693 adjacent Mosey Road. A temporary construction compound is proposed to be located on Section 284 in Certificate of Title Volume 5618 Folio 688, comprising an area of approximately 2.0 hectares.

The terminal substation is approximately 2.0 hectares in area and is located adjacent the Sturt Highway, east of the township of Truro, within Allotment 910 in Certificate of Title Volume 6221 Folio 131.

Several of the properties listed in the Table 2 and 3 in Volume 1 - Project Summary may not be proposed to contain specific wind farm or energy storage infrastructure at this time. These properties form part of the site boundary to provide the applicant with sufficient flexibility for future micro-siting of the wind turbine generators and transmission lines, as well as minor deviations of the access tracks, internal reticulation and services.

All dwellings within the site of the development (within the site boundary) are owned by involved landowners and noted as stakeholder dwellings on the plans accompanying the application.

The wind farm is located on the tablelands that form the wide ridgeline associated with Bald Hill and Long Hill situated within the Northern Mount Lofty Ranges. Detailed landscape and environmental assessments of the wind farm site have been undertaken by WAX Design and EBS Ecology (now Umwelt), and these reports form part of Volume 2 of the application documents. The landform of the area is defined by numerous ridgelines that run north-south through the site creating a series of parallel ridges, wide open valleys, tablelands and isolated topographic features.

The development locality is a modified landscape which contains the following elements:

- Open agricultural landscape dominated by grazing and open paddocks.
- Scattered areas of native vegetation, generally along road verges and creek lines.
- Farm buildings including dwellings and other structures.
- A range of arterial, major local roads and minor local roads.
- Former mines including Benita Copper and Newlands Barite mines.
- Infrastructure electricity distribution/transmission lines.
- A range of major regional and collector and local roads.

The environmental qualities of the development site are further described in detail in Volume 1 - Project Summary and the Native Vegetation Clearance Data Report (by Umwelt formerly EBS Ecology) which forms part of the application documents. The ecological assessment identified 59 native fauna species, including two amphibians, five reptile species, three mammals, 42 birds (six exotic) and seven bats (all native). One reptile and three bird species of national or State conservation significance were identified:

- Pygmy Blue-Tongue Lizard (*Tiliqua adelaidensis*) nationally and State Endangered.
- Diamond Firetail (*Stagonopleura guttata*) nationally and State Vulnerable.
- Rainbow Bee-Eater (*Merops ornatus*) nationally migratory.
- Blue-Winged Parrot (*Neophema chrysostoma*) nationally and State vulnerable.

A sizeable proportion of the development site is considered a possible or likely habitat for the Pygmy Blue Tongue Lizard (PBTL) due to the open grasslands, slopes and spider holes observed across the site. Areas considered unlikely to contain PBTLs are cropping paddocks, very steep ground, very rocky ground or areas with no evidence of spider holes. Umwelt have identified potential impacts on the PBTL from the development including potential direct loss of individuals through habitat clearance during construction, sedimentation of burrows, noise and vibration, loss of habitat, division of populations by infrastructure (such as access tracks) and blade shadow flicker. Due to the nature of the location and construction requirements for the wind farm infrastructure, the extensive area of suitable habitat and the cryptic nature of the PBTL, some level of impact on PBTL cannot be avoided. A range of mitigation measures are incorporated into the Statement of Commitments to minimise impacts on PBTL, including micro-siting of infrastructure, ongoing monitoring and translocation:

- Micro siting of infrastructure away from areas of high population density and/or known locations of PBTL, informed by additional survey during the detailed engineering design phase of the project.
- Minimising the Disturbance Footprint as far as practicable in PBTL habitat. This may include constructing access roads to the narrowest possible width, turbine hardstands kept to the smallest possible dimensions and incorporating design elements such as routing reticulation along access roads and areas of unlikely PBTL habitat (i.e. cropping).

- Preparation and implementation of a PBTL Management Plan that considers strategies for avoiding, minimising and mitigating direct, indirect and unforeseen impacts to PBTL during construction and operation of the Project.
- Preparation and implementation of an offset strategy that provides a benefit to the overall PBTL population in the region.

The ongoing monitoring and potential offset strategy will be further developed as part of the *Environment Protection and Biodiversity Conservation Act (EPBC Act) 1999* (EPBC) referral process.

Two nationally threatened ecological communities, listed under the EPBC Act, were investigated and assessed for qualification within the project boundary. The listed ecological communities being:

- Iron-Grass (*Lomandra spp*) Natural Temperate Grassland of South Australia.
- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia.

No impact is expected to the Peppermint Box Grassy Woodland as a result of the optimised project layout, as the siting of infrastructure has avoided impact to Peppermint Box Grassy Woodland and the Iron-grass Natural Temperate Grassland (INTG) was not of a condition to qualify as significant.

In general terms, the area in which the development is proposed is one of a pleasant open rural character, comprising a variety of natural and man-made features, although highly modified by agricultural activities which have over time resulted in clearance of native vegetation.

3.2 Description of the Locality

The Wax Design Landscape and Visual Assessment report (contained in Volume 2 of the application documents) describes the locality as having five distinct landscape character areas which largely follow the four cardinal directions (north, east, south and west):

> *To the south of the subject land is the Northern Barossa Valley, which has a denser level of development and high quality agricultural landscape with a variety of visual interest created by the smaller lot sizes and variety of land uses (grazing, vineyards, animal husbandry). The Western Pastoral Lands and ridgelines stretch along the western edge of the subject locality and are defined by a more open agricultural landscape with rolling ridgelines. The subject locality itself and to the north are the Central Tablelands; these are characterised by rolling landforms and valleys associated with the Northern Mount Lofty Ranges and have a typically open grass grazing land use with minimal vegetation. To the east of the subject locality is Mount Rufus and associated north/south ridgelines which transition further west into the Western Murray River Plains, the ridgeline associated with Mount Rufus forms a distinct division between the subject locality and the Murray River Plains.*
>
> *The land cover associated with the locality of the development site reflects various agricultural land uses, including arable and pastoral practices, and is consistent across the locality with little variation in scale or function. The landscape surrounding the site is dominated by grazing with open paddocks defined by fenced boundaries and occasional trees to fence lines and creek lines. The land use that occurs on the open valley floor between the local ridgelines and across the tablelands associated with Bald Hill is more diverse, with areas of arable cropping and grazing.*

This land cover creates a patchwork character to the landscape with changes in colour and texture as a result of the different agricultural practices. Typically, the land cover and associated vegetation are low lying with limited visual screening to the west, south and north. Areas to the east associated with the Mount Rufus ridgelines and the northern outskirts of Nuriootpa possess more extensive tree cover. Vineyards are a notable visual element creating a defined pattern to the northern outskirts of Nuriootpa, emphasising the landscape qualities of the Barossa Valley.

Wax notes that (in Section 11) that *"within this visually contained rural landscape, the proposed layout of the Optimised Project will form a compact cluster of 42 wind turbines with a maximum tip height of 220 metres"*.

A locality for the proposed development is difficult to accurately define, not only because of the combined height of the turbine and blades (up to 220 metres), but also because of the topography and the overall area covered by the proposal. Between the northernmost and southernmost turbines, there is approximately 9.0 kilometres (including spacing between turbines). There is approximately 8.5 kilometres between the most eastern and western turbine. The transmission line extends approximately 15 kilometres from the on-site substation to the Robertstown-Tungkillo transmission line and associated terminal substation adjacent the Sturt Highway east of Truro.

Within this locality, the prominent features/elements include:

- The townships of Kapunda, Truro, Eudunda and the areas of Koonunga, St Kitts and Dutton.
- Open agricultural landscape dominated by grazing and open paddocks.
- Areas of native vegetation, generally along ridgelines, road verges and creek lines.
- Farm buildings including dwellings and other structures.
- The former Julia Creek Barite mine located close to the eastern boundary of the site.
- Infrastructure including 275kV and 11kV electricity transmission lines.
- A range of major regional and collector roads:
    - Thiele Highway
    - Sturt Highway
    - Truro Road
    - Belvidere Road
    - Eudunda Road.
- A range of minor roads, including:
    - Mosey Road
    - Bagot Well Road
    - Camel Farm Road
    - Flagstaff Hill Road
    - Teagle Road
    - Weaver Road
    - Noack Road
    - Leakes Pass
    - Holding Road

- Travers Road
- Ben Lomond Road.

The closest Department of Environment and Water reserves to the proposed Twin Creek Wind Farm site are Kaiserstuhl Conservation Park (approximately 25 kilometres south) and Brookfield Conservation Park (approximately 32 kilometres east). Three (3) existing Heritage Agreement areas under the *Native Vegetation Act 1991* are situated 4.0 kilometres south (Heritage Agreement No.287) and 6.0 kilometres east of the project area (Heritage Agreement 677 and 1314). These areas are outside of the site of the development.

The locality can broadly be defined around the extent to which the turbines may be visible, however this will vary from different positions and with varying degrees of clarity. The Zone of Theoretical Visual Influence (ZTVI) prepared by WAX Design, which is part of the application documents, illustrates the visibility of the wind turbine generators.

Landscape character varies throughout the locality, as is described by WAX Design (Section 5.9) in relation to the visual impact of the proposed development:

> *The layout of the proposed wind turbines is likely to result in a single cluster of large infrastructure elements that form a concentrated visual effect in the rural landscape.*
>
> *Travelling through the landscape, the underlying topography of the surrounding ranges modifies views towards the proposed wind farm. The visibility of the proposed development changes due to the screening effects provided by the adjacent hills and ridgelines or areas of existing vegetation.*
>
> *The visual assessment undertaken from the seven selected viewpoints demonstrates that a variety of visual impacts will be experienced within the local (0-3km), sub-regional (3-10km) and regional (>10km) landscapes that surround the proposed wind farm site. To the north and south and from a distance of greater than five kilometres, the visual effect associated with the proposed development will result in wind turbines being seen behind local ridgelines and landforms. In these locations, the potential visual effect is likely to result from sections of the hub and blades visible above the local topography and vegetation.*
>
> *The potential visual effect reduces over distance, with the visual assessment recording the visual effect as slight at a distance of more than ten kilometres, particularly to the northeast. This reflects the different landscape characters around the proposed development site and the significant landscape absorption and screening created by ridgelines and vegetation in the locality.*
>
> *To the south, the distance between the proposed wind farm and the Barossa Valley significantly mitigates the visual effect and limits the potential impact that the Optimised Project may have on the Barossa Valley Character Preservation Zone and the associated areas of higher landscape amenity and cultural value.*

Viewed from the east and west, the proposed wind turbines are likely to be visible and situated on the elevated topography of the Central Tablelands. The scale of the proposed development in relation to the topography and landform of the underlying landscape character is prominent due to the number of wind turbines and the height of the towers and blades in the landscape.

Within five kilometres of the proposed wind farm, the screening provided by local ridgelines and vegetation belts is limited, and the majority of the wind turbines are experienced as visually prominent elements in the rural landscape, producing a degree of visual change of 45%, which is described as substantial. This substantial visual effect alters the underlying visual character and composition of the landscape through the introduction of new elements. Views will be altered, but the sensitivity of the underlying landscape character to change is considered low.

The extract from the WAX Design report quoted above is considered important in understanding the locality, and in the discussion of the impact of the proposed wind farm on the character and amenity of the locality. The assessment utilises the GrimKe matrix (refer Section 5.9 of the WAX Design report) and considers a range of visual change from 'slight' through to 'extreme'. It is noted that the 'substantial visual effect' of the proposed development when viewed from the east and west is described in the GrimKe matrix as noticeable or clearly visible in the field of vision.

In determining the character and amenity of the locality, the following extracts from *Taralga Landscape Guardians Inc v Minister for Planning and Anor ((2007) 161 LGERA 1, at para 1)* cited in the *ERDC No 106 of 2010 R Paltridge and Anor v District Council of Grant (June 2011 at para 25)*, illustrates how a wind farm development can create disparate views that impact on the rural character:

The insertion of wind turbines into a non-industrial landscape is perceived by many as a radical change which confronts their present reality. However those perceptions come in differing hues. To residents, such as members of Taralga Landscape Guardians Inc (the Guardians), the change is stark and negative. It would represent a blight and the confrontation is with their enjoyment of their rural setting.

To others, however, the change is positive. It would represent an opportunity to shift from the societal dependence on high emission fuels to renewable energy sources. For them, the confrontation is beneficial - being one much needed step in policy settings confronting carbon emissions and global warming.

4 Planning and Design Code Assessment

4.1 Planning and Design Code Policy

The proposed development is within the Rural Zone of the Planning and Design Code (version 2023.16 dated 9 November 2023). A number of Overlays apply to various allotments (sections) (but not all land parcels) within the project area, including:

- Water Resources Overlay
- Native Vegetation Overlay
- Hazards (Flooding - Evidence Required) Overlay
- Hazards (Bushfire - Regional Risk) Overlay
- Hazards (Bushfire - General Risk) Overlay
- Environment and Food Production Area Overlay
- Heritage Adjacency Overlay
- Local Heritage Place Overlay
- State Heritage Place Overlay
- Dwelling Excision Overlay
- Limited Land Division Overlay
- Murray-Darling Basin Overlay
- Key Outback and Rural Routes Overlay
- Resource Extraction Protection Area Overlay.

A summary of the land parcels within the project and the relevant Zone and Overlays is contained in **Attachment B**.

In addition to the Zone and Overlay policies, there are policies within the General Development Policies which are relevant to the assessment of the development application, including but not limited to:

- Clearance from Overhead Powerlines
- Design
- Infrastructure and Renewable Energy Facilities
- Interface between Land Uses
- Transport, Access and Parking.

4.2 Overlays

As stated above, there are several Overlays that apply to various properties within the site of the development. However, not all Overlays apply to all properties which form the site of the development. Furthermore, the relevant authority may determine that one or more of the Overlays or the policies of the Overlays is not relevant.

It is further noted that in interpreting the Planning and Design Code, that if there is an inconsistency between provisions in the relevant policies for a particular development, the provisions of an overlay will prevail over all other policies applying in the particular case[4].

It is noted that the site of the development is not located within the Significant Landscape Protection Overlay or the Character Preservation Area Overlay, as illustrated on the extracts from the South Australian Property and Planning Atlas (SAPPA). In both Overlays, renewable energy facilities are a restricted form of development. The site of the development is outside of these Overlays and the Project is assessed on its merits.

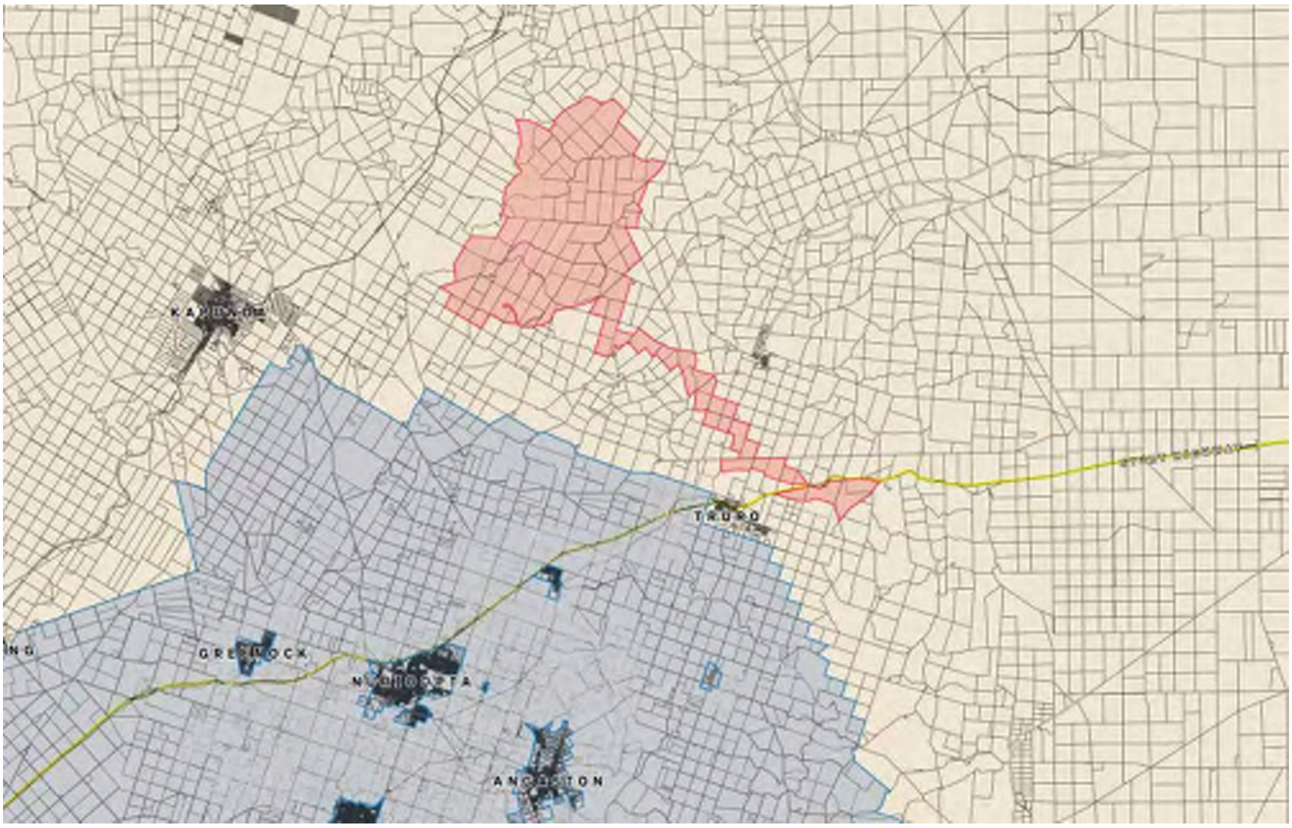


Figure 3: Twin Creek site boundary and location of the Character Preservation Overlay (blue shading) .

[4] As stated in Part 1 - Rules of Intepretation of the Planning and Design Code.

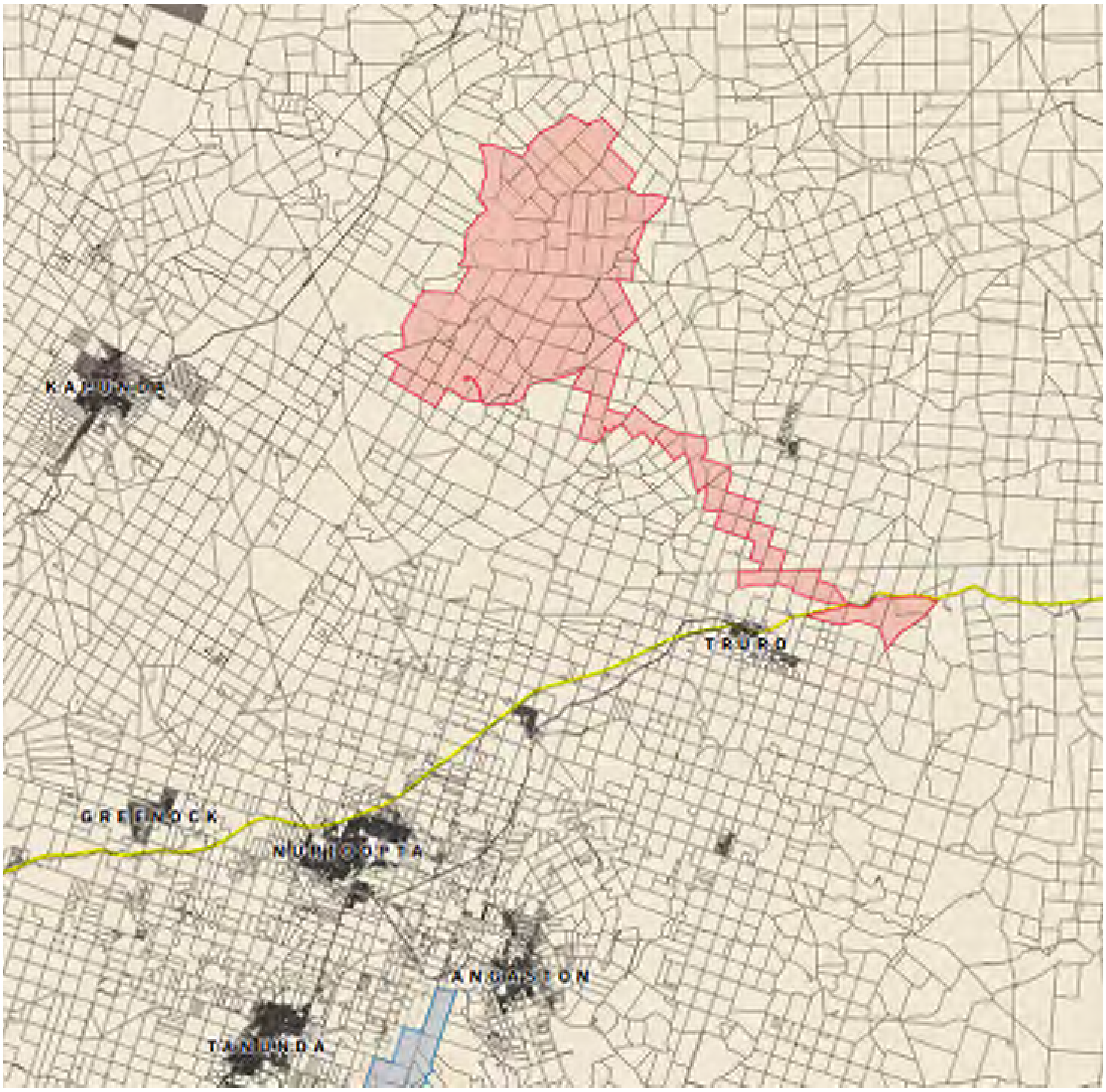


Figure 4: Twin Creek site boundary illustrating the Significant Landscape Protection Overlay (blue shading south-west of Angaston)

4.2.1 Character Preservation Overlay

As noted above, the Character Preservation Overlay does not apply to the site of the development. However, during the assessment of the 2017 development application (422/E003/17) for Twin Creek Wind Farm, there were a range of views expressed regarding the proximity and visibility of the Project to the Barossa Valley Character Preservation District.

The *Character Preservation (Barossa Valley) Act 2012* defines the Barossa Valley district by the plan deposited in the General Registry Office at Adelaide and number GP 4 of 2012 (the GRO Plan) and became operational on 18 January 2013 being *"the plan as it exists on 26 June 2012"*. Part of the Barossa Valley

Character Preservation District extends into the Mid Murray Council and Light Regional Council areas. The Barossa Valley Character Preservation District is represented in the Planning and Design Code as part of the Character Preservation Area Overlay. This overlay is spatially interpreted in the South Australia Property and Planning Atlas (SAPPA).

As previously stated, the site of the development is not located within or adjacent[5] the Barossa Valley Character Preservation District. Lot 386 Dutton Mall Road, Truro (Certificate of Title Volume 6290 Folio 429) is the property in closest proximity to the Character Preservation Area Overlay. This property is in two pieces, Q387 and Q386 as illustrated on Figure 7 below. Piece Q387 is in closest proximity to the Character Preservation District but does not contain any infrastructure and is not part of the site of the development. Piece 386 (the northern piece of this Certificate of Title) contains part of the transmission line of the proposed development in the north-eastern corner of the allotment. It is estimated that the transmission line corridor (within Q386) is approximately 1.8 kilometres from the boundary of the Character Preservation Area Overlay boundary and therefore not adjacent.

Figure 5: Pieces 386 (northern) and 387[6] (southernrelative to the Character Preservation Area Overlay (light yellow shading).

[5] adjacent land is interpreted in Part 1(3) of the Planning, Development and Infrastructure Act 2016 as: adjacent land in relation to other land, means land that is no more than 60 metres from the other land;
[6] Pieces Q387 is the closest parcel to the Character Preservation Area Overlay boundary.

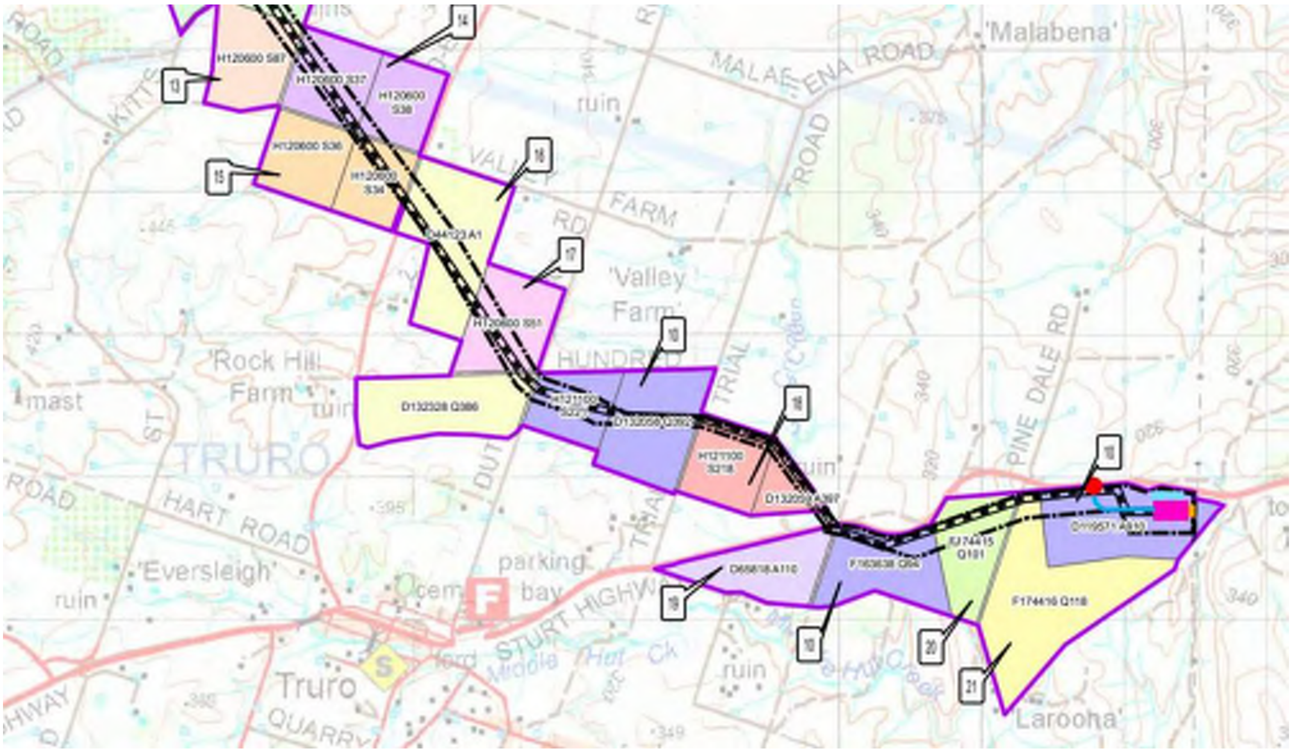


Figure 6: Extract of RES Figure 4 illustrating transmission line on Piece Q386 in proximity to Truro

No further assessment is required or undertaken in relation to the Character Preservation Area Overlay, as it is not relevant to the assessment of the application.

4.2.2 Water Resources Overlay

The Water Resources Overlay seeks to protect the quality of surface water and the natural flow of watercourses, manage flood waters and stormwater runoff. An assessment of the proposed development on protection and management of water resources has been undertaken by AECOM (Twin Creek Wind Farm Civil, Geology and Hydrology) and is further described and assessed in **Section 4.3** below.

Water Resources Overlay Desired Outcome
DO 1 Protection of the quality of surface waters considering adverse water quality impacts associated with projected reductions in rainfall and warmer air temperatures as a result of climate change.
DO2 Maintain the conveyance function and natural flow paths of watercourses to assist in the management of flood waters and stormwater runoff.

4.2.3 *Native Vegetation Overlay*

A detailed assessment of flora and fauna within the site of the development has been undertaken

in the Native Vegetation Data Report by Umwelt. This assessment in the context of the policies of the Native Vegetation Overlay, which seek to protect and avoid or minimise clearance of native vegetation, is discussed in Section 4.3 below.

Native Vegetation Overlay **Desired Outcome**	
DO 1 Areas of native vegetation are protected, retained and restored in order to sustain biodiversity, threatened species and vegetation communities, fauna habitat, ecosystem services, carbon storage and amenity values.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 Development avoids, or where it cannot be practically avoided, minimises the clearance of native vegetation taking into account the siting of buildings, access points, bushfire protection measures and building maintenance.	DTS/DPF 1.1 An application is accompanied by: (a) a declaration stating that the proposal will not, or would not, involve clearance of native vegetation under the Native Vegetation Act 1991, including any clearance that may occur: (i) in connection with a relevant access point and / or driveway (ii) within 10m of a building (other than a residential building or tourist accommodation) (iii) within 20m of a dwelling or addition to an existing dwelling for fire prevention and control (iv) within 50m of residential or tourist accommodation in connection with a requirement under a relevant overlay to establish an asset protection zone in a bushfire prone area or (b) a report prepared in accordance with Regulation 18(2)(a) of the Native Vegetation Regulations 2017 that establishes that the clearance is categorised as 'Level 1 clearance'.
PO 1.2 Native vegetation clearance in association with development avoids the following: (a) significant wildlife habitat and movement corridors (b) rare, vulnerable or endangered plants species (c) native vegetation that is significant because it is located in an area which has been extensively cleared (d) native vegetation that is growing in, or in association with, a wetland environment.	DTS/DPF 1.2 None are applicable.

4.2.4 Hazards (Flooding – Evidence Required) Overlay

Appropriate siting and design of buildings and infrastructure to mitigate potential impacts of flood is sought by the Hazards (Flooding-Evidence Required) Overlay. The proposed development does not include habitable buildings, and the siting of the infrastructure is located on the ridgelines in the case of the wind turbine generators or outside of watercourses and potential areas of flooding for other infrastructure elements. An assessment of the proposed development on protection and management of water resources has been undertaken by AECOM (Twin Creek Wind Farm Civil, Geology and Hydrology) and is further described and assessed in **Section 4.3** below.

Hazards (Flooding-Evidence Required) Overlay	
Desired Outcome	
DO 1 Development adopts a precautionary approach to mitigate potential impacts on people, property, infrastructure and the environment from potential flood risk through the appropriate siting and design of development.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
Flood Resilience	
PO 1.1 Development is sited, designed and constructed to minimise the risk of entry of potential floodwaters where the entry of flood waters is likely to result in undue damage to or compromise ongoing activities within buildings.	DTS/DPF 1.1 Habitable buildings, commercial and industrial buildings, and buildings used for animal keeping incorporate a finished floor level at least 300mm above: (a) the highest point of top of kerb of the primary street or (b) the highest point of natural ground level at the primary street boundary where there is no kerb
Environmental Protection	
PO 2.1 Buildings and structures used either partly or wholly to contain or store hazardous materials are designed to prevent spills or leaks leaving the confines of the building.	DTS/DPF 2.1 Development does not involve the storage of hazardous materials.

4.2.5 Hazards (Bushfire – Regional Risk) Overlay and Hazards (Bushfire – General Risk) Overlay

The Project is sited across two levels of bushfire risk, namely Regional Risk and General Risk, as shown on the extract below. There is substantial overlap in the policies between the two applicable Overlays, all of which seek to mitigate the threat and impact of bushfires on life and property. Bushfire risk and mitigation has been considered in the design of the project and is further discussed in **Section 4.3** and outlined in the Statement of Commitments (in Volume 1 of the development application documentation).

Hazards (Bushfire – Regional Risk) Overlay	
Desired Outcome	
DO 1 Development, including land division responds to the relevant level of bushfire risk and is sited and designed to mitigate the threat and impact of bushfires on life and property taking into account the increased frequency and intensity of bushfires as a result of climate change.	
DO2 To facilitate access for emergency service vehicles to aid the protection of lives and assets from bushfire danger.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
Siting	
PO 1.1 Buildings and structures are located away from areas that pose an unacceptable bushfire risk as a result of vegetation cover and type, and terrain.	DTS/DPF 1.1 None are applicable.
Built Form	
PO 2.1 Buildings and structures are designed and configured to reduce the impact of bushfire through using designs that reduce the potential for trapping burning debris against or underneath the building or structure, or between the ground and building floor level in the case of transportable buildings and buildings on stilts.	DTS/DPF 2.1 None are applicable.

Hazards (Bushfire – General Risk) Overlay	
Desired Outcome	
DO 1 Development, including land division responds to the general level of bushfire risk by siting and designing buildings in a manner that mitigates the threat and impact of bushfires on life and property taking into account the increased frequency and intensity of bushfires as a result of climate change.	
DO2 To facilitate access for emergency service vehicles to aid the protection of lives and assets from bushfire danger.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 Buildings and structures are located away from areas that pose an unacceptable bushfire risk as a result of vegetation cover and type, and terrain.	DTS/DPF 1.1 None are applicable.

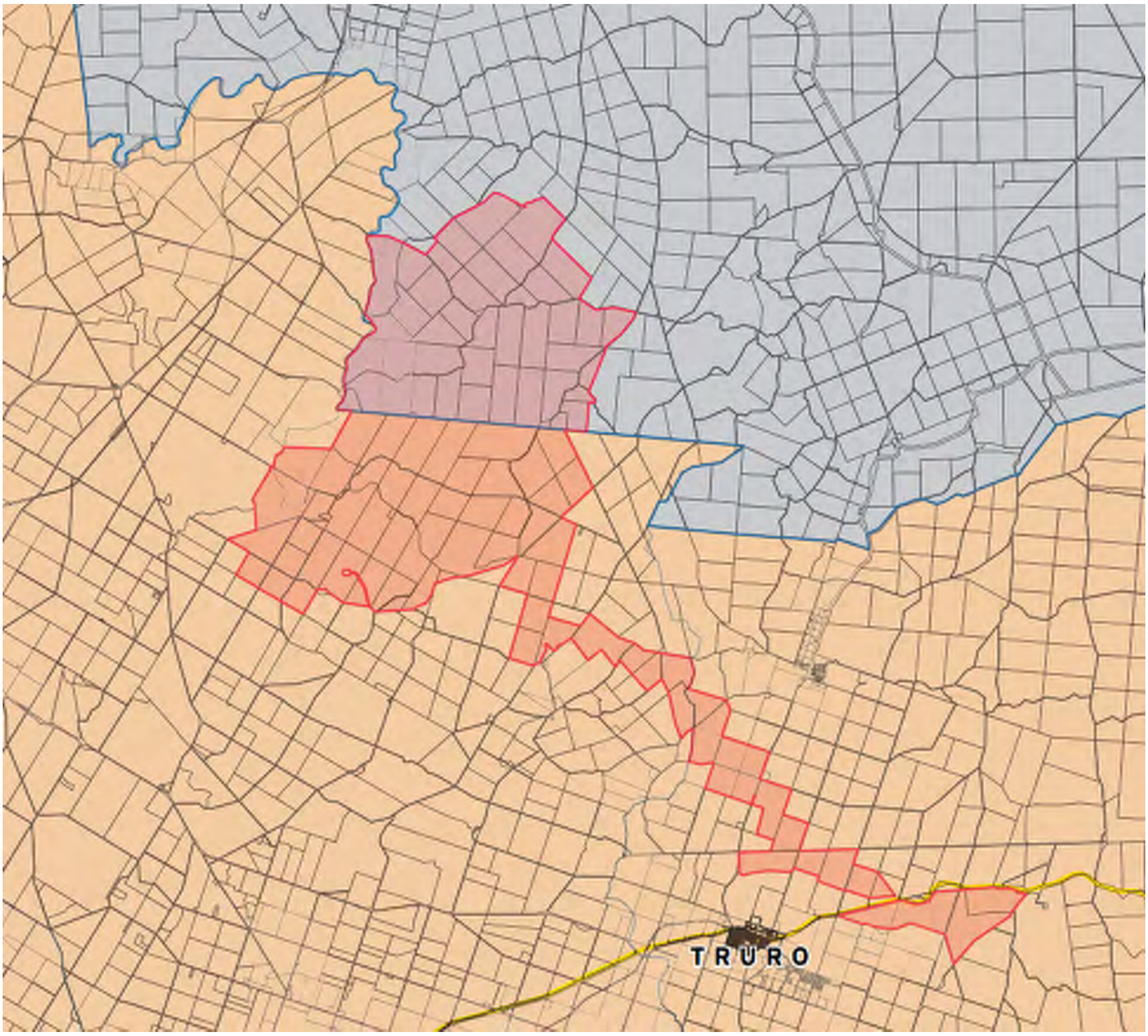


Figure 7: Twin Creek site boundary illustrating the General Risk Overlay (green shading) and Regional Risk Overlay (blue shading

4.2.6 Environment and Food Production Areas Overlay

The Environment and Food Production Areas Overlay applies to some properties within the site of the development, as illustrated on the extract below (**Figure 8**). There is no urban encroachment or land division proposed that would impact the environmental and food production area, which is sought to be protected by Desired Outcome 1 of the Overlay. On this basis, this assessment report does not further consider this Overlay.

Environment and Food Production Areas Overlay Desired Outcome	
DO 1 Protection of valuable rural, landscape, environmental and food production areas from urban encroachment.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 Land division undertaken in accordance with Section 7 of the Planning, Development and Infrastructure Act 2016.	DTS/DPF 1.1 None are applicable.

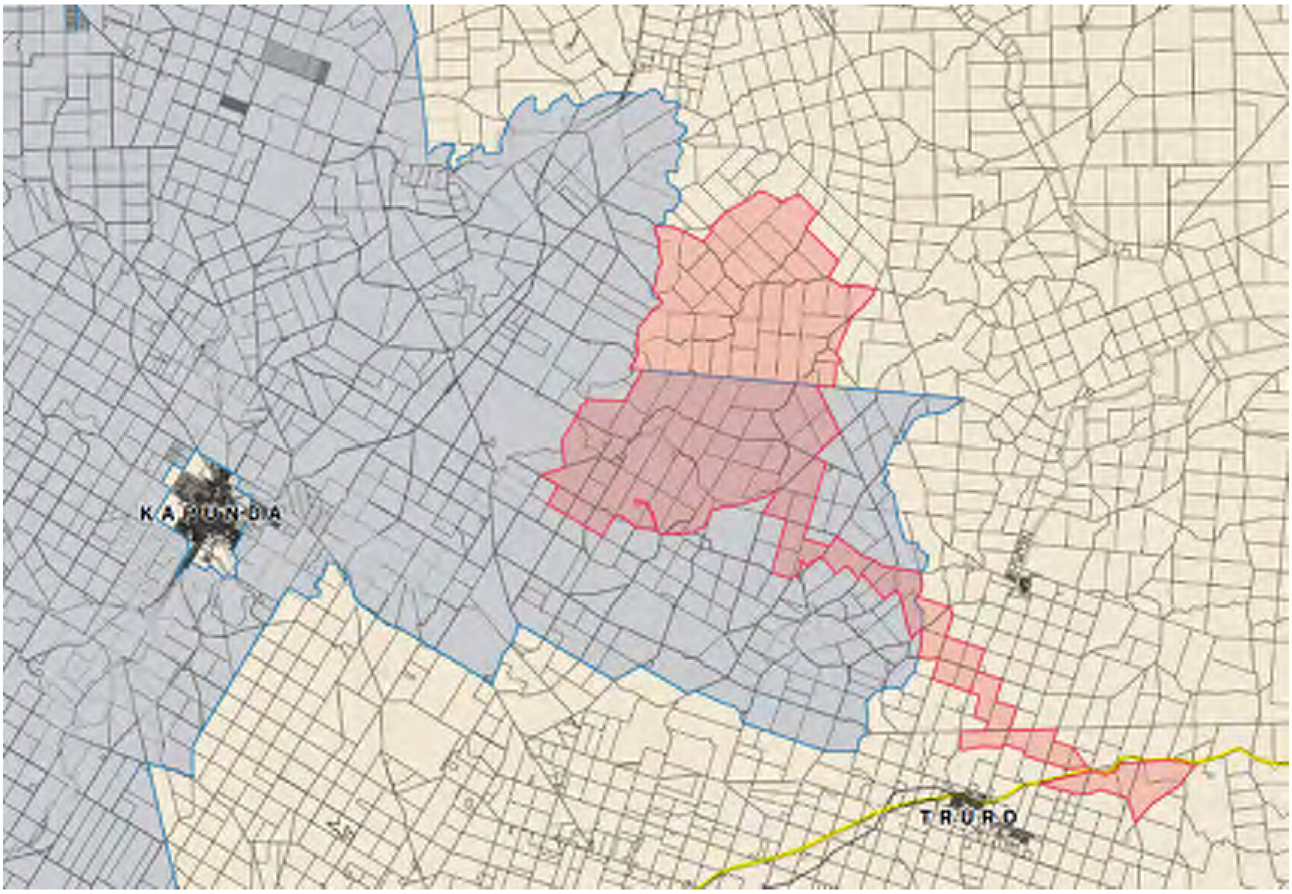


Figure 8: Twin Creek site boundary illustrating the Environment and Food Production Area Overlay

4.2.7 Heritage Adjacency, Local Heritage Place and State Heritage Place Overlays

There are no State or Local Heritage Places within the site of the development, as illustrated in the extract below from SAPPA. Both the State and Local Heritage Place Overlays have been triggered by the land parcel references rather than spatial application. As noted in the rules of interpretation of the Planning and Design Code:

Where a zone, subzone, overlay or technical and numeric variation (TNV) does not spatially apply to the whole of a site that is the subject of the development application, the spatially based rules of the zone (including assessment pathway exclusions), subzone, overlay or TNV are only applicable to the portion of the site to which the zone, subzone, overlay or TNV spatially covers. Reference to the South Australian Property and Planning Atlas of the SA planning database will be made to determine whether a zone, subzone, overlay or TNV is relevant to the site of the proposed development application" (Part 1 – Rules of Interpretation – Planning and Design Code).

As detailed in the Heritage Impact Assessment undertaken by Dash Architects (refer Volume 2 of the application documentation), the transmission line of the Project transverses a land parcel (F174416QP118) that is linked via a Certificate of Title Volume 6157 Folio 823 with State Heritage Place ID 16304 (Stone Wall off Sturt Highway, Truro). Siting of the transmission line does not extend into the area spatially identified on SAPPA as being the State Heritage Place and subsequently the State Heritage Places Overlay has no role to play in the assessment of the development application.

Similarly, the transmission line of the Project transverses a land parcel (H16000SE291) in Certificate of Title Volume 5264 Folio 963, which is the site of Local Heritage Place ID 18224 being Noack's Farm (addressed as 83 Freshwater Road, St Kitts). Noack's Farm is located on Section 291, whereas the transmission line transverses Section 290 of the same Certificate of Title. For the same reasons stated for the State Heritage Places Overlay, the Local Heritage Places Overlay does not apply to the assessment of the Project, as the site of the development does not apply to the site of the local heritage place (as shown spatially on SAPPA).

The Heritage Adjacency Overlay relating to Local Heritage Place ID 18224 (Noack's Farm, Freshwater Road, St Kitts) extends into the site of the development adjacent Mosey Road and Freshwater Road intersection. In addition, the transmission line transverses land within the Heritage Adjacency Overlay as applicable to Local Heritage Places: ID 17722 – Abandoned Farm Complex (Lot 304 Dutton Road, St Kitts, Certificate of Title Volume 5315 Folio 260); ID 18051 – Former St Paul's Lutheran Church (53 Tablelands Road, St Kitts, Certificate of Title Volume 5139 Folio 426); and ID 18050 Doecke's Farm (Lot 102 Wendish Road, St Kitts, Certificate of Title Volume 6090 Folio 968).

The Heritage Impact Assessment outlined in detail in **Section 4.3** of this report assesses the impact of the development on the Local Heritage Places and concludes *"while the proposed transmission lines that connect the wind farm to the terminal station may be visible within some views the relevant Local Heritage Places, such infrastructure will not dominate, encroach on or unduly impact on the setting of the heritage places, nor adversely impact on their heritage and cultural values"* (page 18, Heritage Impact Assessment report).

Heritage Adjacency Overlay Desired Outcome
DO 1 Development adjacent to State and Local Heritage Places maintains the heritage and cultural values of those Places.

Heritage Adjacency Overlay	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 Development adjacent to a State or Local Heritage Place does not dominate, encroach on or unduly impact on the setting of the Place.	DTS/DPF 1.1 None are applicable

Local Heritage Place Overlay	
Desired Outcome	
DO 1 Development maintains the heritage and cultural values of Local Heritage Places through conservation, ongoing use and adaptive reuse.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 The form of new buildings and structures maintains the heritage values of the Local Heritage Place.	DTS/DPF 1.1 None are applicable.
PO 1.2 Massing, scale and siting of development maintains the heritage values of the Local Heritage Place.	DTS/DPF 1.2 None are applicable.

State Heritage Place Overlay	
Desired Outcome	
DO 1 Development maintains the heritage and cultural values of State Heritage Places through conservation, ongoing use and adaptive reuse consistent with Statements of Significance and other relevant documents prepared and published by the administrative unit of the Public Service that is responsible for assisting a Minister in the administration of the Heritage Places Act 1993.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 The form of new buildings and structures maintains the heritage values of the State Heritage Place.	DTS/DPF 1.1 None are applicable.
PO 1.2 Massing, scale and siting of development maintains the heritage values of the State Heritage Place.	DTS/DPF 1.2 None are applicable.

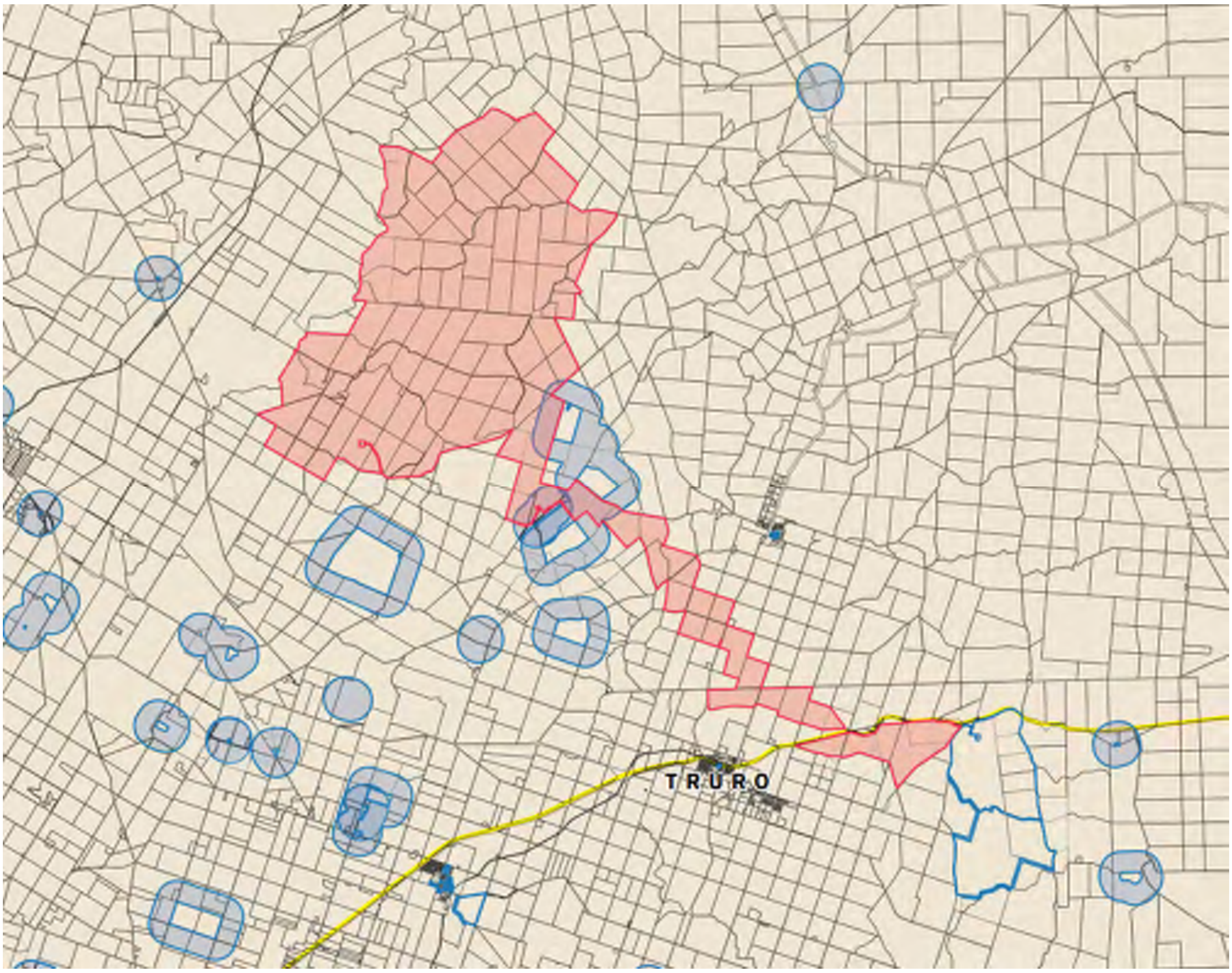


Figure 9: Twin Creek site boundary illustrating the location of the Heritage Adjacency, Local Heritage Place and State Heritage Place Overlays

4.2.8 Dwelling Excision Overlay

As the proposed development does not propose or include any land division associated with the creation of an additional allotment around an existing habitable dwelling, the policies of the Dwelling Excision Overlay have no role to play in the assessment of the application.

