

GOYDER

RENEWABLES ZONE

VOLUME 2: Project Evolution and Specialist Reports



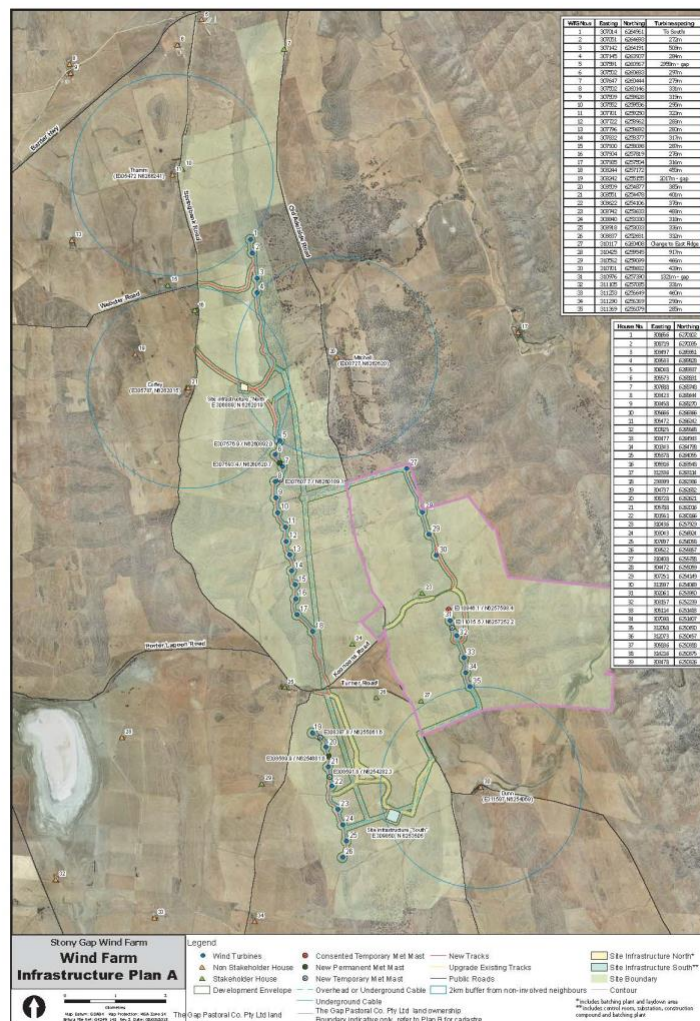
Project Evolution

The Goyder South project has undergone an iterative process of review and refinement since the project commenced in late 2018. Over this time, the layout has been continually adjusted in response to:

- establishment of voluntary setbacks and policy-required setbacks;
- extensive consultation with neighbours, landowners, Council and other interest groups;
- specialist advice and the findings of specialist investigations and technical advisors;
- consideration of commercial and technical requirements for energy and the electricity system.

Stony Gap Wind Farm

In September 2019, Neoen acquired the ~119MW Stony Gap Wind Farm project (SGWF), which was immediately adjacent to Goyder South, from Palisade Investment Partners Pty Ltd. Prior to its acquisition by Palisade, the SGWF project had passed through several other developers' hands. Despite receiving Development Approval in 2014, after a lengthy decision-making process, the SGWF project has not been brought to fruition due to poor market conditions, absence of a suitable Power Purchase Agreement and, eventually, obsolescence of the turbines specified in the Development Approval.



Stony Gap Approved Layout

At a maximum size of approximately 3.2MW, the turbines approved in the SGWF Development Approval are around 60% of the size of the standard turbines in today's market, which has an enormous effect on the ability of the project to achieve a competitive price of power. After several extensions, the SGWF Development Approval is now approaching expiration.

Goyder South represents an incorporation of SGWF into the larger Goyder South project. When Palisade offered SGWF for sale in 2018, Neoen considered it an opportunity to expand the Goyder South project and include additional landowners in the already-large number of families associated with the project. While it was clear that the Development Approval associated with Stony Gap Wind Farm would have to be set aside rather than renewed due to the obsolescence of its turbines, this also presented an opportunity to strike a new chord in the project's relationship with neighbours and the community.

Although SGWF ultimately achieved Development Approval, Neoen acknowledges there was community and Council opposition to the project. Development assessment for SGWF took place at a time when the wind industry was still relatively immature and community engagement practices were limited and concerns about wind farm impacts had not been fully tested and explored.

The industry has subsequently evolved to be more transparent and inclusive, and community attitudes are increasingly positive as the claims of dedicated opponents of renewable energy have been rejected by decision-makers and courts throughout Australia. This shift is evidenced directly by the more positive reception Goyder South has received from community and Council more recently.

While Goyder South has benefited from information obtained through development of SGWF, Neoen have elected to conduct entirely new specialist studies given the time that has elapsed since SGWF was approved.

The Goyder South layout has proceeded through a series of changes and adjustments as the iterative process of initial investigation, layout review and refinement has occurred a number of times as information became available from the engagement process, the specialist investigations and Neoen's own technical and construction advice.

The initial layout included 200 turbines, one solar farm and one project substation. The project now includes 163 turbines (reduced by 37), two solar areas, three smaller substations and a better defined grid connection strategy.

The project commenced in late 2018 involving early communication with key stakeholders and landowners. Specialist consultants and technical advisors were briefed in early 2019 when preliminary investigations commenced. Initial feedback was received in February 2019. Which lead to further investigations and project layout iterations.

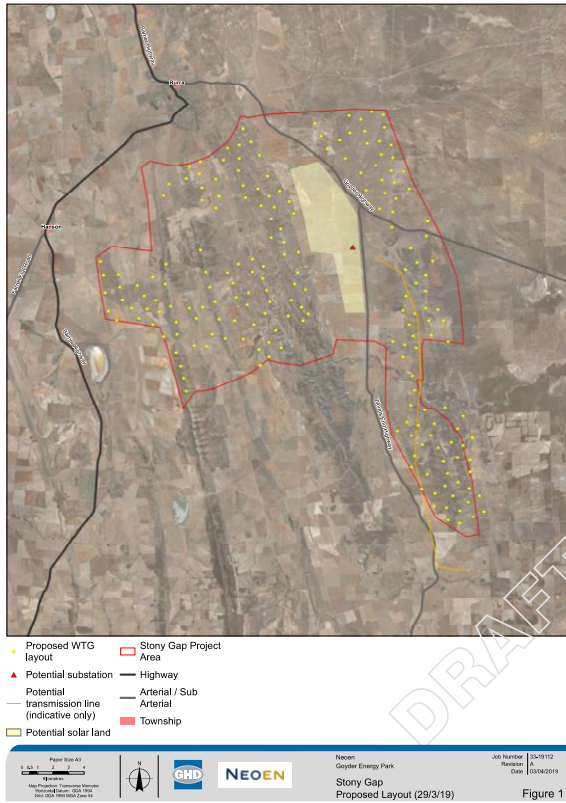
The majority of the first half of 2019 involved landowner negotiations which then extended into a program of broader stakeholder discussions. The feedback from this process and that of the specialist /technical advisors was combined during the latter half of 2019 and early 2020 to produce the final layout in late May 2020.

The following figure provide a visual impression of the nature of the changes which have primarily related to:

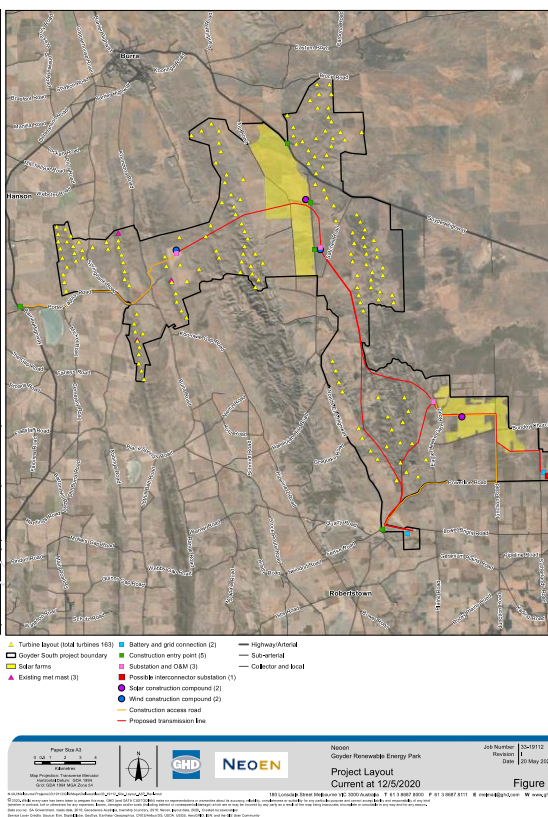
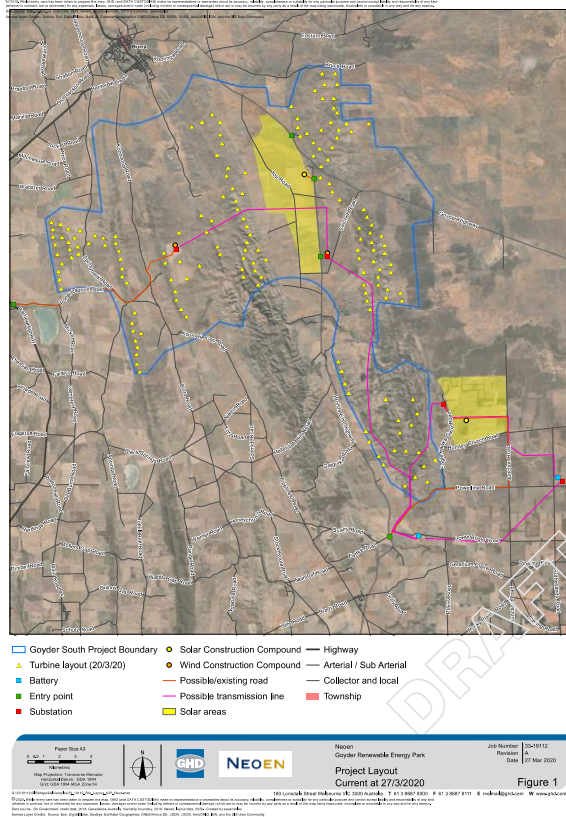
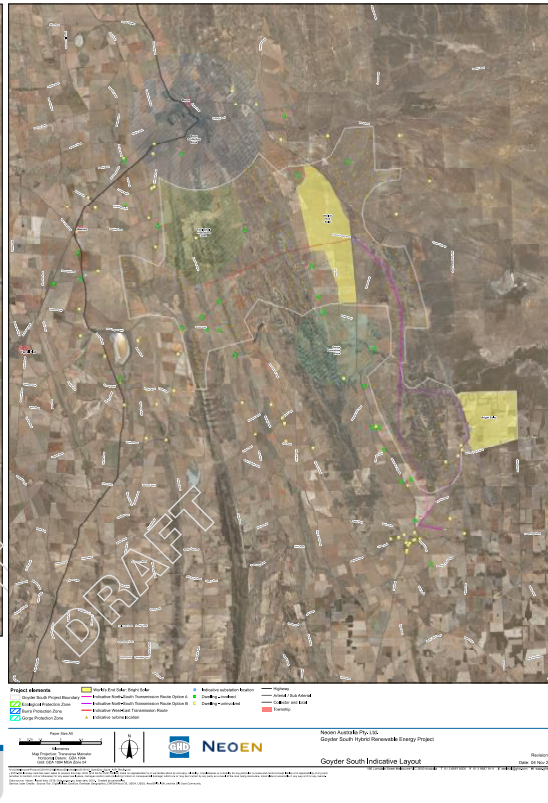
- community and stakeholder requests;
- the results of the preliminary specialist investigations in early 2019;
- technical construction advice in relation to the location of ancillary infrastructure (transmission lines, substations etc...);
- technical, safety and commercial requirements.

A notable change has been the refinement of the project boundary to better communicate the extent of the development.

Initial Working Layout (April 2019) Preliminary Feedback sought



Community Information Day (Nov 2019) – Impact Issues Identified



Refined Working Layout (March 2020) Additional Feedback sought

Final Layout (May 2020)



**Goyder South Hybrid Renewable
Energy Facility:
Flora and Fauna Assessment**

Goyder South Hybrid Renewable Energy Facility: Flora and Fauna Assessment

15 May 2020

Version 4 - Final

Prepared by EBS Ecology for Neoen

Document Control					
Revision No.	Date issued	Authors	Reviewed by	Date Reviewed	Revision type
1	04/10/2019	EBS	EBS	03/10/2019	Draft 1
2	18/12/2019	EBS	EBS	17/12/2019	Draft 2
3	05/02/2020	EBS	EBS	05/02/2020	Draft 3
4	15/05/2020	A. Derry	Dr M. Louter	14/05/2020	Final

Distribution of Copies			
Revision No.	Date issued	Media	Issued to
1	04/10/2019	Electronic	Tom Jenkins and Megan Ward, Neoen
2	18/12/2019	Electronic	Tom Jenkins and Megan Ward, Neoen
3	05/02/2020	Electronic	Tom Jenkins and Megan Ward, Neoen
4	15/05/2020	Electronic	Tom Jenkins and Megan Ward, Neoen

EBS Ecology Project Number: E90101

COPYRIGHT: Use or copying of this document in whole or in part (including photographs) without the written permission of EBS Ecology's client and EBS Ecology constitutes an infringement of copyright.

LIMITATION: This report has been prepared on behalf of and for the exclusive use of EBS Ecology's client, and is subject to and issued in connection with the provisions of the agreement between EBS Ecology and its client. EBS Ecology accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report by any third party.

CITATION: EBS Ecology (2020) Goyder South Hybrid Renewable Energy Facility: Flora and Fauna Assessment. Report to Neoen EBS Ecology, Adelaide.

Cover photograph: Satin Flycatcher (*Myiagra cyanoleuca*) observed in the Project Area during the April 2019 survey.

EBS Ecology
125 Hayward Avenue
Torrensville, South Australia 5031
t: 08 7127 5607
<http://www.ebsecology.com.au>
email: info@ebsecology.com.au

GLOSSARY AND ABBREVIATION OF TERMS

ALA	Atlas of Living Australia
BAM	Bushland Assessment Methodology
BDBSA	Biological Database of South Australia (managed by DEW)
CEC	Clean Energy Council
CP	Conservation Park
COEMP	Construction and Operational Environmental Management Plan
DA	Development Application
DAWE	Department of Agriculture, Water and Environment (formerly DotEE)
DEW	Department for Environment and Water
DEWNR	Department of Environment, Water and Natural Resources (now DEW)
DSEWPC	Department of Sustainability, Environment, Water, Population and Communities (now DotEE)
DotEE	Department of the Environment and Energy (now DAWE)
EBS	Environmental and Biodiversity Services trading as EBS Ecology
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPZ	Ecological Protection Zone
FRWL	Flinders Ranges Worm-lizard (<i>Aprasia pseudopulchella</i>)
Goyder South	Goyder South Hybrid Renewable Energy Facility
GRZ	Goyder Renewables Zone
ha	hectare(s)
IBRA	Interim Biogeographical Regionalisation of Australia
INTG	Iron-grass Natural Temperate Grassland
km	kilometres
kV	Kilovolt
LGA	Local Government Area
m	metre(s)
mm	millimetres
MNES	Matters of National Environmental Significance
Mt	Mount
MW	Megawatts

MWh	Megawatt hour
Neoen	Neoen Australia Pty Ltd
NPW Act	<i>National Parks and Wildlife Act 1972</i>
NRM	Natural Resource Management
NRM Act	<i>Natural Resources Management Act 2004</i>
NV Act	<i>Native Vegetation Act 1991</i>
NVC	Native Vegetation Council
NVIS	Native Vegetation Information System
OMP	Offset Management Plan
PBTL	Pygmy Blue-tongue Lizard (<i>Tiliqua adelaidensis</i>)
PMST	Protected Matters Search Tool
Project Area/ Project	Goyder South Hybrid Renewable Energy Facility
PV	Photovoltaic
SA	South Australia/South Australian
SEB	Significant Environmental Benefit
SHNW	Southern Hairy-nosed Wombat (<i>Lasiornhinus latifrons</i>)
sp.	Species
ssp.	Sub-species
spp.	Species (plural)
TEC	Threatened Ecological Community
VA	Vegetation Association(s)

EXECUTIVE SUMMARY

Neoen is undertaking feasibility studies for the Goyder Renewables Zone (GRZ) development, which has been separated into two projects that will be developed and constructed separately. The first project, the Goyder South Hybrid Renewable Energy Facility (Goyder South), will be located 5 kilometres (km) south of Burra in South Australia and will comprise up to 1,200 Megawatts (MW) of wind, up to 600 MW of solar and up to 900 MW of battery storage.

EBS Ecology (EBS) has been engaged by Neoen to identify and undertake initial ecological assessments of the potential ecological impacts of the proposed Goyder South Project ('the Project Area') and to propose options and recommendations for mitigation where potential impacts have been identified.

A desktop assessment was conducted to determine the potential for any threatened and protected species (both Commonwealth and State listed) to occur within the Project Area. This was achieved by undertaking database searches using a 20 km buffer from a central point within the Project Area – thereby capturing the entire Project Area and immediate surrounding land.

DESKTOP RESULTS

Threatened flora

Three nationally Threatened Ecological Communities (TECs) were identified by the Protected Matters Search Tool (PMST) report as likely to occur within 20 km of the Project Area:

- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (Endangered) – this community is not considered likely to occur within the Project Area;
- Iron-grass Natural Temperate Grassland of South Australia (Critically Endangered) – known to occur within the western section of the Project Area; and
- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia (Critically Endangered) – known to occur within the western section of the Project Area.

Thirteen flora species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were identified in the PMST as potentially occurring or having suitable habitat within 20 km of the Project Area. Two nationally vulnerable flora species were determined as likely to occur within the Project Area: *Dodonaea procumbens* (Trailing Hop-bush) and *Olearia pannosa subsp. pannosa* (Silver Daisy-bush), both of which have been recorded by EBS during previous survey work at the proposed Stony Gap Wind Farm (which is now incorporated into the Project Area which is the subject of this study).

Fifty-four (54) State threatened flora species were identified by the Biological Database of South Australia (BDBSA) as having records within 20 km of the Project Area. Fifteen (15) species were determined as likely to occur with the Project Area, based on recent records, previous survey work by EBS and potential habitat for these species: *Acacia spilleriana* (Spiller's Wattle), *Austrostipa breviglumis* (Cane Spear-grass), *Austrostipa gibbosa* (Swollen Spear-grass), *Austrostipa pilata* (Prickle Spear-grass), *Bothriochloa macra* (Red-leg Grass), *Dodonaea procumbens* (Trailing Hop-bush), *Echinopogon ovatus* (Rough-beard Grass), *Eryngium ovinum* (Blue Devil), *Eucalyptus cajuputea* (Green Mallee), *Lachnagrostis robusta* (Tall Blown-grass), *Logania saxatilis* (Rock Logania), *Maireana rohrlachii* (Rohrlach's Bluebush), *Mentha satereioides*

(Native Pennyroyal), *Olearia pannosa subsp. pannosa* (Silver Daisy-bush) and *Ptilotus erubescens* (Hairy-tails).

Threatened fauna

Twenty-two (22) fauna species listed under the EPBC Act were identified in the PMST as potentially occurring or having suitable habitat within 20 km of the Project Area. This included two fish, 17 birds, one mammal and two reptile species. Two reptile species were determined as likely to occur within the Project Area: the nationally endangered Pygmy Blue-tongue Lizard (PBTL) (*Tiliqua adelaidensis*) and the nationally vulnerable Flinders Ranges Worm-lizard (FRWL) (*Aprasia pseudopulchella*).

Twelve (12) migratory listed fauna species were identified in the PMST as potentially occurring or having suitable habitat within 20 km of the Project Area. Five species were determined as possibly occurring within the Project Area, four of which were largely due to the proximity of Porter Lagoon, which is situated approximately 2 km to the west of the Project Area and can provide refuge for waterbirds when filled with water. These were the Common Sandpiper (*Actitis hypoleucos*), Sharp-tailed Sandpiper (*Calidris acuminata*), Pectoral Sandpiper (*Calidris melanotis*) and Common Greenshank (*Tringa nebularia*). The Fork-tailed Swift (*Apus pacificus*) was also identified as possibly occurring within the Project Area.

Twenty-five (24) State threatened fauna species were identified by the BDBSA as having records within 20 km of the Project Area. This included 21 bird species, one mammal and two reptile species. Eight species (six bird and two reptile) were determined as likely to occur with the Project Area, based on recent records and potential habitat for these species: White-winged Chough (*Corcorax melanorhamphos*); Peregrine Falcon (*Falco peregrinus*); Hooded Robin (*Melanodryas cucullata cucullata*); Restless Flycatcher (*Myiagra inquieta*); Elegant Parrot (*Neophema elegans*); Diamond Firetail (*Stagonopleura guttata*); Flinders Ranges Worm-lizard (*Aprasia pseudopulchella*) and Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*).

Protected areas

There were several protected areas that were identified by the desktop assessment as being relevant to the Project Area. The Hopkins Creek Conservation Park (CP) is situated just outside of the Project Area, towards the southern extent. It conserves important riparian and flood plain habitats for Hopkins and Reed creeks. Two other conservation parks, Mimbara CP and Red Banks CP, are located approximately 4 km and 5 km east of the southern and northern extents of the Project Area, respectively.

Burra Creek Gorge Reserve and World's End Gorge are situated just outside the Project Area; however Burra Creek runs through the Project Area in two main locations. Burra Creek Gorge Reserve holds ecological significance for the local area; River Red Gums (*Eucalyptus camaldulensis*) feature along the Burra Creek and provide important habitat for birds and other wildlife. World's End Gorge is an area rich in biodiversity, with mallee scrubland, peppermint grassy woodland and tussock grassland communities present within the Gorge.

Eight Heritage Agreements have been listed as part of the PMST results; out of the eight agreements, four are summarised as part of this desktop assessment report, based on their proximity to the Project Area. None are situated within the Project Area.

There are five Significant Environmental Benefit (SEB) areas located within close proximity to the Project Area; one SEB area is situated inside the Project Area, SEB2013_2024.

FIELD SURVEY METHODS

Ecological assessments throughout the Project Area were undertaken between 25 March and 11 April (autumn) 2019 and 2 and 5 September (spring) 2019. These surveys were undertaken predominantly to assess:

- Pockets of native vegetation, targeting Iron-grass (*Lomandra* sp.) and Peppermint Box (*Eucalyptus odorata*) to determine whether both species qualified as a TEC;
- Presence of PBTL including mapping any individuals recorded as well as potential habitat; and
- Presence of targeted avifauna such as birds and bats. General fauna was also recorded during the surveys including mapping Southern Hairy-nosed Wombat (*Lasiorninus latifrons*) sightings and burrows.

The additional spring survey was undertaken to:

- Collect additional information about migratory bird species;
- Determine if any of the Wedge-tailed Eagle (*Aquila audax*) nests recorded in autumn were active; and
- Assess additional areas where access was previously not permitted.

Flora

During both autumn and spring 2019 surveys, Vegetation Associations (VAs) were broadly mapped over the Project Area, according to the dominant overstorey species present. The dominant flora species within each vegetation stratum (overstorey, midstorey and understorey) were recorded as well as the presence of threatened species and declared or significant weed species. Flora species within the Project Area were recorded as part of the vegetation association mapping methodology.

Fauna

All native and exotic fauna species encountered (directly observed, or tracks, scats, burrows, nests and other signs of presence) during both the autumn and spring 2019 surveys were recorded.

The habitats present within the Project Area were assessed for suitability for the PBTL during both the autumn and spring 2019 surveys. Vertical spider holes were inspected for the presence of PBTLs along 41 transects using a videoscope, with data collected on the depth and condition of the spider hole and a GPS location recorded at each hole inspected.

Targeted bird surveys were conducted using point counts. A total of 25 point count sites were established during the autumn and spring 2019 surveys. The 5 hectare/30-minute point count methodology was used, whereby, an observer records all birds heard or observed within a 30-minute period in a 5 hectare (ha) search area. An additional opportunistic bird survey was conducted at Porter's Lagoon (approximately 2 km from the western boundary of the Project Area), which was inundated during spring, to check for migratory wader species that were identified in the desktop assessment and could potentially be impacted by the proposed development.

Woodland areas were assessed for potential nesting locations of the State rare Peregrine Falcon (*Falco peregrinus*) and at-risk species Wedge-tailed Eagle (WTE) during both the autumn and spring 2019 surveys. The spring 2019 survey also revisited known WTE nest locations to determine their breeding status.

A passive bat survey was conducted during both autumn and spring 2019 surveys using AnaBat units to record bat ultrasonic echolocation calls in areas thought to be of suitable habitat for bats or that bats may frequent when feeding. AnaBat detectors were set up at four sites for two nights and sound data was analysed to assess the presence of species.

FIELD SURVEY RESULTS

Threatened Ecological Communities (TEC)

Two TECs were identified in the desktop as likely to occur within the Project Area; Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia. At the time of the autumn and spring 2019 surveys, both were not classed as TECs, due to poor conditions, likely caused by drought conditions and grazing pressure.

Vegetation Associations (VAs)

The vegetation attributes of the Project Area can be separated in to eastern and western sectors, which are divided by Burra Creek. Each sector is comprised of two parallel ridges. The western ridges were categorised as an agricultural zone landscape, within which native vegetation consisted of grasslands and tall woodlands of moderate quality. The eastern ridges receive lower rainfall than those in the west, and therefore, pastoral land practices were more widely used than agricultural land practices. Vegetation communities were also reflective of lower rainfall, comprising of native pine and Mallee woodlands, and chenopod shrublands.

Twenty (20) broad VAs were recorded and mapped over the Project Area. Native vegetation covered 26,559.2 ha of the overall Project Area.

The most well represented VAs, spread across the Project Area, were

- VA 8 - *Austrostipa* spp. (Spear Grass) Mixed Grassland;
- VA 5 - *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Mixed Open Mallee; and
- VA 1 - *Maireana aphylla* (Cotton-bush) / *Atriplex stipitata* (Bitter Saltbush) Mixed Low Open Chenopod Shrubland.

Flora

Ninety-nine (99) flora species were recorded within the Project Area during the broad vegetation mapping methodology. This included 74 native and 25 exotic species. Approximately 35 individuals of the nationally and State endangered *Dodonaea subglandulifera* (Peep Hill Hop-bush) were observed in the southeast of the Project Area, within a good quality patch of *Eucalyptus porosa* (Mallee Box) Open Woodland (VA 3). No other threatened flora species were observed within the Project Area during broad vegetation mapping, across both survey periods.

Fauna

Ninety-two (92) fauna species were recorded over the Project Area during the field assessments during autumn and spring 2019. The fauna assemblage comprised of 76 bird (from 55 point count and 19 opportunistic observations).

One amphibian species, the Common Froglet (*Crinia signifera*) was opportunistically heard in Burra Creek within the Project Area.

Five reptile species were recorded over the Project Area. The Pygmy Blue-tongue (*Tiliqua adelaidensis*) (24 individuals), Common Dwarf Skink (*Menetia greyii*) (two individuals); and Tessellated Gecko (*Diplodactylus tessellatus*) (two individuals) were recorded.

Ten ground-dwelling mammal species were recorded over the Project Area. The native mammal species recorded were the Southern Hairy-nosed Wombat (SHNW) (*Lasiorninus latifrons*), Red Kangaroo (*Macropus rufus*), Western Grey Kangaroo (*Macropus fuliginosus*), Euro (*Macropus robustus*) and Short-beaked Echidna (*Tachyglossus aculeatus*). All macropod species (kangaroos and Euro) were abundant and widespread over the Project Area.

Two SHNWs and several active burrow systems (warrens) were observed during the field surveys in autumn and spring 2019. All wombats and warrens were observed in proximity to drainage lines within the Project Area.

Five bat species were identified from the sonograms recorded by AnaBat units over the four sites, surveyed across both autumn and spring survey periods, in the Project Area. The Gould's Wattled Bat (*Chalinolobus gouldii*) and Free-tailed Bats (*Ozimops* sp.) was recorded at all four AnaBat sites. The White-striped Freetail Bat (*Austronomus australis*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*) and Southern Forest Bat (*Vespadelus regulus*) were recorded at three sites. No national or State threatened bat species were recorded in the Project Area during the field assessments in autumn and spring 2019.

Fifty-eight (58) bird species were recorded during point count surveys across the two survey periods, with an additional 19 species recorded opportunistically. The bird families with the greatest representation in the Project Area were Meliphagidae (honeyeaters), Acanthizidae (Australasian warblers) and Psittaculidae (parrots). Six State threatened bird species were recorded within the Project Area.

A total of 586 birds were recorded across the 25 point counts established over the Project Area. The species recorded at the greatest number of point count sites were Little Raven (*Corvus mellori*) Striated Pardalote (*Pardalotus striatus*) and Weebill (*Smicronis brevirostris*) (all at 14 sites), Galah (*Eolophus roseicapilla*) (13 sites) and Australian Magpie (*Gymnorhina tibicen*) (12 sites).

Wedge-tailed Eagle

A total of six WTE nests were recorded over the Project Area during the autumn and spring field assessment periods. These nests were primarily restricted to mid-slope areas of ridgelines that supported *Eucalyptus odorata* woodland. The condition of nests was variable, with four nests in good condition and two nests in poor condition. WTEs were also observed to be sitting on two nests (both of which were determined as being in 'good' condition), detected during the spring survey. Each of the WTE nests were allocated a 1 km buffer regardless of condition, within which no turbines are to be constructed. WTE pairs are known to reuse nest locations across varying seasons, which is why the buffer was applied to all nests.

Pygmy Blue-tongue Lizards

Due to the timing of the PBTL survey, dry conditions and grazing pressure, most grassland areas had low grass cover and the surveyors had no difficulty locating spider burrows. Across both autumn and spring surveys, a total 1,076 spider burrows were inspected for PBTLs along 41 transects across the Project Area, with 24 PBTLs observed within burrows.

Possible and likely PBTL habitat was mapped across the Project Area based on the observation of PBTLs and the presence of suitable habitat characteristics, which was concentrated to the western side of the Project Area. Overall, 450 ha of possible habitat and 47 ha of likely habitat for PBTLs occurred within the Project Area.

RECOMMENDATIONS

As part of the initial survey work several ecological constraints were identified by EBS, which Neoen has committed to addressing as part of the preliminary project design or, where appropriate, micrositeing. In summary, these were identified as:

- Avoid, where possible, areas that have been mapped as patches of Iron-grass (*Lomandra* sp.) and Peppermint Box (*E. odorata*) – where areas cannot be avoided, EBS recommends that targeted surveys need to be undertaken for both Iron-grass and Peppermint Box, to determine if they qualify as TECs, prior to construction taking place. The survey, conditions permitting, should be timed after a good rainfall season. Where areas cannot be avoided, patches containing both Iron-grass and Peppermint Box need to be micrositeed prior to construction, for the placement of wind turbines and associated infrastructure.
- Avoid, where possible, areas that have been identified as known PBTL records, areas mapped as likely PBTL habitat and potential PBTL habitat. Where areas cannot be avoided, micrositeing needs to occur prior to construction, for the placement of wind turbines and associated infrastructure. Neoen have committed to undertaking survey work for micrositeing PBTL within the Project Area, when all infrastructure positions are known.
- Avoid, where possible the area marked as containing records of *Dodonaea subglandulifera* (Peep Hill Hop-bush).
- Avoid, where possible, areas mapped as having conservation value which have been identified by EBS as areas of high bird richness habitat or those vegetation associations containing Mallee Woodland, Sedgeland or Shrubland.
- Avoid, where possible, known Wedge-tailed Eagle nests (active and inactive) and implement a 1 km buffer around mapped nests.
- Complete a full assessment for flora and fauna, in areas that were not assessed or properties that weren't able to be accessed (portions of the south-east section of the Project Area), as part of the initial ecological assessment work.

Table of Contents

1	INTRODUCTION	1
1.1	Objectives	1
1.2	Project Area	1
1.3	Previous surveys conducted.....	2
2	COMPLIANCE AND LEGISLATIVE SUMMARY.....	8
2.1	Environment Protection and Biodiversity Conservation Act 1999	8
2.2	Native Vegetation Act 1991	8
2.3	National Parks and Wildlife Act 1972	9
2.4	Natural Resources Management Act 2004.....	9
3	BACKGROUND INFORMATION.....	12
3.1	Environmental setting	12
3.1.1	Interim Biographical Regionalisation of Australia (IBRA)	12
3.1.2	Administrative boundaries	14
3.1.3	Climate	14
	Heritage Agreements.....	17
	Significant Environmental Benefit areas.....	18
4	METHODS	21
4.1	Desktop assessment	21
4.1.1	Protected Matters Search Tool (PMST) EPBC Act	21
4.1.2	Biological Database of South Australia (BDBSA) NPW Act.....	21
4.2	Field survey	22
4.2.1	Flora.....	23
4.2.2	Fauna.....	24
4.3	Limitations.....	31
5	DESKTOP ASSESSMENT RESULTS.....	33
5.1	Matters of National Environmental Significance	33
5.1.1	Threatened ecological communities	33
5.1.2	Nationally threatened flora.....	34
5.1.3	Nationally threatened fauna.....	36
5.1.4	Migratory fauna	38
5.2	Matters of State Environmental Significance.....	39
6	FIELD SURVEY RESULTS.....	44
6.1	Threatened Ecological Communities.....	44
6.2	Vegetation Associations (VAs)	44
6.2.1	VA 1: Maireana aphylla (Cotton-bush) / Atriplex stipitata (Bitter Saltbush) Mixed Low Open Chenopod Shrubland	47

6.2.2	VA 2: <i>Lomandra multiflora</i> (Hard Mat-rush) / <i>Lomandra effusa</i> (Scented Mat-rush) Mixed Open Grassland	48
6.2.3	VA 3: <i>Eucalyptus porosa</i> (Mallee Box) Open Woodland	49
6.2.4	VA 4: <i>Eucalyptus odorata</i> (Peppermint Box) Open Woodland	51
6.2.5	VA 5: <i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee) Mixed Open Mallee.....	52
6.2.6	VA 6: <i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i> (Inland South Australian Blue Gum) Open Woodland	53
6.2.7	VA 7: <i>Eucalyptus camaldulensis</i> ssp. <i>camaldulensis</i> (River Red Gum) Woodland ...	54
6.2.8	VA 8: <i>Austrostipa</i> spp. (Spear Grass) Mixed Grassland	55
6.2.9	VA 9: Exotic Grassland.....	56
6.2.10	VA 10: <i>Callitris gracilis</i> (Southern Cypress Pine) Low Open Woodland.....	57
6.2.11	VA 11: <i>Juncus</i> sp. / <i>Cyperus gymnocaulos</i> (Spiny Flat-sedge) Low Closed Sedgeland	58
6.2.12	VA 12: <i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush) Low Open Shrubland.....	59
6.2.13	VA 13: <i>Atriplex nummularia</i> (Old-man Saltbush) Plantation.....	60
6.2.14	VA 14: <i>Triodia irritans</i> (Spinifex) grassland +/- Emergent <i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee).....	61
6.2.15	VA 15: <i>Dodonaea lobulata</i> (Lobed-leaf Hop-bush) Shrubland	62
6.2.16	VA 16: <i>Beyeria lechenaultii</i> (Pale Turpentine Bush) Low Shrubland	63
6.2.17	VA 17: <i>Phragmites australis</i> (Common Reed) Grassland	64
6.2.18	VA 18: <i>Senna</i> spp. (Senna) / <i>Acacia rigens</i> (Nealie) Mixed Shrubland	65
6.2.19	VA 19: <i>Nitraria billardiieri</i> (Nitre-bush) Low Shrubland.....	66
6.2.20	VA 20: <i>Maireana pyramidata</i> (Black Bluebush) Low Shrubland.....	67
6.3	Flora.....	68
6.4	Fauna.....	72
6.4.1	Amphibians	74
6.4.2	Reptiles	74
	Flinders Ranges Worm-lizards	75
	Pygmy Blue-tongue Lizards.....	75
6.4.3	Mammals (ground-dwelling)	78
	Southern Hairy-nosed Wombats	78
6.4.4	Bats.....	78
6.4.5	Birds	80
6.5	Raptor Species	82
6.5.1	Peregrine Falcon (<i>Falco peregrinus</i>)	82
6.5.2	Wedge-tailed Eagle (<i>Aquila audax</i>)	82
6.6	Habitat attributes.....	84
7	DISCUSSION.....	87
7.1	Threatened Ecological Communities	87
7.1.1	Iron-grass Natural Temperate Grassland of South Australia	87
7.1.2	Peppermint Box (<i>Eucalyptus odorata</i>) Grassy Woodland of South Australia	88

7.2	Flora.....	90
7.2.1	Dodonaea subglandulifera (Peep Hill Hop-bush) (AUS: EN, SA: EN)	90
7.2.2	Flora species determined as likely to occur.....	91
	Acacia spilleriana (Spiller's Wattle) (AUS: EN, SA: E)	91
	Austrostipa breviglumis (Cane Spear-grass) (SA: R).....	91
	Austrostipa gibbosa (Swollen Spear-grass) (SA: R)	91
	Austrostipa pilata (Prickle Spear-grass) (SA: V)	92
	Bothriochloa macra (Red-leg Grass) (SA: R)	92
	Dodonaea procumbens (Trailing Hop-bush) (AUS: VU, SA: V)	92
	Echinopogon ovatus (Rough-beard Grass) (SA: R)	93
	Eryngium ovinum (Blue Devil) (SA: V).....	93
	Eucalyptus cajuputea (Green Mallee) (SA: R)	94
	Lachnagrostis robusta (Tall Blown-grass) (SA: R)	94
	Logania saxatilis (Rock Logania) (SA: R).....	94
	Maireana rohrlachii (Rohrlach's Bluebush) (SA: R).....	95
	Mentha satuireioides (Native Pennyroyal) (SA: R).....	95
	Olearia pannosa subsp. pannosa (Silver Daisy-bush) (AUS: VU, SA: V)	95
	Ptilotus erubescens (Hairy-tails) (SA: R).....	96
7.3	Fauna.....	98
7.3.1	Nationally threatened	98
7.3.2	State threatened	99
7.3.3	Southern Hairy-nosed Wombat (SHNW).....	101
7.3.4	Wind farm impacts on avifauna	102
8	RECOMMENDATIONS/MITIGATION MEASURES.....	105
8.1	Recommendations to change the layout and location of infrastructure	106
8.1.1	Threatened Ecological Communities	106
8.1.2	Dodonaea subglandulifera (Peep Hill Hop-bush)	107
8.1.3	Pygmy Blue-tongue Lizard (Tiliqua adelaidensis)	107
8.1.4	Flinders Ranges Worm-lizard (Aprasia pseudopulchella)	108
8.2	Recommendations for micro-siting and construction stage.....	108
8.2.1	Development of a Construction and Operational Environmental Management Plan (COEMP)	108
8.2.2	SEB Offset Management Plan.....	108
8.2.3	Pygmy Blue-tongue Lizard (Tiliqua adelaidensis)	108
8.2.4	Raptor monitoring	109
8.2.5	Weed and soil pathogen management.....	109
8.3	Recommendations for monitoring, operational stage.....	110
8.3.1	Pygmy Blue-tongue Lizard.....	110
8.3.2	Wombats.....	110
8.3.3	IdentiFlight	111
8.3.4	Solar farms as wildlife refuge.....	111

8.4	NEXT STEPS	112
9	REFERENCES.....	115
10	APPENDICES.....	120

Appendix 1. BDBSA Flora records within 20 km of the Project Area.	120
Appendix 2. BDBSA Fauna records within 20 km of the Project Area.	143
Appendix 3. Number of individuals of each bird species recorded at point count sites over the Project Area.....	151
Appendix 4. Number and abundance of bird species recorded at Porter's Lagoon (spring 2019).	153

List of Tables

Table 1. Previous surveys conducted by EBS.	2
Table 2. Goyder South project specifications (as of May 2020).....	6
Table 3: Summary of relevant Commonwealth and State legislation.....	10
Table 4: IBRA bioregion, subregion, and environmental association environmental landscape summary.....	12
Table 5. Vegetation types, previously mapped by DEW, within the Project Area.	15
Table 6. Heritage Agreements relevant to the Project Area.....	18
Table 7. Significant Environmental Benefit areas surrounding the Project Area.	18
Table 8. Likelihood rating and criteria for the presence of threatened species.....	22
Table 9. Suitable and unsuitable PBTL habitat attributes.	25
Table 10. Summary of the results from the Protected Matters Search.	33
Table 11. Threatened flora species identified in the PMST report (1) and BDBSA (2) as potentially occurring within 20 km of the Project Area.	34
Table 12. Threatened and migratory fauna species identified in the PMST report (1) and BDBSA (2) as potentially occurring within 20 km of the Project Area.	36
Table 13. Summary of VAs described over the Project Area.....	45
Table 14. Summary of VA 1: <i>Maireana aphylla</i> (Cotton-bush) / <i>Atriplex stipitata</i> (Bitter Saltbush) Mixed Low Open Chenopod Shrubland.	47
Table 15. Summary of VA 2: <i>Lomandra multiflora</i> (Hard Mat-rush) / <i>Lomandra effusa</i> (Scented Mat-rush) Mixed Open Grassland.	48
Table 16. Summary of VA 3: <i>Eucalyptus porosa</i> (Mallee Box) Open Woodland.	49
Table 17. Summary of VA 4: <i>Eucalyptus odorata</i> (Peppermint Box) Open Woodland.	51
Table 18. Summary of VA 5: <i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee) Mixed Open Mallee.....	52
Table 19. Summary of VA 6: <i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i> (Inland South Australian Blue Gum) Open Woodland.	53
Table 20. Summary of VA 7: <i>Eucalyptus camaldulensis</i> ssp. <i>camaldulensis</i> (River Red Gum) Woodland.	54
Table 21. Summary of VA 8: <i>Austrostipa</i> ssp. (Spear Grass) Mixed Grassland.....	55

Table 22. Summary of VA 9: Exotic Grassland.	56
Table 23. Summary of VA 10: <i>Callitris gracilis</i> (Southern Cypress Pine) Low Open Woodland.	57
Table 24. Summary of VA 11: <i>Juncus</i> sp. / <i>Cyperus gymnocaulos</i> (Spiny Flat-sedge) Low Closed Sedgeland.	58
Table 25. Summary of VA 12: <i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush) Low Open Shrubland.	59
Table 26. Summary of VA 13: <i>Atriplex nummularia</i> (Old-man Saltbush) Plantation.	60
Table 27. Summary of VA 14: <i>Triodia irritans</i> (Spinifex) Grassland +/- Emergent <i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee).	61
Table 28. Summary of VA 15: <i>Dodonaea lobulata</i> (Lobed-leaf Hop-bush) Shrubland.	62
Table 29. Summary of VA 16: <i>Beyeria lechenaultii</i> (Pale Turpentine Bush) Low Shrubland.	63
Table 30. Summary of VA 17: <i>Phragmites australis</i> (Common Reed) Grassland.	64
Table 31. Summary of VA 18: <i>Senna</i> spp. (Senna) / <i>Acacia rigens</i> (Nealie) Mixed Shrubland.	65
Table 32. Summary of VA 19: <i>Nitraria billardierei</i> (Nitre-bush) Low Shrubland.	66
Table 33. Summary of VA 20: <i>Maireana pyramidata</i> (Black Bluebush) Low Shrubland.	67
Table 34. Flora species observed in the Project Area during broad vegetation mapping.	68
Table 35. Fauna species observed within the Goyder Project Area.	72
Table 36. Bats recorded over the four AnaBat sites established over the Project Area.	78
Table 37. Wedge-tailed Eagle nests and their condition recorded over the Project Area during the field assessment.	82
Table 38. A sample of bird deaths per turbine per annum at wind farms within Australia.	103

List of Figures

Figure 1. Location of the proposed Goyder South Hybrid Renewable Energy Facility Area.	5
Figure 2. Mean maximum monthly temperatures and mean monthly rainfall recorded at Eudunda Weather Station (site number: 024511) from 1965 to 2019.	14
Figure 3. Remnant vegetation mapped by the Department for Environment and Water (DEW) within the Project Area.	19
Figure 4. Protected areas, Heritage Agreements, SEB areas and watercourses highlighted within the Project Area.	20
Figure 5. Locations of the PBTL transects over the Project Area (transect numbers are not sequential as the Project boundary has changed since survey work was completed).	27
Figure 6. Individual PBTL recorded within the Project Area.	28
Figure 7. Vertical spider holes inspected using videoscope.	28
Figure 8. Location of point count sites (bird survey) and AnaBat sites (bat survey) across the Project Area (bird and bat survey sites are not sequential as the Project boundary has changed since survey was completed).	29
Figure 9. Nationally threatened flora (determined by BDBSA records) within 20 km of the Project Area.	41
Figure 10. State threatened flora BDBSA records within 20 km of the Project Area.	42
Figure 11. State threatened fauna BDBSA records within 20 km of the Project Area.	43

Figure 12. Vegetation Associations mapped over the Project Area.....	46
Figure 13. Representative photo of VA 1: <i>Maireana aphylla</i> (Cotton-bush) / <i>Atriplex stipitata</i> (Bitter Saltbush) Mixed Low Open Chenopod Shrubland.	47
Figure 14. Representative photo of VA 2: <i>Lomandra multiflora</i> (Hard Mat-rush) / <i>Lomandra</i> <i>effusa</i> (Scented Mat Rush) Mixed Open Grassland.	48
Figure 15. Representative photo of VA 3 (poor condition): <i>Eucalyptus porosa</i> (Mallee Box) Open Woodland.	49
Figure 16. Representative photo of VA 3 (good condition): <i>Eucalyptus porosa</i> (Mallee Box) Open Woodland.	50
Figure 17. Representative photo of VA 4: <i>Eucalyptus odorata</i> (Peppermint Box) Open Woodland.	51
Figure 18. Representative photo of VA 5: <i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee) Mixed Open Mallee.	52
Figure 19. Representative photo of VA 6: <i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i> (Inland South Australian Blue Gum) Open Woodland.	53
Figure 20. Representative photo of VA 7: <i>Eucalyptus camaldulensis</i> ssp. <i>camaldulensis</i> (River Red Gum) Woodland.	54
Figure 21. Representative photo of VA 8: <i>Austrostipa</i> ssp. (Spear Grass) Mixed Grassland.....	55
Figure 22. Representative photo of VA 9: Exotic Grassland.	56
Figure 23. Representative photo of VA 10: <i>Callitris gracilis</i> (Southern Cypress Pine) Low Open Woodland.	57
Figure 24. Representative photo of VA 11: <i>Juncus</i> sp. / <i>Cyperus gymnocaulos</i> (Spiny Flat- sedge) Low Closed Sedgeland.	58
Figure 25. Representative photo of VA 12: <i>Alectryon oleifolius</i> (Bullock Bush) Low Open Shrubland.	59
Figure 26. Representative photo of VA 13: <i>Atriplex nummularia</i> (Old-man Saltbush) Plantation.	60
Figure 27. Representative photo of VA 14: <i>Triodia irritans</i> (Spinifex) Grassland +/- Emergent <i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee).	61
Figure 28. Representative photo of VA 15: <i>Dodonaea lobulata</i> (Lobed-leaf Hop-bush) Shrubland.	62
Figure 29. Representative photo of VA 16: <i>Beyeria lechenaultii</i> (Pale Turpentine Bush) Low Shrubland.	63
Figure 30. Representative photo of VA 17: <i>Phragmites australis</i> (Common Reed) Grassland. .	64
Figure 31. Representative photo of VA 18: <i>Senna</i> spp. (Senna) / <i>Acacia rigens</i> (Nealie) Mixed Shrubland.	65
Figure 32. Representative photo of VA 19: <i>Nitraria billardiieri</i> (Nitre-bush) Low Shrubland.....	66
Figure 33. Representative photo of VA 20: <i>Maireana pyramidata</i> (Black Bluebush) Low Shrubland.	67
Figure 34. Photo of <i>Dodonaea subglandulifera</i> (Peep Hill Hop-bush) within the Project Area. .	70
Figure 35. Observations of <i>Dodonaea subglandulifera</i> (Peep Hill Hop-bush) within the Project Area.	71

Figure 36. PBTL search effort across the Project Area: records (blue dot), spider holes surveyed (small pink dot), likely habitat (maroon polygon) and potential habitat (green polygon).....	76
Figure 37. Enlarged image of the north-western section of the Project Area showing PBTL records.	77
Figure 38. SHNW records (green dots) and warrens (yellow polygons) within the Project Area. Two SHNWs were recorded at the green dot in the southeast of the Project Area. Major drainage lines are shown (blue lines).	79
Figure 39. Locations of threatened bird observations and habitats that had high bird species richness.	81
Figure 40. Location of WTE nests recorded over the Project Area with respect to the Vegetation Associations present.	83
Figure 41. An adult WTE observed on Nest 13 (defined as being in 'good' condition), within the Project Area.....	84
Figure 42. A small wetland along Burra Creek within the Project Area.....	85
Figure 43. Rocky outcrop in woodland habitat within the Project Area.	85
Figure 44. A tree hollow within the Project Area.	86
Figure 45. INTG within the Project Area.....	89
Figure 46. <i>Eryngium ovinum</i> (Blue Devil).	94
Figure 47. <i>Mentha satureioides</i> (Native Pennyroyal).	95
Figure 48. EBS Flora records and associations – previous survey work Stony Gap (EBS 2013a). Note: some records fall outside of the current Project boundary, as the Project Area has evolved over time.	97
Figure 49. SHNW warren system along drainage line within the Project Area.	102
Figure 50. Project constraints identified by EBS as part of the initial ecological assessment work.....	113
Figure 51. Ecological Protection Zone implemented by Neoen as part of the preliminary wind farm design.....	114

1 INTRODUCTION

Neoen Australia Pty Ltd (Neoen) is seeking Development Plan Consent for the Goyder South Hybrid Renewable Energy Facility. Neoen has undertaken feasibility studies for the Goyder Renewables Zone (GRZ) development, which has been separated into two projects that will be developed and constructed separately. The first project, Goyder South Hybrid Renewable Energy Facility (Goyder South), will be connected to the existing Robertstown substation, with project construction expected to commence from 2021 onwards.

EBS Ecology (EBS) has been engaged by Neoen to identify and undertake the initial ecological assessments, identify any potential impacts of the Project and to propose options and recommendations for mitigation where potential impacts have been identified.

The initial ecological assessment report is intended to support Federal and State project approval documents such as the Development Application (DA), EPBC Referral and Native Vegetation Clearance Application and comply with Clean Energy Council *Best Practice Guidelines* (Clean Energy Council 2018).

1.1 Objectives

The main objective of the initial flora and fauna assessment report is to contribute to the deliverables required for a DA. This includes:

- Identify, describe and map nationally threatened and State rated flora and fauna, and ecological communities, across the Project Area to enable assessment by Commonwealth (*Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)) and State regulators (*National Parks and Wildlife Act 1972* (NPW Act) and the *Native Vegetation Act 1991* (NV Act));
- Determine the likelihood of presence and status of Commonwealth and State listed flora and fauna species and Threatened Ecological Communities (TECs);
- Estimate the number of Vegetation Associations, determine the habitat value of native vegetation present in the Project Area, and determine subsequent intensity of flora assessments sites required;
- Compose a full list of specific species of interest to search for/target during the field assessments;
- Undertake ecological surveys to ground truth and confirm the findings of the desktop assessment and address any identified gaps in the information; and
- Identify key ecological issues/constraints for the Project Area.

1.2 Project Area

The proposed Goyder South development, herein referred to as the Project Area or Project is 26,559.2 ha in size, begins 5.5 km south of the centre of Burra and extends 27 km south, toward Robertstown in South Australia. This area is located in the eastern portion of the northern Mount Lofty Ranges and wholly located within the Regional Council of Goyder. From a transport and access perspective, the region is serviced by the Barrier Highway, the Burra-Morgan Highway (Goyder Highway) and the Worlds End Highway (Figure 1).

The Project Area is dominated by ridges, plains and undulating hills. The highest ridge is situated along the western edge of the Project Area, spanning the entire length of the site (north to south), with the elevation lowering towards the east of the site.

Land use within the area is predominantly agricultural (e.g. grazing for sheep and cattle). Native vegetation throughout the Project Area is predominately grasslands with small pockets of woody native vegetation. Patches of *Enneapogon avenaceus* grassland comprise most of this area, with small pockets of Iron-grass (*Lomandra* spp.) to the west of the Project Area. Woodland vegetation is generally located to the east and south of the site as elevation becomes lower. These woodlands primarily comprised of *Eucalyptus brachycalyx* / *E. gracilis* mallee woodland. In addition to this, a small pocket of *E. odorata* (Peppermint Box) is situated northwest of the site. The general region contains 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 sparse incidents of remnant woodlands.

1.3 Previous surveys conducted

The Project incorporates land which was first developed as the Stony Gap Wind Farm. Several surveys were previously conducted by EBS at the proposed Stony Gap site, which are summarised in Table 1.

Table 1. Previous surveys conducted by EBS.

Project description	Year	Survey Type	Citation	EBS Project No.
Stage 1 - Stony Gap Wind Farm flora survey and fauna habitat assessment	May 2008	Flora survey and fauna habitat assessment	EBS (2008)	E80308A
Stage 1 - Additional Stony Gap Wind Farm flora and fauna survey and Stony Gap Wind Farm bird utilisation study	November 2008	Targeted surveys: habitat for bat species, Pygmy Blue-tongue Lizards (<i>Tiliqua adelaidensis</i>) (PBTl) and the Flinders Worm-Lizard (<i>Aprasia pseudopulchella</i>)	EBS (2009)	E80308B
Stony Gap Wind Farm and Transmission Line Flora and Fauna - Entura	November & December 2010	Flora and fauna assessment of the revised site and transmission line route, targeted PBTl survey	EBS (2011)	E00903
Stony Gap Stage 2 Flora and Fauna Survey – TRUenergy	January 2012	Flora and fauna assessment – Stage 2	EBS (2012a)	E11102
Stony Gap Proposed Transmission Line Flora and Fauna Survey	February 2012	Vegetation association mapping, vegetation condition, species presence / absence and assessment of wildlife habitat and utilisation	EBS (2012b)	E11102B
Stony Gap Wind Farm Commonwealth Advice – TRUenergy	August 2012	EPBC Referral, Response to Additional Information Request	EBS (2012c)	E11102C
Stony Gap Stage 2 Additional Flora and Fauna Assessments	October & December 2012	Additional flora and fauna assessments of the Proposed Stage 2	EBS (2013a)	E11102D
Stony Gap Stage 1 Additional Flora and Fauna Assessments	October & December 2012	Targeted surveys for flora and fauna species and ecological communities listed under the EPBC Act - Stony Gap Wind Farm –2012	EBS (2013b)	E11102E
		Pygmy Blue-tongue Lizard Construction Environmental Management Plan	EBS (2013c)	

1.4 Proposed Project specifications

The proposed Project will be the largest South Australian energy project ever proposed, and one of the largest in Australia. In summary, Goyder South will comprise of:

- Wind generation of up to 163 turbines with a capacity of up to 1,200 MW.
- Solar generation with a capacity of up to 600 MW.
- Energy storage with a capacity of up to 900 MW/1,800 MWh.
- Three substations, access tracks, underground cabling and overhead transmission lines.
- Permanent operations and maintenance compounds.
- Temporary construction facilities including compounds and laydown areas.
- Several temporary and permanent meteorological masts.

Table 2 on page 6 summarises the Project specifications.

1.4.1 Connection Overview

More specifically, the Project will comprise:

Wind turbine generators: The wind turbines associated with the Project Area will be dispersed across the landscape and it is anticipated they will have a generating capacity of between 4-8 MW per turbine. The turbines will have a maximum tip height of 240 metres (m) (and 200 m for the three turbines closest to Burra to minimise visual impact). However, the final sizing will depend on detailed design and procurement of turbine models and may be shorter than this maximum.

Single-axis tracking, bifacial solar Photovoltaic (PV): The bifacial solar panels will gather light on both faces, with the rear face of the panel harnessing light reflected from the ground. Accordingly, these panels will require greater spacing between rows (up to 10 m) and additional land is required to accommodate this technology. They will be located at two main sites:

- a. Worlds End Solar – at the northern end of the World's End Highway, and
- b. Bright Solar – at the southern end of the project area; to the north-east of Robertstown.

The solar farm component will have a generating capacity of up to 600 MW, across the two main sites. The land at World's End is largely low-intensity grazing land, sparsely populated and increasingly marginal for agricultural use. The land at Bright has previously been cropped but is currently not used either for cropping or grazing due to ongoing drought and consequent de-vegetation.

Batteries: The battery storage infrastructure for Stage 1 of the Project will be located adjacent to the existing Robertstown substation. The battery component for future stages is likely to be located near the planned, nearby interconnector substation (which is likely to be the point of grid connection for Stages 2+ of Goyder South). This means the battery may be split across two sites. It is also proposed that some battery storage may be included at the proposed collector substation sites should this better support the desired Project and grid support outcomes.

Collector substations: The Project will include three 'collector' substations located close to the three stages of turbine development. This includes a substation in the western portion of the project area (in the

ranges), one on the eastern side (near Worlds End Highway) and one in the south (near the Bright solar site.) Overhead transmission lines will connect these substations as described below. The footprint of the substations has been developed to accommodate the substation, switchyard, control room and maintenance shed with some additional land included to accommodate battery facilities if required. Additional land near these substations has been included to accommodate temporary construction-phase facilities.

Overhead transmission line: There will be a double-circuit 275 or 330 kiloVolt (kV) overhead transmission line connecting the three substations and then extending from the Goyder South substation to the to the grid substations initially at Robertstown and later to the New South Wales interconnector substation. It is intended that both the Goyder South Project and, later, the Goyder North Project will ultimately share this transmission line corridor and transmission infrastructure, which will avoid the unnecessary additional visual and ecological impact, cost and land use restrictions associated with two separate corridors and transmission lines.

Temporary construction facilities such as a main construction site and laydown areas will also be required.

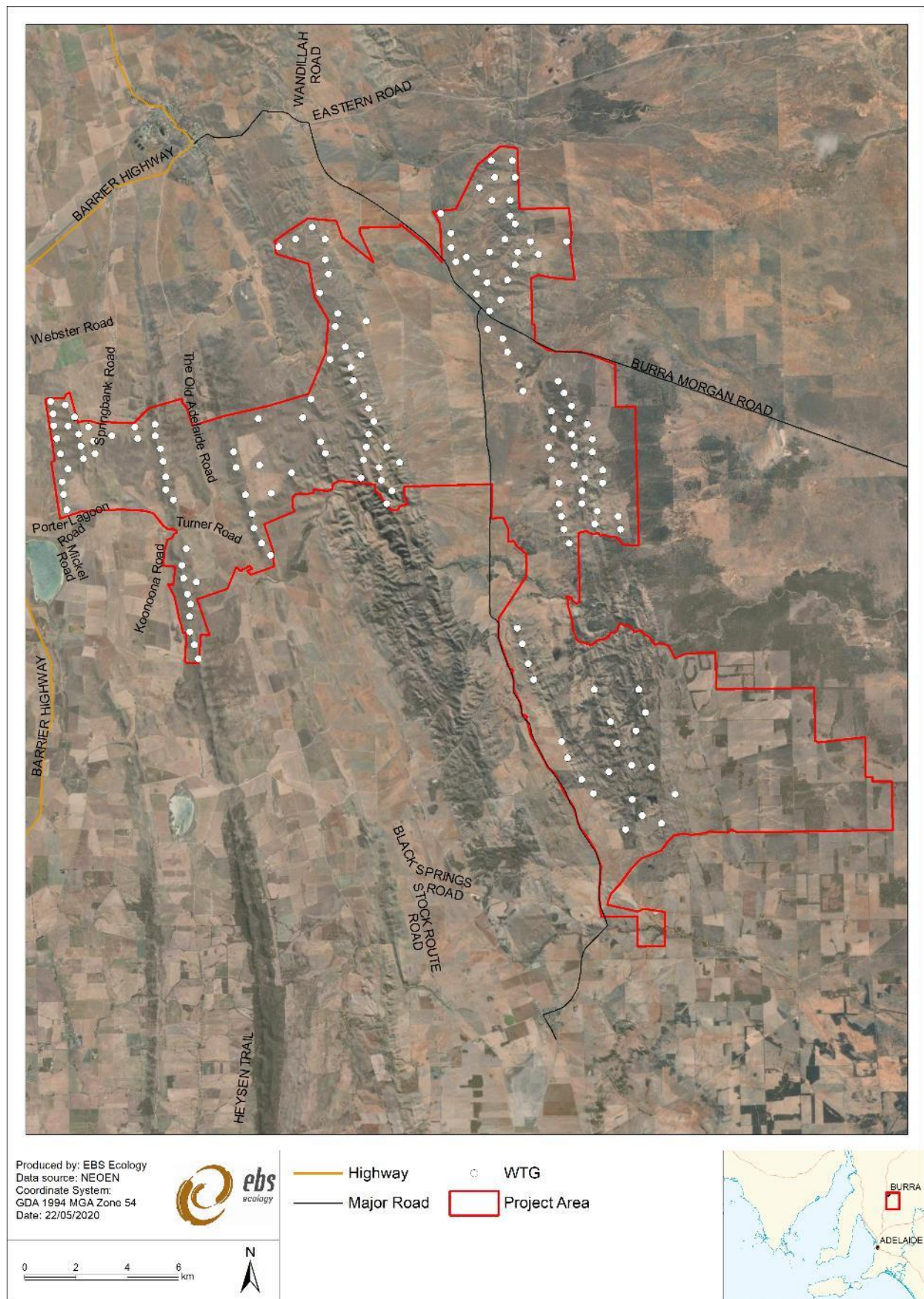


Figure 1. Location of the proposed Goyder South Hybrid Renewable Energy Facility Area.

Table 2. Goyder South project specifications (as of May 2020).

Component	Description
Wind Turbine Generators	<p>Number – max 163</p> <p>Max Height – max 240m (200m for B017, B010 and B024 near Burra)</p> <p>Blade length –max 80m</p> <p>Rotor diameter – max 165m</p> <p>Hub Height – max 160m</p> <p>Footings may be either a mass concrete footing (raft style), piled type rock anchors or a combination of both and up to 26m in diameter</p> <p>Crane hardstand area of 50m x 30m at base of each turbine</p>
Solar Panels	<p>Bifacial panels of approximately 1m x 2m</p> <p>Single-axis trackers (face north and tilts east to west)</p> <p>Mounted on framework of between 1.5 - 3m height</p> <p>Max tilt height 4m with up to 10m spacing between rows.</p>
Substation - West	<p>A fenced compound of 350 x 420m</p> <p>Including Substation and ancillary equipment and an Operations & Maintenance facility</p> <p>Access from Koonoona Road.</p>
Substation - East	<p>A fenced compound of 350 x 420m</p> <p>Including Substation and ancillary equipment and an Operations & Maintenance facility.</p> <p>Screen planting provided on the north, west and south boundaries.</p> <p>Access from Worlds End Highway.</p>
Substation - South	<p>A fenced compound of 150 x 420 containing the substation and ancillary equipment and another compound of 100 x 420 for the Operations & Maintenance facility.</p> <p>Access from Junction Road via Bright Solar Farm</p>
Operations & Maintenance	<p>Co-located with all three substation sites</p> <p>Comprising buildings (office, staff amenities), car park area, workshop and laydown area. Fenced compound of approximately 420m x 100m.</p>
Bright Solar Farm	<p>Up to 300MW solar (800, 000-1,000,000 panels) well-spaced (up to 10m) and mounted on single-axis trackers (to height of 1.5 – 3m).</p> <p>Located on approximately 1,000ha and within a chain mesh fenced compound.</p> <ul style="list-style-type: none"> - Approximately 160-200 photovoltaic boxes or skids (inverters and transformers). - Underground cabling and connections (33-66kV) <p>Internal access tracks</p>
Worlds End Solar Farm	<p>Up to 300MW solar (800,000-1,000,000 panels) well-spaced (up to 10m) and mounted on single-axis trackers (at height of 1.5 – 3m).</p> <p>Located on approximately 1,800ha and within a chain mesh fenced compound.</p> <ul style="list-style-type: none"> - Approximately 160-200 photovoltaic boxes or skids (inverters and transformers). - Underground cabling and connections (33-66kV) <p>Internal access tracks</p>
Battery and Grid Connection (BGC) (Robertstown Substation)	<p>Lithium-ion battery with maximum 900MW power output and energy storage of up to 1,800MWh energy storage. Developed in three stages of approximately 300MW/600MWh each.</p> <p>A 3.5m high fenced compound containing batteries, switchyard and associated equipment, underground cabling and overhead transmission lines. Security CCTV cameras and lighting. O&M compound. Lightning rods of up to 15m.</p>
BGC Operations & Maintenance	<p>Co-located with all three substation sites</p> <p>Comprising buildings (office, staff amenities), car park area, workshop and laydown area. Fenced compound of approximately 420m x 100m.</p>
Transmission Lines	<p>275kV (or 330) overhead transmission lines connecting the substations west and east with the substation south and then to the grid (initially Robertstown and later with interconnector).</p> <p>Transmission line lattice towers of up to 47m height with a footprint of 10m x 10m. Spaced approximately 200-300m apart.</p>
Meteorological Masts	<p>5 existing approved met masts (3 installed for prior Stony Gap project, 2 more approved under Council process).</p> <p>Likely to include additional 8-10 more met masts with a height equivalent to the hub height of the final selected turbine and including appropriate aviation safety markers.</p> <p>The specific locations have yet to be identified as this depends on final micro-siting of turbines.</p>

Component	Description
Access Tracks	Access tracks will be up-to 10m wide to accommodate construction activities and cranes and designed to be of acceptable gradient for CFS vehicles Following construction these tracks will be rehabilitated and reduced to the minimum widths requested by the CFS (7m)
Underground cabling	Underground cabling for transmission (33- 66kV) and communications (fibre). Generally located adjacent access tracks and within the solar and battery facilities. Trench width approx. 500mm per circuit and depth approx. 1.2m (900mm coverage on top). Impact areas of 5m width for single cable plus 1m for additional cable

2 COMPLIANCE AND LEGISLATIVE SUMMARY

A summary of relevant Commonwealth and State environment legislation is provided below, with further detail provided in Table 3.

2.1 Environment Protection and Biodiversity Conservation Act 1999

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places – defined in the Act as ‘Matters of National Environmental Significance’ (MNES).

There are nine MNES protected under the EPBC Act, two of which are of relevance to the Project Area:

- Listed threatened species and TECs; and
- Listed migratory species.

Any action that has, will have, or is likely to have a significant impact on MNES requires Referral under the EPBC Act. Substantial penalties apply for undertaking an action that has, will have, or is likely to have significant impact on a MNES without approval.

2.2 Native Vegetation Act 1991

Native vegetation within the Project Area is protected under the *Native Vegetation Act 1991* (NV Act) and *Native Vegetation Regulations 2017*. Any proposed clearance of native vegetation in South Australia (unless exempt under the regulations) is to be assessed against the Principles of Clearance under the Act and requires approval from the Native Vegetation Council (NVC). Approval is generally conditional on achievement of a net environmental benefit.

An assessment against the Native Vegetation Clearance Principles may not be required if the clearance is considered to comply with **Exemption 5(1)(d) Building or provision of infrastructure including infrastructure in the public interest** (see below). Even if this is the case, a clearance application to the NVC is still required.

Regulation 5(1) (d) Building or provision of infrastructure, including infrastructure in the Public Interest

Pursuant to Section 27(1) (b) of the Act, native vegetation may, subject to any other Act or law to the contrary, be cleared if-

(i)

(A) the clearance is incidental to the construction or expansion of a building or infrastructure, and the Minister has, by instrument in writing, declared that he or she is satisfied that the clearance is in the public interest; or

(B) the clearance is required in connection with the provision of infrastructure or services to a building or proposed building, or to any place; and

- (ii) any development authorisation required by or under the *Development Act 1993* has been obtained; and
- (iii) the NVC is satisfied (on the basis of information provided to the NVC by the person seeking the benefit of this paragraph and such other information as the NVC thinks fit) that, after taking into account the need to preserve biological diversity and the nature and purposes of any proposed building or infrastructure that is yet to be constructed, the proposed site of the building or infrastructure is the most suitable that is available; and
- (iv) the NVC is satisfied (on the basis of information provided to the NVC by the person seeking the benefit of this paragraph and such other information as the NVC thinks fit) that there is no other practicable alternative that would involve no clearance or the clearance of less vegetation or the clearance of vegetation that is less significant or (if relevant) the clearance of vegetation that has been degraded to a greater extent than the vegetation proposed to be cleared; and
- (v) the clearance is undertaken in accordance with a standard operating procedure determined or approved by the NVC for the purposes of this provision or a management plan that has been approved by the NVC, and either -
 - (A) there will be a significant environmental benefit on the property where the clearance is being undertaken or within the same region of the State; or
 - (B) either -the owner of the land (or a person acting on his or her behalf); or person connected with the construction or expansion of the building or infrastructure, or the provision of the infrastructure or services (as the case requires), has, an application to the NVC to proceed with clearing the vegetation in accordance with this provision, made a payment into the Fund of an amount considered by the NVC to be sufficient to achieve a significant environmental benefit in the manner contemplated by section 21(6) of the Act.

2.3 National Parks and Wildlife Act 1972

Native plants and animals in South Australia are protected under the *National Parks and Wildlife Act 1972* (NPW Act). It is an offence to take a native plant or protected animal without approval. Conservation rated flora and fauna species listed on Schedules 7, 8, or 9 of the NPW Act are known to or may occur within the Project Area.

2.4 Natural Resources Management Act 2004

Under the *Natural Resources Management Act 2004* (NRM Act) landholders have a legal responsibility to manage declared pest plants and animals and prevent land and water degradation.

Key components under the Act include the establishment of regional Natural Resource Management (NRM) Boards and development of regional NRM Plans; the ability to control water use through prescription, allocations and restrictions; the requirement to control pest plants and animals and activities that might result in land degradation.

A 'duty of care' is a fundamental component of this Act i.e. ensuring one's environmental and civil obligation by taking reasonable steps to prevent land and water degradation. Persons can be prosecuted if they are considered negligent in meeting their obligations.

Table 3: Summary of relevant Commonwealth and State legislation.

Legislation	Summary	Relevance
Commonwealth		
<i>Environment Protection and Biodiversity Conservation Act 1999</i>	<p>To protect 'matters of national environmental significance': Any action that has, will have or is likely to have a significant impact on a matter of national environmental significance requires Referral and approval under the EPBC Act.</p> <p>To determine whether an action is likely to have a significant impact on a matter of national environmental significance, refer to the <u>Significant Impact Guidelines</u> (Commonwealth of Australia 2013).</p>	<p>Where an activity may trigger requirements of the EPBC Act, this legislation must be taken into account. Significant penalties apply.</p> <p>The EPBC Act Significant Impact Guidelines provide overarching guidance on determining whether an action is likely to have a significant impact on a matter of national environmental significance. In terms of nationally threatened species, the guidelines define an action as likely to have a significant impact if there is a real chance or possibility that it will:</p> <ul style="list-style-type: none"> • lead to a long term decrease in the population • reduce the area of occupancy of the species • fragment an existing population • adversely affect critical habitat • disrupt breeding cycles • modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline • result in the establishment of invasive species that are harmful to the species • introduce disease that may cause the species to decline • interfere with the recovery of the species.
State		
<i>National Parks and Wildlife Act 1972</i>	<p>Allows for the protection of habitat and wildlife through the establishment of parks and reserves (both on land and in State waters); provides for the protection of native flora and fauna; identifies flora and fauna species considered to be of conservation significance (under Schedules 7, 8, and 9 of the Act); and provides for the use of approved wildlife through a system of permits allowing certain actions, i.e. keeping and selling (s.58), harvesting (s.60C), farming (s.60C), hunting (s.68A), releasing (s.55) and undertaking scientific research (s.53) on/of native fauna species, and for the taking of plants (s.49).</p>	<p>A person must not "take" a native plant, protected animal or the eggs of a protected animal without approval (s.48A). To take a protected animal means to remove, hunt, catch, restrain, kill or injure an animal, or attempt to do so. Taking a native plant or protected animal, or the eggs of an animal carries a maximum penalty of \$10 000.</p> <p>Potential impacts on native plants and animals should be avoided where possible, particularly conservation significant flora and fauna species listed in Schedules 7, 8 or 9 of the Act.</p>
<i>Native Vegetation Act 1991</i>	<p>An Act to preserve, enhance and manage the State's native vegetation; provide a regulatory framework to control clearance of vegetation, and provide incentives and assistance to landowners to encourage them to preserve and enhance native vegetation.</p> <p>The Act protects all native vegetation that naturally occurs, i.e. vegetation which has not been planted. This includes all naturally occurring local native plants, from small ground covers and native grasses to mallee scrub and tall trees. It does not cover planted trees.</p> <p>Under the Act, clearance is defined as:</p> <ul style="list-style-type: none"> • the killing or destruction of native vegetation • the removal of native vegetation 	<p>Any clearance of native vegetation in South Australia (unless under exemption) needs approval from the Native Vegetation Council (NVC). The NVC considers applications to clear native vegetation under ten principles. Native vegetation should not be cleared if it is significantly at odds with these principles:</p> <ul style="list-style-type: none"> • it contains a high level of diversity of plant species • it is an important wildlife habitat • it includes rare, vulnerable or endangered plant species • the vegetation comprises a plant community that is rare, vulnerable or endangered • it is a remnant of vegetation in an area which has been extensively cleared • it is growing in, or association with, a wetland environment • it contributes to the amenity of the area • the clearance of vegetation is likely to contribute to soil erosion, salinity, or flooding

Legislation	Summary	Relevance
	<ul style="list-style-type: none"> • the severing of branches, limbs, stems or trunks of native vegetation • the burning, poisoning and slashing of native vegetation • any other substantial damage to native vegetation including activities such as the draining for the reclamation of wetlands or flooding of land • grazing land where stock has been excluded for more than ten years. <p>The Act also provides the opportunity for landholders to enter into voluntary "Heritage Agreement(s)" to ensure vegetation on private land is protected for perpetuity (s.23).</p>	<ul style="list-style-type: none"> • the clearance of vegetation is likely to cause deterioration in the quality of surface or underground water • after clearance, the land is to be used for a purpose which is unsustainable. <p>The NVC will take into account the impacts of the proposed clearance and may grant consent, refuse consent or grant consent subject to certain conditions (s.29). A net environment benefit is generally conditional on an approval being granted.</p> <p>Significant penalties apply if a person clears native vegetation without the permission of the NVC (s.26). The NVC can also take civil enforcement proceedings in the District Court for an order that the native vegetation be re-instated (s.31).</p>
<i>Natural Resources Management Act 2004</i>	<p>To promote and facilitate integrated and sustainable management of all natural resources (water, soil, biodiversity etc.); and to provide for arrangements to involve the community in the development and implementation of regional initiatives to improve the management of the natural resources.</p> <p>Key components include the establishment of regional Natural Resource Management (NRM) Boards and development of regional NRM Plans; the ability to control water use through prescription, allocations and restrictions; requirement to control pest plants and animals, and activities that might result in land degradation.</p> <p>A 'duty of care' is a fundamental element of this Act, i.e., ensuring one's environmental and civil obligation by taking reasonable steps to prevent land and water degradation. Persons can be prosecuted if they are considered negligent in meeting their obligations.</p> <p>The Project Area falls within the South Australian Murray-Darling Basin Natural Resources Management Board. Section 188(5) of the Act requires that the NRM Board must take into account any relevant provision of the regional NRM plan.</p>	<p>The NRM Board may appoint authorised officers to administer and enforce the Act. Authorised officers possess powers of entry, powers to give directions, powers to collect evidence and seize and remove animals and plants. An authorised officer may issue a protection order for the purpose of securing compliance with specified provisions of the Act:</p> <ul style="list-style-type: none"> • breach of the general statutory duty; • breach of the duty not to damage watercourses or lakes; • failure to take action to destroy or control certain animals or plants; • failure to comply with the terms of a management agreement entered into under the Act; and • any other requirement imposed by the NRM Act or a repealed Act and which has been specified in the NRM Regulations. <p>An owner of land who is, or is likely to be, in breach of the general statutory duty under the Act resulting or likely to result in land degradation may be required to prepare an action plan. Failure to comply with a notice requiring preparation of an action plan is an offence. An NRM authority or a State authorised officer may issue a reparation order in certain circumstances where a person has caused harm to a natural resource and repair is necessary.</p> <p>Enforcement action in the Environment, Resources and Development (ERD) Court can be taken if necessary.</p>

3 BACKGROUND INFORMATION

3.1 Environmental setting

3.1.1 Interim Biographical Regionalisation of Australia (IBRA)

The Project Area is located within the Interim Biogeographical Regionalisation of Australia (IBRA) Associations of Burra Hill, Flriorieton, Hansen and Sutherlands. IBRA is a landscape-based approach to classifying the land surface across a range of environmental attributes, which is used to assess and plan for the protection of biodiversity. The Project Area also falls within the Flinders Lofty Block IBRA and Murray Darling Depression bioregion and Broughton, South Olary Plain and Murray Mallee subregions.

Woodland of South Australia (SA), Blue Gum and Peppermint Box are the dominant vegetation types of the Burra Hill IBRA Association. Other IBRA Association vegetation descriptions include:

- Low open woodland of false sandalwood and Bullock bush, chenopod shrubland of bluebush, saltbush or nitrebush, low open woodland of black oak or false sandalwood and tall woodland or River Red Gum;
- Low shrubland of samphire; and
- Open scrub of beaked red mallee and low open woodland of false sandalwood and black oak.

Landscape and remnancy descriptions are summarised in Table 4.

Table 4: IBRA bioregion, subregion, and environmental association environmental landscape summary.

Flinders Lofty Block IBRA bioregion	
Temperate to arid Proterozoic ranges, alluvial fans and plains, and some outcropping volcanics, with the semi-arid to arid north supporting native cypress, Black Oak (belah) and mallee open woodlands, <i>Eremophila</i> and <i>Acacia</i> shrublands, and bluebush/saltbush chenopod shrublands on shallow, well-drained loams and moderately-deep, well-drained red duplex soils. The increase in rainfall to the south corresponds with an increase in low open woodlands of <i>Eucalyptus obliqua</i> and <i>E. baxteri</i> on deep lateritic soils, and <i>E. fasciculosa</i> and <i>E. cosmophylla</i> on shallower or sandy soils.	
Broughton IBRA subregion	
This subregion is characterised by a series of wide undulating intramontane basins with red duplex soils, separated by low but distinct northerly trending strike ridges. In the north the region leads into the Southern Flinders Ranges with no sharply defined landform boundary but a land use boundary marking the northern extremity of wheat cultivation. Due to widespread clearing for farming the only significant remnant of native vegetation is found in the Mount (Mt) Remarkable area, where an open forest dominated by <i>Eucalyptus cladocalyx</i> or by <i>E. goniocalyx</i> and <i>E. leucoxydon</i> on reddish dense loams remains. Degraded remnants of <i>E. leucoxydon</i> and <i>E. odorata</i> woodlands can still be found on stony crests and steep slopes.	
Remnant vegetation	Approximately 106330 ha of the subregion is mapped as remnant native vegetation, of which 3064 ha is formally conserved.
Landform	Hills and valleys; alternating subparallel hilly ridges and valleys with a general N-S trend in north. In south, hilly dissected tableland.
Geology	Dissected lateritized surface in south.
Soil	Hard setting loams with red clayey subsoils, highly calcareous loamy earths, hard setting loams with mottled yellow clayey subsoil, coherent sandy soils, cracking clays.

Vegetation	Assumed native vegetation cover.
Conservation significance	55 species of threatened fauna, 113 species of threatened flora. 0 wetlands of national significance.
Burra Hill IBRA environmental association	
Remnant vegetation	Approximately 32624 ha of the association is mapped as remnant native vegetation, of which 1786 ha is formally conserved.
Landform	Steep strike ridge on metasediments with dissected footslopes.
Geology	Metasediments and alluvium.
Soil	Reddish powdery calcareous loams, hard pedal red duplex soils and reddish calcareous earths.
Vegetation	Woodland of SA Blue Gum and Peppermint Box and woodland of SA Blue Gum.
Conservation significance	20 species of threatened fauna, 54 species of threatened flora. 0 wetlands of national significance.
Murray Darling Depression IBRA bioregion	
An extensive gently undulating sand and clay plain of Tertiary and Quaternary age frequently overlain by aeolian dunes. Vegetation consists of semi-arid woodlands of Black Oak / Belah, Bullock Bush/ Rosewood and Acacia spp., mallee shrublands and heathlands and savanna woodlands.	
Murray Mallee IBRA subregion	
Extensive calcreted plains overlain by a series of sand dunes. The calcreted ridges which form the undulating plain have a distinct west-north-westerly trend. The soils are shallow reddish sands on the plains and deep yellowish sands on the dunes. Fans bordering the Mt Lofty Ranges with low isolated hills rising above them have red duplex soils and calcareous earths subject to sheet erosion. Mallee is the dominant vegetation of the subregion. Its species composition reflects the diminishing coastal influence towards the north, especially in the understorey: broombush gives way here to saltbush and bluebush (<i>Atriplex</i> and <i>Maireana</i> spp.) and hummock grass (<i>Triodia irritans</i>). Blue Gum (<i>E. leucoxylon</i>) and Peppermint Box (<i>E. odorata</i>) are characteristic species in the west of the region. Although tracts of mallee still occur, most of the original vegetation has been cleared for agriculture.	
Remnant vegetation	Approximately 444401 ha of the subregion is mapped as remnant native vegetation, of which 76180 ha is formally conserved.
Landform	Very gently undulating, to flat aeolian sand covered depositional plain of the central-southern Murray Basin.
Geology	East-west linear dunes regularly spaced with cusp-like crests which are consistently steeper on the southern side. Up to four buried paleosols within the dune. Dunes composed of pale to dark reddish-brown calcareous sand with some clay fraction
Soil	Brown calcareous earths and highly calcareous brown loamy earths, hard setting loamy soils with red clayey subsoils, cracking clays.
Vegetation	Mallee heath and shrublands.
Conservation significance	101 species of threatened fauna, 136 species of threatened flora. 9 wetlands of national significance.
Sutherlands IBRA environmental association	
Remnant vegetation	Approximately 32682 ha of the association is mapped as remnant native vegetation, of which 159 ha is formally conserved.
Landform	Undulating plain comprising easterly sloping fans and pediments, dissected by streams rising in the Mt Lofty Ranges.

Geology	Colluvium, siltstone, sandstone and alluvium.
Soil	Red calcareous earths and brown siliceous sands.
Vegetation	Open scrub of Beaked Red Mallee and low open woodland of False Sandalwood and Black Oak.
Conservation significance	18 species of threatened fauna, 5 species of threatened flora. 0 wetlands of national significance.

3.1.2 Administrative boundaries

The Project Area is distributed within the Goyder Local Government Area (LGA) boundaries, the Hundreds of Kooringa, Apoinga, Baldina and Bright, and the South Australian Murray-Darling Basin and Northern and Yorke NRM Regions.

3.1.3 Climate

Climate data was sourced from the Eudunda Weather Station (site number: 024511), located approximately 40 km south of the southern boundary of the Project Area. The area surrounding Burra reaches relatively hot maximum temperatures in summer, with mean maximum temperatures highest in January (29.4 degrees) and February (29.1 degrees). The wettest months are August (55.6 millimetres (mm)), June (51.8 mm) and July (51.2 mm) (Commonwealth of Australia 2019) (Figure 2).

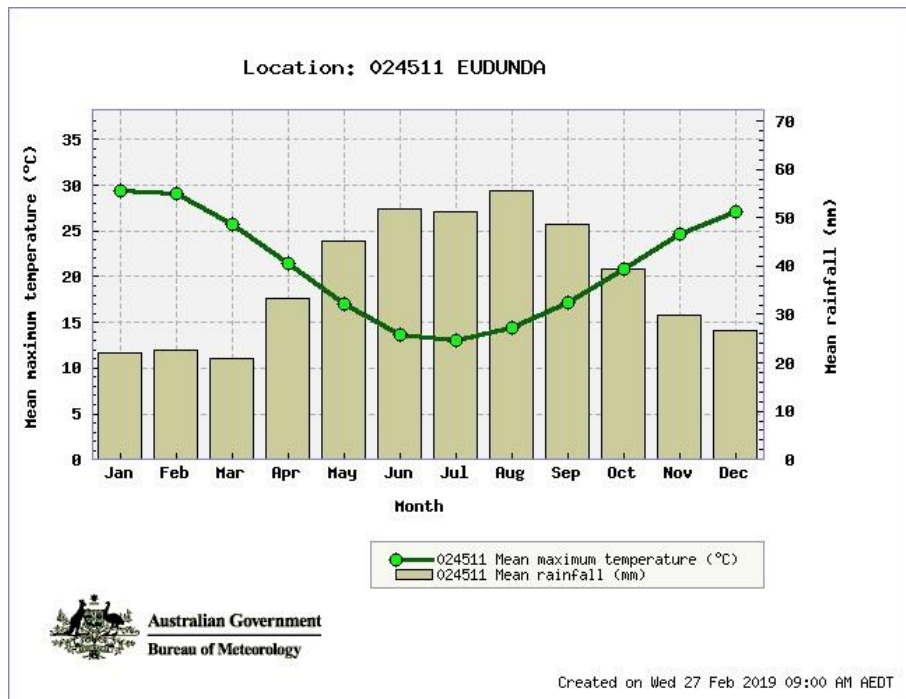


Figure 2. Mean maximum monthly temperatures and mean monthly rainfall recorded at Eudunda Weather Station (site number: 024511) from 1965 to 2019.

3.1.4 DEW Vegetation Mapping

Remnant vegetation has been mapped by the Department for Environment and Water (DEW) as part of the Native Vegetation Information System (NVIS) floristic analysis and mapping project. The NVIS mapping is based on interpretation of aerial photography or Landsat imagery and floristic data derived from Biological Survey of SA vegetation sites or field trips. Given the NVIS mapping is largely derived from remote assessment, it can be inaccurate. As part of the initial ecological assessment field work, EBS has verified previously mapped vegetation data.

NatureMaps was used to determine the broad vegetation types that had previously been mapped within the Project Area (DEW 2019). A total of 21 broad vegetation types were mapped within the Project Area (Table 5 and Figure 3):

- *Eucalyptus* mallee forest and mallee woodland (plains, hills, sand to clay loam) - dominant vegetation type within the Project Area;
- Rushland / Sedgeland (hill footslopes, crests) - significant coverage within the Project Area;
- Tussock grassland (varied) – significant coverage within the Project Area;
- Shrubland <1 m - small coverage across the Project Area; and
- *Callitris* forest and woodland (plains and hillslope) - small coverage across the Project Area.

The environmental description, dominant plant species, and hectares ha)for each vegetation type are detailed within Table 5. It should be noted that the broad vegetation types previously mapped by DEW (2019), do not equal the total number of hectares estimated for the Project Area, as not all of the Project Area has been previously mapped (Figure 3).

Table 5. Vegetation types, previously mapped by DEW, within the Project Area.

Vegetation type	Environmental description	Vegetation description	Area (ha) within Project Area
<i>Eucalyptus</i> mallee forest and mallee woodland	Plains, Hills, Dunes and Swales; Sand to Clay loam; Loamy	<i>Eucalyptus brachycalyx</i> , +/- <i>Eucalyptus oleosa</i> ssp. <i>ampliata</i> , +/- <i>Eucalyptus gracilis</i> mid mallee woodland over <i>Enchylaena tomentosa</i> var. <i>tomentosa</i> , <i>Atriplex vesicaria</i> ssp., <i>Sclerolaena diacantha</i> , <i>Maireana pyramidata</i> shrubs	3514.9
Rushland/ sedgeland	Hill footslope/ crest/slope and Ridge; Sandy loam to Clay; Clayey	<i>Lomandra multiflora</i> ssp. <i>dura</i> , <i>Austrostipa blackii</i> , <i>Aristida behriana</i> , <i>Austrodanthonia caespitosa</i> , <i>Austrostipa nitida</i> low open tussock grassland over <i>Vittadinia gracilis</i> , <i>Vittadinia cuneata</i> var. <i>cuneata</i> forma <i>cuneata</i> , <i>Maireana enchylaenoides</i>	2557.4
Tussock grassland	Varied	Emergent +/- <i>Alectryon oleifolius</i> ssp. <i>canescens</i> , +/- <i>Myoporum platycarpum</i> ssp. low open woodland over emergent +/- <i>Maireana pyramidata</i> over <i>Enneapogon avenaceus</i> , <i>Carrichtera annua</i> , <i>Sclerolaena obliquicuspis</i> , <i>Sclerolaena diacantha</i> , <i>Enneapogon intermedius</i>	1521.5
Chenopod shrubland	Stream channels and Valleys; Alluvial flood plains; along water courses	Emergent <i>Acacia victoriae</i> ssp. mid sparse shrubland over <i>Maireana pyramidata</i> , <i>Rhagodia spinescens</i> , <i>Atriplex vesicaria</i> ssp., <i>Maireana astrotricha</i> low open shrubland over <i>Tetragonia eremaea/tetragonoides</i> , <i>Enneapogon avenaceus</i> , <i>Calotis hispidula</i>	800.4
<i>Eucalyptus</i> mallee forest and mallee woodland	Swales and Sand plain; Loam	<i>Eucalyptus gracilis</i> , <i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> , <i>Eucalyptus socialis</i> ssp., +/- <i>Eucalyptus dumosa</i> mid mallee woodland over <i>Enchylaena tomentosa</i> var.,	763.6

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Vegetation type	Environmental description	Vegetation description	Area (ha) within Project Area
		<i>Senna artemisioides</i> ssp., <i>Senna artemisioides</i> ssp. <i>petiolaris</i> (NC), <i>Grevillea huegelii</i> , <i>Olearia muelleri</i>	
<i>Eucalyptus</i> forest and woodland	Hill footslope/ slope and Plain; Sand to Clay; Loamy	<i>Eucalyptus odorata</i> , +/- <i>Eucalyptus leucoxylon</i> ssp., +/- <i>Callitris glaucophylla</i> low woodland over <i>Austrodanthonia caespitosa</i> , <i>Austrostipa scabra</i> ssp., <i>Austrostipa nitida</i> , <i>Elymus scaber</i> var. <i>scaber</i> , +/- <i>Austrostipa eremophila</i> tussock grasses	599.9
<i>Allocasuarina</i> forest and woodland	Ridge and Hill slope; Sandy loam to Sandy clay loam; Loamy	<i>Allocasuarina verticillata</i> low open woodland over +/- <i>Xanthorrhoea quadrangulata</i> , +/- <i>Bursaria spinosa</i> ssp. <i>spinosa</i> , +/- <i>Acacia pycnantha</i> shrubs over <i>Lomandra densiflora</i> , <i>Astroloma humifusum</i> , <i>Dianella revoluta</i> var., <i>Pultenaea largiflorens</i> , <i>Hibbertia exutiacies</i>	449.6
Chenopod shrubland	Hill footslopes Stony rises with shales and ironstone	<i>Maireana sedifolia</i> , <i>Maireana pyramidata</i> low open shrubland over <i>Sclerolaena obliquicuspis</i> , <i>Eriochiton sclerolaenoides</i> , <i>Carrichtera annua</i> , <i>Austrostipa scabra</i> ssp., <i>Rhodanthe pygmaea</i>	381.0
<i>Eucalyptus</i> forest and woodland	Hill slope/footslope /crest and Plain; Sandy loam to Clay loam; Loamy	<i>Eucalyptus leucoxylon</i> ssp., +/- <i>Eucalyptus odorata</i> , +/- <i>Amyema miquelii</i> mid woodland over <i>Acacia pycnantha</i> , <i>Acacia paradoxa</i> shrubs over <i>Acaena echinata</i> forbs	257.6
Rushland/ sedgeland	Unknown	<i>Lomandra multiflora</i> ssp. <i>dura</i> , <i>Lomandra effusa</i> low sedgeland	151.1
Tussock grassland	Unknown	<i>Themeda triandra</i> , +/- <i>Lomandra effusa</i> , +/- <i>Lomandra multiflora</i> ssp., +/- <i>Austrostipa blackii</i> low tussock grassland	118.8
<i>Eucalyptus</i> mallee forest and mallee woodland	Plains, Hills and Dunes; Sand to Clay; Loamy	+/- <i>Eucalyptus gracilis</i> , <i>Eucalyptus socialis</i> ssp. mid mallee woodland over <i>Pittosporum angustifolium</i> shrubs over <i>Enchylaena tomentosa</i> var. <i>tomentosa</i> , <i>Rhagodia parabolica</i> , <i>Austrostipa nitida</i> , +/- <i>Austrostipa eremophila</i> shrubs	74.8
Rushland/ sedgeland	Stream channel and Swamp; Loamy sand to Clay; Loamy and Clayey; Watercourse and swamps	Emergent <i>Eucalyptus camaldulensis</i> var. <i>trees</i> over <i>Juncus kraussii</i> , <i>Cyperus gymnocaulos</i> , <i>Phragmites australis</i> , <i>Typha domingensis</i> tall sedgeland over <i>Samolus repens</i>	43.7
<i>Eucalyptus</i> mallee forest and mallee woodland	Ridges and Hill slopes	<i>Eucalyptus porosa</i> mid mallee woodland over <i>Cassinia laevis</i> , <i>Rhagodia parabolica</i> , <i>Olearia decurrens</i> , <i>Enchylaena tomentosa</i> var. low open shrubland over <i>Chrysocephalum semipapposum</i> , <i>Solanum petrophilum</i> , <i>Atriplex stipitata</i>	41.1
<i>Eucalyptus</i> forest and woodland	Stream channels; Along major watercourses	<i>Eucalyptus camaldulensis</i> var., +/- <i>Eucalyptus largiflorens</i> low woodland over <i>Acacia victoriae</i> ssp. mid sparse shrubland over <i>Maireana pyramidata</i> , <i>Rhagodia spinescens</i> , <i>Enchylaena tomentosa</i> var. low sparse shrubland over <i>Brassica tournefortii</i>	40.2
Rushland/ sedgeland	Unknown	<i>Lomandra</i> sp. low sedgeland	11.4
Shrubland <1m	Unknown	<i>Acrotriche patula</i> low open shrubland	9.3
Tussock grassland	Unknown	+/- <i>Themeda triandra</i> , +/- <i>Danthonia</i> sp., +/- <i>Lomandra</i> sp., +/- <i>Poa</i> sp., +/- <i>Austrostipa</i> sp. mid closed tussock grassland	9.3
<i>Callitris</i> forest and woodland	Plains and Hill slope; Sand to Clay loam; Sandy and Loamy soils	<i>Callitris gracilis</i> low open woodland over <i>Austrostipa</i> sp., <i>Enchylaena tomentosa</i> var. <i>tomentosa</i> , <i>Senecio pinnatifolius</i> , <i>Einadia nutans</i> ssp., +/- <i>Danthonia</i> sp. tussock grasses	4.0
Tussock grassland	Hill crest/slope; Sandy loam to Clay loam; Loamy	Emergent <i>Bursaria spinosa</i> ssp. <i>spinosa</i> , <i>Allocasuarina verticillata</i> shrubs over <i>Lepidosperma viscidum</i> , <i>Austrostipa blackii</i> , <i>Cryptandra</i> sp. Long	3.1

Vegetation type	Environmental description	Vegetation description	Area (ha) within Project Area
		<i>hypanthium</i> (C.R. Alcock 10626), <i>Lomandra multiflora</i> ssp. low tussock grassland	
<i>Eucalyptus</i> forest and woodland	Plains, Flats, Depressions, Gully and Hill slopes; Sand to Clay loam; Loamy; Drainage depressions	<i>Eucalyptus camaldulensis</i> var., +/- <i>Callitris glaucophylla</i> mid woodland over <i>Lycium ferocissimum</i> , <i>Bursaria spinosa</i> ssp. <i>spinosa</i> shrubs over <i>Cyperus vaginatus</i> , <i>Marrubium vulgare</i> , <i>Lomandra multiflora</i> ssp. <i>dura</i> forbs	2.2
TOTAL			11,354.9

3.1.5 Protected areas

The Hopkins Creek Conservation Park (CP) which is 514.7985 ha in size, is situated just outside of the Project Area, towards the southern extent (Figure 4). It conserves important riparian and flood plain habitats for Hopkins and Reed creeks. Habitats within the park include River Red Gum with various springs along the creeks, Native Pine woodland, Red Mallee and Drooping Sheoak open woodland as well as hummock grassland with scattered shrubs (DEWNR 2011).

Two other conservation parks, Mimbara CP and Red Banks CP, border the south-eastern and northern corners (respectively) of the Project Area (Figure 4).

Burra Creek Gorge Reserve holds ecological significance for the local area; River Red Gums (*Eucalyptus camaldulensis*) feature along the Burra Creek and provide important habitat for birds and other wildlife. This location is also the middle section of the Heysen Trail. World's End Gorge is an area rich in biodiversity, with mallee scrubland, peppermint grassy woodland and tussock grassland communities present within the Gorge. Both gorges are shown in Figure 4. Neoen has committed to implementing a 3 km buffer from Burra Creek Gorge campground to the nearest proposed wind turbine.

Heritage Agreements

Eight Heritage Agreements have been listed as part of the Protected Matters Search Tool results – summarised under States and Reserves (see Section 4.1.1 below). Out of the eight agreements, four are listed below, based on their proximity to the Project Area (Table 6, Figure 4).

A Heritage Agreement is a conservation area on private land, which is established by agreement (or contract) between a landholder and the Minister for Sustainability, Environment and Conservation, under the *Native Vegetation Act 1991*. Agreements are ongoing or perpetual and are binding on future landholders. Even if the property is sold or ownership is transferred, the conservation status of the land under agreement will continue. Native plants and animals within the specified Heritage Agreement area must be protected from the time the agreement is made. It is the responsibility of the landholder to conduct weed and feral animal control and they must abide by relevant legislation such as the NRM Act. If an activity could adversely impact native flora and/or fauna in a Heritage Agreement area, then the Minister will need to grant approval before it can be performed. Furthermore, the planting of vegetation, regardless of whether it is native or exotic, requires Ministerial approval. The Minister is likely to grant approval if an activity is to provide a net benefit for the conservation of the area.

Table 6. Heritage Agreements relevant to the Project Area.

Heritage Agreement ID #	DEW File Number	Date	Area (ha)	Location within Project Area
HA 1294	2003/1047	24/09/2004	415.49	Far southern extent
HA 1520	2009/1015	3/05/2012	482.96	Southern extent (three polygons)
HA 1221	1999/1006	6/06/2001	16.87	Far northern extent
HA 958	1992/1137	25/11/1993	67.63	Far southern extent

Source: NatureMaps *Heritage Agreements* layer (DEW 2019).

Significant Environmental Benefit areas

There are five Significant Environmental Benefit (SEB) areas located within close proximity to the Project Area, and one which is located within the Project Area. These are summarised in Table 7 and shown in Figure 4. An SEB is an action that results in a positive impact on the environment that is over and above the negative impact of the clearance of native vegetation and can be achieved through the establishment (revegetation), management and/or protection of an area of native vegetation (DEWNR 2016). Achieving an SEB is a condition of approval or consent for the clearance of native vegetation.

Table 7. Significant Environmental Benefit areas surrounding the Project Area.

SEB Reference Number	Area (ha)
2008_3088	6.3312
2007_3069	0.4553
2013_2024	2.6188
2014_3052	116.9599
2013_2016	4.3844
1997_2140	2.2636

Source: NatureMaps *Significant Environment Benefit Areas* layer (DEW 2019).

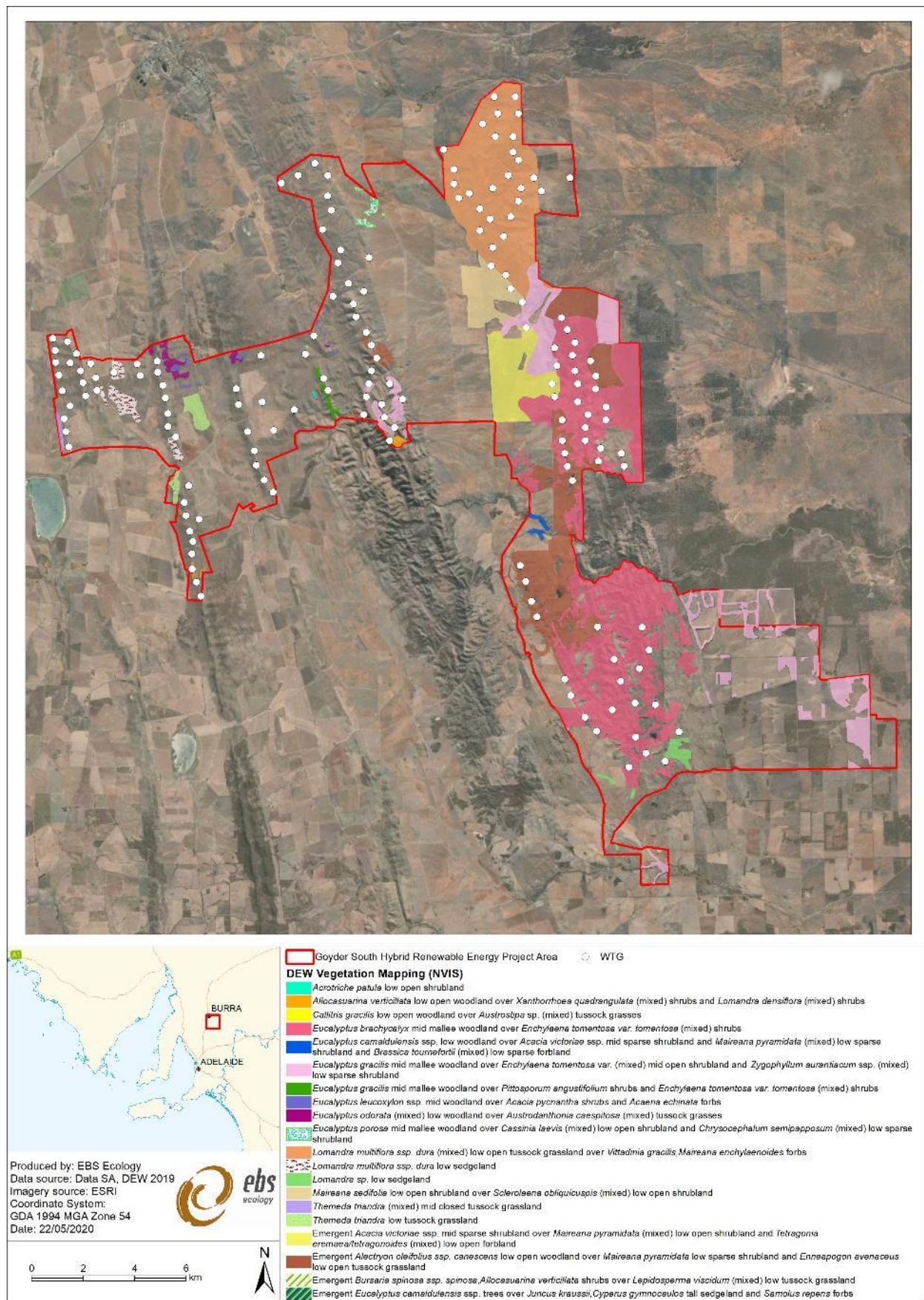


Figure 3. Remnant vegetation mapped by the Department for Environment and Water (DEW) within the Project Area.

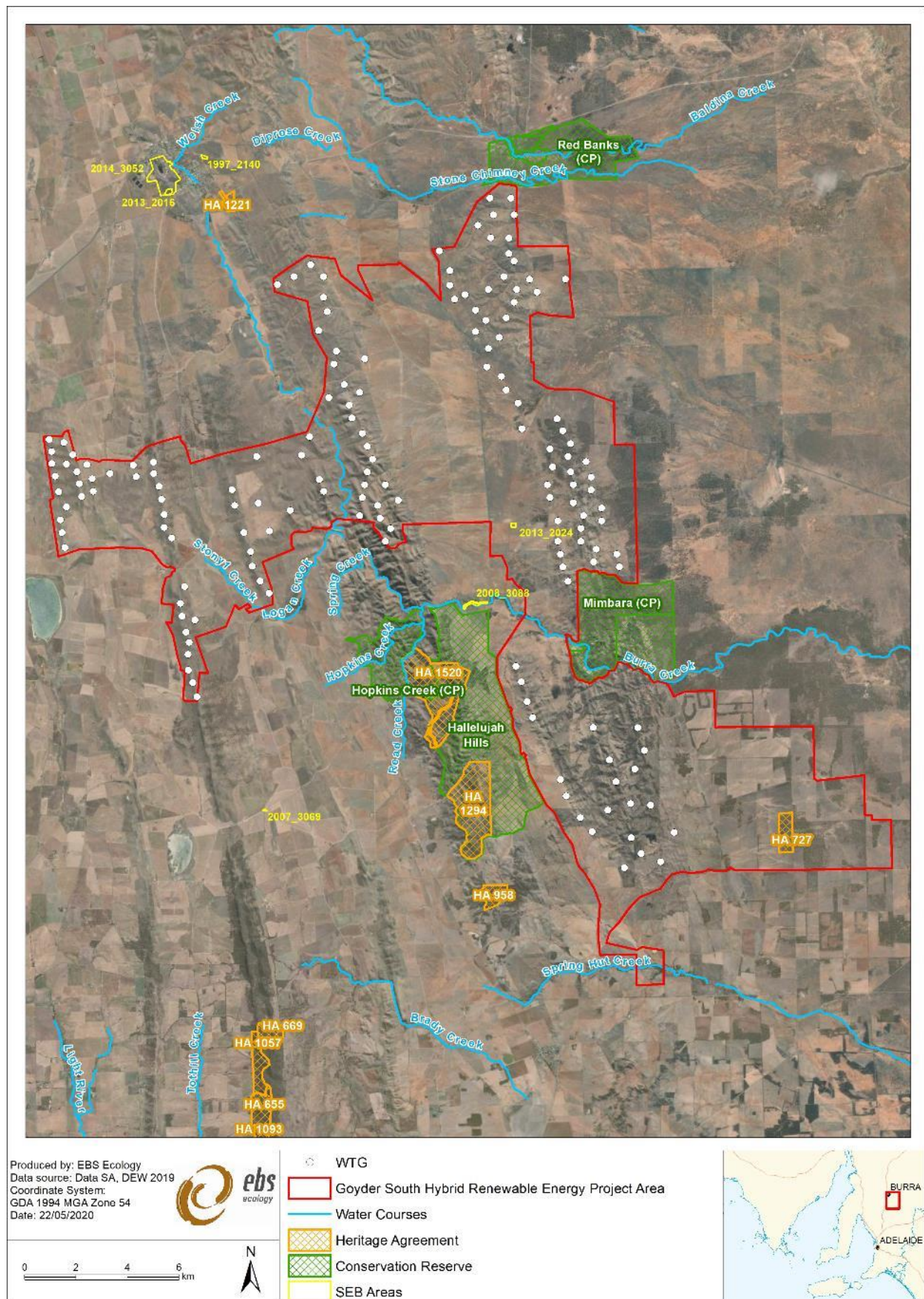


Figure 4. Protected areas, Heritage Agreements, SEB areas and watercourses highlighted within the Project Area.

4 METHODS

4.1 Desktop assessment

A desktop assessment was conducted to determine the potential for any threatened and protected species (both Commonwealth and State listed) to occur within the Project Area. This was achieved by undertaking database searches using a 20 km buffer from the centre point of the Project Area (Figure 9, Figure 10 and Figure 11).

4.1.1 *Protected Matters Search Tool (PMST) EPBC Act*

A Protected Matters Search Tool (PMST) report was generated on 10 January 2019 to identify matters of national environmental significance under the EPBC Act relevant to the Project Area (DotEE 2019). The PMST is maintained by the Department of Agriculture, Water and Environment (DAWE) and was used to identify flora and fauna species or ecological communities of national environmental significance that may occur or have suitable habitat within the Project Area.

4.1.2 *Biological Database of South Australia (BDBSA) NPW Act*

An extraction from the BDBSA was obtained to identify flora and fauna species that have been recorded within 20 km of the Project Area (DEW 2019) (accessed 21/01/2019, record set number *DEWNRBDBSA190121-1*). The BDBSA is comprised of an integrated collection of species records from the South Australian Museum, conservation organisations, private consultancy companies, Birds SA, Birdlife Australia and the Australasian Wader Study Group, which meet DEW standards for data quality, integrity and maintenance.

Threatened species (both Commonwealth and State listed), highlighted within 20 km of the Project Area, are summarised within Section 5. The complete BDBSA search results for both flora and fauna are summarised in Appendix 1 and Appendix 2 and include all species recorded within the region (threatened and common), to the buffer of 20 km.

4.1.3 *Assessment of the likelihood of occurrence*

An assessment to determine the likelihood of occurrence for threatened species and ecosystems within the Project Area was conducted. Each of the threatened species and ecosystems identified by the BDBSA data extract were assigned a rating (highly likely, likely, possible and unlikely), which described their likelihood of occurrence with the Project Area. The following criteria were considered when assigned a likelihood rating:

- Date of the most recent record (taking into consideration the date of the last surveys conducted in the area);
- Proximity of the records (distance to the Project Area);
- Landscape location of the records, vegetation remnancy and vegetation type of the record location (taking into consideration the landscape, remnancy and vegetation type of the Project Area, with higher likelihood assigned to species that were found in similar locations/condition/vegetation associations); and

- Knowledge of the species; habitat preferences, causes of its decline, the conspicuousness of the species and local population trends.

A summary of the likelihood criteria is shown below in Table 8.

Table 8. Likelihood rating and criteria for the presence of threatened species.

Likelihood	Criteria
Highly Likely/Known	<ul style="list-style-type: none"> • Records in the last 10 years, the species does not have highly specific niche requirements, the habitat is largely intact and falls within the known range of the species distribution. • The species was recorded as part of project surveys.
Likely	<ul style="list-style-type: none"> • Records within the previous 20 years, the area falls within the known distribution of the species and the area provides species habitat which is largely intact.
Possible	<ul style="list-style-type: none"> • Records within the previous 20 years, the area falls inside the known distribution of the species, but the area does not provide species habitat which is largely intact. • Records within 20 -40 years, survey effort is considered adequate, habitat is present and intact, and species of similar habitat needs have been recorded in the area.
Unlikely	<ul style="list-style-type: none"> • Records 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 within the previous 40 years despite suitable habitat being known to occur in the area. • No records despite adequate survey effort.

4.1.4 Limitations

Flora and fauna records were sourced from the BDBSA. The BDBSA only includes verified flora and fauna records submitted to DEW or partner organisations. It is recognised that knowledge is poorly captured, and it is possible that threatened species occur that are not reflected by database records. Although much of the BDBSA data have 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 are accurate or fit for any particular purpose of the user or any person to whom the user discloses the information.

BDBSA flora and fauna records were limited to a 20 km buffer around the Project Area. The reliability of the BDBSA data ranges from 100 m to over 100 km. Fauna species, in particular birds, can traverse distances more than the 20 km search buffer, and therefore, additional species may occur. It is also acknowledged that the presence of species may not be adequately represented by database records. Hence, the BDBSA results that have been clipped to a 20 km buffer of the Project Area may not highlight all potential threatened flora and fauna species that may occur in the Project Area.

The findings and conclusions expressed by EBS are based solely upon information in existence at the time of the assessment.

4.2 Field survey

Field surveys were undertaken between 25 March and 11 April (autumn), and 2 and 5 September (spring), 2019. The initial field work in autumn was aimed at surveying for the following:

- Pockets of native vegetation, targeting *Lomandra* sp. (Iron-grass) Grassland and *Eucalyptus odorata* (Peppermint Box) Woodland to determine whether both associations qualified as a TEC;
- Presence of threatened flora and fauna species;

- Presence of PBTTL including mapping any individuals recorded as well as potential habitat; and
- Presence of targeted avifauna such as birds and bats. General fauna was also recorded during the autumn survey including mapping Southern Hairy-nosed Wombat sightings and burrows.

The spring survey targeted all the above but was also undertaken to conduct bird surveys at a selection of point count sites established during the autumn survey to detect migratory and hard-to-detect species at these sites. Additional point count sites were also established in spring where access was previously not permitted. Spring surveys also helped to confirm if any of the WTE nests recorded in autumn were active.

4.2.1 Flora

The flora surveys undertaken within the Project Area were undertaken in line with the Clean Energy Council (CEC) *Best Practice Guidelines* (CEC 2018). Flora studies should be used to document the flora species that occur on site and identify significant species, in conjunction with vegetation mapping (which is best done in spring when most flowering plants are in flower). According to the CEC guidelines, vegetation mapping will record all flora species from within representative plots for each stratum, their height and cover, which is used to identify dominant species within the vegetation community which can then be related to a vegetation mapping unit (CEC 2018).

Threatened ecological community survey

Targeted surveys were undertaken in areas of *Eucalyptus odorata* (Peppermint Box) and *Lomandra* sp. (Iron-grass) to determine if the areas qualified as threatened ecological communities under the EPBC Act.

In areas where both species may qualify as TEC, surveys typically follow the criteria outlined in the *EPBC Act Policy Statement 3.7: Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia* (DEWR 2007).

Species diversity totals are typically obtained using a 50 x 50 m quadrat for each representative area, to measure the extent of *Lomandra* grassland patches and Peppermint Box Woodland. All species observed within the quadrats are then typically recorded with totals compared against the benchmark criteria outlined in the EPBC Act Policy Statement (DEWR 2007).

Areas of Condition Class A are considered the highest quality representation of the community. Condition Class B areas are also of high quality, but do not have the native species diversity of Condition Class A. Classes A and B are indicative of the listed ecological community. Condition Class C areas are typically significantly degraded (low condition), are not included as the listed ecological community and therefore do not trigger the 'significant test' of the EPBC Act. Condition Class C areas are still considered to be amenable to rehabilitation through measures such as weed control, natural regeneration and protection from grazing.

Vegetation survey

The general vegetation survey focused on validating and building on from the broad DEWNR floristic mapping, to obtain a greater understanding of the vegetation communities within the Project Area. This involved surveying all areas of native vegetation and recording the following:

- Location of vegetation associations;

- Species list for each vegetation association;
- Location and extent of declared and serious environmental weed species;
- Flora species of conservation significance; and
- Ecological communities of conservation significance.

During both autumn and spring 2019 surveys, VAs were broadly mapped over the Project Area, according to the dominant overstorey species present. The dominant flora species within each vegetation stratum (overstorey, midstorey and understorey) were recorded as well as the presence of threatened species and declared or significant weed species.

Given the size of the Project Area, the scope to broadly map vegetation associations, and the need for detailed vegetation assessments in the future, not all flora species within the Project Area were recorded. Once the design layout is final including wind turbine placement and associated infrastructure, a specific vegetation assessment based on the Bushland Assessment Methodology (BAM) (NVC 2017) will need to be undertaken across the Project Area. The BAM is endorsed by the Native Vegetation Council and used to assess areas of native vegetation requiring clearance and calculate the SEB requirements for the Project.

During this future detailed vegetation assessment, areas that were not previously surveyed by EBS (Figure 12), largely due to land acquisition constraints, will also be assessed.

4.2.2 Fauna

The fauna surveys undertaken within the Project Area were undertaken in line with CEC *Best Practice Guidelines* (CEC 2018). According to the guidelines, the aim of the fauna habitat survey should be aimed at identifying important habitat components that are on site including:

- Vegetation communities that support a particular suite of fauna e.g. native grassland species and specific fauna species e.g. PBTL;
- Trees with hollows which provide shelter sites for arboreal mammals, nest sites for birds and roost/maternity sites for bats; and
- Lakes, dams, ponds and streams that may provide habitat for waterbirds and frogs.

General fauna

All native and exotic fauna species encountered (directly observed, or tracks, scats, burrows, nests and other signs of presence) during both the autumn and spring 2019 surveys were recorded. Potential fauna refuge sites, such as hollows, rock crevices and creeklines were noted as an indication of availability of suitable habitat. Particular attention was paid to identifying habitat for threatened species. For each fauna opportunistic observation, the species, number of individuals, GPS location, detection methodology (sight, sound or sign) and habitat were recorded.

Pygmy Blue-tongue Lizards

The habitats present within the Project Area were assessed for suitability for the Nationally Endangered PBTL. PBTL surveys were undertaken to assess and categorise suitable habitat as likely, possible or

unlikely PBTL habitat. The habitat assessment was based on the habitat attributes outlined in Table 9 and direct observations of PBTLs made during both the autumn and spring 2019 surveys. Rocky, very steep and cropping areas, and areas lacking spider burrows were considered unlikely to contain PBTLs as these are unsuitable PBTL habitat attributes (Table 9).

Table 9. Suitable and unsuitable PBTL habitat attributes.

Suitable PBTL habitat attributes	Spider burrows within native grasslands with or without an exotic component. PBTLs have also been detected in highly modified treeless grasslands.
	Soil of heavy sandy loam (red-brown earth).
	Footslopes of hills.
	Sheltered areas of footslopes.
Unsuitable PBTL habitat attributes	Areas that been previously cropped.
	Areas lacking spider burrows.
	Areas containing dense ground cover vegetation.
	Steep terrain and exposed ridgelines.
	Overly rocky areas.

Given the large amount of potential PBTL habitat i.e. native grassland areas (with or without an exotic plant component) with hard packed soils (Milne 1999) within the Project Area, two EBS staff inspected spider holes along 59 transects within potential habitat throughout the Project Area (Figure 5). Out of the 59 transects, 52 were recorded in autumn 2019 and seven during the spring 2019 survey (Figure 6).

Vertical spider holes were inspected using a videoscope (Figure 7), which has an illuminated articulating insertion probe approximately 8 mm in diameter, and a digital video display screen (Yateks M-Series). The survey method was consistent with the *Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999* (DSEWPC 2011).

Birds

The bird surveys undertaken within the Project Area were undertaken in line with the CEC *Best Practice Guidelines* (CEC 2018). As part of the guidelines, bird utilisation surveys should aim to identify the avian species on site, the numbers present, and the height that birds fly, and describe utilisation across the site (CEC 2018). The surveys should be conducted during relevant seasons (for the species being studied and the location of the site) and should be aimed at sampling different relevant habitats on site.

Targeted bird surveys were conducted using point counts. A total of 25 point count sites were visited across the autumn and spring 2019 surveys (Figure 8). Ten sites were surveyed only in autumn 2019, ten sites were surveyed only in spring 2019 and five sites were surveyed across both survey periods.

The site selection process for point counts aimed to ensure an even spread across the Project Area and within the different vegetation associations, while also expending greater search effort within areas with a higher potential for threatened species to occur. The 5 ha/30-minute point count methodology was used,

whereby, an observer records all birds heard or observed within a 30-minute period in a 5 ha search area. Surveys were not conducted if weather conditions were windy or rainy.

Data collected for each point count observation were as follows:

- Species observed;
- Number of individuals;
- Height above ground (m) (minimum and maximum);
- Distance from observed (m);
- Behaviour:
 - Flying in a single direction – FLM;
 - Flying (hovering or circling) over or around a single point – FLH;
 - Foraging (feeding) on ground – FOG;
 - Perching/resting/walking on ground – ROG;
 - Perching/resting/climbing on trees or shrubs – ROT; and
- Direction of flight where possible.

If birds were heard or observed outside the search area, they were recorded as opportunistic observations. Bird activity (e.g. flying overhead, flying over circling, resting or foraging on tree/shrub/ground), number of individuals and any other notable observations were recorded. An additional survey was conducted at Porter's Lagoon (approximately 2 km west of the Project Area), which was inundated during spring, to check for migratory wader species that were identified in the desktop assessment and which could potentially be impacted by the proposed development.



Figure 5. Locations of the PBTL transects over the Project Area (transect numbers are not sequential as the Project boundary has changed since survey work was completed).



Figure 6. Individual PBTB recorded within the Project Area.



Figure 7. Vertical spider holes inspected using videoscope.

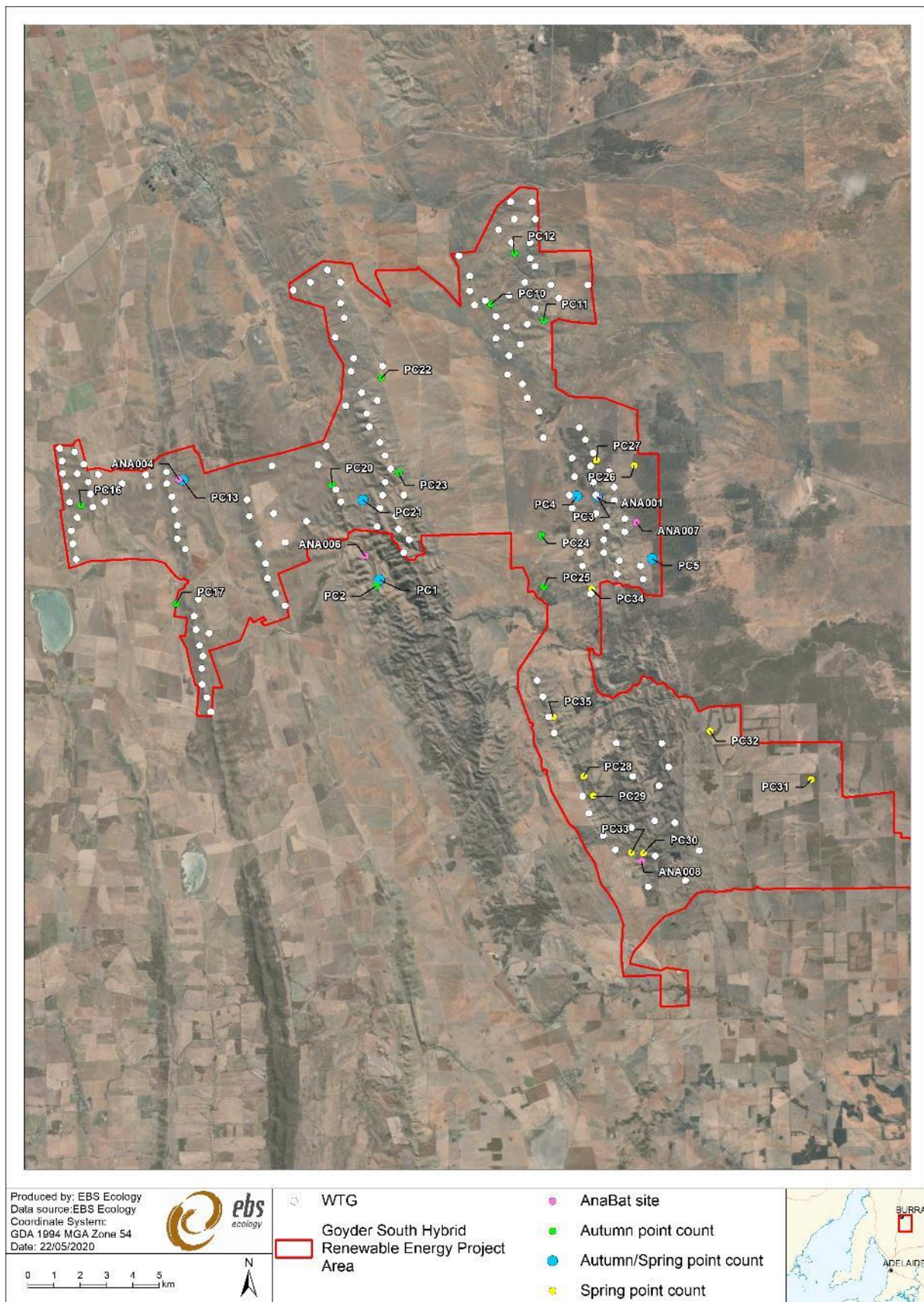


Figure 8. Location of point count sites (bird survey) and AnaBat sites (bat survey) across the Project Area (bird and bat survey sites are not sequential as the Project boundary has changed since survey was completed).

Raptor nests

Woodland areas were assessed for potential nesting locations of the State rare Peregrine Falcon (*Falco peregrinus*) and at-risk species WTE during both the autumn and spring 2019 surveys. The spring 2019 survey also revisited known WTE nest locations to determine their breeding status. To determine the condition and activity of each nest, the following data was recorded:

- Location (gully, slope, hill crest, plain);
- Nest height (measured in m, from the ground to the bottom of the nest);
- Nest depth (measured in cm, from the bottom of the nest to the rim of the nest);
- Nest diameter (measured in m, distance around the outer rim of the nest);
- Size of nest:
 - Small (<60 cm depth, <1.2 m diameter);
 - Medium (60 - 100 cm deep, 1.2 m – 1.5 m diameter);
 - Large (>1 m deep, >1.5 m diameter);
- Whether the nest was intact or dilapidated;
- Activity (not active, possible, in-active);
- Whether whitewash (areas covered in droppings) and nesting material (e.g. fresh branches and/or leaves) was present or absent;
- Nest condition (visually determined to be either poor, moderate or good); and
- Species of raptor on or located near the nest.

Bats

The bat surveys undertaken within the Project Area were undertaken in line with CEC *Best Practice Guidelines* (CEC 2018). Field surveys can determine which bat species use the site and includes those species that breed and roost on the site and those that do not live on the site but forage and/or move across the site. Bat detection systems can be used to record and analyse the echolocation calls of bats. Bat utilisation data cannot be obtained using this technique, as it is only useful for species identification and to gain an appreciation of populations (CEC 2018).

AnaBat units (Titley Electronics, Ballina New South Wales) were used to record bat ultrasonic echolocation calls. AnaBat detectors were set up at four sites for four nights across the survey periods (Figure 8). Since the initial field assessment work was completed, the Project boundary has changed and out of the original eight sites that were visited, five remain current.

The AnaBats were placed in areas thought to be of suitable habitat for bats or that bats may frequent when feeding. Woodland areas seen to contain hollows for roosting and 'fly-way' tunnels through the canopy, as well as a wetland area, were targeted for bat call activity.

Recorded bat echolocation calls were viewed as sonograms and analysed using AnalookW software. The unique pulse rates and frequency characteristics of bat calls were viewed and compared with reference

calls of known species to identify the calls to species level where possible. Species identifications were only made if certain of the call identification.

4.3 Limitations

The findings and conclusions expressed by EBS are based solely upon information in existence at the time of the assessment.

Due to the large size and landform of the Project Area, not all vegetation patches could be searched; instead, a representative sample was surveyed. As such, additional threatened plants may be present and potential turbine areas will need to be searched in detail for the presence of threatened flora species.

Field data collected during the autumn and spring 2019 surveys, combined with the desktop assessment results, is considered to provide a detailed assessment of the species that occur and are likely to occur within the Project Area. However, some plant species may have gone undetected e.g. if they were dormant, inconspicuous or lacked distinguishable features such as flowers or seed at the time of the survey.

Although fauna surveys were conducted during both autumn and spring 2019, it is possible that species additional to those recorded during the field survey periods may occur within the Project Area. For example, reptile and frog species may be present that would only be detected through targeted surveys. Additional bird species may utilise the area including seasonal migrants and vagrants.

Apart from records collected during targeted bird, bat and PBTL surveys, all other fauna records were limited to opportunistic observations, including tracks and traces. The presence of habitat suitable for threatened fauna species indicates that additional targeted surveys may be required when the location of infrastructure is finalised.

The survey effort for PBTLs was based on the experience and skills of the EBS team who have previously undertaken various PBTL surveys. Whilst not every spider hole was inspected within each area that was assessed, the additional data collected (including the presence of a PBTL, spider, other fauna or debris, as well as the depth and condition of the hole) was used to assist in decisions on the likelihood of PBTL occupation and to assist with the preliminary design of the proposed wind farm layout. Given the broad PBTL assessment, PBTLs could occur in areas outside of those mapped as possible or likely habitat. Therefore, pre-construction PBTL surveys are required in all grassland areas within the proposed construction footprint.

AnaBat recordings alone may only represent a proportion of the bat species that are present within or visiting the Project Area. The recording of calls on any one night may be influenced by many factors including temperature, humidity, insect activity, wind and associated vegetation movement.

Some bat species are readily identified via AnaBat recordings, but many are not able to be distinguished to species level by a call recording alone because there is not enough information available on bat reference calls to make definitive identifications. AnaBat call analysis is affected by many factors, these include the suite of species present, the quality of calls recorded (equipment settings, microphone quality, background noise from wind, insects, echoes), the quality of the reference call database for the region and the experience of the analyst. The time taken to identify calls depends on the above and the needs of the client. Deriving an inventory of species for each detector night is much quicker than attempting to identify

every call for each detector night. Often only a low proportion of all calls recorded may be of enough quality to allow identification.

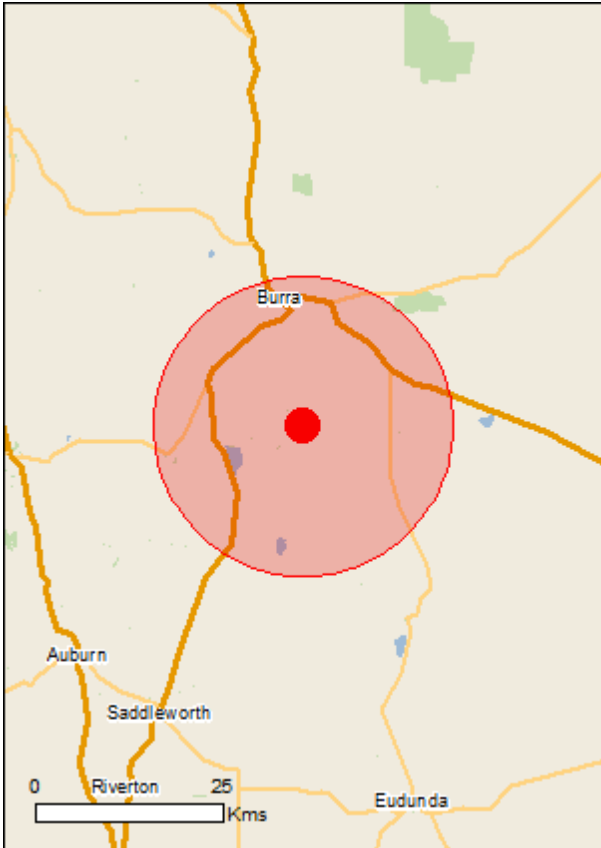
5 DESKTOP ASSESSMENT RESULTS

5.1 Matters of National Environmental Significance

The results of the PMST report (with a buffer of 20 km from the centre point of the Project Area) are summarised in Table 10 (DotEE 2019). The relevant matters of national environmental significance, other matters protected under the EPBC Act, and threatened species listed under the NPW Act are discussed in detail below.

EBS has also used the results from previous surveys completed at Stony Gap (See Table 1, page 2), as a means of determining whether species are likely or known to occur within the Project Area. Species listed as marine under the EPBC Act were excluded since the protection afforded to these species is restricted to within Commonwealth marine areas.

Table 10. Summary of the results from the Protected Matters Search.

Search area (20 km buffer)	Matters of National Environmental Significance	Number
	World Heritage Properties	None
	National Heritage Places	1
	Wetlands of International Importance	1
	Great Barrier Reef Marine Park	None
	Commonwealth Marine Areas	None
	Listed Threatened Ecological Communities	3
	Listed Threatened Species	25
	Listed Migratory Species	12
	Listed Marine Species	18
	Whales and Other Cetaceans	None
	Other Matters Protected by the EPBC Act	
	Commonwealth Heritage Places	None
	Critical Habitats	None
	Commonwealth Land	None
	Commonwealth Reserves Terrestrial	None
	Commonwealth Reserves Marine	None
	Extra Information	
	State and Territory Reserves	12
	Regional Forest Agreements	None
	Invasive Species	35
	Nationally Important Wetlands	None
	Key Ecological Features (Marine)	None

5.1.1 Threatened ecological communities

Three TECs were identified by the PMST report as likely to occur within 20 km of the Project Area:

- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions (Endangered) – this community is not considered likely to occur within the Project Area;

- Iron-grass Natural Temperate Grassland (INTG) of South Australia (Critically Endangered) – known to occur within the Project Area; and
- Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia (Critically Endangered) – known to occur within the Project Area.

Figure 3 maps Iron-grass (*Lomandra multiflora ssp. dura*) largely in the north and west sections of the Project Area, with some small areas to the east and south. Figure 48 (page 97) also shows that Iron-grass Natural Temperate Grassland TEC has been previously assessed and recorded during previous EBS surveys (see Table 1).

Figure 3 maps a small patch of Peppermint Box (*Eucalyptus odorata*) within the western section of the Project Area. Figure 48 (page 97) also shows that *Eucalyptus odorata* has been previously assessed and recorded during previous EBS surveys (see Table 1).

Both Iron-grass Natural Temperate Grassland and Peppermint Box Grassy Woodland TECs are discussed in more detail in Section 7.1. The Project Area was ground-truthed as part of the initial field assessments, to determine the presence of both TECs.

5.1.2 Nationally threatened flora

Thirteen flora species listed under the EPBC Act were identified in the PMST as potentially occurring or having suitable habitat within 20 km of the Project Area (Table 11). Three nationally Vulnerable flora species were determined as likely to occur within the Project Area: *Acacia spilleriana* (Spiller's Wattle), *Dodonaea procumbens* (Trailing Hop-bush) and *Olearia pannosa subsp. pannosa* (Silver Daisy-bush), all three of which have previously been recorded by EBS (Figure 48). These species are discussed in more detail in Section 7.2.

Nationally threatened species that share a State conservation rating and have a BDBSA record, are shown in Figure 9.

Table 11. Threatened flora species identified in the PMST report (1) and BDBSA (2) as potentially occurring within 20 km of the Project Area.

Scientific name	Common name	Conservation status		Source	Last BDBSA record (year)	Likelihood of occurrence within Project Area	EBS Record Y/N
		Aus	SA				
<i>Acacia genistifolia</i>	Broom Wattle		E	2	1990	Unlikely	
<i>Acacia glandulicarpa</i>	Hairy-pod Wattle	VU		1, 2	2008	Possible	
<i>Acacia iteaphlla</i>	Flinders Ranges Wattle		R	2	2004	Possible	
<i>Acacia menzelii</i>	Menzel's Wattle	VU		1		Unlikely	
<i>Acacia montana</i>	Mallee Wattle		R	2	1997	Unlikely	
<i>Acacia spilleriana</i>	Spiller's Wattle	EN	E	1, 2	2012	Likely	Y
<i>Asperula syrticola</i>	Southern Flinders Woodruff		R	2	1993	Possible	
<i>Austrostipa breviglumis</i>	Cane Spear-grass		R	2	2008	Likely	
<i>Austrostipa gibbosa</i>	Swollen Spear-grass		R	2	2005	Likely	
<i>Austrostipa petraea</i>	Flinders Range Spear-grass		R	2	1993	Possible	

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific name	Common name	Conservation status		Source	Last BDBSA record (year)	Likelihood of occurrence within Project Area	EBS Record Y/N
		Aus	SA				
<i>Austrostipa pilata</i>	Prickle Spear-grass		V	2	2003	Likely	
<i>Bothriochloa macra</i>	Red-leg Grass		R	2	2000	Likely	
<i>Caladenia tensa</i>	Greencomb Spider-orchid	EN		1	2007	Possible	
<i>Caladenia xantholeuca</i>	White Rabbits, Flinders Ranges White Caladenia	EN		1		Unlikely	
<i>Centrolepis cephaloformis</i> ssp. <i>cephaloformis</i>	Cushion Centrolepis		R	2	1992	Possible	
<i>Codonocarpus pyramidalis</i>	Slender Bell-fruit, Camel Poison	VU	E	1, 2	2013	Possible	
<i>Cryptandra campanulata</i>	Long-flowered Cryptandra		R	2	2008	Possible	Y
<i>Cullen parvum</i>	Small Scurf-pea		V	2	2010	Possible	
<i>Daviesia benthamii</i> ssp. <i>humilis</i> (NC)	Mallee Bitter-pea		R	2	2003	Possible	
<i>Daviesia Schwarzenegger</i>	Mallee Bitter-pea		R	2	2005	Unlikely	
<i>Dianella longifolia</i> var. <i>grandis</i>	Pale Flax-lily		R	2	1998	Possible	
<i>Diuris behrii</i>	Behr's Cowslip Orchid		V	2	1999	Possible	
<i>Dodonaea procumbens</i>	Trailing Hop-bush	VU	V	1, 2	2004	Likely	Y
<i>Dodonaea subglandulifera</i>	Peep Hill Hop-bush	EN	E	1, 2	2007	Possible	
<i>Echinopogon ovatus</i>	Rough-beard Grass		R	2	2008	Likely	
<i>Eragrostis infecunda</i>	Barren Cane-grass		R	2	1998	Possible	
<i>Eryngium ovinum</i>	Blue Devil		V	2	2013	Likely	Y
<i>Eucalyptus cajuputea</i>	Green Mallee		R*	2	2003	Likely	
<i>Goodenia heteromera</i>	Spreading Goodenia		R	2	1995	Possible	
<i>Juncus australis</i>	Austral Rush		R	2	2004	Possible	
<i>Juncus radula</i>	Hoar Rush		V	2	1992	Possible	
<i>Lachnagrostis limitanea</i>	Spalding Blown-grass	EN	E	1, 2	2005	Possible	
<i>Lachnagrostis robusta</i>	Tall Blown-grass		R	2	2008	Likely	
<i>Leptorhynchus elongatus</i>	Lank Buttons		R	2	2003	Possible	
<i>Leptorhynchus orientalis</i>	Eastern Annual Buttons		R	2	1900	Unlikely	
<i>Lobelia concolor</i>	Poison Pratia		R	2	1993	Possible	
<i>Logania saxatilis</i>	Rock Logania		R	2	2008	Likely	
<i>Maireana excavata</i>	Bottle Fissure-plant		V	2	2000	Possible	
<i>Maireana rohrlachii</i>	Rohrlach's Bluebush		R	2	2013	Likely	Y
<i>Mentha satureioides</i>	Native Pennyroyal		R	2	1999	Likely	Y
<i>Montia australasica</i>	White Purslane		R	2	1993	Possible	
<i>Olearia pannosa</i> subsp. <i>pannosa</i>	Silver Daisy-bush	VU	V	1, 2	2003	Likely	Y

Scientific name	Common name	Conservation status		Source	Last BDBSA record (year)	Likelihood of occurrence within Project Area	EBS Record Y/N
		Aus	SA				
<i>Olearia picridifolia</i>	Rasp Daisy-bush		R	2	2003	Possible	
<i>Phebalium glandulosum</i> ssp. <i>macrocalx</i>	Glandular Phebalium		E	2	2008	Possible	
<i>Phebalium glandulosum</i> ssp. <i>angustifolia</i>	Narrow-leaf Wax-flower		R	2	1981	Unlikely	
<i>Philotheca verrucosa</i>	Bendigo Wax-flower		V	2	1992	Possible	Y
<i>Prasophyllum pallidum</i>	Pale Leek-orchid	VU		1		Unlikely	
<i>Podolepis decipiens</i>			R	2	1981	Unlikely	
<i>Podolepis jaceoides</i>	Showy Copper-wire Daisy		R	2	1981	Unlikely	
<i>Ptilotus erubescens</i>	Hairy-tails		R	2	1999	Likely	Y
<i>Pultenaea kraehenbuehlii</i>	Tothill Busy-pea		R	2	2009	Possible	Y
<i>Rumex dumosus</i>	Wiry Dock		R	2	2003	Possible	
<i>Rtidosperman tenuius</i>	Short-awn Wallaby-grass		R	2	2013	Possible	
<i>Sclerolaena muricata</i> var. <i>villosa</i>	Five-spine Bindi		R	2	1993	Possible	
<i>Senecio megaglossus</i>	Superb Groundsel	VU	E	1, 2	1993	Possible	
<i>Swainsona behriana</i>	Behr's Swainson-pea		V	2	1996	Possible	Y
<i>Swainsona pyrophila</i>	Yellow Swainson-pea	VU	R	1		Unlikely	
<i>Thelmitra grandiflora</i>	Great Sun-orchid		R	2	1982	Unlikely	
<i>Thsanotus tenellus</i>	Grass Fringe-lily		R	2	2008	Possible	

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation codes: CR/CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. 1: EPBC Protected Matters Search Tool. 2: Biological Database of South Australia.

5.1.3 Nationally threatened fauna

Twenty-two (22) fauna species listed under the EPBC Act were identified in the PMST as potentially occurring or having suitable habitat within 20 km of the Project Area (Table 12). This included two fish, 17 birds, one mammal and two reptile species.

Two reptile species were determined as likely to occur within the Project Area: the Nationally Endangered PBTL and Nationally Vulnerable FRWL. Both species are discussed in more detail in Section 7.3.1.

Table 12. Threatened and migratory fauna species identified in the PMST report (1) and BDBSA (2) as potentially occurring within 20 km of the Project Area.

Scientific name	Common name	Conservation status		Source	Last BDBSA record (year)	Likelihood of occurrence within Project Area	EBS Record Y/N
		Aus	SA				
ACTINOPTERYGII	Fish						
<i>Galaxias rostratus</i>	Flathead Galaxias	CE		1		Unlikely	
<i>Maccullochella peelii</i>	Murray Cod	VU		1		Unlikely	
AVES	Birds						

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific name	Common name	Conservation status		Source	Last BDBSA record (year)	Likelihood of occurrence within Project Area	EBS Record Y/N
		Aus	SA				
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi	R	1		Possible	
<i>Anhinga novaehollandiae</i>	Australasian Darter		R	2	2000	Possible	
<i>Anseranas semipalmata</i>	Magpie Goose		E	2	1983	Unlikely	
<i>Apus pacificus</i>	Fork-tailed Swift	Mi		1		Possible	
<i>Ardeotis australis</i>	Australian Bustard		V	2	2000	Unlikely	
<i>Biziura lobata</i>	Musk Duck		R	2	1996	Possible	
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi		1		Possible	
<i>Calidris ferruginea</i>	Curlew Sandpiper	CE, Mi		1		Possible	
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi	R	1		Possible	
<i>Cladorhynchus leucocephalus</i>	Banded Stilt		V	2	2003	Possible	
<i>Corcorax melanorhamphos</i>	White-winged Chough		R	2	2015	Likely	Y
<i>Coturnix ypsilophora</i>	Brown Quail		V	2	2015	Possible	
<i>Falco peregrinus</i>	Peregrine Falcon		R	2	2010	Likely	Y
<i>Gallinago hardwickii</i>	Latham's Snipe	Mi		1		Unlikely	
<i>Grantiella picta</i>	Painted Honeyeater	V		1		Unlikely	
<i>Leipoa ocellata</i>	Malleefowl	VU	V	1		Unlikely	
<i>Melanodryas cucullata</i>	Hooded Robin		R	2	2010	Likely	Y
<i>Melithreptus gularis</i>	Black-chinned Honeyeater		R	2	2006	Possible	
<i>Motacilla cinerea</i>	Grey Wagtail	Mi		1		Unlikely	
<i>Motacilla flava</i>	Yellow Wagtail	Mi		1		Unlikely	
<i>Myiagra cyanoleuca</i>	Satin Flycatcher	Mi	E	1, 2	1998	Unlikely	
<i>Myiagra inquieta</i>	Restless Flycatcher		R	2	2010	Likely	
<i>Neophema chrysostoma</i>	Blue-winged Parrot		V	2	2001	Possible	
<i>Neophema elegans</i>	Elegant Parrot		R	2	2006	Likely	Y
<i>Numenius madagascariensis</i>	Far Eastern Curlew	CE, Mi	V	1		Unlikely	
<i>Pachycephala inornata</i>	Gilbert's Whistler		R	2	1986	Unlikely	
<i>Pandion haliaetus</i>	Osprey	Mi	R	1		Unlikely	
<i>Pedionomus torquatus</i>	Plains-wanderer	CE		1		Unlikely	
<i>Pezoporus occidentalis</i>	Night Parrot	EN	E	1		Unlikely	
<i>Plectorhyncha lanceolata</i>	Striped Honeyeater		R	2	1986	Unlikely	
<i>Porzana tabuensis</i>	Spotless Crake		R	2	2002	Unlikely	
<i>Rostratula australis</i>	Australian Painted Snipe	EN	V	1, 2	2001	Unlikely	
<i>Stagonopleura guttata</i>	Diamond Firetail		V	2	2010	Likely	Y
<i>Tringa nebularia</i>	Common Greenshank	Mi		1		Possible	
<i>Turnix varius</i>	Painted Buttonquail		R	2	2015	Possible	

Scientific name	Common name	Conservation status		Source	Last BDBSA record (year)	Likelihood of occurrence within Project Area	EBS Record Y/N
		Aus	SA				
MAMMALIA	Mammals						
<i>Nyctophilus corbeni</i>	Corben's Long-eared Bat, South-eastern Long-eared Bat	VU		1		Unlikely	
<i>Trichosurus vulpecula</i>	Common Brushtail Possum		R	2	2008	Possible	
REPTILIA	Reptiles						
<i>Aprasia pseudopulchella</i>	Flinders Ranges Worm-lizard	VU		1, 2	2016	Likely	
<i>Tiliqua adelaidensis</i>	Pygmy Blue-tongue Lizard	EN	E	1, 2	2017	Likely	Y

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation codes: CR/CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. Mi: Migratory. 1: EPBC Protected Matters Search Tool. 2: Biological Database of South Australia.