DWELLING EXCISION OVERLAY **Desired Outcome**	
DO 1 Creation of allotments to accommodate existing habitable dwellings in primary production areas is limited to avoid undermining primary production.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 Land division creating an additional allotment to accommodate an existing dwelling does not undermine	DTS/DPF 1.1 Land division satisfies all the following:

DWELLING EXCISION OVERLAY	
the role of primary production areas by being limited and designed to achieve the following: (a) accommodate a dwelling that has had a long term association with primary production on the same allotment (b) contain the excised dwelling within an allotment capable of providing a suitable rural residential amenity (c) maintain all other land (ie land outside the allotment containing the excised dwelling) in suitably sized allotments to support primary production (d) no other dwelling has been excised from the primary production allotment.	(a) no other dwelling has previously been excised from the allotment by creating an additional allotment (b) it does not create more than one additional allotment where the resultant allotments satisfy (i) and (ii): (i) one allotment will contain a single existing lawful dwelling that existed prior to 1 December 2011 and meets all of the following: A. no allotment boundary is closer than 40m to an existing dwelling B. the allotment is no less than 1 hectare and no greater than 4 hectares in area C. if the allotment is of a battle-axe configuration, the driveway 'handle' is no more than 50 metres in length (ii) any other allotment has an area not less than that identified in the Minimum Site Area Technical and Numeric Variation layer in the SA planning database.

4.2.9 Limited Land Division Overlay

Protection of primary production land from fragmentation is sought by the Limited Land Division Overlay, which applies to portion of the transmission line of the Project, as illustrated in the below extract from SAPPA. The development does not involve the division of land at this time, and subsequently no further assessment of this Overlay is applicable.

Should a plan of division be proposed for any of the site of the development, for example an allotment to accommodate the terminal substation, the Limited Land Division Overlay would be applicable to that future development application.

LIMITED LAND DIVISION OVERLAY Desired Outcome	
DO 1 The long term use of land for primary production is maintained by minimising fragmentation through division of land.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 Land division does not result in the creation of an additional allotment.	DTS/DPF 1.1 No additional allotments are created.

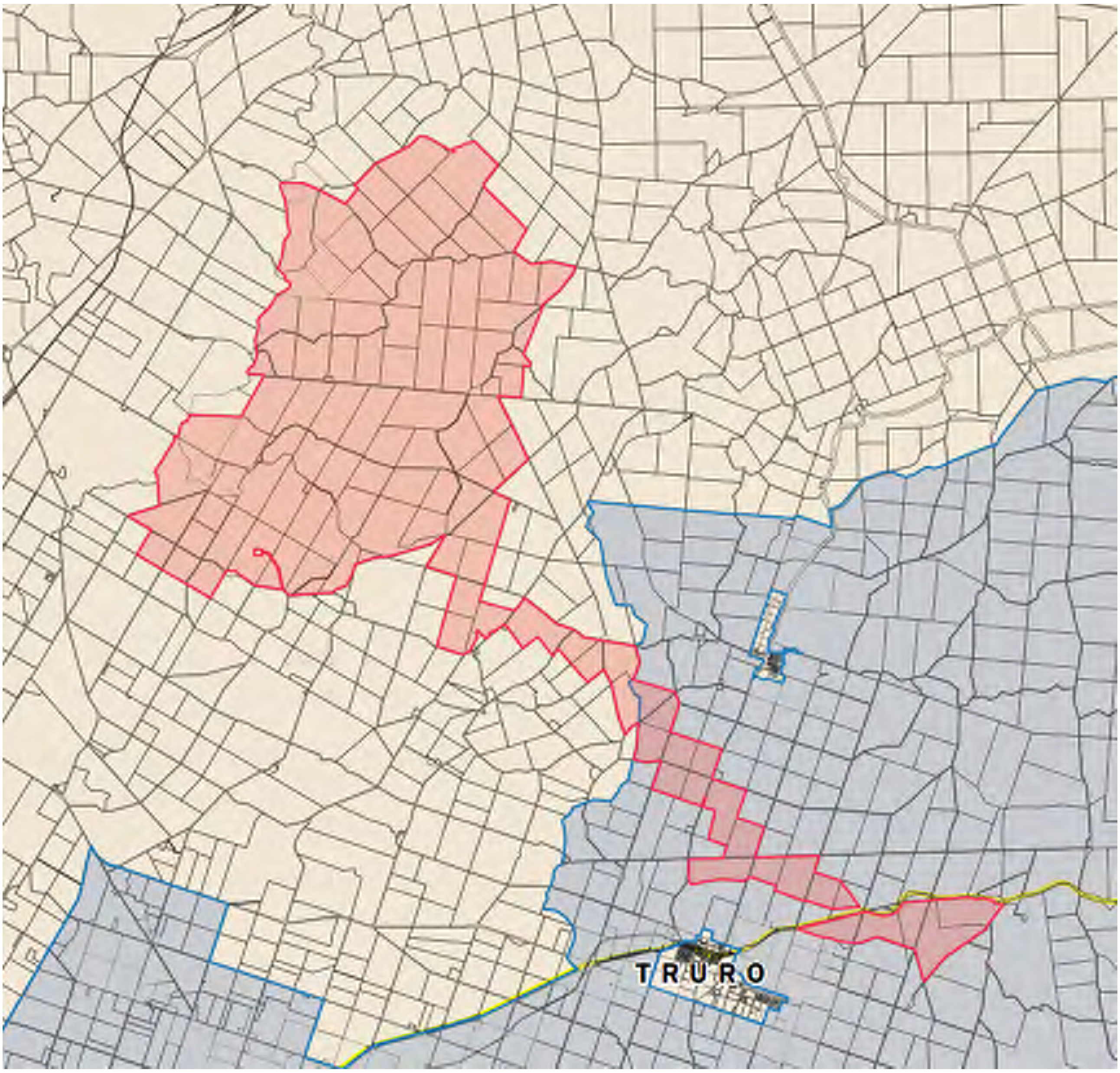


Figure 10: Twin Creek site boundary illustrating the Limited Land Division Overlay

4.2.10 Murray-Darling Basin Overlay

As illustrated on the below extract from SAPPA, portion of the transmission line of the Project is located within the Murray Darling Basin Overlay. The desired outcome of the Overlay is *"sustainable water use in the Murray-Darling Basin area"*. The Project does not involve a land use which requires the taking of water that would place undue strain on water resources in the Murray-Darling Basin. At this time, the Project does not involve the taking of water for which a licence would be required under the *Landscape South Australia Act 2019*. Water required during construction of the project would be associated with the wind turbine generators and associated infrastructure, which will be located on the portion of the site of the development outside of the Murray-Darling Basin Overlay. Access to the water required for construction and its method of acquisition would be determined during the engagement of the construction contractor.

Location of portion of the transmission line and terminal substation within the Murray-Darling Basin Overlay is not further assessed, as the proposed development does not propose to take water from the basin.

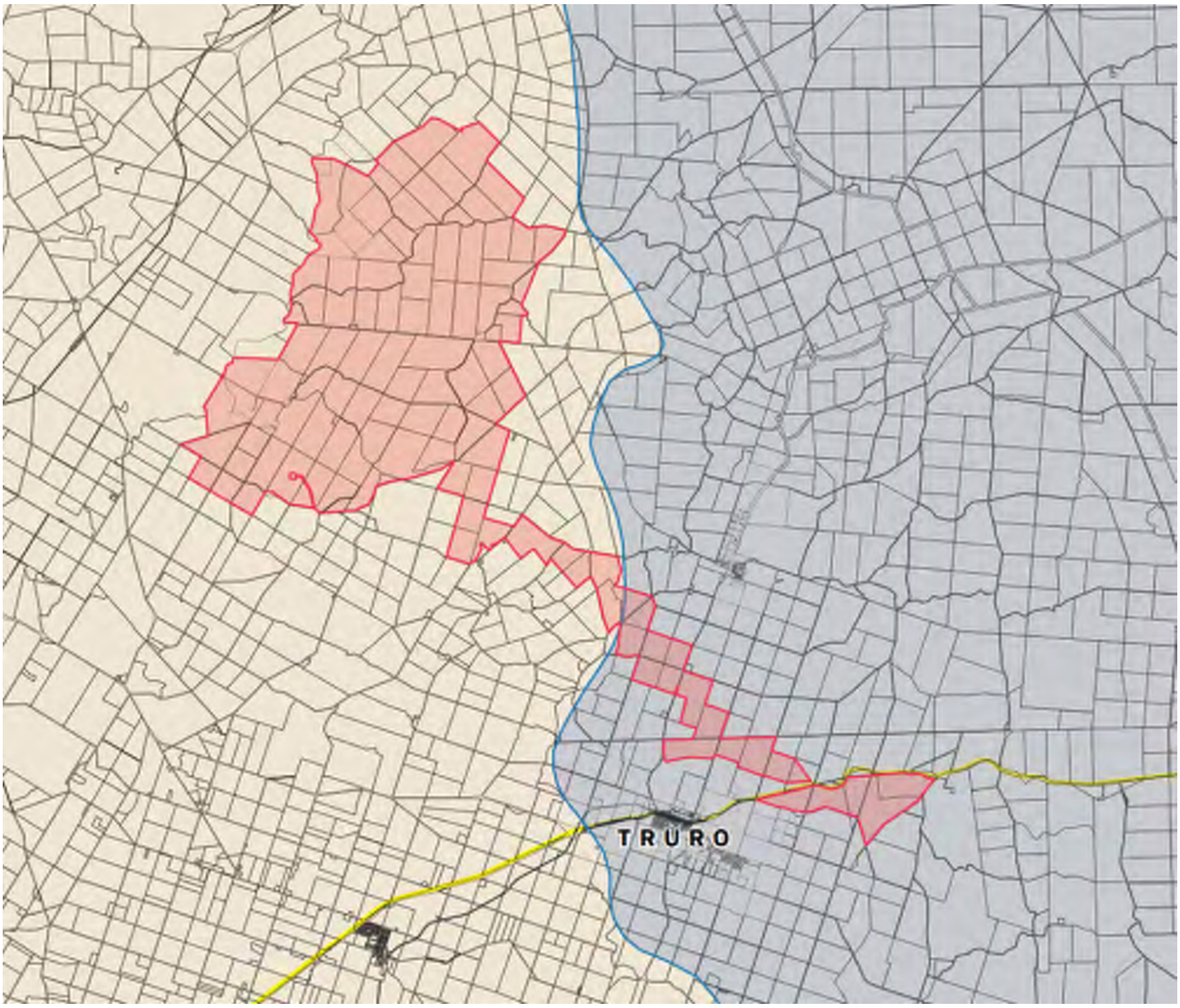


Figure 11: Twin Creek site boundary illustrating the Murray-Darling Basin Overlay

Murray-Darling Basin Overlay Desired Outcome	
DO 1 Sustainable water use in the Murray-Darling Basin area.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 All development, but in particular development involving: (a) horticulture (b) activities requiring irrigation (c) aquaculture (d) industry	DTS/DPF 1.1 Development satisfies either of the following: (a) the applicant has a current water licence in which sufficient spare capacity exists to accommodate the water needs of the proposed use

Murray-Darling Basin Overlay	
(e) intensive animal husbandry (f) horse keeping (g) commercial forestry has a lawful, sustainable and reliable water supply that does not place undue strain on water resources in the Murray-Darling Basin.	or (b) the proposal does not involve the taking of water for which a licence would be required under the Landscape South Australia Act 2019.

4.2.11 Key Outback and Rural Routes Overlay

An assessment of the movement of vehicles for the Project during construction and operation has been undertaken by MFY in the Traffic Impact Assessment (TIA) report, which is further discussed in Section 4.3 of this report.

As illustrated on the below extract from SAPPA, the Key Outback and Rural Routes Overlay applies to a small portion of the site of the development adjacent the Sturt Highway, incorporating an area of the proposed transmission line and terminal substation. Access to the elements of the Project in this location are discussed in the TIA, with reference to the proposed Truro by-pass proposed in this locality.

Key Outback and Rural Routes Overlay Desired Outcome	
DO 1 Safe and efficient movement of vehicle and freight traffic on Key Outback and Rural Routes.	
DO2 Provision of safe and efficient vehicular access to and from Key Outback and Rural Routes.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 Access is designed to allow safe entry and exit to and from a site to meet the needs of development and minimise traffic flow interference associated with access movements along adjacent State maintained roads.	DTS/DPF 1.1 An access point satisfies (a), (b) or (c): (a) where servicing a single dwelling / residential allotment:... (b) where the development will result in 2 and up to 6 dwellings:... (c) where the development will result in 7 or more dwellings, or is a non-residential land use: (i) it will not result in more than one access point servicing the development site (ii) where on a road with a speed limit of 80 km/h or greater vehicles can enter and exit the site using left turn only movements (iii) vehicles can enter and exit the site in a forward direction

Key Outback and Rural Routes Overlay	
	(iv) vehicles can cross the property boundary at an angle between 70 degrees and 90 degrees (v) it will have a width of between 6m and 7m (measured at the site boundary), where the development is expected to accommodate vehicles with a length of 6.4m or less (vi) it will have a width of between 6m and 9m (measured at the site boundary), where the development is expected to accommodate vehicles with a length from 6.4m to 8.8m (vii) it will have a width of between 9m and 12m (measured at the site boundary), where the development is expected to accommodate vehicles with a length from 8.8m to 12.5m (viii) it provides for simultaneous two-way vehicle movements at the access: (A) with entry and exit movements for vehicles with a length up to 5.2m vehicles being fully within the kerbside lane of the road and (B) with entry movements of 8.8m vehicles (where relevant) being fully within the kerbside lane of the road and the exit movements of 8.8m vehicles do not cross the centreline of the road.

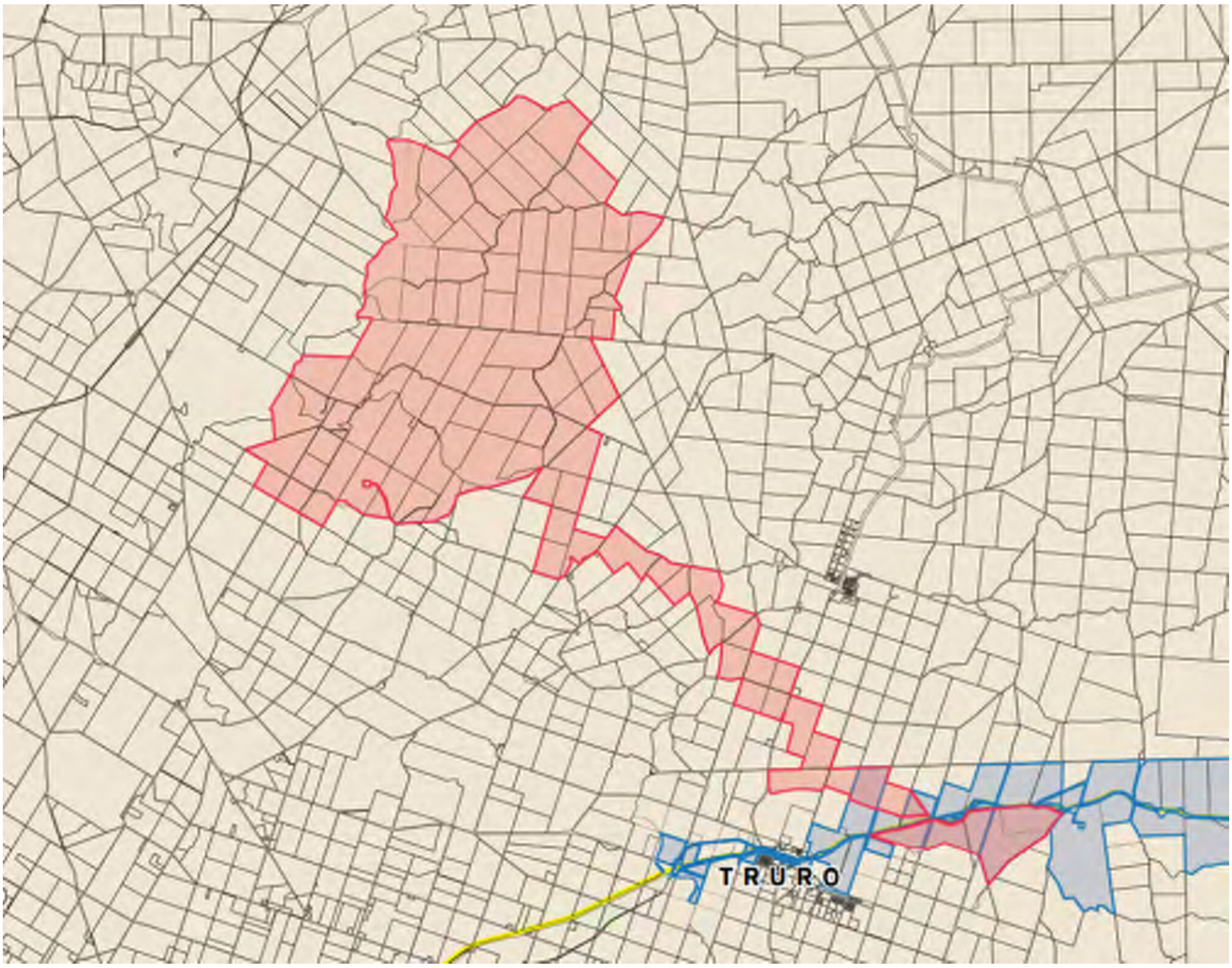


Figure 12: Twin Creek site boundary illustrating the Key Outback and Rural Routes Overlay blue).

4.2.12 Resource Extraction Protection Area Overlay.

The Truro Quarry is located adjacent to the proposed site of the terminal substation of the Project (Lot 910 Sturt Highway, Truro, Certificate of Title Volume 6221 Folio 131), adjacent to the Sturt Highway at Truro. None of the quarrying activities extend into Lot 910, and the boundary of the Resource Extraction Protection Area Overlay is approximately 220 to 450 metres from the boundary with the quarry property (as shown on the below extract from SAPPA). Elements of the terminal substation infrastructure may extend into the Resource Extraction Protection Area Overlay and this area should be assessed against the intent of the policy. The terminal substation does not incorporate development which is defined as a sensitive receiver[7].

In selecting the site for the terminal substation, RES is aware of the quarry to the east of the selected site and considers that the setbacks, topography and proposed landscaping around the site would appropriately and adequately mitigate any potential impacts, as sought by Desired Outcome 1. Currently

[7] Part 8 – Administrative Terms and Definitions of the Planning and Design Code incorporates the following definition for sensitive receiver: Sensitive receiver means: any use for residential purposes or land zoned primarily for residential purposes; child care facility; educational facility; hospital; supported accommodation; tourist accommodation

Allotment 910 comprises a range of high voltage electricity infrastructure which currently co-exists with the quarrying activities. The addition of further electricity infrastructure is not expected to adversely impact upon the ongoing operations of the quarry. Similarly, the existence of the Resource Extraction Protection Area Overlay is not considered to preclude the development of electricity infrastructure in the form of the terminal substation. Given the development does not incorporate a sensitive receiver, and that RES is aware of the quarry's activities, no further assessment of this Resource Extraction Protection Area Overlay is undertaken.

<table>
<tr><th colspan="2">Resource Extraction Protection Area Overlay
Desired Outcome</th></tr>
<tr><td colspan="2">DO 1
Protection of current and future state significant resource extraction activities by ensuring development has regard to potential environmental and amenity impacts generated by the lawful operation of proximate mines and quarries.</td></tr>
<tr><th>Performance Outcome</th><th>Deemed-to-Satisfy Criteria / Designated Performance Feature</th></tr>
<tr><td>PO 1.1
Long-term availability of and ability to extract resources is maintained by ensuring development involving sensitive receivers is:
(a) located away from areas which may be subject to unacceptable noise, dust or vibration emissions generated by current or future resource extraction activities
or
(b) able to adequately mitigate impacts of noise, dust or vibration emissions through design techniques such as:
(i) locating residential accommodation the greatest distance practicable from the resource extraction activity
(ii) placing buildings containing non-sensitive receivers between the resource extraction activity and sensitive receivers
(iii) placing rooms more sensitive to air, noise and vibration impacts (e.g. bedrooms) further away from the resource extraction activity
(iv) providing private or common open space adjacent a building facade that shields the space from impacts of the resource extraction activity.</td><td>DTS/DPF 1.1
Development does not incorporate:
(a) a sensitive receiver
or
(b) alterations or additions to a sensitive receiver which increase the floor area of such buildings by 10% or more
or
(c) land division for the purposes of accommodating a sensitive receiver.</td></tr>
</table>

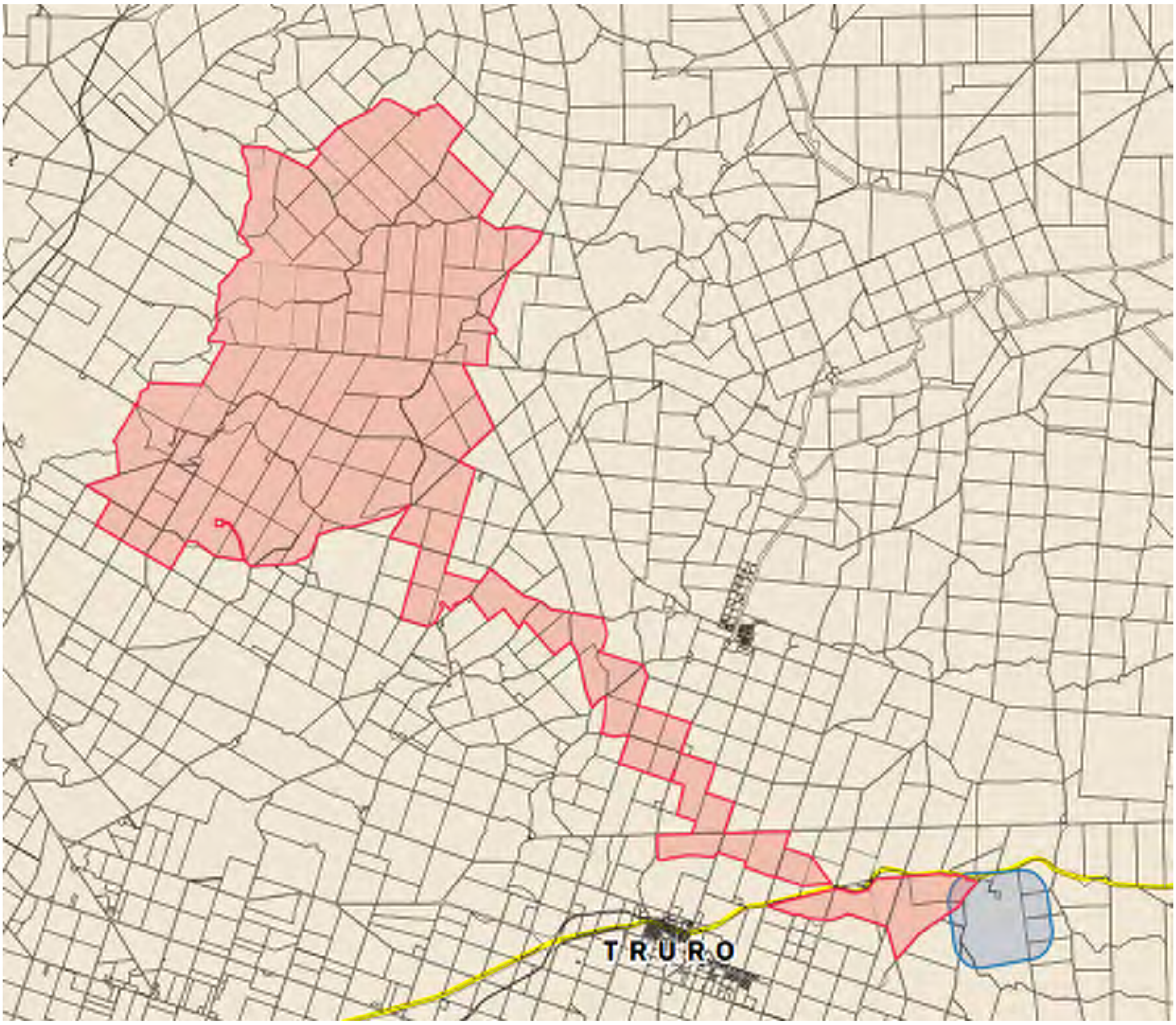


Figure 13: Twin Creek site boundary illustrating the Resource Extraction Protection Area

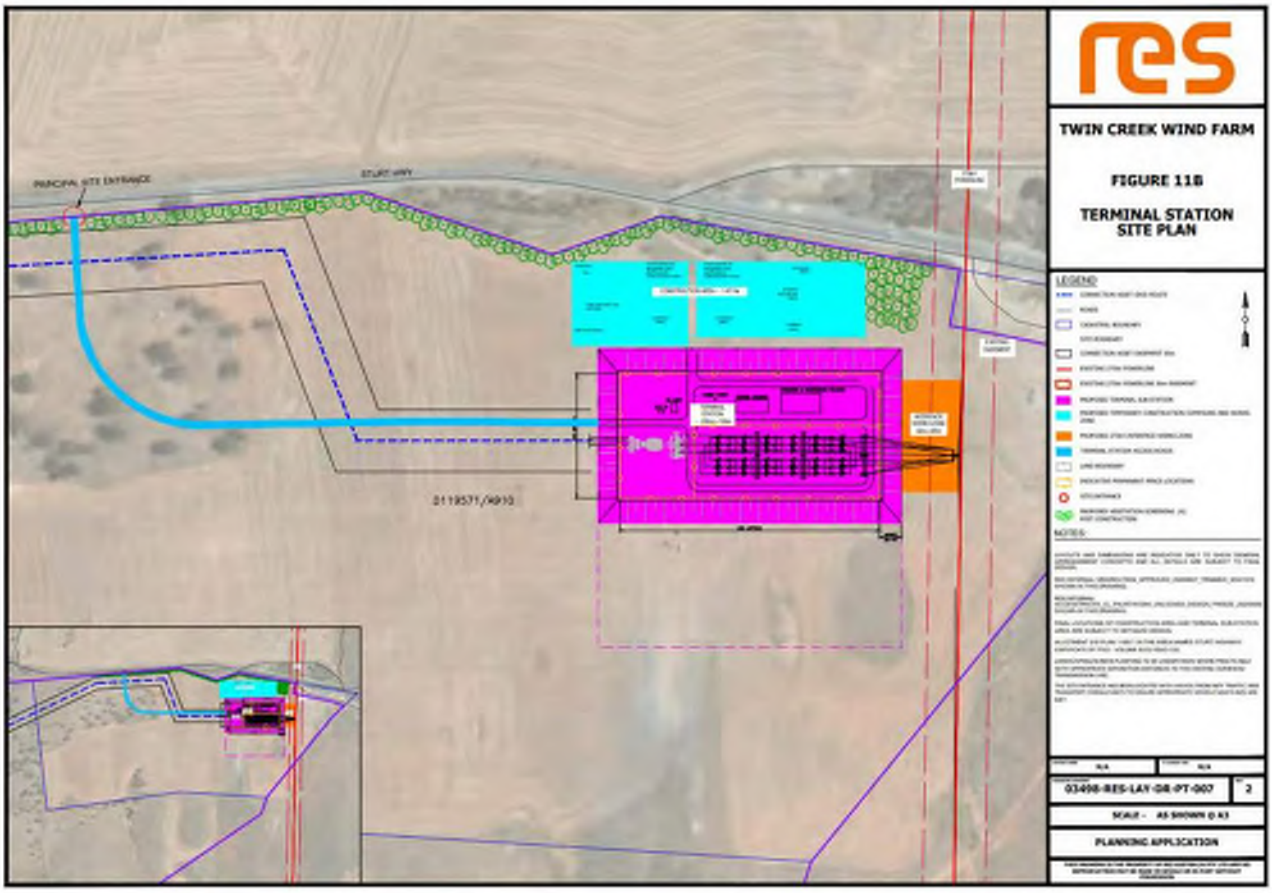


Figure 14: RES Figure 11B - Terminal Substation plan – Allotment 910 Sturt Highway, Truro.

4.3 Assessment Considerations

An assessment has been undertaken against all relevant policies of the Planning and Design Code and this considers the following matters:

- land use
- visual amenity
- noise
- health and the precautionary principle
- shadow flicker, reflection and blade glint
- electromagnetic interference with telecommunications
- impact on flora and fauna/native vegetation
- soil erosion, water supply and stormwater management
- traffic and access
- aviation
- indigenous and European heritage
- bushfire/fire risk.

These matters are discussed and assessed below.

4.3.1 Land Use

Renewable energy facilities are a form of development that the Desired Outcome (DO) of the Rural Zone envisages, to support the economic prosperity of South Australia, as stated in DO1.

Rural Zone Desired Outcome	
DO 1 A zone supporting the economic prosperity of South Australia primarily through the production, processing, storage and distribution of primary produce, forestry and the generation of energy from renewable sources.	
DO2 A zone supporting diversification of existing businesses that promote value-adding such as industry, storage and warehousing activities, the sale and consumption of primary produce, tourist development and accommodation.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
Land Use and Intensity	
PO 1.1 The productive value of rural land for a range of primary production activities and associated value adding, processing, warehousing and distribution is supported, protected and maintained.	DTS/DPF 1.1 Development comprises one or more of the following: (a) Advertisement … (r) Renewable energy facility…
Renewable Energy Facilities	
PO 9.1 Renewable energy facilities and ancillary development minimises significant fragmentation or displacement of existing primary production.	DTS/DPF 9.1 None are applicable.

Performance Outcome (PO) 1.1 of the Rural Zone anticipates a range of primary production and value adding activities on rural land. Designated Performance Feature (DPF) 1.1 identifies renewable energy facilities as a land use that is envisaged to satisfy PO 1.1.

The Rural Zone contains specific policies relating to renewable energy facilities. Performance Outcome 9.1 seeks to ensure that renewable energy facilities do not fragment or displace existing primary production. To that end, it is noted that sustainable rural production predominantly in the form of grazing activities can continue within the site of the development, largely unaffected by the wind farm development. Although the wind farm transverses a large area, its footprint is relatively small. The wind turbine generators comprise a small footprint and in combination with the substations, access tracks, operational and maintenance compounds, and temporary compounds, as included in the disturbance footprint will comprise approximately 7.0 percent of the site area (within site boundary).

Following construction, it is common for the area surrounding the wind turbine generators to be reseeded with pasture that is then available for grazing or cropping (in suitable and accessible locations). The same is true for the temporary construction compounds, which are also removed post construction and rehabilitated to predevelopment agricultural use. This further reduces the already minimal area removed from productive capacity.

Each turbine is linked by an access track with a minimum width of approximately 5.5 metres to accommodate the large and heavy vehicles required for construction. Wherever possible, the tracks follow existing farm access tracks to minimise intrusion into existing paddocks. Those areas of land no longer required for access will be appropriately remediated to the state they existed prior to construction commencing.

Given many of the access tracks are located on elevated areas of poor pasture, the loss of land to primary production is considered minimal. Furthermore, the tracks and turbines are not fenced and therefore stock grazing within paddocks that accommodate wind turbine generators are not restricted in their movement.

Electricity generated by each of the wind turbine generators is collected via a series of underground 33kV cables, which then link to the on-site substation. The underground cabling is constructed within or adjacent the internal access tracks wherever possible. An overhead 275kV transmission line of approximately 15 kilometres extends in a south-east direction from the wind farm substation to the terminal substation, and tee-in to the Robertstown to Tungkillo 275kV transmission line.

The combination of internal undergrounding of electricity infrastructure and designated corridors for overhead transmission lines does not significantly impact on the land available for primary production, particularly given the predominant land use within the area is grazing and animals continue to graze under electricity transmission lines.

The small site required for the on-site substation and operations and maintenance facilities, including the battery storage facility, is less than 6.0 hectares, and is a minimal intrusion in the context of the overall land area. Similarly, the terminal substation is relatively small, being 2.0 hectares.

Temporary laydown and construction facilities will be rehabilitated and therefore be available for primary production purposes following construction. Wind turbine generators and ancillary infrastructure co-exist with primary production activities at other wind farm sites in South Australia, Australia and internationally. Given the principal land use within the site and the locality is dryland grazing and cropping, the minimal reduction in productive land is not a significant impediment to the continued achievement of sustainable primary production activities. Wind farms (and associated infrastructure) and dryland primary production activities can co-exist, and to this end the Desired Outcome and PO 9.1 of the Rural Zones are satisfied.

During the assessment of the original development application for the Twin Creek Wind Farm (Development Application 422/E003/17), there was discussion on the impact of wind turbines on climatic conditions within the locality of Twin Creek Wind Farm, particularly the potential to create or exacerbate frost within the Barossa Valley.

As discussed in Volume 1 – Project Summary of this development application, frost is a common feature in the Mid North district of South Australia, and the region has been described as one of the high frost risk areas of southern Australia. The analysis undertaken as part of the assessment of the original development application concluded that the wind farm is unlikely to have a direct impact on frost climatology in the wider locality, particularly the Barossa Valley region. It is noted that the policies of the Rural Zone seek to protect and maintain productive value of rural land. There is no evidence to indicate that the wind farm would impact the productive value of rural land in the locality due to changed climatic conditions. Furthermore, as previously stated, PO 9.1 seeks to ensure renewable energy facilities minimise fragmentation or displacement of existing primary production and does not discuss climatic implications.

Adverse impacts on aerial application/spraying of agriculture land is a concern that is often raised in relation to wind farm development. In relation to the aerial agricultural application, the aviation assessment (Aviation Impact Assessment by Aviation Projects contained in Volume 2 of the application documents) notes that there is not extensive aerial application undertaken in the locality of the proposed wind farm. This comment is considered consistent with the pattern of land use within the locality, which is principally grazing activities within the elevated rocky land.

It is anticipated that aerial agriculture may be utilised on the plains where cropping activities are undertaken. The location of wind turbine generators, which are generally on elevated land along or adjacent the ridgelines, are therefore unlikely to adversely impact on aerial application on the cropping and grazing land to the east and west. Areas further south of the wind farm site and particularly those used for more intensive agriculture and horticulture within the Barossa Council area may also periodically utilise aerial agriculture applications. It is considered that the separation distance from these land uses and the wind farm will limit any potential interference.

Furthermore, structures such as wind turbine generators and electricity transmission infrastructure (towers and wires) will be noted as hazards by aviation authorities and be known to landowners and aerial agriculture operators. These structures would then be considered in any flight planning of aerial application operators. It is not considered that the wind farm would unreasonably interfere with low altitude aircraft movements associated with agriculture and therefore not impact on the productive value of rural land in the locality.

In addition to the policies contained in the Rural Zone, the General Development Policies – Infrastructure and Renewal Energy Facilities incorporate specific policies to guide siting and design of renewable energy facilities. In relation to Desired Outcome 1 of the Infrastructure and Renewable Energy Facilities policies, the proposed development provides an efficient renewable energy facility that will assist in providing electricity to the national grid in a manner that assists with the stability of the South Australian electricity network.

Infrastructure and Renewable Energy Facilities Desired Outcome
DO 1 Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.

Infrastructure and Renewable Energy Facilities	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
General	
PO 1.1 Development is located and designed to minimise hazard or nuisance to adjacent development and land uses.	DTS/DPF 1.1 None are applicable.
Hazard Management	
PO 4.2 Facilities for energy generation, power storage and transmission are separated as far as practicable from dwellings, tourist accommodation and frequently visited public places (such as viewing platforms / lookouts) to reduce risks to public safety from fire or equipment malfunction.	DTS/DPF 4.2 None are applicable.
Electricity Infrastructure and Battery Storage Facilities	
PO 5.1 Electricity infrastructure is located to minimise visual impacts through techniques including: (a) siting utilities and services: (i) on areas already cleared of native vegetation (ii) where there is minimal interference or disturbance to existing native vegetation or biodiversity (b) grouping utility buildings and structures with non-residential development, where practicable.	DTS/DPF 5.1 None are applicable.
PO 5.3 Battery storage facilities are co-located with substation infrastructure where practicable to minimise the development footprint and reduce environmental impacts.	DTS/DPF 5.3 None are applicable.
Renewable Energy Facilities	
PO 7.1 Renewable energy facilities are located as close as practicable to existing transmission infrastructure to facilitate connections and minimise environmental impacts as a result of extending transmission infrastructure.	DTS/DPF 7.1 None are applicable.
Renewable Energy Facilities (Wind Farm)	
PO 8.1 Visual impact of wind turbine generators on the amenity of residential and tourist development is reduced through appropriate separation.	Wind turbine generators are: (a) set back at least 2000m from the base of a turbine to any of the following zones: i. Rural Settlement Zone ii. Township Zone iii. Rural Living Zone

Infrastructure and Renewable Energy Facilities	
	iv. Rural Neighbourhood Zone with an additional 10m setback per additional metre over 150m overall turbine height (measured from the base of the turbine). (b) set back at least 1500m from the base of the turbine to non-associated (non-stakeholder) dwellings and tourist accommodation
PO 8.2 The visual impact of wind turbine generators on natural landscapes is managed by: (a) designing wind turbine generators to be uniform in colour, size and shape (b) coordinating blade rotation and direction (c) mounting wind turbine generators on tubular towers as opposed to lattice towers	DTS/DPF 8.2 None are applicable.
PO 8.3 Wind turbine generators and ancillary development minimise potential for bird and bat strike.	DTS/DPF 8.3 None are applicable.
PO 8.4 Wind turbine generators incorporate recognition systems or physical markers to minimise the risk to aircraft operations.	DTS/DPF 8.4 No Commonwealth air safety (CASA / ASA) or Defence requirement is applicable.
PO 8.5 Meteorological masts and guidewires are identifiable to aircraft through the use of colour bands, marker balls, high visibility sleeves or flashing strobes.	DTS/DPF 8.5 None are applicable.
Temporary Facilities	
PO 13.1 In rural and remote locations, development that is likely to generate significant waste material during construction, including packaging waste, makes provision for a temporary on-site waste storage enclosure to minimise the incidence of wind-blown litter	DTS/DPF 13.1 A waste collection and disposal service is used to dispose of the volume of waste at the rate it is generated.
PO 13.2 Temporary facilities to support the establishment of renewable energy facilities (including borrow pits, concrete batching plants, laydown, storage, access roads and worker amenity areas) are sited and operated to minimise environmental impact.	DTS/DPF 13.2 None are applicable.

Renewable energy facilities are an anticipated land use within the Rural Zone. The proposed wind farm and BESS will assist to sustainable, reliable, and affordable energy, which directly aligns with the strategic plan of the State Government and thereby addresses the desire for development to add to the economic prosperity of the State.

Impacts on visual amenity, flora and fauna, acoustics, aviation and bushfire are discussed in detail in the following sections of this assessment report. It is however noted that the development (as per the optimised layout of this application) has been designed and sited to include the following measures:

- Comprises the following separation distances:
  - A minimum setback of 2,000 metres from a non-stakeholder dwelling.
  - There are no known tourist accommodation facilities within 2,000 metres of any wind turbine generators.
  - There are no townships, settlements or urban zones within 2,000 metres of any wind turbine generators.
  - The on-site construction operations and maintenance, battery storage and substation compound are set back approximately 870 metres from the nearest public road, being Mosey Road (at its closest point).
  - The temporary construction compound is approximately 500 metres from Mosey Road (at its closest point).
- The wind turbine generators are designed with matte off-white/light grey colour, non-reflective tubular towers, which are uniform in design with co-ordinated blade rotation and direction.
- The onsite compound containing the substation, construction/maintenance and battery storage facilities is sited within existing paddocks and well separated from the nearest public road and non-stakeholder dwellings.
- Temporary facilities are sited within existing paddocks and generally well separated from the nearest public road and non-stakeholder dwellings.
- The development incorporates an overhead transmission line for approximately 15.0 kilometres from the on-site substation to the existing overhead Robertstown - Tungkillo transmission line east of Truro. This was found to be suitable in determining the original application.
- The site of the wind farm is outside of the Barossa Valley Character Preservation District (as shown in RES Figure 9 - Planning Zones and Figure 3 above which illustrates the Character Preservation District Overlay).

In summary, wind farms and energy storage facilities are envisaged land uses within the Rural Zone. Given the minimal reduction in productive farming area, the proposal will not adversely affect the ongoing sustainability of primary production within the locality, and is unlikely to have an adverse impact on the principal function of the Zone.

4.3.2 Visual Amenity

Desired Outcome 1 of the Infrastructure and Renewable Energy Facilities General Development Policy seeks to manage adverse visual impacts of infrastructure and renewable energy facilities. In relation to wind turbine generators, the visual impact on residential and tourist development is managed through appropriate separation, as stated in Performance Outcome 8.1.

RES Figure 6 - House and Turbine Locations (in Volume 3 of the application documents) illustrates the location of associated (stakeholder) and non-associated dwellings. A 2-kilometre buffer has been incorporated around each non-associated dwelling. This 2-kilometre buffer ensures that the separation of at least 1,500 metres sought in DTS/DPF 8.1 between wind turbine generators and non-associated dwellings is satisfied.

A search has been undertaken of tourist accommodation is the locality of the Project. No identified tourist accommodation facilities are within 2.0 kilometres of the development area comprising wind turbine generators. The nearest tourist accommodation generally occur within the surrounding townships of Kapunda, Truro and Eudunda. The nearest identified tourist accommodation to the transmission line is within Truro, however there is no requirement for separation of the transmission line to tourist accommodation.

RES Figure 9 - Planning Zones (in Volume 3 of the application documents) illustrates the site of the development in the context of townships and the applicable Zones. At a height of 220 metres, the wind turbine generators require a setback of 2,700 metres to satisfy DTS/DPF 8.1 for the specified Rural Settlement, Township, Rural Living and Rural Neighbourhood Zones. The nearest township that contains one of these specified zones is Dutton approximately 6.0 kilometres east of the nearest wind turbine generator. Dutton township is within the Rural Settlement Zone. Kapunda to the south-west of the site of the development is estimated to be in excess of 10 kilometres from the nearest wind turbine generator.

Exceeding the quantitative setbacks to non-associated dwellings, tourist accommodation and townships in DTS/DPF 8.1 is considered to satisfy PO 8.1 to reduce the visual impact of wind turbine generators on the amenity of those non-associated uses.

INFRASTRUCTURE AND RENEWABLE ENERGY FACILITIES **Desired Outcome**	
DO 1 Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
Electricity Infrastructure and Battery Storage Facilities	
PO 5.1 Electricity infrastructure is located to minimise visual impacts through techniques including: (a) siting utilities and services: (i) on areas already cleared of native vegetation (ii) where there is minimal interference or disturbance to existing native vegetation or biodiversity (b) grouping utility buildings and structures with non-residential development, where practicable.	DTS/DPF 5.1 None are applicable.

INFRASTRUCTURE AND RENEWABLE ENERGY FACILITIES	
PO 5.3 Battery storage facilities are co-located with substation infrastructure where practicable to minimise the development footprint and reduce environmental impacts.	DTS/DPF 5.3 None are applicable.
Renewable Energy Facilities (Wind Farm)	
PO 8.1 Visual impact of wind turbine generators on the amenity of residential and tourist development is reduced through appropriate separation.	DTS/DPF 8.1 Wind turbine generators are: (a) set back at least 2000m from the base of a turbine to any of the following zones: i. Rural Settlement Zone ii. Township Zone iii. Rural Living Zone iv. Rural Neighbourhood Zone with an additional 10m setback per additional metre over 150m overall turbine height (measured from the base of the turbine). (b) set back at least 1500m from the base of the turbine to non-associated (non-stakeholder) dwellings and tourist accommodation
PO 8.2 The visual impact of wind turbine generators on natural landscapes is managed by: (a) designing wind turbine generators to be uniform in colour, size and shape (b) coordinating blade rotation and direction (c) mounting wind turbine generators on tubular towers as opposed to lattice towers	DTS/DPF 8.2 None are applicable.

As sought by Performance Outcome 8.2, the wind turbine generators are all uniform in colour (off-white/light grey
non-reflective), size (220 metres to tip height) and shape (all 3 blade wind turbine generators of same specifications). The wind turbine generators will be sited to ensure that the blade rotation is co-ordinated in the same direction. Each of the turbines will be constructed on a tubular pole typically 134 metres to the nacelle. All of these design elements satisfy PO 8.2.

Whilst the PO's and associated DPF in relation to visual impact of wind turbine generators is satisfied, a detailed visual assessment has been undertaken by WAX Design (Landscape Character and Probable Visual Effect Assessment in Volume 2 of the application documents). This visual assessment addresses the various elements of the Project, including but not limited to the wind turbine generators. The following table provides an extract of the findings of the landscape assessment for each of the viewpoints.

Table 4: Assessment of Visual Effect – Wax Design

Viewpoint Number & Location	Description Of Locality	Visual Effect
1 **Kapunda-Truro Road, Ebenezer**	Viewpoint 1 is located on the southern edge of the proposed wind farm along the east-west orientated Kapunda-Truro Road close to the intersection with Belvedere Road. The viewpoint is typical of the landscape character of the northern Barossa Valley and represents the probable visual effect that will be experienced within this locality. This productive landscape includes a range of farms, buildings and ancillary structures scattered through the landscape associated with the predominately agricultural land use. Extensive belts of vegetation provide localised landscape amenity, and the rising landform of the Greenhill Ranges provides a degree of visual enclosure within the locality. The ridgelines associated with Bald Hill and St Kitts form a visual envelope and view shed to the north of the viewpoint.	The local ridgelines associated with Bald Hill and St Kitts provide a visual screen behind which the optimised project is located. The proposed wind farm layout produces a concentrated cluster of wind turbines located on the northern horizon line formed by the local topography of Bald Hill that extends north from the viewpoint. The visual effect created by the Optimised Project will result in two distinct visual effects. Several wind turbines appear above the ridgeline, forming prominent visual elements with large sections of the towers, nacelles, and blades visible on and above the ridgeline. This includes turbines T37 to T41. These prominent wind turbines form distinct visual elements within the landscape within a narrow field of view. The blades of other wind turbines are visible low on the horizon, creating intermittent and dynamic visual effects as the blades appear and disappear as the blades rotate. The visual effect can be described as a cluster of infrastructure elements punctuating the northern horizon line of the locality. The visual effect in the landscape is visible over a brief period along the road corridor rather than being visually expansive or impactful over a wider area. The wind turbines are likely to be seen located more distantly behind the existing vegetation cover. Further to the south, the vegetation screening increases, and the visibility of the Optimised Project becomes limited, particularly in relation to the Barossa Valley.
2 **Kapunda-Truro Road, Koonunga**	Viewpoint 2 is located to the south-west of the proposed development along the Kapunda-Truro Road on the rise of a local ridgeline. The viewpoint location is typical of the transitioning landscape between the edge of the northern Barossa Valley, and the western pastoral lands and ridgelines. This viewpoint represents the visual effect that may be experienced by visitors and from dwellings to the south-west of the proposed development, particularly from elevated properties along Brewery Road and to the eastern edge of Kapunda. The progressive agricultural development of the locality has resulted in a cleared landscape with little vegetation to the ridgelines. The open field boundaries and absence of tree coverage is typical to landscape areas to the north-east.	The proposed wind farm will likely create a distinct visual effect within the rural landscape. The 42 wind turbines are visible as a cluster of significant infrastructure elements within the landscape. The visibility and resulting visual effect of the wind turbines is likely to be prominent. However, the visual impact will appear uniform, with no single wind turbine appearing more significant in scale or visual dominance than any other. In this regard, the entire wind farm produces the visual effect without particular visual prominence or variance associated with specific wind turbines, outliers or clusters. The elevation of the wind turbines behind the local ridgelines visually disrupts the underlying horizon line of the locality, particularly to the south and east. The height of the wind turbines and base elevation will be consistent, and the spread of the wind turbines across the rural landscape will be uniform. As such, the resulting visual effect, while prominent, will be perceived relatively easily, and

Viewpoint Number & Location	Description Of Locality	Visual Effect
		the wind farm is likely to be experienced as a single collection of infrastructure elements in the landscape.
3 **Intersection of Bagot Well Road and Kapunda-Eudunda Road, Bagot Well**	Viewpoint 3 is located to the western side of the proposed development at the intersection of Bagot Well Road and the Kapunda-Eudunda Road (Thiele Highway). The viewpoint represents the landscape character of the central tablelands, and the typical landscape associated with the eastern edge of Greenock Ranges and the lower lying undulating landscape between the ranges and tablelands. This viewpoint represents the anticipated visual effect experienced from the northern outskirts of Kapunda as well as the Kapunda-Eudunda Road, and from elevated residential properties to the southwestern side of the wind farm. The land cover transitions from the dense field boundary and vegetated character of the Barossa Valley in the south-east to an open pastoral landscape with larger fields used for grazing and some arable cropping.	The proposed wind farm will form a cluster of infrastructure elements within the landscape. The elevation of the wind turbines creates a degree of uniformity in the visual effect in terms of the vertical alignment of the nacelles, blade tip heights and sweep of the blades. The arrangement of the wind turbines across the mid-ground and foothills adjacent to the Light River increases the visual effect. The existing topography and landscape character of the locality will be impacted, and rather than being perceived as an open rural landscape, the local ridgeline and mid-ground are likely to be changed by the introduction of the wind turbines. The Optimised Project is likely to fragment the landscape character. This fragmentation caused by the wind turbines reduces the legibility of the rural land use, and the wind farm becomes the dominant visual element. To the outskirts of Kapunda, local ridgelines provide a visual screen particularly from the local road corridors and lower lying areas associated with the Kapunda-Eudunda and Kapunda-Truro Road intersection. The degree of visibility is likely to increase from elevated locations and mainly residential properties to the northern ridgeline of Kapunda. From these viewpoints, the visual effect will be similar to that experienced at Viewpoint 2.
4 **Tablelands Road, south of Eudunda**	Viewpoint 4 is located along Tablelands Road and represents the potential visual effect that will be experienced to the north of the wind farm, particularly around the southern outskirts of Eudunda. The viewpoint is typical of the undulating landscape character of the elevated central tablelands. The landscape character surrounding the viewpoint is defined by an open agricultural landscape of grazing and cropping, and a general absence of vegetation apart from a few isolated trees. Numerous hills and localised ridgelines create a defined undulating landscape character typical of the locality.	The wind turbines form a distinct cluster of elements set just behind the ridgeline to the south. The uniform layout creates a dispersed visual effect along the horizon line. The wind turbines will appear layered in front and behind each other. Similar to other viewpoints, the layering of and rotation of the wind turbine blades will increase the complexity of the visual effect. The visual effect of the Optimised Project is concentrated in a narrow field of view within the broader rural landscape of the locality. The location of the viewpoint and the offset distance of the proposed development means that from more elevated locations to the north of the wind farm, the proposed visual effect is limited. The wind turbines are likely to be seen as a distinct cluster of infrastructure elements set low on the horizon line formed by the undulating landscape of the locality. Overall, the visual impact will be seen as a concentrated visual effect located within a single field of view and set low on the visual envelope of the locality formed by the topography of Spring Hill.

Viewpoint Number & Location	Description Of Locality	Visual Effect
		Existing land use and the rural character of the landscape will be altered. While the wind farm and associated turbines will be notable elements within the locality, the compact layout and screening provided by the surrounding topography limits the visibility and potential visual effects. In this regard, the visual effect is notable but limited to a narrow field of view.
5 **Von Reiben Road, east of Eudunda**	Viewpoint 5 is located on Von Reiben Road some 16 kilometres north-east of the proposed development. The viewpoint represents the potential visual effect with a degree of visual change that will be experienced to the northeast and east of the proposed development in relation to regional locations across the Murray Plains. The low lying character of the viewpoint is typical of the Murray Plains with extensive views across the rural landscape of the plains. The underlying land cover is typical of the area consisting of cropping and grazing with scattered belts of vegetation following field boundaries or creeks. To the south-west is the elevated escarpment associated with Mount Rufus, Long Hill and the township of Eudunda. Prominent topographical features such as Mount Rufus are clearly visible along the horizon line. These landforms produce a defined undulating ridgeline in front of the proposed development.	The visual effect to the north is limited due to the local screening provided by ridgelines in the locality. The wind turbines are glimpsed as a series of minor visual elements on the ridge line that is formed by the underlying topography of the region. Visual effects result from the appearance of the blades rotating behind the ridge line. This creates a limited but dynamic visual effect in the landscape. The majority of the turbines, turbine towers, hubs and nacelles will be screened by the local ridgeline, which creates a defined visual enclosure around the proposed wind farm. The potential for a slight visual effect is likely to be experienced from locations to the east of the proposed development. The visual effect is created by the flicking visibility of the wind turbine blades as they appear above and disappear behind the ridgeline. It is anticipated that with varying climatic conditions, the degree of visibility will be further reduced, and from other locations to the east of the development, the wind farm may be completely screened.
6 **Tablelands Road, south of Mount Rufus**	Viewpoint 6 is located on Tablelands Road, south of Mount Rufus, and represents the potential visual effect that will be experienced from locations to the eastern edge of the wind farm development site. The viewpoint is located on one of the many locally elevated hills that form the transitional landscape character between the central tablelands and the Mount Rufus ridgeline. The locality of the viewpoint represents the landscape amenity that is provided by the undulating rural landscape and the combination of extensive vegetation belts, isolated trees, open arable land, isolated farm dwellings and panoramic views to distant ridgelines.	This contained locality is dominated by the scale of the proposed wind farm development. Within the locality, there are no landscape elements, topography, or land use that offset the vertical scale of the wind turbines. This increases the visibility and potential visual effects. The visual effect from Viewpoint 6 is substantial. The extent and spread of the turbines within the landscape create a panoramic visual effect. The wind turbine array extends north and south across the rural landscape. The wind turbines will likely appear as imposed infrastructure elements on the landscape and set against the more distant ridge line of the Southern Mount lofty ranges as they extend east to the Barossa Valley. Consequently, the backdrop and distant visual character of the locality are interrupted by the infrastructure elements of the Optimised Project. The wind turbines are significantly larger than any of the belts of vegetation or isolated trees that surround the viewpoint.

Viewpoint Number & Location	Description Of Locality	Visual Effect
	While the landscape represents a modified agricultural land use, the combination and arrangement of landscape and built form elements provide a degree of visual amenity and scenic value. The elevation and isolated tree cover of the agricultural landscape results in panoramic views to the south-west and, to a lesser extent, the north. Views to the east are contained by local ridgelines associated with Mount Rufus and the southern extent of the ridgelines that continue towards the Barossa Valley. The rolling landscape contains belts of vegetation which increase in frequency and prominence towards the edge of the Barossa Valley further to the south.	The height of the wind turbines extends across the horizon line and the backdrop of the regional landscape, disrupting the visual character of the locality. There is a distinct separation between the mid-ground locality in which the turbines are situated and the distant background formed by the ridge lines that create the visual envelope of the regional locality. This visual effect will be experienced along Tablelands Road to the property adjacent to the wind farm development to the east and southeast.
7 **Sturt Highway, east of Truro**	Viewpoint 7 is located 5.0 kilometres outside Truro along the Sturt Highway. The viewpoint represents the anticipated visual effect that will be experienced to the south-east of the wind farm. The Sturt Highway provides an entrance gateway into the township of Truro. Vehicles travelling along this highway are typically travelling at speeds of between 70 to 80 kilometres per hour. The existing landscape character of the viewpoint is typical of the local area with rolling undulating landforms predominantly grazed defining the land use character. The landscape is punctuated by isolated trees that produce notable visual landscape markers. There is little screening within the wider landscape. The topography of Mount Rufus and the extension of the north-south ridgeline form the dominant landscape feature which defines the horizon line and contains the field of view.	The turbines are seen as a distant cluster of elements located just below a series of ridgelines that define the complex topography of the local area. Due to the compact nature of the layout, distance from the viewpoint, as well as the interrelationship of the undulating ridgelines and local topography, result in a reduced visual effect that is characterised by glimpsed views of wind turbine blades and a limited number of nacelles. Potential visual impacts on the surrounding landscape and Barossa Valley to the east remain limited due to the contained visual character that is formed by the local topography and isolated vegetation groups.
9 **Sturt Highway, east of Transmission Substation**	Viewpoint 9 is located east of the transmission substation along the Sturt Highway. From viewpoint 9 the proposed wind farm will not be visible due to the local ridgelines, limiting the connectivity of the development form and extension of visual impact. The intersection of the 132kV transmission line to the 275kV ElectraNet corridor is located south of the Sturt Highway, to which the transmission substation terminal is	To mitigate the potential visual effect of the substation along the road corridor, it is proposed that landscape treatments are provided between the substation and road reserve. Any screening will need to be undertaken in line with electrical code best practice to avoid potential disruption of supply. Additional landscape treatments along the road corridor, such as an increase of roadside trees, could further fragment and partially screen the substation. Further refining the benching level of the development during the detailed design phase

Viewpoint Number & Location	Description Of Locality	Visual Effect
	proposed. When viewed from close proximity, the transmission substation will be a dominant visual element in the locality. There will be an increase in the concentration of infrastructure elements experienced within the landscape due to its connection to two transmission lines. The visual effect of the substation is increased due to its close proximity to the Sturt Highway. However, due to the road alignment (which curves both before and after this location), local ridges and stands of vegetation along the road corridor, the substation will only be visible when travelling along a limited section of the highway. Further to the south approximately 900 metres of the proposed substation terminal is a small existing quarry providing a scale of development to the locality. This is also combined with the existing 275kv transmission line which traverses across the field of view in a north-south orientation.	could allow the development to sit lower in the landscape and increase the effectiveness of landscape screening treatments.

In conclusion, the visual assessment by WAX Design states:

> *The landscape assessment indicates that the Twin Creek Wind Farm (Optimised Project) will be developed in a modified rural landscape with a defined visual character. The topography of the Nain Ranges, Greenock Ranges, Light Ranges, Barossa Ranges and Mount Rufus create a visual envelope to the north, east and west of the proposed development. To the south, local landforms and the existing belt of vegetation associated with the Barossa Valley limit the visibility of the Project.*
>
> *Throughout the regional locality around the Optimised Project, the existing land use is agricultural, with small woodland pockets of vegetation. Within this visually contained rural landscape, the proposed layout of the Optimised Project will form a compact cluster of 42 wind turbines with a maximum tip height of 220 metres.*
>
> *The potential visual effect is likely to be most notable from the east and west, with the proposed wind turbines situated on the ridges and elevated plateau of the Central Tablelands. The wind turbines appear in the landscape as prominent visual elements, with the vertical scale of the wind turbines likely to appear larger than the scale of the underlying topography.*
>
> *From local and sub-regional locations within five kilometres of the Optimised Project, the potential screening and visual mitigation provided by local ridgelines and vegetation belts is limited, and the majority of the wind farm is visible. The resulting visual effect produces a degree of visual change that will be consistently in the order of 45%, which is described as*

substantial, with the visual character of the locality being altered by the introduction of the wind turbines into the rural landscape. However, the sensitivity of the underlying landscape to change is low due to the agricultural character.

Across the sub-regional landscape, between five and ten kilometres, local ridgelines and tree belts create defined visual screens that reduce and remove the visual effects of the proposed wind turbines. The combination of topography and vegetation provides additional visual mitigation, and the degree of visual change reduces to a range of 28% to 39% and is described as moderate, increasing to substantial.

At distances of over ten kilometres within the regional locality, the degree of visual change reduces significantly to a range of 11% to 18%, particularly to the northeast and southwest and is described as slight.

The associated infrastructure, substations, and transmission lines will provide localised impacts to their immediate site localities. These visual effects will be limited to shorter distances (contained viewsheds) to the east and southeast. There will be no visual effect from the township of Truro. Transient experiences will be witnessed along local roads within the southeast of the regional landscape, with a small section of the Sturt Highway being impacted by the sub-station terminal.

The visual assessment and visual effect interpolation mapping illustrated the relationship between distance and visual effect and the significance of local ridgelines in reducing the visibility of the proposed wind farm in the wider locality. The visual effect is represented as bands of visual change radiating from the proposed wind farm. The consistency of the existing landscape character means that distance and visual absorption are the dominant variables in mitigating the visual effect.

Although the visual effect is likely to be substantial within the local to the subregional area, the containment of the effect can be attributed to the visual character of the landscape coupled with the uniformity of the agricultural character. The visual effects are contained within a defined locality, and the proposed Twin Creek Wind Farm can be accommodated without significantly altering the underlying landscape character.

The findings of the visual assessment report acknowledge that there will be visual change in the region of the wind farm. Whilst the visual assessment indicates that the visual effect is likely to be moderate to substantial utilising the GrimKe matrix methodology, the visual impact of the wind turbine generators is appropriately managed by the satisfaction of the setbacks established in DPF 8.1.

In summary, the Twin Creek Wind Farm and Energy Storage project proposes to manage the visual impacts in the following manner:

- Satisfy the minimum setback of 1,500 metres from all non-associated dwellings. All of the non-associated dwellings have a separation of in excess of 2.0 kilometres from the nearest wind turbine generator. It is noted that the nearest non-stakeholder dwelling (number 117) is approximately 2,000 metres from the nearest turbine in the proposed layout.
- No identified tourist accommodation facilities are within 2,000 metres of the wind turbine generators. The nearest tourist accommodation occurs within the surrounding townships of Kapunda, Truro and Eudunda.

- All wind turbine generators are setback greater than 2,700 metres from the defined settlements;
- The wind turbine generators are to be constructed of tubular towers, all of which are proposed to be a uniform colour, size and shape. Design of the wind farm ensures that the blade rotation is also uniform.
- The access tracks are unlikely to be visually out of character or a dominant element in the wider rural landscape.
- The operations and maintenance compound, incorporating the battery storage facility and on-site substation, is located approximately 900 metres (at the closest point) from Mosey Road and further from the nearest non-stakeholder dwelling. The scale of the substation will be obvious in the predominantly rural landscape and will be mitigated by landscaping treatments.
- The temporary mobile concrete batching plant is proposed to be located north of the operations and maintenance compound, and will have setbacks to non-stakeholder dwellings in excess of 1500 metres, and mitigated by landscaping treatments associated with the operations and maintenance compound.
- The terminal substation and temporary construction compound are located adjacent the Sturt Highway and will only be visible when travelling along a limited section of the Sturt Highway due to the road alignment and local topography. The visibility of the substation will be mitigated by landscaping treatments adjacent the perimeter of the substation and adjacent the road corridor.
- Transmission lines are likely to be viewed as an additional visual element in the landscape rather than a new element given the existence of other electricity infrastructure, including the 275kV line, within the locality.

4.3.3 European Heritage

In addition to the general or broader visual impact assessment of the Project discussed above, a heritage impact assessment has been undertaken to review the extent to which the Project is visible from and within the context of heritage places in the locality. The Heritage Impact Assessment (HIA) prepared by Dash Architects is contained within Volume 2 of the application documents.

As outlined previously in this report, the site of the development does not contain any Local Heritage or State Heritage Places. There are however some Local Heritage and State Heritage Places within the locality of the Project and the Heritage Adjacency Overlay applies to several parcels within the site of the development, particularly those within the transmission line corridor which transverses the area of Dutton and St Kitts.

The places of Local and State Heritage to which the Heritage Adjacency Overlay is relevant include:

Table 5: State and Local Heritage Places - Heritage Adjacency Overlay

Identification Number (ID)	Address	Legal Description	Statement Of Heritage Value
		State	
ID 16304 Stone Wall	5108 Sturt Highway, Truro	QP101 D11957	This stone walling marking the boundary of the 'Grieveston' and 'Baldon' properties is about 11km long and is a good example of an early, common form of boundary fencing. It is

Identification Number (ID)	Address	Legal Description	Statement Of Heritage Value
		Volume 6221 Folio 130	said to have been constructed by Thomas and Anna Standish and family for the landowners in 1874-75.
Local			
ID 18224 Noack's Farm	83 Freshwater Road, St Kitts	Section 291 H16000 Volume 5264 Folio 963	This farm complex represents the settlement of the district by German farmers and indicates their tradition of self-sufficiency and use of local building materials and has been continuously in the hands of the first owner and then his descendants since 1858.
ID 17722 Abandoned Farm Complex	Lot 304 Dutton Road, St Kitts,	S304 H160100 Volume 5315 Folio 260	This now abandoned farm complex retains evidence of the stages of development of the farming property, reflecting the growth of agriculture in the area.
ID 18051 Former St Paul's Lutheran Church	53 Tablelands Road, St Kitts	Allotment 504 D18649 Volume 5139 Folio 426	This small rural church building represents Lutheran settlement in the district and indicates the religious differences that arose in the local congregation, and the eventual unification of branches of the Lutheran Church.
ID 20979 Former St Paul's Lutheran Cemetery	55 Tablelands Road, St Kitts	Allotment 503 D18649 Volume 5462 Folio 953	The cemetery reserve and all grave elements remaining.
ID 18050 Doecke's Farm	Lot 102 Wendish Road, St Kitts	Volume 6090 Folio 968	This farm complex, now abandoned, reflects the settlement in the area by Wendish people and their contribution to the development of agriculture in the area and demonstrates vernacular construction techniques used locally.

The policies of the Heritage Adjacency Overlay of the Planning and Design Code applicable to the assessment of impacts of the Project on local and state heritage places are Desired Outcome 1 and Performance Outcome 1. It is noted in both the DO and PO both refer to 'development adjacent' to State and Local Heritage Places. In the case of the allotments identified as being within the Heritage Adjacency Overlay, there are very few elements that are adjacent to a State or Local Heritage Place, where adjacent[8] is taken to mean within 60 metres from other land.

The infrastructure within the wind farm development area, (being the area containing wind turbine generators and other supporting infrastructure) is within the Heritage Adjacency Overlay associated with Noack's Farm. The only form of encroachment into the Heritage Adjacency Overlay is potentially an access track and boundary fence. Neither the access track and fence are likely to visible from the Noack's Farm complex buildings given the undulating topography and landscaping. As noted in the Heritage Impact Assessment, the proposed wind farm within the Heritage Adjacency Overlay associated with Noack's Farm is considered consistent with DO1 and PO1.1.

[8] As defined in the Planning, Development and Infrastructure Act 2016 – Part 1 (3), adjacent land means: adjacent land in relation to other land, means land that is no more than 60 metres from the other land

Heritage Adjacency Overlay Desired Outcome	
DO 1 Development adjacent to State and Local Heritage Places maintains the heritage and cultural values of those Places.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 Development adjacent to a State or Local Heritage Place does not dominate, encroach on or unduly impact on the setting of the Place.	DTS/DPF 1.1 None are applicable

In relation to the other Local and State Heritage Places which are in the locality of the transmission line and terminal substation, the following is noted from the Heritage Impact Assessment:

4.3.3.1 Abandoned Farm Complex (ID 17722)

- The proposed transmission line is located on the opposite side of Dutton Road, approximately 300 metres from the Abandoned Farm Complex.
- Being a ruin, the immediate setting of the heritage place is generally devoid of modern incursions. While the proposed transmission lines will be visible within the broader setting of the heritage place, they are not considered to dominate, encroach or unduly impact on its setting as:
  - The setting of the ruin is primarily defined by its siting and the property boundaries to the intersection of Duttons and Tablelands Road. The transmission lines are located outside of this curtilage.
  - The infrastructure is located some 300m away from the ruins, on another site across the road.
  - The heritage value of the abandoned farm complex is the manner in which it displays the stages of development of the farming property, reflecting the growth of agriculture in the area. The proposed new transmission line infrastructure on the adjacent site, across the road, does not impact on this value.
  - For these reasons the proposed new transmission lines within the Heritage Adjacency Overlay associated with the Abandoned Farm Complex are considered consistent with DO1 and PO1.1.

4.3.3.2 Former St Paul's Lutheran Church (ID 18051) & Cemetery (ID 20979)

- The proposed transmission lines will run approximately 400m behind the heritage place.
- The immediate environs of the church and cemetery is landscaped with substantial plantings
- The immediate setting of St Paul's Church is to Tablelands Road and the landscaped ground and cemetery within the immediate environs. The landscape behind forms a backdrop to the heritage place, as it does throughout St Kitts.

- The proposed transmission lines will likely have minimal visual presence within the immediate setting of St Paul's Church. They will not impact on the manner by which the heritage place represents Lutheran settlement in the district and indicates the religious differences that arose in the local congregation, and the eventual unification of branches of the Lutheran Church.
- Views of the transmission lines will be largely screened by existing landscaping within the church grounds, and undulating topography. Some views will remain, however they are not considered to dominate, encroach on or unduly impact on the setting of the Place.
- For these reasons the proposed new transmission lines within the Heritage Adjacency Overlay associated with the Former St Paul's Lutheran Church and Cemetery are considered consistent with DO1 and PO1.1.

4.3.3.3 Doecke's Farm (ID 18050)

- While the transmission lines are located some 1.7 kilometres south of the ruins, they are not generally visible within their setting due to the undulating landscape.
- For these reasons the proposed new transmission lines within the Heritage Adjacency Overlay associated with the Doecke's Farm are considered consistent with DO1 and PO1.1.

4.3.3.4 Stone Wall (ID 16304)

The boundary stone wall which is the State Heritage Place is not located on Piece (QP) 118 of Certificate of Title 6157 Folio 823, however this Certificate of Title forms part of the State Heritage listing. The transmission line proposed adjacent the Sturt Highway is well separated from the identified Heritage Adjacency Overlay boundary and it is considered that via the rules of interpretation of the Planning and Design Code that the Overlay does not apply and no assessment is required. It is however noted that within the locality is the Truro quarry and substantial electricity infrastructure. The separation of the proposed transmission line and substation is unlikely to adversely impact upon the setting of the State Heritage place stone wall.

The Heritage Impact Assessment assessed the impact of the development on the Local Heritage Places and concludes "*while the proposed transmission lines that connect the wind farm to the terminal station may be visible within some views from the relevant Local Heritage Places, such infrastructure will not dominate, encroach on or unduly impact on the setting of the heritage places, nor adversely impact on their heritage and cultural values*" (page 18, Heritage Impact Assessment report). The conclusions of the Heritage Impact Assessment are supported, and it is considered that in the context of the applicable policy of the Planning and Design Code, the Project will not adversely impact upon the setting of the heritage places in the locality.

4.3.4 Cultural Heritage

The Desired Outcome of the General Development Policies – Infrastructure and Renewable Energy Facilities seeks to ensure that renewable energy facilities are culturally sensitive.

Infrastructure and Renewable Energy Facilities
Desired Outcome
DO 1
Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.

RES Australia along with its consultants, have undertaken survey work of the site of the development in association with the Ngadjuri Nation Aboriginal Corporation (NNAC). RES will continue to work with the NNAC through the different stages of the development to contribute to a more holistic understanding of Ngadjuri history, and assist in the Ngadjuri people's reclamation of their history and heritage.

RES and the Ngadjuri Nation Aboriginal Corporation have entered into a Cultural Heritage Management Plan (CHMP) to preserve Cultural Heritage in the Project Area and this is currently being updated to capture the optimised project layout.

Scattered artefacts were recorded across the site and further excavation monitoring during construction has been proposed by the NNAC. Where heritage areas are identified the project infrastructure will be micro-sited to mitigate impact.

RES are committed to continue to work with the NNAC to mitigate impacts of the development, and this commitment is outlined in the Statement of Commitments (Volume 1 of the application documents). RES is also fully aware of its responsibilities pursuant to the *Aboriginal Heritage Act 1998*, which are independent of the development application process.

4.3.5 Noise

Policies of the Planning and Design Code seek to manage and mitigate adverse impact on residential amenity, as stated in the Desired Outcome of the Infrastructure and Renewable Energy Facilities and Interface between Land Uses. In the case of a wind farm and energy storage project, a potential adverse impact is that of noise during construction and operation. A detailed Environmental Noise Assessment has been undertaken by Sonus (refer technical reports contained in Volume 2 of the development application documents).

Infrastructure and Renewable Energy Facilities
Desired Outcome
DO 1
Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.

Interface Between Land Use Desired Outcome	
DO 1 Development is located and designed to mitigate adverse effects on or from neighbouring and proximate land uses.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
General Land Use Compatibility	
PO 1.2 Development adjacent to a site containing a sensitive receiver (or lawfully approved sensitive receiver) or zone primarily intended to accommodate sensitive receivers is designed to minimise adverse impacts.	DTS/DPF 1.2 None are applicable.
Activities Generating Noise or Vibration	
PO 4.1 Development that emits noise (other than music) does not unreasonably impact the amenity of sensitive receivers (or lawfully approved sensitive receivers).	DTS/DPF 4.1 Noise that affects sensitive receivers achieves the relevant Environment Protection (Noise) Policy criteria.
PO 4.2 Areas for the on-site manoeuvring of service and delivery vehicles, plant and equipment, outdoor work spaces (and the like) are designed and sited to not unreasonably impact the amenity of adjacent sensitive receivers (or lawfully approved sensitive receivers) and zones primarily intended to accommodate sensitive receivers due to noise and vibration by adopting techniques including: (a) locating openings of buildings and associated services away from the interface with the adjacent sensitive receivers and zones primarily intended to accommodate sensitive receivers (b) when sited outdoors, locating such areas as far as practicable from adjacent sensitive receivers and zones primarily intended to accommodate sensitive receivers (c) housing plant and equipment within an enclosed structure or acoustic enclosure (d) providing a suitable acoustic barrier between the plant and / or equipment and the adjacent sensitive receiver boundary or zone.	DTS/DPF 4.2 None are applicable.
PO 4.4 External noise into bedrooms is minimised by separating or shielding these rooms from service equipment areas and fixed noise sources located on the same or an adjoining allotment.	DTS/DPF 4.4 Adjacent land is used for residential purposes.

The detailed Environmental Noise Assessment has been undertaken in accordance with the South Australian Environment Protection Authority (EPA) Environment Protection (Commercial and Industrial Noise) Policy 2023 and Wind Farms Environmental Noise Guidelines 2021 (SA Guidelines) and the provisions of the Planning and Design Code.

The SA Guidelines were established to ensure a wind farm project did not unreasonably interfere with the acoustic amenity of the surrounding community and therefore provide an objective assessment method for the purpose of satisfying PO 4.1 of the Interface between Land Uses policy. In accordance with DPF 4.1, satisfactory achievement of the Environment Protection (Noise) Policy satisfies PO 4.1 in that a development that complies with the Policy is taken to not unreasonably impact the amenity of sensitive receivers (or lawfully approved sensitive receivers).

Predictions of the noise from the wind farm and ancillary infrastructure have been made by Sonus for non-associated dwellings (landowners without a commercial agreement with the wind farm) within the locality. The Sonus report (Section 4.1.3) lists the assessment criteria for a non-associated dwelling:

> *The predicted equivalent noise level ($L_{Aeq,10}$), adjusted for tonality in accordance with these guidelines, should not exceed:*
>
> - *35 dB(A) at relevant receivers in localities which are primarily intended for rural living; or*
> - *40 dB(A) at relevant receivers in localities in other zones; or*
> - *the background noise (LA90,10) by more than 5 dB(A),*
>
> *whichever is greater, at all relevant receivers for wind speed[9] from cut-in to rated power of the WTG and each integer wind speed in between.*
>
> *Where the wind farm noise exhibits a tonal characteristic, a 5 dB(A) penalty is to be applied to the criteria.*

In assessing the potential effects of the development, the most pertinent considerations are:

- Does the wind farm (including wind turbine generators and other infrastructure) create excessive noise.
- Does the wind farm mitigate[10] or minimise the impact of noise to nearby sensitive receivers.
- Will the wind farm comply with the Environment Protection Policy.

In assessing these matters, it is noted:

- The developer has a general environmental duty pursuant to the *Environment Protection Act 1993*.
- The current Environment Protection (Commercial and Industrial Noise) Policy specifically refers the assessment of wind farms to the Wind Farms Environmental Noise Guidelines (SA Guidelines) as the relevant standard.

[9] Where wind speed is referenced in the Sonus report, it is taken to be the wind speed at the WTG hub height, in accordance with the SA Guidelines, unless specifically noted otherwise.
[10] Macquarie Compact Dictionary 2017 definitions:
Mitigate: to moderate the severity of (anything distressing); to become milder; moderate in severity
Minimise: to reduce to the smallest possible amount or degree; to represent at the lowest possible estimate;

- The use of the terms mitigate and minimise have the meaning established by the dictionary, with all considered to be terms used to contain impact to an acceptable level.
- Satisfaction of the Environment Protection (Commercial and Industrial Noise) Policy is taken to satisfy PO 4.1 of the Interface between Land Uses and not unreasonably impact the amenity of sensitive receivers.
- The Project is located within a Rural Zone. The non-associated dwellings in the locality of the proposed development are located within the same zones, albeit well separated.

In answer to the first three criteria, we defer to the Sonus Environmental Noise Assessment Report. Applying the relevant criteria, an assessment was undertaken by Sonus of the noise at neighbouring dwellings of the wind turbine generators. Sonus notes in relation to the wind turbine generators that *"based upon the assessment, all residences achieve the criteria at all integer hub height wind speeds"*. Further the assessment notes that the *"highest predicted noise level from the ancillary equipment is 34 dB(A) at 125, which is below the night time criteria for either zone in the area"*.

Sonus concludes (Section 6.0) that:

> *Operational noise of the wind turbine generators has been considered against the requirements of the EPA's Wind farms environmental noise guidelines 2021. The ancillary equipment has been assessed against the relevant provisions in the current Environment Protection (Commercial and Industrial Noise) Policy.*
>
> *The predicted noise levels achieve the requirements at all residences, and therefore based upon the assessment, the development is located and designed to minimise hazard or nuisance to adjacent development and land uses with respect to noise.*

In addition to noise of the wind turbine generators, construction noise is often a concern for some landowners within the locality of a wind farm. The Draft Construction Environmental Management Plan (CEMP), contained in Volume 4 of the application documents, outlines the reasonable and practicable noise reduction measures that will be implemented during the construction of the wind farm.

Given the technical nature of an acoustic assessment, we defer to the Sonus report and conclude that the proposed Twin Creek Wind Farm and Energy Storage project will satisfy the relevant provisions of each of Planning and Design Code regarding noise.

4.3.6 Interface Between Land Uses

In addition to the specific policies relating to noise, the General Development Policies - Interface between Land Uses seek to mitigate adverse effects of development on neighbouring and proximate land uses. The assessment below considers potential impacts such as electromagnetic interference, shadow flicker, glare, air quality and the general health of the community.

Interface Between Land Uses **Desired Outcome**
DO 1 Development is located and designed to mitigate adverse effects on or from neighbouring and proximate land uses.

<table>
<tr><th colspan="2">Interface Between Land Uses</th></tr>
<tr><th>Performance Outcome</th><th>Deemed-to-Satisfy Criteria / Designated Performance Feature</th></tr>
<tr><th colspan="2">General Land Use Compatibility</th></tr>
<tr><td>PO 1.2

Development adjacent to a site containing a sensitive receiver (or lawfully approved sensitive receiver) or zone primarily intended to accommodate sensitive receivers is designed to minimise adverse impacts.</td><td>DTS/DPF 1.2

None are applicable.</td></tr>
<tr><td>PO 2.1

Non-residential development does not unreasonably impact the amenity of sensitive receivers (or lawfully approved sensitive receivers) or an adjacent zone primarily for sensitive receivers through its hours of operation having regard to:
(a) the nature of the development
(b) measures to mitigate off-site impacts
(c) the extent to which the development is desired in the zone
(d) measures that might be taken in an adjacent zone primarily for sensitive receivers that mitigate adverse impacts without unreasonably compromising the intended use of that land.</td><td>DTS/DPF 2.1

Development operating within the following hours: ...
<table>
<tr><th>Class of Development</th><th>Hours of Operation</th></tr>
<tr><td>Consulting room</td><td>7am to 9pm, Monday to Friday
8am to 5pm, Saturday</td></tr>
<tr><td>Office</td><td>7am to 9pm, Monday to Friday
8am to 5pm, Saturday</td></tr>
<tr><td>Shop, other than any one or combination of the following:
(a) restaurant
(b) cellar door in the Productive Rural Landscape Zone, Rural Zone or Rural Horticulture Zone</td><td>7am to 9pm, Monday to Friday
8am to 5pm, Saturday and Sunday</td></tr>
</table></td></tr>
<tr><td>PO 3.4
Development that incorporates moving parts, including windmills and wind farms, are located and operated to not cause unreasonable nuisance to nearby dwellings and tourist accommodation caused by shadow flicker.</td><td>DTS/DPF 3.4
None are applicable.</td></tr>
<tr><th colspan="2">Air Quality</th></tr>
<tr><td>PO 5.1
Development with the potential to emit harmful or nuisance-generating air pollution incorporates air pollution control measures to prevent harm to human health or unreasonably impact the amenity of sensitive receivers (or lawfully approved sensitive receivers) within the locality and zones primarily intended to accommodate sensitive receivers.</td><td>DTS/DPF 5.1
None are applicable.</td></tr>
<tr><th colspan="2">Light Spill</th></tr>
<tr><td>PO 6.1
External lighting is positioned and designed to not cause unreasonable light spill impact on adjacent sensitive receivers (or lawfully approved sensitive receivers).</td><td>DTS/DPF 6.1
None are applicable.</td></tr>
<tr><td>PO 6.2
External lighting is not hazardous to motorists and cyclists.</td><td>DTS/DPF 6.2
None are applicable.</td></tr>
</table>

Interface Between Land Uses	
Solar Reflectivity/Glare	
PO 7.1 Development is designed and comprised of materials and finishes that do not unreasonably cause a distraction to adjacent road users and pedestrian areas or unreasonably cause heat loading and micro-climatic impacts on adjacent buildings and land uses as a result of reflective solar glare	DTS/DPF 7.1 None are applicable.
Electrical Interference	
PO 8.1 Development in rural and remote areas does not unreasonably diminish or result in the loss of existing communication services due to electrical interference.	DTS/DPF 8.1 The building or structure: (a) is no greater than 10m in height, measured from existing ground level or (b) is not within a line of sight between a fixed transmitter and fixed receiver (antenna) other than where an alternative service is available via a different fixed transmitter or cable.

INFRASTRUCTURE AND RENEWABLE ENERGY FACILITIES	
Desired Outcome	
DO 1 Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
General	
PO 1.1 Development is located and designed to minimise hazard or nuisance to adjacent development and land uses.	DTS/DPF 1.1 None are applicable.
Visual Amenity	
PO 2.2 Pumping stations, battery storage facilities, maintenance sheds and other ancillary structures incorporate vegetation buffers to reduce adverse visual impacts on adjacent land.	DTS/DPF 2.2 None are applicable.
PO 2.3 Surfaces exposed by earthworks associated with the installation of storage facilities, pipework, penstock, substations and other ancillary plant are reinstated and revegetated to reduce adverse visual impacts on adjacent land.	DTS/DPF 2.3 None are applicable.

4.3.6.1 Human Health Effects

Desired Outcome 1 of the General Development Policies – Interface between Land Uses seek to mitigate adverse effects of development on neighbouring and proximate land uses. Concerns regarding the health impacts on humans living in the locality of wind farms have been widely canvassed over recent years.

Concerns raised relating to the impacts of wind farms on residents' health often relate to infrasound. Infrasound is low frequency noise below the audible frequency range. Infrasound is not regulated either in the SA EPA Wind Farms Environmental Noise Guidelines or by the policies of the Planning and Design Code. It is noted that the SA EPA Wind Farms Environmental Noise Guidelines state:

> *Infrasound was a characteristic of some early wind turbine models and was attributed to turbine blades that were downwind of the main tower. This effect was generated as the blades cut through the turbulence generated around the downwind side of the tower.*
>
> *Modern designs generally have the blades upwind of the tower. Wind conditions affecting the blades and improved blade design minimise the generation of this effect. The EPA carried out an infrasound monitoring project and extensive literature search and is not aware of excessive infrasound being present at any modern wind farm sites...*
>
> *Sensitive receivers residing in the vicinity of a wind farm may attribute excessive infrasound or low frequency noise from a wind farm as a reason for implied adverse health effects. Medical research dedicated to infrasound found that there are no proven physiological effects at infrasound levels below the perception threshold. There is no evidence that modern wind turbines generate infrasound at levels above the infrasound perception threshold. The EPA comparative study on infrasound (2013) and other investigations indicated that a listener has a greater risk of exposure to higher infrasound levels in other environments than in the vicinity of a wind farm.*
>
> *It is not expected that a listener will experience excessive low frequency noise due to operation of a wind farm if the development is designed to meet the noise criteria as set out in the guidelines....*

The question as to whether the health and amenity of the community is adequately protected has also been considered in numerous decisions of the Environment, Resources and Development (ERD) Court regarding wind farm developments. The judgement of the ERD Court in relation to the Palmer Wind Farm (*McLachlan & Ors v Mid Murray Council & Tilt Renewables Australia Pty Ltd – (2018) SAERDC 15*) considered the perceived impact of the wind farm on the human health of the community. This judgement states the following in relation to health and amenity:

> *92 Of all of the witnesses who gave evidence touching upon the topic of human health, Professor Wittert was the most qualified and experienced. Professor Wittert substantiated his opinion with a thorough and wide ranging literature review.*
>
> *93 In his statement, Professor Wittert set out these conclusions.*
>
> *10 Conclusions*
>
> *10.1 Wind farm Noise and adverse health effects*

- *There is no evidence that audible noise resulting from the operation of the wind turbines constitutes a significant risk to health provided the development is compliant with current guidelines (Appendix 9).*
- *Annoyance is acknowledged to occur in a generally small, but probably variable number of individuals and the extent to which this is problematic in a compliant wind farm may depend more on non-acoustic that acoustic factors.*
- *There are undoubtedly some particularly noise sensitive individuals, but it would be surprising if their awareness of this as adults occurred in the context of exposure to wind turbines. However, I am not aware of any specific enquiry in this regard.*
- *The weight of evidence is that when adverse health effects occur they are either circumstantially related or mediated by psychological distress, or both.*
- *The extent to which psychological distress and or sleep disturbance and/or other adverse health effects occur is dependent on a number of other internal and external factors (attitude, visual amenity, nocebo effects, financial interest, et cetera).*

10.2 Low-frequency noise and Infrasound and adverse health effects.

10.2.1 Low-frequency noise

- *The problem with low-frequency noise, as with high-frequency noise, relates to annoyance associated with audibility and the same range of moderating non-acoustic factors. There is no evidence that adverse health effects can be directly attributable to inaudible low-frequency sound emissions.*

10.2.2 Infrasound

- *There is no evidence that inaudible infrasound is associated with any significant physiological or pathophysiological consequences.*
- *There is no evidence that the level of infrasound produced by wind turbines constitutes a problem to health.*

94 *We accept all of Professor Wittert's evidence and his conclusions.*

95 *We do not consider that the proposed wind farm is at odds with Council wide Objective 26 of the Development Plan with respect to health. As to amenity, we accept that, from time to time, the noise and the appearance of the turbines and associated infrastructure will annoy some of the residents in the locality and some visitors to the locality. In our opinion, however, compliance with the 2009 Guidelines will ensure that the noise from the turbines will be kept within limits such as to preserve amenity to the degree contemplated by the Development Plan having regard to all of the relevant provisions.*

In the assessment of the original development application for Twin Creek Wind Farm, several of the representations quoted the Administrative Appeals Tribunal of Australia decision in relation to the Waubra Foundation and Commissioner of Australian Charities and Not-for-profits Commission (2017) AATA 2424 (4 December 2017) in relation to matters associated with health effects from wind farms. Some of the representations quote the AATA decision in relation to the plausible link between wind farms and adverse health outcomes. These comments within the decision include the following:

352 With respect to the medical issues, the experts largely agree that wind turbine emissions are capable of producing, and do produce, noise annoyance (they disagree on the specifics of this). There is also broad agreement that noise annoyance is associated with a range of adverse health outcomes, including hypertension and cardiovascular disease. It will be readily apparent therefore that there is broad agreement that there is a plausible pathway linking wind farm emissions with adverse health outcomes and disease.

360 Both Dr McBride and Professor Wittert acknowledged that noise annoyance was a complex phenomenon, with a person's response to sound dependent not only on individual perception but also attentional, cognitive and emotional factors. Both also noted that wind turbine sound had very specific characteristics, including variability.

361 Both doctors also agreed that physiological stress causes circulatory and hormonal changes which could be precursors of systemic conditions such as hypertension and possibly long-term effects in terms of cardiovascular disease. In addition, both doctors agreed that noise could cause sleep disturbance, which in turn could lead to other adverse health effects such as depression and hypertension, and that some individuals are more sensitive to noise and more likely to be annoyed by it.

It is noted that the AATA judgement related to the revocation of the registration of the Waubra Foundation as a charity, which examined if the Waubra Foundation was an institution whose principal activity is to promote the prevention or control of diseases in humans, and subsequently whether there was evidence that wind farm emissions cause or are associated with diseases and there is a plausible basis for thinking that wind farm emissions could lead to disease. In making its decision the Tribunal sought and heard expert evidence, which included evidence from Professor Wittert and Chris Turnbull (Sonus), who have both provided expert evidence to the ERD Court on wind farm developments, including but not limited to the Stony Gap Wind Farm and Palmer Wind Farm.

Whilst the decision of the Administrative Appeals Tribunal of Australia in relation to the status of the Waubra Foundation as a charity is not relevant to the assessment of the Project, the following is relevant in relation to the effect of the medical and scientific evidence within the AATA decision. The following concluding statement is noted:

470 We consider that the evidence justifies the following conclusions:

- *the proposition that sound emissions from wind farms directly cause any adverse health effects which could be regarded as a "disease" for the purposes of the ACNC Act is not established;*
- *Nor, on the current evidence, is there any plausible basis for concluding that wind farms emissions may directly cause any disease;*

- *However, noise annoyance is a plausible pathway to disease;(361)*
- *There is an established association between WTN annoyance and adverse health effects (eg. this was established by the Health Canada study);*
- *There is an established association between noise annoyance and some diseases, including hypertension and cardiovascular disease, possibly mediated in part by disturbed sleep and or psychological stress/distress;(362)*
- *There are yet no comprehensive studies which have combined objective health measurements with actual sound measurements in order to determine for a given population the relationships between sound emissions of wind turbines, annoyance, and adverse health outcomes. Indeed there is yet no study which has given rise to a soundly based understanding of the degree to which particular types or levels of wind turbine emissions give rise to annoyance, or what levels or types of emissions are associated with what level of annoyance in the population….*

On the basis of all information available, it is considered that there is no scientific evidence that the proposed wind farm will adversely affect the health of people in proximity to the development, as sought by DO1 – Infrastructure and Renewable Energy Facilities.

4.3.6.2 Hours of Operation

There are two elements of the Project to consider in assessing the impact of the hours of operation on adjoining land uses and the amenity of owners and occupiers of land, firstly the construction phase and secondly the operational phase.

The construction phase of the project will occur over an 18 month to two-year period. During this time, there will be considerable activity throughout the development site, involving extensive vehicle movements, construction of the turbines, operation and maintenance facilities, temporary laydown/ storage facilities, temporary concrete batching plant, access tracks and upgrading of public roads. This construction phase will be undertaken in accordance with relevant legislation, particularly the Environment Protection Act 1993, to manage a range of potential environmental impacts, including noise, vibration and dust.

A draft Construction Environmental Management Plan (CEMP) is incorporated in the application documents, which contains a range of management practices in relation to the construction phase of the project. The Draft CEMP indicates that operating hours of the plant during the construction phase would generally be 7.00 am to 7.00 pm Monday to Saturday, with work outside of these times subject to approval from the EPA/Council (subject to qualifications in the approved CEMP).

During the construction period of the Project, the proposal includes temporary laydown/storage and construction facilities. The location of these facilities will mean increased traffic around the area on local roads, and potential for noise and dust associated with these activities. There may be some adverse impact on the amenity of the non-associated dwellings in the locality and the broader community. However, these impacts will be minimised by the short period of time in which they will be used (up to two years), and suitable management of these facilities in accordance with EPA legislation and the Construction Environmental Management Plans.

It is noted that the temporary construction facilities could incorporate a temporary concrete batching plant during the construction phase. Suitable separation distances are provided (a minimum of 200 metres for noise, in accordance with the EPA Evaluation Distances for Effective Air Quality and Noise Management guidelines (as updated January 2023) between the batching plant and the nearest non-stakeholder dwelling). The separation distance between this temporary batching plant and the nearest residence (House 125) is in approximately 1.5 kilometres. The potential impacts on the adjoining dwelling and properties within the locality will be managed by a final Construction Environmental Management Plan, and in accordance with EPA legislation and licence conditions.

Development of 275kV transmission lines adjacent to, or within the road reserves, which link the on-site substation to the terminal substation are likely to be viewed as an additional visual element in the landscape rather than a new element. Given the new overhead transmission lines would be viewed against the background of the hills and that this form of electricity infrastructure is commonplace in the wider locality, it is not considered this infrastructure will unreasonably affect the amenity of people living within the locality.

It is acknowledged that there may be some short-term impact on the amenity of owners and occupiers of land during the construction phase of the wind farm and energy storage project. However, the development does not preclude the envisaged land uses within the Rural Zone continuing. In this regard, the development satisfies the intent of the relevant objectives and principles of development control – Interface between Land Uses and Infrastructure and Renewable Energy Facilities.

Post construction and during the operational phase of the Project, the wind turbine generators will operate 24 hours per day, seven days per week when wind conditions are conducive to the generation of electricity within the parameters of the selected wind turbine generator. Similarly, the battery energy storage facility will operate continuously and be utilised to provide electricity to the grid as required and in accordance with its service/licence conditions.

Other than the visibility of the wind turbine generators and ancillary infrastructure, the potential impacts of continuous operation of the wind farm and energy storage facility on the locality are considered to be noise and lighting. There is no requirement for obstacle limitation lighting on the wind turbine generators. Furthermore, the acoustic assessment concludes that the noise levels from the Project will be compliant, and therefore the hours of operation are not a significant impediment to the ongoing use of adjoining land.

4.3.6.3 Electromagnetic Interference (EMI) Impacts

Performance Outcome 8.1 of the Interface between Land Uses policy of the Planning and Design Code specifically seeks that development does not unreasonably diminish or result in the loss of existing communication services due to electrical interference. A detailed assessment EMI Assessment Report (included in Volume 2 of the development application documentation) by DNV, examines the potential electromagnetic interference (EMI) impacts associated with the development and operation of the Project.

The EMI Assessment Report (Section 5) acknowledged that *"if not properly designed, wind farms have the potential to interfere with radiocommunications services. Two services that are most likely to be affected include television broadcast signals and fixed point-to-point microwave signals. Terrestrial broadcast signals are commonly used to transmit domestic television, while microwave links are used for line-of-sight connections for data, voice and video. The interference mechanisms are different for each of these and, hence, there are different ways to avoid interference"*.