5.1.4 Migratory fauna

Twelve (12) migratory listed fauna species were identified in the PMST as potentially occurring or having suitable habitat within 20 km of the Project Area (Table 12). Five migratory species were determined as possibly occurring in the Project Area: Common Sandpiper (*Actitis hypoleucos*), Fork-tailed Swift (*Apus pacificus*), Sharp-tailed Sandpiper (*Calidris acuminata*), Pectoral Sandpiper (*Calidris melanotis*) and Common Greenshank (*Tringa nebularia*).

The Sandpiper species and Greenshank are migratory shorebirds that inhabit the fringes of wetlands, lakes and dams, where they may forage on exposed mud and within shallow water. As such, suitable habitat may be present within the Project Area in the form of pastoral dams.

These species have the potential to fly-over the Project Area based on the proximity of Porter Lagoon, which is situated approximately 2 km to the west of the Project Area. Porter Lagoon may provide a refuge for waterbirds such as the Banded Stilt (*Cladorhynchus leucocephalus*), Red-necked Avocet (*Recurvirostra novaehollandiae*), waterfowl and other waders during good seasons where water is plentiful. Two records of the Sharp-tailed Sandpiper were also listed with the Atlas of Living Australia (ALA) for Porter Lagoon (records dated 1982 and 2003), which also indicates this species' potential to utilise the lagoon.

As stated above, species listed as marine under the EPBC Act were excluded since the protection afforded to these species is restricted to within Commonwealth marine areas.

5.1.5 National Heritage Place

The Australian Cornish Mining Site at Burra was identified within the PMST results as being a National Heritage Place within 20 km of the Project Area. The Australian Heritage Database describes this Heritage Listing as Place ID106304.

5.1.6 Nationally Important Wetland

The Coorong, and Lakes Alexandrina and Albert Wetland was identified within the PMST results as being a wetland of national importance, although its proximity to the Project Area was described as 100 – 150 km upstream. The Coorong and Lakes Alexandrina and Albert Ramsar site is located at the downstream end of the Murray River, in south-east South Australia. The Murray River flows into Lake Alexandrina and out to the Southern Ocean through the Murray Mouth Estuary. Lake Albert is a terminal lake connected to Lake Alexandrina by a narrow channel. Its primary source of water is from Lake Alexandrina, supplemented by groundwater discharge and surface water runoff.

The Coorong, and Lakes Alexandrina and Albert Wetland will not be impacted upon by any proposed development in the Project Area.

5.2 Matters of State Environmental Significance

5.2.1 State threatened flora

Fifty-four (54) State threatened flora species were identified by the BDBSA as having records within 20 km of the Project Area (Table 11). Fifteen (15) species were determined as likely to occur with the Project Area, based on recent records, previous survey work by EBS (see Table 1 page 2, Figure 48 page 97) and potential habitat for these species:

- *Acacia spilleriana* (Spiller's Wattle);
- *Austrostipa breviglumis* (Cane Spear-grass);
- *Austrostipa gibbosa* (Swollen Spear-grass);
- *Austrostipa pilata* (Prickle Spear-grass);
- *Bothriochloa macra* (Red-leg Grass);
- *Dodonaea procumbens* (Trailing Hop-bush);
- *Echinopogon ovatus* (Rough-beard Grass);
- *Eryngium ovinum* (Blue Devil);
- *Eucalyptus cajuputea* (Green Mallee);
- *Lachnagrostis robusta* (Tall Blown-grass);
- *Logania saxatilis* (Rock Logania);
- *Maireana rohrbachii* (Rohrlach's Bluebush);
- *Mentha satureioides* (Native Pennyroyal);
- *Olearia pannosa subsp. pannosa* (Silver Daisy-bush); and
- *Ptilotus erubescens* (Hairy-tails).

These likely species are discussed in more detail in Section 7.2. The location of BDBSA threatened flora records are shown in Figure 10.

5.2.2 State threatened fauna

Twenty-four (24) State threatened fauna species were identified by the BDBSA as having records within 20 km of the Project Area (Table 12). This included 21 bird species, one mammal and two reptile species. Eight species (six bird and two reptile) were determined as likely to occur with the Project Area, based on recent records and potential habitat for these species (Table 12):

- White-winged Chough (*Corcorax melanorhamphos*);
- Peregrine Falcon (*Falco peregrinus*);
- Hooded Robin (*Melanodryas cucullata cucullata*);
- Restless Flycatcher (*Myiagra inquieta*);
- Elegant Parrot (*Neophema elegans*);
- Diamond Firetail (*Stagonopleura guttata*);
- Flinders Ranges Worm-lizard (*Aprasia pseudopulchella*); and
- Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*).

These likely species are discussed in more detail in Section 7.3.2. The location of BDBSA threatened fauna records is shown in Figure 11.

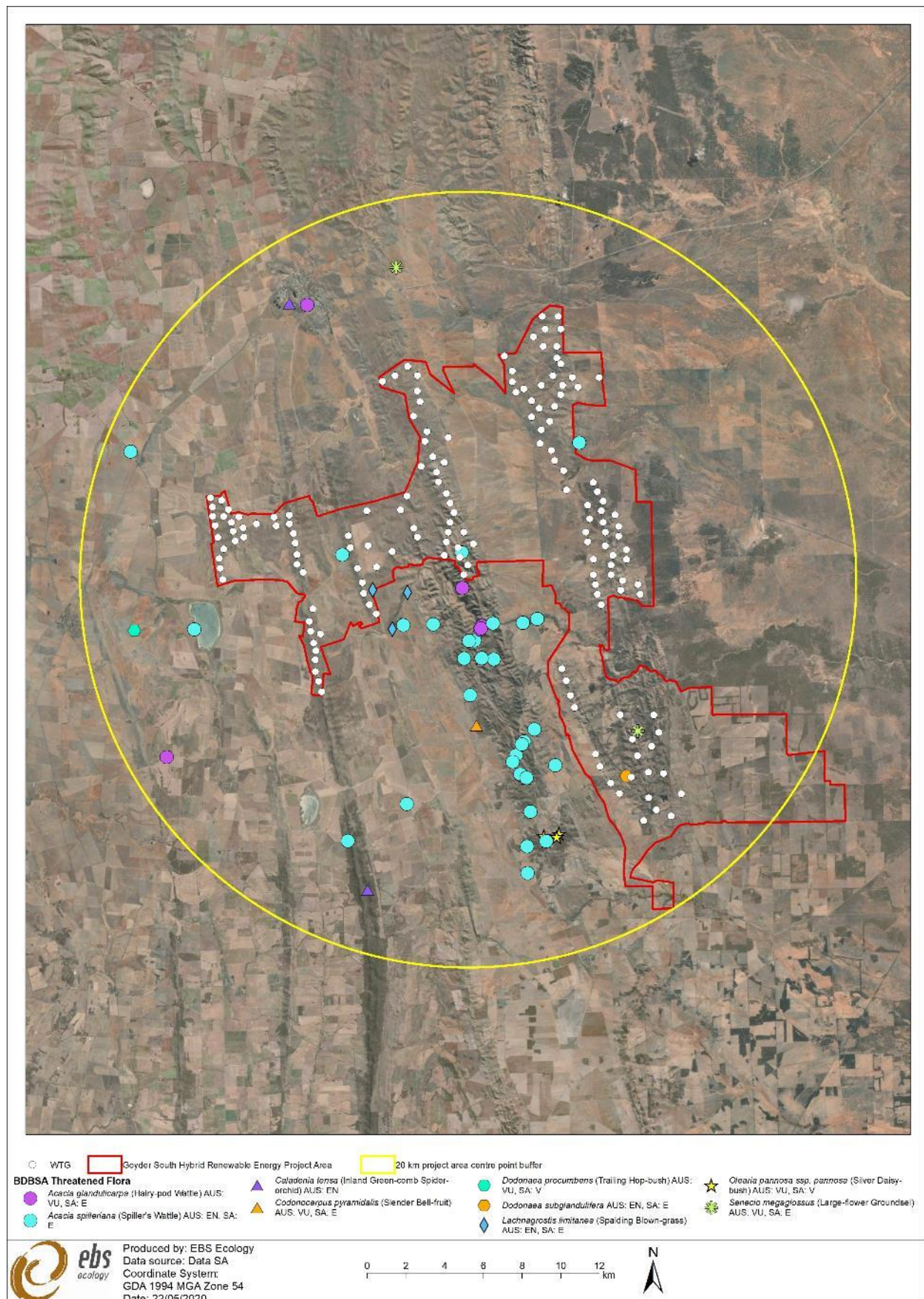


Figure 9. Nationally threatened flora (determined by BDBSA records) within 20 km of the Project Area.

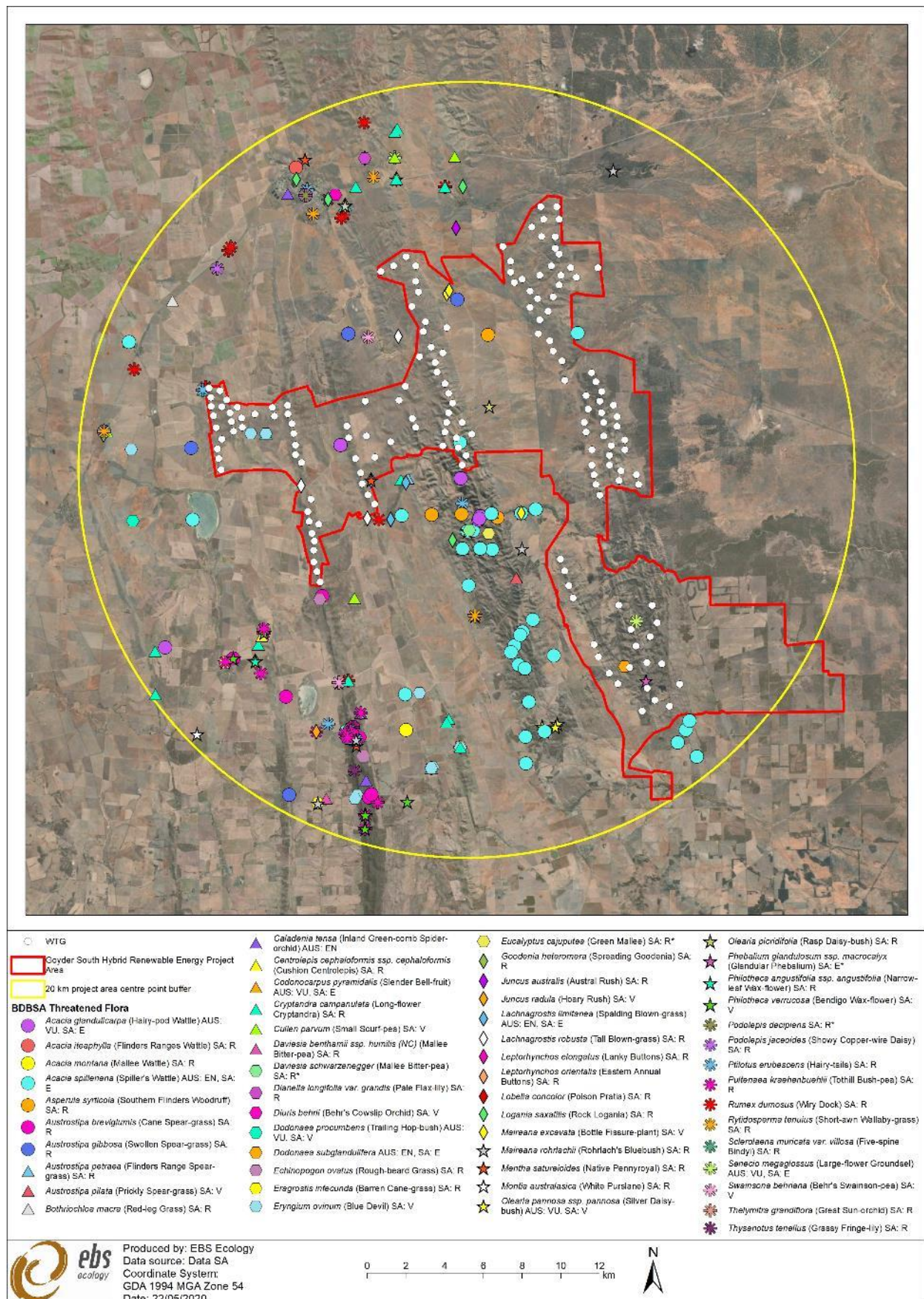


Figure 10. State threatened flora BDBSA records within 20 km of the Project Area.

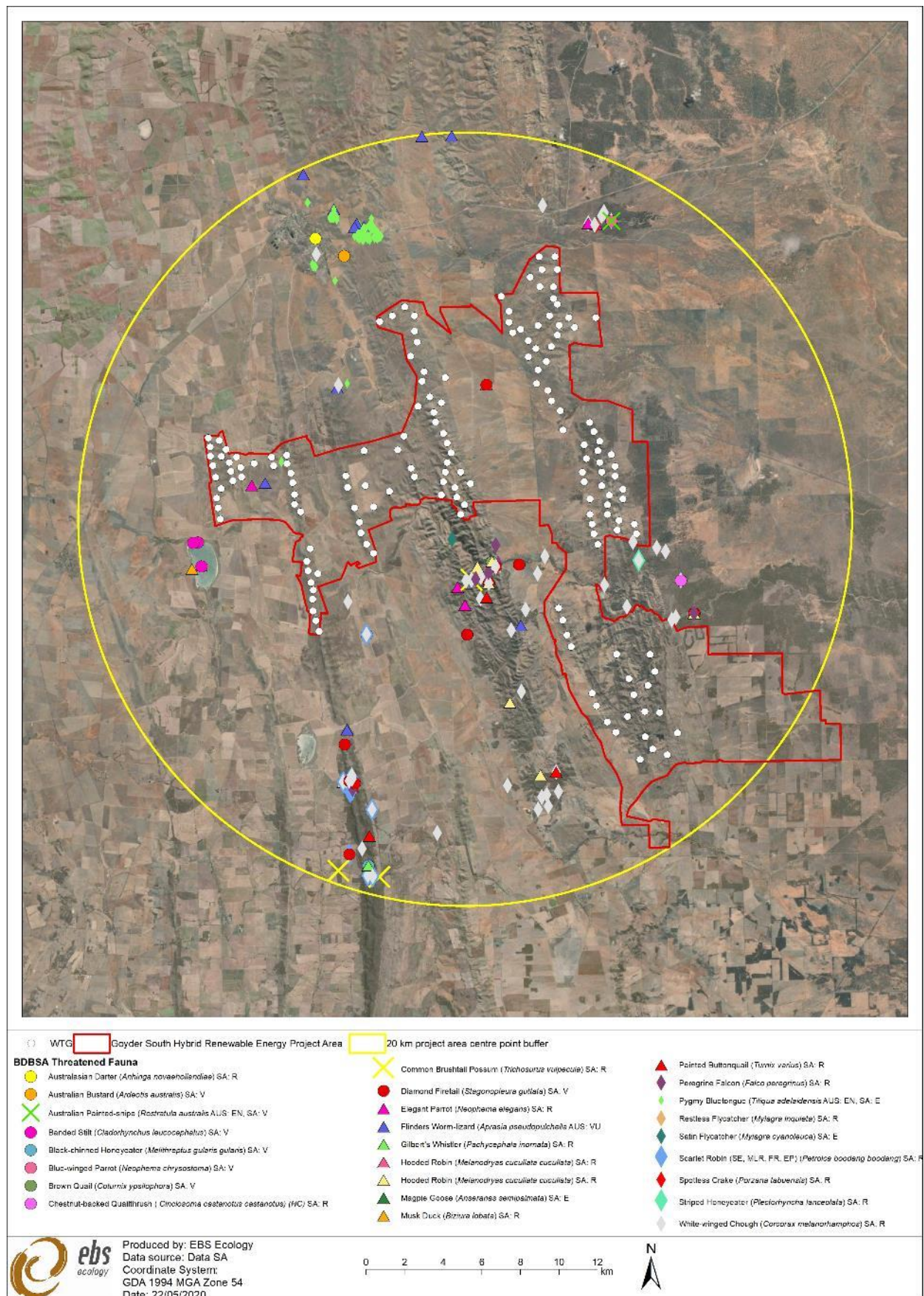


Figure 11. State threatened fauna BDBSA records within 20 km of the Project Area.

6 FIELD SURVEY RESULTS

6.1 Threatened Ecological Communities

Two TECs were identified by the PMST report as likely to occur within 20 km of the Project Area, previously identified from survey work at Stony Gap (EBS 2013a) and identified during both the autumn and spring 2019 surveys. These are Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia.

Peppermint Box (*Eucalyptus odorata*) was mapped as Vegetation Association (VA) 4 within the western section of the Project Area (Figure 12) (Figure 48, page 114), and recorded as one distinct patch, 38.9 ha in size. While this patch did not qualify as a TEC, any pure stand of *E. odorata* with a reasonable density would qualify as Class C, unless completely degraded. Class C is described as amendable to rehabilitation (> 5 natives and 1 of more perennial grass species) (DEWR 2007).

During a good year, it is expected that enough native species (15), native broad-leaved herbaceous species resistance to disturbance (3), and native grasses (2) could occur within Peppermint Box associations to qualify as Class B (and therefore constitute a TEC). This was particularly relevant to the singular patch recorded, which would most likely qualify as a TEC as it would be considered contiguous, although it was degraded. A larger area of *E. odorata* extends north from this patch, outside the Project boundary (Figure 12).

The largest patches of Iron-grass (*Lomandra multiflora* ssp. *dura*) were recorded within the western and north-eastern sections of the Project Area as well as smaller patches distributed in the south-eastern section of the Project Area (Figure 12) (Figure 45 page 89). Although a previous patch of Iron-grass qualified as Class B during the field survey at Stony Gap (EBS 2013a), none qualified during the autumn and spring 2019 surveys. The conditions were considered poor during the surveys (i.e. the area was considered to be in severe drought) and therefore assessment against the criteria was not warranted as it was highly unlikely that any patches would have qualified as Class C. During a good year, however, it is expected that enough native species and grasses within Lomandra Grassland would be present to qualify as Class B (and could therefore constitute a TEC).

6.2 Vegetation Associations (VAs)

The field surveys for the flora baseline study were undertaken from 1 to 5 April and 2 to 5 September 2019. The vegetation attributes of the Project Area can be separated into eastern and western sectors, which are divided by Burra Creek. Each sector is comprised of two parallel ridges. The western ridges were categorised as an agricultural zone landscape, within which native vegetation consisted of grasslands and tall woodlands of moderate quality, of which the woodland was mostly represented by *Eucalyptus leucoxylon* ssp. *pruinosa* (Inland South Australian Blue Gum). There was extremely low vegetation remnancy in the western sector due to extensive cropping. Where remnant vegetation occurred, stock had degraded the quality of the vegetation. Where remnant woodlands occurred in the western sector, there were considered important for the conservation of regional fauna species (see Section 7.3.2), many of which are now threatened due to habitat loss.

The eastern ridges receive lower rainfall than those in the west, and therefore, pastoral land practices were more widely used than agricultural land practices. Vegetation communities were also reflective of lower rainfall, comprising of native pine and Mallee woodlands, and chenopod shrublands. While stock grazing had degraded the quality of these vegetation communities, all the vegetative strata were intact. The vegetation communities within the eastern ridges have higher remnancy due to their low agricultural value.

The condition of native vegetation across the Project Area varied between properties in response to the land management practices of the various landholders.

Twenty (20) broad VAs were recorded and mapped over the Project Area (Table 13; Figure 12). A summary of each broad VA observed is provided below in Sections 6.2.1 to 6.2.20. The most well represented VAs, spread across the Project Area, were VA 8, 5 and 1 (Table 13; Figure 12). Native vegetation covered 26,559.2 ha of the overall Project Area. Cropping land was mapped across 5,177.5 ha of the Project Area and 1,940.4 ha remains unknown (due to areas that were not surveyed as part of the baseline assessments).

Table 13. Summary of VAs described over the Project Area.

VA	Description	Area (ha)
1	<i>Maireana aphylla</i> (Cotton-bush) / <i>Atriplex stipitata</i> (Bitter Saltbush) Mixed Low Open Chenopod Shrubland	1,880.184
2	<i>Lomandra multiflora</i> ssp. <i>dura</i> (Hard Mat-rush) / <i>Lomandra effusa</i> (Scented Mat-rush) Mixed Open Grassland	863.678
3	<i>Eucalyptus porosa</i> (Mallee Box) Open Woodland	455.033
4	<i>Eucalyptus odorata</i> (Peppermint Box) Closed Woodland	38.879
5	<i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee) Mixed Open Mallee	4,031.465
6	<i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i> (Inland South Australian Blue Gum) Open Woodland	321.787
7	<i>Eucalyptus camaldulensis</i> ssp. <i>camaldulensis</i> (River Red Gum) Woodland	1.117
8	<i>Austrostipa</i> spp. (Spear Grass) Mixed Grassland	9,349.755
9	Exotic Grassland	881.183
10	<i>Callitris gracilis</i> (Southern Cypress Pine) Low Open Woodland	2.902
11	<i>Juncus</i> sp. (Rush) / <i>Cyperus gymnocaulos</i> (Spiny Flat-sedge) Mixed Low Closed Sedgeland	41.435
12	<i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush) Low Open Woodland	78.977
13	<i>Atriplex nummularia</i> (Old-man Saltbush) Plantation	12.735
14	<i>Triodia irritans</i> (Spinifex) Grassland +/- Emergent <i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee)	49.002
15	<i>Dodonaea lobulata</i> (Lobed-leaf Hop-bush) Shrubland	24.601
16	<i>Beyeria lechenaultii</i> (Pale Turpentine Bush) Low Shrubland	26.242
17	<i>Phragmites australis</i> (Common Reed) Grassland	54.587
18	<i>Senna</i> spp. (Senna) / <i>Acacia rigens</i> (Nealie) Mixed Shrubland over Chenopod Shrubs	549.097
19	<i>Nitraria billardierei</i> (Nitrate-bush) Low Shrubland	424.11
20	<i>Maireana pyramidata</i> (Black Bluebush) Low Shrubland	317.403
	Cropped areas	5,177.533
	Amenity / Urban	37.103
	Unknown	1,940.394
	Total	26,559.2

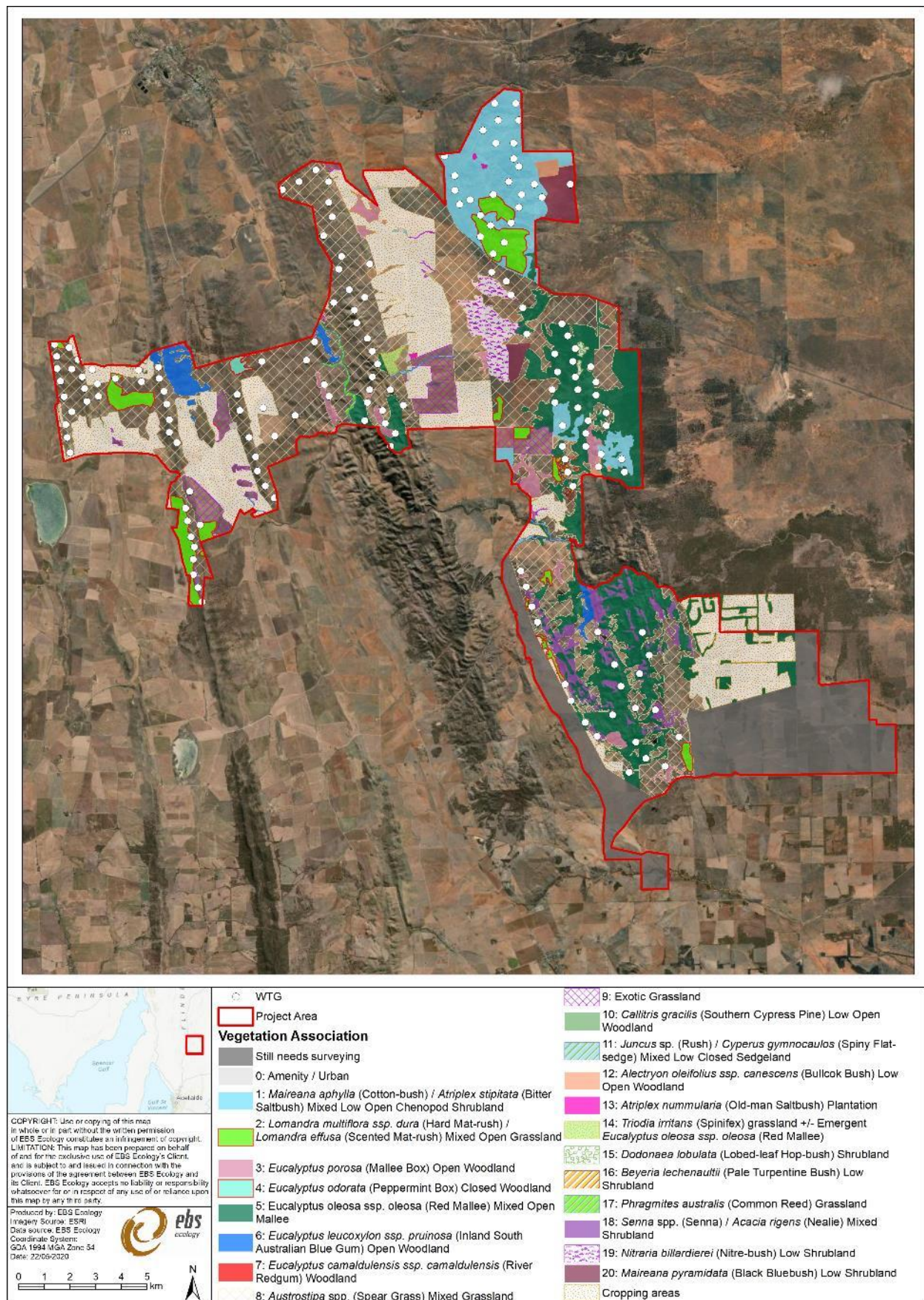


Figure 12. Vegetation Associations mapped over the Project Area.

6.2.1 VA 1: *Maireana aphylla* (Cotton-bush) / *Atriplex stipitata* (Bitter Saltbush) Mixed Low Open *Chenopod* Shrubland

VA 1 dominated the area on the east to the eastern-most range before the transition to Mallee communities on the plains (Figure 12). VA 1 was reflective of semi-arid, pastoral habitats, where overgrazing had facilitated increased abundances of species with low palatability, such as *Maireana pyramidata* (Black Bluebush). The prevailing drought conditions over South Australia at the time of survey may have led to the southward movement of kangaroos from the arid and semi-arid zone to the Mid North. High numbers of kangaroos in the Project Area would exacerbate grazing pressure on palatable species, such as *Atriplex vesicaria* (Bladder Saltbush), limiting their regeneration. The dominant flora species within VA 1 are described in Table 14. A representative photo of VA 1 is shown in Figure 13.

Table 14. Summary of VA 1: *Maireana aphylla* (Cotton-bush) / *Atriplex stipitata* (Bitter Saltbush) Mixed Low Open *Chenopod* Shrubland.

Overstorey species	<i>Maireana aphylla</i> (Cotton-bush) <i>Atriplex stipitata</i> (Bitter Saltbush) <i>Maireana pyramidata</i> (Black Bluebush) <i>Maireana sedifolia</i> (Pearl Bluebush) <i>Maireana georgei</i> (Satin Bluebush)
Midstorey species	<i>Ptilotus obovatus</i> (Silver Mulla Mulla) <i>Lomandra effusa</i> (Scented Mat-rush)
Understorey species	<i>Sclerolaena diacantha</i> (Grey Copperburr) <i>Sclerolaena obliquicuspis</i> (Oblique-spined Bindyi)
Threatened species	None observed
Declared or significant weeds	<i>Nicotiana glauca</i> (Tree Tobacco)



Figure 13. Representative photo of VA 1: *Maireana aphylla* (Cotton-bush) / *Atriplex stipitata* (Bitter Saltbush) Mixed Low Open *Chenopod* Shrubland.

6.2.2 VA 2: *Lomandra multiflora* (Hard Mat-rush) / *Lomandra effusa* (Scented Mat-rush) Mixed Open Grassland

Vegetation Association 2 was recorded on the slopes of ranges in areas with very shallow soils (Figure 12). The species richness of VA 2 was low as midstorey and understorey species, except for *Lomandra* species, were scarce. This association covered 863.7 ha of the overall Project Area. The dominant flora species within VA 2 are described in Table 15. A representative photo of VA 2 is shown in Figure 14.

Table 15. Summary of VA 2: *Lomandra multiflora* (Hard Mat-rush) / *Lomandra effusa* (Scented Mat-rush) Mixed Open Grassland.

Overstorey species	<i>Lomandra effusa</i> (Scented Mat Rush) <i>Lomandra multiflora</i> ssp. <i>dura</i> (Hard Mat-rush)
Midstorey species	<i>Beyeria opaca</i> (Dark Turpentine Bush) <i>Bursaria spinosa</i> ssp. (Bursaria)
Understorey species	None
Threatened species	None observed
Declared or significant weeds	<i>Echium plantagineum</i> (Salvation Jane) <i>Medicago</i> sp. (Medic) <i>Salvia verbenaca</i> (Wild Sage)



Figure 14. Representative photo of VA 2: *Lomandra multiflora* (Hard Mat-rush) / *Lomandra effusa* (Scented Mat Rush) Mixed Open Grassland.

6.2.3 VA 3: *Eucalyptus porosa* (Mallee Box) Open Woodland

Eucalyptus porosa (Mallee Box) Woodlands were largely restricted to the eastern extent of the Project Area and were in best condition along the fringes of Burra Creek in the eastern section of the Project Area and in the southeast of the Project Area (Figure 12). The areas where VA 3 occurred were within transitional zones between grassland areas (VAs 2 and 8) and Mallee (VA 5) and were associated with sandy soils. Numerous raptor and raven nests were present within VA 3 as *Eucalyptus porosa* was the tallest tree species present within Mallee communities. The dominant flora species within VA 3 are described in Table 16. Representative photos of VA 3 are shown in Figure 15 and Figure 16.

Table 16. Summary of VA 3: *Eucalyptus porosa* (Mallee Box) Open Woodland.

Overstorey species	<i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush) <i>Callitris gracilis</i> (Southern Cyperus Pine) <i>Eucalyptus porosa</i> (Mallee Box)
Midstorey species	<i>Beyeria opaca</i> (Dark Turpentine Bush) <i>Bursaria spinosa</i> ssp. (<i>Bursaria</i>) <i>Dodonaea viscosa</i> ssp. (Sticky Hop-bush) <i>Melaleuca lanceolata</i> (Dryland Tea-tree) <i>Pittosporum angustifolium</i> (Native Apricot)
Understorey species	<i>Atriplex stipitata</i> (Bitter Saltbush) <i>Enchylaena tomentosa</i> (Ruby Saltbush) <i>Maireana</i> spp. (Bluebushes) <i>Olearia pimeleoides</i> (Pimelea Daisy-bush) <i>Rhagodia candolleana</i> (Berry Saltbush) <i>Rhagodia spinescens</i> (Spiny Saltbush) <i>Roepera crenata</i> (Notched Twinleaf)
Threatened species	<i>Dodonaea subglandulifera</i> (AUS: EN, SA: E) (see Section 6.3)
Declared or significant weeds	<i>Asphodelus fistulosus</i> (Onion Weed) <i>Carrichtera annua</i> (Ward's Weed)



Figure 15. Representative photo of VA 3 (poor condition): *Eucalyptus porosa* (Mallee Box) Open Woodland.



Figure 16. Representative photo of VA 3 (good condition): *Eucalyptus porosa* (Mallee Box) Open Woodland.

6.2.4 VA 4: *Eucalyptus odorata* (Peppermint Box) Open Woodland

VA 4 was mostly restricted to western facing slopes on the ridgelines present within the Project Area (Figure 12). The understorey of VA 4 was highly modified due to grazing from stock and kangaroos. Areas with less degradation from grazing occurred on steep, rocky slopes where stock were less likely or unable to graze. These steep, rocky slopes may have moderate species richness following winter and spring rainfall. This single patch of VA 4 was of high value for fauna, as trees provided a nesting platform for Wedge-tailed Eagles (Figure 40) and hollows for bird and bat species to roost and nest. The dominant flora species within VA 4 are described in Table 17. A representative photo of VA 4 is shown in Figure 17.

Table 17. Summary of VA 4: *Eucalyptus odorata* (Peppermint Box) Open Woodland.

Overstorey species	<i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i> (Inland South Australian Blue Gum) <i>Eucalyptus odorata</i> (Peppermint Box) <i>Eucalyptus porosa</i> (Mallee Box)
Midstorey species	<i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush) <i>Myoporum platycarpum</i> ssp. (False Sandalwood) <i>Bursaria spinosa</i> ssp. (Bursaria) <i>Pittosporum angustifolium</i> (Native Apricot)
Understorey species	<i>Rhagodia candolleana</i> (Berry Saltbush) <i>Rhagodia spinescens</i> (Spiny Saltbush)
Threatened species	None observed
Declared or significant weeds	<i>Carrichtera annua</i> (Ward's Weed) <i>Asphodelus fistulosus</i> (Onion Weed) <i>Lycium ferocissimum</i> (African Boxthorn) <i>Marrubium vulgare</i> (Horehound)



Figure 17. Representative photo of VA 4: *Eucalyptus odorata* (Peppermint Box) Open Woodland.

6.2.5 VA 5: *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Mixed Open Mallee

VA 5 predominantly occurred within the eastern extent of the Project Area, however, isolated patches on alkaline outcrops and rises were present on the south-central section of the Project Area (Figure 12). The areas of VA 5 in the eastern extent of the Project Area were intact and provided high habitat value for fauna species as hollow bearing trees were common and food resources, such as nectar, would be abundant when *E. oleosa* are in flower. The small remnants of VA 5 on alkaline outcrops and rises were highly degraded due to their small size and location within a matrix of agricultural land. Kangaroos that feed on the agricultural land were using the small remnants for refuge, which degraded the condition of vegetation. The dominant flora species within VA 5 are described in Table 18. A representative photo of VA 5 is shown in Figure 18.

Table 18. Summary of VA 5: *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Mixed Open Mallee.

Overstorey species	<i>Eucalyptus oleosa</i> ssp. (Red Mallee) <i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush) <i>Dodonaea viscosa</i> ssp. <i>angustissimus</i> (Narrow-leaf Hop-bush)
Midstorey species	<i>Atriplex stipitata</i> (Bitter Saltbush) <i>Maireana astrotricha</i> (Low Bluebush) <i>Maireana aphylla</i> (Cotton-bush)
Understorey species	<i>Enneapogon</i> sp. (Bottle-washers) <i>Dissocarpus paradoxus</i> (Ball Bindyi)
Threatened species	None observed
Declared or significant weeds	<i>Carrichtera annua</i> (Ward's Weed)

**Figure 18. Representative photo of VA 5: *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Mixed Open Mallee.**

6.2.6 VA 6: *Eucalyptus leucoxylon* ssp. *pruinosa* (Inland South Australian Blue Gum) Open Woodland

VA 6 was almost exclusively restricted to the western ridges of the Project Area (Figure 12), where it grew in shallow soils on lower and mid-slopes that were unsuitable for cropping. The dominant overstorey species in VA 6 was *Eucalyptus leucoxylon* ssp. *pruinosa* (Inland South Australian Blue Gum), which was the tallest tree species recorded in the Project Area, and therefore, offered significant amenity value. The *E. leucoxylon* ssp. *pruinosa* trees are important to fauna as they were suitable for nesting raptors, supported hollows and provided food resources (e.g. growth tips, flowers, psyllids, lerp and nectar). The low remnancy and high ecological value of VA 6 resulted in this association being of the utmost importance for conservation. The dominant flora species within VA 6 are described in Table 19. A representative photo of VA 6 is shown in Figure 19.

Table 19. Summary of VA 6: *Eucalyptus leucoxylon* ssp. *pruinosa* (Inland South Australian Blue Gum) Open Woodland.

Overstorey species	<i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i> (Inland South Australian Blue Gum)
Midstorey species	<i>Rhagodia spinescens</i> (Spiny Saltbush)
Understorey species	<i>Austrostipa</i> sp. (Spear-grass) <i>Rytidosperma</i> sp. (Wallaby-grass) <i>Themeda triandra</i> (Kangaroo Grass)
Threatened species	None observed
Declared or significant weeds	<i>Avena barbata</i> (Bearded Oats) <i>Hordeum vulgare</i> (Barley) <i>Trifolium</i> sp. (Clover) <i>Lolium</i> sp. (Ryegrass)



Figure 19. Representative photo of VA 6: *Eucalyptus leucoxylon* ssp. *pruinosa* (Inland South Australian Blue Gum) Open Woodland.

6.2.7 VA 7: *Eucalyptus camaldulensis* ssp. *camaldulensis* (River Red Gum) Woodland

VA 7 was a riparian community restricted to Burra Creek, which runs through the Project Area, in two main locations (Figure 12). A small patch of VA 7 occurs (1.1 ha), as the majority has been avoided as part of the Project design. The dominant overstorey species was *Eucalyptus camaldulensis* ssp. *camaldulensis* (River Red Gum), which was in moderate condition, however, there was little evidence of regeneration. Stock grazing within VA 7 would limit recruitment, and therefore, this association is expected to degrade over time. The dominant flora species within VA 7 are described in Table 20. A representative photo of VA 7 is shown in Figure 20.

Table 20. Summary of VA 7: *Eucalyptus camaldulensis* ssp. *camaldulensis* (River Red Gum) Woodland.

Overstorey species	<i>Acacia salicina</i> (Broughton Willow) <i>Eucalyptus camaldulensis</i> ssp. <i>camaldulensis</i> (River Red Gum)
Midstorey species	<i>Phragmites australis</i> (Common Reed) <i>Typha domingensis</i> (Narrow-leaf Bulrush)
Understorey species	<i>Thyridia repens</i> (Creeping Monkey-flower) <i>Juncus subsecundus</i> (Finger Rush) <i>Cyperus gymnocaulos</i> (Spiny Flat-sedge)
Threatened species	None observed
Declared or significant weeds	<i>Onopordum acanthus</i> (Scotch Thistle)

**Figure 20. Representative photo of VA 7: *Eucalyptus camaldulensis* ssp. *camaldulensis* (River Red Gum) Woodland.**

6.2.8 VA 8: *Austrostipa* spp. (Spear Grass) Mixed Grassland

VA 8 had the greatest coverage of any native vegetation association in the Project Area (9,349.8 ha) (Figure 12). The condition of the grassland was poor with most tussocks grazed to their base, which has left them vulnerable to mortality. A seed bank of native grasses should be present within the soil, however, if over-grazing of VA 8 continues then exotic grass species are expected to increase in dominance over time. Few fauna species used VA 8 as habitats, however, it was determined as the preferred habitat for the Pygmy Blue-tongue Lizard. The dominant flora species within VA 8 are described in Table 21. A representative photo of VA 8 is shown in Figure 21.

Table 21. Summary of VA 8: *Austrostipa* spp. (Spear Grass) Mixed Grassland.

Overstorey species	<i>Aristida behriana</i> (Brush Wire-grass) <i>Austrostipa</i> sp. (Spear-grass) <i>Themeda triandra</i> (Kangaroo Grass)
Midstorey species	<i>Rytidosperma caespitosum</i> (Common Wallaby-grass)
Understorey species	<i>Ptilotus spathulatus</i> (Pussy-tails) <i>Vittadinia cuneata</i> var. (Fuzzy New Holland Daisy)
Threatened species	None observed
Declared or significant weeds	<i>Avena barbata</i> (Bearded Oats) <i>Hordeum vulgare</i> (Barley) <i>Trifolium</i> sp. (Clover) <i>Salvia verbenaca</i> (Wild Sage)

**Figure 21. Representative photo of VA 8: *Austrostipa* spp. (Spear Grass) Mixed Grassland.**

6.2.9 VA 9: Exotic Grassland

VA 9 was widespread over plains in the central and eastern sectors of the Project Area (Figure 12). The association occurred in areas that were previously cleared of native vegetation and have since been colonised by exotic grasses, primarily *Avena barbata* (Bearded Oats). Native flora species were scarce within VA 9, however, *Austrostipa* sp. (Spear-grass) and *Vittadinia australasica* var. (Sticky New Holland Daisy) were recorded. The dominant flora species within VA 9 are described in Table 22. A representative photo of VA 9 is shown in Figure 22.

Table 22. Summary of VA 9: Exotic Grassland.

Overstorey species	None observed	
Midstorey species	<i>Austrostipa</i> sp. (Spear-grass) <i>Euphorbia drummondii</i> (Caustic Weed) <i>Rytidosperma</i> sp. (Wallaby-grass) <i>Vittadinia australasica</i> var. (Sticky New Holland Daisy)	
Understorey species	<i>*Asteriscus spinosus</i> (Golden Pallensis) <i>*Avena barbata/fatua</i> (Wild Oat) <i>*Bromus</i> sp. (Brome) <i>*Diploaxis tenuifolia</i> (Lincoln Weed) <i>*Echium plantagineum</i> (Salvation Jane)	<i>*Lolium rigidum</i> (Wimmera Ryegrass) <i>*Hordeum leporinum</i> (Wall Barley-grass) <i>*Marrubium vulgare</i> (Horehound) <i>*Onopordum acaulon</i> (Horse Thistle) <i>*Vulpia myuros</i> (Rat's-tail Fescue)
Threatened species	None observed	
Declared or significant weeds	<i>Nicotiana glauca</i> (Tree Tobacco)	



Figure 22. Representative photo of VA 9: Exotic Grassland.

6.2.10 VA 10: *Callitris gracilis* (Southern Cypress Pine) Low Open Woodland

VA 10 was recorded in a small section of the Project Area (2.9 ha) on steep, rocky slopes in southern and eastern extent (Figure 12). The vegetation within VA 10 was intact, however, has been degraded by grazers, including kangaroos, deer and goats. The vegetative structure of VA 10 was diverse, with significant cover from a suite of flora species within each stratum. As such, VA 10 is expected to support a diverse fauna assemblage due to the variety of foraging, nesting and roosting mediums present. The dominant flora species within VA 10 are described in Table 23. A representative photo of VA 10 is shown in Figure 23.

Table 23. Summary of VA 10: *Callitris gracilis* (Southern Cypress Pine) Low Open Woodland.

Overstorey species	<i>Callitris gracilis</i> (Southern Cypress Pine) <i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee) <i>Eucalyptus porosa</i> (Mallee Box)
Midstorey species	<i>Acacia argyrophylla</i> (Silver Mulga-bush)
Understorey species	<i>Austrostipa</i> sp. (Spear-grass) <i>Triodia irritans</i> (Spinifex) <i>Vittadinia gracilis</i> (Woolly New Holland Daisy)
Threatened species	None observed
Declared or significant weeds	<i>Carrichtera annua</i> (Ward's Weed) <i>Marrubium vulgare</i> (Horehound)

**Figure 23. Representative photo of VA 10: *Callitris gracilis* (Southern Cypress Pine) Low Open Woodland.**

6.2.11 VA 11: *Juncus* sp. / *Cyperus gymnocaulos* (Spiny Flat-sedge) Low Closed Sedgeland

VA 11 was located within slight depressions on flat plains areas near Burra Creek (Figure 12). The condition of VA 11 has been degraded by stock, which have grazed out palatable species and facilitated the dominance of unpalatable species in the association. Furthermore, the increased nutrients associated with the faecal matter of stock has led to the invasion and abundance of invasive weeds. Despite the extensive degradation of VA 11, it remains an important refuge for wetland species, including frogs, and given the relative low cover of sedgelands in the region, it is of ecological importance. The dominant flora species within VA 11 are described in Table 24. A representative photo of VA 11 is shown in Figure 24.

Table 24. Summary of VA 11: *Juncus* sp. / *Cyperus gymnocaulos* (Spiny Flat-sedge) Low Closed Sedgeland.

Overstorey species	<i>Cyperus gymnocaulos</i> (Spiny Flat-sedge) <i>Juncus flavidus</i> (Yellow Rush)
Midstorey species	None observed
Understorey species	None observed
Threatened species	None observed
Declared or significant weeds	<i>Avena barbata</i> (Wild Oats) <i>Hordeum vulgare</i> (Barley) <i>Juncus usitatus</i> (Common Rush) <i>Salvia verbenaca</i> (Wild Sage)



Figure 24. Representative photo of VA 11: *Juncus* sp. / *Cyperus gymnocaulos* (Spiny Flat-sedge) Low Closed Sedgeland.

6.2.12 VA 12: *Alectryon oleifolius* ssp. *canescens* (Bullock Bush) Low Open Shrubland

VA 12 was distributed within small patches in the eastern extent of the Project Area near Mallee Open Woodland (VA 3 and VA 5) communities on moderate slopes (Figure 12). The dominant overstorey species, *Alectryon oleifolius* ssp. *canescens* (Bullock Bush), has limited coverage within the Project Area due to its high palatability. Therefore, recruitment of this species is expected to be low or nil due to stock, kangaroo and rabbit grazing. Due to the lack of recruitment in the dominant overstorey species, established individuals are of ecological significance and should be avoided. The dominant flora species within VA 12 are described in Table 25. A representative photo of VA 12 is shown in Figure 25.

Table 25. Summary of VA 12: *Alectryon oleifolius* ssp. *canescens* (Bullock Bush) Low Open Shrubland.

Overstorey species	<i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush)
Midstorey species	<i>Pittosporum angustifolium</i> (Native Apricot)
Understorey species	<i>Maireana erioclada</i> (Rosy Bluebush) <i>Maireana georgei</i> (Satiny Bluebush) <i>Olearia muelleri</i> (Mueller's Daisy bush) <i>Rhagodia spinescens</i> (Spiny Saltbush)
Threatened species	None observed
Declared or significant weeds	<i>Carrichtera annua</i> (Ward's Weed) <i>Marrubium vulgare</i> (Horehound)

**Figure 25. Representative photo of VA 12: *Alectryon oleifolius* (Bullock Bush) Low Open Shrubland.**

6.2.13 VA 13: *Atriplex nummularia* (Old-man Saltbush) Plantation

VA 13 was located on the eastern plains of the Project Area (Figure 12). The plantations were comprised of *Atriplex nummularia* (Old-man Saltbush), which was likely to have been planted for sheep fodder or landscape stabilisation. As large dense chenopods are present within VA 13, it offers habitat for a range of passerine species including Chats and Grass Parrots. The dominant flora species within VA 13 are described in Table 26. A representative photo of VA 13 is shown in Figure 26.

Table 26. Summary of VA 13: *Atriplex nummularia* (Old-man Saltbush) Plantation.

Overstorey species	<i>Atriplex nummularia</i> (Old-man Saltbush) <i>Lycium australe</i> (Australian Boxthorn)
Midstorey species	<i>Enchylaena tomentosa</i> (Ruby Saltbush) <i>Maireana brevifolia</i> (Short-leaf Bluebush)
Understorey species	<i>Roepera crenata</i> (Notched Twinleaf)
Threatened species	None observed
Declared or significant weeds	<i>Carrichtera annua</i> (Ward's Weed) <i>Mesembryanthemum nodiflorum</i> (Slender Iceplant)



Figure 26. Representative photo of VA 13: *Atriplex nummularia* (Old-man Saltbush) Plantation.

6.2.14 VA 14: *Triodia irritans* (Spinifex) grassland +/- Emergent *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee)

VA 14 was located near the centre of the Project Area, immediately east of Burra Creek. The area supporting VA 14 dominated the crest and upper slopes of hills, which are exposed to high winds, shallow soil depth and low rainfall. The presence of emergent *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) as an overstorey species within VA 14 occurred on the crests of hills, while few scattered individuals occurred on hill slopes. The dense and spiny structure of *Triodia irritans* (Spinifex) means that the shrub is an important shrub species for reptiles, which take refuge within the hummocks. The dominant flora species within VA 14 are described in Table 27. A representative photo of VA 14 is shown in Figure 27.

Table 27. Summary of VA 14: *Triodia irritans* (Spinifex) Grassland +/- Emergent *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee).

Overstorey species	<i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee)
Midstorey species	<i>Lomandra effusa</i> (Scented Mat-rush) <i>Triodia irritans</i> (Spinifex)
Understorey species	<i>Erodium</i> sp. (Heron's-bill) <i>Medicago</i> sp. (Medic) <i>Ptilotus spathulatus</i> (Pussy-tails)
Threatened species	None observed
Declared or significant weeds	<i>Asphodelus fistulosus</i> (Onion Weed)



Figure 27. Representative photo of VA 14: *Triodia irritans* (Spinifex) Grassland +/- Emergent *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee).

6.2.15 VA 15: *Dodonaea lobulata* (Lobed-leaf Hop-bush) Shrubland

VA 15 was present in the far eastern ridge of the Project Area within a relatively small depression and surrounding gentle rocky slopes. The association had scattered emergent *Alectryon oleifolius* ssp. *canescens* (Bullock Bush) and *Callitris gracilis* (Southern Cyperus Pine), and was associated with the surrounding by Mallee (VA 5), which, combined with the relatively intact mid- and understorey, provided good structural diversity for habitat. The dominant flora species within VA 15 are described in Table 28. A representative photo of VA 15 is shown in Figure 28.

Table 28. Summary of VA 15: *Dodonaea lobulata* (Lobed-leaf Hop-bush) Shrubland.

Overstorey species	<i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush) <i>Callitris gracilis</i> (Southern Cyperus Pine)
Midstorey species	<i>Beyeria lechenaultii</i> (Pale Turpentine Bush) <i>Dodonaea lobulata</i> (Lobed-leaf Hop-bush) <i>Rhagodia parabolica</i> (Mealy Saltbush)
Understorey species	<i>Atriplex stipitata</i> (Bitter Saltbush) <i>Vittadinia</i> sp. (New Holland Daisy)
Threatened species	None observed
Declared or significant weeds	<i>Moraea setifolia</i> (Thread Iris)



Figure 28. Representative photo of VA 15: *Dodonaea lobulata* (Lobed-leaf Hop-bush) Shrubland.

6.2.16 VA 16: *Beyeria lechenaultii* (Pale Turpentine Bush) Low Shrubland

VA 16 was sparsely present on eastern ridges on low gentle slopes where there was low soil cover and rock outcropping. This association occurred between areas that have been previously cleared and Mallee (VA 5) and is likely present as a transitional community slowing returning from clearance and loss of topsoil to a Mallee structure over time. The dominant flora species within VA 16 are described in Table 29. A representative photo of VA 16 is shown in Figure 29.

Table 29. Summary of VA 16: *Beyeria lechenaultii* (Pale Turpentine Bush) Low Shrubland.

Overstorey species	<i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush) <i>Dodonaea viscosa</i> ssp. <i>angustissimus</i> (Narrow-leaf Hop-bush) <i>Hakea leucoptera</i> ssp. <i>leucoptera</i> (Silver Needlewood)
Midstorey species	<i>Beyeria lechenaultii</i> (Pale Turpentine Bush) <i>Maireana aphylla</i> (Cotton-bush) <i>Maireana astrotricha</i> (Low Bluebush)
Understorey species	<i>Atriplex stipitata</i> (Bitter Saltbush) <i>Enneapogon</i> sp. (Bottle-washers) <i>Sclerolaena obliquicuspis</i> (Oblique-spined Bindyi)
Threatened species	None observed
Declared or significant weeds	<i>Asphodelus fistulosus</i> (Onion Weed) <i>Nicotiana glauca</i> (Tree Tobacco)



Figure 29. Representative photo of VA 16: *Beyeria lechenaultii* (Pale Turpentine Bush) Low Shrubland.

6.2.17 VA 17: *Phragmites australis* (Common Reed) Grassland

VA 17 occurred along Burra Creek where in certain areas the dominant *Phragmites australis* (Common Reed) had formed dense stands. This association includes freshwater wetlands, which are a State endangered ecosystem (DEH 2001), and are likely to provide important habitat for fish, frogs, turtles and water birds. Given the relative low cover of wetlands in the region, VA 17 is of ecological importance. Freshwater wetlands and *P. australis* Grasslands are threatened by weed invasion and grazing, and it is likely that VA 17 would have occurred along Burra Creek from the north of the Project Area to the northern extent of VA 17 if not for substantial weed infestation and stock grazing and trampling. The dominant flora species within VA 17 are described in Table 30. A representative photo of VA 17 is shown in Figure 30.

Table 30. Summary of VA 17: *Phragmites australis* (Common Reed) Grassland.

Overstorey species	<i>Eucalyptus camaldulensis</i> ssp. <i>camaldulensis</i> (River Red Gum)
Midstorey species	<i>Phragmites australis</i> (Common Reed) <i>Typha domingensis</i> (Narrow-leaf Bulrush)
Understorey species	<i>Thyridia repens</i> (Creeping Monkey-flower) <i>Juncus subsecundus</i> (Finger Rush) <i>Cyperus gymnocaulos</i> (Spiny Flat-sedge)
Threatened species	None observed
Declared or significant weeds	<i>Onopordum acanthium</i> (Scotch Thistle)



Figure 30. Representative photo of VA 17: *Phragmites australis* (Common Reed) Grassland.

6.2.18 VA 18: *Senna* spp. (Senna) / *Acacia rigens* (Nealie) Mixed Shrubland

VA 18 occurred along rolling hills of the south-eastern ridges of the Project Area, south of Burra Creek. Tall shrubs including *Acacia rigens* (Nealie) and *Senna* spp. (Senna) dominated VA 18, with the dominate overstorey species of associated Mallee (VA 5) and woodland (VA 3, 10 and 12) communities occurring as scattered emergents.

VA 18 closer to Burra Creek was highly degraded due to stock grazing and drought conditions. Conditions gradually improved further south and between 4 and 6 km from Burra Creek the vegetation within VA 18 was in excellent condition with high floristic diversity, little impact from grazing and few weeds. The remaining mapped areas of VA 18 are yet to be ground truthed and therefore the condition of VA 18 across the entire Project Area remains unknown. The dominant flora species within VA 18 are described in Table 31. A representative photo of VA 18 is shown in Figure 31.

Table 31. Summary of VA 18: *Senna* spp. (Senna) / *Acacia rigens* (Nealie) Mixed Shrubland.

Overstorey species	<i>Alectryon oleifolius</i> ssp. <i>canescens</i> (Bullock Bush) <i>Callitris gracilis</i> (Southern Cyperus Pine) <i>Eucalyptus oleosa</i> ssp. <i>oleosa</i> (Red Mallee)	
Midstorey species	<i>Acacia rigens</i> (Nealie) <i>Bursaria spinosa</i> (Bursaria) <i>Eremophila alternifolia</i> (Narrow-leaf Emubush) <i>Exocarpos aphyllus</i> (Leafless Cherry)	<i>Hakea leucoptera</i> ssp. <i>leucoptera</i> (Silver Needlewood) <i>Senna artemisioides</i> ssp. <i>coriacea</i> (Broad-leaf Desert Senna) <i>Senna artemisioides</i> ssp. <i>petiolaris</i>
Understorey species	<i>Austrostipa</i> sp. (Spear-grass) <i>Atriplex stipitata</i> (Bitter Saltbush) <i>Beyeria lechenaultii</i> (Pale Turpentine Bush) <i>Enchylaena tomentosa</i> (Ruby Saltbush)	<i>Eremophila glabra</i> (Tar Bush) <i>Lomandra effusa</i> (Scented Mat-rush) <i>Maireana brevifolia</i> (Short-leaf Bluebush) <i>Olearia pimeleoides</i> (Pimelea Daisy-bush)
Threatened species	None observed	
Declared or significant weeds	<i>Moraea setifolia</i> (Thread Iris)	



Figure 31. Representative photo of VA 18: *Senna* spp. (Senna) / *Acacia rigens* (Nealie) Mixed Shrubland.

6.2.19 VA 19: *Nitraria billardieri* (Nitre-bush) Low Shrubland

VA 19 occurred on a floodplain area between the eastern ridges of the Project Area, adjacent to Worlds End Highway, between Goyder Highway and Satchel Road. The species composition and structure of VA 19 was dominated by *Nitraria billardieri* (Nitre-bush) to 1 m high, with an understorey consisting of a low diversity of chenopod shrubs. The dominant flora species within VA 19 are described in Table 32. A representative photo of VA 19 is shown in Figure 32.

Table 32. Summary of VA 19: *Nitraria billardieri* (Nitre-bush) Low Shrubland.

Overstorey species	<i>Nitraria billardieri</i> (Nitre-bush)
Midstorey species	<i>Atriplex stipitata</i> (Bitter Saltbush) <i>Enchylaena tomentosa</i> (Ruby Saltbush) <i>Maireana aphylla</i> (Cotton-bush)
Understorey species	<i>Austrostipa</i> sp. (Spear-grass)
Threatened species	None observed
Declared or significant weeds	<i>Lycium ferocissimum</i> (African Boxthorn) <i>Moraea setifolia</i> (Thread Iris) <i>Onopordum acanthium</i> (Scotch Thistle)



Figure 32. Representative photo of VA 19: *Nitraria billardieri* (Nitre-bush) Low Shrubland.

6.2.20 VA 20: *Maireana pyramidata* (Black Bluebush) Low Shrubland

VA 20 occurred on a floodout area east of the far eastern ridge, north of Goyder Highway. VA 20 was dominated by *Maireana pyramidata* (Black Bluebush) up to 1 m in height, which offers habitat for a range of passerine species including Grass Parrots and Chats, with White-fronted Chats (*Epthianura albifrons*), Orange Chats (*Epthianura aurifrons*) and Crimson Chats (*Epthianura tricolor*) all observed in this association during the spring survey. The dominant flora species within VA 20 are described in Table 33. A representative photo of VA 20 is shown in Figure 33.

Table 33. Summary of VA 20: *Maireana pyramidata* (Black Bluebush) Low Shrubland.

Overstorey species	<i>Maireana pyramidata</i> (Black Bluebush)
Midstorey species	<i>Atriplex stipitata</i> (Bitter Saltbush) <i>Enchylaena tomentosa</i> (Ruby Saltbush) <i>Maireana brevifolia</i> (Short-leaf Bluebush)
Understorey species	<i>Roepera crenata</i> (Notched Twinleaf) <i>Sclerolaena obliquicuspis</i> (Oblique-spined Bindyi)
Threatened species	None observed
Declared or significant weeds	<i>Asphodelus fistulosus</i> (Onion Weed) <i>Carrichtera annua</i> (Ward's Weed) <i>Nicotiana glauca</i> (Tree Tobacco)



Figure 33. Representative photo of VA 20: *Maireana pyramidata* (Black Bluebush) Low Shrubland.

6.3 Flora

Ninety-nine (99) flora species were recorded within the Project Area during the broad vegetation mapping methodology. This included 74 native and 25 exotic species (Table 34).

Approximately 35 individuals of the nationally and State endangered *Dodonaea subglandulifera* (Peep Hill Hop-bush) (Figure 34) were observed in the southeast of the Project Area, within a good quality patch of *Eucalyptus porosa* (Mallee Box) Open Woodland (VA 3) (Figure 35). The habitat consisted of low hills with rocky outcrops. No other threatened flora species were observed during broad vegetation mapping, across the autumn and spring survey periods.

Table 34. Flora species observed in the Project Area during broad vegetation mapping.

Scientific name	Common name	Conservation status	
		Aus	SA
<i>Acacia argyrophylla</i>	Silver Mulga-bush		
<i>Acacia pycnantha</i>	Golden Wattle		
<i>Acacia rigens</i>	Nealie		
<i>Acacia salicina</i>	Broughton Willow		
<i>Alectryon oleifolius</i> ssp. <i>canescens</i>	Bullock Bush		
<i>Allocasuarina verticillata</i>	Drooping She-oak		
<i>Aristida behriana</i>	Brush Wire-grass		
* <i>Asphodelus fistulosus</i>	Onion Weed		
* <i>Asteriscus spinosus</i>	Golden Pallensis		
<i>Atriplex nummularia</i>	Old-man Saltbush		
<i>Atriplex stipitata</i>	Bitter Saltbush		
<i>Austrostipa</i> sp.	Spear-grass		
* <i>Avena barbata</i>	Bearded Oats		
<i>Beyeria lechenaultii</i>	Pale Turpentine Bush		
<i>Beyeria opaca</i>	Dark Turpentine Bush		
* <i>Bromus</i> sp.	Brome		
<i>Bursaria spinosa</i>	Bursaria		
<i>Callitris gracilis</i>	Southern Cyperus Pine		
* <i>Carrichtera annua</i>	Ward's Weed		
* <i>Cynara cardunculus</i>	Artichoke Thistle		
<i>Cyperus gymnocaulos</i>	Spiny Flat-sedge		
* <i>Diplotaxis tenuifolia</i>	Lincoln Weed		
<i>Dissocarpus paradoxus</i>	Ball Bindyi		
<i>Dodonaea baueri</i>			
<i>Dodonaea lobulata</i>	Lobed-leaf Hop-bush		
<i>Dodonaea subglandulifera</i>	Peep Hill Hop-bush	EN	E
<i>Dodonaea viscosa</i> ssp.	Sticky Hop-bush		
<i>Dodonaea viscosa</i> ssp. <i>angustissimus</i>	Narrow-leaf Hop-bush		
* <i>Echium plantagineum</i>	Salvation Jane		
<i>Enchylaena tomentosa</i>	Ruby Saltbush		
<i>Enneapogon</i> sp.	Bottlewashers		
<i>Eremophila alternifolia</i>	Narrow-leaf Emubush		
<i>Eremophila glabra</i>	Tar Bush		
<i>Erodium</i> sp.	Heron's-bill		

Scientific name	Common name	Conservation status	
		Aus	SA
<i>Eucalyptus camaldulensis</i> ssp. <i>camaldulensis</i>	River Red Gum		
<i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i>	Inland South Australian Blue Gum		
<i>Eucalyptus odorata</i>	Peppermint Box		
<i>Eucalyptus oleosa</i> ssp. <i>oleosa</i>	Red Mallee		
<i>Eucalyptus porosa</i>	Mallee Box		
<i>Euphorbia drummondii</i>	Caustic Weed		
<i>Exocarpos aphyllus</i>	Leafless Cherry		
* <i>Gomphocarpus cancellatus</i>	Broad-leaf Cottonbush		
<i>Hakea leucoptera</i> ssp. <i>leucoptera</i>	Silver Needlewood		
* <i>Hordeum leporinum</i>	Wall Barley-grass		
* <i>Hordeum vulgare</i>	Barley		
<i>Juncus flavidus</i>	Yellow Rush		
<i>Juncus subsecundus</i>	Finger Rush		
* <i>Juncus usitatus</i>	Common Rush		
* <i>Lolium rigidum</i>	Wimmera Ryegrass		
* <i>Lolium</i> sp.	Ryegrass		
<i>Lomandra effusa</i>	Scented Mat-rush		
<i>Lomandra multiflora</i> ssp. <i>dura</i>	Hard Mat-rush		
<i>Lycium australe</i>	Australian Boxthorn		
* <i>Lycium ferocissimum</i>	African Boxthorn		
<i>Maireana aphylla</i>	Cotton-bush		
<i>Maireana astrotricha</i>	Low Bluebush		
<i>Maireana brevifolia</i>	Short-leaf Bluebush		
<i>Maireana erioclada</i>	Rosy Bluebush		
<i>Maireana georgei</i>	Satin Bluebush		
<i>Maireana pyramidata</i>	Black Bluebush		
<i>Maireana sedifolia</i>	Pearl Bluebush		
* <i>Marrubium vulgare</i>	Horehound		
* <i>Medicago</i> sp.	Medic		
<i>Melaleuca lanceolata</i>	Dryland Tea-tree		
* <i>Mesembryanthemum nodiflorum</i>	Slender Iceplant		
* <i>Moraea setifolia</i>	Thread Iris		
<i>Myoporum platycarpum</i>	False Sandalwood		
* <i>Nicotiana glauca</i>	Tree Tobacco		
<i>Nitraria billardiarei</i>	Nitre-bush		
* <i>Olea europaea</i>	Olive		
<i>Olearia muelleri</i>	Mueller's Daisy-bush		
<i>Olearia pimeleoides</i>	Pimelea Daisy-bush		
* <i>Onopordum acanthus</i>	Scotch Thistle		
* <i>Onopordum acaulon</i>	Horse Thistle		
<i>Oxalis perennans</i>	Native Sorrel		
<i>Phragmites australis</i>	Common Reed		
<i>Pittosporum angustifolium</i>	Native Apricot		
<i>Ptilotus obovatus</i>	Silver Mulla Mulla		
<i>Ptilotus spathulatus</i>	Pussy-tails		
<i>Rhagodia candolleana</i>	Berry Saltbush		

Scientific name	Common name	Conservation status	
		Aus	SA
<i>Rhagodia parabolica</i>	Mealy Saltbush		
<i>Rhagodia spinescens</i>	Spiny Saltbush		
<i>Roepera crenata</i>	Notched Twinleaf		
<i>Rytidosperma caespitosum</i>	Common Wallaby-grass		
<i>Rytidosperma</i> sp.	Wallaby-grass		
* <i>Salvia verbenaca</i>	Wild Sage		
<i>Sclerolaena diacantha</i>	Grey Copperburr		
<i>Sclerolaena obliquicuspis</i>	Oblique-spindled Bindyi		
<i>Senna artemisioides</i> ssp. <i>coriacea</i>	Broad-leaf Desert Senna		
<i>Senna artemisioides</i> ssp. <i>petiolaris</i>			
<i>Themeda triandra</i>	Kangaroo Grass		
<i>Thyridia repens</i>	Creeping Monkey-flower		
* <i>Trifolium</i> sp.	Clover		
<i>Triodia irritans</i>	Spinifex		
<i>Typha domingensis</i>	Narrow-leaf Bulrush		
<i>Vittadinia australasica</i>	Sticky New Holland Daisy		
<i>Vittadinia cuneata</i>	Fuzzy New Holland Daisy		
<i>Vittadinia gracilis</i>	Woolly New Holland Daisy		
<i>Vulpia myuros</i>	Rat's-tail Fescue		

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). SA: South Australia (*National Parks and Wildlife Act 1972*). Conservation codes: CE: Critically Endangered. EN/E: Endangered. VU/V: Vulnerable. R: Rare. Mi: Migratory. *: denotes exotic species. 1: EPBC Protected Matters Search Tool. 2: Biological Database of South Australia.



Figure 34. Photo of *Dodonaea subglandulifera* (Peep Hill Hop-bush) within the Project Area.

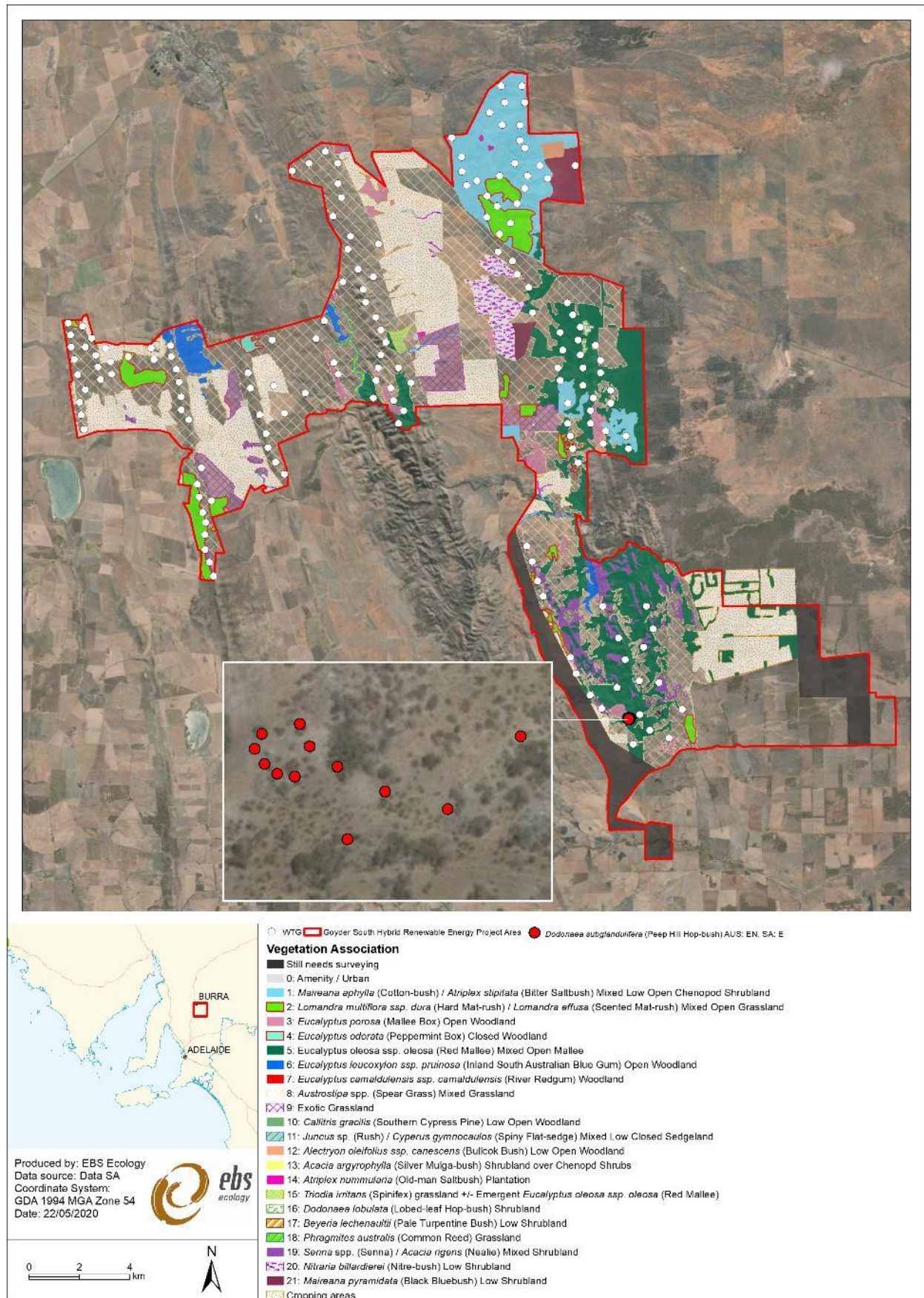


Figure 35. Observations of *Dodonaea subglandulifera* (Peep Hill Hop-bush) within the Project Area.

6.4 Fauna

Ninety-two (92) fauna species were recorded over the Project Area during the field assessments during autumn and spring 2019 (Table 35). The fauna assemblage comprised of 76 bird (from 55-point count and 19 opportunistic observations), 10 mammals (including two opportune observations), five reptile and one amphibian species. Six introduced fauna species were recorded, while the remaining 86 fauna species were indigenous to the area.

Table 35. Fauna species observed within the Goyder Project Area.

Scientific Name	Common Name	EPBC Act Status	NPW Act Status	Autumn 2019	Spring 2019
AMPHIBIA	Amphibians				
<i>Crinia signifera</i>	Common Froglet			✓	
AVES	Birds				
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater			✓	✓
<i>Acanthiza nana</i> [^]	Yellow Thornbill			✓	
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill			✓	✓
<i>Accipiter cirrocephalus cirrocephalus</i>	Collared Sparrowhawk			✓	
<i>Accipiter fasciatus</i>	Brown Goshawk				✓
<i>Acrocephalus australis</i>	Australian Reed-Warbler				✓
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar				✓
<i>Anas gracilis</i> [^]	Grey Teal			✓	
<i>Anthochaera carunculata</i>	Red Wattlebird			✓	✓
<i>Anthus australis</i>	Australian Pipit			✓	
<i>Aphelocephala leucopsis</i>	Southern Whiteface			✓	✓
<i>Aquila audax</i>	Wedge-tailed Eagle			✓	✓
<i>Artamus cyanopterus</i>	Dusky Woodswallow			✓	✓
<i>Barnardius zonarius barnardi</i>	Mallee Ringneck			✓	✓
<i>Chrysococcyx basalis</i>	Horsfield's Bronze-Cuckoo				✓
<i>Chenonetta jubata</i> [^]	Maned Duck			✓	
<i>Climacteris picumnus</i>	Brown Treecreeper			✓	✓
<i>Colluricincla harmonica</i>	Grey Shrike-thrush			✓	✓
<i>Coracina novaehollandiae</i>	Black-faced Cuckooshrike				✓
<i>Corcorax melanorhamphos</i>	White-winged Chough		R	✓	✓
<i>Corvus mellori</i>	Little Raven			✓	✓
<i>Cracticus torquatus</i>	Grey Butcherbird			✓	✓
<i>Dacelo novaeguineae</i>	Laughing Kookaburra				✓
<i>Daphoenositta chrysoptera</i>	Varied Sittella				✓
<i>Dicaeum hirundinaceum</i> [^]	Mistletoebird			✓	
<i>Dromaius novaehollandiae</i>	Emu				✓
<i>Egretta novaehollandiae</i>	White-faced Heron			✓	✓
<i>Eolophus roseicapilla</i>	Galah			✓	✓
<i>Epthianura albifrons</i> [^]	White-fronted Chat			✓	✓
<i>Epthianura aurifrons</i> [^]	Orange Chat				✓
<i>Epthianura tricolor</i> [^]	Crimson Chat				✓
<i>Falco berigora</i> [^]	Brown Falcon				✓
<i>Falco cenchroides</i>	Nankeen Kestrel			✓	✓

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common Name	EPBC Act Status	NPW Act Status	Autumn 2019	Spring 2019
<i>Gavicalis virescens</i>	Singing Honeyeater			✓	✓
<i>Geopelia placida</i> [^]	Peaceful Dove				✓
<i>Grallina cyanoleuca</i>	Magpielark			✓	✓
<i>Gymnorhina tibicen</i>	Australian Magpie			✓	✓
<i>Hirundo neoxena</i> [^]	Welcome Swallow			✓	
<i>Lichenostomus ornatus</i>	Yellow-plumed Honeyeater				✓
<i>Malurus lamberti</i>	Variegated Fairywren				✓
<i>Malurus splendens</i>	Splendid Fairy-wren				✓
<i>Manorina flavigula</i>	Yellow-throated Miner			✓	✓
<i>Megalurus gramineus</i>	Little Grassbird				✓
<i>Melanodryas cucullata cucullata</i>	Hooded Robin		R		✓
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater				✓
<i>Microcarbo melanoleucos melanoleucos</i>	Little Pied Cormorant			✓	✓
<i>Microeca fascinans fascinans</i>	Jacky Winter				✓
<i>Myiagra cyanoleuca</i> [^]	Satin Flycatcher		E	✓	
<i>Myiagra inquieta</i> [^]	Restless Flycatcher		R		✓
<i>Neophema elegans</i> [^]	Elegant Parrot		R	✓	
<i>Nesoptilotis leucotis</i>	White-eared Honeyeater			✓	✓
<i>Ocyphaps lophotes</i>	Crested Pigeon			✓	✓
<i>Pachycephala pectoralis</i>	Golden Whistler			✓	✓
<i>Pachycephala rufiventris</i>	Rufous Whistler			✓	✓
<i>Pardalotus punctatus</i>	Spotted Pardalote			✓	✓
<i>Pardalotus striatus</i>	Striated Pardalote			✓	✓
<i>Passer domesticus</i> [*]	House Sparrow			✓	✓
<i>Petrochelidon nigricans</i>	Tree Martin				✓
<i>Petroica goodenovii</i>	Red-capped Robin				✓
<i>Phaps chalcoptera</i>	Common Bronzewing				✓
<i>Platycercus elegans</i>	Crimson Rosella			✓	✓
<i>Pomatostomus ruficeps</i> [^]	Chestnut-crowned Babbler				✓
<i>Pomatostomus superciliosus</i>	White-browed Babbler			✓	✓
<i>Psephotellus varius</i> [^]	Mulga Parrot			✓	
<i>Psephotus haematonotus</i>	Red-rumped Parrot			✓	✓
<i>Ptilotula penicillata</i>	White-plumed Honeyeater			✓	✓
<i>Pyrrholaemus brunneus</i>	Redthroat				✓
<i>Rhipidura albiscapa</i>	Grey Fantail			✓	✓
<i>Rhipidura leucophrys</i>	Willie Wagtail			✓	✓
<i>Smicrornis brevirostris</i>	Weebill			✓	✓
<i>Stagonopleura guttata</i>	Diamond Firetail		V	✓	
<i>Strepera versicolor</i> [^]	Grey Currawong				✓
<i>Sturnus vulgaris</i> [*]	Common Starling			✓	✓
<i>Tadorna tadornoides</i> [^]	Australian Shelduck				✓
<i>Vanellus miles</i> [^]	Masked Lapwing				✓
<i>Vanellus tricolor</i> [^]	Banded Lapwing				✓
MAMMALIA	Mammals				
<i>Austronomus australis</i>	White-striped Freetail Bat			✓	✓

Scientific Name	Common Name	EPBC Act Status	NPW Act Status	Autumn 2019	Spring 2019
<i>Cervus dama</i> *	Fallow Deer			✓	
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat			✓	✓
<i>Lasiorninus latifrons</i> ^	Southern Hairy-nosed Wombat			✓	✓
<i>Lepus europaeus</i> *	European Hare				✓
<i>Macropus fuliginosus</i>	Western Grey Kangaroo			✓	
<i>Macropus robustus</i>	Euro			✓	
<i>Macropus rufus</i> ^	Red Kangaroo			✓	
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat			✓	✓
<i>Oryctolagus cuniculus</i> *	Rabbit (European Rabbit)			✓	✓
<i>Ozimops</i> sp.	Free-tailed Bats			✓	✓
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna			✓	✓
<i>Vespadelus regulus</i>	Southern Forest Bat			✓	✓
<i>Vulpes vulpes</i> *	Fox (Red Fox)			✓	
REPTILIA	Reptiles				
<i>Ctenophorus decresii</i>	Tawny Dragon			✓	✓
<i>Diplodactylus tessellatus</i>	Tessellated Gecko			✓	✓
<i>Menetia greyii</i>	Common Dwarf Skink			✓	
<i>Tiliqua adelaidensis</i>	Pygmy Blue-tongue Lizard			✓	✓
<i>Tiliqua rugosa</i>	Sleepy Lizard				✓

Conservation status

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). Conservation Codes: **CR/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. *denotes exotic species. ^denotes opportunistic observations.

6.4.1 Amphibians

One amphibian species, the Common Froglet (*Crinia signifera*) was opportunistically heard in Burra Creek within the Project Area (Table 35). Other frog species may occur in the Project Area; however, the autumn field assessment was conducted outside the calling period (breeding season) for these species, and frog species were not targeted during the spring survey.

6.4.2 Reptiles

Five reptile species were recorded over the Project Area (Table 35). Three species were recorded during searches using videoscopes within spider holes:

- Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*) (24 individuals);
- Common Dwarf Skink (*Menetia greyii*) (two individuals); and
- Tessellated Gecko (*Diplodactylus tessellatus*) (two individuals).

Numerous Sleepy Lizards (*Tiliqua rugosa*) and Tawny Dragons (*Ctenophorus decresii*) were opportunistically observed across the Project Area and in rocky outcrop areas along the ridgelines of the Project Area.

Flinders Ranges Worm-lizards

An area consisting of *Austrostipa* sp. (Spear-grass) Grassland with flat surface rocks, appeared to be suitable habitat for the Flinders Ranges Worm-lizard however it was recorded outside of the Project Area, on a ridgeline to the north-west.

Pygmy Blue-tongue Lizards

Due to the timing of the PBTL survey, dry conditions and grazing pressure, most grassland areas had low grass cover and the surveyors had no difficulty locating spider burrows. Across both autumn and spring surveys, a total 1,076 spider burrows were inspected for PBTLs along 41 transects across the Project Area, with 24 PBTLs observed (Figure 36 and Figure 37). It should be noted that numbering of transects is not sequential in Figure 36, due to the fact the Project Area has reduced in size since survey work first began.

Possible and likely PBTL habitat was mapped across the Project Area based on the observation of PBTLs and the presence of suitable habitat characteristics (see Section 7.3.1), which was concentrated to the western side of the Project Area (Figure 36). Overall, 450.324 ha of possible habitat and 47.449 ha of likely habitat for PBTLs occurred within the Project Area.

The majority of the potential PBTL habitat east of Burra Creek was highly degraded due to a combination of dry conditions and high grazing pressure, including a large area where cattle grazing had caused extensive damage to the surface of the soil. Potential PBTL habitat assessed along the far eastern range, and north of Goyder Hwy was considered unsuitable, based on the shallow and rocky soil. Areas that had previously been ploughed and cropped were deemed unsuitable PBTL habitat. Recommendations that address the PBTL are provided later in this report (Sections 7.3.1, 8.1.3, 8.2.3 and 8.3.1).

At the time of publishing this report (May 2020), there are properties and areas in the southeast of the Project Area remaining that are yet to be assessed for PBTL occurrence/habitat.

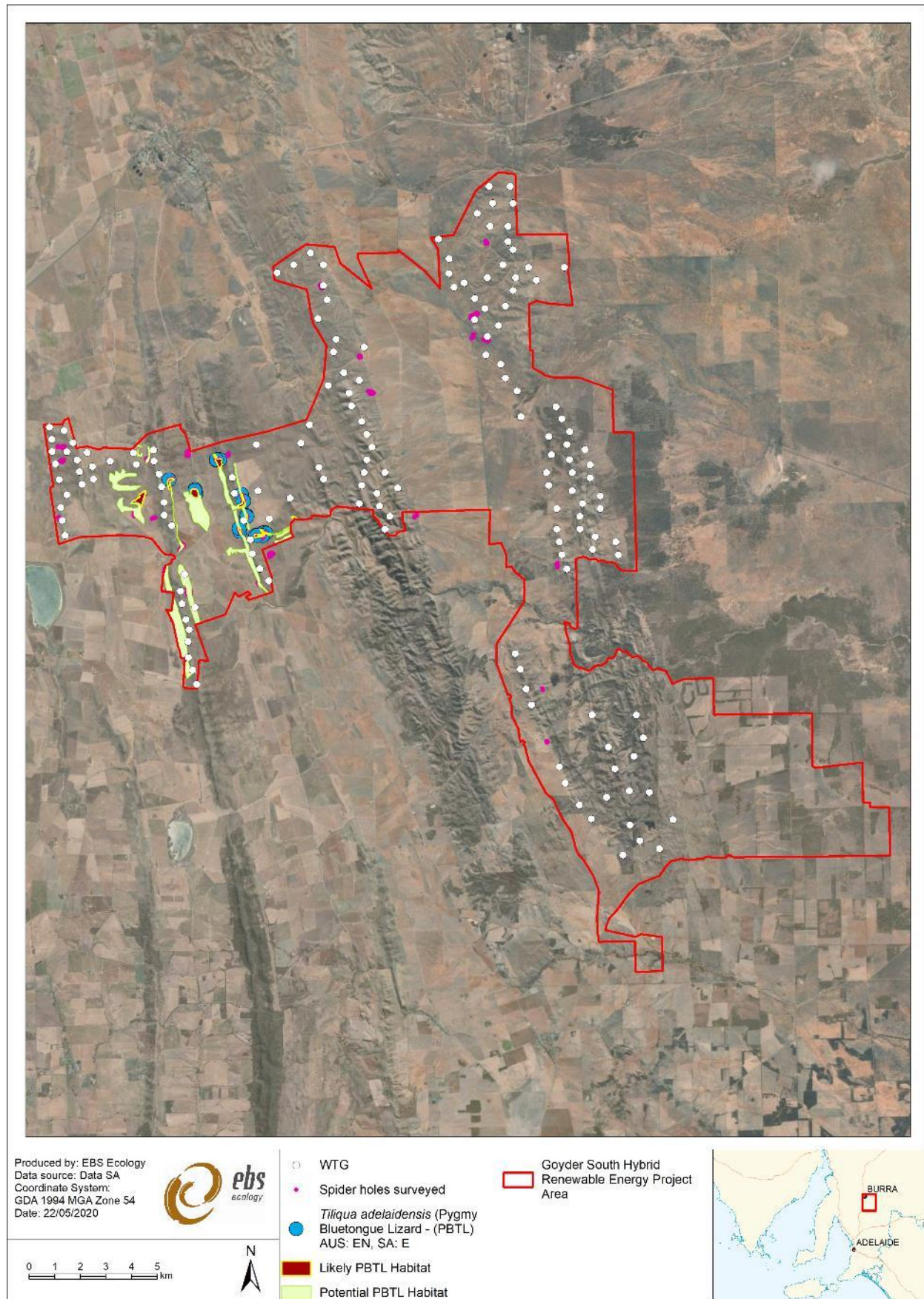


Figure 36. PBTL search effort across the Project Area: records (blue dot), spider holes surveyed (small pink dot), likely habitat (maroon polygon) and potential habitat (green polygon).

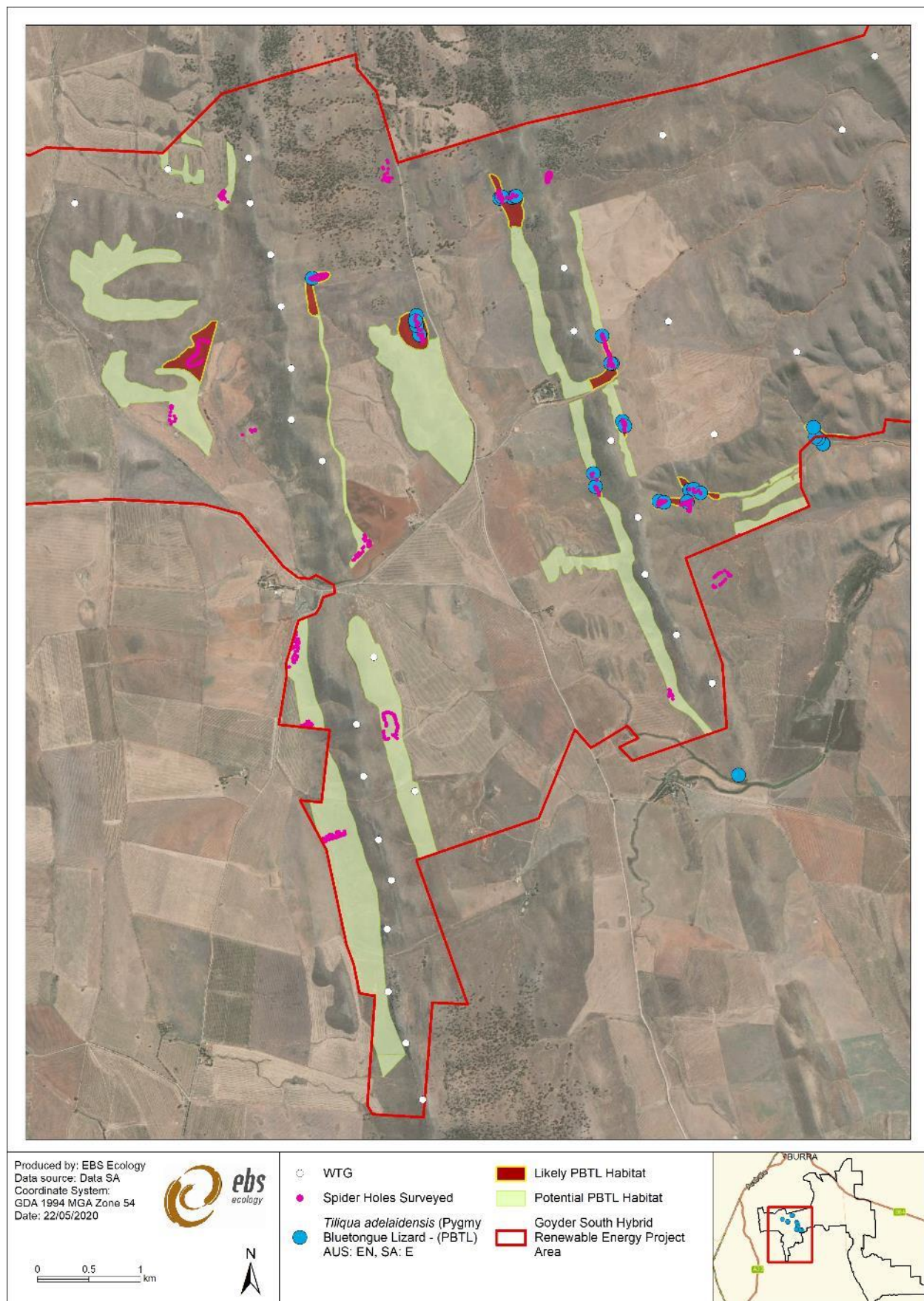


Figure 37. Enlarged image of the north-western section of the Project Area showing PBTL records.

6.4.3 Mammals (ground-dwelling)

Ten ground-dwelling mammal species were recorded over the Project Area (Table 35). The native mammal species recorded were the Southern Hairy-nosed Wombat (SHNW) (*Lasiorninus latifrons*), Red Kangaroo (*Macropus rufus*), Western Grey Kangaroo (*Macropus fuliginosus*), Euro (*Macropus robustus*) and Short-beaked Echidna (*Tachyglossus aculeatus*). All macropod species (kangaroos and Euro) were abundant and widespread over the Project Area. Four of the ten ground-dwelling mammal species recorded were introduced species: Fallow Deer (*Cervus dama*), Hare (*Lepus europaeus*), Rabbit (*Oryctolagus cuniculus*) and Red Fox (*Vulpes vulpes*). No national or State threatened ground dwelling mammal species were recorded in the Project Area during the field assessments conducted in autumn and spring 2019.

Southern Hairy-nosed Wombats

Two SHNWs and several active burrow systems (warrens) were observed during the field surveys in autumn and spring 2019 (Figure 38). All wombats and warrens were observed in proximity to drainage lines within the Project Area. GPS waypoints were used to locate the warrens and aerial imagery was used to map the extent of the warrens (Figure 38).

6.4.4 Bats

Five bat species were identified from the sonograms recorded by AnaBat units over four sites, surveyed across both autumn and spring survey periods, in the Project Area (Table 36) (Figure 8, page 29). The Gould's Wattled Bat (*Chalinolobus gouldii*) and Free-tailed Bats (*Ozimops* sp.) was recorded at all four AnaBat sites. The White-striped Freetail Bat (*Austronomus australis*), Lesser Long-eared Bat (*Nyctophilus geoffroyi*) and Southern Forest Bat (*Vespadelus regulus*) were recorded at three sites. No national or State threatened bat species were recorded in the Project Area during the field assessments in autumn and spring 2019.

Table 36. Bats recorded over the four AnaBat sites established over the Project Area.

Species	Common name	ANA 001	ANA 004	ANA 005	ANA 007	ANA 008
<i>Austronomus australis</i>	White-striped Freetail Bat	✓	✓	✓	✓	
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	✓	✓	✓	✓	✓
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	✓		✓	✓	✓
<i>Ozimops</i> sp.	Free-tailed Bats	✓	✓	✓	✓	✓
<i>Vespadelus regulus</i>	Southern Forest Bat	✓		✓	✓	✓

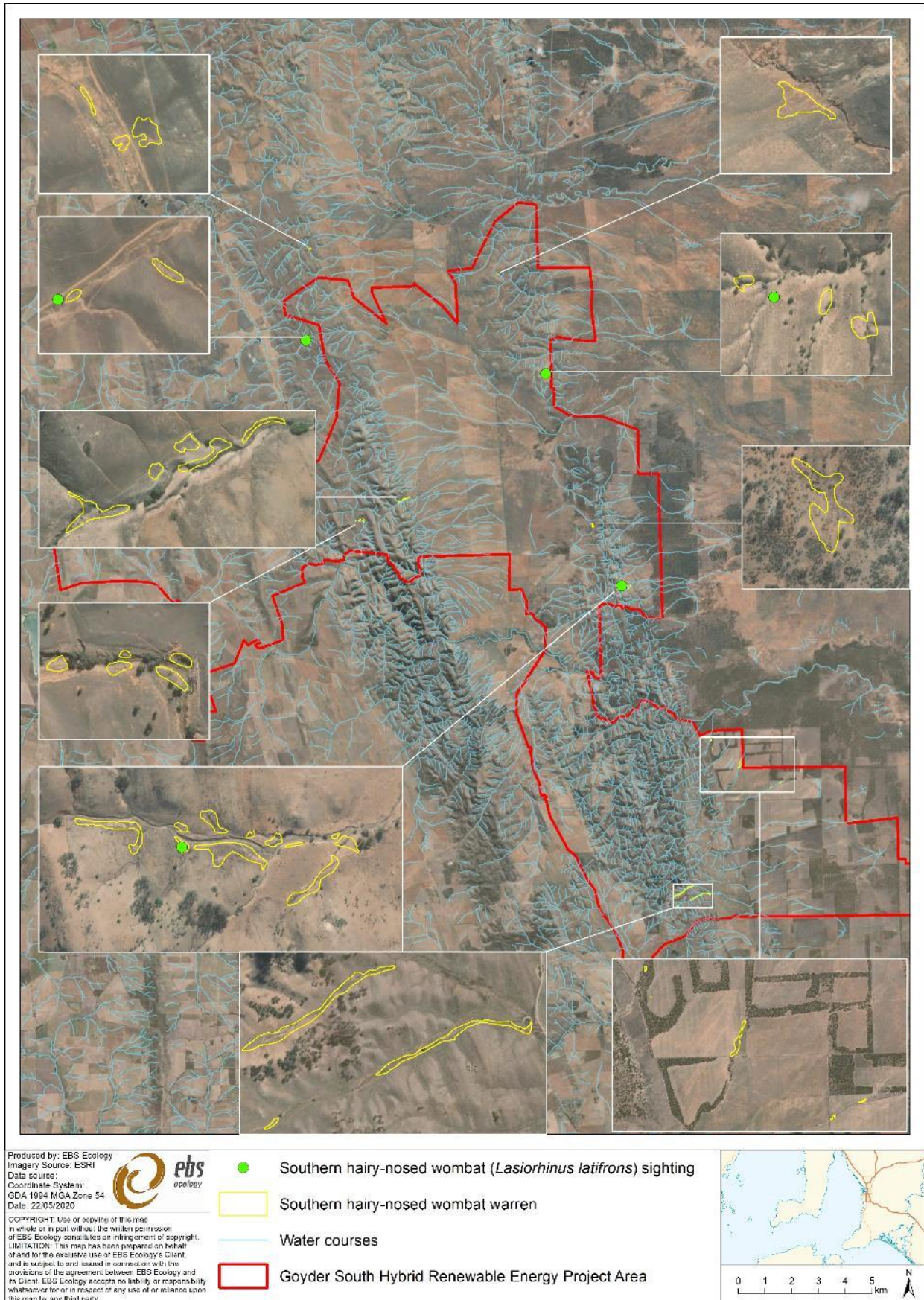


Figure 38. SHNW records (green dots) and warrens (yellow polygons) within the Project Area. Two SHNWs were recorded at the green dot in the southeast of the Project Area. Major drainage lines are shown (blue lines).

6.4.5 Birds

Fifty-seven (57) bird species were recorded during point count surveys across the two survey periods, with an additional 19 species recorded opportunistically (Appendix 3). The bird families with the greatest representation in the Project Area were Meliphagidae (honeyeaters), Acanthizidae (Australasian warblers) and Psittaculidae (parrots). Two introduced bird species were recorded within the Project Area: Common Starling (*Sturnus vulgaris*) and (Turdus merula) and House Sparrow (*Passer domesticus*).

A total of 587 birds were recorded across the 25 point counts established over the Project Area (Appendix 3). The species recorded at the greatest number of point count sites were Little Raven (*Corvus mellori*), Striated Pardalote (*Pardalotus striatus*) and Weebill (*Smicrornis brevirostris*) (all at 14 sites), Galah (*Eolophus roseicapilla*) (13 sites) and Australian Magpie (*Gymnorhina tibicen*) (12 sites). The most abundant species at point count sites were Galah (*Eolophus roseicapilla*) (98 individuals), Weebill (*Smicrornis brevirostris*) (65 individuals), Little Raven (*Corvus mellori*) (44 individuals), and Striated Pardalote (*Pardalotus striatus*) (36 individuals).

The point count sites with the highest average cumulative (i.e. autumn + spring) species richness occurred in the following habitats:

- VA 3: *Eucalyptus porosa* (Mallee Box) Open Woodland;
- VA 5: *Eucalyptus oleosa* ssp. *oleosa* (Red Mallee) Mixed Open Mallee;
- VA 6: *Eucalyptus leucoxylon* ssp. *pruinosa* (Inland South Australian Blue Gum) Open Woodland; and
- VA 11: *Juncus* sp. / *Cyperus gymnocaulos* (Spiny Flat-sedge) Low Closed Sedgeland.

A map showing the spread of habitats with high bird species richness is shown in Figure 39.

No nationally listed threatened bird species were recorded over the Project Area during both the autumn and spring 2019 survey. However, six State threatened fauna species were recorded within the Project Area (Table 35):

- White-winged Chough (*Corcorax melanorhamphos*) – State Rare;
- Elegant Parrot (*Neophema elegans*) – State Rare;
- Hooded Robin (*Melanodryas cucullata cucullata*) – State Rare;
- Satin Flycatcher (*Myiagra cyanoleuca*) - State Endangered;
- Diamond Firetail (*Stagonopleura guttata*) – State Vulnerable; and
- Restless Flycatcher – State Rare (observed just outside the Project Area).

These species are discussed in more detail in Section 7.3.2. A map showing the locations of State threatened bird observations is shown in Figure 39.

Porter's Lagoon was surveyed opportunistically during the spring 2019 survey to determine if any migratory wader species were present. Sixteen (16) species and 42 individuals were recorded at Porter's Lagoon (Appendix 4).

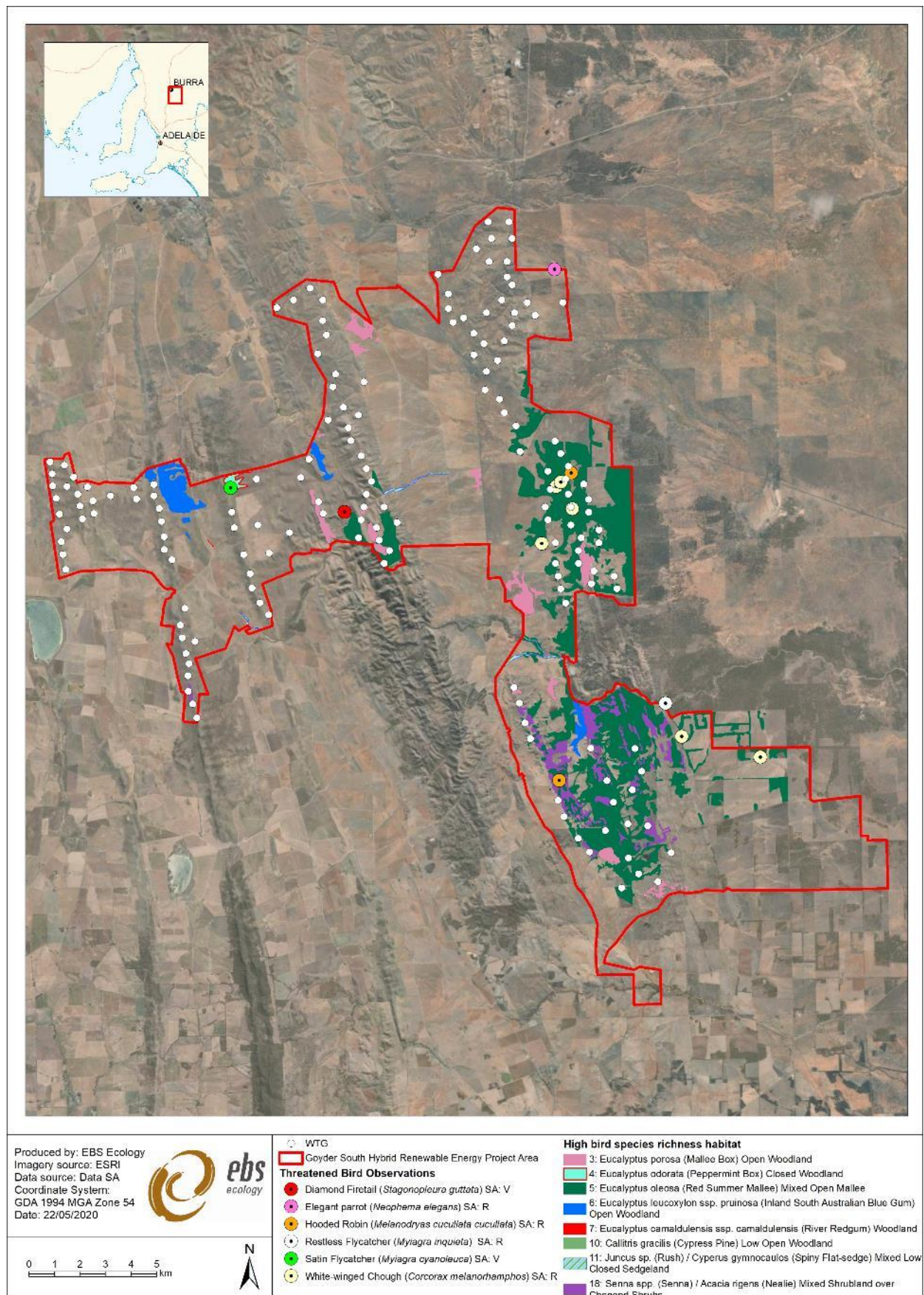


Figure 39. Locations of threatened bird observations and habitats that had high bird species richness.

6.5 Raptor Species

6.5.1 Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon was targeted during both the autumn and spring 2019 surveys. While this species was recorded during the spring 2019 survey (whereby a single bird was observed sitting on a WTE nest), this record was outside of the current Project boundary. It is expected that this species is likely to utilise the Project Area for both foraging and breeding and that additional surveys would most likely detect more than one individual.

6.5.2 Wedge-tailed Eagle (*Aquila audax*)

A total of six WTE nests (Figure 40) were recorded over the Project Area during the autumn and spring field assessment periods (Table 37). These nests were primarily restricted to mid-slope areas of ridgelines that supported *E. odorata* woodland (Figure 41) however, an isolated nest was also recorded in *E. porosa* open woodland (Nest 15).

The condition of nests was variable, with four nests in good condition and two nests in poor condition. WTEs were also observed to be sitting on two nests (both of which were determined as being in 'good' condition), detected during the spring survey: Nest 13 and Nest 14. Each of the WTE nests were allocated a 1 km buffer regardless of condition, within which no turbines are to be constructed. WTE pairs are known to reuse nest locations across varying seasons, which is why the buffer was applied to all nests.

Table 37. Wedge-tailed Eagle nests and their condition recorded over the Project Area during the field assessment.

Nest ID	Easting	Northing	Condition*	Comment	VA Description
9	310114	6260901	Good		<i>Eucalyptus odorata</i> (Peppermint Box) Closed Woodland
11	307434	6263043	Poor		<i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i> (South Australian Blue Gum) Open Woodland
12	307318	6263633	Poor	Two WTEs observed near nest (Autumn)	<i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i> (South Australian Blue Gum) Open Woodland
13	314152	6260431	Good	Observed adult WTE on nest (Spring)	<i>Eucalyptus leucoxylon</i> ssp. <i>pruinosa</i> (South Australian Blue Gum) Open Woodland
14	310668	6260634	Good	Observed adult WTE on nest (Spring)	<i>Eucalyptus odorata</i> (Peppermint Box) Closed Woodland
15	325681	6245438	Good		<i>Eucalyptus porosa</i> (Mallee Box) open woodland

*Nest condition as of most recent (spring 2019) assessment. Note: Nest ID is not sequential as the Project boundary has changed since survey work was completed.

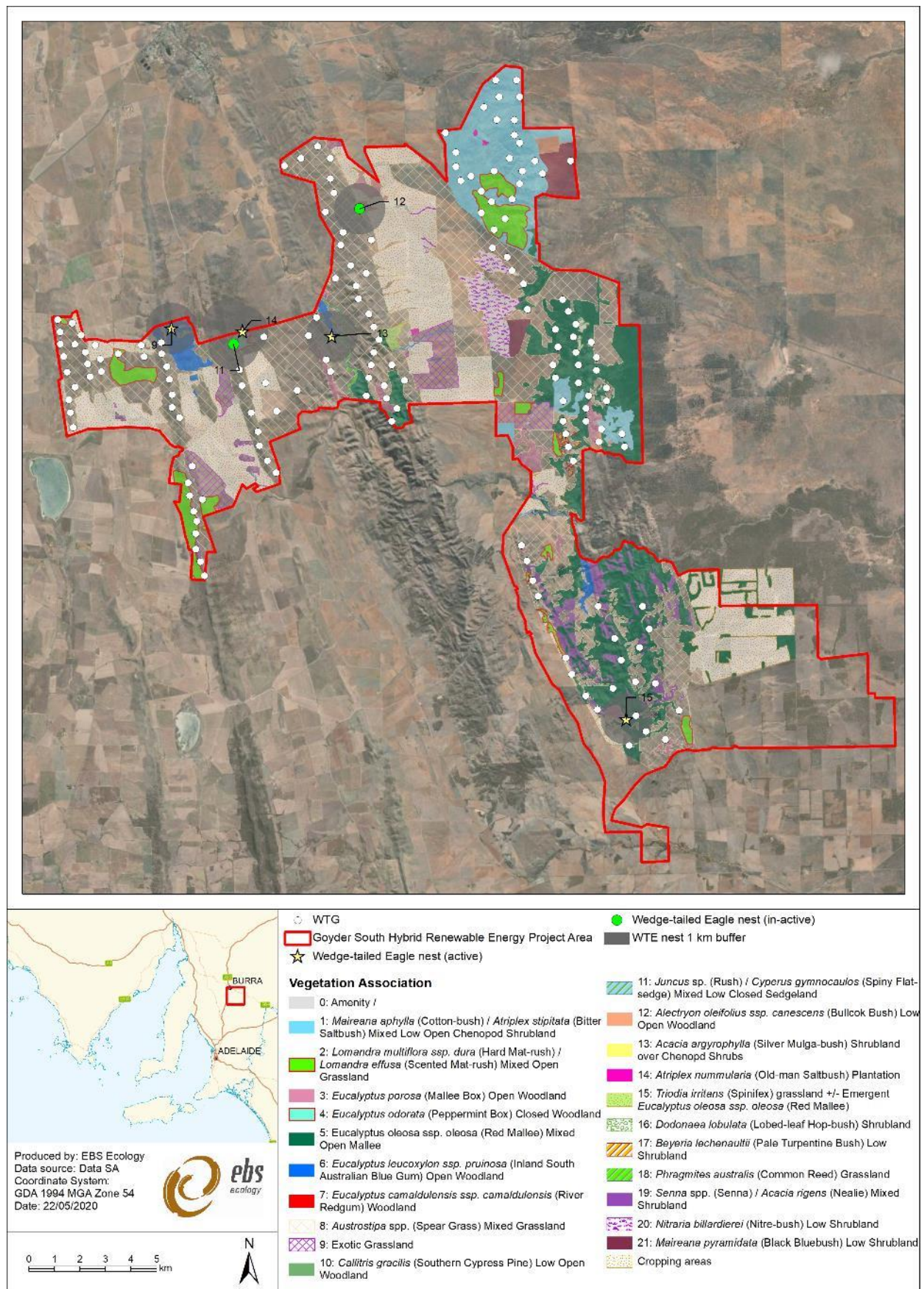


Figure 40. Location of WTE nests recorded over the Project Area with respect to the Vegetation Associations present.



Figure 41. An adult WTE observed on Nest 13 (defined as being in 'good' condition), within the Project Area.

6.6 Habitat attributes

Additional to the VAs discussed in Section 6.2, and PBTL and SHNW habitat discussed in Sections 6.4.2 and 6.4.3, other key habitat features within the Project Area included:

- Numerous creeklines and low lying areas – providing ephemeral flowing water and pooled water potentially utilised by a range of terrestrial and aquatic fauna (Figure 42). Burra Creek was flowing at the time of the surveys. It should be noted that fish and aquatic fauna were not assessed as part of this Project; fish are not currently listed under the NPW Act and are not provided in database searches from DEW;
- Dams – providing an artificial water source and foraging habitat for bats and waterfowl;
- Small surface rock in pasture and woodland areas, and large exposed rock faces in woodlands (Figure 43) and along creeklines – providing habitat for reptiles and refuge for threatened plants; and
- Tree hollows – present in all woodland and Mallee VAs in live and standing and fallen dead trees, providing habitat particularly for birds, bats, small mammals and reptiles (Figure 44).



Figure 42. A small wetland along Burra Creek within the Project Area.



Figure 43. Rocky outcrop in woodland habitat within the Project Area.



Figure 44. A tree hollow within the Project Area.

7 DISCUSSION

7.1 Threatened Ecological Communities

Two TECs were determined as likely to occur, and are known to the Project Area from the autumn and spring 2019 surveys and from previous surveys completed by EBS at Stony Gap (see Figure 48).

7.1.1 *Iron-grass Natural Temperate Grassland of South Australia*

Iron-grass Natural Temperate Grassland of South Australia (INTG) is listed as Critically Endangered under the EPBC Act. INTGs are unique to South Australia and are predominantly distributed on the slopes and hills of the Mount Lofty Ranges, west of the River Murray and throughout the Mid North.

INTG TEC comprises a grassland dominated by *Lomandra multiflora* ssp. *dura* and/or *Lomandra effusa* (Iron-grasses), with tussock-forming (clumping) grasses, low shrubs and a range of other native plants in the ground layer. Trees and tall shrubs are generally absent or very sparse (less than 10 % cover). To qualify as the EPBC listed community, patches must be at least 0.1 ha in size and meet native species diversity and density criteria (DEWR 2007).

Fifteen (15) INTG patches (VA 2) were observed within the Project Area (Figure 12; Figure 45). All INTG patches observed were in poor to very poor condition, with low native species diversity and low to moderate tussock density. This is most likely due to drought conditions and grazing pressure.

Conditions during the autumn and spring 2019 surveys were poor due to:

- Below average annual rainfall in 2017 and 2018 (Commonwealth of Australia 2019);
- Below average monthly rainfall in January, February, March, April, June, July and August of 2019 (Commonwealth of Australia 2019); and
- Compounding grazing pressure.

When assessed against the criteria outlined in the *EPBC Act Policy Statement 3.7, Nationally Threatened Species and Ecological Communities, Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia*, none of the 15 INTG patches observed in 2019 qualified as Class A, B or C, as each patch did not have a native species diversity of greater than five species. However, given the poor conditions during the autumn and spring 2019 surveys, INTG patches will need to be assessed against the criterion to determine their condition class in more favourable conditions. If conditions do not improve before construction, it is recommended that as a worst case scenario, these INTG patches qualify as a TEC, and are addressed as part of the EPBC Referral process.

Seven patches of INTG were assessed in October 2012 (EBS 2013a), against the criteria outlined in the *EPBC Act Policy Statement 3.7, Nationally Threatened Species and Ecological Communities, Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia*. One of the patches assessed (patch seven) qualified as class B and was therefore listed as a national TEC (Figure 45).

7.1.2 Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia

Peppermint Box (*Eucalyptus odorata*) Grassy Woodland of South Australia was listed as Critically Endangered under the EPBC Act in 2007, due to a severe decline in distribution and an ongoing loss of integrity. The dominant tree species is *E. odorata*, however, other species of Eucalypt commonly co-occur. A grassy understorey is most often present, although some shrubs may exist such as *Bursaria spinosa* (Bursaria) and *Acacia pycnantha* (Golden Wattle). The majority of remnants occur between Victor Harbor and Port Augusta, encompassing the mid-north region, as well as the Adelaide region, Mount Lofty Ranges and part of Yorke Peninsula.

Three patches of *E. odorata* Woodland (VA 4) were observed within the Project Area (Figure 12). The understorey of VA 4 was highly modified due to grazing from stock and kangaroos. Areas less degraded from grazing occurred on steep, rocky slopes where stock were less likely or unable to graze. These steep, rocky slopes may have moderate species richness following winter and spring rainfall.

When assessed against the criteria outlined in the *EPBC Act Policy Statement 3.7, Nationally Threatened Species and Ecological Communities*, *Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia*, the single *E. odorata* patch observed in 2019 did not qualify as an ecological community, since it did not contain at least 15 native plant species. Classes A and B are indicative of the listed ecological community, with areas of condition Class A, being considered the highest quality representation of the TEC.

Although there was only a singular patch of VA 4 recorded within the Project Area, it was considered of high value for fauna, as trees provide nesting habitat for the Wedge-tailed Eagle and hollows for bird and bat species to roost and nest. The State Endangered Satin Flycatcher (*Myiagra cyanoleuca*) was also recorded within this VA.

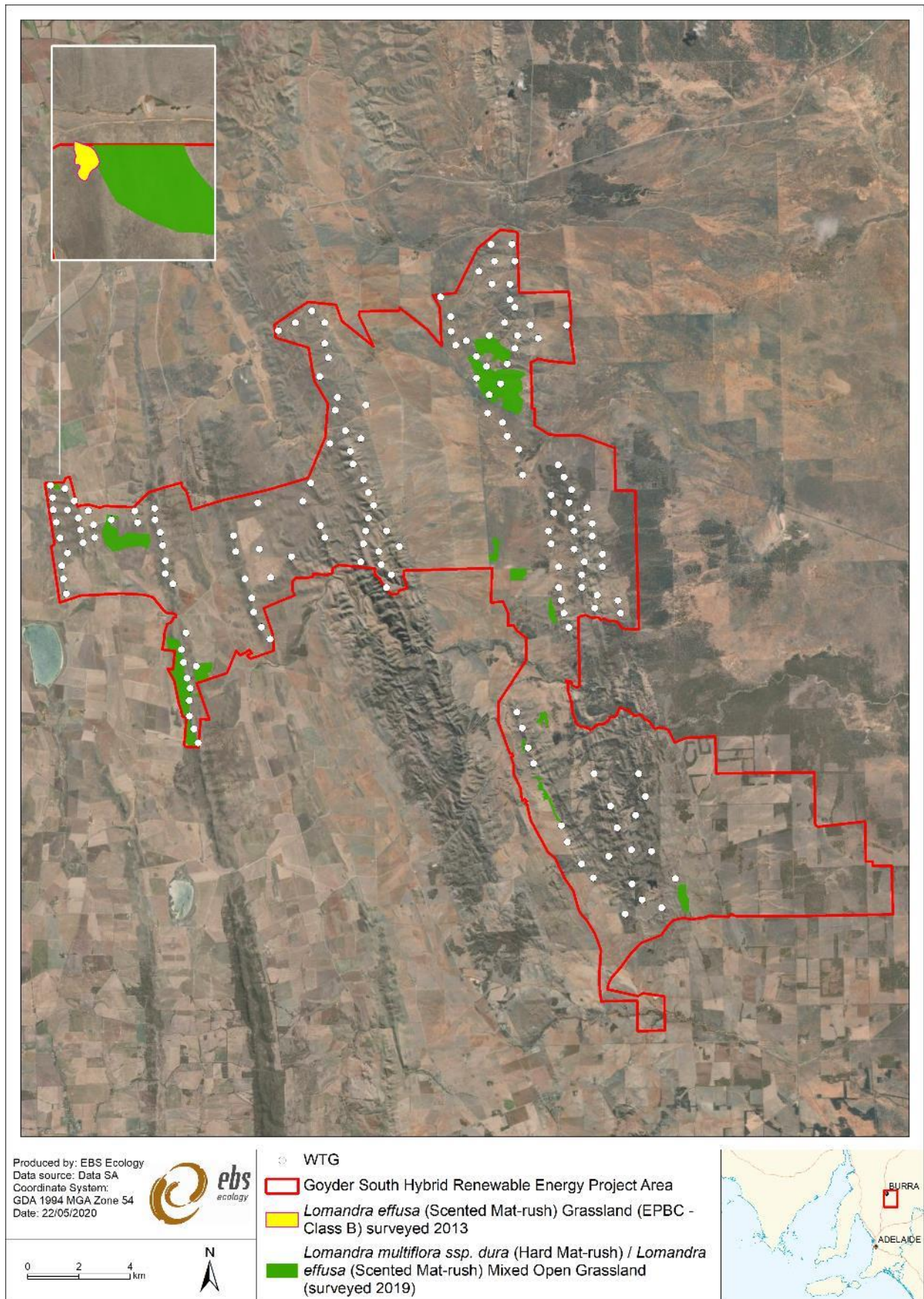


Figure 45. INTG within the Project Area.

7.2 Flora

Given the size of the Project Area, the scope to broadly map VAs, and the need for detailed native vegetation assessments in the future (e.g. native vegetation clearance assessments, targeted EPBC assessments in proposed infrastructure areas), not all flora species within the Project Area were recorded.

Conditions during the autumn and spring 2019 surveys were poor (see Section 7.1) and it is likely that more flora species, including threatened species, may occur in Project Area and will be recorded during planned native vegetation assessments, particularly if conditions improve. The threatened flora species that are likely to occur within the Project Area are discussed below in Section 7.2.1 and 7.2.2.

7.2.1 *Dodonaea subglandulifera* (Peep Hill Hop-bush) (AUS: EN, SA: EN)

Dodonaea subglandulifera (Peep Hill Hop-bush) is endemic to South Australia and is currently listed as Endangered under the EPBC Act and NPW Act. It is an erect, perennial shrub growing 1-2 m in height, has short pinnate leaves approximately 1.5 cm long with 9-17 viscous leaflets with raised glands on their lower surface (Jessop and Tolkien 1986).

D. subglandulifera was previously only known from six sites with a total population of less than 3,000 individual plants (Kahrmanis *et al.* 2001; Graham *et al.* 2001). However, information collected during preparation of the recovery plan for the species increased knowledge of extant occurrences to 45 sites and over 45,700 individual plants, comprising 11 subpopulations (Moritz and Bickerton 2010). The species is conserved at two sites, a conservation park and a sanctuary, in the form of translocated subpopulations (Moritz and Bickerton 2010).

D. subglandulifera occurs primarily on low hills on loamy soils associated with rocky (limestone, slate, shale) outcrops (Jusaitis and Sorensen 1994; Smith 2000), which occur to the east of the range country, just before the vegetation changes to Mallee flats (Smith 2000). The species occurs in native vegetation associated with rock outcrops including low open woodland, open shrubland and Mallee. Associated over- and midstorey species within suitable habitat include *Eucalyptus porosa* (Mallee Box), *E. dumosa*, *E. oleosa* ssp. *oleosa* (Red Mallee); *E. phenax*, *Callitris gracilis* (Southern Cyperus Pine), *Allocasuarina verticillata* (Drooping Sheoak); *Beyeria lechenaultii* (Pale Turpentine Bush), *Alectryon oleifolius* ssp. *oleifolius* (Bullock Bush), *Acacia calamifolia*, *A. argyrophylla* (Silver Mulga-bush), and *A. hakeoides*. The understorey is quite variable at most sites (Moritz and Bickerton 2010).

Approximately 35 individuals were observed in a rocky outcrop area within *Eucalyptus porosa* (Mallee Box) Open Woodland (VA 3) in the southeast of the Project Area, just south of Black Peak Road and approximately 9 km north-northeast of Robertstown (Figure 35). It is possible that this is the small sub-population of 35 discovered in 2007 near Blackpoint Hill approximately 10 km north of Robertstown (Moritz and Bickerton 2010).

On Eagle Hawke Gate Road, approximately 7.5 km to the northeast of Robertstown, four sites have been recorded by Smith (2000) containing over 5055 plants on private land and 100 plants on the roadside reserve. The private land is noted to contain high quality native vegetation and is identified as a priority site for protection and management (Moritz and Bickerton 2010).

Based on the discovery of approximately 35 *D. subglandulifera* individuals is the southeast of the Project Area, the nearby sub-populations on Eagle Hawke Gate Road, and the presence of suitable habitat within the Project Area, it is likely that more sub-populations may be found if targeted searches of suitable habitat were undertaken south of Burra Creek in the southeast of the Project Area.

Given that this species is currently listed as nationally Endangered it is considered that all currently occupied and potential habitat is critical to its survival (Moritz and Bickerton 2010).

7.2.2 Flora species determined as likely to occur

Two nationally Vulnerable flora species and 14 State conservation rated flora species were determined as likely to occur within the Project Area based on previous records and potential habitat (Figure 48). These are described in more detail below.

***Acacia spilleriana* (Spiller's Wattle) (AUS: EN, SA: E)**

Acacia spilleriana (Spiller's Wattle) is bushy rounded shrub which grows to between 1 and 3 m and is endemic to South Australia. It grows on rocky hills, commonly along watercourses and roadsides (Whibley and Symon, 1992; Maslin, 2001a). There are no estimates of total population numbers for the species, however, most roadside populations are reported as sparse or consisting of one to two plants (State Herbarium of South Australia, 2005). From two collections, the seed viability was high, ranging from 95% to 100%, so this species would be useful to re-populate areas as an offset (DotEE 2009).

This species was previously recorded during Stony Gap surveys (EBS 2013a) and mapped in the western area of the Project Area (Figure 48). Although this species was not recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Austrostipa breviglumis* (Cane Spear-grass) (SA: R)**

Austrostipa breviglumis (Cane Spear-grass) is native to Australia and is found in the Flinders Ranges and the Mount Lofty Ranges in South Australia growing in hills and ridges on sandy loam soils. This is a shortly rhizomatous perennial grass to 1.6 m high, with culms branching from near the base and with glabrous nodes. The leaves are glabrous or finely scabrid with blade flat or inrolled to 20 cm long and 2.5 mm wide. The inflorescence is a long and spreading panicle to 40 cm long with short, green to purplish-grey glumes and is flowering between September and January.

A. breviglumis was determined as likely to occur within the Project Area based on potential habitat. The last record for this species was in 2008 within 20 km of the Project Area (Appendix 1). Although this species wasn't recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Austrostipa gibbosa* (Swollen Spear-grass) (SA: R)**

Austrostipa gibbosa (Swollen Spear-grass) is found in the southern Flinders Ranges, Mount Lofty Ranges and the South-east in South Australia growing on rich loamy soil along creeks and seasonally wet areas in woodland and grassland. It is a tufted perennial grass to 1.5 m high with culms unbranched and pubescent nodes. Leaves are glabrous or sparsely pubescent, sometimes scabrous with blade flat,

channelled or inrolled to 30 cm long and 5 mm wide. The inflorescence is an open panicle to 40 cm long with bulging green glumes. *Austrostipa gibbosa* flowers between October and January.

A. gibbosa was determined as likely to occur within the Project Area based on potential habitat. The last record for this species was in 2005 within 20 km of the Project Area (Appendix 1). Although this species wasn't recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Austrostipa pilata* (Prickle Spear-grass) (SA: V)**

Austrostipa pilata (Prickle Spear-grass) is near endemic to South Australia and found on the Eyre Peninsula, Flinders Ranges and the northern Mount Lofty Ranges growing on hill slopes in mallee. *A. pilata* is a loosely tufted perennial grass to 80 cm high, with firm and slender culms (to 1 mm diam. at base) and pubescent to almost glabrous black nodes. Leaves are scabrous or pubescent but never densely pubescent; white hair tufts in axils; leaf blade erect, sharp-pointed and strongly inrolled to 12 cm long and 6 mm wide; sheaths slender and tight around culm. The Inflorescence is a sparse slender contracted panicle to 20 cm long with straw-coloured glumes to 10 mm long. *A. pilata* flowers between October and November.

A. pilata was determined as likely to occur within the Project Area based on potential habitat. Although this species wasn't recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Bothriochloa macra* (Red-leg Grass) (SA: R)**

Bothriochloa macra (Red-leg Grass) is found mainly in the southern part of South Australia south of Port Augusta but with a few scattered records further north in grasslands and grassy woodland communities but often in degraded sites. *B. macra* is a perennial grass, glabrous except for the inflorescence, with slender stems, usually reddish-purple to 80 cm high. The leaf blades are flat to 20cm long, approximately 3 mm wide; sparsely hairy, green, sometimes with maroon colouring at the tips. The inflorescence is a simple panicle to 8cm long with racemes to 6 cm long and the species is flowering between December and April.

B. macra was determined as likely to occur within the Project Area based on potential habitat. Although this species wasn't recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Dodonaea procumbens* (Trailing Hop-bush) (AUS: VU, SA: V)**

Dodonaea procumbens (Trailing Hop-bush) is a poorly-known small prostrate shrub endemic to south-eastern Australia, where it occurs in South Australia, Victoria and New South Wales. *D. procumbens* can be distinguished from other *Dodonaea* species by its prostrate habit, and from prostrate members of various pea genera (when not flowering or fruiting) by its generally toothed leaves and absence of stipules. South Australian populations have been recorded in open *Eucalyptus camaldulensis*, *E. fasciculosa* and *E. leucoxylon* woodlands in low-lying areas (West 1986), and in native grasslands, where it grows with *Lepidosperma viscidum*, *Themeda triandra*, *Rytidosperma* spp., *Austrostipa* spp. and shrubs including *Acacia acinacea*, *D. viscosa* and *Bursaria spinosa* (Carter 2010). At Mokota Conservation Park (which is

situated north of Burra, South Australia), the species grows in *Rytidosperma* low tussock grassland on rocky outcrops and in shallow soils, with *Vittadinia cuneata*, *Calocephalus citreus*, *Leptorhynchus tetrachaetus*, and *Triptilodiscus pygmaeus* (DEH 2006).

D. procumbens was determined as likely to occur within the Project Area based on potential habitat and the fact *D. procumbens* was previously recorded by EBS (2013a) (Figure 48) predominantly in the western corner of the Project Area. The last record for this species was in 1994 within 20 km of the Project Area (Appendix 1). Although this species was not recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Echinopogon ovatus* (Rough-beard Grass) (SA: R)**

Echinopogon ovatus was determined as likely to occur within the Project Area based on potential habitat. *Echinopogon* is a genus of grasses native to Australia, New Guinea, Indonesia, and New Zealand. They are commonly known as hedgehog grasses (ALA, accessed 2019), are perennial with bristly panicles. The distribution of *E. ovatus* is within Flinders Ranges, Northern Lofty, Southern Lofty, Kangaroo Island and South-eastern SA. Although this species was not recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Eryngium ovinum* (Blue Devil) (SA: V)**

Eryngium ovinum, commonly known as the blue devil, is a plant species native to Australia and is widespread throughout temperate woodlands and grasslands. Blue devil is a perennial herb, which dies down during autumn and emerges in late winter to flower in summer.

The Blue Devil has been previously detected at two separate locations within the previous Stony Gap Project Area (Figure 46) (EBS 2012). There were approximately 11 individuals and four juveniles located in one small patch and 300 to 400 individuals were recorded in a second patch was located on the eastern boundary close to Springbank Road.

E. ovinum was determined as likely to occur within the Project Area based on potential habitat and the fact *E. ovinum* was previously recorded by EBS (Figure 48) predominantly in the middle-western corner of the Project Area. The last record for this species was in 2013 within 20 km of the Project Area (Appendix 1). Although this species was not recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.



Figure 46. *Eryngium ovinum* (Blue Devil).

***Eucalyptus cajuputea* (Green Mallee) (SA: R)**

Eucalyptus cajuputea was determined as likely to occur within the Project Area based on potential habitat. *E. cajuputea*, commonly known as the narrow-leaved peppermint box is a mallee that is endemic to South Australia. The mallee is native to the northern portion of the Eyre Peninsula, in the Flinders Range and northern parts of the Mount Lofty Ranges. It is often found on rocky ridges and hillslopes on the adjacent footslopes and undulating plains growing in rocky sandy soils (Seeds of SA 2016). Although this species wasn't recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Lachnagrostis robusta* (Tall Blown-grass) (SA: R)**

Lachnagrostis robusta (Tall Blown-grass), like the majority of *Lachnagrostis* species, grow in lowland habitats in Northern and Yorke, South Australian Murray Darling Basin and the South East of South Australia. It is an annual species with culms that are erect or geniculately ascending, 60–80 cm tall, 3–4 noded. Its leaf-sheaths are antrorsely scabrous and the ligule is an eciliate membrane, the leaf-blades are linear, flat, 10–17 cm long, 3.5–5 mm wide. The leaf-blade surface is scabrous, and the inflorescence is a compound, pyramidal panicle of 12–25 cm long. *L. robusta* flowers between November and December.

L. robusta was determined as likely to occur within the Project Area based on potential habitat. Although this species was not recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Logania saxatilis* (Rock Logania) (SA: R)**

Logania saxatilis was determined as likely to occur within the Project Area based on potential habitat. Endemic to South Australia and found in the Flinders Ranges and the Mount Lofty Ranges, growing on steep-sided sandstone gorges in open woodland community and in crevices of rocky outcrops in shallow sandy or clay-rich soils. Although this species was not recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Maireana rohrlachii* (Rohrlach's Bluebush) (SA: R)**

Spindly, divaricately branched shrub to c. 1 m high; found in heavy soils on exposed ridges and stony outcrops. Also occurs as an understorey species within low grassy woodlands.

Maireana rohrlachii was determined as likely to occur within the Project Area based on potential habitat and the fact *M. rohrlachii* was previously recorded during survey work at Stony Gap (EBS 2012b); this species was located within a small pocket to the far west of the Stony Gap area (EBS 2012b) (Figure 48).

***Mentha satureioides* (Native Pennyroyal) (SA: R)**

Mentha satureioides was determined as likely to occur within the Project Area based on potential habitat and the fact *M. satureioides* has been recorded at several locations during previous survey work at Stony Gap (EBS 2012) (Figure 47); predominantly associated within minor drainage lines. Only one patch was located out of a drainage line.



Figure 47. *Mentha satureioides* (Native Pennyroyal).

***Olearia pannosa subsp. pannosa* (Silver Daisy-bush) (AUS: VU, SA: V)**

Olearia pannosa subsp. pannosa (Silver Daisy-bush) is endemic to South Australia and found scattered in the southern part in agricultural areas on road sides and with few individuals. The species occurs in sandy, flat areas and in hilly, rocky areas in woodland or mallee. The species is a spreading undershrub or shrub to 1.5 m high, producing root suckers. Stems are woody at least at the base, branched with appressed hairs. Leaves with petioles are up to 15 mm long, broad-ovate to elliptic, acute to shallowly cordate at the base, acute to obtuse at the apex, to 9 cm long and 5cm wide, prominently reticulate-veined, dark green and shiny above and white- to rusty-tomentose below with margins flat. The flower head is solitary, terminal and in the upper leaf axils, on long stalk to 30 cm long often with 1 or 2 reduced leaves. Flowers are large, white rarely pale-mauve daisy with a yellow centre. The flowering time for *O. pannosa ssp. pannosa* ranges from August to October.

O. pannosa subsp. pannosa was determined as likely to occur within the Project Area based on potential habitat and the fact *O. pannosa subsp. pannosa* was previously recorded by EBS (Figure 48) south of the Project Area. Although this species was not recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

***Ptilotus erubescens* (Hairy-tails) (SA: R)**

Ptilotus erubescens is an erect perennial plant with a woody rootstock, stems to c. 25 cm high, hairy especially when young. This species grows in fertile soils in grassy woodlands found mainly in the southern Flinders Ranges and Mount Lofty Ranges of South Australia.

P. erubescens was determined as likely to occur within the Project Area based on potential habitat and the fact *P. erubescens* was previously recorded by EBS (EBS 2013a) (Figure 48) on the far western boundary of the Project Area. Although this species was not recorded during the autumn and spring 2019 surveys, it is likely to be recorded again given better seasonal conditions and additional survey work.

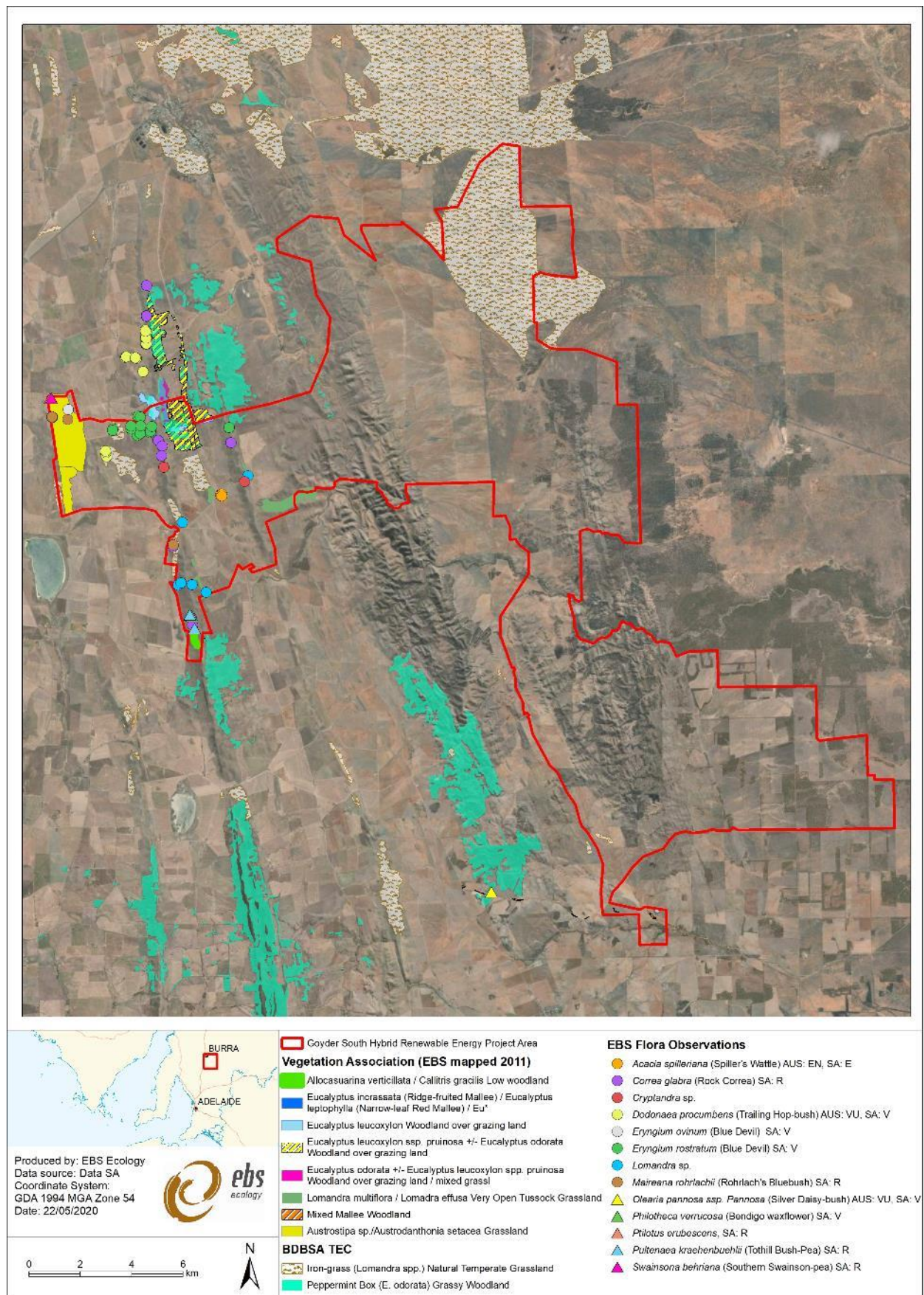


Figure 48. EBS Flora records and associations – previous survey work Stony Gap (EBS 2013a). Note: some records fall outside of the current Project boundary, as the Project Area has evolved over time.

7.3 Fauna

7.3.1 *Nationally threatened*

The nationally listed fauna species that were recorded during the field assessments in autumn and spring 2019 or identified as likely to occur in the desktop assessment are discussed in detail below.

Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*) (AUS: EN, SA: E)

The PBTL is currently listed as nationally Endangered under the EPBC Act and Endangered in South Australia under the NPW Act. The PBTL is now known from 27 sites, ranging from north of Port Wakefield in the Hummocks to south of Peterborough and west of Clare (Duffy *et al.* 2012). Prior to 2000, the population was estimated to be around 5000 lizards, based on 10 known populations. Since this time, another 17 populations have been discovered. Suitable habitats are largely on private land, therefore historically surveys were not as accessible.

The weather and survey conditions were optimal for the duration of both survey periods due to low grass levels and fine/sunny conditions, which are important when searching for spider/PBTL burrows. Therefore, the results from the survey locations can be reported with a high degree of confidence.

Suitable PBTL habitat was mostly confined to the footslopes of the two ridges in the western half of the Project Area (Figure 36 and Figure 37), and therefore PBTL surveys were concentrated in these areas. This corresponds with historic BDBSA records and previous surveys conducted by EBS for the Stony Gap Project (see Table 1, page 2).

Once the proposed infrastructure layout is determined, further surveys will need to be undertaken in all areas that overlap with likely and possible PBTL habitat. It is also important to ground truth the areas mapped as unlikely habitat within the proposed infrastructure layout given the broad scale of the PBTL occurrence and habitat assessment. Furthermore, even though searches failed to find the species in certain sections of the Project Area, their presence cannot be ruled out given potentially suitable habitat is present, and the proximity to known populations. PBTLs are known to inhabit highly degraded grasslands and hence any spider holes in unploughed grasslands (including exotic grasslands) within the Project Area should be considered an indication that this species may exist. In general, PBTs are unlikely to occur along the ridge-tops due to a lack of soil profile. However, grassland/pasture areas along the sides of the ridges could potentially contain a soil profile suitable for this species to persist.

The following potential impacts of the Project on PBTLs must be considered when selecting an appropriate buffer zone from known PBTL locations:

- Direct loss of individuals during construction;
- Noise and vibration disturbance during construction;
- Runoff from construction areas leading to sedimentation build-up in and/or around burrows;
- Division and isolation of populations caused by the construction of vehicular access tracks; and
- Disturbance from turbine blade shadow flicker during operation.

The potential presence of PBTLs should be given consideration with respect to the placement of infrastructure and access tracks and any changes in design layout. Where the refined layout is within potential habitat, a more detailed targeted survey within summer months, will be required when grass cover has declined, and spider's holes are more visible. The survey envelope should extend at least 50 m beyond the footprint of proposed infrastructure. Any new infrastructure (or changes) that are proposed within potential PBTL will need to be surveyed for the presence of PBTLs. Further investigation of spider holes may be required where turbines, roads and other infrastructure are planned within potential habitat to micro-site them in suitable locations. Even if no PBTLs are observed during this type of survey, they cannot be ruled out from occurring.

Further investigation is also required where PBTLs have been found. Again, a population survey in summer months will be required when grass cover has decreased, and spider holes are more visible. This population survey is required to determine the extent of the population and to assist with managing the impacts of the wind farm on this species.

PBTL habitat should be avoided where possible. Alternatively, more detailed surveys and infrastructure design may be undertaken in consultation with the PBTL Recovery Team to attempt to suitably place infrastructure to avoid impacting PBTL habitat and individuals.

7.3.2 State threatened

The State listed fauna species that were recorded during the field assessments in autumn and spring 2019 or identified as likely to occur in the desktop assessment are discussed in detail below.

White-winged Chough (*Corcorax melanorhamphos*) (SA: R)

White-winged Choughs were recorded within open eucalypt woodland and mallee associations over the Project Area (Figure 39). At each location, family parties of up to 20 individuals occurred. Within large remnants, White-winged Choughs regularly use remnant edges, where a mixture of habitats occurs, such as grassland and woodland (Cox and Bauer 1997). While in small woodlands, both core and edge areas are used (Anderson and Burgin 2008). The use of mallee and woodland edges by White-winged Choughs was also observed in the Project Area. Cox and Bauer (1997) identified that grassland and edge habitats had higher invertebrate biomass than forested areas. Food resources are therefore considered to impact habitat usage by White-winged Choughs.

Hooded Robin (*Melanodryas cucullata*) (SA: R)

The Hooded Robin is a small passerine that inhabits drier eucalypt forests, woodland and scrubs that are typically dominated by *Eucalypt*, *Casuarina* or *Callitris* species (Pizzey and Knight 2014). Hooded Robins were recorded at two different sites during the field assessments and are likely to be resident in these sites. As the presence of Hooded Robins is positively associated with ungrazed or lightly grazed ground cover dominated by native perennial tussock grasses, significant portions of the Project Area supporting forests, woodland and scrubs may be unsuitable habitat for Hooded Robins due to stock grazing (Priday 2010).

Restless Flycatcher (*Myiagra inquieta*) (SA: R)

The Restless Flycatcher is a small passerine that inhabits open forests and woodlands, river red gums near water, and inland and coastal scrubs (Pizzey and Knight 2014). The *Eucalypt* and *Callitris* communities present over the Project Area would provide suitable potential habitat for the Restless Flycatcher (G. Oerman, *Pers. Obs.* 2019). This species was not recorded during the autumn assessment however a pair of Restless Flycatchers were observed opportunistically in riparian vegetation during the spring survey, just outside the Project Area (Figure 39).

Elegant Parrot (*Neophema elegans*) (SA: R)

A single Elegant Parrot was observed in the Project Area during the autumn 2019 field assessment (Figure 39). This species was also recorded during previous survey work, completed by EBS at the Stony Gap site, in November/December 2010 (EBS 2011). This was within *Maireana aphylla* (Cottonbush), *Atriplex stipitata* (Bitter Saltbush) mixed low open chenopod shrubland. As the Elegant Parrot may occur in open forests, woodland and scrublands, in addition to chenopod shrublands, potential habitat for the species is widespread across the Project Area.

Diamond Firetail (*Stagonopleura guttata*) (SA: V)

The Diamond Firetail was observed adjacent to *Eucalyptus oleosa* (Red Summer Mallee) Mixed Open Mallee within the Project Area, as well as in previous survey work completed by EBS at the Stony Gap site in November/December 2010 (EBS 2011). The species was recorded at a riparian area, presumably where Diamond Firetails would drink and forage. As mass germination of exotic grasses occurs in the winter months, perennial native grasses which do not mass germinate, such as those present within the *E. odorata* woodland may also be a crucial food resource. Access of stock to the area of *E. odorata* grassy woodland (Figure 39) could result in the loss of the population. Stock grazing and subsequent loss or degradation of native tussock grasses would have rendered large areas of eucalypt woodland as unsuitable for the presence of Diamond Firetails.

Satin Flycatcher (*Myiagra cyanoleuca*) (SA: E)

A pair of Satin Flycatchers were recorded in the Project Area during the autumn field assessment in the single patch of *E. odorata* woodland. Satin Flycatchers are very rarely recorded in South Australia, particularly the Mid North, where vagrants have been previously observed (Pizzey and Knight 2014). The species typically inhabits heavily vegetated gullies in forests, and taller woodlands, however, during migration may occur in a wider range of habitats including forests, woodlands, mangroves and trees in open country. Satin Flycatchers migrate from the eastern seaboard north of Brisbane to southern areas extending to south-eastern South Australia and Tasmania, where they are typically recorded between September and April (Pizzey and Knight 2014). As Satin Flycatchers recorded in the Mid North are vagrants, no important habitat for this species occurs within the Project Area.

Peregrine Falcon (*Falco peregrinus*) (SA: R)

The Project Area boundary has evolved over the progression of investigative assessments undertaken as part of the Goyder South Project. As such, some species that were identified as likely to occur through the desktop assessment and were in fact recorded during the survey work undertaken by EBS, have been removed from the results section. One such species that warrants discussion here, is the Peregrine Falcon

which was observed during field assessments conducted by EBS, but which is now outside the current Project footprint.

The autumn observation was in cleared land adjacent to a creekline where woodland communities (VA 6 and VA 7) occurred. The spring observation was of a single bird nesting in a disused Wedge-tailed Eagle nest. In addition, a previous field assessment by EBS (2011) within the Project Area at the Stony Gap site in October/December 2010, identified one Peregrine Falcon nest.

No Peregrine Falcon nests were recorded during the March/April 2019 field assessment within the then Project boundary (at the time of survey), however, this occurred outside the species' breeding season. Peregrine Falcons nesting within the Project Area would be reliant upon the use of dis-used raven and raptor nests as the species does not build its own nest and typically uses elevated platforms on cliff faces or artificial structures for nesting (Pizzey and Knight 2014). It is expected that this species is likely to utilise the Project Area for both foraging and breeding and that additional surveys would most likely detect more than one individual.

7.3.3 Southern Hairy-nosed Wombat (SHNW)

Wombats are the largest burrowing mammals in the world. They spend over 75% of their time in their burrows, which allow them to survive in the harsh, seasonally changing and unpredictable environment of semi-arid and arid Australia (Finlayson *et al.* 2005; Sparrow *et al.* 2016). In suitable environmental conditions (e.g. calcareous soils on calcrete, intermediate surface rockiness), wombats construct large warren complexes that allow long-term occupation (Marshall *et al.* 2018).

The large warrens and digging and foraging behaviour of wombats can cause conflict with agricultural operations (Figure 49). Indeed, nearly 80% of farmers that were surveyed indicated that wombats caused damage on their property, and that their burrowing behaviour was a major management issue, with nearly 75% stating that wombats were a 'problem' (Sparrow *et al.* 2011; Sparrow 2012). Wombats burrowing in cropping paddocks and under infrastructure such as fences and water tanks can be concerning for safety (farm machinery falling into collapsed burrows) and lead to loss of water for stock, stock escaping or financial loss due to damaged equipment (Sparrow *et al.* 2016). Other impacts caused by wombats include erosion and grazing competition (SA MDB NRMB 2011).