The EMI assessment has found that the project has the potential to cause interference to digital television signals received at dwellings in the vicinity, FM radio broadcasts to the west and northwest of the Project, Swoop wireless internet and the meteorological radar at Buckland Park. Potential EMI impacts on other services considered in the assessment, including trigonometrical stations, CB radio, and mobile phones, are either considered to be minor or have been addressed through consultation with the service operators. In summary the EMI report states:

> *Broadcast towers and transmission paths around the Project were investigated to determine if EMI would be experienced as a result of the development and operation of the Project. The Project will involve the installation of up to 42 wind turbine generators. DNV has considered a turbine geometry that will be conservative for turbine configurations with dimensions satisfying all of the following criteria: a rotor diameter of 172 m or less and an upper tip height of 220 m or less.*
>
> *The results of this assessment, including feedback obtained from relevant stakeholders, are summarised in Table 2. It is noted that the Project has the potential to cause interference to meteorological radar operations, digital television signals received at dwellings in the vicinity of the Project, and FM radio broadcasts to the northwest of the Project.*
>
> *Turbines at the Project may interfere with point-to-area style services such as mobile phone signals, radio broadcasting, and terrestrial television broadcasting, particularly in areas with poor or marginal signal coverage. Dwellings within approximately 5-10 km of the Project that are currently receiving signals from the Adelaide television broadcast transmitter may experience interference to those services. Feedback received from BAI Communications suggest that impacts to signals from the Adelaide broadcast transmitter are likely, but no viewers are expected to be affected. If interference to these services is experienced, a range of options are available to rectify difficulties.*
>
> *Interference to the FM radio signal broadcast by the nearby Flow FM transmission tower may be experienced near the edges of the signal coverage area to the west and northwest of the Project. However, Flow FM advised that the areas at risk of interference may also receive signals from other nearby broadcast towers. Flow FM have been contacted regarding the current turbine layout and dimensions, and have expressed further concerns about the potential for interference to signals from their FM transmitter at Kapunda. It is understood that Flow FM is undertaking further assessment into the potential for interference and is seeking advice from ACMA to establish an understanding of how any impact to the FM radio signal from the Kapunda transmitter may be mitigated.*
>
> *Since it is not possible to determine the potential EMI impacts on point-to-multipoint links and emergency services without obtaining further information from the relevant operators, DNV has consulted with organisations operating services that may be affected by the Project. SA Power Networks previously raised concerns regarding their point-to-multipoint link that*

> *crosses the site. DNV have modelled an exclusion zone based on the second Fresnel zone for the link, and SA Power Networks have confirmed that the interference zone applied is sufficient. There are no turbines located within the exclusion zones set by DNV. DNV has also reviewed the point-to-multipoint link locations provided by SWOOP, who provide wireless internet services to residents in the vicinity of the Project, and has identified potential for interference to some link paths. DNV understands that the Customer is intending to engage with SWOOP to develop technical solutions aimed at minimising potential interference to those links.*
>
> *Feedback received from the Bureau of Meteorology (the Bureau) indicates that there is a potential for the Project to materially impact on the operation of their Buckland Park radar and the associated weather monitoring and prediction services. DNV understands that the Customer has commenced discussions with the Bureau in relation to measures that may be deployed to minimise the potential impact on Bureau infrastructure. Discussions to date indicate that the installation of automatic weather stations and automatic rain stations if/as required would be incorporated as part of the Customer's commitment to the Project.*
>
> *Potential EMI impacts on other services considered in this assessment, including trigonometrical stations, survey marks, CB radio and satellite television are not expected or are considered to be minor.*

DNV discuss a range of mitigation measures that may be considered and implemented in relation to potential interference. In relation to digital television signals, DNV state in their report that *"although DTV signals are generally unlikely to be susceptible to interference from wind turbines in areas of adequate coverage, interference could be encountered in areas where coverage is marginal and antennas at dwellings may receive a reflected signal from a turbine that is of sufficient power to interfere with the signal received directly from the transmitter. Based on the coverage maps for the area around the Project, it is possible that some areas could be deemed to have marginal reception, and interference could be encountered"*. If DTV interference is experienced at nearby dwellings as a result of the Project, potential mitigation options may include realigning/tuning or relocating the user's antenna, installing a more directional or higher gain antenna, installing cable or satellite television or installing a television relay transmitter.

In relation to the potential interference with Flow FM radio signal broadcast, DNV have identified potential mitigation options, including installing high-quality antenna and/or amplifiers at affected residences, increasing the broadcast signal strength from the Kapunda transmitter or nearby Maitland or Mt Bryan transmitters, moving the Kapunda transmitter to a new location more than 4km from any turbine, or installing a signal repeater on the opposite side of the Project. RES is committed to ongoing discussions with Flow FM and identifying appropriate mitigation measures. This commitment is included in the Statement of Commitments.

Similarly, RES will undertake further discussions with the Bureau of Meteorology regarding the potential impact on the Buckland Park radar. It is however noted that DNV state the potential mitigation options to be discussed with the Bureau may include installing automatic weather stations and automatic rain stations to provide coverage in the affected area, supplementing data from the affected radar. Ongoing discussions with the Bureau of Meteorology in relation to the potential interference with the Buckland Park radar and mitigation options have been included in the Statement of Commitments.

4.3.6.4 Air Quality

The potential impacts on air quality are generally those associated with the construction phase of the Project, particularly movement of vehicles and earthworks required in constructing access tracks, trenching and preparing each wind turbine site, which is likely to create a risk of causing a dust nuisance. Performance Outcome 5.1 of the Interface between Land Uses policy seeks to ensure development incorporates air pollution control measures to prevent harm to human health or unreasonable impact on the amenity of sensitive receivers.

The nearest sensitive receivers (non-associated dwellings) to the site of the development are illustrated on Figure 6 of the plans contained in Volume 3 of the development application documents. It is noted that all non-associated dwellings are a minimum of 2,000 metres from a wind turbine generator, however some of these dwellings are in closer proximity to the site access and construction compounds. It is estimated that the nearest non-associated dwelling (House 125 on Noack Road) to the site of the on-site substation/construction compound is approximately 1200m to the southeast of this area. Access to this principal construction compound is from Mosey Road. The nearest non-associated dwellings (House 9 and House 123 on Freshwater Road) to this principal site access are approximately 700 metres (in a direct line) to the west. In addition to these dwellings, there are several non-associated dwellings on the transmission line route.

Minimisation of dust during the construction phase is addressed in the Draft Construction Environmental Management Plan (CEMP in Volume 4 of the development application documents). The techniques to minimise nuisance by air pollution include the following:

- Ensure dust generating activities are mitigated if conditions are not favourable (i.e. strong winds that would release dust off site).
- Dust controls would include the use of suppressants including water spraying as required. Water spraying would extend to access tracks, stockpiles and the sites being excavated for the construction.
- Limit bare earth exposure to that essential to the efficient and effective construction.
- Use vegetation cover, mulch covers, or other suitable methods where possible.
- Rehabilitate or allow natural regeneration of bare areas as soon as the area is no longer needed for construction.
- Cover all loose loads for transport to and from the site.
- Maintain sealed public roads free of trafficked soil materials.
- Restrict vehicle travelling speed (<40km/h) on unsealed access tracks, within the site, where possible.
- All vehicles and equipment operated on the site will comply with regulatory emission standards.
- Minimise machinery idling times, as appropriate.

In addition, a construction Traffic Management Plan (TMP) will be prepared prior to construction to identify the route for vehicles and any specific mitigation required, i.e. management of potential fugitive material during transportation, operation of equipment to control exhaust emissions and a procedure for complaints.

These practices are satisfactory in meeting the intent of the planning policies to minimise nuisance to sensitive receivers in relation to air quality.

4.3.6.5 Shadow Flicker, Glare and Light Spill

Interface between Land Use policies seek to minimise nuisance to sensitive receivers (dwellings and tourist accommodation) and road users, due to shadow flicker, external lighting and glare.

The development does not include the lighting of the wind turbine generators, as this not required for aviation safety. Subsequently, lighting of the proposed development would simply incorporate security lighting of operations and maintenance and construction compounds. The design of this lighting is likely to incorporate lighting on buildings and light poles on the perimeter of compounds, all of which would be suitably separated from the nearest non-associated dwelling, so as not to create unreasonable light spill for sensitive receivers or road users, as sought by PO 6.1 and 6.2 of the Interface between Land Uses policies.

Materials and finishes of all elements of the development, including the wind turbine generators would be non-reflective and not create conditions of glare that is likely to be an unreasonable distraction to road users. Blade glint is the regular reflection of the sun off one or more rotating turbine blades. DNV note in their conclusions that *"blade glint is not likely to be an issue provided non reflective coatings are used on the turbine blades"*.

An assessment of potential distraction of the development to road users has been undertaken by MFY in the Traffic Impact Assessment (discussed in Section 4.3.8 below). The conclusions of the "cone of vision" assessment by MFY is that the turbines would not be a potential distraction to drivers given the separation distance from public roads. In this regard the development has been designed so as not to unreasonably cause a distraction to road users, as sought by PO 7.1 of the Interface between Land Uses policy.

Performance Outcome 3.4 of the Interface between Land Uses policy seeks that development including wind farms do not cause unreasonable nuisance to nearby dwellings and tourist accommodation as a result of shadow flicker. Shadow flicker is the modulation of light levels resulting from the periodic passage of a rotating wind turbine blade between the sun and an observer. The duration of shadow flicker experienced at a specific location can be determined using geometric analysis. Shadow flicker has been assessed in detail by DNV in the Shadow Flicker and Blade Glint Assessment report, included in Volume 2 of the development application documents.

Impact of shadow flicker has been assessed for the dwellings within the vicinity of the wind farm, utilising the Environment Protection and Heritage Council (EPHC) Draft National Wind Farm Development Guidelines. The Draft National Guidelines recommend that the modelled theoretical shadow flicker duration should not exceed 30 hours per year, and that the actual or measured shadow flicker duration should not exceed 10 hours per year.

The findings of the DNV shadow flicker assessment, as stated in the conclusion are that "*Based on the modelling conducted by DNV, one associated dwelling is predicted to experience theoretical and actual shadow flicker duration that exceed the limits recommended by the Draft National Guidelines. However, DNV understands that this dwelling is currently owned by the Customer and is planned to be demolished prior to* *construction of the Project. No other dwellings are predicted to experience shadow flicker at a level of intensity that is likely to cause annoyance*".

Blade glint involves the regular reflection of the sun off rotating turbine blades. Its occurrence depends on a combination of circumstances arising from the orientation of the nacelle, angle of the blade and the angle of the sun. The reflectiveness of the surface of the blades is also a determining factor. The blades of the wind turbines to be constructed at Twin Creek will comprise a non-reflective coating, which removes the potentially annoying reflective glint.

4.3.7 Flora & Fauna

The Planning and Design Code contains extensive policy regarding the protection of native vegetation and biodiversity, including those comprised within the Native Vegetation Overlay (quoted in Section 4.2.3 of this report), and is clearly the intent of the Desired Outcome of the Infrastructure and Renewable Energy Facilities policy.

Infrastructure and Renewable Energy Facilities Desired Outcome
DO 1 Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.

Extensive assessments of flora and fauna within the site of the development has been undertaken by EBS Ecology (EBS now known as Umwelt) and this is described in detail in Volume 1 - Project Summary. A Native Vegetation Data Report has been prepared by Umwelt which identifies the level of clearance for the purposes of the development application as Level 4 clearance due to the total biodiversity score (greater than 250). As noted in Section 2 of the Native Vegetation Data Report, a worst case scenario for the purposes of vegetation clearance has been utilised:

> *The clearance areas showcase the worst-case scenario. That is, calculation of areas required for clearance of vegetation for the wind turbine generators (WTG) and ancillary infrastructure, along with the infrastructure associated with construction of the TL (transmission line) route has been overstated and overcalculated. For example, the SEB calculated for the TL route has assumed clearance of vegetation within the entire corridor, however, this is not the intended construction methodology. The poles and infrastructure required for the TL will be micro-sited to avoid vegetation included scattered trees resulting in partial clearance. This micro-siting also applies to WTG hard stands areas, access tracks and associated infrastructure (i.e. construction compound). To enable opportunities for avoidance as the project progresses through detailed design...*

The optimised layout will be subject to a Native Vegetation Act application and a referral to the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW) pursuant to the Environment Protection and Biodiversity Act 1999 (EPBC referral). The native vegetation and EPBC referrals will be undertaken as part of the assessment of the optimised layout, albeit the EPBC referral may occur subsequent to the development application/authorisation.

The design of the optimised layout has been informed by the investigations, findings and recommendations of Umwelt. The following matters are noted from the Native Vegetation Data Report:

- Most of the impacted vegetation within the Project consists of grasslands, which does not support a high diversity of species.
- The Project does include areas that are likely and known habitat for threatened species such as the Pygmy Blue-tongue Lizard (PBTL) and Flinders Ranges Worm Lizard. Woodland trees provide hollows and shelter refuge for certain species, specifically large birds of prey such as Wedge-tailed Eagles.
- Woodland within the wind farm area is mostly cleared, with some patches of woodland comprising a high diversity of species along the transmission line route.
- It is uncertain whether the clearance of 19.11 ha of woodland will lead to a long-term decrease in population for the Diamond Firetail, however this would be the subject of a referral to DCCEEW. It is unlikely that the clearance will fragment a population as large patches of connecting woodland exist outside of the Development Area. Similarly for Blue-winged Parrots and Rainbow Bee-eaters, large amounts of suitable habitat exist outside of the Development Area.
- The clearance of woodland is unlikely to result in invasive species becoming established, as numerous weed species already exist and are widespread within the area.
- It is currently unknown whether this Project will have a significant impact on PBTL. A Significant Impact Assessment under the provisions of the EPBC Act will form part of the referral process to DCCEEW for this Project.
- Given the high level of impact from weeds, fragmentation and historical clearing, the vegetation under application is unlikely to represent essential habitat for any threatened fauna species.
- All species of fauna surveyed are species that are commonly found in grasslands and woodlands. The Project Area does include habitat features essential for maintaining local populations, such as hollow trees or wetlands, and a reduction in impacts to these have been considered during the design phase.
- A total of 158.14 ha of Lomandra Tussock Grasslands were mapped across the Development Area. Of that 158.14ha, 7.87ha will be impacted by the proposed clearance (4.97% of that community in the Development Area). The condition of the vegetation is not representative of a remnant vegetation due to large incursions of weeds and impacts from grazing.

The optimised layout of the wind farm has considered ecological assessments undertaken in relation to design and siting of infrastructure to minimise with the aim of limiting impacts on native vegetation and the PBTL. A range of mitigation measures are incorporated into the Statement of Commitments to minimise impacts, including micro-siting of infrastructure, inclusion of buffer zones around Wedge-tailed Eagle nests and areas of woodland. The ongoing monitoring and potential translocation of PBTL will be further considered as part of the EPBC referral process.

Performance outcome 8.3 of the Infrastructure and Renewable Energy Facilities policy seeks to minimise potential for bird and bat strike. In the Bird and Bat Risk Assessment - Addendum prepared by Umwelt (as contained in Volume 2 of the development application documentation) the impacts on birds and bats are discussed extensively. The implementation of exclusion buffers around known raptor nests and woodlands is the principal method of minimising potential bird and bat strike.

The benefits of exclusion buffers around known nest locations of at-risk bird species are as follows:

- Buffers are generally focussed around areas of high bird activity (e.g., woodland); these are areas where raptor species may potentially nest.
- During the construction of proposed wind farms, raptor species are more likely to be at risk of disturbance from activities conducted within close proximity to nest locations. By implementing exclusion buffers, disturbance levels to these bird species would be avoided/minimized as much as possible.
- Raptors such as Wedge-tailed Eagles are territorial and typically return to the same area to nest each year. The placement of exclusion buffers around nest locations would assist with lessening disturbance levels to this species.
- Juvenile raptors (and juvenile birds in general) are deemed to be more susceptible to collision with WTGs. Newly fledged juveniles would need to learn how to forage on their own and are deemed more naïve and thus less likely to avoid structures such as turbines during this learning process. The implementation of exclusion buffers around known nest sites assists in decreasing the risk of juvenile raptors/birds colliding with WTGs.

A minimum buffer of 500 metres from nests of the Wedge-tailed Eagle sites to wind turbine generators and other infrastructure was incorporated in the original and approved development. The buffer from the nests is maintained as part of the optimised layout.

Bats are more at risk of rotor strike/barotrauma when traversing between patches of woodland. The optimised layout of the proposed development protects areas of woodland and incorporates a 200-metre buffer from high quality woodlands where possible.

<table>
<tr><th colspan="2">Infrastructure And Renewable Energy Facilities

Desired Outcome</th></tr>
<tr><td colspan="2">DO 1
Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.</td></tr>
<tr><th>Performance Outcome</th><th>Deemed-to-Satisfy Criteria / Designated Performance Feature</th></tr>
<tr><th colspan="2">Hazard Management</th></tr>
<tr><td>PO 8.3
Wind turbine generators and ancillary development minimise potential for bird and bat strike.</td><td>DTS/DPF 8.3
None are applicable.</td></tr>
</table>

All clearance of native vegetation cannot be avoided, however the design of the optimised layout seeks to minimise the amount of clearance, whilst protecting areas of high quality vegetation, particularly areas of habitat. As stated in the Native Vegetation Data Report, the calculated native vegetation clearance is a 'worst case' calculation, as micro siting of infrastructure during the detailed design of the development will minimise the clearance, particularly scattered trees within the wind farm area and along the transmission line route.

RES has identified a revegetation area (approximately 25 hectares) as part of the Significant Environmental Benefit (SEB) for the development, which is outlined in the management plan attached to the Native Vegetation Clearance Data Report by Umwelt. The environmental benefits of the on-ground SEB include:

- *Reduce the weed species across the Offset Area.*
- *Increase natural regeneration, species diversity and native grass cover across the Offset Area.*
- *Prevent and manage new infestation of non-native plants or animals.*
- *Prevent stock grazing.*
- *Rehabilitate and stabilise erosion gullies.*

These goals will aim to improve the condition the existing vegetation back to its pre-European form. This will result in the establishment of the threatened TEC Peppermint Box Grassy Woodlands. Revegetation will form a large part of this management plan and will include the planting of State threatened species such as:

- *Dianella longifolia (Pale Flax-lily)* - State Rare
- *Cullen parvum (Scurf-pea)* - State Vulnerable.

It is considered the policy intent of the Planning and Design Code to minimise impact on vegetation and the natural environment is suitably and adequately addressed by the development.

4.3.8 Traffic

Traffic movement associated with the development has been assessed by MFY and is discussed in the Traffic Impact Assessment (contained in Volume 2 of the development application documents).

As previously outlined, portion of the site of the development, namely some of the properties adjacent Sturt Highway at Truro are within the Key Outback and Rural Routes Overlay, which seeks to ensure safe and efficient movement of vehicles and freight traffic. In addition to the policies of the Key Outback and Rural Routes Overlay which informs safe location of access from State maintained roads, there are several General Development Policies - Transport, Access and Parking which guide vehicle movements, access and parking, some of which are quoted below.

Key Outback and Rural Routes Overlay **Desired Outcome**
DO 1 Safe and efficient movement of vehicle and freight traffic on Key Outback and Rural Routes.
DO2 Provision of safe and efficient vehicular access to and from Key Outback and Rural Routes.

Key Outback and Rural Routes Overlay	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 1.1 Access is designed to allow safe entry and exit to and from a site to meet the needs of development and minimise traffic flow interference associated with access movements along adjacent State maintained roads.	DTS/DPF 1.1 An access point satisfies (a), (b) or (c): (a) where servicing a single dwelling / residential allotment:... (b) where the development will result in 2 and up to 6 dwellings:... (c) where the development will result in 7 or more dwellings, or is a non-residential land use: (i) it will not result in more than one access point servicing the development site (ii) where on a road with a speed limit of 80 km/h or greater vehicles can enter and exit the site using left turn only movements (iii) vehicles can enter and exit the site in a forward direction (iv) vehicles can cross the property boundary at an angle between 70 degrees and 90 degrees (v) it will have a width of between 6m and 7m (measured at the site boundary), where the development is expected to accommodate vehicles with a length of 6.4m or less (vi) it will have a width of between 6m and 9m (measured at the site boundary), where the development is expected to accommodate vehicles with a length from 6.4m to 8.8m (vii) it will have a width of between 9m and 12m (measured at the site boundary), where the development is expected to accommodate vehicles with a length from 8.8m to 12.5m (viii) it provides for simultaneous two-way vehicle movements at the access: (A) with entry and exit movements for vehicles with a length up to 5.2m vehicles being fully within the kerbside lane of the road and (B) with entry movements of 8.8m vehicles (where relevant) being fully within the kerbside lane of the road and the exit movements of 8.8m vehicles do not cross the centreline of the road.

General Development Policies – Transport, Access and Parking	
Desired Outcome	
DO 1 A comprehensive, integrated and connected transport system that is safe, sustainable, efficient, convenient and accessible to all users.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
Movement Systems	
PO 1.1 Development is integrated with the existing transport system and designed to minimise its potential impact on the functional performance of the transport system.	DTS/DPF 1.1 None are applicable.
PO 1.2 Development is designed to discourage commercial and industrial vehicle movements through residential streets and adjacent other sensitive receivers.	DTS/DPF 1.2 None are applicable.
PO 1.3 Industrial, commercial and service vehicle movements, loading areas and designated parking spaces are separated from passenger vehicle car parking areas to ensure efficient and safe movement and minimise potential conflict.	DTS/DPF 1.3 None are applicable.
PO 1.4 Development is sited and designed so that loading, unloading and turning of all traffic avoids interrupting the operation of and queuing on public roads and pedestrian paths.	DTS/DPF 1.4 All vehicle manoeuvring occurs onsite.
Sightlines	
PO 2.1 Sightlines at intersections, pedestrian and cycle crossings, and crossovers to allotments for motorists, cyclists and pedestrians are maintained or enhanced to ensure safety for all road users and pedestrians.	DTS/DPF 2.1 None are applicable.
Vehicle Access	
PO 3.1 Safe and convenient access minimises impact or interruption on the operation of public roads.	DTS/DPF 3.1 The access is: (a) provided via a lawfully existing or authorised driveway or access point or an access point for which consent has been granted as part of an application for the division of land or (b) not located within 6m of an intersection of 2 or more roads or a pedestrian activated crossing.
PO 3.3 Access points are sited and designed to accommodate the type and volume of traffic likely to be generated by the development or land use.	DTS/DPF 3.3 None are applicable.
PO 3.4	DTS/DPF 3.4 None are applicable.

General Development Policies – Transport, Access and Parking	
Access points are sited and designed to minimise any adverse impacts on neighbouring properties.	
PO 3.8 Driveways, access points, access tracks and parking areas are designed and constructed to allow adequate movement and manoeuvrability having regard to the types of vehicles that are reasonably anticipated.	DTS/DPF 3.8 None are applicable.
PO 3.9 Development is designed to ensure vehicle circulation between activity areas occurs within the site without the need to use public roads.	DTS/DPF 3.9 None are applicable.
Access for People with Disabilities	
PO 4.1 Development is sited and designed to provide safe, dignified and convenient access for people with a disability.	DTS/DPF 4.1 None are applicable.
Vehicle Parking Rates	
PO 5.1 Sufficient on-site vehicle parking and specifically marked accessible car parking places are provided to meet the needs of the development or land use having regard to factors that may support a reduced on-site rate such as: (a) availability of on-street car parking (b) shared use of other parking areas (c) in relation to a mixed-use development, where the hours of operation of commercial activities complement the residential use of the site, the provision of vehicle parking may be shared (d) the adaptive reuse of a State or Local Heritage Place.	DTS/DPF 5.1 Development provides a number of car parking spaces on-site at a rate no less than the amount calculated using one of the following, whichever is relevant: (a) Transport, Access and Parking Table 2 - Off-Street Vehicle Parking Requirements in Designated Areas if the development is a class of development listed in Table 2 and the site is in a Designated Area (b) Transport, Access and Parking Table 1 - General Off-Street Car Parking Requirements where (a) does not apply (c) if located in an area where a lawfully established carparking fund operates, the number of spaces calculated under (a) or (b) less the number of spaces offset by contribution to the fund.
Vehicle Parking Areas	
PO 6.1 Vehicle parking areas are sited and designed to minimise impact on the operation of public roads by avoiding the use of public roads when moving from one part of a parking area to another.	DTS/DPF 6.1 Movement between vehicle parking areas within the site can occur without the need to use a public road.
PO 6.2 Vehicle parking areas are appropriately located, designed and constructed to minimise impacts on adjacent sensitive receivers through measures such as ensuring they are attractively developed and landscaped, screen fenced, and the like.	DTS/DPF 6.2 None are applicable.
PO 6.6 Loading areas and designated parking spaces for service vehicles are provided within the boundary of the site.	DTS/DPF 6.6 Loading areas and designated parking spaces are wholly located within the site.

The key issues with regard to traffic and transport relate to the additional vehicles accessing the proposed wind farm site during its construction, and to a considerably lesser degree during operation. It is acknowledged that the proposed wind farm construction period will have an effect on the daily activities of the local community due to potentially increased traffic delays and noise. This will primarily be impacts on the adjacent landowners and the centres of Truro, Kapunda, Eudunda and the area of Koonunga.

A detailed Traffic Impact Assessment (TIA) has been undertaken by MFY and is included in Volume 2 of the development application documents. This assessment report gives particular consideration to the transportation of the proposed wind farm components (particularly the wind turbine blades, given they are the longest and most difficult element to transport) during the 18 to 24 month construction period. The report (Section 6) notes that "the traffic generated during the construction phase represents the greatest demand for the site, occurring over the assumed 18 month period. Overall, it is estimated that there will be 108, 838 one-way vehicle trips, comprised of:

- 1,038 over size and over mass vehicle (OSOM) trips.
- 57,640 general access truck trips (up to 19.0m semi-trailers).
- 50,160 light vehicle trips.

The above listed trips however, will occur over a minimum 18 month period. When broken down to average trips per day, the effects on the road network are considered to be acceptable given the capacity and status of the road network. The average daily trip generation would be 273 vehicle trips, including three (3) OSOM vehicle movements.

The MFY analysis concluded that the traffic increase on the roads will be minimal, albeit measurable as the current volumes are already low.

During the construction phase of the wind farm there is potential for impacts on the safe and convenient movement of people and goods in the region. This construction period is estimated to be 18 months to two years. During this phase of the development it is important that the potential impacts are minimised. It is considered that the preferred route (and alternatives) along with the practices already identified in the TIA report and briefly outlined above, along with the preparation of a detailed Traffic Management Plan prior to construction commencing, would satisfy the intent of the Planning and Design Code policies in providing safe and convenient movement of goods and people in the locality of the development.

During the operational phase of the project, the traffic generated will be limited to maintenance vehicles infrequently visiting the site. Post construction and during the operational phase of the wind farm, it is unlikely that the proposal will adversely effect the road network, or the safe and convenient movement of people and goods.

The need for appropriate management of traffic movements is acknowledged and these will be addressed further as part of a Traffic Management Plan to be authorised by the relevant authorities prior to construction commencing. On this basis, it is considered that the proposal adequately addresses the requirements of the Planning and Design Code regarding road traffic and transportation.

In addition, the MFY Traffic Impact Assessment assessed the sightlines for vehicle access to the wind farm from Mosey Road and to the terminal substation on the Sturt Highway at Truro. The siting and design of the vehicle access to the terminal substation has been informed by a sightline analysis undertaken by MFY and is considered to be safe and convenient. Similarly, the sightlines for vehicles entering and exiting the wind farm site from Mosey Road are adequate and appropriate.

Whilst a detailed parking analysis has not been undertaken for the development, it is noted that the typical designs of each of the construction compounds (temporary or permanent) incorporate the provision of car parking spaces for staff and visitors.

As discussed in Section 4.3.6.5 above, MFY have also analysed the potential distraction of the wind turbine generators when operational from publicly assessable roads, in the cone of vision assessment. The assessment found that the turbines are appropriately separated from the roads so as not to be a distraction. For this reason the development is considered to satisfy the PO 7.1 Interface between Land Uses regarding potential distraction to road users.

General Development Policies – Interface Between Land Uses	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
PO 7.1 Development is designed and comprised of materials and finishes that do not unreasonably cause a distraction to adjacent road users and pedestrian areas or unreasonably cause heat loading and micro-climatic impacts on adjacent buildings and land uses as a result of reflective solar glare.	DTS/DPF 7.1 None are applicable.

In accordance with the summary of the Traffic Impact Assessment (refer summary below), it is considered that the relevant policies of the Planning and Design Code, as they relate to traffic matters, are appropriately satisfied. The further detailed assessment of the development prior to construction as part of a Traffic Management Plan will further assist in managing the potential impacts of the development during the construction phase.

> *This report has addressed potential road safety and access requirements associated with the proposed Twin Creek Wind Farm. The traffic impact associated with the operation of the proposed facility will be negligible and will relate to safety for users of the adjacent roads rather than any impact created by traffic associated with the proposal.*
>
> *A site assessment and analysis of the proposed development confirm that the locations of the turbines will satisfy the criteria for lateral and vertical clearance requirements to mitigate driver distraction on public roads.*
>
> *Access to the development will be located such that sightline criteria are met and will be designed to accommodate the largest anticipated vehicle. Two access points will be provided to service separate areas of the site where connectivity is constrained by the natural terrain.*

Notwithstanding the negligible impact associated with the operation of the proposal, the delivery turn path requirements for the turbines will be considerable, thus necessitating road infrastructure upgrades to service the site. These upgrades, which would be detailed in the construction traffic management plan, would appear to be accommodated within existing road reserve, although a review of the requirements having regard to the specific delivery vehicle will clarify any temporary construction works required.

The assessment has identified an OSOM route which would facilitate access between Port Adelaide or Port Pirie and the site. The transportation of turbine components will occur on these routes.

There will be a requirement to identify a road connection which can accommodate the OSOM vehicles between the access point(s) for the site and the OSOM route. The route which would be via Truro Road and Bagot Well Road, will require the bridge on Bagot Road to be upgraded to accommodate the design vehicle. A detailed assessment of the agreed access route will identify the infrastructure upgrade requirements to facilitate access to the site.

4.3.9 Aviation

Renewable energy facilities should be located so they do not adversely impact on air transport safety, including the operation of airfields and landing strips, as stated in PO 4.1 of the Infrastructure and Renewable Energy Facilities policies. An Aviation Impact Assessment (AIA) has been undertaken by Aviation Projects for the Project and this report is contained in Volume 2 of the development application documents.

The AIA notes the following in relation to air transport and safety:

- Certified airports: The Project is not located within 30 nm of any certified aerodrome, and therefore will not affect any Procedures for Air Navigation Services - Aircraft Operations PANS-OPS surfaces or obstacle limitation surfaces.
- Aircraft Landing Areas (ALAs): There are no active verified ALAs located within 3 nm of the Project. There is one unverified ALA within 3nm of the Project.
- Air Routes and Lowest Safe Altitude: The Project will not affect any route or grid lowest safe altitude Aviation Facilities.
- The Project will not penetrate any protection areas associated with aviation facilities.
- Due to the distance and intervening terrain between the Project and the primary and secondary radar facilities located at Adelaide airport, it is anticipated there will be no impact to radar facilities.
- Based on the Project WTG layout and maximum blade tip height of up to 220 m AGL, the blade tip elevation of the highest WTG will not exceed 706.1 m AHD (2317 ft AMSL), and:
  - is not located within 30 nm of any certified aerodrome and will not affect any terminal instrument flight procedures
  - will not penetrate any OLS surfaces
  - will not have an impact on nearby designated air routes
  - will not have an impact on the grid LSALT of 3400 ft established in ERC Low and 3800 ft established in ERC High
  - will not have an impact on operational airspace

- is wholly contained within Class G airspace
- is outside the clearance zones associated with civil aviation navigation aids and communication facilities.
- the proposed WTGs will not require obstacle lighting to maintain an acceptable level of safety to aircraft.

The AIA investigations and conclusions indicate that the Project is unlikely to impact on air safety of air transport. Furthermore, lighting of the turbines is not required for obstacle limitation purposes and therefore lighting from this component of the turbine will not impact on the amenity of the locality. For these reasons it is considered that the proposal suitably addresses POs 4.1 and 8.4 as stated below.

It is noted that the development does not propose any new or additional meteorological masts. The existing meteorological mast contains the necessary recognition markings.

Infrastructure And Renewable Energy Facilities **Desired Outcome**	
DO 1 Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
Hazard Management	
PO 4.1 Infrastructure and renewable energy facilities and ancillary development located and operated to not adversely impact maritime or air transport safety, including the operation of ports, airfields and landing strips.	DTS/DPF 4.1 None are applicable.
Renewable Energy Facilities (Wind Farm)	
PO 8.4 Wind turbine generators incorporate recognition systems or physical markers to minimise the risk to aircraft operations.	DTS/DPF 8.4 No Commonwealth air safety (CASA / ASA) or Defence requirement is applicable.
PO 8.5 Meteorological masts and guidewires are identifiable to aircraft through the use of colour bands, marker balls, high visibility sleeves or flashing strobes.	DTS/DPF 8.5 None are applicable.

Implications for aerial agriculture application in and around wind farms is frequently a matter of discussion during the assessment of these development applications. The AIA notes that there is not extensive aerial application undertaken in the locality of the proposed wind farm. As outlined in Section 4.3.1 it is anticipated that aerial agriculture may be utilised on the plains where cropping activities are undertaken.

The location of wind turbine generators, which are generally on elevated land along or adjacent the ridgelines, is therefore unlikely to adversely impact on aerial application on the cropping and grazing land to the east and west. The AIA notes that "*it is reasonable to conclude that safe aerial application operations would still be possible on properties within the Project site and neighbouring the Project site*", particularly following engagement with local aerial agricultural operators to develop procedures for such aircraft operation in the vicinity of the Project.

Fixed wing aerial agriculture aircraft are utilised in aerial bushfire fighting throughout the State and were utilised in the locality of the Project for the Pinery fires. Concerns are sometimes raised that installation of wind turbine generators limits the capacity of aerial fire fighting. The impacts of the wind farm are further discussed in Section 4.3.10 below.

In the assessment of the original development application for the Twin Creek Wind Farm development, concerns were raised that the wind farm development would adversely impact on ballooning in the Barossa Valley region. There are two Barossa Valley based ballooning operators and neither have a set base (rather a customer meeting point) but will launch and land wherever the local conditions allow. It is understood that following customer pick up the operators will drive to the best launch site, typically within 12-15 nm of the pick-up site. Flights are usually one hour and the path will be wherever the wind takes them. It is theoretically possible some flights may be outside of the Barossa Valley and toward the Twin Creek Wind Farm or any other direction. An obstacle noted in publications and charts needs to be considered in any flight plan. Therefore, the remedy for the risk of collision with a wind turbine is to ensure that the turbine coordinates and elevations are provided to Airservices Australia for marking on aeronautical charts, which is standard procedure.

4.3.10 Bushfire

The site of the development is located across two levels of bushfire risk, namely Regional Risk and General Risk, as discussed in Section 4.2.5 of this report.

There is substantial overlap in the policies between the applicable Hazards (Bushfire – Regional Risk) Overlay and Hazards (Bushfire – General Risk) Overlay, all of which seek to mitigate the threat and impact of bushfires on life and property. In addition, the Performance Outcomes 4.2 and 4.3 of the Infrastructure and Renewable Energy Facilities policies address bushfire hazard management. PO 4.3 seeks that development provides appropriate access tracks, safety equipment and water tanks and establishes cleared areas around substations, battery storage and operations compounds.

Hazards (Bushfire – Regional Risk) Overlay **Desired Outcome**
DO 1 Development, including land division responds to the relevant level of bushfire risk and is sited and designed to mitigate the threat and impact of bushfires on life and property taking into account the increased frequency and intensity of bushfires as a result of climate change.
DO2 To facilitate access for emergency service vehicles to aid the protection of lives and assets from bushfire danger.

Hazards (Bushfire – Regional Risk) Overlay	
Performance Outcome	**Deemed-To-Satisfy Criteria / Designated Performance Feature**
Siting	
PO 1.1 Buildings and structures are located away from areas that pose an unacceptable bushfire risk as a result of vegetation cover and type, and terrain.	DTS/DPF 1.1 None are applicable.
Built Form	
PO 2.1 Buildings and structures are designed and configured to reduce the impact of bushfire through using designs that reduce the potential for trapping burning debris against or underneath the building or structure, or between the ground and building floor level in the case of transportable buildings and buildings on stilts.	DTS/DPF 2.1 None are applicable.
Vehicle Access -Roads And Driveways	
PO 5.1 Roads are designed and constructed to facilitate the safe and effective: (a) access, operation and evacuation of fire-fighting vehicles and emergency personnel (b) evacuation of residents, occupants and visitors.	DTS/DPF 5.1 Roads: (a) are constructed with a formed, all-weather surface (b) have a gradient of not more than 16 degrees (1-in-3.5) at any point along the road (c) have a cross fall of not more than 6 degrees (1-in-9.5) at any point along the road (d) have a minimum formed road width of 6m (e) provide overhead clearance of not less than 4.0m between the road surface and overhanging branches or other obstructions including buildings and/or structures (Figure 1) (f) allow fire-fighting services (personnel and vehicles) to travel in a continuous forward movement around road curves by constructing the curves with a minimum external radius of 12.5m (Figure 2) (g) incorporating cul-de-sac endings or dead end roads do not exceed 200m in length and the end of the road has either: (i) a turning area with a minimum formed surface radius of 12.5m (Figure 3) or (ii) a 'T' or 'Y' shaped turning area with a minimum formed surface length of 11m and minimum internal radii of 9.5m (Figure 4)

Hazards (Bushfire – Regional Risk) Overlay	
	(h) incorporate solid, all-weather crossings over any watercourse that support fire-fighting vehicles with a gross vehicle mass (GVM) of 21 tonnes.
PO 5.3 Development does not rely on fire tracks as means of evacuation or access for fire-fighting purposes unless there are no safe alternatives available.	DTS/DPF 5.3 None are applicable.

In addition to the policies of the Planning and Design Code, it is understood that the SA Country Fire Service (CFS) are utilising the Victorian Country Fire Authority Guidelines - Design Guidelines and Model Requirements - Renewable Energy Facilities 2024 (CFA Guidelines) in the absence of a specific South Australian standard or guideline for assessment of fire risk for renewable energy projects.

In addition to the preparation of a detailed Bushfire Management Plan prior to construction, the proposal incorporates the following design features to mitigate the threat of bushfire:

- Vegetation management on-site.
- Procedures for shutting down of turbines in emergency situations.
- The potential fire risk associated with electrical failure will be managed by the following measures:
  - use of fully enclosed electrical equipment on turbine structures and pad-mount transformers.
  - extensive use of underground cabling between turbines.
  - design of any overhead lines in accordance with industry standards.
  - exclusion of vegetation from within the substation enclosures.
  - use of circuit breakers and fuses to interrupt any electrical fault.
- Install dedicated static water storage tanks (of concrete or steel construction) at the entrances to the development and/or in other locations determined appropriate in consultation with the CFS.
- Construction of infrastructure such as the BESS, inverters, substation and operations and maintenance areas on a hard stand surface.
- Internal access tracks of minimum 6 metres in width with suitable all-weather surface.
- Suitable turn around areas for emergency vehicles within (or adjacent) the operations and maintenance compound, the temporary construction compounds, substations and principal and emergency vehicle access points.
- Control of ground cover vegetation during high fire danger periods.

A detailed Bushfire Management Plan will be prepared for the project as outlined in the Statement of Commitments (Volume 1 - Project Summary of the application documents) and include the following measures:

- In consultation with the CFS, prepare a Bushfire Management Plan that addresses the following during construction:

- Activities to be undertaken during the Fire Danger Season are appropriate under the Fire and Emergency Services Act 2005 and Fire and Emergency Services Regulations 2021 - 2005 Division 54 - Fire Prevention of the regulations.
- Staff, contractors and site visitors to be informed of fire response procedures that follow identified legislative requirements, policies and procedures
- Works during the fire danger season to have appropriate permits from Local Government, (Goyder, Light Regional and Mid Murray Councils).
- Construction and operational works follow appropriate Work Health and Safety requirements.
- Principal Contractor to ensure there is a bushfire survival plan for personnel at the site.
- Facilitate a high standard of communication with landowners, relevant stakeholders and the community regarding daily activities through community liaison groups or similar.
- Primary contact person for the community to contact with concerns, questions or issues to be established.
- Ensure all contractors:
  - Are appropriately briefed and understand their legal obligations in relation to managing bushfire risks.
  - Have appropriate procedures, safe work practices, contingency plans, MSDS for operation of all equipment, chemicals, flammable materials that may contribute to bushfires.
- Have appropriate "initial" suppression equipment available on site i.e. fire extinguishers or firefighting equipment in vehicles.
- Carry emergency communications equipment.
- Vehicles should keep to the tracks whenever possible.
- Restrict low clearance vehicles with catalytic converters from entering the site on high fire danger days.
- Restrict smoking to prescribed areas.
- Consider a policy of "no work" or "essential work only" on declared Catastrophic Fire Danger Days.
- Provide appropriate bushfire training for contractors and staff.
- Ensure all building construction is in line with the Minister Specifications of building in Bushfire risk areas.
- Ensure appropriate bunding in areas where there is potential for flammable fuels and oils to leak and create bushfires or other environmental risks.
- Ensure all access roads and tracks are identified and meet standards for emergency vehicle access
- Consider appropriate signs to assist emergency response crews determine track names, location and turbines etc.
- Establish emergency assembly areas.
- Consider the option to have all power lines underground within the wind farm development site.

- Ensure all environmental risks of construction have been considered and approved by relevant authority.
- Consider security fencing as necessary around turbines and substations to prevent public access.
- Provide adequate access tracks to assist CFS in responding to and managing fires on site.
- Ensure adequate access to water for CFS, and/or for sprinklers, and the provision of onsite static water supplies.
- Consider early fire/smoke detection systems, in built fire protection systems, remote alarming and notification systems in turbines to report potential bushfire risks from any mechanical or electrical failures.

• Ensure that the Bushfire Management Plan incorporates the following for the operation phase of the project:

  - Invite local brigades on regular site familiarisation tours.
  - Communicate to community the bushfire risk mitigation works undertaken.
  - Provide site plans to CFS marking assets, access points, tracks, firebreaks, hazards and water points once facility is constructed.
  - Undertake regular inspections and maintain records of all turbines, the substation, and power lines (including easements).
  - Ensure suitable firefighting equipment is available onsite or readily accessible
  - Ensure staff and contractors are trained in firefighting equipment and have appropriate personal protective clothing.
  - Ensure the maintenance of fuel load management zones (A and B zones).
  - Consider remote shut down possibilities of turbine operations during high bushfire risk days, actual bushfires or reported faults.
  - Consider lightning conductors to dissipate electricity to ground and reduce turbine damage and bushfire risk.
  - Ensure all access roads and tracks are maintained to meet appropriate standards for emergency vehicle access.

Performance Outcome 4.2 of the Infrastructure and Renewable Energy Facilities policies seeks to incorporate practical separation between energy generation, storage and transmission infrastructure to dwellings, tourist accommodation and frequently visited public places. Whilst the policies do not specify the separation distance, it is noted that each of the wind turbine generators achieves a minimum 2,000 metres separation from non-associated stakeholder dwellings, and the minimum separation from construction and operation facilities, and the battery energy storage facilities is appropriately 1,200 metres. There are several dwellings along the transmission corridor that have smaller setbacks than from other infrastructure, however the transmission infrastructure will be constructed within the easement corridor and in accordance with the necessary standards. With these separation distances and in combination with the fire management techniques, it is considered the development achieves the intent of this policy.

Infrastructure And Renewable Energy FacilitieS Desired Outcome	
DO 1 Efficient provision of infrastructure networks and services, renewable energy facilities and ancillary development in a manner that minimises hazard, is environmentally and culturally sensitive and manages adverse visual impacts on natural and rural landscapes and residential amenity.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
Hazard Management	
PO 4.2 Facilities for energy generation, power storage and transmission are separated as far as practicable from dwellings, tourist accommodation and frequently visited public places (such as viewing platforms / lookouts) to reduce risks to public safety from fire or equipment malfunction.	DTS/DPF 4.2 None are applicable.
PO 4.3 Bushfire hazard risk is minimised for renewable energy facilities by providing appropriate access tracks, safety equipment and water tanks and establishing cleared areas around substations, battery storage and operations compounds.	DTS/DPF 4.3 None are applicable.

Aerial firefighting is a tool available to CFS in fighting bushfire. The CFS fact sheet Understanding Aerial Firefighting highlights that "…*community perception is that aircraft alone put out bushfires, this is not true*" and the CFS website addressing aerial firefighting defines aerial firefighting as *"the use of aircraft and other aerial resources to assist firefighters on the ground in achieving bushfire suppression objectives"*. It is important to note that firefighting aircraft (regardless of their size or type) do not extinguish a bushfire alone but are deployed to provide an important support function to ground firefighting resources.

Twin Creek Wind Farm is in the CFS Secondary Response Zone (refer CFS Operations Tri Manual SOP 11.1 Aerial Fire Fighting). This means that bushfire suppression activities may be able to be supported by aerial suppression (rotary and fixed wing) based on a specific request by an Incident Controller and approved at a state level. There is no guarantee that aircraft for either suppression or an observation platform will be available for immediate dispatch, particularly in the Secondary Response Zone. This will be determined at the time by the CFS State Air Resource Coordinator (SARC) in consultation with the CFS Regional Office and Incident Management. Pilots, air attack supervisors and air operation managers constantly undertake dynamic risk assessments to review and consider options and determine appropriate strategies to safely undertake suppression operations. In this context, aerial firefighting will treat turbine towers the same as any other obstacle.

Impacts of wind farm development on aerial fire-fighting is often a concern of the community. It is noted that concerns relating to impacts on aerial fire-fighting were considered in the Palmer Wind Farm appeal to the ERD Court (*McLachlan & Ors v Mid Murray Council & Tilt Renewables Australia Pty Ltd – (2018*) *SAERDC 15*). In its judgement, the Court stated:

> *147 We accept that, in the event of a fire near the WTGs, firefighting tactics, including aerial tactics, may be different from what they would have been in the absence of the WTGs, depending upon the nature of the fire and weather conditions.*
>
> *149 Mr Ferguson said that the wind farm would not pose an unacceptable bushfire risk, and nor would it prevent aerial firefighting, although it may change routes and tactics to some extent.*
>
> *150 We are satisfied that the proposed development is acceptable in relation to its impact upon firefighting capacity. Any new land use in a rural area will need to be considered in the event of a fire, and may change the approach to firefighting. The proposed wind farm will generate new considerations for the CFS and also offer new opportunities.*

RES acknowledges and appreciates the importance of adequate and appropriate bushfire management in the locality, particularly given bushfire events in the region over recent years. It is however considered that the development of the Twin Creek Wind Farm may vary the approach to bushfire management but not significantly impact upon the capacity for aerial firefighting to occur within the region.

4.3.11 Water

The Light River flows along the western boundary of the Twin Creek Wind Farm site. Infrastructure associated with the wind farm (particularly the area accommodating the wind turbine generators and ancillary infrastructure) is not located immediately adjacent to the Light River. The Civil, Geology and Hydrology report by AECOM contained in Volume 2 of the application documents notes that the Light River has a catchment of approximately 1820 square kilometres. Freshwater Creek, Spring Creek and numerous ephemeral creeks are within the development site of the wind farm. The AECOM report notes that a River Catchment Plan for the Light River observes that the creeks on the site have poor native watercourse vegetation. This Catchment Plan also noted that the Light River has remnant vegetation and downstream from the site had good native watercourse vegetation.

Due to the topography of the site, some access tracks and electricity infrastructure may cross watercourses. As part of the design, crossing of watercourses has been minimised, given difficulties created for manoeuvring of large vehicles and/or the desire to minimise additional physical infrastructure. Any crossing of a watercourse required to implement the project will be the subject of detailed design and addressed in the final CEMP.

As detailed in the AECOM Civil, Geology and Hydrology assessment, foundation blasting may occur on landforms dominated by rocky outcropping bedrock (siltstones and sandy siltstone). Groundwater is expected at depths in excess of 15 metres below ground surface and is sourced from fractures within the bedrock. The groundwater salinity is of brackish quality, restricting its use to stock water. In summary, studies from similar groundwater/aquifer environments in the U.S. have indicated that short-term, sporadic foundation blasting of the bedrock aquifer should not have any long-term measurable effect on surrounding groundwater supply bores at the Twin Creek site.

Once operational, the wind farm is unlikely to have adverse impacts on the watercourses within or downstream of the site of the development. The nature of the development does not require extraction of water, nor create waste in a manner that would adversely affect the natural systems of the watercourses. Nevertheless, the operation and maintenance facilities will require collection, use and disposal of wastewater. The plans which accompany the development application show an indicative layout of the operations and maintenance facilities, which includes on-site stormwater disposal.

It is anticipated that these facilities will be self-sufficient and not generate off-site impacts. The final design and layout, including on-site water collection and disposal, will be subject to further design. Detailed design of these facilities will be undertaken in accordance with the principles of water sensitive design and in accordance with the Construction Environmental Management Plan, a draft of which forms part of the application documents.

The construction of the wind farm has the potential to create impacts on watercourses and groundwater by erosion and landslip, through the earthworks associated with constructing or upgrading of access tracks, footings for the turbines, and site development for both temporary and permanent operation, and maintenance facilities. In addition, the temporary concrete batching plant within the construction facilities would require disposal of wastewater.

Water utilised during the construction phase may be sourced from the aquifer, however this will be subject to approval through other legislation. The option also exists to obtain water from an external source, and transport and store it within the construction facilities.

Hazards (Flooding-Evidence Required) Overlay	
Desired Outcome	
DO 1 Development adopts a precautionary approach to mitigate potential impacts on people, property, infrastructure and the environment from potential flood risk through the appropriate siting and design of development.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
Flood Resilience	
PO 1.1 Development is sited, designed and constructed to minimise the risk of entry of potential floodwaters where the entry of flood waters is likely to result in undue damage to or compromise ongoing activities within buildings.	DTS/DPF 1.1 Habitable buildings, commercial and industrial buildings, and buildings used for animal keeping incorporate a finished floor level at least 300mm above: (a) the highest point of top of kerb of the primary street or (b) the highest point of natural ground level at the primary street boundary where there is no kerb

Hazards (Flooding-Evidence Required) Overlay	
Environmental Protection	
PO 2.1 Buildings and structures used either partly or wholly to contain or store hazardous materials are designed to prevent spills or leaks leaving the confines of the building.	DTS/DPF 2.1 Development does not involve the storage of hazardous materials.

WATER RESOURCES OVERLAY	
Desired Outcome	
DO 1 Protection of the quality of surface waters considering adverse water quality impacts associated with projected reductions in rainfall and warmer air temperatures as a result of climate change.	
DO2 Maintain the conveyance function and natural flow paths of watercourses to assist in the management of flood waters and stormwater runoff.	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
Water Catchment	
PO 1.1 Watercourses and their beds, banks, wetlands and floodplains (1% AEP flood extent) are not damaged or modified and are retained in their natural state, except where modification is required for essential access or maintenance purposes.	DTS/DPF 1.1 None are applicable.
PO 1.5 Development that increases surface water run-off includes a suitably sized strip of vegetated land on each side of a watercourse to filter runoff to: (a) reduce the impacts on native aquatic ecosystems (b) minimise soil loss eroding into the watercourse.	DTS/DPF 1.5 A strip of land 20m or more wide measured from the top of existing banks on each side of the watercourse is free from development, livestock use and revegetated with locally indigenous vegetation
PO 1.6 Development resulting in the depositing or placing of an object or solid material in a watercourse or lake occurs only where it involves any of the following: (a) the construction of an erosion control structure (b) devices or structures used to extract or regulate water flowing in a watercourse (c) devices used for scientific purposes (d) the rehabilitation of watercourses.	DTS/DPF 1.6 None are applicable.
PO 1.7	DTS/DPF 1.7

WATER RESOURCES OVERLAY	
Watercourses, floodplains (1% AEP flood extent) and wetlands protected and enhanced by retaining and protecting existing native vegetation.	None are applicable.
PO 1.8 Watercourses, floodplains (1% AEP flood extent) and wetlands are protected and enhanced by stabilising watercourse banks and reducing sediments and nutrients entering the watercourse.	DTS/DPF 1.8 None are applicable.
PO 1.9 Dams, water tanks and diversion drains are located and constructed to maintain the quality and quantity of flows required to meet environmental and downstream needs.	DTS/DPF 1.9 None are applicable.

The AECOM Civil, Geology and Hydrology assessment notes that there are signs of erosion on the site, particularly near the creeks. It is acknowledged that construction of the wind farm has the potential to result in soil erosion and sedimentation and mitigation measures are incorporated in the Draft Construction Environmental Management Plan (Volume 4 of the development application). These measures include:

- utilising existing access tracks wherever practical;
- minimising vegetation clearance;
- retention of all contaminated stormwater and process wastewater on-site;
- locating stockpiles away from drainage lines and in areas least susceptible to wind erosion;
- effectively controlling surface runoff entering and leaving the site;
- designing crossings of watercourses in consultation with relevant authorities;
- providing truck and wheel wash facilities at exit points;
- undertaking all equipment wash-down within an identified wash down area with wash down contained within that area;
- conducting the refuelling of vehicles or equipment at least 30 metres away from a water body, watercourse or drainage channel; and
- Undertaking all construction activities in accordance with the EPA Environment Protection (Water Quality) Policy 2015.

There will be a low risk of detrimental effect on water quality during construction, provided that work complies with a Construction Environment Management Plan (CEMP) incorporating a Soil Erosion and Drainage Management Plan for each element of the development. Potential impacts on natural features due to erosion and landslip can be minimised through appropriate management, utilising techniques already outlined in the draft CEMP.

Amenities developed as part of the Operations and Maintenance facilities of the Project will incorporate appropriately designed and sited waste water management systems, in accord with PO 12.1 and DTS/DPF 12.1 of the Infrastructure and Renewable Energy Facilities policies.

Infrastructure And Renewable Energy Facilities	
Performance Outcome	**Deemed-to-Satisfy Criteria / Designated Performance Feature**
Wastewater Services	
PO 12.1 Development is connected to an approved common wastewater disposal service with the capacity to meet the requirements of the intended use. Where this is not available an appropriate on-site service is provided to meet the ongoing requirements of the intended use in accordance with the following: (a) it is wholly located and contained within the allotment of the development it will service (b) in areas where there is a high risk of contamination of surface, ground, or marine water resources from on-site disposal of liquid wastes, disposal systems are included to minimise the risk of pollution to those water resources (c) septic tank effluent drainage fields and other wastewater disposal areas are located away from watercourses and flood prone, sloping, saline or poorly drained land to minimise environmental harm.	DTS/DPF 12.1 Development is connected, or will be connected, to an approved common wastewater disposal service with the capacity to meet the requirements of the development. Where this is not available it is instead capable of being serviced by an on-site waste water treatment system in accordance with the following: (a) the system is wholly located and contained within the allotment of development it will service; and (b) the system will comply with the requirements of the South Australian Public Health Act 2011.

4.3.12 Sloping Land and Soil Erosion

The site of the development contains numerous ridgelines and valleys. To construct the wind farm a number of these ridgelines will be accessed by new or upgraded existing access tracks, some of which may exceed a 1 in 8 gradient. The design and siting of the access tracks will seek to limit earthworks, however the nature of the movement of components during construction will require some alteration to the natural landform. The General Development Policies – Design provide guidance in relation to soil erosion and slope stability.

Soil erosion and slope stability is discussed in AECOM's Civil, Geology, Geotechnical and Hydrology Assessment, which forms part of the application documents. As stated below, this report summarises the slope stability and erosion position (Section 7.3, 7.5 and 7.6) as follows:

> *Slope Stability*
>
> *No evidence of significant existing landslides was observed at the site during this study, however, slope stability assessment was beyond the scope of the current study.*
>
> *If significant thicknesses of new cuts or fills are required for access road construction, the stability of such earthworks must be assessed.*

The stability of turbine footings in close proximity to steep slopes must also be assessed, particularly where the rock mass is highly fractured or has unfavourably orientated defects.

Erosion

Considerable erosion of the relatively thin soil cover was observed across the site, especially adjacent to creeks. The soil erosion had resulted in the accumulation of significant quantities of sediment in some creek beds.

Any new excavations that expose the soil profile must be provided with protection from erosion, and mitigation measures such as silt fences may be required down gradient of active earthworks areas to avoid fouling the natural creeks.

Future Geotechnical Investigations

A staged approach to future geotechnical investigations is recommended, with initial test pitting recommended at each turbine location to assess the near-surface rock strength, weathering, fracture spacing and the orientation of the main rock defects at each proposed turbine site. Similar investigations at key points along proposed access road tracks and at the proposed substation site should also be performed.

As discussed previously, addressing soil erosion and maintaining water quality are matters to be addressed during construction and can be adequately managed by practices outlined in the CEMP. As outlined in the draft CEMP and discussed in the civil engineering report accompanying the application, access tracks will align with existing tracks wherever possible, minimise the clearance of native vegetation, and avoid areas of higher native vegetation, control stormwater discharge, be constructed of gravelled surfaces. Those areas of land no longer required for access will be appropriately remediated to the state they existed prior to construction commencing. Earthworks are a significant component of the construction of the wind farm, both in terms of access tracks and turbine construction. It is acknowledged that during the construction of the wind farm, appropriate management will need to be in place to minimise the impact on sloping land. These practices, in draft form, are contained in the CEMP that accompanies the application documents and address the intent of the provisions of the Planning and Design Code to minimise environmental harm.

General Development Policies – Design	
Performance Outcome	**Deemed-To-Satisfy Criteria / Designated Performance Feature**
Water Sensitive Design	
PO 5.1 Development is sited and designed to maintain natural hydrological systems without negatively impacting: (a) the quantity and quality of surface water and groundwater (b) the depth and directional flow of surface water and groundwater (c) the quality and function of natural springs.	DTS/DPF 5.1 None are applicable.

General Development Policies – Design Earthworks And Sloping Land	
PO 8.1 Development, including any associated driveways and access tracks, minimises the need for earthworks to limit disturbance to natural topography.	DTS/DPF 8.1 Development does not involve any of the following: (a) excavation exceeding a vertical height of 1m (b) filling exceeding a vertical height of 1m (c) a total combined excavation and filling vertical height of 2m or more.
PO 8.2 Driveways and access tracks are designed and constructed to allow safe and convenient access on sloping land (with a gradient exceeding 1 in 8).	DTS/DPF 8.2 Driveways and access tracks on sloping land (with a gradient exceeding 1 in 8) satisfy (a) and (b): (a) do not have a gradient exceeding 25% (1-in-4) at any point along the driveway (b) are constructed with an all-weather trafficable surface.
PO 8.3 Driveways and access tracks on sloping land (with a gradient exceeding 1 in 8): (a) do not contribute to the instability of embankments and cuttings (b) provide level transition areas for the safe movement of people and goods to and from the development (c) are designed to integrate with the natural topography of the land.	DTS/DPF 8.3 None are applicable.
PO 8.4 Development on sloping land (with a gradient exceeding 1 in 8) avoids the alteration of natural drainage lines and includes on-site drainage systems to minimise erosion.	DTS/DPF 8.4 None are applicable.
PO 8.5 Development does not occur on land at risk of landslip nor increases the potential for landslip or land surface instability.	DTS/DPF 8.5 None are applicable.

4.3.13 Decommissioning and Rehabilitation

At the end of its economic life, all equipment will either be replaced with comparable new equipment, or the wind farm will be decommissioned. Replacement is expected to be subject to new approvals.

A draft decommissioning and rehabilitation plan would be prepared and submitted to the relevant authority for approval (if/as required), based on industry best practice (at that time), prior to commissioning of the wind farm. This plan would outline anticipated decommissioning processes required for the removal of installed infrastructure.

4.3.14 *Summary of Assessment of the Planning and Design Code*

In summary, the proposed wind farm and battery energy storage project and ancillary components has substantial planning merit when assessed against the relevant provisions of the Planning and Design Code. The planning merits are:

- the development is a renewable energy facility that provides a benefit to the community and the State;
- a renewable energy facility is an envisaged land use within the Rural Zone;
- retention of the principal and underlying land use of the locality, that is primary production;
- the proposal is unlikely to have a significant adverse effect on aerial agriculture within the locality;
- the siting and design of the wind farm and energy storage facilities adequately minimise the effect on the natural environment;
- the development does not adversely affect safety of water or air transport;
- the minimum setback of 1,500 metres to all non-associated (non-stakeholder) dwellings for a wind turbine generator is comfortably satisfied by the development which incorporates a minimum 2,000 metre setback;
- there are no known tourist accommodation facilities within the locality (that is, within 1,500 metres of the nearest wind turbine generator);
- there are no townships, settlements or urban zones within 2,700 metres of any wind turbine generators;
- predicted noise levels are compliant with relevant noise criteria for sensitive receivers;
- the turbines are designed to minimise glare/blade glint;
- the wind farm is compliant with guidelines for theoretical and actual shadow flicker to owners and occupiers of non-associated dwellings;
- the proposal contains suitable methodology that minimises impacts such as dust and noise through the construction phase;
- the proposal contains suitable methodology for managing traffic movements, particularly during construction;
- the proposal contains suitable methodology for minimising the visual effect of the infrastructure (other than wind turbine generators) via new vegetation planting in appropriate locations;
- the proposal contains suitable methodology for minimising and managing impacts of EMI; and
- the proposal contains suitable methodology for managing fire risks.

5 Conclusion

This report has undertaken an assessment of the proposed development against the relevant provisions of the Planning and Design Code. Renewable energy facilities are an envisaged land use within the Rural Zone. The proposed Twin Creek Wind Farm and Energy Storage project adequately and appropriately addresses potential effects, particularly those associated with noise, protection of flora and fauna, European and Aboriginal heritage, and traffic movements in a manner sought by the Planning and Design Code.

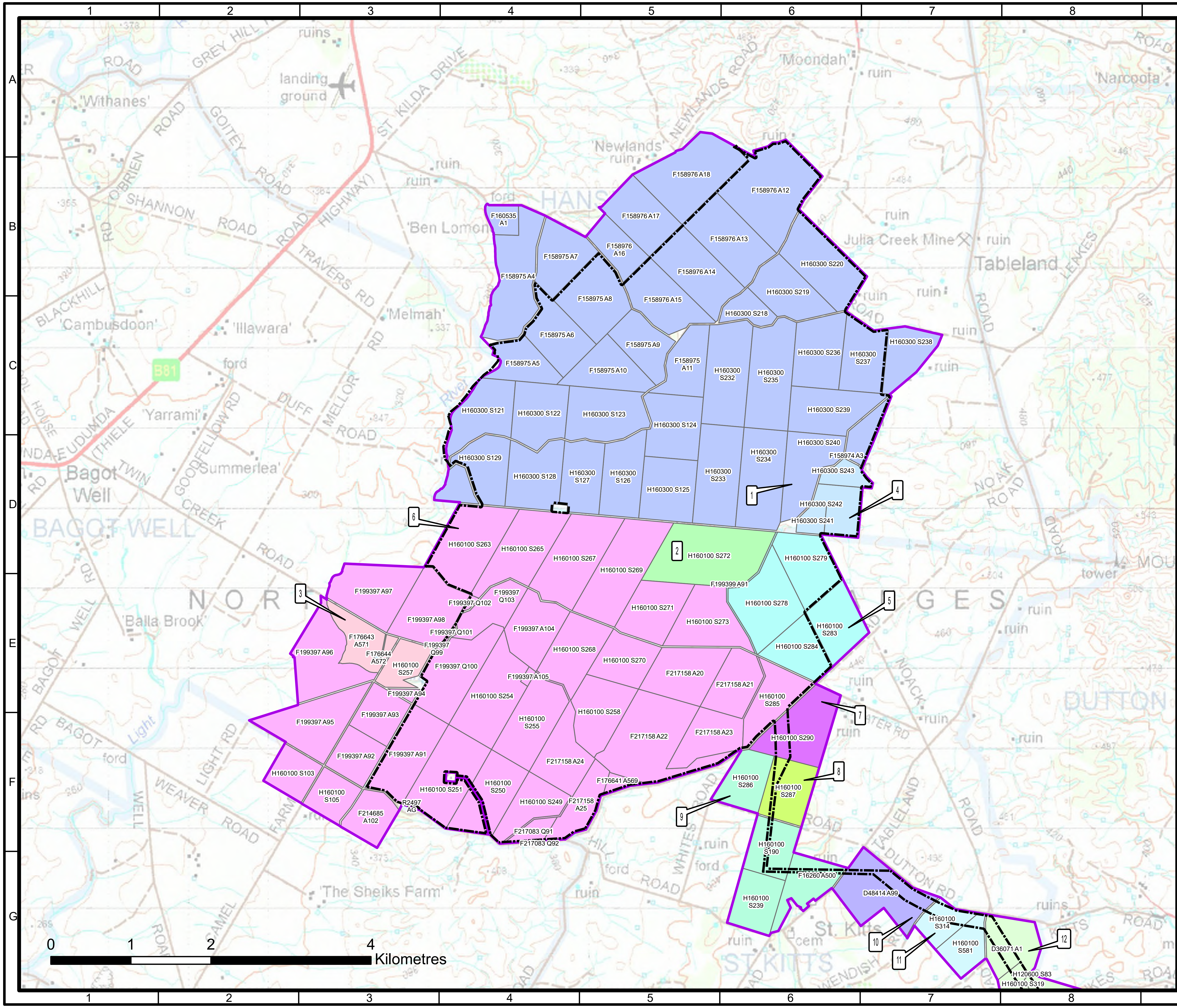
On balance, the proposed Twin Creek Wind Farm and Energy Storage project is a suitable form of development within the Rural Zone and applicable Overlays that suitably addresses potential effects, it is not seriously at variance with the Planning and Design Code and warrants the granting of development authorisation.

Julie Jansen RPIA(Fellow)
BA, BA(Hons), GDURP

Attachment A

Landownership Wind Farm and Grid Route

MASTERPLAN
TOWN + COUNTRY PLANNERS SINCE 1977



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TWIN CREEK WIND FARM

FIGURE 3

LANDOWNERSHIP WIND FARM

DEVELOPMENT AREA (2024)

SITE BOUNDARY (2024)

LANDOWNER

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The site of the development excludes road reserves. Access tracks within road reserves would be the subject of agreements with the affected Council, as required.

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LAYOUT DWG N/A | LAYOUT NO. N/A

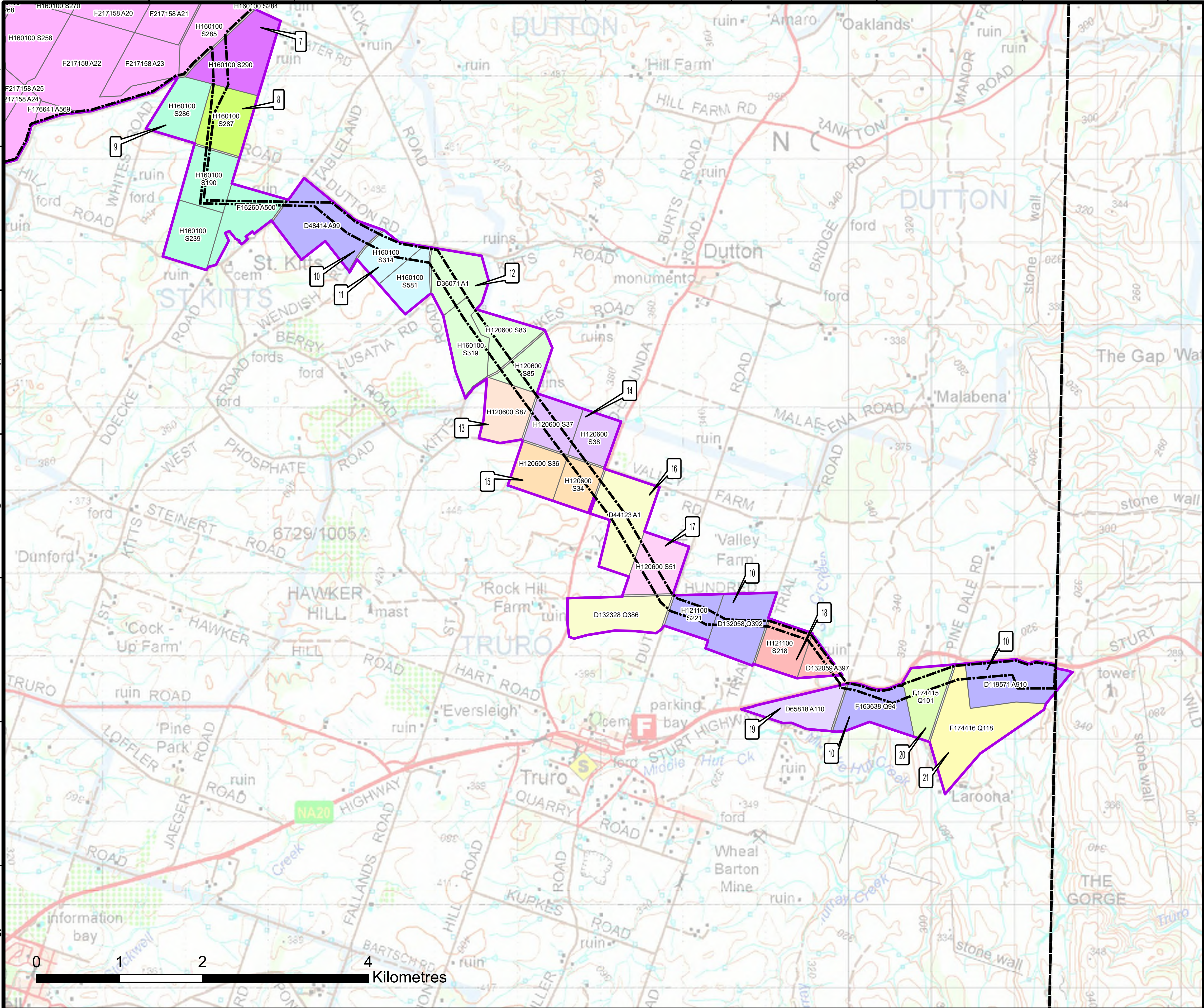
DRAWING NUMBER

03498-RES-PRO-DR-TE-001

SCALE - 1:45,000 @ A3

COORDS GDA 1994 MGA Zone 54

PLANNING APPLICATION



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TWIN CREEK WIND FARM

FIGURE 3

LANDOWNERSHIP GRID ROUTE

SOURCE DATA © GOVERNMENT OF SOUTH AUSTRALIA (DEPARTMENT FOR ENVIRONMENT & WATER).

DEVELOPMENT AREA (2024)

SITE BOUNDARY (2024)

275kV POWERLINE

LANDOWNER

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21

The site of the development excludes road reserves. Access tracks within road reserves would be the subject of agreements with the affected Council, as required.

Page 2 of 2

LAYOUT DWG N/A | LAYOUT NO. N/A

DRAWING NUMBER

03498-RES-PRO-DR-TE-001

SCALE - 1:45,000 @ A3

COORDS GDA 1994 MGA Zone 54

PLANNING APPLICATION

Wind farm and ancillary infrastructure land parcels

Allotment/ Section	Volume[11]	Folio	Number	Infrastructure	Local Government Area
A15	Vol 5293	Fol 926	F158976	T3 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
A12	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
A13	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
A14	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
A16	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
A17	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
A18	Vol 5293	Fol 926	F158976	No Infrastructure Planned	Regional Council Of Goyder
S220	Vol 5293	Fol 927	H160300	T1, T2 Hardstand, Access Track, Planning Corridor , Cables.	Regional Council Of Goyder
S219	Vol 5293	Fol 927	H160300	T30 Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S218	Vol 5293	Fol 927	H160300	Access Track, Planning Corridor, Cables	Regional Council Of Goyder
S236	Vol 5293	Fol 928	H160300	T6 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S237	Vol 5293	Fol 928	H160300	T7 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S239	Vol 5293	Fol 928	H160300	T11, T12 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S240	Vol 5293	Fol 928	H160300	T23 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S238	Vol 5293	Fol 928	H160300	No Infrastructure Planned	Regional Council Of Goyder
S122	Vol 5293	Fol 930	H160300	T13, T14 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S127	Vol 5293	Fol 930	H160300	T15, T20 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S124	Vol 5293	Fol 930	H160300	T16 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder

[11] All references Certificates of Title (CT) with Volume and Folio, unless otherwise stated. CR refers to Crown Record

Allotment/ Section	Volume[11]	Folio	Number	Infrastructure	Local Government Area
S128	Vol 5293	Fol 930	H160300	T19 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S125	Vol 5293	Fol 930	H160300	T21 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S126	Vol 5293	Fol 930	H160300	Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S123	Vol 5293	Fol 930	H160300	Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S121	Vol 5293	Fol 930	H160300	No Infrastructure Planned	Regional Council Of Goyder
S129	Vol 5293	Fol 930	H160300	No Infrastructure Planned	Regional Council Of Goyder
S232	Vol 5293	Fol 931	H160300	T4, T10 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S235	Vol 5293	Fol 931	H160300	T5 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S233	Vol 5293	Fol 931	H160300	T17, T22 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
S234	Vol 5293	Fol 931	H160300	T18 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
A3	Vol 5293	Fol 933	F158974	Access Track, Planning Corridor, Cables	Regional Council Of Goyder
A10	Vol 5293	Fol 934	F158975	T8 Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
A11	Vol 5293	Fol 934	F158975	T9 Hardstand, Access Track, Planning Corridor, Cables.	Regional Council Of Goyder
A4	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A5	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A6	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A7	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A8	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder
A9	Vol 5293	Fol 934	F158975	No Infrastructure Planned	Regional Council Of Goyder

Allotment/ Section	Volume[11]	Folio	Number	Infrastructure	Local Government Area
A104	Vol 5390	Fol 991	F199397	Access Track, Planning Corridor, Cables	Light Regional Council
A105	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A91	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
Q99	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
Q100	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
Q101	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
Q102	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
Q103	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A92	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A93	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A94	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A95	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A96	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A97	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
A98	Vol 5390	Fol 991	F199397	No Infrastructure Planned	Light Regional Council
S105	Vol 5531	Fol 405	H160100	No Infrastructure Planned	Light Regional Council
S103	Vol 5531	Fol 406	H160100	No Infrastructure Planned	Light Regional Council
S271	Vol 5618	Fol 687	H160100	T31, T32 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S284	Vol 5618	Fol 688	H160100	Access Track, Construction Compound And Material Laydown Area, Planning Corridor, 275kv Line, Cables	Light Regional Council
S283	Vol 5618	Fol 688	H160100	No Infrastructure Planned	Regional Council Of Goyder
S272	Vol 5618	Fol 689	H160100	T28, T29 Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
S249	Vol 5618	Fol 690	H60100	No Infrastructure Planned	Light Regional Council

Allotment/ Section	Volume[11]	Folio	Number	Infrastructure	Local Government Area
S285	Vol 5618	Fol 691	H160100	Access Track, Site Entrance, Planning Corridor, 275kv Line, Cables.	Light Regional Council
S273	Vol 5618	Fol 692	H160100	T33 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S278	Vol 5618	Fol 693	H160100	Access Track, Battery Energy Storage Facility, Concrete Batching Plant Area, Operation And Maintenance Facilitiesm 33kv/275kv Substation, Planning Corridor, 275kv Line, Cables	Light Regional Council
S255	Vol 5618	Fol 694	H160100	T39 Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
S250	Vol 5618	Fol 694	H160100	No Infrastructure Planned	Light Regional Council
S251	Vol 5618	Fol 694	H160100	No Infrastructure Planned	Light Regional Council
S254	Vol 5618	Fol 694	H160100	No Infrastructure Planned	Light Regional Council
Ag	Vol 5618	Fol 694	R2497	No Infrastructure Planned	Light Regional Council
S263	Vol 5618	Fol 695	H160100	T24 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S265	Vol 5618	Fol 696	H160100	T25 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S269	Vol 5618	Fol 697	H160100	T27 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S279	Vol 5618	Fol 698	H160100	No Infrastructure Planned	Light Regional Council
S258	Vol 5618	Fol 699	H160100	T40 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S270	Vol 5618	Fol 700	H160100	T35 Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
S267	Vol 5618	Fol 701	H160100	T26 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
S257	Vol 5618	Fol 702	H160100	No Infrastructure Planned	Light Regional Council
S268	Vol 5618	Fol 703	H160100	T34 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
Q91	Vol 5618	Fol 704	F217083	No Infrastructure Planned	Light Regional Council

Allotment/ Section	Volume[11]	Folio	Number	Infrastructure	Local Government Area
Q92	Vol 5618	Fol 704	F217083	No Infrastructure Planned	Light Regional Council
A569	Vol 5618	Fol 705	F176641	No Infrastructure Planned	Light Regional Council
A91	Vol 5618	Fol 706	F199399	Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
A102	Vol 5618	Fol 707	F214685	No Infrastructure Planned	Light Regional Council
A571	Vol 5618	Fol 708	F176643	No Infrastructure Planned	Light Regional Council
A20	Vol 5625	Fol 166	F217158	T36, S37 Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
A23	Vol 5625	Fol 166	F217158	T38 Hardstand, Access Track, Planning Corridor, Cables.	Light Regional Council
A22	Vol 5625	Fol 166	F217158	T41 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
A24	Vol 5625	Fol 166	F217158	T42 Hardstand, Access Track, Planning Corridor, Cables	Light Regional Council
A21	Vol 5625	Fol 166	F217158	Access Track, Planning Corridor, Cables	Light Regional Council
A25	Vol 5625	Fol 166	F217158	No Infrastructure Planned	Light Regional Council
A572	Vol 5826	Fol 797	F176644	No Infrastructure Planned	Light Regional Council
A1	Vol 5878	Fol 290	F160535	No Infrastructure Planned	Regional Council Of Goyder
S241	Vol 5964	Fol 335	H160300	No Infrastructure Planned	Regional Council Of Goyder
S242	Vol 5964	Fol 335	H160300	Access Track, Planning Corridor, Cables	Regional Council Of Goyder
S243	Vol 5964	Fol 335	H160300	Access Track, Planning Corridor, Cables	Regional Council Of Goyder

Grid connection infrastructure land parcels

Allotment/ Section	Volume	Folio	Number	Infrastructure	Local Government Area
S581	Vol 5146	Fol 519	H160100	275kv Overhead Line	Light Regional Council
S290	Vol 5264	Fol 963	H160100	275kv Overhead Line	Light Regional Council
S314	Vol 5274	Fol 160	H160100	275kv Overhead Line	Light Regional Council
Q94	Vol 5304	Fol 717	F163638	275kv Overhead Line	Mid Murray Council
S221	Vol 5315	Fol 264	H121100	275kv Overhead Line	Mid Murray Council
A1	Vol 5322	Fol 638	D44123	275kv Overhead Line	Mid Murray Council
Q101	Vol 5360	Fol 970	F174415	275kv Overhead Line	Mid Murray Council
S87	Vol 5460	Fol 955	H120600	275kv Overhead Line	Mid Murray Council
S190	Vol 5476	Fol 305	H160100	275kv Overhead Line	Light Regional Council
A500	Vol 5485	Fol 289	F16260	275kv Overhead Line	Light Regional Council
S38	Vol 5485	Fol 579	H120600	275kv Overhead Line	Mid Murray Council
S36	Vol 5485	Fol 733	H120600	275kv Overhead Line	Mid Murray Council
A99	Vol 5486	Fol 561	D48414	275kv Overhead Line	Light Regional Council
S34	Vol 5503	Fol 860	H120600	275kv Overhead Line	Mid Murray Council
S37	Vol 5517	Fol 458	H120600	275kv Overhead Line	Mid Murray Council
S286	Vol 5552	Fol 876	H160100	No Infrastructure Planned	Light Regional Council
S239	Vol 5569	Fol 233	H160100	No Infrastructure Planned	Light Regional Council
S83	Vol 5616	Fol 778	H120600	275kv Overhead Line	Mid Murray Council
S85	Vol 5616	Fol 778	H120600	275kv Overhead Line	Mid Murray Council
S319	Vol 5616	Fol 778	H160100	275kv Overhead Line	Light Regional Council
S287	Vol 5663	Fol 19	H160100	275kv Overhead Line	Light Regional Council
S51	Vol 5812	Fol 749	H120600	275kv Overhead Line	Mid Murray Council
A110	Vol 5947	Fol 941	D65818	275kv Overhead Line	Mid Murray Council
S218	Vol 5950	Fol 567	H121100	275kv Overhead Line	Mid Murray Council

Allotment/ Section	Volume	Folio	Number	Infrastructure	Local Government Area
A1	Vol 6124	Fol 753	D36071	275kv Overhead Line	Light Regional Council
Q118	Vol 6157	Fol 823	F174416	275kv Overhead Line	Mid Murray Council
A910	Vol 6221	Fol 131	D119571	275kv Overhead Line Terminal Substation, Access Track, Vegetative Screening, Electrical Infrastructure	Mid Murray Council
A397	Vol 6288	Fol 554	D132059	275kv Overhead Line	Mid Murray Council
Q392	Vol 6288	Fol 558	D132058	275kv Overhead Line	Mid Murray Council
Q386	Vol 6290	Fol 429	D132328	275kv Overhead Line	Mid Murray Council

Attachment B

Project Land Parcels and Planning and Design Code Zone and Overlays

MASTERPLAN
TOWN + COUNTRY PLANNERS SINCE 1977

Project Land Parcels and Planning and Design Code Zone and Overlays

Table 1: Wind Farm Land Parcels and Infrastructure

Allotment - Section	Certificate Of Title[1]	Address	Zone	Overlays						
				Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency
S220	VOL 5293 FOL 927 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A15	VOL 5293 FOL 926 F158976	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S232	VOL 5293 FOL 931 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S235	VOL 5293 FOL 931 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S236	VOL 5293 FOL 928 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S237	VOL 5293 FOL 928 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A10	VOL 5293 FOL 934 F158975	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A11	VOL 5293 FOL 934 F158975	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S239	VOL 5293 FOL 928 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S122	VOL 5293 FOL 930 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			

[1] Vol and Fol refer to 'Volume' and 'Folio' in a Certificate of Title (CT)

Allotment - Section	Certificate Of Title[1]	Address	Zone	Overlays						
				Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency
S127	VOL 5293 FOL 930 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S124	VOL 5293 FOL 930 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S233	VOL 5293 FOL 931 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S234	VOL 5293 FOL 931 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S128	VOL 5293 FOL 930 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S125	VOL 5293 FOL 930 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S126	VOL 5293 FOL 930 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S123	VOL 5293 FOL 930 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S219	VOL 5293 FOL 927 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S240	VOL 5293 FOL 928 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S263	VOL 5618 FOL 695 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S265	VOL 5618 FOL 696 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X

Allotment - Section	Certificate Of Title[1]	Address	Zone	Overlays						
				Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency
S267	VOL 5618 FOL 701 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S269	VOL 5618 FOL 697 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S272	VOL 5618 FOL 689 H160100	Lot 272 Mosey Road, Bagot Well	Rural	X	X	X		X	X	
S249	VOL 5618 FOL690 H60100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
A104	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
A105	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
A91	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
Q99	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
Q100	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
Q101	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
Q102	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
Q103	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	

Allotment - Section	Certificate Of Title[1]	Address	Zone	Overlays						
				Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency
S271	VOL 5618 FOL 687 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S273	VOL 5618 FOL 692 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S268	VOL 5618 FOL 703 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
Q91	VOL 5618 FOL 704 F217083	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
Q92	VOL 5618 FOL 704 F217083	Lot 258 Mosey Road, St Kitts	Rural	x	x	x		x	x	x
A569	VOL 5618 FOL 705 F176641	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S270	VOL 5618 FOL 700 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
A20	VOL 5625 FOL 166 F217158	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
A23	VOL 5625 FOL 166 F217158	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S255	VOL 5618 FOL 694 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S250	VOL 5618 FOL 694 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S251	VOL 5618 FOL 694 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X

Allotment - Section	Certificate Of Title[1]	Address	Zone	Overlays						
				Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency
S254	VOL 5618 FOL 694 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S258	VOL 5618 FOL 699 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
A22	VOL 5625 FOL 166 F217158	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
A24	VOL 5625 FOL 166 F217158	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
A21	VOL 5625 FOL 166 F217158	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
A25	VOL 5625 FOL 166 F217158	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S278	VOL 5618 FOL 693 H160100	Lot 91 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S279	VOL 5618 FOL 698 H160100	Lot 91 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S284	VOL 5618 FOL 688 H160100	Lot 91 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S285	VOL 5618 FOL 691 H160100	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
S283	VOL 5618 FOL 688 H160100	Lot 91 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
A1	VOL 5878 FOL 290 F160535	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			

Allotment - Section	Certificate Of Title[1]	Address	Zone	Overlays						
				Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency
A3	VOL 5293 FOL 933 F158974	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A4	VOL 5293 FOL 934 F158975	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A5	VOL 5293 FOL 934 F158975	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A6	VOL 5293 FOL 934 F158975	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A7	VOL 5293 FOL 934 F158975	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A8	VOL 5293 FOL 934 F158975	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A9	VOL 5293 FOL 934 F158975	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A12	VOL 5293 FOL 926 F158976	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A13	VOL 5293 FOL 926 F158976	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A14	VOL 5293 FOL 926 F158976	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A16	VOL 5293 FOL 926 F158976	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
A17	VOL 5293 FOL 926 F158976	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			

Allotment - Section	Certificate Of Title[1]	Address	Zone	Overlays						
				Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency
A18	VOL 5293 FOL 926 F158976	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S121	VOL 5293 FOL 930 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S129	VOL 5293 FOL 930 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S218	VOL 5293 FOL 927 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S241	VOL 5964 FOL 335 H160300	Lot 241 Noak Road, Hansborough	Rural	X	X	X	X			
S242	VOL 5964 FOL 335 H160300	Lot 241 Noak Road, Hansborough	Rural	X	X	X	X			
S243	VOL 5964 FOL 335 H160300	Lot 241 Noak Road, Hansborough	Rural	X	X	X	X			
S238	VOL 5293 FOL 928 H160300	178 Ben Lomond Road, Hansborough	Rural	X	X	X	X			
S257	VOL 5618 FOL 702 H160100	346B Twin Creek Road, Bagot Well	Rural	X	X	X		X	X	
A92	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
A93	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
A94	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	

Allotment - Section	Certificate Of Title[1]	Address	Zone	Overlays						
				Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency
A95	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
A96	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
A97	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
A98	VOL 5390 FOL 991 F199397	Lot 91 Flagstaff Hill Road, Bagot Well	Rural	X	X	X		X	X	
A571	VOL 5618 FOL 708 F176643	346B Twin Creek Road, Bagot Well	Rural	X	X	X		X	X	
A572	VOL 5826 FOL 797 F176644	346A Twin Creek Road, Bagot Well	Rural		X	X		X	X	
A102	VOL 5618 FOL 707 F214685	Lot 100 Camel Farm Road, Koonunga	Rural	X	X	X		X	X	
S103	VOL 5531 FOL 406 H160100	Lot 100 Camel Farm Road, Koonunga	Rural	X	X	X		X	X	
S105	VOL 5531 FOL 405 H160100	Lot 100 Camel Farm Road, Koonunga	Rural	X	X	X		X	X	
AG	VOL 5618 FOL 694 R2497	Lot 258 Mosey Road, St Kitts	Rural	X	X	X		X	X	X
A91	VOL 5618 FOL 706 F199399	Lot 91 Mosey Road, St Kitts	Rural	X	X	X		X	X	X

Table 2: Grid Connection Land Parcels and Infrastructure

Allotment - Section	Certificate Of Title	Zone	Overlays													
			Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency	Local Heritage Place	Dwelling Excision	Limited Land Division	Murray-Darling Basin	Key Outback and Rural Routes	Resource Extraction Protection Area	State Heritage Place
S290	VOL 5264 FOL 963 H160100	Rural	X	X	X		X	X	X	18224						
S286	VOL 5552 FOL 876 H160100	Rural	X	X	X		X	X								
S287	VOL 5663 FOL 19 H160100	Rural	X	X	X		X	X	X							
S190	VOL 5476 FOL 305 H160100	Rural	X	X	X		X	X	X							
S239	VOL 5569 FOL 233 H160100	Rural	X	x	X		X	x								
A500	VOL 5485 FOL 289 F16260	Rural	X	X	X		X	X	X							
A99	VOL 5486 FOL 561 D48414	Rural	X	X	X		X	X	X							
S314	VOL 5274 FOL 160 H160100	Rural	X	X	X		X	X	X							
S581	VOL 5146 FOL 519 H160100	Rural	X	X	X		X	X	X							
A1	VOL 6124 FOL 753 D36071	Rural	X	X	X		X	X			X	X	X			
S319	VOL 5616 FOL 778 H160100	Rural	X	X	X		X				X	X	X			

Allotment - Section	Certificate Of Title	Zone	Overlays													
			Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency	Local Heritage Place	Dwelling Excision	Limited Land Division	Murray-Darling Basin	Key Outback and Rural Routes	Resource Extraction Protection Area	State Heritage Place
S83	VOL 5616 FOL 778 H120600	Rural	X	X	X		X				X	X	X			
S85	VOL 5616 FOL 778 H120600	Rural	X	X	X		X	X			X	X	X			
S87	VOL 5460 FOL 955 H120600	Rural	X	X	X		X				X	X	X			
S37	VOL 5517 FOL 458 H120600	Rural	X	X	X		X				X	X	X			
S38	VOL 5485 FOL 579 H120600	Rural	X	X	X		X				X	X	X			
S36	VOL 5485 FOL 733 H120600	Rural	X	X	X		X				X	X	X			
S34	VOL 5503 FOL 860 H120600	Rural	X	X	X		X				X	X	X			
A1	VOL 5322 FOL 638 D44123	Rural	X	X	X		X				X	X	X			
S51	VOL 5812 FOL 749 H120600	Rural	X	X	X		X				X	X	X			
Q386	VOL 6290 FOL 429 D132328	Rural	X	X	X		X				X	X	X			
S221	VOL 5315 FOL 264 H121100	Rural	X	X	X		X				X	X	X			
Q392	VOL 6288 FOL 558 D132058	Rural	X	X	X		X				X	X	X	X		

Allotment - Section	Certificate Of Title	Zone	Overlays													
			Water Resources	Native Vegetation	Hazards (Flooding – Evidence Required)	Hazards (Bushfire – Regional)	Hazards (Bushfire – General)	Environment and Food Production Area	Heritage Adjacency	Local Heritage Place	Dwelling Excision	Limited Land Division	Murray-Darling Basin	Key Outback and Rural Routes	Resource Extraction Protection Area	State Heritage Place
S218	VOL 5950 FOL 567 H121100	Rural	X	X	X		X				X	X	X			
A397	VOL 6288 FOL 554 D132059	Rural	X	X	X		X				X	X	X	X		
A110	VOL 5947 FOL 941 D65818	Rural	X	X	X		X				X	X	X	X		
Q94	VOL 5304 FOL 717 F163638	Rural	X	X	X		X				X	X	X	X		
Q95	VOL 5304 FOL 717 F163638	Rural	X	X	X		X				X	X	X	x		
Q101	VOL 5360 FOL 970 F174415	Rural	X	X	X		X				X	X	X	X		
Q118	VOL 6157 FOL 823 F174416	Rural	X	X	X		X		X		X	X	X	X	X	16304
A910	VOL 6221 FOL 131 D119571	Rural	X	X	X		X				X	X	X	X	X	

Note: Zones and Overlays as obtained from SAPPA for Planning and Design Code

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Socio Economic Impact Assessment

by Hudson Howells

hudson howells

strategic management consultants

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RES Australia Pty Ltd

Twin Creek Wind Farm Socio-Economic Impact Assessment

Updated September 2023

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EXECUTIVE SUMMARY

This socio-economic impact assessment focuses on the effect of the Twin Creek Wind Farm Project on regional incomes and employment associated with the construction and operating phases of the project. This effect arises through the primary expenditure directly associated with the project, and then from further 'rounds' of indirect expenditure that this direct expenditure stimulates as it flows to supplying industries and into incomes and consumption.

The economic modelling for the project has been undertaken using indicative assumptions with respect to labour supply. The commitment of the project developers is that there will be prioritisation of local contractors wherever possible, but the modelling assumes that the wind turbine generators are imported from interstate or overseas, and the major local impact is based on transport and assembly.

From a **State perspective**, economic modelling indicates that the project will generate $662 million of value added (which is a net contribution to Gross State Product[1]) in the State of South Australia over the period of construction and that this would happen over two years (allowing for lagged flow through effects). 3,178 person years[2] of employment in South Australia would be supported – or an average of over 1,589[3] jobs sustained per year over two years. Once operational the project is estimated to support annually $20.7 million of value added in South Australia, and support directly and indirectly in the order of 91 jobs per year. The impact at the national level would be similar to the state level, unless there are constraints in national labour and capital markets with such constraints likely to be limited in the current macroeconomic environment.

From a **regional perspective**[4], the modelling indicates that the project will generate $285 million of value added (contribution to Gross Regional Product) in the region (Barossa and Lower North) over the period of construction and, again allowing for lagged flow through effects, this would happen over two years. 1,652 person years of employment would be supported, or an average of 826 jobs sustained per year over two years. Once operational the project is estimated to support annually $11.2 million of value added in the region, and support directly and indirectly (including the multiplier impact) approximately 63 jobs per year.

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[1] Value added is the way in which economic activity is measured in the National Accounting system. At the national level this is equivalent to Gross Domestic Product (GDP) and is made up of returns to labour (wages and salary and taxes on labour) and returns to capital (gross operating surplus (or profits plus depreciation and financing costs) and company tax and GST). At the state level, the national accounts call this amount the Gross State Product.

[2] i.e. the number of full time equivalent annual jobs created over the period.

[3] 1,474÷3

[4] Regional in this context is defined as the ABS regions of the Barossa and Lower North.

From a **local perspective**[5], based on the assumptions used (which involve the project drawing labour from both the Goyder and Light areas) the modelling indicates that the project will generate:

- $85 million of value added (contribution to Gross Regional Product) in the LGA of Goyder over the period of construction and, again allowing for lagged flow through effects, this would happen over two years. 511 person years of employment for local residents would be supported, or an average of 255 jobs sustained per year over two years. Once operational the project is estimated to support annually $4.1 million of value added in the region, and support directly and indirectly (including the induced impact) approximately 24 jobs per year.

- $92 million of value added (contribution to Gross Regional Product) in the LGA of Light over the period of construction over two years. 552 person years of employment for local residents would be supported, or an average of 276 jobs sustained per year over two years. Once operational the project is estimated to support annually $4.0 million of value added in the region, and support directly and indirectly (including the multiplier impact) approximately 23 jobs per year.

The above economic modelling results are summarised in the following tables:

2 Year Construction Impacts

Contribution to GRP - South Australia	Employment Impact - South Australia	Contribution to GRP - Lower North & Barossa	Employment Impact - Region of Lower North & Barossa	Contribution to GRP - Goyder LGA	Employment Impact - Goyder LGA	Contribution to GRP - Light LGA	Employment Impact - Light LGA
$661.9 million	3178; or 1589 per annum	$284.7 million	1652; or 826 per annum	$85.2 million	511; or 255 per annum	$92.4 million	552; or 276 per annum

Note – GSP is Gross State Product, GRP is Gross Regional Product, and jobs are in FTE's or person years.

Annual Operational Impacts

Contribution to GRP - South Australia	Employment Impact - South Australia	Contribution to GRP - Lower North & Barossa	Employment Impact - Region of Lower North & Barossa	Contribution to GRP - Goyder LGA	Employment Impact - Goyder LGA	Contribution to GRP - Light LGA	Employment Impact - Light LGA
$20.7 million	92 per annum	$11.2 million	63 per annum	$4.1 million	24 per annum	$4 million	23 per annum

[5] Local in this context is the LGA's of Goyder and Light.

These outcomes are based on assumed levels of local supply, and where more of the activity can be retained in the region (while acknowledging the specialist nature of the construction itself), the more extensive the degree of regional economic activity.

Wind farms can have other positive and negative socio-economic impacts depending on a variety of factors and the specific communities being impacted by the developments. For example, farmers hosting turbines may receive positive financial benefits while other communities might be subject to visual impacts from windfarm infrastructure with no financial benefits. In addition to employment and income generation, property values and carbon emissions are socio-economic externalities of wind farms.

In relation to property values, many studies[6] (with most of the work in this area done in the period 2005-2015) by independent organisations around the world have failed to find any correlation between wind turbines and declining property values. Some studies have found positive property value impacts associated with:

- Improved regional amenities and infrastructure including local roads, firefighting access roads, etc.
- Increased regional incomes, jobs and property demand (as assessed above).
- Additional rental income from hosting wind turbine generators.
- Provision of a drought-proofing income streams.
- Provision of post-retirement income for farmers.
- Improved biodiversity via less intensive farm activity.
- Prevention of land subdivision and slowing down the process of productive agricultural land changing to rural residential uses in the short to medium term with the shift caused by the additional income generated from the wind farm providing additional cash streams to underpin agricultural use.
- Erosion control and passive wind protection for stock from sub stations and turbine wind turbine generators structures.

6 For example, the Lawrence Berkeley Study, United States, States http://eetd.lbl.gov/ea/ems/reports/lbnl-2829e.pdf, reported in Wind Energy the Facts, Clean Energy Council, March 2013

There will be localised positive and negative impacts associated with wind farms depending on individual property locations. Some may appreciate faster than market trends due to improved farm incomes from hosting wind turbine generators and improved access to infrastructure. Some may fail to keep pace with market trends due to visual and noise impacts. Potential disruption during wind turbine generator assembly and infrastructure establishment is also noted. However, the evidence supports no overall long term negative impact on property values associated with wind farm developments.

Finally, renewable wind energy generation has significant environmental benefits through **carbon emissions reduction** where it replaces coal or gas generated electricity.

It is assumed that the Twin Creek Wind Farm will have the following operating characteristics:

- Total wind farm nominal capacity of up to 270 megawatts.
- Annual average utilisation rate of 38.7% capacity factor/utilisation[7].
- Total generation of approximately 1,025.93 Gigawatt hours (Gwh) per annum.