Based on the above information, and the observations of SHNWs and their warrens within the Project Area (Figure 38), there is potential for conflict with wombats during the construction and operation of the Project. The following potential impacts of the Project on SNHWs must be considered when selecting an appropriate buffer zone from known SHNW locations:

- Direct loss of individuals during construction;
- Noise and vibration disturbance during construction;
- Runoff from construction areas leading to sedimentation build-up in and/or around burrows;
- Division and isolation of populations caused by the construction of vehicular access tracks; and
- Disturbance from turbine blade shadow flicker during operation.

The following potential impacts of SNHWs on proposed infrastructure must be considered when selecting an appropriate buffer zone from known SHNW locations:

- Damage to infrastructure from burrows;

- Reduction in structural integrity of infrastructure from burrows; and
- Damage to vehicles and construction plant, as well as safety hazard, from hard-to-see burrows.

Although SHNWs and their warrens were restricted to drainage lines, three good seasons would likely see an increase in the adult wombat populations within the Project Area (SA MDB NRMB 2011). Recolonization may often occur within a short time, after wombats are removed (Sparrow et al. 2011; Sparrow 2012). Both of these factors should be considered when selecting an appropriate buffer zone from known SHNW locations.

Recommended management techniques to reduce the impacts to wombats and the impacts caused by wombats to wind and solar farm infrastructure are discussed in Section 8.3.2.



Figure 49. SHNW warren system along drainage line within the Project Area.

7.3.4 Wind farm impacts on avifauna

The potential impacts of wind farms on avifauna, are summarised as follows:

- Rotor strikes (bird mortality);
- Barotrauma (bat mortality);
- Clearance and degradation of habitat;
- Acoustic masking; and
- Behavioural avoidance.

Rotor strikes

To determine an accurate estimation of bird strikes at wind farms, scavenging rates and the likelihood of surveyor detection need to be incorporated into analyses. Accurate assessments of bird strike at wind farms in southern-eastern Australia that are publicly available are scarce. Furthermore, assessments are influenced by the surrounding habitat and presence of local bird populations. For the five reports reviewed as part of this report, bird deaths per turbine per annum varied from 0.9 to 13.40 per annum (Table 38). It should be noted that the data collected for an operating wind farm in the Mid-North, South Australia, was collected over four turbines that had been identified as high risk of bird strike (due to their proximity to breeding and foraging habitat). Hornsdale Wind Farm reporting is focussed on these high risk turbines only, and as such the mean number of bird deaths per turbine for this wind farm as a whole, is likely to be lower.

The integrity of owner-reported data from the other sites summarised in Table 38 may need to be considered when reviewing bird death data, in particularly Macarthur Wind Farm, which would appear to be more lethal on a per-turbine basis. Refer to Section 9 to obtain references on these wind farm sites.

Raptors are one of the most at-risk groups of bird from wind farms as they are prone to rotor strike as they regularly fly at heights swept by turbine rotors, have 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.* 2011). Three species of raptor have been struck at Hornsdale Wind Farm; Wedge-tailed Eagle, Peregrine Falcon and Nankeen Kestrel (*Falco cenchroides*), while feathers from a Brown Falcon (*Falco berigora*) believed to have been struck were found underneath a turbine. Impacts of wind farms on Wedge-tailed Eagles may be particularly severe, with 18 individuals struck over one year of operation of the Ararat Wind Farm, Victoria (BL&A 2018).

Table 38. A sample of bird deaths per turbine per annum at wind farms within Australia.

Wind farm	Location	Bird deaths per turbine per annum	Reference
Hornsdale	Mid-North, South Australia	6.90 - 13.19	EBS (2019)
MacArthur	South-Western Victoria	13.40 ± 2.37	AERS (2015)
Waubra	Central Victoria	1.5	Acciona 2012
Bluff Point	North-Western Tasmania	1.7	Hydro Tasmania 2012
Studland	North-Western Tasmania	0.9	Hydro Tasmania 2012

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). The number of bat mortalities at wind farms is expected to be substantial, with 44 bat carcasses identified within one year of monthly monitoring over 25 turbines at Ararat Wind Farm, Victoria (BL&A 2018). 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). Opportune observations of bat carcasses were recorded during bird mortality monitoring at Hornsdale Wind Farm, with two carcasses found in the first year of monthly

monitoring over four turbines (EBS 2019). The two carcasses were from two species; Gould's Wattled Bat (*Chalinolobus gouldii*) and a species of Free-tailed Bat (*Ozimops* sp.).

Clearance and degradation of habitat

The Project will result in the direct clearance of habitat for hardstands and tracks. The clearance and fragmentation of habitat is expected to be unfavourable to small passerine species with specific habitat preferences and favourable to large generalist species (Szabo *et al.* 2011). In addition to this, hollows, which provide nesting and roosting locations for birds and bats may be cleared. Furthermore, where native vegetation borders the infrastructure footprint it is expected to become degraded from weed invasion, erosion and other edge effects.

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 was detected in the European Robin (*Erithacus rubecula*), which as a result 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 their territory, which could reduce breeding success (Zwart *et al.* 2016). In South Australia, acoustic masking is thought to be one of the key drivers of reduced songbird abundance in areas within 500 m of mining activity (Read *et al.* 2015).

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. In Norway, 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.* 2011). 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).

8 RECOMMENDATIONS/MITIGATION MEASURES

As part of the initial survey work, a number of ecological constraints were identified by EBS (Figure 50, page 113), which Neoen has committed to addressing, as part of the preliminary wind farm design.

Burra Creek Gorge holds ecological significance for the local area and is rich in biodiversity. Neoen has instituted a voluntary 3 km setback from Burra Creek Gorge campground to minimise visual impact to this predetermined sensitive area (Figure 51, page 114).

As the Project has evolved, Neoen has sought to avoid and protect known Wedge-tailed Eagle and Peregrine Falcon nests (active and in-active), patches of Peppermint Box (*E. odorata*), and locations of recorded PBTLs and likely and possible PBTL habitat. Initially, Neoen delineated an Ecological Protection Zone (EPZ) (Figure 51) within the Project Area, with the intention of limiting infrastructure within the EPZ. Subsequently, following further investigations, Neoen elected to exclude the area of the Ecological Protection Zone (EPZ) from the Project Area entirely, which resulted in the voluntary reduction of turbines by Neoen (approximately 18 wind turbines were removed from the original project layout proposed in January 2019).

In EBS's opinion, Neoen's election to exclude the EPZ from the Project Area altogether, is likely to afford significant protection to Wedge-tailed Eagles, Peppermint Box (*E. odorata*) Grassy Woodland, Pygmy Blue-tongue Lizards and known habitat and areas that provided habitat for threatened bird species as well as high bird species richness habitat (Figure 51).

In summary, as a result of changes to the Project Area boundary and proposed project layout over time, potential impacts to flora and fauna from the Project have been significantly reduced. Some of the benefits of these changes include:

- Number of patches of Peppermint Box (*E. odorata*) (VA2) within the Project Area, reduced from three to one;
- For the PBTL:
 - Number of locations within the Project Area where individuals have been recorded reduced from 62 individuals to 24;
 - Area of likely habitat within the Project Area reduced from 194 ha to 47 ha;
 - Area of possible habitat within the Project Area reduced from 870 ha to 450 ha.
- Area of possible habitat and locations of finds of two skins potentially belonging to the FRWL no longer within the Project Area;
- Area of high density of threatened bird species no longer within the Project Area – these species included: the White-winged Chough (5 records), Peregrine Falcon (2 records) and Diamond Firetail (1 record);
- Number of Wedge-tailed Eagles nests (active and in-active) within the Project Area reduced from 15 to six; and
- Number of locations within the Project Area where bird individuals have been recorded reduced from 931 (representing 68 bird species) to 586 (representing 58 species).

8.1 Recommendations to change the layout and location of infrastructure

- Avoid where possible, areas that have been mapped as patches of Iron-grass (*Lomandra* sp.) and Peppermint Box (*E. odorata*) – where areas cannot be avoided, EBS recommends that targeted surveys need to be undertaken for both Iron-grass and Peppermint Box, to determine if they qualify as TECs, prior to construction taking place. The survey, conditions permitting, should be timed after a good rainfall season. Where areas cannot be entirely avoided, locations of wind turbines and associated infrastructure should be micrositied prior to construction to avoid patches containing both Iron-grass and Peppermint Box;
- Avoid, where possible, areas that have been identified as known PBTL records, areas mapped as likely PBTL habitat and, potential PBTL habitat. Where areas cannot be entirely avoided, locations of wind turbines and associated infrastructure should be micrositied prior to construction to minimise impacts on PBTL burrows and habitat. Neoen has committed to undertaking survey work for micrositing PBTL within the Project Area, in the event that the Project is approved and prior to finalising the location of the Project infrastructure;
- Avoid, where possible the area marked as containing records of *Dodonaea subglandulifera* (Peep Hill Hop-bush);
- Avoid, where possible, areas mapped as having conservation value which have been identified by EBS as areas of high bird richness habitat or those vegetation associations containing Mallee Woodland, Sedgeland or Shrubland;
- Avoid, where possible, known Wedge-tailed Eagle nests (active and in-active) and implement a 1 km buffer around mapped nests; and
- Complete a full assessment for flora and fauna, in areas that were not assessed or properties that weren't able to be accessed (south-east section of the Project Area), as part of the initial ecological assessment work.

8.1.1 Threatened Ecological Communities

From the autumn and spring 2019 surveys, Peppermint Box (*E. odorata*) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia were not classed as TECs relevant to the Project Area.

During a good year, it is expected that enough native species (15), native broad-leaved herbaceous species resistance to disturbance (3), and native grasses (2) could occur within both potential TECs to qualify as Class B (and therefore constitute a TEC). Neoen has committed to undertaking a targeted assessment for both potential TECs within the Project Area, prior to construction and once a final infrastructure layout is known. It is recommended that these targeted surveys are completed (if practical) once a good season has occurred. If conditions do not improve before construction, it is recommended that as a worst case scenario, these INTG patches qualify as a TEC, and are addressed as part of the EPBC Referral process.

Neoen has committed to submitting an EPBC Referral to the Department of Agriculture, Water and Environment (DAWE), to address the potential impacts the proposal may have on MNES, which is likely to include both TECs and the Pygmy Blue-tongue Lizard.

8.1.2 *Dodonaea subglandulifera* (Peep Hill Hop-bush)

The following recommendations have been made to mitigate the potential impacts of the Project on *Dodonaea subglandulifera*:

- Given that *D. subglandulifera* was recorded within the southeast of the Project Area and there are some areas of the Project Area that are yet to be surveyed, it is recommended that further targeted searches to identify undiscovered sub-populations be undertaken;
- Develop strategies to ensure that the population of *D. subglandulifera* is not directly or indirectly impacted by the Project; the same should apply if further populations are found during subsequent survey work; and
- Determine whether the Project has the potential to have a significant impact on *D. subglandulifera* as part of the Referral process.

8.1.3 *Pygmy Blue-tongue Lizard* (*Tiliqua adelaidensis*)

One of the objectives of the Recovery Plan for the Pygmy Blue-tongue Lizard, was to manage the recovery process through an effective recovery team, which supports, guides and evaluates the implementation and outcomes of the recovery plan (Duffy *et al.* 2012).

The following recommendations have been made to mitigate the potential impacts of the Project on PBTL populations and PBTL habitat:

- Exclude the areas identified as containing PBTLs (plus adopt an appropriate exclusion buffer) from any disturbance associated with the Project. It is recommended that the PBTL Recovery Team is consulted with, over the appropriate buffer. Queries regarding guidelines or actions recommended around PBTL in South Australia, typically goes through the Recovery Team at some stage of a Project;
- Undertake a review of the Project and the options based on the constraints identified (PBTL population locations) within this report;
- Define all infrastructure, including access tracks, and undertake further surveys in area categorised as likely and possible PBTL habitat;
- Ground truth the areas mapped as unlikely habitat within the proposed infrastructure layout;
- Undertake further PBTL surveys if the proposed infrastructure layout is modified to fall within areas likely or possibly containing PBTLs; and
- Areas with PBTLs may be considered as a potential offset for vegetation clearance associated with the Project, once the final SEB offset is known.

EBS recommends that discussions with the PBTL Recovery Team should include, but aren't limited to:

- The selection of an appropriate exclusion buffer zone from the known PBTL locations;
- The potential impacts of the Project on known locations of PBTL; and

- If the proposed infrastructure layout is modified, where PBTL surveys need to be undertaken.

8.1.4 Flinders Ranges Worm-lizard (*Aprasia pseudopulchella*)

EBS has deemed it most likely that the Flinders Ranges Worm-lizard does not occur within the Project Area, however it is recommended that further surveys within likely and possible habitat for this species, within the proposed infrastructure layout, during the same time that targeted surveys for PBTL occur.

8.2 Recommendations for micro-siting and construction stage

8.2.1 Development of a Construction and Operational Environmental Management Plan (COEMP)

The development and implementation of a Construction and Operational Environmental Management Plan (COEMP) is recommended as part of Neoen's commitment to mitigating any potential impacts. The development of a COEMP may also be an approval condition under the *Environment Protection and Biodiversity Conservation Act, 1999*, once an EPBC Referral is completed.

The COEMP details the environmental management requirements of the Project. The focus of the COEMP would be the management of the any INTG, Peppermint Box (*E. odorata*) and Pygmy Blue-tongue Lizard populations identified within the Project Area, to ensure its quality/coverage and numbers are not diminished as a result of constructing and operating the wind farm.

8.2.2 SEB Offset Management Plan

The development and implementation of an SEB Offset Management Plan (OMP) covering a 10-year management period for each SEB Offset area is recommended during the construction and operational stages. The SEB OMP should aim to detail the management activities required for the SEB areas to ensure that an SEB is achieved for the Project. The SEB Offset is for native vegetation clearance only at a State level (as determined under the *Native Vegetation Act 1991*) and managed through the Native Vegetation Branch.

Flora and fauna monitoring of SEB Offset areas is a standard requirement for the implementation of an SEB OMP. EBS recommends that the monitoring program utilises standard Bushland Assessment Methods, as detailed by the Native Vegetation Branch. The results of the monitoring will inform the management of the SEB Offset area and ensure the environmental benefits of the management actions are measured. The monitoring (and subsequent reporting to NVC) should be undertaken annually.

It should be noted that an SEB OMP does not include any potential EPBC Offset requirements which, if required, need to focus on the potential impacts of the proposed wind farm on Matters of National Environmental Significance (e.g. Pygmy Blue-tongue Lizard, *Lomandra* grasslands and Peppermint Box). A separate EPBC Offset Management Plan should be implemented, if required, to ensure that an EPBC Offset is achieved for the Project.

8.2.3 Pygmy Blue-tongue Lizard (*Tiliqua adelaidensis*)

The presence of PBTL are known to the Project Area. From the two surveys undertaken at the time of writing the current report (May 2020), PBTL are located within specific areas of the Project Area, excluding

cropped and small areas of unsuitable habitat. Areas which are suitable to PBTL should be avoided. Utilising cropping areas as much as possible for major infrastructure layouts will reduce the impact to PBTL habitat. Neoen has committed to submitting an EPBC Referral, to address any potential impacts of the Project on Pygmy Blue-tongue Lizards.

Neoen has committed to undertaking a targeted PBTL survey once the design layout is final, which will include micro-siting proposed wind turbines locations and all associated infrastructure including access tracks, substations and transmission line around any PBTL burrows (where targeted surveys identify them as present) and, wherever possible, around potential habitat. Surveys are recommended prior to construction, to determine which spider holes are occupied so as to determine the best options possible with regard to turbine and infrastructure placement.

EBS proposes that Neoen liaise with the PBTL Recovery Team to investigate the possibility of re-locating PBTL from areas of less suitability that are impacted by the proposed Project, into areas that are considered optimal PBTL habitat and are avoided by the Project. Such actions could potentially assist with reducing potential direct impacts on PBTL and this can be explored to be included as a potential management action as part of the EPBC Referral. It should be noted that a PBTL Relocation Management Plan/Subplan should be prepared if this option is considered.

8.2.4 Raptor monitoring

Whilst there is no statutory requirement to monitor known raptor nest locations, it is recommended that Neoen undertake breeding success monitoring where construction activities are located within or close to known raptor nest buffers. In addition to this, EBS recommends additional bird and nest monitoring which could be undertaken on a broader scale (outside of the nest exclusion buffer).

If surveys of Wedge-tailed Eagle nests are undertaken, they should be undertaken prior, during and close to the end of the breeding season (prior to, during and post-construction) to determine breeding status of nests and to determine nesting success. Surveys close to the end of the breeding season would help to determine breeding and fledgling success and provide a means of assessing potential disturbance effects caused by the wind farm, which could be incorporated into future environmental risk assessments and adaptive management.

It is recommended that if raptor monitoring is undertaken, it should be during construction and operation, as well as for approximately three years after commissioning. Neoen may also explore the idea of extending monitoring beyond the three years, post construction.

Monitoring would involve a brief site visit at the beginning and end of the breeding season each year to check the status of breeding activity at known raptor nest locations. Specific details with regard to the time period of these breeding surveys will be outlined as part of the COEMP. This is likely to occur in June/July (when birds typically pair up) and around October/November (fledging) each year.

8.2.5 Weed and soil pathogen management

Ongoing weed management and monitoring is recommended pre-, during and post-construction of the proposed Project. This includes weed management practices and hygiene procedures to ensure that weed

species are not introduced to the site or further spread within or off-site. Specific weed management actions should be detailed in a Weed/Pathogen Management Plan.

8.3 Recommendations for monitoring, operational stage

The rollout of the COEMP and OMP is also recommended as part of the operational stage of the proposed Project.

8.3.1 *Pygmy Blue-tongue Lizard*

EBS recommends that discussions with the PBTL Recovery Team should include, but aren't limited to:

- The use of artificial burrows – if the density of a population is low at a site because of a lack of suitable spider burrows, the addition of artificial burrows may help to increase Pygmy Blue-tongue Lizard numbers (Schofield 2006); and
- Establishing new populations – it may be possible to reintroduce PBTL's at some sites. Its success will depend on factors such as soil types, habitat quality, habitat size, current and historical land management practices and the availability of lizards to establish new populations (Schofield 2006). Furthermore, the availability of spider burrows and PBTL food resources should be taken into account.

8.3.2 *Wombats*

Implementing an integrated approach to managing the potential impacts caused by Southern Hairy-nosed Wombat is recommended. Observations of Southern Hairy-nosed Wombat and warrens were restricted to drainage line areas within the Project Area (Figure 38). Therefore, avoidance of these areas would be the first mitigation measure that is recommended.

The issue of wombat management is well known in the region and, as such, the Murray Darling Basin NRM have recommended the following non-lethal management techniques to reduce the impact of wombats on wind and solar farm infrastructure (SA MDB NRMB 2011):

- **Electric fencing** – Two electric wires placed at 15 cm and 30 cm above the ground can prevent access by wombats. This technique may be appropriate to protect infrastructure (e.g. turbines) that are not able to be placed an adequate distance away from a large warren;
- **Fence alterations** – In areas that need to be fenced (e.g. solar arrays), leaving a 15 cm gap at the base of a fence can allow free movement of wombats and prevent them from digging under the fence. If security is a priority, 'wombat gates' can be installed to allow wombats to move freely through a fence;
- **Burrow/warren marking** – Clearly marking existing burrows and warrens (e.g. with a star dropper or flagging tape) can reduce the risk of damage to vehicles and machinery, as well as the burrows/warrens themselves;

- **Remove access to harbour sites** – Access to spaces underneath infrastructure (e.g. solar array foundations, site buildings, etc.) can be restricted through the installation of heavy gauge mesh, or a buried wire apron; and
- **One-way gates** – Should wombat burrows pose a risk to infrastructure; one-way gates can be installed to restrict access and allow any wombats to exit the burrows prior ripping the burrows.

8.3.3 *IdentiFlight*

As birds, especially raptors, are prone to turbine strike (as discussed in Section 7.3.4 *Rotor Strikes*), the use of IdentiFlight (which can detect raptor activity near turbines and subsequently generate an alert that can idle turbines nearby), is a recommendation by EBS that could be further investigated with regard to reducing the possible number of bird strikes. There is currently no projections on the costs associated with IdentiFlight and the proposed Project.

At present, only one wind farm in Australia; Cattle Wind Farm, located in the Central Highlands of Tasmania, has incorporated this technology into wind farm operation (Vorrath 2018). At Cattle Wind Farm, 16 towers mounted with IdentiFlight (radar) units have been installed in areas of high eagle activity over the 144 MW wind farm (Vorrath 2018). The success of IdentiFlight units were demonstrated by McClure *et al.* (2018) at a wind farm in Wyoming, USA, where the following results were recorded:

- IdentiFlight detected 96% of birds detected by observers and 562% more birds than observers;
- IdentiFlight misclassified nine of 149 eagles as non-eagles for a false negative rate of 6%;
- IdentiFlight misclassified 287 of 1013 non-eagles for eagles for a false positive rate of 28%;
- The median distance at classification for birds classified as eagles by IdentiFlight was 793 m; and
- The median time from detection till classification by IdentiFlight was 0.4 seconds.

8.3.4 *Solar farms as wildlife refuge*

An investigation into the use of solar farms as a wildlife refuge, could be undertaken by EBS on behalf of Neoen, if deemed a suitable option for the proposed Project. At present, there is a lack of data to indicate what the benefits of solar farms are to wildlife. A Project by the Royal Society for the Protection of Birds and a clean technology firm Anesco investigated if solar farms in England and Wales could potentially have a positively impact on threatened wildlife including turtle doves and skylarks. It was expected that wild flower meadow areas and seed-rich planting located in the 'unused' margins of the solar farms and where tracks were located between the solar panels, would help boost insects such as bees and butterflies and provide food and nesting areas for birds (The Guardian, 2016).

For the proposed Project the target species would firstly need to be determined, as well as a possible control area outside of the solar farm areas to compare impacts of the solar farm on wildlife. The investigation would need to determine if revegetating in and around the solar panels would be environmentally and financially viable and whether the creation of wildlife habitat would result in net gain/benefit for target species.

8.4 NEXT STEPS

Once the design layout is final including wind turbine placement and associated infrastructure, a specific vegetation assessment based on the Bushland Assessment Methodology (BAM) (NVC 2017) will need to be undertaken across the Project Area. The BAM is endorsed by the NVC and used to assess areas of native vegetation requiring clearance and calculate the SEB requirements for the Project. Areas identified as still requiring surveying in Figure 12, will also be captured as part of the BAM vegetation assessment.

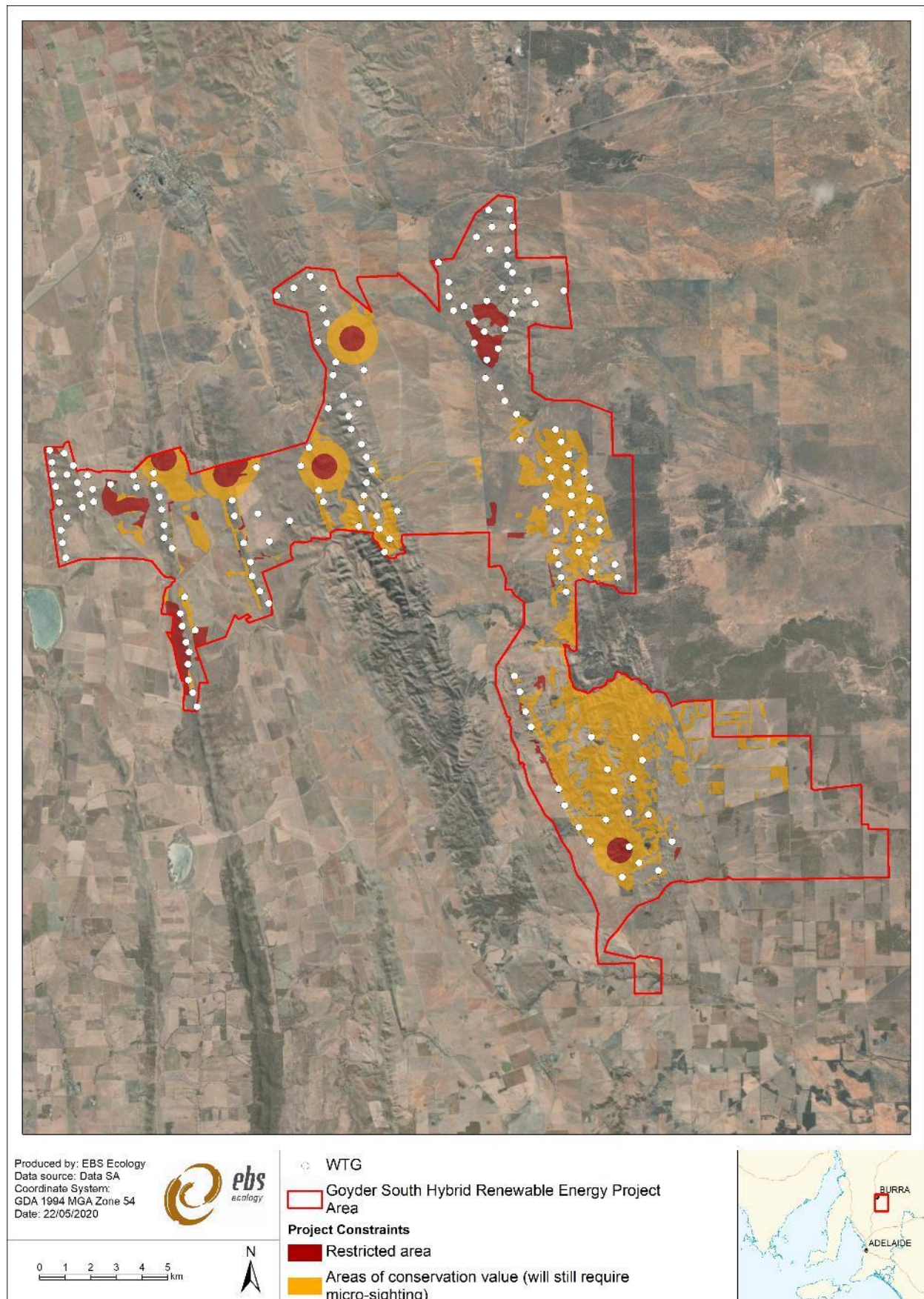


Figure 50. Project constraints identified by EBS as part of the initial ecological assessment work.

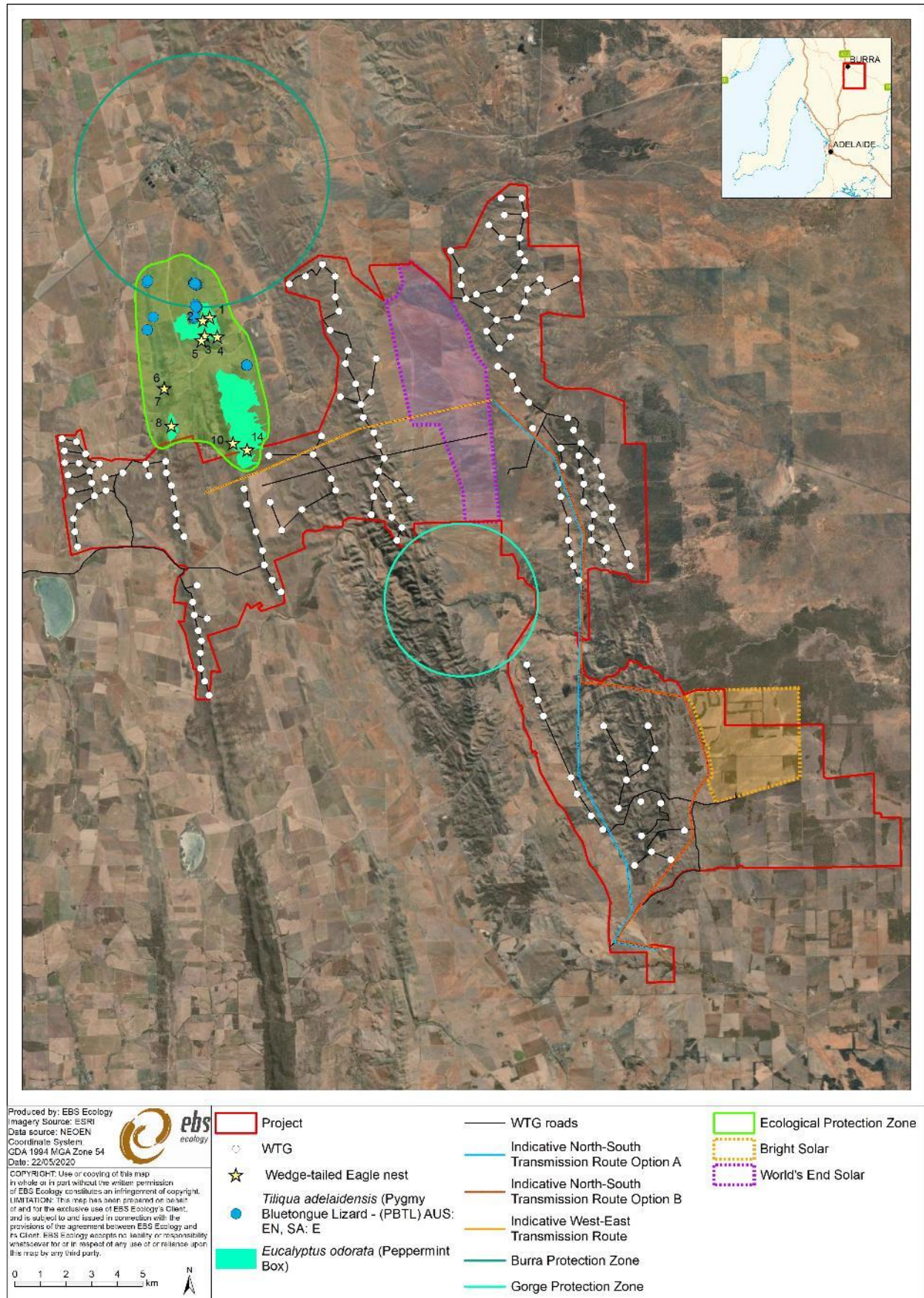


Figure 51. Ecological Protection Zone implemented by Neoen as part of the preliminary wind farm design.

9 REFERENCES

- Acciona Energy (2012) Bird monitoring. Waubra Wind Farm Newsletter (18). Retrieved from <http://www.accionacom.au/community/newsletters>.
- Anderson, L., Burgin, S. (2008) Patterns of bird predation on reptiles in small woodland remnant edges in peri-urban north-western Sydney, Australia. *Landscape Ecology* **23**: pp. 1039-1047.
- Atlas of Living Australia (ALA) *Echinopogon* P. Beauv. Hedgehog Grasses – Available at: <https://bie.ala.org.au/species/http://id.biodiversity.org.au/node/apni/2912327#> [Accessed June 2019].
- Australian Ecological Research Services (AERS) (2015) Macarthur Wind Farm, Bat and avifauna mortality monitoring. March 2014 to February 2015. Prepared for AGL Energy Limited. Australian Ecological Research Services, Portland, Victoria.
- Beston, J.A., Diffendorfer, J.E., Loss, S.R., Johnson, D.H. (2016) Prioritizing avian species for risk of population-level consequences from wind energy development. *PLoS ONE* doi: 10.1371/journal.pone.0150813.
- Brett Lane & Associates (BL&A) (2018) Ararat wind farm – bird and bat monitoring program. First year annual report April 2017 to March 2018. Ararat Wind Farm Pty Limited Windlab. Prepared by Brett Lane & Associates, Hawthorn, Victoria.
- Carter, O. (2010) *National Recovery Plan for Trailing Hop-bush Dodonaea procumbens*. Department of Sustainability and Environment, Melbourne.
- Clean Energy Council (2018) *Best Practice Guidelines: For Implementation of Wind Energy Projects in Australia*. Published by Clean Energy Australia.
- Commonwealth of Australia, Bureau of Meteorology (2019) Climate statistics for Australian locations – Eudunda. Available at: <http://www.bom.gov.au/jsp/ncc/cdio/cvg/av> [Accessed 27/02/2019].
- Cox, S.J., Bauer, J.J. (1997) Species interactions between White-winged Chough and Australia Magpie in a fragmented landscape. *Pacific Conservation Biology* **3**(3): pp. 289-294.
- Dahl, E.L., Bevanger, K., Nygard, T., Roskaft, E., Stokke, B.G. (2011) Reduced breeding success in white-tailed eagles at Smola windfarm, western Norway, is caused by mortality and displacement. *Biological Conservation* **145** (1): pp. 79-85, doi: 10.1016/j.biocon.2011.10.012.
- Department for Environment and Heritage (DEH) (2001) Provisional List of Threatened Ecosystems of South Australia (unpublished and provisional). Department for Environment and Heritage, Adelaide.
- Department of Environment and Heritage (DEH) (2006) *Mokota Conservation Park Draft Grassland Management Plan*. Internal Report.

Department of the Environment and Water Resources (DEWR) (June 2007) *Environment Protection and Biodiversity Conservation Act Policy Statement 3.7 Nationally Threatened Species and Ecological Communities: Peppermint Box (Eucalyptus odorata) Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia*.

Department of Environment and Natural Resources (DEWNR) (2011) Parks of the Mid North. DENR.

Available at: <http://www.environment.sa.gov.au/files/sharedassets/parks/psa-gen-parksofthemidnorth.pdf> [Accessed 17 January 2019].

Department of Environment, Water and Natural Resources (DEWNR) (2016) *Policy for a Significant Environmental Benefit under the Native Vegetation Act 1991 and Native Vegetation Regulations 2017*. DEWNR. Available at:

https://www.environment.sa.gov.au/files/sharedassets/public/native_veg/policy-for-a-significant-environmental-benefit-rep.pdf. [Accessed 17 January 2019].

Department of Environment and Water (DEW) (2019) *Biological Database of SA*. Recordset number DEWNRBDBSA190121-1 (provided 21/01/2019).

Department of Environment and Water (DEW) (2019) NatureMaps: Significant Environment Benefit

Areas Layer. Available at: <http://spatialwebapps.environment.sa.gov.au/naturemaps/?locale=en-us&viewer=naturemaps>. [Accessed 17 January 2019].

Department of the Environment and Energy (DotEE) (2009) Approved Conservation Advice for: *Acacia spilleriana* (Spiller's Wattle).

Department of the Environment and Energy (DotEE) (2019) EPBC Protected Matters Search, Available at: <http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf> [Accessed 10 January 2019].

Department of Sustainability, Environment, Water, Population and Communities (DSEWPC) (2011) *Survey guidelines for Australia's threatened reptiles: Guidelines for detecting reptiles listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999*. Commonwealth of Australia 2011.

Duffy, A., L. Pound & T. How (2012) *Recovery Plan for the Pygmy Bluetongue Lizard Tiliqua adelaidensis*. Department of Environment and Natural Resources, South Australia. Available from: <http://www.environment.gov.au/biodiversity/threatened/recovery-plans/recovery-plan-pygmy-bluetongue-lizard-tiliqua-adelaidensis-2012>. In effect under the EPBC Act from 24-Jul-2012.

EBS Ecology (2008) *Stony Gap Wind Farm Flora Survey and Fauna Assessment, 13th – 16th May 2008*. Report to Hydro Tasmania. Environmental and Biodiversity Services, Adelaide.

EBS Ecology (2009) *Additional Stony Gap Wind Farm Flora and Fauna Survey, November 2008*. Report to Hydro Tasmania. Environmental and Biodiversity Services, Adelaide.

- EBS Ecology (2011) *Stony Gap Wind Farm - Additional Flora and Fauna Assessment, November and December 2010*. Report to Entura Hydro Tasmania. EBS Ecology, Adelaide.
- EBS Ecology (2012b) *Stony Gap Stage 2 Flora and Fauna Survey*. Report to TRUenergy. EBS Ecology, Adelaide.
- EBS Ecology (2012c) *Targeted surveys for flora and fauna species and ecological communities listed under the EPBC Act 1999 - Stony Gap Wind Farm – 2012*. Report to TRUenergy Renewable Development Pty Ltd. EBS Ecology, Adelaide.
- EBS Ecology (2013a) *Stony Gap Stage 2 Additional Flora and Fauna Assessments*. Report to Energy Australia. EBS Ecology, Adelaide.
- EBS Ecology (2013b) *Targeted surveys for flora and fauna species and ecological communities listed under the EPBC Act 1999 - Stony Gap Wind Farm – 2012*. Report to TRUenergy Renewable Development Pty Ltd. EBS Ecology, Adelaide.
- EBS Ecology (2013c) PBTL Construction Environmental Management Plan- Stony Gap. Report to Energy Australia. EBS Ecology, Adelaide.
- EBS Ecology (2019) Bird Strike Monitoring – Year 1 Hornsdale Wind Farm. Report to Neoen. EBS Ecology, Adelaide.
- Finlayson G.R., Shimmin G.A., Temple-Smith P.D., Handasyde K., Taggart D.A. (2005) Burrow use and ranging behaviour of the southern hairy-nosed wombat, *Lasiorhinus latifrons*, in the Murraylands, South Australia. *Journal of Zoology* **265**, pp. 189–200.
- Graham A., Oppermann A., Inns R.W. (2001) Biodiversity Plan for the Northern Agricultural Districts. Department for Environment and Heritage, Adelaide.
- Hydro Tasmania (2012). Bluff point wind farm and Studland Bay Wind Farm annual environmental performance report 2011. Hobart: Hydro Tasmania.
- Jessop J.P., Toelken H.R. (1986) Flora of South Australia – Parts I-IV. State Herbarium of South Australia, Adelaide.
- Jusaitis M., Sorensen B. (1994) Conservation Studies on Endangered Plant Species from South Australia's Agricultural Regions. Black Hill Flora Centre.
- Kahrimanis M.J., Carruthers S., Opperman A. and Inns R. (2001) *Biodiversity Plan for the South Australian Murray-Darling Basin*. Adelaide, South Australia: Department of Environment and Heritage.
- Marshall V.M., Taggart D.A., Ostendorf B. (2018) Scale-dependent habitat analysis and implications for climate change risk for the southern hairy-nosed wombat. *Australian Mammalogy* **40**, pp. 162–172.

- Maslin, B.R. (2001a) Mimosaceae. Acacia part 1. In: Orchard, A.E. & A. Wilson, eds. *Flora of Australia*. **11A**:pp 1-673. Melbourne, Victoria: Australian Biological Resources Study and CSIRO Publishing.
- McClure, C.J.W., Martinson, L., Allison, T.D. (2018) Automated monitoring for birds in flight: Proof of concept with eagles at a wind power facility. *Biological Conservation* **224**: pp. 26-33.
- Moritz K.N., Bickerton D.C. (2010) Recovery Plan for the Peep Hill hop-bush *Dodonaea subglandulifera* 2010. Report to the Recovery Planning and Implementation Section, Australian Government Department of the Environment, Water, Heritage and the Arts, Canberra.
- Native Vegetation Council (NVC) Bushland Assessment Manual (2017) Native Vegetation Management Unit. State of South Australia 2015.
- Pizzey, G. and Knight, F. (2014) *The Field Guide to the Birds of Australia – 9th Edition*. CSIRO Publishing.
- Priday, S.D. (2010) Beyond the 'woody remnant' paradigm in conservation of woodland birds: habitat requirements of the Hooded Robin (*Melanodryas cucullata cucullata*). *Emu – Austral Ornithology* **110**(2): pp. 118-124.
- Schofield, J. (2006) *Pygmy Bluetongue Lizards: Best Practice Management Guidelines for Landholders*, Report for the Department for Environment and Heritage, Adelaide.
- Smith J. (2000) A survey for nationally threatened plant species on Local Government reserves and roadsides in the Northern Mount Lofty Ranges. Unpublished Thesis for an Honours Degree in Natural Resource Management. University of Adelaide.
- Sparrow E.E. (2012) Understanding the southern hairy-nosed wombat in the Far West and on Eyre Peninsula: community engagement and ecological research. Report for Department of Environment, Water and Natural Resources, Adelaide.
- Sparrow E.E., Parsons M.H., Blumstein D.T. (2016) Novel use for a predator scent: Preliminary data suggest that wombats avoid recolonising collapsed burrows following application of dingo scent. *Australian Journal of Zoology* **64**, pp. 192–197.
- Sparrow E.E., Taggart D.A., O'Brien C. (2011) State-wide survey of southern hairy-nosed wombats. Report for Department of Environment, Water and Natural Resources, Adelaide.
- Szabo, J.K., Vesk, P.A., Baxter, P.W.K., Possingham, H.P. (2011) Paying the extinction debt: woodland birds in the Mount Lofty Ranges, South Australia. *Emu* **111**(1) pp. 59-70.
- The Guardian (2016) Solar farms to create natural habitats for threatened British species. Available at: <https://www.theguardian.com/environment/2016/mar/07/solar-farms-to-create-natural-habitats-for-threatened-british-species> [Accessed 18 December 2019].

- Vorrath, S. (2018) Tasmania wind farm Australia's first to use eagle protection technology. Renew Economy. Available at: <https://reneweconomy.com.au/tasmania-wind-farm-australias-fire-to-use-eagle-protection-technology-79633/> [Accessed 10 January 2019].
- West, J.G. (1986) Sapindaceae. In: Jessop, J.P. & H.R. Toelken, eds. *Flora of South Australia*, Part II: Leguminosae-Rubiaceae. 4th Edition. Adelaide: South Australian Government Printing Division.
- Whibley, D.J.E. & D.E. Symon (1992) *Acacias of South Australia*. Adelaide, South Australia: Flora and Fauna of South Australia Handbook Committee.
- Zwart, M.C., Dunn, J.C., McGowan, P.J.K., Whittingham, M.J. (2016) Wind farm noise suppresses territorial defence behaviour in a songbird. *Behavioural Ecology* **27**(1): pp. 101-108.

10 APPENDICES

Appendix 1. BDBSA Flora records within 20 km of the Project Area.

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Acacia acinacea</i>	Wreath Wattle			Y	13/09/2007
<i>Acacia argyrophylla</i>	Silver Mulga-bush			Y	15/06/2005
<i>Acacia brachybotrya</i>	Grey Mulga-bush			Y	25/11/2013
<i>Acacia calamifolia</i>	Wallowa			Y	5/11/2014
<i>Acacia calamifolia (NC)</i>	Wallowa			Y	11/11/2003
<i>Acacia cupularis</i>	Cup Wattle			Y	24/12/2005
<i>Acacia euthycarpa</i>	Wallowa			Y	30/07/2009
<i>Acacia genistifolia</i>	Broom Wattle		E	Y	30/12/1990
<i>Acacia glandulicarpa</i>	Hairy-pod Wattle	VU	E	Y	8/05/2008
<i>Acacia hakeoides</i>	Hakea Wattle			Y	10/11/2003
<i>Acacia iteaphylla</i>	Flinders Ranges Wattle		R	Y	11/01/2004
<i>Acacia ligulata</i>	Umbrella Bush			Y	8/05/2008
<i>Acacia microcarpa</i>	Manna Wattle			Y	8/05/2008
<i>Acacia montana</i>	Mallee Wattle		R	Y	18/08/1977
<i>Acacia notabilis</i>	Notable Wattle			Y	2/12/2003
<i>Acacia nyssophylla</i>	Spine Bush			Y	1/01/1932
<i>Acacia oswaldii</i>	Umbrella Wattle			Y	5/11/2014
<i>Acacia paradoxa</i>	Kangaroo Thorn			Y	4/10/2009
<i>Acacia pycnantha</i>	Golden Wattle			Y	5/11/2014
<i>Acacia retinodes</i>	Wirilda			Y	5/10/2008
<i>Acacia sp.</i>	Wattle			Y	8/05/2008
<i>Acacia spilleriana</i>	Spiller's Wattle	EN	E	Y	3/10/2012
<i>Acacia triquetra</i>	Mallee Wreath Wattle			Y	
<i>Acacia victoriae ssp. victoriae</i>	Elegant Wattle			Y	18/12/2001
<i>Acacia wattsiiana</i>	Dog Wattle			Y	5/10/2008
<i>Acaena echinata</i>	Sheep's Burr			Y	10/12/2013
<i>Acaena sp.</i>	Sheep's Burr			Y	27/11/2001
<i>Acer sp.</i>	Maple			N	19/12/2001
<i>Acianthus pusillus</i>	Mosquito Orchid			Y	16/06/1969
<i>Acrotriche affinis</i>	Ridged Ground-berry			Y	5/10/2008
<i>Acrotriche patula</i>	Prickly Ground-berry			Y	25/11/2013
<i>Actinobole uliginosum</i>	Flannel Cudweed			Y	5/11/2014
<i>Adonis microcarpa</i>	Pheasant's Eye			N	27/02/1993
<i>Adriana quadripartita</i>	Coast Bitter-bush			Y	8/11/2003
<i>Agave americana var. (NC)</i>	Century Plant			N	16/11/2001
<i>Agrostis avenacea var. avenacea (NC)</i>	Common Blown-grass			Y	1/05/2000
<i>Aira caryophyllea</i>	Silvery Hair-grass			N	1/10/1999
<i>Aira cupaniana</i>	Small Hair-grass			N	5/10/2008
<i>Aira elegantissima</i>	Delicate Hair-grass			N	17/11/1993
<i>Aira sp.</i>	Hair-grass			N	8/05/2008
<i>Ajuga australis</i>	Australian Bugle			Y	29/10/2003
<i>Ajuga australis f. A (A. G. Spooner 9058)</i>	Australian Bugle			Y	10/11/2003
<i>Alectryon oleifolius ssp. canescens</i>	Bullock Bush			Y	5/11/2014
<i>Allium roseum</i>				N	9/11/1994
<i>Allocasuarina muelleriana ssp. muelleriana</i>	Common Oak-bush			Y	31/08/1995
<i>Allocasuarina verticillata</i>	Drooping Sheoak			Y	4/10/2009

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Alternanthera denticulata</i>	Lesser Joyweed			Y	18/03/1995
<i>Amphibromus nervosus</i>	Veined Swamp Wallaby-grass			Y	1/11/2001
<i>Amphipogon caricinus</i> var. <i>caricinus</i>	Long Grey-beard Grass			Y	1/06/1999
<i>Amsinckia calycina</i>	Hairy Fiddle-neck			N	29/10/2003
<i>Amsinckia lycopsoidea</i>	Bugloss Fiddle-neck			N	17/11/1993
<i>Amyema miquelii</i>	Box Mistletoe			Y	5/10/2008
<i>Amyema preissii</i>	Wire-leaf Mistletoe			Y	4/10/2008
<i>Angianthus tomentosus</i>	Hairy Angianthus			Y	1/10/1907
<i>Anthosachne scabra</i>	Native Wheat-grass			Y	21/09/2012
<i>Apium graveolens</i>	Celery			N	20/10/1981
<i>Apium prostratum</i> var. <i>prostratum</i>	Native Celery			Y	5/11/2014
<i>Apium prostratum</i> var. <i>prostratum</i>	Native Celery			Y	1/06/2005
<i>Arabidella filifolia</i>	Thread-leaf Cress			Y	19/08/1979
<i>Arabidella trisecta</i>	Shrubby Cress			Y	20/10/1981
<i>Arctotheca calendula</i>	Cape Weed			N	21/09/2012
<i>Aristida behriana</i>	Brush Wire-grass			Y	10/12/2013
<i>Aristida contorta</i>	Curly Wire-grass			Y	1/06/1999
<i>Aristida</i> sp.	Three-awn/Wire-grass			Y	21/09/2012
<i>Arthropodium fimbriatum</i>	Nodding Vanilla-lily			Y	10/12/2013
<i>Arthropodium minus</i>	Small Vanilla-lily			Y	4/10/2008
<i>Arthropodium</i> sp.	Vanilla-lily			Y	2/12/2003
<i>Arthropodium strictum</i>	Common Vanilla-lily			Y	21/09/2012
<i>Arundo donax</i>	Giant Reed			N	1/04/2001
<i>Asperula conferta</i>	Common Woodruff			Y	5/10/2008
<i>Asperula syrticola</i>	Southern Flinders Woodruff		R	Y	21/11/1993
<i>Asphodelus fistulosus</i>	Onion Weed			N	17/09/2010
<i>Asplenium flabellifolium</i>	Necklace Fern			Y	11/11/1995
<i>Asteridea athrixioides</i>	Wirewort			Y	27/02/1993
<i>Asteridea athrixioides</i> f. <i>athrixioides</i> (NC)	Wirewort			Y	2/12/2003
<i>Astroloma humifusum</i>	Cranberry Heath			Y	5/10/2008
<i>Atriplex acutibractea</i> ssp. <i>acutibractea</i>	Pointed Saltbush			Y	11/03/1980
<i>Atriplex acutibractea</i> ssp. <i>acutibractea</i>	Pointed Saltbush			Y	1/04/2001
<i>Atriplex angulata</i>	Fan Saltbush			Y	1/04/2001
<i>Atriplex eardleyae</i>	Eardley's Saltbush			Y	3/12/1993
<i>Atriplex holocarpa</i>	Pop Saltbush			Y	0/01/1900
<i>Atriplex leptocarpa</i>	Slender-fruit Saltbush			Y	18/03/1995
<i>Atriplex lindleyi</i> ssp. <i>inflata</i>	Corky Saltbush			Y	1/05/2000
<i>Atriplex lindleyi</i> ssp. <i>lindleyi</i>	Baldoo			Y	17/09/2010
<i>Atriplex paludosa</i> ssp. <i>paludosa</i>	Marsh Saltbush			Y	1/04/2001
<i>Atriplex prostrata</i>	Creeping Saltbush			N	1/11/2003
<i>Atriplex pumilio</i>	Mat Saltbush			Y	5/11/2014
<i>Atriplex semibaccata</i>	Berry Saltbush			Y	5/11/2014
<i>Atriplex</i> sp.	Saltbush			Y	27/11/2001
<i>Atriplex stipitata</i>	Bitter Saltbush			Y	5/11/2014
<i>Atriplex suberecta</i>	Lagoon Saltbush			Y	15/12/2012
<i>Atriplex velutinella</i>	Sandhill Saltbush			Y	27/10/1994
<i>Atriplex vesicaria</i>	Bladder Saltbush			Y	5/11/2014
<i>Atriplex vesicaria</i> ssp. (NC)	Bladder Saltbush			Y	8/05/2008
<i>Atriplex vesicaria</i> ssp. <i>calcicola</i> (NC)	Bladder Saltbush			Y	31/07/1991
<i>Austrodracopis</i> sp. (NC)				Y	8/05/2008

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Austrostipa acrocliliata</i>	Graceful Spear-grass			Y	5/11/2014
<i>Austrostipa blackii</i>	Crested Spear-grass			Y	4/10/2008
<i>Austrostipa breviglumis</i>	Cane Spear-grass		R	Y	5/10/2008
<i>Austrostipa curticoma</i>	Short-crest Spear-grass			Y	15/11/1996
<i>Austrostipa drummondii</i>	Cottony Spear-grass			Y	5/11/2014
<i>Austrostipa elegantissima</i>	Feather Spear-grass			Y	5/11/2014
<i>Austrostipa eremophila</i>	Rusty Spear-grass			Y	25/11/2013
<i>Austrostipa eremophila/uberula</i>				Y	25/11/2013
<i>Austrostipa exilis</i>	Heath Spear-grass			Y	28/10/2003
<i>Austrostipa flavescens</i>	Coast Spear-grass			Y	4/12/2010
<i>Austrostipa gibbosa</i>	Swollen Spear-grass		R	Y	1/11/2005
<i>Austrostipa hemipogon</i>	Half-beard Spear-grass			Y	31/10/2003
<i>Austrostipa mollis</i>	Soft Spear-grass			Y	5/10/2008
<i>Austrostipa nitida</i>	Balcarra Spear-grass			Y	4/12/2010
<i>Austrostipa nodosa</i>	Tall Spear-grass			Y	10/12/2013
<i>Austrostipa petraea</i>	Flinders Range Spear-grass		R	Y	3/12/1993
<i>Austrostipa pilata</i>	Prickly Spear-grass		V	Y	31/10/2003
<i>Austrostipa platychaeta</i>	Flat-awn Spear-grass			Y	4/12/2010
<i>Austrostipa uberula</i>	Fine-hairy Spear-grass			Y	10/12/2013
<i>Austrostipa scabra group</i>	Falcate-awn Spear-grass			Y	25/05/2000
<i>Austrostipa scabra ssp.</i>	Rough Spear-grass			Y	15/11/1996
<i>Austrostipa scabra ssp. falcata</i>	Slender Spear-grass			Y	4/10/2008
<i>Austrostipa scabra ssp. scabra</i>	Rough Spear-grass			Y	31/10/2003
<i>Austrostipa setacea</i>	Corkscrew Spear-grass			Y	5/10/2008
<i>Austrostipa sp.</i>	Spear-grass			Y	5/11/2014
<i>Austrostipa trichophylla</i>				Y	1/11/2005
<i>Avellinia michelii</i>	Avellinia			N	5/10/2008
<i>Avena barbata</i>	Bearded Oat			N	10/12/2013
<i>Avena fatua</i>	Wild Oat			N	4/10/2008
<i>Avena sativa</i>	Cultivated Oat			N	25/11/1993
<i>Avena sp.</i>	Oat			N	21/09/2012
<i>Avena sterilis ssp. ludoviciana</i>	Wild Oat			N	10/12/1988
<i>Banksia marginata</i>	Silver Banksia			Y	28/10/1994
<i>Baumea juncea</i>	Bare Twig-rush			Y	8/11/2003
<i>Bellardia latifolia</i>	Red Bartsia			N	23/10/1992
<i>Bellardia trixago</i>	Bellardia			N	8/11/2003
<i>Berula erecta</i>	Water Parsnip			N	29/07/2009
<i>Beyeria lechenaultii</i>	Pale Turpentine Bush			Y	5/11/2014
<i>Billardiera cymosa ssp. cymosa</i>	Sweet Apple-berry			Y	0/01/1900
<i>Blennospora drummondii</i>	Dwarf Button-flower			Y	19/09/1982
<i>Boerhavia dominii</i>	Tar-vine			Y	15/12/2012
<i>Boerhavia dominii (NC)</i>	Tar-vine			Y	9/11/2003
<i>Boerhavia sp.</i>	Tar-vine			Y	9/11/1997
<i>Bolboschoenus caldwellii</i>	Salt Club-rush			Y	29/07/2009
<i>Bolboschoenus medianus</i>	Marsh Club-rush			Y	1/04/2001
<i>Bothriochloa macra</i>	Red-leg Grass		R	Y	4/04/2000
<i>Brachyachne ciliaris</i>	Hairy Native Couch			Y	2/12/2003
<i>Brachypodium distachyon</i>	False Brome			N	5/10/2008
<i>Brachyscome ciliaris var. ciliaris</i>	Variable Daisy			Y	5/11/2014
<i>Brachyscome ciliaris var. lanuginosa</i>	Woolly Variable Daisy			Y	8/11/1997
<i>Brachyscome goniocarpa</i>	Dwarf Daisy			Y	19/08/1979
<i>Brachyscome lineariloba</i>	Hard-head Daisy			Y	5/11/2014

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Brachyscome lineariloba/perpusilla</i>				Y	21/10/1992
<i>Brachyscome perpusilla</i>	Tiny Daisy			Y	5/10/2008
<i>Brassica sp.</i>				N	11/01/2004
<i>Briza maxima</i>	Large Quaking-grass			N	5/10/2008
<i>Briza minor</i>	Lesser Quaking-grass			N	5/10/2008
<i>Bromus alopecuroides</i>	Mediterranean Brome			N	25/11/1993
<i>Bromus arenarius</i>	Sand Brome			Y	7/10/1993
<i>Bromus diandrus</i>	Great Brome			N	10/12/2013
<i>Bromus diandrus (NC)</i>	Great Brome			N	21/04/2008
<i>Bromus hordeaceus ssp. hordeaceus</i>	Soft Brome			N	21/09/2012
<i>Bromus madritensis</i>	Compact Brome			N	23/10/1992
<i>Bromus rubens</i>	Red Brome			N	25/11/2013
<i>Bromus sp.</i>	Brome			Y	8/05/2008
<i>Buglossoides arvensis</i>	Sheepweed			N	4/10/2008
<i>Bulbine bulbosa</i>	Bulbine-lily			Y	10/12/2013
<i>Bupleurum semicompositum</i>	Hare's Ear			N	11/11/2003
<i>Bursaria spinosa ssp.</i>	Bursaria			Y	5/10/2008
<i>Bursaria spinosa ssp. spinosa</i>	Sweet Bursaria			Y	25/11/2013
<i>Caesia calliantha</i>	Blue Grass-lily			Y	24/09/1991
<i>Caladenia tensa</i>	Inland Green-comb Spider-orchid	EN		Y	23/09/2007
<i>Caladenia tentaculata</i>	King Spider-orchid			Y	11/11/2003
<i>Caladenia toxochila</i>	Bow-lip Spider-orchid			Y	0/01/1900
<i>Calandrinia calyptata</i>	Pink Purslane			Y	31/10/2003
<i>Calandrinia eremaea</i>	Dryland Purslane			Y	4/10/2008
<i>Calandrinia granulifera</i>	Pigmy Purslane			Y	1/06/1999
<i>Calandrinia sp.</i>	Purslane/Parakeelya			Y	31/07/1991
<i>Calandrinia volubilis</i>	Twining Purslane			Y	29/11/1998
<i>Callistemon teretifolius</i>	Needle Bottlebrush			Y	1/03/1997
<i>Callitriche stagnalis</i>	Common Water Starwort			N	5/10/1993
<i>Callitris glaucophylla</i>	White Cypress-pine			Y	18/08/1985
<i>Callitris gracilis</i>	Southern Cypress Pine			Y	5/11/2014
<i>Callitris sp.</i>	Native Pine			Y	16/11/2001
<i>Calocephalus citreus</i>	Lemon Beauty-heads			Y	21/09/2012
<i>Calostemma purpureum</i>	Pink Garland-lily			Y	21/09/2012
<i>Calotis hispidula</i>	Hairy Burr-daisy			Y	16/09/2010
<i>Calotis sp.</i>	Burr-daisy			Y	25/11/2013
<i>Calytrix tetragona</i>	Common Fringe-myrtle			Y	2/12/2003
<i>Carduus tenuiflorus</i>	Slender Thistle			N	25/11/2013
<i>Carex breviculmis</i>	Short-stem Sedge			Y	1/06/1999
<i>Carex divisa</i>	Divided Sedge			N	9/11/2003
<i>Carex gaudichaudiana</i>	Fen Sedge			Y	23/10/1992
<i>Carex inversa var. inversa</i>	Knob Sedge			Y	1/11/2005
<i>Carex inversa var. major</i>	Knob Sedge			Y	7/12/1992
<i>Carex tereticaulis</i>	Rush Sedge			Y	2/04/1994
<i>Carissa spinarum</i>	Conker Berry			Y	2/12/2003
<i>Carpobrotus rossii</i>	Native Pigface			Y	12/09/1934
<i>Carpobrotus rossii (NC)</i>	Native Pigface			Y	1/04/2001
<i>Carpobrotus sp. Short calyx (S.T.Blake 20451)</i>	Native Pigface			Y	0/01/1900
<i>Carrichtera annua</i>	Ward's Weed			N	5/11/2014
<i>Carthamus lanatus</i>	Saffron Thistle			N	10/12/2013
<i>Cassinia arcuata</i>	Drooping Cassinia			Y	1/08/1991
<i>Cassinia arcuata (NC)</i>	Drooping Cassinia			Y	1/08/1991

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Cassinia complanata</i>	Sticky Cassinia			Y	5/10/2008
<i>Cassinia laevis ssp. laevis</i>	Curry Bush			Y	8/11/2003
<i>Cassinia sp.</i>	Cassinia			Y	30/07/2009
<i>Cassinia uncata (NC)</i>	Sticky Cassinia			Y	1/06/1999
<i>Cassytha glabella f. dispar</i>	Slender Dodder-laurel			Y	2/12/2003
<i>Cassytha melantha</i>	Coarse Dodder-laurel			Y	5/11/2014
<i>Cassytha sp.</i>	Dodder-laurel			Y	11/03/1980
<i>Casuarina pauper</i>	Black Oak			Y	1/04/2001
<i>Casuarinaceae sp.</i>	Sheaok Family			Y	21/04/2008
<i>Catapodium rigidum</i>	Rigid Fescue			N	10/11/2003
<i>Cenchrus clandestinus</i>	Kikuyu			N	11/01/2004
<i>Cenchrus longispinus</i>	Spiny Burr-grass			N	1/01/2010
<i>Cenchrus spinifex</i>	Spiny Burr-grass			N	1/01/2010
<i>Centaurea calcitrapa</i>	Star Thistle			N	8/05/2008
<i>Centaurea melitensis</i>	Malta Thistle			N	4/10/2008
<i>Centaurea solstitialis</i>	St Barnaby's Thistle			N	20/01/1994
<i>Centaurea sp.</i>	Centaury			N	25/11/2013
<i>Centaurium sp.</i>	Centaury			N	8/12/1998
<i>Centaurium tenuiflorum</i>	Branched Centaury			N	11/11/2003
<i>Centipeda cunninghamii</i>	Common Sneezeweed			Y	7/05/1995
<i>Centranthus macrosiphon</i>				N	7/10/1993
<i>Centrolepis aristata</i>	Pointed Centrolepis			Y	5/10/2008
<i>Centrolepis cephaloformis ssp. cephaloformis</i>	Cushion Centrolepis		R	Y	21/10/1992
<i>Centrolepis polygyna</i>	Wiry Centrolepis			Y	31/10/2003
<i>Centrolepis strigosa ssp. strigosa</i>	Hairy Centrolepis			Y	5/10/2008
<i>Cerastium glomeratum</i>	Common Mouse-ear Chickweed			N	23/09/2014
<i>Cestrum parqui</i>	Green Poison-berry			N	16/05/1974
<i>Chamaescilla corymbosa var. corymbosa</i>	Blue Squill			Y	5/10/2008
<i>Chamaesyce drummondii (NC)</i>	Caustic Weed			Y	9/11/2003
<i>Chara sp.</i>				Y	29/07/2009
<i>Cheilanthes austrotenuifolia</i>	Annual Rock-fern			Y	5/10/2008
<i>Cheilanthes distans</i>	Bristly Cloak-fern			Y	20/11/1993
<i>Cheilanthes lasiophylla</i>	Woolly Cloak-fern			Y	8/11/2003
<i>Cheilanthes sieberi ssp. sieberi</i>	Narrow Rock-fern			Y	4/10/2008
<i>Chenopodium curvispicatum</i>	Cottony Goosefoot			Y	5/11/2014
<i>Chenopodium desertorum ssp.</i>	Desert Goosefoot			Y	8/12/1998
<i>Chenopodium desertorum ssp. desertorum</i>	Frosted Goosefoot			Y	5/11/2014
<i>Chenopodium desertorum ssp. microphyllum</i>	Small-leaf Goosefoot			Y	30/07/2009
<i>Chenopodium glaucum</i>	Glaucous Goosefoot			?	1/11/2003
<i>Chenopodium sp.</i>	Goosefoot			Y	11/03/1980
<i>Chloris sp.</i>	Windmill Grass/Chloris			Y	8/05/2008
<i>Chloris truncata</i>	Windmill Grass			Y	25/05/2000
<i>Chondrilla juncea</i>	Skeleton Weed			N	1/04/2001
<i>Chrysocephalum apiculatum</i>	Common Everlasting			Y	5/11/2014
<i>Chrysocephalum apiculatum (NC)</i>	Common Everlasting			Y	5/10/2008
<i>Chrysocephalum baxteri</i>	White Everlasting			Y	5/10/2008
<i>Chrysocephalum semipapposum</i>	Clustered Everlasting			Y	26/11/2017
<i>Chrysocephalum sp.</i>	Everlasting			Y	27/10/1994
<i>Cicendia quadrangularis</i>	Square Cicendia			N	20/09/1998

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Cichorium intybus</i>	Chicory			N	15/12/2012
<i>Cirsium sp.</i>	Thistle			N	21/09/2012
<i>Cirsium vulgare</i>	Spear Thistle			N	29/07/2009
<i>Clematis decipiens</i>	Old Man's Beard			Y	21/08/1971
<i>Clematis microphylla</i>	Old Man's Beard			Y	4/10/2008
<i>Clematis microphylla</i> var. <i>microphylla</i> (NC)	Old Man's Beard			Y	30/07/2009
<i>Codonocarpus pyramidalis</i>	Slender Bell-fruit	VU	E	Y	25/11/2013
<i>Comesperma sp.</i>	Milkwort			Y	5/10/2008
<i>Comesperma volubile</i>	Love Creeper			Y	11/11/2003
<i>Compositae sp.</i>	Daisy Family			Y	25/11/2013
<i>Conium maculatum</i>	Hemlock			N	29/07/2009
<i>Convolvulus angustissimus</i>	Narrow-leaf Bindweed			Y	1/11/2005
<i>Convolvulus angustissimus</i> ssp.	Narrow-leaf Bindweed			Y	5/11/2014
<i>Convolvulus angustissimus</i> ssp. <i>angustissimus</i> (NC)	Narrow-leaf Bindweed			Y	29/10/2003
<i>Convolvulus angustissimus</i> ssp. <i>peninsularum</i> (NC)	Narrow-leaf Bindweed			Y	1/06/1999
<i>Convolvulus arvensis</i>	Field Bindweed			N	10/12/1988
<i>Convolvulus clementii</i> (NC)				Y	25/05/2000
<i>Convolvulus erubescens</i> (NC)	Australian Bindweed			Y	11/11/2003
<i>Convolvulus microsepalus</i>	Small-flower Bindweed			Y	5/06/1993
<i>Convolvulus recurvatus</i> ssp. <i>nullarborensis</i>				Y	14/02/1993
<i>Convolvulus recurvatus</i> ssp. <i>recurvatus</i>	Australian Bindweed			Y	1/11/2001
<i>Convolvulus remotus</i>	Grassy Bindweed			Y	10/12/2013
<i>Convolvulus sp.</i>	Bindweed			Y	21/09/2012
<i>Correa glabra</i> (NC)	Rock Correa			Y	1/06/1999
<i>Correa glabra</i> var. <i>turnbullii</i>	Smooth Correa			Y	4/10/2008
<i>Correa sp.</i>	Correa			Y	11/03/1980
<i>Corybas incurvus</i>	Slaty Helmet-orchid			Y	31/08/1995
<i>Cotoneaster pannosus</i>	Cotoneaster			N	7/07/1988
<i>Cotula australis</i>	Common Cotula			Y	1/06/1999
<i>Cotula bipinnata</i>	Ferny Cotula			N	14/09/1993
<i>Cotula coronopifolia</i>	Water Buttons			N	29/07/2009
<i>Craspedia glauca</i> (NC)	Billy-buttons			Y	10/11/2003
<i>Craspedia variabilis</i>	Billy-buttons			Y	5/10/2008
<i>Crassula colligata</i> ssp. <i>colligata</i>				Y	5/10/2008
<i>Crassula colligata</i> ssp. <i>lamprosperma</i>				Y	17/09/2010
<i>Crassula colorata</i> var.	Dense Crassula			Y	5/11/2014
<i>Crassula colorata</i> var. <i>acuminata</i>	Dense Crassula			Y	5/10/2008
<i>Crassula colorata</i> var. <i>colorata</i>	Dense Crassula			Y	1/06/1999
<i>Crassula colorata/sieberiana</i> complex	Crassula			Y	31/07/1991
<i>Crassula decumbens</i> var. <i>decumbens</i>	Spreading Crassula			Y	1/06/1999
<i>Crassula natans</i> var. <i>minus</i>	Water Crassula			N	19/09/1982
<i>Crassula sieberiana</i> ssp. <i>tetramera</i> (NC)	Australian Stonecrop			Y	9/11/2003
<i>Crassula sp.</i>	Crassula/Stonecrop			Y	5/11/2014
<i>Cratystylis conocephala</i>	Bluebush Daisy			Y	16/03/2008
<i>Crepis foetida</i> ssp. <i>foetida</i>	Stinking Hawksbeard			N	10/11/2003
<i>Critesion murinum</i> ssp. (NC)	Barley-grass			N	23/10/1992
<i>Cryptandra amara</i> var. (NC)	Cryptandra			Y	1/08/1991

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Cryptandra amara</i> var. <i>amara</i> (NC)	Spiny Cryptandra			Y	27/10/1994
<i>Cryptandra campanulata</i>	Long-flower Cryptandra		R	Y	5/10/2008
<i>Cryptandra</i> sp. <i>Floriferous</i> (W.R.Barker 4131)	Pretty Cryptandra			Y	27/10/1994
<i>Cullen australasicum</i>	Tall Scurf-pea			Y	11/01/2004
<i>Cullen discolor</i>	Prostrate Scurf-pea			Y	8/12/1983
<i>Cullen parvum</i>	Small Scurf-pea		V	Y	24/11/2010
<i>Cupressus macrocarpa</i>	Monterey Cypress			N	1/03/1987
<i>Cymbonotus preissianus</i>	Austral Bear's-ear			Y	1/06/1999
<i>Cymbopogon ambiguus</i>	Lemon-grass			Y	30/07/2009
<i>Cymbopogon oblectus</i>	Silky-head Lemon-grass			Y	25/05/2000
<i>Cynara cardunculus</i> ssp. <i>flavescens</i>	Artichoke Thistle			N	1/01/2011
<i>Cynodon dactylon</i> (NC)	Couch			N	11/01/2004
<i>Cynodon dactylon</i> var. <i>dactylon</i>	Couch			N	8/05/2008
<i>Cynoglossum suaveolens</i>	Sweet Hound's-tongue			Y	10/12/2013
<i>Cynosurus echinatus</i>	Rough Dog's-tail Grass			N	1/04/2001
<i>Cyperus gymnocaulos</i>	Spiny Flat-sedge			Y	5/11/2014
<i>Cyperus</i> sp.	Flat-sedge			Y	27/11/2001
<i>Cyperus vaginatus</i>	Stiff Flat-sedge			Y	30/07/2009
<i>Cytisus scoparius</i>	English Broom			N	2/12/2003
<i>Dactylis glomerata</i>	Cocksfoot			N	26/10/1991
<i>Dactyloctenium radicans</i>	Button-grass			Y	0/01/1900
<i>Danthonia</i> sp. (NC)	Wallaby-grass			Y	19/12/2001
<i>Datura stramonium</i>	Common Thorn-apple			N	21/01/1934
<i>Datura wrightii</i>	Hairy Thorn-apple			N	27/02/1993
<i>Daucus glochidiatus</i>	Native Carrot			Y	16/09/2010
<i>Daviesia benthamii</i> ssp. <i>humilis</i> (NC)	Mallee Bitter-pea		R	Y	9/11/2003
<i>Daviesia brevifolia</i>	Leafless Bitter-pea			Y	27/11/2001
<i>Daviesia leptophylla</i>	Narrow-leaf Bitter-pea			Y	5/10/2008
<i>Daviesia schwarzenecker</i>	Mallee Bitter-pea		R*	Y	24/12/2005
<i>Dianella brevicaulis/revoluta</i> var.	Black-anther Flax-lily			Y	28/10/1994
<i>Dianella longifolia</i> var. <i>grandis</i>	Pale Flax-lily		R	Y	10/12/1988
<i>Dianella revoluta</i> (NC)				Y	11/03/1980
<i>Dianella revoluta</i> var.				Y	8/11/1997
<i>Dianella revoluta</i> var. <i>revoluta</i>	Black-anther Flax-lily			Y	5/10/2008
<i>Dianella</i> sp.	Flax-lily			Y	21/09/2012
<i>Dichanthium sericeum</i> ssp. <i>sericeum</i>	Silky Blue-grass			Y	17/02/1999
<i>Dillwynia hispida</i>	Red Parrot-pea			Y	8/12/1998
<i>Dimorphotheca fruticosa</i>	Trailing African Daisy			N	23/09/2014
<i>Diplotaxis tenuifolia</i>	Lincoln Weed			N	1/01/2010
<i>Disphyma crassifolium</i> ssp. <i>clavellatum</i>	Round-leaf Pigface			Y	27/10/1994
<i>Dissocarpus paradoxus</i>	Ball Bindyi			Y	5/11/2014
<i>Distichlis distichophylla</i>	Emu-grass			Y	5/11/2014
<i>Dittrichia graveolens</i>	Stinkweed			N	15/06/2005
<i>Diuris behrii</i>	Behr's Cowslip Orchid		V	Y	1/06/1999
<i>Dodonaea baueri</i>	Crinkled Hop-bush			Y	10/12/2013
<i>Dodonaea bursariifolia</i>	Small Hop-bush			Y	25/02/1992
<i>Dodonaea hexandra</i>	Horned Hop-bush			Y	11/11/2003
<i>Dodonaea lobulata</i>	Lobed-leaf Hop-bush			Y	5/11/2014
<i>Dodonaea procumbens</i>	Trailing Hop-bush	VU	V	Y	26/11/2004

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Dodonaea procumbens</i> X <i>Dodonaea viscosa</i> ssp. <i>spatulata</i>				Y	24/03/1994
<i>Dodonaea stenozyga</i>	Desert Hop-bush			Y	29/07/1991
<i>Dodonaea subglandulifera</i>		EN	E	Y	28/11/2007
<i>Dodonaea viscosa</i> ssp.	Sticky Hop-bush			Y	10/11/1993
<i>Dodonaea viscosa</i> ssp. <i>angustissima</i>	Narrow-leaf Hop-bush			Y	9/11/2003
<i>Dodonaea viscosa</i> ssp. <i>cuneata</i>	Wedge-leaf Hop-bush			Y	10/11/2003
<i>Dodonaea viscosa</i> ssp. <i>spatulata</i>	Sticky Hop-bush			Y	4/10/2009
<i>Drosera auriculata</i>	Tall Sundew			Y	23/09/2007
<i>Drosera glanduligera</i>	Scarlet Sundew			Y	1/06/1999
<i>Drosera macrantha</i> ssp. <i>planchonii</i>	Climbing Sundew			Y	5/10/2008
<i>Drosera peltata</i> (NC)	Pale Sundew			Y	1/06/1999
<i>Drosera whittakeri</i>	Scented Sundew			Y	21/09/2012
<i>Drosera whittakeri</i> (NC)	Scented Sundew			Y	24/09/1991
<i>Duma florulenta</i>	Lignum			Y	30/10/2003
<i>Dysphania pumilio</i>	Small Crumbweed			Y	0/01/1900
<i>Echinopogon ovatus</i>	Rough-beard Grass		R	Y	4/10/2008
<i>Echium plantagineum</i>	Salvation Jane			N	10/12/2013
<i>Einadia nutans</i> ssp.	Climbing Saltbush			Y	8/11/2003
<i>Einadia nutans</i> ssp. <i>nutans</i>	Climbing Saltbush			Y	5/11/2014
<i>Elachanthus pusillus</i>	Elachanth			Y	16/09/2010
<i>Eleocharis pallens</i>	Pale Spike-rush			Y	28/12/1992
<i>Eleusine indica</i>	Crowsfoot Grass			N	1/12/1988
<i>Elymus scaber</i> var. <i>scaber</i> (NC)	Native Wheat-grass			Y	2/12/2003
<i>Enchylaena tomentosa</i> var.	Ruby Saltbush			Y	30/07/2009
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush			Y	5/11/2014
<i>Enneapogon nigricans</i>	Black-head Grass			Y	10/12/2013
<i>Enneapogon</i> sp.	Bottle-washers/Nineawn			Y	8/05/2008
<i>Epilobium billardierianum</i> ssp. <i>billardierianum</i>	Robust Willow-herb			Y	8/11/2003
<i>Epilobium hirtigerum</i>	Hairy Willow-herb			Y	0/01/1900
<i>Eragrostis australasica</i>	Cane-grass			Y	12/12/1953
<i>Eragrostis brownii</i>	Bentham's Love-grass			Y	0/01/1900
<i>Eragrostis cilianensis</i>	Stink Grass			N	21/04/2008
<i>Eragrostis curvula</i>	African Love-grass			N	21/04/2008
<i>Eragrostis infecunda</i>	Barren Cane-grass		R	Y	10/12/1988
<i>Eragrostis parviflora</i>	Weeping Love-grass			Y	30/12/1984
<i>Eragrostis pilosa</i>	Indian Love-grass			N	16/02/2005
<i>Eremophila alternifolia</i>	Narrow-leaf Emubush			Y	5/11/2014
<i>Eremophila deserti</i>	Turkey-bush			Y	1/01/1986
<i>Eremophila glabra</i> ssp. <i>glabra</i>	Tar Bush			Y	1/09/1931
<i>Eremophila longifolia</i>	Weeping Emubush			Y	15/06/2005
<i>Eremophila oppositifolia</i> ssp. <i>oppositifolia</i>	Opposite-leaved Emubush			Y	5/11/2014
<i>Eremophila scoparia</i>	Broom Emubush			Y	5/11/2014
<i>Eremophila sturtii</i>	Turpentine Bush			Y	8/12/1983
<i>Eriochilus cucullatus</i> (NC)	Parson's Bands			Y	24/09/1991
<i>Eriochiton sclerolaenoides</i>	Woolly-fruit Bluebush			Y	5/11/2014
<i>Erodiochiton elderi</i>	Koonamore Daisy			Y	7/12/1983
<i>Erodium botrys</i>	Long Heron's-bill			N	4/10/2008
<i>Erodium brachycarpum</i>	Short-fruit Heron's-bill			N	13/09/1992
<i>Erodium cicutarium</i>	Cut-leaf Heron's-bill			N	16/09/2010

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Erodium crinitum</i>	Blue Heron's-bill			Y	16/09/2010
<i>Erodium moschatum</i>	Musky Herons-bill			N	23/09/2014
<i>Erodium sp.</i>	Heron's-bill/Crowfoot			Y	21/09/2012
<i>Eryngium ovinum</i>	Blue Devil		V	Y	2/12/2013
<i>Eryngium rostratum/vesiculosum</i>	Blue Devil			Y	21/09/2012
<i>Eucalyptus brachycalyx</i>	Gilja			Y	15/06/2005
<i>Eucalyptus cajuputea</i>	Green Mallee		R*	Y	12/11/2003
<i>Eucalyptus camaldulensis ssp.</i>	River Red Gum			Y	21/04/2008
<i>Eucalyptus camaldulensis ssp. camaldulensis</i>	River Red Gum			Y	5/11/2014
<i>Eucalyptus camaldulensis var. camaldulensis (NC)</i>	River Red Gum			Y	1/04/2001
<i>Eucalyptus cladocalyx (NC)</i>	Sugar Gum			Y	8/05/2008
<i>Eucalyptus dumosa</i>	White Mallee			Y	2/12/2003
<i>Eucalyptus gracilis</i>	Yorrell			Y	5/11/2014
<i>Eucalyptus leptophylla (NC)</i>	Narrow-leaf Red Mallee			Y	25/02/1992
<i>Eucalyptus leucoxylon (NC)</i>	South Australian Blue Gum			Y	12/03/1980
<i>Eucalyptus leucoxylon ssp.</i>	South Australian Blue Gum			Y	8/05/2008
<i>Eucalyptus leucoxylon ssp. leucoxylon</i>	South Australian Blue Gum			Y	25/05/2000
<i>Eucalyptus leucoxylon ssp. pruinosa</i>	Inland South Australian Blue Gum			Y	10/12/2013
<i>Eucalyptus microcarpa</i>	Grey Box			Y	17/02/1999
<i>Eucalyptus odorata</i>	Peppermint Box			Y	25/11/2013
<i>Eucalyptus odorata (NC)</i>	Peppermint Box			Y	5/10/2008
<i>Eucalyptus oleosa (NC)</i>	Red Mallee			Y	11/01/2004
<i>Eucalyptus oleosa ssp.</i>				Y	5/11/2014
<i>Eucalyptus oleosa ssp. oleosa</i>	Red Mallee			Y	24/10/1994
<i>Eucalyptus phenax ssp. phenax</i>	White Mallee			Y	18/03/1995
<i>Eucalyptus porosa</i>	Mallee Box			Y	5/11/2014
<i>Eucalyptus socialis (NC)</i>	Beaked Red Mallee			Y	10/11/2003
<i>Eucalyptus socialis ssp.</i>	Beaked Red Mallee			Y	8/05/2008
<i>Eucalyptus socialis ssp. socialis</i>	Beaked Red Mallee			Y	5/11/2014
<i>Eucalyptus socialis ssp. viridans</i>	Beaked Red Mallee			Y	20/10/1981
<i>Eucalyptus sp.</i>				Y	8/05/2008
<i>Euchiton sphaericus</i>	Annual Cudweed			Y	29/10/2003
<i>Euphorbia australis var. erythrantha</i>				Y	27/02/1993
<i>Euphorbia dallachyana</i>	Caustic Weed			Y	15/12/2012
<i>Euphorbia drummondii (NC)</i>				Y	5/11/2014
<i>Euphorbia helioscopia</i>	Sun Spurge			N	26/04/1993
<i>Euphorbia multifaria</i>				Y	20/10/1981
<i>Euphorbia tannensis ssp. eremophila</i>	Desert Spurge			Y	27/02/1993
<i>Euphorbia terracina</i>	False Caper			N	23/09/2014
<i>Euphorbia verrucitesta</i>				Y	29/10/2003
<i>Eutaxia diffusa</i>	Large-leaf Eutaxia			Y	3/10/2012
<i>Eutaxia microphylla</i>	Common Eutaxia			Y	5/11/2014
<i>Exocarpos aphyllus</i>	Leafless Cherry			Y	5/11/2014
<i>Exocarpos cupressiformis</i>	Native Cherry			Y	4/10/2009
<i>Festuca arundinacea</i>	Tall Meadow Fescue			N	15/12/2012
<i>Filago pyramidata</i>	Filago			N	9/11/2003
<i>Foeniculum vulgare</i>	Fennel			N	19/12/2001
<i>Frankenia sp.</i>	Sea-heath			Y	5/11/2014

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Fraxinus angustifolia</i> ssp. <i>angustifolia</i>	Desert Ash			N	15/03/1987
<i>Freesia cultivar</i>	Freesia			N	8/11/1997
<i>Fumaria bastardi</i>	Bastard Fumitory			N	8/11/2003
<i>Fumaria capreolata</i>	White-flower Fumitory			N	23/09/2014
<i>Fumaria officinalis</i> ssp. <i>officinalis</i>	Common Fumitory			N	20/10/1981
<i>Fumaria parviflora</i> var. <i>parviflora</i>	Small-flower Fumitory			N	15/12/2012
<i>Gahnia lanigera</i>	Black Grass Saw-sedge			Y	2/12/2003
<i>Gahnia trifida</i>	Cutting Grass			Y	1/10/2005
<i>Galenia</i> sp.	Galenia			N	9/11/1997
<i>Galium divaricatum</i>	Slender Bedstraw			N	19/10/1981
<i>Galium gaudichaudii</i> (NC)	Rough Bedstraw			Y	4/10/2008
<i>Galium gaudichaudii</i> ssp. <i>gaudichaudii</i>	Rough Bedstraw			Y	29/10/1967
<i>Galium leptogonium</i>	Reflexed Bedstraw			Y	21/08/1971
<i>Galium migrans</i> (NC)	Loose Bedstraw			Y	2/12/2003
<i>Galium migrans</i> ssp. <i>migrans</i>	Loose Bedstraw			Y	23/09/2004
<i>Galium murale</i>	Small Bedstraw			N	5/10/2008
<i>Galium spurium</i>	Bedstraw			N	26/09/1993
<i>Geijera linearifolia</i>	Sheep Bush			Y	5/11/2014
<i>Genista monspessulana</i>	Montpellier Broom			N	27/11/2001
<i>Geococcus pusillus</i>	Earth Cress			Y	30/07/2000
<i>Geranium dissectum</i>	Cut-leaf Geranium			N	10/11/1993
<i>Geranium retrorsum</i>	Grassland Geranium			Y	4/10/2008
<i>Geranium</i> sp.	Geranium			Y	21/09/2012
<i>Glaucium corniculatum</i>	Bristly Horned-poppy			N	29/10/2003
<i>Glischrocaryon flavescens</i>	Yellow Pennants			Y	28/11/2007
<i>Glycine clandestina</i> var. (NC)	Twining Glycine			Y	9/11/2003
<i>Glycine rubiginosa</i>	Twining Glycine			Y	2/12/2003
<i>Gnaphalium indutum</i> ssp. <i>indutum</i>	Tiny Cudweed			Y	30/10/2003
<i>Gnaphalium</i> sp.	Cudweed			Y	13/11/1996
<i>Gnephosis tenuissima</i>	Dwarf Golden-tip			Y	8/12/1983
<i>Gomphocarpus cancellatus</i>	Broad-leaf Cotton-bush			N	27/11/2001
<i>Gonocarpus elatus</i>	Hill Raspwort			Y	4/10/2008
<i>Gonocarpus mezerianus</i>	Broad-leaf Raspwort			Y	5/10/2008
<i>Gonocarpus</i> sp.	Raspwort			Y	27/11/2001
<i>Gonocarpus tetragynus</i>	Small-leaf Raspwort			Y	5/10/2008
<i>Goodenia albiflora</i>	White Goodenia			Y	11/11/2003
<i>Goodenia blackiana</i>	Native Primrose			Y	5/10/2008
<i>Goodenia fascicularis</i> (NC)	Silky Goodenia			Y	16/09/2010
<i>Goodenia geniculata</i>	Bent Goodenia			Y	8/12/1998
<i>Goodenia glauca</i>	Pale Goodenia			Y	25/11/1993
<i>Goodenia heteromera</i>	Spreading Goodenia		R	Y	8/05/1995
<i>Goodenia pinnatifida</i>	Cut-leaf Goodenia			Y	21/09/2012
<i>Goodenia pusilliflora</i>	Small-flower Goodenia			Y	16/09/2010
<i>Goodenia</i> sp.	Goodenia			Y	10/12/2013
<i>Goodenia varia</i>	Sticky Goodenia			Y	11/11/2003
<i>Goodenia willisiana</i>	Silver Goodenia			Y	1/08/1991
<i>Gramineae</i> sp.	Grass Family			Y	30/07/2009
<i>Grevillea huegelii</i>	Comb Grevillea			Y	10/11/2003
<i>Grevillea ilicifolia</i> ssp. <i>ilicifolia</i>	Holly-leaf Grevillea			Y	3/10/2012
<i>Grevillea ilicifolia</i> var. <i>ilicifolia</i> (NC)	Holly-leaf Grevillea			Y	1/08/1991
<i>Grevillea lavandulacea</i> ssp. <i>lavandulacea</i>	Spider-flower			Y	1/08/1991

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Gypsophila paniculata</i>				N	19/03/2000
<i>Gypsophila tubulosa</i>	Annual Chalkwort			N	27/01/1969
<i>Haeckeria punctulata</i>	Sticky Haeckeria			Y	3/12/1993
<i>Hakea carinata</i>	Erect Hakea			Y	21/10/1992
<i>Hakea leucoptera</i> ssp. <i>leucoptera</i>	Silver Needlewood			Y	5/11/2014
<i>Hakea prostrata</i>				N	26/09/1993
<i>Hakea rostrata</i>	Beaked Hakea			Y	8/05/2008
<i>Hakea rugosa</i>	Dwarf Hakea			Y	1/10/2003
<i>Halgania cyanea</i>	Rough Blue-flower			Y	1/11/2005
<i>Haloragis aspera</i>	Rough Raspwort			Y	9/11/1997
<i>Halosarcia</i> sp. (NC)	Samphire			Y	16/11/2001
<i>Hardenbergia violacea</i>	Native Lilac			Y	1/06/1999
<i>Helichrysum leucopsidium</i>	Satin Everlasting			Y	25/11/2013
<i>Helichrysum</i> sp.	Everlasting			Y	1/08/1991
<i>Heliotropium asperrimum</i>	Rough Heliotrope			Y	0/01/1900
<i>Heliotropium curassavicum</i>	Smooth Heliotrope			N	0/01/1900
<i>Heliotropium europaeum</i>	Common Heliotrope			?	15/06/2005
<i>Helminthotheca echioides</i>	Ox-tongue			N	29/10/2003
<i>Herniaria cinerea</i>	Rupturewort			N	16/09/2010
<i>Hibbertia crinita</i>	Velvet-leaf Guinea-flower			Y	1/06/1999
<i>Hibbertia exutiacies</i>	Prickly Guinea-flower			Y	5/10/2008
<i>Hordeum glaucum</i>	Blue Barley-grass			N	17/09/2010
<i>Hordeum leporinum</i>	Wall Barley-grass			N	25/11/1993
<i>Hordeum marinum</i>	Sea Barley-grass			N	9/11/2003
<i>Hordeum</i> sp.	Barley-grass			N	25/11/2013
<i>Hordeum vulgare</i>	Barley			N	19/12/2001
<i>Hornungia procumbens</i>	Oval Purse			N	18/08/1977
<i>Hyalosperma demissum</i>	Dwarf Sunray			Y	5/10/2008
<i>Hyalosperma glutinosum</i> ssp. <i>glutinosum</i>	Golden Sunray			Y	1/06/1999
<i>Hyalosperma semisterile</i>	Orange Sunray			Y	12/11/2003
<i>Hybanthus floribundus</i> ssp. <i>floribundus</i>	Shrub Violet			Y	4/10/2009
<i>Hydrocotyle callicarpa</i>	Tiny Pennywort			Y	5/10/2008
<i>Hydrocotyle laxiflora</i>	Stinking Pennywort			Y	4/10/2008
<i>Hypericum perforatum</i>	St John's Wort			N	18/12/2001
<i>Hypochaeris glabra</i>	Smooth Cat's Ear			N	30/07/2009
<i>Hypochaeris radicata</i>	Rough Cat's Ear			N	10/12/2013
<i>Hypochaeris</i> sp.	Cat's Ear			N	21/09/2012
<i>Hypoxis</i> sp.	Yellow Star-lily			Y	21/09/2012
<i>Indigofera helmsii</i>	Helm's Indigo			Y	22/03/1987
<i>Ipomoea indica</i>	Purple Morning-glory			N	18/03/1998
<i>Iris germanica</i> (NC)	Flag Iris			N	8/11/1997
<i>Isachne globosa</i>	Swamp Millet			Y	11/07/1977
<i>Iseilema membranaceum</i>	Small Flinders-grass			Y	
<i>Isoetopsis graminifolia</i>	Grass Cushion			Y	16/09/2010
<i>Isolepis cernua</i>	Nodding Club-rush			Y	8/11/2003
<i>Isolepis hookeriana</i>	Grassy Club-rush			Y	7/12/1992
<i>Isolepis marginata</i>	Little Club-rush			N	31/10/2003
<i>Isolepis platycarpa</i>	Flat-fruit Club-rush			Y	26/12/1997
<i>Isolepis stellata</i>	Star Club-rush			Y	3/12/1993
<i>Juncus aridicola</i>	Inland Rush			Y	1/01/2005
<i>Juncus australis</i>	Austral Rush		R	Y	1/01/2004
<i>Juncus bufonius</i>	Toad Rush			Y	9/11/2003

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Juncus capitatus</i>	Dwarf Rush			N	10/10/2003
<i>Juncus flavidus</i>	Yellow Rush			Y	1/06/1999
<i>Juncus kraussii</i>	Sea Rush			Y	5/11/2014
<i>Juncus pallidus</i>	Pale Rush			Y	23/05/2000
<i>Juncus radula</i>	Hoary Rush		V	Y	28/12/1992
<i>Juncus sp.</i>	Rush			Y	27/11/2001
<i>Juncus subsecundus</i>	Finger Rush			Y	5/10/2008
<i>Kennedia prostrata</i>	Scarlet Runner			Y	1/06/1999
<i>Kickxia elatine ssp. crinita</i>	Twining Toadflax			N	23/04/1988
<i>Lachnagrostis aemula</i>	Blown-grass			Y	1/12/2003
<i>Lachnagrostis billardierei ssp. billardierei</i>	Coast Blown-grass			Y	1/11/2003
<i>Lachnagrostis filiformis</i>	Common Blown-grass			Y	1/12/2005
<i>Lachnagrostis limitanea</i>	Spalding Blown-grass	EN	E	Y	20/11/2005
<i>Lachnagrostis perennis</i>	Perennial Blown-grass			Y	10/12/1988
<i>Lachnagrostis robusta</i>	Tall Blown-grass		R	Y	16/01/2008
<i>Lactuca serriola</i> (NC)	Prickly Lettuce			N	11/01/2004
<i>Lactuca serriola f.</i>	Prickly Lettuce			N	29/07/2009
<i>Lactuca serriola f. serriola</i>	Prickly Lettuce			N	8/05/2008
<i>Lagenophora huegelii</i>	Coarse Bottle-daisy			Y	5/10/2008
<i>Lamarckia aurea</i>	Toothbrush Grass			N	8/11/2003
<i>Lamium amplexicaule var. amplexicaule</i>	Deadnettle			N	11/11/2003
<i>Lasiopetalum baueri</i>	Slender Velvet-bush			Y	1/10/2005
<i>Lasiopetalum behrii</i>	Pink Velvet-bush			Y	27/02/1993
<i>Lathyrus latifolius</i>	Perennial Pea			N	4/10/2008
<i>Lawrencia squamata</i>	Thorny Lawrencia			Y	3/12/1993
<i>Leiocarpa tomentosa</i>	Woolly Plover-daisy			Y	13/08/1977
<i>Leiocarpa websteri</i>	Narrow Plover-daisy			Y	
<i>Leontodon rhagadioloides</i>	Cretan Weed			N	5/10/2008
<i>Lepidium africanum</i>	Common Peppercress			N	21/04/2008
<i>Lepidium coronopus</i>	Flat Swine's Cress			N	5/10/2008
<i>Lepidium didymum</i>	Lesser Swine's-cress			N	6/10/1999
<i>Lepidium draba</i>	Hoary Cress			N	1/11/2003
<i>Lepidium draba</i> (NC)	Hoary Cress			N	9/11/1997
<i>Lepidium papillosum</i>	Warty Peppercress			Y	10/11/2003
<i>Lepidium pseudohyssopifolium</i>				Y	1/01/2005
<i>Lepidium sp.</i>	Peppercress			Y	5/11/2014
<i>Lepidosperma curtisiae</i>	Little Sword-sedge			Y	26/12/1997
<i>Lepidosperma laterale</i> (NC)	Sharp Sword-sedge			Y	24/09/1991
<i>Lepidosperma sp.</i>	Sword-sedge/Rapier-sedge			Y	19/12/2001
<i>Lepidosperma viscidum</i>	Sticky Sword-sedge			Y	5/10/2008
<i>Leptorhynchus elongatus</i>	Lanky Buttons		R	Y	12/11/2003
<i>Leptorhynchus orientalis</i>	Eastern Annual Buttons		R	Y	0/01/1900
<i>Leptorhynchus squamatus ssp. squamatus</i>	Scaly Buttons			Y	26/11/2017
<i>Leptorhynchus tetrachaetus</i>	Little Buttons			Y	11/11/2003
<i>Leptorhynchus waitzia</i>	Button Immortelle			Y	29/10/1994
<i>Leucopogon cordifolius</i>	Heart-leaf Beard-heath			Y	13/08/1977
<i>Levenhookia dubia</i>	Hairy Stylewort			Y	5/10/2008
<i>Lichen sp.</i>				Y	5/10/2008
<i>Limonium companyonis</i>	Sea-lavender			N	29/07/2009
<i>Limonium hyblaenum</i>				N	26/10/1994
<i>Limonium sinuatum</i>	Notch-leaf Sea-lavender			N	3/12/1993
<i>Limonium sp.</i>	Sea-lavender			N	16/11/2001

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Linum marginale</i>	Native Flax			Y	2/12/2003
<i>Linum usitatissimum</i>	Field Flax			N	28/12/1992
<i>Lissanthe strigosa ssp. subulata</i>	Peach Heath			Y	4/02/1969
<i>Lobelia anceps</i>	Angled Lobelia			Y	8/11/2003
<i>Lobelia concolor</i>	Poison Pratia		R	Y	25/11/1993
<i>Logania saxatilis</i>	Rock Logania		R	Y	10/10/2008
<i>Logfia gallica</i>	Narrow Cudweed			N	30/10/2003
<i>Lolium perenne</i>	Perennial Ryegrass			N	8/05/2008
<i>Lolium perenne X Lolium rigidum</i>	Hybrid Ryegrass			N	30/10/2003
<i>Lolium rigidum</i>	Wimmera Ryegrass			N	11/11/2003
<i>Lolium sp.</i>	Ryegrass			N	8/05/2008
<i>Lolium X hybridum</i>	Hybrid Ryegrass			N	17/11/1993
<i>Lomandra collina</i>	Sand Mat-rush			Y	2/12/2003
<i>Lomandra densiflora</i>	Soft Tussock Mat-rush			Y	10/12/2013
<i>Lomandra effusa</i>	Scented Mat-rush			Y	10/12/2013
<i>Lomandra micrantha ssp.</i>	Small-flower Mat-rush			Y	21/09/2012
<i>Lomandra micrantha ssp. micrantha</i>	Small-flower Mat-rush			Y	5/10/2008
<i>Lomandra multiflora ssp. dura</i>	Hard Mat-rush			Y	10/12/2013
<i>Lomandra nana</i>	Small Mat-rush			Y	26/12/1997
<i>Lomandra sp.</i>	Mat-rush			Y	8/05/2008
<i>Luzula meridionalis</i>	Common Wood-rush			Y	5/10/2008
<i>Lycium australe</i>	Australian Boxthorn			Y	5/11/2014
<i>Lycium ferocissimum</i>	African Boxthorn			N	20/09/2011
<i>Lysiana exocarpi ssp. exocarpi</i>	Harlequin Mistletoe			Y	5/11/2014
<i>Lysimachia arvensis</i>	Pimpernel			N	5/10/2008
<i>Lythrum hyssopifolia</i>	Lesser Loosestrife			Y	29/07/2009
<i>Maireana aphylla</i>	Cotton-bush			Y	8/05/2008
<i>Maireana brevifolia</i>	Short-leaf Bluebush			Y	5/11/2014
<i>Maireana enchylaenoides</i>	Wingless Fissure-plant			Y	5/11/2014
<i>Maireana erioclada</i>	Rosy Bluebush			Y	5/11/2014
<i>Maireana excavata</i>	Bottle Fissure-plant		V	Y	25/05/2000
<i>Maireana georgei</i>	Satiny Bluebush			Y	27/10/1994
<i>Maireana georgei/turbinata</i>	Satiny Bluebush			Y	5/11/2014
<i>Maireana lobiflora</i>	Lobed Bluebush			Y	16/09/2010
<i>Maireana pentatropis</i>	Erect Mallee Bluebush			Y	5/11/2014
<i>Maireana pyramidata</i>	Black Bluebush			Y	5/11/2014
<i>Maireana radiata</i>	Radiate Bluebush			Y	5/11/2014
<i>Maireana rohrlachii</i>	Rohrlach's Bluebush		R	Y	25/11/2013
<i>Maireana sedifolia</i>	Bluebush			Y	5/11/2014
<i>Maireana sp.</i>	Bluebush/Fissure-plant			Y	30/07/2009
<i>Maireana trichoptera</i>	Hairy-fruit Bluebush			Y	5/11/2014
<i>Maireana turbinata</i>	Top-fruit Bluebush			Y	22/09/2014
<i>Malva parviflora</i>	Small-flower Marshmallow			N	23/09/2014
<i>Marrubium vulgare</i>	Horehound			N	25/11/2013
<i>Marsdenia australis</i>	Native Pear			Y	1/01/2005
<i>Marsilea costulifera</i>	Narrow-leaf Nardoo			Y	10/12/1988
<i>Marsilea drummondii</i>	Common Nardoo			Y	28/12/1992
<i>Marsilea drummondii (NC)</i>	Common Nardoo			Y	25/11/1993
<i>Mauranthemum paludosum</i>	Ox-eye Daisy			N	26/09/1993
<i>Medicago littoralis (NC)</i>	Strand Medic			N	4/12/1992
<i>Medicago minima var. minima</i>	Little Medic			N	17/09/2010
<i>Medicago polymorpha</i>	Burr-medic			N	30/07/2009

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Medicago sativa</i>	Lucerne			N	21/04/2008
<i>Medicago sp.</i>	Medic			N	25/11/2013
<i>Medicago truncatula</i>	Barrel Medic			N	8/11/2003
<i>Melaleuca lanceolata</i>	Dryland Tea-tree			Y	5/11/2014
<i>Melaleuca lanceolata ssp. lanceolata (NC)</i>	Dryland Tea-tree			Y	9/11/2003
<i>Melaleuca sp.</i>	Tea-tree			Y	8/05/2008
<i>Melilotus indicus</i>	King Island Melilot			N	8/11/2003
<i>Menkea australis</i>	Fairy Spectacles			Y	24/10/1994
<i>Mentha satuireioides</i>	Native Pennyroyal		R	Y	1/06/1999
<i>Mesembryanthemum aitonis</i>	Angled Iceplant			N	17/09/2010
<i>Mesembryanthemum crystallinum</i>	Common Iceplant			N	27/10/1994
<i>Mesembryanthemum nodiflorum</i>	Slender Iceplant			N	17/09/2010
<i>Microseris lanceolata</i>	Yam Daisy			Y	5/10/2008
<i>Microtis arenaria</i>	Notched Onion-orchid			Y	5/10/2008
<i>Microtis frutetorum</i>				Y	1/11/2001
<i>Microtis unifolia complex</i>	Onion-orchid			Y	1/06/1999
<i>Millotia muelleri</i>	Common Bow-flower			Y	1/10/2005
<i>Millotia myosotidifolia</i>	Broad-leaf Millotia			Y	5/11/2014
<i>Millotia perpusilla</i>	Tiny Bow-flower			Y	1/06/1999
<i>Millotia tenuifolia var. tenuifolia</i>	Soft Millotia			Y	5/10/2008
<i>Minuartia mediterranea</i>	Slender Sandwort			N	11/11/2003
<i>Minuria leptophylla</i>	Minnie Daisy			Y	12/11/2003
<i>Moenchia erecta</i>	Erect Chickweed			N	30/10/2003
<i>Montia australasica</i>	White Purslane		R	Y	26/01/1993
<i>Moraea flaccida</i>	One-leaf Cape Tulip			N	21/09/2012
<i>Moraea setifolia</i>	Thread Iris			N	22/09/2014
<i>Moss sp.</i>				Y	5/10/2008
<i>Muehlenbeckia sp.</i>	Lignum			Y	8/05/2008
<i>Muscari armeniacum</i>	Grape Hyacinth			N	8/11/1997
<i>Myoporum montanum</i>	Native Myrtle			Y	5/11/2014
<i>Myoporum petiolatum</i>	Sticky Boobialla			Y	23/09/2007
<i>Myoporum platycarpum (NC)</i>	False Sandalwood			Y	11/03/1980
<i>Myoporum platycarpum ssp.</i>	False Sandalwood			Y	11/01/2004
<i>Myoporum platycarpum ssp. perbellum</i>	Mallee Sandalwood			Y	12/11/2003
<i>Myoporum platycarpum ssp. platycarpum</i>	False Sandalwood			Y	5/11/2014
<i>Myriophyllum verrucosum</i>	Red Milfoil			Y	10/12/1988
<i>Narcissus tazetta</i>	Polyanthus Narcissus			N	6/08/1988
<i>Neatostema apulum</i>	Hairy Sheepweed			N	25/11/2013
<i>Nepeta cataria</i>	Catmint			N	27/02/1993
<i>Neurachne alopecuroidea</i>	Fox-tail Mulga-grass			Y	31/10/2003
<i>Nicotiana glauca</i>	Tree Tobacco			N	29/07/2009
<i>Nicotiana maritima</i>	Coast Tobacco			Y	9/11/2003
<i>Nitraria billardiieri</i>	Nitre-bush			Y	8/05/2008
<i>Oenothera lindheimeri</i>	Clock Weed			N	29/02/1992
<i>Oenothera stricta ssp. stricta</i>	Common Evening Primrose			N	18/12/2001
<i>Olea europaea ssp.</i>	Olive			N	8/05/2008
<i>Olea europaea ssp. europaea</i>	Olive			N	10/11/1993
<i>Olearia brachyphylla</i>	Short-leaf Daisy-bush			Y	30/07/2009
<i>Olearia brachyphylla (NC)</i>	Short-leaf Daisy-bush			Y	31/07/1991
<i>Olearia decurrens</i>	Winged Daisy-bush			Y	5/11/2014
<i>Olearia floribunda</i>	Heath Daisy-bush			Y	11/03/1980

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Olearia minor</i>	Heath Daisy-bush			Y	29/10/2003
<i>Olearia muelleri</i>	Mueller's Daisy-bush			Y	5/11/2014
<i>Olearia pannosa ssp. pannosa</i>	Silver Daisy-bush	VU	V	Y	2/12/2003
<i>Olearia picridifolia</i>	Rasp Daisy-bush		R	Y	10/11/2003
<i>Olearia pimeleoides</i>	Pimelea Daisy-bush			Y	5/11/2014
<i>Olearia pimeleoides ssp. (NC)</i>	Pimelea Daisy-bush			Y	24/10/1994
<i>Olearia ramulosa</i>	Twiggy Daisy-bush			Y	2/12/2003
<i>Olearia teretifolia</i>	Cypress Daisy-bush			Y	13/09/1991
<i>Olearia tubuliflora</i>	Rayless Daisy-bush			Y	19/09/1982
<i>Omphalolappula concava</i>	Burr Stickseed			Y	24/08/1946
<i>Oncosiphon suffruticosum</i>	Calomba Daisy			N	1/01/1992
<i>Onopordum acanthium</i>	Scotch Thistle			N	1/04/2001
<i>Onopordum acaulon</i>	Horse Thistle			N	15/06/2005
<i>Opercularia turpis</i>	Twiggy Stinkweed			Y	1/06/1999
<i>Ophioglossum lusitanicum</i>	Austral Adder's-tongue			Y	1/06/1999
<i>Ornithogalum thyrsoides</i>	Chincherinchee			N	9/11/1997
<i>Osteocarpum salsuginosum</i>	Inland Bonefruit			Y	5/11/2014
<i>Oxalis perennans</i>	Native Sorrel			Y	25/11/2013
<i>Oxalis perennans (NC)</i>	Native Sorrel			Y	2/12/2003
<i>Oxalis pes-caprae</i>	Soursob			N	21/09/2012
<i>Ozothamnus retusus</i>	Notched Bush-everlasting			Y	12/11/2003
<i>Panicum capillare var. brevifolium</i>	Witch-grass			N	21/04/2008
<i>Panicum hillmanii</i>	Witch-grass			N	15/12/2012
<i>Panicum sp.</i>	Panic/Millet			Y	8/05/2008
<i>Papaver dubium</i>	Long-headed Poppy			N	1/11/1999
<i>Papaver hybridum</i>	Rough Poppy			N	7/10/1993
<i>Parapholis incurva</i>	Curly Ryegrass			N	11/11/2003
<i>Parietaria cardiostegia</i>	Mallee Smooth-nettle			Y	0/01/1900
<i>Parietaria debilis</i>	Smooth-nettle			Y	4/10/2008
<i>Parietaria debilis (NC)</i>	Smooth-nettle			Y	8/11/2003
<i>Paspalum sp.</i>				N	29/07/2009
<i>Pauridia glabella var. glabella</i>	Tiny Star			Y	16/09/2010
<i>Pentameris airoides ssp. airoides</i>	False Hair-grass			N	4/10/2008
<i>Persicaria prostrata</i>	Creeping Knotweed			Y	1/06/1999
<i>Petrorhagia dubia</i>	Velvet Pink			N	8/11/2003
<i>Petrorhagia sp.</i>	Pink			N	4/10/2008
<i>Phalaris aquatica</i>	Phalaris			N	8/05/2008
<i>Phalaris paradoxa</i>	Paradox Canary-grass			N	25/11/1993
<i>Phalaris sp.</i>	Canary Grass			N	29/07/2009
<i>Phebalium glandulosum ssp. macrocalyx</i>	Glandular Phebalium		E*	Y	31/10/2008
<i>Philothea angustifolia ssp. angustifolia</i>	Narrow-leaf Wax-flower		R	Y	22/10/1981
<i>Philothea verrucosa</i>	Bendigo Wax-flower		V	Y	21/10/1992
<i>Phragmites australis</i>	Common Reed			Y	5/11/2014
<i>Phyllangium divergens</i>	Wiry Mitrewort			Y	5/10/2008
<i>Phyllanthus saxosus</i>	Rock Spurge			Y	10/11/2003
<i>Picnomon acarna</i>	Soldier Thistle			N	11/11/2003
<i>Pimelea curviflora var.</i>	Curved Riceflower			Y	2/12/2003
<i>Pimelea curviflora var. gracilis</i>				Y	17/11/1993
<i>Pimelea curviflora var. sericea</i>	Curved Riceflower			Y	10/11/1993
<i>Pimelea glauca</i>	Smooth Riceflower			Y	4/10/2008
<i>Pimelea humilis</i>	Low Riceflower			Y	8/09/1973

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Pimelea micrantha</i>	Silky Riceflower			Y	12/11/2003
<i>Pimelea microcephala</i> ssp. <i>microcephala</i>	Shrubby Riceflower			Y	25/02/1992
<i>Pimelea serpyllifolia</i> ssp. <i>serpyllifolia</i>	Thyme Riceflower			Y	25/11/2013
<i>Pimelea simplex</i> ssp. <i>continua</i>	Desert Riceflower			Y	20/10/1981
<i>Pimelea stricta</i>	Erect Riceflower			Y	30/07/2009
<i>Pinus halepensis</i>	Aleppo Pine			N	21/04/2008
<i>Pinus radiata</i>	Radiata Pine			N	8/05/2008
<i>Pinus</i> sp.	Pine			N	18/12/2001
<i>Piptatherum miliaceum</i>	Rice Millet			N	8/05/2008
<i>Pisum sativum</i>				N	18/03/1995
<i>Pittosporum angustifolium</i>	Native Apricot			Y	5/11/2014
<i>Plagiobothrys pluriseptatus</i>	White Rochelia			Y	24/08/1946
<i>Plantago bellardii</i>	Hairy Plantain			N	24/09/1991
<i>Plantago coronopus</i> ssp. <i>commutata</i>	Bucks-horn Plantain			N	1/10/1999
<i>Plantago drummondii</i>	Dark Plantain			Y	16/09/2010
<i>Plantago gaudichaudii</i>	Narrow-leaf Plantain			Y	5/10/2008
<i>Plantago hispida</i>	Hairy Plantain			Y	4/10/2008
<i>Plantago lanceolata</i> var.	Ribwort			N	10/12/2013
<i>Plantago</i> sp.	Plantain			Y	21/09/2012
<i>Plantago</i> sp. B (R.Bates 44765)	Little Plantain			Y	4/10/2008
<i>Plantago varia</i>	Variable Plantain			Y	19/09/1996
<i>Plantago varia</i> complex	Native Plantain			Y	23/10/1992
<i>Pleurosorus rutifolius</i>	Blanket Fern			Y	4/10/2008
<i>Poa bulbosa</i>	Bulbous Meadow-grass			N	4/10/2008
<i>Poa crassicaudex</i>	Thick-stem Tussock-grass			Y	5/10/2008
<i>Poa labillardieri</i> var. <i>labillardieri</i>	Common Tussock-grass			Y	30/07/2009
<i>Poa poiformis</i> var. <i>poiformis</i>	Coast Tussock-grass			Y	9/11/1997
<i>Poa pratensis</i>	Kentucky Blue-grass			N	31/10/1988
<i>Poa</i> sp.	Meadow-grass/Tussock-grass			Y	21/09/2012
<i>Podolepis capillaris</i>	Wiry Podolepis			Y	3/03/1987
<i>Podolepis decipiens</i>			R*	Y	21/10/1981
<i>Podolepis jaceoides</i>	Showy Copper-wire Daisy		R	Y	19/10/1981
<i>Podolepis</i> sp.	Copper-wire Daisy			Y	25/11/2013
<i>Podolepis tepperi</i>	Delicate Copper-wire Daisy			Y	5/11/2014
<i>Podotheca angustifolia</i>	Sticky Long-heads			Y	4/10/2008
<i>Pogonolepis muelleriana</i>	Stiff Cup-flower			Y	5/11/2014
<i>Polycarpon tetraphyllum</i>	Four-leaf Allseed			N	20/01/1990
<i>Polygonum aviculare</i>	Wireweed			N	8/05/2008
<i>Polygonum aviculare</i> (NC)	Wireweed			N	18/12/2001
<i>Polypogon monspeliensis</i>	Annual Beard-grass			N	8/11/2003
<i>Polypogon viridis</i>	Water Bent			N	8/11/2003
<i>Pomaderris paniculosa</i> ssp.				Y	1/08/1991
<i>Pomaderris paniculosa</i> ssp. <i>paniculosa</i>	Mallee Pomaderris			Y	9/11/2003
<i>Populus alba</i>	White Poplar			N	
<i>Populus nigra</i>	Lombardy Poplar			N	22/10/1993
<i>Poranthera microphylla</i>	Small Poranthera			Y	2/11/1968
<i>Poranthera microphylla</i> (NC)	Small Poranthera			Y	10/11/2003
<i>Poranthera triandra</i>	Three-petal Poranthera			Y	29/10/2003
<i>Prasophyllum fitzgeraldii</i>	Fitzgerald's Leek-orchid			Y	23/10/1992

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Prasophyllum odoratum</i>	Scented Leek-orchid			Y	23/09/2007
<i>Prasophyllum odoratum</i> (NC)	Scented Leek-orchid			Y	10/11/2003
<i>Prostanthera behriana</i>	Downy Mintbush			Y	4/10/2008
<i>Prostanthera striatiflora</i>	Striated Mintbush			Y	27/12/2007
<i>Prunus</i> sp.	Plum			N	8/05/2008
<i>Pterostylis biseta</i>	Two-bristle Greenhood			Y	19/09/1982
<i>Pterostylis biseta</i> (NC)	Two-bristle Greenhood			Y	8/11/2003
<i>Pterostylis plumosa</i>	Bearded Greenhood			Y	19/09/1982
<i>Pterostylis robusta</i>	Large Shell-orchid			Y	1/06/1999
<i>Pterostylis sanguinea</i>	Blood Greenhood			Y	3/09/1977
<i>Pterostylis</i> sp.	Greenhood			Y	24/09/1991
<i>Ptilotus erubescens</i>	Hairy-tails		R	Y	1/06/1999
<i>Ptilotus nobilis</i> ssp. <i>angustifolius</i>	Yellow-tails			Y	28/10/1994
<i>Ptilotus obovatus</i>	Silver Mulla Mulla			Y	5/11/2014
<i>Ptilotus obovatus</i> (NC)	Silver Mulla Mulla			Y	8/11/2003
<i>Ptilotus seminudus</i>	Rabbit-tails			Y	12/11/2003
<i>Ptilotus</i> sp.	Mulla Mulla			Y	10/12/2013
<i>Ptilotus spathulatus</i>	Pussy-tails			Y	5/11/2014
<i>Puccinellia distans</i>	Reflexed Poa			N	1/10/2005
<i>Puccinellia fasciculata</i>	Borrer's Saltmarsh-grass			N	3/12/1993
<i>Puccinellia stricta</i>	Australian Saltmarsh-grass			Y	1/11/2001
<i>Puccinellia stricta</i> (NC)	Australian Saltmarsh-grass			Y	30/10/2003
<i>Pultenaea kraehenbuehlii</i>	Tothill Bush-pea		R	Y	6/10/2009
<i>Pultenaea largiflorens</i>	Twiggy Bush-pea			Y	5/10/2008
<i>Pultenaea</i> sp.	Bush-pea			Y	16/11/2001
<i>Pyrorchis nigricans</i>	Black Fire-orchid			Y	1/01/1961
<i>Radyera farragei</i>	Desert Rose Mallow			Y	8/12/1983
<i>Ranunculus amphitrichus</i>	Small River Buttercup			Y	11/07/1977
<i>Ranunculus hamatosetosus</i>	Hill Buttercup			Y	21/09/2007
<i>Ranunculus lappaceus</i>	Native Buttercup			Y	2/11/1968
<i>Ranunculus muricatus</i>	Pricklefruit Buttercup			N	7/12/1992
<i>Ranunculus pachycarpus</i>	Thick-fruit Buttercup			Y	5/10/2008
<i>Ranunculus sessiliflorus</i> var. <i>sessiliflorus</i>	Annual Buttercup			Y	1/06/1999
<i>Raphanus raphanistrum</i>	Wild Radish			N	30/07/2000
<i>Reichardia tingitana</i>	False Sowthistle			N	9/11/2003
<i>Reseda lutea</i>	Cut-leaf Mignonette			N	1/01/2010
<i>Reseda luteola</i>	Wild Mignonette			N	15/12/2012
<i>Rhagodia parabolica</i>	Mealy Saltbush			Y	20/11/2014
<i>Rhagodia preissii</i> ssp. <i>preissii</i>	Mallee Saltbush			Y	15/06/2005
<i>Rhagodia</i> sp.	Saltbush			Y	16/11/2001
<i>Rhagodia spinescens</i>	Spiny Saltbush			Y	5/11/2014
<i>Rhagodia ulicina</i>	Intricate Saltbush			Y	31/07/1991
<i>Rhamnus alaternus</i>	Blowfly Bush			N	23/09/2014
<i>Rhodanthe floribunda</i>	White Everlasting			Y	8/12/1983
<i>Rhodanthe laevis</i>	Smooth Daisy			Y	5/10/2008
<i>Rhodanthe polygalifolia</i>	Milkwort Everlasting			Y	5/11/2014
<i>Rhodanthe pygmaea</i>	Pigmy Daisy			Y	16/09/2010
<i>Rhyncharrhena linearis</i>	Bush Bean			Y	18/03/1995
<i>Riccia lamellosa</i>				Y	12/08/1952
<i>Robinia pseudoacacia</i>	Black Locust			N	7/10/1993
<i>Roepera ammophila</i>	Sand Twinleaf			Y	16/09/2010
<i>Roepera apiculata</i>	Pointed Twinleaf			Y	5/11/2014

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Roepera aurantiaca</i>	Shrubby Twinleaf			N	11/01/2004
<i>Roepera aurantiaca</i> ssp. <i>aurantiaca</i>	Shrubby Twinleaf			Y	5/11/2014
<i>Roepera crenata</i>	Notched Twinleaf			Y	2/12/2003
<i>Roepera glauca</i>	Pale Twinleaf			Y	10/11/1993
<i>Roepera ovata</i>	Dwarf Twinleaf			Y	27/10/1994
<i>Roepera</i> sp.	Twinleaf			Y	26/10/1994
<i>Romulea minutiflora</i>	Small-flower Onion-grass			N	4/10/2008
<i>Romulea rosea</i> var. <i>australis</i>	Common Onion-grass			N	31/10/2003
<i>Romulea</i> sp.	Onion-grass			N	10/12/2013
<i>Rorippa nasturtium-aquaticum</i>	Watercress			N	29/07/2009
<i>Rorippa</i> sp.	Watercress/Bitter-cress			Y	29/07/2009
<i>Rosa canina</i>	Dog Rose			N	1/01/2011
<i>Rosa</i> sp.	Wild Rose/Briar			N	1/11/2003
<i>Rostraria cristata</i>	Annual Cat's-tail			N	4/10/2008
<i>Rostraria pumila</i>	Tiny Bristle-grass			N	17/09/2010
<i>Rubus</i> sp.	Blackberry			N	16/11/2001
<i>Rumex brownii</i>	Slender Dock			Y	4/10/2008
<i>Rumex brownii</i> (NC)	Slender Dock			Y	23/10/1992
<i>Rumex conglomeratus</i>	Clustered Dock			N	25/11/1993
<i>Rumex crispus</i>	Curled Dock			N	1/11/2003
<i>Rumex dumosus</i>	Wiry Dock		R	Y	31/10/2003
<i>Rumex dumosus</i> var. <i>dumosus</i> (NC)	Wiry Dock			Y	17/11/1993
<i>Rumex pulcher</i> ssp. <i>pulcher</i>	Fiddle Dock			N	8/05/2008
<i>Rumex</i> sp.	Dock			Y	30/07/2009
<i>Ruppia megacarpa</i>	Widgeon Grass			Y	26/11/1976
<i>Rytidosperma auriculatum</i>	Lobed Wallaby-grass			Y	30/10/2003
<i>Rytidosperma caespitosum</i>	Common Wallaby-grass			Y	10/12/2013
<i>Rytidosperma carphoides</i>	Short Wallaby-grass			Y	26/10/1995
<i>Rytidosperma duttonianum</i>	Brown-back Wallaby-grass			Y	25/11/1993
<i>Rytidosperma erianthum</i>	Hill Wallaby-grass			Y	31/10/2003
<i>Rytidosperma fulvum</i>	Leafy Wallaby-grass			Y	25/11/1993
<i>Rytidosperma pilosum</i>	Velvet Wallaby-grass			Y	9/11/1997
<i>Rytidosperma racemosum</i> var. <i>racemosum</i>	Slender Wallaby-grass			Y	4/12/1992
<i>Rytidosperma setaceum</i>	Small-flower Wallaby-grass			Y	21/09/2012
<i>Rytidosperma</i> sp.	Wallaby-grass			Y	5/11/2014
<i>Rytidosperma tenuius</i>	Short-awn Wallaby-grass		R	Y	25/11/2013
<i>Sagina apetala</i>	Annual Pearlwort			N	8/11/2003
<i>Salsola australis</i>	Buckbush			Y	10/12/2013
<i>Salvia verbenaca</i> var.	Wild Sage			N	21/09/2012
<i>Salvia verbenaca</i> var. <i>verbenaca</i>	Wild Sage			N	10/12/2013
<i>Salvia verbenaca</i> var. <i>vernalis</i>	Wild Sage			N	17/09/2010
<i>Samolus repens</i>	Creeping Brookweed			Y	5/11/2014
<i>Santalum acuminatum</i>	Quandong			Y	5/11/2014
<i>Santalum murrayanum</i>	Bitter Quandong			Y	25/02/1992
<i>Sarcocornia blackiana</i>	Thick-head Samphire			Y	9/04/1989
<i>Sarcocornia quinqueflora</i>	Beaded Samphire			Y	30/10/2003
<i>Sarcozona praecox</i>	Sarcozona			Y	20/10/1981
<i>Scabiosa atropurpurea</i>	Pincushion			N	8/05/2008
<i>Scaevola albida</i>	Pale Fanflower			Y	27/11/2001
<i>Scaevola humilis</i>	Inland Fanflower			Y	25/11/2013

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Scaevola spinescens</i>	Spiny Fanflower			Y	11/01/2004
<i>Schenkia australis</i>	Spike Centaury			Y	17/11/1993
<i>Schinus molle</i>	Pepper-tree			N	22/09/2014
<i>Schismus barbatus</i>	Arabian Grass			N	17/09/2010
<i>Schoenoplectus pungens</i>	Spiky Club-rush			Y	1/11/2003
<i>Schoenus apogon</i>	Common Bog-rush			Y	1/10/1999
<i>Schoenus nanus</i>	Little Bog-rush			Y	1/06/1999
<i>Scleranthus pungens</i>	Prickly Knawel			Y	25/10/1994
<i>Sclerochloa dura</i>	Hard Meadow-grass			N	1/11/2005
<i>Sclerolaena brachyptera</i>	Short-wing Bindyi			Y	1/05/2000
<i>Sclerolaena diacantha</i>	Grey Bindyi			Y	5/11/2014
<i>Sclerolaena muricata</i> var. <i>villosa</i>	Five-spine Bindyi		R	Y	3/11/1993
<i>Sclerolaena obliquicuspis</i>	Oblique-spined Bindyi			Y	5/11/2014
<i>Sclerolaena patenticuspis</i>	Spear-fruit Bindyi			Y	5/11/2014
<i>Sclerolaena uniflora</i>	Small-spine Bindyi			Y	27/05/1989
<i>Scorzonera laciniata</i> (NC)	Scorzonera			N	28/10/1994
<i>Scorzonera laciniata</i> var. <i>laciniata</i>	Scorzonera			N	1/11/2005
<i>Sebaea ovata</i>	Yellow Sebaea			Y	10/11/2003
<i>Selliera radicans</i>	Shiny Swamp-mat			Y	29/07/2009
<i>Senecio anethifolius</i> (NC)	Feathery Groundsel			Y	9/11/2003
<i>Senecio anethifolius</i> ssp. <i>anethifolius</i>	Feathery Groundsel			Y	3/12/1993
<i>Senecio dolichocephalus</i>	Woodland Groundsel			Y	21/09/2007
<i>Senecio glossanthus</i>	Annual Groundsel			Y	5/11/2014
<i>Senecio glossanthus</i> (NC)	Annual Groundsel			Y	10/11/2003
<i>Senecio megaglossus</i>	Large-flower Groundsel	VU	E	Y	1/06/1993
<i>Senecio odoratus</i>	Scented Groundsel			Y	21/09/2007
<i>Senecio phelleus</i>	Woodland Groundsel			Y	27/10/1963
<i>Senecio pinnatifolius</i> (NC)	Variable Groundsel			Y	1/04/2001
<i>Senecio quadridentatus</i>	Cotton Groundsel			Y	10/11/2003
<i>Senecio</i> sp.	Groundsel			Y	23/10/1992
<i>Senecio spanomerus</i>				Y	6/08/1988
<i>Senecio tenuiflorus</i> (NC)	Woodland Groundsel			Y	31/10/2003
<i>Senna artemisioides</i> ssp. <i>filifolia</i>	Fine-leaf Desert Senna			Y	4/10/2008
<i>Senna artemisioides</i> ssp. <i>petiolaris</i>				Y	5/11/2014
<i>Senna artemisioides</i> ssp. <i>petiolaris</i> (NC)	Flat-stalk Senna			Y	11/03/1980
<i>Senna artemisioides</i> ssp. <i>X artemisioides</i>	Silver Senna			Y	10/12/2013
<i>Senna artemisioides</i> ssp. <i>X coriacea</i>	Broad-leaf Desert Senna			Y	5/11/2014
<i>Setaria constricta</i>	Knotty-butt Paspalidium			Y	1/05/2000
<i>Setaria verticillata</i>	Whorled Pigeon-grass			N	15/12/2012
<i>Sida corrugata</i> var.	Corrugated Sida			Y	10/12/2013
<i>Sida corrugata</i> var. <i>angustifolia</i>	Grassland Sida			Y	15/12/2012
<i>Sida corrugata</i> var. <i>corrugata</i>	Corrugated Sida			Y	25/11/2013
<i>Sida intricata</i>	Twiggy Sida			Y	26/12/1997
<i>Sida petrophila</i>	Rock Sida			Y	30/07/2009
<i>Sida</i> sp.	Sida			Y	16/03/2008
<i>Sida spodochroma</i>				Y	1/05/2000
<i>Silene apetala</i>	Sand Catchfly			N	5/10/2008
<i>Silene gallica</i> var.	French Catchfly			N	21/10/1992
<i>Silene gallica</i> var. <i>gallica</i>	French Catchfly			N	23/09/2014
<i>Silene nocturna</i>	Mediterranean Catchfly			N	11/11/2003

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Silene sp.</i>	Catchfly			N	25/11/2013
<i>Silene vulgaris</i>	Bladder Campion			N	10/11/1995
<i>Siloxerus multiflorus</i>	Small Wrinklewort			Y	5/10/2008
<i>Silybum marianum</i>	Variegated Thistle			N	23/09/2014
<i>Sisymbrium erysimoides</i>	Smooth Mustard			N	17/09/2010
<i>Sisymbrium irio</i>	London Mustard			N	17/09/2010
<i>Sisymbrium orientale</i>	Indian Hedge Mustard			N	23/09/2014
<i>Sisymbrium sp.</i>	Wild Mustard			N	25/11/2013
<i>Solanum elaeagnifolium</i>	Silver-leaf Nightshade			N	1/01/2011
<i>Solanum esuriale</i>	Quena			Y	26/07/1973
<i>Solanum laciniatum</i>	Cut-leaf Kangaroo-apple			Y	5/01/1908
<i>Solanum nigrum</i>	Black Nightshade			N	30/07/2009
<i>Solanum oligacanthum</i>	Desert Nightshade			Y	17/05/1974
<i>Solanum simile</i>	Kangaroo Apple			Y	0/01/1900
<i>Solenogyne dominii</i>	Smooth Solenogyne			Y	1/06/1999
<i>Solidago canadensis</i>	Golden Rod			N	23/04/1988
<i>Sonchus asper ssp. glaucescens</i>	Rough Sow-thistle			N	26/10/1994
<i>Sonchus hydrophilus</i>	Native Sow-thistle			Y	8/11/2003
<i>Sonchus oleraceus</i>	Common Sow-thistle			N	10/12/2013
<i>Sonchus oleraceus (NC)</i>	Common Sow-thistle			N	15/06/2005
<i>Sonchus sp.</i>	Sow-thistle			Y	1/11/2003
<i>Sorghum halepense</i>	Johnson Grass			N	18/04/1995
<i>Sparaxis bulbifera</i>	Sparaxis			N	23/05/2000
<i>Spergularia bocconeii</i>	Red Sand-spurrey			N	
<i>Spergularia brevifolia</i>	Salt Sand-spurrey			Y	0/01/1900
<i>Spergularia diandra</i>	Lesser Sand-spurrey			N	16/09/2010
<i>Spergularia diandra (NC)</i>	Lesser Sand-spurrey			N	1/11/2003
<i>Spergularia marina</i>	Salt Sand-spurrey			Y	29/07/2009
<i>Spergularia marina (NC)</i>	Salt Sand-spurrey			N	30/10/2003
<i>Spergularia media</i>	Coast Sand-spurrey			N	6/06/1993
<i>Sphenopus divaricatus</i>	Wedge-foot Grass			N	30/10/2003
<i>Sporobolus virginicus</i>	Salt Couch			Y	1/11/2005
<i>Spyridium parvifolium</i>	Dusty Miller			Y	4/10/2009
<i>Spyridium stenophyllum ssp. renovatum</i>	Forked Spyridium			Y	30/01/1998
<i>Stachys arvensis</i>	Stagger Weed			N	8/11/1997
<i>Stackhousia monogyna</i>	Creamy Candles			Y	4/10/2008
<i>Stackhousia monogyna (NC)</i>	Creamy Candles			Y	11/11/2003
<i>Stackhousia sp.</i>	Candles			Y	21/09/2012
<i>Stackhousia subterranea</i>	Creamy Candles			Y	20/11/1993
<i>Stellaria media</i>	Chickweed			N	23/09/2014
<i>Stemodia florulenta</i>	Bluerod			Y	8/12/1983
<i>Stenopetalum lineare</i>	Narrow Thread-petal			Y	1/09/2005
<i>Stenopetalum lineare (NC)</i>	Narrow Thread-petal			Y	10/11/2003
<i>Stuartina muelleri</i>	Spoon Cudweed			Y	5/10/2008
<i>Swainsona behriana</i>	Behr's Swainson-pea		V	Y	19/09/1996
<i>Swainsona colutooides</i>	Bladder Swainson-pea			Y	8/12/1983
<i>Swainsona formosa</i>	Sturt Pea			Y	8/10/1936
<i>Swainsona oroboides</i>	Variable Swainson-pea			Y	22/10/1992
<i>Swainsona oroboides complex</i>	Variable Swainson-pea			Y	22/10/1992
<i>Swainsona tephrotricha</i>	Ashy-haired Swainson-pea			Y	28/08/2000
<i>Symphotrichum subulatum</i>	Aster-weed			N	29/07/2009
<i>Taeniatherum caput-medusae</i>	Medusa's Head			N	28/12/1952

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Tagetes erecta</i>	Mexican Marigold			N	1/06/2004
<i>Tamarix aphylla</i> (NC)	Athel Pine			N	1/04/2001
<i>Tamarix ramosissima</i>				N	14/02/1993
<i>Tanacetum parthenium</i>	Feverfew			N	27/05/1989
<i>Tecticornia halocnemoides</i> ssp. <i>halocnemoides</i>	Grey Samphire			Y	29/07/2009
<i>Tecticornia indica</i> ssp. <i>leiostachya</i>	Brown-head Samphire			Y	27/10/1994
<i>Tecticornia pergranulata</i> ssp.	Black-seed Samphire			Y	1/04/2001
<i>Tecticornia pergranulata</i> ssp. <i>pergranulata</i>	Black-seed Samphire			Y	30/10/2003
<i>Templetonia egena</i>	Broombush Templetonia			Y	2/12/1983
<i>Tetragonia eremaea</i>	Desert Spinach			Y	5/11/2014
<i>Tetragonia eremaea/tetragonoides</i>	Native Spinach			Y	31/07/1991
<i>Teucrium racemosum</i>	Grey Germander			Y	23/05/2000
<i>Teucrium sessiliflorum</i>	Mallee Germander			Y	29/10/2003
<i>Thelymitra albiflora</i>				Y	5/10/2008
<i>Thelymitra antennifera</i>	Lemon Sun-orchid			Y	1/10/2003
<i>Thelymitra arenaria</i>				Y	19/09/1982
<i>Thelymitra bracteata</i>	Slender Sun-orchid			Y	1/10/2003
<i>Thelymitra glaucophylla</i>	Scented Sun-orchid			Y	
<i>Thelymitra grandiflora</i>	Great Sun-orchid		R	Y	18/09/1982
<i>Thelymitra juncifolia</i>	Spotted Sun-orchid			Y	1/10/2003
<i>Thelymitra luteociliium</i>	Yellow-tuft Sun Orchid			Y	5/10/2008
<i>Thelymitra megalyptra</i>	Scented Sun-orchid			Y	1/10/2003
<i>Thelymitra nuda</i>				Y	31/10/2003
<i>Thelymitra nuda</i> (NC)	Scented Sun-orchid			Y	31/10/2003
<i>Thelymitra rubra</i>	Salmon Sun-orchid			Y	10/10/2003
<i>Themeda triandra</i>	Kangaroo Grass			Y	10/12/2013
<i>Threlkeldia diffusa</i>	Coast Bonefruit			Y	1/04/2001
<i>Thyridia repens</i>	Creeping Monkey-flower			Y	5/11/2014
<i>Thysanotus baueri</i>	Mallee Fringe-lily			Y	1/11/2005
<i>Thysanotus patersonii</i>	Twining Fringe-lily			Y	5/10/2008
<i>Thysanotus</i> sp.	Fringe-lily			Y	24/09/1991
<i>Thysanotus tenellus</i>	Grassy Fringe-lily		R	Y	5/10/2008
<i>Tragopogon porrifolius</i>	Salsify			N	15/12/2012
<i>Tribolium acutiflorum</i>				N	9/04/1989
<i>Tribulus terrestris</i>	Caltrop			N	21/02/1974
<i>Tricoryne elatior</i>	Yellow Rush-lily			Y	11/11/2003
<i>Tricoryne tenella</i>	Tufted Yellow Rush-lily			Y	27/02/1993
<i>Trifolium angustifolium</i>	Narrow-leaf Clover			N	10/12/2013
<i>Trifolium arvense</i> var. <i>arvense</i>	Hare's-foot Clover			N	10/12/2013
<i>Trifolium campestre</i>	Hop Clover			N	10/12/2013
<i>Trifolium dubium</i>	Suckling Clover			N	24/09/1991
<i>Trifolium glomeratum</i>	Cluster Clover			N	30/10/2003
<i>Trifolium scabrum</i>	Rough Clover			N	10/12/2013
<i>Trifolium</i> sp.	Clover			N	19/12/2001
<i>Trifolium subterraneum</i>	Subterranean Clover			N	21/10/1992
<i>Trifolium tomentosum</i>	Woolly Clover			N	25/11/1993
<i>Triglochin centrocarpum</i> (NC)	Dwarf Arrowgrass			Y	1/06/1999
<i>Triglochin nana</i>	Dwarf Arrowgrass			Y	5/10/2008
<i>Triglochin striata</i>	Streaked Arrowgrass			Y	5/11/2014
<i>Triodia bunicola</i> (NC)	Flinders Ranges Spinifex			Y	1/06/1999
<i>Triodia scariosa</i>	Spinifex			Y	9/11/2003
<i>Triptilodiscus pygmaeus</i>	Small Yellow-heads			Y	5/10/2008

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Triticum aestivum</i>	Wheat			N	25/11/1993
<i>Trymalium wayi</i>	Grey Trymalium			Y	2/12/2003
<i>Typha domingensis</i>	Narrow-leaf Bulrush			Y	5/11/2014
<i>Typha sp.</i>	Bulrush			Y	16/11/2001
<i>Unidentified alien sp.</i>				N	21/09/2012
<i>Unidentified sp.</i>				Y	15/11/1998
<i>'unverified species - nv'</i>				?	9/11/1997
<i>Urospermum picroides</i>	False Hawkbit			N	11/11/2003
<i>Urtica urens</i>	Small Nettle			N	23/09/2014
<i>Valerianella discoidea</i>	Lesser Corn-salad			N	10/10/2008
<i>Valerianella muricata</i>				N	1/10/1985
<i>Velleia arguta</i>	Toothed Velleia			Y	25/05/2000
<i>Velleia connata</i>	Cup Velleia			Y	8/12/1983
<i>Velleia paradoxa</i>	Spur Velleia			Y	1/10/1999
<i>Vellereophyton dealbatum</i>	White Cudweed			N	9/02/1998
<i>Verbena supina</i> (NC)	Trailing Verbena			N	25/11/1993
<i>Veronica plebeia</i>	Trailing Speedwell			Y	1/06/1999
<i>Vicia monantha</i>	Spurred Vetch			N	9/11/2003
<i>Vicia sp.</i>	Vetch			N	23/05/2000
<i>Vinca major</i>	Blue Periwinkle			N	8/11/1997
<i>Vittadinia australasica</i> var. <i>australasica</i>	Sticky New Holland Daisy			Y	10/12/2013
<i>Vittadinia blackii</i>	Narrow-leaf New Holland Daisy			Y	5/11/2014
<i>Vittadinia cervicularis</i> var. <i>cervicularis</i>	Waisted New Holland Daisy			Y	9/11/2003
<i>Vittadinia condyloides</i>	Club-hair New Holland Daisy			Y	25/05/2000
<i>Vittadinia cuneata</i> var.	Fuzzy New Holland Daisy			Y	15/06/2005
<i>Vittadinia cuneata</i> var. <i>cuneata</i>	Fuzzy New Holland Daisy			Y	31/10/2003
<i>Vittadinia gracilis</i>	Woolly New Holland Daisy			Y	26/11/2017
<i>Vittadinia megacephala</i>	Giant New Holland Daisy			Y	5/11/2014
<i>Vittadinia sp.</i>	New Holland Daisy			Y	21/09/2012
<i>Vulpia bromoides/myuros</i>				Y	23/10/1992
<i>Vulpia muralis</i>	Wall Fescue			N	16/09/2010
<i>Vulpia myuros f.</i>	Fescue			N	13/11/1996
<i>Vulpia myuros f. megalura</i>	Fox-tail Fescue			N	24/09/1991
<i>Vulpia myuros f. myuros</i>	Rat's-tail Fescue			N	5/10/2008
<i>Vulpia sp.</i>	Fescue			N	25/11/2013
<i>Wahlenbergia communis</i>	Tufted Bluebell			Y	1/04/2001
<i>Wahlenbergia gracilenta</i>	Annual Bluebell			Y	5/10/2008
<i>Wahlenbergia luteola</i>	Yellow-wash Bluebell			Y	11/11/2003
<i>Wahlenbergia multicaulis</i>	Tadgell's Bluebell			Y	10/11/1993
<i>Wahlenbergia sp.</i>	Native Bluebell			Y	25/11/2013
<i>Wahlenbergia stricta</i> ssp. <i>stricta</i>	Tall Bluebell			Y	5/10/2008
<i>Walwhalleya proluta</i>	Rigid Panic			Y	24/10/1994
<i>Walwhalleya proluta</i> (NC)	Rigid Panic			Y	18/12/2001
<i>Westringia rigida</i>	Stiff Westringia			Y	5/11/2014
<i>Wilsonia backhousei</i>	Narrow-leaf Wilsonia			Y	1/03/1987
<i>Wilsonia rotundifolia</i>	Round-leaf Wilsonia			Y	30/10/2003
<i>Wurmbea dioica</i> ssp.	Early Nancy			Y	16/09/2010
<i>Wurmbea dioica</i> ssp. <i>brevifolia</i>	Early Nancy			Y	4/10/2008
<i>Wurmbea dioica</i> ssp. <i>dioica</i>	Early Nancy			Y	5/10/2008

Scientific Name	Common name	Aus	SA	Indigenous (Y/N)	Last sighting
<i>Wurmbea dioica</i> ssp. <i>dioica</i> (NC)	Early Nancy			Y	11/11/2003
	Early Star-lily			Y	22/10/1992
<i>Xanthium spinosum</i>	Bathurst Burr			N	18/07/1971
<i>Xanthorrhoea quadrangulata</i>	Rock Grass-tree			Y	4/10/2009
<i>Xerochrysum bracteatum</i>	Golden Everlasting			Y	27/09/2006
<i>Zaluzianskya divaricata</i>	Spreading Night-phlox			N	31/10/2003
<i>Zygophyllum ammophilum</i> (NC)	Sand Twinleaf			Y	24/10/1994
<i>Zygophyllum aurantiacum</i> (NC)	Shrubby Twinleaf			Y	27/10/1994
<i>Zygophyllum aurantiacum</i> ssp. <i>aurantiacum</i> (NC)	Shrubby Twinleaf			Y	9/11/2003

Conservation status: **Aus:** Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). Conservation Codes: **CR/CE:** Critically Endangered. **ENE:** Endangered. **VU/V:** Vulnerable. **R:** Rare.

Appendix 2. BDBSA Fauna records within 20 km of the Project Area.

Exotic	Scientific name	Common name	Conservation status		Last sighting (year)	No. observed
			Aus	SA		
	ACTINOPTERI					
*	<i>Gambusia holbrooki</i>	Eastern Gambusia			8/04/2014	20
*	<i>Oncorhynchus mykiss</i>	Rainbow Trout			9/09/2005	2
*	<i>Salmo trutta</i>	Brown Trout			9/09/2005	2
	AMPHIBIANS					
	<i>Crinia signifera</i>	Common Froglet			8/09/2005	47
	<i>Crinia sp.</i>				30/10/2003	2
	<i>Limnodynastes dumerilii</i>	Banjo Frog			4/10/2008	2
	<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog			8/09/2005	10
	<i>Neobatrachus pictus</i>	Burrowing Frog			4/10/2008	10
	<i>Crinia signifera</i>	Common Froglet			8/09/2005	47
	<i>Crinia sp.</i>				30/10/2003	2
	<i>Limnodynastes dumerilii</i>	Banjo Frog			4/10/2008	2
	<i>Limnodynastes tasmaniensis</i>	Spotted Marsh Frog			8/09/2005	10
	<i>Neobatrachus pictus</i>	Burrowing Frog			4/10/2008	10
	AVES					
	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater			20/09/2015	75
	<i>Acanthiza apicalis</i>	Inland Thornbill			21/07/2009	18
	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill			28/08/2015	72
	<i>Acanthiza nana</i>	Yellow Thornbill			28/08/2015	50
	<i>Acanthiza reguloides</i>	Buff-rumped Thornbill			4/10/2008	40
	<i>Acanthiza sp.</i>	thornbills			31/10/2003	2
	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill			19/09/2015	50
	<i>Acanthorhynchus tenuirostris halmaturinus</i>	Eastern Spinebill			25/08/2007	1
	<i>Accipiter cirrocephalus cirrocephalus</i>	Collared Sparrowhawk			11/10/2010	4
	<i>Accipiter fasciatus</i>	Brown Goshawk			23/01/2008	18
	<i>Acrocephalus australis</i>	Australian Reed Warbler			30/11/2014	30
	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar			4/10/2008	10
*	<i>Alauda arvensis</i>	Eurasian Skylark			30/10/2003	20
	<i>Anas castanea</i>	Chestnut Teal			10/05/2002	5
	<i>Anas gracilis</i>	Grey Teal			2/02/2010	12
*	<i>Anas platyrhynchos</i>	Mallard (Northern Mallard)			3/05/2005	10
	<i>Anas superciliosa</i>	Pacific Black Duck			8/05/2015	31
	<i>Anas superciliosa x platyrhynchos</i>	Pacific Black Duck			24/10/1987	1
	<i>Anhinga novaehollandiae</i>	Australasian Darter		R	10/10/2000	2
	<i>Anseranas semipalmata</i>	Magpie Goose		E	1/09/1983	1

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Exotic	Scientific name	Common name	Conservation status		Last sighting (year)	No. observed
			Aus	SA		
	<i>Anthochaera carunculata</i>	Red Wattlebird			28/08/2015	84
	<i>Anthus australis</i>	Australian Pipit			23/10/2010	39
	<i>Aphelocephala leucopsis</i>	Southern Whiteface			19/09/2015	54
	<i>Apus pacificus</i>	Fork-tailed Swift			28/11/2006	1
	<i>Aquila audax</i>	Wedge-tailed Eagle			30/11/2014	45
	<i>Ardea alba modesta</i>	Great Egret			13/08/2000	1
	<i>Ardea pacifica</i>	White-necked Heron			31/10/2003	2
	<i>Ardeotis australis</i>	Australian Bustard		V	25/05/2000	1
	<i>Artamus cinereus</i>	Black-faced Woodswallow			21/10/2010	1
	<i>Artamus cyanopterus</i>	Dusky Woodswallow			19/09/2015	16
	<i>Artamus personatus</i>	Masked Woodswallow			25/08/2007	6
	<i>Artamus superciliosus</i>	White-browed Woodswallow			25/08/2007	4
	<i>Aythya australis</i>	Hardhead			1/04/2005	6
	<i>Barnardius zonarius</i>	Australian Ringneck			19/09/2015	52
	<i>Barnardius zonarius zonarius</i> (NC)	Port Lincoln Parrot			28/10/2000	3
	<i>Biziura lobata</i>	Musk Duck		R	6/11/1996	1
	<i>Cacatua galerita</i>	Sulphur-crested Cockatoo			30/09/2002	2
	<i>Cacatua sanguinea sanguinea</i>	Little Corella			20/09/2015	34
	<i>Cacatua sp.</i>	Cacatua cockatoos and corellas			26/04/2005	3
	<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo			9/06/2000	1
	<i>Calamanthus (Calamanthus) campestris</i>	Rufous Fieldwren			25/11/2006	3
	<i>Calamanthus (Calamanthus) fuliginosus</i>	Striated Fieldwren			1/04/2001	1
	<i>Calidris acuminata</i>	Sharp-tailed Sandpiper			30/10/2003	2
	<i>Calidris ruficollis</i>	Red-necked Stint			30/10/2003	1
	<i>Caligavis chrysops samueli</i>	Yellow-faced Honeyeater			21/07/2009	44
*	<i>Carduelis carduelis</i>	European Goldfinch			31/07/2001	2
	<i>Chalcites basalis</i>	Horsfield's Bronze Cuckoo			19/09/2015	23
	<i>Chalcites osculans</i>	Black-eared Cuckoo			19/09/2015	2
	<i>Charadrius bicinctus</i>	Double-banded Plover			21/04/1984	1
	<i>Charadrius ruficapillus</i>	Red-capped Plover			30/10/2003	5
	<i>Chenonetta jubata</i>	Maned Duck			17/08/2005	22
	<i>Cheramoeca leucosterna</i>	White-backed Swallow			25/11/2006	2
	<i>Chlidonias hybrida</i>	Whiskered Tern			27/09/1998	1
	<i>Chroicocephalus novaehollandiae</i>	Silver Gull			30/10/2003	13
	<i>Cinclosoma castanotum</i> (NC)	Chestnut Quailthrush		ssp	23/10/2010	2
	<i>Circus approximans</i>	Swamp Harrier			29/10/2003	2
	<i>Circus assimilis</i>	Spotted Harrier			12/11/2003	8

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Exotic	Scientific name	Common name	Conservation status		Last sighting (year)	No. observed
			Aus	SA		
	<i>Cladorhynchus leucocephalus</i>	Banded Stilt		V	29/10/2003	3
	<i>Climacteris picumnus</i>	Brown Treecreeper			20/09/2015	62
	<i>Colluricincla harmonica</i>	Grey Shrikethrush			20/09/2015	132
*	<i>Columba livia</i>	Feral Pigeon			19/09/2015	43
	<i>Coracina maxima</i>	Ground Cuckooshrike			11/02/2004	1
	<i>Coracina novaehollandiae</i>	Black-faced Cuckooshrike			8/05/2015	66
	<i>Corcorax melanorhamphos</i>	White-winged Chough		R	20/09/2015	86
	<i>Corvus bennetti</i>	Little Crow			29/06/2002	2
	<i>Corvus coronoides</i>	Australian Raven			20/09/2015	21
	<i>Corvus mellori</i>	Little Raven			20/09/2015	130
	<i>Corvus sp.</i>	crows			11/02/2004	6
	<i>Coturnix pectoralis</i>	Stubble Quail			1/11/2003	8
	<i>Coturnix ypsilophora</i>	Brown Quail		V	8/05/2015	1
	<i>Cracticus torquatus</i>	Grey Butcherbird			28/08/2015	43
	<i>Cygnus atratus</i>	Black Swan			3/05/2005	19
	<i>Dacelo novaeguineae</i>	Laughing Kookaburra			20/09/2015	57
	<i>Daphoenositta chrysoptera</i>	Varied Sittella			19/09/2015	22
	<i>Dicaeum hirundinaceum</i>	Mistletoebird			20/09/2015	61
	<i>Dromaius novaehollandiae</i>	Emu			19/06/2013	17
	<i>Egretta novaehollandiae</i>	White-faced Heron			20/09/2015	39
	<i>Elanus axillaris</i>	Black-shouldered Kite			30/11/2014	12
	<i>Elseyornis melanops</i>	Black-fronted Dotterel			29/12/2000	3
	<i>Eolophus roseicapilla</i>	Galah			20/09/2015	247
	<i>Epthianura albifrons</i>	White-fronted Chat			30/10/2003	7
	<i>Eurostopodus argus</i>	Spotted Nightjar			29/11/2006	2
	<i>Falco berigora</i>	Brown Falcon			28/08/2015	20
	<i>Falco cenchroides</i>	Nankeen Kestrel			19/09/2015	72
	<i>Falco longipennis</i>	Australian Hobby			16/04/2002	8
	<i>Falco peregrinus</i>	Peregrine Falcon		R	11/10/2010	11
	<i>Falco subniger</i>	Black Falcon			27/09/1998	3
	<i>Fulica atra</i>	Eurasian Coot			8/05/2015	27
	<i>Gallinula tenebrosa</i>	Dusky Moorhen			3/05/2005	22
	<i>Gallirallus philippensis mellori</i>	Buff-banded Rail			1/04/2001	2
	<i>Gavialis virens</i>	Singing Honeyeater			28/08/2015	62
	<i>Geopelia placida</i>	Peaceful Dove			20/09/2015	28
	<i>Glareola maldivarum</i>	Oriental Pratincole			23/11/1975	1
	<i>Gliciphila melanops</i>	Tawny-crowned Honeyeater			21/07/2009	1
	<i>Glossopsitta concinna</i>	Musk Lorikeet			23/06/2007	6
	<i>Grallina cyanoleuca</i>	Magpielark			23/06/2007	70
	<i>Gymnorhina tibicen</i>	Australian Magpie			20/09/2015	181
	<i>Haliastur sphenurus</i>	Whistling Kite			8/11/2003	1
	<i>Hieraaetus morphnoides</i>	Little Eagle			19/11/2016	4
	<i>Himantopus leucocephalus</i>	White-headed Stilt			30/10/2003	13

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Exotic	Scientific name	Common name	Conservation status		Last sighting (year)	No. observed
			Aus	SA		
	<i>Hirundo neoxena</i>	Welcome Swallow			9/05/2015	51
	<i>Lalage tricolor</i>	White-winged Triller			4/09/2004	2
	<i>Malacorhynchus membranaceus</i>	Pink-eared Duck			2/02/2010	3
	<i>Malurus cyaneus</i>	Superb Fairywren			4/09/2004	12
	<i>Malurus cyaneus leggei</i>	Superb Fairywren			8/05/2015	21
	<i>Malurus lamberti</i>	Variegated Fairywren			20/09/2015	40
	<i>Malurus leucopterus</i>	White-winged Fairywren			25/11/2006	13
	<i>Malurus splendens</i>	Splendid Fairywren			1/04/2001	1
	<i>Manorina flavigula</i>	Yellow-throated Miner	ssp	ssp	28/08/2015	27
	<i>Manorina melanocephala</i>	Noisy Miner			4/11/2006	27
	<i>Megalurus cruralis</i>	Brown Songlark			30/10/2003	10
	<i>Megalurus gramineus</i>	Little Grassbird			25/11/2006	12
	<i>Megalurus mathewsi</i>	Rufous Songlark			19/09/2015	5
	<i>Melanodryas cucullata</i>	Hooded Robin		ssp	3/03/1987	1
	<i>Melanodryas cucullata cucullata</i>	Hooded Robin		R	21/10/2010	9
	<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater			20/09/2015	43
	<i>Melithreptus gularis</i>	Black-chinned Honeyeater		ssp	27/09/2006	3
	<i>Melithreptus lunatus</i>	White-naped Honeyeater			4/07/2007	3
	<i>Melopsittacus undulatus</i>	Budgerigar			9/11/2003	9
	<i>Merops ornatus</i>	Rainbow Bee-eater			19/09/2015	43
	<i>Microcarbo melanoleucos melanoleucos</i>	Little Pied Cormorant			8/05/2015	20
	<i>Microeca fascians</i>	Jacky Winter		ssp	28/08/2015	17
	<i>Milvus migrans</i>	Black Kite			19/09/2015	4
	<i>Mirafra javanica</i>	Horsfield's Bush Lark			30/10/2003	4
	<i>Myiagra cyanoleuca</i>	Satin Flycatcher		E	29/11/1998	1
	<i>Myiagra inquieta</i>	Restless Flycatcher		R	23/10/2010	4
	<i>Neophema chrysostoma</i>	Blue-winged Parrot		V	1/04/2001	1
	<i>Neophema elegans</i>	Elegant Parrot		R	25/11/2006	9
	<i>Nesoptilotis leucotis</i>	White-eared Honeyeater			12/05/2002	9
	<i>Nesoptilotis leucotis leucotis</i>	White-eared Honeyeater			28/08/2015	24
	<i>Ninox boobook</i>	Southern Boobook			28/11/2006	11
	<i>Northiella haematogaster (NC)</i>	Bluebonnet		ssp	21/10/2010	2
	<i>Nycticorax caledonicus</i>	Nankeen Night Heron			13/08/2000	1
	<i>Nymphicus hollandicus</i>	Cockatiel			11/10/2010	10
	<i>Ocyphaps lophotes</i>	Crested Pigeon			11/10/2010	56
	<i>Pachycephala inornata</i>	Gilbert's Whistler		R	31/08/1986	2
	<i>Pachycephala pectoralis</i>	Golden Whistler			25/08/2007	14
	<i>Pachycephala rufiventris</i>	Rufous Whistler			1/04/2001	4
	<i>Pachycephala rufiventris rufiventris</i>	Rufous Whistler			9/05/2015	61

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Exotic	Scientific name	Common name	Conservation status		Last sighting (year)	No. observed
			Aus	SA		
	<i>Pardalotus punctatus</i>	Spotted Pardalote			20/09/2015	35
	<i>Pardalotus striatus</i>	Striated Pardalote			20/09/2015	138
	<i>Parvipsitta porphyrocephala</i>	Purple-crowned Lorikeet			28/11/2006	10
*	<i>Passer domesticus</i>	House Sparrow			25/11/2006	53
	<i>Pelecanus conspicillatus</i>	Australian Pelican			10/06/2001	2
	<i>Peltohyas australis</i>	Inland Dotterel			19/05/1984	1
	<i>Petrochelidon ariel</i>	Fairy Martin			28/11/2006	3
	<i>Petrochelidon nigricans</i>	Tree Martin			30/11/2014	13
	<i>Petroica boodang boodang</i>	Scarlet Robin		R	4/10/2008	17
	<i>Petroica goodenovii</i>	Red-capped Robin			20/09/2015	45
	<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant			21/10/1998	1
	<i>Phalacrocorax varius</i>	Great Pied Cormorant			26/04/2005	3
	<i>Phaps chalcoptera</i>	Common Bronzewing			28/08/2015	48
	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater			17/05/1999	1
	<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater			25/08/2007	1
	<i>Platalea flavipes</i>	Yellow-billed Spoonbill			21/10/1998	1
	<i>Platycercus elegans</i>	Crimson Rosella			20/09/2015	114
	<i>Platycercus elegans subadelaidae</i>	Adelaide Rosellas			26/10/2000	1
	<i>Plectorhyncha lanceolata</i>	Striped Honeyeater		R	5/12/1986	1
	<i>Podargus strigoides</i>	Tawny Frogmouth			25/08/2007	6
	<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe			2/02/2010	2
	<i>Pomatostomus ruficeps</i>	Chestnut-crowned Babbler			21/10/2010	4
	<i>Pomatostomus superciliosus</i>	White-browed Babbler			20/09/2015	36
	<i>Porzana tabuensis</i>	Spotless Crane		R	11/05/2002	1
	<i>Psephotellus varius</i>	Mulga Parrot			19/09/2015	14
	<i>Psephotus haematonotus</i>	Red-rumped Parrot			17/08/2005	32
	<i>Psephotus haematonotus haematonotus</i>	Red-rumped Parrot			8/05/2015	20
	<i>Ptilotula ornata</i>	Yellow-plumed Honeyeater			28/08/2015	10
	<i>Ptilotula penicillata</i>	White-plumed Honeyeater			20/09/2015	86
	<i>Purnella albifrons</i>	White-fronted Honeyeater			25/11/2006	11
	<i>Pyrrholaemus brunneus</i>	Redthroat			19/09/2015	18
	<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet			30/10/2003	6
	<i>Rhipidura albiscapa</i>	Grey Fantail			28/08/2015	70
	<i>Rhipidura leucophrys</i>	Willie Wagtail			20/09/2015	86
	<i>Rostratula australis</i>	Australian Painted-snipe	EN	V	1/04/2001	1
	<i>Smicromis brevirostris</i>	Weebill			20/09/2015	137
*	<i>Spilopelia chinensis</i>	Spotted Dove			31/07/2001	5
	<i>Stagonopleura guttata</i>	Diamond Firetail		V	23/10/2010	22

Goyder South Hybrid Renewable Energy Project: Flora and Fauna Assessment

Exotic	Scientific name	Common name	Conservation status		Last sighting (year)	No. observed
			Aus	SA		
	<i>Stiltia isabella</i>	Australian Pratincole			5/02/1982	1
	<i>Strepera versicolor</i>	Grey Currawong			28/08/2015	68
	<i>Struthidea cinerea</i>	Apostlebird			28/08/2015	9
*	<i>Sturnus vulgaris</i>	Common Starling			19/09/2015	84
	<i>Sugomel niger</i>	Black Honeyeater			8/03/1986	3
	<i>Tachybaptus novaehollandiae</i>	Australasian Grebe			8/05/2015	25
	<i>Tadorna tadornoides</i>	Australian Shelduck			30/10/2003	25
	<i>Taeniopygia guttata</i>	Zebra Finch			15/04/1995	1
	<i>Threskiornis moluccus</i>	Australian White Ibis			29/11/1998	1
	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher			19/09/2015	11
	<i>Todiramphus sanctus</i>	Sacred Kingfisher			28/11/2006	10
	<i>Tribonyx ventralis</i>	Black-tailed Nativehen			7/09/2002	6
	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet			21/04/2000	1
*	<i>Turdus merula</i>	Common Blackbird			30/11/2014	61
	<i>Turnix varius</i>	Painted Buttonquail		R	28/08/2015	3
	<i>Turnix velox</i>	Little Buttonquail			11/11/2003	3
	<i>Tyto delicatula delicatula</i>	Eastern Barn Owl			10/05/2002	3
	<i>Vanellus miles</i>	Masked Lapwing			2/02/2010	29
	<i>Vanellus tricolor</i>	Banded Lapwing			30/10/2003	3
	<i>Zosterops lateralis</i>	Silvereye			20/09/2015	63
MAMMALS						
	<i>Austronomus australis</i>	White-striped Free-tailed Bat			13/04/2011	6
*	<i>Bos taurus</i>	Cattle (European Cattle)			17/06/2014	2
*	<i>Capra hircus</i>	Goat (Feral Goat)			6/07/2009	4
*	<i>Cervus dama</i>	Fallow Deer			11/11/2003	4
*	<i>Cervus elaphus</i>	Red Deer			12/11/2003	1
	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat			11/11/2011	10
	<i>Chalinolobus morio</i>	Chocolate Wattled Bat			11/11/2011	2
*	<i>Equus caballus</i>	Horse (Brumby)			1/01/1986	1
*	<i>Felis catus</i>	Domestic Cat (Feral Cat)			12/11/2003	3
	<i>Lasiorhinus latifrons</i>	Southern Hairy-nosed Wombat			23/10/2010	5
*	<i>Lepus europaeus</i>	European Brown Hare			31/10/2003	5
	<i>Macropus fuliginosus</i>	Western Grey Kangaroo			23/06/2015	96
	<i>Macropus robustus</i>	Euro			17/06/2014	17
	<i>Macropus rufus</i>	Red Kangaroo			22/06/2015	55
	<i>Macropus sp.</i>				30/09/2012	13
	<i>Mormopterus sp.</i>				11/11/2011	8
*	<i>Mus musculus</i>	House Mouse			1/11/2003	8
	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat			11/11/2011	5
*	<i>Oryctolagus cuniculus</i>	Rabbit (European Rabbit)			1/10/2012	16
*	<i>Ovis aries</i>	Sheep (Feral Sheep)			23/10/2010	5

Exotic	Scientific name	Common name	Conservation status		Last sighting (year)	No. observed
			Aus	SA		
*	<i>Rattus rattus</i>	Black Rat (Ship Rat, Roof Rat)			2/10/1995	1
	<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat			11/11/2011	2
	<i>Sminthopsis murina</i>	Common Dunnart			1/10/2012	8
*	<i>Sus scrofa</i>	Pig (Feral Pig)			7/10/2011	2
	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	ssp		1/10/2012	22
	<i>Trichosurus vulpecula</i>	Common Brushtail Possum		R	28/09/2008	3
	<i>Vespadelus sp.</i>				11/11/2011	3
*	<i>Vulpes vulpes</i>	Fox (Red Fox)			2/10/2012	9
	REPTILES					
	<i>Anilius bicolor</i>	Southern Blind Snake			9/11/2003	1
	<i>Aprasia pseudopulchella</i>	Flinders Worm-lizard	VU		1/10/2016	26
	<i>Christinus marmoratus</i>	Marbled Gecko			10/11/2003	15
	<i>Cryptoblepharus cf plagioccephalus</i> (NC)	Desert Wall skink			15/10/1992	2
	<i>Cryptoblepharus pannosus</i>	Speckled Wall Skink			13/11/2003	6
	<i>Cryptoblepharus sp.</i>	(blank)			11/11/2003	2
	<i>Ctenophorus decresii</i>	Tawny Dragon			11/10/2015	64
	<i>Ctenophorus pictus</i>	Painted Dragon			1/04/2001	1
	<i>Ctenotus orientalis</i>	Spotted Ctenotus			29/10/2003	2
	<i>Ctenotus spaldingi</i>	Eastern Striped Skink			5/10/2008	12
	<i>Delma mollerii</i>	Gulfs Delma			1/11/2016	32
	<i>Diplodactylus furcosus</i>	Ranges Stone Gecko			31/10/2003	12
	<i>Diplodactylus vittatus complex</i> (NC)	Stone Geckos			11/11/2003	8
	<i>Egernia sp.</i>				10/11/2003	1
	<i>Egernia striolata</i>	Eastern Tree Skink			11/11/2003	3
	<i>Gehyra lazelli</i>	Southern Rock Dtella			5/10/2008	36
	<i>Gehyra variegata</i> (NC)	Tree Dtella			3/10/2008	4
	<i>Gehyra variegata complex</i>				14/10/1992	2
	<i>Hemiergis decresiensis</i>	Three-toed Earless Skink			5/10/2008	46
	<i>Hemiergis peronii</i>	Four-toed Earless Skink			12/11/2003	7
	<i>Heteronotia binoei</i>	Bynoe's Gecko			12/11/2003	10
	<i>Lampropholis guichenoti</i>	Garden Skink			5/10/2008	2
	<i>Lerista bougainvillii</i>	Bougainville's Skink			1/03/2017	35
	<i>Lerista dorsalis</i>	Southern Four-toed Slider			28/10/2003	2
	<i>Lerista sp.</i>				28/10/2003	1
	<i>Lialis burtonis</i>	Burton's Snake-lizard			12/11/2003	4
	<i>Menetia greyii</i>	Dwarf Skink			1/03/2017	52
	<i>Morethia adelaidensis</i>	Adelaide Snake-eye			1/03/2017	13
	<i>Morethia boulengeri</i>	Common Snake-eye			5/10/2008	23
	<i>Morethia obscura</i>	Mallee Snake-eye			12/11/2003	26
	<i>Parasuta nigriceps</i>	Mitchell's Short-tailed Snake			29/10/2003	4

Exotic	Scientific name	Common name	Conservation status		Last sighting (year)	No. observed
			Aus	SA		
	<i>Parasuta spectabilis</i>	Mallee Black-headed Snake			3/10/2008	38
	<i>Pogona barbata</i>	Eastern Bearded Dragon			5/10/2008	6
	<i>Pogona vitticeps</i>	Central Bearded Dragon			1/04/2001	2
	<i>Pseudemoia entrecasteauxii</i>	Southern Grass Skink			30/08/1978	1
	<i>Pseudonaja textilis</i>	Eastern Brown Snake			1/10/2008	28
	<i>Strophurus intermedius</i>	Southern Spiny-tailed Gecko			19/05/1991	1
	<i>Tiliqua adelaidensis</i>	Pygmy Blue-tongue	EN	E	1/03/2017	898
	<i>Tiliqua occipitalis</i>	Western Blue-tongue			25/09/2011	1
	<i>Tiliqua rugosa</i>	Sleepy Lizard			23/10/2017	53
	<i>Tiliqua scincoides</i>	Eastern Blue-tongue			1/03/2017	7
	<i>Tympanocryptis lineata</i>	Lined Earless Dragon			1/01/1950	1
	<i>Underwoodisaurus milii</i>	Common Barking Gecko			1/04/2001	6
	<i>Varanus gouldii</i>	Sand Goanna			2/11/2014	3
	<i>Varanus sp.</i>	goannas			23/10/2010	1

Conservation status

Aus: Australia (*Environment Protection and Biodiversity Conservation Act 1999*). **SA:** South Australia (*National Parks and Wildlife Act 1972*). Conservation Codes: **CR/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.

Appendix 3. Number of individuals of each bird species recorded at point count sites over the Project Area.

Species	Common name	EPB C	NP W	PC 3	PC 4	PC 5	PC1 0	PC1 1	PC1 2	PC1 3	PC1 6	PC1 7	PC2 0	PC2 1	PC2 2	PC2 3	PC2 4	PC2 5	PC2 6	PC2 7	PC2 8	PC2 9	PC3 0	PC3 1	PC3 2	PC3 3	PC3 4	PC3 5	Cou nt	Su m	
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater				1																	1	2	1				1		5	6
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill																												0	0	
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill			4	3															1		2	3					3	2	7	18
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk					1																							1	1	
<i>Accipiter fasciatus</i>	Brown Goshawk																				1								1	1	
<i>Acrocephalus australis</i>	Australian Reed Warbler														3														1	3	
<i>Anthochaera carunculata</i>	Red Wattlebird														3					1								2	4		
<i>Anthus australis</i>	Australian Pipit							1		5					1													5	10		
<i>Apheocephala leucopsis</i>	Southern Whiteface			2	1																2	3					3	5	11		
<i>Aquila audax</i>	Wedge-tailed Eagle												2	1						1						1		4	5		
<i>Artamus cyanopterus</i>	Dusky Woodswallow										6				5													3	15		
<i>Barnardius zonarius barnardi</i>	Mallee Ringneck			2		2													2		1					4		5	10		
<i>Chalcides basalis</i>	Horsfield's Bronze Cuckoo			1															2		1						3	4	3	4	
<i>Climacteris picumnus</i>	Brown Treecreeper													4													3	3	10		
<i>Colluricincla harmonica</i>	Grey Shrike-thrush			1	1	2								3		2				1				1	1		1	9	13		
<i>Coracina novaehollandiae</i>	Black-faced Cuckooshrike													1											1		2	3	4		
<i>Corcorax melanorhamphos</i>	White-winged Chough		R	1																								4	2	5	
<i>Corvus mellori</i>	Little Raven			4	2	2							1	20						1	1	1	1	1	1	1	6	1	14	44	
<i>Cracticus torquatus</i>	Grey Butcherbird			1	1	1												1											6	6	
<i>Dacelo novaeguineae</i>	Laughing Kookaburra										3																		1	3	
<i>Daphoenositta chrysoptera</i>	Varied Sittella					5																							1	5	
<i>Dromaius novaehollandiae</i>	Emu																												1	2	
<i>Egretta novaehollandiae</i>	White-faced Heron														1														1	1	
<i>Eolophus roseicapilla</i>	Galah			5	5	4		1		14			1	54									3	2	2	2	1	4	13	98	
<i>Falco cenchroides</i>	Nankeen Kestrel											1																	1	3	
<i>Gavialis virescens</i>	Singing Honeyeater			2	1															1	2							2	6	9	
<i>Grallina cyanoleuca</i>	Magpie-lark													3															1	3	
<i>Gymnorhina tibicen</i>	Australian Magpie			1	1	2				1			1	2									1	1			1	3	12	21	
<i>Malurus lamberti</i>	Variegated Fairy-wren																												4	9	
<i>Malurus splendens</i>	Splendid Fairy-wren																												1	2	
<i>Manorina flavigula</i>	Yellow-throated Miner					3							10																4	21	
<i>Megalururus gramineus</i>	Little Grassbird													1															1	1	
<i>Melanodryas cucullata cucullata</i>	Hooded Robin (SE, MM, MLR, AP, YP, MN)		R																	1	2							2	3		
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater																												3	5	
<i>Microcarbo melanoleucos melanoleucos</i>	Little Pied Cormorant													2															1	2	
<i>Microeca fascians assimilis</i>	Jacky Winter (MM LNE, FR, EP, NW)					3														2									2	5	
<i>Nesoptilotis leucotis</i>	White-eared Honeyeater			3																									5	7	
<i>Ocyphaps lophotes</i>	Crested Pigeon			1										2															3	5	
<i>Pachycephala pectoralis</i>	Golden Whistler					1															1								2	2	
<i>Pachycephala rufiventris</i>	Rufous Whistler																												2	2	
<i>Pardalotus punctatus</i>	Spotted Pardalote					2														2									2	4	
<i>Pardalotus striatus</i>	Striated Pardalote			6		8					3			2		1				1			3	2	2	2	2	1		14	36

Species	Common name	EPB C	NP W	PC 3	PC 4	PC 5	PC1 0	PC1 1	PC1 2	PC1 3	PC1 6	PC1 7	PC1 0	PC2 1	PC2 2	PC2 3	PC2 4	PC2 5	PC2 6	PC2 7	PC2 8	PC2 9	PC2 0	PC3 1	PC3 2	PC3 3	PC3 4	PC3 5	Cou nt	Su m	
Passer domesticus*	House Sparrow														2														1	2	
Petrochelidon nigricans	Tree Martin										8																		1	8	
Petroica goodenovii	Red-capped Robin			2																									1	2	
Phaps chalcoptera	Common Bronzewing			2																							2		2	4	
Platyercus elegans	Crimson Rosella														4														2	7	
Pomatostomus superciliosus	White-browed Babbler			1	5																6	3	3	1					6	19	
Psephenotus haematonotus	Red-rumped Parrot										11			3															2	14	
Ptilinula ornata	Yellow-plumed Honeyeater						3													1	1								3	5	
Ptilinula penicillata	White-plumed Honeyeater						5				10			9															3	24	
Pyrrholaemus brunneus	Redthroat																			1									1	1	
Rhipidura albiscapa	Grey Fantail						2																						2	5	
Rhipidura leucophrys	Willie Wagtail													2								1							3	9	
Smicromis brevirostris	Weebill			14	6	10							3						2	2	3	6	5	4	1	2	4	3	14	65	
Stagonopleura guttata	Diamond Firetail		V											1															1	1	
Sturnus vulgaris*	Common Starling										1			1															2	2	
Grand Total				55	28	56	1	1	1	6	80	1	1	21	121	2	1	0	16	12	27	30	31	18	7	20	36	11	5	57	587

As per Figure 8, Green = autumn point count, Blue = autumn/spring point count and yellow = spring point count.

Conservation status

Aus: Australia (Environment Protection and Biodiversity Conservation Act 1999), SA: South Australia (National Parks and Wildlife Act 1972), Conservation Codes: **CRICE**: Critically Endangered, **ENIE**: Endangered, **VUNV**: Vulnerable, **R**: Rare, *: denoted exotic species, ssp.: the conservation status applies at the sub-species level.

Appendix 4. Number and abundance of bird species recorded at Porter's Lagoon (spring 2019).

	Scientific name	Common name	Conservation status		No. of individuals
			Aus	SA	
	<i>*Alauda arvensis</i>	Eurasian Skylark			1
	<i>Anthus australia</i>	Australasian Pipit			1
	<i>Charadrius ruficapillus</i>	Red-capped Plover			5
	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike			1
	<i>Corvus mellori</i>	Little Raven			2
	<i>Eolophus roseicapilla</i>	Galah			10
	<i>Epthianura albifrons</i>	White-fronted Chat			1
	<i>Epthianura aurifrons</i>	Orange Chat			1
	<i>Falco cenchroides</i>	Australian Kestrel			1
	<i>Gymnorhina tibicen</i>	Australian Magpie			2
	<i>Lalage tricolor</i>	White-winged Triller			1
	<i>Larus novaehollandiae</i>	Silver Gull			2
	<i>Manorina flavigula</i>	Yellow-throated Miner			2
	<i>Pardalotus striatus</i>	Striated Pardalote			1
	<i>Sturnus vulgaris</i>	Common Starling			3
	<i>Vanellus miles</i>	Masked Lapwing			8
				Total	42

* denotes exotic species



EBS Ecology
125 Hayward Avenue
Torrensville, SA 5031
www.ebsecology.com.au
t. 08 7127 5607



Goyder South Hybrid Renewable Energy Facility



LANDSCAPE AND VISUAL ASSESSMENT

Prepared for:

Neoen Australia Pty Ltd

Prepared by:

GREEN BEAN DESIGN

landscape architects

GREEN BEAN DESIGN PTY LTD

Principal: Andrew Homewood *Grad Dip. LM, BSc (Dual Hons), Dip. Hort*, Registered Landscape Architect, AILA, MEIANZ

PO Box 3178 Austral NSW 2179

(ABN: 86 603 575 702)

DOCUMENT CONTROL

ITEM	DETAIL
Project Name:	Goyder South Hybrid Renewable Energy Facility
Report Title:	Landscape and Visual Impact Assessment
Project Number:	19-264
Version Number:	v4
Status:	Final
Author:	Andrew Homewood , Registered Landscape Architect, AILA <i>Graduate Diploma Landscape Management, Bachelor Science (Dual Honours)</i> <i>Landscape Design and Archaeology, National Diploma Horticulture</i>
Date	9 June 2020

Contents	Page
Executive summary	8
Section 1	Introduction
1.1	Introduction 9
1.2	Location 9
1.3	Regional Council of Goyder Development Plan 10
Section 2	Methodology and report structure
2.1	Methodology 12
2.2	Report structure 12
Section 3	Project description
3.1	Project description 15
3.2	Wind turbines 15
3.3	Solar panels 16
3.4	Battery storage 17
3.5	Aviation obstacle lighting 18
3.6	Wind monitoring masts 19
3.7	On site access roads 19
3.8	Construction 20
Section 4	Viewshed
4.1	Viewshed 22
Section 5	Panorama and aerial photographs
5.1	Panorama and aerial photographs 23
Section 6	Landscape character assessment
6.1	Landscape character area 45
6.2	Landscape character assessment 45
Section 7	Zone of Visual Influence (wind turbines)
7.1	Zone of Visual Influence 50
7.2	ZVI methodology 50
7.3	Visibility 51
7.4	Climate and atmospheric conditions 52
Section 8	Key views and visual effects
8.1	Introduction 58
8.2	Sensitivity of visual receivers 58
8.3	Magnitude of visual effects 58
8.4	Views from townships and localities 62

Contents		Page
	8.5	Burra Gorge and campsite 62
	8.6	Views from transport corridors 63
	8.7	Views from agricultural land 64
	8.8	Views from publicly accessible locations 64
	8.9	Views from dwellings 65
	8.10	Summary of visual effect (within 5km of wind turbines) 101
	8.11	Summary of visual effect (beyond 5km of wind turbines) 101
Section 9	Cumulative assessment (wind turbines)	
	9.1	Cumulative Impact Assessment 102
Section 10	Wind turbine shadow flicker and blade glint summary	
	10.1	Introduction 103
	10.2	Shadow flicker modelling outcomes 103
	10.3	Blade glint 104
Section 11	Solar panel sun glint, glare and lighting	
	11.1	Introduction 105
	11.2	Sun glint 105
	11.3	Glare 105
	11.4	Assessment 105
	11.5	Lighting 106
Section 12	Photomontages	
	12.1	Photomontages 107
Section 13	Pre-construction and construction	
	13.1	Potential visual effects 125
Section 14	Mitigation measures	
	14.1	Mitigation measures 129
	14.2	Detail design 129
	14.3	Construction 129
	14.4	Operation 129
	14.5	On-site and off-site landscape mitigation 130
Section 15	Conclusion	
	15.1	Conclusion 131
Appendix A	DNV-GL Shadow Flicker and Blade Glint Assessment	

Figures

Figure 1	Regional locality
Figure 2	Project site and general layout
Figure 3	Panorama and aerial photo locations
Figure 4	Panorama photo sheet 1
Figure 5	Panorama photo sheet 2
Figure 6	Panorama photo sheet 3
Figure 7	Panorama photo sheet 4
Figure 8	Panorama photo sheet 5
Figure 9	Panorama photo sheet 6
Figure 10	Panorama photo sheet 7
Figure 11	Panorama photo sheet 8
Figure 12	Panorama photo sheet 9
Figure 13	Panorama photo sheet 10
Figure 14	Panorama photo sheet 11
Figure 15	Panorama photo sheet 12
Figure 16	Aerial photo A1
Figure 17	Aerial photo A2
Figure 18	Aerial photo A3
Figure 19	Aerial photo A4
Figure 20	Aerial photo A5
Figure 21	Aerial photo A6
Figure 22	Aerial photo A7
Figure 23	Aerial photo A8
Figure 24	Zone of Theoretical Visibility
Figure 25	ZVI diagram for tip of blade
Figure 26	ZVI diagram for hub height
Figure 27	Wind turbine visibility
Figure 28	Solar panel visibility
Figure 29	Dwelling locations
Figure 30	Photomontage locations
Figure 31	Photomontage BU03
Figure 32	Photomontage BU06
Figure 33	Photomontage BU07
Figure 34	Photomontage BU10
Figure 35	Photomontage BU12
Figure 36	Photomontage BU13

Figures

Figure 37	Photomontage BU14
Figure 38	Photomontage BU15
Figure 39	Photomontage BU16
Figure 40	Photomontage BU18
Figure 41	Photomontage BU21
Figure 42	Photomontage BU22
Figure 43	Photomontage BU23
Figure 44	Photomontage BU24
Figure 45	Photomontage BU10

Glossary

This Landscape and Visual Impact Assessment has adopted and adapted the following definitions from Guidelines for Landscape and Visual Impact Assessment (2013).

Table 1 Glossary

Cumulative effects	The summation of effects that result from changes caused by a development in conjunction with other past, present or reasonably foreseeable actions.
Magnitude	A combination of the scale, extent and duration of an effect.
Mitigation	Measures, including any processes, activity or design to avoid, reduce, remedy or compensate for adverse landscape and visual effects of a development project.
Photomontage (Visualisation)	Computer simulation or other technique to illustrate the appearance of a development.
Sensitivity	Susceptibility of a receiver to a specific type of change.
Visibility	A relative determination at which the proposal can be clearly discerned and described.
Visual amenity	The value of a particular area or view in terms of what is seen.
Visual effect	The changes in the character of the available views resulting from the development or the changes in visual amenity of the visual receivers.
Visual Impact Assessment	A process of applied professional and methodical techniques to assess and determine the extent and nature of change to the composition of existing views that may result from a development.
View location	A place or situation from which a proposed development may be visible.
Visual receiver	Individual and/or defined groups of people who have the potential to be affected by a proposal.
Visual significance	A measure of the importance or gravity of the visual effect culminating from the degree of magnitude and receiver sensitivity.

Executive Summary

Green Bean Design Pty Ltd (GBD) was commissioned by Neoen Australia Pty Ltd (the Proponent) to undertake a Landscape and Visual Impact Assessment (LVIA) for the proposed Goyder South Hybrid Renewable Energy Facility South (the Project).

The Project's principal assets would comprise up to 163 wind turbines, solar panels and up to 900MW/1800MWh of lithium-ion battery storage across two facilities. These principal assets would also be supported by a range of ancillary infrastructure such as access roads, site office, workshop, up to three substations, meteorological masts (including 3 existing masts on the project site), temporary construction compounds, temporary concrete batching plants and temporary laydown areas.

The majority of proposed wind turbines have been modelled and assessed with an overall maximum blade tip height of up to 240 metres (m). Three wind turbines (B010, B017 and B024) have been reduced to a 200 m maximum tip height to mitigate visual impact from the Burra township. The wind turbines would be the most visible component of the Project.

This LVIA has determined that the landscape within, and immediately surrounding the Project Site, is generally robust and defined by visually strong forms and patterns and is considered to exhibit attributes which tend to result in a moderate sensitivity with some potential to accommodate change.

Whilst the broader landscape displays visual characteristics and heritage elements which are highly valued and have a high degree of visual amenity, the immediate landscape character is represented by a partially modified agricultural landscape, comprising lower rounded and sparsely timbered, grassed and cropped hills. The Project Site landscape character is commonly found, and generally ubiquitous, within the broader landscape.

The removal of small amounts of vegetation to facilitate construction of the Project, is not considered to result in a significant impact on existing landscape values within, or beyond the Project Site. The removal of vegetation would be largely restricted to the construction of access roads, wind turbine hardstands and solar panel installation and would not result in a significant change to the overall extent or context of existing views.

The Project would have potential to result in a range of visual effects on a small number of dwellings and homesteads within 5km of the Project Site. These impacts would be dependent on a number of physical and environmental characteristics (e.g. landform and vegetation) surrounding the dwellings which would determine overall visibility and prominence of the Project within specific views.

Although some mitigation measures are considered appropriate to minimise the visual effects for a number of ancillary structures associated with the Project, it is acknowledged that the degree to which the wind turbines may be visually mitigated is limited by their scale and position within the landscape relative to surrounding view locations.

Introduction

Section 1

1.1 Introduction

This LVIA has been prepared by GBD on behalf of the Proponent to accompany a development application for the proposed Goyder South Hybrid Renewable Energy Facility. This LVIA is an assessment of the suitability of the Project and its principal assets within the landscape surrounding the Project Site, as well as considering the potential extent and degree of visual effects on people living in, and travelling through, the surrounding landscape.

This LVIA has been prepared with regard to the following documents and guidelines to identify and consider potential landscape and visual impacts:

- Wind Farm Development Guidelines for Developers and Local Government Planners (2014), Central Local Government Region of South Australia; and
- Regional Council of Goyder Development Plan, Renewable Energy Facilities (Consolidated 24 November 2016).

In addition, this LVIA has also considered landscape and visual impact assessment guidance set out in:

- Guidelines for Landscape and Visual Impact Assessment, Third Edition, Landscape Institute and Institute of Environmental Management & Assessment, 2013;
- Siting and Designing Wind Farms in the Landscape, Version 3a August 2017, Scottish Natural Heritage; and
- Visual Representation of Wind Farms, Version 2.2 February 2017, Scottish Natural Heritage

1.2 Location

The proposed development is located approximately 5km south of Burra extending approximately 30km south toward Robertstown. This area is located in the eastern portion of the northern Mount Lofty Ranges and wholly located within the Regional Council of Goyder. From a transport and access perspective, the region is serviced by the Barrier Highway, the Burra-Morgan Highway (Goyder Highway) and the Worlds End Highway.

The project is located within the Mid North Region (for the purposes of strategic land use planning) and the SA Murray-Darling Basin Natural Resource Management Area. The project is located within the “Northern Ranges” of the Rangelands part of the SA Murray-Darling Basin NRM. This area is generally described as a transitional zone between cropping and pastoral country. It is noted that the project is not located within a prescribed water resources area.

The Goyder South project incorporates land which was first developed as the “Stony Gap” project, a wind only project that received development approval in 2014.

1.3 Regional Council of Goyder Development Plan

The Project and its principal assets would be located in the Regional Council of Goyder Primary Production Zone. This LVIA notes the Regional Council of Goyder Development Plan states that wind farms and ancillary development are an envisaged form of development within this zone, and further states that:

Such facilities may be of a large scale, comprise a number of components and require an extended and/or dispersed development pattern. These facilities will need to be located in areas where they can take advantage of the natural resource upon which they rely and, as a consequence may be need to be:

- *located in visually prominent locations such as ridgelines*
- *visible from scenic routes and valuable scenic and environmental areas*
- *located closer to roads than envisaged by generic setback policy.*

This, coupled with the large scale of these facilities (in terms of both height and spread of components), renders it difficult to mitigate the visual impacts of wind farms to the degree expected of other types of development. Subject to implementation of management techniques set out by general / council wide policy regarding renewable energy facilities, these visual impacts are to be accepted in pursuit of benefits derived from increased generation of renewable energy.

In consideration of Renewable Energy Facilities, the Regional Council of Goyder also notes that:

The visual impacts of wind farms and ancillary development (such as substations, maintenance sheds, access roads and wind monitoring masts) should be managed through:

(a) wind turbine generators being:

- (i) setback at least 1000 metres from non-associated (non-stakeholder) dwellings and tourist accommodation*
- (ii) setback at least 2000 metres from defined and zoned township, settlement or urban areas (including deferred urban areas)*
- (iii) regularly spaced*
- (iv) uniform in colour, size and shape and blade rotation direction*
- (v) mounted on tubular towers (as opposed to lattice towers)*

(b) provision of vegetated buffers around substations, maintenance sheds and other ancillary structures.

The Project Site regional locality is illustrated in **Figure 1**.

Legend



Proposed wind turbines
(indicative extent)



Operational wind farms
and/or wind farm precincts

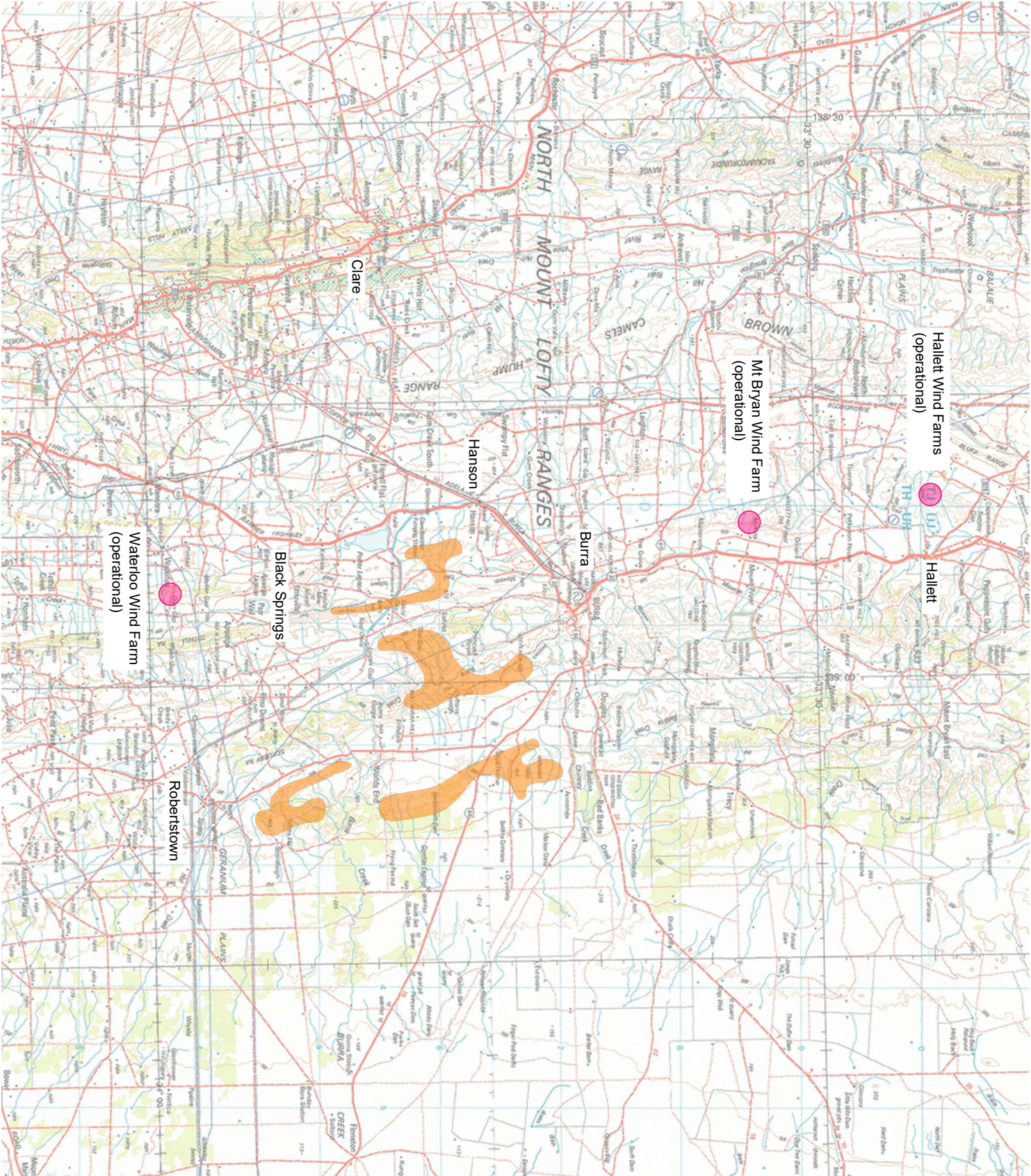


Figure 1
Regional locality

Goyder South Hybrid Renewable Energy Facility

Methodology and report structure

Section 2

2.1 Methodology

The methodology employed for this LVIA has been based on existing guidelines identified in Section 1.1. The methodology is also based on professional judgement and assessment of multiple wind farm projects undertaken by GBD within South Australia Queensland, New South Wales, Victoria and Tasmania. The key tasks incorporated into the LVIA methodology are identified in **Table 2**.

2.2 Report structure

This LVIA report been structured into 14 parts as follows:

Table 2 – Report structure

Report section	Description
1 – Introduction	This section provides an introductory section that describes the intent and purpose of the LVIA.
2 – Methodology and report structure	This section sets out the structure and methodology employed in the LVIA preparation.
3 – Project description	This section describes the regional and local position of the Project relative to existing landscape features and places and describes the key visible components of the Project.
4 – Viewshed	This section identifies the area of land surrounding the wind farm which may be potentially affected by the Project.
5 – Panorama photographs	This section illustrates the LVIA with panorama photographs taken during the site inspection. The panorama photographs are provided to illustrate the general appearance of typical landscape characteristics that occur within and surrounding the Project Site.
6 – Landscape Character Assessment	This section describes the physical characteristics of the landscape surrounding the Project Site and

Table 2 – Report structure

Report section	Description
	determines the overall sensitivity of the landscape to the Project.
7 – Zone of theoretical visibility	This section identifies a theoretical area of the landscape from which wind turbines may be visible within the viewshed, and describes a range of factors which may influence the Project's visibility within the viewshed.
8 – Visual effects (key view points)	This section describes and determines the potential visual effect of the Project on key viewpoints within the viewshed.
9 – Cumulative assessment	This section describes the potential impact of alternate existing and/or known wind farm developments within proximity to the Project Site.
10 – Shadow flicker/blade glint assessment summary	This section presents a summary of the shadow flicker and blade glint assessment prepared by DNV-GL.
11 – Solar panel sun glint, glare and lighting	This section describes the potential visual effect of sun glint, glare and lighting associated with the solar panels within proximity to the Project Site.
12 – Wind turbine photomontages	This section presents photomontage of the proposed wind turbines to illustrate potential views toward the Project from surrounding public view locations.
13 – Pre-construction and construction	This section describes the activities associated with pre-construction and during construction which may create visual impacts.

Table 2 – Report structure

Report section	Description
14 – Mitigation measures	This section outlines potential mitigation measures to minimise visual impacts arising from the Projects development.
15 – Conclusion	Conclusions are drawn on the overall visual effect of the Project.
Appendix A	Appendix A presents the detailed Shadow flicker and blade glint assessment prepared by DNV-GL.

Project description

Section 3

3.1 Project description (wind turbines)

The key visual Project components would comprise:

- up to 163 wind turbines (160 to a maximum 240 metre tip height and 3 to a maximum 200 metre tip height)
- up to 3,000 hectares of single axis photovoltaic panels (PV panels)
- up to 2 battery storage facilities
- up to 3 substations and associated infrastructure
- up to 55km of overhead transmission line (275kV or 330kV double circuit)
- up to 2 Operations and Maintenance compounds (including site office and workshop) with car parking
- meteorological masts
- crane hardstand areas
- on-site access roads for construction, operation and ongoing maintenance and
- signage.

Temporary works associated with the construction of the Project that may be visible during construction phases include:

- temporary site offices and construction compounds
- temporary meteorological masts
- temporary laydown areas and
- mobile concrete batching plant and rock crushing facilities.

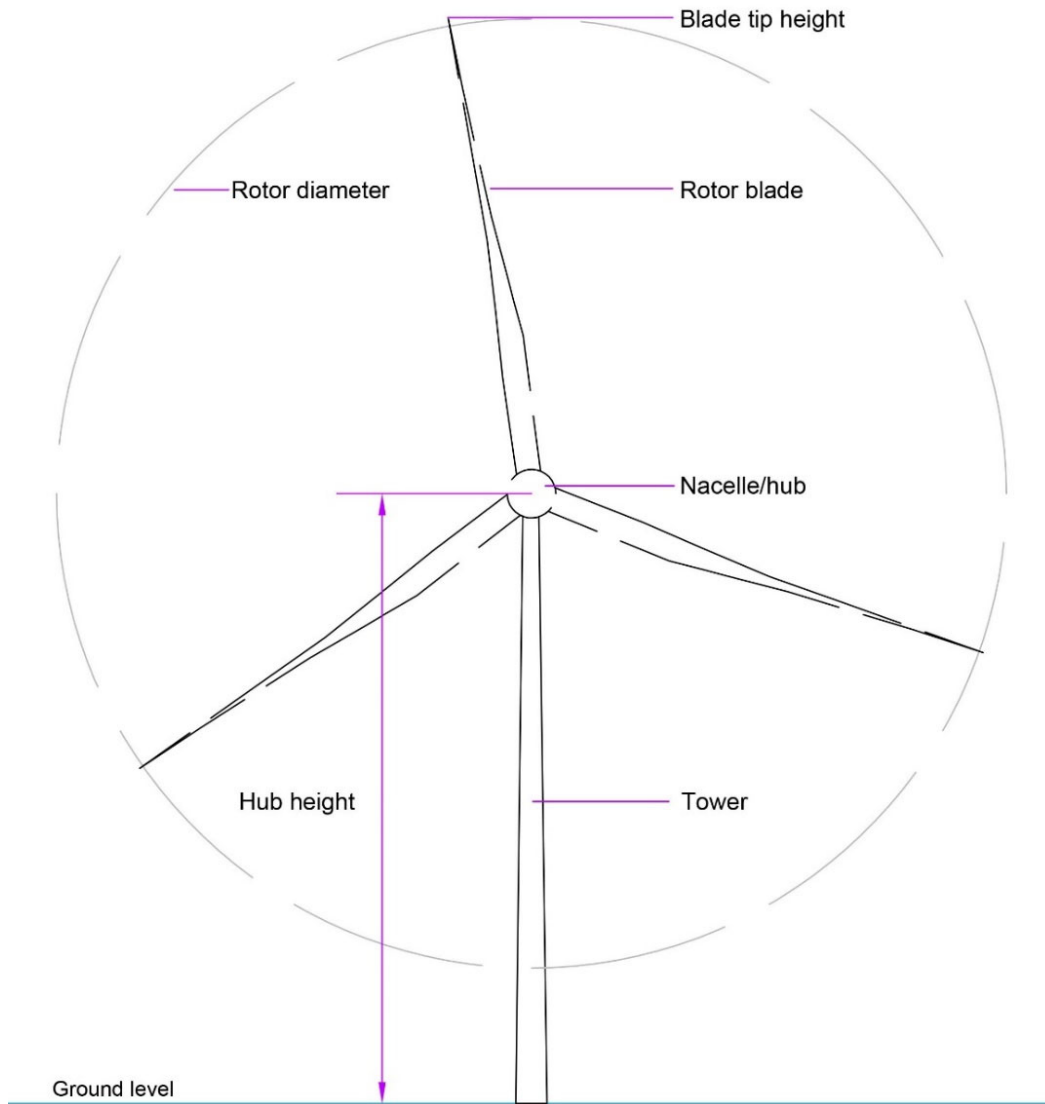
The indicative Project Site and layout is illustrated in **Figure 2**.

3.2 Wind turbines

The specific elements of the wind turbines typically comprise:

- concrete foundations
- tubular tapering steel and/or concrete towers
- nacelles at the top of the tower housing electrical generator and gearbox (depending on design)
- a hub attached to the nacelle and
- three composite material blades attached to the hub.

The following diagram identifies the main components of a typical wind turbine:



3.3 Solar panels

The key solar infrastructure components of the project would include:

- bifacial photovoltaic panels (around 1m x 2m) mounted on framework with maximum pole/axis height of 3m height, and maximum tilt height of 4m (up to 10m spacing between rows)
- power conversion blocks (PCB) (Inverters 1 – 2.5MW capacity, step-up transformers and switchgear)
- collection circuits, underground cables for connection to the terminal substation
- safety fencing of the entire facility (chain mesh)
- access track (up to 7m wide) to and from site and within solar arrays and to PCBs and
- temporary construction compound, offices and laydown area.



Plate 1 – Typical solar panel detail and arrangement (Image supplied: Neoen Australia Pty Ltd 2020)



Plate 2 – Typical inverters (Image: GBD 2018)

3.4 Battery storage

The battery storage infrastructure will be located adjacent to the existing Robertstown substation and/or the planned nearby interconnector substation.



Plate 3 – Typical battery storage facility, Hornsdale SA (Image supplied: Neoen Australia Pty Ltd 2017)



Plate 4 – Typical battery storage facility, Hornsdale SA (Image: GBD 2018)

3.5 Aviation obstacle lighting

The Proponent commissioned an Aviation Impact Statement (AIS) which was completed by Chiron Aviation Consultants Pty Ltd (November 2019). The AIS included a detailed consideration with regard to obstacle lighting

needs and requirements for the installation and operation of obstacle lighting. The AIS concluded that there will be a low level of aviation safety risk associated with the potential for an aircraft collision without obstacle lighting on the wind turbines. The AIS concluded that no obstacle lighting is required for wind turbines. Accordingly, this LVIA has not undertaken an assessment of potential visual effects associated with obstacle lighting.

3.6 Wind monitoring masts

Wind monitoring masts would be installed on-site, extending up to the wind turbine hub height. The permanent wind monitoring masts are expected to be of a guyed, narrow lattice or tubular steel design. The permanent wind monitoring masts would not create a significant visual impact in the context of the overall wind farm development.

3.7 On-site access roads

On-site access roads would be constructed to provide access to turbine locations across the site during construction and operation. During construction, the running width of access roads would be approximately 6 m and wider on corners. Following construction, the disturbance will be rehabilitated leaving a road of sufficient a running width to accommodate turbine delivery.

The access road design is developed on a number of environmental grounds, including minimising the potential for visual impact by considering:

- the overall length and extent
- the use of existing farm track route and laneways
- the need for clearing vegetation
- the potential for erosion
- the extent of cut and fill and
- the potential to maximise rehabilitation at the completion of the construction phase.



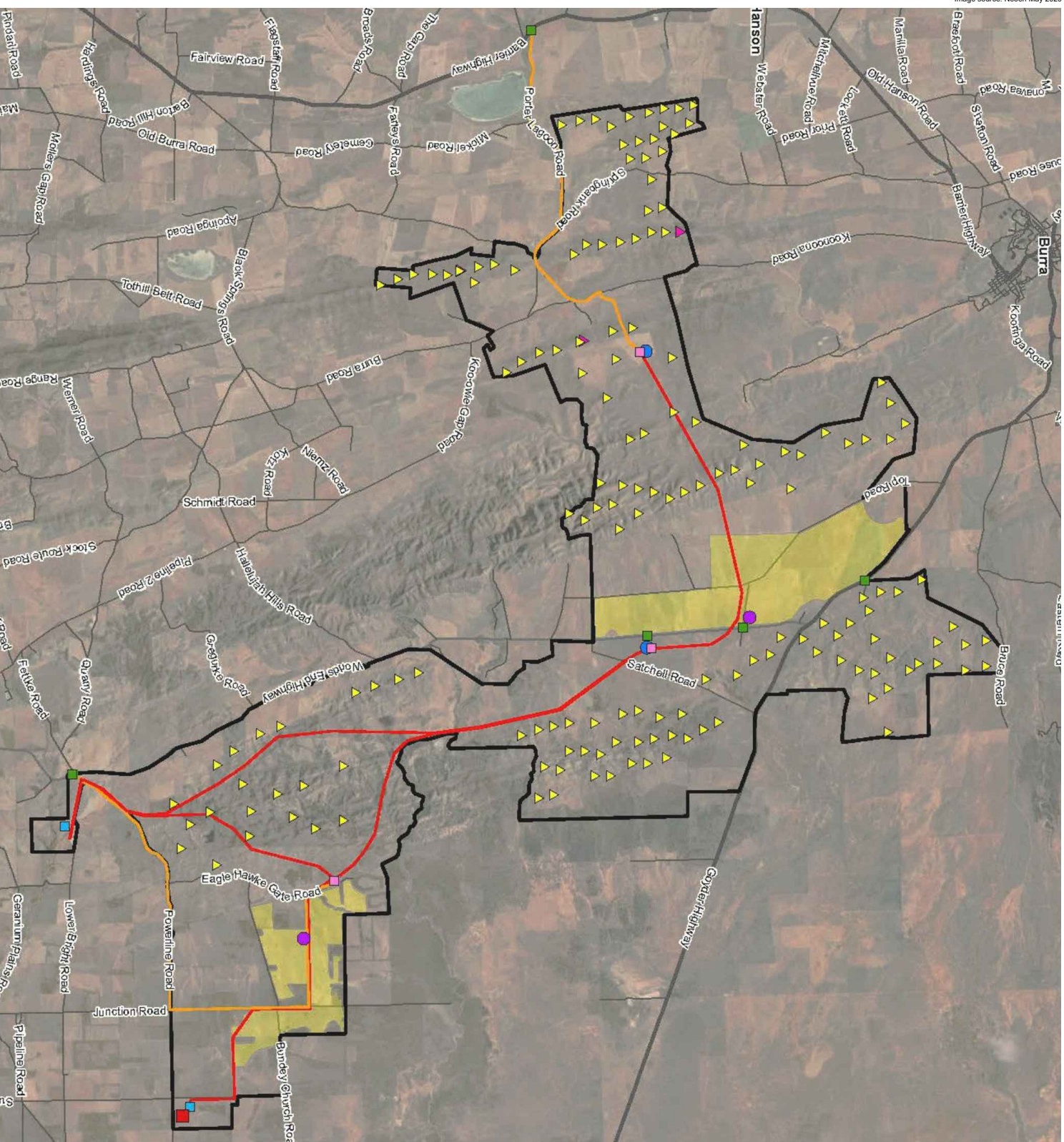
Plate 5 – Typical substation facility, Hornsdale SA (Image: GBD 2018)

3.8 Construction

There are potential visual impacts that could occur during both pre-construction and construction phases of the project. The extent and nature of pre-construction and construction activities will vary at different locations within the Project Site. The key pre-construction and construction activities that will be visible from areas surrounding the Project include:

- ongoing detailed site assessment including sub surface geotechnical investigations
- various civil works to upgrade local roads and access point
- construction compound buildings and facilities
- construction facilities, including portable structures and laydown areas
- various construction and directional signage
- mobilisation of rock crushing equipment and concrete batching plant
- excavation and earthworks and
- various construction activities including erection of wind turbines, monitoring masts and terminal substation with associated electrical infrastructure works.

The majority of pre-construction and construction activities, some of which will result in physical changes to the landscape, are generally temporary in nature and are typically restricted to various discrete areas within or just beyond the immediate Project Site. The majority of pre-construction and construction activities will be unlikely to result in an unacceptable level of visual impact given their duration and temporary nature.



- Legend**
- ▲ Turbine layout (total turbines 163)
 - ▭ Goyder South project boundary
 - Solar farms
 - ▲ Existing met mast (3)
 - ▲ Construction entry point (5)
 - Substation and O&M (3)
 - Possible interconnector substation
 - Solar construction compound (2)
 - Wind construction compound (2)
 - Construction access road
 - Road (sub arterial)
 - Road (collector and local)

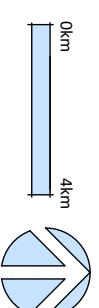


Figure 2
Project site and general layout

Goyder South Hybrid Renewable Energy Facility

Viewshed

Section 4

4.1 Viewshed

For the purpose of this LVIA the viewshed is defined as the area of land surrounding and beyond the Project Site which may be potentially affected by the Project's assets. In essence, the viewshed defines this LVIA study area. The overall viewshed for the Project has been illustrated at 5km extending across the landscape away from the wind turbines. The 5km viewshed extends to illustrate the location of dwellings and farms to the east and north north-east and south of the Project Site.

It is important to note that the wind turbines would be visible from areas of the landscape beyond the 5km viewshed; however, within the general parameters of normal human vision, a wind turbine at a maximum tip height of 240m to the tip of the rotor blade would occupy a relatively small proportion of a person's field of view from distances in excess of 5km and result in a relatively lower level of perceived visual significance. The relationship between the Project viewshed and dwellings is illustrated in **Figure 29**.

Panorama and aerial photographs

Section 5

5.1 Panorama and aerial photographs

A series of panorama and aerial photographs were taken during the fieldwork to illustrate landscape characteristics within and surrounding the Project Site and to give a sense of the overall site in its setting. The panorama and aerial photographs were digitally stitched together to form a segmented panorama image to provide a visual illustration of the existing view from each photo location.

The panorama and aerial photographs presented in this LVIA have been annotated to identify local features within and beyond the Project Site. The photograph locations are illustrated in **Figure 3**, and the panorama and aerial photographs illustrated in **Figures 4 to 23**.

Goyder South Hybrid Renewable Energy Facility

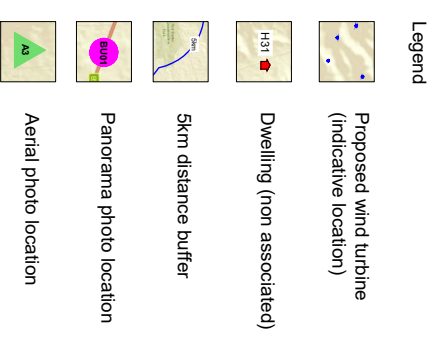
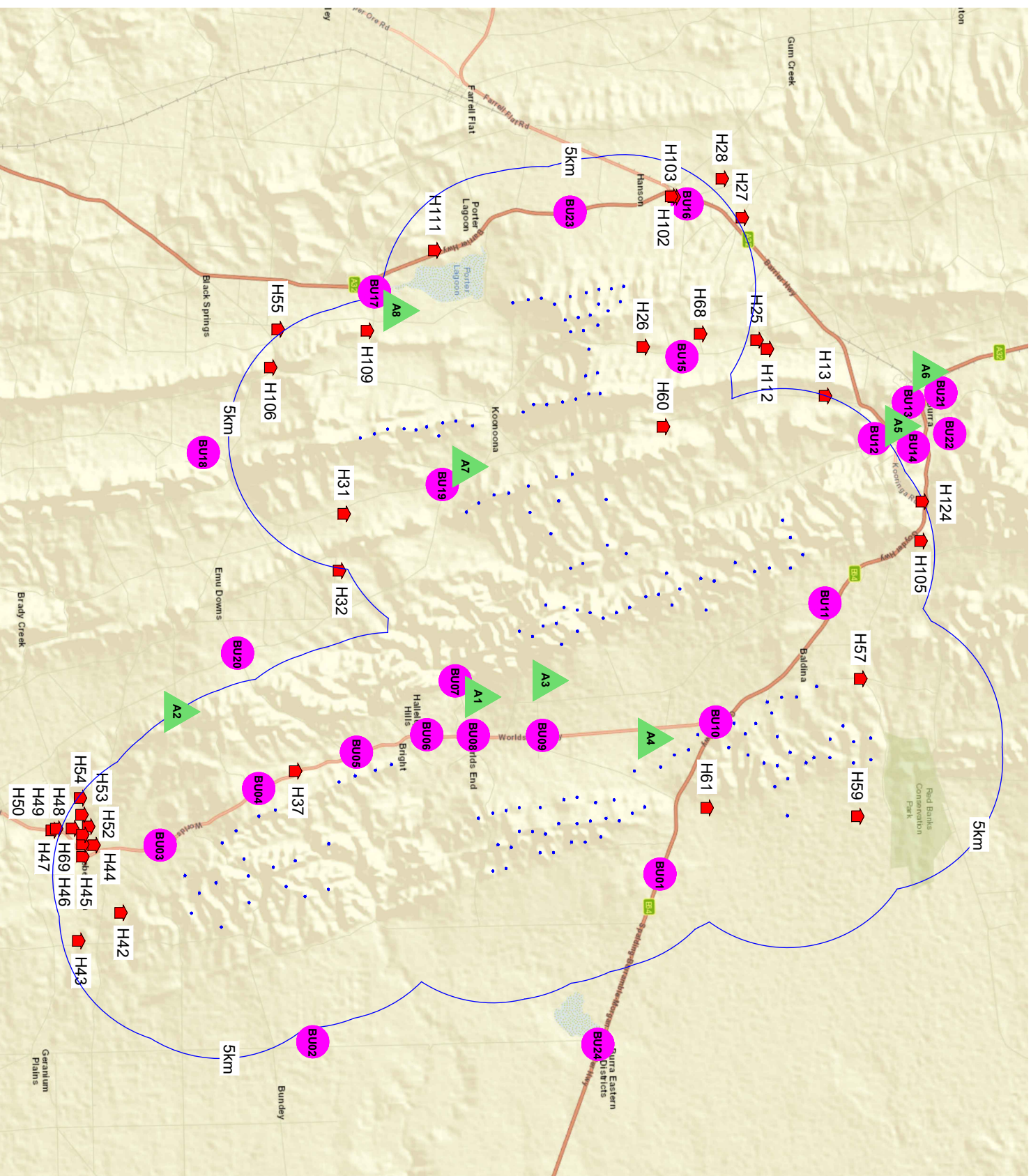


Figure 3
Panorama and aerial
photo locations

Goyder Highway

Medium to long distance views toward wind turbines along low hills and slopes

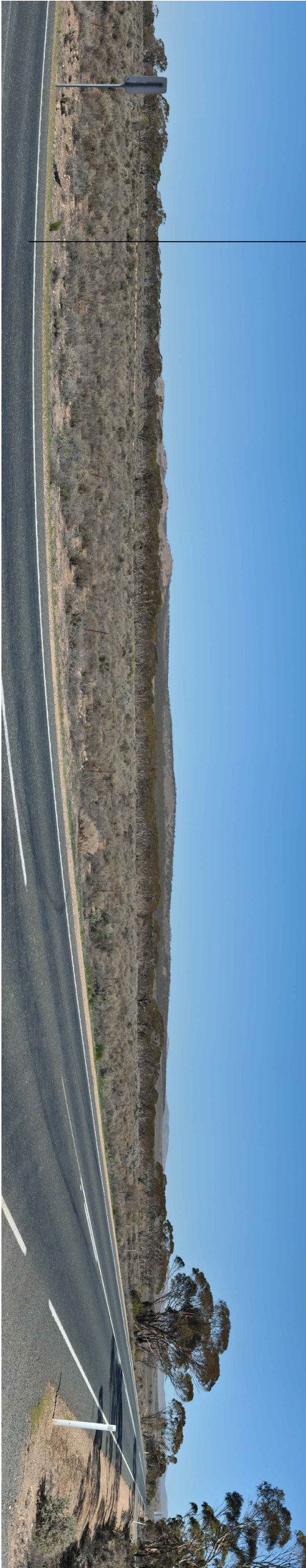


Photo location BU01 Existing view south to north west from Goyder Highway rest stop south east of Burra

Direct short distance views toward solar panels and turbines beyond from minor unsealed access road.

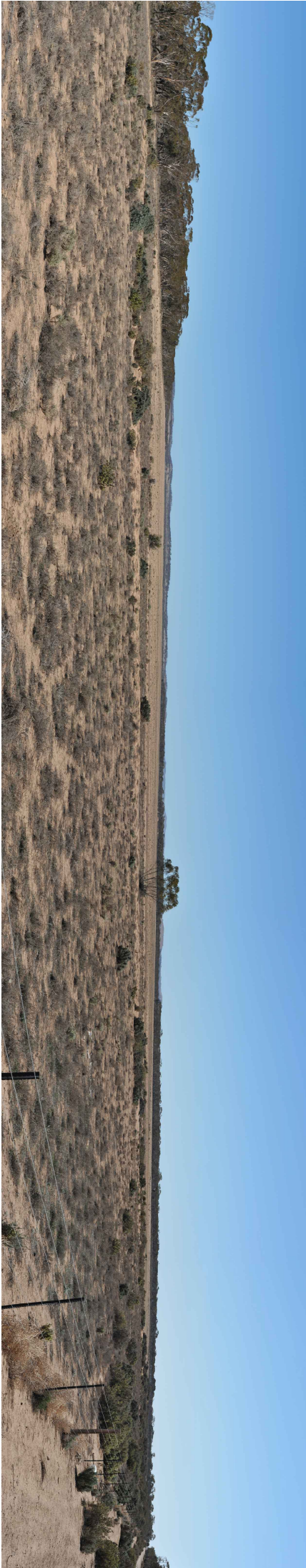
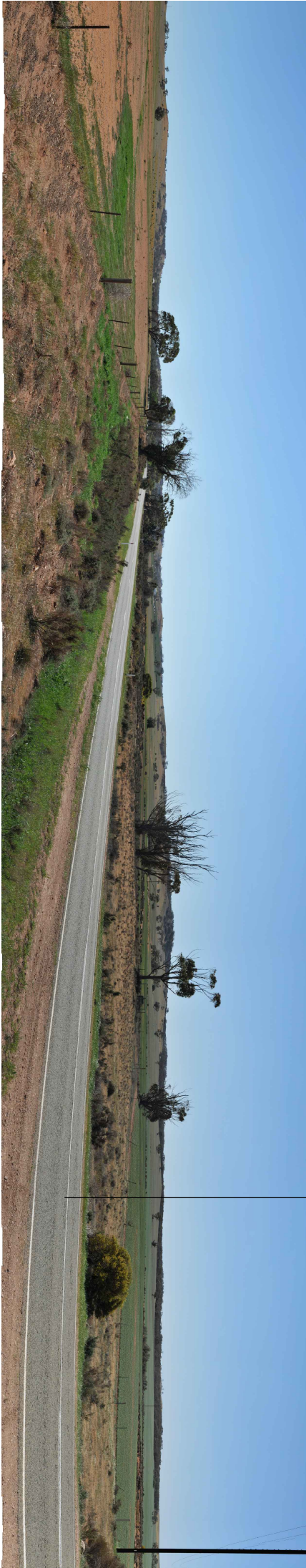


Photo location BU02 Existing view west to north toward southern solar farm site

Figure 4
Panorama photo sheet 1

Short to long distance views toward wind turbines along low hills and slopes



Worlds End High way

Photo location BU03 Existing view north west to east from Worlds End Highway (refer figure 31 photomontage BU03)

Short to long distance views toward wind turbines along low slopes



Worlds End High way

Photo location BU04 Existing view north to south east adjoining Worlds End Highway

Figure 5
Panorama photo sheet 2



Hallelujah Hills Road

Short to long distance views toward wind turbines along low hills and slopes

Worlds End Highway

Photo location BU05 Existing view from Hallelujah Hills Road and Worlds End Highway



Medium to long distance views toward wind turbines along hills and ridgelines

Medium to long distance views toward wind turbines on low hills and slopes

Worlds End Highway

Photo location BU06 Existing view adjoining Worlds End Highway from Heysen Trail (refer figure 32 photomontage BU06)

Figure 6
Panorama photo sheet 3

Long distance views toward wind turbines along low hills and slopes



Worlds End Camp Site

Photo location BU07 Existing view north east to east from Worlds End Campsite (refer figure 33 photomontage BU07)

Worlds End Gorge Road Burra Gorge

Long distance views toward wind turbines along hills and ridgelines

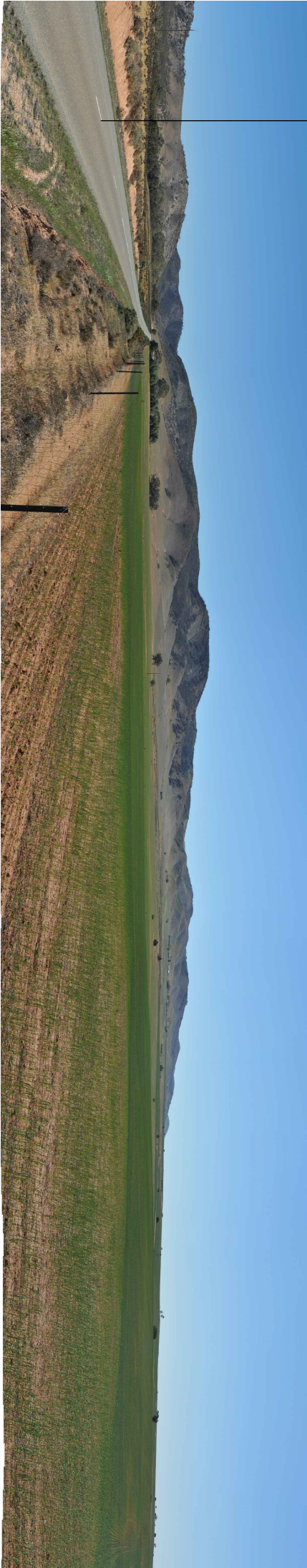
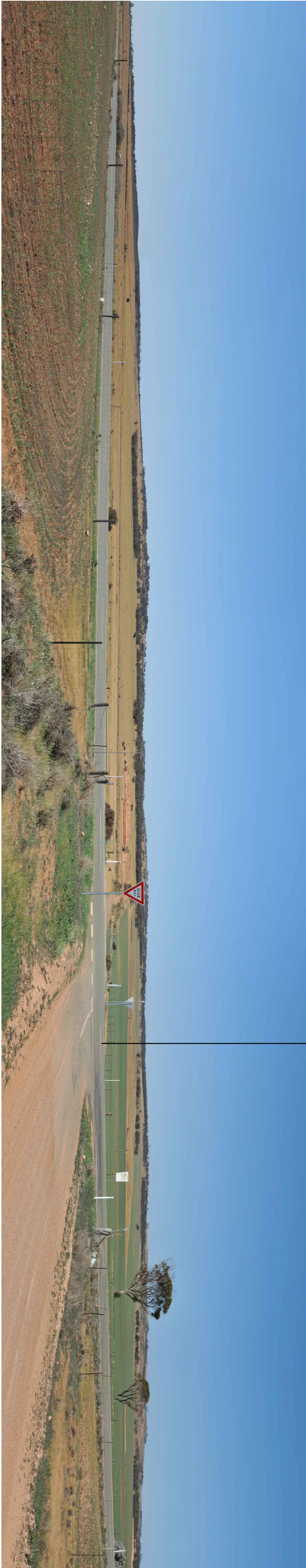


Photo location BU08 Existing view west to north north west from Worlds End Gorge Road adjoining Worlds End Highway

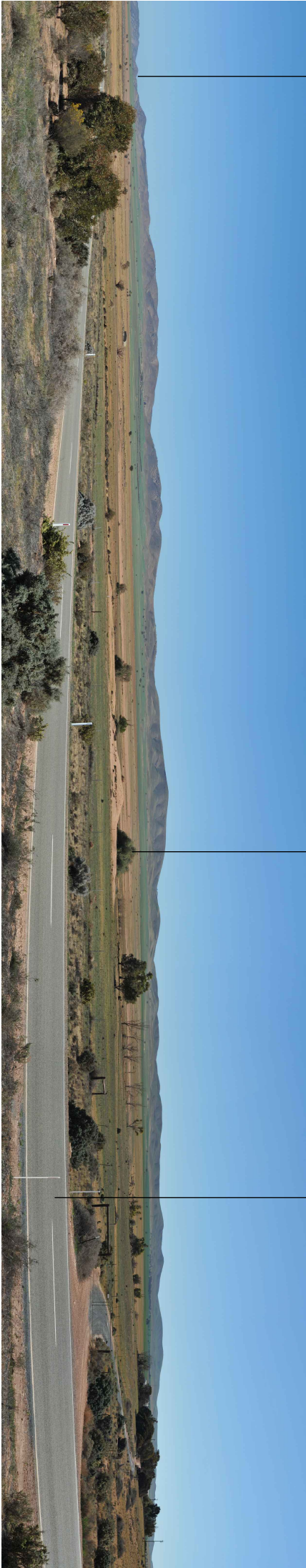
Figure 7
Panorama photo sheet 4



Short to long distance views toward wind turbines along low hills and slopes

Worlds End Highway

Photo location BU09 Existing view east to north north east from Satchel Road West adjoining Worlds End Highway



Burra Gorge

Short to long distance views toward wind turbines along hills and ridgelines

Solar farm (north)

Worlds End Highway

Photo location BU10 Existing view adjoining Worlds End Highway toward north solar farm site

Figure 8
Panorama photo sheet 5



Top End Road

Medium distance views toward wind turbines along low hills and slopes

Photo location BU11 Existing view south west to north west from Top End Road

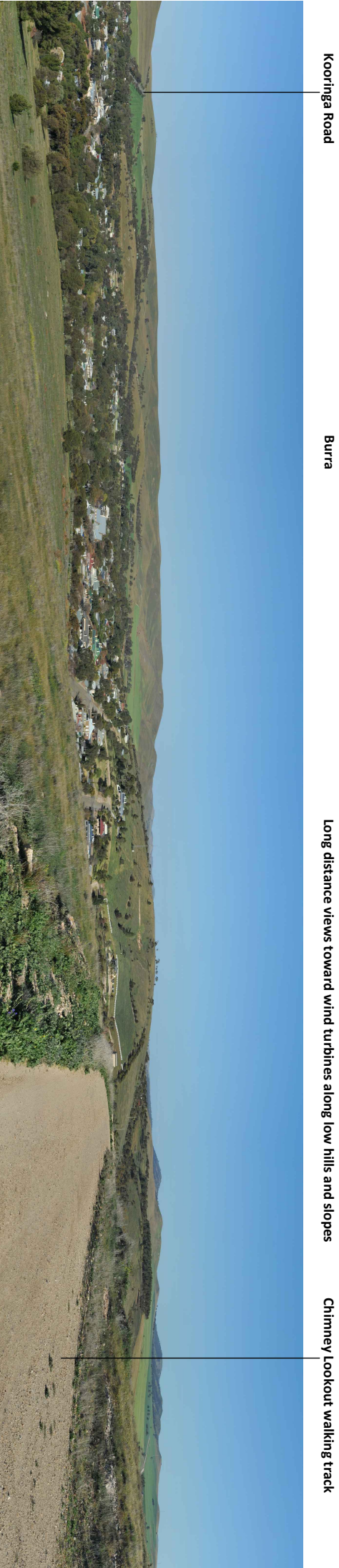


Market Street

Distant views toward wind turbines largely restricted by foreground hills and slopes

Photo location BU12 Existing view south to south east from Market Street (Barrier Highway) Burra (refer figure 35 photomontage BU12)

Figure 9
Panorama photo sheet 6



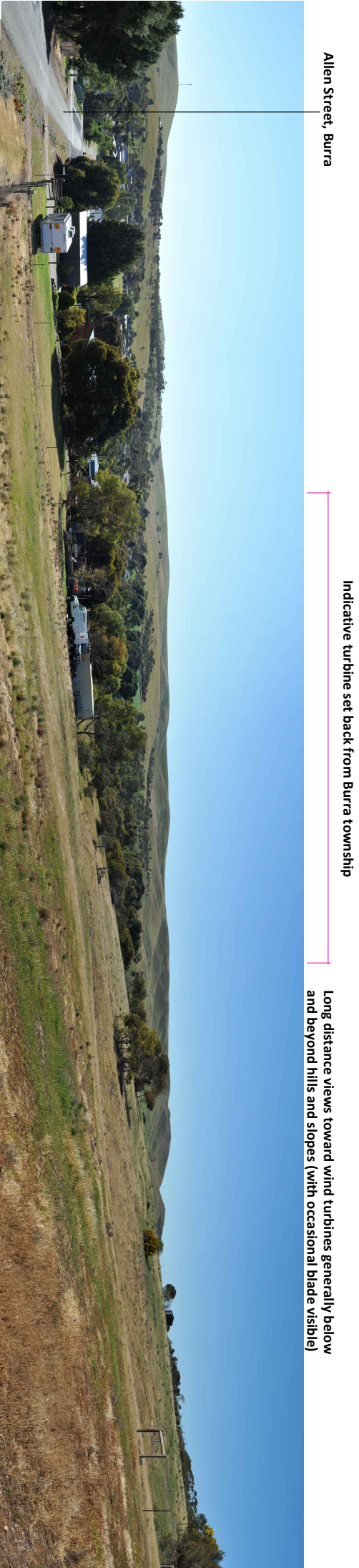
Koorlinga Road

Burra

Long distance views toward wind turbines along low hills and slopes

Chimney Lookout walking track

Photo location BU13 Existing view east to south east from Chimney Hill Lookout, Burra Mine Site (refer figure 36 photomontage BU13)



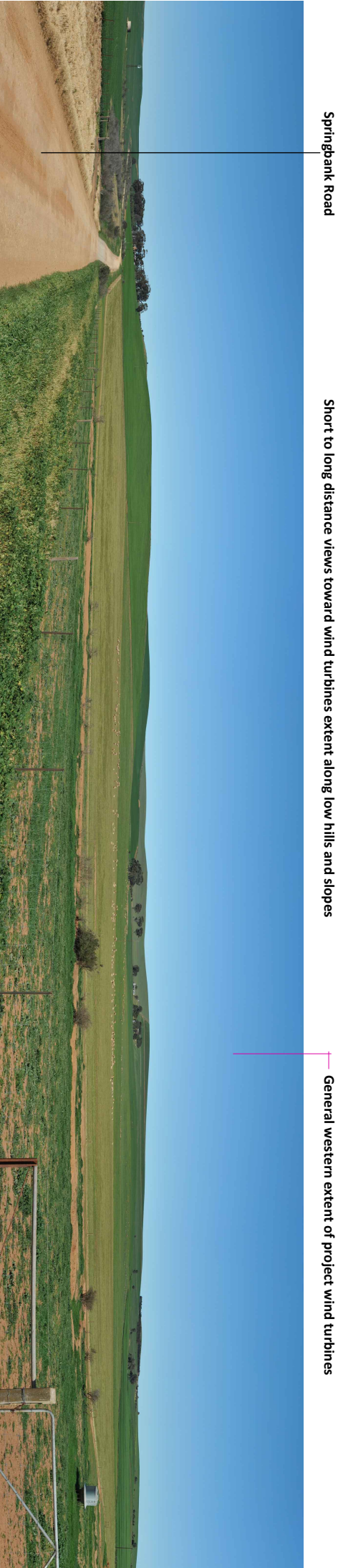
Allen Street, Burra

Indicative turbine set back from Burra township

Long distance views toward wind turbines generally below and beyond hills and slopes (with occasional blade visible)

Photo location BU14 Existing view east to south from Allen Street, Burra (refer figure 37 photomontage BU14)

Figure 10
Panorama photo sheet 7



Springbank Road

Short to long distance views toward wind turbines extend along low hills and slopes

General western extent of project wind turbines

Photo location BU15 Existing view south to south south west from Springbank Road (refer figure 38 photomontage BU15)



Medium distance views toward wind turbines along low slopes

Photo location BU16 Existing view north east to south east West Terrace, Hanson

Figure 11
Panorama photo sheet 8



Photo location BU17 Existing view north east to south south east from Farley's Road

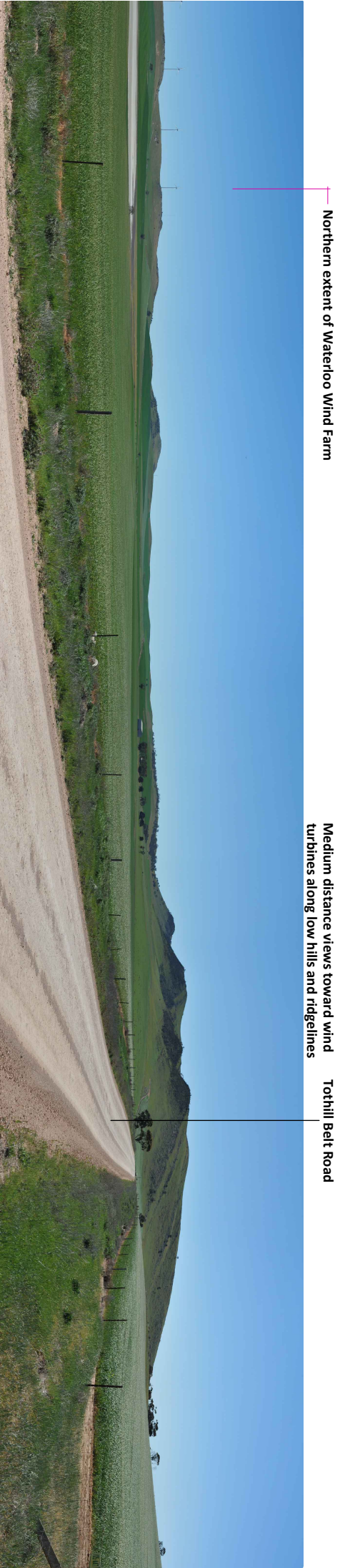


Photo location BU18 Existing view west to north east from Tothill Belt Road (refer figure 40 photomontage BU18)

Figure 12
Panorama photo sheet 9



Photo location BU19 Existing view north west to north east from Burra Road and Koo Owie Gap Road



Photo location BU20 Existing view north east to north west from Hallelujah Hills Road

Figure 13
Panorama photo sheet 10



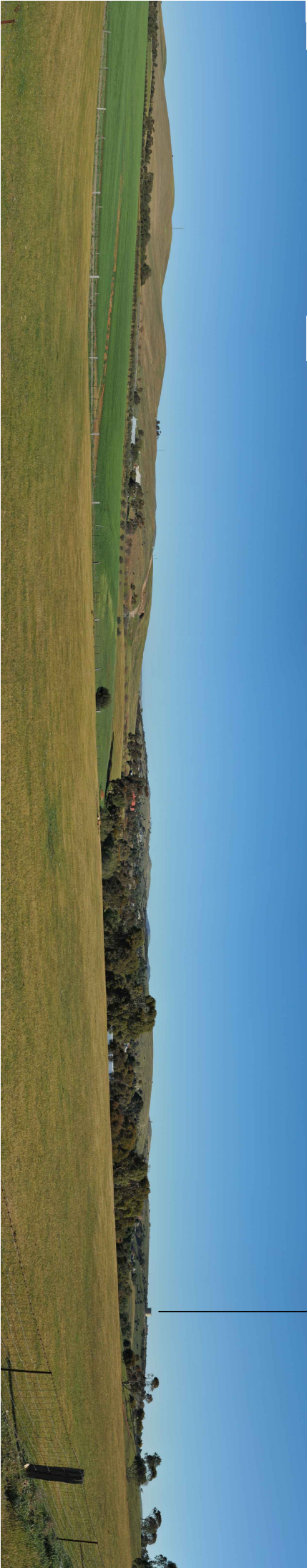
Barrier Highway

Burra

Long distance views toward wind turbines beyond ridgelines

Burra Mine Site

Photo location BU21 Existing view east to south west from Burra mine town lookout (refer figure 41 photomontage BU21)



Long distance views toward wind turbines along ridgelines

Burra Mine Site

Water tank

Photo location BU22 Existing view north east to north west from Llanelly Road, Burra (refer figure 42 photomontage BU22)

Figure 14
Panorama photo sheet 11

Medium distance views toward wind turbines along low hills

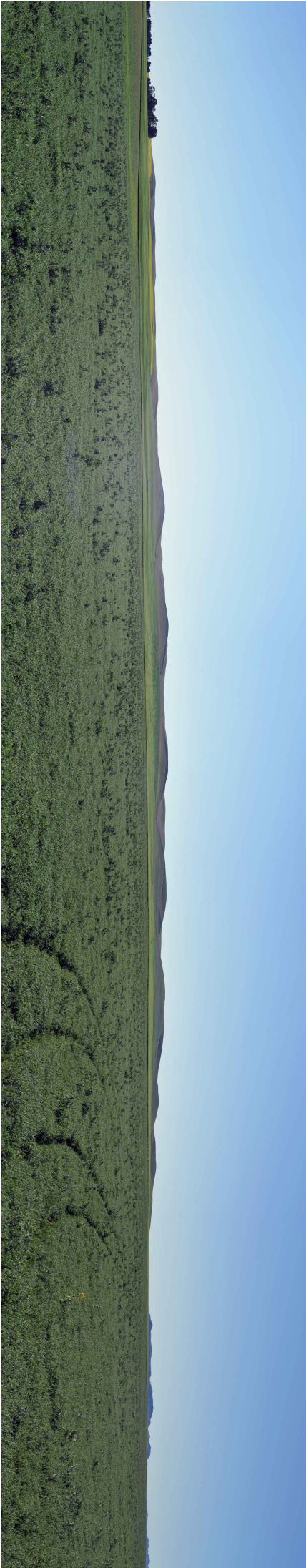


Photo location BU23 Existing view north east to south south east from Barrier Highway (refer figure 43 photomontage BU23)

Expansive and long distance views toward wind turbines along ridgelines and low hills (to both sides of highway)

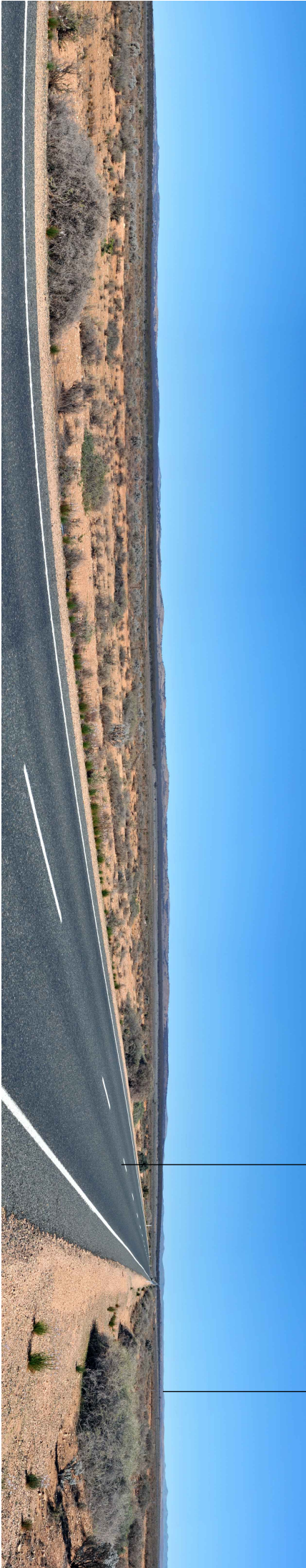


Photo location BU24 Existing view south west to north west from Goyder Highway (refer figure 44 photomontage BU24)

Figure 15
Panorama photo sheet 12



Aerial photo location A1 Existing view above the Worlds End Camp Site toward Burra Gorge and hills beyond

Figure 16
Aerial photo 1

Mount Bryan

Worlds End Highway

Hallelujah Hills Road



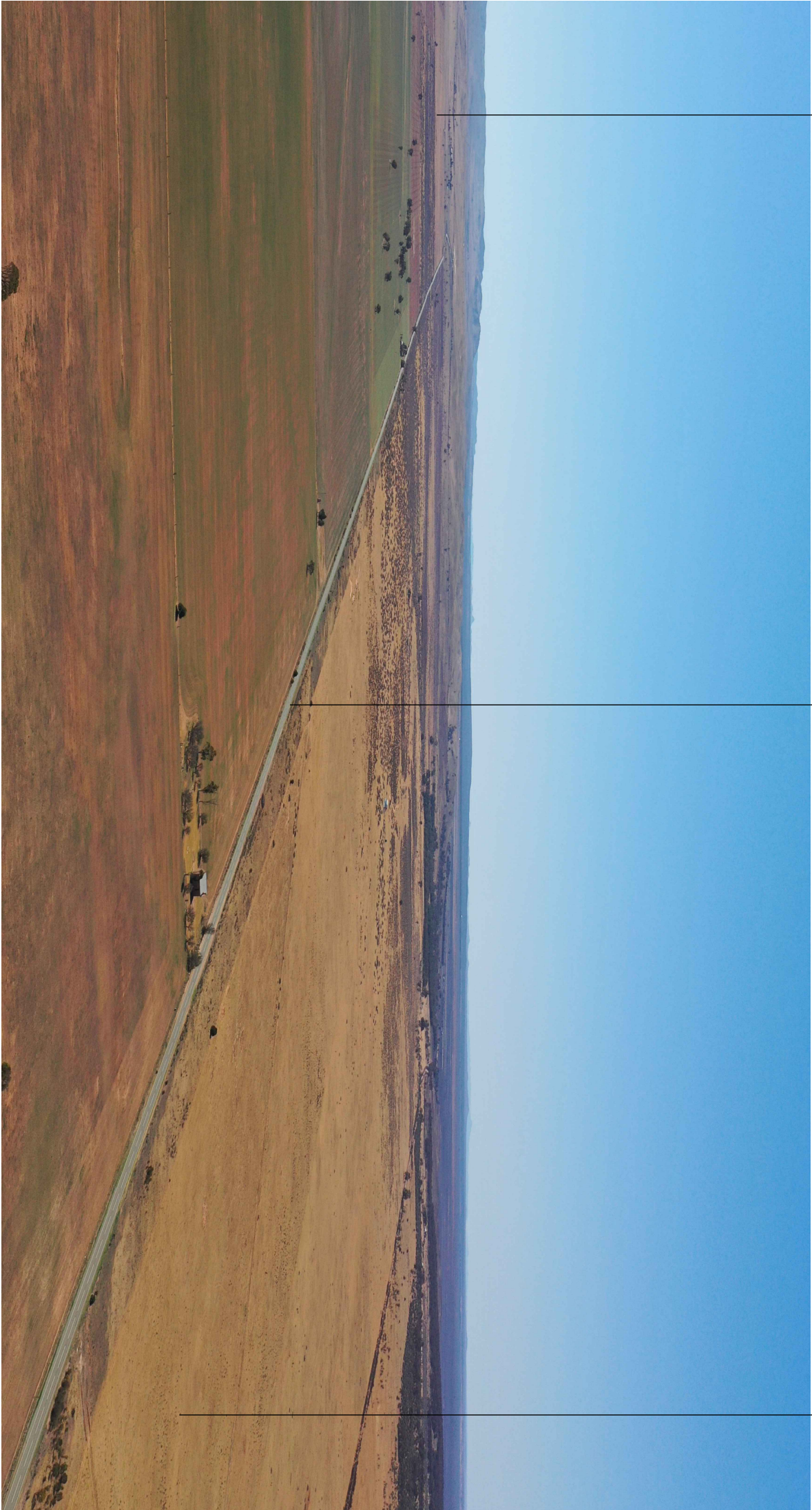
Aerial photo location A2 Existing view above the Hallelujah Hills Road toward the Worlds End Highway

Figure 17
Aerial photo 2

Proposed solar facility (north)

Worlds End Highway

Proposed substation
(general locality)



Aerial photo location A3 Existing view toward the Worlds End Highway extending toward the solar facility (north)

Figure 18
Aerial photo 3

Proposed solar facility (north)

Worlds End Highway

Goyder Highway



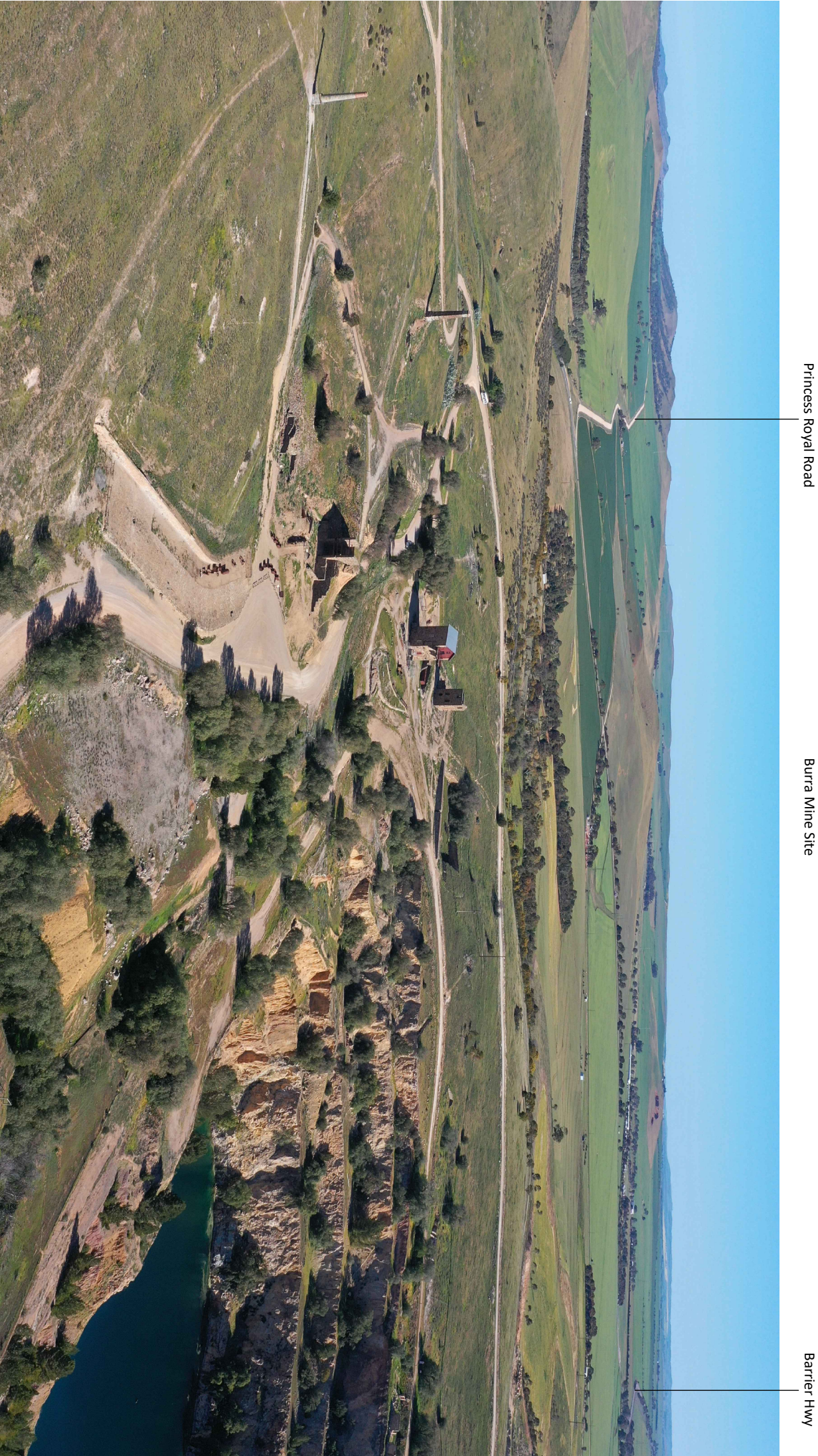
Aerial photo location A4 Existing view above the Worlds End Highway toward the Goyder Highway intersection.

Figure 19
Aerial photo 4



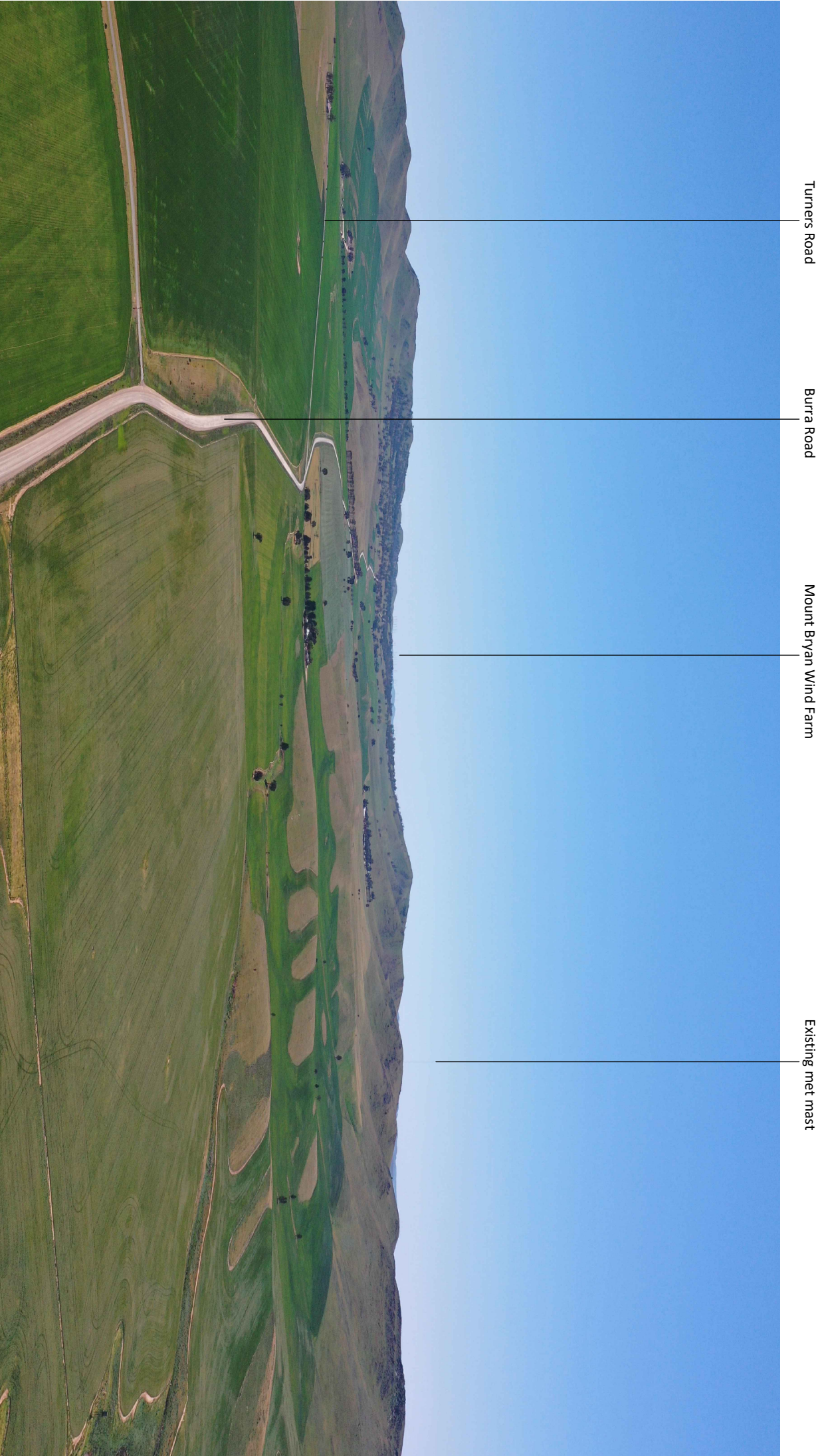
Aerial photo location A5 Existing view above Burra looking south toward the project site

Figure 20
Aerial photo 5



Aerial photo location A6 Existing view above Burra Mine Site looking south to south west toward the project site

Figure 21
Aerial photo 6



Aerial photo location A7 Existing view above Burra Road looking north with far distant views toward Mount Bryan Wind Farm

Figure 22
Aerial photo 7



Aerial photo location A8 Existing view above Farlays Road looking north with far distant views toward Mount Bryan Wind Farm

Figure 23
Aerial photo 8

Landscape character assessment

Section 6

6.1 Landscape character area

As part of the LVIA process it is important to understand the nature and sensitivity of different components of landscape character, and to assess them in a clear and consistent process. For the purpose of this LVIA, landscape character is defined as *‘the distinct and recognisable pattern of elements that occur consistently in a particular type of landscape’* (The Countryside Agency and Scottish Natural Heritage 2002). The pattern of elements includes characteristics such as landform, vegetation, land use and settlement.

For the purpose of this LVIA, the landscape character surrounding the Project has been determined as a singular landscape unit which generally occurs within the 5km viewshed of the Project Site. The landscape unit represents an area that is relatively recognisable in terms of its key landscape elements and physical attributes; which include a combination of topography/landform, vegetation/landcover, land use and built structures (including rural dwellings and local road corridors).

For the purpose of this LVIA the predominant landscape unit within and surrounding the Project Site has been identified as low undulating hills and ridgeline areas combining pastoral, cultivated and modified agricultural lands interspersed with occasional and scattered tree cover.

6.2 Landscape character assessment

An understanding of a particular landscape’s key characteristics and principal visual features is important in defining a distinctiveness and sense of place and to determine its sensitivity to change. The criteria applied in the determination of landscape character assessment and the ability of a landscape to accommodate change are outlined in **Table 3**. These criteria are based on established industry good practice employed in the assessment of wind farm developments and have been adopted for numerous wind farm assessments across Australia. The criteria are within the Guidelines for Landscape and Visual Impact Assessment, Third Edition, Landscape Institute and Institute of Environmental Management & Assessment, 2013 – Chapter 5 Assessment of landscape effects.

Landscape sensitivity is a relative concept, and landscape values of the surrounding environment may be considered of a higher or lower sensitivity than other areas in the region. Whilst landscape character assessment is largely based on a systematic description and analysis of landscape characteristics, this LVIA acknowledges that some individuals and other members of the local community may place higher values on the local landscape. These values may transcend preferences (likes and dislikes) and include personal and cultural influences.

Table 3 – Criteria for the assessment of landscape character

Landscape Character Assessment Criteria			
Characteristic	Aspects indicating lower sensitivity to the wind farm development	↔	Aspects indicating higher sensitivity to the wind farm development
Landform and scale:	<ul style="list-style-type: none"> • Large scale landform • Simple • Featureless • Absence of strong topographical variety 	↔	<ul style="list-style-type: none"> • Small scale landform • Distinctive and complex • Human scale indicators • Presence of strong topographical variety
Landcover: patterns, complexity and consistency	<ul style="list-style-type: none"> • Simple • Predictable • Smooth, regular and uniform 	↔	<ul style="list-style-type: none"> • Complex • Unpredictable • Rugged and irregular
Settlement and human influence	<ul style="list-style-type: none"> • Concentrated settlement pattern • Presence of contemporary structures (e.g. utility, infrastructure or industrial elements) 	↔	<ul style="list-style-type: none"> • Dispersed settlement pattern • Absence of modern development, presence of small scale, historic or vernacular settlement
Movement	<ul style="list-style-type: none"> • Prominent movement, busy 	↔	<ul style="list-style-type: none"> • No evident movement, still
Rarity	<ul style="list-style-type: none"> • Common or widely distributed example of landscape character area within a regional context 	↔	<ul style="list-style-type: none"> • Unique or limited example of landscape character area within a regional context
Intervisibility with adjacent landscapes	<ul style="list-style-type: none"> • Limited views into or out of landscape • Neighbouring landscapes of low sensitivity • Weak connections, self-contained area and views • Simple large-scale backdrops 	↔	<ul style="list-style-type: none"> • Prospects into and out from high ground or open landscape • Neighbouring landscapes of high sensitivity • Contributes to wider landscape • Complex or distinctive backdrops

The landscape sensitivity assessment criteria set out in **Table 3** have been evaluated for the landscape character area by applying a professionally determined judgement on a sliding scale between 1 and 5.

A scale of 1 indicates a landscape characteristic with a lower sensitivity to the wind farm development (and will be more likely to accommodate the wind farm development). A scale of 5 indicates a landscape characteristic with a high level of sensitivity to the wind farm development (and less likely to accommodate the wind farm development).

The scale of sensitivity for the landscape character area is outlined in **Table 4** and is set out against each characteristic identified in **Table 3**.

The overall landscape sensitivity for the landscape character area is a summation of the scale for each characteristic identified in **Tables 4**.

The overall scale is expressed as a total out of 30 (i.e. 6 characteristics for the landscape character area with a potential top scale of 5). Each characteristic is assessed separately and the criteria set out in **Table 3** are not ranked in equal significance. The overall landscape sensitivity for the landscape character area has been determined as either:

High (Scale of 23 to 30) – key characteristics of the landscape character area will be impacted by the Project, and will result in major and visually dominant alterations to perceived characteristics of the landscape character area which may not be fully mitigated by existing landscape elements and features. The degree to which the landscape may accommodate the Project will result in a number of perceived uncharacteristic and significant changes.

Medium (Scale 15 to 22) – distinguishable characteristics of the landscape character area may be altered by the Project, although the landscape character area may have the capability to absorb some change. The degree to which the landscape character area may accommodate the Project will potentially result in the introduction of prominent elements to the landscape character area, but may be accommodated to some degree.

Low Rating (Scale of 7 to 14) – the majority of the landscape character area characteristics are generally robust, and will be less affected by the Project. The degree to which the landscape may accommodate the Project will not significantly alter existing landscape character.

Negligible Rating (Up to 6) the characteristics of the landscape character area will not be impacted or visibly altered by the Project.

Table 4 – Landscape character area

	Lower Sensitivity		↔	Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Rating	1	2	3	4	5
Landform and Scale				4	
The landform and morphology of the landscape within and immediately surrounding the Project Site is relatively consistent with areas of gentle to moderately inclined landform extending around the Project Site. There is an overall large scale to the broader landscape defined by patterns being more moderate in scale. Landscape features and stronger topographical elements beyond the Project Site create a greater degree of complexity and more visually compartmentalised areas as a result of tree covered hills and gullies surrounding and beyond Burra Gorge.					

Table 4 – Landscape character area

	Lower Sensitivity		↔	Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Rating	1	2	3	4	5
Landcover			3		
	<p>Within the Project Site landcover is relatively simple and predictable, together with that of the immediate and surrounding landscape. Tree cover is generally limited within the 5km viewshed, occurring within steeper gullies across the Project Site or along drainage lines and intermittently along road corridors. European settlement established an agricultural presence which defines some of the contemporary farming areas within and beyond the Project Site.</p>				
Settlement and human influence				4	
	<p>Settlement is generally dispersed within the rural landscape immediately beyond the Project Site incorporating farmsteads and individual dwellings. There are small to moderate scale, historic or vernacular structures within the landscape including those associated with both the Burra township and the historic mine site. The majority of historic built elements or features resultant from human interactions are visually contained by the proximate landform surrounding and screening the Burra township from extensive and distant views.</p> <p>The Burra township is located around 5km to the north to of the Project Site (from closest wind turbine to the Burra Post Office on the Barrier Highway and Chapel Street intersection).</p>				
Movement				4	
	<p>Movement within and immediately adjacent to the Project Site is limited to a generally low to moderate frequency of vehicular movements and more notably along the Barrier Highway and Burra Morgan Road extending around the northern and western portions of the Project Site.</p>				
Rarity		2			
	<p>The Project Site and adjoining landscape are considered to be a relatively common landscape type within a regional context and do not tend to exhibit landscape features or elements which would only occur within the Project Site.</p>				

Table 4 – Landscape character area

	Lower Sensitivity		↔	Higher Sensitivity	
	Low	Low to Med	Medium	Med to High	High
Rating	1	2	3	4	5
Intervisibility			3		
	<p>Areas of landscape surrounding the Project Site can allow for far distant and regional scale views. Whilst views can, depending on prevailing climatic conditions, extend toward portions of landscapes with a moderate to high visual sensitivity, the level of distant visibility is generally restricted to landform silhouettes. Whilst the wind turbines would be visible from some elevated areas, the distance between wind farm and distant elevated receiver locations would tend to render the Project wind turbines as generally noticeable, but not dominant features which occupy a relatively small portion of the overall available view.</p>				
Overall Sensitivity Rating	<p>Score 20 out of 30</p> <p>In consideration of the existing landscape characteristics, the distinguishable characteristics of the landscape character area may be altered by the Project, although the landscape character area may have the capability to absorb some change. The degree to which the landscape character area may accommodate the Project will potentially result in the introduction of prominent elements to the landscape character area, but may be accommodated to some degree.</p>				

Zone of Visual Influence

Section 7

7.1 Zone of Visual Influence (ZVI)

The ZVI diagrams are used to identify theoretical areas of the landscape from which wind turbines, or portions of turbines, may be visible within the viewshed. They are useful for providing an overview as to the extent to which the Project may be visible from surrounding areas within the viewshed.

7.2 ZVI Methodology

The ZVI methodology is a purely geometric assessment where the visibility of the wind turbines is determined from carrying out calculations based on a digital terrain model of the Project Site and the surrounding terrain.

Calculations have been made to determine the visibility of the wind turbines from blade tips (essentially a view toward any part of the wind turbine rotor, including views toward the tips), and hub height (essentially a view between the nacelle and tip of blade).

The ZVI assessment methodology is very conservative as:

- the screening effects of any structures and vegetation above ground level are not considered in any way. Therefore, the Project may not be visible at some locations indicated on the ZVI diagrams due to the local presence of trees or other screening materials.
- additionally, the number of turbines visible from any location is also influenced by prevailing weather conditions. Inclement or cloudy weather would tend to mask the visibility of the wind turbines.

Accordingly, while a ZVI diagram is a useful visualisation tool, it is very conservative in nature and the level of visibility as illustrated in the ZVI diagram is unlikely to occur from all view locations within the surrounding viewshed.

A diagram illustrating the tip of blade and hub height visibility is illustrated in **Figure 24** and the ZVI hub and tip height diagrams are shown in **Figures 25 and 26**.

Both tip of blade and hub height ZVI diagrams illustrate similar areas of potential visibility and highlight the extent and influence of the Flinders Ranges hill and ridgeline landforms to the north of the Project Site.

The ZVI Diagrams illustrate the visual effect influenced by the topography and landscape features surrounding the Project Site. There is a greater proportional number of wind turbines potentially visible to the east and west of the Project Site, across gently undulating and relatively level rural/agricultural and generally sparsely populated landscape areas, with fewer wind turbines potentially visible from areas within 5km the north of the Project Site. There are various pockets of land within and beyond 5km of the wind turbines, and more extensive areas between 5km and beyond 10km of the wind turbines, where wind turbines will become less visible due to screening landform.

7.3 Visibility

The level of wind turbine farm visibility within the Project viewshed can result from a number of factors including, but not limited to:

Distance

With an increase in distance the proportion of a person's horizontal and vertical view cone occupied by a visible turbine structure, group of turbine structures would decline.

As the view distance increases so do the atmospheric effects resulting from dust particles and moisture in the atmosphere, which makes the wind turbines appear to be grey thus potentially reducing the contrast between the wind turbines and the background against which they are viewed.

Whilst the distance between a view location and the wind turbines is a primary factor to consider when determining potential visibility, there are other issues which may also affect the degree of visibility. The influence of distance on visibility and proportional representation with regard to wind turbines is illustrated in **Figure 27** and for the photo voltaic panels in **Figure 28**.

Movement

The visibility of the wind turbines would vary between the categories of static and dynamic view locations. In the case of static views the relationship between a wind turbine and the landscape would not tend to vary greatly. The extent of vision may be relatively wide as a person would tend to scan back and forth across the landscape where panoramic views are available.

In contrast views from a moving vehicle are dynamic as the visual relationship between wind turbines is constantly changing as well as the visual relationship between the wind turbines and the landscape in which they are seen. The extent of vision can be partially constrained by the available view from within a vehicle at proximate distances.

Relative position

In situations where the view location is at a lower elevation than the wind turbine structure most of it would be viewed against the sky. The degree of visual contrast between a white coloured turbine and the sky would depend on the presence of background clouds and their colour. Dark grey clouds would contrast more strongly with white turbines than a background of white clouds.

The level of contrast is also influenced by the position of the sun relative to the individual wind turbines and the view location. Where the sun is located in front of the viewer, the visible portion of the wind turbine would be seen in shadow. Where the background to the wind turbine is dark toned the visual contrast would be reduced.

Where the sun is located behind the view location then the visible portion of the wind turbine would be in full sun. If the background is also light toned, such as white clouds, then the contrast is less when compared to a dark background.

7.4 Climatic and Atmospheric Conditions

Local climatic and atmospheric conditions have the potential to influence the visibility of the Project from surrounding view locations, and more significantly, from middle ground and distant view locations.

Rainfall would tend to reduce the level of visibility toward the Project from a number of surrounding view locations, with the degree of visibility tending to decrease over distance. Rain periods may also reduce the number of visitors travelling through the areas from which the Project may be visible, and potentially decrease the duration of time spent at a particular public view location with a view toward the Project.

Cloud cover would also tend to reduce the level of visibility of the Project and lessen the degree of contrast between the wind turbine structures and the background against which the wind turbines may be visible.

On clear or partly cloudy days, the position of the sun would also have an impact on the degree of visibility of the Project. The degree of impact would be largely dependent on the relationship between the position and angle of the sun relative to the view location. Late afternoon and early evening views toward the west would result in the wind turbines silhouetted above the horizon line, and with increasing distance would tend to reduce the contrast between the wind turbine structures and the surrounding landform.

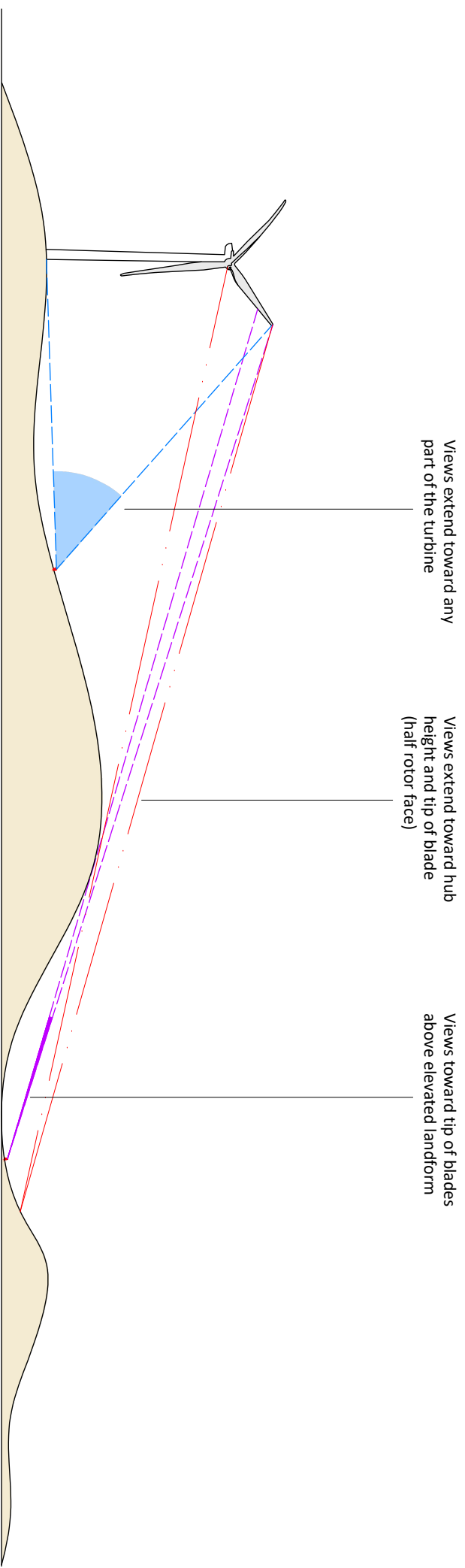


Figure 24
ZVI visibility

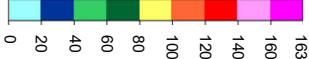
NOTES:

The ZVI methodology is a purely geometric assessment where the visibility of the proposed wind turbines are determined from carrying out calculations based on a digital terrain model of the site and the surrounding terrain.

This assessment methodology is assumed to be conservative as the screening effects of any structures and vegetation above ground level are not considered in any way. Therefore the wind farm may not be visible at many of the locations indicated on the ZVI maps due to the local presence of trees, vegetation or other screening potential. While the ZVI maps are a useful visualisation tool, they are very conservative in nature.

Additionally, the number of turbines visible at any one time is also affected by the weather condition at the time. Inclement or cloudy weather tends to mask the visibility of the proposed wind project.

LEGEND:
Number of wind turbine tips visible



Dwelling non associated

Proposed wind turbine (indicative location)

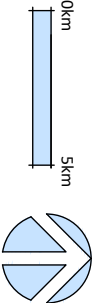


Figure 25
Zone of Theoretical Visibility
Wind turbine tip height

NOTES:

The ZVI methodology is a purely geometric assessment where the visibility of the proposed wind turbines are determined from carrying out calculations based on a digital terrain model of the site and the surrounding terrain.

This assessment methodology is assumed to be conservative as the screening effects of any structures and vegetation above ground level are not considered in any way. Therefore the wind farm may not be visible at many of the locations indicated on the ZVI maps due to the local presence of trees, vegetation or other screening potential. While the ZVI maps are a useful visualisation tool, they are very conservative in nature.

Additionally, the number of turbines visible at any one time is also affected by the weather condition at the time. Inclement or cloudy weather tends to mask the visibility of the proposed wind project.

LEGEND:

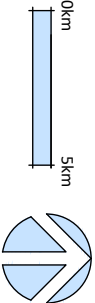
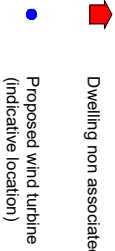
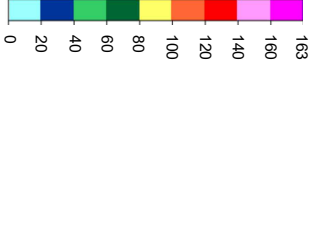
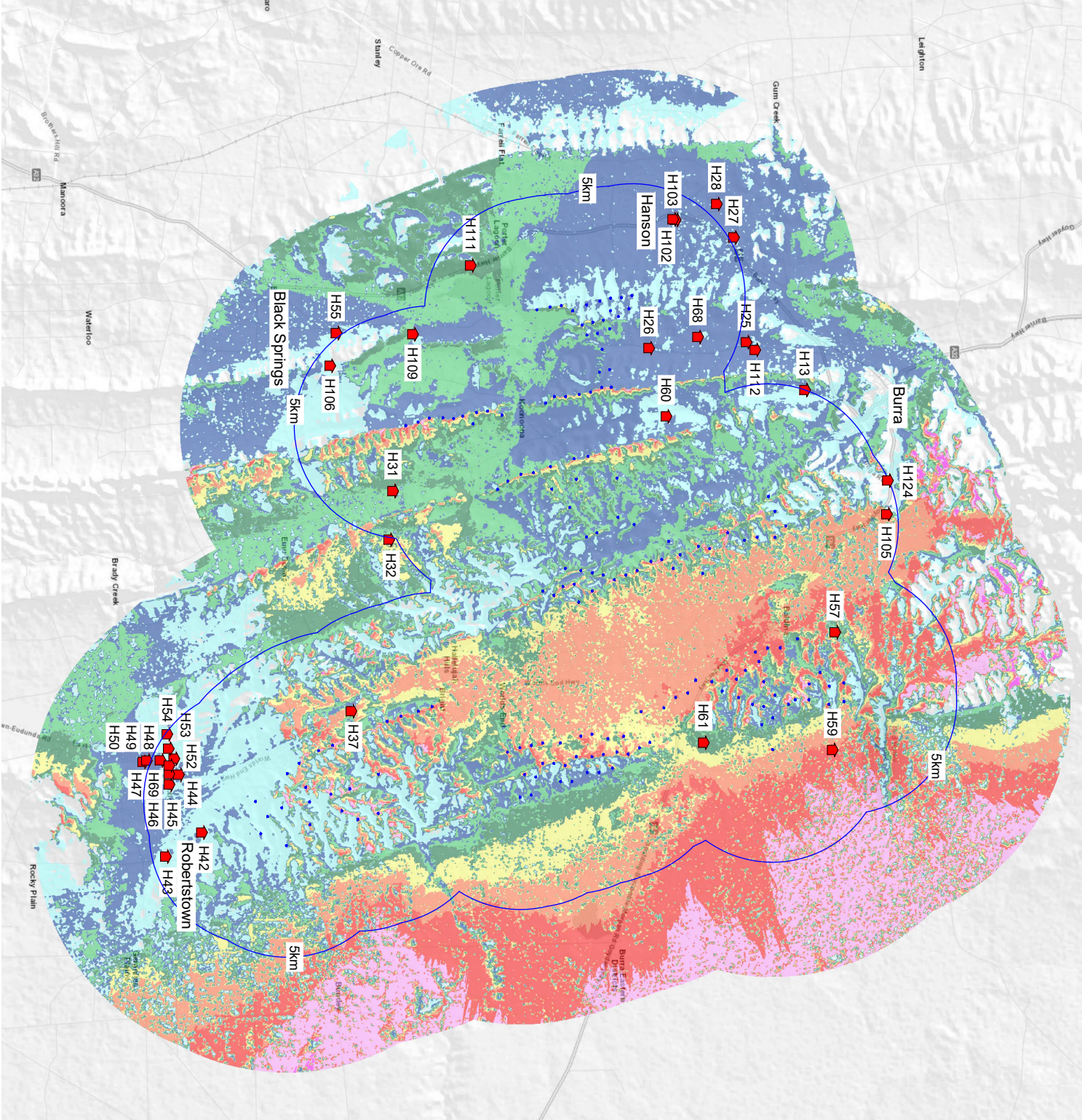


Figure 26
Zone of Theoretical Visibility
Wind turbine hub height



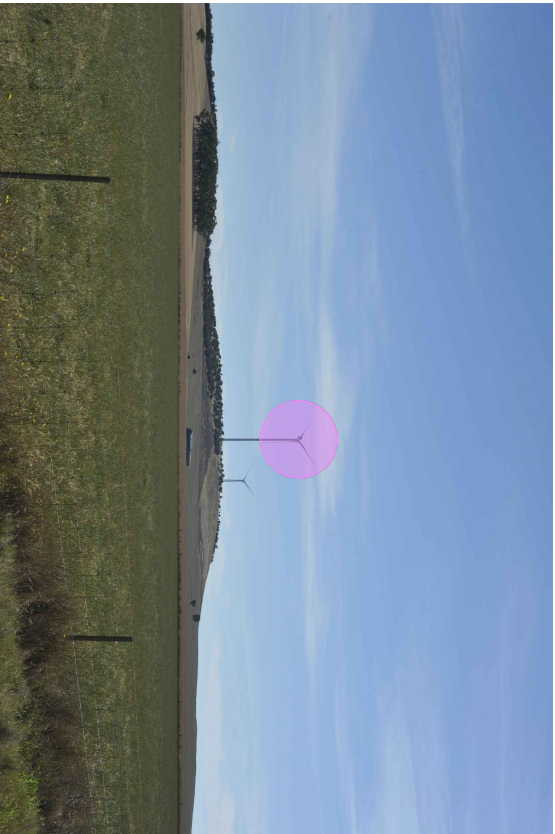


Image 1 Modelled wind turbine 240 metre tip height - view distance 2 km



Image 2 Modelled wind turbine 240 metre tip height - view distance 3 km



Image 3 Modelled wind turbine 240 metre tip height- view distance 4 km



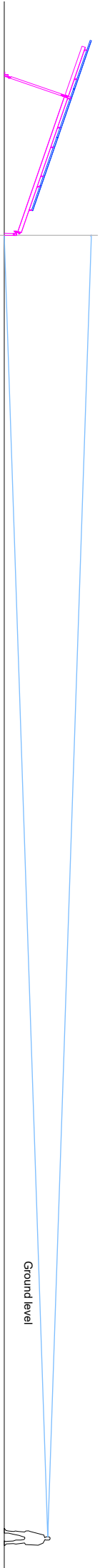
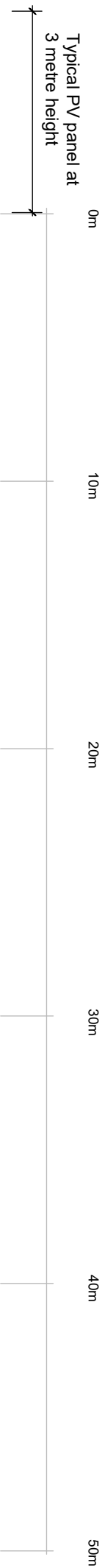
Image 4 Modelled wind turbine 240 metre tip height - view distance 5 km

Modelled wind turbine 240 metre tip height
Photographs: Nikon D7700, 50mm prime lens

Approximate wind turbine swept area

2km 3km 4km 5km

Figure 27
Wind turbine visibility



The PV panels viewed from a 50 metre distance would occupy less than 4% of the vertical human view cone



The PV panels viewed from a 100 metre distance would occupy less than 2% of the vertical human view cone



The PV panels viewed from a 200 metre distance would occupy less than 1% of the vertical human view cone

Figure 28
Photo voltaic panels -
distance and visual effect

Key views and visual effects

Section 8

8.1 Introduction

The overall determination of visual effects resulting from the construction and operation of the Project would result primarily from a combination of receiver sensitivity and the magnitude of visual effects.

A determination of visual effects from the combination of receiver sensitivity and the magnitude of visual effect is a well-established methodology and has been applied extensively on wind farm LVIA in South Australia and across Australia. The standard methodology is set out in industry and best practice guidelines including the Guidelines for Landscape and Visual Impact Assessment, Third Edition, Landscape Institute and Institute of Environmental Management & Assessment, 2013 – Chapter 6 Assessment of visual effects.

8.2 Sensitivity of visual receivers

Judging the sensitivity of visual receivers needs to take account of the occupation or activity of people experiencing the view at particular locations and the extent to which their attention or interest is focussed on views within and surrounding the Project Site.

8.3 Magnitude of visual effects

Judging the magnitude of the visual effects needs to take account of:

- the scale of the change in the view with respect to the loss or addition of features in the view and changes in its composition, including the proportion of the view occupied by the proposed development
- the degree of contrast or integration of any new features or changes in the landscape with the existing or remaining landscape elements and characteristics in terms of form, scale and mass, line height, colour and texture
- the nature of the view of the proposed development, in terms of the relative amount of time over which it will be experienced and whether views will be full, partial or glimpses.

Tables 5 and 6 set out definitions and criteria for sensitivity and magnitude.

The combination of sensitivity and magnitude will provide the rating of visual effect for viewpoints. **Table 7** sets out the relative visual impact grading values which combines issues of sensitivity and magnitude for the Project.

Table 5 – Receiver location sensitivity

View Category	Sensitivity
Dwellings	Highest Sensitivity
Areas of high scenic value (National Parks or designated landscapes)	▽
Public recreational areas	▽
Rural employment/farming	▽
Motorists	▽
Business (commercial)	▽
Industrial areas	Lower Sensitivity

Table 6 – Magnitude assessment criteria

Criteria	Definition
Distance	
Very short	<1km
Short	1 – 3km
Moderate	3km – 5km
Long	+5km
Duration of effect	
High	> 2 hours
Moderate	30 - 120 minutes
Low	10 – 30 minutes
Very low	< 10 minutes
Degree of screening	
High	Screening effectively blocks views toward Project
Moderate	Screening partially screens views toward Project
Low	Screening filters some views toward Project
Very low	Limited or no screening toward Project

Table 6 – Magnitude assessment criteria

Criteria	Definition
Wind turbine hub visibility	
Very high	140+
High	101-140
Moderate	61-100
Low	21-60
Very low	1-20

An overall determination of visual effect at each receiver location has also been assessed and determined against the visual impact grading matrix in **Table 7** below. The levels of sensitivity and magnitude outlined in **Table 7** are **used as a guide** to determine levels of visual effect and are not absolute as the determination of visual effect also incorporates a degree of professional judgement.

Whilst a dwelling location may have an overall high magnitude (resulting from high sensitivity, short view distance and high wind turbine visibility), which results in a high visual impact; the visual impact may be offset and mitigated through tree cover or intervening landform which partially or completely screens the Project Site.

The location of the non-host dwellings is illustrated in **Figure 29**. Host landowner dwellings and non-dwelling structures, such as agricultural sheds, within 5km of the Project have not been assessed. The visibility of wind turbines is used as an effective method to determine the impact of the entire Project as they are the largest elements of the project.

8.4 Views from townships and localities

Townships and localities within the landscape surrounding the Project include:

- Burra
- Robertson and
- Clare.

Whilst the Project's wind turbines would be visible over distances between the localities and the project site, views toward the wind turbines would be partially restricted by built structures within urban areas, as well as tree cover and landform within and surrounding and beyond regional localities. Views from locations within the majority of the Burra township would be screened by buildings and urban infrastructure; however, some dwellings within Burra, including those within the northern elevated fringe of the township may have greater visual exposure toward the project site. Dwellings within sections of north Burra are likely to have elevated and distant views toward wind turbines; however, some views toward the project site will be screened by landform as well as areas of scattered tree cover as illustrated in the aerial photo figures. Overall visibility from the Burra township is also constrained by landform which is demonstrated in both aerial figures and the Zone of Visual Influence diagrams.

Other project infrastructure including the solar and battery facilities will not be visible from townships with views limited by distance and undulating landform.

Table 8 Visual impact grading

	Wind	Solar
Sensitivity of visual receiver	High	High
Magnitude of visual effects	Low	Negligible
Visual Impact	Low (with the influence of visual screening)	Negligible

8.5 Burra Gorge and Worlds End campsite

Views from within, as well as views out from the Burra Gorge and the adjoining Worlds End camp site toward wind turbines are likely to be partially screened or blocked by a combination of landform and tree cover. There are unlikely to be any significant views toward the wind turbines from these areas, and they would not be unduly impacted by the Project.

Table 9 Visual impact grading

	Wind	Solar
Sensitivity of visual receiver	High	High
Magnitude of visual effects	Negligible to low	Negligible to low
Visual Impact	Negligible	Negligible

8.6 Views from transport corridors (highways and local roads)

Wind turbines would be visible from short through to long distant views whilst travelling along sections of the Barrier Highway and the Burra Morgan Road (Goyder Highway). Views from the Goyder Highway travelling north west toward Burra would include proximate views toward wind turbines as the Highway passes through the eastern wind turbine cluster. Views from the Goyder Highway would also extend toward the north solar farm facility adjoining the Goyder Highway between the Worlds End Highway and Top Road.

The Project would also be visible from a number of local roads which extend through the project site crossing east to west and north to south. The dynamic and constantly changing nature of views from vehicles travelling along local roads will tend to be transitory in nature and generally short term; however, views from local roads are likely to offer moderate to short distance and direct views toward the wind turbines from vehicles making regular trips to and from surrounding dwellings. As the sensitivity of receivers travelling along highways and local roads tends to be low, in combination with the generally short duration of views, the overall visual impact from roads is likely to be low.

Table 10 Visual impact grading (highways)

	Wind	Solar
Sensitivity of visual receiver	Low	Low
Magnitude of visual effects	Low to Moderate	Moderate
Visual Impact	Low to Moderate	Low to Moderate

Table 11 Visual impact grading (local roads)

	Wind	Solar
Sensitivity of visual receiver	Low	Low
Magnitude of visual effects	Moderate	Moderate
Visual Impact	Moderate	Moderate

8.7 Views from agricultural land

It is acknowledged that the Project may have the potential to impact people engaged in farming or rural based activities, where views toward wind turbines occur from surrounding and non-associated agricultural areas. Ultimately the level of impact would depend on the type of activities engaged in as well as the location of the activities together with the degree of screening provided by local vegetation within individual properties. Whilst views toward the turbines will occur from a wide area of surrounding rural agricultural land, this LVIA has determined that the sensitivity of visual impacts is less for those employed or carrying out work in rural areas compared to potential views from dwellings; however, the sensitivity of individual view locations will also depend on the perception of the viewer.

Table 12 Visual impact grading

	Wind	Solar
Sensitivity of visual receiver	Low	Low
Magnitude of visual effects	Moderate	Moderate
Visual Impact	Moderate-low	Moderate-low

8.8 View from publicly accessible locations

Publicly accessible locations, other than road corridors, include various public open spaces including sections of the Heysen Trail, Burra Gorge, recreational areas, reserves or public meeting places. The majority of public open spaces and recreational areas are those associated and located within surrounding urban localities, where the influence of both distance and existing vegetative cover is likely to screen any potential views toward the project site.

Table 13 Visual impact grading

	Wind	Solar
Sensitivity of visual receiver	High	High
Magnitude of visual effects	Low to Moderate	Low to Moderate
Visual Impact	High to Moderate	High to Moderate

8.9 Views from dwellings

Existing dwellings illustrated in **Figure 29** include dwellings that are not associated.

The site inspection noted that some dwellings within the landscape surrounding the wind farm were screened by tree and/or windbreak shelter planting. It is possible that not all dwellings will have direct or significant views toward the wind turbines.

For the purpose of this LVIA only non-associated (non-host) have been incorporated into the Residential Visual Effect Matrix in **Table 14**.