It is conservatively assumed that when electricity is generated through coal fired stations, it produces 0.8 tonnes of carbon per megawatt hour[8] of electricity generated. So the generation of 1,025.93 Gwh per annum through coal generation would produce in the order of 0.82 million tonnes of carbon emissions. At a carbon price of $40 per tonne (the minimum that policy frameworks consider necessary to meet carbon reduction targets though above current prices in trading schemes[9]), the value of carbon emission savings associated with the Twin Creek Wind Farm is estimated to be $32.8 million per annum or a net present value of $347.5 million over a 20 year period (discount rate of 7% real).

[7] Defined as the actual output of the project relative to its maximum possible output.
[8] Annual carbon emissions from the National Electricity Market were down in 2021 by 4.2% by 7.0 Megatonne of CO_2-e (down to 160.4 for the year and there has been over a 50% decline over the last decade (https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-gas-inventory-quarterly-update-december-2021). Carbon pollution per megawatt-hour has also fallen: down to 0.53 tonnes per megawatt hour, However these reductions are a consequence of the shift towards renewables, and as such coal generated power will be higher than this average.
[9] It is estimated that prices of $40-80 per metric ton of carbon dioxide emitted are needed to keep global warming within a 2-point degree, as provided by the Paris agreement. Higher prices again will be required to achieve global emission targets. However current prices as identified in carbon taxes or carbon trading schemes are well below that level. A critical factor in policy frameworks will be achieving the higher levels of price and a pertinent issue in this context is the recent announcement by the Prime Minister in Germany of Australia becoming a member of the Carbon Club (who have an agenda around carbon prices).

1 INTRODUCTION

RES Australia Pty Ltd (RES Australia) proposes to develop the Twin Creek Wind Farm within the Mid North area of South Australia. The site of the proposed wind farm is approximately 90km north east of Adelaide and north east of Kapunda. The site is located about 10km northeast of Kapunda, accessed via Twin Creek Road. In addition to employment and income generation, property values and carbon emissions are socio-economic externalities of wind farms.

RES is one of the world's leading independent renewable energy companies, with the expertise to develop, engineer, construct, finance, and operate projects around the globe. RES Australia has been developing renewable energy projects in Australia since 2004.

The proposed wind farm will consist of the following components:

- Up to 42 Wind Turbines Generators (WTG).
- Each WTG has a name-plate capacity up to 7.2 Megawatts (MW), with a total installed nominal capacity up to 270MW.
- Overall height of turbines would be up to 220 metres at the blade tip, a hub height of up to 134m and a rotor diameter of up to 172m.
- Associated hard standing areas and access roads.
- Operations and maintenance building with associated car parking.
- Two electrical substations - one project substation within the windfarm boundary and one cut-in terminal substation.
- A battery energy storage facility with an indicative capacity of 215MW
- Overhead and underground electrical cable reticulation.
- Overhead transmission line for approximately 15 kilometres from the on-site substation to the existing overhead Robertstown - Tungkillo transmission line east of Truro.
- Meteorological masts for measuring wind speed and other climatic conditions.

- Temporary construction facilities including a borrow pit and concrete batching plant facilities.

Hudson Howells has been engaged by RES Australia to undertake a Socio-Economic Impact Assessment on the project in terms of economic benefits to South Australia and the local region (i.e. the Light Regional Council and Regional Council of Goyder). This report contains the following key assessments:

- A Regional Baseline Assessment that details the socio-economic environment of the region for both the Light Regional Council and Regional Council of Goyder. It is recognised that transmission lines will travel through the Mid Murray Council region (to Truro) but there will be little socio economic impact on this region.

- An economic assessment of the Twin Creek Wind Farm Project in terms of economic benefits to local communities of Goyder and Light, the broader region of Barossa and Lower North (ABS regions) and also to the state of South Australia.

- An assessment of the associated benefits of offsetting carbon by displacing the need for further non-renewable generation development, such as coal or gas fired power stations.

In addition to the above, consideration is given in this assessment to the potential impact of the project on local property values.

2 REGIONAL BASELINE ASSESSMENT - LIGHT

2.1 LOCATIONAL ANALYSIS

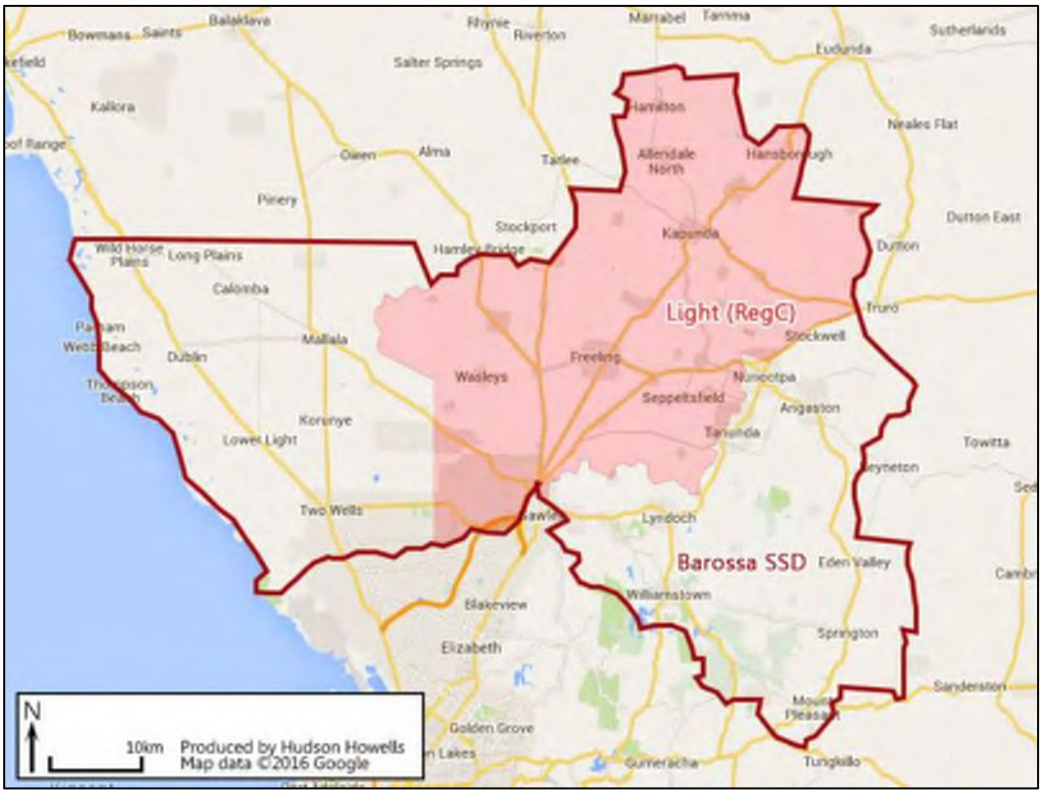
The information contained in this section has been sourced from publicly available data with relevant sources noted and includes:

- A brief description of the Light Regional Council.
- An overview of population growth in the Light Regional Council Local Government Area (LGA), including forecast future growth in population in the region.
- An analysis of socio-demographics of the Light LGA population.
- A brief analysis of internal population migration into and out of the Light LGA.
- An analysis of employment trends in Light LGA, including the growth in employment, using the latest 2021 Census data.
- An analysis of businesses within the Light LGA by industry, including size and turnover.

The Light Regional Council is located within the Barossa Statistical Area Level 3 (Barossa SA3 as defined in ABS data) and is located north-east of the Adelaide metropolitan area, stretching between The Barossa Council to the east and the Adelaide Plains Council to the west. The Barossa SA3 forms the northern section of the Outer Adelaide Statistical Division, which is included within the Greater Adelaide region. The Council contains the townships of Kapunda, Greenock, Freeling, Wasleys and Roseworthy, and the suburb of Hewett. The region mixes a rich mining heritage with farming, with the benefits of the Barossa Valley. Map 2.1 illustrates the Council's boundary in relation to the surrounding councils.

The Sturt Highway and Barrier Highway are the key transport routes through the region, providing regional access from Adelaide, and further to regional New South Wales and Victoria. Main roads provide access to regional towns within the Council and alternative routes to other major regional towns throughout the State.

Map 2.1 – Light Regional Council



2.2 POPULATION AND DEMOGRAPHICS

2.2.1 Historical Population

Historical Estimated Resident Population (ERP) figures are released annually by the Australian Bureau of Statistics (ABS). Table 2.2 compares the historical population levels of Light LGA in comparison with the Northern Plains and Barossa region, Greater Adelaide and South Australia. The Northern Plains and Barossa region (as defined by the Department of Transport and Infrastructure, SA) comprises the Local Government Areas of Light, Barossa, and Adelaide Plains. Key points to note from Table 2.2 include:

- Light LGA population increased by over 2,300 people between 2011 and 2022. This represented average growth of 1.5% per annum, which exceeded the average South Australian population growth of 1.0% per annum over the same period.

- Historically, around 40% of the Northern Plains and Barossa region resided within the Light LGA.

- Current population of Light LGA is estimated at around 16,330 people.

Table 2.2 –Estimated Resident Population, 2011 – 2022

	Light LGA	Northern Plains & Barossa	Greater Adelaide	South Australia
2011	13,984	33,715	1,264,091	1,639,614
2016	15,048	36,424	1,324,057	1,712,673
2021	16,083	38,797	1,515,491	1,803,192
2022	16,332	39,376	1,534,333	1,823,954
Av. Annual Change (%)				
2011-2016	1.5%	1.6%	1.0%	0.9%
2016-2021	1.4%	1.3%	2.9%	1.1%
2021-2022	1.5%	1.5%	1.2%	1.2%
2011 – 2022	1.5%	1.5%	1.9%	1.0%

Source: Australian Bureau of Statistics, Regional Population Growth, Australia, Cat. No. 3218.0. Department for Trade and Investment, Government of South Australia 2023 Population Projections for South Australia and Population Projection Regions, 2021-51, June 2023

2.2.2 Forecast Population

Table 2.3 provides population forecast comparisons for Light LGA, the Northern Plains and Barossa region, Greater Adelaide and South Australia from 2021 to 2036. Population forecasts are as presented in the Department of Planning Transport and Infrastructure (DPTI) Population Projection reports for Local Government Areas (2016 – 2036) and South Australia and its Regions (2021-2051). All regions as listed in Table 2.3 are projected to increase by over 1% in the period between 2021 – 2036.

Table 2.3 –Estimated Resident Population, 2021 – 2036

	Light LGA	Northern Plains & Barossa	Greater Adelaide	South Australia
2021 ERP	16,083	38,797	1,515,491	1,803,192
2026	17,004	41,444	1,613,797	1,909,398
2031	18,161	44,261	1,699,895	2,001,612
2036	19,276	47,536	1,781,920	2,090,042
Av. Annual Change (%)				
2021-2026	1.1%	1.4%	1.3%	1.2%
2026-2031	1.4%	1.4%	1.1%	1.0%
2031-2036	1.2%	1.5%	1.0%	0.9%
2021-2036	1.3%	1.5%	1.2%	1.1%

Source: Department of Planning, Transport and Infrastructure, Government of South Australia, Population Projections for South Australian Local Government Areas, 2016-2036, December 2019 release. Department for Trade and Investment, Government of South Australia 2023 Population Projections for South Australia and Population Projection Regions, 2021-2051, June 2023

Future population growth for Light LGA is projected to increase to nearly 19,300 people by 2036, representing a net increase of over 3,100 people from 2021, or an average increase of 1.3% per annum over the 15-year period. In comparison, the Northern Plains and Barossa region is forecast to have a slightly higher population growth of 1.5% per annum between 2021 and 2036, whereas South Australia is forecast to increase by an average of 1.1% per annum.

2.2.3 Socio-demographic Profile

Key socio-demographic characteristics of the Light LGA from the 2021 Census are provided in Table 2.4, with the main features as follows:

- The average age distribution of Light LGA residents indicates a younger family profile, with 20% of the population aged under 15 years, and an average age of 40 years. In comparison, Barossa SA3 residents have an average age of 44 years which is more than the South Australian average of 41 years.

- Average weekly per capita income of Light LGA residents is 5% above the South Australian average whereas the Barossa SA3 average is only 0.5% above the State average.

- Average weekly household income is 22% above the South Australian average.

- Average household size is higher than the South Australian average of 2.4 people, reflecting the younger family profile of the region.

- House ownership within the Light LGA is higher when compared to both Barossa SA3 and South Australia (87% compared to 83% and 71% respectively). Median monthly mortgage payments are equivalent to the South Australian median of $1,500.

- Car ownership in the Light LGA is 6% higher than the South Australian average of 93% of households owning one or more cars, reflecting the regional location.

Table 2.4 – Light LGA Socio-Economic Characteristics, 2021

	Light LGA	Barossa SA3	Greater Adelaide	South Australia
Age Distribution:				
0 - 14 years	20.1%	18.2%	17.1%	17.0%
15 - 24 years	13.1%	10.7%	12.2%	11.7%
25 - 44 years	22.1%	21.9%	27.3%	25.9%
45 - 64 years	29.1%	28.2%	24.7%	25.4%
65+ years	15.6%	21.0%	18.7%	20.0%
Median Age	40	44	39	41
Dependency Ratio[1]	35.7%	39.2%	35.8%	37.0%
Av. Weekly Per Capita Income	$770	$738	$762	$734
Per Capita Income Var.[2]	5%	0.5%	4%	
Household Income:				
$0 - $33,799	13.8%	17.6%	18.3%	19.6%
$33,800 - $77,999	29.3%	33.1%	30.5%	31.9%
$78,000 - $155,999	36.7%	32.8%	31.8%	30.8%
$156,000+	20.2%	16.5%	19.4%	17.7%
Av. Weekly Household Income	$1,781	$1,479	$1,548	$1,455
Household Income Var.[2]	22%	2%	6%	
Av. Household Size	2.8	2.5	2.5	2.4
Housing Status:				
Owner/purchaser[3]	87.1%	83.0%	70.5%	71.3%
Renter	12.9%	17.0%	29.5%	28.7%
Median Monthly Mortgage	$1,500	$1,400	$1,562	$1,500
Median Weekly Rent	$280	$285	$320	$300
Car Ownership:				
% 0 cars	1.5%	2.7%	7.7%	7.2%
% 1 car	21.5%	28.5%	37.1%	36.4%
% 2+ cars	77.0%	68.8%	55.2%	56.4%

Note: Based on place of enumeration.
1. Dependency ratio refers to the proportion of the population aged between 0-14 and over 65 years.
2. Compared to the South Australian benchmark.
3. 'Other' tenure types have not been included.
Source: Australian Bureau of Statistics, 2021 Census of Population and Housing - 2021 Census Tables.

2.2.4 Internal Migration

The following table highlights net migration between 2016 and 2021 for the Light LGA.

Between 2016 and 2021, 64.1% of the people in the Light LGA did not change address. However, a total of 961 people moved within the Light LGA during that period. Net population gains to the region came from the Cities of Playford and Salisbury, while top statistical areas for population migration out of Light LGA were the adjacent Gawler LGA, the State of Queensland and the Charles Sturt LGA area. Since the last statistical period (2006-2011), net migration with Gawler LGA shifted from a net gain (+87) to a net loss in 2021 (-62) and the population migration out of Light LGA to Victor Harbor LGA and Yorke Peninsula LGA approximately doubled.

Table 2.5 – Key Statistical Areas Ranked by Light LGA Net Migration

Statistical Area	Net Gain	Statistical Area	Net Loss
Playford (C)	220	Gawler (T)	-62
Salisbury (C)	140	Queensland	-52
Overseas	112	Charles Sturt (C)	-38
Tea Tree Gully (C)	76	Barossa (C)	-33
Victoria	48	Victor Harbor (C)	-28
Northern Territory	41	Yorke Peninsula (C)	-25
New South Wales	36	Holdfast Bay (C)	-22
Roxby Downs (DC)	18	Western Australia	-19
Burnside (C)	15	Campbelltown (C)	-19
Mitcham (C)	14	Norwood Payneham St Peters (C)	-19
Whyalla (CC)	13	Western Australia	-19
Australian Capital Territory	10	Mount Barker (DC)	-17
Onkaparinga (C)	7	West Torrens (C)	-15
Kingston (DC)	6	Berri Barmera	-14
Unley (C)	5	Port Adelaide Enfield (C)	-12
Adelaide (C)	1	Northern Areas (C)	-12

Source: Australian Bureau of Statistics 2021 Census of Population and Housing 2021

2.3 LABOUR MARKET

2.3.1 Light LGA Employment Profile – Key Trends

The demographics and employment profile of Light LGA residents has changed over the years due to an aging population.

Examining Census information from 2016 and 2021, Table 2.6 outlines the key demographic trends for the residents in Light LGA in comparison to Barossa SA3 and Greater Adelaide.

The key findings from this analysis are as follows:

- Incomes in the Light LGA have increased by 15.1%, slightly lower when compared to the Barossa SA3 (16.2%) but significantly lower than that experienced across Greater Adelaide (23.5%) by 8.4%.

- The age profile of the Light LGA population is becoming slightly older, with population aged 25-44 years decreasing by 1.4%, slightly greater than the Barossa SA3 benchmark change (-0.4%). In comparison, the Greater Adelaide population is aging quicker, with an increase in the 25–44 year old age bracket increasing by 0.6% over the same period.

- Blue-collar occupations have decreased in the Light LGA. In 2021, 36.2% of the region's population were working in blue-collar occupations, which is lower than 2016 (37.5%). This proportion is higher than the Greater Adelaide benchmark and slightly lower than Barossa SA3, indicating the high proportion of industrial employment in the region.

- Labour force participation within the Light LGA has increased to 82.5% (+2.6%), remains comparable to Barossa SA3 (82.7%) and is higher than the Greater Adelaide average (79.7%).

- Unemployment in the Light LGA is some 0.3% lower than Barossa SA3 (3.2% compared to 3.5%) and lower when compared to the Greater Adelaide average of 5.5%.

The demographic trends occurring in the Light LGA are consistent with an aging population and improving employment opportunities within the region with unemployment lower than in 2016.

Table 2.6 – Light LGA Resident Population Demographics

	Light (LGA)	Barossa SA3	Greater Adelaide
Median Weekly Per Capita Income:			
% growth 2016-2021	*+15.1%*	*+16.2%*	*+23.5%*
Population Aged 25-44 Years:			
% change 2016-2021	*-1.4%*	*-0.4%*	*+0.6%*
Blue Collar Occupations:			
2016	37.5%	39.9%	29.0%
2021	36.2%	38.4%	28.2%
% change 2016-2021	*-1.3%*	*-1.5%*	*-0.8%*
Labour Force Participation:			
2016	79.9%	79.4%	75.2%
2021	82.5%	82.7%	79.7%
% change 2016-2021	*+2.6%*	*+3.3%*	*+4.5%*
Unemployment[1]:			
2016	5.3%	5.0%	7.7%
2021	3.2%	3.5%	5.5%
% change 2016-2021	*-2.1%*	*-1.5%*	*-2.2%*

Note: Based on place of usual residence.
1. Unemployed as proportion of total labour force.
Source: Australian Bureau of Statistics, Census of Population and Housing – 2016 and 2021 Census Tables.

2.3.2 Resident Labour Force Structure

The following Table 2.7 examines the labour force and age profile of Light LGA population in 2021.

- Light LGA had a labour force of 8,368 people, of who 55.6% were employed full-time.

- The Light LGA labour force has increased by over 1,100 people since 2011, however the percentage of full-time workers has decreased between the years 2011 (58.1%) to 2021 (55.6%) by 2.5%.

- The proportion of full-time workers is higher when compared to Greater Adelaide (54.3%) but comparable with the proportion of full-time works in the overall Barossa Statistical Area (55.8%).

- The unemployment rate in Light LGA has dropped since the last Census period from 4.3% (2011) to 3.2% (2021).

- The Light LGA unemployment rate (3.2%) is lower than the Greater Adelaide average of 5.5% and Barossa SA3 average of 3.5%.

- Youth unemployment remains particularly high with 27% of unemployed aged between 15 – 19 years compared to 17% in Greater Adelaide and Barossa SA3.

Table 2.7 – Light LGA Resident Population Demographics

	Light (LGA)	Barossa SA3	Greater Adelaide
Employed:			
- Full-time	55.6%	55.8%	54.3%
- Part-time	35.1%	34.5%	35.0%
- Away from work	6.1%	6.2%	5.2%
Total Employed	96.8%	96.5%	94.5%
Unemployed:			
- Looking for full-time work	1.8%	1.9%	2.9%
- Looking for part-time work	1.4%	1.6%	2.6%
Total Unemployed	3.2%	3.5%	5.5%
Total Labour Force	8,368	19,086	709,968
Not in the labour force	3,676	10,469	395,473
Unemployed:			
15-19 years	27%	17%	17%
20-24 years	17%	14%	17%
25-34 years	13%	17%	21%
35-44 years	12%	14%	16%
45-54 years	12%	16%	14%
55-64 years	16%	18%	12%
65 + years	3%	4%	3%

Note: Based on place of usual residence.
Source: Australian Bureau of Statistics, 2021 Census of Population and Housing -2021 Census Tables

2.3.3 Employment by Industry

Census data for 2016 and 2021 also show that the changing demographics are resulting in a shift in the type of industries employing these residents, as outlined in Tables 2.8 and 2.9.

Table 2.8 indicates that industrial employment is significant within the Light LGA with over a third of residents employed within Manufacturing, Construction, Transport/Warehousing, and Wholesale Trade (28.6% compared to 21.7% of Greater Adelaide). However, the proportion of residents employed within these sectors has decreased since 2011 by 5.0% in Light LGA compared to a 4.5% decrease in Greater Adelaide. The proportion of Light LGA residents employed in Manufacturing in 2021 has decreased to 12.6% (-1.4% between 2016 and 2021), whilst Health Care and Social Assistance increased by 0.9%, between 2016 and 2021.

The largest increase over the 5-year period was in the Education and Training Sector with an increase of 1.2%.

Table 2.8 – Light LGA Proportion of Population by Industry, 2016 - 2021

	Light LGA			Greater Adelaide
	2016	2021	Change	2021
Manufacturing	14.0%	12.6%	-1.4%	6.8%
Health care and social assistance	11.4%	12.3%	+0.9%	17.1%
Retail trade	9.2%	9.4%	+0.2%	9.7%
Agriculture, forestry and fishing	9.0%	8.0%	-1.0%	1.2%
Construction	8.3%	9.0%	+0.7%	8.4%
Education and training	8.0%	9.2%	+1.2%	9.0%
Public administration and safety	6.6%	6.4%	-0.2%	7.1%
Accommodation and food services	5.7%	5.3%	-0.4%	6.6%
Transport, postal and warehousing	5.1%	4.5%	-0.6%	4.1%
Administrative and support services	3.7%	3.8%	+0.1%	3.8%
Professional, scientific and technical services	3.6%	3.6%	+0.0%	7.1%
Wholesale trade	2.7%	2.5%	-0.2%	2.4%
Financial and insurance services	1.4%	1.3%	-0.1%	3.2%
Mining	0.9%	1.6%	+0.7%	0.9%
Electricity, gas, water and waste services	0.9%	0.9%	+0.0%	1.3%
Arts and recreation services	1.2%	1.0%	-0.2%	1.5%
Rental, hiring and real estate services	0.9%	0.9%	+0.0%	1.3%
Information media and telecommunications	0.9%	0.6%	-0.3%	1.2%
Other services	3.5%	3.7%	+0.2%	4.0%

Note: Based on place of usual residence.
Source: Australian Bureau of Statistics, Census of Population and Housing 2016 and 2021.

2.3.4 Employment by Occupation

Table 2.9 provides an overview of the change in occupations within Light LGA between 2016 and 2021.

Although just under a third of Light LGA residents continue to be employed within industrial sectors (28.6% compared to 21.7% of Greater Adelaide), over half of occupations within Light LGA remain white-collar.

Blue-collar employment decreased by 1.3% between 2016 and 2021 with the greatest reduction of occupations within the Labourers category (-1.8%). However, white-collar occupations largely have increased between 2016 and 2021 (except Managers and Sales Workers which decreased by 0.2% and 0.3% respectively). The largest increase in employment was within the Professionals category with an increase of 1.0% to 14.7% (compared to 13.7% in 2016).

Table 2.9 – Light LGA Proportion of Population by Occupation, 2016 – 2021

	Light LGA			Greater Adelaide
	2016	2021	Change	2021
Blue Collar: Labourers	14.1%	12.3%	-1.8%	9.5%
Machinery Operators and Drivers	7.8%	7.6%	-0.2%	5.6%
Technicians and Trades Workers	15.6%	16.3%	+0.7%	13.2%
Total Blue Collar	37.5%	36.2%	-1.3%	28.3%
White Collar: Managers	15.5%	15.3%	-0.2%	12.3%
Professionals	13.7%	14.7%	+1.0%	24.0%
Clerical and Administrative Workers	12.7%	12.9%	+0.2%	13.4%
Sales Workers	8.8%	8.5%	-0.3%	8.6%
Community and Personal Service Workers	11.8%	12.4%	+0.6%	13.4%
Total White Collar	62.5%	63.8%	+1.3%	71.7%

Note: Based on place of usual residence.
Source: Australian Bureau of Statistics, Census of Population and Housing -2021 Census Tables.

2.4 JOURNEY TO WORK

Tables 2.10 to 2.11 analyse the structure of employment of both Light LGA residents and those employed within the region who live outside the LGA. The following tables are based on data from the 2021 Census.

2.4.1 Working within Light LGA

In 2021, over 5,300 people worked in the Light LGA.

Of the employed population that worked within the Light LGA region, 42.6% lived in the Light LGA area and over half lived outside the Light LGA area (57.4%).

The largest number of workers commuting to the Light LGA for work came from nearby Barossa LGA (17.2%) and Gawler LGA (10.5%) with 8% of workers also commuting from Playford LGA.

Table 2.10 – Light LGA Residential Location of Local Workers, 2021

	Workers Place of Residence (Light LGA)	
Light LGA	**No.**	**%**
Light (LGA)	2,289	42.6%
Barossa (C)	926	17.2%
Adelaide Plains (C)	128	2.4%
Total Barossa SA3	*3,343*	*62.2%*
Other LGAs		
Gawler (T)	562	10.5%
Playford (C)	432	8.0%
Salisbury (C)	179	3.3%
Tea Tree Gully (C)	127	2.4%
Port Adelaide Enfield (C)	88	1.6%
Clare and Gilbert Valleys (DC)	83	1.5%
Goyder (RC)	71	1.3%
Wakefield (DC)	53	1.0%

Note: Based on place of usual residence.
Source: Australian Bureau of Statistics, 2021 Census of Population and Housing 2021

2.4.2 Light LGA Resident Workforce

Table 2.11 provides an overview of the locations where residents of Light LGA work in 2021 (which may be within the residing area or elsewhere).

In 2021, the Agriculture, Forestry and Fishing industry comprised 8.0% of Light LGA residents working in the industry compared to 14% held by the non-Metropolitan employed population.

28.6% of Light LGA residents worked in industrial industries (Manufacturing (12.6%), Constructions (9.0%), Transport, Postal & Warehousing (4.5%) and Wholesale Trade (2.5%)), whilst over 60% of the Light LGA working residents were employed in other industries (such as, Health Care and Social Assistance (12.3%), Retail Trade (9.4%), Education and Training (9.2%) and Accommodation and Food Services (5.3%).

65.8% of working residents of Light LGA travelled outside the Light LGA area to work.

Light LGA residents were likely to commute for work to LGAs closer to home, such as Barossa LGA (15.5%), Gawler LGA (10.3%) and Adelaide Plains LGA (1.0%) but also commuted to northern metropolitan areas such as, the Cities of Salisbury (9.1%) and Playford (8.6%). Some Light LGA residents continued to travel further for work with 4% travelling to Adelaide being a commute of between 1 and 1 ½ hours one way.

Table 2.11 – Light LGA Industry Sector of Employment, 2021

	Light (LGA)		Non-Metro. South Aust.
Industry Sector of Employment	**No.**	**%**	**%**
Agriculture, Forestry and Fishing	645	8.0%	14.0%
Industrial Industries	2,316	28.6%	23.1%
Other Industries	5,146	63.4%	62.9%
Total	*8,107*	*100.0%*	*100.0%*

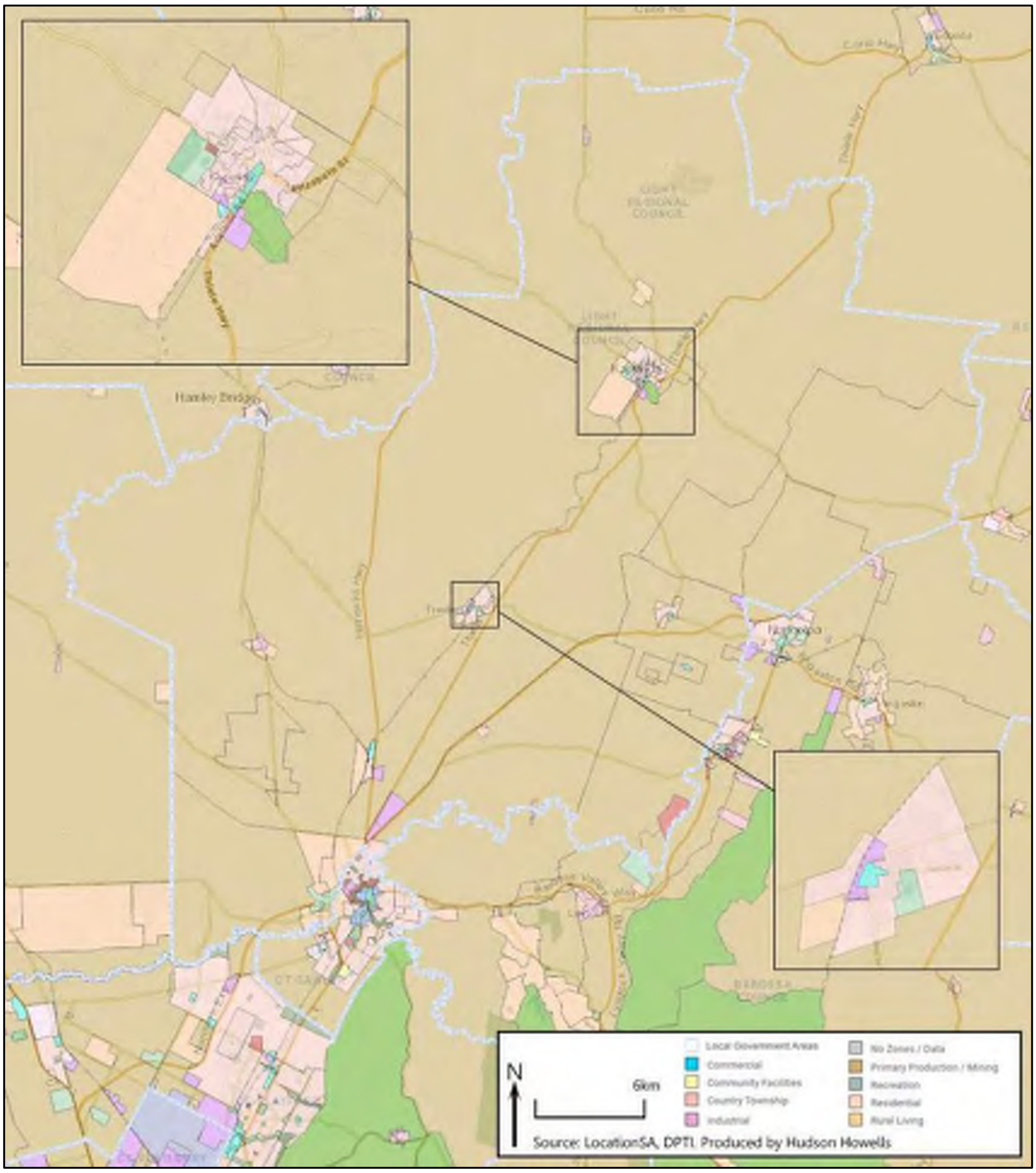
Note: Based on place of usual residence.
Source: Australian Bureau of Statistics, 2021 Census of Population and Housing Census Table 2021

2.5 EMPLOYMENT TRENDS

2.5.1 Land Use

As shown in Map 2.1, the Light LGA is predominantly currently zoned for primary production. Larger towns of Kapunda and Freeling are primarily residential with rural living on the fringe of the town, with commercial uses located along main roads and adjacent industrial areas. Townships of Wasleys, Greenock, Allendale North, Roseworthy are a mix of residential and rural living with associated small commercial areas.

Map 2.1 –Land Use



2.5.2 Number of Businesses

Data relating to the 'Counts of Australian Businesses' are released annually by the Australian Bureau of Statistics (ABS). The counts in this release are heavily influenced by entry and exits within Australia's small business sector, and we note that the scope of business counts is limited to businesses actively remitting in a GST role.

Table 2.12 and Chart 2.1 compares the change in the number of businesses within Light LGA between 2019 and 2022 by employment size and industry division.

Key points to note from Table 2.12 and Chart 2.1 include:

- Light LGA had a total of 1,427 businesses in 2022, increasing by 69 businesses (+5%) since 2019.

- Businesses employing nineteen or less employees accounted for 98% of total businesses in 2022, comprising 891 non-employing businesses and 505 businesses employing between one and nineteen employees.

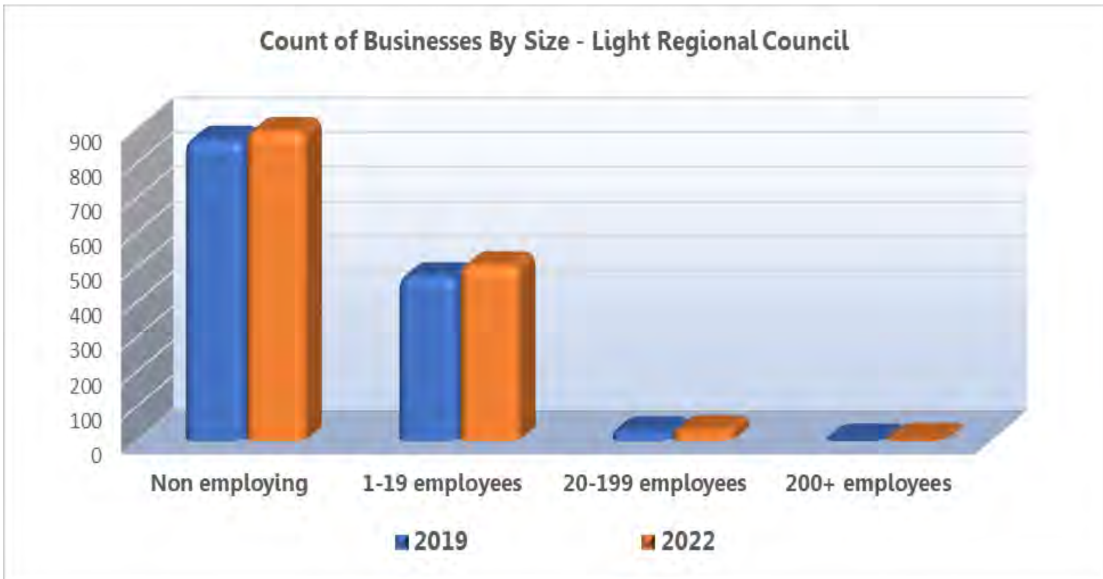
- Agriculture, Forestry and Fishing had the most businesses operating in the Light LGA in 2022 (427 businesses or 30% of total businesses).

Table 2.12 – Count of Businesses by Industry and Size in Light LGA, 2019 - 2022

	19 or less employees			Total		
Industry	**2019**	**2022**	**% change**	**2019**	**2022**	**% change**
Agriculture, Forestry and Fishing	418	423	+1.2%	426	427	+0.2%
Mining	0	0	-	0	0	-
Construction	243	253	+4%	247	254	+3%
Rental, Hiring & Real Estate Services	121	127	+5%	115	128	+11%
Manufacturing	102	111	+9%	108	121	+12%
Transport, Postal and Warehousing	80	83	+4%	76	85	+12%
Prof., Scientific & Technical Services	71	88	+24%	73	92	+26%
Retail Trade	42	47	+12%	43	49	+14%
Financial and Insurance Services	70	24	-66%	64	25	-61%
Accommodation and Food Services	31	30	-3%	36	34	-6%
Wholesale Trade	24	39	+63%	29	41	+41%
Health Care and Social Assistance	24	34	+42%	26	37	+42%
Administrative and Support Services	28	39	+39%	30	40	+33%
Arts and Recreation Services	9	15	+67%	12	12	+0%
Education and Training	9	11	+22%	5	11	+120%
Public Administration and Safety	3	0	-100%	5	3	-40%
Information, Media & Telecommunications	3	3	+0%	3	3	+0%
Elec., Gas, Water & Waste Services	6	3	-50%	3	4	+33%
Other Services	57	61	+7%	57	61	+7%
Total	*1,341*	*1,391*	*+4%*	*1,358*	*1,427*	*+5%*

Note: Excludes 'Currently unknown'.
Source: Australian Bureau of Statistics, Counts of Australian Businesses, including Entries and Exits, Cat. No. 8165.0 June 2016 – June 2020 released 16 February 2021 and June 2018 – June 2022 released December 2022

Chart 2.1 - Count of Businesses by Size in Light LGA, 2019 - 2022



Source: Australian Bureau of Statistics, Counts of Australian Businesses, including Entries and Exits, Cat. No. 8165.0 June 2016 – June 2020 released 16 February 2021 and June 2018 – June 2022 released December 2022

2.5.3 Business Turnover Levels

Table 2.13 and Chart 2.2 compares the change in the number of businesses within the Light LGA between 2018 and 2022 by level of turnover and industry division.

Key points to note from Table 2.13 and Chart 2.2 include:

- Nearly half of all businesses within the Light LGA had an annual turnover over more than $200,000 (44%), including 7% or 97 businesses with an annual turnover of $2 million or more.

- A majority number of businesses within turnover ranges experienced overall growth in total numbers between 2018 and 2022.

- Agriculture, Forestry and Fishing had the greatest number of businesses in the Light LGA with an annual turnover of more than $2 million in 2022 (32 businesses).

Table 2.13 – Count of Businesses by Industry and Turnover in Light LGA, 2018 – 2022

	$200k+ turnover			Total		
Industry	2018	2022	% change	2018	2022	% change
Agriculture, Forestry and Fishing	198	194	-2%	422	427	+1%
Construction	97	119	+23%	235	254	+8%
Rental, Hiring & Real Estate Services	44	43	-2%	116	128	+10%
Manufacturing	59	66	+12%	104	121	+16%
Transport, Postal and Warehousing	46	46	+0%	79	85	+8%
Prof., Scientific & Technical Services	11	24	+118%	76	92	+21%
Financial and Insurance Services	16	8	+50%	63	25	-60%
Retail Trade	25	29	+16%	51	49	-4%
Accommodation and Food Services	19	25	+32%	36	34	-6%
Wholesale Trade	9	21	+133%	35	41	+17%
Health Care and Social Assistance	12	12	+0%	27	37	+37%
Administrative and Support Services	7	7	+0%	29	40	+38%
Arts and Recreation Services	3	3	+0%	5	12	+140%
Education and Training	4	4	+0%	8	11	+38%
Elec., Gas, Water & Waste Services	3	0	-100%	3	4	+33%
Public Administration and Safety	3	0	-100%	4	3	-25%
Information Media and Telecommunications	3	3	+0%	3	3	+0%
Mining	0	0	+0%	3	0	-100%
Other Services	21	23	+10%	60	61	+2%
Total	*580*	*627*	*+8%*	*1,359*	*1,427*	*+5%*

Note: Excludes 'Currently unknown'.
Source: Australian Bureau of Statistics, Counts of Australian Businesses, including Entries and Exits, Cat. No. 8165.0. June 2014 to June 2018 released 21 February 2019 and June 2018 to June 2022 released 16 December 2022.

Chart 2.2 - Count of Businesses by Turnover in Light LGA, 2018 – 2022

Source: Australian Bureau of Statistics, Counts of Australian Businesses, including Entries and Exits, Cat. No. 8165.0. June 2014 to June 2018 released 21 February 2019 and June 2018 to June 2022 released 16 December 2022.

2.6 TOWNSHIP SERVICES

In addition to accommodation, workers locating temporarily to the Study Area will require a wide range of other convenience services, and the project will also need to source trade and other services from businesses located in the immediate region. This section provides an overview of the services located in the main townships in the Light region of the Study Area.

The Light Regional Council contains the townships of Kapunda, Greenock, Freeling, Wasleys and Roseworthy, and the suburb of Hewett. The region mixes a rich mining heritage with farming, with the benefits of the Barossa Valley wine region.

Kapunda serves as the major service centre for the region and will be the major source of services likely to be required to support the proposed wind farm project. It is easily accessed from Adelaide (77 kilometres) and its northern suburbs via the Fatchen Expressway and is geographically well positioned to the major tourism centres of the Barossa Valley, Clare Valley and the River Murray. Kapunda is located approximately 10 kilometres south west of the project and offers a range of regional services including:

- Accommodation options ranging from the Kapunda Tourist Park to several bed and breakfast and farm stay options. Other accommodation options within the Light Regional Council area and within easy access of the project site include:
    - Novatel Barossa Valley Resort.
    - The Louise.
    - The Reserve Barossa Valley.
    - Seppeltsfield Vineyard Cottages.
- Major banks and postal services.
- Medical and emergency services (Kapunda Hospital and medical practices).
- Hotels – Kapunda (4), plus Roseworthy (1), Allendale North (1), Freeling (2), Greenock (1) and Wasleys (1).
- Main street retail, café and bakery services.
- Automotive and mechanical services.

- Tourism and related services in Kapunda and the surrounding region, including vineyards and wineries.

- Recreation facilities including the Kapunda Library, Kapunda Bowling Club and Kapunda Golf Course.

3 REGIONAL BASELINE ASSESSMENT - GOYDER

3.1 LOCATIONAL ANALYSIS

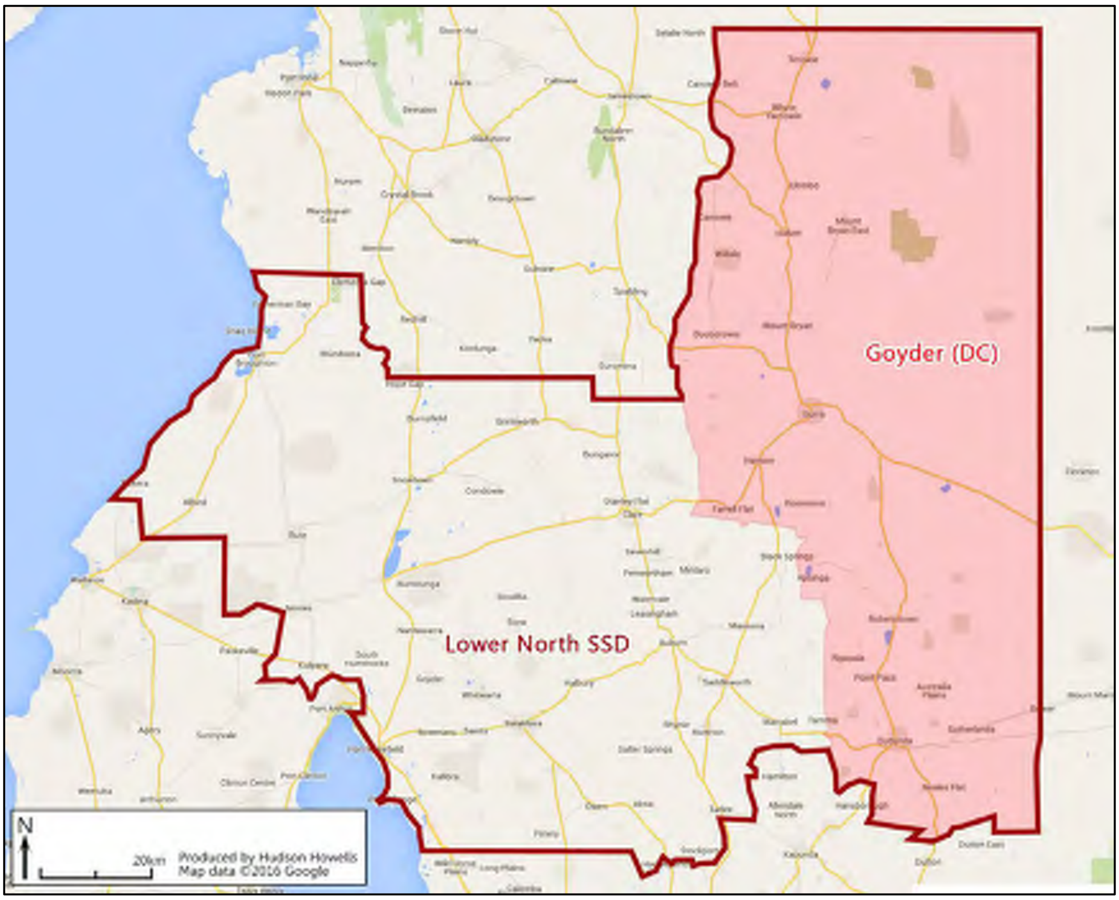
The information contained in this section has again been sourced from publicly available data with relevant sources noted and includes:

- A brief description of the Goyder Regional Council.
- An overview of population growth in the Goyder Regional Council Local Government Area (LGA), including forecast future growth in population in the region.
- An analysis of socio-demographics of the Goyder LGA population.
- A brief analysis of internal population migration into and out of the Goyder LGA.
- An analysis of employment trends in Goyder LGA, including the growth in employment, using the latest 2021 Census data.
- An analysis of businesses within the Goyder LGA by industry, including size and turnover.

The Regional Council of Goyder is located within the Lower North Statistical Area Level 3 (SA3) and is located in the Mid North of South Australia, stretching between the District Council of Peterborough to the north, Mid Murray Council to the lower east and south, and the Light Regional Council, Clare and Gilbert Valleys District Council, and Northern Areas to the west. The Lower North SA3 stretches across from Unincorporated pastoral lands to the east to upper Yorke Peninsula and Spencer Gulf to the west. The Council contains the townships of Burra, Eudunda, Hallett, Robertstown, and Terowie, in addition to a number of smaller localities. The region combines a mix of agricultural and pastoral uses with an increasing manufacturing industry. Map 3.1 illustrates the Council's boundary in relation to the surrounding councils.

The Barrier Highway is the key transport route through the region, providing regional access from Adelaide and regional New South Wales (via Broken Hill). The Thiele Highway and Goyder Highway provide access to regional towns within the Council and alternative routes to other major regional towns in adjacent regions.

Map 3.1 – Goyder District Council



3.2 POPULATION AND DEMOGRAPHICS

3.2.1 Historical Population

Historical Estimated Resident Population (ERP) figures are released annually by the Australian Bureau of Statistics (ABS). Table 3.1 compares the historical population levels of Goyder LGA in comparison with the Lower North SA3 and South Australia. The Lower North SA3 region comprises the Local Government Areas of Goyder, Clare and Gilbert Valleys, Wakefield and Barunga West. Key points to note from Table 3.1 include:

- Goyder LGA population decreased slightly between 2017 and 2022 by 93 people over the five year period. This represented average growth of -0.4% per annum, which was significantly lower than the average South Australian population growth of 1.1% per annum over the same period.

- Historically, around 18% of the Lower North SSD region resided within the Goyder LGA.

- Current population of Goyder LGA is estimated at around 4,134 people.

Table 3.1 –Estimated Resident Population, 2017 – 2022

	Goyder LGA	Lower North SA3	South Australia
2017	4,227	23,123	1,729,608
2018	4,183	23,036	1,748,010
2019	4,161	23,119	1,770,048
2020	4,142	23,101	1,793,547
2021	4,138	23,154	1,803,192
2022	4,134	23,212	1,821,537
Av. Annual Change (%)			
2017-2018	+1.0%	+0.4%	+1.1%
2018-2019	-0.5%	+0.4%	+1.3%
2019-2020	-0.5%	-0.1%	+1.3%
2020-2021	-0.1%	+0.2%	+0.5%
2021-2022	-0.1%	+0.3%	+1.0%
2017-2022	-0.4%	+0.1%	+1.1%

Source: ABS Population Projections for South Australia, 2016 – 2036, published 2020; ABS Regional Population Growth Cat. No: 3218.0

3.2.2 Forecast Population

Table 3.2 provides population forecast comparisons for Goyder LGA, Lower North SA3, Non-Metro South Australia and South Australia from 2022 to 2036. Population forecasts are as presented in the DPTI 'Population Projections for South Australian Local Government Areas, 2016-2036' released in December 2019 and the DPTI 'Local Area (SA2 & LGA) Population Projections for South Australia 2016-2036' published in 2020.