Goyder South Hybrid Renewable Energy Facility

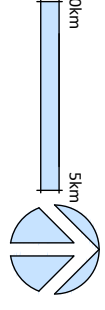
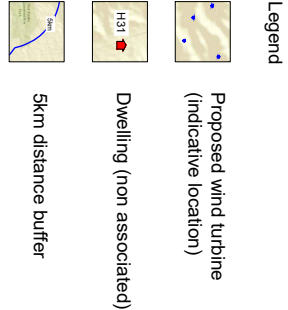
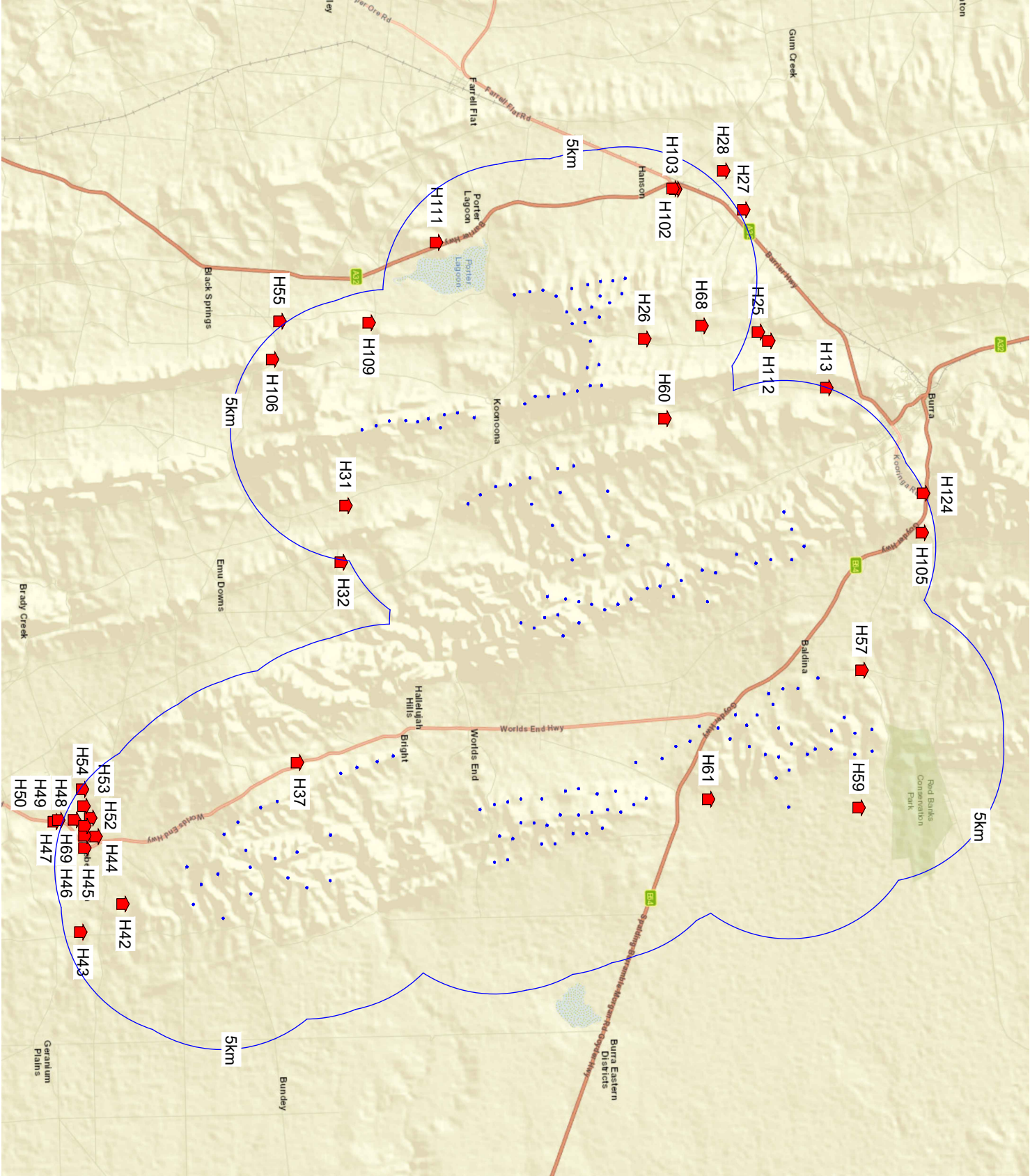


Figure 29
Dwelling locations

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

		MAGNITUDE					
SENSITIVITY		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	Degree of visibility and screening	Visual effect
Receiver location	Category of receiver location and sensitivity grading						
Non-host dwellings up to 5km from a wind turbine							
H13	Non-host landowner Dwelling Sensitivity: High	Moderate 4.90km (B010)	High	Low	Low	Moderate distance views would extend from the dwelling and/or curtilage in a south to south east direction toward the locality of wind turbines located along hills and ridgelines within the northern and central portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations, battery storage facilities and overhead transmission lines would be effectively screened by distance and screening through undulating landform. Views toward solar panels in the north and south solar facilities would be screened by landform	Low

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
						and vegetation between the dwelling and the solar facility sites. Degree of existing screening at dwelling: Low to moderate.	
H26	Non-host landowner Dwelling Sensitivity: High	Short 2.00km (SG002)	High	Low	Moderate	Short distance views would extend from the dwelling and/or curtilage in a southerly direction toward wind turbines within the western portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations, battery storage facilities and overhead transmission lines would be effectively screened by distance and screening through undulating landform.	High

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
						Views toward solar panels in the north and south solar facilities would be screened by landform and vegetation between the dwelling and the solar facility sites. Degree of existing screening at dwelling: Low to moderate	
H31	Non-host landowner Dwelling Sensitivity: High	Moderate 2.98km (SG072)	High	Moderate	Moderate to high	Moderate distance views would extend from the dwelling and/or curtilage in a north to north east direction toward the locality of wind turbines located along hills and ridgelines within the western portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations, battery storage facilities and overhead transmission lines would	Moderate to high

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
	Category of receiver location and sensitivity grading					<p>be effectively screened by distance and screening through undulating landform.</p> <p>Views toward solar panels in the north and south solar facilities would be screened by landform and vegetation between the dwelling and the solar facility sites.</p> <p>Degree of existing screening at dwelling: Low to moderate</p>	
H37	Non-host landowner Dwelling Sensitivity: High	Short 1.53km (SG058)	High	Moderate to High	Moderate	<p>Short distance views would extend from the dwelling and/or curtilage in a north east through to south east direction toward the locality of wind turbines located along low hills and ridgelines within the southern portion of the Project Site.</p> <p>Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling.</p>	High

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
	Category of receiver location and sensitivity grading					Views toward ancillary electrical infrastructure including the substations, battery storage facilities and overhead transmission lines would be effectively screened by distance and screening through undulating landform. Views toward solar panels in the north and south solar facilities would be screened by landform and vegetation between the dwelling and the solar facility sites. Degree of existing screening at dwelling: Low to moderate	
H42	Non-host landowner Dwelling Sensitivity: High	Short 2.6km (SG072)	High	Low	Low	Short distance views would extend from the dwelling and/or curtilage in a north direction toward the locality of wind turbines located along low hills within the southern portion of the Project Site. Views toward wind turbines within	Low

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
	Category of receiver location and sensitivity grading					<p>the majority of the Project Site are likely to be screened by undulating hills beyond the dwelling.</p> <p>Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line (to the Robertson substation) would be generally screened by tree cover beyond the dwelling.</p> <p>Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site.</p> <p>Degree of existing screening at dwelling: Low to moderate</p>	
H43	Non-host landowner	Moderate 4.35km	High			Moderate distance views would extend from the dwelling and/or curtilage in a north direction	Low

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
	Dwelling Sensitivity: High	(SG070)				<p>toward the locality of wind turbines located along low hills within the southern portion of the Project Site. Views toward wind turbines within the majority of the Project Site are likely to be screened by undulating hills beyond the dwelling.</p> <p>Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line (to the Robertson substation) would be generally screened by tree cover beyond the dwelling.</p> <p>Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site.</p> <p>Degree of existing screening at dwelling: Low to moderate</p>	

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
H44	Non-host landowner Dwelling Sensitivity: High	Moderate 3.60km (SG071)	High	Low	Moderate	Moderate distance views would extend from the dwelling and/or curtilage in a north east direction toward the locality of wind turbines located along low hills within the southern portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line (to the Robertson substation) would be located north east to east of the dwelling at around 700 metres.	Low to moderate

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY		MAGNITUDE				Visual effect
	Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	Degree of visibility and screening	
						Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: Low to moderate	
H45	Non-host landowner Dwelling Sensitivity: High	Moderate 3.98km (SG071)	High	Low	Moderate	Moderate distance views would extend from the dwelling and/or curtilage in a north to north east direction toward the locality of wind turbines located along low hills within the southern portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating	Low to moderate

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY Category of receiver location and sensitivity grading	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
						landform. The Stage 1 overhead transmission line (to the Robertson substation) would be located north east to east of the dwelling at around 995 metres. Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: Low to moderate	
H46	Non-host landowner Dwelling Sensitivity: High	Moderate 4.11km (SG071)	High	Low	Moderate	Moderate distance views would extend from the dwelling and/or curtilage in a north east direction toward the locality of wind turbines located along low hills within the southern portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling.	Low to moderate

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY Category of receiver location and sensitivity grading	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
						Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line (to the Robertson substation) would be located north east to east of the dwelling at around 1 kilometre. Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: Moderate to high	
H47	Non-host landowner Dwelling	Moderate 4.44km (SG071)	High	Low	Moderate	Moderate distance views would extend from the dwelling and/or curtilage in a north east direction toward the locality of wind turbines located along low hills within the southern portion of the	Low

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
	Sensitivity: High					<p>Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling.</p> <p>Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line (to the Robertson substation) would be located north east to east of the dwelling at around 1.5km.</p> <p>Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site.</p> <p>Degree of existing screening at dwelling: Moderate to high</p>	

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading
H48	Non-host landowner Dwelling Sensitivity: High		Moderate 4.60km (SG071)	High	Low	Moderate
						Moderate distance views would extend from the dwelling and/or curtilage in a north east direction toward the locality of wind turbines located along low hills within the southern portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line (to the Robertson substation) would be located north east to east of the dwelling at around 1.7km.
						Low

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
						Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: Moderate to high	
H51	Non-host landowner Dwelling Sensitivity: High	Moderate 4.50km (SG071)	High			Moderate distance views would extend from the dwelling and/or curtilage in a north east direction toward the locality of wind turbines located along low hills within the southern portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line	Low

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
	Category of receiver location and sensitivity grading					(to the Robertson substation) would be located north east to east of the dwelling at around 1.5km. Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: Moderate to high	
H52	Non-host landowner Dwelling Sensitivity: High	Moderate 4.04km (SG071)	High	Very low	Low to moderate	Moderate distance views would extend from the dwelling and/or curtilage in a north east direction toward the locality of wind turbines located along low hills within the southern portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling.	Low to Moderate

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY Category of receiver location and sensitivity grading	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
						Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line (to the Robertson substation) would be screened by tree cover north east of the dwelling. Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: Moderate	
H53	Non-host landowner Dwelling	Moderate 4.44km (SG071)	High	Very low	Low to moderate	Moderate distance views would extend from the dwelling and/or curtilage in a north east direction toward the locality of wind turbines along low hills within the southern portion of the Project	Low

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
	Sensitivity: High					<p>Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling.</p> <p>Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line (to the Robertson substation) would be screened by tree cover north east of the dwelling.</p> <p>Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site.</p> <p>Degree of existing screening at dwelling: Moderate</p>	

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
H54	Non-host landowner Dwelling Sensitivity: High		Moderate 4.82km (SG071)	High	Very low	Low to moderate	Low
						<p>Moderate distance views would extend from the dwelling and/or curtilage in a north east direction toward the locality of wind turbines along low hills within the southern portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling.</p> <p>Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line (to the Robertson substation) would be screened by tree cover north east of the dwelling.</p>	

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
						Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: High	
H57	Non-host landowner Dwelling Sensitivity: High	Short 1.7km (B053)	High	Moderate to High	High	Short distance views would extend from the dwelling and/or curtilage in a west to south and easterly direction toward the wind turbines located along low hills within the eastern and central portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be partially screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be effectively	High

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

	SENSITIVITY	MAGNITUDE					
Receiver location	Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	Degree of visibility and screening	Visual effect
						screened by distance and screening through undulating landform. Views toward solar panels in the north solar facility would not form a significant visual element within the landscape. Degree of existing screening at dwelling: High	
H59	Non-host landowner Dwelling Sensitivity: High	Short 2.14km (B078)	High	Moderate to High	High	Short distance views would extend from the dwelling and/or curtilage in a west to south direction toward the wind turbines located along low hills within the eastern and central portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be partially screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations, overhead power lines	High

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
						and battery storage facilities would be effectively screened by distance and screening through undulating landform. Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: Low	
H60	Non-host landowner Dwelling Sensitivity: High	Short 2.74km (SG007)	High	Low	Moderate	Short distance views would extend from the dwelling and/or curtilage in a southerly direction toward the wind turbines located along low hills within the western and central western portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be partially screened by undulating hills beyond the dwelling.	Moderate to high

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
						Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be screened by undulating landform. Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: Low	
H61	Non-host landowner Dwelling Sensitivity: High	Short 2.47km (B088)	High	High	High	Short distance views would extend from the dwelling and/or curtilage in a southerly to westerly direction toward the wind turbines located along low hills within the eastern and central portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be partially screened by undulating hills beyond the dwelling.	High

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
						Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be screened by undulating landform. Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: Low	
H68	Non-host landowner Dwelling Sensitivity: High	Moderate 3.36km (SG002)	High	Low	Moderate	Moderate distance views would extend from the dwelling and/or curtilage in a southerly direction toward wind turbines within the western portion of the Project Site. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling.	Moderate to high

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
						Views toward ancillary electrical infrastructure including the substations, battery storage facilities and overhead transmission lines would be effectively screened by distance and screening through undulating landform. Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site. Degree of existing screening at dwelling: Moderate	
H69	Non-host landowner Dwelling Sensitivity: High	Moderate 4.17km (SG071)	High	Low	Low to moderate	Moderate distance views would extend from the dwelling and/or curtilage in a north east direction toward the locality of wind turbines located along low hills within the southern portion of the Project Site. Views toward wind turbines within	Low to moderate

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
						<p>other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling.</p> <p>Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating landform. The Stage 1 overhead transmission line (to the Robertson substation) would be located north east to east of the dwelling at around 1.3 kilometre.</p> <p>Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility site.</p> <p>Degree of existing screening at dwelling: Moderate to high</p>	

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY		MAGNITUDE				Visual effect
	Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	Degree of visibility and screening	
H102	Non-host landowner Dwelling Sensitivity: High	Moderate 3.97km (SG001)	High	Low	Low	Moderate distance views south east from the dwelling and/or curtilage toward the locality of wind turbines would be largely screened by tree cover surrounding the dwelling. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating landform. Views toward solar panels in the north or south solar facility areas would be screened by landform between the dwelling and the solar facility sites.	Low to moderate

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY Category of receiver location and sensitivity grading	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
						Degree of existing screening at dwelling: Moderate to high	
H103	Non-host landowner Dwelling Sensitivity: High	Moderate 3.74km (SG001)	High	Low	Low	Moderate distance views south east from the dwelling and/or curtilage toward the locality of wind turbines would be largely screened by tree cover surrounding the dwelling. Views toward wind turbines within other portions of the Project Site are likely to be screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations and battery storage facilities would be effectively screened by distance and screening through undulating landform. Views toward solar panels in the north or south solar facility areas would be screened by	Low to moderate

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
						landform between the dwelling and the solar facility sites. Degree of existing screening at dwelling: Moderate to high	
H105	Non-host landowner Dwelling Sensitivity: High	Moderate 4.54km (B024)	High	High	Moderate to high	Moderate distance views would extend from the dwelling and/or curtilage in a south and south easterly direction toward the wind turbines located along low hills within the eastern and central portion of the Project Site. Some views may be partially screened by tree planting surrounding the dwelling. Views toward wind turbines within other portions of the Project Site are likely to be partially screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be effectively	Moderate to high

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
						<p>screened by distance and screening through undulating landform.</p> <p>Views toward solar panels in the south solar facility would be screened by landform between the dwelling and the solar facility sites. Views toward solar panels in the north solar facility would be partially screened by landform and screened from the dwelling by tree planting around the dwelling.</p> <p>Degree of existing screening at dwelling: Moderate</p>	
H106	Non-host landowner Dwelling Sensitivity: High	Moderate 4.22km (SG072)	High	Low	Low	<p>Moderate distance views would extend from the dwelling and/or curtilage in a north to north easterly direction toward the wind turbines located along low hills within the south west portion of the Project Site. Some views may be partially screened by tree planting surrounding</p>	Low to moderate

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY Category of receiver location and sensitivity grading	MAGNITUDE				Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
					<p>the dwelling. Views toward wind turbines within other portions of the Project Site are likely to be partially screened by undulating hills beyond the dwelling.</p> <p>Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be effectively screened by distance and screening through undulating landform.</p> <p>Views toward solar panels in the north or south solar facility areas would be screened by landform between the dwelling and the solar facility sites.</p> <p>Degree of existing screening at dwelling: Moderate</p>	

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading		
H109	Non-host landowner Dwelling Sensitivity: High	Moderate 3.75km (SG054)	High	Moderate	Moderate	Moderate distance views would extend from the dwelling and/or curtilage in a north to north easterly direction toward wind turbines located along low hills within the south west portion of the Project Site. Some views may be partially screened by tree planting surrounding the dwelling. Views toward wind turbines within other portions of the Project Site are likely to be partially screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be effectively screened by distance and screening through undulating landform. Views toward solar panels in the north or south solar facility areas would be screened by	Moderate

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

Receiver location	SENSITIVITY	MAGNITUDE				Degree of visibility and screening	Visual effect
		Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	
						landform between the dwelling and the solar facility sites. Degree of existing screening at dwelling: Low to moderate	
H111	Non-host landowner Dwelling Sensitivity: High	Moderate 3.53km (SG036)	High	Moderate	Moderate	Moderate distance views would extend from the dwelling and/or curtilage in a north east to easterly direction toward the wind turbines located along low hills within the western portion of the Project Site. Some views may be partially screened by tree planting surrounding the dwelling. Views toward wind turbines within other portions of the Project Site are likely to be partially screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be effectively	Low to moderate

Table 14 – Dwelling visual effect matrix (Refer Figure 29 for dwelling locations)

	SENSITIVITY	MAGNITUDE					
Receiver location	Category of receiver location and sensitivity grading	Approximate distance to closest turbine (and turbine ID)	Potential duration of effect	Extent of visibility (ZVI hub height)	Overall magnitude grading	Degree of visibility and screening	Visual effect
						partially screened by undulating hills beyond the dwelling. Views toward ancillary electrical infrastructure including the substations, overhead power lines and battery storage facilities would be effectively screened by distance and screening through undulating landform. Views toward solar panels in the north or south solar facility areas would be screened by landform between the dwelling and the solar facility sites. Degree of existing screening at dwelling: Moderate	

8.10 Summary of non-associated dwelling visual effect

This LVIA identified a combined total of 28 non-host dwellings within the Project's 5km viewshed.

An assessment of non-host dwellings determined:

- 5 of the 28 dwelling locations would have a High visual effect.
- 4 of the 28 dwelling locations would have a Moderate to high visual effect and
- 1 of the 28 dwelling locations would have a Moderate visual effect
- 9 of the 28 dwelling locations would have a Low to moderate visual effect and
- 9 of the 28 dwelling locations would have a Low visual effect.

The field assessment for the majority of dwelling locations was undertaken from the closest publicly accessible location, with a conservative approach adopted where there was no opportunity to confirm the actual extent of available view from areas within or immediately surrounding the residence. It is anticipated that some visibility ratings would be less than those determined subject to a process of verification of existing screening from private property.

8.11 Summary of visual significance (beyond 5km of wind turbines)

The majority of dwellings located beyond 5km of the wind turbines are unlikely to be significantly impacted by the Project. The localised influence of topography, as illustrated in the ZVI diagrams, and influence of distance, has some impact on the extent and nature of views beyond 5 km of the wind farm site. As noted for dwellings within 5km of wind turbines, a number of dwellings beyond 5km of the wind turbines also maintain planting for privacy or wind break purposes around their dwellings. Where present, planting around or beyond dwellings would tend to filter and/or screen views toward wind turbines, and the effectiveness of existing tree and shrub planting heights will increase in proportion with the distance of a dwelling from the wind turbines.

Cumulative assessment

Section 9

9.1 What is Cumulative Impact Assessment?

A cumulative landscape and visual impact may result from a wind farm being constructed in conjunction with other existing or proposed wind farm developments or other large-scale infrastructure projects and may be either associated or separate to it.

Separate wind farm or other developments may occur within the established viewshed of the proposed wind farm or may be located within a regional context where visibility is dependent on a journey between each site or project viewshed.

‘Direct’ cumulative visual impacts may occur where two or more wind farms or other infrastructure developments have been constructed within the same locality and may be viewed from the same view location simultaneously.

‘Indirect’ cumulative visual impacts may occur where two or more wind farms or other infrastructure developments have been constructed within the same locality and may be viewed from the same view location but not within the same field of view (i.e. the viewer has to turn their head in order to view both wind farms).

‘Sequential’ cumulative visual impacts may arise as a result of multiple wind farms or other infrastructure developments being observed at different locations during the course of a journey (e.g. from a vehicle travelling along a highway or from a network of local roads), which may form an impression of greater magnitude within the construct of short term memory.

An assessment and determination of cumulative visual impact notes other wind farm developments within the broader viewshed, or regional locality, which may result in cumulative impacts. These include the operational Waterloo Wind Farm around 5km south west of the Project Site (and closest wind turbine), the operational Mount Bryan Wind Farm around 17km north west of the Project Site (and closest wind turbine), as well as the Hornsdale and Hallet group of wind farms in excess of 30km to the north north west the Project Site. Other wind farm developments are illustrated in **Figure 1**.

There would be no significant direct visual link between other regional wind farms and wind turbines within the Project Site; however, moderate to long distant views toward one or more wind farms would be visible from some elevated, but generally unpopulated areas including portions of the Barrier Highway to the west and north of the Project Site.

The potential for views toward wind turbines within the Project Site as well as other existing wind farms from dwellings and local roads/highways are partially restricted by tree cover and landform and the overall potential for any significant ‘indirect’ and ‘sequential’ cumulative impacts are considered to be low to moderate.

Wind turbine shadow flicker & blade glint assessment summary

Section 10

10.1 Introduction

Due to their height, wind turbines can cast shadows on surrounding areas at a significant distance from the base of the wind turbine tower. Coupled with this, the moving blades create moving shadows. When viewed from a stationary position, the moving shadows appear as a flicker giving rise to the phenomenon of 'shadow flicker'. When the sun is low in the sky the length of the shadows increases, increasing the shadow flicker affected area around the wind turbine.

A shadow flicker and blade glint assessment has been prepared by DNV-GL to determine and illustrate the potential impact of shadow flicker and blade glint on surrounding view locations. The detailed Shadow Flicker and Blade Glint assessment for the proposed project is included at LVIA **Appendix A**.

A shadow flicker assessment may overestimate the actual number of annual hours of shadow flicker at a particular location due to a number of reasons including:

- the probability that the wind turbines will not face into or away from the sun all of the time;
- the occurrence of cloud cover;
- the amount of particulate matter in the atmosphere (moisture, dust, smoke etc...) which may diffuse sunlight;
- the presence of vegetation; and
- periods where the wind turbine may not be in operation due to low winds, or high winds or for operational or maintenance reasons.

10.2 Shadow flicker modelling outcomes

The results of the shadow flicker modelling prepared by DNV-GL are detailed in **Appendix A**. The DNV-GL report notes that:

'Based on the outcomes of the modelling conducted in the course of this assessment, a total of 16 dwellings are expected to experience shadow flicker. Out of these dwellings, 12 are predicted to experience theoretical shadow flicker for 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 at the same 12 dwellings are predicted to exceed the recommended limit of 10 hours per year within 50 m of the dwelling. All the dwellings at which the recommended annual durations are predicted to be exceeded are understood to be stakeholders in the proposed wind farm.

It is noted that the theoretical shadow flicker durations at three of these dwellings is very high, with theoretical annual durations exceeding 100 hours within 50 m of the dwelling, at dwellings H66, H123, H125. However, based on the information provided by the Customer, DNV GL understands that dwellings H66 and H123 are unoccupied.

As the calculation of the predicted actual shadow flicker duration does not take into account any reduction due to vegetation or other shielding effects around each house in calculating the number of shadow flicker hours, the values presented may still be regarded as conservative’.

10.3 Blade glint

Glint is a phenomenon that results from the direct reflection of sunlight (also known as specular reflection) from a reflective surface that would be visible when the sun reflects off the surface of the wind turbine at the same angle that a person is viewing the wind turbine surface. Glint may be noticeable for some distance, but usually results in a low impact.

The surfaces of the wind turbines, including the towers and blades, are largely convex, which will tend to result in the divergence of light reflected from the surfaces, rather than convergence toward a particular point. This will reduce the potential for blade glint.

Blade glint can also be further mitigated through the use of matt coatings which, if applied correctly, will generally mitigate potential visual impacts caused by glint.

The DNV-GL Shadow Flicker and Blade Glint assessment results are detailed in the LVIA **Appendix A**.

Solar panel sun glint, glare and lighting

Section 11

11.1 Introduction

This LVIA has considered a number of issues concerned with the potential for reflectivity of sunlight from the PV panels. Sunlight reflection is often perceived as a significant issue in relation to solar facilities; however, a primary function for the PV panels is to absorb sunlight energy rather than reflect it. The technical process in manufacturing PV panels includes an anti-reflection coating to the solar cell wafers within each panel that minimises potential for sunlight reflection. The proposed PV panels utilise high transmission, low iron glass, which absorbs greater amounts of light and produces less reflectance than standard glass. Primarily sunlight reflection would be visible as either 'sun glint' or 'glare'.

11.2 Sun glint

Sun glint is a phenomenon that results from the direct reflection of sunlight (also known as specular reflection) from a reflective surface that would be visible when the sun reflects off the surface of the PV panels at the same angle that a person is viewing the PV panel surface.

11.3 Glare

Sunlight reflection from the polycrystalline structure of the individual PV panels may also result in glare (also known as diffuse reflection). Glare from a reflective surface occurs where sunlight is reflected at many angles rather than a single angle observed as sun glint.

There are a number of factors that determine both intensity and extent of sun glint and glare and include:

- the distance and orientation of the PV panels relative to surrounding view locations
- the offset horizontal angle of the PV panels
- time of day and seasonal variations defining position and angle of sunlight
- the occurrence of cloud cover
- the amount of particulate matter in the atmosphere (moisture, dust, smoke etc...) which may diffuse sunlight and
- the presence of screening vegetation relative to view locations.

11.4 Assessment

The measure of how strongly various materials can reflect light from sources such as the sun (the 'albedo') has been measured (Power Engineers 2010 and Sunpower Corporation 200) and determined as a reflected energy percentage. These studies have shown that common materials utilised within rural/agricultural environments, including steel, standard glass and plexiglass can have higher reflected energy percentages than materials employed for PV glass panels.

Based on the results of previous assessments for PV solar power projects and studies carried out in a number of countries, the potential for sun glint and glare would not be expected to have a significant impact on dwellings surrounding the proposed solar facilities, or upon motorists or people travelling through or over the surrounding landscape.

This LVIA notes the screening influence of local topography for the north and south solar facilities, and some partial screening through vegetation beyond the south solar facility. Given the majority of dwellings surrounding the Project Site will not have a line of sight toward the proposed solar panels, the potential for sun glint to create a significant visual impact is considered to be low.

11.5 Lighting

The proposed solar facilities will not incorporate permanent night time lighting into the Project Site, therefore permanent night time lighting will not give rise to potential visual impacts. However, it may be necessary to undertake maintenance on solar panels or Power Conversion Blocks at night time when the solar facilities are not generating. In such cases, localised temporary lighting may be needed to ensure safe conduct of the maintenance work. Such lighting should be managed to ensure that it is focused inward to the work area and does not impact surrounding area. Given the location of neighbouring dwelling there is low potential for significant visual impacts to occur.

Photomontages

Section 12

12.1 Photomontages

Photomontages have been prepared to illustrate the general appearance of the Project following construction. The photomontages have been located to illustrate views from areas close to non-host dwellings or to illustrate cumulative impacts where possible.

The photomontage locations were selected following a review of ZVI maps, together with a site inspection to identify potential representative viewpoints. The photomontage locations were selected from surrounding road corridors and at a range of distances between the viewpoint and wind turbine to illustrate the potential influence of distance on visibility. The photomontages locations are illustrated in **Figure 3** and photomontages presented in **Figures 30 to 44**. **Figure 45** illustrates the proposed view toward the wind turbines and the north solar facility from south of the Worlds End Highway and Goyder Highway intersection.

Each photomontage was generated through the following steps:

- A digital terrain model (DTM) of the Project Site was created from a terrain model of the surrounding area using digital contours
- The site DTM was loaded in the modelling software package
- The layout of the wind farm and 3-dimensional representation of the wind turbine was configured in the modelling software
- The wind turbine dimensions assumed are a tip height of 240m with a hub height of 160m and blade length of 80m (3 wind turbines, B010, B017 and B024 have been reduced from a 240m to a 200m tip height to mitigate views from the Burra township)
- The location of each viewpoint (photo location) was configured in the modelling software for sun position for each viewpoint by using the time and date of the photographs from that viewpoint
- The view from each photomontage location was then assessed in the modelling software package. This process requires accurate mapping of the terrain as modelled, with that as seen in the photographs. The photographs, taken from each photomontage location were loaded into the modelling software and the visible turbines superimposed on the photographs
- The photomontages were adjusted using Photoshop CS3 to compensate for fogging due to haze or distance, as well as screening by vegetation or obstacles and
- The final image was converted to JPG format and imported and annotated as the final figure.

The horizontal and vertical field of view within the majority of the photomontages exceeds the parameters of normal human vision. However, in reality the eyes, head and body can all move and under normal conditions a person would sample a broad area of landscape within a panorama view. Rather than restricting the extent of

each photomontage to a single photographic image, a broader field of view is presented to more fully illustrate the extent of the wind turbines.

Whilst a photomontage can provide an image that illustrates a very accurate representation of a wind turbine in relation to its proposed location and scale relative to the surrounding landscape, this LVIA acknowledges that large scale objects in the landscape can appear smaller in photomontage than in real life and is partly due to the fact that a flat image does not allow the viewer to perceive any information relating to depth or distance.

Legend

Proposed wind turbine
(indicative location)

Dwelling (non associated)

5km distance buffer

Photomontage location

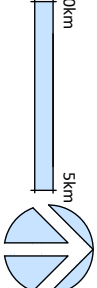
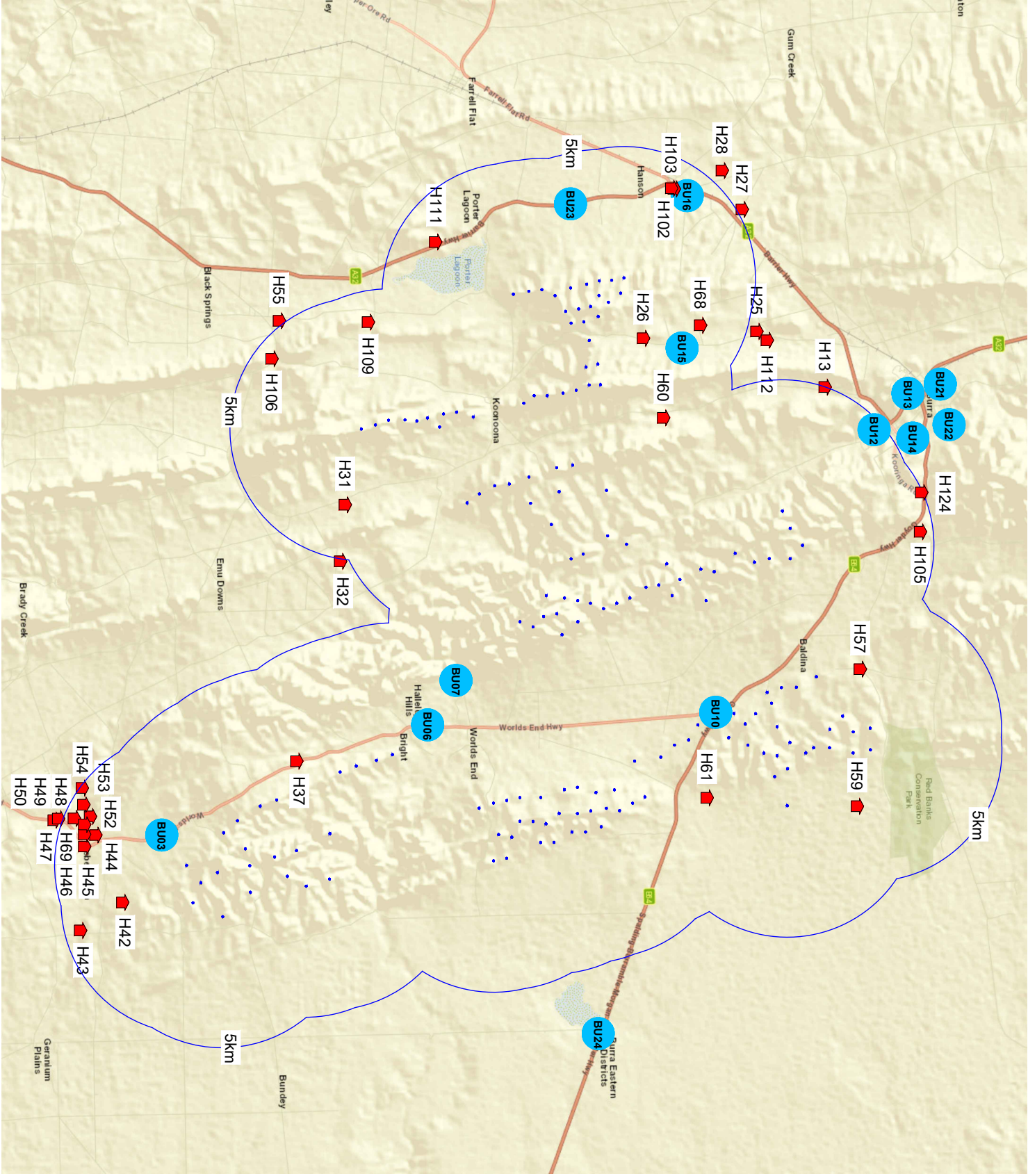


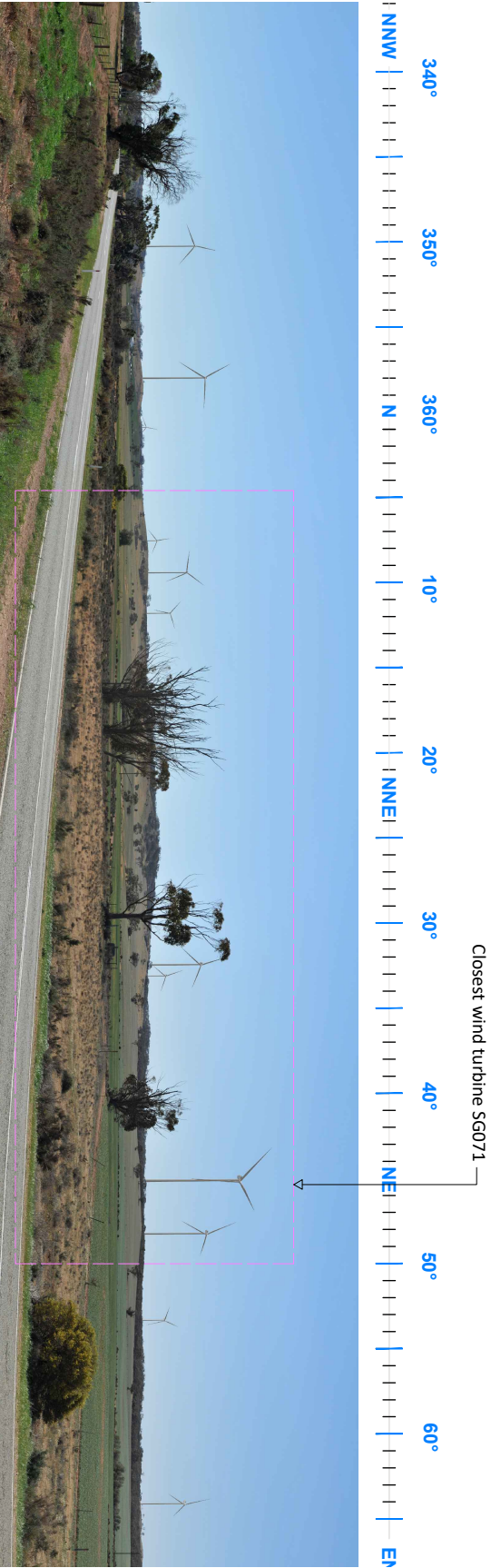
Figure 30
Photomontage locations

GREEN BEAN DESIGN

landscape architects

Goyder South Hybrid Renewable Energy Facility





Photomontage BU03 - Proposed view north north west to east north east from the Worlds End Highway. Approximate distance to closest visible wind turbine 1.5 km



Photomontage BU03 - Detail view through 45 degrees

General Notes:

Coordinates:

Easting 324726, Northing 6243195

Photo date:

12th September 2019, 12.28pm

Camera:

Nikon D850, 50mm 1:1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU03 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

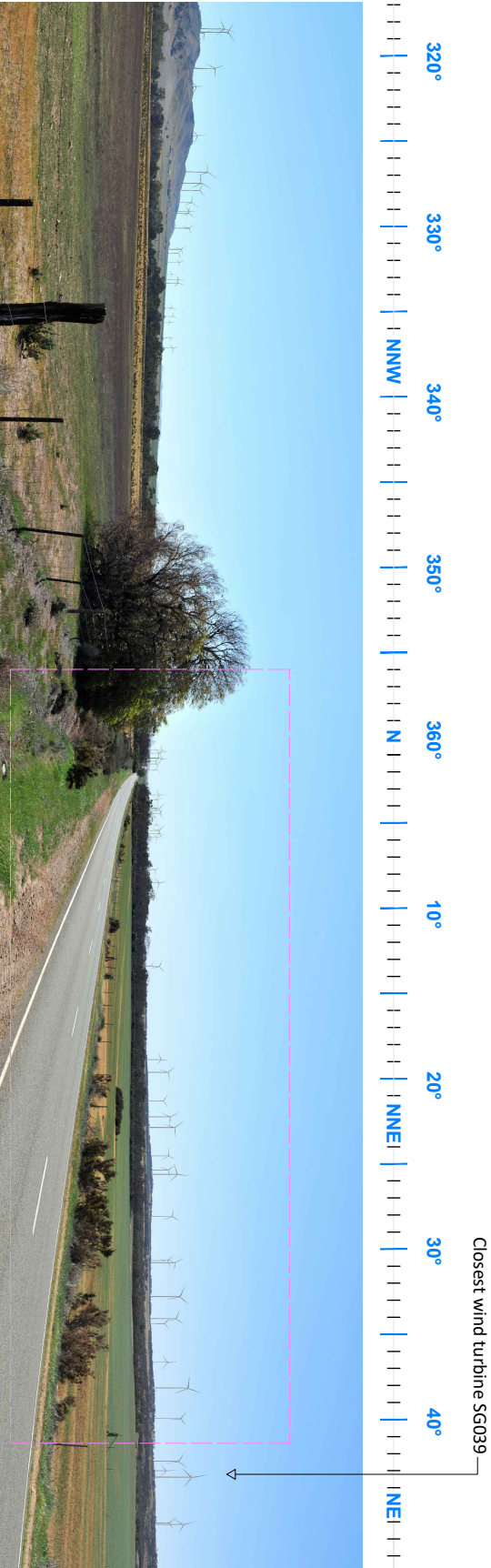
The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 31

Photomontage BU03
Worlds End Highway



Extent of detail view



Photomontage BU06 - Proposed view north west to north east from the Worlds End Highway. Approximate distance to closest visible wind turbine 4.3 km



Photomontage BU06 - Detail view through 45 degrees

Goyder South Hybrid Renewable Energy Facility



Extent of detail view

General Notes:

Coordinates:

Easting 240315, Northing 6307803

Photo date:

12th September 2019, 1.29pm

Camera:

Nikon D850, 50mm 1:1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU06 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

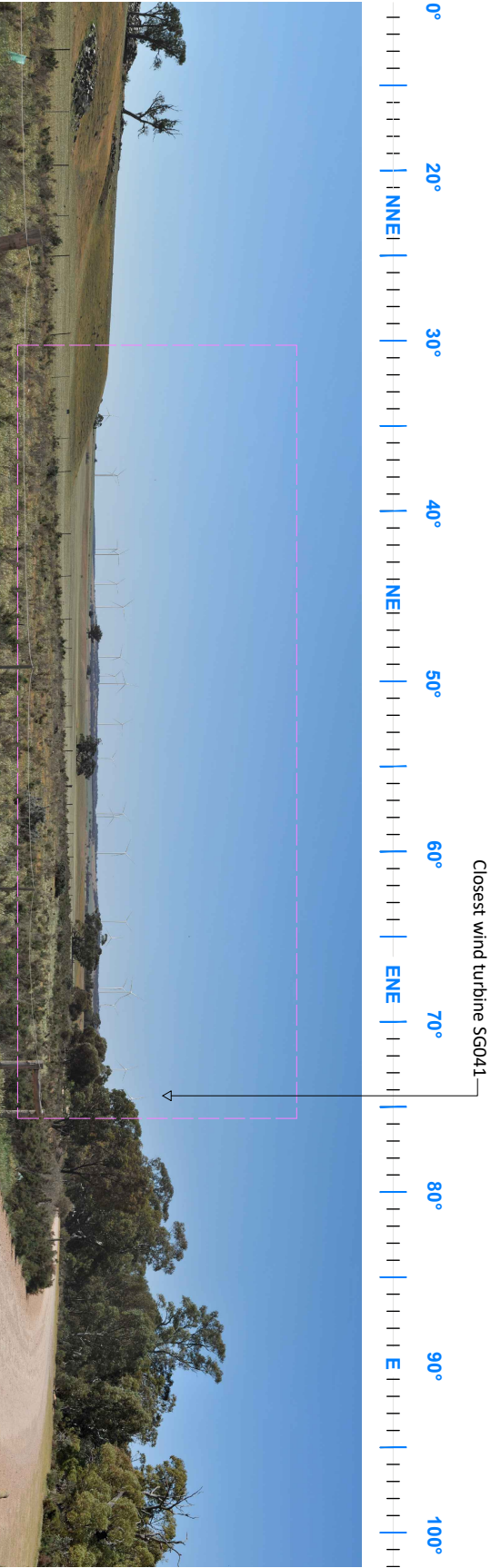
A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 32

Photomontage BU06
Worlds End Highway



Photomontage BU07 - Proposed view north north east to east from the Worlds End Camping Site. Approximate distance to closest visible wind turbine 5.1 km



Photomontage BU07 - Detail view through 45 degrees

General Notes:

Coordinates:

Easting 318511, Northing 6254639

Photo date:

12th September 2019, 1.15pm

Camera:

Nikon D850, 50mm 1:1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU07 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 33

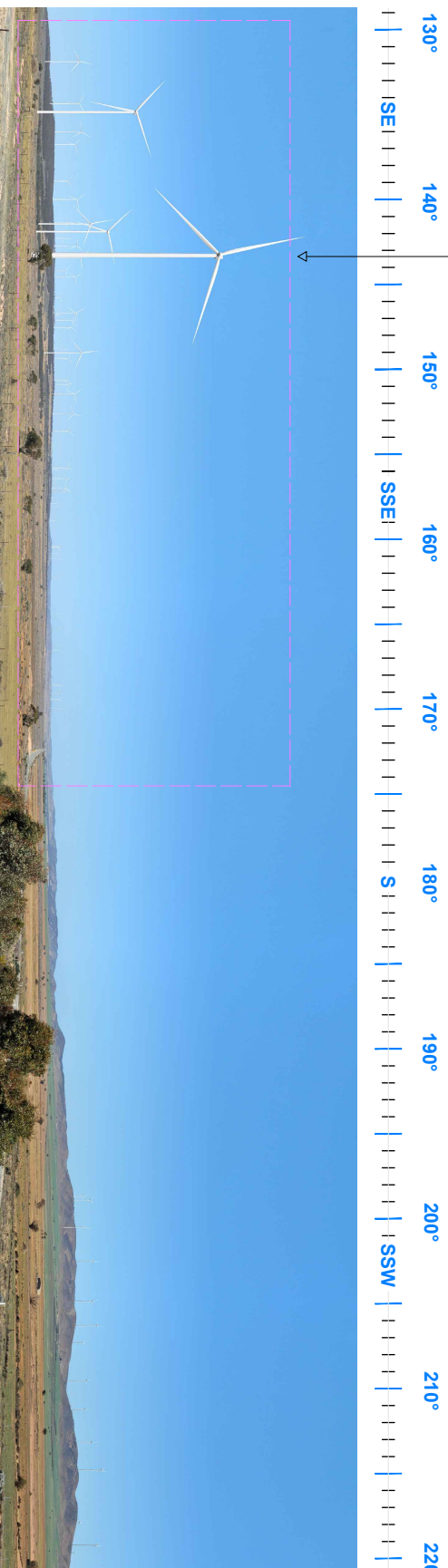
Photomontage BU07

Worlds End Camp Site

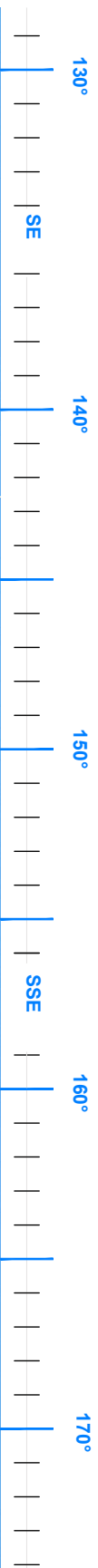


Extent of detail view

Closest wind turbine B064



Photomontage BU10 - Proposed view south east to south west from the Worlds End Highway. Approximate distance to closest visible wind turbine 750 m



Photomontage BU10 - Detail view through 45 degrees

General Notes:

Coordinates:

Easting 319999, Northing 6264455

Photo date:

12th September 2019, 2.18pm

Camera:

Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU10 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.



Photomontage BU10 - Detail view through 45 degrees

Goyder South Hybrid Renewable Energy Facility

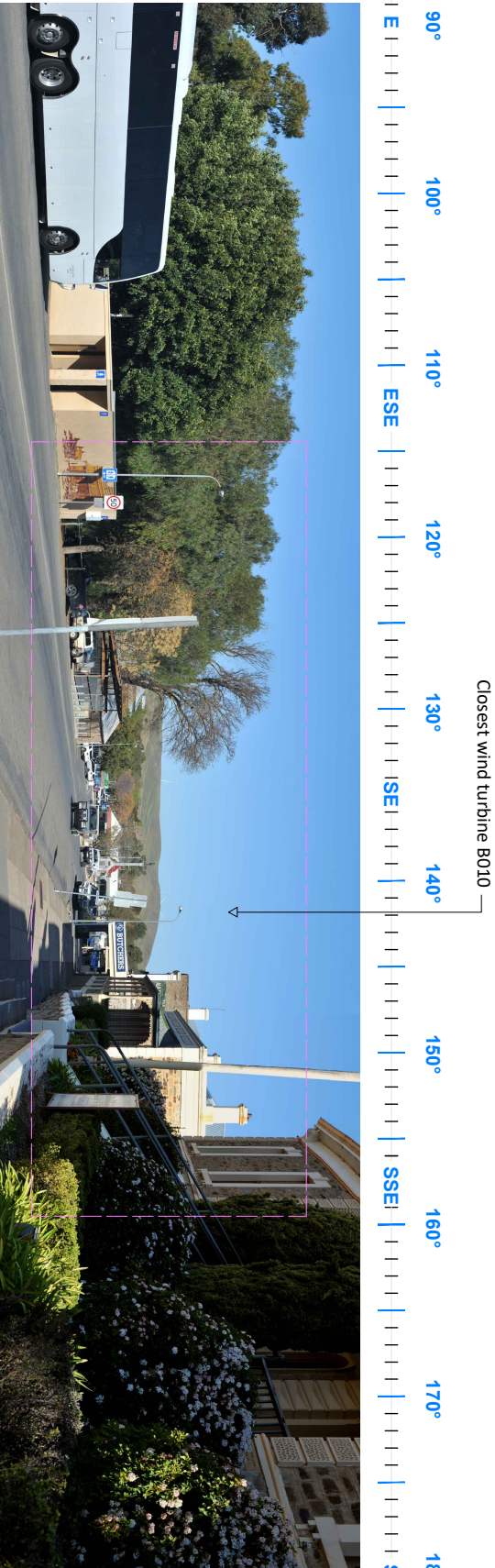
Extent of detail view

Figure 34

Photomontage BU10
Worlds End Highway (north)

GREEN BEAN DESIGN

landscape architects



Photomontage BU12 - Proposed view east to south from Market Street, Burra (Barrier Hwy). Approximate distance to closest visible wind turbine 5.5 km



Photomontage BU12 - Detail view through 45 degrees

General Notes:

Coordinates:
Easting 308803, Northing 6271362

Photo date:
12th September 2019, 3.51pm

Camera:
Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU12 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

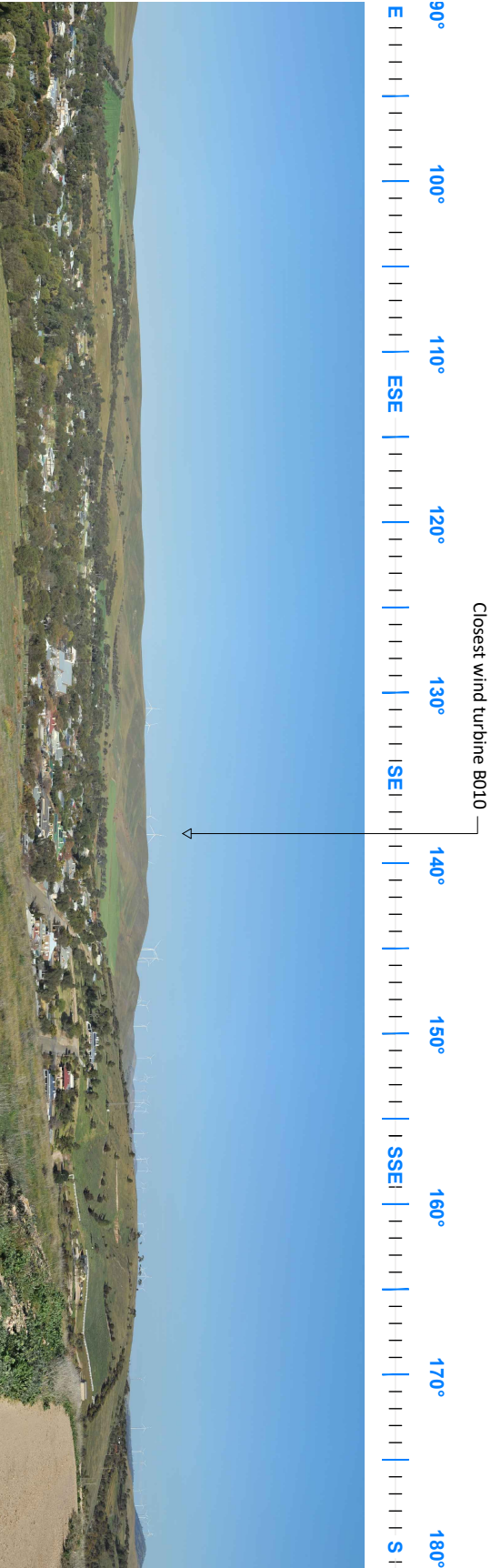
The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 35

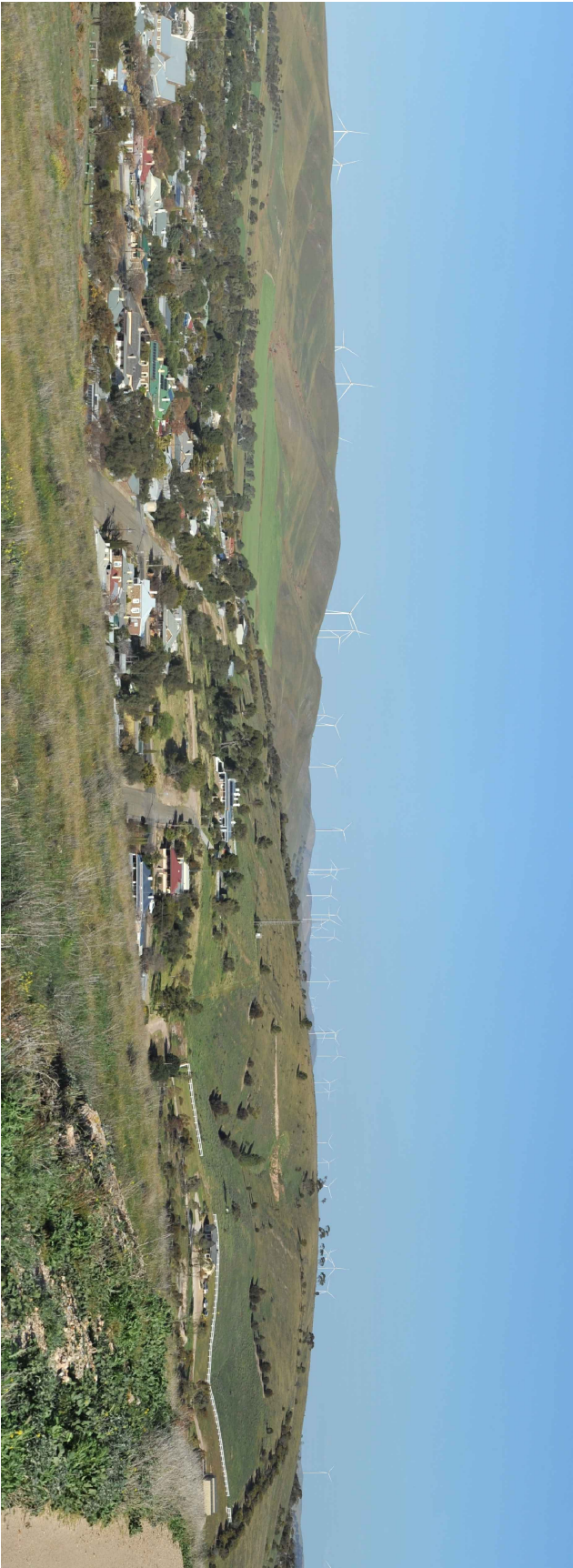
Photomontage BU12
Market Street, Burra (Barrier Hwy)



Extent of detail view



Photomontage BU13 - Proposed view east to south from the Chimney Lookout, Burra Mine. Approximate distance to closest visible wind turbine 5.8 km



Photomontage BU13 - Detail view through 45 degrees

General Notes:

Coordinates:

Easting 308332, Northing 6271326

Photo date:

12th September 2019, 4.38pm

Camera:

Nikon D850, 50mm 1:1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU13 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

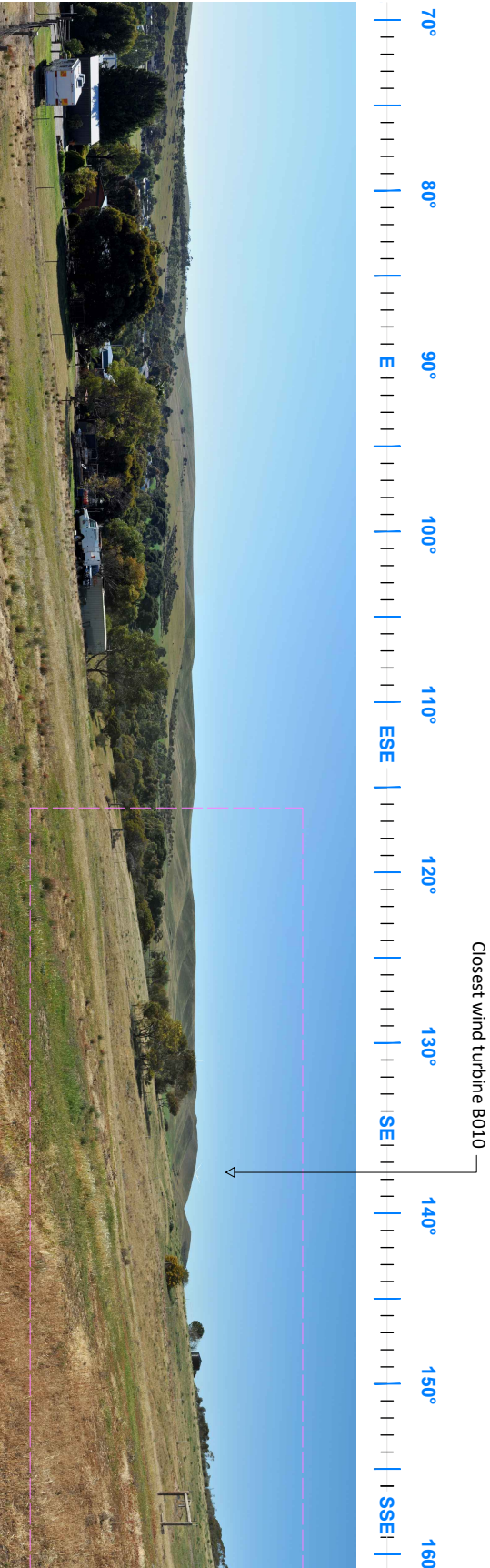
The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 36

Photomontage BU13

Chimney Lookout, Burra Mine



Photomontage BU14 - Proposed view east north east to south south east from the Allen Street. Approximate distance to closest visible wind turbine 4.6 km



Photomontage BU14 - Detail view through 45 degrees

General Notes:

Coordinates:
Easting 309147, Northing 6270571

Photo date:
13th September 2019, 9.38am

Camera:
Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU14 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

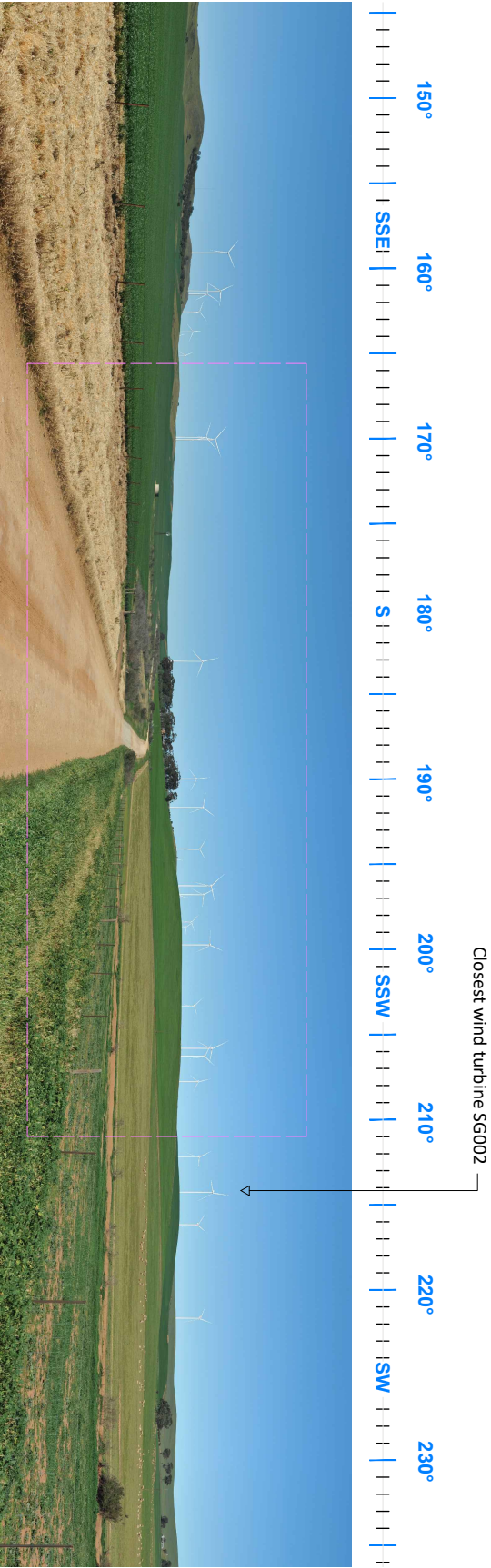
The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 37

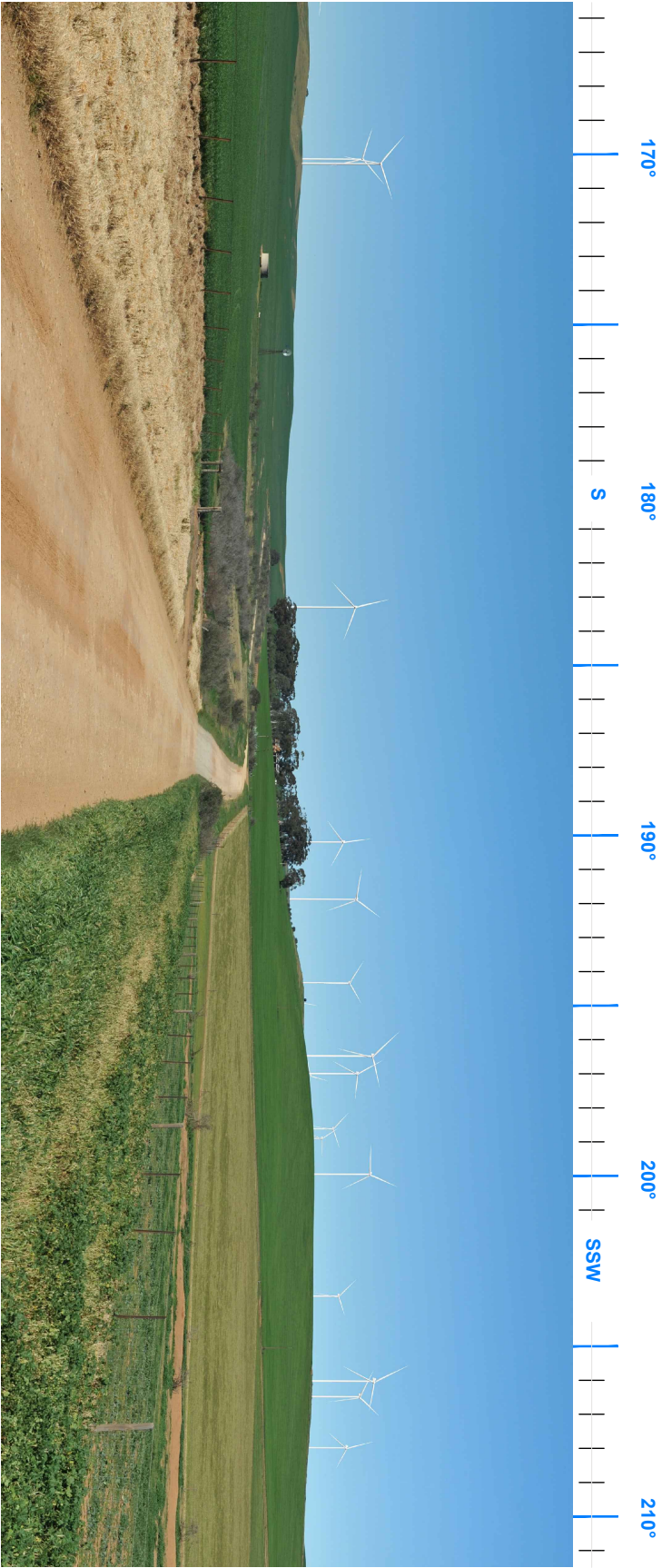
Photomontage BU14
Allen Street, Burra



Extent of detail view



Photomontage BU15 - Proposed view south south east to south from the Springbank Road. Approximate distance to closest visible wind turbine 3 km



Photomontage BU15 - Detail view through 45 degrees

General Notes:

Coordinates:
Easting 305961, Northing 6263251

Photo date:
13th September 2019, 10.02am

Camera:
Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU15 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

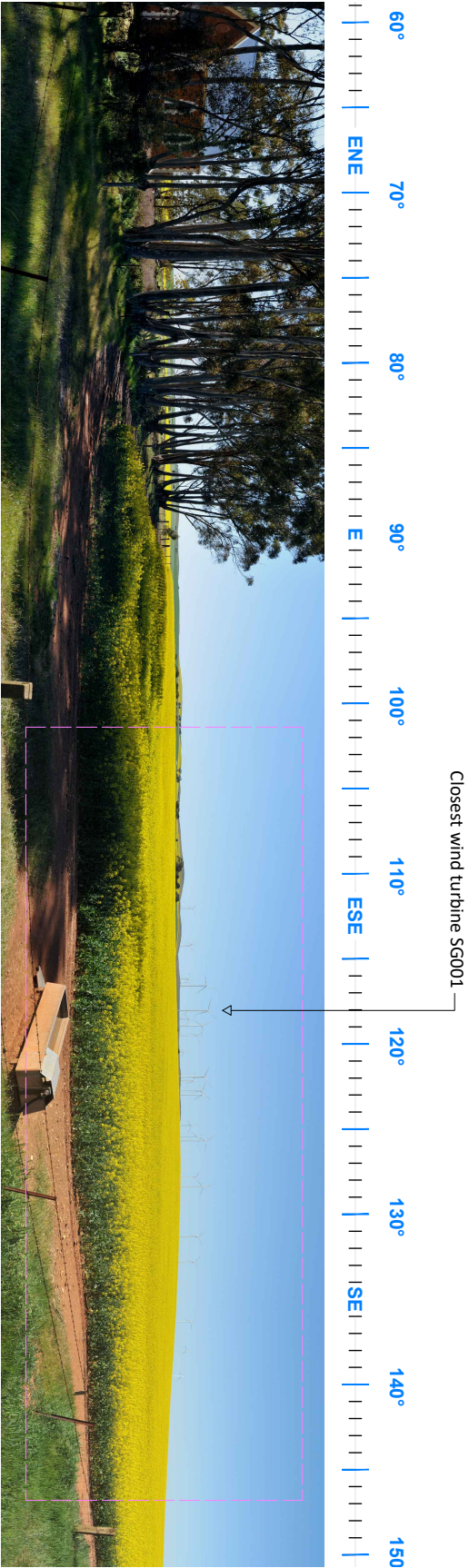
The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 38

Photomontage BU15
Springbank Road, Burra



Extent of detail view



General Notes:

Coordinates:
Easting 29965, Northing 6262889

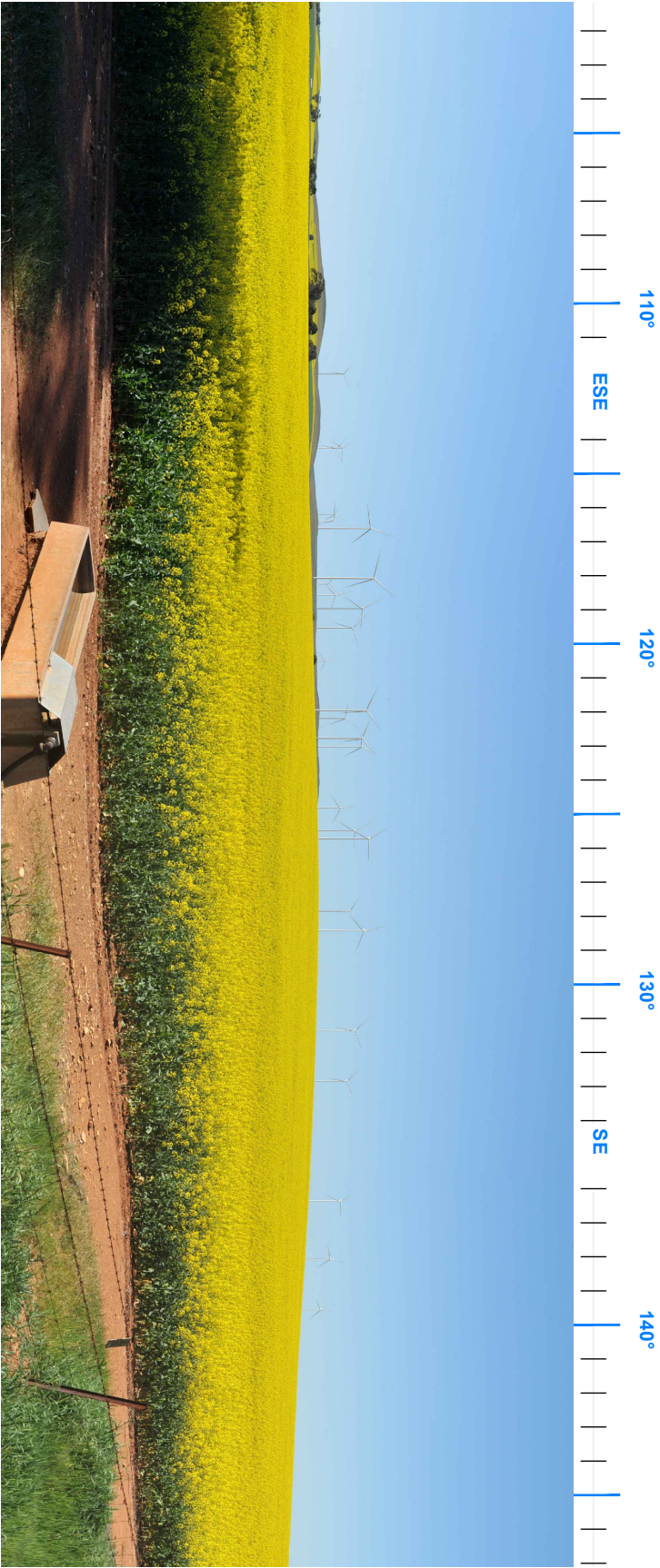
Photo date:
13th September 2019, 10.52am

Camera:
Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU16 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage BU16 - Proposed view east north east to south south east from the West Terrace, Hanson. Approximate distance to closest visible wind turbine 4 km



Photomontage BU16 - Detail view through 45 degrees

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

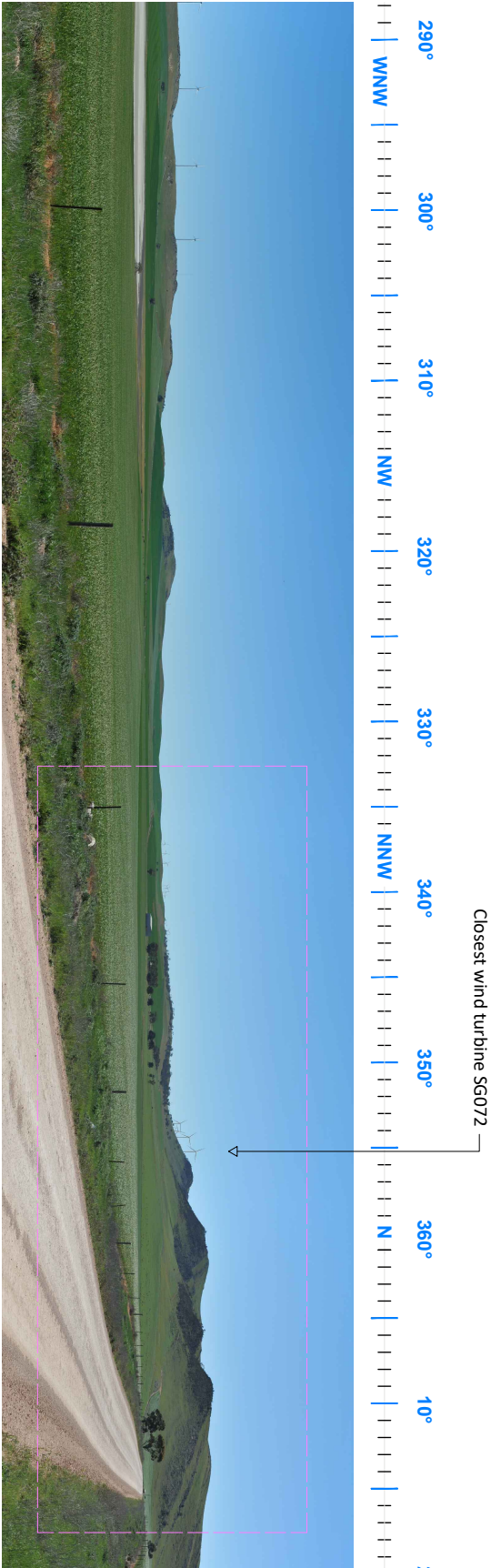
The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

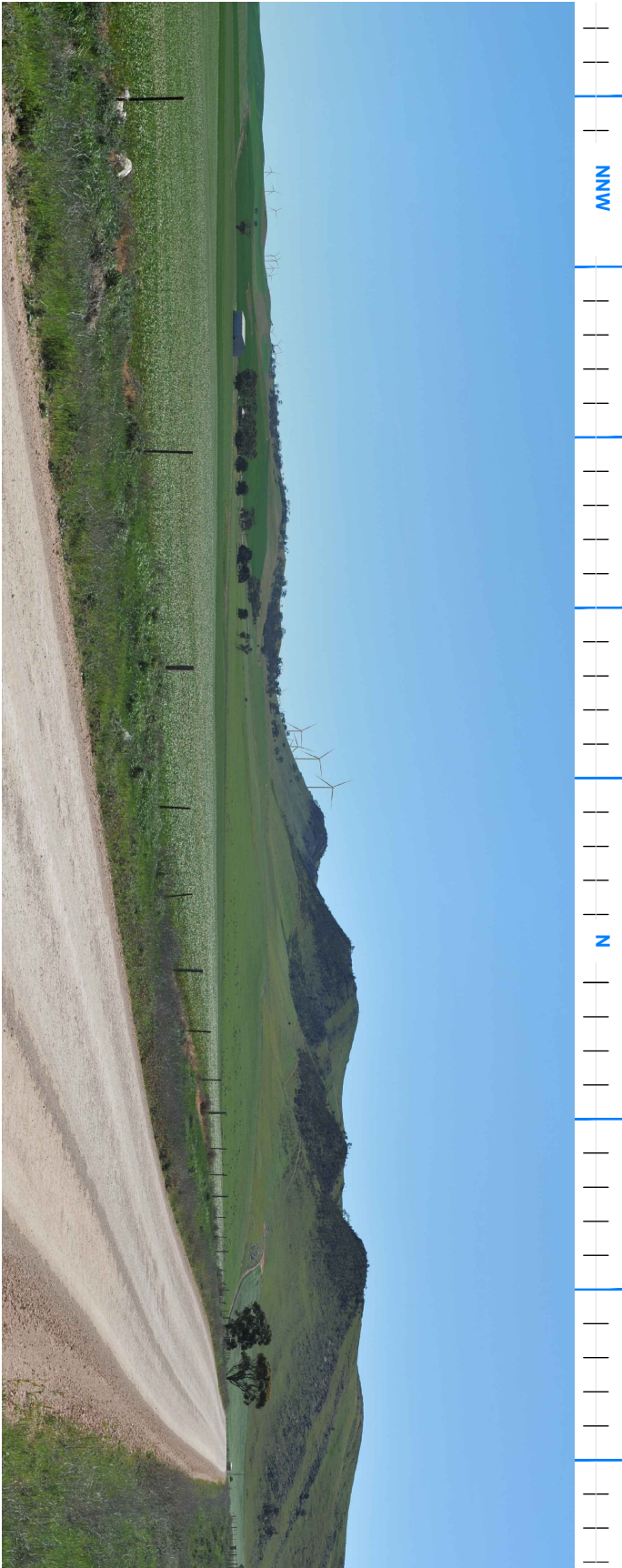
Figure 39
Photomontage BU16
West Terrace, Hanson



Extent of detail view



Photomontage BU18 - Proposed view west north west to north north east from the Tothill Belt Road. Approximate distance to closest visible wind turbine 6 km



Photomontage BU18 - Detail view through 45 degrees

General Notes:

Coordinates:
Easting 309759, Northing 6245107

Photo date:
13th September 2019, 12.12pm

Camera:
Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU18 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

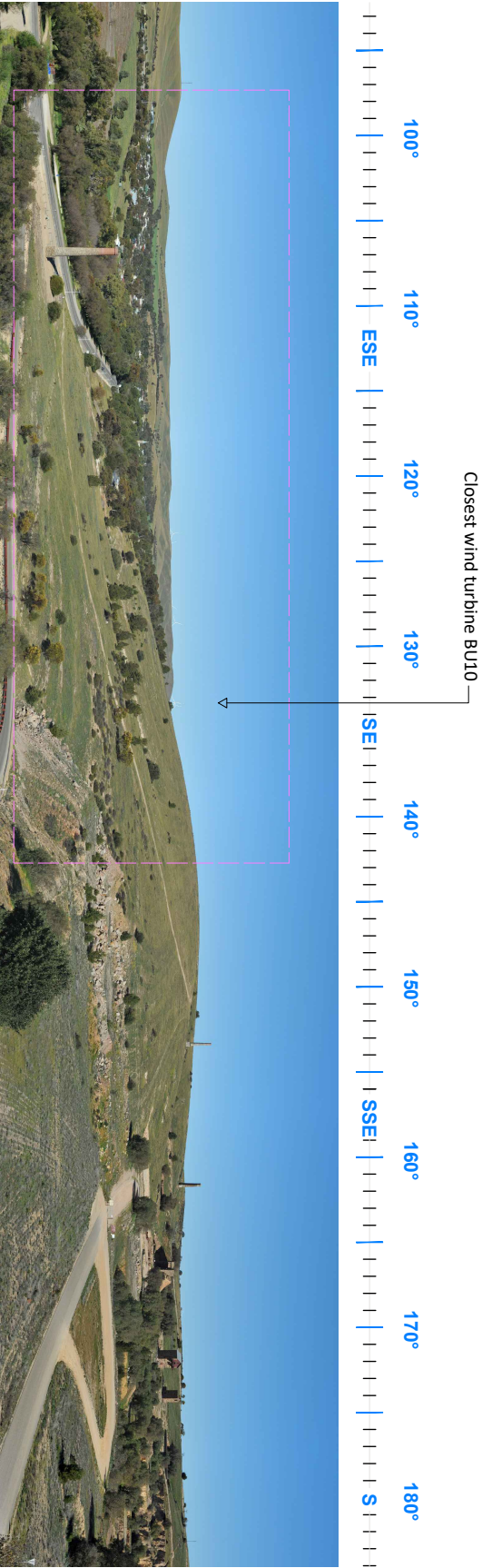
The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 40

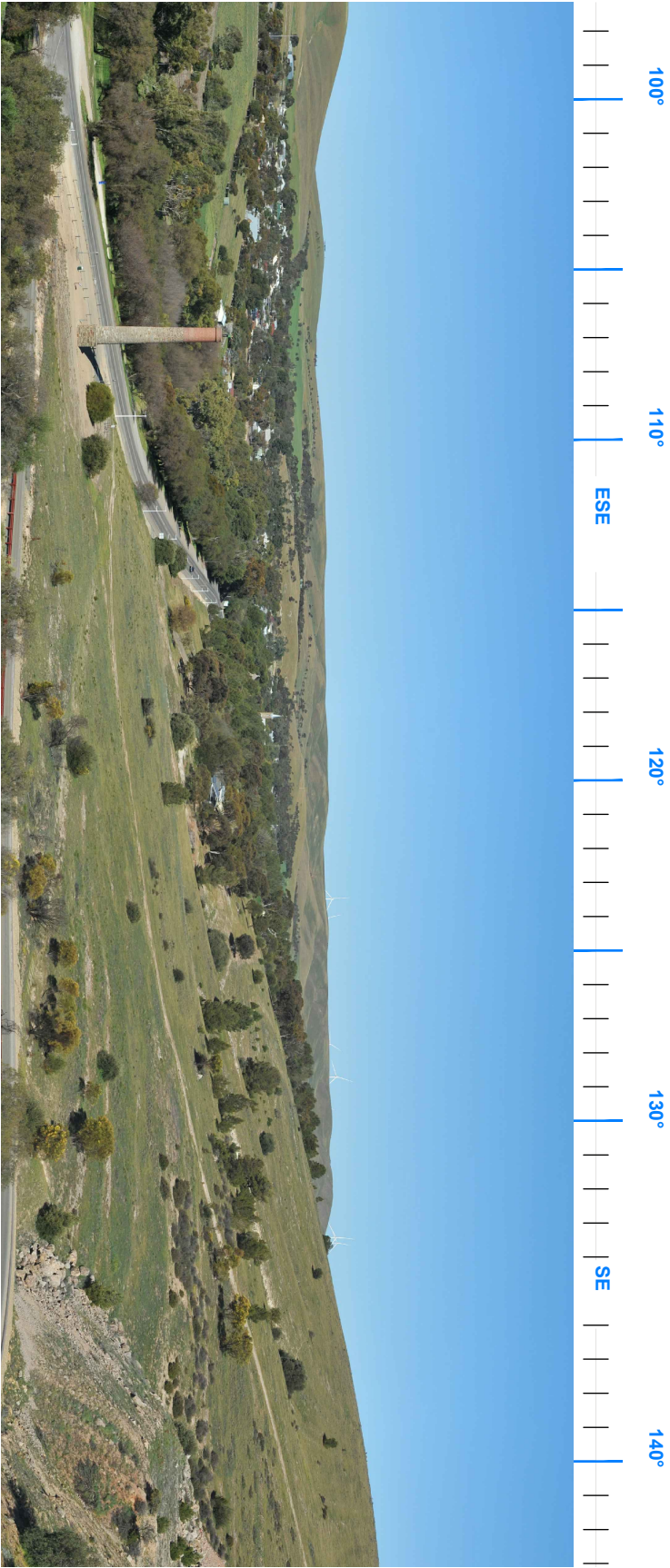
Photomontage BU18
Tothill Belt Road



Extent of detail view



Photomontage BU21 - Proposed view east south east to south from the Burra Mine Town Lookout. Approximate distance to closest visible wind turbine 6.4 km



Photomontage BU21 - Detail view through 45 degrees

General Notes:

Coordinates:
Easting 307992, Northing 6271823

Photo date:
13th September 2019, 3.40pm

Camera:
Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU21 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

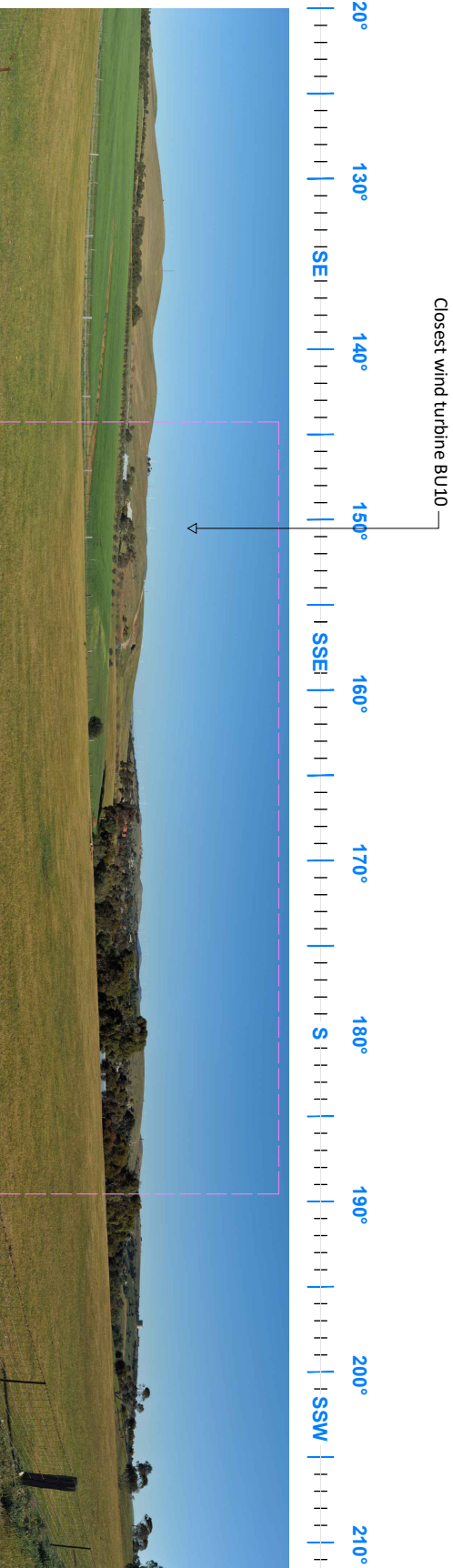
Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

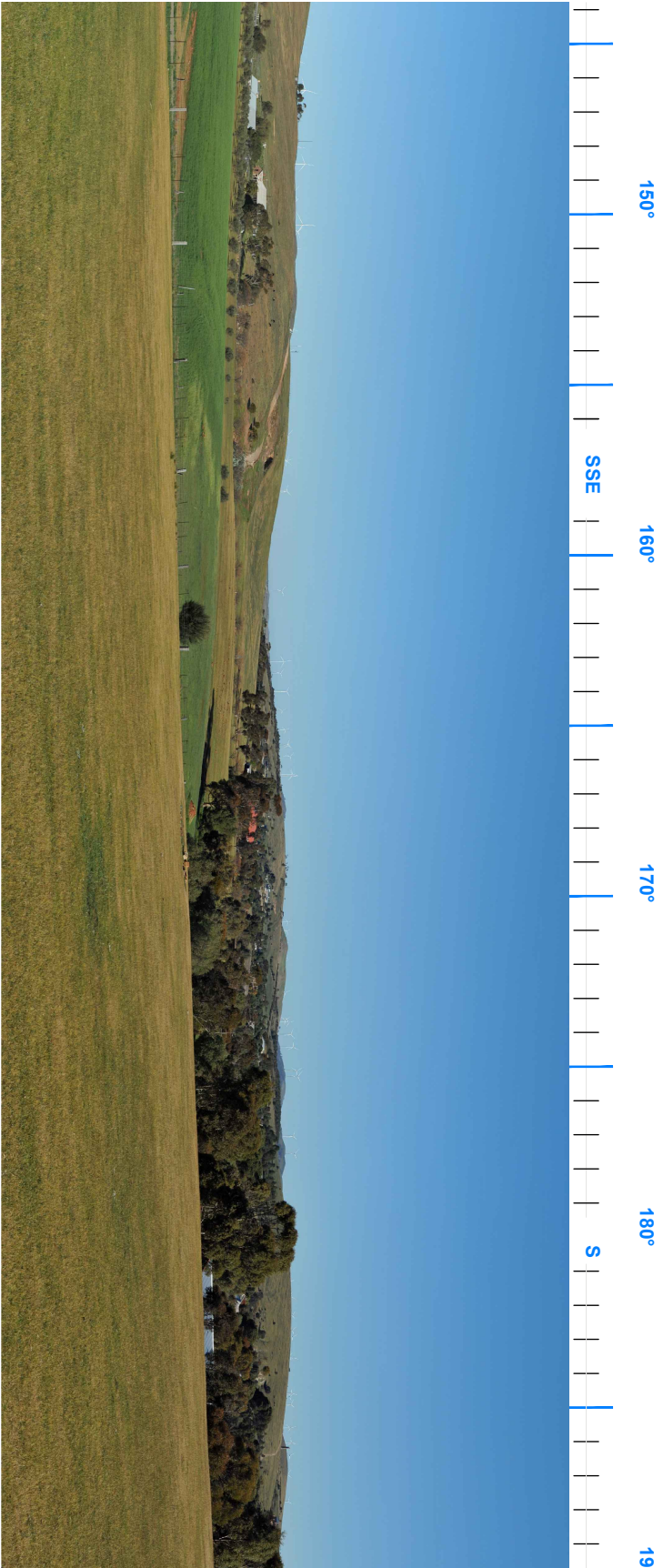
The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 41
Photomontage BU21
Burra Mine, Town Lookout



Photomontage BU22 - Proposed view south east to south south west from the Llanelly Street, Burra. Approximate distance to closest visible wind turbine 6.9 km



Photomontage BU22 - Detail view through 45 degrees

General Notes:

Coordinates:

Easting 308709, Northing 6272970

Photo date:

13th September 2019, 4.11pm

Camera:

Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU22 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

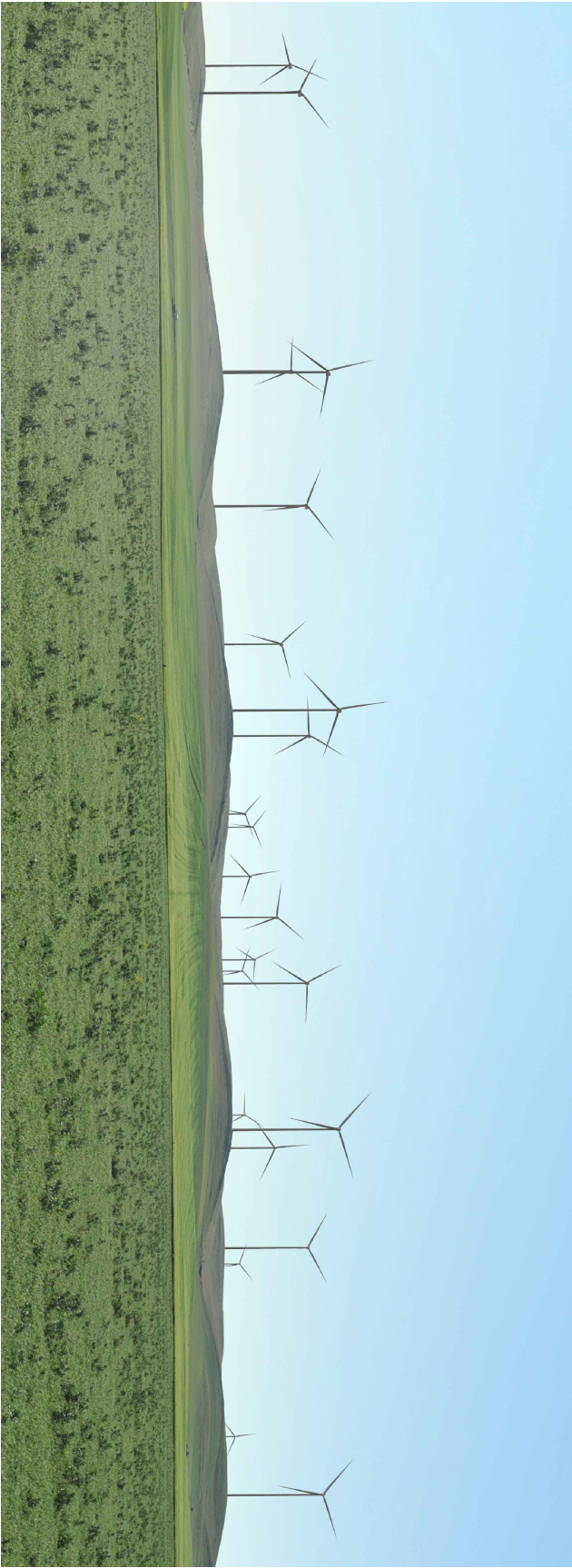
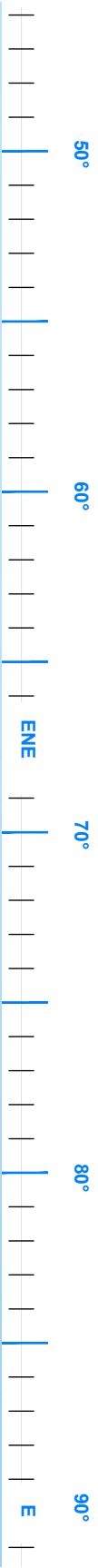
The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 42

Photomontage BU22
Llanelly Street, Burra



Photomontage BU23 - Proposed view north east to east south east from the Barrier Highway. Approximate distance to closest visible wind turbine 3.1 km



Photomontage BU23 - Detail view through 45 degrees

Goyder South Hybrid Renewable Energy Facility



Extent of detail view

General Notes:

Coordinates:
Easting 300369, Northing 6258900

Photo date:
14th September 2019, 9.08am

Camera:
Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU23 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

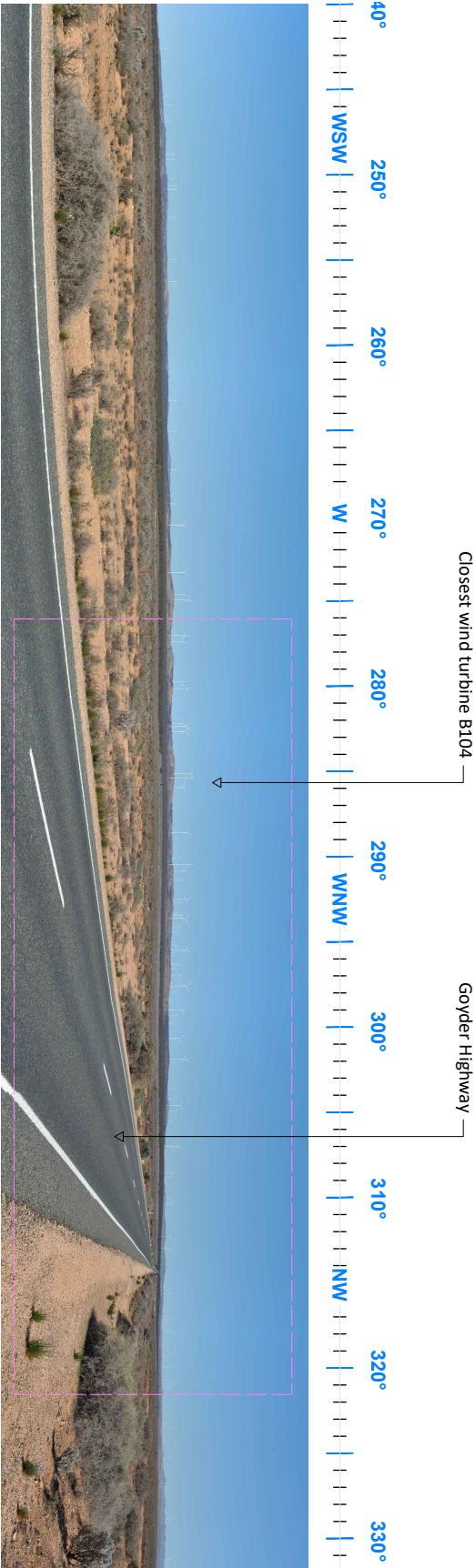
Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 43
Photomontage BU23
Barrier Highway



Photomontage BU24 - Proposed view south to west from the Goyder Highway. Approximate distance to closest visible wind turbine 7.6 km



Photomontage BU24 - Detail view through 45 degrees

General Notes:

Coordinates:

Easting 330981, Northing 6260608

Photo date:

14th September 2019, 10.41am

Camera:

Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU24 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and the distance to the turbines, but can never be 100% accurate.

The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 44

Photomontage BU24

Goyder Highway





Photomontage BU10 - Proposed view south south west to west from the Worlds End Highway. Approximate distance to closest visible wind turbine 750 m



Photomontage BU10 - Detail view through 45 degrees

General Notes:

Coordinates:
Easting 319999, Northing 6264455

Photo date:
12th September 2019, 2.18pm

Camera:
Nikon D850, 50mm 1.1.4D Lens

Original Page Format - A3 Landscape

Photomontage BU10 is illustrated at a view angle of around 90 degrees which is within the central, binocular field, of human vision.

Photomontage limitations

A photomontage can never show exactly what the wind and solar farm will look like in reality due to factors such as different lighting, weather and seasonal conditions which vary through time and the resolution of the image. Also a static image cannot convey turbine movement.

The images provided give a reasonable impression of the scale of the turbines and solar panels and the distance to these elements, but can never be 100% accurate.

The viewpoints illustrated are representative of views in this location, but cannot represent visibility at all locations.

Figure 45
Photomontage BU10
Worlds End Highway (north)



Pre-construction and construction

Section 13

13.1 Potential visual impacts

There are potential visual impacts that could occur during both pre-construction and construction phases of the project. The Project construction phase for the stages incorporating the wind, solar and battery facilities is likely to occur over a number of years, although the extent and nature of pre-construction and construction activities would vary at different locations within the Project area.

The key pre-construction and construction activities that would be visible from areas surrounding the proposed wind farm include:

- ongoing detailed site assessment including sub surface geotechnical investigations
- various civil works to upgrade local roads and access point
- temporary construction compound buildings and facilities
- temporary construction facilities, including portable structures and laydown areas
- various temporary construction and directional signage
- mobilisation of rock crushing equipment and concrete batching plant (if required)
- excavation and earthworks and
- various construction activities including erection of wind turbines, monitoring mast and electrical infrastructure works.

The majority of pre-construction and construction activities, some of which would result in physical changes to the landscape (which have been assessed in this LVIA report), are generally temporary in nature and for the most part restricted to various discrete areas within or beyond the immediate wind farm project area. The majority of pre-construction and construction activities would be unlikely to result in an unacceptable level of visual impact for their duration and temporary nature. The following images illustrate typical construction activities during preparation and installation of wind turbines:



Plate 1 Cable laying equipment



Plate 2 Typical crane plant utilised in wind turbine construction



Plate 3 Typical storage and laydown area



Plate 4 Typical contractors site office and amenities compound



Plate 5 Typical view toward wind turbines under construction

Mitigation measures

Section 14

14.1 Mitigation measures

The British Landscape Institute states '*the purpose of mitigation is to avoid, reduce, or where possible remedy or offset any significant negative (adverse) effects on the environment arising from the proposed development*' (2012). In general mitigation measures would reduce the potential visual impact of the Project by reducing the visual prominence of the wind turbines and associated structures by minimising the visual contrast between the wind turbines and the landscape in which they are viewed.

The following mitigation measures are also supported by the management of visual impacts through:

- the regularly spaced layout of the wind turbines which generally avoid resultant visual complexity
- the proposed application of uniform colours, size and shape across the Projects principal assets and
- the utilisation of solid tubular wind turbine towers (as opposed to lattice structures).

The landscape plan mitigation measures generally involve reducing the extent of visual contrast between the visible portions of the proposed structures and the surrounding landscape and are discussed below.

14.2 Detail design

Mitigation measures during the detail design process should consider:

- further refinement in the design and layout where possible, which may assist in the mitigation of bulk and height of proposed structures and
- a review of materials and colour finishes for selected components including the use of non-reflective finishes to structures where possible.

14.3 Construction

Mitigation measures during the construction period should consider actions to:

- minimise tree removal where possible
- avoidance of temporary light spill beyond the construction site where temporary lighting is required
- progressively rehabilitate disturbed areas and
- protect mature trees within the Project Site where possible.

14.4 Operation

Mitigation measures during the operational period should consider:

- ongoing maintenance and repair of constructed elements
- replacement of damaged or missing constructed elements and
- long term maintenance (and replacement as necessary) of vegetation within the Project Site to maintain visual filtering and screening of external views where appropriate.

14.5 On-site and off-site landscape mitigation

Subject to the requirements and conditions of the Development Application, the Proponent will seek to consult and undertake reasonable and feasible landscape mitigation works at dwellings surrounding the Project Site to mitigate views toward the Projects principal assets. The Proponent will also investigate the feasibility for 'on-site' landscape works to screen smaller scale elements within the Project Site such as those associated with the solar facility, battery storage and substations.

Conclusion

Section 15

15.1 Conclusion

The key findings of this LVIA are summarised below:

- The landscape character type, identified and described in this LVIA, is generally well represented throughout the local areas and more generally within the broader portions of the landscape area surrounding the Project Site.
- The distinguishable characteristics of the landscape character area may be altered by the Project, although the landscape character area would have the capability to absorb some change. The degree to which the landscape character area may accommodate the Project will potentially result in the introduction of prominent elements to the landscape character area, but these may be accommodated to some degree.
- Views toward the Project from local roads will offer a range of transitory views which will be subject to direction of travel and potential screening influence of vegetation alongside road corridors. Views from highways and some local roads would be partially screened and/or filtered by local topography and roadside tree planting.
- Given separation distances, the Project is unlikely to have a significant visual effect on the character of surrounding localities and the Burra township, where views toward the Project from the majority of dwelling and/or commercial view locations would be screened by adjoining buildings or structures and/ or surrounding tree cover and landform.
- Some dwellings surrounding the Project Site maintain privacy and/or shelter planting around dwellings. The extent of planting reduces the potential visibility of the Project from a number of view locations within the surrounding viewshed.
- This LVIA identified 28 non-host dwellings within 5km of the Project and determined that the majority of these dwellings would not experience a significant (high) visual effect as a result of the Project.
- This LVIA considers that the north and south solar facilities would not result in significant visual impacts from sensitive view locations (including dwellings) with visibility toward these facilities largely constrained by landform following low hills.
- Given separation distances between key sensitive view locations and the overhead power line easements, it is unlikely that overhead power lines would form prominent visual elements from many of these view locations. The substation and battery storage facilities would also tend not form prominent visual elements in the landscape where views from key sensitive view locations over moderate to long distances are screened by combinations of undulating landforms and/or vegetation.
- Proposed mitigation works, including landscape screening, is considered likely to mitigate views toward the majority of the Projects principal assets.

- Overall this LVIA concludes that the Project would not have an unreasonable impact on the landscape character, or the visual amenity of people living, working, or travelling through the landscape surrounding the Project Site.

Limitations

GBD has prepared this report in accordance with the usual care and thoroughness of the consulting profession for the use of Neoen Australia Pty Ltd. 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 GBD Proposal (December 2018).

The methodology adopted and sources of information used are outlined in this report. GBD has made no independent verification of this information beyond the agreed scope of works and GBD assumes no responsibility for any inaccuracies or omissions. No indications were found during our investigations that information contained in this report as provided to GBD was false.

This report was completed between January 2019 and May 2020 and is based on the conditions encountered and information reviewed at the time of preparation. GBD 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.

© Green Bean Design Pty Ltd 2020. This report is subject to copyright. Other than for the purposes and subject to conditions prescribed under the Copyright Act, or unless authorised by GBD in writing, no part of it may, in any form nor by any means (electronic, mechanical, micro copying, photocopying, recording or otherwise), be reproduced, stored in a retrieval system or transmitted without prior written permission. Inquiries should be addressed to GBD in writing.

Appendix A

DNV-GL Shadow Flicker and Blade Glint Assessment 28 March 2018

GOYDER WIND FARM

Shadow Flicker and Blade Glint Assessment

Green Bean Design Pty Ltd

Report No.: PP315180-AUME-R-01-B

Date: 22 May 2020

Status: Draft



IMPORTANT NOTICE AND DISCLAIMER

1. This document is intended for the sole use of the Customer as detailed on the front page of this document to whom the document is addressed and who has entered into a written agreement with the DNV GL entity issuing this document ("DNV GL"). To the extent permitted by law, neither DNV GL nor any group company (the "Group") assumes any responsibility whether in contract, tort including without limitation negligence, or otherwise howsoever, to third parties (being persons other than the Customer), and no company in the Group other than DNV GL shall be liable for any loss or damage whatsoever suffered by virtue of any act, omission or default (whether arising by negligence or otherwise) by DNV GL, the Group or any of its or their servants, subcontractors or agents. This document must be read in its entirety and is subject to any assumptions and qualifications expressed therein as well as in any other relevant communications in connection with it. This document may contain detailed technical data which is intended for use only by persons possessing requisite expertise in its subject matter.
2. This document is protected by copyright and may only be reproduced and circulated in accordance with the Document Classification and associated conditions stipulated or referred to in this document and/or in DNV GL's written agreement with the Customer. No part of this document may be disclosed in any public offering memorandum, prospectus or stock exchange listing, circular or announcement without the express and prior written consent of DNV GL. A Document Classification permitting the Customer to redistribute this document shall not thereby imply that DNV GL has any liability to any recipient other than the Customer.
3. This document has been produced from information relating to dates and periods referred to in this document. This document does not imply that any information is not subject to change. Except and to the extent that checking or verification of information or data is expressly agreed within the written scope of its services, DNV GL shall not be responsible in any way in connection with erroneous information or data provided to it by the Customer or any third party, or for the effects of any such erroneous information or data whether or not contained or referred to in this document.
4. Any wind or energy forecasts estimates or predictions are subject to factors not all of which are within the scope of the probability and uncertainties contained or referred to in this document and nothing in this document guarantees any particular wind speed or energy output.

KEY TO DOCUMENT CLASSIFICATION

Strictly Confidential	:	For disclosure only to named individuals within the Customer's organisation.
Private and Confidential	:	For disclosure only to individuals directly concerned with the subject matter of the document within the Customer's organisation.
Commercial in Confidence	:	Not to be disclosed outside the Customer's organisation.
DNV GL only	:	Not to be disclosed to non-DNV GL staff
Customer's Discretion	:	Distribution for information only at the discretion of the Customer (subject to the above Important Notice and Disclaimer and the terms of DNV GL's written agreement with the Customer).
Published	:	Available for information only to the general public (subject to the above Important Notice and Disclaimer).

Project name: Goyder Wind Farm DNV GL - Energy
Report title: Shadow Flicker and Blade Glint Assessment Renewables Advisory
Customer: Green Bean Design Pty Ltd Level 12, 350 Queen St
PO Box 3178, Austral, NSW, 2179 Australia Melbourne, VIC 3000
Contact person: Andy Homewood Australia
Date of issue: 22 May 2020 Tel: +61 3 8615 1515
Project No.: PP315180
Report No.: PP315180-AUME-R-01-B

Task and objective:

Conduct Shadow Flicker and Blade Glint Assessment of the proposed Goyder Wind Farm.

Prepared by: Verified by: Approved by:

M Purcell
*Senior Engineer
Developer Support Services (Pacific)*

J Jobin
*Senior Engineer
Developer Support Services (Pacific)*

T Gilbert
*Principal Engineer, Head of Section
Developer Support Services (Pacific)*

J Jobin
*Senior Engineer
Developer Support Services (Pacific)*

M Quan
*Engineer
Developer Support Services (Pacific)*

- ☐ Strictly Confidential
☐ Private and Confidential
☐ Commercial in Confidence
☐ DNV GL only
☒ Customer's Discretion
☐ Published

Keywords:
Goyder Wind Farm, shadow flicker, blade glint

Reference to part of this report which may lead to misinterpretation is not permissible.

Rev. No.	Date	Reason for Issue	Prepared by	Verified by	Approved by
A	20 Dec 2019	First issue - DRAFT	M Purcell	J Jobin	T Gilbert
B	22 May 2020	Revision to turbine layout and dwelling list	J Jobin	M Quan	T Gilbert

Table of contents

EXECUTIVE SUMMARY	II
Regulatory requirements	ii
Assessment methodology	ii
Assessment results	iii
1 DESCRIPTION OF THE WIND FARM SITE	1
1.1 The project	1
1.2 Proposed wind farm layout	1
1.3 Shadow receptor locations	1
2 REGULATORY REQUIREMENTS	2
2.1 Shadow flicker	2
2.2 Blade glint	2
3 ASSESSMENT METHODOLOGY	3
3.1 Shadow flicker	3
3.2 Blade glint	6
4 ASSESSMENT RESULTS	7
4.1 Shadow flicker	7
4.2 Blade glint	7
5 CONCLUSION	8
6 REFERENCES	9

EXECUTIVE SUMMARY

DNV GL Australia Pty Ltd ("DNV GL") has been commissioned by Green Bean Design Pty Ltd ("GBD" or "the Customer") to independently assess the expected annual shadow flicker duration in the vicinity of the proposed Goyder Wind Farm ("the Project"). This document has been prepared pursuant to DNV GL proposal L2C-182448-AUME-SFA-01-A and subsequent variation orders and is subject to the terms and conditions contained therein.

DNV GL has been commissioned by the Customer to independently assess the expected annual shadow flicker duration in the vicinity of the Project and any associated impact of blade glint for the final wind turbine model and layout chosen for the Project. The purpose of this report is to demonstrate compliance with relevant guidelines and regulations with respect to shadow flicker impacts.

Regulatory requirements

Shadow flicker involves the modulation of light levels resulting from the periodic passage of a rotating wind turbine blade between the sun and an observer.

The South Australian Wind Farms Development Plan Amendment [1] (SA Development Plan Amendment) states that the impacts of shadow flicker on nearby property owners and occupiers, road users, and wildlife should be minimised, but does not provide recommended limits for shadow flicker. The EPHC Draft National Wind Farm Development Guidelines [2] (Draft National Guidelines) recommend a limit on the theoretical shadow flicker duration at dwellings in the vicinity of the wind farm of 30 hours per year, and a limit on the actual shadow flicker duration of 10 hours per year.

This assessment was based on the methodology for assessing shadow flicker durations recommended by the Draft National Guidelines. Calculations were carried out assuming houses had either one or two stories, with window heights of either 2 m or 6 m, respectively. The relevant shadow flicker duration at a dwelling was taken as the maximum calculated duration occurring within 50 m of the dwelling.

Blade glint involves the reflection of light from a turbine blade, and can be seen by an observer as a periodic flash of light coming from the wind turbine.


The Draft National Guidelines note that blade glint is not generally a problem provided that non-reflective coatings are used for the surface of the blades.

Assessment methodology

DNV GL modelled the shadow flicker based upon a 163-turbine layout provided by the Customer [3]. As requested by the Customer, the majority of turbine locations were modelled with a hub height of 160 m, rotor diameter of 160 m, and tip height of 240 m [4]; with the exception of turbines B010, B017 and B024 which were modelled with a hub height of 120 m. The Customer has also provided the locations of 93 dwellings in the vicinity of the wind farm.

These have been used, in combination with a digital elevation model (DEM) of the site area, to determine the theoretical duration of shadow flicker caused by the Goyder Wind Farm at each dwelling.

The theoretical shadow flicker durations at dwellings (sensitive locations) within, and neighbouring, the Project have been determined using a purely geometric analysis which considers the relative position of the sun throughout the year, the wind turbines at the site, local topography and the viewer. The actual shadow flicker duration likely to be experienced at each dwelling has then been predicted by estimating the possible reduction in shadow flicker duration due to cloud cover and turbine orientation.



It is noted that the Project is in an area with high wind farm development activity. As such there may be cumulative shadow flicker impacts from multiple projects simultaneously. However, cumulative impacts have not been considered in the current assessment.

Assessment results

Based on the outcomes of the modelling conducted in the course of this assessment, a total of 16 dwellings are expected to experience shadow flicker. Out of these dwellings, 12 are predicted to experience theoretical shadow flicker for 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 at the same 12 dwellings are predicted to exceed the recommended limit of 10 hours per year within 50 m of the dwelling. All the dwellings at which the recommended annual durations are predicted to be exceeded are understood to be stakeholders in the proposed wind farm.

It is noted that the theoretical shadow flicker durations at three of these dwellings is very high, with theoretical annual durations exceeding 100 hours within 50 m of the dwelling, at dwellings H66, H123, H125. However, based on the information provided by the Customer, DNV GL understands that dwellings H66 and H123 are unoccupied.

As the calculation of the predicted actual shadow flicker duration does not take into account any reduction due to vegetation or other shielding effects around each house in calculating the number of shadow flicker hours, the values presented may still be regarded as conservative.

1 DESCRIPTION OF THE WIND FARM SITE

1.1 The project

The proposed Goyder Wind Farm ("the Project") is located approximately 5 km south-east of the town of Burra and 120 km north-east of Adelaide, in South Australia. An overview of the site location is presented in Figure 1.

The site largely follows the elevated ridgelines in the area and surrounding flat land. The ridgelines are generally forested with varying densities and the flat land surrounding the site consists mostly of farmland. A digital elevation model (DEM), extending to approximately 20 km from the site, was derived from publicly available SRTM1 data [5].

1.2 Proposed wind farm layout

The turbine layout provided by the Customer [3] is composed of 163 turbines, with turbine base elevations ranging from approximately 281 m to 664 m. An elevation map of the site is shown in Figure 2, and a list of coordinates of the proposed turbine locations are given in Table 1.

As requested by the Customer, DNV GL has modelled the shadow flicker based on a turbine model with a hub height of 160 m, rotor diameter of 160 m, and tip height of 240 m [4] for most turbines, with the exception of turbines B010, B017 and B024, which were modelled with a reduced hub height of 120 m. No specific turbine model was supplied and therefore the maximum blade chord length, which is defined as the dimension through the thickest part of the blade, was not defined.

1.3 Shadow receptor locations

A list of 93 dwellings or shadow receptors neighbouring the wind farm was supplied to DNV GL by the Customer [3]. The coordinates of receptors within 2450 m; corresponding to 15 times the proposed rotor diameter plus 50 m, of proposed turbine locations are presented in Table 2.

DNV GL has modelled all listed receptors as habitable building structures. Sensitive receptors situated more than 1600 m (10 rotor diameters) from turbine locations will have predicted annual shadow flicker durations of zero hours due to the shadow flicker distance limit assumed for the analysis, as discussed further in Sections 2.1 and 3.1. It should be noted that DNV GL has not carried out a detailed and comprehensive survey of sensitive land uses and building locations in the area and is relying on information provided by the Customer.

The Customer has indicated in [3] the project involvement status of each dwelling and whether these dwelling are classified as occupied or not.

2 REGULATORY REQUIREMENTS

2.1 Shadow flicker

The South Australian Wind Farms Development Plan Amendment [1] states that:

"Wind farms and ancillary development should avoid or minimise... impacts on nearby property owners/occupiers, road users and wild life [caused by] shadowing, flickering, reflection or glint..."

However, the SA Development Plan Amendment does not provide recommended limits for shadow flicker, or a methodology for calculating shadow flicker durations.

Recommendations for shadow flicker limits relevant to wind farms in Australia are included in the EPHC Draft National Wind Farm Development Guidelines released in July 2010 [2]. The Draft National Guidelines recommend that the modelled theoretical shadow flicker duration at a dwelling should not exceed 30 hours per year, and that the actual or measured shadow flicker duration should not exceed 10 hours per year. The Draft National 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 [6] or approximately 1200 m to 1500 m for modern wind turbines (which typically have rotor diameters of 120 m to 150 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). The Draft National Guidelines further state that *"no assessment is required for residences beyond this distance"*.

2.2 Blade glint

The Draft National Guidelines provide guidance on blade glint and state that:

"The sun's light may be reflected from the surface of wind turbine blades. Blade Glint has the potential to annoy people. All major wind turbine 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."

3 ASSESSMENT METHODOLOGY

3.1 Shadow flicker

3.1.1 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:

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

3.1.2 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 the turbines 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.

In line with the methodology proposed in the Draft National Guidelines, DNV GL 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 would be facing a particular direction. The shadow flicker calculations for dwelling locations have been carried out with a temporal resolution of 1 minute; if shadow flicker is predicted to occur in any 1-minute period, the model records this as 1 minute of shadow flicker. 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.

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 UK wind industry considers that 10 rotor diameters is appropriate [6], while the Draft National Guidelines suggest a distance equivalent to 265 times the maximum blade chord as an appropriate limit. For the current assessment, DNV GL has implemented a maximum shadow length of 10 times the rotor diameter, 1600 m, as maximum blade chord was not supplied for this assessment.



Beyond this distance limit, 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 annoyed by shadow flicker intensities below the “moderate level of intensity” assumed by this distance limit. To account for this possibility, DNV GL has also assessed the shadow flicker for an increased distance limit of 15 times the rotor diameter, 2400 m, which is meant to also include shadow flicker below a “moderate level of intensity”.

The model also makes the following assumptions and simplifications:

- there are clear skies every day of the year
- the blades of the turbines are always perpendicular to the direction of the line of sight from the location of interest to the sun
- the turbines are always rotating.

The first two of these items are addressed in the calculation of the predicted actual shadow flicker duration as described in Section 3.1.4. The third item means that the results generated by the model may be slightly conservative, as there will be some periods of time when the turbines are not rotating, but is unlikely to have a significant impact on the results.

The settings used to execute the model can be seen in Table 3.

To illustrate typical results, an indicative shadow flicker map for a turbine located in a relatively flat area is shown in Figure 3. 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 solstice and conversely the lobes to the south result from the winter solstice. 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.

3.1.3 Factors affecting duration

Shadow flicker duration calculated in this manner 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 overestimate of 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.

3.1.4 Predicted actual duration


As discussed above in Section 3.1.3, 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. Exclusion of these factors means that the theoretical calculation is likely to be conservative. An attempt has been made to quantify the likely reduction in shadow flicker duration due cloud cover and, therefore, produce a prediction of the actual shadow flicker duration likely to be experienced at a sensitive receptor.

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

- Snowtown (021046), located approximately 62 km from the site [7].
- Clare Post Office (021014), located approximately 25 km from the site [8].
- Georgetown (021020), located approximately 64 km from the site [9].
- Eudunda (024511), located approximately 29 km from the site [10].

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 35% and 58%, and the average annual cloud cover is approximately 48%. This means that on an average day, 48% 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 impact 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 was provided by the Customer [11], and used



to estimate the reduction in shadow flicker duration due to rotor orientation. The wind rose is shown overlaid on the indicative shadow flicker map in Figure 3. 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 GL 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 for operational or maintenance reasons has not been considered. It is therefore likely that the adjusted shadow flicker durations presented here can still be regarded as a conservative assessment.

3.2 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, provided the blades are coated with a non-reflective paint, and it is not considered further here.

4 ASSESSMENT RESULTS

4.1 Shadow flicker

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

The theoretical predicted shadow flicker durations at all dwellings identified to be affected by shadow flicker are presented in Table 4. The maximum predicted theoretical shadow flicker durations within 50 m of these receptors are also presented in this table. The results are also shown in the form of shadow flicker maps in Figure 4 to Figure 7. The shadow flicker values presented in these maps represent the worst case between the results at 2 m and 6 m above ground.

The results indicate that, out of the dwellings identified by the Customer, 16 dwellings are predicted to experience some shadow flicker based on the methodology recommended by the Draft National Guidelines. However, it is understood that all these dwellings are owned by parties who have some involvement in the proposed wind farm.

For the turbine layout and dimensions considered, 12 of these dwellings are predicted to experience theoretical shadow flicker durations that exceed the limit recommended by the current guidelines. When considering the predicted actual shadow flicker duration, which takes into account the reduction in shadow flicker due to cloud cover and rotor orientation, the same 12 receptors are expected to experience actual shadow flicker durations in excess of the limit recommended in the guidelines.

It is also noted that the theoretical shadow flicker durations at several of these dwellings is very high, with theoretical annual durations exceeding 100 hours at dwellings H66, H123, H125. However, based on the information provided by the Customer, DNV GL understands that dwellings H66 and H123 are unoccupied.

Beyond the 10D distance limit, 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 part of the methodology outlined in the Draft National Guidelines, DNV GL has also assessed the shadow flicker impacts for the Project for an increased distance limit that is intended to include shadow flicker below a "moderate level of intensity". For the purpose of this assessment, the distance limit has been increased by 50% (to 15D), and the results of this additional assessment are illustrated in the map presented in Figure 4 and Figure 5. These results indicate that, 11 additional dwellings (total of 27) have the potential to be exposed to shadow flicker below a "moderate level of intensity". These dwellings are noted in Table 4. DNV GL recommends that the potential for shadow flicker to cause annoyance at these dwellings be carefully considered and discussed with the landowners.

If shadow flicker presents a problem, its effects can be reduced through a number of measures. These include the installation of screening structures or planting of trees to block shadows cast by the turbines, the use of turbine control strategies which shut down turbines when shadow flicker is likely to occur, or the relocation of turbines.

4.2 Blade glint

As discussed in Section 3.2, blade glint is not generally a problem for modern wind turbines, provided that the blades are coated with a non-reflective paint.

5 CONCLUSION

A shadow flicker assessment has been carried out at dwelling locations in the vicinity of the Project, with the purpose of demonstrating compliance with current guidelines and regulations. The modelling results indicate that, for the turbine layout and dimensions considered, 12 dwellings are predicted to experience theoretical shadow flicker durations that exceed the limits recommended by Draft National Guidelines. When considering the predicted actual shadow flicker duration, which takes into account the reduction in shadow flicker due to cloud cover and rotor orientation, the same 12 receptors are expected to experience actual shadow flicker durations in excess of the limit recommended in the guidelines. It is however understood that all these dwellings are stakeholders in the proposed wind farm.

It is noted that the theoretical shadow flicker durations at three of these dwellings is very high, with theoretical annual durations exceeding 100 hours at dwellings H66, H123, H125. However, based on the information provided by the Customer, DNV GL understands that dwellings H66 and H123 are unoccupied.

It is also noted that the prediction of the actual shadow flicker duration presented here does not take into account any reduction due to vegetation or other shielding effects around each sensitive receptor in calculating the number of shadow flicker hours. Therefore, the values presented may still be regarded as conservative.

DNV GL recommends that the Customer investigate mitigation measures with the owners of dwellings where the recommended shadow flicker limits are exceeded to reduce the effect of shadow flicker, if required, to ensure they do not experience unreasonable annoyance. These measures may include relocation or removal of turbines, deployment of shadow flicker controllers, or the installation of screening structures or planting of trees to block shadows cast by the turbines.

The results presented have been generated based on hypothetical turbine models. If the turbine selected for the site has dimensions smaller than those considered, but within the indicative turbine envelope, then shadow flicker durations are likely to be lower than those predicted here.

As discussed in previous sections, blade glint is not generally a problem for modern wind turbines, provided that the blades are coated with a non-reflective paint.

6 REFERENCES

1. "Statewide Wind Farms Development Plan Amendment", Department of Planning, Transport and Infrastructure, Government of South Australia, October 2012
2. "National Wind Farm Development Guidelines – Public Consultation Draft", Environmental Protection and Heritage Council (EPHC), July 2010
3. "Turbine Layout 04.05.20.kmz". Google Earth data file. Attachment to email from A. Homewood (GBD) to T.Gilbert (DNV GL), 12 May 2020
4. Information within email from A. Homewood (GBD) to D. Price (DNV GL), 03 April 2020
5. "SRTM Worldwide Elevation Data (1 arc-second resolution, SRTM Plus V3)", National Aeronautics and Space Administration (NASA), elevation grid downloaded from Global Mapper (v19.1) Online Data interface, 9 October 2019
6. "Planning for Renewable Energy – A Companion Guide to PPS22", Office of the Deputy Prime Minister, UK, 2004
7. "Climate statistics for Australian locations – Snowtown", Bureau of Meteorology, viewed 22 October 2019, http://www.bom.gov.au/climate/averages/tables/cw_021046_All.shtml
8. "Climate statistics for Australian locations – Clare Post Office", Bureau of Meteorology, viewed 22 October 2019, http://www.bom.gov.au/climate/averages/tables/cw_021014_All.shtml
9. "Climate statistics for Australian locations – Georgetown", Bureau of Meteorology, viewed 22 October 2019, http://www.bom.gov.au/climate/averages/tables/cw_021020_All.shtml
10. "Climate statistics for Australian locations – Eudunda", Bureau of Meteorology, viewed 29 October 2019, http://www.bom.gov.au/climate/averages/tables/cw_024511_All.shtml
11. Image within email from A. Homewood (GBD) to D. Price (DNV GL), 3 December 2019

List of Tables

Table 1	Goyder Wind Farm turbine coordinates.....	11
Table 2	Shadow receptor locations within 2450 m of turbines at the Goyder Wind Farm.....	12
Table 3	Shadow flicker model settings for theoretical shadow flicker calculation.....	13
Table 4	Theoretical and predicted actual annual shadow flicker duration	14

List of Figures

Figure 1	Location of the Goyder Wind Farm.....	15
Figure 2	Elevation map of the Goyder Wind Farm.....	16
Figure 3	Indicative shadow flicker map and wind direction frequency distribution	17
Figure 4	Theoretical annual shadow flicker duration – Western section of the Project.....	18
Figure 5	Theoretical annual shadow flicker duration – Eastern section of the Project.....	19
Figure 6	Predicted actual annual shadow flicker duration – Western section of the Project.....	20
Figure 7	Predicted actual annual shadow flicker duration – Eastern section of the Project.....	21

Table 1 Goyder Wind Farm turbine coordinates

WTG ID	Easting ¹ [m]	Northing ¹ [m]	WTG ID	Easting ¹ [m]	Northing ¹ [m]	WTG ID	Easting ¹ [m]	Northing ¹ [m]
B001	310545	6259113	B073	321200	6265800	SG017	305104	6259538
B004	311500	6260400	B074	321200	6262995	SG018	304600	6259340
B005	311557	6258594	B075	321300	6268900	SG019	322800	6259300
B008	312000	6257500	B076	321300	6268300	SG020	307700	6259240
B010	312300	6267100	B077	321382	6270456	SG021	305146	6259046
B015	312800	6258300	B078	321500	6269800	SG022	303803	6259030
B017	312950	6267400	B079	321500	6268000	SG023	304700	6258840
B021	313239	6260452	B080	321500	6266400	SG024	322900	6258800
B023	313557	6261167	B081	321600	6266900	SG025	307800	6258740
B024	313600	6267866	B082	321652	6262482	SG026	310640	6258500
B025	313900	6265300	B083	322100	6267300	SG027	304100	6258440
B026	313934	6259504	B084	321806	6261480	SG028	307900	6258140
B027	314100	6267400	B085	322400	6266800	SG029	303870	6257940
B028	314100	6266600	B086	322900	6260700	SG030	323200	6257900
B029	314111	6259050	B087	323000	6260000	SG031	307900	6257640
B030	314240	6266039	B088	323176	6261872	SG032	311000	6257440
B031	314300	6262700	B089	323400	6261400	SG033	303930	6257440
B032	314500	6264000	B090	323500	6267300	SG034	308200	6257240
B033	314600	6264500	B091	323600	6260400	SG035	323200	6257100
B034	314900	6263200	B092	323700	6260900	SG036	304047	6256856
B035	315100	6262400	B093	323700	6259800	SG037	311260	6256694
B036	315200	6261900	B094	323800	6259300	SG039	323300	6256600
B037	315500	6262900	B095	323800	6258600	SG040	311330	6256140
B038	315500	6258100	B096	324100	6257600	SG041	323400	6256100
B039	315600	6261300	B097	324100	6257100	SG042	311635	6255557
B040	315600	6258800	B098	324200	6258100	SG043	323600	6255545
B042	315700	6264200	B099	324300	6260200	SG044	308700	6255340
B043	315700	6259300	B100	324500	6259600	SG046	311981	6255086
B044	315800	6260800	B101	324500	6259100	SG047	308532	6254688
B045	315800	6259800	B102	324600	6256300	SG048	308600	6254185
B046	316000	6260300	B103	324700	6256800	SG049	309100	6254040
B047	316200	6258500	B104	324900	6258400	SG050	308746	6253570
B048	316300	6258000	B105	324900	6257900	SG051	308870	6253176
B049	316500	6259300	B106	325500	6256600	SG052	308829	6252703
B050	316500	6257100	B107	325600	6256100	SG053	321574	6252245
B051	316700	6257600	B108	326200	6248240	SG054	308840	6252095
B052	317000	6258700	B109	326306	6249851	SG055	321786	6251631
B053	318600	6268400	B110	326569	6248960	SG056	309010	6251599
B054	319002	6267634	B111	326810	6246833	SG057	322007	6250856
B055	319008	6267069	B112	326054	6245573	SG058	322223	6250246
B056	319194	6266523	B113	327729	6245777	SG059	324578	6249860
B058	319600	6266700	SG001	303430	6261070	SG060	325213	6248597
B060	320000	6266100	SG002	304000	6260940	SG061	323300	6247835
B061	320001	6265257	SG003	304350	6260472	SG062	325469	6247751
B062	320100	6269400	SG004	303520	6260598	SG063	323533	6247192
B063	320400	6265700	SG007	307485	6260178	SG064	325147	6246641
B064	320440	6263888	SG008	303536	6260125	SG065	325791	6246808
B065	320500	6266900	SG009	304101	6260112	SG066	324084	6246344
B066	320500	6264600	SG010	304898	6260085	SG067	324541	6245806
B067	320564	6270453	SG011	306702	6260071	SG069	326444	6244948
B068	320600	6268909	SG012	304513	6259798	SG070	327200	6244640
B069	320700	6269800	SG013	307500	6259740	SG071	325787	6244398
B070	320934	6265033	SG014	305800	6259740	SG072	309172	6251050
B071	321014	6263525	SG015	303664	6259640			
B072	321100	6267400	SG016	306817	6259623			

Notes:

1. Coordinate system: MGA Zone 54, GDA94 datum.

Table 2 Shadow receptor locations within 2450 m of turbines at the Goyder Wind Farm

Receptor ID	Landowner Status	Easting ¹ [m]	Northing ¹ [m]	Nearest turbine ID	Distance to nearest turbine [m]
<i>Dwellings within of the sensitive zone defined by the Guidelines limits – 1650 m (10D + 50 m)</i>					
H2	Involved	317246	6260505	B046	1263
H3	Involved	310428	6257934	SG026	604
H4	Involved	307689	6255954	SG044	1183
H5	Involved	311589	6254061	SG046	1097
H6	Involved	318057	6257146	B051	1431
H8	Involved (unoccupied)	309122	6256801	SG034	1021
H10	Involved	322096	6248677	SG061	1469
H12	Involved	324464	6244837	SG067	972
H37	Non-involved	321911	6248741	SG058	1537
H38	Involved (unoccupied)	322515	6246966	SG063	1043
H39	Involved	328206	6246991	B113	1305
H40	Involved (unoccupied)	328142	6247359	B111	1432
H41	Involved	327919	6246592	B113	837
H62	Involved	307411	6254099	SG048	1192
H63	Involved (unoccupied)	309519	6255856	SG044	968
H64	Involved (unoccupied)	310449	6255800	SG040	944
H66	Involved (unoccupied)	317705	6258263	B052	829
H67	Involved (unoccupied)	319848	6268210	B054	1024
H113	Involved	327012	6246133	B111	729
H117	Involved	323771	6244703	SG067	1345
H123	Involved (unoccupied)	321055	6251732	SG053	730
H125	Involved	325631	6246183	SG065	645
<i>Dwellings outside of the sensitive zone defined by the Guidelines limits – 1650 m (10D + 50 m)</i>					
H1	Involved	312335	6263106	B031	2007
H7	Involved	316157	6267220	B027	2065
H11	Involved (unoccupied)	321665	6248672	SG058	1670
H26	Non-involved	305760	6261894	SG002	2002
H29	Non-involved	304473	6255055	SG036	1851
H30	Involved	307101	6251401	SG054	1872
H56	Involved	314940	6269823	B024	2372
H57	Non-involved	318374	6270088	B053	1703
H59	Non-involved	323618	6270103	B078	2139
H65	Involved (unoccupied)	321758	6254451	SG043	2142
H101	Involved	301426	6260110	SG008	2110

Notes:

1. Coordinate system: MGA Zone 54, GDA94 datum.

Table 3 Shadow flicker model settings for theoretical shadow flicker calculation

Model setting	Value
Maximum shadow length	1600 m
Year of calculation	2031
Minimum elevation of the sun	3°
Time step	1 min (5 min for map)
Rotor modelled as	Sphere (disc for turbine orientation reduction calculation)
Sun modelled as	Disc
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 ¹	8 points evenly spaced (every 45°) on 25 m and 50 m radius circles centred on the house location

Table 4 Theoretical and predicted actual annual shadow flicker duration

House ID ¹	Status	Easting ² [m]	Northing ² [m]	Contributing turbines	Theoretical annual				Predicted actual annual ³			
					At dwelling [hr/yr] 2 m	6 m	Max within of dwelling [hr/yr] 2 m	50 m 6 m	At dwelling [hr/yr] 2 m	6 m	Max within of dwelling [hr/yr] 2 m	50 m 6 m
H1 ⁴	Involved	312335	6263106	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H2	Involved	317246	6260505	B044 B045 B046	31.8	31.9	45.4	45.9	12.3	12.3	17.2	17.4
H3	Involved	310428	6257934	B005 SG026	29.6	27.9	64.0	62.1	5.4	5.2	13.7	13.3
H6	Involved	318057	6257146	B050 B051	24.3	24.4	25.8	25.9	8.8	8.8	9.3	9.3
H7 ⁴	Involved	316157	6267220	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H8	Involved (unoccupied)	309122	6256801	SG031 SG034	61.9	62.0	65.4	65.3	18.6	18.7	19.5	19.6
H11 ⁴	Involved (unoccupied)	321665	6248672	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H12	Involved	324464	6244837	SG071	27.7	26.9	35.0	34.7	10.9	10.6	14.9	14.7
H26 ⁴	Non-involved	305760	6261894	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H30 ⁴	Involved	307101	6251401	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H38	Involved (unoccupied)	322515	6246966	SG063	23.1	23.2	25.4	25.4	8.5	8.5	9.2	9.2
H39	Involved	328206	6246991	B111	14.2	14.2	15.2	15.3	5.6	5.6	6.1	6.0
H40	Involved (unoccupied)	328142	6247359	B111	32.1	32.3	34.2	34.2	13.9	13.9	14.4	14.3
H41	Involved	327919	6246592	B111	19.9	20.0	21.5	21.8	7.2	7.2	7.8	7.8
H57 ⁴	Non-involved	318374	6270088	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H59 ⁴	Non-involved	323618	6270103	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H62	Involved	307411	6254099	SG047 SG048 SG050	58.1	59.1	68.2	68.8	20.9	21.2	25.5	25.8
H63 ⁴	Involved (unoccupied)	309519	6255856	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H64	Involved (unoccupied)	310449	6255800	SG037 SG040 SG042	52.8	52.9	70.6	69.0	19.4	19.2	24.2	23.7
H65 ⁴	Involved (unoccupied)	321758	6254451	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H66	Involved (unoccupied)	317705	6258263	B047 B048 B052	89.9	92.8	105.3	106.4	27.4	28.1	32.5	33.1
H67	Involved (unoccupied)	319848	6268210	B053 B068 B075 B076	37.1	35.1	70.1	68.1	12.1	11.6	22.2	21.6
H101 ⁴	Involved	301426	6260110	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H113	Involved	327012	6246133	SG065 B113	28.7	31.3	69.4	73.3	7.7	8.1	22.6	24.6
H117 ⁴	Involved	323771	6244703	-	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H123	Involved (unoccupied)	321055	6251732	SG053 SG055	122.2	119.8	166.0	164.8	39.8	39.1	55.8	55.2
H125	Involved	325631	6246183	B111 SG064 SG066 SG067	122.9	128.9	152.9	155.2	38.6	40.5	50.6	51.3

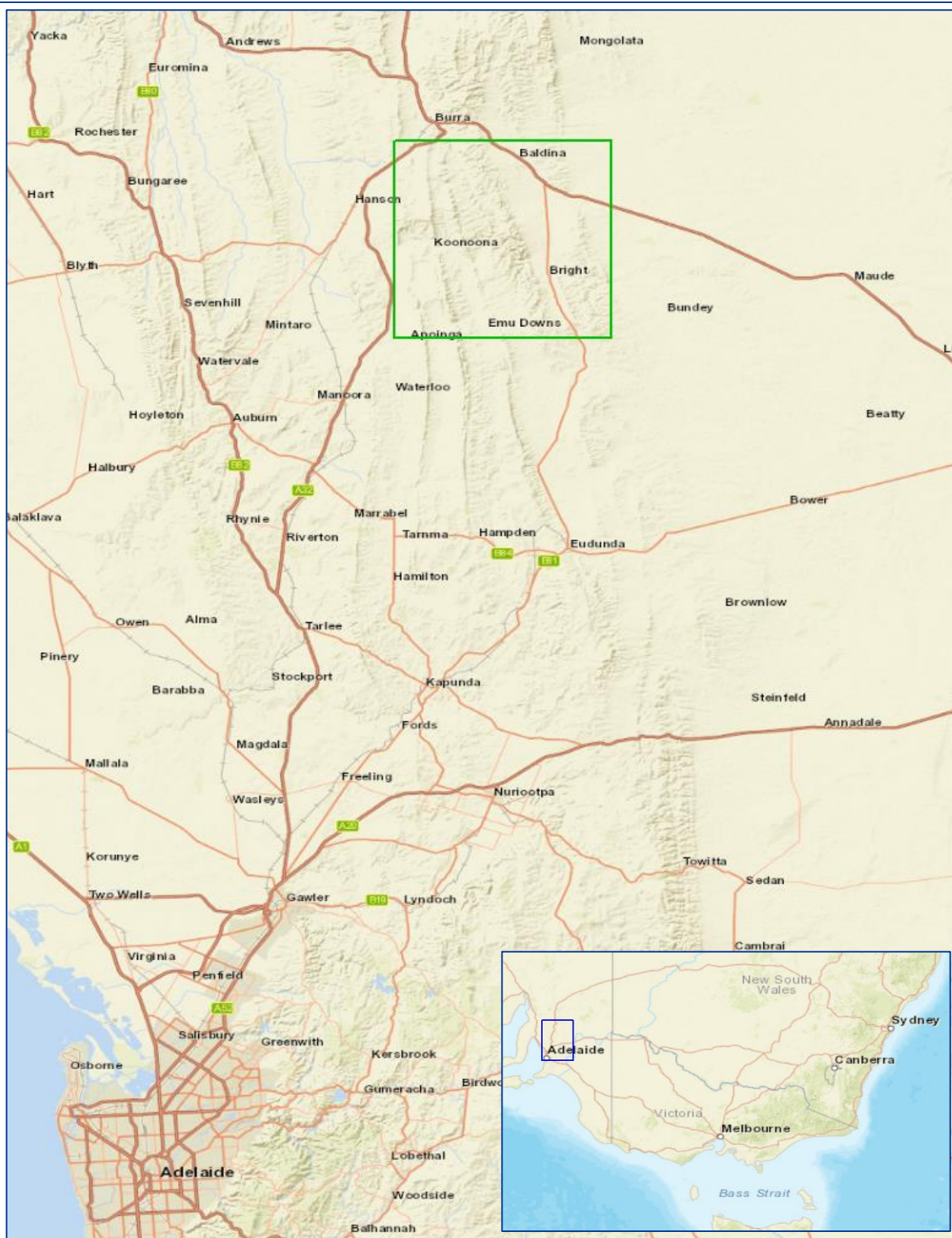
Recommended duration limits

30 hr/yr

10 hr/yr

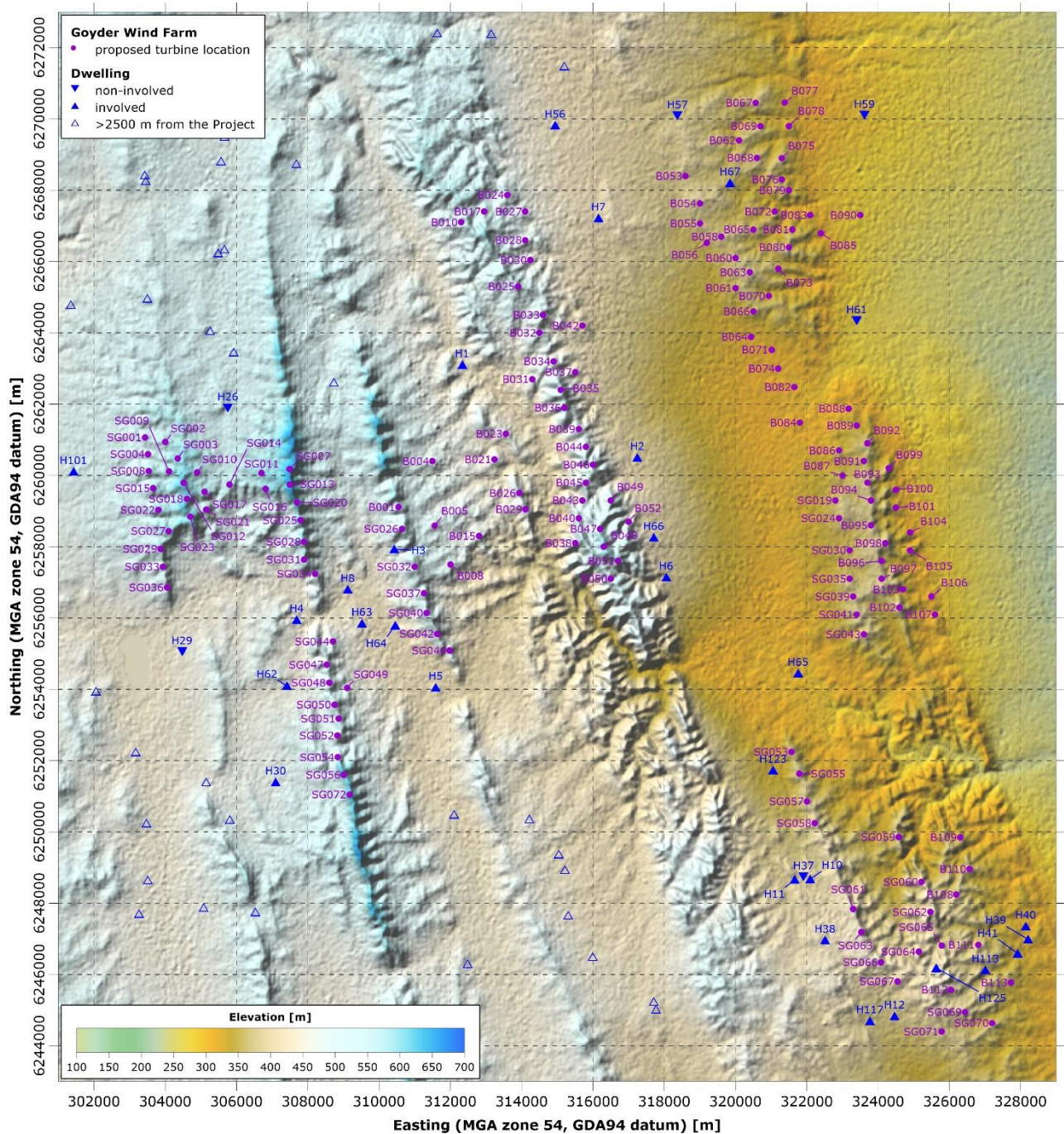
Notes:

1. Dwellings identified in Table 2 with no theoretical shadow flicker occurrence when considering 15 D shadow length have been omitted from this table.
2. Coordinate system: MGA Zone 54, GDA94 datum.
3. Considering likely reductions in shadow flicker duration due to cloud cover and turbine orientation.
4. Dwelling predicted to experience shadow flicker below a moderate level of intensity based on the criteria set in the Draft National Guidelines.



Background imagery extracted from ESRI World Street Map raster (Sources: Esri, HERE, DeLorme, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri (Thailand), MapmyIndia, © OpenStreetMap contributors, and the GIS User Community.)

Figure 1 Location of the Goyder Wind Farm



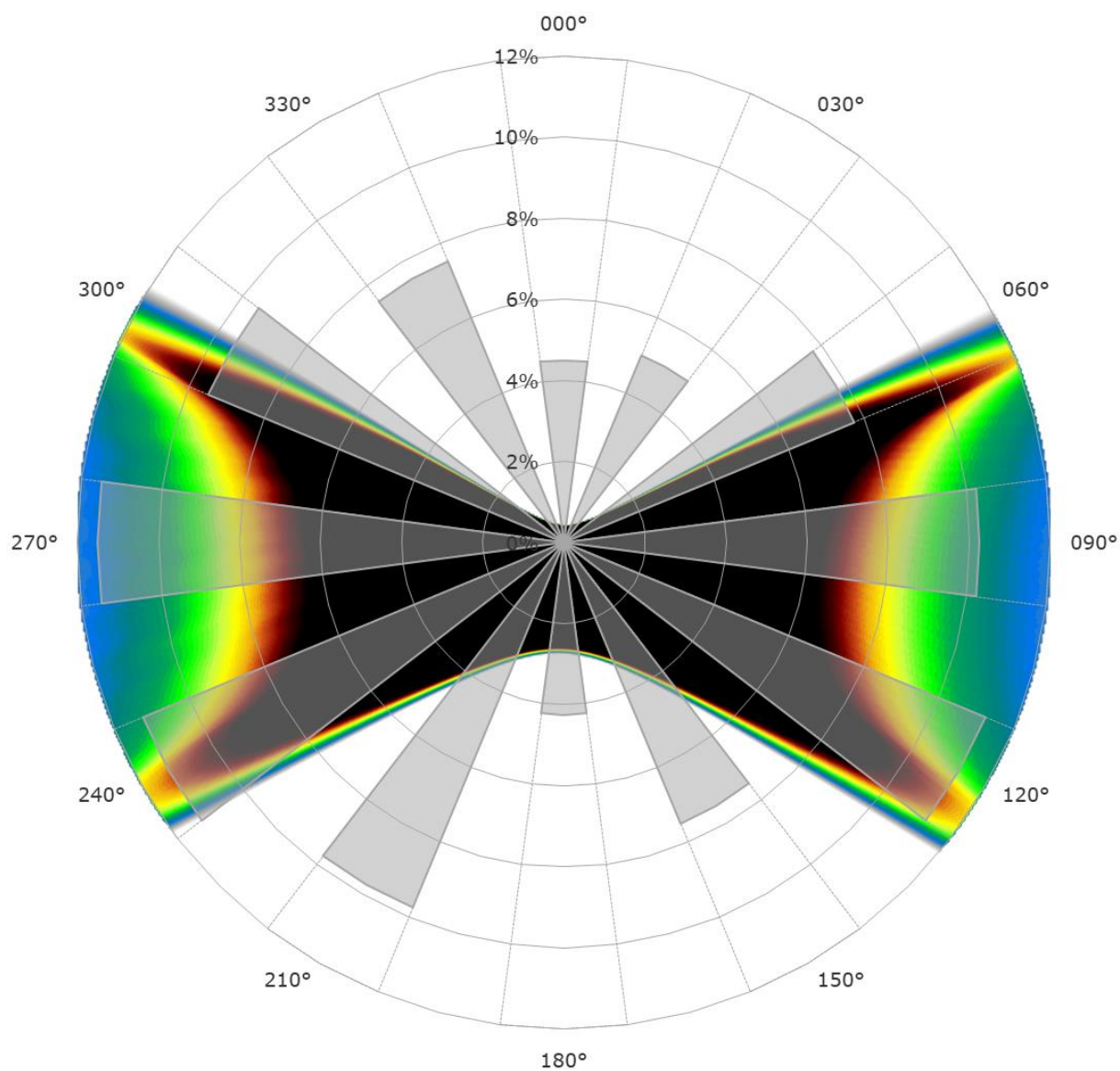
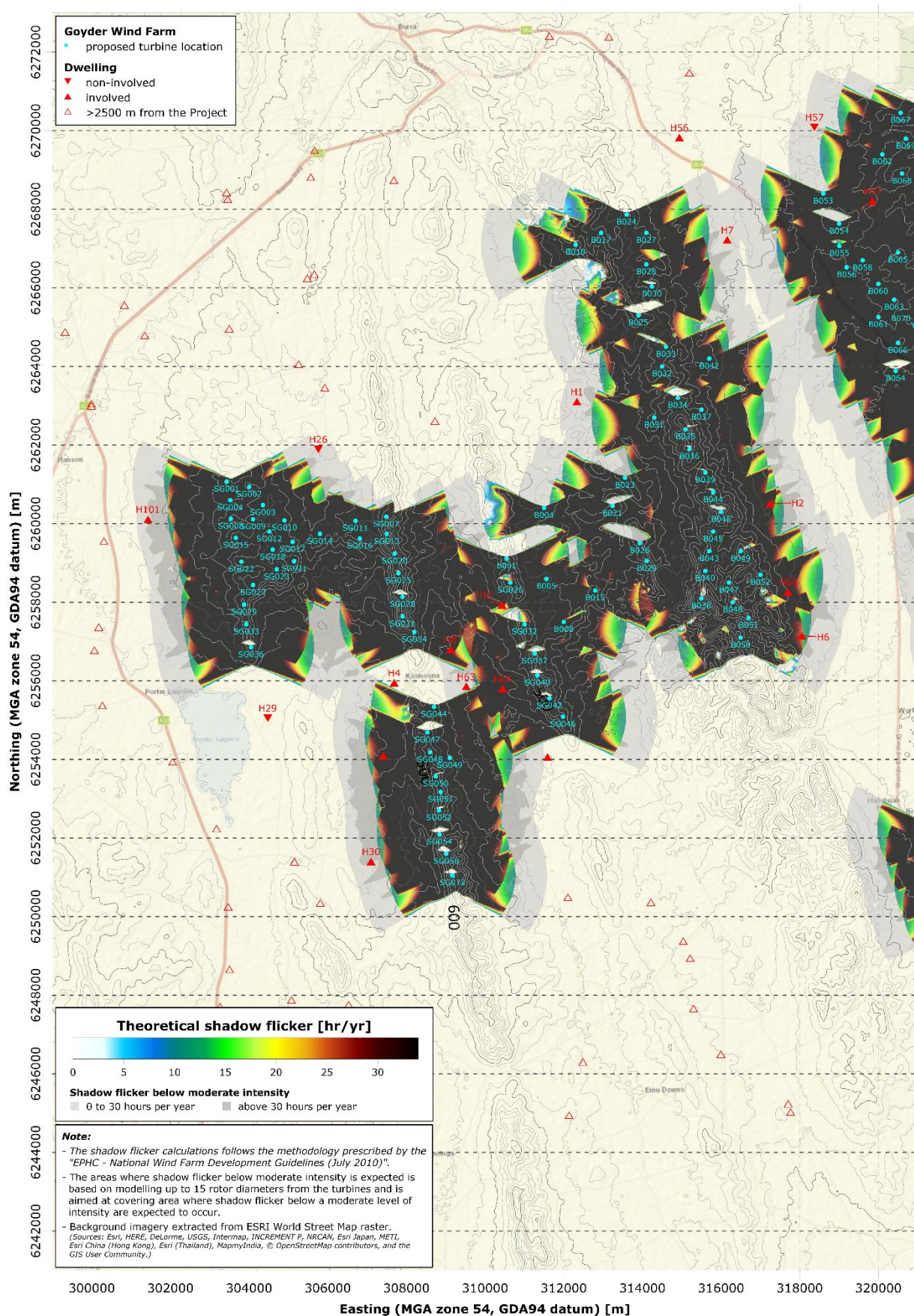
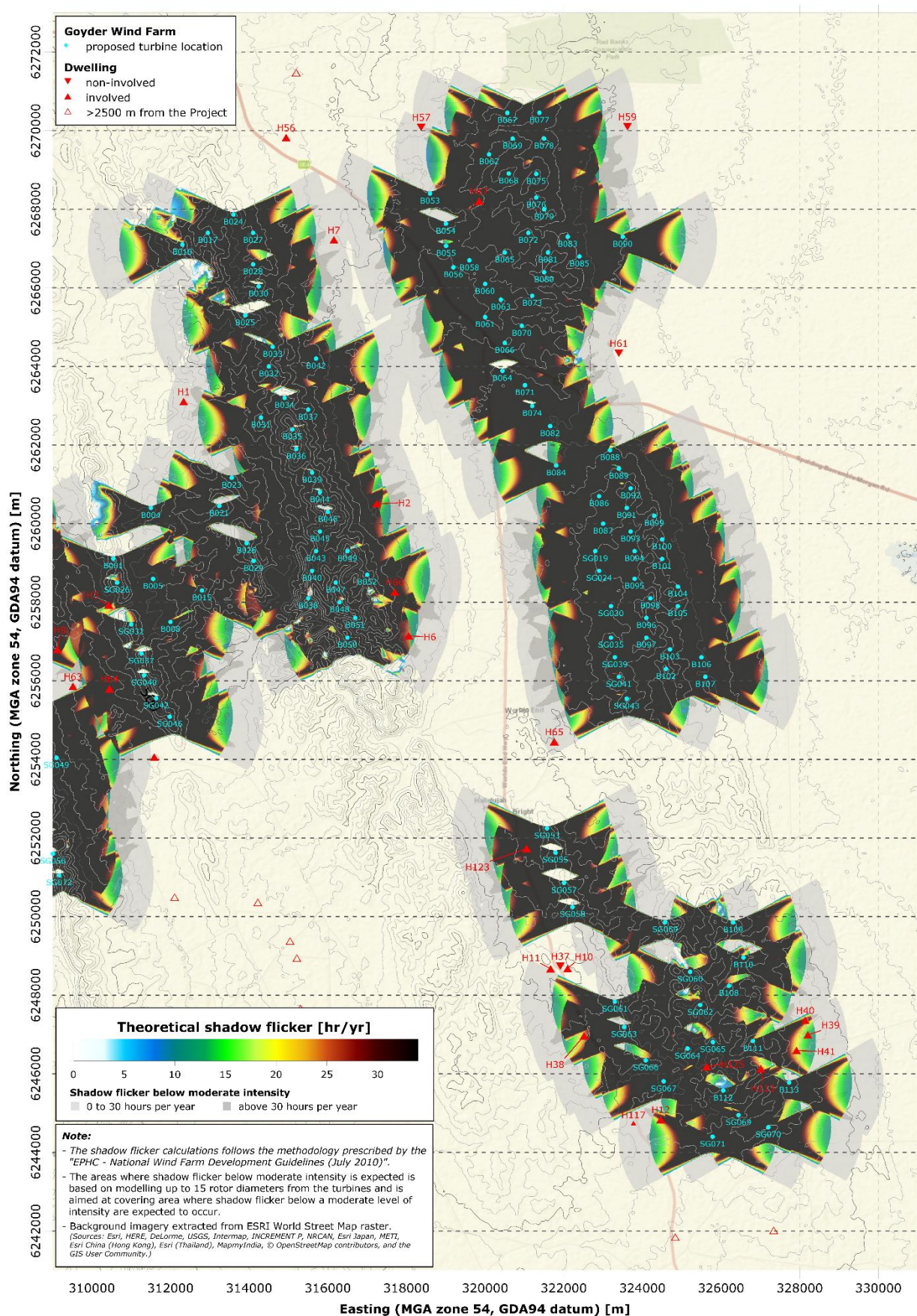
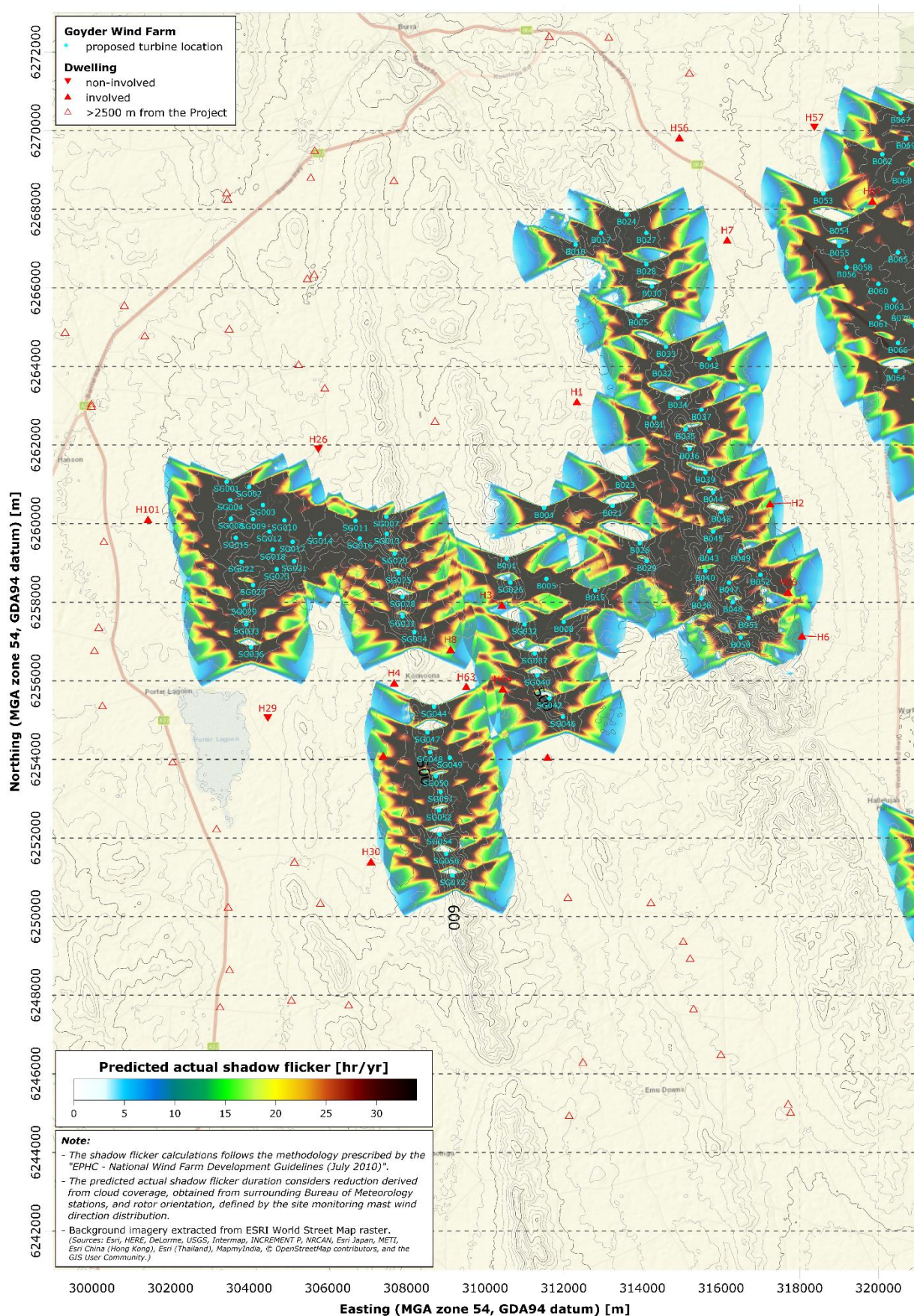
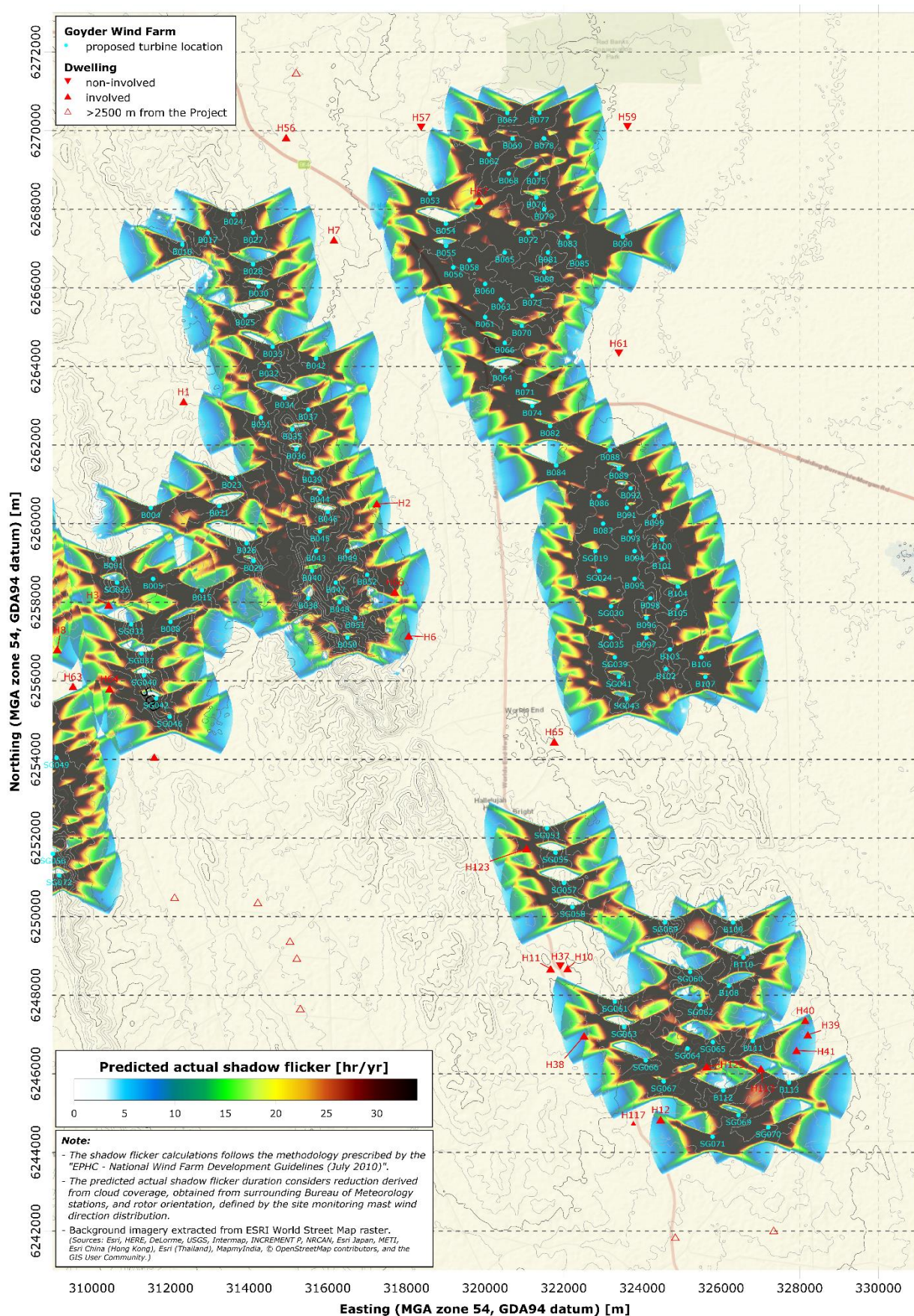


Figure 3 Indicative shadow flicker map and wind direction frequency distribution











ABOUT DNV GL

Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil and gas, and energy industries. We also provide certification services to customers across a wide range of industries. Operating in more than 100 countries, our 16,000 professionals are dedicated to helping our customers make the world safer, smarter and greener.