Table 3.2 –Estimated Resident Population, 2022 - 2036

	Goyder LGA	Lower North SA3	Non-Metro. SA	South Australia
2022 ERP	4,134	23,212	287,701	1,821,537
2026	4,267	23,118	295,601	1,866,715
2031	4,277	23,687	301,717	1,936,812
2036	4,302	24,245	306,797	2,001,047
Av. Annual Change (%)				
2022-2026	+0.8%	-0.1%	+0.7%	+0.6%
2026-2031	+0.1%	+0.5%	+0.4%	+0.8%
2031-2036	+0.1%	+0.5%	+0.3%	+0.7%
2022-2036	+0.3%	+0.3%	+0.5%	+0.7%

Source: Department of Planning, Transport and Infrastructure Population Projections for South Australian Local Government Areas 2016-2036, released December 2019 and Department of Planning, Transport and Infrastructure, Government of South Australia, Local Area (SA2 & LGA) Population Projections for South Australia, 2016 – 2036, published 2020

Future population growth for Goyder LGA is projected to increase to 4,300 people by 2036 representing a net increase of 168 people from 2022, or an average increase of 0.3% per annum over the 14-year period. In comparison, Lower North SA3 is forecast to have a similar population growth of 0.3% per annum between 2022 and 2036, and South Australia is forecast to increase by an average of 0.7% per annum over the same period.

3.2.3 Socio-demographic Profile

Key socio-demographic characteristics of the Goyder LGA from the 2021 Census are provided in Table 3.3, with the main features as follows:

- The average age distribution of Goyder LGA residents indicates an older age profile, with 27% of the population aged over 65 years, and an average age of 51 years. In comparison, the Lower North SA3 has an established family profile with an average age of 49 years.

- Average weekly per capita income of Goyder LGA residents is 32% below the South Australian average whereas the Lower North SA3 average is 15% below the State average.

- Average weekly household income is 37% below the South Australian average.

- Average household size is slightly lower than the South Australian average of 2.4 people, reflecting the older age profile of the region.

- House ownership within the Goyder LGA is higher when compared to both Lower North SA3 and South Australia (81% compared to 79% and 71% respectively). Median monthly mortgage payments are $633 less when compared to the South Australian median ($867 compared to $1,500).

- Car ownership (97%) is higher than the South Australian average of 93% of households owning one or more cars, reflecting the regional location.

Table 3.3 – Goyder LGA Socio-Economic Characteristics, 2021

	Goyder LGA	Lower North SA3	Non-Metro SA	South Australia
Age Distribution:				
0 - 14 years	15.6%	16.9%	16.7%	17.0%
15 - 24 years	8.9%	9.2%	9.9%	11.7%
25 - 44 years	17.9%	19.0%	21.1%	25.9%
45 - 64 years	30.4%	28.8%	27.4%	25.4%
65+ years	27.2%	26.1%	24.9%	20.0%
Median Age	51	49	47	41
Dependency Ratio[1]	42.8%	43.0%	41.6%	37.0%
Av. Weekly Per Capita Income	$497	$622	$646	$734
Per Capita Income Var.[2]	-32%	-15%	-12%	
Household Income:				
$0 - $33,799	32.3%	32.9%	32.0%	26.7%
$33,800 - $77,999	45.6%	42.3%	41.3%	38.8%
$78,000 - $155,999	19.2%	20.7%	22.3%	27.2%
$156,000+	2.9%	4.1%	4.4%	7.3%
Av. Weekly Household Income	$916	$1,144	$1,190	$1,455
Household Income Var.[2]	-37%	-21%	-18%	
Av. Household Size	2.2	2.3	2.3	2.4
Housing Status:				
Owner/purchaser[3]	80.8%	79.0%	74.0%	71.3%
Renter	19.2%	21.0%	26.0%	28.7%
Median Monthly Mortgage	$867	$1,081	$1,153	$1,500
Median Weekly Rent	$190	$220	$220	$300
Car Ownership:				
% 0 cars	3%	3.8%	5.6%	7.2%
% 1 car	31.8%	31.8%	34.0%	36.4%
% 2+ cars	65.2%	64.4%	60.4%	56.4%

Note: Based on place of enumeration.
1. Dependency ratio refers to the proportion of the population aged between 0-14 and over 65 years.
2. Compared to the South Australian benchmark.
3. 'Other' tenure types have not been included.
Source: Australian Bureau of Statistics, Census of Population and Housing 2021 Census Tables.

3.2.4 Internal Migration

The following table highlights net migration during 2021-2022 for the Goyder LGA.

The region had a net population loss of 14 people through internal migration. Net population gains to the region came from the City of Playford and Onkaparinga LGA and nearby Light LGA, while top statistical areas for population migration out of Goyder LGA were to the Copper Coast and nearby Barossa LGA.

Table 3.4 – Key Statistical Areas Ranked by Goyder LGA Net Migration

Statistical Area	Net Gain	Statistical Area	Net Loss
Playford (C)	19	Copper Coast (C)	-15
Onkaparinga (C)	13	Barossa (C)	-15
Light (C)	10	Mount Remarkable (C)	-8
Clare and Gilbert Valleys (DC)	8	Loxton Waikerie (C)	-7
Coorong (C)	7	Renmark Paringa (C)	-5
Port Pirie (C)	6	Tea Tree Gully (C)	-3
Alexandrina (C)	5	Berri Barmera (C)	-1
Yorke Peninsula (DC)	5	Northern Areas (C)	-1

3.3 LABOUR MARKET

3.3.1 Goyder LGA Employment Profile – Key Trends

The demographics and employment profile of Goyder LGA residents has changed over the years due to an aging population.

Examining Census information from 2016 and 2021, Table 3.5 outlines the key demographic trends for the residents in Goyder LGA in comparison to Lower North SA3 and Non-Metro South Australia.

The key findings from this analysis are as follows:

- Incomes have increased by 3.3% in Goyder LGA which is far less compared to the increases experienced in the Lower North SA3 (13.1%) and across Non-Metro South Australia (17.5%). Overall, the growth in incomes has slowed over all regions since the 2006-2011 statistical period.

- The age profile of the Goyder LGA population is becoming older, with the population aged 25-44 years decreasing by 4.3%, a decrease greater than the Lower North SA3 benchmark change of 4% between 2016 to 2021. In comparison, the Non-Metro South Australian population decreased by 1.9% over the same period.

- Blue-collar occupations have decreased in the Goyder LGA. In 2021, 38.2% of the region's population were working in blue-collar occupations, which is lower than 2016 (39.5%). The percentage change between 2016 and 2021 is consistent with the Lower North SA3 benchmark and slightly higher (by 0.3%) than the Non-Metro South Australian benchmark, The Goyder LGA continues to experience a high proportion of agricultural and industrial employment within the region.

- Labour force participation within the Goyder LGA has increased to 75.9% (+2.7%), lower than both the Lower North SA3 and Non-Metro South Australia benchmarks (79.3% and 77.2% respectively).

- Unemployment in the Goyder LGA is some 0.9% higher than the Lower North SA3 (5.2% compared to 4.3%) and 0.4%. higher when compared to the Non-Metro South Australian average of 4.8% in 2021.

The demographic trends occurring in the Goyder LGA are consistent with an aging population and changing employment opportunities within the region.

Table 3.5 – Goyder LGA Resident Population Demographics

	Goyder LGA	Lower North SA3	Non-Metro SA
Median Weekly Per Capita Income:			
% growth 2016-2021	+3.3%	+13.1%	+17.5%
Population Aged 25-44 Years:			
% change 2016-2021	-4.3%	-4.0%	-1.9%
Blue Collar Occupations:			
2016	39.5%	37.5%	38.3%
2021	38.2%	36.2%	37.3%
% change 2016-2021	-1.3%	-1.3%	-1.0%
Labour Force Participation:			
2016	73.2%	75.4%	74.2%
2021	75.9%	79.3%	77.2%
% change 2016-2021	+2.7%	+3.9%	+3.0%
Unemployment[1]:			
2016	6.3%	5.1%	6.6%
2021	5.2%	4.3%	4.8%
% change 2016-2021	-1.1%	-0.8%	-1.8%

Note: Based on place of usual residence.
1. Unemployed as proportion of total labour force.
Source: Australian Bureau of Statistics, Census of Population and Housing 2016 and 2021 Census Tables

3.3.2 Resident Labour Force Structure

The following Table 3.6 examines the labour force and age profile of Goyder LGA population in 2021.

- Goyder LGA had a labour force of 1,768 people, of who 51.4% were employed full-time.
- The proportion of full-time workers is lower when compared to Non-Metro South Australia (53.5%).
- In 2021, the unemployment rate in Goyder LGA (5.3%) exceeded the Non-Metro South Australian average of 4.8%.
- It is clear that mature age unemployment is particularly high, with 53% of unemployed aged older than 45 years compared to 41% in Non-Metro South Australia.

Table 3.6 – Goyder LGA Resident Population Demographics 2021

	Goyder LGA	Lower North SA3	Non-Metro SA
Employed:			
- Full-time	51.4%	52.6%	53.5%
- Part-time	36.7%	36.3%	35.0%
- Away from work	6.6%	6.8%	6.7%
Total Employed	94.7%	95.7%	95.2%
Unemployed:			
- Looking for full-time work	3.3%	2.4%	2.8%
- Looking for part-time work	2.0%	1.9%	2.0%
Total Unemployed	5.3%	4.3%	4.8%
Total Labour Force	1,768	10,255	176,233
Not in the labour force	1,406	7,376	127,714
Unemployed:			
15-19 years	12%	12%	13%
20-24 years	3%	11%	13%
25-34 years	27%	17%	19%
35-44 years	5%	12%	14%
45-54 years	17%	18%	18%
55-64 years	32%	24%	20%
65+ years	4%	6%	3%

Note: Based on place of usual residence.
Source: Australian Bureau of Statistics, Census of Population and Housing 2021 Census Tables

3.3.3 Employment by Industry

Census data for 2016 and 2021 also show that the changing demographics are resulting in a shift in the type of industries employing these residents, as outlined in Tables 3.7 and 3.8.

Table 3.7 indicates that employment within the agricultural industry is significant within the Goyder LGA with nearly a third of residents employed within Agriculture, Forestry and Fishing (29.1% compared to 14.0% of Non-Metro South Australia), and nearly a quarter of the population employed in 'Sheep, Beef Cattle and Grain Farming' (19.7%). Whilst the agriculture industry is the highest employer for Goyder LGA residents, employment within Agriculture, Forestry and Fishing decreased by 3.4% between 2016 and 2021, in comparison with the Administration and Support Services Sector and Mining which have increased in the five years to 2021 (+1.2% and +1.1% respectively).

Table 3.7 – Goyder LGA Proportion of Population by Industry, 2016 - 2021

	Goyder LGA			Non-Metro South Aus.
	2016	2021	Change	2021
Agriculture, forestry and fishing	32.5%	29.1%	-3.4%	14.0%
Manufacturing	8.7%	7.8%	-0.9%	9.0%
Health care and social assistance	9.1%	9.5%	+0.4%	13.4%
Retail trade	7.7%	8.6%	+0.9%	9.5%
Accommodation and food services	5.9%	5.3%	-0.6%	6.8%
Education and training	5.8%	6.2%	+0.4%	7.9%
Construction	5.4%	5.7%	+0.3%	7.9%
Transport, postal and warehousing	4.0%	4.3%	+0.3%	4.0%
Public administration and safety	3.2%	3.5%	+0.3%	4.7%
Administrative and support services	2.1%	3.3%	+1.2%	3.5%
Professional, scientific and technical services	2.5%	2.6%	+0.1%	2.7%
Wholesale trade	1.8%	2.4%	+0.6%	2.2%
Mining	1.2%	2.3%	+1.1%	2.8%
Electricity, gas, water and waste services	1.1%	0.7%	-0.4%	1.2%
Financial and insurance services	0.7%	0.2%	-0.5%	1.1%
Information media and telecommunications	0.2%	0.3%	+0.1%	0.5%
Rental, hiring and real estate services	0.5%	0.2%	-0.3%	0.8%
Arts and recreation services	0.5%	1.0%	+0.5%	0.9%
Other services	2.8%	3.1%	+0.3%	3.7%

Note: Based on place of usual residence.
Source: Australian Bureau of Statistics, Census of Population and Housing 2016 & 2021.

3.3.4 Employment by Occupation

Table 3.8 provides an overview of the change in occupations within Goyder LGA between 2016 and 2021.

Nearly a third of Goyder LGA residents are employed within manager positions (27.2% compared to 17.1% of Non-Metro South Australia), with nearly three-quarters of those managers working within the Agriculture, Forestry and Fishing industry. However, overall the Managers category in Goyder LGA has decreased by 1.2% between 2016 and 2021.

Blue-collar employment decreased by 1.3% between 2016 and 2021, due to a reduction of occupations within the Labourers category by 1.8%. Employment within the Sales Workers and Community and Personal Service Workers sectors experienced the greatest increases between 2016 and 2021 (+1.3% and +1.5% respectively).

Table 3.8 – Goyder LGA Proportion of Population by Occupation, 2016 – 2021

	Goyder LGA			Non-Metro South Aus
	2016	2021	Change	2021
Blue Collar: Labourers	17.7%	15.9%	-1.8%	15.4%
Machinery Operators and Drivers	8.7%	8.7%	+0.0%	8.3%
Technicians and Trades Workers	13.1%	13.6%	+0.5%	14.4%
Total Blue Collar	39.5%	38.2%	-1.3%	38.1%
White Collar: Managers	28.4%	27.2%	-1.2%	17.1%
Professionals	9.3%	8.9%	-0.4%	13.4%
Clerical and Administrative Workers	8.7%	8.8%	+0.1%	10.1%
Sales Workers	5.9%	7.2%	+1.3%	8.5%
Community and Personal Service Workers	8.2%	9.7%	+1.5%	12.8%
Total White Collar	60.5%	61.8%	+1.3%	61.9%

Note: Based on place of usual residence.
Source: Australian Bureau of Statistics, Census of Population and Housing- 2016 and 2021 Census Tables.

3.4 JOURNEY TO WORK

Tables 3.9 to 3.10 analyse the employment structure of both Goyder LGA residents and those employed within the region who live outside the LGA. The following tables are based on Journey to Work data from the 2021 Census.

3.4.1 Working within Goyder LGA

In 2021, Goyder LGA had 1,374 employed persons aged 15 years and older working within the LGA.

Table 3.9 shows that the number of locally employed residents of Goyder LGA was still higher than the number of employed persons commuting to the Goyder region for work. The highest number of commuters to Goyder LGA for work continued to come from nearby LGA's such as Barossa LGA (75) and Light LGA (71). However, commuters also travelled to the Goyder region from Adelaide (16) and the northern metropolitan councils of Playford (10) and Salisbury (23).

Table 3.9 – Goyder LGA Residential Location of Local Workers, 2021

	Residential Location of Goyder LGA Workers
Goyder LGA	**No.**
Goyder (LGA)	1,374
Barossa (C)	75
Light (C)	71
Salisbury (C)	23
Adelaide (C)	16
Playford (C)	10

Note: Based on place of usual residence.
Source: Australian Bureau of Statistics, 2021 Census of Population and Housing

3.4.2 Goyder LGA Resident Workforce

Table 3.10 provides an overview of the industries Goyder LGA residents work in 2021 (which may be within the residing area or elsewhere).

In 2021, nearly one-third of Goyder LGA residents worked within the Agriculture, Forestry and Fishing industry (29.1%) in comparison to 14.0% held by the Non-Metropolitan population.

20.2% of Goyder LGA residents worked in industrial industries (Manufacturing (7.8%), Construction (5.7%), Wholesale Trade (2.4%) and Transport, Postal & Warehousing (4.3%)), whilst half of the Goyder LGA working residents were employed in other industries (such as, Health Care and Social Assistance (9.5%), Retail Trade (8.6%) and Education and Training (6.2%)).

Residents from nearby LGA's continue to commute to Goyder LGA for work, such as, Barossa LGA (27) and Light LGA (50) and adjacent Mid Murray LGA (15) as well as metropolitan council areas such as the Cities of Playford (10) and Port Adelaide Enfield (10).

Table 3.10 – Goyder LGA Industry Sector of Employment, 2021

	Goyder (LGA)		Non-Metro. South Aust.
Industry Sector of Employment	**No.**	**%**	**%**
Agriculture, Forestry and Fishing	487	29.1%	14.0%
Industrial Industries	339	20.2%	23.1%
Other Industries	845	50.7%	62.9%
Total	*1,671*	*100.0%*	*100.0%*

Note: Based on place of usual residence.
Source: Australian Bureau of Statistics, 2021 Census of Population and Housing Census Table 2021

3.5 EMPLOYMENT TRENDS

3.5.1 Land Use

As shown in Map 3.1, the Goyder LGA is predominantly currently zoned for primary production. The town of Burra consists of commercial zoned uses along Market Street with a large historical zone in the centre of the town, with residential living and industrial uses to the north-west. The town of Eudunda is primarily residential with commercial uses located along the main road and adjacent industrial areas.

Data relating to the 'Counts of Australian Businesses' are released annually by the Australian Bureau of Statistics (ABS). The counts in this release are heavily influenced by entry and exits within Australia's small business sector, and we note that the scope of business counts is limited to businesses actively remitting in a GST role.

3.5.2 Number of Businesses

Table 3.11 and Chart 3.1 compares the change in the number of businesses within the Goyder LGA between 2019 and 2022 by employment size and industry division.

Key points to note from Table 3.11 and Chart 3.1 include:

- Goyder LGA had a total of 570 businesses in 2022, increasing by 3 businesses since 2019.

- Businesses employing nineteen or less employees accounted for 98% of total businesses in 2022, comprising 359 non-employing businesses and 197 businesses employing between one and nineteen employees.

- Agriculture, Forestry and Fishing had the most businesses operating in Goyder LGA in 2022 (311 businesses or 55% of total businesses).

Map 3.1 –Land Use

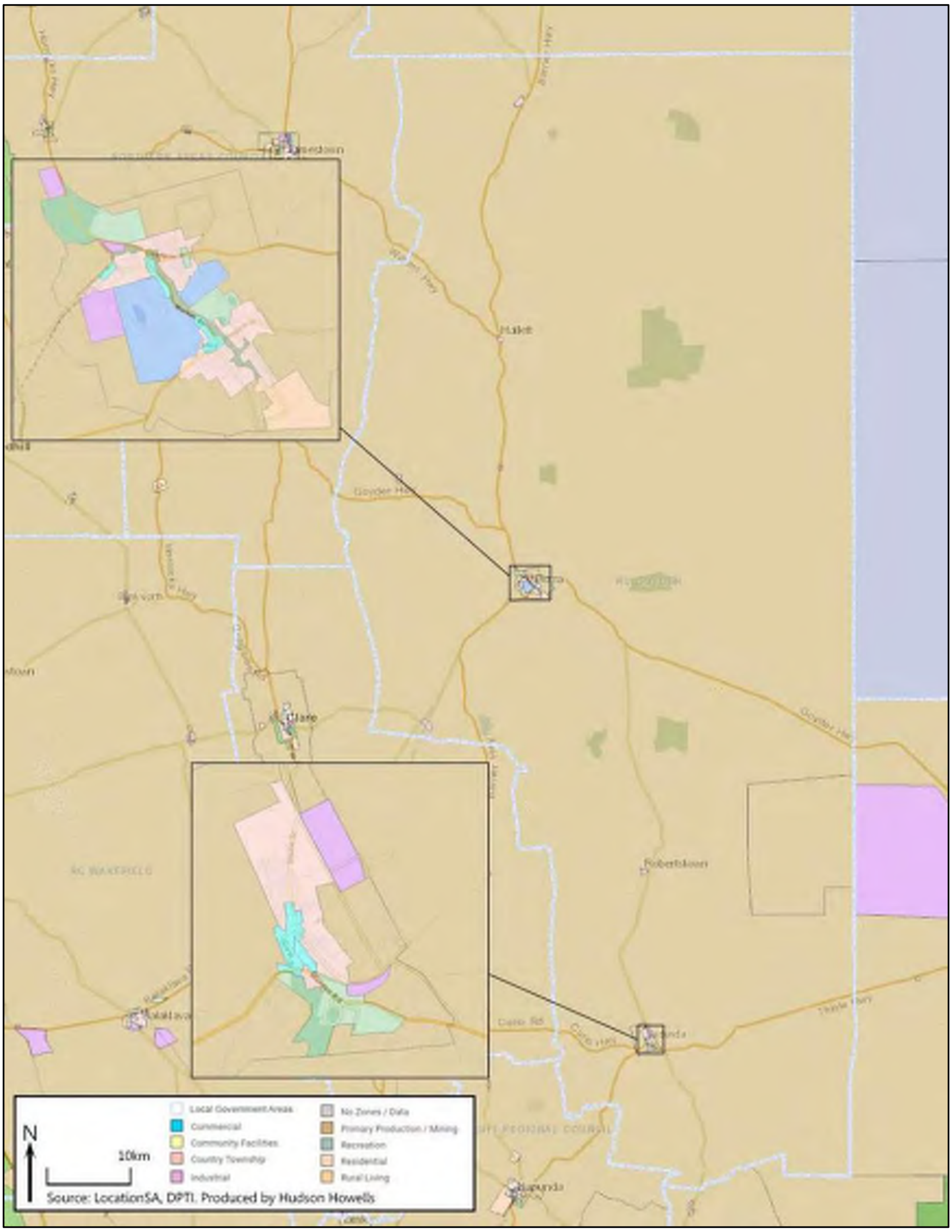
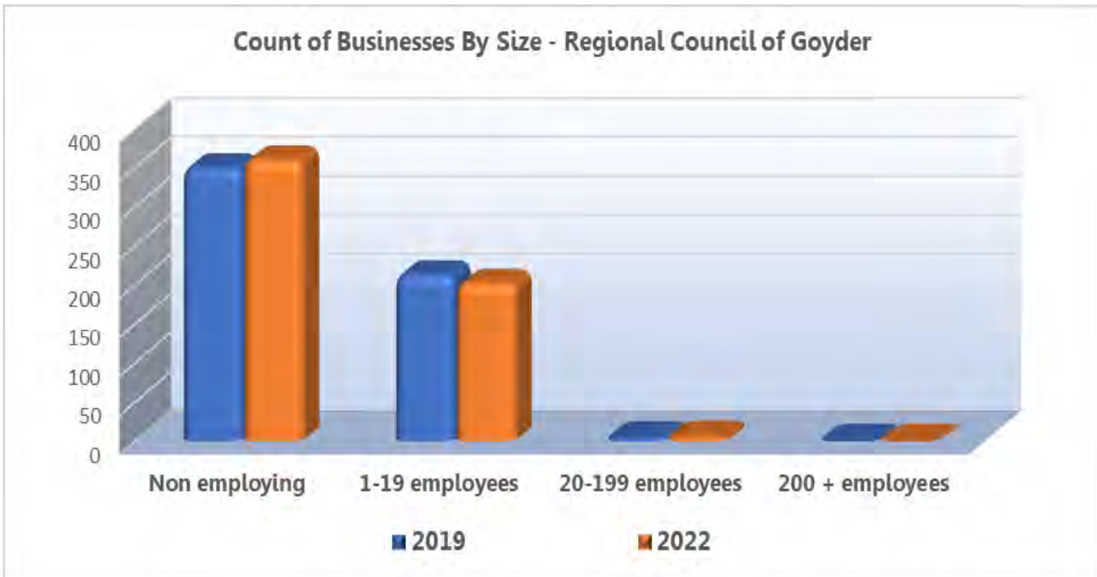


Table 3.11 – Count of Businesses by Industry and Size in Goyder LGA, 2019 – 2022

Industry	19 or less employees			Total		
	2019	2022	% change	2019	2022	% change
Agriculture, Forestry and Fishing	335	308	-8%	337	311	-8%
Construction	46	48	+4%	46	48	+4%
Rental, Hiring & Real Estate Services	40	49	+23%	39	48	+23%
Transport, Postal and Warehousing	30	29	-3%	31	31	-
Retail Trade	24	24	-	25	24	-4%
Manufacturing	12	14	+17%	13	15	+15%
Accommodation and Food Services	17	18	+6%	17	17	-
Prof., Scientific and Technical Services	14	20	+43%	14	20	+43%
Financial and Insurance Services	12	4	-67%	12	4	-67%
Wholesale Trade	8	13	+63%	8	12	+50%
Administrative and Support Services	0	5	-	3	7	+133%
Elec., Gas, Water and Waste Services	3	3	-	3	3	-
Education and Training	0	3	-	0	3	-
Arts and Recreation Services	6	0	-100%	0	3	-
Mining	0	0	-	0	0	-
Health Care and Social Assistance	0	6	-	3	8	+167%
Public Administration & Safety	3	0	-100%	3	3	-
Information Media & Telecommunications	0	0	-	0	0	-
Other Services	13	12	-8%	13	13	-
Total	*563*	*556*	*-1.2%*	*567*	*570*	*+0.5%*

Note: Excludes 'Currently unknown'.
Source: Australian Bureau of Statistics, Counts of Australian Businesses, including Entries and Exits, Cat. No. 8165.0 June 2016-June 2020 released 16 February 2021 and June 2018 to June 2022 released 16 December 2022

Chart 3.1 - Count of Businesses by Size in Goyder LGA , 2019 – 2022



Source: Australian Bureau of Statistics, Counts of Australian Businesses, including Entries and Exits, Cat. No. 8165.0 June 2016-June 2020 released 16 February 2021 and June 2018 to June 2022 released 16 December 2022

Business Turnover Levels

Table 3.12 and Chart 2.2 compares the change in the number of businesses within the Goyder LGA between 2018 and 2022 by level of turnover and industry division. Key points to note from Table 3.12 and Chart 3.2 include:

- Nearly a half of all businesses within the Goyder LGA had an annual turnover over more than $200,000 (47%), including nearly 6% or 31 businesses with an annual turnover of $2 million or more.

- The total number of businesses within turnover ranges between 2018 and 2022 have decreased by 1.2%, with those businesses with a turnover greater than $200,000 per annum decreasing by 0.4% during that period.

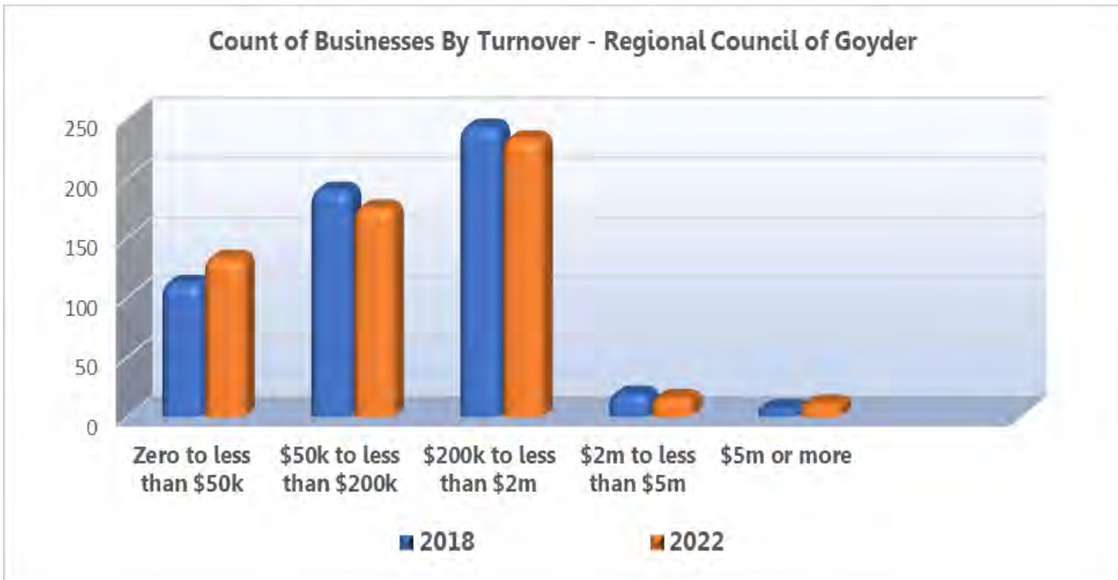
- Agriculture, Forestry and Fishing had the greatest number of businesses in the Goyder LGA with an annual turnover of more than $2 million in 2022 (16 businesses).

Table 3.12 – Count of Businesses by Industry and Turnover in Goyder LGA, 2018– 2022

	$200k+ turnover			Total		
Industry	**2018**	**2022**	**% change**	**2018**	**2022**	**% change**
Agriculture, Forestry and Fishing	183	153	-16%	339	311	-8%
Construction	18	18	-	47	48	+2%
Rental, Hiring & Real Estate Services	4	10	+150%	29	48	+66%
Transport, Postal and Warehousing	15	14	-7%	34	31	-9%
Retail Trade	14	17	+21%	29	24	-17%
Manufacturing	5	12	+140%	13	15	+15%
Prof., Scientific and Technical Services	4	9	+125%	17	20	+18%
Accommodation and Food Services	8	8	-	17	17	-
Financial and Insurance Services	0	0	-	15	4	-73%
Wholesale Trade	6	7	+17%	6	12	+100%
Administrative and Support Services	0	4	-	3	7	+133%
Elec., Gas, Water and Waste Services	3	0	-100%	5	3	-40%
Mining	0	0	-	0	0	-
Public Administration and Safety	0	0	-	3	0	-100%
Education and Training	0	3	-	0	3	-
Arts and Recreation Services	0	0	-	0	3	-
Health Care and Social Assistance	3	0	-100%	3	8	+167%
Information Media & Telecomm.	0	3	-	0	0	-
Other Services	4	8	+100%	14	13	-7%
Total	*267*	*266*	*-0.4%*	*574*	*567*	*-1.2%*

Note: Excludes 'Currently unknown'.
Source: Australian Bureau of Statistics, Counts of Australian Businesses, including Entries and Exits, Cat. No. 8165.0 – June 2014 – June 2018 released 21 February 2019 and June 2018 – June 2022 released 16 December 2022

Chart 3.2 - Count of Businesses by Turnover in Goyder LGA, 2018 – 2022



Source: Australian Bureau of Statistics, Counts of Australian Businesses, including Entries and Exits, Cat. No. 8165.0 – June 2014 – June 2018 released 21 February 2019 and June 2018 – June 2022 released 16 December 2022

3.6 TOWNSHIP SERVICES

In addition to accommodation, workers locating temporarily to the Study Area will require a wide range of other convenience services, and the project will also need to source trade and other services from businesses located in the immediate region. This section provides an overview of the services located in the main townships in the Goyder region of the Study Area.

The Regional Council of Goyder contains the townships of Burra, Eudunda, Hallett, Robertstown, and Terowie, in addition to a number of smaller localities.

Burra (154 kilometres north east of Adelaide) and Eudunda (103 kilometres north east of Adelaide) serve as the major service centres for the region and, in addition to Kapunda, will be sources of services available to support the proposed wind farm project. Burra is located approximately 70 kilometres north of the project site, while Eudunda is located approximately 20 kilometres north east of the site.

Burra offers a range of regional services including:

- Accommodation options including country hotel, motor inn, caravan park and self-contained cottages.

- Home hardware (Thrifty-Link).
- Hotels (5 including Mount Bryan).
- Restaurants and cafes.
- Major banks and postal services.
- Medical and emergency services (Burra Hospital and medical practices).
- Main street retail.
- Automotive and mechanical services.
- Tourism and related services in Burra and the surrounding region.
- Recreation facilities including the Burra Regional Art Gallery, Golf Course, Swimming Pool, Lawn Bowls and Tennis Courts, Walking and Cycling Trails

Eudunda offers a range of regional services including:

- Accommodation options including country hotel (Eudunda and Light), motel and bed and breakfast.
- Hotels (2 – Eudunda and Light).
- Bank (1) and postal services.
- Hardware services.
- Main street retail and café services.
- Main street retail.
- Automotive and mechanical services.
- Tourism and related services in Eudunda and the surrounding region.
- Recreation facilities including Health and Fitness Centre, Swimming Pool, 9-Hole Golf Course and Walking Trails.

4 ECONOMIC IMPACT ASSESSMENT

The objectives of the economic impact assessment include:

- An economic assessment of the Twin Creek Wind Farm Project in terms of economic benefits to local communities of the LGA's of Goyder and Light, the broader region of Barossa and Lower North (ABS regions) and also to the state of South Australia. It is recognised that transmission lines will travel through the Mid Murray Council region (to Truro) but there will be little socio economic impact on this region.

- An assessment of the associated benefits of offsetting carbon by displacing the need for further non-renewable generation development, such as coal or gas fired power stations.

In addition to the above, consideration is given in this assessment to the potential impact of the project on local property values.

This paper does not consider the impact of investment and supply conditions for renewable energies on the underlying energy market and prices. This is a complex issue and beyond the scope of this project.

4.1 Project Assumptions

The economic modelling undertaken for this project is based on the following expenditure estimates supplied by the project proponent for construction and operation of the Twin Creek Wind Farm. These estimates reflect the current project model as at September 2023.and may be subject to change as the project evolves:

- Total wind farm nominal capacity of 270 megawatts.

- Total construction cost of $4.7 million per megawatt - $860 million apportioned over 2 years as follows:
  - Year 1 – 84%
  - Year 2 – 16%

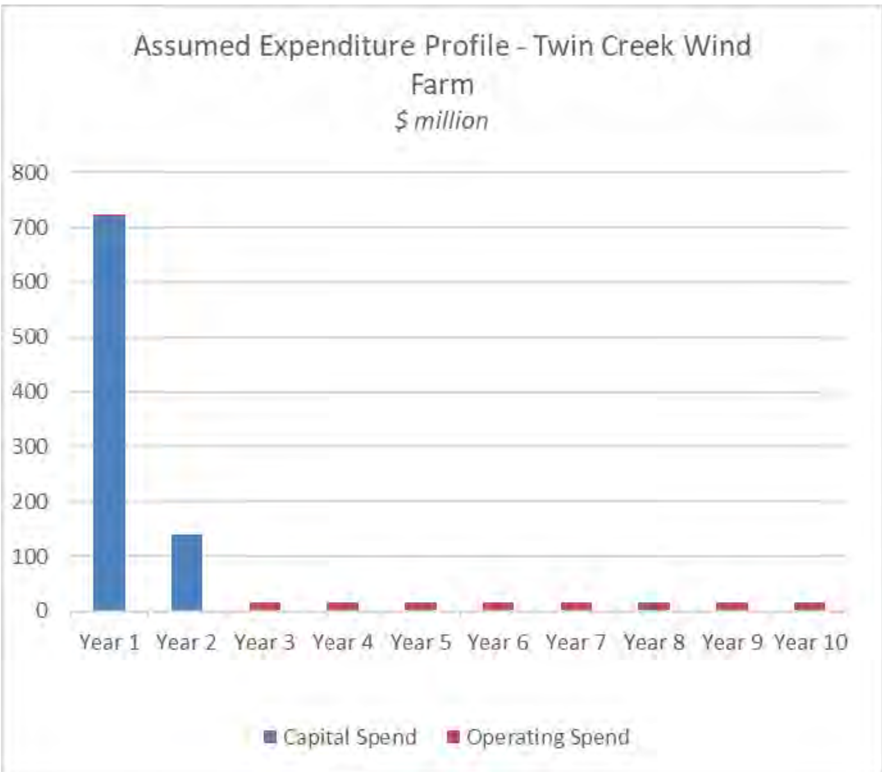
- The total construction cost of $860 million includes all construction and associated works, with assumptions as to the nature of the spend based on other studies undertaken by Hudson Howells as follows:

    - WTG supply & install (%) - 65.0%
    - U/g reticulation (%) - 6.0%
    - Civil works - 7.5%
    - Substation (%) - 6.0%
    - Network connection (%) - 14.0%
    - O&M compound & car parking (%) - 1.5%

- Annual operating costs assuming average utilisation are based on $83 per megawatt hour - $18.03 million per annum.

An indicative time line of the expenditure profile is provided in Chart 4.1 below.

Chart 4.1



4.2 Broad Project Methodology

This economic impact assessment focuses on the effect of the Twin Creek Wind Farm Project on regional and local incomes and employment associated with the construction and operating phases of the project. This effect arises through the primary expenditure directly associated with the project, and then from further 'rounds' of indirect expenditure that this direct expenditure stimulates as it flows to supplying industries and into incomes and consumption.

The importance of the construction and operating expenditure identified above is that it will sustain turnover in local industry and will support local jobs and incomes. The use of economic impact assessments based on State and Regional Input Output Tables has been a prominent process[10] for translating directly created expenditure (a final demand stimulus) into jobs and incomes, and for establishing the extent of the flow-on impacts. Overall the methodology used here is similar that which has been used internationally in other jurisdictions to look at regional economic impacts of wind farms[11].

The use of these Input Output tables allows an assessment of the impact of a certain event or events (in this case the Twin Creek Wind Farm Project) on the incomes (value added or Gross State/Regional Product) and employment of a specified region or regions. This is consistent with national accounting frameworks.

The assessment for this project looks at the impact across 4 regions:

- The local impact – measured in terms of the contribution in the LGA's of Goyder and Light individually.

- The broader region, as defined by the ABS in its regional definitions of Barossa and Lower North.

- The state of South Australia – it should be noted that this region is inclusive of the regions above and the estimates of economic activity in the region are not additive to that of the state.

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[10] Alternative economy wide models are available, including econometric models or CGE models. Input-Output models are general equilibrium models in that the impacts of one sector are considered across the broader economy, but they assume infinite elasticity of supply. The other models include the impact of resource constraints (under varying assumptions). The evidence suggests that at the regional and state geographic levels such constraints are minimal in a long run perspective – as capital and labour can flow relatively easily across borders, and as such input output provides an appropriate methodology.

[11] See for example Michael C. Slattery, Eric Lantz , Becky L. Johnson State and Local Economic Impacts from Wind Energy Projects: Texas Case Study, Energy Policy 39 (2011) 7930–7940.

The analysis develops estimates of economic impact for the regions based on indicative input-output tables developed for the regions above. The tables at the state level have been derived using a 2023/24 South Australian input output table[12], and using the location quotient method (based on regional employment data for the relevant regions from the 2021 2020/21 labour force survey and the 2021 Census and including 2020/21 national accounts data). The table is then updated to 2023/24 adjusting for actual and expected inflation. The tables for the Barossa and Lower North region also used the location quotient method, based on the state table, while the local table is based (using the location quotient method) on the regional table.

4.3 Economic Assessment

This section details the economic impact assumptions and findings of the project assuming certain levels of direct supply from local industry. It is assumed that a significant component of the equipment is imported and much of the local spend being on transport and assembly.

4.3.1 Core Assumptions

Tables 4.1 and 4.2 below show the assumptions for capital and operating expenditure by category and source. The assumed distributions are based on the nature of the spend and specific assumptions regarding the expenditure profiles for the state, region and LGAs. It should be noted that the major assumption that impacts economic outcomes is the percentage of imported material. The distribution of local product to other sectors is not as critical (in an order of magnitude perspective).

Table 4.1 presents the assumptions in terms of the broad basis of expenditure (i.e. nature of expenditure). The payment to labour is also assumed to include commercial arrangements with respect to landowners impacted by the project. The capital spend of $860 million that occurs in the areas (including the state) is based on assumptions that the project development and operations involve maximising the commitment to local supply. It is assumed that 15% of that will be spent in each of the local areas – some to construction contractors, some to light metal manufacturing, some to transport but most ($35 million over two years) to labour in the construction process. While the project mostly sits in the Light area, it is assumed that it will draw labour and services/inputs from across the two councils

[12] The tables for this study have been developed using the 2020/21 national input output table as prepared by the ABS as a base. This table has been contracted to 28 sectors, defining sectors that are relevant5 to energy and infrastructure projects

(permanent and temporary residents for the construction period and from elsewhere in the state, and in the case of specialist labour, outside the state).

Table 4.2 extends the detail of the distribution of supply chain expenditures (i.e. purchasing of inputs, and the regional spend of wages) to match the 28 sector Input Output Tables that have been developed for this project. The spend of labour wages and salaries is allocated first as a direct contribution (including margins on labour, and oncosts) which is not included in the table which shows first round inputs. The direct contribution added to the supply chain assumptions and is additionally distributed based on the average consumption vector from the respective regions with an allowance for the labour being drawn from broader regions and as such some of these spend being directed outside of the nominated region. The table also involves the conversion of these values from purchasers' prices to basic prices, as the raw data for construction etc. includes margins, taxes and subsidies. All monetary values in Input Output models are expressed as basic values. The prime differences between purchaser prices and basic values are that:

- Basic values exclude the cost of transport and wholesale and retail trade embedded in the purchase price (and allocate these to the transport and trade sectors).

- GST will be allocated to Gross Operating Surplus

The core assumptions to make the adjustments from purchaser price distributions to basic values are:

- The average value added in each of the industry sectors is extracted and then the GST component (at 10% - which is only paid on the value added) is deducted and separately identified – assumed to be spent equally on public administration, health and education.

- The purchaser price is adjusted for the average margin for wholesale, retail and transport sectors, as identified in national Input Output tables.

Table 4.1 - Assumed Expenditure Distributions

	Capital				Operating			
	Goyder	Light	Region	State	Goyder	Light	Region	State
Building Construction	2.0%	2.0%	7.5%	15.0%	2.0%	2.0%	10.0%	15.0%
Fabricated metals	1.0%	1.0%	5.0%	10.0%	1.0%	1.0%	5.0%	5.0%
Transport	2.0%	2.0%	5.0%	10.0%	2.0%	2.0%	2.5%	2.5%
Spend of Labour	10.0%	10.0%	25.0%	30.0%	30.0%	25.0%	65.0%	70.0%
Imports	85.0%	85.0%	57.5%	35.0%	65.0%	70.0%	17.5%	7.5%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Source: Assumptions

Table 4.2 - Assumed Supply Chain Expenditure Distributions in Basic Values

	Capital Spend				Operating Spend			
	Goyder	Light	Region	State	Goyder	Light	Region	State
Agriculture, Forestry and Fishing	0.0%	0.0%	0.1%	0.2%	0.2%	0.1%	0.5%	0.7%
Mining	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.2%	0.2%
Non transport equipment manufacturing	0.9%	0.9%	4.6%	9.3%	0.9%	1.0%	4.7%	4.8%
Other Manufacturing	0.1%	0.1%	0.9%	1.5%	1.1%	0.9%	3.2%	4.5%
Electricity generation	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.2%	0.2%
Electricity transmission, distribution and sale	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.3%	0.4%
Other energy	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Water and Waste	0.0%	0.0%	0.1%	0.2%	0.1%	0.1%	0.4%	0.6%
Residential Building Construction	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Non-Residential Building Construction	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Heavy and Civil Engineering Construction	1.9%	1.9%	7.0%	14.0%	1.9%	1.9%	9.3%	14.0%
Construction Services	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%
Wholesale Trade	0.1%	0.1%	0.4%	0.8%	0.5%	0.4%	1.5%	2.3%
Retail Trade	0.2%	0.2%	1.0%	2.0%	1.2%	1.0%	3.6%	6.1%
Acccommodation and Food Services	0.1%	0.1%	0.6%	1.1%	0.6%	0.5%	2.3%	3.4%
Road transport	1.9%	1.9%	4.7%	9.4%	2.0%	2.0%	2.7%	2.9%
Other transport	0.0%	0.0%	0.1%	0.2%	0.1%	0.1%	0.3%	0.7%
Information Media & Telecommunications	0.0%	0.0%	0.1%	0.3%	0.1%	0.1%	0.3%	1.0%
Finance & Insurance Services	0.0%	0.0%	0.3%	1.1%	0.2%	0.3%	1.0%	3.3%
Ownership of dwellings	0.4%	0.4%	2.3%	3.8%	2.7%	2.3%	8.3%	11.5%
Property Services	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Professional, scientific & technical services	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.3%
Administrative services	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%	0.1%	0.2%
Public administration and safety	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Education & Training	0.0%	0.1%	0.4%	0.7%	0.4%	0.4%	1.4%	2.1%
Health care and social assistance	0.1%	0.1%	0.5%	1.2%	0.5%	0.6%	2.0%	3.6%
Arts, sport and recreation	0.0%	0.0%	0.1%	0.3%	0.1%	0.1%	0.4%	0.8%
Other Services	0.0%	0.1%	0.3%	0.6%	0.3%	0.4%	1.1%	1.8%
GST	0.5%	0.5%	2.1%	4.1%	1.3%	1.2%	4.1%	6.2%
Total	**6.2%**	**6.4%**	**26.0%**	**51.4%**	**14.3%**	**13.4%**	**48.3%**	**71.8%**

Source: Assumptions

4.3.2 Modelling Results – State Level Outcomes

Tables 4.3 – 4.5 below show the results of using the resultant expenditure distribution as an exogenous shock to the Input Output Table for South Australia with the aggregated expenditures, in the context that they would represent an increase in final demand[13], and distributed as per Table 4.2 through the Input Output Table. Tables 4.3 and 4.4 show the detailed outcomes – with the level of activity generated by industry sector. Table 4.5 provides a summary of the outcomes.

The modelling indicates that the project will generate $662 million of value added[14] (incomes created or contribution to Gross State Product) in the State of South Australia over the period

[13] This analysis assesses the contribution of the project in isolation. It does not compare the project with other possible projects, and nor does it investigate the change in expenditure levels at existing energy providers, as this project takes on market share – although this is expected to be negligible given the fixed cost context of the industry.
[14] Contribution to Gross State or Regional Product (GSP/GRP) – and defined as the returns to labour and the returns to capital as per the national accounting framework.

of construction and that this would happen over two years (allowing for lagged flow through effects). 3,178 person years[15] of employment would be supported – or an average of 1,589 jobs sustained per year over two years. Once operational the project is estimated to support annually $20.7 million of incomes, and support directly and indirectly in the order of 91 jobs per year.

Table 4.3 - Estimates of Economic Activity by Sector Related to Aggregate Capital Spend for South Australia – Outcomes Over Life of Project

(Note employment should be interpreted as person years of employment rather than number of jobs at a point of time - See earlier definitions of person years of employment)

	Expend-iture ($m)	Value Added ($m)			Compensation of Employment ($m)			Employment (FTE's)		
		Direct	Induced	Total	Direct	Induced	Total	Direct	Induced	Total
On-site activity		$258.00		$258.00	$154.80		$258.00	968		968
Agriculture, Forestry and Fishing	$1.93	$0.78	$7.93	$8.70	$0.17	$1.78	$1.95	4	37	41
Mining	$0.71	$0.26	$5.76	$6.02	$0.09	$1.99	$2.08	1	16	16
Non transport equipment manufacturing	$80.09	$26.86	$1.05	$27.91	$18.73	$0.73	$19.47	206	8	214
Other Manufacturing	$12.89	$2.65	$14.52	$17.18	$1.81	$9.92	$11.73	19	105	124
Electricity generation	$0.65	$0.15	$0.57	$0.73	$0.05	$0.20	$0.25	0	1	2
Electricity transmission, distribution and sale	$1.17	$0.44	$3.46	$3.90	$0.11	$0.90	$1.02	1	6	6
Other energy	$0.06	$0.05	$0.22	$0.27	$0.02	$0.07	$0.08	0	0	0
Water and Waste	$1.78	$0.78	$4.54	$5.33	$0.25	$1.44	$1.69	2	10	12
Residential Building Construction	$0.01	$0.00	$1.19	$1.19	$0.00	$0.50	$0.51	0	9	9
Non-Residential Building Construction	$0.01	$0.00	$0.83	$0.83	$0.00	$0.41	$0.41	0	5	5
Heavy and Civil Engineering Construction	$120.32	$33.49	$0.06	$33.55	$15.40	$0.03	$15.43	148	0	149
Construction Services	$0.28	$0.07	$14.36	$14.43	$0.04	$7.18	$7.22	1	109	109
Wholesale Trade	$6.51	$3.01	$14.56	$17.56	$1.81	$8.75	$10.56	11	55	66
Retail Trade	$17.44	$8.54	$17.02	$25.57	$5.82	$11.60	$17.42	85	170	255
Acccommodation and Food Services	$9.68	$3.94	$7.58	$11.52	$2.55	$4.89	$7.44	51	97	148
Road transport	$80.52	$34.56	$6.24	$40.80	$18.73	$3.38	$22.12	225	41	266
Other transport	$2.12	$0.73	$7.90	$8.63	$0.42	$4.49	$4.91	4	45	49
Information Media & Telecommunications	$2.74	$1.04	$5.69	$6.72	$0.38	$2.09	$2.47	3	17	20
Finance & Insurance Services	$9.43	$5.03	$25.08	$30.11	$1.46	$7.27	$8.73	11	53	64
Ownership of dwellings	$32.99	$23.81	$33.05	$56.86	$0.00	$0.00	$0.00	0	0	0
Property Services	$0.00	$0.00	$8.35	$8.35	$0.00	$3.00	$3.00	0	23	24
Professional, scientific & technical services	$0.85	$0.33	$24.30	$24.63	$0.25	$18.43	$18.68	3	198	201
Administrative services	$0.54	$0.25	$11.98	$12.24	$0.23	$10.97	$11.20	2	76	78
Public administration and safety	$0.17	$0.09	$4.22	$4.30	$0.07	$3.31	$3.38	1	27	27
Education & Training	$6.02	$3.75	$5.76	$9.51	$3.30	$5.06	$8.36	27	41	68
Health care and social assistance	$10.20	$6.22	$9.15	$15.37	$5.72	$8.41	$14.13	45	66	112
Arts, sport and recreation	$2.39	$0.70	$1.54	$2.24	$0.48	$1.05	$1.54	9	19	28
Other Services	$5.25	$1.99	$7.45	$9.44	$0.82	$6.77	$7.59	25	93	118
Total	**$406.75**	**$417.54**	**$244.36**	**$661.90**	**$233.50**	**$124.63**	**$461.33**	**1,849**	**1,329**	**3,178**

Source: Modelled Result

[15] Person years are the number of full time annual job equivalents over the period of construction.

Table 4.4 - Estimates of Annual Economic Activity by Sector Related to Operating Spend for South Australia

	Expend-iture ($m)	Value Added ($m)			Compensation of Employment ($m)			Employment (FTE's)		
		Direct	Induced	Total	Direct	Induced	Total	Direct	Induced	Total
On-site activity		$10.64		$10.64	$6.39		10.64455	39.9		39.9
Agriculture, Forestry and Fishing	$0.10	$0.04	$0.22	$0.26	$0.01	$0.05	$0.06	0.2	1.0	1.2
Mining	$0.04	$0.01	$0.15	$0.16	$0.00	$0.05	$0.05	0.0	0.4	0.4
Non transport equipment manufacturing	$0.73	$0.24	$0.03	$0.27	$0.17	$0.02	$0.19	1.9	0.2	2.1
Other Manufacturing	$0.68	$0.14	$0.32	$0.46	$0.10	$0.22	$0.31	1.0	2.3	3.3
Electricity generation	$0.03	$0.01	$0.01	$0.02	$0.00	$0.00	$0.01	0.0	0.0	0.0
Electricity transmission, distribution and sale	$0.06	$0.02	$0.09	$0.12	$0.01	$0.02	$0.03	0.0	0.2	0.2
Other energy	$0.00	$0.00	$0.01	$0.01	$0.00	$0.00	$0.00	0.0	0.0	0.0
Water and Waste	$0.09	$0.04	$0.11	$0.15	$0.01	$0.03	$0.05	0.1	0.2	0.3
Residential Building Construction	$0.00	$0.00	$0.03	$0.03	$0.00	$0.01	$0.01	0.0	0.2	0.2
Non-Residential Building Construction	$0.00	$0.00	$0.02	$0.02	$0.00	$0.01	$0.01	0.0	0.1	0.1
Heavy and Civil Engineering Construction	$2.13	$0.59	$0.00	$0.59	$0.27	$0.00	$0.27	2.6	0.0	2.6
Construction Services	$0.01	$0.00	$0.31	$0.31	$0.00	$0.15	$0.16	0.0	2.3	2.4
Wholesale Trade	$0.35	$0.16	$0.31	$0.47	$0.10	$0.19	$0.28	0.6	1.2	1.8
Retail Trade	$0.93	$0.45	$0.37	$0.83	$0.31	$0.25	$0.56	4.5	3.7	8.3
Acccommodation and Food Services	$0.51	$0.21	$0.17	$0.38	$0.14	$0.11	$0.25	2.7	2.2	4.9
Road transport	$0.44	$0.19	$0.13	$0.32	$0.10	$0.07	$0.18	1.2	0.9	2.1
Other transport	$0.11	$0.04	$0.17	$0.21	$0.02	$0.10	$0.12	0.2	1.0	1.2
Information Media & Telecommunications	$0.15	$0.06	$0.14	$0.20	$0.02	$0.05	$0.07	0.2	0.4	0.6
Finance & Insurance Services	$0.50	$0.27	$0.64	$0.91	$0.08	$0.19	$0.26	0.6	1.4	1.9
Ownership of dwellings	$1.75	$1.26	$0.75	$2.02	$0.00	$0.00	$0.00	0.0	0.0	0.0
Property Services	$0.00	$0.00	$0.22	$0.22	$0.00	$0.08	$0.08	0.0	0.6	0.6
Professional, scientific & technical services	$0.04	$0.02	$0.53	$0.55	$0.01	$0.40	$0.41	0.1	4.3	4.5
Administrative services	$0.03	$0.01	$0.29	$0.31	$0.01	$0.27	$0.28	0.1	1.9	1.9
Public administration and safety	$0.01	$0.00	$0.08	$0.09	$0.00	$0.06	$0.07	0.0	0.5	0.6
Education & Training	$0.32	$0.20	$0.13	$0.33	$0.18	$0.12	$0.29	1.4	1.0	2.4
Health care and social assistance	$0.54	$0.33	$0.21	$0.54	$0.30	$0.20	$0.50	2.4	1.6	3.9
Arts, sport and recreation	$0.13	$0.04	$0.04	$0.08	$0.03	$0.03	$0.05	0.5	0.5	0.9
Other Services	$0.28	$0.11	$0.14	$0.25	$0.04	$0.16	$0.20	1.3	1.8	3.1
Total	**$9.97**	**$15.10**	**$5.62**	**$20.72**	**$8.30**	**$2.84**	**$15.40**	**61.7**	**29.8**	**91.5**

Source: Modelled Result

Table 4.5 - Estimates of Economic Activity for South Australia

	Total GSP Impact (3 yrs)	Average Annual GSP Impact	Total Jobs Impact (Person Years - over 2 yrs)	Average Annual Jobs Impact
Construction Phase				
Direct and first round	$417.5 million	$208.8 million	1,849	925
Indirect	$244.4 million	$122.2 million	1,329	664
Total	*$661.9 million*	*$331 million*	*3,178*	*1,589*
Operating Phase				
Direct and first round		$15.1 million		62
Indirect		$5.6 million		30
Total		*$20.7 million*		*92*

Source: Modelled Result
**Full Time Equivalent Jobs*
Note – these numbers are rounded versions of the numbers in the tables above, as the modelling should be interpreted in terms of order of magnitude, but it means that not all numbers are exactly additive.

It should be noted that the impact at the national level would be similar to that estimated for the State level, unless there are constraints in national labour and capital markets. Such constraints would reduce the level of impact, with the project drawing resources into South

Australia and out of other states. If such constraints existed (i.e. at extended times with very low unemployment rates, or where the project might have significant effects on exchange rates) the national outcomes would be best modelled using a CGE model to allow for those constraints, but in the context of the current national economy, it is reasonable to assume the constraints are not severe.

4.3.3 Modelling Results – Barossa-Lower North Region Outcomes

Tables 4.6 – 4.8 below show the results of applying the regional expenditures as per Table 4.4 above to the regional Input Output Table for the Barossa-Lower North Region. It should be noted these results are inclusive in the South Australia results.

Tables 4.6 and 4.7 show the detailed outcomes with the level of activity generated by industry sector, while Table 4.8 provides a summary of the outcomes.

From a regional perspective, the modelling indicates that the project will generate $285 million of value added (incomes created or contribution to Gross Regional Product) in the region over the period of construction and, again allowing for lagged flow through effects, this would happen over two years. 1,652 person years of employment would be supported, or again an average of 826 jobs sustained per year over two years. Once operational the project is estimated to support annually $11.2 million of incomes in the region, and support directly and indirectly (including the induced impact) approximately 63 jobs per year.

Table 4.6 - Estimates of Economic Activity by Sector Related to Aggregate Capital Spend for the Barossa-Lower North Region – Outcomes Over Life of Project

(Note that employment should be interpreted as person years of employment rather than number of jobs at a point of time)

	Expend-	Value Added ($m)			Compensation of Employment ($m)			Employment (FTE's)		
	iture ($m)	Direct	Induced	Total	Direct	Induced	Total	Direct	Induced	Total
On-site activity		**$129.00**		$129.00	$129.00		$129.00	806.3		806.3
Agriculture, Forestry and Fishing	$1.15	$0.46	$3.36	$3.82	$0.10	$0.75	$0.86	2.2	15.9	18.0
Mining	$0.42	$0.15	$2.48	$2.64	$0.05	$0.86	$0.91	0.4	6.8	7.2
Non transport equipment manufacturing	$39.97	$13.41	$0.05	$13.46	$9.35	$0.04	$9.39	102.6	0.4	103.0
Other Manufacturing	$7.67	$1.58	$6.08	$7.66	$1.08	$4.15	$5.23	11.4	43.8	55.1
Electricity generation	$0.38	$0.09	$0.22	$0.31	$0.03	$0.08	$0.11	0.2	0.5	0.7
Electricity transmission, distribution and sale	$0.64	$0.24	$1.21	$1.45	$0.06	$0.32	$0.38	0.4	2.0	2.4
Other energy	$0.02	$0.02	$0.05	$0.07	$0.01	$0.02	$0.02	0.0	0.0	0.0
Water and Waste	$1.06	$0.47	$1.69	$2.16	$0.15	$0.54	$0.69	1.1	3.8	4.9
Residential Building Construction	$0.00	$0.00	$0.49	$0.49	$0.00	$0.21	$0.21	0.0	3.7	3.7
Non-Residential Building Construction	$0.00	$0.00	$0.27	$0.27	$0.00	$0.13	$0.13	0.0	1.7	1.7
Heavy and Civil Engineering Construction	$60.16	$16.74	-$0.03	$16.72	$7.70	-$0.01	$7.69	74.2	-0.1	74.1
Construction Services	$0.15	$0.04	$5.82	$5.86	$0.02	$2.91	$2.93	0.3	44.0	44.3
Wholesale Trade	$3.59	$1.66	$5.45	$7.10	$1.00	$3.28	$4.27	6.2	20.5	26.7
Retail Trade	$8.49	$4.16	$5.40	$9.56	$2.83	$3.68	$6.51	41.5	53.8	95.3
Acccommodation and Food Services	$5.37	$2.19	$2.60	$4.79	$1.41	$1.68	$3.09	28.1	33.3	61.4
Road transport	$40.42	$17.35	$2.58	$19.93	$9.41	$1.40	$10.80	113.2	16.8	130.0
Other transport	$0.82	$0.28	$1.98	$2.26	$0.16	$1.12	$1.28	1.6	11.2	12.8
Information Media & Telecommunications	$0.82	$0.31	$0.95	$1.26	$0.11	$0.35	$0.46	0.9	2.9	3.8
Finance & Insurance Services	$2.34	$1.25	$3.79	$5.04	$0.36	$1.10	$1.46	2.6	8.0	10.7
Ownership of dwellings	$19.64	$14.17	$12.28	$26.45	$0.00	$0.00	$0.00	0.0	0.0	0.0
Property Services	$0.00	$0.00	$1.72	$1.72	$0.00	$0.62	$0.62	0.0	4.8	4.8
Professional, scientific & technical services	$0.22	$0.09	$3.78	$3.87	$0.06	$2.87	$2.93	0.7	30.9	31.6
Administrative services	$0.32	$0.15	$4.05	$4.20	$0.14	$3.70	$3.84	1.0	25.8	26.8
Public administration and safety	$0.07	$0.03	$1.01	$1.04	$0.03	$0.79	$0.82	0.2	6.4	6.6
Education & Training	$3.40	$2.12	$2.01	$4.13	$1.87	$1.77	$3.63	15.3	14.4	29.7
Health care and social assistance	$4.61	$2.81	$2.54	$5.36	$2.59	$2.34	$4.92	20.4	18.5	38.9
Arts, sport and recreation	$0.92	$0.27	$0.35	$0.62	$0.18	$0.24	$0.42	3.3	4.3	7.6
Other Services	$2.59	$0.98	$2.50	$3.48	$0.33	$2.46	$2.80	12.2	31.2	43.4
Total	**$205.26**	**$210.03**	**$74.68**	**$284.70**	**$168.03**	**$37.37**	**$205.40**	**1246.3**	**405.3**	**1651.6**

Source: Modelled Result

Table 4.7 - Estimates of Annual Economic Activity by Sector Related to Operating Spend for the Barossa-Lower North Region

	Expend-iture ($m)	Value Added ($m)			Compensation of Employment ($m)			Employment (FTE's)		
		Direct	Induced	Total	Direct	Induced	Total	Direct	Induced	Total
On-site activity		$5.93		$5.93	$5.93		$5.93	37.1		37.1
Agriculture, Forestry and Fishing	$0.07	$0.02	$0.14	$0.16	$0.00	$0.03	$0.03	0.1	0.6	0.7
Mining	$0.03	$0.00	$0.09	$0.10	$0.00	$0.03	$0.03	0.0	0.2	0.3
Non transport equipment manufacturing	$0.71	$0.06	$0.19	$0.24	$0.01	$0.16	$0.17	1.8	0.0	1.9
Other Manufacturing	$0.49	$0.05	$0.23	$0.28	$0.00	$0.19	$0.19	0.7	1.3	2.0
Electricity generation	$0.02	$0.01	$0.01	$0.01	$0.00	$0.00	$0.00	0.0	0.0	0.0
Electricity transmission, distribution and sale	$0.04	$0.01	$0.05	$0.06	$0.00	$0.02	$0.02	0.0	0.1	0.1
Other energy	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Water and Waste	$0.07	$0.01	$0.08	$0.08	$0.00	$0.03	$0.03	0.1	0.1	0.2
Residential Building Construction	$0.00	$0.00	$0.01	$0.01	$0.00	$0.01	$0.01	0.0	0.1	0.1
Non-Residential Building Construction	$0.00	$0.00	$0.01	$0.01	$0.00	$0.00	$0.00	0.0	0.1	0.1
Heavy and Civil Engineering Construction	$1.42	$0.39	$0.00	$0.39	$0.01	$0.17	$0.18	1.7	0.0	1.7
Construction Services	$0.01	$0.00	$0.16	$0.17	$0.00	$0.08	$0.08	0.0	1.3	1.3
Wholesale Trade	$0.23	$0.06	$0.20	$0.26	$0.00	$0.16	$0.16	0.4	0.6	1.0
Retail Trade	$0.55	$0.13	$0.30	$0.43	$0.00	$0.29	$0.29	2.7	1.6	4.2
Acccommodation and Food Services	$0.35	$0.07	$0.15	$0.22	$0.00	$0.14	$0.14	1.8	1.0	2.8
Road transport	$0.42	$0.06	$0.20	$0.25	$0.00	$0.14	$0.14	1.2	0.5	1.7
Other transport	$0.05	$0.01	$0.07	$0.07	$0.00	$0.04	$0.04	0.1	0.3	0.4
Information Media & Telecommunications	$0.05	$0.00	$0.05	$0.05	$0.00	$0.02	$0.02	0.1	0.1	0.2
Finance & Insurance Services	$0.15	$0.03	$0.18	$0.21	$0.00	$0.06	$0.06	0.2	0.3	0.4
Ownership of dwellings	$1.26	$0.37	$0.91	$1.28	$0.00	$0.00	$0.00	0.0	0.0	0.0
Property Services	$0.00	$0.00	$0.06	$0.06	$0.00	$0.02	$0.02	0.0	0.2	0.2
Professional, scientific & technical services	$0.01	$0.01	$0.11	$0.11	$0.00	$0.09	$0.09	0.0	0.9	0.9
Administrative services	$0.02	$0.01	$0.13	$0.14	$0.00	$0.13	$0.13	0.1	0.8	0.9
Public administration and safety	$0.00	$0.00	$0.03	$0.03	$0.00	$0.02	$0.02	0.0	0.2	0.2
Education & Training	$0.22	$0.04	$0.15	$0.20	$0.00	$0.17	$0.17	1.0	0.4	1.4
Health care and social assistance	$0.30	$0.04	$0.22	$0.26	$0.00	$0.24	$0.24	1.3	0.6	1.9
Arts, sport and recreation	$0.06	$0.00	$0.03	$0.03	$0.00	$0.02	$0.02	0.2	0.1	0.4
Other Services	$0.17	$0.00	$0.13	$0.13	$0.00	$0.10	$0.10	0.8	0.8	1.6
Total	**$6.71**	**$7.29**	**$3.89**	**$11.19**	**$5.96**	**$2.36**	**$8.33**	**51.5**	**12.1**	**63.6**

Source: Modelled Result

Table 4.8 - Estimates of Economic Activity for the Barossa-Lower North Region

	Total GSP Impact (3 yrs)	Average Annual GSP Impact	Total Jobs Impact (Person Years - over 2 yrs)	Average Annual Jobs Impact
Construction Phase				
Direct and first round	$210 million	$105 million	1,246	623
Indirect	$74.7 million	$37.3 million	405	203
Total	*$284.7 million*	*$142.4 million*	*1,652*	*826*
Operating Phase				
Direct and first round		$7.3 million		51
Indirect		$3.9 million		12
Total		*$11.2 million*		*63*

Source: Modelled Result
Note – these numbers are rounded versions of the numbers in the tables above, as the modelling should be interpreted in terms of order of magnitude, but it means that not all numbers are exactly additive.

4.3.4 Modelling Results – LGA's of Goyder and Light

Tables 4.9 – 4.11 below show the results of applying the expenditures (as per Table 4.2) above to the local Input Output Table for the Regional Council of Goyder, while Tables 4.12 – 4.14 show the results for the Light Regional Council. Tables 4.9 and 4.10, and 4.12 and 4.13 show the detailed outcomes with the level of activity generated by industry sector, while Tables 4.11 and 4.15 provide a summary of the outcomes.

From a local perspective in the Regional Council of Goyder, the modelling indicates that the project will generate $85 million of value added (incomes created or contribution to Gross Regional Product), especially in transport services, but also a result of the impact of direct labour supplied. This occurs over the period of construction and would happen over two years. 511 person years of employment would be supported, or an average of 255 jobs sustained per year over two years. Once operational the project is estimated to support annually $4.1 million of incomes in the region, and support directly and indirectly (including the multiplier impact) approximately 24 jobs per year.

Table 4.9 - Estimates of Economic Activity by Sector Related to Aggregate Capital Spend for the Regional Council of Goyder – Outcomes Over Life of Project

(Note that employment should be interpreted as person years of employment rather than number of jobs at a point of time)

	Expend-iture ($m)	Value Added ($m)			Compensation of Employment ($m)			Employment (FTE's)		
		Direct	Induced	Total	Direct	Induced	Total	Direct	Induced	Total
On-site activity		$51.60		$51.60	$51.60		$51.60	322.5		322.5
Agriculture, Forestry and Fishing	$0.18	$0.07	$0.68	$0.76	$0.02	$0.15	$0.17	0.3	3.2	3.6
Mining	$0.07	$0.02	$0.52	$0.54	$0.01	$0.18	$0.19	0.1	1.4	1.5
Non transport equipment manufacturing	$8.01	$2.69	-$0.03	$2.66	$1.87	-$0.02	$1.85	20.6	-0.2	20.3
Other Manufacturing	$1.23	$0.25	$1.31	$1.57	$0.17	$0.90	$1.07	1.8	9.5	11.3
Electricity generation	$0.06	$0.01	$0.00	$0.01	$0.01	$0.00	$0.00	0.0	0.0	0.0
Electricity transmission, distribution and sale	$0.08	$0.03	$0.13	$0.16	$0.01	$0.03	$0.04	0.0	0.2	0.3
Other energy	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Water and Waste	$0.12	$0.05	$0.26	$0.32	$0.02	$0.08	$0.10	0.1	0.6	0.7
Residential Building Construction	$0.00	$0.00	$0.10	$0.10	$0.00	$0.04	$0.04	0.0	0.8	0.8
Non-Residential Building Construction	$0.00	$0.00	$0.05	$0.05	$0.00	$0.02	$0.02	0.0	0.3	0.3
Heavy and Civil Engineering Construction	$16.04	$4.47	$0.02	$4.48	$2.05	$0.01	$2.06	19.8	0.1	19.9
Construction Services	$0.03	$0.01	$0.76	$0.77	$0.00	$0.38	$0.38	0.1	5.7	5.8
Wholesale Trade	$0.56	$0.26	$1.19	$1.45	$0.16	$0.72	$0.87	1.0	4.5	5.5
Retail Trade	$1.43	$0.70	$1.27	$1.97	$0.48	$0.86	$1.34	7.0	12.6	19.6
Acccommodation and Food Services	$0.74	$0.30	$0.48	$0.78	$0.19	$0.31	$0.50	3.9	6.1	10.0
Road transport	$15.92	$6.83	$0.61	$7.44	$3.70	$0.33	$4.03	44.6	4.0	48.5
Other transport	$0.14	$0.05	$0.43	$0.47	$0.03	$0.24	$0.27	0.3	2.4	2.7
Information Media & Telecommunications	$0.10	$0.04	$0.12	$0.16	$0.01	$0.05	$0.06	0.1	0.4	0.5
Finance & Insurance Services	$0.36	$0.19	$0.38	$0.57	$0.06	$0.11	$0.16	0.4	0.8	1.2
Ownership of dwellings	$3.14	$2.27	$2.73	$5.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Property Services	$0.00	$0.00	$0.09	$0.09	$0.00	$0.03	$0.03	0.0	0.2	0.2
Professional, scientific & technical services	$0.04	$0.01	$0.71	$0.72	$0.01	$0.54	$0.55	0.1	5.8	5.9
Administrative services	$0.05	$0.02	$0.74	$0.77	$0.02	$0.68	$0.70	0.2	4.7	4.9
Public administration and safety	$0.01	$0.01	$0.22	$0.22	$0.00	$0.17	$0.17	0.0	1.4	1.4
Education & Training	$0.57	$0.36	$0.33	$0.69	$0.31	$0.29	$0.61	2.6	2.4	5.0
Health care and social assistance	$0.79	$0.48	$0.46	$0.94	$0.44	$0.42	$0.86	3.5	3.3	6.8
Arts, sport and recreation	$0.14	$0.04	$0.07	$0.11	$0.03	$0.05	$0.08	0.5	0.9	1.4
Other Services	$0.48	$0.18	$0.63	$0.81	$0.05	$0.60	$0.65	2.3	7.9	10.2
Total	**$50.29**	**$70.95**	**$14.25**	**$85.20**	**$61.26**	**$7.17**	**$68.43**	**431.7**	**79.0**	**510.7**

Source: Modelled Result

Table 4.10 - Estimates of Annual Economic Activity by Sector Related to Operating Spend for the Regional Council of Goyder

	Expend-iture ($m)	Value Added ($m)			Compensation of Employment ($m)			Employment (FTE's)		
		Direct	Induced	Total	Direct	Induced	Total	Direct	Induced	Total
On-site activity		$2.74		$2.74	$2.74		$2.74	17.1		17.1
Agriculture, Forestry and Fishing	$0.02	$0.01	$0.03	$0.04	$0.00	$0.01	$0.01	0.0	0.1	0.2
Mining	$0.01	$0.00	$0.02	$0.02	$0.00	$0.01	$0.01	0.0	0.1	0.1
Non transport equipment manufacturing	$0.15	$0.05	$0.00	$0.05	$0.03	$0.00	$0.03	0.4	0.0	0.4
Other Manufacturing	$0.14	$0.03	$0.04	$0.07	$0.02	$0.03	$0.05	0.2	0.3	0.5
Electricity generation	$0.01	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Electricity transmission, distribution and sale	$0.01	$0.00	$0.01	$0.01	$0.00	$0.00	$0.00	0.0	0.0	0.0
Other energy	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Water and Waste	$0.01	$0.01	$0.01	$0.01	$0.00	$0.00	$0.00	0.0	0.0	0.0
Residential Building Construction	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Non-Residential Building Construction	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Heavy and Civil Engineering Construction	$0.28	$0.08	$0.00	$0.08	$0.04	$0.00	$0.04	0.3	0.0	0.4
Construction Services	$0.00	$0.00	$0.02	$0.02	$0.00	$0.01	$0.01	0.0	0.1	0.2
Wholesale Trade	$0.06	$0.03	$0.04	$0.07	$0.02	$0.02	$0.04	0.1	0.1	0.3
Retail Trade	$0.16	$0.08	$0.04	$0.12	$0.05	$0.03	$0.08	0.8	0.4	1.2
Acccommodation and Food Services	$0.08	$0.03	$0.02	$0.05	$0.02	$0.01	$0.03	0.4	0.2	0.6
Road transport	$0.30	$0.13	$0.02	$0.15	$0.07	$0.01	$0.08	0.8	0.1	1.0
Other transport	$0.02	$0.01	$0.01	$0.02	$0.00	$0.01	$0.01	0.0	0.1	0.1
Information Media & Telecommunications	$0.01	$0.00	$0.00	$0.01	$0.00	$0.00	$0.00	0.0	0.0	0.0
Finance & Insurance Services	$0.04	$0.02	$0.02	$0.04	$0.01	$0.00	$0.01	0.0	0.0	0.1
Ownership of dwellings	$0.35	$0.25	$0.09	$0.34	$0.00	$0.00	$0.00	0.0	0.0	0.0
Property Services	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Professional, scientific & technical services	$0.00	$0.00	$0.02	$0.02	$0.00	$0.02	$0.02	0.0	0.2	0.2
Administrative services	$0.01	$0.00	$0.03	$0.03	$0.00	$0.02	$0.03	0.0	0.2	0.2
Public administration and safety	$0.00	$0.00	$0.01	$0.01	$0.00	$0.00	$0.01	0.0	0.0	0.0
Education & Training	$0.06	$0.04	$0.01	$0.05	$0.03	$0.01	$0.04	0.3	0.1	0.4
Health care and social assistance	$0.09	$0.05	$0.02	$0.07	$0.05	$0.01	$0.06	0.4	0.1	0.5
Arts, sport and recreation	$0.02	$0.00	$0.00	$0.01	$0.00	$0.00	$0.01	0.1	0.0	0.1
Other Services	$0.05	$0.02	$0.02	$0.04	$0.01	$0.02	$0.03	0.3	0.2	0.5
Total	**$1.87**	**$3.59**	**$0.48**	**$4.07**	**$3.10**	**$0.24**	**$3.35**	**21.3**	**2.6**	**23.9**

Source: Modelled Result.

Table 4.11 - Estimates of Economic Activity for the Regional Council of Goyder

	Total GSP Impact (3 yrs)	Average Annual GSP Impact	Total Jobs Impact (Person Years - over 2 yrs)	Average Annual Jobs Impact
Construction Phase				
Direct and first round	$71 million	$35.5 million	432	216
Indirect	$14.2 million	$7.1 million	79	39
Total	*$85.2 million*	*$42.6 million*	*511*	*255*
Operating Phase				
Direct and first round		$3.6 million		21
Indirect		$0.5 million		3
Total		*$4.1 million*		*24*

Source: Modelled Result
Note – these numbers are rounded versions of the numbers in the tables above, as the modelling should be interpreted in terms of order of magnitude, but it means that not all numbers are exactly additive.

From a local perspective in the Light Regional Council, the modelling indicates that the project will generate $92 million of value added (incomes created or contribution to Gross Regional Product), over the period of construction and this would happen over two years.

552 person years of employment would be supported, or an average of 276 jobs sustained per year over two years. Once operational the project is estimated to support annually $4.0 million of incomes in the region, and support directly and indirectly (including the multiplier impact) approximately 23 jobs per year.

Table 4.12 Estimates of Economic Activity by Sector Related to Aggregate Capital Spend for the Light Regional Council – Outcomes Over Life of Project

(Note that employment should be interpreted as person years of employment rather than number of jobs at a point of time)

	Expend-iture ($m)	Value Added ($m)			Compensation of Employment ($m)			Employment (FTE's)		
		Direct	Induced	Total	Direct	Induced	Total	Direct	Induced	Total
On-site activity		$51.60		$51.60	$51.60		$51.60	322.5		322.5
Agriculture, Forestry and Fishing	$0.20	$0.08	$0.83	$0.91	$0.02	$0.19	$0.20	0.4	3.9	4.3
Mining	$0.07	$0.03	$0.64	$0.66	$0.01	$0.22	$0.23	0.1	1.7	1.8
Non transport equipment manufacturing	$8.61	$2.89	$0.11	$3.00	$2.01	$0.08	$2.09	22.1	0.9	23.0
Other Manufacturing	$1.30	$0.27	$1.61	$1.88	$0.18	$1.10	$1.29	1.9	11.6	13.6
Electricity generation	$0.00	$0.00	$0.06	$0.06	$0.00	$0.02	$0.02	0.0	0.1	0.1
Electricity transmission, distribution and sale	$0.07	$0.03	$0.19	$0.21	$0.01	$0.05	$0.06	0.0	0.3	0.4
Other energy	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Water and Waste	$0.14	$0.06	$0.31	$0.37	$0.02	$0.10	$0.12	0.1	0.7	0.8
Residential Building Construction	$0.00	$0.00	$0.13	$0.13	$0.00	$0.06	$0.06	0.0	1.0	1.0
Non-Residential Building Construction	$0.00	$0.00	$0.08	$0.08	$0.00	$0.04	$0.04	0.0	0.5	0.5
Heavy and Civil Engineering Construction	$17.20	$4.79	$0.01	$4.79	$2.20	$0.00	$2.20	21.2	0.0	21.3
Construction Services	$0.02	$0.00	$1.76	$1.76	$0.00	$0.88	$0.88	0.0	13.3	13.3
Wholesale Trade	$0.62	$0.29	$1.43	$1.72	$0.17	$0.86	$1.03	1.1	5.4	6.5
Retail Trade	$1.52	$0.74	$1.59	$2.33	$0.51	$1.08	$1.59	7.4	15.8	23.3
Acccommodation and Food Services	$0.79	$0.32	$0.61	$0.93	$0.21	$0.39	$0.60	4.1	7.8	11.9
Road transport	$17.38	$7.46	$0.73	$8.19	$4.04	$0.39	$4.44	48.7	4.7	53.4
Other transport	$0.12	$0.04	$0.62	$0.66	$0.02	$0.35	$0.38	0.2	3.5	3.7
Information Media & Telecommunications	$0.09	$0.03	$0.20	$0.23	$0.01	$0.07	$0.08	0.1	0.6	0.7
Finance & Insurance Services	$0.20	$0.11	$0.93	$1.04	$0.03	$0.27	$0.30	0.2	2.0	2.2
Ownership of dwellings	$3.56	$2.57	$3.33	$5.90	$0.00	$0.00	$0.00	0.0	0.0	0.0
Property Services	$0.00	$0.00	$0.29	$0.29	$0.00	$0.11	$0.11	0.0	0.8	0.8
Professional, scientific & technical services	$0.03	$0.01	$1.03	$1.04	$0.01	$0.78	$0.79	0.1	8.4	8.5
Administrative services	$0.05	$0.02	$1.06	$1.08	$0.02	$0.97	$0.99	0.1	6.7	6.9
Public administration and safety	$0.01	$0.00	$0.34	$0.35	$0.00	$0.27	$0.27	0.0	2.2	2.2
Education & Training	$0.46	$0.29	$0.57	$0.86	$0.25	$0.50	$0.76	2.1	4.1	6.2
Health care and social assistance	$0.68	$0.41	$0.73	$1.15	$0.38	$0.67	$1.05	3.0	5.3	8.3
Arts, sport and recreation	$0.15	$0.05	$0.09	$0.13	$0.03	$0.06	$0.09	0.6	1.1	1.6
Other Services	$0.42	$0.16	$0.92	$1.08	$0.05	$0.81	$0.87	2.0	11.5	13.5
Total	**$53.71**	**$72.25**	**$20.19**	**$92.45**	**$61.81**	**$10.33**	**$72.13**	**438.2**	**114.1**	**552.3**

Source: Modelled Result

Table 4.13 - Estimates of Annual Economic Activity by Sector Related to Operating Spend for the Light Regional Council

	Expend-iture ($m)	Value Added ($m)			Compensation of Employment ($m)			Employment (FTE's)		
		Direct	Induced	Total	Direct	Induced	Total	Direct	Induced	Total
On-site activity		$2.28		$2.28	$2.28		$2.28	14.3		14.3
Agriculture, Forestry and Fishing	$0.03	$0.01	$0.04	$0.05	$0.00	$0.01	$0.01	0.1	0.2	0.2
Mining	$0.01	$0.00	$0.03	$0.03	$0.00	$0.01	$0.01	0.0	0.1	0.1
Non transport equipment manufacturing	$0.15	$0.05	$0.00	$0.06	$0.04	$0.00	$0.04	0.4	0.0	0.4
Other Manufacturing	$0.17	$0.04	$0.05	$0.09	$0.02	$0.04	$0.06	0.3	0.4	0.7
Electricity generation	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Electricity transmission, distribution and sale	$0.01	$0.00	$0.01	$0.01	$0.00	$0.00	$0.00	0.0	0.0	0.0
Other energy	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Water and Waste	$0.02	$0.01	$0.01	$0.02	$0.00	$0.00	$0.01	0.0	0.0	0.0
Residential Building Construction	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Non-Residential Building Construction	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	0.0	0.0	0.0
Heavy and Civil Engineering Construction	$0.30	$0.08	$0.00	$0.09	$0.04	$0.00	$0.04	0.4	0.0	0.4
Construction Services	$0.00	$0.00	$0.05	$0.05	$0.00	$0.02	$0.02	0.0	0.4	0.4
Wholesale Trade	$0.08	$0.04	$0.05	$0.09	$0.02	$0.03	$0.05	0.1	0.2	0.3
Retail Trade	$0.20	$0.10	$0.05	$0.15	$0.07	$0.04	$0.10	1.0	0.5	1.5
Acccommodation and Food Services	$0.10	$0.04	$0.02	$0.06	$0.03	$0.01	$0.04	0.5	0.3	0.8
Road transport	$0.33	$0.14	$0.03	$0.17	$0.08	$0.01	$0.09	0.9	0.2	1.1
Other transport	$0.02	$0.01	$0.02	$0.03	$0.00	$0.01	$0.02	0.0	0.1	0.1
Information Media & Telecommunications	$0.01	$0.00	$0.01	$0.01	$0.00	$0.00	$0.00	0.0	0.0	0.0
Finance & Insurance Services	$0.03	$0.01	$0.04	$0.05	$0.00	$0.01	$0.02	0.0	0.1	0.1
Ownership of dwellings	$0.47	$0.34	$0.12	$0.46	$0.00	$0.00	$0.00	0.0	0.0	0.0
Property Services	$0.00	$0.00	$0.01	$0.01	$0.00	$0.00	$0.00	0.0	0.0	0.0
Professional, scientific & technical services	$0.00	$0.00	$0.03	$0.03	$0.00	$0.02	$0.03	0.0	0.3	0.3
Administrative services	$0.01	$0.00	$0.04	$0.04	$0.00	$0.04	$0.04	0.0	0.3	0.3
Public administration and safety	$0.00	$0.00	$0.01	$0.01	$0.00	$0.01	$0.01	0.0	0.1	0.1
Education & Training	$0.06	$0.04	$0.02	$0.06	$0.03	$0.02	$0.05	0.3	0.2	0.4
Health care and social assistance	$0.09	$0.05	$0.03	$0.08	$0.05	$0.03	$0.08	0.4	0.2	0.6
Arts, sport and recreation	$0.02	$0.01	$0.00	$0.01	$0.00	$0.00	$0.01	0.1	0.0	0.1
Other Services	$0.06	$0.02	$0.03	$0.05	$0.01	$0.03	$0.04	0.3	0.3	0.6
Total	**$2.18**	**$3.29**	**$0.72**	**$4.01**	**$2.69**	**$0.37**	**$3.06**	**19.1**	**3.9**	**23.0**

Source: Modelled Result

Table 4.14 - Estimates of Economic Activity for the Light Regional Council

	Total GSP Impact (3 yrs)	Average Annual GSP Impact	Total Jobs Impact (Person Years - over 2 yrs)	Average Annual Jobs Impact
Construction Phase				
Direct and first round	$72.3 million	$36.1 million	438	219
Indirect	$20.2 million	$10.1 million	114	57
Total	*$92.4 million*	*$46.2 million*	*552*	*276*
Operating Phase				
Direct and first round		$3.3 million		19
Indirect		$0.7 million		4
Total		*$4 million*		*23*

Source: Modelled Result
Note – these numbers are rounded versions of the numbers in the tables above, as the modelling should be interpreted in terms of order of magnitude, but it means that not all numbers are exactly additive.

In terms of tracing the expenditures, using Light as the example - of the $860 million the assumptions above suggest that 15% will be spent in the region. But 10% of that is spent on regionally sourced labour, and this has a direct contribution to incomes but also involves next level expenditures as these wages are spent. The smaller the region however more of what household income is spent on is imported into the region (and they also pay tax which is modelled as a leakage). From the Input Output table developed for this study for Light Council area, only 67% is spent in the region, the other 33% is imported (or taxes paid). The smaller the region, the higher this leakage.

This also explains some of the modelled differences between Goyder and Light. Goyder is a smaller less contained region than Light and as such household consumption has more imports. Further, because of that, it has slightly smaller multipliers. Therefore despite the assumptions being the same – the results are slightly higher for Light than for Goyder.

4.4 Additional Economic Impacts

This report focusses primarily on the potential employment and income benefits of the proposed Twin Creek Wind Farm Project. Job creation is an important community benefit and, at the regional level, the level of job creation is dependent upon two key factors:

1. The amount of investment and operational activity that can be captured by the region; and

2. The preparedness of the region and its people to apply for and accept available job vacancies. Having suitably trained people and geared up companies will maximize regional employment and incomes.

Examples of jobs created in the construction phase include:

- Project developers
- Field engineers
- Environmental managers and consultants
- Legal support
- Administrative and office support
- Numerous construction-related positions
- Transportation managers
- Contract and sub-contract managers
- On-site quarry operation
- Project controls engineers
- Safety technicians

Examples of jobs created in the operational phase include:

- Project managers
- Project coordinators
- Production managers
- Wind turbine technicians
- Wind turbine maintenance
- Environmental consultants
- Administrative and office support

Wind farms generally can have positive and negative socio-economic impacts depending on a variety of factors and the specific communities being impacted by the developments. For example, farmers hosting turbines may receive positive financial benefits while other communities might be subject to visual impacts with financial implications. Other than employment and income generation, two of the possible externalities of wind farms that are often discussed are on property values and carbon emissions. These are considered below.

4.4.1 Property Values

Many studies by independent organisations around the world have failed to find significant correlation between the presence of wind turbines and declining property values. While some studies have found negative impact, others have found positive property value impacts associated with:

- Improved regional amenities and infrastructure including local roads, firefighting access roads, etc.

- Increased regional incomes, jobs and property demand (as assessed above).

- Additional rental income from hosting wind turbine generators.

- Provision of a drought-proofing income streams.

- Provision of post-retirement income for farmers.

- Improved biodiversity via less intensive farm activity.

- Prevention of land subdivision and slowing down the process of productive agricultural land changing to rural residential uses in the short to medium term with the shift caused by the additional income generated from the wind farm providing additional cash flows to supplement the underlying agricultural use.

- Erosion control and passive wind protection for stock from sub stations and turbine wind turbine generators structures.

The majority of studies into the impacts occurred mostly over the period 2005-2015, and there does not seem to be much since that time.

The Senate committee inquiry into "The Social and Economic Impact of Rural Wind Farms" (2010-2013) examined the research to that point and heard submissions and concluded (Chapter 4) that the impact on property values was unclear, but noted that this was unlikely to be the case in areas that were not heavily populated. They also noted the impacts in terms of farmer incomes and employment generated had a positive offsetting effect.

A report on community acceptance of rural wind farms by the CSIRO's Science into Society found that rural landowners with wind farm infrastructure on their properties stood to gain from such benefits.[16]

For properties without wind farm infrastructures but in the line of sight of turbines, statistical evidence supports that property values do not perform worse than properties in comparable regions without wind turbines. In many cases, property values have actually gone up faster than values in the comparable regions.

A study conducted by the South Australia Department of Lands looked at properties located near eight wind farms and found no evidence that wind turbines caused property values to drop. The report found that wind farms "do not appear to have negatively affected property values in most cases". The report also found that "no reductions in sale price were evident for rural properties or residential properties located in nearby townships with views of the wind farm".[17]

Internationally, a decade long study across nine different states in the US by the Lawrence Berkeley National Research Laboratory found no negative relationship between wind turbines and property values. The study found "neither the view of the wind facilities nor the distance of the home to those facilities is found to have any consistent, measurable, and statistically significant effect on home sales prices".[18]

Also, the University of New Hampshire's Impact of the Lempster Wind Power Project on Local Residential Property Values from January 2012 found no evidence that the project had an impact on property values in the region. The study also said "this is consistent with the near unanimous findings of other studies — based their analysis on arms-length property sales transactions — that have found no conclusive evidence of wide spread, statistically significant changes in property values resulting from wind power projects".[19]

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[16] CSIRO report http://www.csiro.au/Organisation-Structure/Flagships/Energy-Transformed-Flagship/Exploring-community-acceptance-of-rural-wind-farms-in-Australia.aspx, reported in Wind Energy the Facts, Clean Energy Council, March 2013.
[17] South Australia Department of Lands report http://www.lpi.South Australia.gov.au/__data/assets/pdf_file/0018/117621/t0L51WT8.pdf reported in Wind Energy the Facts, Clean Energy Council, March 2013.
[18] Lawrence Berkeley study, United States http://eetd.lbl.gov/ea/ems/reports/lbnl-2829e.pdf, reported in Wind Energy the Facts, Clean Energy Council, March 2013. This study was further confirmed in the August 2013 study by the Berkley National Laboratory "A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States" which used data for 50,000 home sales across the USA for homes from within 1 mile ot within 10 miles of a wind farm to conclude that "we find no statistical evidence that home values near turbines were affected in the post-construction or post-announcement/pre-construction periods".
[19] *Impact of the Lempster Wind Power Project on Local Residential Property Values*, January 2012 http://antrim-wind.com/files/2012/05/14B_lempster_property_value_impacts_final-copy-copy.pdf reported in Wind Energy the Facts, Clean Energy Council, March 2013

While the above studies and evidence support that wind farms have no long term detrimental impact on overall property values, it must be recognised that over time many other factors impact property values such as general market conditions, population trends and the local property supply/demand balance.

There will be localised positive and negative impacts associated with wind farms depending on individual property locations and characteristics. Some may appreciate faster than market trends due to improved farm incomes from hosting wind turbine generators (more than offsetting the marginal loss of productive land) and improved access to infrastructure. Some may fail to keep pace with market trends due to perceptions of visual and noise impacts. Potential disruption during wind turbine generator assembly and infrastructure establishment is also noted. However, the evidence supports no overall long term negative impact on property values associated with wind farm developments.

4.4.2 Carbon Emissions

Renewable wind energy generation has significant environmental benefits through carbon emissions reduction where it replaces coal or gas generated electricity. The debate in this area comes down conclusively on the carbon reduction benefits of wind farms relative to fossil fuels[20]

To estimate the value of this reduction it is assumed that the Twin Creek Wind Farm will have the following operating characteristics:

- Total wind farm nominal capacity of up to 270 megawatts.
- Annual average utilisation rate of 38.7% capacity factor/utilisation[21].
- Total generation of approximately 1,025.93 Gigawatt hours (Gwh) per annum.

It is conservatively assumed that when electricity is generated through coal fired stations, it produces 0.8 tonnes of carbon per megawatt hour[22] of electricity generated. So the generation of 1,025.93 Gwh per annum through coal generation would produce in the order

[20] The arguments re carbon emissions in wind versus fossil fuels generated electricity is summarized by Professor Barry Brook (University of Adelaide) at http://bravenewclimate.com/2010/09/01/wind-power-emissions-counter/
[21] Defined as the actual output of the project relative to its maximum possible output.
[22] Annual carbon emissions from the National Electricity Market were down in 2021 by 4.2% by 7.0 Megatonne of CO_2-e (down to 160.4 for the year and there has been over a 50% decline over the last decade (https://www.dcceew.gov.au/climate-change/publications/national-greenhouse-gas-inventory-quarterly-update-december-2021). Carbon pollution per megawatt-hour has also fallen: down to 0.53 tonnes per megawatt hour, However these reductions are a consequence of the shift towards renewables, and as such coal generated power will be higher than this average.

of 0.82 million tonnes of carbon emissions. At a carbon price of $40 per tonne (the minimum that policy frameworks consider necessary to meet carbon reduction targets though above current prices in trading schemes[23]), the value of carbon emission savings associated with the Twin Creek Wind Farm is estimated to be $32.8 million per annum or a net present value of $347.5 million over a 20 year period (discount rate of 7% real).

[23] It is estimated that prices of $40-80 per metric ton of carbon dioxide emitted are needed to keep global warming within a 2-point degree, as provided by the Paris agreement. Higher prices again will be required to achieve global emission targets. However current prices as identified in carbon taxes or carbon trading schemes are well below that level. A critical factor in policy frameworks will be achieving the higher levels of price and a pertinent issue in this context is the recent announcement by the Prime Minister in Germany of Australia becoming a member of the Carbon Club (who have an agenda around carbon prices).

5 CONCLUSION

This socio-economic impact assessment focuses on the effect of the Twin Creek Wind Farm Project on regional incomes and employment associated with the construction and operating phases of the project. This effect arises through the primary expenditure directly associated with the project, and then from further 'rounds' of indirect expenditure that this direct expenditure stimulates as it flows to supplying industries and into incomes and consumption.

The economic modelling for the project has been undertaken using indicative assumptions with respect to labour supply. The commitment of the project developers is that there will be prioritisation of local contractors wherever possible, but the modelling assumes that the wind turbine generators are imported from interstate or overseas, and the major local impact is based on transport and assembly.

From a **State perspective**, economic modelling indicates that the project will generate $662 million of value added (which is a net contribution to Gross State Product[24]) in the State of South Australia over the period of construction and that this would happen over two years (allowing for lagged flow through effects). 3,178 person years[25] of employment in South Australia would be supported – or an average of over 1,589[26] jobs sustained per year over two years. Once operational the project is estimated to support annually $20.7 million of value added in South Australia, and support directly and indirectly in the order of 91 jobs per year. The impact at the national level would be similar to the state level, unless there are constraints in national labour and capital markets with such constraints likely to be limited in the current macroeconomic environment.

From a **regional perspective**[27], the modelling indicates that the project will generate $285 million of value added (contribution to Gross Regional Product) in the region (Barossa and Lower North) over the period of construction and, again allowing for lagged flow through effects, this would happen over two years. 1,652 person years of employment would be supported, or an average of 826 jobs sustained per year over two years. Once operational the project is estimated to support annually $11.2 million of value added in the region, and support directly and indirectly (including the multiplier impact) approximately 63 jobs per year.

[24] Value added is the way in which economic activity is measured in the National Accounting system. At the national level this is equivalent to Gross Domestic Product (GDP) and is made up of returns to labour (wages and salary and taxes on labour) and returns to capital (gross operating surplus (or profits plus depreciation and financing costs) and company tax and GST). At the state level, the national accounts call this amount the Gross State Product.
[25] i.e. the number of full time equivalent annual jobs created over the period.
[26] 1,474÷3
[27] Regional in this context is defined as the ABS regions of the Barossa and Lower North.

From a **local perspective**[28], based on the assumptions used (which involve the project drawing labour from both the Goyder and Light areas) the modelling indicates that the project will generate:

- $85 million of value added (contribution to Gross Regional Product) in the LGA of Goyder over the period of construction and, again allowing for lagged flow through effects, this would happen over two years. 511 person years of employment for local residents would be supported, or an average of 255 jobs sustained per year over two years. Once operational the project is estimated to support annually $4.1 million of value added in the region, and support directly and indirectly (including the induced impact) approximately 24 jobs per year.

- $92 million of value added (contribution to Gross Regional Product) in the LGA of Light over the period of construction over two years. 552 person years of employment for local residents would be supported, or an average of 276 jobs sustained per year over two years. Once operational the project is estimated to support annually $4.0 million of value added in the region, and support directly and indirectly (including the multiplier impact) approximately 23 jobs per year.

These outcomes are based on assumed levels of local supply, and where more of the activity can be retained in the region (while acknowledging the specialist nature of the construction itself), the more extensive the degree of regional economic activity.

Wind farms can have other positive and negative socio-economic impacts depending on a variety of factors and the specific communities being impacted by the developments. For example, farmers hosting turbines may receive positive financial benefits while other communities might be subject to visual impacts from windfarm infrastructure with no financial benefits. In addition to employment and income generation, property values and carbon emissions are socio-economic externalities of wind farms.

[28] Local in this context is the LGA's of Goyder and Light.