Goyder South Renewable Energy Facility

Environmental Noise Assessment

June 2020

S5868C4

sonus.

Contact: Jason Turner

Associate

Email: jturner@sonus.com.au

www.sonus.com.au

Document Title : Goyder South Renewable Energy Facility
Environmental Noise Assessment

Document Reference : S5868C4

Date : June 2020

Author : Jason Turner, MAAS

Reviewer : Mathew Ward

© Sonus Pty Ltd. All rights reserved.

This report may not be reproduced other than in its entirety. The report is for the sole use of the client for the particular circumstances described in the report. Sonus accepts no responsibility to any other party who may rely upon or use this report without prior written consent.

GLOSSARY	4
1 INTRODUCTION	5
2 PROJECT DESCRIPTION	6
3 DEVELOPMENT PLAN.....	7
4 ASSESSMENT FRAMEWORK	8
4.1 Solar, Battery and Substation Noise	8
4.2 Wind Farm Noise.....	8
4.3 Construction Noise.....	8
4.4 Indicative Equipment	9
5 NOISE PROPAGATION MODEL.....	10
6 SOLAR, BATTERY, AND SUBSTATION ASSESSMENT	11
6.1 Noise Criteria.....	11
6.2 Noise Sources.....	11
6.3 Predicted Noise Level.....	14
7 WIND FARM ASSESSMENT	16
7.1 Noise Monitoring	16
7.2 Noise Criteria.....	18
7.3 Noise Predictions	21
8 CONSTRUCTION NOISE	24
9 CONCLUSION.....	25
APPENDIX A	26
APPENDIX B	27
APPENDIX C.....	28
APPENDIX D	30
APPENDIX E.....	32
APPENDIX F.....	35
APPENDIX G	37
APPENDIX H	38

GLOSSARY

2009 Guidelines	<i>Wind Farms Environmental Noise Guidelines 2009 (SA EPA).</i>
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 all existing noise sources in the environment (in the absence of 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, <i>The propagation of noise from petrochemical complexes to neighbouring communities</i> (May 1981).
CNVMP	Construction noise and vibration management plan.
Day	The period between 7am and 10pm as defined by the <i>Policy</i> .
dB(A)	A-weighted noise in decibels.
EPA	Environment Protection Authority.
Equivalent noise level	Energy averaged noise level over a period of time.
Involved landowner	Landowner with a commercial agreement with the wind farm developer to have one or more wind turbine generators installed on their land.
$L_{A90,10}$	A-weighted noise level exceeded for 90% of a 10 minute time period. Represents the background noise level.
Neighbour	Not an involved landowner.
Night	The period between 10pm and 7am as defined by the <i>Policy</i> .
Policy	<i>Environment Protection (Noise) Policy 2007</i>
Sound power level	A measure of the sound energy emitted from a source of noise.
Weather category 6	The CONCAWE weather conditions which is most conducive for the propagation of noise, resulting in highest predicted noise levels.
WHO Guidelines	<i>World Health Organisation Guidelines for Community Noise</i>
Worst-case	Operational and weather conditions which result in the highest noise level at neighbours.
WTG	Wind turbine generator

1 INTRODUCTION

Sonus has conducted an environmental noise assessment of the proposed *Goyder South Renewable Energy Facility* (**Goyder South**).

Goyder South is located approximately 6km south of Burra extending approximately 30 km south towards Robertstown. This area is located in the eastern portion of the northern Mount Lofty Ranges and wholly located within the Regional Council of Goyder.

Goyder South comprises wind turbine generators (WTGs), solar photovoltaic arrays and battery storage.

This report assesses environmental noise during construction and operation of Goyder South by comparing predicted noise levels at both involved landowners and neighbours with criteria provided by the *Wind farms environmental noise guidelines 2009* Guidelines and the *Environment Protection (Noise) Policy 2007* as relevant.

2 PROJECT DESCRIPTION

Goyder South is proposed to comprise up to 1200 MW of wind generation, up to 600 MW of bifacial solar photovoltaic arrays and up to 900 MW/1800 MWh of battery storage dispatched via three substations distributed across the site.

The noise from Goyder South will be associated with:

- 163 WTG's dispersed across an area of approximately 30,000 hectares;
- Solar inverters and transformers located at two separate solar photovoltaic sites;
- battery inverters and cooling systems as required for the battery storage located at two separate battery storage sites; and,
- transformers located at three separate substations.

The Goyder South layout is provided in Appendix A (Figure A1).

3 DEVELOPMENT PLAN

Goyder South is proposed to be located within a *Primary Production Zone* of the Goyder Council Development Plan¹. Nearby dwellings are also located within a *Primary Production Zone* with dwellings at the southern side of Burra located in a *Rural Living Zone*. The Development Plan has been reviewed and particular regard has been given to the following Objectives and Principles of Development Control (PDC):

General Section – Interface between Land Uses

Objective 1 Development located and designed to prevent adverse impact and conflict between land uses.

Objective 2 Protect community health and amenity and support the operation of all desired land uses.

PDC 1 Development should not detrimentally affect the amenity of the locality or cause unreasonable interference through any of the following:

(b) noise

PDC 2 Development should be designed and sited to minimise negative impact on existing and potential future land uses desired in the locality.

Noise

PDC 6 Development should be designed, constructed and sited to minimise negative impacts of noise and to avoid unreasonable interference.

PDC 7 Development should be consistent with the relevant provisions each of the following documents:

(a) AS 2107 Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors

(b) AS 3671 Acoustics - Road Traffic Noise Intrusion, Building Siting and Construction

(c) the current Environment Protection (Noise) Policy

General Section – Renewable Energy Facilities

Objective 3 Location, siting, design and operation of renewable energy facilities to avoid or minimise adverse impacts on the natural environment and other land uses.

Wind Farms and Ancillary Development

PDC 3 Wind farms and ancillary development should avoid or minimise the following impacts on nearby property owners / occupiers, road users and wildlife:

(b) excessive noise

¹ Consolidated 24 November 2016

4 ASSESSMENT FRAMEWORK

Interface between Land Uses PDC 7 of the Goyder Council Development Plan makes reference to the *Environment Protection (Noise) Policy 2007* (the **Policy**).

4.1 Solar, Battery and Substation Noise

The Policy provides appropriate objective criteria for the assessment of noise from the solar, battery and transformer components of Goyder South. The Policy is based on the World Health Organisation (the **WHO**) Guidelines to prevent annoyance, sleep disturbance and unreasonable interference with the amenity of a locality. Therefore, compliance with the Policy is considered to satisfy the relevant provisions of the Development Plan related to environmental noise from these sources.

4.2 Wind Farm Noise

The Policy refers to the EPA's *Wind farms environmental noise guidelines 2003* (the **2003 Guidelines**) for the assessment of wind farm noise in South Australia. The *Wind farms environmental noise guidelines 2009* (the **2009 Guidelines**) replaced the 2003 Guidelines.

The 2009 Guidelines have been developed to ensure a wind farm does not unreasonably impact on the acoustic amenity of surrounding dwellings. Therefore, compliance with the contemporary 2009 Guidelines is considered to satisfy the relevant provisions of the Development Plan that relate to wind farm noise.

4.3 Construction Noise

The appropriate assessment methodology for noise from construction activities is provided by the Policy. The Policy provides an emphasis on implementing reasonable and practicable noise reduction measures during typical day time construction hours. The Policy also establishes objective requirements for night time activity should such activity be required.

4.4 Indicative Equipment

The final make and model of the equipment used for Goyder South will be selected through a competitive procurement process in the future and therefore is not available at the development application stage.

The sound power levels in this assessment are provided for indicative purposes to show that suitable contemporary makes and models can achieve the relevant objective requirements.

A final assessment will be made following detailed design to confirm that the final solar, battery and WTG arrangement and selections will comply with the relevant criteria as outlined in this report.

5 NOISE PROPAGATION MODEL

The predictions of environmental noise from Goyder South utilise the CONCAWE² noise propagation model and SoundPLAN noise modelling software. The sound propagation model considers the following influences:

- sound power levels of each individual noise source;
- the locations of noise sources;
- separation distances between noise sources and dwellings;
- local topography;
- influence of the ground;
- air absorption; and,
- meteorological conditions.

The CONCAWE system divides meteorological conditions into six separate “weather categories”, depending on 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, whilst 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).

For a conservative assessment, the noise model has considered meteorological conditions corresponding to Weather Category 6, resulting in the “worst case” noise level at the receivers for a given operating scenario.

² 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.

6 SOLAR, BATTERY, AND SUBSTATION ASSESSMENT

6.1 Noise Criteria

The Policy provides goal noise levels to be achieved at receivers during the day and night periods based on the principally promoted land use of the Development Plan Zones in which the noise sources and the receivers are located.

The goal noise levels which apply during the night are more stringent than those which apply during the day and are considered the most relevant (conservative) criteria for the combined noise from the operation of the solar, battery and substation components, even though the solar component might only operate at a limited capacity and duration during the night time period (for example, during the summer period when daylight can occur prior to 7am).

The Policy provides the following average goal noise levels ($L_{eq,15min}$) during the night (10pm until 7am) for a new development:

- 45 dB(A) at dwellings located in a *Primary Production Zone*; and,
- 40 dB(A) at dwellings located in a *Rural Living Zone*.

In addition to the above, when measuring or predicting noise levels for comparison with the goal noise levels of the Policy, adjustments are made for any dominant characteristic of tone, low frequency, modulation or impulsiveness. A 5 dB(A) penalty is added if one characteristic is present, 8 dB(A) is added for two characteristics and 10 dB(A) is added for three or four characteristics. In order to apply a penalty, the characteristic must be dominant when considered within the context of the existing acoustic environment at the noise receivers.

6.2 Noise Sources

The following noise sources have been included in this assessment to provide an indication of the noise from the substations (noise sources detailed in item 1 below), the solar photovoltaic sites (noise sources detailed in items 2 and 3 below), and battery storage sites (noise sources detailed in items 4 and 5 below). The co-ordinates of items 1, 4 and 5 are provided in Appendix B:

1. High-voltage transformer(s) with an overall capacity of 660MVA at each of the three substations, being Substation East, Substation South and Substation West.
2. 120 x 2.5MW solar inverters evenly distributed across each solar photovoltaic site (240 units in total);

3. 120 x 3MVA transformers evenly distributed across each solar photovoltaic site (240 units in total);
4. Battery inverters with a capacity of 300 MW at the Robertstown battery storage site and each of the three substations, and a capacity of 600 MW at the Interconnector battery storage site. It is noted that the assumed noise sources exceed the proposed 900MW to show that there is flexibility where the batteries can be located, however the Goyder South proposal is for no more than 900MW of battery storage; and,
5. Air-conditioning condensing units corresponding to a battery capacity of 300 MW at the Robertstown battery storage site and each of the three substations, and a battery capacity of 600 MW at the Interconnector battery storage site (in the circumstance where the batteries are required to be maintained at a conditioned air temperature, which will be dependent on the final technology selected).

The following input data have been used for the above noise sources:

1. Transformer(s) with an overall capacity of 660MVA at each of the three substations, each with a sound power level equivalent to the level derived from the Australian/New Zealand Standard AS/NZS60076.10:2009, *Power transformers - Determination of sound levels (IEC 60076-10, Ed. 1(2001) MOD)* as summarised in Table 1.

Table 1: 660 MVA substation transformer sound power levels.

Octave Band Centre Frequency (Hz)	Sound Power Level (dB(A) re 1 pW)
63 Hz	85
125 Hz	93
250 Hz	100
500 Hz	103
1,000 Hz	95
2,000 Hz	92
4,000 Hz	85
Total	105

2. Each of the 240 solar inverters will be acoustically similar to the *SMA Sunny Central 2500-EV inverter* with the one third octave sound power level data as summarised in Table 2.

Table 2: Solar inverter sound power levels.

One Third Octave Band Centre Frequency (Hz)	Sound Power Level (dB(A) re 1 pW)
25 Hz	43
31.5 Hz	46
40 Hz	49
50 Hz	52
63 Hz	56
80 Hz	60
100 Hz	64
125 Hz	65
160 Hz	65
200 Hz	68
250 Hz	72
315 Hz	80
400 Hz	77
500 Hz	72
630 Hz	74
800 Hz	77
1,000 Hz	76
1,250 Hz	72
1,600 Hz	70
2,000 Hz	70
2,500 Hz	81
3,150 Hz	91
4,000 Hz	70
5,000 Hz	69
6,300 Hz	78
8,000 Hz	69
10,000 Hz	66
Total	92

3. Each of the 3MVA transformers at the solar sites will have total sound power levels equivalent to the level derived from the Australian/New Zealand Standard AS/NZS60076.10:2009, *Power transformers - Determination of sound levels (IEC 60076-10, Ed. 1(2001) MOD)* as summarised in Table 3.

Table 3: 3MVA solar transformer sound power levels.

Octave Band Centre Frequency (Hz)	Sound Power Level (dB(A) re 1 pW)
63 Hz	52
125 Hz	60
250 Hz	67
500 Hz	70
1,000 Hz	62
2,000 Hz	59
4,000 Hz	52
Total	73

4. For every 2.5MW of battery storage, the inverters will have one third octave sound power levels equivalent to the data as per Table 3. That is, the noise level from the battery inverters required for 300MW of battery storage at the Robertstown battery site and each of the three substations will be 120 times greater than the levels in Table 3, and the battery inverters required at the Interconnector battery site for 600MW of battery storage will be 240 times greater than the levels in Table 3. It has been assumed that the batteries themselves will not increase the noise levels above the inverters.
5. The noise from air-conditioning condensing units corresponding to the battery capacity at the Robertstown battery storage site and each of the three substations will have octave band sound power levels as summarised in Table 4, and the air-conditioning condensing units corresponding to the battery capacity at the Interconnector battery site will have octave band sound power levels as summarised in Table 5.

Table 4: Air-conditioning total sound power level at Robertstown battery site and each substation.

Octave Band Centre Frequency (Hz)	Sound Power Level (dB(A) re 1 μ W)
63 Hz	92
125 Hz	93
250 Hz	97
500 Hz	101
1,000 Hz	102
2,000 Hz	99
4,000 Hz	95
8,000 Hz	87
Total	107

Table 5: Air-conditioning total sound power level at Interconnector battery site.

Octave Band Centre Frequency (Hz)	Sound Power Level (dB(A) re 1 μ W)
63 Hz	95
125 Hz	96
250 Hz	100
500 Hz	104
1,000 Hz	105
2,000 Hz	102
4,000 Hz	98
8,000 Hz	90
Total	110

6.3 Predicted Noise Level

The predicted noise level at each receiver has been based on the inputs and noise model detailed above. The co-ordinates of receivers, the land use zoning and the resultant noise criteria determined from the Policy are provided in Appendix C.

A summary of the predicted noise levels are provided in Table 6 below. The noise at receivers not provided in the table below are predicted to be less than 20 dB(A).

Some of the equipment proposed for Goyder South will have audible tonality in close proximity, although the potential for it to be a dominant characteristic is diminished by the masking effect of (broadband) cooling fan systems used in the inverters and from the air conditioning condensing units. Notwithstanding the above, a penalty of 5 dB(A) for dominant tonality has been added to the predicted noise levels in Table 6 to provide for a conservative assessment approach:

Table 6: Solar Battery and Substation Noise Predictions.

House ID	Criterion (dB(A))	Predicted Noise Level (dB(A))	Compliance
Receivers Closest to Robertstown Battery Storage Site			
H42	45	36	Yes
H45	45	35	Yes
H44	45	33	Yes
H46	45	32	Yes
H14	45	32	Yes
H69	45	32	Yes
H43	45	31	Yes
H47	45	29	Yes
H48	45	28	Yes
H15	45	28	Yes
H51	45	28	Yes
H52	45	28	Yes
H49	45	27	Yes
H50	45	26	Yes
H53	45	25	Yes
H54	45	23	Yes
Receivers Closest to Solar North			
H7	45	28	Yes
Receivers Closest to Substation East			
H2	45	26	Yes
H66	45	26	Yes
H6	45	24	Yes
Receivers Closest to Substation West			
H3	45	32	Yes
H1	45	23	Yes
H8	45	23	Yes
H64	45	21	Yes
H63	45	20	Yes
Receivers Closest to Substation/Solar South			
H40	45	30	Yes
H39	45	28	Yes
H41	45	26	Yes
H113	45	21	Yes

The predictions (as detailed above) indicate that the relevant criterion will be achieved at all locations.

7 WIND FARM ASSESSMENT

7.1 Noise Monitoring

To determine the background noise levels at various wind speeds, background noise monitoring was conducted at 5 locations in the vicinity of the proposed wind farm between 4 September and 22 November 2019. The background noise monitoring was conducted in accordance with the 2009 Guidelines.

Monitoring Locations

The monitoring locations are summarised in Table 7 (with the locations also shown in Appendix H).

Table 7: Noise monitoring locations

Monitoring Location ID	Co-ordinates (UTM WGS84 54H)	
	Easting	Southing
H4	307715	6256049
H57	318349	6270092
H61	323390	6264320
H37	321931	6248752
H126	309968	6270362

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

Photographs of the monitoring equipment at each monitoring location are provided in Appendix D.

Equipment

The background noise was measured using a combination of *Rion* "NL-52" and *Rion* "NL-21" sound level meters, all of which have a noise floor of less than 20 dB(A). The sound level meters had all been laboratory (NATA) calibrated and were also tested on site at the beginning and end of the measurement period using a *Rion* "NC74" calibrated reference sound source.

The wind speed was also measured at a height of 1.5m above ground level at H4 and H61 using *Rainwise* "WindLog" anemometers to identify any periods where wind directly on the microphone may have influenced the measured background noise levels.

Additionally, rainfall was also measured at a height of 1.5m above ground level at H4 using a *Rainwise* "Rainlog" sensor to identify any periods where rain on the microphone may have influenced the measured background noise levels.

Collected Data

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

During the background noise monitoring period, Neoen measured the average wind speed, in 10-minute intervals, at a range of heights between 40m and 150m above ground level using a *SODAR* Triton device to provide an indication of the hub height wind speed. The location of the *SODAR* is provided in Table 8.

Table 8: SODAR Location

Co-ordinates (UTM WGS84 Z54)	
Easting	Southing
310972	6257356

The 2009 Guidelines specify that the background noise level data should be correlated with wind speed data referenced to the WTG hub height. The wind speeds at a hub height of 160m above ground level have been provided by Neoen based on the *SODAR* measurement data.

Data Analysis

Prior to correlation and a regression analysis of the noise and wind data, the data points corresponding to any of the following were removed:

- periods of rainfall, including the 10-minute periods before and after any rainfall events, measured using the *Rainwise* “Rainlog” sensor at H4;
- periods where the wind speed exceeded 5 m/s for more than 90% of the measurement period, based on the data collected at the closest *Rainwise* “WindLog” anemometers at either H4 or H61;
- hub height wind speeds below the cut-in (4 m/s) and above the rated power (15 m/s); and,
- data points clearly influenced by extraneous noise sources.

Table 9 summarises the number of data points at each monitoring location following data removal detailed above.

Table 9: Data Points.

Monitoring Location ID	Number of Data Points
H4	6305
H37	5735
H57	5596
H61	5303
H126	6286

The resultant background noise data for each monitoring location were correlated with the hub height wind speed data to produce a least squares regression analysis and line of best fit, in accordance with the 2009 Guidelines. The data and the regression curves³ are shown in Appendix E.

7.2 Noise Criteria

The noise criteria that relates to the wind farm are separated into two categories, being a *neighbour* or an *involved landowner*.

It is understood that Neoen has not yet finalised the commercial agreements with all landowners identified as *involved landowners* in this report.

In order to proceed with the Development Application while negotiations are concluded, Neoen has designed the assessed layout on the basis that the identified *involved landowners* will agree to be involved with Goyder South.

If any landholders should choose not to be involved in Goyder South, or if Neoen ultimately fails to achieve an agreement with any of the identified *involved landowners*, Neoen commits to adjusting the layout and design as necessary to achieve compliance with the criterion that applies to a *neighbour*.

³ The correlation coefficient for each regression curve indicates the relationship between the background noise at the dwelling and the wind speed at the wind farm site. A low correlation coefficient indicates a limited relationship, as will naturally occur in many circumstances including locations that are shielded from the winds across the wind farm site, rather than indicating any deficiency in the data or its analysis.

Neighbours

To protect the *neighbours* to the wind farm, the 2009 Guidelines require:

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 speed⁴ from cut-in to rated power of the WTG and each integer wind speed in between.

Where the wind farm exhibits a tonal characteristic, a 5 dB(A) penalty is to be applied to the criteria.

Whilst the background noise level results indicate that the assessment criteria can be increased above the baseline level of 40 dB(A) at some dwellings at higher wind speeds, the wind farm has been conservatively designed to achieve 40 dB(A) at all *neighbours*. That is, there is no reliance on the existing background noise levels to mask or reduce the impacts of the wind farm at the *neighbours*.

Involved Landowners

The 2009 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.

⁴ Where wind speed is referenced in this report, it is taken to be at the hub height, in accordance with the SA Guidelines, unless specifically noted otherwise.

Where a landowner has formed a commercial agreement with the developer (becoming an *involved landowner*) the 2009 Guidelines enable different (less onerous) noise criterion.

The criterion is based on the WHO guidelines which provide recommendations with regard to protecting against:

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

The recommendations of the WHO Guidelines are repeated below:

“For a good night's sleep, the equivalent sound level should not exceed 30 dB(A) (inside the bedroom) for continuous background noise”

and

“To protect the majority of people from being seriously annoyed during the daytime, the sound pressure level on balconies, terraces and outdoor living areas should not exceed 55 dB L_{Aeq} for a steady continuous noise. To protect the majority of people from being moderately annoyed during the daytime, the outdoor sound pressure level should not exceed 50 dB L_{Aeq} .”

An outdoor level of 45 dB(A) at the *involved landowners* will easily satisfy the WHO Guidelines, including inside a bedroom with the windows to the dwelling open.

Summary of Status

The co-ordinates of the dwellings, the land use zoning, landowner status and the resultant noise criteria determined from the 2009 Guidelines are included in Appendix C.

7.3 Noise Predictions

WTG Locations and Sound Power Levels

The proposed wind farm layout comprises up to 163 WTGs, with the co-ordinates of the WTGs provided in Appendix F. The closest WTG from each dwelling and the separation distance between them is provided in Appendix G.

The preliminary assessment has been made based on an indicative WTG selection with a hub height of 160m above ground level. The sound power levels used for the assessment of WTGs are shown in Table 10.

Table 10: WTG Sound Power Level - Maximum at any Wind Speed.

Octave Band Centre Frequency (Hz)	Sound Power Level (dB(A) re 1 pW)
63 Hz	88.8
125 Hz	94.4
250 Hz	97.9
500 Hz	98.9
1,000 Hz	100.7
2,000 Hz	100.3
4,000 Hz	94.1
8,000 Hz	80.6
Total	106.3

The above sound power level is equivalent to a range of currently available contemporary WTG selections. An assessment will be made during the detailed design phase to confirm that the final WTG selection complies with the criteria.

A specific example of one contemporary WTG which could achieve the above sound power level used in this assessment is the *GE 6.0-155*.

In addition, Neoen commit to seeking a guarantee from the successful manufacturer to ensure that the final WTG selection will be free of tonality at all surrounding dwellings.

Predicted Noise Levels

The noise level at dwellings has been predicted based on the above sound power levels in Table 10 and compared with the relevant criteria. The worst case predicted noise levels from the WTGs are compared with the corresponding noise criterion at each receiver in Table 11.

The predicted noise level contours at the wind speed corresponding to the WTG maximum sound power levels are provided in Appendix H. Appendix H also shows:

- the locations of *neighbours*;
- the locations of *involved landowners*;
- the location of Rural Living land use zoning;
- the noise monitoring locations; and,
- the WTG locations.

Notwithstanding the fact that the final make and model of the WTG used for Goyder South will be selected through a competitive procurement process and a final assessment will be made during the detailed design to confirm that the procured WTG selection complies with the relevant criteria; Table 11 and Appendix H indicate that:

- The requirements of the 2009 Guidelines can be achieved at all *Neighbours*, more specifically:
 - the baseline criterion of 35 dB(A) applied to *neighbours in localities which are primarily intended for rural living* can be achieved;
 - the baseline criterion of 40 dB(A) applied to *neighbours in localities in other zones* can be achieved; and,
- The requirements of the 2009 Guidelines, being a level of 45 dB(A) for this assessment, can be achieved at all *Involved landowners*.

Table 11: Noise Predictions.

House ID	Criterion (dB(A))	Predicted Noise Level (dB(A)) ⁵	Compliance
H1	Involved	36	Yes
H2	Involved	41	Yes
H3	Involved	44	Yes
H4	Involved	40	Yes
H5	Involved	38	Yes
H6	Involved	38	Yes
H7	Involved	36	Yes
H8	Involved	41	Yes
H9	Involved	24	Yes
H10	Involved	37	Yes
H11	Involved	36	Yes
H12	Involved	40	Yes
H13	40	22	Yes
H14	Involved	28	Yes
H15	Involved	18	Yes
H16	Involved	32	Yes
H17	Involved	31	Yes
H19	Involved	23	Yes
H20	Involved	26	Yes
H21	Involved	19	Yes
H22	40	19	Yes
H23	Involved	19	Yes
H24	40	19	Yes
H25	40	23	Yes
H26	40	38	Yes
H27	40	22	Yes
H28	40	21	Yes
H29	40	34	Yes
H30	Involved	36	Yes
H31	40	29	Yes
H32	40	24	Yes
H33	40	22	Yes
H34	40	21	Yes
H35	40	20	Yes
H36	40	20	Yes
H37	40	36	Yes
H38	Involved	39	Yes
H39	Involved	38	Yes
H40	Involved	37	Yes
H41	Involved	41	Yes
H42	40	30	Yes
H43	40	22	Yes
H44	40	25	Yes
H45	40	23	Yes
H46	40	23	Yes
H47	40	22	Yes
H48	40	21	Yes

House ID	Criterion (dB(A))	Predicted Noise Level (dB(A)) ⁵	Compliance
H49	40	20	Yes
H50	40	20	Yes
H51	40	22	Yes
H52	40	23	Yes
H53	40	22	Yes
H54	40	21	Yes
H55	40	20	Yes
H56	Involved	32	Yes
H57	40	37	Yes
H58	Involved	26	Yes
H59	40	35	Yes
H60	40	32	Yes
H61	40	36	Yes
H62	Involved	40	Yes
H63	Involved	41	Yes
H64	Involved	42	Yes
H65	Involved	35	Yes
H66	Involved	42	Yes
H67	Involved	44	Yes
H68	40	30	Yes
H69	40	23	Yes
H101	Involved	36	Yes
H102	40	26	Yes
H103	40	26	Yes
H104	Involved	28	Yes
H105	40	23	Yes
H106	40	22	Yes
H107	Involved	22	Yes
H108	40	28	Yes
H109	40	28	Yes
H110	Involved	25	Yes
H111	40	26	Yes
H112	40	23	Yes
H113	Involved	44	Yes
H114	Involved	24	Yes
H115	Involved	18	Yes
H117	Involved	37	Yes
H118	40	19	Yes
H119	40	19	Yes
H120	40	18	Yes
H121	40	19	Yes
H122	40	27	Yes
H122	Involved	20	Yes
H123	Involved	42	Yes
H124	40	22	Yes
H125	Involved	45	Yes
H126	35	24	Yes

⁵ The maximum equivalent noise level at any wind speed

8 CONSTRUCTION NOISE

The Policy provides an emphasis on implementing reasonable and practicable noise reduction measures and does not set mandatory standards or objective criteria for construction activity which is conducted during typical day time hours.

The Policy establishes a more stringent objective approach for night-time construction activity, requiring an average goal noise level of 45 dB(A) and a maximum goal noise level of 60 dB(A) to be met for night time construction works. The objective approach does not apply “if other grounds exist that the Authority (...) determines to be sufficient”.

A Construction Noise and Vibration Management Plan (**CNVMP**) will be prepared prior to construction commencing to ensure compliance with the Policy. The CNVMP will also provide the community consultation and complaint assessment processes for the construction phase.

As construction traffic and activity will typically be limited to the hours between 7am and 7pm on any day other than a Sunday or public holidays, the CNVMP will predominantly address the adoption of “all reasonable and practicable” noise mitigation measures.

These measures will include the following subject to detailed information on the actual construction processes used:

- construction of temporary acoustic barriers where required;
- proprietary enclosures around machines if necessary;
- exhaust silencers on equipment;
- substituting construction methods with alternative processes that produce less noise where cost effective to do so;
- the fitting of broadband reversing signals to vehicles which remain on the site; and,
- administrative measures such as inspections, scheduling and providing training to establish a noise minimisation culture for the works.

The CNVMP will also address specific activities (such as blasting, concrete batching, percussion drilling rigs, crushing etc.) when the construction processes are refined and finalised. The CNVMP will address any activity that is required to occur outside of the typical construction hours (such as concrete pouring before 7am on days of extreme heat).

9 CONCLUSION

An environmental noise assessment has been made of the proposed Goyder South Renewable Energy Facility, which comprises up to 1200 MW of wind generation, up to 600 MW of bifacial solar photovoltaic arrays and up to 900 MW/1800 MWh of battery storage dispatched via three substations distributed across the site.

Noise predictions from the solar, battery and substation have been made and assessed against criteria developed in accordance with the *Environment Protection (Noise) Policy 2007*.

Noise predictions from the wind farm have been made and assessed against criteria developed in accordance with the *Wind Farms Environmental Noise Guidelines 2009*.

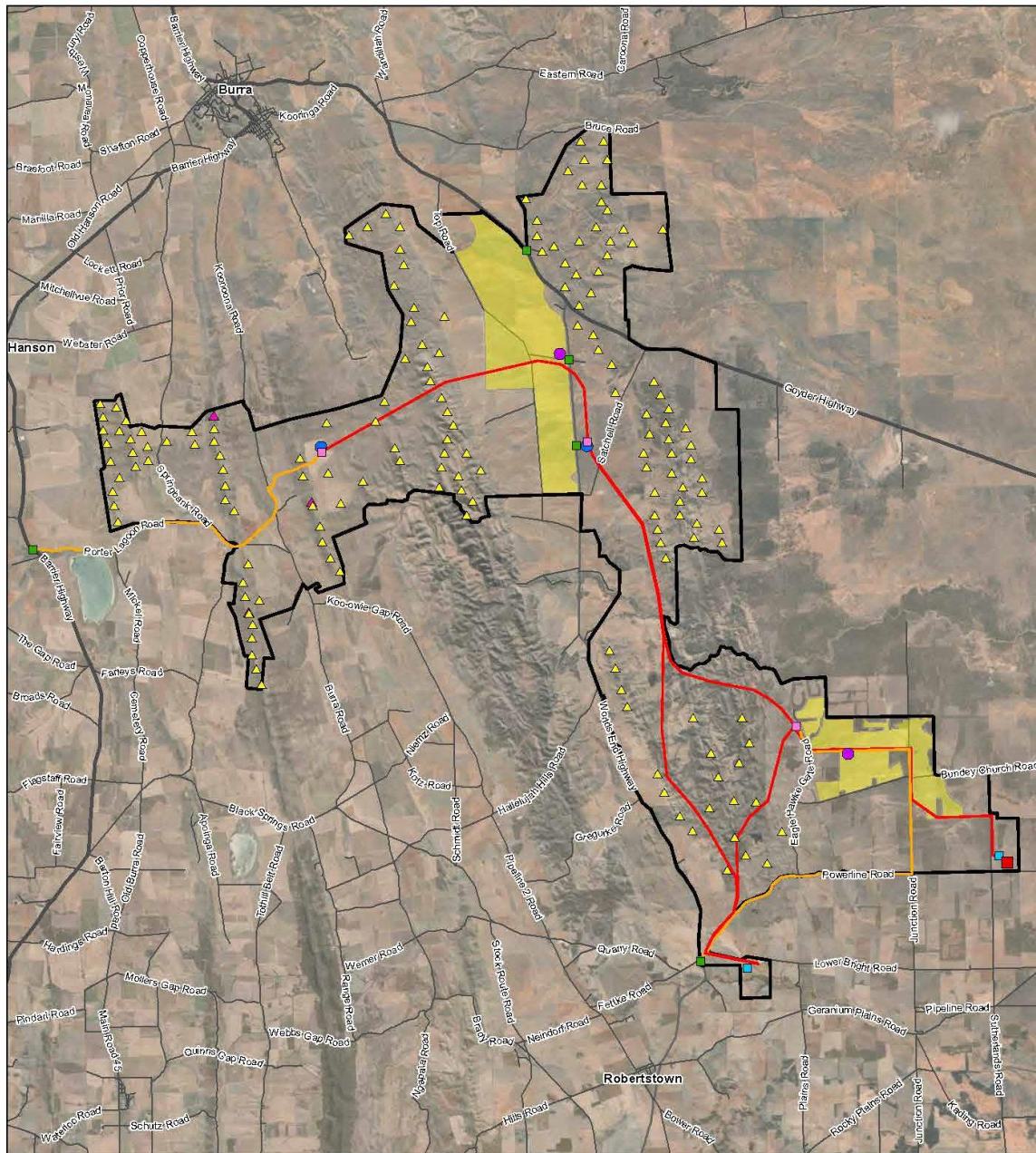
Based on the predictions, the requirements of the *Environment Protection (Noise) Policy 2007* and *Wind Farms Environmental Noise Guidelines 2009* can be achieved at all surrounding dwellings.

A final assessment will also be made during the detailed design stage to confirm that the final equipment selections comply with the relevant criteria.

Based on the above it is considered that the proposal is *located and designed to minimise adverse impact* and *does not detrimentally affect the amenity of the locality*, satisfying the relevant provisions of the Goyder Council Development Plan.

APPENDIX A

Figure A1: Goyder South Renewable Energy Facility Layout



- ▲ Turbine layout (total turbines 163)
- Battery and grid connection (2)
- Construction entry point (5)
- Substation and O&M (3)
- Possible interconnector substation (1)
- Solar construction compound (2)
- Wind construction compound (2)
- Construction access road
- Proposed transmission line
- Highway/Arterial
- Sub-arterial
- Collector and local

Paper Size A3
0 0.5 1 2 3 4
Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: ODA 1994
Grid: ODA 1994 MGA Zone 54

NEOEN

NEOEN

Project Layout
Current at 12/5/2020

Job Number 33-19112
Revision 1
Date 20 May 2020

Figure 1

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E me@mail@ghd.com W www.ghd.com

© 2020. While every care has been taken to prepare this map, GHD and NEOEN make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and accept no liability or responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damages) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way for any reason.

Data source: SA Government, map data, 2019; GeoSource Australia, township boundary, 2015; Neoen, layout data, 2020. Created by sonus.

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

APPENDIX B

Table B1: Battery and Substation Equipment Locations

Site	Co-ordinates (UTM WGS84 54H)	
	Easting	Southing
Battery inverters and Air-Conditioning		
Robertstown	326465	6240960
Interconnector	335450	6244950
Transformers, Battery inverters and Air-Conditioning		
Substation East	320800	6259765
Substation South	328220	6249585
Substation West	311320	6259410

APPENDIX C

Table C1: House Location, Status and Noise Criteria

House ID	Co-ordinates (UTM WGS84 54H)		Zoning	Solar, Battery, and Substation Assessment	Wind Farm Assessment	
	Easting	Southing		Policy Noise Criterion (dB(A))	Landowner Status	2009 Guidelines Baseline Noise Criterion (dB(A))
H1	312335	6263106	Primary Production	45	Involved	
H2	317246	6260505	Primary Production	45	Involved	
H3	310428	6257934	Primary Production	45	Involved	
H4	307715	6256049	Primary Production	45	Involved	
H5	311589	6254061	Primary Production	45	Involved	
H6	318057	6257146	Primary Production	45	Involved	
H7	316157	6267220	Primary Production	45	Involved	
H8	309122	6256801	Primary Production	45	Involved	
H9	303171	6252241	Primary Production	45	Involved	
H10	322096	6248677	Primary Production	45	Involved	
H11	321665	6248672	Primary Production	45	Involved	
H12	324464	6244837	Primary Production	45	Involved	
H13	307682	6268743	Primary Production	45	Neighbour	40
H14	324836	6241845	Primary Production	45	Involved	
H15	325968	6238548	Primary Production	45	Involved	
H16	305923	6263462	Primary Production	45	Involved	
H17	300305	6259555	Primary Production	45	Involved	
H19	298295	6259186	Primary Production	45	Involved	
H20	303496	6264965	Primary Production	45	Involved	
H21	303456	6268262	Primary Production	45	Involved	
H22	303426	6268430	Primary Production	45	Neighbour	40
H23	305567	6268819	Primary Production	45	Involved	
H24	305665	6269503	Primary Production	45	Neighbour	40
H25	305481	6266247	Primary Production	45	Neighbour	40
H26	305760	6261894	Primary Production	45	Neighbour	40
H27	300827	6265565	Primary Production	45	Neighbour	40
H28	299318	6264882	Primary Production	45	Neighbour	40
H29	304473	6255055	Primary Production	45	Neighbour	40
H30	307101	6251401	Primary Production	45	Involved	
H31	312105	6250495	Primary Production	45	Neighbour	40
H32	314218	6250365	Primary Production	45	Neighbour	40
H33	315040	6249377	Primary Production	45	Neighbour	40
H34	315213	6248946	Primary Production	45	Neighbour	40
H35	315301	6247663	Primary Production	45	Neighbour	40
H36	317768	6245029	Primary Production	45	Neighbour	40
H37	321911	6248741	Primary Production	45	Neighbour	40
H38	322515	6246966	Primary Production	45	Involved	
H39	328206	6246991	Primary Production	45	Involved	
H40	328142	6247359	Primary Production	45	Involved	
H41	327919	6246592	Primary Production	45	Involved	
H42	327338	6242018	Primary Production	45	Neighbour	40
H43	328389	6240448	Primary Production	45	Neighbour	40
H44	324733	6240953	Primary Production	45	Neighbour	40
H45	325128	6240468	Primary Production	45	Neighbour	40
H46	324756	6240416	Primary Production	45	Neighbour	40
H47	324370	6240182	Primary Production	45	Neighbour	40

House ID	Co-ordinates (UTM WGS84 54H)		Zoning	Solar, Battery, and Substation Assessment	Wind Farm Assessment	
	Easting	Southing		Policy Noise Criterion (dB(A))	Landowner Status	2009 Guidelines Baseline Noise Criterion (dB(A))
H48	324267	6240053	Primary Production	45	Neighbour	40
H49	324168	6239661	Primary Production	45	Neighbour	40
H50	324141	6239526	Primary Production	45	Neighbour	40
H51	324117	6240214	Primary Production	45	Neighbour	40
H52	323975	6240787	Primary Production	45	Neighbour	40
H53	323562	6240559	Primary Production	45	Neighbour	40
H54	322995	6240470	Primary Production	45	Neighbour	40
H55	305075	6247884	Primary Production	45	Neighbour	40
H56	314940	6269823	Primary Production	45	Involved	
H57	318374	6270088	Primary Production	45	Neighbour	40
H58	315194	6271481	Primary Production	45	Involved	
H59	323618	6270103	Primary Production	45	Neighbour	40
H60	308727	6262618	Primary Production	45	Neighbour	40
H61	323400	6264338	Primary Production	45	Neighbour	40
H62	307411	6254099	Primary Production	45	Involved	
H63	309519	6255856	Primary Production	45	Involved	
H64	310449	6255800	Primary Production	45	Involved	
H65	321758	6254451	Primary Production	45	Involved	
H66	317705	6258263	Primary Production	45	Involved	
H67	319848	6268210	Primary Production	45	Involved	
H68	305258	6264061	Primary Production	45	Neighbour	40
H69	324658	6240384	Primary Production	45	Neighbour	40
H101	301426	6260110	Primary Production	45	Involved	
H102	299988	6263054	Primary Production	45	Neighbour	40
H103	299984	6263000	Primary Production	45	Neighbour	40
H104	300176	6257368	Primary Production	45	Involved	
H105	313146	6272388	Primary Production	45	Neighbour	40
H106	306530	6247758	Primary Production	45	Neighbour	40
H107	303466	6250252	Primary Production	45	Involved	
H108	305810	6250352	Primary Production	45	Neighbour	40
H109	305152	6251397	Primary Production	45	Neighbour	40
H110	300270	6255374	Primary Production	45	Involved	
H111	302055	6253944	Primary Production	45	Neighbour	40
H112	305659	6266350	Primary Production	45	Neighbour	40
H113	327012	6246133	Primary Production	45	Involved	
H114	301347	6264794	Primary Production	45	Involved	
H115	312136	6244948	Primary Production	45	Involved	
H117	323771	6244703	Primary Production	45	Involved	
H118	312486	6246308	Primary Production	45	Neighbour	40
H119	303503	6248656	Primary Production	45	Neighbour	40
H120	303261	6247708	Primary Production	45	Neighbour	40
H121	315996	6246501	Primary Production	45	Neighbour	40
H122	317706	6245239	Primary Production	45	Neighbour	40
H122	300066	6256780	Primary Production	45	Involved	
H123	321055	6251732	Primary Production	45	Involved	
H124	311630	6272412	Primary Production	45	Neighbour	40
H125	325631	6246183	Primary Production	45	Involved	
H126	309968	6270362	Rural Living	40	Neighbour	35

APPENDIX D

Figure D1: H4 Monitoring Equipment.



Figure D3: H57 Monitoring Equipment.



Figure D2: H37 Monitoring Equipment.



Figure D4: H61 Monitoring Equipment.



Figure D5: H126 Monitoring Equipment.



APPENDIX E

Figure E1: H4 Background Noise Regression Curve.

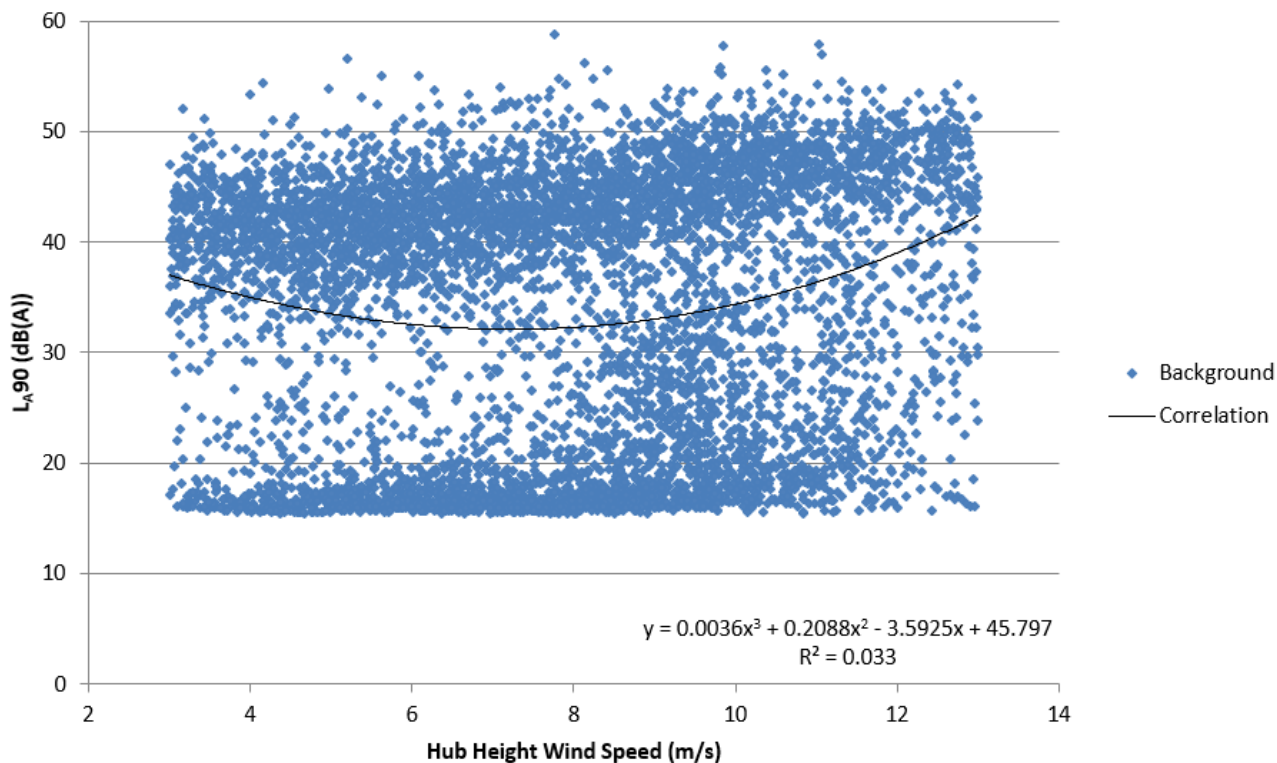


Figure E2: H37 Background Noise Regression Curve.

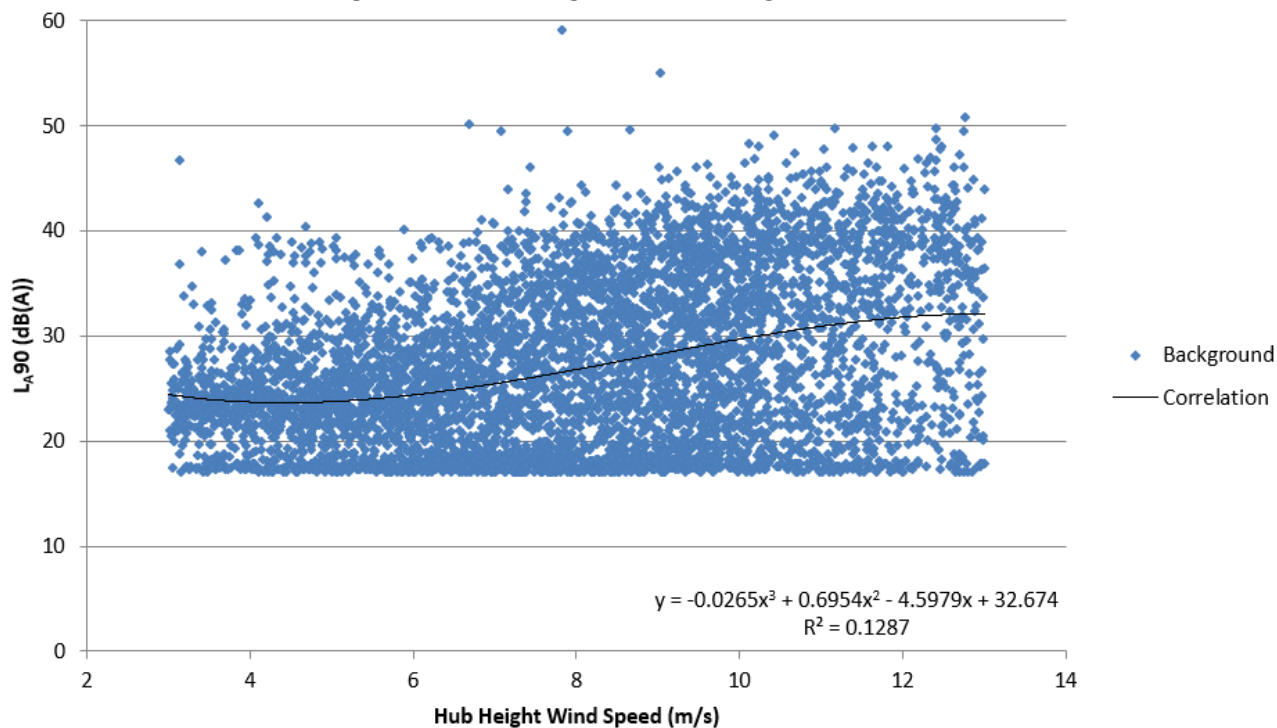


Figure E3: H57 Background Noise Regression Curve.

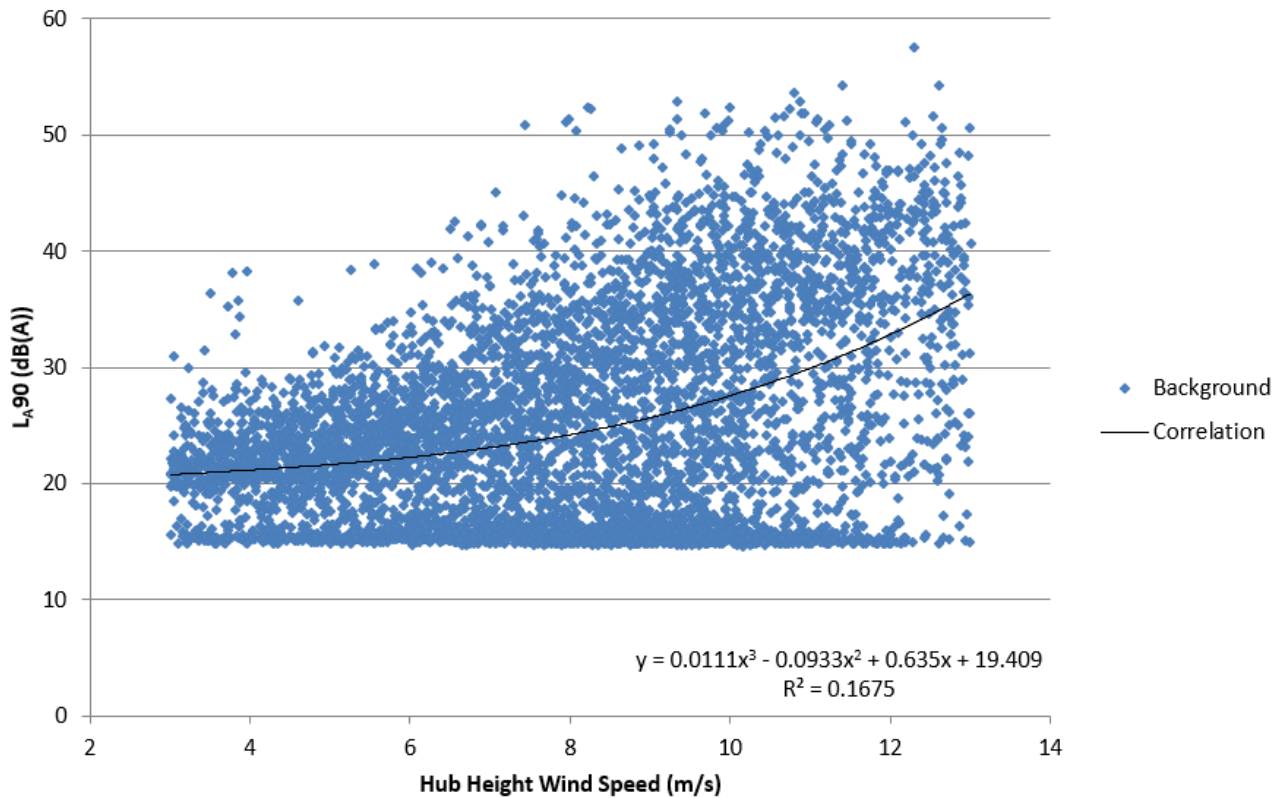


Figure E4: H61 Background Noise Regression Curve.

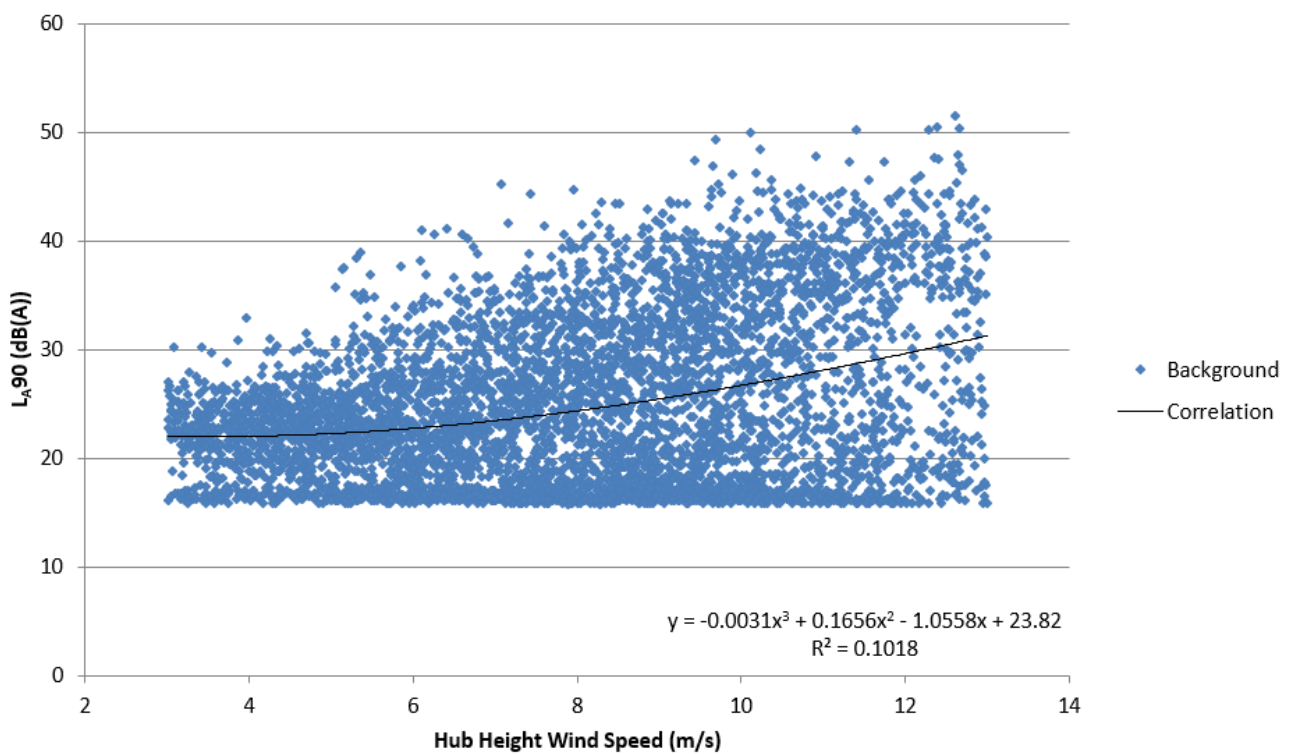
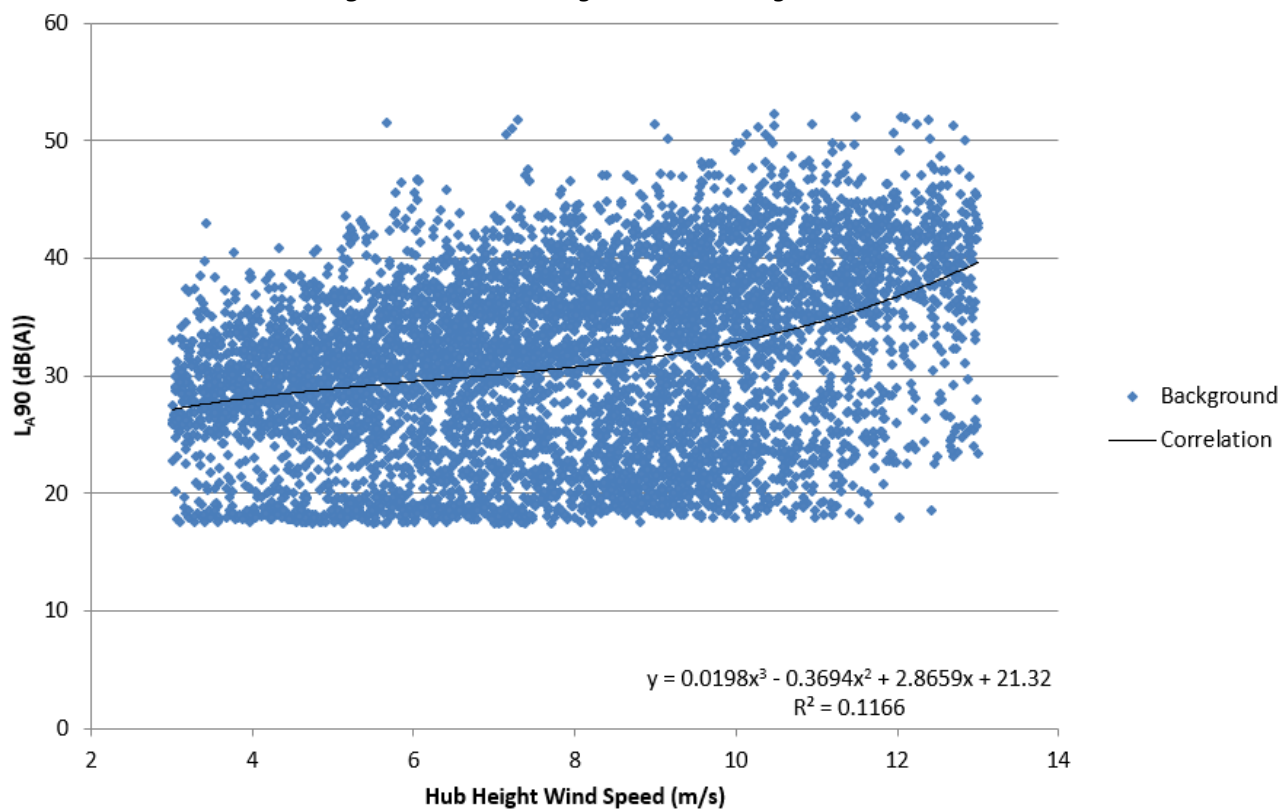


Figure E5: H126 Background Noise Regression Curve.



APPENDIX F

Table F1: WTG Locations

WTG ID	Co-ordinates (UTM WGS84 54H)	
	Easting	Southing
B001	310545	6259113
B004	311500	6260400
B005	311557	6258594
B008	312000	6257500
B010	312300	6267100
B015	312800	6258300
B017	312950	6267400
B021	313239	6260452
B023	313557	6261167
B024	313600	6267866
B025	313900	6265300
B026	313934	6259504
B027	314100	6267400
B028	314100	6266600
B029	314111	6259050
B030	314240	6266039
B031	314300	6262700
B032	314500	6264000
B033	314600	6264500
B034	314900	6263200
B035	315100	6262400
B036	315200	6261900
B037	315500	6262900
B038	315500	6258100
B039	315600	6261300
B040	315600	6258800
B042	315700	6264200
B043	315700	6259300
B044	315800	6260800
B045	315800	6259800
B046	316000	6260300
B047	316200	6258500
B048	316300	6258000
B049	316500	6259300
B050	316500	6257100
B051	316700	6257600
B052	317000	6258700
B053	318600	6268400
B054	319002	6267634
B055	319008	6267069
B056	319194	6266523
B058	319600	6266700
B060	320000	6266100
B061	320001	6265257
B062	320100	6269400
B063	320400	6265700
B064	320440	6263888
B065	320500	6266900

WTG ID	Co-ordinates (UTM WGS84 54H)	
	Easting	Southing
B066	320500	6264600
B067	320564	6270453
B068	320600	6268909
B069	320700	6269800
B070	320934	6265033
B071	321014	6263525
B072	321100	6267400
B073	321200	6265800
B074	321200	6262995
B075	321300	6268900
B076	321300	6268300
B077	321382	6270456
B078	321500	6269800
B079	321500	6268000
B080	321500	6266400
B081	321600	6266900
B082	321652	6262482
B083	322100	6267300
B084	321806	6261480
B085	322400	6266800
B086	322900	6260700
B087	323000	6260000
B088	323176	6261872
B089	323400	6261400
B090	323500	6267300
B091	323600	6260400
B092	323700	6260900
B093	323700	6259800
B094	323800	6259300
B095	323800	6258600
B096	324100	6257600
B097	324100	6257100
B098	324200	6258100
B099	324300	6260200
B100	324500	6259600
B101	324500	6259100
B102	324600	6256300
B103	324700	6256800
B104	324900	6258400
B105	324900	6257900
B106	325500	6256600
B107	325600	6256100
B108	326200	6248240
B109	326306	6249851
B110	326569	6248960
B111	326810	6246833
B112	326054	6245573
SG065	326033	6246898

WTG ID	Co-ordinates (UTM WGS84 54H)	
	Easting	Southing
B113	327729	6245777
SG001	303430	6261070
SG002	304000	6260940
SG003	304350	6260472
SG004	303520	6260598
SG007	307485	6260178
SG008	303536	6260125
SG009	304101	6260112
SG010	304898	6260085
SG011	306702	6260071
SG012	304513	6259798
SG013	307500	6259740
SG014	305800	6259740
SG015	303664	6259640
SG016	306817	6259623
SG017	305104	6259538
SG018	304600	6259340
SG019	322800	6259300
SG020	307700	6259240
SG021	305146	6259046
SG022	303803	6259030
SG023	304700	6258840
SG024	322900	6258800
SG025	307800	6258740
SG026	310640	6258500
SG027	304100	6258440
SG028	307900	6258140
SG029	303870	6257940
SG030	323200	6257900
SG031	307900	6257640
SG032	311000	6257440
SG033	303930	6257440
SG034	308200	6257240
SG035	323200	6257100
SG036	304047	6256856
SG037	311260	6256694
SG039	323300	6256600
SG040	311330	6256140
SG041	323400	6256100
SG042	311635	6255557
SG043	323600	6255545
SG044	308700	6255340
SG046	311981	6255086
SG047	308532	6254688
SG048	308600	6254185
SG049	309100	6254040
SG050	308746	6253570
SG051	308870	6253176
SG052	308829	6252703
SG053	321574	6252245

WTG ID	Co-ordinates (UTM WGS84 54H)	
	Easting	Southing
SG054	308840	6252095
SG055	321786	6251631
SG056	309010	6251599
SG057	322007	6250856
SG058	322223	6250246
SG059	324578	6249860
SG060	325213	6248597
SG061	323300	6247835
SG062	325469	6247751
SG063	323533	6247192
SG064	325147	6246641
SG066	324084	6246344
SG067	324541	6245806
SG069	326444	6244948
SG070	327200	6244640
SG071	325787	6244398
SG072	309172	6251050

APPENDIX G

Table G1: Closest WTG to each dwelling with distance in relation to dwelling

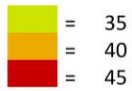
House ID	Landowner Status	Closest WTG to Dwelling	Distance to closest WTG (m)
H1	Involved	B031	2007
H2	Involved	B046	1263
H3	Involved	SG026	604
H4	Involved	SG044	1214
H5	Involved	SG046	1097
H6	Involved	B051	1431
H7	Involved	B027	2065
H8	Involved	SG034	1021
H9	Involved	SG036	4697
H10	Involved	SG061	1469
H11	Involved	SG058	1670
H12	Involved	SG067	972
H13	Neighbour	B010	4902
H14	Involved	SG071	2724
H15	Involved	SG071	5853
H16	Involved	SG002	3172
H17	Involved	SG008	3281
H19	Involved	SG008	5324
H20	Involved	SG001	3896
H21	Involved	SG001	7192
H22	Neighbour	SG001	7360
H23	Involved	B010	6949
H24	Neighbour	B010	7057
H25	Neighbour	SG002	5510
H26	Neighbour	SG002	2002
H27	Neighbour	SG001	5194
H28	Neighbour	SG001	5607
H29	Neighbour	SG036	1851
H30	Involved	SG054	1872
H31	Neighbour	SG072	2985
H32	Neighbour	SG072	5092
H33	Neighbour	SG072	6102
H34	Neighbour	SG072	6397
H35	Neighbour	SG072	7003
H36	Neighbour	SG063	6157
H37	Neighbour	SG058	1537
H38	Involved	SG063	1043
H39	Involved	B113	1304
H40	Involved	B111	1432
H41	Involved	B113	837
H42	Neighbour	SG070	2626
H43	Neighbour	SG070	4357
H44	Neighbour	SG071	3603
H45	Neighbour	SG071	3985
H46	Neighbour	SG071	4113
H47	Neighbour	SG071	4448
H48	Neighbour	SG071	4603

House ID	Landowner Status	Closest WTG to Dwelling	Distance to closest WTG (m)
H49	Neighbour	SG071	5006
H50	Neighbour	SG071	5143
H51	Neighbour	SG071	4505
H52	Neighbour	SG071	4040
H53	Neighbour	SG071	4437
H54	Neighbour	SG071	4819
H55	Neighbour	SG072	5178
H56	Involved	B024	2372
H57	Neighbour	B053	1703
H58	Involved	B024	3951
H59	Neighbour	B078	2140
H60	Neighbour	SG007	2738
H61	Neighbour	B088	2476
H62	Involved	SG048	1192
H63	Involved	SG044	968
H64	Involved	SG040	944
H65	Involved	SG043	2142
H66	Involved	B052	829
H67	Involved	B054	1023
H68	Neighbour	SG002	3365
H69	Neighbour	SG071	4170
H101	Involved	SG008	2110
H102	Neighbour	SG001	3973
H103	Neighbour	SG001	3950
H104	Involved	SG029	3738
H105	Neighbour	B024	4545
H106	Neighbour	SG072	4221
H107	Involved	SG054	5681
H108	Neighbour	SG072	3434
H109	Neighbour	SG054	3753
H110	Involved	SG036	4057
H111	Neighbour	SG036	3528
H112	Neighbour	SG002	5659
H113	Involved	B111	729
H114	Involved	SG001	4267
H115	Involved	SG072	6784
H117	Involved	SG067	1345
H118	Neighbour	SG072	5785
H119	Neighbour	SG072	6154
H120	Neighbour	SG072	6790
H121	Neighbour	SG058	7266
H122	Neighbour	SG063	6146
H122	Involved	SG033	3920
H123	Involved	SG053	730
H124	Neighbour	B024	4954
H125	Involved	SG064	666
H126	Neighbour	B010	4010

APPENDIX H

Figure H1: Noise Predictions

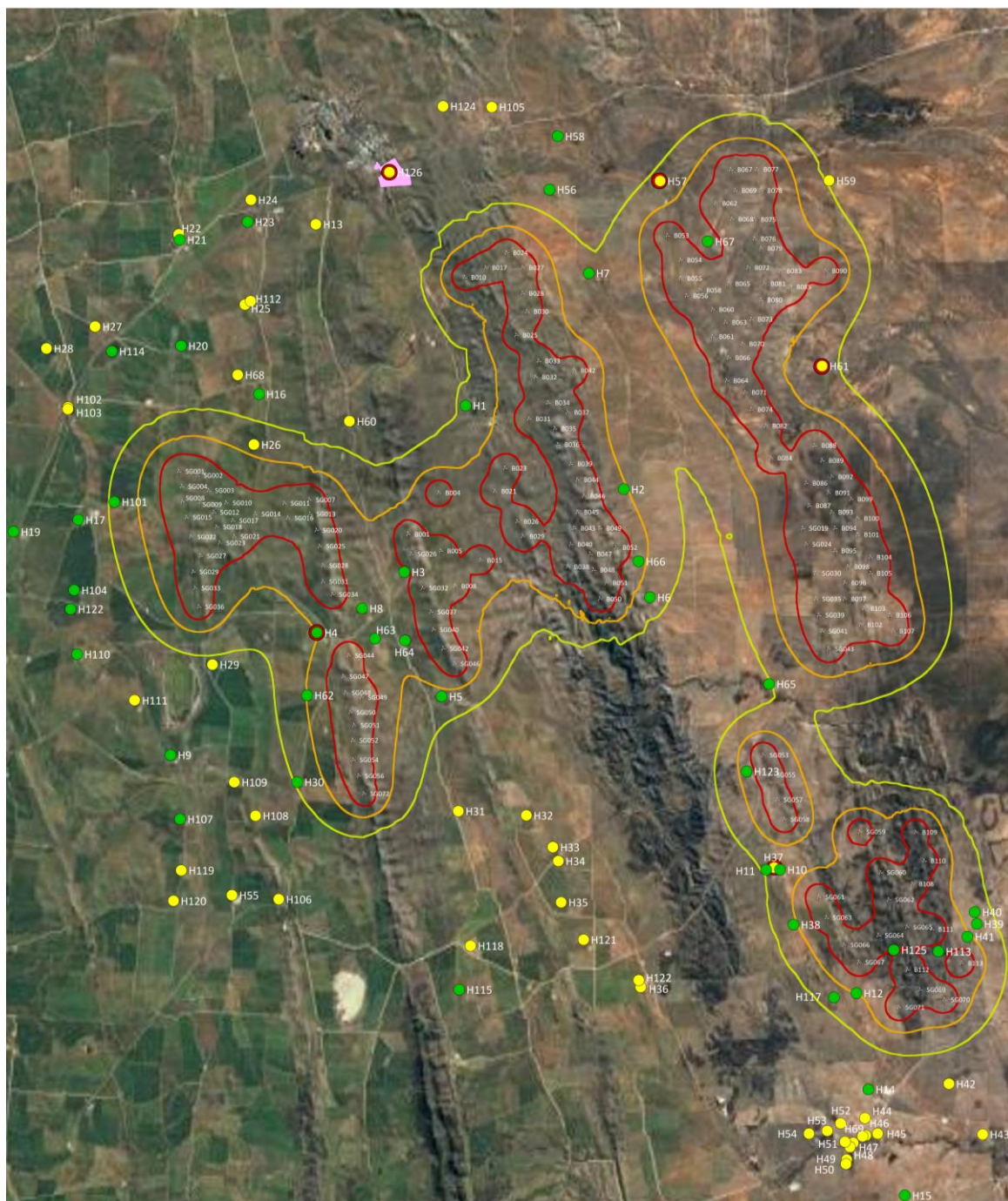
Predicted Noise level



Goyder South Renewable Energy Facility
163 WTGs with 160m Hub Height

Legend

- Neighbour
- Wind Turbine Generators
- Rural Living Area
- Involved Landowner
- Noise Monitoring Location



2020

IHC

Independent Heritage Consultants Pty Ltd

Goyder Renewable Zone
Goyder South Hybrid Renewable Energy Facility
Desktop Heritage Assessment

Place	Stony Gap, South Australia
Report Description	Heritage assessment
Issue Date	May 2020
Author(s)	Steve Damhuis, Guadalupe Cincunegui
Version	Final (redacted and layout update)
Associates	N/A
Client	Neoen
Disclaimer	<p>This report expresses the professional opinion of the authors based on the information cited and presented in this report.</p> <p>This report is a redacted version of the original report prepared for the project.</p> <p>Information contained in this report that is not publicly available regarding Aboriginal cultural heritage has been removed in line with advice from DPC-AAR.</p>
Copyright	<p>© Independent Heritage Consultants</p> <p>The intellectual property in this report remains the property of IHC and may only be used for the purpose for which it was produced.</p> <p>It is prohibited to use this document in any other form than for its stated purpose or for research unless written permission is obtained from IHC and the source is fully acknowledged. Reproduction of the report for commercial purposes is prohibited.</p> <p>Third party material used in this publication is the property of the specified copyright owner unless otherwise indicated and is used according to the licensing conditions.</p>
Limitation	<p>This report has been prepared on behalf of and for the exclusive use of IHC's client and is subject to and issued in connection with the provisions of the agreement between IHC and its client. IHC accepts no liability or responsibility whatsoever for or in any respect of any use of or reliance upon this report by any third party.</p>
Citation	<p>IHC 2020. Goyder Renewable Zone – Goyder South Hybrid Renewable Energy Facility. Assessment of heritage. Report prepared for Neoen Pty Ltd, Adelaide.</p>

ABBREVIATIONS

Term	Meaning
ACHM	Australian Cultural Heritage Management
CEMP	Construction Environmental Management Plan
DEW	Department of Environment and Water
EPBCA	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
GRZ	Goyder Renewables Zone
ICOMOS	International Council on Monuments and Sites
IHC	Independent Heritage Consultants
MNES	Matters of National Environmental Significances
MW	Megawatts
RNE	Register of the National Estate
NTA	<i>Native Title Act 1993</i>
SHA	State Heritage Area
SLSA	State Library of South Australia

EXECUTIVE SUMMARY

Independent Heritage Consultants (IHC) has been engaged by Neoen to carry out a desktop Aboriginal and European heritage assessment for the Goyder South Hybrid Renewable Energy Facility (Map 1).

The proposed Goyder South Hybrid Renewable Energy Facility will consist of up to 1200MW of wind, 600MW of solar and 900MW/1800 MWh (2 hours) of battery storage, Stage 1 (400MW wind, 200MW solar and 300MW/600Mwh battery) is expected to connect to the existing Robertstown substation. The remainder is likely to connect to the planned new interconnector substation

Aboriginal Heritage

To prepare this assessment IHC has completed heritage register searches as well as a comprehensive literature review including all previous heritage work carried out in the project area. This literature review revealed likely Aboriginal site types and landform associations for the project area. Site types to be expected are stone cairns, culturally modified trees, and quarries, and to a lesser extent, stone artefact scatters, campsites, engravings, paintings and burials. It was determined that these sites are more likely located along ridgelines and creeks (including the Burra Gorge).

The literature review also highlighted a single DPC-AAR listed site within the project area and a number of previously surveyed areas that potentially do not require further assessment. While this has highlighted future time/cost savings for Neoen, it has also identified a number of gaps where additional work is recommended.

In all the previous studies, only one reference was made to an ethnographic association. This related to the quartzite outcrops running along the Brown Hill Range. However, this was not defined as a site under the Aboriginal Heritage Act 1988 (AHA). This suggests that there is a low potential for any ethnographic sites (definable under the AHA) to be identified within the current project area.

This report represents a redacted version of the original desktop assessment prepared for this project. Information contained in this report that is not publicly available regarding Aboriginal cultural heritage has been removed in line with advice from DPC-AAR.

Legal Obligations

The main requirement for this project to comply with the AHA is to not damage, disturb or interfere with Aboriginal heritage sites, objects and/or remains.

- Any known DPC-AAR sites must be avoided. If they can not be avoided Ministerial consent under section 23 of the AHA is required.
- In the event that any new Aboriginal heritage sites are identified during works in the area, they are also afforded blanket protection by the AHA and if they can not be avoided, Ministerial consent under section 23 of the AHA is required.

Common Heritage Management Options

Although not legal requirements of the Aboriginal Heritage Act, IHC strongly recommends that Neoen consider the following management options to minimise the risk of breaching the AHA;

- Although the risk of impacting ethnographic sites in the project area has been identified as “low” the best way to mitigate against inadvertently impacting an ethnographic site is to consult with the relevant Aboriginal group. IHC understands that Neoen has engaged with Ngadjuri to carry out an anthropological survey of the Stage 1 site to inform the micro-siting of infrastructure during the detailed design phase, and intends to procure similar surveys over the remainder of the site as development of those stages progresses.

- Neoen should consider engaging archaeologists to carry out a site avoidance survey in the remaining unsurveyed development footprint to identify and record any unknown archaeological sites that may be present. If Neoen cannot avoid these or design around them, then Ministerial consent under section 23 of the AHA will be required.
- IHC recommend that Neoen manage heritage risk during works by ensuring all contractors and workers are aware of heritage risks and how to manage them accordingly. This can be outlined during initial site inductions.
- Neoen should implement a site discovery procedure for unexpected heritage discoveries during project works (IHC have provided Neoen with a site discovery procedure).
- Neoen should consider engaging an archaeologist to be on call and assist in identifying any heritage items found during works.

European Heritage

During the course of this assessment, IHC has completed heritage register searches, a comprehensive literature review and a review of the Australian historic themes to identify the European heritage and archaeological values of the project area.

The reviewed previous studies made reference to a number of historical archaeological features (stone walls, building remnants and archaeological features), however none of these were recorded in detail. This, combined with the proximity of the project area to a National heritage area (Burra) and identification of a number of historic themes in the region suggests that there is potential for additional European (archaeological) heritage to be identified.

Legal Obligations

All European built heritage and subsurface archaeological features, whether listed or not, are protected and must be managed in line with the requirements of the EPBCA, the Heritage Places Act and the Development Act.

- There is one National heritage place in the general vicinity of the project area, the town of Burra. Neoen is investigating the need for an EPBC referral to manage visual impacts on Burra and specialist advice has been sought. Neoen will continue to address this matter in consultation with the relevant Commonwealth department.
- There are three State listed built heritage places in the general project vicinity and these will not be impacted by the current layout design. The current layout has been designed to set back from any State listed built heritage items.
- There are no local listed built heritage place in or adjacent to the current layout.
- There is potential for sub-surface European archaeological deposits and sites to be present in the current layout area. Any archaeological deposit uncovered by the proposed development must be reported to Heritage SA. A qualified archaeologist with an approved s27 permit from Heritage SA records any archaeological deposits identified during works.

Common Heritage Management Options

Although not legal requirements of the Heritage Places Act, IHC strongly recommends that Neoen consider the following management options to minimise heritage risk and breaching the Act;

- IHC recommend that Neoen engage a qualified archaeologist to carry out a survey of the project area and identify and record any potential archaeological sites and/or deposits in the development footprint. If

Neoen cannot avoid these or design around items of recorded heritage, such as ruins, walls or archaeological deposits, then these will need to be managed pursuant to s.27 of the Heritage Places Act.

- IHC recommend that Neoen manage heritage risk during works by ensuring all contractors and workers are aware of heritage risks and how to manage them accordingly. This can be outlined during initial site inductions.
- Neoen should implement a site discovery procedure for unexpected heritage discoveries during project works (IHC have provided Neoen with a site discovery procedure).
- Neoen should consider engaging an archaeologist to be on call and assist in identifying any heritage items found during works.

Table of Contents

ABBREVIATIONS	2
1 INTRODUCTION.....	8
1.1 Objectives.....	8
2 PROJECT	ERROR! BOOKMARK NOT DEFINED.
2.1 Background	10
2.2 Location	10
2.3 Impacts	11
3 COMPLIANCE AND LEGISLATIVE SUMMARY	12
3.1 Commonwealth Legislation	12
3.1.1 Environment Protection and Biodiversity Conservation Act 1999 (amended 2003)	12
3.1.2 Native Title Act 1993	12
3.2 South Australian Legislation	13
3.2.1 The Heritage Places Act 1993	13
3.2.2 Aboriginal Heritage Act 1988 (amended 2016).....	13
3.2.3 Native Title Act 1994	14
3.2.4 Development Act 1993 and the Planning, Development and Infrastructure Act 2016	14
3.3 Non-Statutory	14
3.3.1 The Burra Charter (1979) - Amended 2013	15
4 ABORIGINAL HERITAGE BACKGROUND	16
5 EUROPEAN HERITAGE BACKGROUND	17
5.1 Regional Council of Goyder	17
5.2 Pastoralism	17
5.3 Burra and Mining	17
5.4 Stony Gap	19
5.5 Princess Royal Mine & Homestead.....	21
5.6 Previous Relevant Heritage Studies.....	22
5.7 European Archaeological Potential	23
5.8 Discussion.....	24
6 HERITAGE REGISTER SEARCHES	25
6.1 Aboriginal Heritage.....	25
6.2 European Heritage Registers	25

6.2.1	Australian Historic Themes Framework	25
6.2.2	Heritage items noted in previous reports.	26
7	ENVIRONMENTAL LANDFORMS AND HERITAGE SITES.....	29
7.1	Aboriginal Heritage.....	29
7.2	European Heritage	29
8	SUMMARY & RECOMMENDATIONS.....	30
9	REFERENCES.....	33

List of Tables

Table 1. Previous studies carried out in the general project region	22
Table 2. Heritage items noted	26
Table 3. Australian historic themes framework	28

List of Maps

Map 1. Goyder South Project Area and associated infrastructure	9
Map 2. National and State European heritage sites in proximity to the project area.	27

List of Figures

Figure 1. View across Burra towards Stony Gap – circa 1874 (SLSA B12174)	18
Figure 2. Location of Isabella and Jesse Humphry’s property at Stony Gap (SLSA B12174)	19
Figure 3. The Humphry’s family home at Stony Gap (Brooks 2015).	20
Figure 4. Stony Gap wattle and daub house – circa 1910 (SLSA B46757)	20
Figure 5. Stony Gap School Robertstown circa. 1900 (SLSA B46574).....	21
Figure 6. Princess Royal Homestead. Site of the Princess Royal Mine (National Library PIC P1864/1-87 LOC Q97).....	22

1 INTRODUCTION

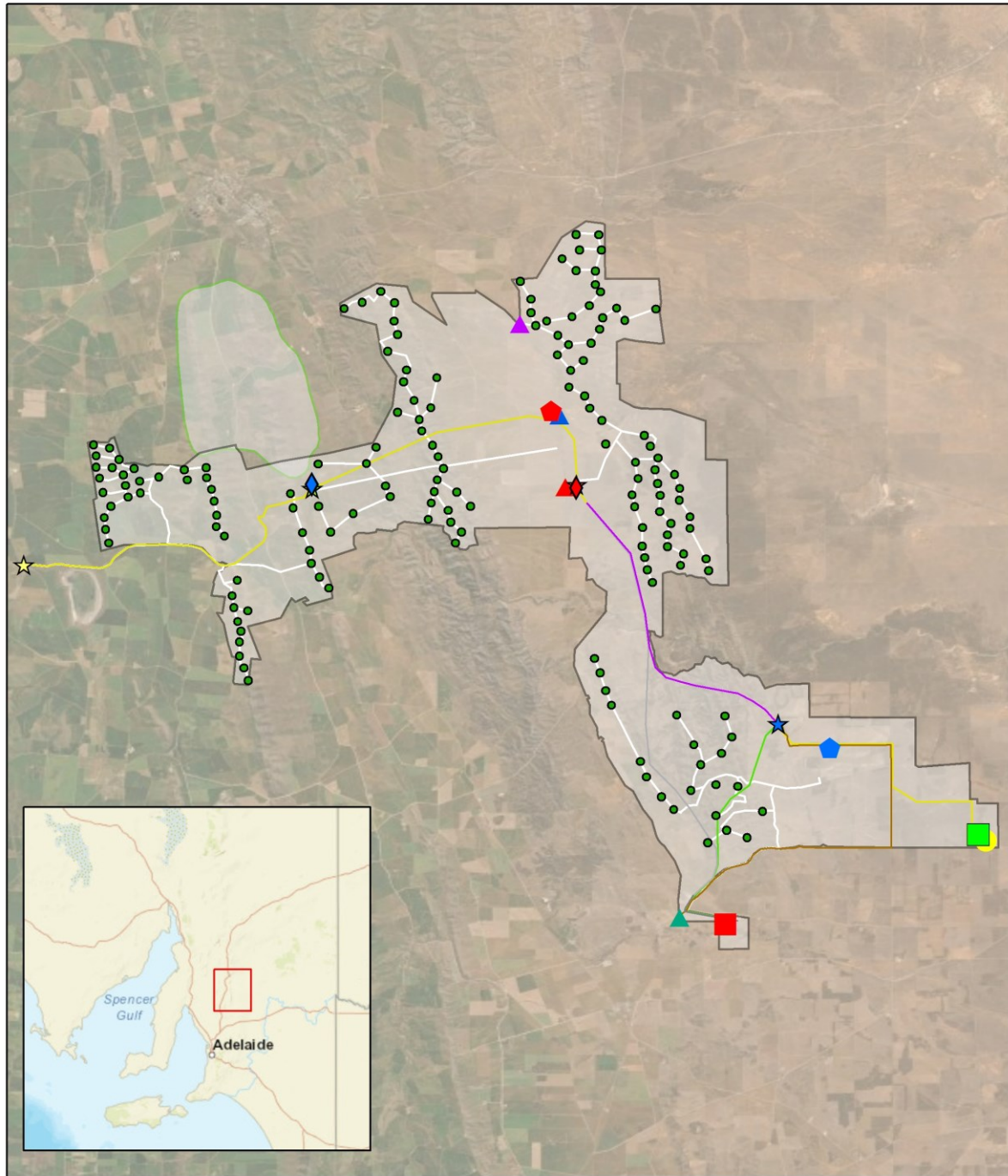
Independent Heritage Consultants (IHC) has been engaged by Neoen to carry out a desktop assessment of Aboriginal and European heritage for the Goyder South Hybrid Renewable Energy Facility.

This assessment has been prepared with the information available to date to fulfil identify sites of Aboriginal and European heritage so they can be avoided or appropriately managed.

1.1 Objectives

The specific objectives of this heritage assessment are as follows:

- Carry out a heritage desktop study, considering both Aboriginal and European heritage
- Develop a comprehensive understanding of the heritage context of the project area
- Identify/assess potential risks/constraints for the development
- Outline if and what further heritage management is recommended pursuant to relevant heritage legislation with respect to proceeding with the development on the land
- Address any other matters that may be considered necessary to obtain a development approval for the project on the site.



Produced by: IHC
 info@ihconsultants.com.au
 Coordinate System:
 GDA 1994 MGA Zone 54
 Date: 22/05/2020



0 2.5 5 10
 Kilometers

Legend

- | | | |
|-------------------------------------|-----------------------------------|----------------------------------|
| ● Turbine locations | ▲ South Entry | — East entry to sub east |
| ■ Battery 1 | ★ Substation East | — Entry road to Substation south |
| ■ Battery 2 | ★ Substation South | — Stage 2+ Trans Line Route |
| ▲ East Entry | ★ Substation West | — To subst West 1 |
| ▲ North Entry Solar | ★ West Entry | — Trans Line Route 1 |
| ▲ North Entry | ◆ Wind Construction Compound East | — Trans Line Route 2 |
| ● Possible I/C Sub Location | ◆ Wind Construction Compound West | — Trans line route 2 cont |
| ▲ Solar Construction Compound North | — Alternative Transmission Route | — Transmission from Sub west |
| ▲ Solar Construction Compound South | | — West Entry road |
| | | — Access tracks |
| | | □ Goyder South Project Boundary |
| | | □ GHD |

Map 1. Goyder South Facility Area and associated infrastructure

2 PROJECT

2.1 Background

The Goyder South project incorporates land which was first developed as “Stony Gap”, a wind only project that received Development approval in 2014. In purchasing the project from Palisade, Neoen saw the opportunity to merge the Stony Gap site into the new, much larger **Goyder South Hybrid Renewable Energy Facility**, itself part of the larger **Goyder Renewables Zone (GRZ)**, a concept which Neoen has been developing since late 2017

The **Goyder Renewables Zone** will complement the “Energy Connect” project under development by ElectraNet and the South Australian government for a large interconnector to New South Wales from the nearby Robertstown substation.

2.2 Location

The proposed development is located approximately 5km south of Burra extending approximately 30 km south toward Robertstown. This area is located in the eastern portion of the northern Mount Lofty Ranges and wholly located within the Goyder Regional Council area. From a transport and access perspective, the region is serviced by the Barrier Highway, the Burra-Morgan Highway (Goyder Highway) and the Worlds End Highway.

The project is located within the Mid North Region (for the purposes of strategic land use planning) and the SA Murray-Darling Basin Natural Resource Management Area. The project is located within the “Northern Ranges” of the Rangelands part of the SA Murray-Darling Basin NRM. This area is generally described as a transitional zone between cropping and pastoral country. It is noted that the project is not located within a prescribed water resources area.

The Goyder South Hybrid Renewable Energy Facility will comprise a number of project elements as generally described below:

Wind turbine generators: Up to 163 turbines with a maximum tip height of 240m (and 200m for turbines B010, B017 and B024 which are closest to Burra to minimise visual impact). The final sizing will depend on the specific wind resource characteristics on each portion of the site and the requirements of individual power purchasers, which may be less than these maximums. The wind turbines associated with Goyder South are dispersed across an area of approximately 30,000 hectares and will have a generating capacity of between 4-8MW per turbine. The actual footprint of the turbines will be approximately 0.1% of the total project land area and will impede neither grazing nor cropping.

Single-axis tracking, bifacial solar PV: The bifacial solar panels will gather light on both faces, with the rear face of the panel harnessing light reflected from the ground. Accordingly, these panels will require greater spacing between rows (up to 10m) and therefore additional land is required to accommodate this technology. They will have a generating capacity of up to 600MW and will be located at two sites:

- a. Near the World’s End Highway approximately halfway between Burra and Robertstown, and
- b. In the area named Bright to the north-east of Robertstown.

The land at the Worlds End Solar Farm was once cropping land but is now largely low-intensity grazing land, sparsely populated and increasingly marginal. The land at the Bright Solar Farm has previously been cropped but is currently not used either for cropping or grazing due to ongoing drought and consequent de-vegetation.

Batteries: The battery storage infrastructure is expected to be located adjacent to the existing Robertstown substation **and/or** the planned nearby interconnector substation (which is likely to be the point of grid connection for Stages 2+ of Goyder South), as it will likely be desirable to locate battery storage directly adjacent to these grid substations to reduce the impact of any line disruptions and perform wider grid stabilisation functions. Neoen has, however, proposed that some battery storage (up to 300MW) may be included at the proposed collector substation sites should this better support the desired facility and grid support outcomes.

Substations: The facility will include three ‘collector’ substations located in proximity to the three stages of turbine development. This includes a substation in the western portion of the project area (in the ranges), one on the eastern side (near Worlds End Highway) and one in the south near the southern solar site. Overhead transmission lines as described below will connect these substations. The footprint of the substations has been developed to accommodate the substation and associated equipment as well as the operations and maintenance facilities. Approximately 2ha of additional land has been included to accommodate battery facilities if required for grid support reasons.

Overhead transmission line: There will be a double-circuit 275 or 330kV overhead transmission line connecting the three substations and then extending from the Goyder South substation to the to the grid substations initially at Robertstown and later to the NSW interconnector substation. It is intended that both the Goyder South and Goyder North facilities will ultimately share this transmission line corridor and transmission infrastructure, which will avoid the unnecessary additional visual and ecological impact, cost and land use restrictions associated with two separate corridors and transmission lines.

2.3 Impacts

The precise impacts from the proposed works are yet to be fully finalised, but generally the following can be concluded;

- New footings and other works are likely to require excavation which will cause disturbance
- Location of access roads, solar arrays and reticulation/electricity connections are likely to cause disturbance. Understanding the European heritage landscape may assist Neoen in adjusting site plans to avoid these sites, in which case no further intervention may be required.
- Construction site and laydown areas

3 COMPLIANCE AND LEGISLATIVE SUMMARY

The principal pieces of legislation relevant to the current heritage assessment are summarised below.

3.1 Commonwealth Legislation

3.1.1 *Environment Protection and Biodiversity Conservation Act 1999 (amended 2003)*

The *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) is the Australian Government's central piece of environmental legislation. It applies to all Australian territories and waters. Under the Act, actions that are likely to have a significant impact upon defined Matters of National Environmental Significance (MNES) are subject to an assessment and approval process. A proponent proposing to take an action that may have a significant impact on a MNES must refer that action to the Commonwealth Minister for the Environment. The EPBC Act prescribes nine MNES as triggers for Commonwealth assessment. These are;

- World heritage sites
- National heritage sites
- Nationally threatened species and ecological communities
- Migratory species protected under international agreements
- The Commonwealth marine environment
- The Great Barrier Reef Marine Park
- Nuclear actions, including uranium mining
- A water resource, in relation to coal seam gas development and large coal mining development

The EPBC Act is only relevant in relation to heritage sites if the site is entered onto the National Heritage List or the Register of the National Estate. There are no heritage items inside the current project area that would require referral under the EPBC Act. Neoen is investigating the need for an EPBC referral regarding impact on the listed town of Burra as a separate process and specialist advice has been sought. Neoen will continue to address this matter in consultation with the relevant Commonwealth agency.

3.1.2 *Native Title Act 1993*

The *Commonwealth Native Title Act 1993* (NTA) is part of the Commonwealth's response to the High Court's decision in *Mabo v Queensland (No.2)* and adopts the common law definition of native title, defined as the rights and interests that are possessed under the traditional laws and customs of Aboriginal people in land and waters.

The NTA recognises the existence of Aboriginal land ownership tradition where connections to country have been maintained and where acts of government have not extinguished this connection. Native title can co-exist with other types of land title (such as pastoral leases), but is extinguished by others (such as freehold title).

The Future Act process provides native title holders and registered native title applicants with specific rights from the time the claim is registered, until it is determined. These rights vary from the right to be consulted, to the right to negotiate over some future acts, or activities on the land.

Public works that commenced prior to the implementation of this Act are generally considered exempt from the requirements of the Future Acts provision in the NTA.

3.2 South Australian Legislation

3.2.1 The Heritage Places Act 1993

The *Heritage Places Act 1993* (HPA) makes provision for the identification, recording and conservation of places and objects of non-Indigenous heritage significance in South Australia. The Act establishes the South Australian Heritage Council and allows for the identification and protection of places of heritage significance. The South Australian Heritage Register lists all places of heritage significance to South Australia. Heritage Places and objects must meet criteria outlined in section 15 of the Act. Once registered, state heritage places are protected under both the HPA and the *Development Act 1993* (superseded by the *Planning, Development and Infrastructure Act 2016*). Any impacts to a State heritage place are considered development and as such requires development approval.

The HPA also includes provision for the protection of all archaeological resources (Archaeological provisions Guideline 2019). These guidelines provide best practice advice about the process for managing potential, known or newly discovered archaeological heritage in South Australia. An archaeological investigation and assessment is the process to follow to satisfy the requirements of the HPA as they relate to archaeological resources.

Under sections 26, 27 and 28 it is an offence to carry out the following actions without a permit from the South Australian Heritage Council:

- Excavate or disturb a State Heritage Place designated as a place of archaeological significance; or remove archaeological artefacts from such a place.
- Excavate or disturb any land (not designated as a place of archaeological significance) for the purpose of searching for or recovering archaeological artefacts of heritage significance; or excavate or disturb any land (not designated as a place of archaeological significance) knowing or having reasonable cause to suspect that the excavation or disturbance will or is likely to result in an archaeological artefact of heritage significance being discovered, exposed, moved, damaged or destroyed.
- Damage, destroy or dispose of an archaeological artefact removed from a State Heritage Place designated as a place of archaeological significance (whether removed before or after the entry of that place in the Register) and to damage, destroy or dispose of an object entered in the Register (either as a provisional or confirmed entry).

Penalties for any offences under section 26, 27 and 28 of the HPA are up to \$75,000.

Under section 36 of the *Heritage Places Act 1993*, a person who intentionally or recklessly damages a heritage place or engages in conduct, knowing that it will or might destroy or reduce the significance of a State Heritage Place can be fined a maximum penalty of \$120,000.

If items of heritage significance or areas of **archaeological potential** are identified these items are protected under section 26, 27 and 28 of the Act. If the project is able to avoid these items completely, then sections 26, 27 and 28 do not apply.

3.2.2 Aboriginal Heritage Act 1988 (amended 2016)

The South Australian *Aboriginal Heritage Act 1988* (AHA) is administered by the Department of Premier and Cabinet, Aboriginal Affairs and Reconciliation (DPC-AAR). Any Aboriginal site, object or remains whether previously recorded or not is covered under the blanket protection of this Act. The AHA provides the following definition of an Aboriginal site in section 3:

“Aboriginal site” means an area of lands;

- a) That is of significance to Aboriginal tradition or;*
- b) That is of significance according to Aboriginal archaeology, anthropology or history.*

Under section 23 of the AHA it is an offence to damage, or interfere with an Aboriginal site, objects or remains unless written authorisation from the Minister for Aboriginal Affairs and Reconciliation has been obtained. Penalties for an offence under this section are up to \$10,000 or six months imprisonment in the case of an individual and \$50,000 in the case of a corporate body.

In 2016, the Minister for Aboriginal Affairs and Reconciliation introduced changes to the AHA to make the Act more inclusive of Aboriginal people in decision making about Aboriginal heritage in the State.

The changes introduce an agreement making process that allows land use proponents and Recognised Aboriginal Representative Bodies (RARB) to agree on the direct management of Aboriginal heritage. Regulations and guidelines have been developed to provide detail and assistance with Act compliance (Department of State Development 2018). There are currently no RARB's for the project area and so the original section 23 process will apply if Aboriginal sites are identified and cannot be avoided during development.

3.2.3 Native Title Act 1994

Provisions within the NTA allow for the States to develop their own native title legislation provided the State legislation does not conflict with the Commonwealth Act. South Australia has enacted an alternative State 'right to negotiate' scheme authorised by the Commonwealth under Section 43 of the NTA.

The current project area is in the Native Title Claim Area (National Native Title Tribunal (NNTT) No. SC2011/002, Federal Court No SAD304/2011) of the Ngadjuri Nation # 2. A small portion of the project area may extend to the Native Title Claim Area of the First Peoples of the Murray and Mallee # 2 (National Native Title Tribunal No.SCD2100/002), but this has not yet been clarified.

3.2.4 Development Act 1993 and the Planning, Development and Infrastructure Act 2016

The *Development Act 1993* is the principal legislation to facilitate the planning and development of South Australia. Development is defined as; the demolition, removal, conversion, alteration or painting of, or addition to, the place, or any other work that could materially affect the heritage value of the place. Section 32 of the *Development Act* states that any act or activities defined as a development can be undertaken with a development approval.

All State and Local Heritage Places, provisional and confirmed, are subject to heritage provisions of the *Development Act 1993*. For most work to, or adjacent to, and/or within the same land parcel containing a State Heritage Place, development approval is required and a development application is referred to the Minister responsible for the HPA for response.

The *Planning, Development and Infrastructure Act 2016* repeals the *Development Act 1993* and will become operational over a five-year period. The Act allows local governments (councils) to include places of local heritage into a Planning and Design Code which will replace Development Plans. The Act deals with planning and development measures in South Australian and more specifically with proposed activity which may materially affect heritage places of local or State significance. The aim of the new Act will be to transform numerous Development Plans into consistent state-wide regulations guiding planning and development.

There are two state heritage items in the project area and where works are likely to take place on land parcels containing State Heritage items, this constitutes development as defined by the Development Act and will require preparation of a Heritage Impact Assessment to mitigate impact. However, the visual impacts of the project may constitute "development" under the Development Act on the town of Burra and may require additional assessment.

3.3 Non-Statutory

There are a number of important non-statutory documents used in heritage best practice to inform the management of significant sites and resources but which are not legally binding. One such document is *The Burra Charter*.

3.3.1 The Burra Charter (1979) - Amended 2013

The Australia ICOMOS Charter for the Conservation of Places of Cultural Significance is known as The Burra Charter. The Burra Charter was first adopted in Burra in 1979. It identifies the standard for best practice in the conservation of heritage places in Australia and State heritage organisations incorporate the principles and logic of this charter into guidelines and other conservation planning documents.

The Burra Charter is important as it outlines the requirements for assessing cultural heritage significance. It is not a legal requirement to adopt the Burra Charter guidelines, however these requirements are reflected in the significance assessment criteria included in section 16 of the South Australian *Heritage Places Act 1993*.

4 ABORIGINAL HERITAGE BACKGROUND

Redacted for the public version of this report.

5 EUROPEAN HERITAGE BACKGROUND

5.1 Regional Council of Goyder

The current project area lies within the Regional Council of Goyder. The Council was created in 1997 when four municipalities in the region were amalgamated. These were the District Councils of Burra, Eudunda, Hallett and Robertstown. The region has played an important role in the development of South Australia, with its significant pastoral and mining history. The importance of the pastoral and mining history of the region is reflected in the many towns, areas and structures of European heritage interest and their inclusion on National, State and local heritage registers.

5.2 Pastoralism

South Australia was founded on the idea that controlled subdivision and sale of its 'waste lands' would make the fortunes of gentlemen and establish lesser folk as a prosperous and stable population. Once the site of the capital city was established in 1836, all subsequent exploration usually involved the search for land suitable for exploitation (Marsden 1983). The spread of settlement moved outwards in an arc from the city of Adelaide and pastoralists seeking pastoral runs carried much of the early exploration in the region. Many of the early properties were established through 'squatting' and stock was moved about as required by natural feed and water resources.

Despite the declared government aims of regulating land-holding and of preventing squatting no official attempts were made to regulate exploration and land claims until the introduction of occupation licenses in 1842. These licenses were vague as to the extent of the pastoral land held and they did not provide any security in terms of land tenure. As a result, the first pastoralists in the region with occupation licenses felt little compelled to modify or make improvements to the land (Marsden 1983). In 1851, pastoral leases lasting fourteen years and providing compensation for land improvements were introduced and the region changed dramatically as a result with many pastoralists clearing, fencing and erecting permanent buildings (Marsden 1983). The system of licenses continued until the South Australian Government introduced the *Waste Lands Act* of 1855. This greatly improved security of tenure which resulted in almost all of the suitable grazing land in the region being taken up by the 1860's.

Pastoral runs in the region generally employed a few dozen people, who formed a small village at the head station, with smaller numbers situated at out-stations. The runs were mostly unfenced, with a very small number of stone walls, which were very expensive. Generally, the graziers relied on shepherds to keep track of the flocks and look after their wellbeing. Living alone or more usually in pairs, a shepherd and a hut-keeper, these workers were scattered across the landscape in tiny wooden huts about five kilometres apart, looking after flocks of perhaps 1,000 sheep (Bell 1993). By the mid-1860s post and wire fencing was coming into widespread use. This not only defined station boundaries but also usurped the role of the shepherd and contributed to the building of larger and more permanent buildings, such as boundary riders' huts, and virtual villages clustered about an increasingly substantial station homestead (Marsden 1983).

5.3 Burra and Mining

In the mid 1840s the colony of South Australia was suffering a severe recession and the spread of pastoralism north was not seen as a viable economic activity (Bell 1998). The discovery of major copper deposits and the opening of mines at Kapunda (in 1844) and at Burra (1845) shifted the focus of attention from pastoralism to mining.

In 1845, a mineral discovery occurred on the Burra Creek (the creek intersects the Goyder South project area north-south). A shepherd (Thomas Pickett) came across the copper, later known as the 'monster lode' (Auhl 1979) (Figure 1). The discovery of the copper deposit at Burra directed worldwide attention at the mineral resources of South Australia and Australia for the first time (Cooper 2011). By the end of 1850, there were forty nine separate active metal mining operations in South Australia with thirty-eight individual copper mines (Cooper 2011). The copper

discovery at Burra also triggered an influx of migrants, most notably from the English county of Cornwall. From the earliest days in the colony, Cornish migrants entered South Australia in the role of well diggers and general labourers. The discovery of copper in Burra occurred at a time when tin and copper mining in Cornwall were on the decline, and so, with the promise of free passage and improved living conditions, it was an easy step to persuade Cornish migrants to enter mining enterprises at Burra (Dutton 1846).

The Germans also played a large role in the development of the Burra region, in particular due to the special relationship between the South Australian Company Director, George Fife Angus and German religious refugees (Pike 1967).



Figure 1. View across Burra towards Stony Gap – circa 1874 (SLSA B12174)

Tours to view the workings at the ‘monster mine’ at Burra became commonplace at this time, and contributed to a more general awareness of the region's potential, with selectors soon clamoring for land adjacent to and en route to these ‘tent cities’. The influx of Cornish, Welsh and German miners has left a lasting impact on these towns, and many of the miners later settled on nearby blocks of land. The Burra copper deposits had attracted a population of 5,000 by 1850 (Marsden 1983).

Mining also led to the development of many of the roads and tracks in the region. In this regard, the impact of “bullockies,” the men who carted the ore on bullock drawn wagons from Burra to major rail lines for export, was immense. These men created tracks and roads which are in use today and to accommodate them, inns and hotels were established and flourished in the region.

“They were the pathfinders who made their own roads, their own creek crossings and campsites. In the busiest years of the copper boom twelve hundred drivers were punching eight thousand bullocks between the Burra mines and Port Adelaide along a variety of routes down the Light Valley and the Gilbert Valley ... soon a string of wayside inns marked the end of each day's journey. Blacksmiths' shops were set up near the inns and around many of these places small villages grew (Burrows 1973).

With the decline of mining in the 1870s it was agriculture and a steady accumulation of community services serving farming families which provided an enduring basis for settlements in the region. The prosperity of the 1870s and early 1880s was stopped dead in the mid 1880s by a series of droughts, particularly severe in 1885, and another drop

in world prices for wool, wheat and copper (Dallwitz and Marsden 1983). The numerous ruins of farms and farm buildings in the region attest to the decline in population at this time.

5.4 Stony Gap

James and Hannah Flower were farmers and butchers who emigrated from Timbsury England to Adelaide with their children in 1854. After a number of years working in Adelaide, they purchased land at Stony Gap (Brooks 2015). The Flowers' eldest daughter Isabella and her husband Jesse Humphry followed her parents to Stony Gap in 1859 and purchased the adjoining land in the Hundred of Kooringa on the Hundred of Apoinga boundary (Stony Gap) (Land Titles Office Historical Names Index) (Figure 2).

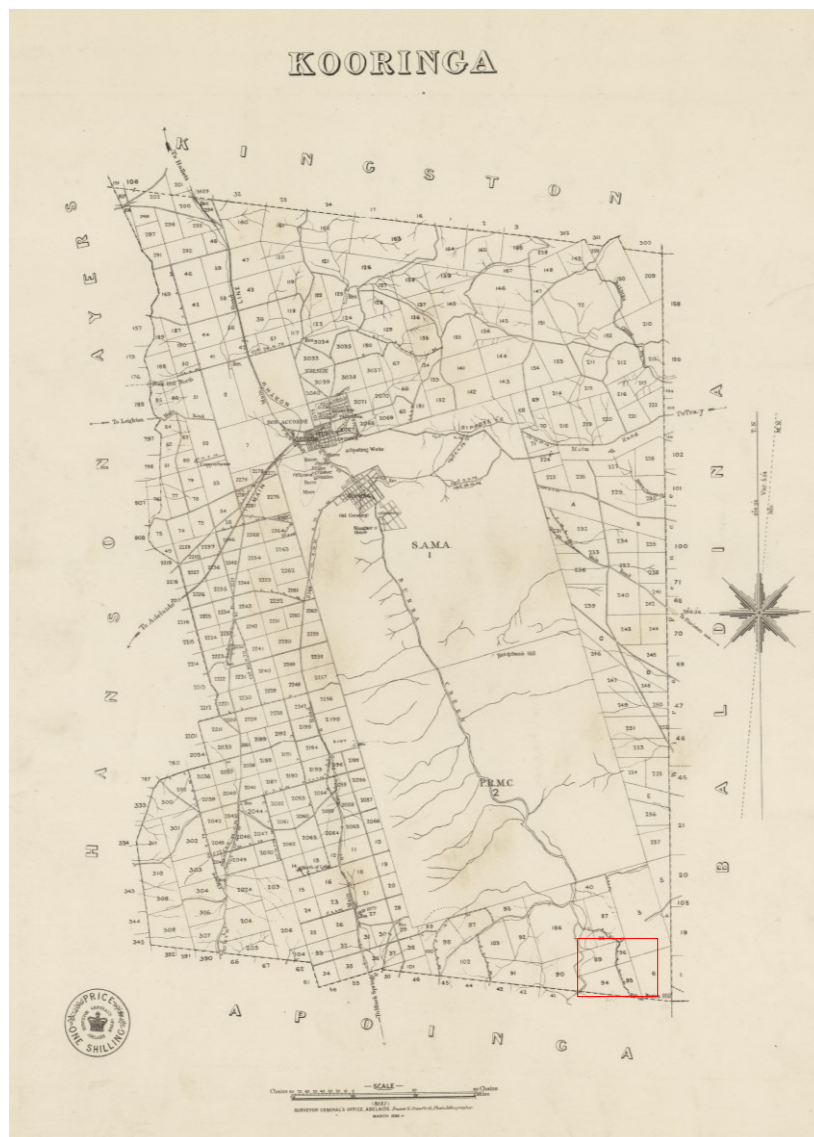


Figure 2. Location of Isabella and Jesse Humphry's property at Stony Gap (SLSA B12174)

Stony Gap was located on the main bullock team track from Burra to Black Springs and the land had been given as part of a fourteen year lease. Prior to the Flower family purchasing the land, it had been leased by James Logan and consequently the area had a number of locations and buildings named after him (Logan's Hut, Logan's Flat, Logan's Farm, Logan's Creek and Logan's Gap) (Brooks 2015).

The 1860 Almanac (SA Almanac 1839-1883) shows the Humphry and Flower farms as being located on Logan's Flat. The Flower farm is labelled "Bloomfield Farm" (See figure 3 below) and appears on the 1870-1880 register and again in the 1880 Almanac (SA State Records). The Humphrey and Flower homes were located at the base of rolling hills,

near the creeks and buildings were simply built of local materials (Figure 4). The hills were perfect for grazing sheep and the flat land below was good cropping land. The families succeeded at sheep farming and each extended their holdings by 1000 acres (Books 2015).



Figure 3. The Humphry's family home at Stony Gap (Brooks 2015).



Figure 4. Stony Gap wattle and daub house – circa 1910 (SLSA B46757)

As the Stony Gap community grew, they built a church and school for themselves (Figure 5) and petitioned the education board for a teacher, which they received for the period between 1864 and 1874 (Brooks 2015).

In the late 1870's, following a number of deaths in the Stony Gap community, the Humphry family leased their land and moved to Farrell Flat. The property there was located next to the recently built Gawler to Burra railway and provided access to the railway station and yards where wool and wheat was loaded for delivery to Adelaide (Brook 2015). Isabella Humphry died in 1875, and following the death of her husband Jesse Humphry in 1909, the Stony gap property was left to two of his sons as co-owners (Brook 2015). Jesse and Isabella Humphry are buried at Black Springs Cemetery.



Figure 5. Stony Gap School Robertstown circa. 1900 (SLSA B46574)

5.5 Princess Royal Mine & Homestead

After the discovery of copper at Burra in 1845, the region was split into two, the South Australia Mining Association took on the Burra Burra Mine (Monster Mine) and the second area became the Princess Royal Mine operated by the Princess Royal Mining Company. The Monster Mine led to the development of the town of Burra, and the Princess Royal Mining Company also planned to create a township, which would be called “Princess Royal” and was to be established where the current homestead remains. The Princess Royal Mine was significantly less successful than the Burra Monster mine and in 1860 the 10,000 acre property was sold as pastoral country (Anderson 2005).

Andrew McCulloch purchase the property and it was in 1864 that he commissioned the construction of the Princess Royal Station Homestead (Figure 6). The homestead was built on the site of the former mining village (Cockburn 1925). The public were regularly invited to enjoy the grounds of the homestead which was described as a “Victorian English Country house” for picnics and other special occasions. Architect, engineer and businessman Edmund Wright designed the house, he later went on to become the Mayor of Adelaide in 1859.

The Princess Royal Station homestead is State heritage listed, as are the coach house and stables adjacent. In 1900 the property was sold to another pastoral pioneer John Tennant and it remained in the Tennant family until the year 2000.



Figure 6. Princess Royal Homestead. Site of the Princess Royal Mine (National Library PIC P1864/1-87 LOC Q97)

5.6 Previous Relevant Heritage Studies

A number of European heritage studies have been carried out in the general vicinity of the project area (Table 1). These studies provide us with an insight into the European heritage context for the wider area, as well as identifying potential site types that may be present in the project area itself.

Table 1. Previous studies carried out in the general project region

Year	Authors	Description
1983	Dalliwitz and Marsden	Dalliwitz and Marsden carried out a heritage survey of the Lower North (Burra Burra) for the Department of Environment and Planning and the South Australian Heritage Commission. A number of items were recorded including stone walls, waterholes, shearing sheds and yards throughout the region. Multiple items were recommended for State and local heritage listing.
1990	Historical Consultants and Hames Sharley	Historical consultants and Hames Sharley carried out a heritage survey of the Lower North of South Australia. The survey was part of a programme of systematic heritage recording across South Australia and commissioned by the Department for Environment and Planning. Due to budget constraints, the survey targeted eight towns in the region; Angaston, Auburn, Burra, Clare, Kapunda, Port Wakefield, Saddleworth and Tanunda. The aim of the survey was to provide an authoritative description and evaluation of the heritage resources of the eight towns for the purposes of conservation, planning and assessment. It was as a result of this heritage survey that the town of Burra was recommended as a State Heritage Area owing to the unique heritage landscape in which it is situated.
1994	Webb, L.E	Webb prepared an Environmental Impact Statement for the Burra Creek Gorge Recreation Reserve. Webb records that adjacent to the Reserve (in the current project area) lies the ruins of Worlds End Station, dating to 1853. The report also records the remains of a wrought iron swing suspension bridge near the eastern end of the Reserve on the Burra

		Robertstown road; an abandoned homestead and a number of old farm buildings north of the Gorge.
1995	H. Crow and P. Clark	Clark and Crow were engaged by the Robertstown Council to undertake an archaeological survey of the Burra Gorge (World's End) Recreational Reserve. A brief review of European heritage is provided which highlights the use of the area as a recreational park for picnics and games from the early 1900's. Two tennis courts were located near the creek which are no longer visible and the remains of an old swing bridge built in 1885 and used until 1904. The remains of Worlds End station (1837-1854) are also mentioned but not identified in any detail.
2000	Austral Archaeology and Peter Bell	Austral Archaeology in association with Historical Research (Peter Bell) and Flight Path Architects carried out a heritage survey of the upper north region for the Department of Environment and Heritage (Heritage South Australia) and Mount Remarkable, Peterborough, Northern Areas, Orroroo/Carrieton, Goyder and Port Pirie Councils. The objective of the survey was to provide an authoritative description and evaluation of the heritage resources of the region for the purposes of assessment, conservation and planning
2003	K. Walshe and J. Bonnell	Time Map were engaged by Wind Prospect to carry out a desktop assessment of known Aboriginal and non-Aboriginal archaeological sites and heritage places for five ranges situated near the township of Hallett. The project area is located 10 km from the current Goyder 1 project area. The desktop identified numerous non-Aboriginal heritage places in and around the townships of Hallett, Mount Bryan and Burra. The report recommended a ground survey by a qualified archaeologist to record and identify these sites. The report highlighted that the most likely types of European heritage sites expected in the project area relate to early mining and pastoral activities (huts, windmills, water tanks, stone walls, fences, ruins, homestead complexes, shearing sheds, bridges, dugouts and dwellings).
2008	D. Puletama and D. Mott	ACHM was engaged to carry out an Aboriginal and European cultural heritage desktop study of the Stony Gap Wind Farm project area. The report did not identify any registered European sites, but mention is made of a number of European ruins in the area. It assessed that there remained a high potential for additional European heritage sites to be located in the project area.
2008	D. Puletama and D. Mott	ACHM was engaged by Roaring 40's to carry out an Aboriginal and European heritage assessment and site survey of the Stony Gap Wind Farm project area. The report mentions a number of European heritage items, but does not provide specific locations or descriptions. It is unlikely that European heritage would have been accurately recorded considering the report inaccurately states that European heritage is not protected unless listed.
2010	Cincunegui	ACHM was engaged to carry out an Aboriginal and European heritage study of the Stony Gap Wind Farm transmission line corridors. The report records a number of European heritage ruins which were part of an existing stock route through the area and provides coordinates. The report recommended that these sites be recorded by a qualified archaeologist under a section 27 permit in line with the requirements of the Heritage Places Act.

5.7 European Archaeological Potential

An assessment of archaeological potential considers the historical sequence of occupation in light of any extant structures, as well as the impact of more recent activities on earlier occupation phases and as such reveals the

intactness of the archaeological resource. This, when tied in with the extent to which a site may contribute knowledge not available from other sources to current themes in historical archaeology and related disciplines (research value or potential) establishes the archaeological significance of the site.

The project area has been subject to archaeological inspections previously, however the main aim of these inspections has been to identify Aboriginal heritage. As such remnants of European heritage have only been mentioned in passing and have rarely had their locations recorded (Cincunegui 2010). The site history indicates that since European settlement, the area has had a number of development phases and that the project area may contain items of heritage significance which tie in with the National listing of Burra and the general European settlement of the region.

5.8 Discussion

The background research for European settlement of the region indicates that the project area has a long history of pastoralism and mining. In particular, the history of the region is tied in closely with the discovery of copper and mining in South Australia. The historical importance of the region is reflected in the number of National and State heritage listed places as well as the remaining standing heritage structures and buildings.

Given the long history of grazing and pastoral activity in the region, it is feasible that European heritage sites of significance exist within the study area and are not listed in the South Australian Heritage Register. The European heritage framework indicates that heritage sites which may remain in the area can include standing structures such as buildings, fences, walls or generally objects associated with settlement and exploration. All previous heritage studies in the region have highlighted that European heritage items remain unrecorded in and around the town of Burra and some in the current project area of Goyder South.

6 HERITAGE REGISTER SEARCHES

6.1 Aboriginal Heritage

Redacted for the public version of this report.

6.2 European Heritage Registers

The methodology undertaken for assessing the European heritage values of the project area involved reviewing the following registers, databases and documents:

- The Australian Places Inventory – for all places on the State and Commonwealth heritage registers and lists
- The Australian Heritage Database – for World Heritage Places, National Heritage Places and Commonwealth Heritage Places
- The South Australian Heritage Places Database – for places of State and Local heritage significance
- The Register of the National Estate (non-statutory)

Archival records at the South Australian Archives, the State Library of South Australia and National Library of Australia were also accessed for information about the general area. Reference was made to historic plans, aerial photographs, heritage surveys and other records to build a picture of the gradual development of the region.

Each register was searched using GIS shape files of the project area boundary. Listed heritage places in the vicinity of the project area are shown on Map 2.

There are three State heritage listed places registered near the Goyder South project area on the South Australian Heritage Database. Princess Royal Homestead (State Heritage Number 14374) and Princess Royal Station (Coach House, Stables and Attached Gate – State Heritage Number 14375), as well as Apoinga Smelter site and Koonooba Station (Map 2). All State heritage listed places are located well outside of proposed impact areas.

The town of Burra was inscribed on the National Heritage List in 2017 as a result of its remnant mining heritage including an outstanding collection of nineteenth century civic, residential, church and Cornish mining structures scattered throughout the region. While Burra is outside of the current project area, (Map 2) the heritage of the region and background history of the project area indicates a high potential for unrecorded European heritage remnants and archaeological deposits to be present that relate to the early European history of Burra and the surrounding region.

6.2.1 Australian Historic Themes Framework

Heritage items, including landscapes, buildings, structures, relics and places are non-renewable and important resources for understanding the past. An analysis of history is central to heritage assessment and management. All heritage items need to be considered in the context of history, as well as the history of the wider region. Understanding the heritage themes of the region will assist in determining the significance of any heritage items identified within the project area.

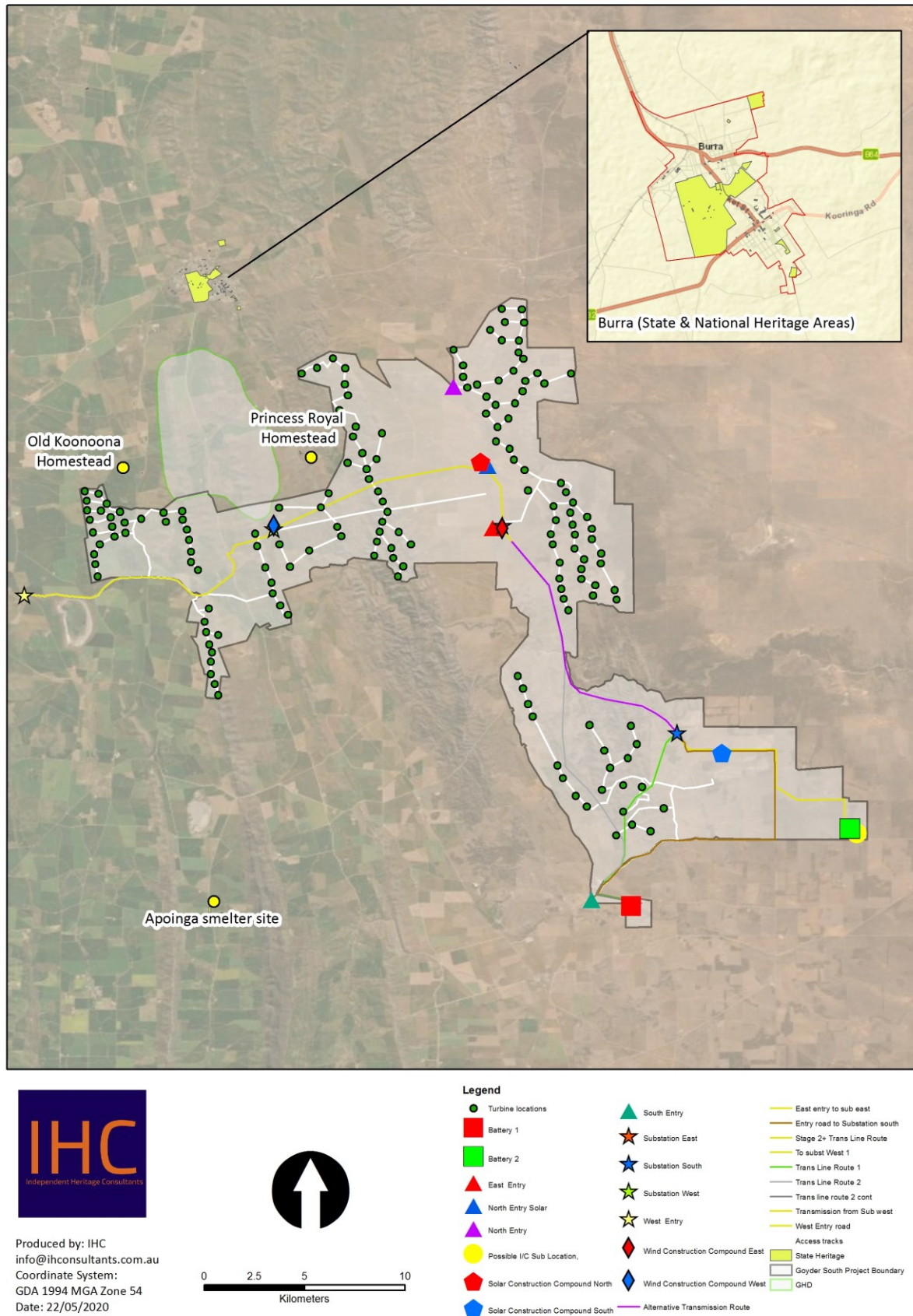
The Australian Heritage Council's Australian Historic Themes Framework is a powerful tool in best practice identification of heritage places and provide an important structural approach for any future heritage work, providing a framework for significance assessment and understanding the specific history of a place in the wider context. The thematic history presented below has been developed by IHC to better understand the underlying historical influences which have shaped and continue to shape the heritage of Stony Gap and the broader region. Any historical remnants or archaeological deposits found in the Goyder South project area will relate to the thematic heritage themes identified in Table 3 below.

6.2.2 Heritage items noted in previous reports.

There are a number of Aboriginal heritage reports which make passing mention of European heritage items and potential archaeology in the current project area as well as surrounding areas (Time Map 2003, ACHM 2008, 2009). These items were not recorded in detail at the time of these surveys, as the focus was predominantly on Aboriginal heritage, however their presence indicates a potential for further heritage items to be identified. The heritage items identified in these earlier surveys are listed below (Table 2).

Table 2. Heritage items noted

Source	Number	Location
Cincunegui 2010	Historic building remnant on Transline Route	319966.81 E 6241914.43 N
Cincunegui 2010	Historic building remnant on Transline Route	318818.89E 6242086.70N
Webb 1994	Worlds End Station	Adjacent to Worlds End Reserve
Webb 1994	Historic building remnant	Near public road access to Burra Creek Gorge Recreation Reserve
Web 1994	Wrought Iron swing suspension bridge	Eastern end of Reserve on Burra- Robertstown Road.



Map 2. National and State European heritage sites in proximity to the project area.

Table 3. Australian historic themes framework

Australian theme	State theme	Local theme	Examples likely to exist in the project area
Peopling Australia	European settlers	Activities relating to adapting to diverse environments, migrating to save or preserve a way of life or seek new opportunity.	Settlement, land distribution, built structures, archaeological remains of early occupation. Early houses, markers, fencing.
	Surveying the continent	Looking for inland seas and waterways, looking for overland stock routes, prospecting for precious metals, looking for land with agricultural potential, laying out boundaries.	Explorer marks, early land division surveys, tree markers, early mines.
Developing local, regional and national economies	Utilising natural resources	Mining. Activities associated with the identification, extraction, processing and distribution of mineral ores.	Archaeological evidence relating to early mining activities, processing plants, mineral specimens mine shaft, slag heaps, housing and artefacts relating to the use of the region for mining.
	Developing primary production	Grazing stock, breeding animals, developing agricultural industries. Pastoralism. Activities associated with the breeding, raising, processing and distribution of livestock for human use.	Pastoral station, shearing shed, slaughter yard, pastoral landscape, hay barn, wheat harvester, silo, dairy, rural landscape, plantation, fencing, plough markings, shed, irrigation ditch, well, water trough, wool store.
	Establishing communication	Establishing postal services. Developing routes to export wool, wheat and copper. Developing electric means of communication.	Telegraph equipment, network of telegraph poles, access tracks, mail routes, bullock routes, railway lines.
	Establishment of towns.	Selecting township sites, settlements to serve rural Australia. Remembering significant phases in the development of settlements towns and cities. Activities associated with creating, planning and managing urban functions, landscape and lifestyles in towns, suburbs and villages.	Stony Gap town layout, streetscape, village reserve, civic centre, roads, market place, boundary features, early fencing, early housing (school/church/homesteads).
Building settlements, towns and cities	Land tenure	Activities for identifying forms of ownership and occupancy of land and water (Aboriginal and non-Aboriginal).	Fence, survey mark, subdivision, land title document, boundary stone wall, rock engravings, shelters, cairns, survey markers, territory/state markers.
	Working on the land	Activities associated with developing the land for mining, grazing, infrastructure.	Bullock roads, fencing, outhouses, sheds, animal pens/yards, temporary and permanent buildings for mining, housing and farming.

7 ENVIRONMENTAL LANDFORMS AND HERITAGE SITES

7.1 Aboriginal Heritage

Redacted for the public version of this report.

7.2 European Heritage

Given the long history of grazing and pastoral activity in the region, it is feasible that European heritage sites of significance exist within the study area and are not listed in the South Australian Heritage Register. Considering the proximity of Goyder South to Burra, European heritage sites that may exist in the region are likely to be associated with access to potable water, good farming land and access to towns such as Burra and Robertson. Remnant heritage will include standing structures such as buildings, fences, walls or generally objects associated with settlement and exploration. European sites of heritage significance (both listed and unlisted) are afforded the same blanket protection as Aboriginal sites and are protected under section 26, 27 and 28 of the *Heritage Places Act 1993*.

8 SUMMARY & RECOMMENDATIONS

Independent Heritage Consultants (IHC) has been engaged by Neoen to carry out a desktop Aboriginal and European heritage assessment for the Goyder South Hybrid Renewable Energy Facility.

The proposed Goyder South Hybrid Renewable Energy Facility will consist of up to 1200MW of wind, 600MW of solar and 900MW/1800 MWh (2 hours) of battery storage, Stage 1 (400MW wind, 200MW solar and 300MW/600Mwh battery) is expected to connect to the existing Robertstown substation. The remainder is likely to connect to the planned new interconnector substation

Aboriginal Heritage

To prepare this assessment IHC has completed heritage register searches as well as a comprehensive literature review including all previous heritage work carried out in the project area. This literature review revealed likely Aboriginal site types and landform associations for the project area. Site types to be expected are stone cairns, culturally modified trees, and quarries, and to a lesser extent, stone artefact scatters, campsites, engravings, paintings and burials. It was determined that these sites are more likely located along ridgelines and creeks (including the Burra Gorge).

The literature review also highlighted a single DPC-AAR listed site within the project area and a number of previously surveyed areas that potentially do not require further assessment. While this has highlighted future time/cost savings for Neoen, it has also identified a number of gaps where additional work is recommended.

In all the previous studies, only one reference was made to an ethnographic association. This related to the quartzite outcrops running along the Brown Hill Range. However, this was not defined as a site under the Aboriginal Heritage Act 1988 (AHA). This suggests that there is a low potential for any ethnographic sites (definable under the AHA) to be identified within the current project area.

Legal Obligations

The main requirement for this project to comply with the AHA is to not damage, disturb or interfere with Aboriginal heritage sites, objects and/or remains.

- Any known DPC-AAR sites must be avoided. If they can not be avoided Ministerial consent under section 23 of the AHA is required.
- In the event that any new Aboriginal heritage sites are identified during works in the area, they are also afforded blanket protection by the AHA and if they can not be avoided, Ministerial consent under section 23 of the AHA is required.

Common Heritage Management Options

Although not legal requirements of the Aboriginal Heritage Act, IHC strongly recommends that Neoen consider the following management options to minimise the risk of breaching the AHA;

- Although the risk of impacting ethnographic sites in the project area has been identified as “low” the best way to mitigate against inadvertently impacting an ethnographic site is to consult with the relevant Aboriginal group. IHC understands that Neoen has engaged with Ngadjuri to carry out an anthropological survey of the Stage 1 site to inform the micro-siting of infrastructure during the detailed design phase, and intends to procure similar surveys over the remainder of the site as development of those stages progresses.
- Neoen should consider engaging archaeologists to carry out a site avoidance survey in the remaining unsurveyed development footprint to identify and record any unknown archaeological sites that may be

present. If Neoen cannot avoid these or design around them, then Ministerial consent under section 23 of the AHA will be required.

- IHC recommend that Neoen manage heritage risk during works by ensuring all contractors and workers are aware of heritage risks and how to manage them accordingly. This can be outlined during initial site inductions.
- Neoen should implement a site discovery procedure for unexpected heritage discoveries during project works (IHC have provided Neoen with a site discovery procedure).
- Neoen should consider engaging an archaeologist to be on call and assist in identifying any heritage items found during works.

European Heritage

During the course of this assessment, IHC has completed heritage register searches, a comprehensive literature review and a review of the Australian historic themes to identify the European heritage and archaeological values of the project area.

The reviewed previous studies made reference to a number of historical archaeological features (stone walls, building remnants and archaeological features), however none of these were recorded in detail. This, combined with the proximity of the project area to a National heritage area (Burra) and identification of a number of historic themes in the region suggests that there is potential for additional European (archaeological) heritage to be identified.

Legal Obligations

All European built heritage and subsurface archaeological features, whether listed or not, are protected and must be managed in line with the requirements of the EPBCA, the Heritage Places Act and the Development Act.

- There is one National heritage place in the general vicinity of the project area, the town of Burra. Neoen is investigating the need for an EPBC referral to manage visual impacts on Burra and specialist advice has been sought. Neoen will continue to address this matter in consultation with the relevant Commonwealth department.
- There are three State listed built heritage places in the general project vicinity and these will not be impacted by the current layout design. The current layout has been designed to set back from any State listed built heritage items.
- There are no local listed built heritage place in or adjacent to the current layout.
- There is potential for sub-surface European archaeological deposits and sites to be present in the current layout area. Any archaeological deposit uncovered by the proposed development must be reported to Heritage SA. A qualified archaeologist with an approved s27 permit from Heritage SA records any archaeological deposits identified during works.

Common Heritage Management Options

Although not legal requirements of the Heritage Places Act, IHC strongly recommends that Neoen consider the following management options to minimise heritage risk and breaching the Act;

- IHC recommend that Neoen engage a qualified archaeologist to carry out a survey of the project area and identify and record any potential archaeological sites and/or deposits in the development footprint. If Neoen cannot avoid these or design around items of recorded heritage, such as ruins, walls or archaeological deposits, then these will need to be managed pursuant to s.27 of the Heritage Places Act.

- IHC recommend that Neoen manage heritage risk during works by ensuring all contractors and workers are aware of heritage risks and how to manage them accordingly. This can be outlined during initial site inductions.
- Neoen should implement a site discovery procedure for unexpected heritage discoveries during project works (IHC have provided Neoen with a site discovery procedure).
- Neoen should consider engaging an archaeologist to be on call and assist in identifying any heritage items found during works.

9 REFERENCES

Aboriginal Heritage Act 1998 (South Australia).

Aboriginal and Torres Strait Islander Heritage Protection Act 1984 (Commonwealth).

ACHM 2004 Aboriginal and historic cultural heritage survey and consultation: Waterloo Wind Farm Project. Report prepared for Hydro Tasmania.

ACHM 2008 Cultural heritage survey of the Robertstown Wind Farm proposal area, Robertstown, South Australia. Report prepared for roaring 40's.

ACHM 2009a Aboriginal cultural heritage survey of the North Brown Hill Wind Farm location, near Jamestown, South Australia. Report prepared for Suzlon Energy.

ACHM 2009 Aboriginal cultural heritage survey of the Carmody's Hill Wind Farm location near Georgetown, South Australia. Report prepared for Hydro Tasmania.

Anderson, M. 2005. Princess Royal: from the ashes of disaster. SA Life vol. 2 No. 11 (November 2005) pp.108-9.

Anderson, S. 2005 An Aboriginal heritage survey of the Hallett Hill wind farm. A report to Wind Prospect Pty Ltd., Adelaide.

Anderson, S. 2008 North Brown Hill: Aboriginal Heritage Assessment Desktop Study. Unpublished report to Wind Prospect Pty Ltd.

Auhl, I. 1979. Burra: glimpses of the past. Hawthorndene, South Australia, Investigator Press.

Bell, P. 1998 The Heritage of the Upper North: a short history. Unpublished report prepared for the South Australian Department for Environment, Heritage and Aboriginal Affairs.

Berndt, R., C. Berndt and J. Stanton 1964 A World of the First Australians. Sydney: Lansdown Press.

Biddle, J. P. 1925 Aboriginal markings on rocks near Burra (Kooringa). Transactions of the Royal Society South Australia 49.

Burrows, M. 1973. A brief history of Riverton and the Gilberton Valley. Published by the Riverton District Council, South Australia.

Campbell, T. D. 1925 Detailed notes on the Aboriginal intaglios near Burra. Transactions of the Royal Society South Australia 49:123-127.

Cincunegui, G. 2010 Cultural heritage survey of Stony Gap Wind Farm extension project. Report prepared for Roaring 40s Renewable Energy.

Cockburn, R. 1925. Pastoral pioneers of South Australia. Adelaide: Publishers Limited.

Cooper, B.J. 2011. Geologists and the Burra Copper Boom, South Australia 1845-1851. In J.E.Ortoz, O.Puche, I, Rábano, L.F. Mazadiego (eds) History of Research in Mineral Research. Cuadernos del museo Geominero, 13, Instituto Geológica y Minero de España Madrid.

Crow, H. and P. Clark 1995 Burra Gorge (Worlds End) Recreation Reserve and archaeology survey. Report to Robertstown Council.

- Curr, E. 1886-7 The Australian Race: its origin, languages, customs, place of landing in Australia, and the routes by which it spread itself over the continent. Melbourne: Government Printer
- Dallwitz, J. & S. Marsden. 1983. Heritage of the Lower North, South Australian Historic Preservation Plan Regional heritage Survey Series: Region 8, Adelaide, South Australian Department of Environment and Planning.
- Development Act 1993 (South Australia)
- Department of Environment, Water and Natural Resources 2015 Government of South Australia Website. Accessed online at <http://www.environment.sa.gov.au/our-places/cultural-heritage/sa-heritageregister> on 21 January, 2019.
- Department of the Environment n.d Government of South Australia Website. Accessed online at <https://www.environment.gov.au/heritage/publications-and-resources/australian-heritage-database> on 21 January, 2019.
- Dutton, F.S. 1846. South Australia and its mines. T & W Boone London.
- EBS 2018 Robertstown solar: desktop heritage assessment. Report prepared for EPS Energy.
- Elkin, A. 1940 Kinship in South Australia. Oceania 8:4 and 9:1:419-452.
- Environment Protection & Biodiversity Conservation Act 1999 (amended 2003)
- Gray, J 1930 Notes on Native Tribe Formerly Resident at Orroroo, South Australia. SA Naturalist 11:1:4-6.
- Heritage Places Act 1998 (South Australia)
- Johns, R.K. 2006. The Cornish at Burra, South Australia. Journal of Australasian Mining History, 4, 166-182.
- Lower, K. 2009 Landscape archaeology and Indigenous nation building in Ngadjuri country. Unpublished Masters of Archaeology thesis. Flinders University.
- McDonald, J. 1997 Interim heritage management report: ADI Site, St. Mary's. Volume 1: Text. Report to Lend Lease – ADI Joint Venture in response to the Section 22 Committee Interim Report. Sydney: NSW NPWS.
- Marsden, S. 1983. The Lower North of South Australia – a short history. Unpublished report prepared for the South Australian Department for Environment, Heritage and Aboriginal Affairs
- Mawson, D and P. Hossfeld 1926 Relics of Aboriginal Occupation in the Olary District. Transactions of the Royal Society of South Australia 50.
- Mountford, C. 1940 The Ngadjuri Tribe, Northern South Australia. Manuscript field notes of information from Barney Waria.
- Mullen, D. 2009 Aboriginal and European cultural heritage desktop study for the Stony Gap Wind Farm DA (Stage II). Report prepared for Hydro Tasmania Consulting.
- Native Title Act 1993 (Commonwealth)
- Noyle, R. 1974 Clare – a district history. Adelaide: Investigator Press.
- Pike, D. 1967. Paradise of Dissent: South Australia 1829-1857. Melbourne University Press (Second Edition).

Puletama, D. and D. Mott 2008 Aboriginal and European cultural heritage desktop study for the Stony Gap Wind Farm project area, South Australia. Report prepared for Hydro Tasmania Consulting.

Puletama, D. and D. Mott 2008 Cultural heritage survey of the Stony Gap Wind Farm proposal area, Stony Gap, South Australia. Report prepared for Hydro Tasmania Consulting.

Stockton, J. 1995 A survey for Aboriginal heritage sites between Morgan and Burra, South Australia. A report to Department of Transport.

Tindale, N. 1932 Genealogical data recorded by Board for Anthropological Research expedition members 1928-1966. South Australian Museum Archives.

Tindale, N. 1937 Two Legends of the Ngadjuri Tribe from the Middle North of South Australia. Transactions of the Royal Society of South Australia 50:156-159.

Tindale, N. and H. Lindsay 1963 Aboriginal Australians. Jacaranda Press.

Tindale, N.B. 1974 Aboriginal tribes of Australia; their terrain, environmental controls, distribution, limits and proper names. Canberra.

Tindale, N. 1987 The Wanderings of Tjilbruke: A Tale of the Kurna People of Adelaide. Records of the SA Museum, Vol 20.

The Register, 26 September 1840.

Walshe, K. and J. Bonnell 2003 Archaeological and anthropological desktop study of a proposed wind farm development area, Hallett, South Australia. A report to Wind Prospect Pty Ltd, Adelaide.

Warrior, F., F. Knight, S. Anderson and A. Pring 2005 Aboriginal People of the Mid North Region of South Australia. Meadows: SASOSE Council Inc.

Webb, L.M. 1994. Concept Plan for the Development of the Burra Creek Gorge (Worlds End) Recreation Reserve. Unpublished report prepared for the District Council of Robertstown.

Wood, V. 2007 Aboriginal cultural heritage survey and reporting: Willogoleche Hill wind farm. A report to AARD, Adelaide.

Wood, V. 2009 Indigenous and non-Indigenous desktop cultural heritage study of the proposed Bluff Grid Connection, SA. A report to Wind Prospect Pty Ltd.

Wood, V. 2010 Aboriginal cultural heritage desktop study of the proposed amendments to the Willogoleche Hill Wind Farm. A report to Wind Prospects Pty Ltd.



Goyder Renewables Zone

Neoen

Goyder South - Traffic Impact Assessment

IW204800-CT-RPT-0001 | C

01 June 2020

Document history and status

Revision	Date	Description	By	Review	Approved
A	1/10/2019	Draft for comment	MJH / CGB	NRA	BP
B	28/05/2020	Final	MJH	AS	BP
C	01/06/2020	Revised Final	MJH		BP

Distribution of copies

Revision	Issue approved	Date issued	Issued to	Comments
A	BP	1/10/2019	SFG/NEOEN	Draft for comment
B	BP	28/05/2020	SFG/NEOEN	Final
C	BP	01/06/2020	SFG/NEOEN	Revised Final

Goyder Renewables Zone

Project No: IW204800
Document Title: Goyder South - Traffic Impact Assessment
Document No.: IW204800-CT-RPT-0001
Revision: C
Date: 01 June 2020
Client Name: Neoen
Project Manager: Melisse Heintze
Author: Chris Babadimas / Melisse Heintze
File Name: C:\Users\HeintzeM\Desktop\IW204800-CT-RPT-0001 - Goyder South TIA_RevC_Final (2020-06-01 CLEAN).docx

Jacobs Group (Australia) Pty Limited
ABN 37 001 024 095
Level 3, 121 King William Street
Adelaide SA 5000 Australia
T +61 8 8113 5400
F +61 8 8113 5440
www.jacobs.com

© Copyright 2020 Jacobs Group (Australia) Pty Limited. The concepts and information contained in this document are the property of Jacobs. Use or copying of this document in whole or in part without the written permission of Jacobs constitutes an infringement of copyright.

Limitation: This document has been prepared on behalf of, and for the exclusive use of Jacobs' client, and is subject to, and issued in accordance with, the provisions of the contract between Jacobs and the client. Jacobs accepts no liability or responsibility whatsoever for, or in respect of, any use of, or reliance upon, this document by any third party.

Contents

Executive Summary	1
1. Introduction	4
1.1 Background	4
1.2 Overview	4
1.3 Other Related Documentation	5
2. Proposed Development	6
2.1 Description of On-site Development	6
3. Existing Area Conditions	9
3.1 Study Area	9
3.2 Study Area Land Use	9
3.3 Site Accessibility	11
3.4 Existing Road Conditions	13
3.5 Existing Access Road Conditions	21
3.6 Crash History	28
4. Transportation Requirements for Development	29
4.1 Development Lifespan Phases	29
4.2 Equipment Specifications	30
4.3 Vehicle Types and Permits	32
4.4 Sight Distance Requirements	32
5. Projected Traffic Generation and Impacts	33
5.1 Generated Traffic	33
5.2 Traffic Impacts	37
6. Traffic Impact Assessment and Recommended Upgrades	40
6.1 Site Access Assessment and Recommended Upgrades	40
6.2 Designated Routes Assessment and Recommended Upgrades	49
6.3 Council Road Assessment and Recommended Upgrades	54
7. Findings and Recommendations	59
7.1 Site Accessibility	59
7.2 Traffic Impacts	59
7.3 Improvements	59
8. Conclusions	61
Appendix A. Crash Data	62
Appendix B. Crash Types	66
Appendix C. Intersection Treatment Types	67

Executive Summary

Jacobs Group (Australia Pty Ltd) (Jacobs) has been commissioned by Neoen to undertake a Traffic Impact Assessment (TIA) for the traffic and transport impacts of construction traffic and transportation of over size and over mass components to the Goyder South Hybrid Renewable Energy Project (**Goyder South**), which comprises the southern component of the Goyder Renewables Zone. The northern component of the Zone, Goyder North, is expected to be considered as a future stage.

The proposed Goyder South site is located in the Regional Council of Goyder and is approximately 130km north-east of Adelaide. Access to the site is proposed via five access points across three highways; the Barrier Highway (one access point), Goyder Highway (one access point), and Worlds End Highway (three access points). The project site extends over an approximate 30,000 hectares.

The Goyder South development is proposed to comprise up to 1,200MW of wind generation (up to 163 wind turbines), up to 600MW of solar PV, and up to 900MW and 1,800MWh of battery storage. Included in the construction to support the development are collector substations, overhead transmission lines, underground cables, and internal access tracks.

Route Options

Two route options were assessed for construction vehicles to access the Goyder South development initiating from the Sturt Highway. The two route options are as follows:

- **Designated Route 1 (D1):** Sturt Highway – Horrocks Highway – Barrier Highway – Goyder Highway – Copperhouse Road – Worlds End Highway
- **Designated Route 2 (D2):** Sturt Highway – Horrocks Highway – Thiele Highway – East Terrace (bypass of Kapunda) – Thiele Highway – Three Chain Road (bypass of Eudunda) – Worlds End Highway – Goyder Highway – Copperhouse Road – Barrier Highway

Traffic Impacts

To assess the potential impact to the operation of the existing road network as a result of the construction of the development, the total generated traffic has been divided into three categories:

- **Light Vehicle traffic** (e.g. 4WDs and cars) associated with staff movements to and from the site.
- **Heavy Commercial Vehicles** (e.g. >2-tonne trucks, semi-trailers, dump trucks etc.) associated with deliveries to site that will travel on State controlled roads.
- **Over size and over mass vehicles** associated with haulage of large turbine components (e.g. blades, nacelles, tower sections) to site that may only travel under NHVR and DPTI permit.

The number of one-way trips for each vehicle during the assumed peak construction period (Months 5-14) is estimated in the following table.

Vehicle Type	Total Generated Traffic	Traffic During Peak Construction Period (months 5 - 14) (10 months = 261 working days)	Peak Daily Traffic between Months 5 and 14
Light Vehicles	$1,650 + 6 + 98,329 = 99,985$	79,988	306 trips/day
Heavy Commercial Vehicles (HCVs)	$513 + 9,675 + 1,210 = 11,398$	9,118	35 trips/day
Over Size / Over Mass (OSM) Vehicles	$861 + 3 + 22 = 886$	709	2 – 3 trips/day
Total	112,269	89,815	344 return vehicle trips/day

In the context of the traffic volumes on the existing State controlled roads, the additional traffic volumes associated with the project per day are expected to result in a relatively minor perceptible impact despite the significant percentage increases below, with all roads continuing to operate well under capacity. The maximum two way volume impacts of the proposed development per day across each State controlled highway (with known traffic volumes) is shown in the following table.

	Horrocks Highway	Barrier Highway	Goyder Highway	Worlds End Highway	Thiele Highway
Total (Existing + Generated) VPD	Up to 6988	Up to 2788	Up to 1488	Up to 1288	Up to 5488
Total Traffic Increase	Up to +21%	Up to +69%	Up to +146%	Up to +529%	Up to +115%
HCV % Existing	Up to 11%	Up to 23%	Up to 26%	Up to 29%	Up to 19%
HCV % Total	Up to 10%	Up to 16%	Up to 14%	Up to 10%	Up to 12%
LOS	A	A	A	A	A

Finding and Recommendations

Based on the Traffic Impact Assessment, the principal issues surrounding the transportation impacts will be associated with the construction phase. This is due to the delivery of over mass and over size loads and the higher number of vehicle movements. It is Jacobs' recommendation that Designated Route 1 (D1) be used for the transport of over mass and over size loads to the site, excepting for deliveries required to access the site via Access T5 due to constraints (fords) located along Worlds End Highway. Designated Route 2 (D2) is recommended to be used (as well as D1) for vehicle movements which meet the gazetted routes level. Additional approvals and permits will need to be sought to permit the transport of over mass and over size loads travelling via D1, noting the route has more constrained geometry and a lower gazetted level than D2.

To ensure transportation impacts are minimal on the road network, adjacent towns and local residents, it is recommended that a specific Traffic Management Plan (TMP) is developed.

Recommendations have been provided to improve the key areas which were identified as being incapable of accommodating the extra vehicle movements associated with the construction phase of the project:

- New Intersections:
 - **Access Point (T2):** Full basic turn treatment. Provide double two-way barrier lines. Provide 50m sealed apron.
- Intersection Upgrade:
 - **Access Point (T1):** Full basic turn treatment. Provide double two-way barrier lines. Provide 50m sealed apron.
 - **Access Point (T3):** Full basic turn treatment. Provide double two-way barrier lines. Provide 50m sealed apron.
 - **Access Point (T4):** Channelised right turn treatment on the major road (Goyder Highway), and basic left turn treatments for the major and minor roads. Provide double two-way barrier lines. Remove existing trees to meet required site distances. Provide 50m sealed apron.
 - **Access Point (T5):** Channelised right turn treatment on the major road (Barrier Highway), and basic left turn treatments for the major and minor roads. Provide 50m sealed apron.
 - **Goyder Highway and Worlds End Highway:** Channelised right turn treatment on the major road (Goyder Highway), and channelised left turn treatment for the minor road.
- Priority Signage:
 - Intersection of Porter Lagoon Road and Springbank Road.
 - Intersection of Koonoona Road and Burra Road.

- Intersection of Koonoona Road and Turner Road.
- Intersection of Burra Road and Turner Road.

1. Introduction

1.1 Background

Jacobs have been engaged by Neoen to undertake a Traffic Impact Assessment (TIA) suitable to inform the development application planned for the Goyder Renewables Zone – Goyder South.

The Goyder Renewables Zone comprises two projects:

- Zone 1 – Goyder North, and
- Zone 2 – Goyder South.

Goyder North will be subject to a separate development application in the foreseeable future (and constructed after Goyder South), and associated traffic impacts will therefore not be covered in this report.

The Goyder South Hybrid Renewable Energy Project is believed to be the largest South Australian energy project ever proposed, and one of the largest in Australia, incorporating up to:

- 1,200MW of wind
- 600MW of solar
- 900MW and 1,800MWh (2 hour) battery storage.

Goyder South is planned to be built across a number of stages, the first of which is expected to comprise approximately 400MW of wind, 200MW of solar and 300MW of battery storage. It is expected to be built without the need for any major grid works (connecting into the existing Robertstown 275kV substation) and will not be reliant on the planned Robertstown-Wagga Wagga interconnector. It is expected that Stages 2+ of Goyder South, and all stages of Goyder North, will require the proposed SA/NSW interconnector in order to be viable. The SA/NSW 330kV interconnector is a proposed new transmission link between Robertstown in SA and the National Electricity Market, which will improve security of electricity supply in SA and will also supply the NSW grid.

1.2 Overview

This technical report documents the Traffic Impact Assessment for the Goyder South Development Application.

This TIA outlines the traffic and transport impacts of construction, operation and decommissioning traffic of the Goyder South development site and provides recommendations in response to the impacts.

This TIA is an expression of the professional opinion of Jacobs, based upon details that were available during the execution of the assessment. It is not a final conclusion and should only be taken as a guideline in terms of consideration for actual transport setup and route to be used, and/or modifications to be done. Those details will need to be finalised in a Traffic Management Plan as a Condition should the development be approved. Jacobs does not take responsibility in the case where any assumptions and considerations made in this document are not accurate for execution.

This document does not include calculations for any bridge infrastructure load-bearing capacities. Any description of bridges in this document is for guideline only. Jacobs recommends engaging a structural engineer, to verify the structural capacity of any such installations highlighted as areas of concern in this report, and incorporate these findings into the Traffic Management Plan.

This TIA is based on observations made of each route on a site visit on 9 July 2019. All parties should be aware that road conditions could change anytime between the date of route observations and the project execution, for reasons including adverse weather, road modifications/repairs by authorities and general deterioration.

1.3 Other Related Documentation

This report should be read in conjunction with the documents detailed in **Table 1-1**, as produced by Jacobs to inform the Goyder Renewables Zone development application.

Table 1-1: Related documentation

Document #	Type	Title / Description	Author	Date of Issue
IW204800-CT-RPT-0001 (this report)	Report	Goyder South –Traffic Impact Assessment, Goyder Renewables Energy Zone	Jacobs	01 June 2020
IW204800-CT-RPT-0002	Report	Goyder North –Traffic Impact Assessment, Goyder Renewables Energy Zone	Jacobs	To be issued in the foreseeable future.

2. Proposed Development

2.1 Description of On-site Development

The Goyder South area of the proposed Goyder Renewables Zone is wholly located in the Regional Council of Goyder. The Goyder South project area extends in a north-south direction from approximately 5km south of Burra extending approximately 30km south toward Robertstown and extends in the east-west direction approximately 20 km (refer **Figure 2-1**). This area is located in the eastern portion of the northern Mount Lofty Ranges.

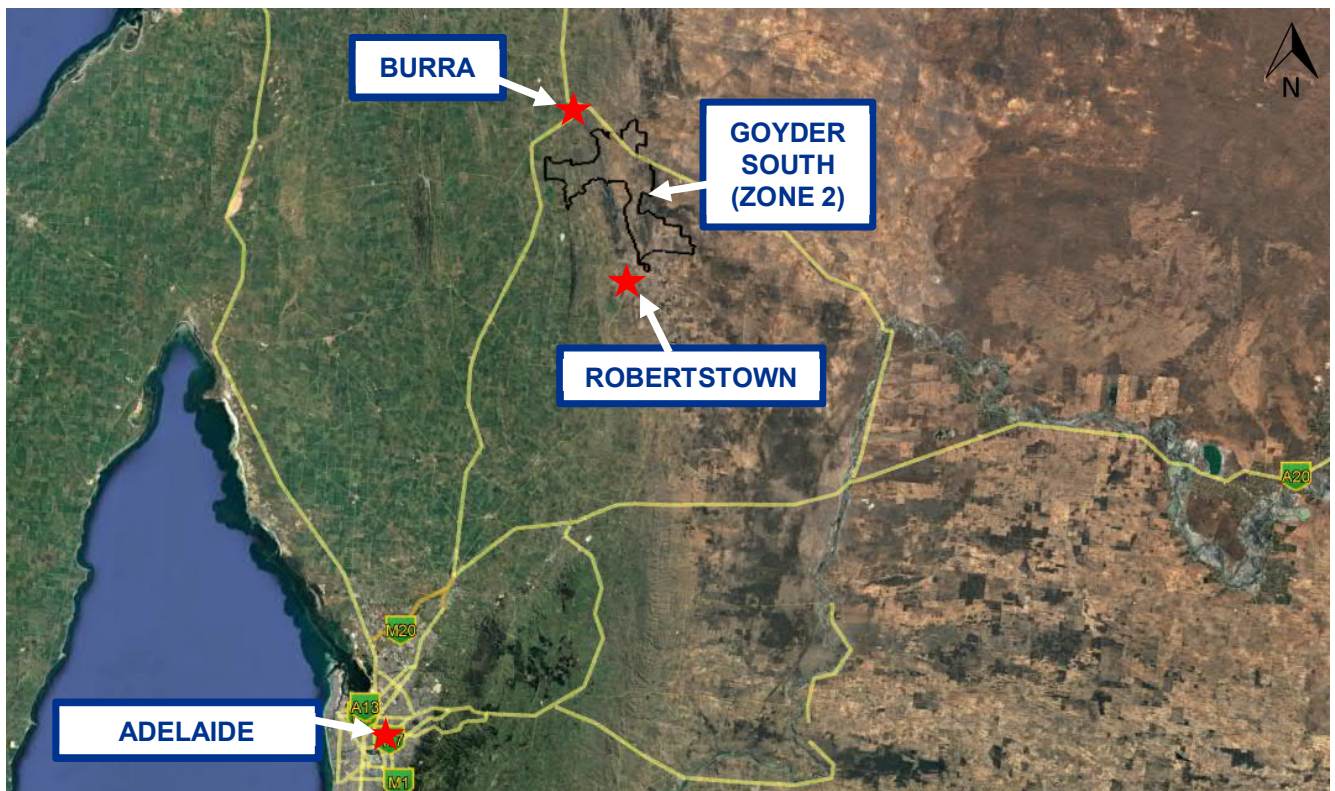


Figure 2-1: Location of the Goyder South Renewables Energy Zone

The Goyder South development will comprise up to:

- 1,200MW of wind;
- 600MW of solar; and
- 900MW and 1,800MWh (2 hours) of battery storage.

Once the Goyder South development is completed and fully operational, it has the potential to generate more than 4,800,000 MWh annually. The Goyder South development is planned to be built in approximately three overlapping stages, with each stage providing of 400MW of wind, 200MW of solar and 300MW of battery.

The key structures for the Goyder South development will include (refer **Figure 2-2** for location):

- Up to 163 wind turbines – dispersed on several ridges across of an area of approximately 30,000 hectares;
- Solar photovoltaic panels, photovoltaic boxes or skids and fencing (occupying an area of up to 3,000 hectares) located near the north of Worlds End Highway towards Burra, and/or towards the north-east of Robertstown;
- Battery, facility and fencing – located adjacent to the existing Robertstown substation and/or the planned new SA-NSW interconnector substation.

- Substations – Three collector substations proposed, which will connect to the Robertstown substation or planned interconnector substation.
- Overhead and/or underground transmission lines from the project substation(s) to the grid substation.
- Two operations and maintenance (O&M) facilities;
- Internal access tracks and underground cabling within the project area;

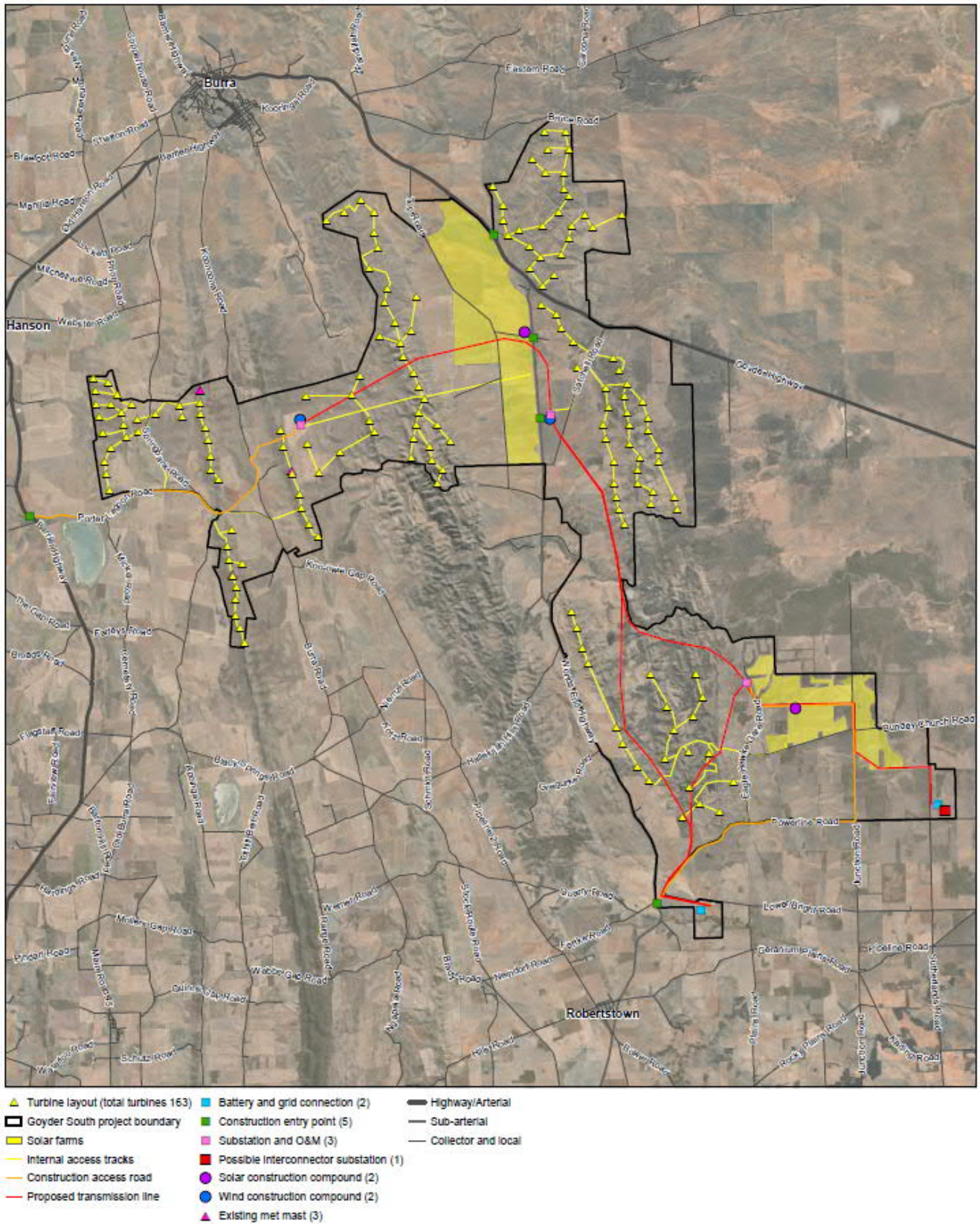


Figure 2-2: Key Structures for Goyder South development

3. Existing Area Conditions

3.1 Study Area

The Goyder South development area was primarily selected due to the world-class wind resources and appropriate land use (primarily grazing land, and some marginal cropping land). The site also has the benefit of being an excellent solar resource and ideal terrain for solar development. The site is outlined in **Figure 3-1**. The Goyder South development area was also selected due to the following:

- Accessibility due to the proximity of the Barrier Highway, Worlds End Highway, and Goyder Highway;
- Access to the existing electricity transmission network via the Robertstown substation, approximately 5km north-east of Robertstown, and approximately 2km south of the most southern point of the site;
- Proximity to the new substation which will be purpose-built for the SA-NSW interconnector.

3.2 Study Area Land Use

The Goyder South development area is currently designated as primary production land by the relevant Development Plan. The land is largely low-intensity grazing land, sparsely populated and increasingly marginal for agricultural use.

It is noted that the township of Burra, located to the north of the Goyder South site, is largely designated as State Heritage Area (refer **Figure 3-1** and **Figure 3-2**). From a traffic perspective, the Burra town centre is not impacted by the proposed development as the transport route options propose to utilise the existing gazetted restricted access vehicle network routes which bypass the Burra town centre.

It is also noted that there are the following conservation parks / natural landmarks in the area (but external to the zone). These are identified in **Figure 3-1**:

- Worlds End Gorge
- Hopkins Creek Conservation Park
- Mimbara Conservation Park.

These land uses are not directly impacted by the proposed development and are not considered to be significant trip generators.

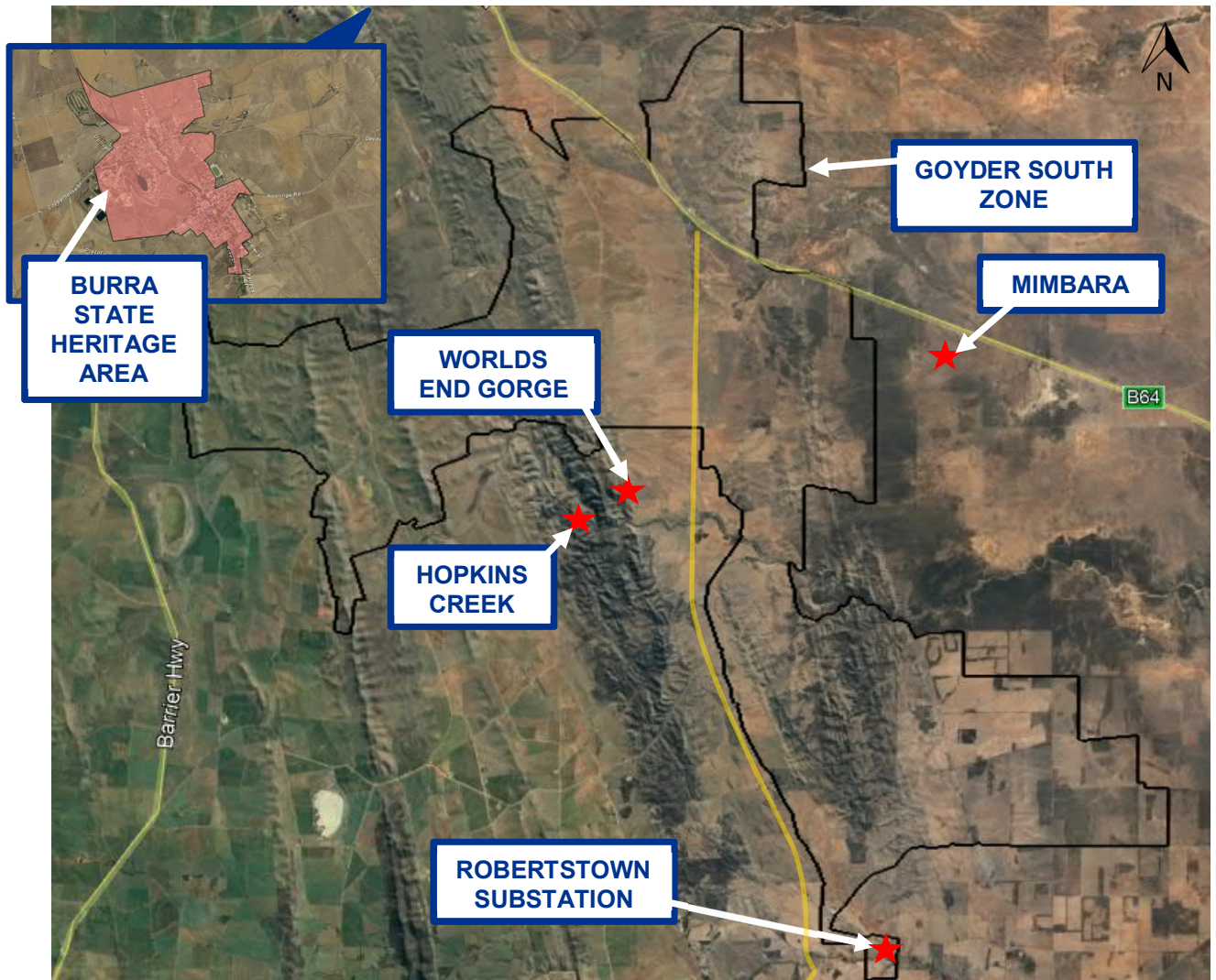


Figure 3-1: Outline of Goyder South, including State Heritage Area of Burra (top left insert), conservation parks, natural landmarks, and nearby substation.

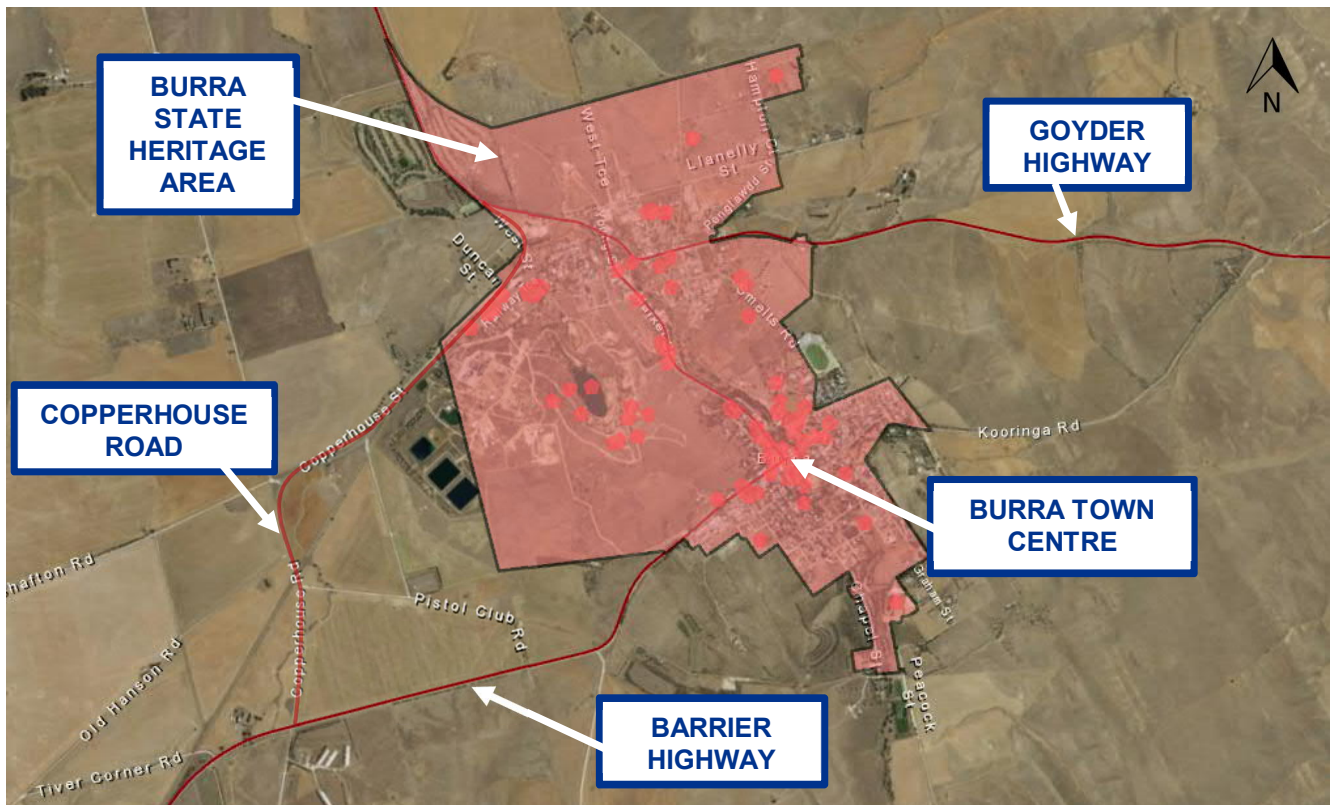


Figure 3-2: State Heritage Area of Burra

3.3 Site Accessibility

Five site access points are proposed to Goyder South, provided from the following three highways (site access points shown in **Figure 3-3**):

- Worlds End Highway – 3 access points (T1, T2 & T3)
- Goyder Highway – 1 access points (T4)
- Barrier Highway – 1 access point (T5).

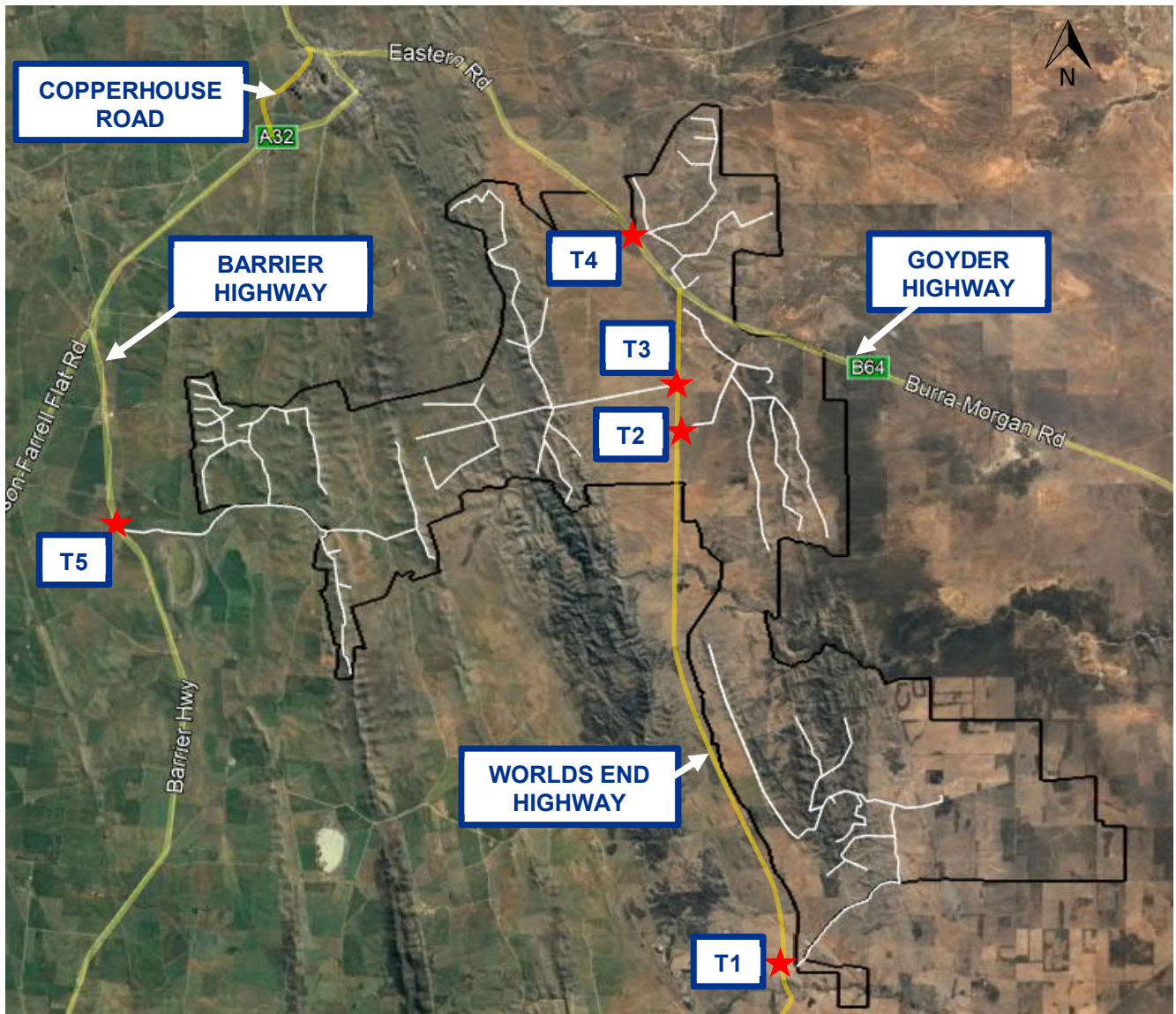


Figure 3-3: Site Access Points of Goyder South

The transport of over size and over mass Energy Zone Componentry is assumed to originate from Port Adelaide via the Northern Expressway to Gawler, to then be transported via the Sturt Highway and then through the routes proposed below to reach access points T1 to T5 (site access points shown in **Figure 3-3**). The access points are proposed to be accessed via the following designated construction, operating and decommissioning routes (routes shown in **Figure 3-4**):

- Designated Route 1 (D1): Sturt Highway – Horrocks Highway – Barrier Highway – Goyder Highway – Copperhouse Road – Worlds End Highway
- Designated Route 2 (D2): Sturt Highway – Horrocks Highway – Thiele Highway – East Terrace (bypass of Kapunda) – Thiele Highway – Three Chain Road (bypass of Eudunda) – Worlds End Highway – Goyder Highway – Copperhouse Road – Barrier Highway

Designated Route 1 (D1) is proposed to be used for the transport of components which will require an over size and/or over mass vehicle, as well as other vehicles which meet the current gazetted routes requirements. Designated Route 2 (D2) is proposed to solely be used for vehicles which meet the current gazetted routes requirements.

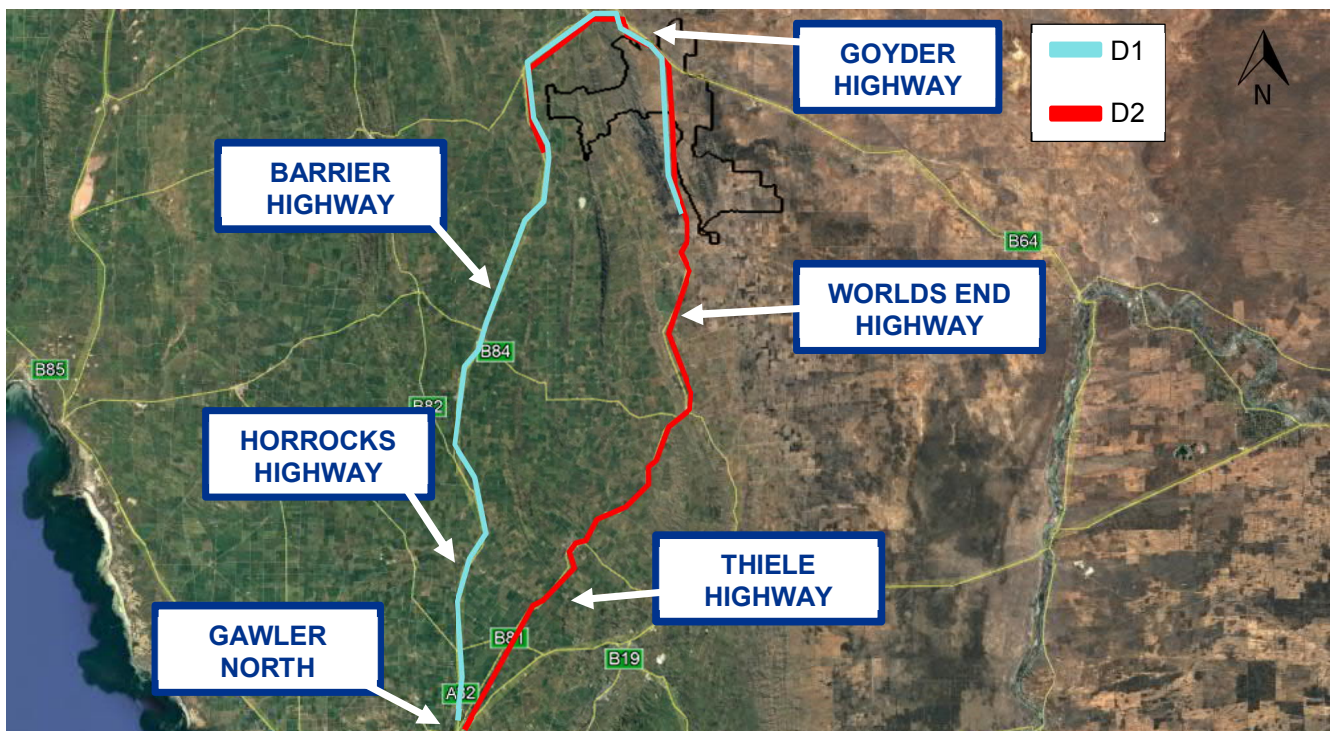


Figure 3-4: Designated Route 1 and Designated Route 2 to Goyder South

3.4 Existing Road Conditions

The existing highways and roads forming part of the designated routes from Gawler (Sturt Highway) to the Goyder South development area are described in the following section. The description of the existing road conditions includes information regarding the road location, speed limits, line markings, gazetted routes, notable bridge structures, traffic volumes, property access, and other significant characteristics.

3.4.1 Horrocks Highway (D1 & D2)

Horrocks Highway is an arterial road under the care and control of the Department of Planning, Transport and Infrastructure (DPTI). The highway extends from Gawler to the south to Wilmington to the north. For the purpose of this assessment, the below description will focus on Horrocks Highway from its intersection at Sturt Highway (at Gawler) to the turn-off onto Barrier Highway, approximately 7 km south of Riverton.

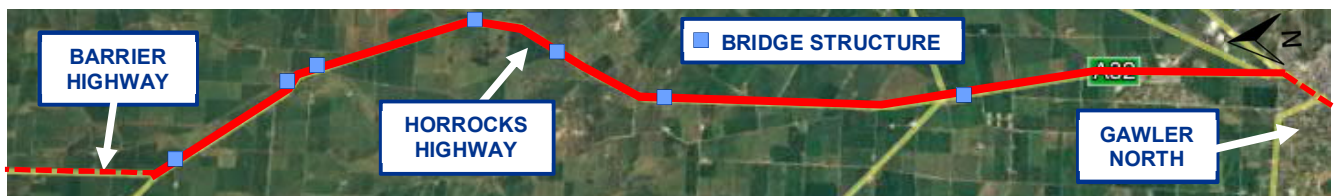


Figure 3-5: Relevant section of the Horrocks Highway

The highway has a sealed width of approximately 10 m, with 3.7 m wide lanes and sealed shoulders. These lane and carriageway widths meet the Austroads desirable widths (3.5m). A 110 km/h speed limit applies to the highway, except for where it passes through the local towns of Roseworthy, Templers, and Tarlee, where a 60 km/h, 80 km/h, and 60 km/h speed limit applies respectively. The majority of the Horrocks Highway in the study area has single broken barrier lines with several sections of double two-way barrier lines and alternating double one-way barrier lines.

There are seven bridge structures along the Horrocks Highway, marked on **Figure 3-5**. As the Horrocks Highway is currently gazetted for OSM 4.0m Wide up to 93.5t Low Loader vehicles, it is assumed that the bridge structures are suitable for the transport of over size and/or over mass vehicles up to this gazetted level.

The highway section is also currently gazetted for GML and HML vehicles up to 36.5m Road Trains, PBS Level 3A vehicles, 5 Axle Cranes (Level 1) and 6 Axle Cranes (Day Travel).

The most recent DPTI traffic data volumes for Horrocks Highway are listed in **Table 3-1** below (sourced from Location SA Viewer). Each section in the table refers to a different section along the highway, where reference points for the start and finish are at its intersecting road.

Table 3-1: DPTI traffic data for Horrocks Highway, between its intersection with Thiele Highway and Barrier Highway (data sourced from Location SA Viewer)

Section	Start (Intersecting Road)	Finish (Intersecting Road)	Vehicles per Day (VPD) Two Way	Year Collected	Percent Commercial Vehicles
1	Barrier Highway	Tarlee Road	3400	2016	11%
2	Tarlee Road	Templers Road	3300	2016	9.5%
3	Templers Road	Roseworthy Road	4600	2018	10.5%
4	Roseworthy Road	Thiele Highway	6300	2015	7%

Several rural properties are noted to have direct access points to/from the Horrocks Highway.

3.4.2 Barrier Highway (D1 & D2)

Barrier Highway is an arterial road under the care and control of the Department of Planning, Transport and Infrastructure (DPTI). The highway extends from the centre of Burra to approximately 7km South of Riverton. Barrier Highway passes through several towns. A list of these towns, in order of travelling north, is provided below:

- Riverton
- Saddleworth
- Manoorra
- Burra

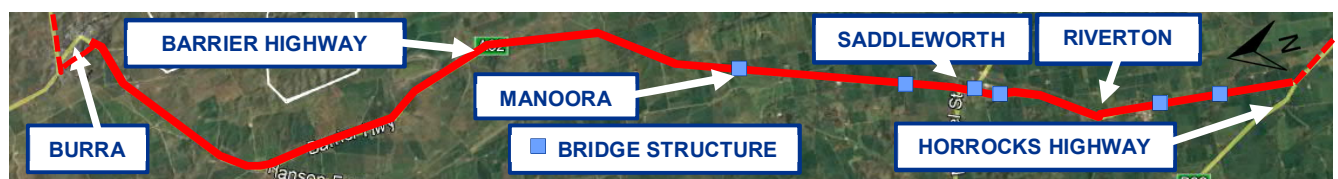


Figure 3-6: Relevant section of the Barrier Highway

The sections of the highway which pass through these towns are relatively straight and do not have any noted restrictions for permitted heavy vehicles. The section of the Barrier Highway from its intersection at Copperhouse Road to the town centre of Burra is omitted from the details below because it will not be used by construction traffic due to the Copperhouse Road bypass (Section 3.4.3).

Barrier Highway has a sealed width of approximately 9 m, with 3.7 m wide lanes and sealed shoulders. A 110 km/h speed limit applies to the highway, except for where the speed reduces at the towns. The majority of the Barrier Highway has single broken barrier lines, with the remaining areas a mixture of alternating double one-way barrier lines and double two-way barrier lines.

There are six bridge structures along this section of the Barrier Highway. As the Barrier Highway is currently gazetted for OSM 4.0m Wide up to 93.5t Low Loader vehicles, it is assumed that the bridge structures are suitable for the transport of over size and/or over mass vehicles up to this gazetted level.

The Barrier Highway also forms part of the current gazetted routes for GML and HML vehicles up to 36.5m Road Trains, PBS Level 3A vehicles, 5 Axle Cranes (Level 1) and 6 Axle Cranes (Day Travel).

The most recent DPTI traffic data volumes for Barrier Highway are listed in **Table 3-2** below (sourced from Location SA Viewer). Each section in the table refers to a different section along the highway, where reference points for the start and finish are at its intersecting road.

Table 3-2: DPTI traffic data for Barrier Highway, between its intersection with Horrocks Highway and Copperhouse Road (data sourced from Location SA Viewer)

Section	Start (Intersecting Road)	Finish (Intersecting Road)	Vehicles per Day (VPD) Two Way	Year Collected	Percent Commercial Vehicles
1	Copperhouse Road	Farrell Flat Road	1300	2019	21%
2	Farrell Flat Road	Saddleworth Road	1000	2018	23%
3	Saddleworth Road	Belvidere Road	2100	2016	17%
4	Belvidere Road	Riverton Road	1600	2018	18%
5	Riverton Road	Horrocks Highway	1600	2016	14.5%

Several rural properties and businesses are noted to have direct access points to/from the Barrier Highway.

3.4.3 Burra Bypass – Copperhouse Road / Copperhouse Street / West Street (D1 & D2)

The Burra bypass changes its road/street name along its length. Starting from the southern intersection with Barrier Highway and travelling north, for the first 1.5 km section it is called Copperhouse Road. From that point continuing on for 2 km the road is called Copperhouse Street. For the last 500 m the road is called West Street before intersecting with the Goyder Highway. It is one continuous road/street. For the purpose of this assessment it will be referred to as Copperhouse Road.

Copperhouse Road is a sealed road under the care and control of the Regional Council of Goyder. The road extends from approximately 3 km south-west of Burra centre at the southern intersection with the Barrier Highway, to approximately 2.5 km north-west of Burra centre at the northern intersection with the Goyder Highway. Copperhouse Road is used as a heavy vehicle bypass for Burra township.

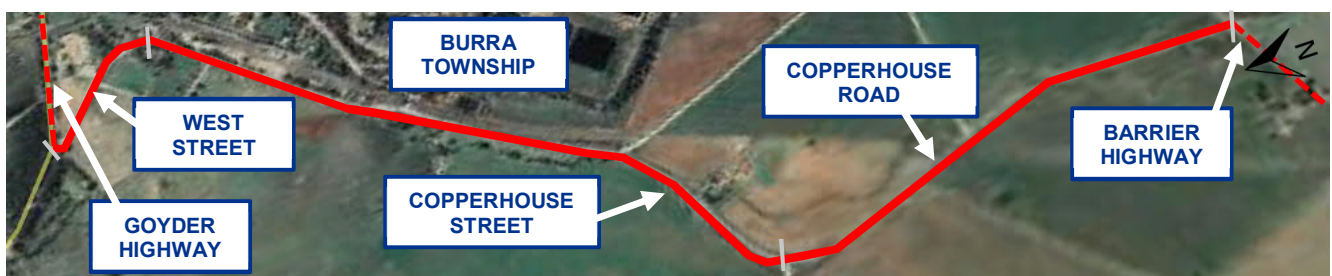


Figure 3-7: Burra bypass – Copperhouse Road / Copperhouse Street / West Street

There were improvements made this year to the southern intersection of Barrier Highway and Copperhouse Road. The most notable improvement is a separated left turn lane on the Barrier Highway, for vehicles turning left onto Copperhouse Road.

Copperhouse Road has a sealed width of approximately 8 m, with 3.5 m wide lanes and unsealed shoulders. Along the first 1.5 km (starting from the southern intersection with Barrier Highway) there is a 110 km/h speed limit. For the next 1 km there is a speed limit of 80 km/h, this is likely due to the road entering/exiting a residential area. For the remaining section of the road, until it intersects with the northern intersection of Goyder Highway, there is a 60 km/h speed limit. This is likely due to the road being within a residential area. The

majority of Copperhouse Road has double two-way or single barrier lines, with short sections of single broken barrier lines and alternating double one-way barrier lines.

Copperhouse Road forms part of the current gazetted routes for GML and HML vehicles up to 36.5m Road Trains, PBS Level 3A vehicles, OSM 4.0m Wide up to 93.5t Low Loader vehicles, 5 Axle Cranes (Level 1) and 6 Axle Cranes (Day Travel).

The traffic volumes along this road are unknown. Noting the reported vehicles per day volumes along the adjacent Barrier Highway road segments south and adjacent Goyder Highway road segments north, the volume along this road could be in the order of 300 and 500 vehicles per day with between 30% and 43% commercial vehicles.

Several rural properties and businesses are noted to have direct access points to/from Copperhouse Road.

3.4.4 Goyder Highway (D1 & D2)

Goyder Highway is an arterial road under the care and control of the Department of Planning, Transport and Infrastructure (DPTI). The highway extends from the centre of Burra to the border of South Australia and Victoria.

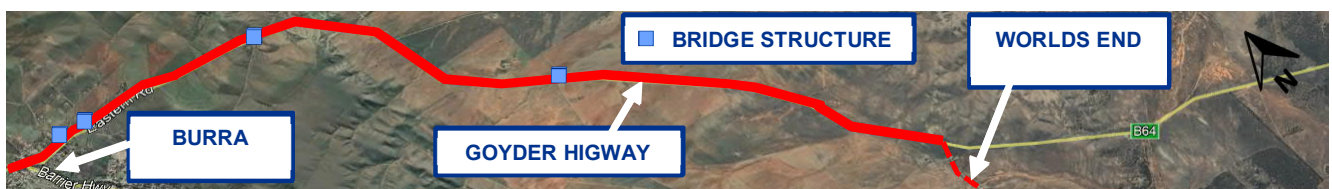


Figure 3-8: Relevant section of the Goyder Highway

In the vicinity of the assessment area (between Burra and the intersection of Goyder Highway and Worlds End Highway), the highway has a sealed width of approximately 10 m, with 3.7 m wide lanes and sealed shoulders. A 110 km/h speed limit applies to the highway, except for Burra, where it drops briefly to 80 km/h and then to 50 km/hr in the Burra township. The majority of the Goyder Highway in the assessment area has single broken barrier lines and double two-way barrier lines, with also several short sections of alternating double one-way barrier lines.

There are four bridge structures along the Goyder Highway. As the Goyder Highway is currently gazetted for OSM 4.5m Wide up to 93.5t Low Loader vehicles, it is assumed that the bridge structures are suitable for the transport of over size and/or over mass vehicles up to this gazetted level. It is noted that a bridge restriction speed of 10 km/h applies to the bridge 0.8 km east of Sancreed Street in Burra North for 3 and 4 Axle Cranes.

The Goyder Highway also forms part of the current gazetted routes for GML and HML vehicles up to 36.5m Road Trains, and PBS Level 3A vehicles.

The most recent DPTI traffic data volumes for Goyder Highway are listed in **Table 3-3** below (sourced from Location SA Viewer). Each section in the table refers to a different section along the highway, where reference points for the start and finish are at its intersecting road.

Table 3-3: DPTI traffic data for Goyder Highway, between its intersection with Barrier Highway and Worlds End Highway (data sourced from Location SA Viewer)

Section	Start (Intersecting Road)	Finish (Intersecting Road)	Vehicles per Day (VPD) Two Way	Year Collected	Percent Commercial Vehicles
1	West Street (Copperhouse Road bypass)	Barrier Highway	1200	2019	16.5%
2	Barrier Highway	Landore Street	800	2019	20%

Section	Start (Intersecting Road)	Finish (Intersecting Road)	Vehicles per Day (VPD) Two Way	Year Collected	Percent Commercial Vehicles
3	Landore Street	Kooringa Road	470	2019	25.5%
4	Kooringa Road	Eastern Road	650	2019	20%
5	Eastern Road	Worlds End Highway	600	2019	23.5%

Several rural properties are noted to have direct access points to/from the Goyder Highway.

3.4.5 Worlds End Highway (D1 & D2)

Worlds End Highway is an arterial road under the care and control of the Department of Planning, Transport and Infrastructure (DPTI). The 52km highway extends from Eudunda to approximately 13km South-East of Burra, where it connects to the Goyder Highway. The Worlds End Highway also passes through Robertstown approximately 22km North of Eudunda.

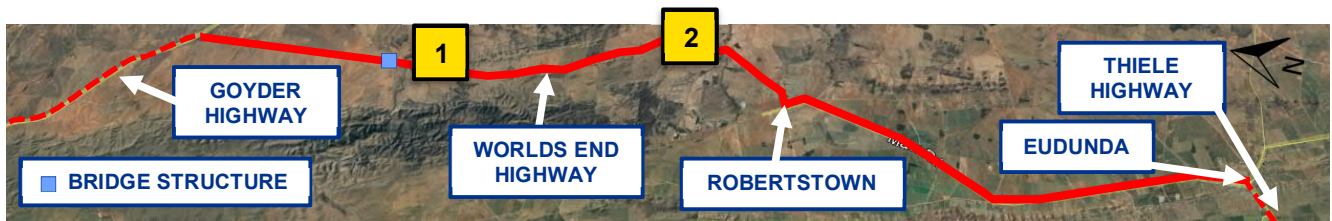


Figure 3-9: Worlds End Highway

The highway has a sealed width of approximately 8 m, with 3.7 m wide lanes and unsealed shoulders. A 110 km/h speed limit applies to the highway, except for Robertstown, where it drops briefly to 80 km/h and then to 50 km/hr in the township. The majority of the Worlds End Highway has single broken barrier lines, with the remaining areas a mixture of alternating double one-way barrier lines and double two-way barrier lines.

There are several vertical geometry constraints along Worlds End Highway. These constraints are due to dips and low points in the road which are also possible floodways. The location of the constraints are marked on the above route picture (constraints 1 and 2 shown as yellow boxes in **Figure 3-9**), and shown in **Figure 3-10** below.



Figure 3-10: Vertical geometry constraints looking south along the Worlds End Highway. Constraint 1 located south of Hallelujah Hills Road (left), constraint 2 located north of Powerline Road (right).

Due to these constraints, the route to the development area travelling in a northbound direction from Adelaide via the Thiele Highway (and the bypasses of Kapunda (via East Terrace) and Eudunda (via Three Chain Road) townships, refer sections 3.4.7 and 3.4.8) is likely to restrict the transport of the wind turbines blades and other over-length components (to be transported via vehicles over 26 m length) due to risk of vehicles “bottoming-out” through the fords located to the towards the southern end of the proposed development site along Worlds End

Highway (between Hallelujah Hills Road and Powerline Road), but should be subjected to further investigation by the engaged transport company once vehicles and componentry sizes are confirmed.

The Worlds End Highway forms part of the current gazetted routes for GML and HML vehicles up to 26m B Doubles, PBS Level 2A vehicles, and OSM 23m 42.5t Low Loader vehicles. The route is considered suitable for the remainder of the construction traffic that meet these gazetted road levels.

A 90° right turn was also observed along the Worlds End Highway as it passes through Robertstown, as shown in **Figure 3-11** (location of Robertstown shown in **Figure 3-9**). This right turn would also possibly pose an issue for the transport of the over-length wind turbines blade components.

If this turn movement does pose an issue for restricted access vehicles, East Road which bypasses the township could be considered as an alternate route. However, this route is only gazetted for 19m HML vehicles from its junction at Worlds End Highway to the south to Commercial St / Geranium Plain Road intersection to the north. East Street, the 50m road segment which connects East Road to Worlds End Highway to the north does not currently form part of the restricted access vehicle network, as such, use of this route for heavy vehicles would require additional approvals and permits.

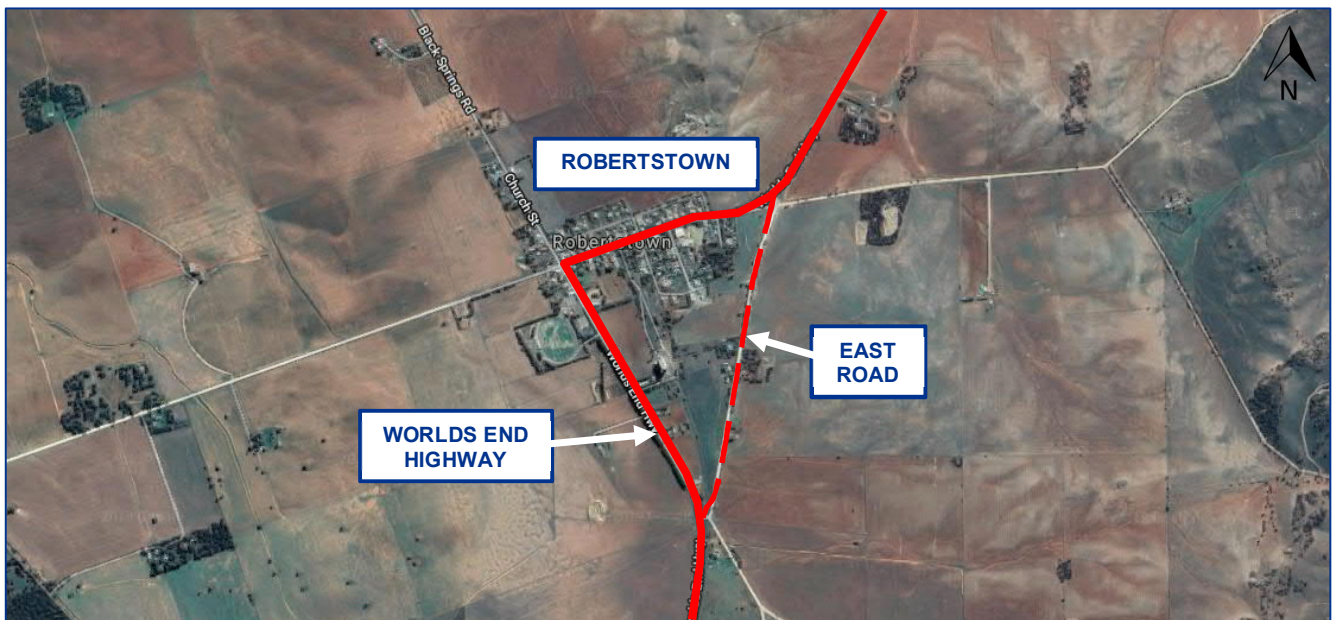


Figure 3-11: 90 Degree turn of Worlds End Highway passing through Robertstown (and alternate bypass route marked by dashed line) (location of Robertstown shown in Figure 3-9)

There is one bridge structure along the Worlds End Highway (at Burra Creek), marked on **Figure 3-9**. As the Worlds End Highway is currently gazetted for OSM 23m 42.5t Low Loader vehicles, it is assumed that the bridge structure is suitable for the transport of over size and/or over mass vehicle loads up to this gazetted level.

The most recent DPTI traffic data volumes for Worlds End Highway are listed in **Table 3-4** below (sourced from Location SA Viewer). Each section in the table refers to a different section along the highway, where reference points for the start and finish are at its intersecting road.

Table 3-4: DPTI traffic data for Worlds End Highway, between its intersection with Goyder Highway and Australia Plains Road (Location SA Viewer)

Section	Start (Intersecting Road)	Finish (Intersecting Road)	Vehicles per Day (VPD) Two Way	Year Collected	Percent Commercial Vehicles
1	Goyder Highway	Powerline Road	130	2019	28.5%
2	Powerline Road	East Road	170	2019	23%

3	East Road	Second Avenue	550	2019	15.5%
4	Second Avenue	Cutting Road	380	2019	16%
5	Cutting Road	Australia Plains Road	600	2019	14%

It should be noted that the Worlds End Highway provides the only direct access to/from the Worlds End Gorge and Worlds End Hike-in Camp Site.

3.4.6 Thiele Highway (D2)

Thiele Highway is an arterial road under the care and control of the Department of Planning, Transport and Infrastructure (DPTI). The highway extends from Gawler to Morgan (approximately 115km) and passes through Kapunda and Eudunda. The turn-off to Worlds End Highway is located at Eudunda.

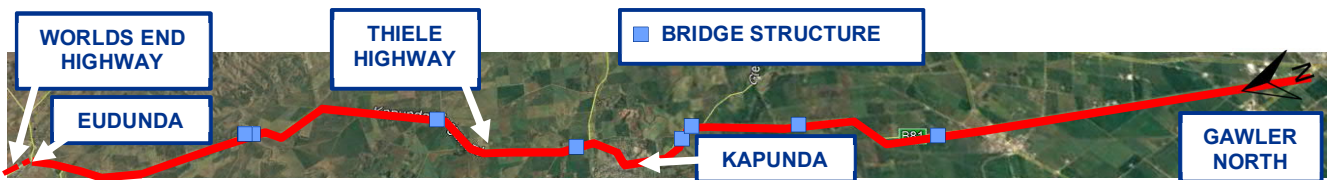


Figure 3-12: Relevant section of the Thiele Highway

From Gawler to Eudunda, the highway has a width of approximately 10 m, with 3.7 m wide lanes and varying unsealed and sealed shoulders. A 110 km/h speed limit applies to the highway, except for when vehicles pass through Kapunda and Eudunda, where the speed limit drops to 50 km/hr. The majority of the Thiele Highway has single broken barrier lines, with the remaining areas a mixture of alternating double one-way barrier lines and double two-way barrier lines. There are eight bridge structures along the Thiele Highway, marked on **Figure 3-12**. As the Thiele Highway is currently gazetted for OSM 4.0m Wide up to 93.5t Low Loader vehicles, it is assumed that the bridge structure is suitable for the transport of over size and/or over mass vehicle loads up to this gazetted level.

The section of Thiele Highway also forms part of the current gazetted routes for GML and HML vehicles up to 26m B Doubles, PBS Level 2A, and 3 Axle Cranes.

The most recent DPTI traffic data volumes for Thiele Highway are listed in **Table 3-5** below (sourced from Location SA Viewer). Each section in the table refers to a different section along the highway, where reference points for the start and finish are at its intersecting road.

Table 3-5: DPTI traffic data for Thiele Highway, between its intersection with Horrocks Highway and Three Chain Road (Location SA Viewer)

Section	Start (Intersecting Road)	Finish (Intersecting Road)	Vehicles per Day (VPD) Two Way	Year Collected	Percent Commercial Vehicles
1	Horrocks Highway	Gray Street	4800	2018	8%
2	Gray Street	Hanson Street	3400	2015	9%
3	Hanson Street	Greenock Road	2900	2016	11%
4	Greenock Road	Perry Road	3800	2016	12%
5	East Terrace	Curio Highway	1200	2016	11%
6	Curio Highway	Gunn Street	1500	2016	12%
7	Gunn Street	Three Chain Road	600	2019	18.5%

Several rural properties are noted to have direct access points to/from Thiele Highway.

3.4.7 Bypass of Kapunda Township – East Terrace (D2)

East Terrace is an approximate 4km road which can be used as a bypass of Kapunda (location shown in **Figure 3-12**). It is under the care and control of the Light Regional Council. Driving north-east, the first 2km of the road is unsealed, and the second 2km of the road is sealed. East Terrace connects two locations of the Thiele Highway, approximately 3km south of Kapunda centre and approximately 1.5km north-east of Kapunda centre.



Figure 3-13: Kapunda bypass – East Terrace

On the unsealed section of East Terrace, the road width is approximately 8 m wide. Given the unsealed nature of the road, the default rural speed limit of 100 km/h applies to this road.

The sealed section of East Terrace has a sealed width of approximately 8 m, with 3.7 m wide lanes and minor sealed shoulders. The road is posted with 80 km/h speed limit signage. The sealed section of East Terrace was recently upgraded in 2017, which involved new line markings, signage, and shoulder widening. Around the bends and intersections, there is a single barrier line (i.e. no overtaking permitted). On the other sections, the straights, there is single broken lines. There are also standard edge lines along the entire sealed section and a safety barrier towards the southern end.

The entire length of East Terrace forms part of the current gazetted routes for GML vehicles up to 26m B Doubles and OSM 25m 59.5t Low Loader vehicles.

The sealed section of East Terrace (with connection to Thiele Highway south via Perry Road) also forms part of the current gazetted routes for GML and HML vehicles up to 26 m B Doubles, PBS Level 2B and OSM 23m 42.5t Low Loader vehicles.

It is also noted that the continuation of the Thiele Highway through the township (and not using the bypass via East Terrace) is currently gazetted for OSM 4.0m Wide up to 93.5t Low Loader Vehicles and 3 Axles Cranes.

There are no records available to provide traffic volume information.

Several rural properties are noted to have direct access to/from East Terrace. East Terrace also provides the only direct access to Mantina Quarries and Kapunda Christchurch Anglican Cemetery.

3.4.8 Bypass of Eudunda Township – Three Chain Road (D2)

Three Chain Road is an approximate 2.5km sealed road which can be used as a bypass of Eudunda (location of Eudunda shown in **Figure 3-12**). Three Chain Road is under the care and control of the Regional Council of Goyder. The road connects Thiele Highway (approximately 1km south-east of Eudunda centre) to Worlds End Highway (approximately 1.5km north of Eudunda centre).



Figure 3-14: Eudunda bypass – Three Chain Road

The Three Chain Road bypass was built in 2017 to improve freight movement in the region. The works also included a new junction at the Thiele Highway intersection, and an improved junction at the Worlds End Highway intersection.

An 80 km/h speed limit applies to the majority of the road, where a 50 km/h speed limit applies in the vicinity of the intersections at the highways at both ends. Towards the ends of the road it has a double barrier line (i.e. no overtaking permitted). Along the majority of the road there is a single broken barrier line, or a double one-way barrier line with alternating overtaking directions.

Three Chain Road forms part of the current gazetted routes for GML and HML vehicles up to 26m B Doubles, and PBS Level 2A vehicles. It is noted that the road is not currently gazetted for OSM vehicles, although the Thiele Highway and Worlds End Highway are both currently gazetted for OSM 23m 42.5t Low Loader vehicles, these two routes are not connected about Eudunda.

It is also noted that Bruce Street which provides connection to Thiele Highway and Worlds End Highway through the Eudunda town centre (i.e. not the bypass via Three Chain Road) is currently gazetted for OSM 40t Special Purpose Vehicles. There are no records available to provide traffic volume information.

Three rural properties are noted to have direct access points to/from Three Chain Road.

3.5 Existing Access Road Conditions

Four of the five proposed access roads from the highways surrounding the Goyder South site are existing local access roads. Their existing conditions are noted in the subsections following.

3.5.1 Powerline Road (Access T1)

Powerline Road is an unsealed road under the care and control of the Regional Council of Goyder. The road is located to the west off Worlds End Highway, approximately 5.2km north of Robertstown. At the proposed T1 access, a construction access road is proposed to follow Powerline Road for approximately 9 kilometres to Junction Road, where it continues on north along Junction Road for 4.5km, then continues east along an unnamed road for 3.6km, before continuing north along Eagle Hawke Gate Road (refer **Figure 3-15**). The proposed construction access road is intended to provide access to the proposed southern solar farm and solar construction compound, to a cluster of wind turbines, battery and grid connections, and possible substations (refer **Figure 2-2** for location of key structures for the Goyder South development).

‘Constraint 2’ (as identified in Section 3.4.5 above) is located along Worlds End Highway approximately 850m north of Powerline Road junction (refer **Figure 3-15** for location of ‘Constraint 2’ in relation to Powerline Road (Access T1)). Noting the key structures that the T2 Access is expected to service, it is recommended that over size vehicles accessing the development via Access T2 do so from the south via Robertstown.

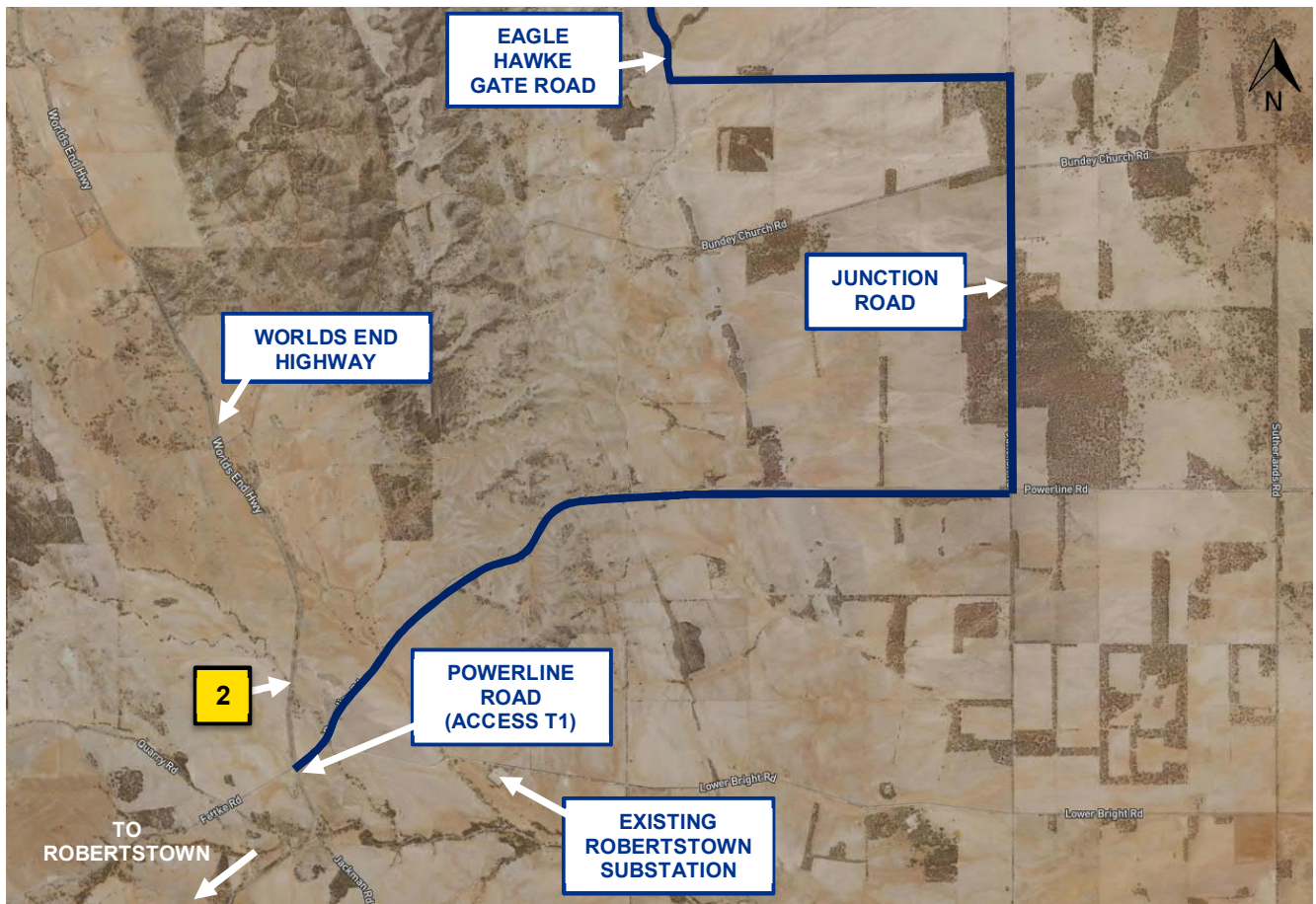


Figure 3-15: Powerline Road (Access T1) and local road continuations to the internal site road network

Powerline Road has an approximate width of 9m, within a corridor approximately 20m wide. Given the unsealed nature of the road, the default rural speed limit of 100km/h applies to this road.

The road (and most of the proposed construction access road) currently forms part of the gazetted HML 19m network. There are no records available to provide traffic volume information.

One rural property appears to have direct access to/from Powerline Road. It is likely that five other rural properties indirectly use Powerline Road for road access.

3.5.2 Duttons Trough Road (Access T3)

Duttons Trough Road is an unsealed road under the care and control of the Regional Council of Goyder. The road intersects with Worlds End Highway, approximately 2.1km south of the Goyder Highway / Worlds End Highway junction (refer **Figure 3-15**).

The proposed T3 Access is intended to provide access to the proposed northern solar farm and solar construction compound, and to a cluster of wind turbines (likely via a new internal access road connection from Top Road) (refer **Figure 2-2** for location of key structures for the Goyder South development). Duttons Trough Road forms a junction with Top Road approximately 1.5km west of Worlds End Highway.

Duttons Trough Road (and Top Road) has an approximate width of 8m, within a corridor approximately 20m wide. Given the unsealed nature of the road, the default rural speed limit of 100km/h applies to this road.

Duttons Trough Road (and Top Road) currently forms part of the gazetted HML 19m network. There are no records available to provide traffic volume information.

There are no rural property with direct access to/from Duttons Trough Road. One rural property located along Top Road is likely to access their property via Duttons Trough Road.

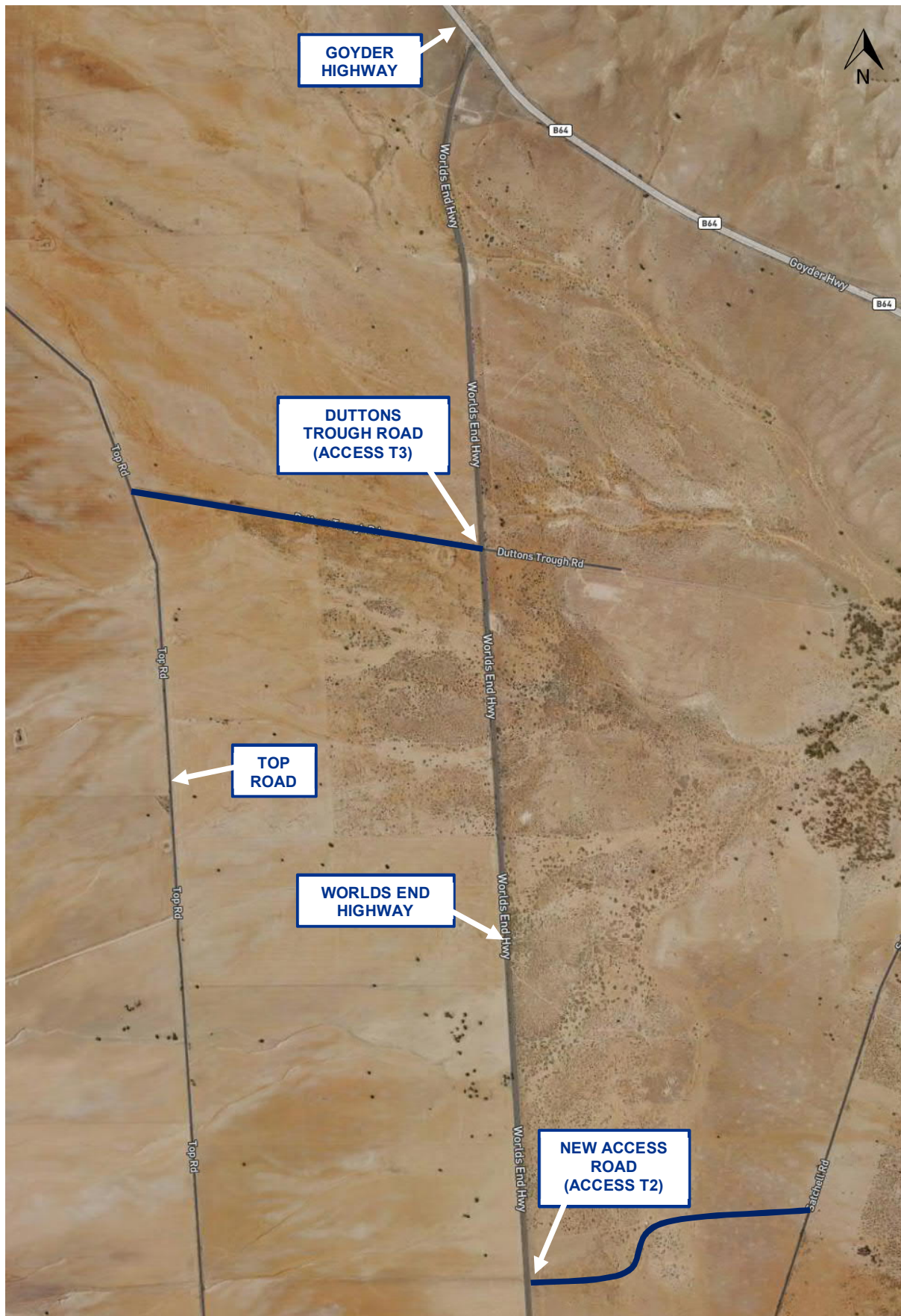


Figure 3-16: Proposed New Access Road (Access T2) and Duttons Trough Road (Access T3)

3.5.3 Unnamed Road (Access T4)

One of the access points for the site is located on an unsealed rural property access road which connects to the Goyder Highway (refer **Figure 3-17**), to provide access to the northern most cluster of wind turbines located north of the Goyder Highway. The unnamed road is located approximately 2.4km north-west of the Goyder Highway / Worlds End Highway junction.



Figure 3-17: Unnamed Road (Access T4)

This road has an approximate width of 4m. Given the unsealed nature of the road, the default rural speed limit of 100km/h applies to this road.

The road currently forms part of the gazetted HML 19m network. There are no records available to provide traffic volume information.

One rural property appears to have direct access to/from this road.

3.5.4 Porter Lagoon Road (Access T5)

Porter Lagoon Road is an unsealed road under the care and control of the Regional Council of Goyder. The road extends from a junction with the Barrier Highway to a junction with Koonoona Road, a distance of approximately 8km (refer **Figure 3-18**).

At the proposed T5 access, a construction access road is proposed to follow Porter Lagoon Road to Koonoona Road, where it continues on north-east along Koonoona Road for approximately 3km (refer **Figure 3-18**). The proposed T5 Access is intended to provide access to numerous clusters of wind turbines (via new internal access road connections from Springbank Road, Turner Road and Koonoona Road) (refer **Figure 2-2** for location of key structures for the Goyder South development).

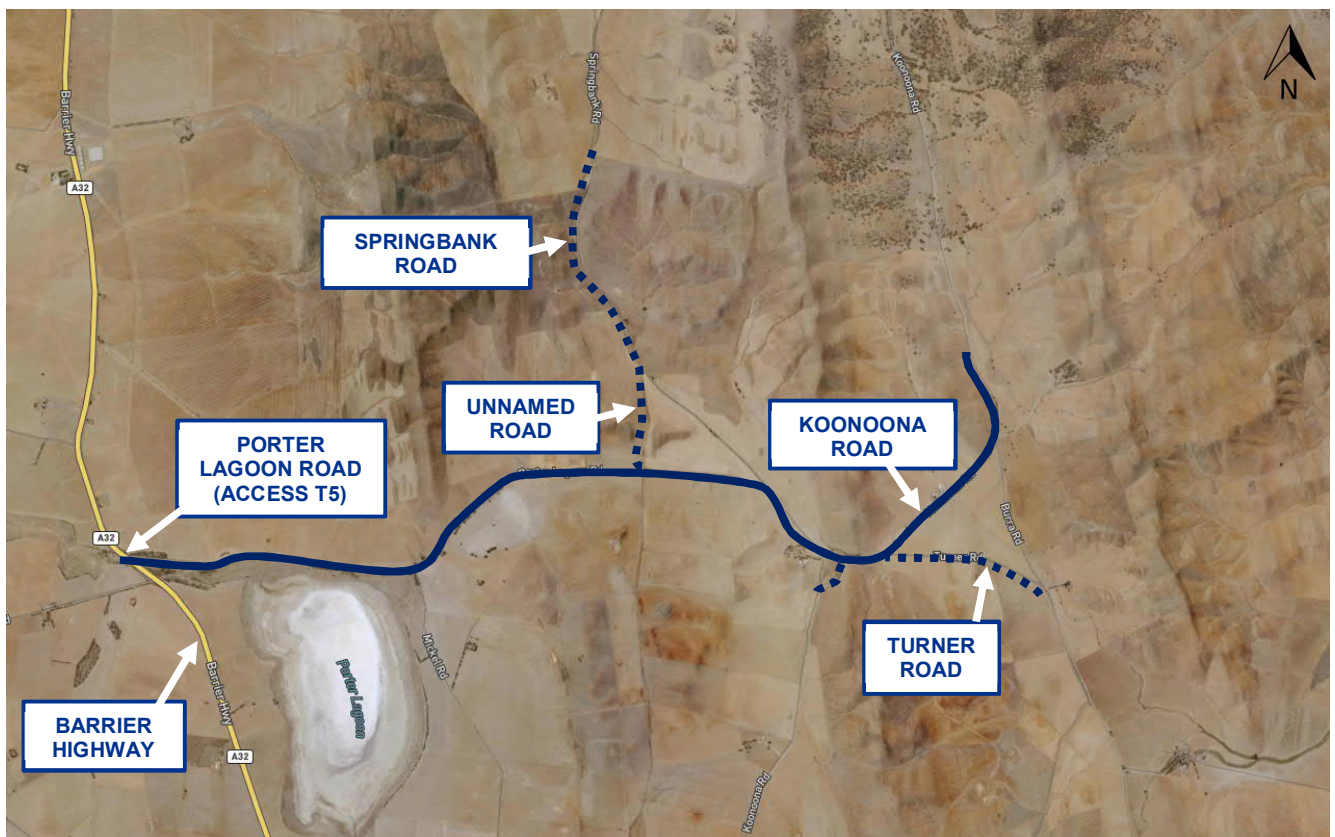


Figure 3-18: Porter Lagoon Road (Access T5) and local road continuations to the internal site road network

Porter Lagoon Road has an approximate width of 7m. Given the unsealed nature of the road, the default rural speed limit of 100km/h applies.

The road currently forms part of the gazetted HML 19m network. There are a number of horizontal curves along the alignment which do not warrant further investigation due to the low degree of the curves. The road provides access to one rural property provided on the southern side of the road. On the eastern half of the road, there are pipelines on the north and south side of the road. The pipelines extend approximately 4km. The pipeline on the north is approximately 3m away from the road, the pipeline on the south is approximately 5m away from the road.

There are no records available to provide traffic volume information.

3.5.5 Koonoona Road (continuation of Access T5)

Koonoona Road is an unsealed road under the care and control of the Regional Council of Goyder. The road extends from a junction with the Barrier Highway to a junction with Black Springs Road, a distance of

approximately 25km (refer **Figure 3-18**). However, only approximately 400m of the road forms part of the internal site road network. This is from its intersection to Porter Lagoon Road to its intersection with Turner Road.

Koonoona Road has an approximate width of 6m. Given the unsealed nature of the road, the default rural speed limit of 100 km/h applies. Consideration should be made to reducing the speed limit along this road, given the narrow road width of this two-way unsealed road. The road currently forms part of the gazetted HML19m network.

There are a number of horizontal curves and vertical changes along the alignment. The road segment which forms part of the T5 construction access road provides direct access to two rural properties on either side of the road.

There are no records available to provide traffic volume information.

3.5.6 Unnamed Road (continuation of Access T5 as an internal access road)

The Unnamed Road is an unsealed road under the care and control of the Regional Council of Goyder. The road extends from a junction with Porter Lagoon Road to a junction with Springbank Road, a distance of approximately 1km (refer **Figure 3-18**). This road forms part of the internal site road network.

The Unnamed Road has an approximate width of 6m. Given the unsealed nature of the road, the default rural speed limit of 100km/h applies. Consideration should be made to reducing the speed limit along this road, given the narrow road width of this two-way unsealed road. The road currently forms part of the gazetted HML 19m network.

There are no records available to provide traffic volume information, nor does the road provide direct access to any rural properties.

3.5.7 Springbank Road (continuation of Access T5 as an internal access road)

Springbank Road is an unsealed road under the care and control of the Regional Council of Goyder. The road extends from a junction with Porter Lagoon Road to a junction with the Barrier Highway, a distance of approximately 14km (refer **Figure 3-18**). However, only approximately 2.2km of the road forms part of the internal site road network (extending north from the Unnamed Road).

Springbank Road has an approximate width of 6m. Given the unsealed nature of the road, the default rural speed limit of 100km/h applies. Consideration should be made to reducing the speed limit along this road, given the narrow road width of this two-way unsealed road. The road currently forms part of the gazetted HML 19m network. There are two horizontal curves along the alignment, which may warrant further investigation for OSM vehicles. The road segment which forms part of the T5 internal access road network does not provide direct access to any rural properties.

There are no records available to provide traffic volume information.

3.5.8 Turner Road (continuation of Access T5 as an internal access road)

Turner Road is an unsealed road under the care and control of the Regional Council of Goyder. The road extends from a junction with Porter Lagoon Road to a junction with Burra Road, a distance of approximately 1.5km (refer **Figure 3-18**). The entire road forms part of the internal site road network.

Turner Road has an approximate width of 6m. Given the unsealed nature of the road, the default rural speed limit of 100 km/h applies. Consideration should be made to reducing the speed limit along this road, given the narrow road width of this two-way unsealed road. The road currently forms part of the gazetted HML19m network.

There is direct access to one rural property along the road. There are no records available to provide traffic volume information.

3.6 Crash History

A review of the available recorded crash data in the vicinity of the Goyder South development area from Location SA Map Viewer indicates numerous road crashes along the designated routes. The data is recorded from 2014 to the end of 2018. The injury, serious injury and fatal road crash statistics, as well as road crash locations where there were two or more crashes, are summarised below for the Barrier Highway, Goyder Highway, Worlds End Highway, and Copperhouse Road. Detailed statistics of the roads and highways along the Designated Route 1 and Designated Route 2 are located in **Appendix A**. Refer **Appendix B** for crash types.

Barrier Highway (between Horrocks Highway and Copperhouse Road):

- 11 injury crashes, 8 serious injury crashes, 3 fatal crashes.
 - Intersection of Barrier Highway and Copperhouse Road:
 - Crashes: 2 injury crashes, 1 serious injury crash, 1 fatality crash;
 - Crash type: All right-angle collisions.

Goyder Highway (between Copperhouse Road and Worlds End Highway):

- 4 injury crashes, 1 serious injury crash.
 - Intersection of Goyder Highway and Worlds End Highway:
 - Crashes: 1 injury crash, 1 property damage crash (>\$5000 or vehicle towed away);
 - Crash type: All roll overs.
 - Intersection of Goyder Highway and Koorunga Road:
 - Crashes: 2 injury crashes;
 - Crash type: All hit fixed objects.

Worlds End Highway:

- 1 injury crash, 2 serious injury crashes, 1 fatal crash.
 - No locations with 2 or more crashes.

Copperhouse Road:

- 1 fatal crash.
 - No locations with two or more crashes.

4. Transportation Requirements for Development

4.1 Development Lifespan Phases

There are three phases involved over the lifespan of the Goyder South development. These phases are the construction phase, operational phase, and the decommissioning / renewal phase.

4.1.1 Construction Phase (Phase 1)

The construction phase for the Goyder South development area is anticipated to be a 5-6-year process and will have impact on the surrounding road network. The construction phase of the project is divided into three stages. Each proposed stage involves the development of a different area of the Goyder South site.¹ Each stage is planned to deliver the following:

- 400MW of wind generation
- 200MW of solar generation
- 300MW of battery storage
- Total: 900MW per stage.

Each construction stage is expected to take 18 – 24 months, with the start and end dates of stages potentially overlapping. Depending on the assessment process, Stage 1 is proposed to start during mid-2021. Stage 2 is proposed to start during early 2023. Stage 3 is expected to start during 2025. These timelines are subject to the timing of each stage to reach financial close, which depends on numerous factors such as the availability of Power Purchase Agreements.

The principal construction traffic and transport activities that will be carried out during the construction stages will be required to travel along the designated routes listed in Section 3.3. These activities include the following:

- Delivery of the wind turbine components, including foundation materials;
- Delivery of the solar farm components;
- Delivery of the substation and power connection equipment;
- Delivery of the battery components;
- Delivery of other construction equipment and materials; and
- Transport of construction staff.

4.1.2 Operations Phase (Phase 2)

The operations phase of the proposed Goyder South development area is forecasted to last approximately 30 years. The traffic and transport movements associated with the operation and maintenance of the site are recommended to travel along the designated routes listed in Section 3.3. These movements include the following:

- Staff accessing the site for regular inspections;
- Routine servicing and maintenance of wind turbines and solar panels;
- Replacement of wind turbine and solar panel components; and
- Possible maintenance of roads and access tracks.

¹ The exact geographical areas of each development stage has not yet been determined, but is anticipated to be rolled out in an approximate south to north and west to east direction

4.1.3 Decommissioning Phase (Phase 3)

The wind turbines and solar panels have an approximate lifespan of 30 years. Towards the end of this lifespan a decision will be made on whether to decommission the site, involving removal of existing turbines, panels, and other related site equipment, or to renew the site, involving installation of new turbines and panels (requiring a new Development Approval). The construction traffic and transport movements involved in this phase will likely be less than during construction phase 1 (most of the concrete associated with the turbines is anticipated to be left in the ground and covered over rather than removed and transported by road, to minimise ecological disturbance).

4.2 Equipment Specifications

The construction phase of the Renewables Zone will have an impact on the existing road network, in particular due to the size and weight of the particular components such as the wind turbine components and substation equipment. Depending on the equipment being transported during these phases (particularly the construction phase), over size and/or over mass (OSM) permits will need to be obtained through the National Heavy Vehicle Regulator (NHVR) and Department of Planning, Transport and Infrastructure (DPTI). Any vehicles exceeding the following criteria will require an OSM permit:

- Over mass limit: 42.5 tonnes
- Over size limits:
 - Width: 2.5m
 - Height: 4.3m
 - Length: 19m (for a combination other than B-double, road train, car carrier).

4.2.1 Wind Turbines

The wind turbines proposed will have a maximum blade tip height of up to 240m. The turbine will comprise of blades of up to approximately 80m in length and a hub height of up to approximately 160m. Each turbine consists of the following components:

- 5-8 tower sections;²
- 1 turbine hub;
- 1 nacelle;
- 1 cooler top;
- 1 drive train;
- 3 blades.

² Please note that this assumes a steel tower construction. Some manufacturers specify concrete towers (or concrete and steel) at certain hub heights. Neoen has informed Jacobs that where some or all segments are concrete, overall traffic figures are unlikely to change materially as the segments are more numerous, but smaller.

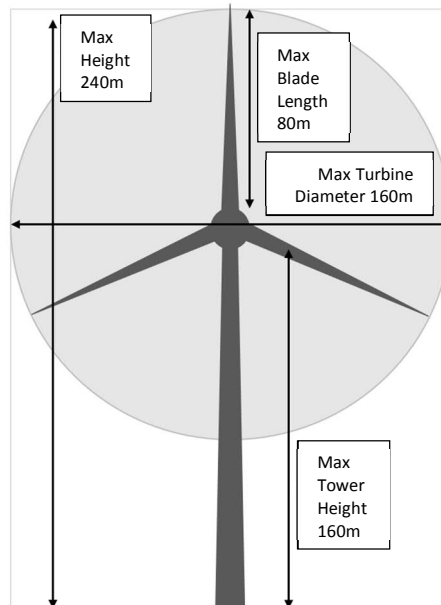


Figure 4-1: Maximum dimensions of Wind Turbine Generators proposed for Goyder South

The approximate weight and dimensions of the individual wind turbine components listed above and whether the component requires OSM vehicles to transport the components are summarised in **Table 4-1** and **Table 4-2** below.

Table 4-1: Wind turbine component dimensions, weight, and requirements for over size and over mass vehicles

Component	Max Height (m)	Max Length (m)	Max Width (m)	Max Weight (tonnes)	Over Mass Vehicle Required	Over Size Vehicle Required
Nacelle (w/o Drive Train)	4.35	18.176	4.2	90.99	✓	✓
Drive Train	3.0	7.5	2.7	105.36	✓	✓
Cooler Top	3.0	5.2	2.3	2.33	x	x
Hub	4.88	4.98	4.401	78.28	✓	✓
Blades	4.0	81.1	4.5	31.30	x	✓

Table 4-2: Wind turbine tower dimensions, weight, and requirements for over size and over mass vehicles

Component	Max Diameter (m)	Max Length (m)	Max Weight (tonnes)	Over Mass Vehicle Required	Over Size Vehicle Required
5 Section Towers					
Tower Section (max weight)	6.3	25.76	90	✓	✓
Tower Section (max length)	4.15	33	65	✓	✓
7 Section Towers (149m Tower)					
Tower Section (max weight)	6.3	17.08	83	✓	✓
Tower Section (max length)	4.4	30	58	✓	✓

4.2.2 Substation and Battery Infrastructure

The approximate weight and dimensions of the individual battery and substation related components listed above and whether the component requires OSM vehicles to transport the components are summarised in **Table 4-3** below.

Table 4-3: Substation and battery component dimensions, weight, and requirements for over size and over mass vehicles

Component	Max Height (m)	Max Length (m)	Max Width (m)	Max Weight (tonnes)	Over Mass Vehicle Required	Over Size Vehicle Required
Substation Transformer	5	8.5	4.5	130	✓	✓

4.2.3 Other Components

All other components involved in the construction phase which are not listed above do not require OSM vehicles to transport. These include solar panel components

4.3 Vehicle Types and Permits

4.3.1 Over Size and Over Mass Permits

The key focus for the transport of materials/components to the site revolves around the size and weight of the wind turbine components, battery equipment, and substation equipment. The delivery of these components will require an over size permit, over mass permit, or both permits (as specified in Section 4.2) obtained from NHVR and DPTI. Conditions employed for the transport of over size and/or over mass loads will involve:

- Pilot and escort requirements – to provide advanced warning to approaching traffic through appropriate signage,
- Police escort requirements – required for the safe movement of other traffic.
- Night travel restrictions.

4.4 Sight Distance Requirements

Appropriate vehicle sight distance at key intersections and site access points is an important requirement. Delivery vehicles will often be slow moving and take time to clear the road, hence it is critical for oncoming vehicles to have sufficient time to reduce speed and avoid a collision.

The required stopping sight distance under Austroads guidelines is 279m for heavy vehicles and 241m for passenger vehicles. These distances consider the following assumptions:

- Minimum reaction time of 2.5s (design worst-case);
- Design speed of 120 km/hr (for a posted speed limit of 110 km/h);
- Coefficient of deceleration of 0.36 (desirable minimum value).

The assessment of the sight distances for the key intersections and site access points using the values above are discussed in Section 6.

5. Projected Traffic Generation and Impacts

5.1 Generated Traffic

5.1.1 Construction Phase (Phase 1) Traffic Generation

Estimated construction vehicle trip movements per construction stage are detailed in the following tables. The movements are shown per stage of (anticipated) 400MW wind, 200MW solar and 300MW battery instead of over the entire construction phase for Goyder South (three stages). This is due to:

- A stage comprising 400MW of wind will, with today's turbine technology, consist of approximately 66 turbines. While this is more than one third of the turbine locations proposed in the DA, it represents a good 'worst case scenario' for traffic impacts. Neoen also anticipates that the MW capacity of turbines will continue to increase with time such that subsequent stages of approximately 400MW will consist of fewer turbines;
- The three construction stages are assumed to be of equal size and therefore equal for vehicles movements generated;
- The three construction stages are expected to have minor overlap. This overlap will not be over the peak of the construction stages, noting that the peak traffic generated is expected to be over a 10-month period in the middle of the stage;
- Therefore, a single construction stage has been considered instead of the entire construction phase (three stages) to inform the assessment of traffic impact on the existing road users.

An increase of 10% has been applied by Jacobs to the estimated one-way trips for construction vehicles listed in the tables below (see Revised Estimated Total trips (one way) column). This is to allow for any unforeseen increases in trip movements during the construction phase. The 10% contingency has not been applied to the tower sections, blades, hubs and nacelles as there is a fixed number of these components for the project.

Table 5-1: Estimated total construction traffic per stage for wind turbine components

Components		Estimated Total Construction Traffic per Stage for Turbine components over one construction stage (18-24 months).		
		Estimated Total Trips (One Way).	Revised (Additional 10%) Estimated Total Trips (One Way).	Vehicle Type to Transport Components
Tower Sections (7 per WTG)**	Length up to 33.0 meters Diameter up to 6.3 meters Weight up to 90,000 kgs	462	462#	Heavy Duty Semi-trailer (Over Size / Over Mass)
Blades (3 per WTG)***	Length up to 81.1 meters	198	198#	Extended Articulated Vehicle (Over Size)
Hubs & Transformers*	Length up to 8.5 meters Width up to 4.5 meters Height up to 5.0 meters Weight up to 130,000 kgs	66	66#	Heavy Duty Semi-trailer (Over Size / Over Mass)
Drive Trains	Length up to 7.5 meters Width up to 2.7 meters Height up to 3.0 meters Weight up to 105,360 kgs	66	66#	Heavy Duty Semi-trailer (Over Size / Over Mass)
Nacelle*	Length up to 18.18 meters Width up to 4.2 meters Height up to 4.35 meters	66	66#	Heavy Duty Semi-trailer (Over Size / Over Mass)

Components		Estimated Total Construction Traffic per Stage for Turbine components over one construction stage (18-24 months).		
		Estimated Total Trips (One Way).	Revised (Additional 10%) Estimated Total Trips (One Way).	Vehicle Type to Transport Components
	Weight up to 98,985 kgs			
Cooler Top	Length up to 3.0 meters Width up to 5.2 meters Height up 2.3 meters Weight up to 2,333 kgs	66	66#	Semi-trailer
Tools – Shipping Containers		356	392	Semi-trailer
Crane equipment		50	55	Trucks
		2	3	Cranes
Pilot Vehicles		1650	1650#	Light Vehicles
Total Light Vehicle Movements (one-way)		1650	1650	Car / Light Vehicles
Total Heavy Commercial Vehicle (HCV) Movements (one-way)		356 + 66 + 50 = 472	392 + 66 + 55 = 513	HCVs
Total Over Size / Over Mass (OSM) Vehicle Movements (one-way)		860	861	OSM Vehicles

- * assumed one pilot vehicle required based on component dimensions (number of pilots may be more than one, and to be determined on a case by case basis for each load)
- ** assumed two pilot vehicles required based on component dimensions (number of pilots may be more than two, and to be determined on a case by case basis for each load)
- *** assumed three pilot vehicles required based on component dimensions (number of pilots may be more than three, and to be determined on a case by case basis for each load)
- # based on fixed number of components to be transported

Table 5-2: Estimated total construction traffic per stage for other construction materials

Components	Estimated Total Construction Traffic for Other Construction Materials over one construction stage (18-24 months)			Comment
	Estimated Total Trips (One Way)	Revised Estimated Total Trips (One Way)	Vehicle Type	
<u>Foundations and Road Materials</u>				
WTG foundations and substation foundations (Concrete materials: sand, cement, potable water)	1,848	2,033	Semi-trailer / B-double	Materials delivered to the on-site concrete batch plant, then batched and delivered to the foundation in a concrete agitator
Reinforcement	198	218	Semi-trailer	
Pavement materials for access tracks and hardstands	1,980	2,178	Semi-trailer / B-double	Estimated trips for 50% material imported from off-site quarry. Assume 50% imported and 50% sourced on-site.
Pavement materials for benches	200	220	Semi-trailer / B-double	Site facilities bench, concrete batch plant bench, substation bench, laydown area bench, O&M building bench

Components	Estimated Total Construction Traffic for Other Construction Materials over one construction stage (18-24 months)			Comment
	Estimated Total Trips (One Way)	Revised Estimated Total Trips (One Way)	Vehicle Type	
Water for dust suppression and material conditioning	1,188	1,307	Semi-trailer tanker	
Misc. deliveries	50	55	Semi-trailer / B-double	Drainage infrastructure, fencing, gates, conduits, etc
<u>Electrical Equipment</u>				
Substation transformers	2	2#	Heavy Duty Semi-trailer (Over Size / Over Mass)	Typical Physical Parameters of 240MVA transformers: Height (m) = 5.0 Width (m) = 4.5 Length (m) = 8.5 Weight (Tonnes) = 130
Kiosk transformers	1	1	Semi-trailer / B-double	
Underground cables	100	110	Semi-trailer / B-double	Typical Physical Parameters – MV cable drum: Height (m) = 3.3 Width (m) = 2.2 Weight (Kg) = 7800
Misc. substation equipment – substation building	1	1#	Heavy Duty Semi-trailer (Over Size / Over Mass)	Typical Physical Parameters – substation building: Length (m) = 30 Width (m) = 5.5 Height (m) = 3.5 Weight (Kg) = 120,000
Solar components	2,880	3,168	A-doubles / B-doubles	
Battery components	350	385	A-doubles / B-doubles	
Pilot Vehicles	6	6#	Light Vehicles	
Total Light Vehicle Movements (one-way)	6	6	Car / Light Vehicles	
Total Heavy Commercial Vehicle (HCV) Movements (one-way)	8,795	9,675	HCVs	
Total Over Size / Over Mass (OSM) Vehicle Movements (one-way)	3	3	OSM Vehicles	

based on fixed number of components to be transported

Table 5-3: Estimated total construction traffic per stage for construction staff traffic and site establishment / demobilisation

Components	Estimated Total for Construction Staff and Work Site Activity over one construction stage (18-24 months)			Comment
	DA Estimated Total Trips (One Way)	Revised Estimated Total Trips (One Way)	Vehicle Type	
Site Establishment – Site Facilities	20	22	Semi-trailer / B-double	Portable office modules, water tanks, generator, etc
Site Establishment – Construction Equipment	30	33	Semi-trailer / B-double	Standard excavators, rollers, trenching machines, etc
Site Establishment – Construction Equipment – OSM**	10	11	Heavy Duty Semi-trailer (Over Size / Over Mass)	Large excavators, bulldozers, etc
Site Demobilisation – Site Facilities	20	22	Semi-trailer / B-double	Portable office modules, water tanks, generator, etc
Site Demobilisation – Construction Equipment	30	33	Semi-trailer / B-double	Standard excavators, rollers, trenching machines, etc
-Site Demobilisation – Construction Equipment – OSM**	10	11	Heavy Duty Semi-trailer (Over Size / Over Mass)	Large excavators, bulldozers, etc
Staff and Contractors	40,750	44,825	Car / Light Vehicles	Assumed 100 vehicles per day for a peak of 6 months, 50 vehicles per day for 12 months, and 25 vehicles per day for 6 months
Site Personnel and Misc. – Solar	1,000	1,100	Heavy Vehicle	
	43,200	47,520	Car / Light Vehicles	
Site Personnel and Misc. – Battery	5,400	5,940	Car / Light Vehicles	
Pilot Vehicles	40	44	Light Vehicles	
Total Light Vehicle Movements (one-way)	89,390	98,329	Car / Light Vehicles	
Total Heavy Commercial Vehicle (HCV) Movements (one-way)	1,100	1,210	HCVs	
Total Over Size / Over Mass (OSM) Vehicle Movements (one-way)	20	22	OSM Vehicles	

** assumed two pilot vehicles required (number of pilots may be more than two, and to be determined on a case by case basis for each load)

5.1.2 Operation and Maintenance Phase (Phase 2) Traffic Generation

The traffic associated with the long-term operation of the Goyder South development will be minimal. This phase involves the *commissioning and testing* and then the ongoing *operations and maintenance*. The commissioning and testing will require attendance by a number of technical and maintenance staff on a daily basis for a period of up to 6 months directly after the construction phase 1 is complete. The vehicles used will be typically commercial vehicles such as light vehicles and four-wheel drives.

As the commissioning and testing is completed, the development phase will move into the operations phase. The traffic generated during the operations phase is significantly lower than the construction phase and the traffic impacts on the surrounding area will therefore be minimal. The traffic generated during the operations phase will consist largely of the following:

- Permanent on-site operations personnel (most likely living locally) travelling to and from their homes to the operations and maintenance (O&M) compound/site office on a daily basis in light vehicles and four-wheel drives;
- Routine inspection and maintenance by operations personnel (most likely living locally) travelling from the O&M compound/site office to the substations, turbines and solar arrays on a daily basis in light vehicles and four-wheel drives. Note that only a few turbines or a small section of solar array would be subject to inspection and maintenance per day.
- Heavy maintenance or repair deliveries travelling to the O&M compound/site office, substations, turbines and panel arrays on an as-required (rare) basis to deliver key spares, consumables or components. Some trips may be from interstate where items are not available locally.

5.1.3 Decommissioning / Renewal Phase (Phase 3) Traffic Generation

Two options may be considered towards the end of the lifespan of the Goyder South project. These options are (1) to decommission the site, or (2) to renew the site. Regardless of which option is chosen, both options will require the removal of the wind turbines and solar panels. Traffic generation will likely be less than during the construction phase (as most of the concrete associated with the turbines foundations is anticipated to be left in the ground and covered over to minimise ecological disturbance). If the project is renewed, a separate Development Application will be required, which is outside the scope of this TIA.

The traffic generation and impacts should be re-assessed around the time when the site will be decommissioned or renewed, as the baseline traffic conditions on the road network will likely be changed over the lifespan of Goyder South.

5.2 Traffic Impacts

The impact of the generated traffic during the construction stage has been divided into three categories:

- Light Vehicle traffic (e.g. 4WDs and cars) associated with staff movements to and from the construction site.
- Heavy Commercial Vehicles (e.g. >2-tonne trucks, semi-trailers, dump trucks etc.) associated with deliveries to site that will travel on State controlled roads.
- Over Size and/or Over Mass vehicles associated with haulage of large turbine components (e.g. blades, nacelles, tower sections) to site that may only travel under NHVR and DPTI permit.

To evaluate impacts of generated traffic on the capacity of the adjacent road system, the estimated trips from Section 5.1.1 have been converted to daily traffic volumes in each category in the table below.

Table 5-4: Traffic generated during each construction stage (one-way)

Vehicle Type	Total Generated Traffic	Traffic During Peak Construction Period (months 5 - 14) (10 months = 261 working days)	Peak Daily Traffic between Months 5 and 14
Light Vehicles	$1,650 + 6 + 98,329 = 99,985$	79,988	306 trips/day
Heavy Commercial Vehicles (HCVs)	$513 + 9,675 + 1,210 = 11,398$	9,118	35 trips/day
Over Size / Over Mass (OSM) Vehicles	$861 + 3 + 22 = 886$	709	2 – 3 trips/day

Vehicle Type	Total Generated Traffic	Traffic During Peak Construction Period (months 5 - 14) (10 months = 261 working days)	Peak Daily Traffic between Months 5 and 14
Total	112,269	89,815	344 return vehicle trips/day

Note:

- It is assumed (as a worst case) that 80% of activity occurs within the ten (10) months peak construction period between Months 5 – 14.
- A six (6) day working week has been assumed.
- Each OSM vehicle is assumed to be accompanied by up to three pilot vehicles (which has been factored into the light vehicle numbers).

These generated daily trips (doubled to reflect two-way movements, i.e. 688 trips per day) may then be compared to the current daily traffic volumes along the two proposed routes (D1 and D2). A worst-case scenario is assumed where the traffic movements are solely along either Designated Route 1 or Designated Route 2, and not shared between them.

Table 5-5: Traffic impact along assessed highways and roads

Start (Intersecting Road)	Finish (Intersecting Road)	Existing VPD	Total (Existing + Generated) VPD	Traffic Increase (Existing vs. Total)	Existing HV%	Total HV% (Existing + Generated)
Horrocks Highway						
Barrier Highway	Tarlee Road	3400	4088	20%	11%	10%
Tarlee Road	Templers Road	3300	3988	21%	9.5%	9%
Templers Road	Roseworthy Road	4600	5288	15%	10.5%	10%
Roseworthy Road	Thiele Highway	6300	6988	11%	7%	7%
Barrier Highway						
Copperhouse Road	Farrell Flat Road	1300	1988	53%	21%	15.5%
Farrell Flat Road	Saddleworth Road	1000	1688	69%	23%	16%
Saddleworth Road	Belvidere Road	2100	2788	33%	17%	14%
Belvidere Road	Riverton Road	1600	2288	43%	18%	14%
Riverton Road	Horrocks Highway	1600	2288	43%	14.5%	12%
Goyder Highway						
Barrier Highway	Landore Street	800	1488	86%	20%	13.5%
Landore Street	Koorunga Road	470	1158	146%	25.5%	13.5%
Koorunga Road	Eastern Road	650	1338	106%	20%	12.5%
Eastern Road	Worlds End Highway	600	1288	115%	23.5%	14%
Worlds End Highway						

Start (Intersecting Road)	Finish (Intersecting Road)	Existing VPD	Total (Existing + Generated) VPD	Traffic Increase (Existing vs. Total)	Existing HV%	Total HV% (Existing + Generated)
Goyder Highway	Powerline Road	130	818	529%	28.5%	9%
Powerline Road	East Road	170	858	405%	23%	9%
East Road	Second Avenue	550	1238	125%	15.5%	10%
Second Avenue	Cutting Road	380	1068	181%	16%	9.5%
Cutting Road	Australia Plains Road	600	1288	115%	14%	9.5%
Thiele Highway						
Horrocks Highway	Gray Street	4800	5488	14%	8%	7.5%
Gray Street	Hanson Street	3400	4088	20%	9%	8.5%
Hanson Street	Greenock Road	2900	3588	24%	11%	10%
Greenock Road	Perry Road	3800	4488	18%	12%	11%
East Terrace	Curio Highway	1200	1888	57%	11%	9%
Curio Highway	Gunn Street	1500	2188	46%	12%	10%
Gunn Street	Three Chain Road	600	1288	115%	18.5%	11.5%

From a traffic capacity viewpoint, the impact of the construction traffic is not considered significant. Although the % increase on some roads is substantial and sometimes more than doubled the existing volume, the roads have spare capacity to accommodate the increase volume, therefore impact is not considered significant.

The roads and highways operating level based on the figures from the table above is as following:

- Horrocks Highway: Level of Service (LOS) "A" (i.e. uncongested) for existing traffic and with construction traffic.
- Barrier Highway: Level of Service (LOS) "A" (i.e. uncongested) for existing traffic and with construction traffic.
- Goyder Highway: Level of Service (LOS) "A" (i.e. uncongested) for existing traffic and with construction traffic.
- Worlds End Highway: Level of Service (LOS) "A" (i.e. uncongested) for existing traffic and with construction traffic.
- Thiele Highway: Level of Service (LOS) "A" (i.e. uncongested) for existing traffic and with construction traffic.

The OSM vehicles will operate under pilot and may be pulled over when necessary to minimise traffic delay.

Although the impact is not considered significant, the following section of this report makes some recommendations for intersection upgrades to safely accommodate the construction and passing by traffic during the project.

6. Traffic Impact Assessment and Recommended Upgrades

The following section details the suitability of the designated routes regarding the impacts of traffic and transport related activities associated with the Goyder South project during the construction, operational and decommissioning / renewal phases of the project.

The project will generate additional traffic during the construction and operational phases, with the traffic generated during the construction phase to be far greater than that generated during the ongoing operational phase. The extra movement of traffic has been considered in this assessment.

Discussed first are the standards for minimum requirements of intersection geometry based on vehicle through and turning volumes. Discussed next is an assessment of the specific site access points with proposed recommended upgrades (if deemed necessary). Followed by an assessment of the designated routes (Route 1 and Route 2) leading to the development area with proposed recommended upgrades (where required).

6.1 Site Access Assessment and Recommended Upgrades

6.1.1 Site Access Upgrade Requirements

The standards for the upgrades of intersections are described below. The process of selecting an appropriate treatment includes consideration of:

- Safety of road users;
- Traffic volumes;
- Objectives for the road network;
- Topography and natural/built environment;
- Speed environment.

The following information regarding turn treatment types and selection is taken from the Austroads Guide to Traffic Management. The three types of unsignalised at-grade turn treatments, including considerations in selection between treatments are as follows (example intersection turn treatments are shown in **Appendix C**):

- Basic: Suitable for rural locations with low cross and turning volumes.
- Auxiliary: Suitable for rural locations where high-speed, low-volume traffic occurs and the volume and slow manoeuvring of turning traffic is sufficient to create a conflict with following traffic.
- Channelised: Suitable when turning traffic movements are heavy with frequent queuing, and where conflicting vehicle paths need to be separated.

The warrants for the preferred minimum treatments are shown in **Figure 6-1**, these warrants were used for treatment selection for the route network intersection upgrades. As the available information regarding traffic volumes on the major roads/highways is for vehicles per day, assumptions have been made for vehicles per hour based on the vehicles per day value. The assumption made is that the vehicles per hour volume is 20% of the vehicles per day volume (worst-case scenario). This number was chosen with consideration to peaks which may occur in the morning or afternoon when residents are travelling to/from work.

Assumptions have also been made regarding the turning volumes as there is no known information. Given the low amount of rural property access from the site access points (T2, T4, T5), the assumption made is that the turning existing volumes per hour are 5% of the existing vehicles per hour value (worst-case scenario). For site access points (T1, T3), there are no existing turning volumes as they will be new intersections. An assumption has also been made that the estimated construction vehicles per hour is 20% of the estimated construction vehicles per day (calculated in Section 5). Another assumption has been made that the construction vehicles per hour equals the turn volumes per hour.

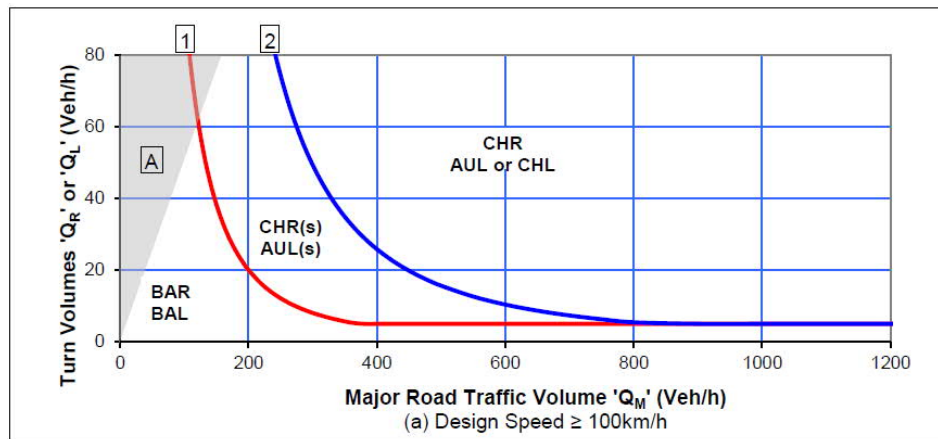
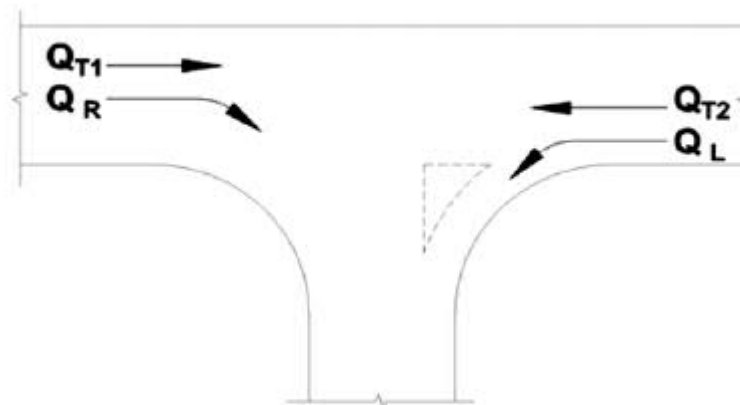


Figure 6-1: Warrants for turn treatments on major roads at unsignalised intersections (Austroads – Guide to Traffic Management).



Road type	Turn type	Splitter island	Q_M (veh/h)
Two-lane two-way	Right	No	$= Q_{T1} + Q_{T2} + Q_L$
		Yes	$= Q_{T1} + Q_{T2}$
	Left	Yes or no	$= Q_{T2}$

Figure 6-2: Calculation of major road traffic volume Q_M (Austroads – Guide to Traffic Management).

6.1.2 Site Access Upgrade Introduction

The proposed Goyder South development will be accessed via five entry points (T1 to T5) along the following highways (Figure 6-3):

- Worlds End Highway (T1, T2, T3)
- Goyder Highway (T4)
- Barrier Highway (T5).

Access points T1, T3, T4 and T5 currently exist and access points T2 will be created as part of this development.

Discussed in the sections below are the following:

- The existing conditions of the access points (T1, T3, T4, T5) or roads at the proposed access points (T2).
- An assessment of their suitability for the movements of construction vehicles.

- Proposed recommended upgrade requirements dependent on the assessment outcome.

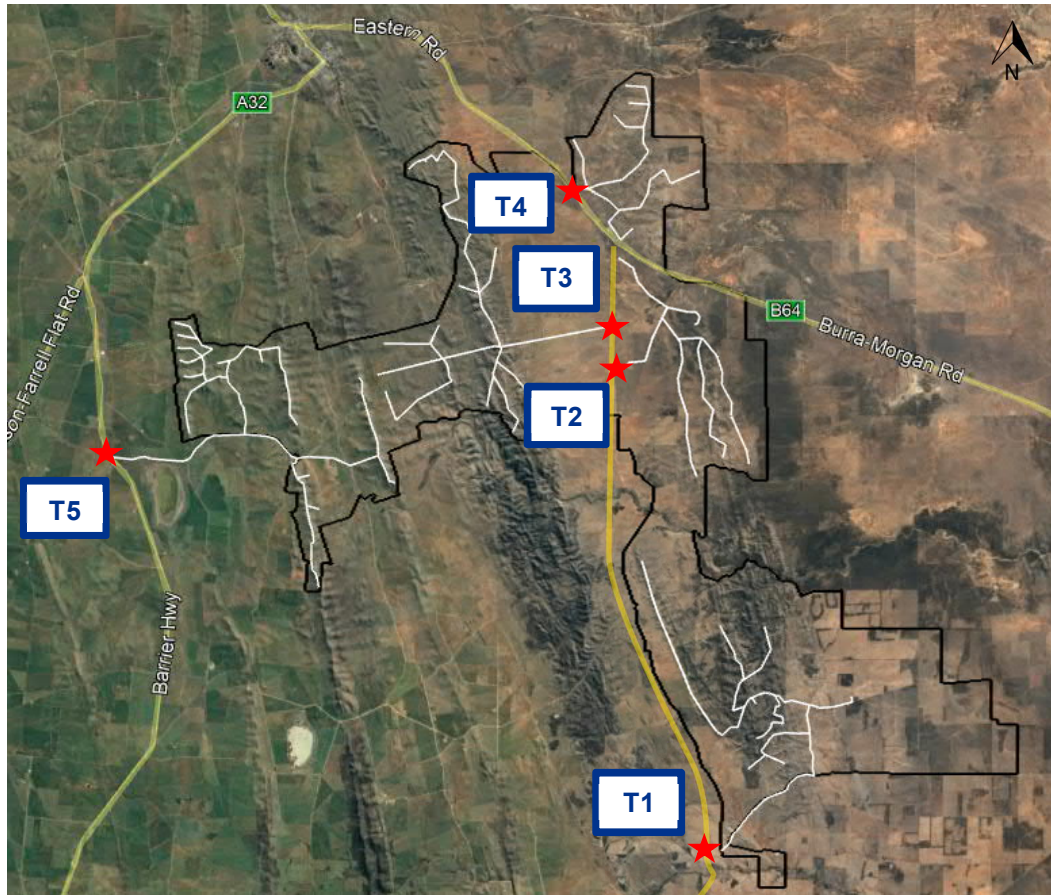


Figure 6-3: Site Access Points to Goyder South

6.1.3 Access Point T1

The existing access point for this area is at the intersection of the Worlds End Highway and Powerline Road. Site access is proposed to be on the eastern side of the highway. **Figure 6-4** below shows aerial imagery and the street view.



Figure 6-4: Aerial image of T1 access point (left) (MetroMap 2020). Proposed T1 access point location looking north along the Worlds End Highway (right) (Google Maps 2014)

At this location, the Worlds End Highway has a sealed width of approximately 8m, with 3.7m wide lanes with unsealed shoulders and a 110km/h speed limit applies. In the vicinity of the existing intersection, the highway also has broken barrier line permitting vehicles to overtake when travelling northbound only, which commences for 100m south of the intersection as the highway exits a curve located south of the intersection, and continues for 150m north. South of this, the highway has double barrier lines, and to the north the highway has a single broken barrier line. The highway also has continuous edge lines the whole length. Little vegetation was observed on the side of the road.

There are existing 170 two-way recorded vehicles per day travelling along this section of the highway, which is considered relatively low. There is expected to be a generated additional of up to 688 two-way vehicles (612 light vehicles, 73 heavy vehicles, 3 OSM vehicles) per day during the peak of the construction phase. This is a significant increase compared to its existing volumes, but can be accommodated by the current configuration. **Table 6-1** below shows the known and assumed movement volumes considered for the turn treatment assessment.

Table 6-1: Major road traffic volume (VPD / VPH) and Turn Volumes for Access Point 1.

Existing Vehicles Per Day (VPD)		Assumed Existing Vehicles Per Hour (VPH)		Estimated Construction Vehicles Per Hour (VPH)	Total Vehicles Per Hour (VPH)
170		34		138	172
		Assumed Turn Volumes Per Hour		Estimated Construction Turn Volumes Per Hour	Total Turn Volumes Per Hour
		3		138	141
Q _{T1}	Q _{T2}	Q _R	Q _L	Q _{M(R)} = Q _{T1} + Q _{T2} + Q _L	Q _{M(L)} = Q _{T2}
15	16	70	71	102	16

It is assumed that all construction OSM vehicles will approach T1 access from the south (i.e. travelling in a northbound direction), and all other construction light and heavy vehicles and will approach equally from both the north and south.

Given the total vehicles per hour and turn volumes per hour in the table above, and **Figure 6-1**, the recommendation is that a new intersection be installed conforming to DPTI, Council, and Austroads requirements to safely accommodate the construction and passing by traffic during the project. The recommendation is to provide the following turn treatments for the new Access Point 1 on Worlds End Highway:

- Basic right turn (BAR) on the major road.
- Basic left turn (BAL) on the major road.

- Basic left turn (BAL) on the minor road.

The other recommendations to improve safety at the new access point are as follows:

- Provide double two-way barrier lines (i.e. no overtaking), with a break in the barrier lines at the intersection.
- Provide a 50m sealed apron (50m sealed road from the highway) along the new access road.

6.1.4 Access Point T2

There is currently no existing site access point for this location. Site access is proposed to be on the eastern side of the highway, approximately 3km south of Duttons Trough Road and 1.8km north of Satchell Road.

Figure 6-5 below shows aerial imagery and the street view.



Figure 6-5: Aerial image of T2 access point (left) (MetroMap 2020). Proposed T2 access point location looking south along the Worlds End Highway (right) (Google Maps 2014).

At this location, the Worlds End Highway has a sealed width of approximately 8m, with 3.7m wide lanes and sealed shoulders and a 110km/h speed limit applies. The highway also has single broken barrier lines and continuous edge lines. The highway is straight and flat, where sight distances along the highway are more than adequate to meet the minimum requirement of 279m.

There are an existing 130 two-way recorded vehicles per day travelling along this section of the highway, which is considered relatively low. There are also currently no left-turn or right-turn treatments at the intersection. There is expected to be a generated additional of up to 688 two-way vehicles (612 light vehicles, 73 heavy vehicles, 3 OSM vehicles) per day during the peak of the construction phase. Although this is a significant increase compared to its existing volumes, this increase can be accommodated by the current road configuration. **Table 6-2** below shows the known and assumed movement volumes considered for the turn treatment assessment.

Table 6-2: Major road traffic volume (VPD / VPH) and Turn Volumes for Access Point 2.

Existing Vehicles Per Day (VPD)	Assumed Existing Vehicles Per Hour (VPH)	Estimated Construction Vehicles Per Hour (VPH)	Total Vehicles Per Hour (VPH)
130	26	138	164

		Assumed Turn Volumes Per Hour		Estimated Construction Turn Volumes Per Hour	Total Turn Volumes Per Hour
		2		138	140
Q_{T1}	Q_{T2}	Q_R	Q_L	$Q_{M(R)} = Q_{T1} + Q_{T2} + Q_L$	$Q_{M(L)} = Q_{T2}$
12	12	69	71	95	12

It is assumed that all construction OSM vehicles will approach T2 access from the north (i.e. travelling in a southbound direction), and all other construction light and heavy vehicles will approach equally from both the north and south.

Given the total vehicles per hour and turn volumes per hour in the table above, and **Figure 6-1**, upgrades to this intersection will be required conforming to DPTI, Council, and Austroads requirements as the existing turning treatments are insufficient to safely accommodate the construction and passing by traffic during the project. The recommendation is to maintain the following turn treatments at the existing intersection:

- Basic right turn (BAR) on the major road.
- Basic (BAL) on the major road.
- Basic left turn (BAL) on the minor road.

It is important to note that the turn treatments are recommended due to the increase in volumes from the construction traffic, and not due to the existing traffic volumes. The other recommendations to improve safety at the access point are as follows:

- Provide double two-way barrier lines (i.e. no overtaking), with a break in the barrier lines at the intersection.
- Provide a 50m sealed apron (50m sealed road from the highway) along Satchell Road.

6.1.5 Access Point T3

The existing access point for this area is at the intersection of the Worlds End Highway and Duttons Trough Road (located approximately 2.1km south of Goyder Highway / Worlds End Highway junction). Site access is proposed to be on the western side of the highway. **Figure 6-6** below shows aerial imagery and the street view.



Figure 6-6: Aerial image of T3 access point (left) (MetroMap 2020). Proposed T3 access point location looking south along the Worlds End Highway (right) (Google Maps 2014).

At this location, the Worlds End Highway has a sealed width of approximately 8m, with 3.7m wide lanes with unsealed shoulders and a 110km/h speed limit applies. The highway also has single broken barrier lines and continuous edge lines. The highway is straight and flat, where sight distances along the highway are more than adequate to meet the minimum requirement of 279m.

As noted for Access Points 2 in the section above, there are an existing 130 two-way recorded vehicles per day travelling along this section of the highway, which is relatively low. There is expected to be a generated additional of up to 688 two-way vehicles (612 light vehicles, 73 heavy vehicles, 3 OSM vehicles) per day during the peak of the construction phase. Although this is a significant increase compared to its existing volumes, this increase can be accommodated by the current road configuration. **Table 6-3** below shows the known and assumed movement volumes considered for the turn treatment assessment.

Table 6-3: Major road traffic volume (VPD / VPH) and Turn Volumes for Access Point 3.

Existing Vehicles Per Day (VPD)		Assumed Existing Vehicles Per Hour (VPH)		Estimated Construction Vehicles Per Hour (VPH)	Total Vehicles Per Hour (VPH)
130		26		138	164
		Assumed Turn Volumes Per Hour		Estimated Construction Turn Volumes Per Hour	Total Turn Volumes Per Hour
		2		138	140
Q _{T1}	Q _{T2}	Q _R	Q _L	Q _{M(R)} = Q _{T1} + Q _{T2} + Q _L	Q _{M(L)} = Q _{T2}
12	12	69	71	95	12

It is assumed that all construction OSM vehicles will approach T3 access from the north (i.e. travelling in a southbound direction), and all other construction light and heavy vehicles will approach equally from both the north and south.

Given the total vehicles per hour and turn volumes per hour in the table above, and **Figure 6-1**, the recommendation is that a new intersection be installed conforming to DPTI, Council, and Austroads requirements as the existing turning treatments are insufficient to safely accommodate the construction and passing by traffic during the project. The recommendation is to provide the following turn treatments to the Worlds End Highway:

- Basic right turn (BAR) on the major road.
- Basic left turn (BAL) on the major road.
- Basic left turn (BAL) on the minor road.

The other recommendations to improve safety at the access point are as follows:

- Provide double two-way barrier lines (i.e. no overtaking), with a break in the barrier lines at the intersection.
- Provide a 50m sealed apron (50m sealed road from the highway) along the new access road.

6.1.6 Access Point T4

The existing access point for this area is at the intersection of the Goyder Highway and an Unnamed Road, which is on the eastern side of the highway which serves as a rural property access. **Figure 6-7** below shows aerial imagery and the street view.



Figure 6-7: Aerial image of T4 access point (left) (Google Earth 2018). Proposed T4 access point location looking north along the Goyder Highway (right) (pictures taken in 2019).

At this location, the Goyder Highway has a sealed width of approximately 10m, with 3.7m wide lanes and sealed shoulders and a 110km/h speed limit applies. The highway also has double two-way barrier lines with a break at the existing intersection and continuous edge lines. The highway is relatively straight and flat, however, sight distances are reduced by three trees. The trees are on the western side of the highway, one to the north and two to the south, which will need to be investigated at the detailed design stage. The southern trees reduce sight distances to approximately 80m, and the northern tree reduces sight distances to approximately 100m. The highway at this location therefore does not meet the minimum requirement of 279m. There are also currently no existing dedicated left-turn or right-turn treatments at the intersection.

There are 600 two-way recorded vehicles per day travelling along this section of the highway, which is considered relatively low. There is expected to be a generated additional of up to 688 two-way vehicles (612 light vehicles, 73 heavy vehicles, 3 OSM vehicles) per day during the peak of the construction phase, which is a roughly 115% increase compared to its existing volumes. **Table 6-4** below shows the known and assumed movement volumes considered for the turn treatment assessment.

Table 6-4: Major road traffic volume (VPD / VPH) and Turn Volumes for access point 4.

Existing Vehicles Per Day (VPD)		Assumed Existing Vehicles Per Hour (VPH)		Estimated Construction Vehicles Per Hour (VPH)	Total Vehicles Per Hour (VPH)
600		120		138	258
		Assumed Turn Volumes Per Hour		Estimated Construction Turn Volumes Per Hour	Total Turn Volumes Per Hour
		6		138	144
Q_{T1}	Q_{T2}	Q_R	Q_L	$Q_{M(R)} = Q_{T1} + Q_{T2} + Q_L$	$Q_{M(L)} = Q_{T2}$
57	57	71	73	187	57

Whilst the site distances are currently compromised at the access point because of the trees, it is still considered an appropriate location for T4 access.

It is assumed that all construction OSM vehicles will approach T4 access from the west (i.e. travelling in an eastbound direction), and all other construction light and heavy vehicles will approach equally from both the east and west.

Given the total vehicles per hour and turn volumes per hour in the table above, and **Figure 6-1**, upgrades to this intersection will be required to conform DPTI, Council, and Austroads requirements as the existing turning treatments are insufficient to safely accommodate the construction and passing by traffic during the project. The recommendation is to upgrade the intersection to provide for the following turn treatments:

- Channelised right turn (CHR) on the major road.
- Basic left turn (BAL) on the major road.
- Basic left turn (BAL) on the minor road.

It is important to note that the turn treatments are recommended due to the increase in volumes from the construction traffic, and not due to the existing traffic. The other recommendations to improve safety at the access point are as follows:

- Remove the existing three trees along the western side of the highway to meet the minimum required sight distance.
- Provide double two-way barrier lines (i.e. no overtaking), with a break in the barrier lines at the intersection.
- Provide a 50m sealed apron (50m sealed road from the highway) along the existing unnamed road.

6.1.7 Access Point T5

The existing access point for this area is at the intersection of the Barrier Highway and Porter Lagoon Road, on the eastern side of the highway. This intersection is approximately 350m north-west of Neill Road. **Figure 6-8** below shows aerial imagery and the street view.

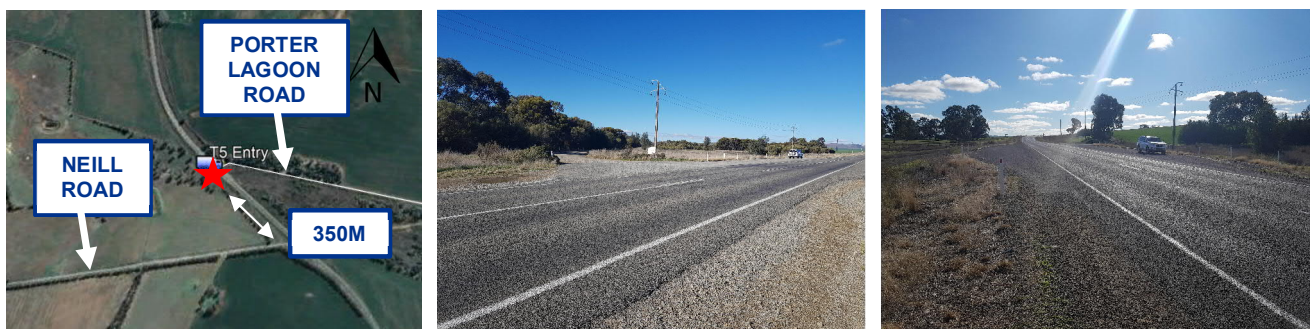


Figure 6-8: Aerial image of proposed T5 access point location (left) (Google Earth 2018). Street view looking south-east along the Barrier Highway (middle, left) (pictures taken in 2019).

At this location, the Barrier Highway has a sealed width of approximately 10m, with 3.7m wide lanes and sealed shoulders and a 110km/h speed limit applies. The highway at this location also has double one-way barrier lines, with vehicles permitted to overtake heading south. The highway is flat in this vicinity, however contains two slight bends to the north and south which reduces the sight distance for vehicles driving in either direction. Sight distances along the highway are approximately 200m to the north, which does not meet the minimum requirement of 279m and 500m to the south, which does meet the minimum requirement.

There are 1000 recorded vehicles per day travelling along this section of the highway. There is expected to be a generated additional of up to 688 two-way vehicles (612 light vehicles, 73 heavy vehicles, 3 OSM vehicles) per day during the peak of the construction phase, which is a 69% increase compared to its existing volumes. **Table 6-5** below shows the known and assumed movement volumes considered for the turn treatment assessment.

Table 6-5: Major road traffic volume (VPD / VPH) and Turn Volumes for access point 5.

Existing Vehicles Per Day (VPD)		Assumed Existing Vehicles Per Hour (VPH)		Estimated Construction Vehicles Per Hour (VPH)	Total Vehicles Per Hour (VPH)
1000		200		138	338
		Assumed Turn Volumes Per Hour		Estimated Construction Turn Volumes Per Hour	Total Turn Volumes Per Hour
		10		138	148
Q _{T1}	Q _{T2}	Q _R	Q _L	Q _{M(R)} = Q _{T1} + Q _{T2} + Q _L	Q _{M(L)} = Q _{T2}

95	95	75	73	263	95
----	----	----	----	-----	----

It is assumed that all construction OSM vehicles will approach T5 access from the south (i.e. travelling in a northbound direction), and all other construction light and heavy vehicles will approach equally from both the north and south.

There are currently no existing left-turn treatments on either the major or minor road. Regarding right-turn treatment, there is an approximate 60m long and 5m wide extended sealed shoulder on the north-western side of the intersection, as seen in **Figure 6-8**. Ideally, the treatment should extend north-west past the intersection. However, the sealed shoulder extends far enough for a vehicle performing the right turn movement.

Given the total vehicles per hour and turn volumes per hour in the table above, and **Figure 6-1**, upgrades to this intersection will be required conforming to DPTI, Council, and Austroads requirements as the existing turning treatments are insufficient to safely accommodate the construction and passing by traffic during the project. The recommendation is to provide the following turn treatments to the intersection:

- Channelised right turn (CHR) on the major road.
- Basic left turn (BAL) on the major road.
- Basic left turn (BAL) on the minor road.

It is important to note that the turn treatments are recommended due to the increase in volumes from the construction traffic, and not due to the existing traffic. The other recommendations to improve safety at the access point are as follows:

- Provide a 50m sealed apron (50m sealed road from the highway) along Porter Lagoon Road.

6.2 Designated Routes Assessment and Recommended Upgrades

A summary of the gazetted levels of the two routes (D1 and D2) proposed in Section 3.3 are listed in **Table 6-6** below.

Table 6-6: Maximum gazetted PBS Level along the highways and roads for routes D1 and D2

	Horrocks Highway	Barrier Highway	Goyder Highway	Worlds End Highway	Copperhouse Road	Thiele Highway	East Terrace	Three Chain Road
D1	3A	3A	3A	2A	3A	-	-	-
D2	3A	3A	3A	2A	3A	2B	26m B-Double	2A

Due to the existing limitations mentioned in the existing conditions (Section 3.4) and the lower gazetted levels of roads along D2, D1 is recommended to be used as the route for over size and over mass vehicles, with the exception of over size vehicle access to Access T5.

Either D1 or D2 will be suitable for other traffic and transport movements during the project lifespan, provided that the vehicles meet the routes gazetted level.

As both routes will be used for the over size and over mass vehicles, it requires an investigation and assessment into the existing conditions to determine whether the route can accommodate those vehicles or whether any upgrades are recommended.

6.2.1 Designated Route D1

Barrier Highway and Horrocks Highway Intersection

The intersection of the Horrocks Highway and Barrier Highway provides the link for vehicles travelling to the development area. **Figure 6-9** below shows screenshot from Google Maps (2014) of the Intersection.

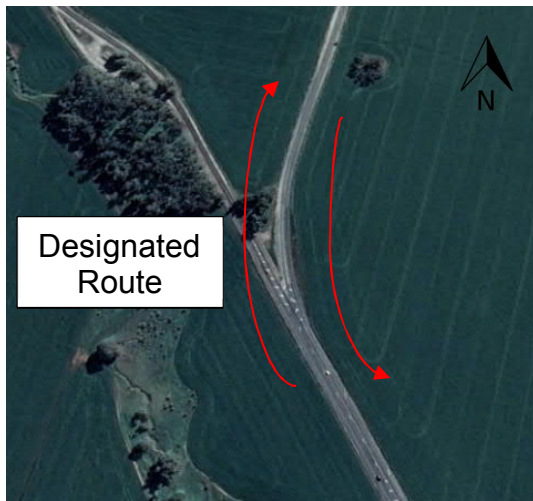


Figure 6-9: Barrier Highway and Horrocks Highway intersection, looking north along the Barrier Highway.

Both highways are relatively straight and flat, therefore there is a clear sight distance for vehicles driving in all directions. There is an existing approximate 150m dedicated right-turn lane for vehicles turning from Horrocks Highway onto the Barrier Highway. Travelling from the Barrier Highway onto Horrocks Highway, there is an approximate 250m left slip lane which merges onto the Horrocks Highway. Due to geometry constraints, there is no left-turn from the Horrocks Highway onto the Barrier Highway, and no right-turn from Barrier Highway onto the Horrocks Highway. The maximum gazetted vehicle size permitted through this intersection is a 36.5m Road Train (PBS Level 3A).

Noting the movement for over size vehicles to the proposed development occurs between Horrocks Highway south and Barrier Highway, the alignment of the intersection approaches is forgiving in the form of an obtuse angle, which should enable over sized vehicles to undertake this turn movement through the intersection under escort / traffic control without need for intersection upgrade works.

Upgrades to this intersection are not recommended due to the following:

- Current gazetted level – PBS Level 3A
- The existing turn treatments and sight distances are sufficient to safely accommodate the construction and residential traffic during the project.
- The intersection geometry for the turn movement is forgiving, which should enable over sized vehicles to undertake this turn movement through the intersection under escort / traffic control without need for intersection upgrade works.

Goyder Highway and Worlds End Highway Intersection

The intersection of the Goyder Highway and Worlds End Highway provides the link for vehicles transporting wind turbine components to the entry points along the Worlds End Highway, and the link for construction vehicles in the development area. Figure 6-10 below shows pictures taken in May of 2019.



Figure 6-10: Goyder Highway and Worlds End Highway intersection, left picture is looking north-east along the Worlds End Highway and right picture is looking south-east along the Goyder Highway.

At this location, the Goyder Highway has a sealed width of approximately 10m, with 3.7m wide lanes and sealed shoulders and a 110km/h speed limit applies. The highway at this location also has double two-way barrier lines. The Barrier Highway has a sealed width of approximately 10m, with 3.7m wide lanes and sealed shoulders and a 110km/h speed limit. The Barrier Highway also has a single barrier line. The highways are straight and flat, with sight distances more than adequate to meet the minimum requirement of 279m. There is currently no existing left-turn or right-turn treatments at the intersection.

Noting the movement for over size vehicles to the proposed development occurs between Goyder Highway east and Worlds End Highway, the intersection geometry is forgiving in that it is flat, wide and relatively barren of vegetation, which should enable the over size vehicles to take a wide berth under escort to safely travel through the intersection.

Table 6-7 below shows the known and assumed movement volumes considered for the turn treatment selection. The same process detailed in Section 6.1.1 of turn treatment selection is used below. An assumption has been made that the turn volumes per hour are 20% of the turn existing vehicles per hour volume, as both highways are major roads used for vehicle movements. The major road for this intersection is the Goyder Highway due to the higher number of vehicles per day travelling along the highway.

Noting the assumption that the number of access points in use would be limited to one at a time, with the development constructed as a rolling construction site, it is assumed that of the peak hour trips travelling through the intersection would occur when construction access is via either Access T2 or T3, which would see the greatest construction traffic volume through this intersection (i.e. with all construction OSM vehicles and half of the construction light and heavy vehicles approaching the intersection from the east or returning from the south).

Table 6-7: Major road traffic volume (VPD / VPH) and Turn Volumes for the Goyder Highway and Worlds End Highway Intersection.

Existing Vehicles Per Day (VPD)		Assumed Existing Vehicles Per Hour (VPH)		Estimated Construction Vehicles Per Hour (VPH)	Total Vehicles Per Hour (VPH)
600		120		138	258
		Assumed Turn Volumes Per Hour		Estimated Construction Turn Volumes Per Hour	Total Turn Volumes Per Hour
		13		138	151
Q _{T1}	Q _{T2}	Q _R	Q _L	Q _{M(R)} = Q _{T1} + Q _{T2} + Q _L	Q _{M(L)} = Q _{T2}
60	49	81	70	179	49

Given the total vehicles per hour and turn volumes per hour in the table above, and **Figure 6-1**, upgrades to this intersection installed conforming to DPTI and Austroads requirements are recommended as the existing turning treatments are insufficient to safely accommodate the construction (specifically transport of wind turbines) and

passing by traffic during the project. The recommendation is to provide the following turn treatments to the intersection:

- Channelised right turn (CHR) on the major road.
- Channelised left turn (CHL) on the minor road.

These turning treatments will allow other vehicles traversing the highways to overtake construction vehicles in either direction along both highways and allow sufficient turning paths for the construction vehicles transporting wind turbine components.

Copperhouse Road and Barrier Highway Intersection

The intersection of Copperhouse Road and Barrier Highway provides the link to the bypass of Burra. **Figure 6-11** below shows pictures taken in May of 2019.



Figure 6-11: Copperhouse Road and Barrier Highway intersection, looking east along the Barrier Highway.

At this location, the Barrier Highway has a sealed width (including slip lane) of approximately 14m, with 3.7m wide lanes and sealed shoulders and a 110 km/h speed limit applies. Barrier Highway at this location also has double two-way barrier lines. Copperhouse Road has a sealed width of approximately 8m, with 3.5m wide lanes and sealed shoulders and a 110km/h speed limit applies. The road also has double two-way barrier lines. Both Barrier Highway and Copperhouse Road are straight and flat, therefore there is a clear sight distance for vehicles driving in either direction, which is more than adequate to meet the minimum requirement of 279m.

There are currently existing turning treatments at this intersection for all turns. There is 3.7m slip lane for the left-turn from Barrier Highway onto Copperhouse Road. There is an approximate 2m wide sealed shoulder for vehicles passing other vehicles which are performing a right-turn from Barrier Highway to Copperhouse Road. There is also a give-way line and a sealed shoulder with chevrons for the left-turn from Copperhouse Road onto Barrier Highway.

Upgrades to this intersection are not recommended as the existing turn treatments (upgraded in 2019) and sight distances are sufficient to safely accommodate the construction and passing by traffic during the project.

Copperhouse Road and Goyder Highway Intersection

The intersection of Copperhouse Road and Goyder Highway provides the link to the bypass of Burra. **Figure 6-12** below shows screenshot from Google Maps (2015) of the Intersection.



Figure 6-12: Copperhouse Road and Goyder Highway intersection, looking north along Copperhouse Road.

At this location, the Goyder Highway has a sealed width of approximately 12m, with 3.7m wide lanes and sealed shoulders and an 80 km/h speed limit applies. Goyder Highway at this location also has a single barrier line. Copperhouse Road has a sealed width of approximately 8m, with 3.5m wide lanes and sealed shoulders and an 80km/h speed limit applies. Both Barrier Highway and Copperhouse Road are flat in this vicinity. Sight distances along the Goyder Highway at the intersection are approximately 200m to the north and 400m to the south-east (only the latter meets the minimum requirement of 279m).

There is currently an existing turning treatment at this intersection – a dedicated right-turn lane is provided from Goyder Highway onto Copperhouse Road. There is also a large sealed shoulder with chevrons for the left-turn from Copperhouse Road onto Goyder Highway. There is no turn treatment or sealed shoulder for the left-turn from Goyder Highway onto Copperhouse Road.

Noting the length of the wind turbine blades (up to 80m), it is anticipated that swept paths of these oversized components will encroach into the property directly west of the intersection in order to navigate this acute turn movement. Swept path analysis will need to be undertaken with the correct vehicle dimensions as part of the TMP.

As noted previously, the movements at this intersection form part of the OSM Routes (4.0m Wide up to 93.5t Low Loader and 4 Axle Crane Network) and PBS Route (Level 3A). Therefore, with consideration of existing conditions, upgrades to this intersection are not recommended.

Goyder Highway

The location shown on **Figure 6-13** below is a section of the Goyder Highway which passes through Burra with a significant curve through an urbanised environment.

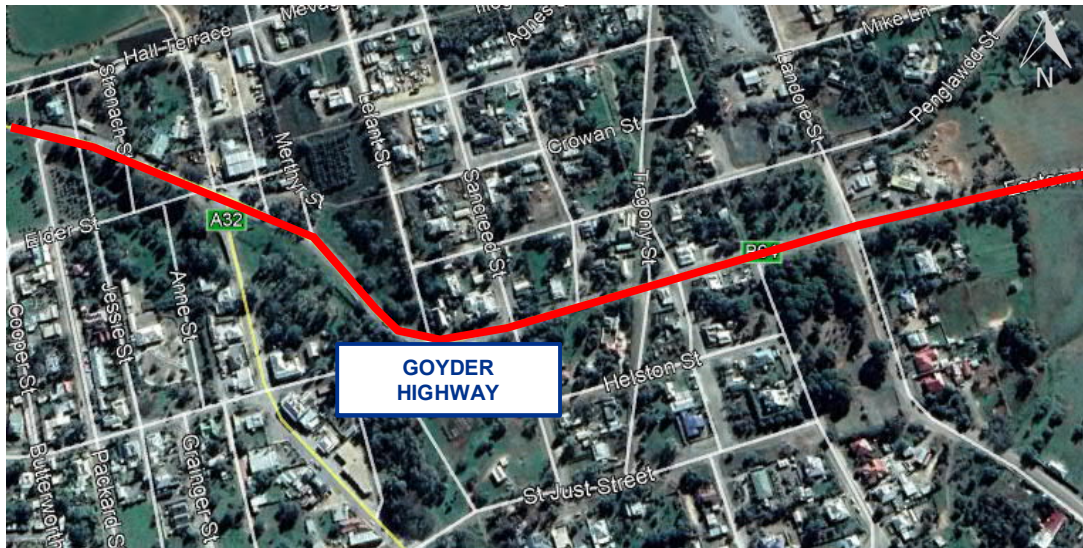


Figure 6-13: Bend in road along the Goyder Highway through Burra

It is likely that an over sized vehicle may require the full width of the roadway to navigate this bend, which could be safely undertaken under escort.

As noted previously, this route forms part of the OSM Routes (4.6m Wide up to 93.5t Low Loader and 4 Axle Crane Network) and PBS Route (Level 3A).

6.3 Council Road Assessment and Recommended Upgrades

There is a local road network in the Goyder South site which is accessed from the T5 access point and is proposed to be used for over size vehicle movements. These roads are shown on **Figure 3-18** in Section 3.5.4.

6.3.1 Intersection Assessment and Recommended Upgrades

The following intersections were assessed due to possible priority, site distance, and over size vehicle swept path issues.

Porter Lagoon Road and Springbank Road Intersection

The intersection between Porter Lagoon Road and Springbank Road shown in **Figure 6-14** below. Porter Lagoon Road at this intersection is noted to be used for construction vehicles, whereas Springbank Road at this intersection is not noted to be used. It can be seen from the intersection geometry that there is no clear right of way distinction between vehicles travelling south-east on Porter Lagoon Road, and for vehicles travelling south-east from Springbank Road onto Porter Lagoon Road. There is also expected to be a minimum 18-month construction period. For the reasons above, priority signage is recommended.

At the intersection between Porter Lagoon Road and Springbank Road, a give-way sign is recommended to be installed on the lead into the intersection from Springbank Road, in order that traffic on Springbank Road is directed to yield priority to traffic on Porter Lagoon Road.

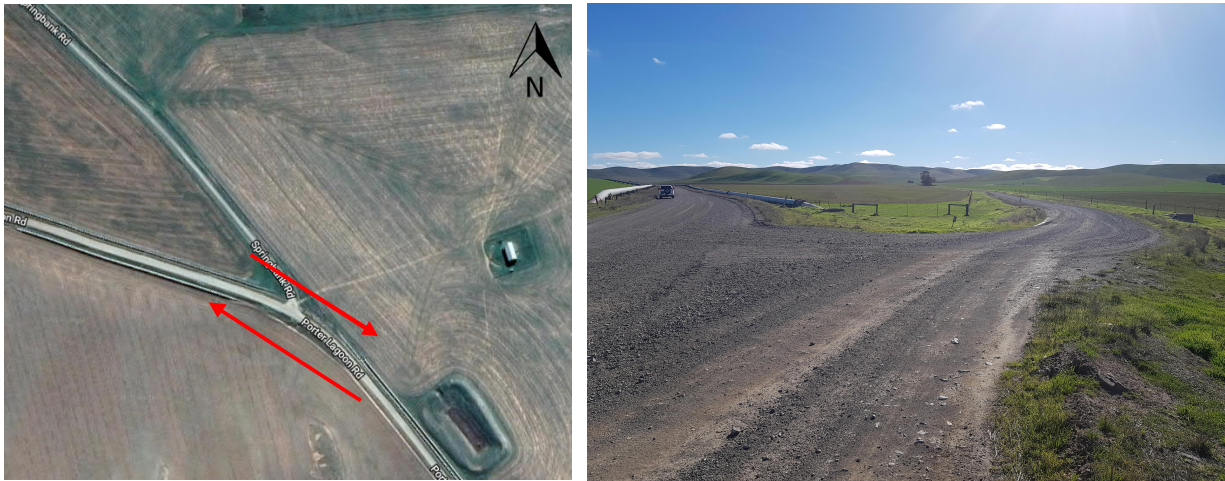


Figure 6-14: Intersection of Porter Lagoon Road and Springbank Road (left). Construction vehicle movements marked with red arrows. Photo taken at intersection looking north-east in May 2019 (right).

Porter Lagoon Road and Koonoona Road Intersection

The intersection between Porter Lagoon Road and Koonoona Road is shown below in **Figure 6-15**. Both roads in this area are noted to be used for construction vehicles.



Figure 6-15: Intersection of Porter Lagoon Road and Koonoona Road. Construction vehicle movements marked with red arrows.

As the roads at the intersection are perpendicular to one another, and noting the length of the wind turbine blades (up to 80m), it is anticipated that swept paths of these oversized components will encroach into the property directly west of the intersection in order to navigate this turn movement. Swept path analysis will need to be undertaken with the correct vehicle dimensions as part of the TMP.

Koonoona Road and Turner Road Intersection

The intersection between Koonoona Road and Turner Road is shown in **Figure 6-16** below. Both roads in this area are noted to be used for construction vehicles. It can be seen that there is no clear right of way distinction between vehicles travelling east on Koonoona Road and vehicles travelling east on Koonoona Road onto Turner Road. There is also expected to be a minimum 18-month construction period. For the reasons above, priority signage is recommended.

At the intersection between Koonoona Road and Turner Road, a give-way sign is recommended to be installed on the lead into the intersection from Turner Road, so that traffic travelling on Turner Road is directed to yield priority to traffic travelling on Koonoona Road.



Figure 6-16: Intersection of Koonoona Road and Burra Road. Construction vehicle movements marked with red arrows.

Koonoona Road and Burra Road Intersection

The intersection between Koonoona Road and Burra Road is shown in **Figure 6-17** below. Koonoona Road at this area is noted to be used for construction vehicles, whereas Burra Road is not noted to be used. It can be seen that there is no clear right of way distinction between vehicles travelling north on Koonoona Road and vehicles travelling north from Burra Road onto Koonoona Road. There is also expected to be a minimum 18-month construction period. For the reasons above, priority signage is recommended.

At the intersection between Koonoona Road and Burra Road, a give-way sign is recommended to be installed on the lead into the intersection from Burra Road, so that traffic travelling on Burra Road is directed to yield priority to traffic travelling on Koonoona Road.



Figure 6-17: Intersection of Koonoona Road and Turner Road. Construction vehicle movements marked with red arrows.

Burra Road and Turner Road Intersection

The intersection between Burra Road and Turner Road is shown in **Figure 6-18** below. Turner Road at this area is noted to be used for construction vehicles, whereas Burra Road is not noted to be used. It can be seen that there is no clear right of way distinction between vehicles travelling south on Burra Road and vehicles travelling south from Turner Road onto Burra Road. There is also expected to be a minimum 18-month construction period. For the reasons above, priority signage is recommended.

At the intersection between Burra Road and Turner Road, a give-way sign is recommended to be installed on the lead into the intersection from Turner Road, so that traffic travelling on Turner Road is directed to yield priority to traffic travelling on Burra Road.

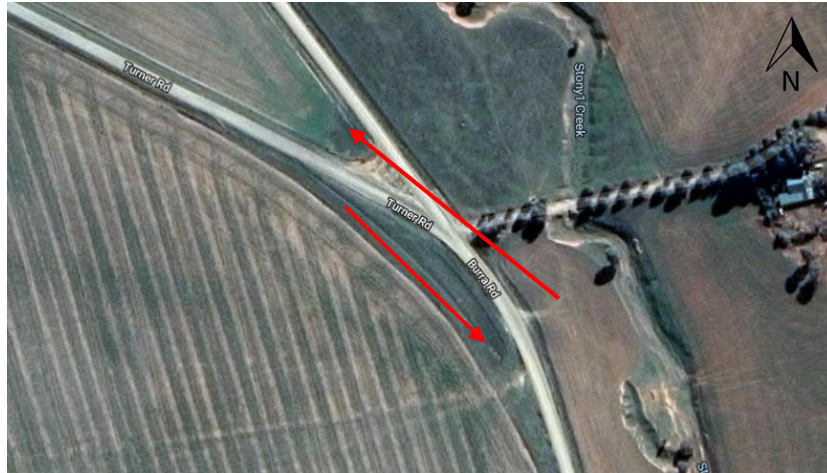


Figure 6-18: Intersection of Burra Road and Turner Road. Construction vehicle movements marked with red arrows.

Unnamed Road and Porter Lagoon Road Intersection

The intersection between the Unnamed Road and Porter Lagoon Road is shown below.



Figure 6-19: Intersection of Porter Lagoon Road and Unnamed Road

As the roads at the intersection are perpendicular to one another, and noting the length of the wind turbine blades (up to 80m), it is anticipated that swept paths of these oversized components will encroach into the property directly west of the intersection in order to navigate this turn movement. Swept path analysis will need to be undertaken with the correct vehicle dimensions as part of the TMP.

6.3.2 Horizontal Geometry Assessment and Recommended Upgrades

The following sections were assessed due to possible horizontal geometry restrictions along the council roads. No other constraints were identified along the council roads shown on **Figure 3-18**.

Springbank Road

The location shown in **Figure 6-20** below is located to the north of the unnamed road (refer **Figure 3-18** for reference).

Noting the switching turn movements along this section of Springbank Road, it is recommended that swept path analysis be undertaken with the correct vehicle dimensions as part of the TMP to determine whether any works are required to widen the road to enable the safe passage of over size vehicles.

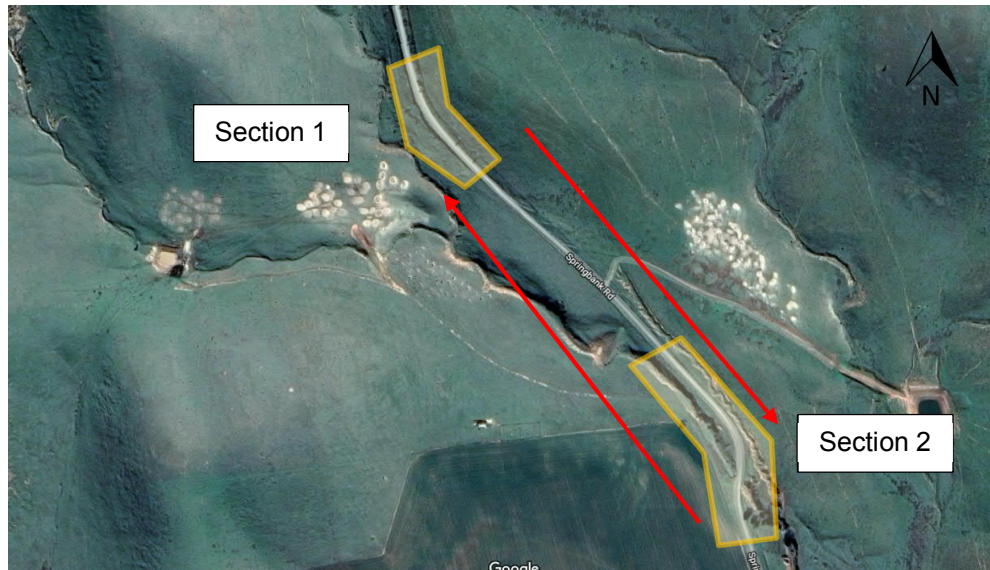


Figure 6-20: Sections along Springbank Road which require a swept path analysis

7. Findings and Recommendations

7.1 Site Accessibility

The assessment of the existing road conditions in the Goyder South development area identifies and recommends two routes to gain access to the development area. These routes are:

- Route 1: Sturt Highway – Horrocks Highway – Barrier Highway – Copperhouse Road – Goyder Highway – Worlds End Highway.
- Route 2: Sturt Highway – Horrocks Highway – Thiele Highway – East Terrace (bypass of Kapunda) – Thiele Highway – Three Chain Road (bypass of Eudunda) – Worlds End Highway – Goyder Highway – Copperhouse Road – Barrier Highway.

Route 1 is specifically recommended over Route 2 to be used for the over size and/or over mass vehicles. This is for the following reasons:

- Route 1 has a higher gazetted level.
- The road geometry and conditions of Route 1 do not pose limitations to the transport of the over size and/or over mass wind turbines components, whereas in Route 2 there were limitations identified. These constraints are located along Worlds End Highway north of Powerline Road. As such, Route 2 is only recommended for over size and/or over mass vehicles access via Access T5 (subject to relevant approvals and permits).

Either Route 1 or Route 2 will be suitable for other traffic and transport movements during the project lifespan provided that the movements meet the gazetted road levels. Route 1 may be necessary for some movements over Route 2 as Route 2 has some roads/highways with lower gazetted levels (e.g. PBS Level 2A and 2B).

7.2 Traffic Impacts

The assessment of the traffic impacts the increased traffic movements will have on the road network identified that the principal issues will be surrounding the construction phase. This is due to the delivery of over size and over mass equipment, and the high number of construction vehicle movements. The traffic generated during the operational and maintenance phase will be minimal compared to the existing traffic movement volumes on the road network.

To ensure the transportation impacts on the road network, adjacent towns and local residents are minimised, it is recommended that a specific Traffic Management Plan (TMP) is developed to coordinate between the transport contractor programs. A TMP should be developed in consultation with DPTI and local councils to ensure all road safety and traffic issues are addressed and the impacts to the local communities and road users are minimised. The TMP should include:

- Specified delivery periods, routes and access points to the development area for all equipment and materials supplied.
- Designated warning signage, appropriate controls and procedures to address potential traffic impacts and to ensure vehicles use the designated routes.
- Controls to inform road users and local communities of the changed traffic conditions.

7.3 Improvements

Recommendations have been provided to improve the key areas which were identified as being incapable of accommodating the extra vehicle movements associated with the construction phase of the project. The improvements are summarised below:

- New Intersections:
 - **Access Point (T2):** Full basic turn treatment. Provide double two-way barrier lines. Provide 50m sealed apron.

- Intersection Upgrade:
 - **Access Point (T1):** Full basic turn treatment. Provide double two-way barrier lines. Provide 50m sealed apron.
 - **Access Point (T3):** Full basic turn treatment. Provide double two-way barrier lines. Provide 50m sealed apron.
 - **Access Point (T4):** Channelised right turn treatment on the major road (Goyder Highway), and basic left turn treatments for the major and minor roads. Provide double two-way barrier lines. Remove existing trees to meet required site distances. Provide 50m sealed apron.
 - **Access Point (T5):** Channelised right turn treatment on the major road (Barrier Highway), and basic left turn treatments for the major and minor roads. Provide 50m sealed apron.
 - **Goyder Highway and Worlds End Highway:** Channelised right turn treatment on the major road (Goyder Highway), and channelised left turn treatment for the minor road.
- Priority Signage:
 - Intersection of Porter Lagoon Road and Springbank Road.
 - Intersection of Koonoona Road and Burra Road.
 - Intersection of Koonoona Road and Turner Road.
 - Intersection of Burra Road and Turner Road.

8. Conclusions

The traffic and transport issues arising from the proposed Goyder South project will impact the local community surrounding the proposed site and the through traffic along the surrounding highways. This impact will be primarily during the construction phase where there will be a large number of vehicle movements within a short period of time compared to the operational phase.

Through adopting the specified site access routes, implementing the required and recommended upgrades discussed in Section 6, and implementing the management and mitigation measures discussed in Section 7, the traffic impacts associated with the additional vehicle movements generated during the construction stages should be minimised and road safety on the road network maintained.

Traffic impact can be minimised by providing adequate notification to the local community, restricting OSM vehicle deliveries to off-peak times where practical, and employment of appropriate traffic control.

A detailed Traffic Management Plan (TMP) will need to be prepared in consultation with DPTI and local councils prior to construction to ensure that the overall impact and disturbance to infrastructure and other road users is minimal.

Based on the assessment undertaken for the proposed Goyder South project, the following conclusions are reached:

- One new intersection is proposed from the State controlled road network (from Worlds End Highway) to facilitate a new site access point (Access T2). The remaining 4 site access points from the State controlled road network utilise existing local council and rural property access roads, with additional upgrades proposed.
- Recommendations for turning treatment upgrades at intersections have been provided to improve the efficiency and safety of traffic movement, due to the large number of turning vehicle movements in the construction phase.
- There will be a substantial increase in heavy vehicle traffic during the construction stages of the project, however existing traffic volumes surrounding the project area are relatively low. There is a risk of surrounding drivers unexpectedly encountering slow-moving vehicles. Signs warning drivers to expect slow moving traffic should be considered as part of the TMP to manage this risk.
- Due to the greatly reduced traffic generation during the operational phase of the project, no significant operational traffic impacts have been identified in addition to construction stage impacts.
- The lifespan of the technology associated with the project is approximately 30 years. Towards the end of this lifespan a decision will be made either for decommissioning or renewal. In either instance another assessment of traffic impacts will be required (and in the case of renewal, as part of a full DA).
- Permits will need to be obtained from NHVR and DPTI for all vehicles transporting equipment and materials to the Goyder South Hybrid Renewable Energy project which are outside the mass and dimension limits of current gazetted highways and roads specified in the document.

Appendix A. Crash Data

At the locations where there are more than one crash, the statistics do not distinguish between what type of crash caused what injury. Therefore, these locations are numbered in the left hand column and the location listed at the bottom of the tables.

A.1 Horrocks Highway

Highway / Road	Crash Type	Property Damage Crash (>\$5000 or vehicle towed away)	Injury Crashes	Fatal Crashes	Serious Injury Crashes	Total Crashes
Horrocks Highway	Rear End	5	2		1	8
	Side Swipe	1	1			2
	Right Angle		3			3
	Head On	2	2		3	7
	Hit Pedestrian / Parked Vehicle / Animal / Object	10	7		1	18
	Roll Over	3	1		1	5
	Right Turn					0
	Left Road	4	1			5
	Other				1	1
	Rear end and left road	1	1			2
	Rear end, right angle, roll over, right turn	4	4			8

All road crash locations were single crashes, except for the following locations:

- 1) Intersection of Horrocks Highway and Kidmans Road:
- 2) Intersection of Horrocks Highway and Roseworthy Road:

A.2 Barrier Highway

Highway / Road	Crash Type	Property Damage Crash (>\$5000 or vehicle towed away)	Injury Crashes	Fatal Crashes	Serious Injury Crashes	Total Crashes
Barrier Highway	Rear End					0
	Side Swipe	1	1			2
	Right Angle	3	2	1	3	9
	Head On		1			1
	Hit Pedestrian / Parked Vehicle / Animal / Object	6	4	2	5	17
	Roll Over	2	2			4
	Right Turn					0
	Left Road		1			1

All road crash locations were single crashes, except for the intersection of Barrier Highway and Copperhouse Road. Below are the road crash statistics for this location.

- Crashes: 2 injury crashes, 1 serious injury crash, 1 fatality crash;
- Crash type: All right-angle collisions;

As mentioned in Section 3.4.3, there have been recent upgrades (2019) to the road geometry at this intersection. These upgrades were undertaken to improve the safety at the intersection.

A.3 Goyder Highway

Highway / Road	Crash Type	Property Damage Crash (>\$5000 or vehicle towed away)	Injury Crashes	Fatal Crashes	Serious Injury Crashes	Total Crashes
Goyder Highway	Rear End					0
	Side Swipe	1				1
	Right Angle	1				1
	Head On					0
	Hit Pedestrian / Parked Vehicle / Animal / Object	1	2		1	4
	Roll Over	1	2			3
	Right Turn					0
	Left Road					0

All road crash locations were single crashes, except for the following locations:

- 1) Intersection of Goyder Highway and Worlds End Highway
- 2) Intersection of Goyder Highway and Koorunga Road

A.4 Worlds End Highway

Highway / Road	Crash Type	Property Damage Crash (>\$5000 or vehicle towed away)	Injury Crashes	Fatal Crashes	Serious Injury Crashes	Total Crashes
Worlds End Highway	Rear End					0
	Side Swipe				1	1
	Right Angle					0
	Head On				1	1
	Hit Pedestrian / Parked Vehicle / Animal / Object	3				3
	Roll Over	1	1	1		3
	Right Turn					0
	Left Road					0

All road crash locations were single crashes.

A.5 Thiele Highway

Highway / Road	Crash Type	Property Damage Crash (>\$5000 or vehicle towed away)	Injury Crashes	Fatal Crashes	Serious Injury Crashes	Total Crashes
Horrocks Highway	Rear End	2	3			5
	Side Swipe	1	1			2
	Right Angle		3			3
	Head On	1	2		2	5
	Hit Pedestrian / Parked Vehicle / Animal / Object	11	7			18
	Roll Over	1	3		1	5
	Right Turn			1		1
	Left Road	3	3			6
	Other	1				1
	rear end and right angle	1	2			3
	side swipe and roll over	1	1			2
	side swipe, right angle and roll over	2			1	3
	right angle, hit fixed object, right turn	2	2		1	5
	right angle	1	1			2
	roll over and head on	2	1			3
	Right angle, rear end	1	5	1	1	8
	Hit object, right turn, right angle	1	3			4

All road crash locations were single crashes, except for the following locations:

- 3) Intersection of Thiele Highway and Bagot Well Road
- 4) Intersection of Thiele Highway and Anlaby Road
- 5) Intersection of Thiele Highway and Borrow Street
- 6) Intersection of Thiele Highway and Hanson Street
- 7) Intersection of Thiele Highway and Daveyston Road
- 8) Intersection of Thiele Highway and Nurse Road
- 9) Intersection of Thiele Highway and Roseworthy Road
- 10) Intersection of Thiele Highway and Gawler-Kapunda Road

A.6 Copperhouse Road

Highway / Road	Crash Type	Property Damage Crash (>\$5000 or vehicle towed away)	Injury Crashes	Fatal Crashes	Serious Injury Crashes	Total Crashes
Copperhouse Road	Rear End	1				1
	Side Swipe					0
	Right Angle					0
	Head On			1		1
	Hit Pedestrian / Parked Vehicle / Animal / Object					0
	Roll Over					0
	Right Turn					0
	Left Road					0

All road crash locations were single crashes.

A.7 East Terrace

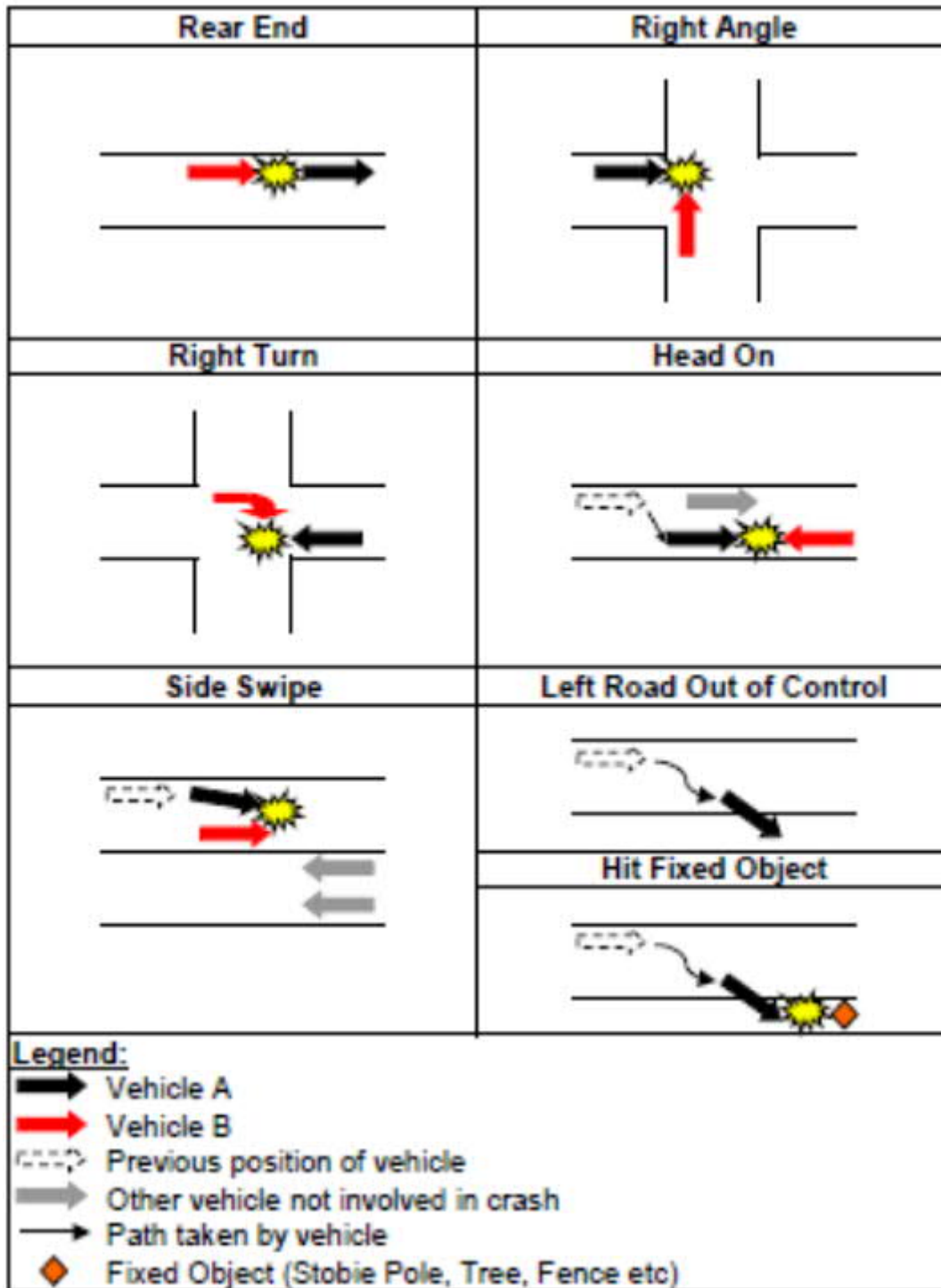
Highway / Road	Crash Type	Property Damage Crash (>\$5000 or vehicle towed away)	Injury Crashes	Fatal Crashes	Serious Injury Crashes	Total Crashes
East Terrace	Rear End					0
	Side Swipe					0
	Right Angle					0
	Head On	2				2
	Hit Pedestrian / Parked Vehicle / Animal / Object	1				1
	Roll Over		1			1
	Right Turn					0
	Left Road					0

All road crash locations were single crashes.

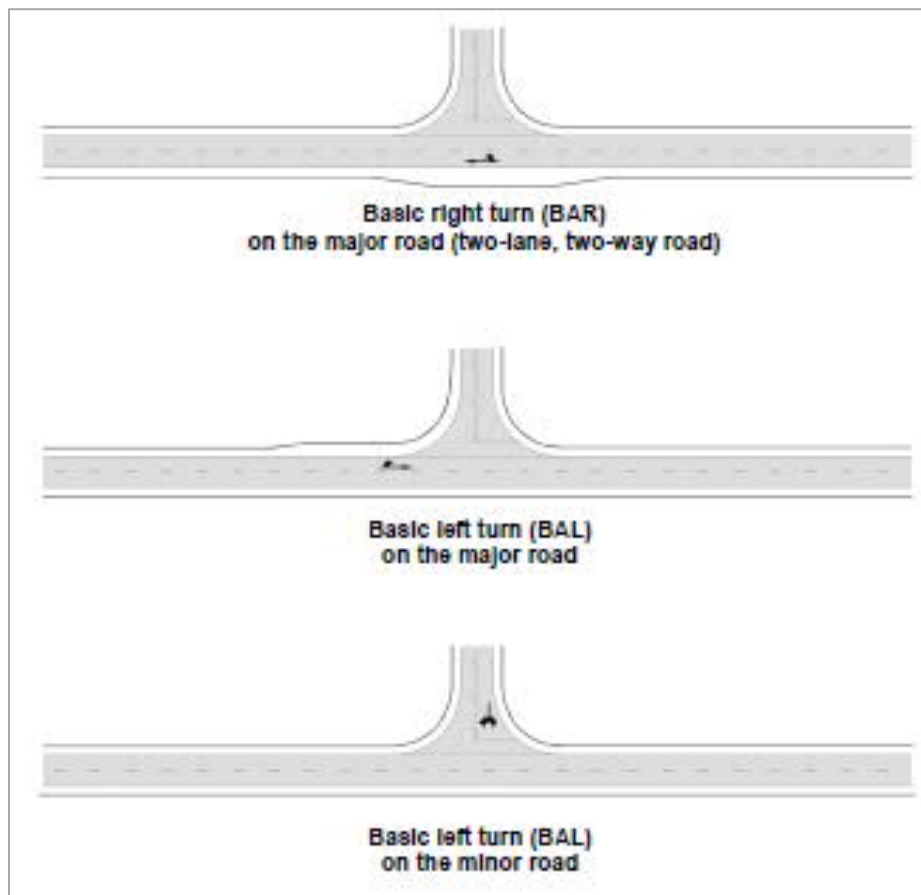
A.8 Three Chain Road

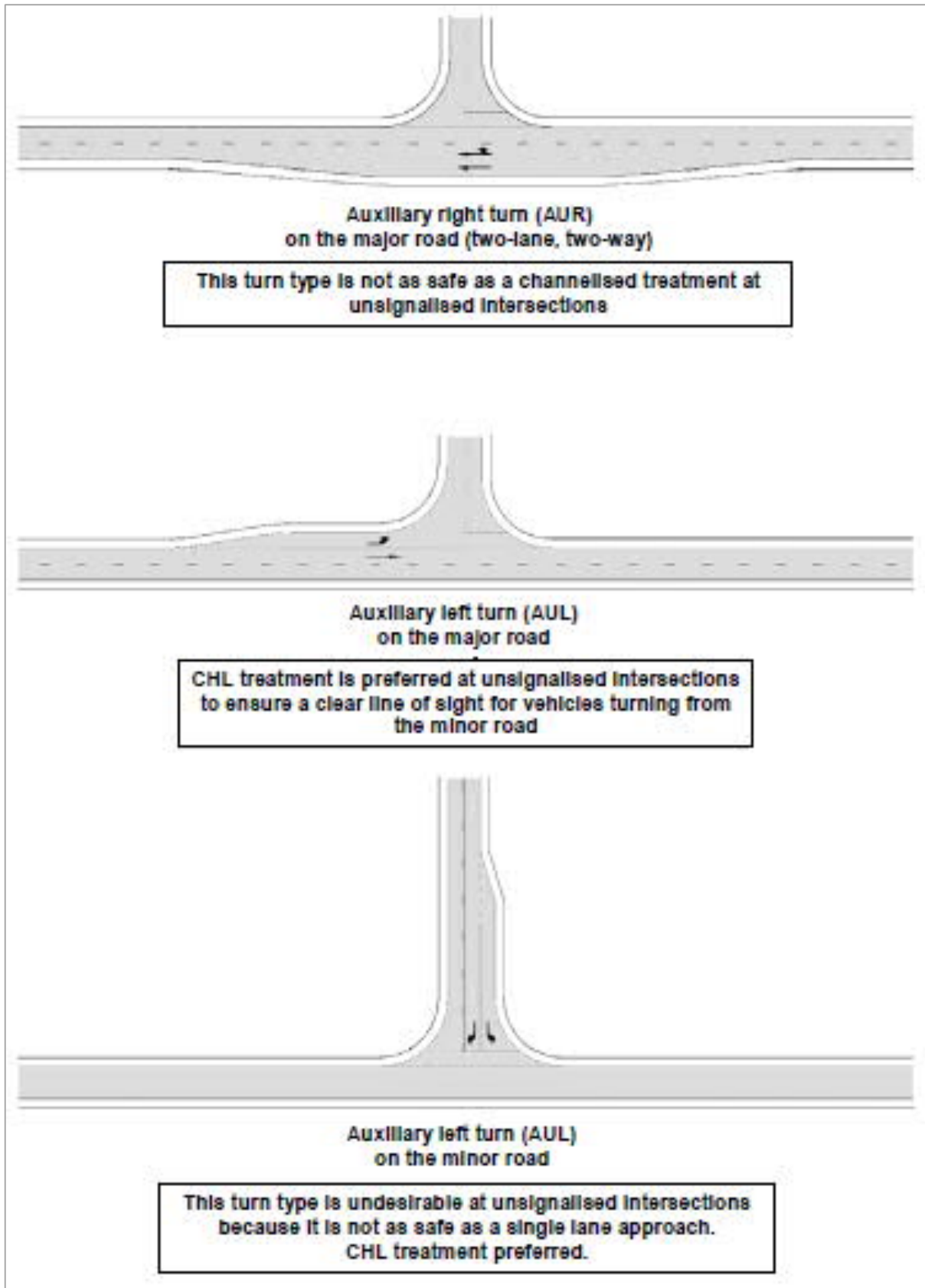
There is one recorded crash along Three Chain Road (a head-on property damage crash).

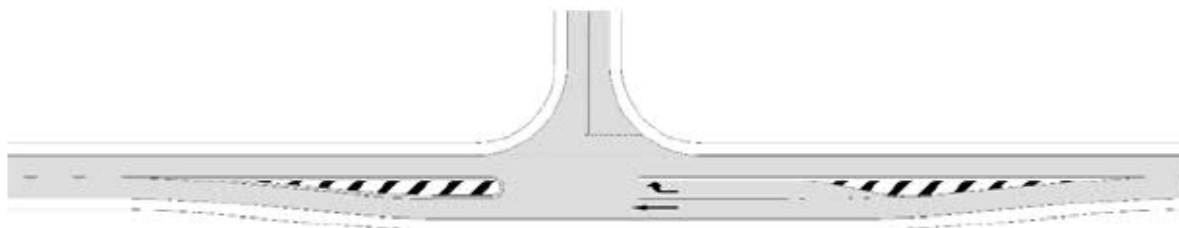
Appendix B. Crash Types



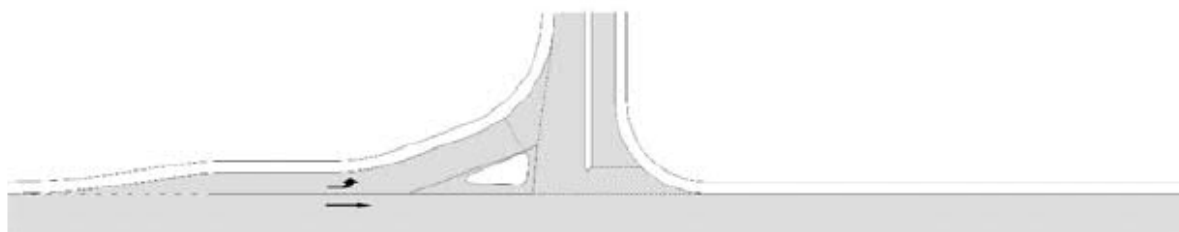
Appendix C. Intersection Treatment Types



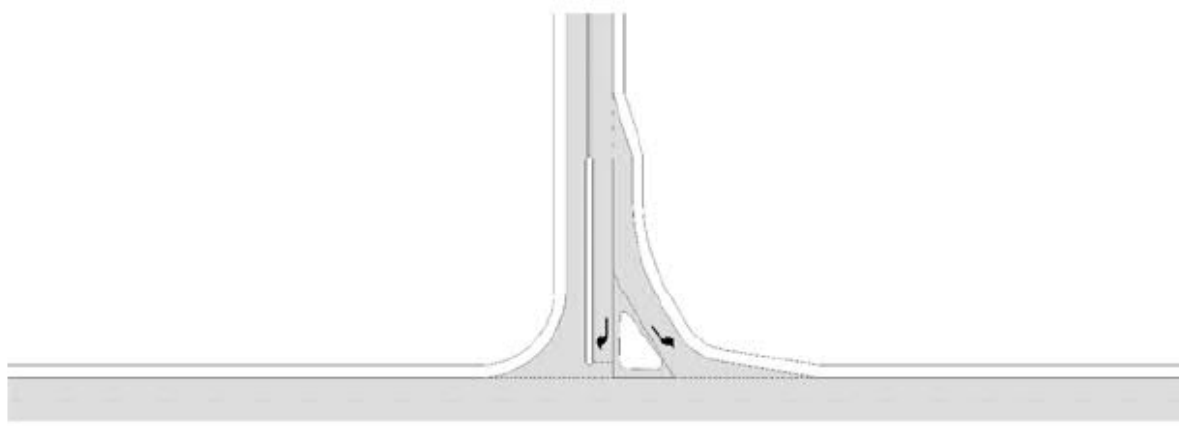




**Channelised right turn (CHR)
on the major road**



**Channelised left turn (CHL)
on the major road**



**Channelised left turn (CHL)
on the minor road**



Neoen Australia Pty Ltd
Goyder South Hybrid Renewable Energy Facility
Electromagnetic Interference Assessment

June 2020

Table of contents

1.	Introduction	4
1.1	Purpose of this Report	4
1.2	Abbreviations	5
1.3	References.....	5
1.4	Consultation	5
2.	Facility Overview	7
2.1	Introduction	7
2.2	Background	7
2.3	Location	7
2.4	Project Components	8
3.	Electromagnetic Interference Theory	10
3.1	Radiation of Electromagnetic Energy	10
3.2	Diffraction	10
3.3	Reflection	12
3.4	Scattering.....	12
3.5	Near Field Effects	13
4.	Guidelines and Codes.....	14
5.	Analysis of Development Impact.....	15
5.1	Methodology	15
5.2	Fixed Point-to-Point Radio Systems	16
5.3	Point-to-Multipoint Systems	16
5.4	Land Mobile Radio Systems	16
5.5	Digital Television Broadcast	17
5.6	AM / FM Narrowcast and Broadcast.....	22
5.7	Cellular Mobile Telephone Systems (CMTS) and Wireless Broadband.....	23
5.8	Wireless Broadband.....	23
5.9	Aircraft Navigational Systems.....	24
5.10	Maritime Radio Systems	25
5.11	Meteorological Radar	25
5.12	Trigonometrical Systems	27
5.13	Defence Radio Systems	28
5.14	South Australia Government Radio Network (SAGRN).....	28
5.15	Goyder Connect Broadband Service	29
5.16	50 Hz Radiation	30
5.17	General Mitigation Strategies	31
6.	Conclusion	32
6.1	Scope and Limitations	32

7. Summary of Mitigation Strategies and Recommendations.....	33
--	----

Table index

Table 1 – Definitions.....	5
Table 2 – References	5
Table 3 – Points of Contact	5
Table 4 – Mitigation Strategies and Recommendations for Fixed Point-to-Point Radio Systems	16
Table 5 – Mitigation Strategies and Recommendations for Land Mobile Radio Services	17
Table 6 – Mitigation Strategies and Recommendations for Digital Television.....	22
Table 7 – Mitigation Strategies and Recommendations for AM / FM Services.....	22
Table 8 – Mitigation Strategies and Recommendations for Meteorological Radar.....	27
Table 9 – Mitigation Strategies and Recommendations for Goyder Connect Services	30
Table 10 – Mitigation Strategies and Recommendations Summary	33

Figure index

Figure 1 – Fresnel Zone over the Radio Path [Ref 1]	11
Figure 2 – Fresnel Zone Clearance Criteria [Ref 2]	11
Figure 3 – Fresnel Zone Calculation [Ref 3]	11
Figure 4 – Reflection of Radio Signals by Wind Turbine Infrastructure [Ref 4]	12
Figure 5 – Scattering of Radio Signals by Wind Turbine Infrastructure	13
Figure 6 – Burra & Bald Hill TV Transmitter Coverage	18
Figure 7 – Spencer Gulf (The Bluff) TV Transmitter Coverage.....	19
Figure 8 – Adelaide (Crafers) TV Transmitter Coverage	19
Figure 9 – Burra Digital Television Transmitter Scatter Zones	20
Figure 10 – Adelaide (Crafers) Digital Television Transmitter Scatter Zones from Turbine Layout	21
Figure 11 – Spencer Gulf (The Bluff) Digital Television Transmitter Scatter Zones from Turbine Layout.....	21
Figure 12 – Telstra Mobile Coverage in Windfarm Vicinity	23
Figure 13 – NBN Co Fixed Wireless Coverage in Windfarm Vicinity.....	24
Figure 14 – NBN Co Fixed Wireless Coverage near Hanson.....	24
Figure 15 – Bureau of Meteorology Radar Stations in Wind Turbine Development Area Vicinity.....	25

Figure 16 – Bureau of Meteorology Weather Radar Example Interference from Snowtown
Stage II Wind Farm26

Figure 17 – Bureau of Meteorology Buckland Park Radar Scan Interference Zone by Tip
Height in Wind Turbine Development Area26

Figure 18 – Wind Turbine Layout Examples to Minimise Adverse Effects to Bureau Weather
Radar Operation27

Figure 19 – Global Navigation Satellite System (GNSS) Receivers near Wind Turbine
Development Area28

Figure 20 – Coverage Plot provided by Goyder Connect29

Appendices

Appendix A - Radio Sites in Vicinity of Wind Farm ACMA Details

Appendix B - Point-to-Point Radio Link Exclusion Zones

Appendix C - Television Signal Scatter Zones from Broadcast Transmitters

Appendix D - Radio Transmitters in Vicinity of Project

Appendix E – Consultation Reference Letters

1. Introduction

1.1 Purpose of this Report

The purpose of this report is to assess the potential for radio interference effects caused by the proposed wind turbines, solar generation equipment, and associated energy storage electrical equipment planned as part of the Goyder South Hybrid Renewable Energy Facility.

The proposed Goyder South Hybrid Renewable Energy Facility is located in the mid north region of South Australia.

This report assesses potential electromagnetic interference caused by the proposed wind farm, solar farm, battery storage and associated power transmission infrastructure and identifies mitigation measures where required. Services identified within a 40 km radius of the hybrid renewable energy facility includes:

- Fixed Point-to-Point Microwave Radio Systems,
- Fixed Point-to-Multipoint Systems,
- Land Mobile Radio Systems,
- Digital Television Broadcast,
- AM/FM Radio Broadcast,
- Cellular Mobile Phone and Wireless Broadband Systems,
- Aircraft Telecommunications Systems,
- Maritime Radio Systems,
- Trigonometrical Systems,
- Meteorological Radar, and
- Defence Radio Systems.

The impact of 50 Hz electromagnetic radiation is also considered in this study.

1.1.1 Layout Changes

GHD notes that some elements of the layouts depicted in figures throughout this report (including turbines and project boundaries) have changed slightly since this study was commenced, and that as a result these layout elements may no longer be consistent with figures in Volume 1 or the other specialist studies. In particular, turbine numbers have been reduced (and the project boundary has been tightened, though this is not relevant as it is not a physical asset).

GHD has nevertheless elected to utilise earlier layouts in this report with more numerous turbines as this is likely to present a more conservative result. The slight inconsistency of these figures with those elsewhere in the Development Application in no way affects the findings and recommendations of this report.

1.2 Abbreviations

The following abbreviations have been used in this report:

Table 1 – Definitions

Abbreviation	Definition
ACMA	Australian Communications and Media Authority
AM	Amplitude Modulation
BoM	Bureau of Meteorology
FM	Frequency Modulation
GHz	Giga-Hertz (10^9)
kHz	Kilo-Hertz (10^3)
LMR	Land Mobile Radio
MHz	Mega-Hertz (10^6)
PTP	Point to Point
PTMP	Point to Multi-Point
VAST	Viewer Access Satellite Television

1.3 References

Table 2 – References

Ref No	Reference
1	Visiwave™, http://www.vias.org/wirelessnetw/wndw_04_08b.html
2	Rat River Technologies, http://www.ratriver.tech.ca/archives/tools/fresnel_zone_clearance_calculator.htm
3	Fixed-Link Wind Turbine Exclusion Zone Method, D F Bacon, Radio Communications Agency
4	Kordia, Manhinerangi Wind Farm EMI Report
5	International Telecommunications Union Recommendation ITU-R BT.1893, Assessment of impairment caused to digital television reception by a wind turbine
6	Draft National Wind Farm Development Guidelines, Environment Protection and Heritage Council, July 2010
7	ARPANSA Base Station Survey – Base Station Frequency Bands http://www.arpansa.gov.au/RadiationProtection/BaseStationSurvey/spectra.cfm , 9 Feb 2017
8	Wind Farm Development Guidelines for Developers and Local Government Planners, Central Local Government Region of South Australia, June 2014

1.4 Consultation

The following points of contact have been identified for consultation with the respective organisations:

Table 3 – Points of Contact

Organisation	Contact Person	Contact Details
Bureau of Meteorology	Paul Hettrick RF Spectrum Manager	03 9669 4860 windfarmenquiries@bom.gov.au
Department of Defence	Land Planning and Spatial Information	land.planning@defence.gov.au
Sihero Pty Ltd	Luke Bavistock Freight and Livestock Manager	08 8892 2421 admin@princessroyal.com.au

Organisation	Contact Person	Contact Details
Aussie Broadband	Murray Quine Project Manager & Engineer	03 5165 0134 Murray.Quine@team.aussiebroadband.com.au
Geoscience Australia	Ryan Ruddick Director GNSS Infrastructure and Informatics National Positioning Infrastructure	02 6249 9426 ClientServices@ga.gov.au
South Australian Government Radio Network	Frank de Piaz SAGRN - Government & Public Safety	08 8425 0013 sagr@motorolasolutions.com
Telstra	Munyun Tan SA Local Relationship Manager Commercial Engineering, Networks and IT	02 9866 0652 Munyun.Tan@team.telstra.com

2. Facility Overview

2.1 Introduction

Neoen Australia Pty Ltd is seeking Development Plan Consent for the Goyder South Hybrid Renewable Energy Facility (Goyder South).

The proposed Goyder South development will be located south of Burra and north of Robertstown in the Goyder Regional Council area. The project will comprise up to 1,200MW of wind generation, up to 600MW of solar PV generation and up to 900MW/1,800MWh of battery storage. The project will connect to the grid at the Robertstown substation but also makes provision to connect to the grid at the planned SA-NSW interconnector substation.

2.2 Background

The Goyder South project incorporates land which was first developed as the Stony Gap Wind Farm. This project received Development Approval in 2014. In purchasing the project from Palisade, Neoen saw the opportunity to merge the Stony Gap site into the new, much larger hybrid Goyder South project, itself part of the larger Goyder Renewables Zone (GRZ), a project concept which Neoen has been developing since late 2017 which also incorporates the 'Goyder North' project to the north of Burra.

Goyder North and Goyder South are divided by the town of Burra. The GRZ represents one of the most ambitious renewable energy developments ever proposed and will be ideally placed to complement the "EnergyConnect" project under development by ElectraNet and the South Australian government for a large interconnector to New South Wales from the nearby Robertstown substation. Neoen intends to submit a separate DA for the Goyder North project in the future.

2.3 Location

The northern tip of the proposed development is approximately 5.5 km south of the centre of Burra. It extends approximately 27 km to the south, with the southern tip being a distance of approximately 5 km from the centre of Robertstown. It is 24 km from east to west at its greatest width in the north, tapering to its narrowest width of 3 km in the southern portion of the site. The land within the development site is generally privately owned and comprises predominantly dryland cropping and grazing.

This area is located in the eastern portion of the northern Mount Lofty Ranges and wholly located within the Regional Council of Goyder. From a transport and access perspective, the region is serviced by the Barrier Highway, the Burra-Morgan Highway (Goyder Highway) and the Worlds End Highway.

The project is located within the Mid North Region (for the purposes of strategic land use planning) and the SA Murray-Darling Basin Natural Resource Management Area. The project is located within the "Northern Ranges" of the Rangelands part of the SA Murray-Darling Basin NRM. This area is generally described as a transitional zone between cropping and pastoral country. It is noted that the project is not located within a prescribed water resources area.

The Goyder South site is characterised by world-class wind and solar resources and complimentary land uses (comprising primarily marginal grazing land located on the edge of Goyder's Line). Recognising the immense benefits to consumers and the National Electricity Market as a whole of dispatchable 'baseload' power, Neoen has also added a large battery storage component to smooth and firm the output of the wind and solar.

At its full size of approximately 1,200MW of wind, 600MW of solar and 900MW/1,800MWh of battery storage, Goyder South will generate up to 4,800,000 MWh of power annually—estimated to be equivalent to the following:

<i>Equivalent tonnes of CO₂ avoided per year</i>	2,112,000
<i>Equivalent number of cars taken off the road</i>	872,000
<i>Equivalent number of trees planted</i>	39,360,000

2.4 Project Components

In summary, the Goyder South Hybrid Renewable Energy Facility comprises:

- Wind generation of up to 163 turbines with a capacity of up to 1,200MW;
- Solar generation with a capacity of up to 600MW;
- Energy storage with a capacity of up to 900MW/1,800MWh;
- Associated infrastructure for connection to the electricity grid including three sub-stations, access tracks, underground cabling and overhead transmission lines;
- Permanent operations and maintenance compounds;
- Temporary construction facilities including compounds and laydown areas; and
- A number of temporary and permanent meteorological masts (in addition to those already on the site) to record wind speed and other meteorological data.

It is planned to build the project in stages in response to market demand and Power Purchase Agreement availability. While the size and composition of each stage is not yet certain, the current intention is to construct in three overlapping stages of approximately up to 400MW of wind, up to 200MW of solar and up to 300MW/600MWh of battery storage.

More specifically, the Goyder South project will comprise:

1. **Wind turbine generators:** Up to 163 turbines with a maximum tip height of 240 m (and 200m for the three turbines closest to Burra to minimise visual impact). The final sizing will depend on the specific wind resource characteristics on each portion of the site and the requirements of individual power purchasers, and may be less than these maximums.
2. **Single-axis tracking, bifacial solar PV:** The bifacial solar panels will gather light on both faces, with the rear face of the panel harnessing light reflected from the ground. Accordingly, these panels will require greater spacing between rows (up to 10 m) and additional land is required to accommodate this technology. They will be located at two main sites:
 - a) Worlds End Solar – at the northern end of the World's End Highway, and
 - b) Bright Solar – at the southern end of the project area; to the north-east of Robertstown.
3. **Batteries:** The battery storage infrastructure for Stage 1 of the project will be located adjacent to the existing Robertstown substation. The battery component for future stages is likely to be located near the planned, nearby interconnector substation (which is likely to be the point of grid connection for Stages 2+ of Goyder South). This means the battery may be split across two sites. It is also proposed that some battery storage may be included at the proposed collector substation sites should this better support the desired project and grid support outcomes.
4. **Collector substations:** The project will include three 'collector' substations located close to the three stages of turbine development. This includes a substation in the western

portion of the project area (in the ranges), one on the eastern side (near Worlds End Highway) and one in the south (near the Bright solar site.) These substations will be connected by overhead transmission lines as described below. The footprint of the substations has been developed to accommodate the substation, switchyard, control room and maintenance shed with some additional land included to accommodate battery facilities if required. Additional land near these substations has been included to accommodate temporary construction-phase facilities.

5. **Overhead transmission line:** There will be a double-circuit 275 or 330kV overhead transmission line connecting the three substations and then extending from the Goyder South substation to the to the grid substations initially at Robertstown and later to the NSW interconnector substation. It is intended that both the Goyder South project and, later, the Goyder North project will ultimately share this transmission line corridor and transmission infrastructure, which will avoid the unnecessary additional visual and ecological impact, cost and land use restrictions associated with two separate corridors and transmission lines.

Temporary construction facilities will also be required and include the following:

- Two wind construction compounds co-located with the western and eastern substations;
- Two solar construction compounds located within the Worlds End and Bright solar areas;
- The construction compounds will include office, staff amenities and carparking facilities as well as storage and laydown areas;
- The wind construction compounds will include an option for a temporary batching plant facility; and
- Laydown areas will also be required at the base of each turbine.

All construction facilities and construction impact areas will be decommissioned and rehabilitated at the conclusion of the construction phase.

3. Electromagnetic Interference Theory

Electromagnetic fields are a combination of electric fields associated with a voltage source and magnetic fields associated with current flowing through a conductor. These fields increase in strength with voltage and current.

Radio system interference may occur when a wind turbine is located in such a way as to induce an unwanted disturbance to radio waves propagated between a signal source and signal receiver. This may occur by way of radiation of electromagnetic energy by the turbine within the operating band of the radio system, diffraction or partial reflection of the radio system signal by the turbine tower and rotor.

The following sections briefly describe the various types of interference that may impact on existing operational telecommunications services in the vicinity of Goyder South Hybrid Renewable Energy Facility to provide context to the specific findings identified in Section 5 of this report.

3.1 Radiation of Electromagnetic Energy

Electromagnetic interference potentially occurs when the wind turbine electrical infrastructure radiates energy with a frequency within the operating frequency of a radio communications system.

Turbines supplied within Australia are required to be compliant with electromagnetic compatibility as defined in relevant Australian Standards. As a result of complying with these standards, the electromagnetic interference due to radiation is negligible.

Solar inverters, battery storage inverters, synchronous condensers, and transformers may cause interference to radio signals due to the emission of electromagnetic fields. These electric fields typically propagate over very short distances (tens of metres) and are limited to “near-field” effects. All solar generation equipment and associated storage infrastructure installed as part of the renewable energy park will comply with Australian Standards and thus the impacts of electromagnetic interference from the solar infrastructure is expected to be negligible.

3.2 Diffraction

Diffraction occurs when the wind turbine infrastructure is positioned such that the signal of a radio communications system is partially or temporarily blocked causing a reduction in the signal power at the radio signal receiver.

For point-to-point radio systems it is understood that the radio signal travels on a path between the signal source and signal receiver defined by an ellipsoid area known as the Fresnel zone.

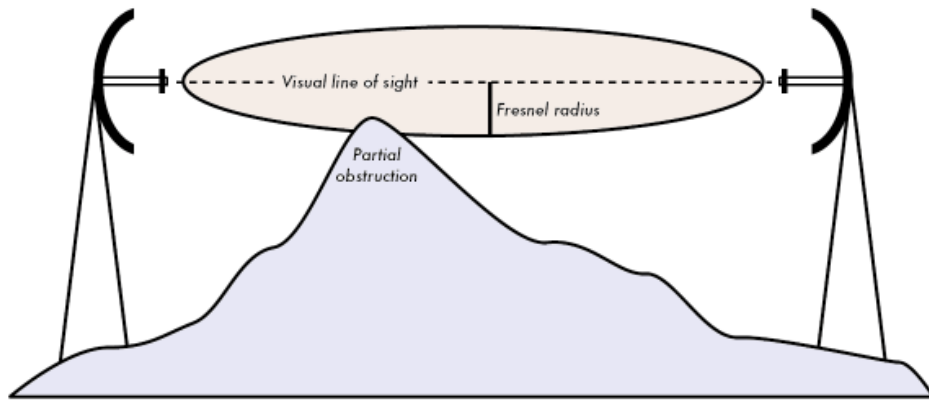


Figure 1 – Fresnel Zone over the Radio Path [Ref 1]

The Fresnel zone is defined as the locus between two points, such as a radio transmitter and receiver, where the indirect ray path length from the point T to point R is multiple of the half-wavelength distance of the radio signal. Refer to Figure 2 and Figure 3 for further details.

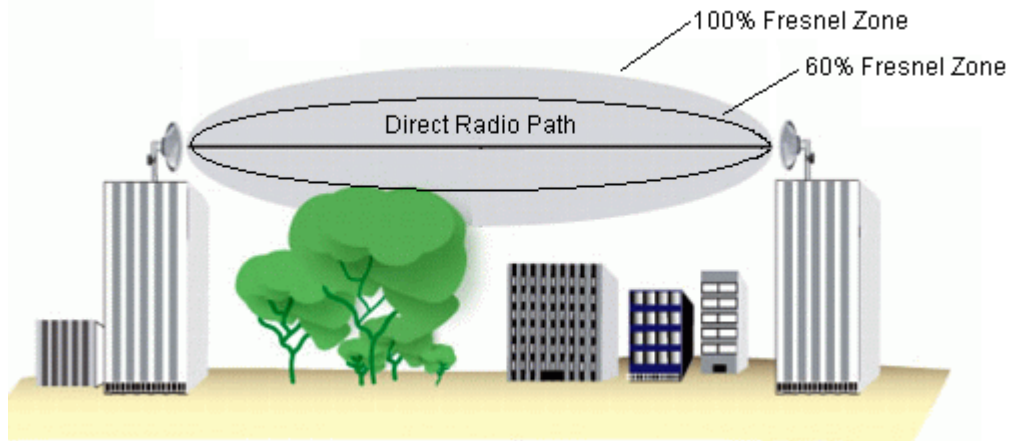


Figure 2 – Fresnel Zone Clearance Criteria [Ref 2]

In the presence of an obstruction between the signal source and the signal receiver, it is generally accepted that an obstructed path provided with 60% clearance of the first Fresnel zone will operate without degradations to the communications system.

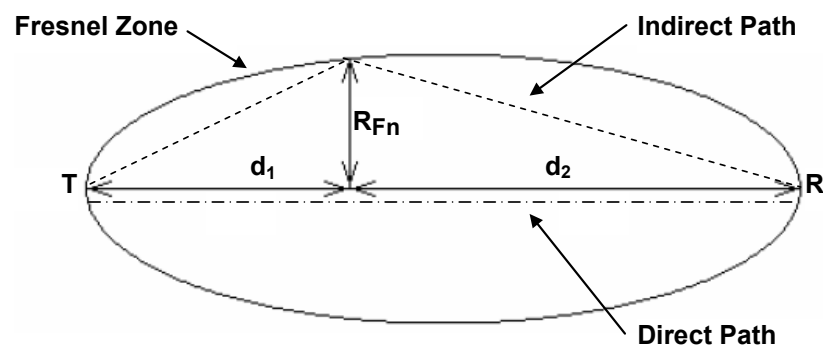


Figure 3 – Fresnel Zone Calculation [Ref 3]

The Fresnel zone is defined by the formula:

$$R_{Fn} = \sqrt{\frac{n\lambda d_1 d_2}{d_1 + d_2}} \quad (1)$$

R_{Fn} = the nth Fresnel Zone Radius in metres
 n = the nth Fresnel zone
 λ = the wavelength of the transmitted signal in metres
 d_1 = the distance from T in metres
 d_2 = the distance from R in metres

F1 may be used to describe the first Fresnel zone between two points. F1 may also be described as the 100% Fresnel zone. In this case, F2 is the second Fresnel zone or the 200% Fresnel zone.

According to D F Bacon [Ref 4] it is recommended to design the geographic wind turbine layout such that all infrastructure including turbine blades are located outside the second Fresnel zone of all point-to-point radio systems.

The second Fresnel zone defines the region where an object such as a wind turbine may cause a reflected signal to be transmitted to the receiver at a half wavelength (180°) out of phase with the direct ray causing maximum interference potential.

The drawings included in Appendix B plot the ray-line (direct line of sight) and the second Fresnel zone for selected (high-risk) links.

3.3 Reflection

Reflection occurs when the wind turbine infrastructure is positioned such that the incident ray of a radio communication system is partially or temporarily reflected from its normal path of propagation. The complex geometrical design of the wind turbine causes the reflected signals to be dispersed or 'scattered' over a wide angle. These reflections have the potential to generate destructive interference to the radio signal resulting in signal power reduction or unwanted duplication of the radio signal as seen in Figure 4.

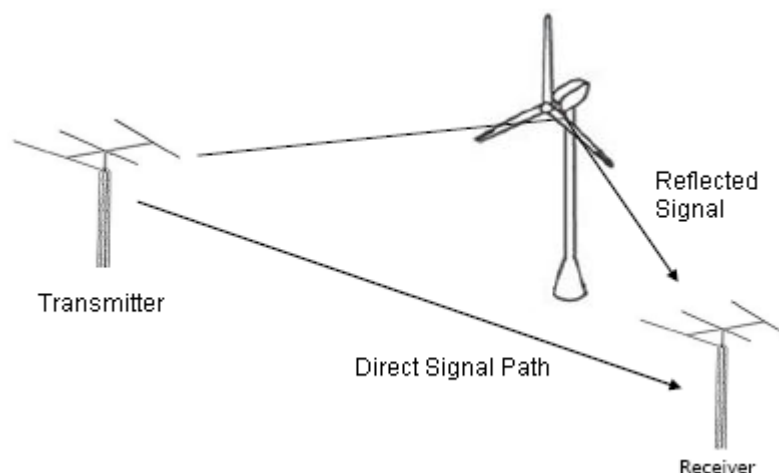


Figure 4 – Reflection of Radio Signals by Wind Turbine Infrastructure [Ref 4]

At the boundary of the second Fresnel zone, any reflected wave will be 180° out of phase with the direct signal, which can lead to cancellation effects at the receiver. As such, any turbine located along (and near) the F2 boundary has the potential to significantly degrade a radio link.

3.4 Scattering

Wind turbines have been observed to cause interference by scattering the incident signal. Scattering is described as either 'forward' or 'back' and is depicted in Figure 4 below.

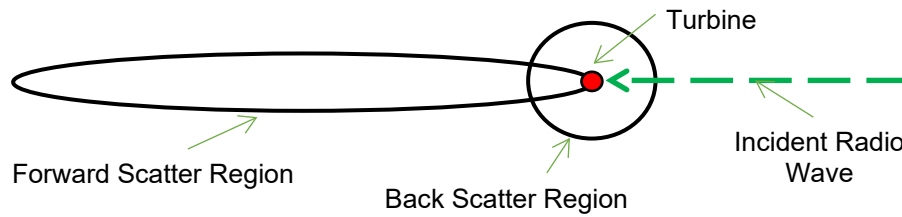


Figure 5 – Scattering of Radio Signals by Wind Turbine Infrastructure

The forward scatter region is significant and can extend as far as 5 km forward of the wind turbine. Where the receiver is in direct line of sight of a turbine, but shielded from a direct signal from the transmission tower, the forward scatter region may extend beyond 5 km. The back scattering region created by the incident signal is generally less than 1 km from the turbine.

3.5 Near Field Effects

Wind turbine infrastructure located close to a radio communication system such that the separation distance is within the near field of the radiating antenna has the potential to detrimentally affect the normal radiation pattern of the antenna causing unwanted signal power reductions to the radio system service area. The result is an alteration of the antenna's impedance. The near-field exclusion zone is typically less than 200 m for microwave radio systems.

4. Guidelines and Codes

Development Plans are based on Council areas and are the statutory planning policy documents used for Development Assessment purposes.

The policies listed under the heading of “Renewable Energy Facilities” in the General section of the Development Plan includes a specific section for Wind Farms and Ancillary Development. Furthermore, the Central Local Government Region of South Australia have created the Wind Farm Development Guidelines for Developers and Local Government Planners with the aim of informing wind farm developers and Council planners an acceptable level of documentation that wind farm developers must provide, but also suggests a higher standard of development detail that exceeds the minimum requirements and supports a best practice approach.

Principle of Development Control (PDC) 3 of the Renewable Energy Facilities module of the General section of the Development Plan states that wind farms and ancillary development should avoid or minimise interference with television, radio communication signals and geographic positioning systems on nearby property owners / occupiers and road users. Additionally, a Draft National Wind Farm Development Guidelines document was created in July 2010 by a working group co-ordinated by The Environment Protection and Heritage Council of Australia and New Zealand. Section F – Electromagnetic Interference of this guideline details the issues addressed in this EMI assessment and references the relevant Australian Standards and publications surrounding EMI caused by wind farm developments in Australia.

5. Analysis of Development Impact

5.1 Methodology

5.1.1 Radio System Search

A search was conducted on the Australian Communications and Media Authority (ACMA) radio communications database in August 2019 to identify all licensed radio systems, with operating frequencies above 30 MHz, within 40 km of the proposed Goyder South Hybrid Renewable Energy Facility precinct.

The results of the ACMA radio communications data extraction were reviewed and presented in graphical format depicting the radio site locations and ray-lines of the radio systems within the vicinity of the wind farm. The map was refined to only show those radio sites and services with the potential impact for radio-interference caused by the proposed Goyder South Hybrid Renewable Energy Facility area.

The resulting map (and subsequent zoomed sections in the vicinity of the wind farm site) is presented in Appendix B.

5.1.2 Assumptions

Based on information provided by Neoen Australia Pty Ltd, the proposed wind turbine sizes could be up to a maximum tip height of 240 m, with a maximum hub height of 160 m and comprising of rotors of maximum 160 m diameter. At the time of writing, the exact turbine model and manufacturer is yet to be determined as, in wind farm development, a procurement process is typically carried out after Development Approval is obtained.

5.1.3 Radio Technology Review

The following radio system technologies were considered in this assessment:

- Fixed Point-to-Point Microwave Radio Systems,
- Fixed Point-to-Multipoint Systems,
- Land Mobile Radio Systems,
- Digital Television Broadcast,
- AM/FM Radio Broadcast,
- Cellular Mobile Phone and Wireless Broadband Systems,
- Aircraft Telecommunications Systems,
- Maritime Radio Systems,
- Meteorological Radar,
- Trigonometrical Systems, and
- Defence Radio Systems.

Radio services below 30 MHz, including AM Radio Broadcast services, were excluded from this assessment as the propagation characteristics of the radio wave does not rely on direct-ray transmission characteristic between the transmitting and receiving antennas, e.g. AM radio broadcast services, operating within the Medium Frequency band of 300 kHz - 3 MHz, relies on ground wave (surface wave or sky wave) propagation.

Section 4.16 summarises the possible impacts and mitigation strategies for each radio service that may be impacted by the windfarm development.

5.2 Fixed Point-to-Point Radio Systems

There are numerous radio systems of interest that operate within the vicinity of the proposed Goyder South Hybrid Renewable Energy Facility area as shown in Appendix D. The eleven point-to-point radio links identified as passing through or adjacent to the wind farm areas are listed in Appendix A. The ray line of each point-to-point system not extending outside of the study area, and the 200% Fresnel zone (second Fresnel zone) has been indicated on the point-to-point link drawings in Appendix B. When determining final wind turbine locations the Fresnel zones shown across the site boundary are considered exclusion zones. During the construction of the Goyder South Hybrid Renewable Energy Facility these zones should not be entered when lifting turbines into place.

Table 4 – Mitigation Strategies and Recommendations for Fixed Point-to-Point Radio Systems

Impact	Mitigation Strategy	Recommendation
SA Water link (licence #226752) is likely to be impeded by SG056.	Alternative service routing. Replacement with 3G/4G or satellite communications. Provision of repeater.	Neoen will liaise with SA Water to determine suitable rectification options.
No impact anticipated to other services if turbines are kept out of the nominated exclusion zones.	Nil	Ensure micro-siting of the wind turbines such that blade tips do not enter the second Fresnel exclusion zones of existing radio systems.

5.3 Point-to-Multipoint Systems

There is one point-to-multipoint transmission site of interest that operates within the proposed boundaries of the Goyder South Hybrid Renewable Energy Facility, and is shown in Figure 5c of Appendix D. The details of this site are referenced in Appendix A.

The site listed has the potential to observe diffraction, reflection and scattering with the wind turbines within the coverage area of the radio sites. Consultation with the radio licence owners, Aussie Broadband, was undertaken to understand the coverage requirements and possible impacts and mitigation strategies has been conducted and the parties have determined that there will be no impact on their point to multipoint system. As of 13 August 2019 Aussie Broadband have turned off their point-to-multipoint system, and are in the process of decommissioning their associated point-to-point microwave backhaul radio infrastructure. At the time of this writing this report, Aussie Broadband's licences are active and have been included in the electromagnetic interference modelling.

5.4 Land Mobile Radio Systems

There are two Land Mobile Radio (LMR) transmission sites of interest that operate within the vicinity of the proposed wind farm, as shown in Figure 5d of Appendix D. Details of these sites are referenced in Appendix A.

Interference to LMR coverage by the proposed wind farm development is anticipated to be minimal, as the LMR transmitters within range of the wind farm are localised services and operating on frequencies that are more resilient to interference.

The sites listed have the potential to observe reflection and scattering with the wind turbines within the coverage area of the radio sites. GHD have commenced consultation with Motorola Solutions (SAGRN operators), Spark Infrastructure Pty Ltd and Sihero Pty Ltd to determine if there will be any impact on their land mobile radio system, since the coverage currently provided from their sites is unknown.

In these circumstances, it is advisable to collect information about the services before and after construction so that if issues are identified after completion of the wind farm, a comparison can be made and the extent of the impact can be quantified and remedial action implemented. [Ref 8]

Table 5 – Mitigation Strategies and Recommendations for Land Mobile Radio Services

Impact	Service Mitigation Strategy	Recommendation
Potential minor impact anticipated to SAGRN land mobile radio service.	Avoid micro-siting to within 20 m of transmitter locations; ideally avoid moving any closer than 100 m away.	Record signal levels in the affected areas of LMR operations prior to the construction of the wind turbines to establish a baseline.
Potential minor impact anticipated to Spark Infrastructure Pty Ltd land mobile radio service.		
Potential minor impact anticipated to Sihero Pty Ltd land mobile radio service.		

5.5 Digital Television Broadcast

Appendix A lists the television broadcast sites identified during the radio services search as outlined in Section 4.1. The locations of these facilities are identified in the TV and radio broadcast transmitter drawing included in Appendix D.

Wind farms have the potential to cause signal degradation to TV reception due to scattering, diffraction and near field effects. Digital TV is not susceptible to visible “ghosting” degradation as was experienced with analogue broadcasts; any impact of reflections from the turbines would be a minor reduction of coverage at the limit of the service area.

The zone of potential interference for a wind farm on digital television broadcast is the resultant total of the effects from the individual turbines. The International Telecommunications Union Recommendation ITU-R BT.1893 [Ref 7] states that impacts beyond 10 km from a wind farm are unlikely. The key factors listed by this recommendation that lead to degraded TV reception are when the receiver is already at the fringe of television reception zone and when the receiver is located within approximately 2 km of the wind farm (i.e. in the range affected by back scattering of signals off the turbine). The biggest effect occurs when the receiver is near the wind turbine area and in line of sight of the turbines but not in line of sight of the TV transmitter.

Digital television coverage in the wind turbine area is covered by multiple transmitters. Figure 6 shows coverage from local Burra and Bald Hill transmitters, Figure 7 show coverage from the Spencer Gulf (The Bluff) transmitter and Figure 8 shows coverage from Adelaide (Crafers) transmitter.

Some dwellings close to the wind farm may be in TV signal scatter zones, depending which TV transmitter they receive TV signals from. Potentially affected areas are marked by plotting

forward and backscatter zones in a keyhole shape inline between the transmitter and each turbine. Figure 9 shows potential TV signal scatter zones from the Burra transmitter, Figure 10 shows potential TV signal scatter zones from the Adelaide (Crafers) transmitter, and Figure 11 shows potential TV signal scatter zones from the Spencer Gulf (The Bluff) transmitter. The television signal scatter zones shown in are modelled if the receivers are utilising high gain antennas. If low gain receive antennas are used, then the forward scatter zones could extend up to 10 km past each turbine.

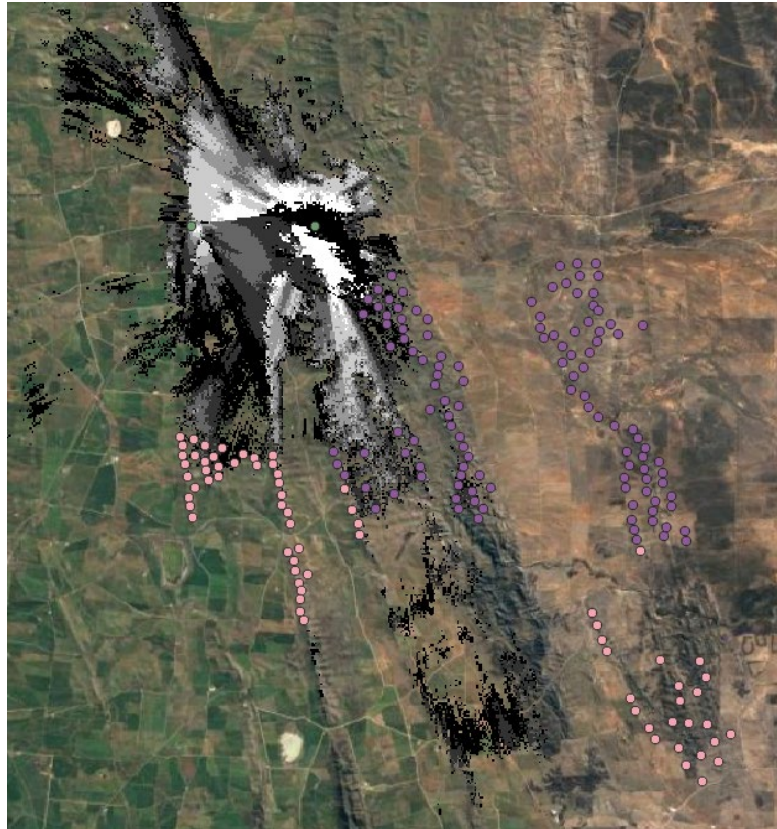


Figure 6 – Burra & Bald Hill TV Transmitter Coverage

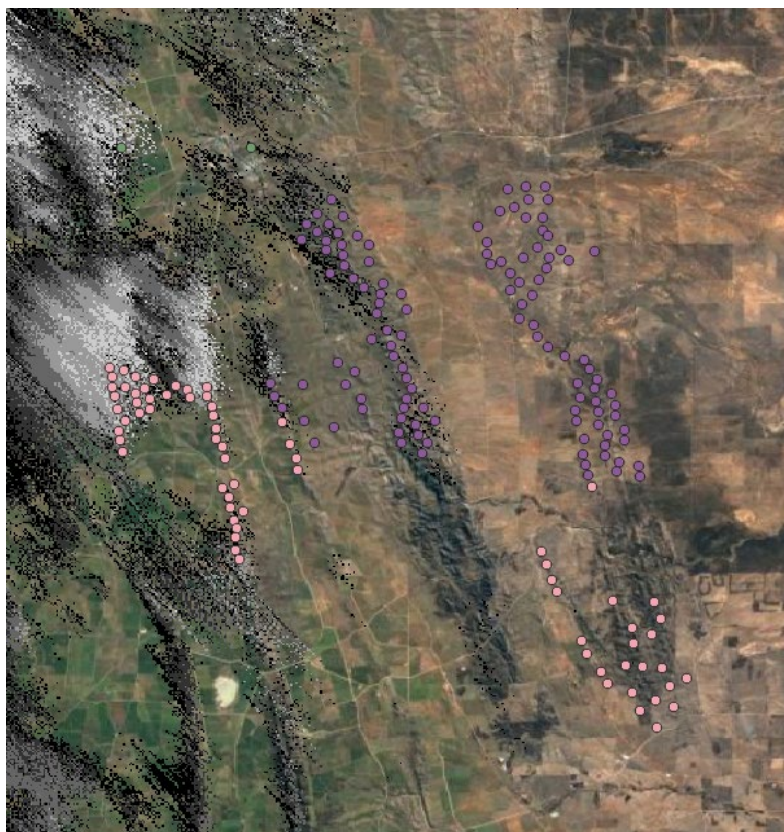


Figure 7 – Spencer Gulf (The Bluff) TV Transmitter Coverage

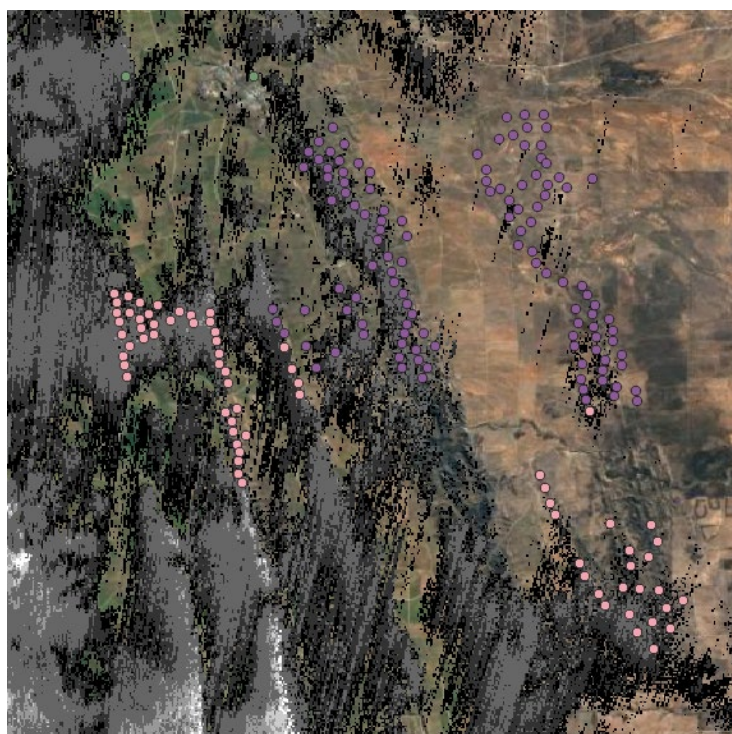


Figure 8 – Adelaide (Crafrers) TV Transmitter Coverage

A small amount of reception degradation may occur due to the wind turbines, but it is likely to have minimal impact. There is the potential for signal degradation to receptors who are behind the wind turbines and their television transmitter. In Figure 9, Figure 10, Figure 11, dwellings are indicated by yellow squares, and where a dwelling lies inside a scatter zone indicated by the pink shading, depending on which transmitter they receive signals from, may have minor signal

degradation. Steps should be taken in these areas to ensure affected users are monitored pre- and post-construction.

If the signal degradation is significant the mitigation strategy would be to realign, reposition or replace existing antennas to higher gain alternatives, as this can remedy the majority of forward scatter signal degradation effects or viewer access satellite television (VAST) for affected users.

These properties are already in an area of marginal reception and will likely be eligible for the government-funded VAST (Viewer Access Satellite Television) service, utilised to provide television coverage to areas of Australia with poor to no TV transmitter coverage, should their existing over the air reception be significantly impacted by the wind farm development. The VAST service utilises common channels across entire states; however localised news and radio services are provided by additional channels to ensure access to these services is not lost in transitioning from FTA antenna to VAST satellite service.

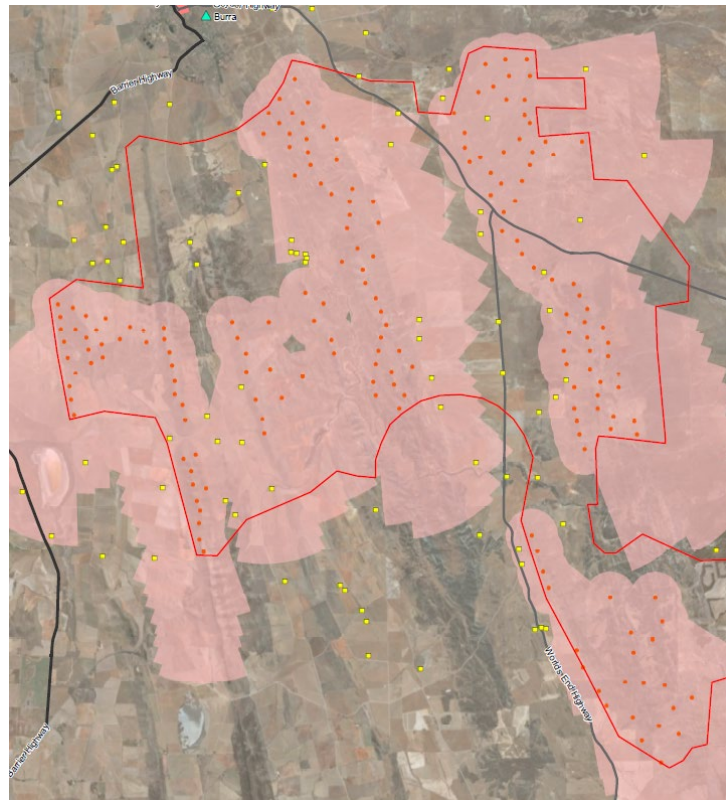


Figure 9 – Burra Digital Television Transmitter Scatter Zones

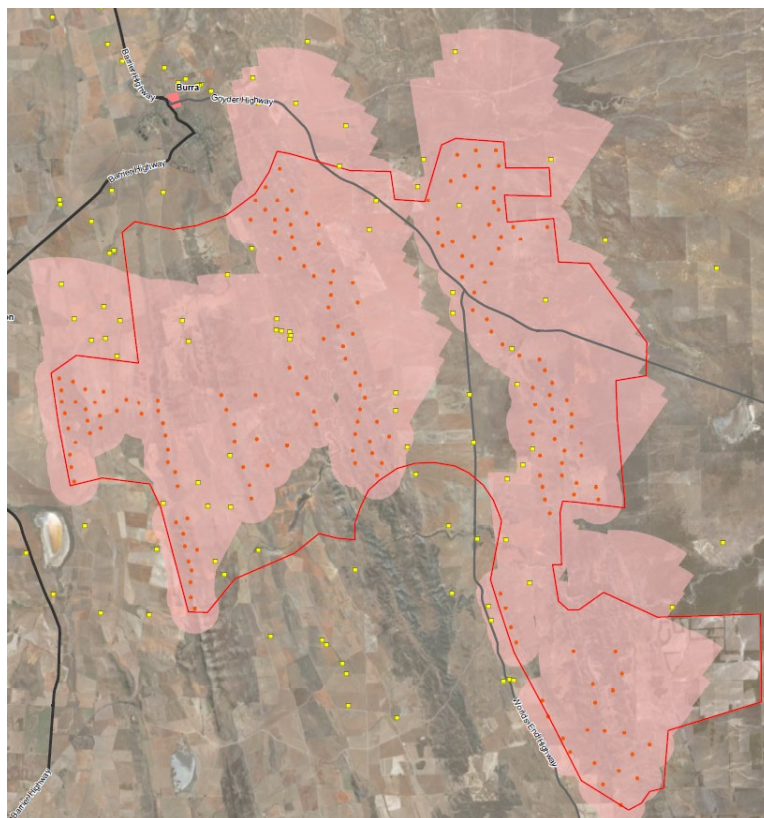


Figure 10 – Adelaide (Crafers) Digital Television Transmitter Scatter Zones from Turbine Layout

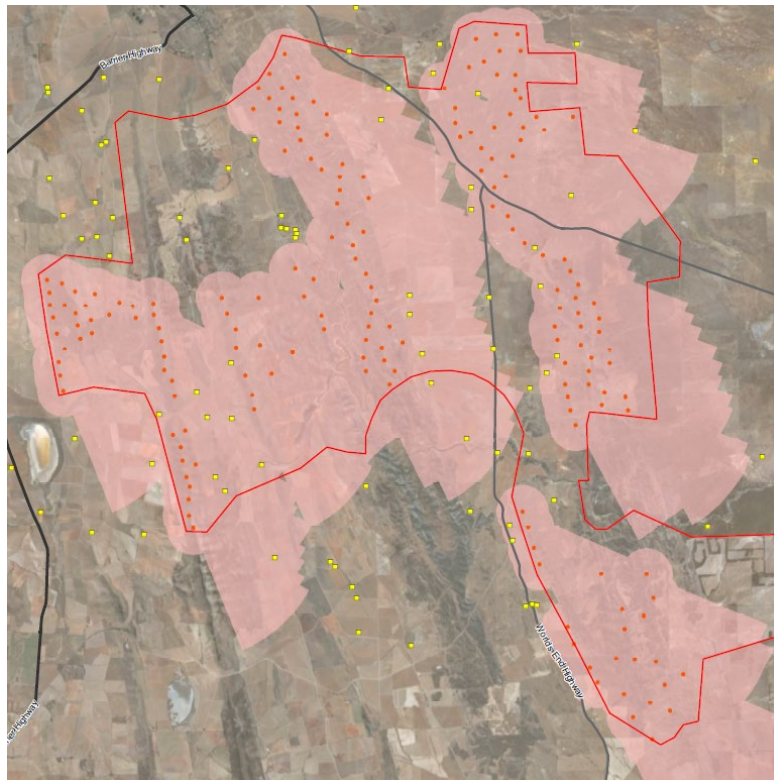


Figure 11 – Spencer Gulf (The Bluff) Digital Television Transmitter Scatter Zones from Turbine Layout

Table 6 – Mitigation Strategies and Recommendations for Digital Television

Impact	Service Mitigation Strategies	Recommendation
Potential minor service degradation to local community, i.e. TV reception within 10 km of wind farm may be affected.	<p>Realign antennas on affected dwellings in a more direct path to their respective transmitter.</p> <p>Realign antennas on affected dwellings to another television transmitter, such as Spencer Gulf (The Bluff) or Adelaide (Crafers).</p> <p>Replace antennas on affected dwellings with a higher gain antenna</p> <p>Relocate antennas on affected dwellings to another position on the property that is less affected</p> <p>Install satellite television on affected dwellings</p> <p>Install a television relay station in or near the townships.</p>	<p>Neoen will undertake a pre- and post-construction assessment of the television and radio reception strength at the location of any existing or approved dwellings as at the date of development approval that are within 5 kilometres of any turbine. The assessments will be undertaken by an independent television and radio monitoring specialist, and include testing at locations to be determined by the television and radio monitoring specialist to enable the average television and radio reception strength to be determined.</p> <p>If the post-construction assessment establishes an unacceptable increase in interference to reception as a result of the wind farm, as determined by the independent television and radio monitoring specialist, measures to restore the affected reception to pre-construction quality will be undertaken.</p>

5.6 AM / FM Narrowcast and Broadcast

The following FM Radio services were identified within 40 km of the proposed Goyder South Hybrid Renewable Energy Facility development area. Services nominated as narrowcast are typically low-powered services located within their respective townships for local service only (no applicable services have been identified). Services nominated as broadcast are typically high-powered services for wider area coverage.

Appendix A lists the FM broadcast radio services identified during the radio services search.

Overseas and local experience indicates that radio reception is unlikely to be affected by operating wind farms. The majority of FM services transmitting in the vicinity of the wind farm are narrowcast services not focussed on servicing the wind farm area.

Broadcast FM services are in a low frequency range and hence they are more resilient to disturbances. There may be a small chance of signal degradation for services for receivers in the immediate vicinity of the wind farm.

Table 7 – Mitigation Strategies and Recommendations for AM / FM Services

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Measure signal levels in wind farm vicinity to establish a baseline, as per TV signal mitigation recommendation.

5.7 Cellular Mobile Telephone Systems (CMTS) and Wireless Broadband

Details of the closest CMTS and Wireless Broadband sites up to 40 km from the wind farm are included on the cellular and spectrum licence transmitter drawing in Appendix D. These sites operate in the 700 MHz, 850 MHz, 900 MHz, 1.8 GHz, 2.1 GHz, 2.3 GHz, and 2.6 GHz bands depending on function and licensee. [Ref 10]

Cellular mobile phone technologies provide for robust communications in areas of significant obstruction via multi-path communications between customer equipment and the network base station sites. The CMTS services to the immediate area around the wind farm site are provided by three operators (Telstra, Optus and Vodafone) from multiple base station sites.

Figure 12 shows the Telstra mobile coverage in the vicinity of the windfarm. Given the prevalence of cellular towers in several directions around the wind farm, interference to cellular phone coverage is anticipated to be minimal except for those users operating in close proximity to the proposed wind farm such as maintenance staff and potentially for users on Goyder South Hybrid Renewable Energy Facility.

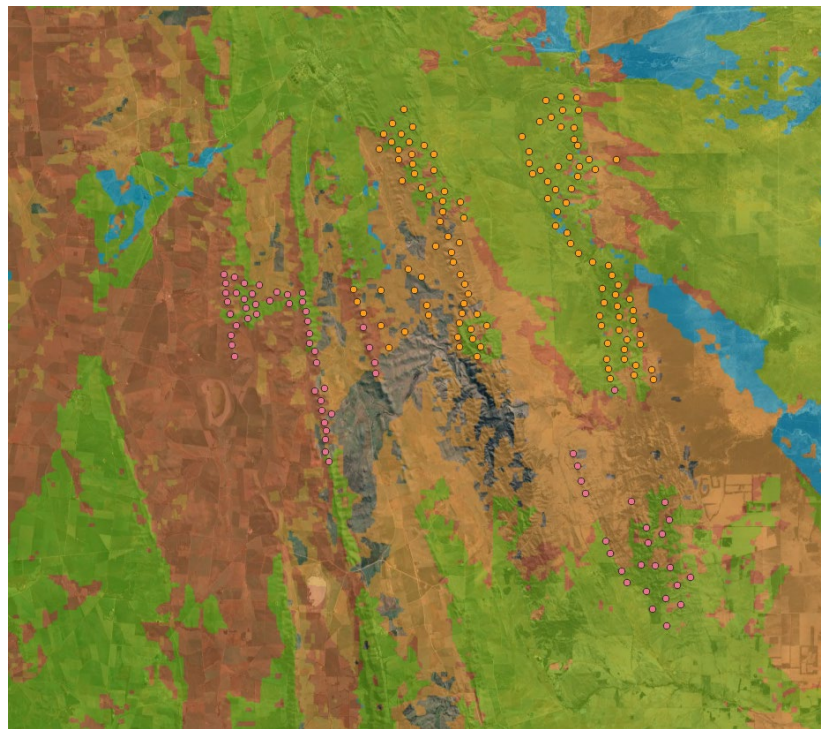
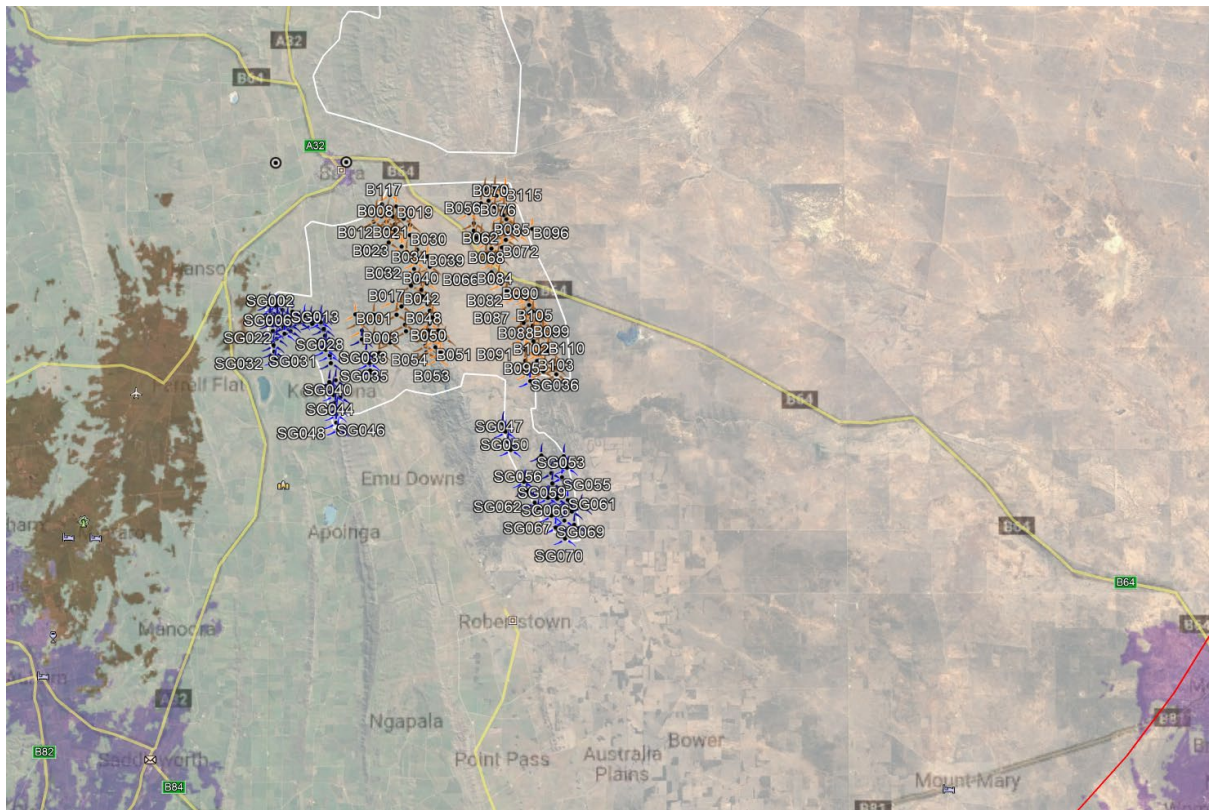


Figure 12 – Telstra Mobile Coverage in Windfarm Vicinity

5.8 Wireless Broadband

The Goyder South Hybrid Renewable Energy Facility will not affect NBN Co Fixed Wireless coverage as shown in Figure 13 as the NBN Co Fixed Wireless coverage does not extend into the proposed wind farm area.



The closest turbine is more than 1.6 km from the closest proposed NBN Co Fixed Wireless coverage area located in Hanson as show in Figure 14.

5.9 Aircraft Navigational Systems

No aircraft navigation system sites of concern were identified during the radio services search as outlined in Section 5.1.

5.10 Maritime Radio Systems

No maritime radio system sites of concern were identified during the radio services search as outlined in Section 5.1.

5.11 Meteorological Radar

The results of the radio services search indicated that the Bureau of Meteorology (BoM) does not operate radar facilities within the study area. However, as shown in Figure 15, the Buckland Park weather radar station is approximately 95 km away from the proposed Goyder South Hybrid Renewable Energy Facility location.

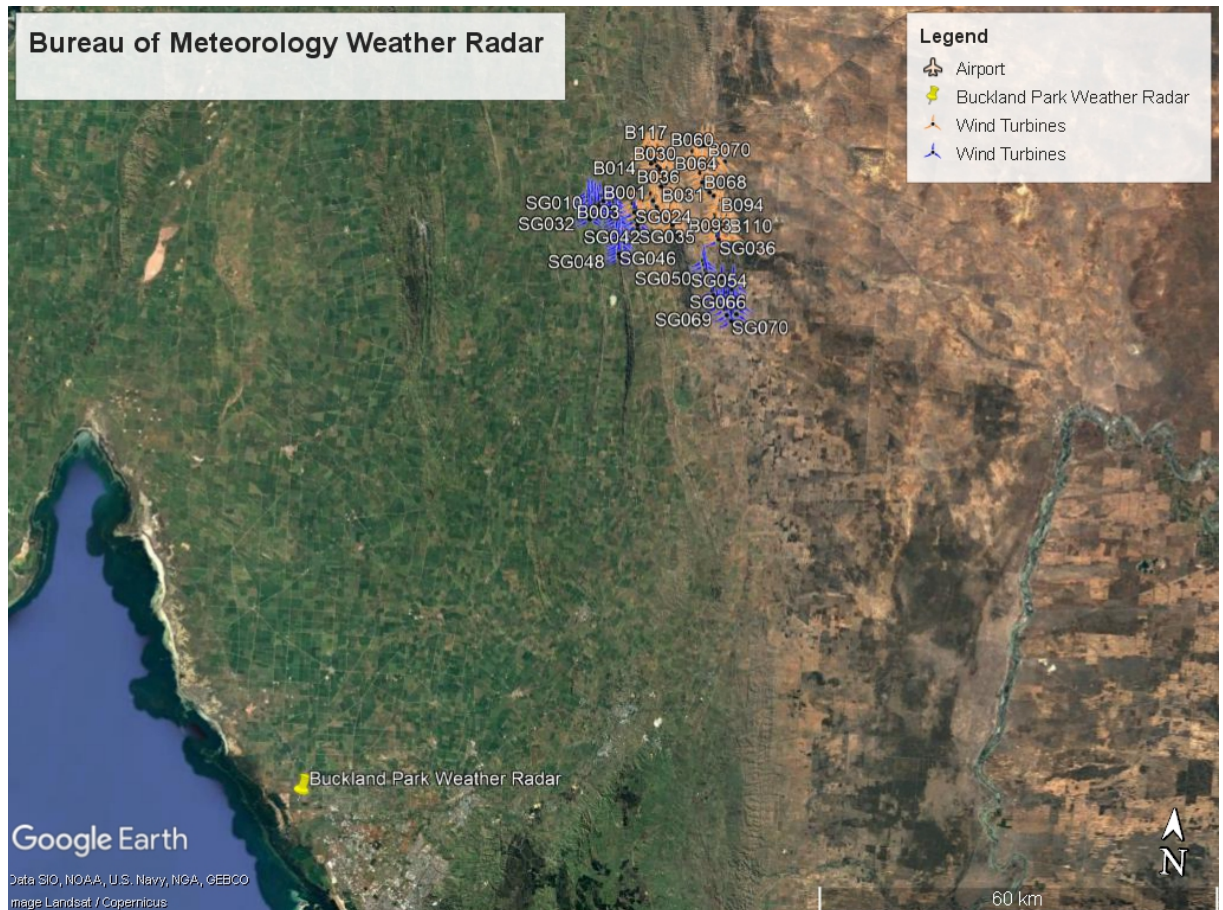


Figure 15 – Bureau of Meteorology Radar Stations in Wind Turbine Development Area Vicinity

The three main effects exhibited by wind turbines on weather radars are:

- Beam blocking
- Clutter
- Doppler mode false artefacts

The largest impact on the radar is caused by the Doppler mode. To minimise this effect, there should be no turbines constructed within 10 km of an S-band radar, as advised by the Bureau of Meteorology. The nearest turbine planned for this facility is more than 9 times this exclusion zone distance.

Wind farms are currently operational in South Australia's mid north region, such as Snowtown Stage 1 and Stage 2, within the theoretical path of the radar beam from Buckland Park weather radar and interference has been detected as shown in Figure 16.

BoM Adelaide (Buckland Park) Radar Loop - Rain Rate - IDR64
01/11/2017 UTC - 04:00 15/11/2017 UTC

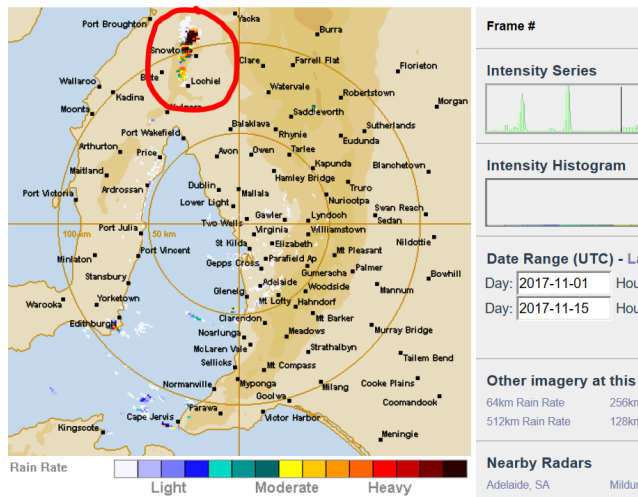


Figure 16 – Bureau of Meteorology Weather Radar Example Interference from Snowtown Stage II Wind Farm

GHD have liaised with the Bureau of Meteorology and determined that the proposed Goyder South Hybrid Renewable Energy Facility, under normal radio propagation conditions, should not pose an interference risk to the Buckland Park weather radar. The proposed turbine locations are beyond the theoretical path of the Buckland Park radar beam, as shown in Figure 17. However, future southward expansion of the Goyder South Hybrid Renewable Energy Facility could risk turbines being placed within the interference zones of the Buckland Park radar.

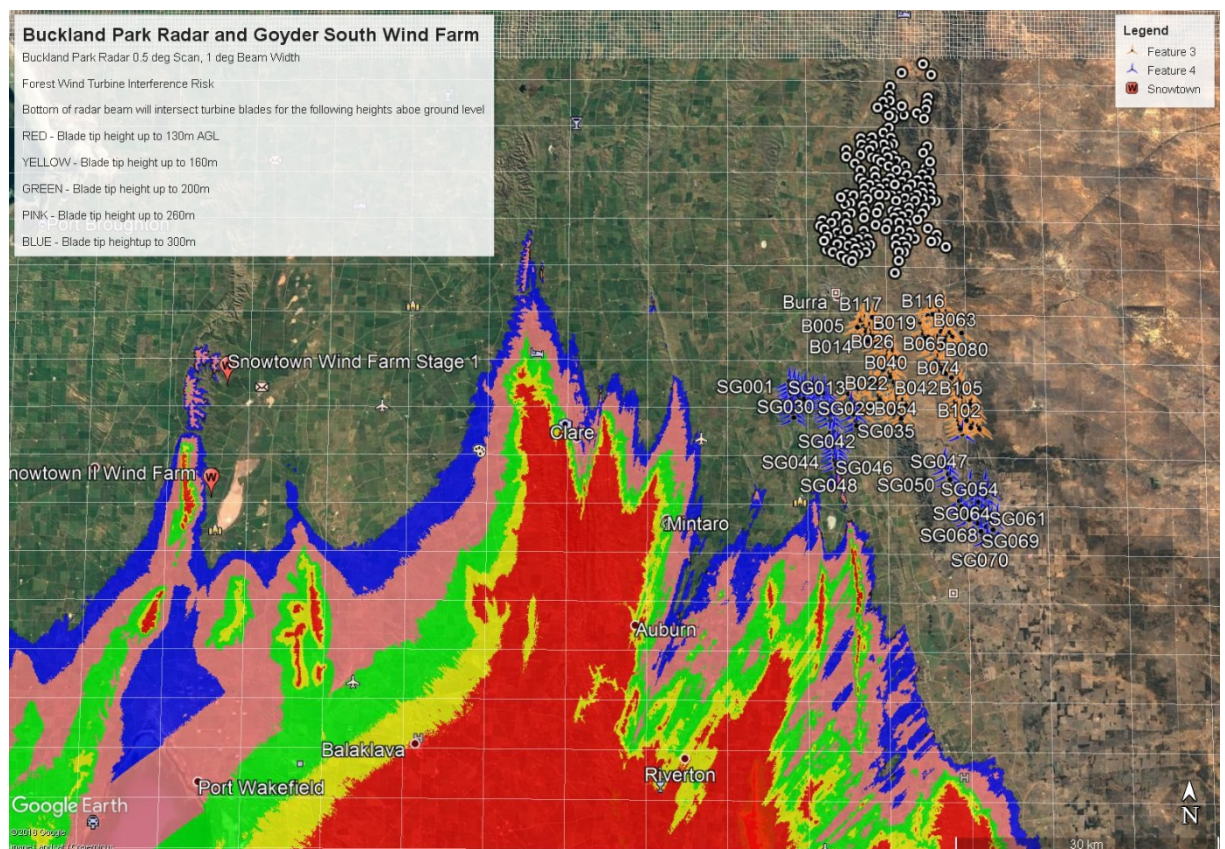


Figure 17 – Bureau of Meteorology Buckland Park Radar Scan Interference Zone by Tip Height in Wind Turbine Development Area

To minimise adverse effects to Bureau of Meteorology weather radar operations, turbines should be spaced in radial alignment with respect to the radar transmitter location in accordance with the alignment examples in Figure 18. However, due to the proposed turbines being located along a north – south ridge and the Buckland Park weather radar being almost directly south, the turbines collectively will form a larger radar cross-section area, which may cause some interference during extraordinary radio propagation conditions.

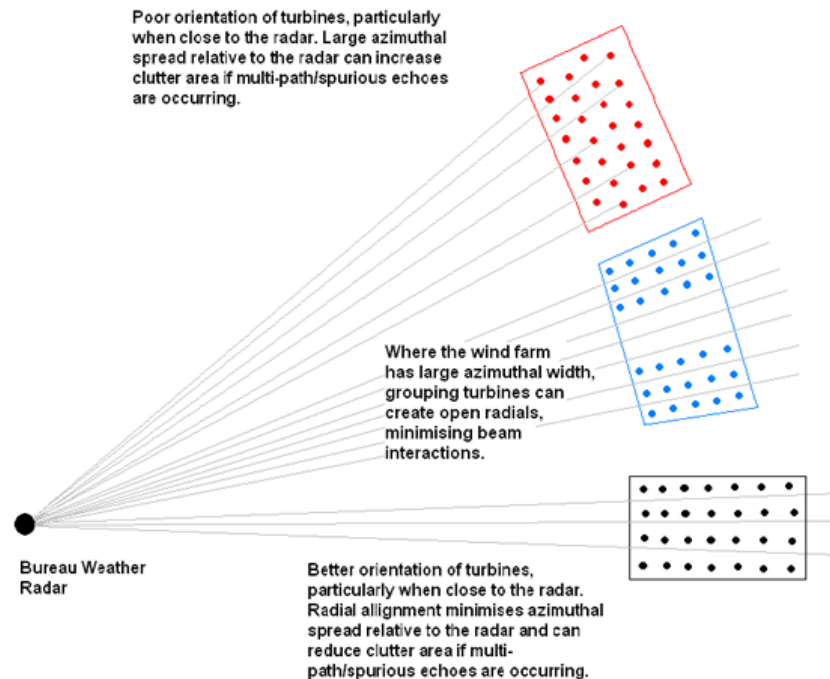


Figure 18 – Wind Turbine Layout Examples to Minimise Adverse Effects to Bureau Weather Radar Operation

Table 8 – Mitigation Strategies and Recommendations for Meteorological Radar

Impact	Service Mitigation Strategy	Recommendation
None to minor impact anticipated to weather-watch radar systems during extraordinary radio propagation conditions.	Take the radar impact into consideration where possible for any micro siting of the layout.	Liaise closely with BoM and provide sufficient information to allow them to reconfigure their radar systems.

5.12 Trigonometrical Systems

Trigonometrical systems operate across Australia are administered by Geoscience Australia. The two closest trigonometrical systems to the proposed Goyder South Hybrid Renewable Energy Facility are the permanent geodetic quality Global Navigation Satellite System (GNSS) receivers: the PTSV AuScope receiver approximately 140 km south south-east and the SA45 AuScope receiver approximately 150 km north-west of the proposed wind turbine area.

Consultation was conducted with Geosciences Australia to confirm that there are no foreseeable impacts to their trigonometrical stations, GNSS reference stations or associated

facilities or services associated with the proposed Goyder South Hybrid Renewable Energy Facility development.

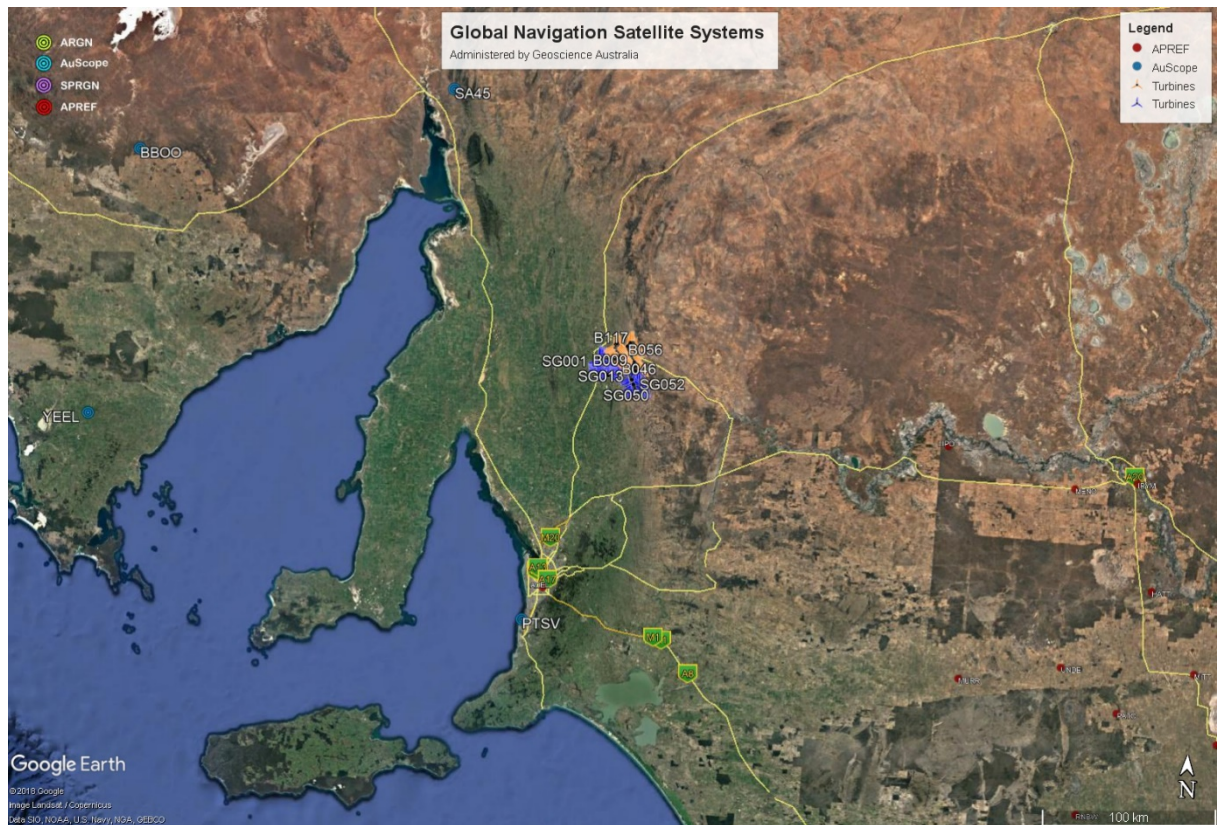


Figure 19 – Global Navigation Satellite System (GNSS) Receivers near Wind Turbine Development Area

5.13 Defence Radio Systems

Defence radio systems are not required to be listed in the ACMA radio communications database. The 40 km study area doesn't contain any publicly listed defence bases so it is anticipated that there are no defence radio systems that will be affected.

There is a point to point link from a defence site in St. Kilda, SA to Woodstock, QLD. The operating frequency of this link is 2 MHz, which over a link of this size (approximately 1900 km), the method of propagation would be sky wave. Skywave propagation refers to the propagation of radio waves reflected back towards the Earth from the ionosphere. Therefore it is not expected that this service is to be affected by the windfarm construction.

GHD have liaised with the Defence Land Planning and Spatial Information team to confirm that there will be no impact to defence radio systems.

5.14 South Australia Government Radio Network (SAGRN)

The Attorney-General's Department (ADG) of South Australia operates a network of repeaters and point to point microwave links serving a variety of public safety radio communication services across the state known as the SAGRN. Analysis of their specific radio sites and links are covered in section 4.2, 4.3 and 4.4 and detailed in Appendix A.

In consultation with the AGD, and their network operator Motorola Solutions, it has been determined that it is desirable to maintain a minimum separation of 100 meters between any SAGRN link path and the outer diameter of any turbine blade. If this separation is maintained the ADG is confident that there to be no effect on SAGRN inter-site link performance.

5.15 Goyder Connect Broadband Service

Goyder Connect operates a high-speed 5.8GHz microwave radio broadband service to local residents and businesses, similar to NBN Fixed Wireless to cover a number of areas in which only NBN satellite services are available.

The proposed wind turbines will be constructed centrally to Goyder Connect's STN transmitter, largely within the green zone (strong coverage) in Figure 20 below.

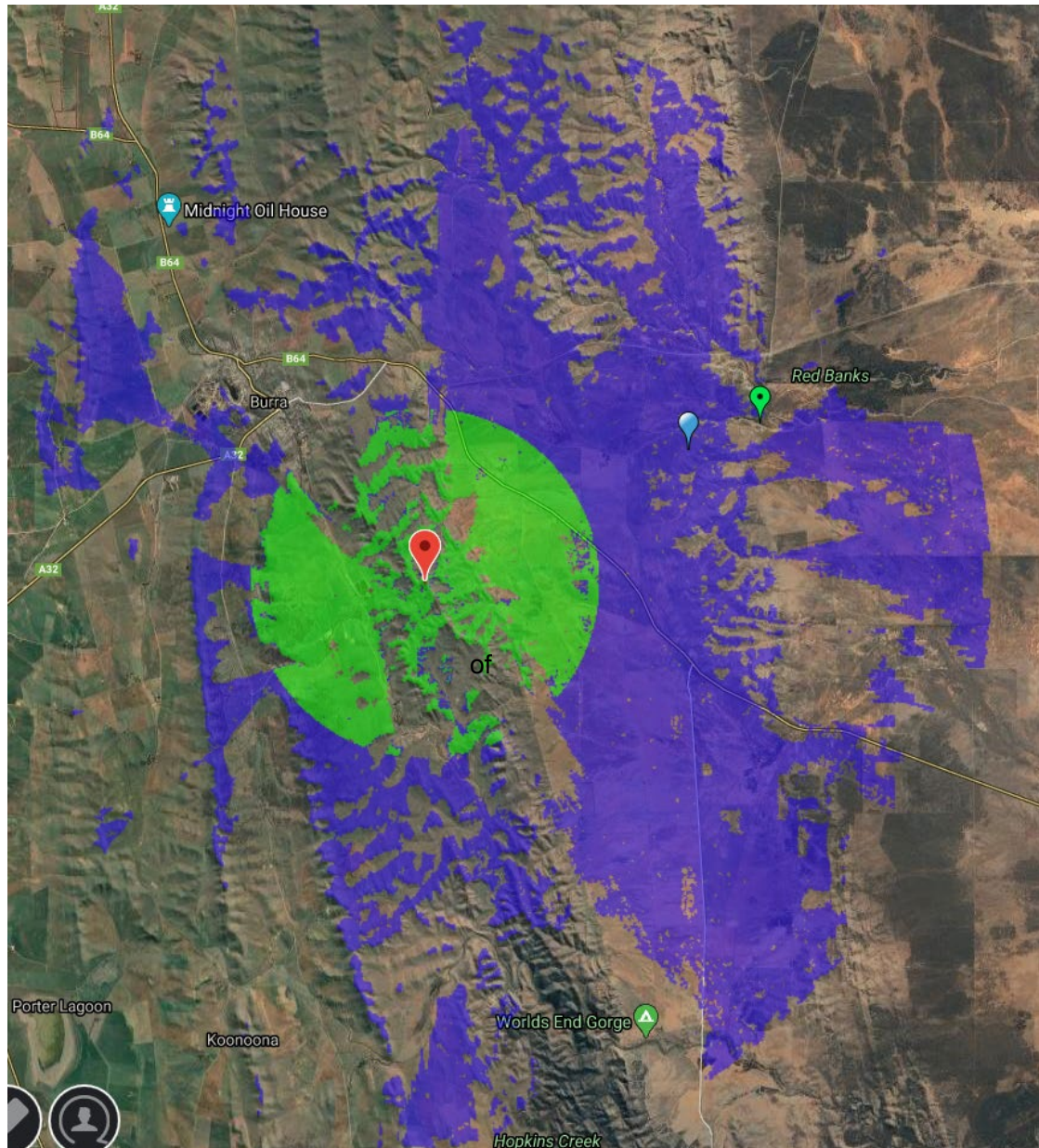


Figure 20 – Coverage Plot provided by Goyder Connect

Neoen through GHD have engaged extensively with the operators of Goyder Connect and discussed the availability and cost of technical solutions in the event of impacts on the service, including installation of new repeater stations. Neoen commits to rectifying any issues for Goyder Connect, including (if necessary) installation of such repeater stations, promptly and at its cost.

Table 9 – Mitigation Strategies and Recommendations for Goyder Connect Services

Impact	Service Mitigation Strategy	Recommendation
Backbone Link STN-WDY impeded by Turbines B026 (and possibly B029 and B023)	Construct repeater station.	Liaise with Goyder Connect to agree on alternative service delivery path.
Backbone Link STN-BHN possibly impeded by Turbine B010	Construct repeater station.	Liaise with Goyder Connect to agree on alternative service delivery path.
Landowner C1 may lose coverage due to Turbine B017 impeding the signal.	Review service delivery through alternative tower.	Verify installation location at customer end and re-analyse.
	Construct repeater station.	Liaise with Goyder Connect to agree on alternative service delivery path.
Landowner H3 may lose coverage due to Turbine B004 impeding the signal.	Review service delivery through alternative tower.	Verify installation location at customer end and re-analyse.
	Construct repeater station.	Liaise with Goyder Connect to agree on alternative service delivery path.
Landowner H2 may lose coverage due to Turbine B025 and B033 impeding the signal.	Review service delivery through alternative tower.	Verify installation location at customer end and re-analyse.
	Construct repeater station.	Liaise with Goyder Connect to agree on alternative service delivery path.
Landowner H56 may lose coverage due to Turbine B024 impeding the signal.	Review service delivery through alternative tower.	Verify installation location at customer end and re-analyse.
	Construct repeater station.	Liaise with Goyder Connect to agree on alternative service delivery path.
Landowners C3, C4 and H57 may lose coverage due to Turbine B027 impeding the signal.	Review service delivery through alternative tower.	Verify installation location at customer end and re-analyse.
	Construct repeater station.	Liaise with Goyder Connect to agree on alternative service delivery path.

5.16 50 Hz Radiation

The main sources of electromagnetic fields associated with wind farms are the substations and transmission lines. The transmission line and substation will be equivalent to others in the electricity transmission network, with comparable electromagnetic field levels.

The reticulation throughout the Goyder South Hybrid Renewable Energy Facility will be both overhead and underground, with voltages of 33kV and 275kV. Electromagnetic field strength from buried cables measured above ground is minimal compared to what is radiated from overhead lines.

Designing to the standards utilised by ElectraNet (275 kV) and SA Power Networks (33kV) will ensure safe levels of electromagnetic radiation are achieved.

5.17 General Mitigation Strategies

All types of radio communications can benefit from general mitigation through the design of the turbine and the choice of materials used in its construction.

The turbines have been spaced to mitigate the effect of creating a “virtual wall” of turbines. A virtual wall is an electromagnetic barrier between a TV transmitter and households serviced by that transmitter.

In addition, wind farm developers should utilise (wherever practical) equipment complying with the Electromagnetic Emission Standard, AS/NZS 61000.6.4:2012 to avoid the creation of excessive noise at frequencies that interfere with radio communication signals. Electrical insulation and shielding should be considered in the turbine design to reduce the RF noise emitted from the electronic control systems located in the nacelle.

6. Conclusion

As demonstrated earlier in this report, Neoen Australia Pty Ltd have made several endeavours to reduce the impact on existing radio services in the region through the choice of turbine materials and the layout of the turbines. This report demonstrates compliance with the Central Local Government Region of South Australia's Wind Farm Development Guidelines for Developers and Local Government Planners and the South Australian Development Plan Principle of Development Control 3, and that with the implementation of the proposed mitigation measures, that the wind farm development is designed, located and sited to avoid, minimise and mitigate electromagnetic interference to pre-existing television, radar and radio transmission and reception services.

6.1 Scope and Limitations

This report has been prepared by GHD for Neoen Australia Pty Ltd and may only be used and relied on by Neoen Australia Pty Ltd for the purpose agreed between GHD and Neoen Australia Pty Ltd as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Neoen Australia Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was finalised.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by Neoen Australia Pty Ltd, publicly available details on the ACMA radio communications licence database and information from consultation with other entities impacted by the proposed wind farm, which GHD has not independently verified or checked the information beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

7. Summary of Mitigation Strategies and Recommendations

Table 10 – Mitigation Strategies and Recommendations Summary

Service and Impact	Mitigation Strategy	Recommendation
Fixed Point to Point SA Water link (licence #226752) is likely to be impeded by SG056.	Alternative service routing. Replacement with 3G/4G or satellite communications. Provision of repeater.	Neoen will liaise with SA Water to determine suitable rectification options.
Fixed Point to Point Minor to no impact anticipated to services if turbines are kept out of the nominated exclusion zones.	Nil	Ensure micro-siting of the wind turbines such that blade tips do not enter the second Fresnel exclusion zones of existing radio systems.
Digital Television Potential minor service degradation to local community, i.e. TV reception within 10 km of wind farm may be affected.	Realign antennas on affected dwellings in a more direct path to their respective transmitter. Realign antennas on affected dwellings to another television transmitter, such as Spencer Gulf (The Bluff) or Adelaide (Crafers). Replace antennas on affected dwellings with a higher gain antenna Relocate antennas on affected dwellings to another position on the property that is less affected Install satellite television on affected dwellings Install a television relay station in or near the townships.	Neoen will undertake a pre- and post-construction assessment of the television and radio reception strength at the location of any existing or approved dwellings as at the date of development approval that are within 5 kilometres of any turbine. The assessments will be undertaken by an independent television and radio monitoring specialist, and include testing at locations to be determined by the television and radio monitoring specialist to enable the average television and radio reception strength to be determined. If the post-construction assessment establishes an unacceptable increase in interference to reception as a result of the wind farm, as determined by the independent television and radio monitoring specialist, measures to restore the affected reception to pre-construction quality will be undertaken.
AM/FM Services Minor to no impact anticipated to services.	Nil.	Measure signal levels in wind farm vicinity to establish a baseline, as per TV signal mitigation recommendation.
Meteorological Radar None to minor impact anticipated to weather-watch radar systems during extraordinary radio propagation conditions.	Take the radar impact into consideration where possible for any micro siting of the layout.	Liaise closely with BoM and provide sufficient information to allow them to reconfigure their radar systems.

Service and Impact	Mitigation Strategy	Recommendation
Land Mobile Radio Potential minor impact anticipated to SAGRN, Spark Infrastructure and Sihero land mobile radio services.	Avoid micro-siting to within 20 m of transmitter locations; ideally avoiding moving any closer than 100 m away.	Record signal levels in the affected areas of LMR operations prior to the construction of the wind turbines to establish a baseline.
Goyder Connect Backbone Link STN-WDY impeded by Turbines B026 (and possibly B029 and B023)	Construct repeater station.	Liaise with Goyder Connect to agree on alternative service delivery path.
Goyder Connect Backbone Link STN-BDH possibly impeded by Turbine B010	Construct repeater station.	Liaise with Goyder Connect to agree on alternative service delivery path.
Goyder Connect Landowner C1 may lose coverage due to Turbine B017 impeding the signal.	Review service delivery through alternative tower. Construct repeater station.	Verify installation location at customer end and re-analyse. Liaise with Goyder Connect to agree on alternative service delivery path.
Goyder Connect Landowner H3 may lose coverage due to Turbine B004 impeding the signal.	Review service delivery through alternative tower. Construct repeater station.	Verify installation location at customer end and re-analyse. Liaise with Goyder Connect to agree on alternative service delivery path.
Goyder Connect Landowner H2 may lose coverage due to Turbine B025 and B033 impeding the signal.	Review service delivery through alternative tower. Construct repeater station.	Verify installation location at customer end and re-analyse. Liaise with Goyder Connect to agree on alternative service delivery path.
Goyder Connect Landowner H56 may lose coverage due to Turbine B024 impeding the signal.	Review service delivery through alternative tower. Construct repeater station.	Verify installation location at customer end and re-analyse. Liaise with Goyder Connect to agree on alternative service delivery path.
Goyder Connect Landowners C3, C4 and H57 may lose coverage due to Turbine B027 impeding the signal.	Review service delivery through alternative tower. Construct repeater station.	Verify installation location at customer end and re-analyse. Liaise with Goyder Connect to agree on alternative service delivery path.

Appendices

Appendix A - Radio Sites in Vicinity of Wind Farm ACMA Details

Point to Point Radio Links

Licence No.	Licensee	Radio Site A	Radio Site B	Operating Frequency
1503766	Telstra Corporation Limited	Telstra Site Albert SA 5417	Telstra Site 7km SE of Mount Bryan & 10 km N of Burra	1.4435 GHz 1.504 GHz
1806000	SAGRN	ETSA & Electranet site 5 km NW of Point Pass Windy Hill	Telstra Site 7km SE of Mount Bryan & 10 km N of Burra	7.940425 GHz 8.251745 GHz
228473	Spark Infrastructure SA Pty Ltd	Major Radio Site 5 km NW of Lochiel Trig Point Bumbunga Hill	Telstra Site 7km SE of Mount Bryan & 10 km N of Burra	404.675 MHz 414.125 MHz
1503765	Telstra Corporation Limited	Telstra/SAGRN/Link Site Bennys Hill Road Clare	Telstra Site 7km SE of Mount Bryan & 10 km N of Burra	1.4335 GHz 1.494 GHz
1805996	SAGRN	Telstra site 10.5 km ENE of Jamestown Brownes Hill	Telstra Site 7km SE of Mount Bryan & 10 km N of Burra	7.881125 GHz 8.192445 GHz
1914230	Sihero Pty Ltd	Sihero Site 5km SW of Mt Bryan	Stein Hill SW of Burra	450.825 MHz 460.325 MHz
1940023	Aussie Broadband Pty Ltd	Optus/Vodafone Site Lot 2 Quarry Rd Clare	Mount Cone 10 km North of Burra	18.58 GHz 19.59 GHz
1937805	Aussie Broadband Pty Ltd	Aussie Broadband tower 4.5 km NE of Watervale Mount Horrocks	Mount Cone 10 km North of Burra	10.935 GHz 11.425 GHz
1235718	ElectraNet Pty Ltd	Electranet tower Hallet Hill 4 km NW of Mount Bryan	ETSA & Electranet site 5 km NW of Point Pass Windy Hill	7.851475 GHz 8.162795 GHz
1505455	Regional Council of Goyder	Hallet Hill 4 Km North-West of Mount Bryan	CFS/Broadcasting Tower Julia Road EUDUNDA	410.6 MHz

Point to Multipoint Sites

ACMA Site No.	Location (GDA94)	Site Name	Licensee(s)	Operating Frequency
9013850	-33.590507, 138.948662	Mount Cone 10 km North of Burra	Aussie Broadband Pty Ltd	3.615 GHz

Land Mobile Radio Sites

ACMA Site No.	Location (GDA94)	Site Name	Licensee(s)	Operating Frequency
24314	-33.590384, 138.947803	Mount Cone 10 km North of Burra	SAGRN Spark Infrastructure Pty Ltd	Various frequencies between 148.8125 – 427.175 MHz
9010042	-33.721102, 138.982549	Stein Hill 5km SW of Burra	Sihero Pty Ltd	473.775 MHz 478.975 MHz

Television Broadcast Sites

Callsign	Licence No.	Operating Frequency
Broadcast Site The Stock Route Site BURRA ACMA Site Number: 41322		
SBS34 (Special Broadcasting Service Corporation)	1602332	571.5 MHz
SGS36 (Spencer Gulf Telecasters Pty Limited (Channel 7))	1601034	585.5 MHz
GDS37 (Spencer Gulf Telecasters Pty Limited (Channel 9))	1601166	592.5 MHz
GTS39 (Spencer Gulf Telecasters Pty Limited (Channel 10))	1601033	606.5 MHz
ABC35 (Australian Broadcasting Corporation)	1601786	578.5 MHz
Link Site BALD HILL NORTH ACMA Site Number: 140678		
SGS48 (Spencer Gulf Telecasters Pty Limited (Channel 7))	1601037	669.5 MHz
GDS49 (Spencer Gulf Telecasters Pty Limited (Channel 9))	1601035	676.5 MHz
GTS50 (Spencer Gulf Telecasters Pty Limited (Channel 10))	1601036	683.5 MHz
Broadcast Site Crafrers ADELAIDE ACMA Site Numbers: 23181, 23132		
SAS6 (TX Australia, Channel Seven)	1156296	177.5 MHz
SBS7 (TX Australia, Special Broadcasting Service)	1961928	184.5 MHz
NWS8 (TX Australia, Channel Nine)	1156297	191.5 MHz
ADS11 (TX Australia, Channel Ten)	1156298	219.5 MHz
ABC12 (Broadcast Australia, Australian Broadcasting Corporation)	1156330	226.5 MHz
Broadcast Site TV Track THE BLUFF ACMA Site Number: 24650		
SGS40 (Spencer Gulf Telecasters Pty Limited)	1942528	613.5 MHz
SBS41 (Broadcast Australia, Special Broadcasting Service)	1931753	620.5 MHz
GDS42 (Spencer Gulf Telecasters Pty Limited)	1942529	627.5 MHz
ABC43 (Australian Broadcasting Corporation)	1957972	634.5 MHz
GTS44 (Spencer Gulf Telecasters Pty Limited)	1384236	641.5 MHz

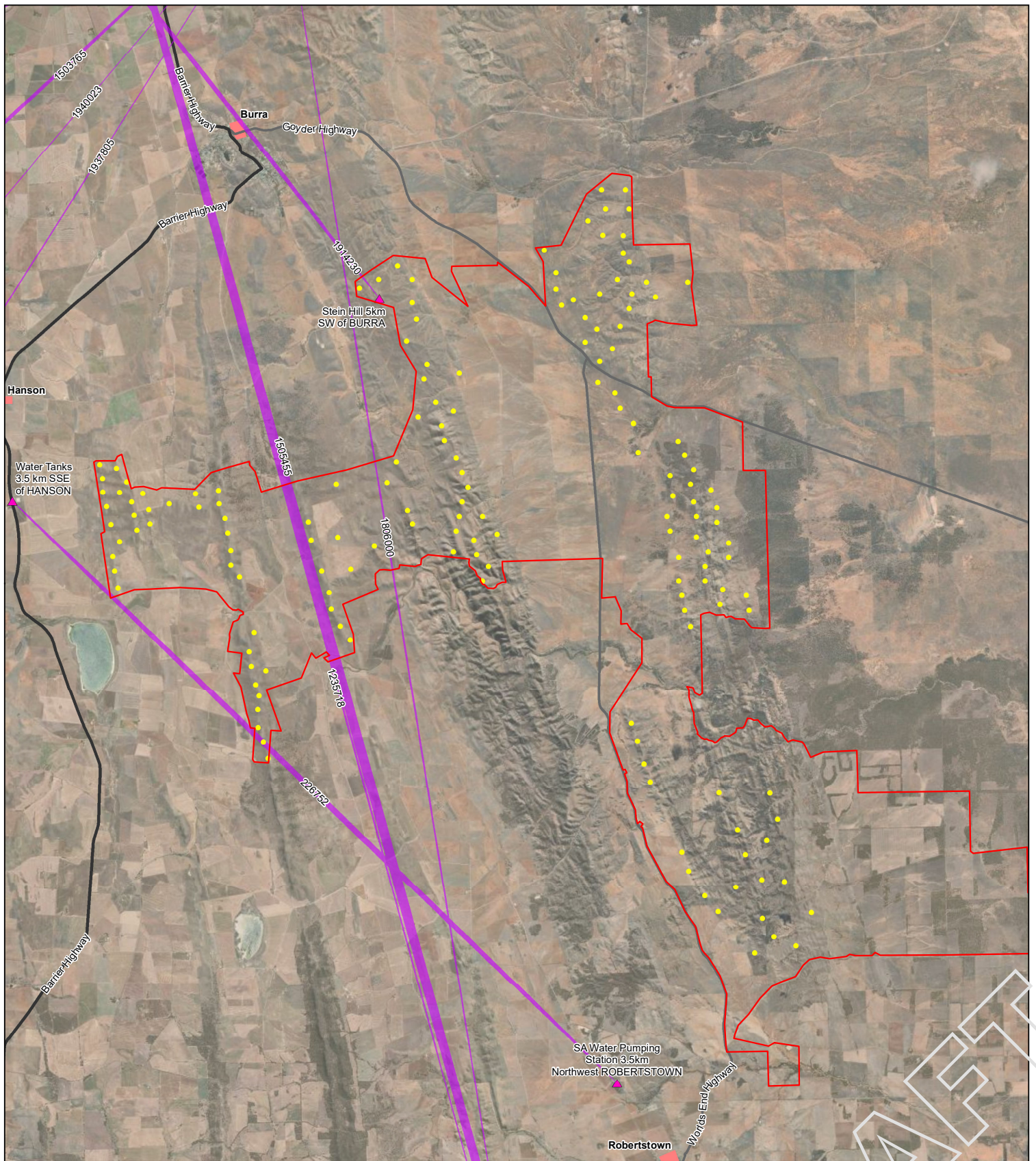
AM/FM Radio Broadcast Sites

Callsign	Licence No.	Operating Frequency
CBRS Repeater site 29 km N of Burra MT BRYAN (Flow FM)		
ACMA Site Number: 24320		
8SAT (Commercial Broadcasting)	1599568	107.5 MHz
5 Gleeson Street CLARE (Bundaburg Narrowcasters)		
ACMA Site Number: 138372		
5S88 (Narrowcast)	644257	87.6 MHz
15 Vanga Avenue CLARE (United Christian Broadcasters)		
ACMA Site Number: 139338		
VKJ664 (Narrowcast)	1187779	88 MHz
United Church Main North Road and Henry Street (United Christian Broadcasters)		
ACMA Site Number: 139982		
VKC622 (Narrowcast)	1198911	87.6 MHz

Appendix B - Point-to-Point Radio Link Exclusion Zones

Contents

- Electromagnetic Interference Assessment – Figure 1a – Point-to-Point Radio Link Exclusion Zones (Turbine Area only)
- Electromagnetic Interference Assessment – Figure 1b – Point-to-Point Radio Link Exclusion Zones



□ Goyder South Project Area

▲ Transmitters

● Turbine layout (shown at scale, 180m dia)

■ Point-to-Point Fresnel exclusion zones - labelled by ACMA Licence No.

— Highway

— Arterial / Sub Arterial

■ Township

Paper Size A3
0 0.5 1 2 3 4
Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54



NEOEN

Neoen
Goyder South Hybrid Renewable Energy Project

Goyder South Point to Point
Radio Link Exclusion Zones

Job Number 33-19112
Revision C
Date 29/05/2020

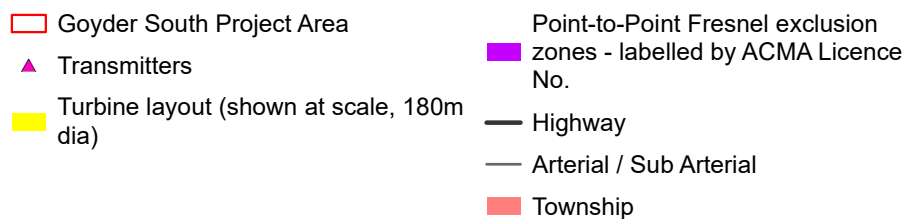
Figure 1a

N:\AU\Melbourne\Projects\33\19112\GIS\Maps\Deliverables\33_19112_KBM_A3P_RevB.mxd

© 2020. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: Data.sa.gov.au, base data, 2019; Neoen, project area, 2020; ACMA, transmitters, 2019; GHD, no-go zones, 2019 Created by: savanables
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

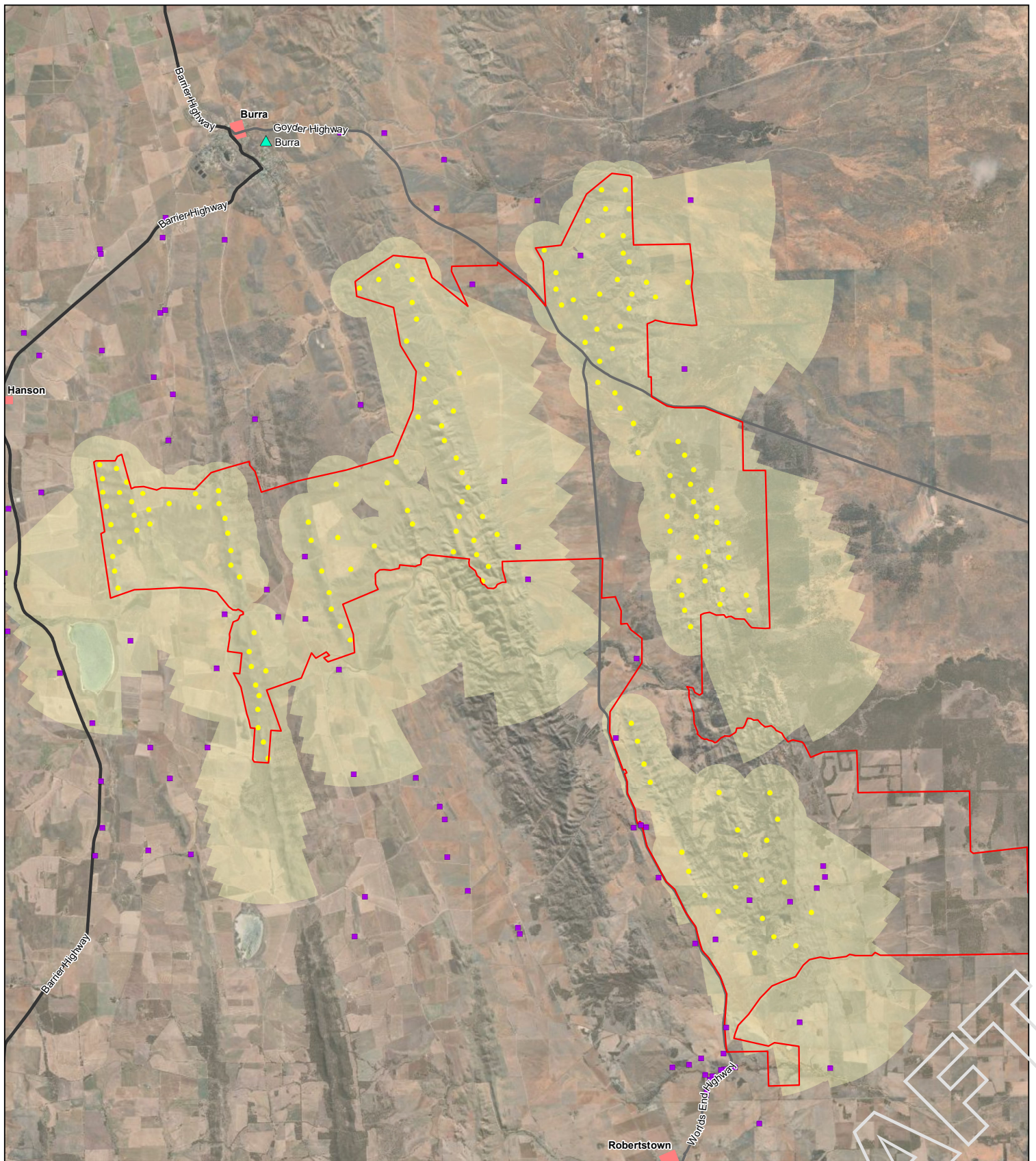
180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com



Appendix C - Television Signal Scatter Zones from Broadcast Transmitters

Contents

- Electromagnetic Interference Assessment – Figure 2 – Burra Transmitter Scatter Zone
- Electromagnetic Interference Assessment – Figure 3 – Adelaide Transmitter Scatter Zone
- Electromagnetic Interference Assessment – Figure 4 – Spencer Gulf Transmitter Scatter Zone



- Goyder South Project Area
- Dwelling
- Turbine layout (shown at scale, 180m dia)
- Scatter zone
- ▲ TV transmitters
- Highway
- Arterial / Sub Arterial
- Township

Paper Size A3
0 0.5 1 2 3 4
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54



NEOEN

Neoen
Goyder South Hybrid Renewable Energy Project

Goyder South
Burra Transmitter Scatter

Job Number | 33-19112
Revision | C
Date | 29/05/2020

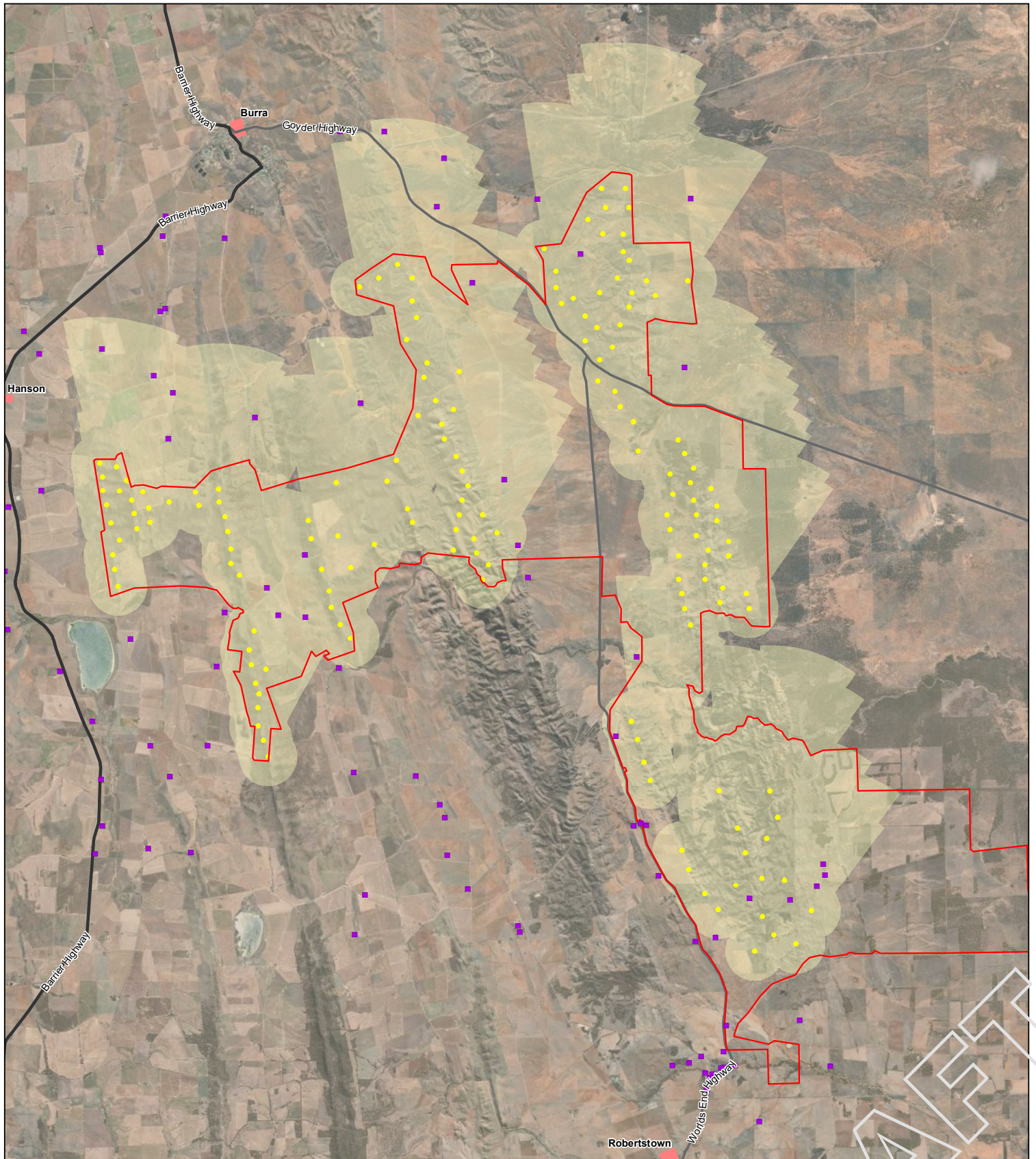
Figure 2

N:\AU\Melbourne\Projects\33\19112\GIS\Maps\Deliverables\33_19112_KBM_A3P_RevB.mxd

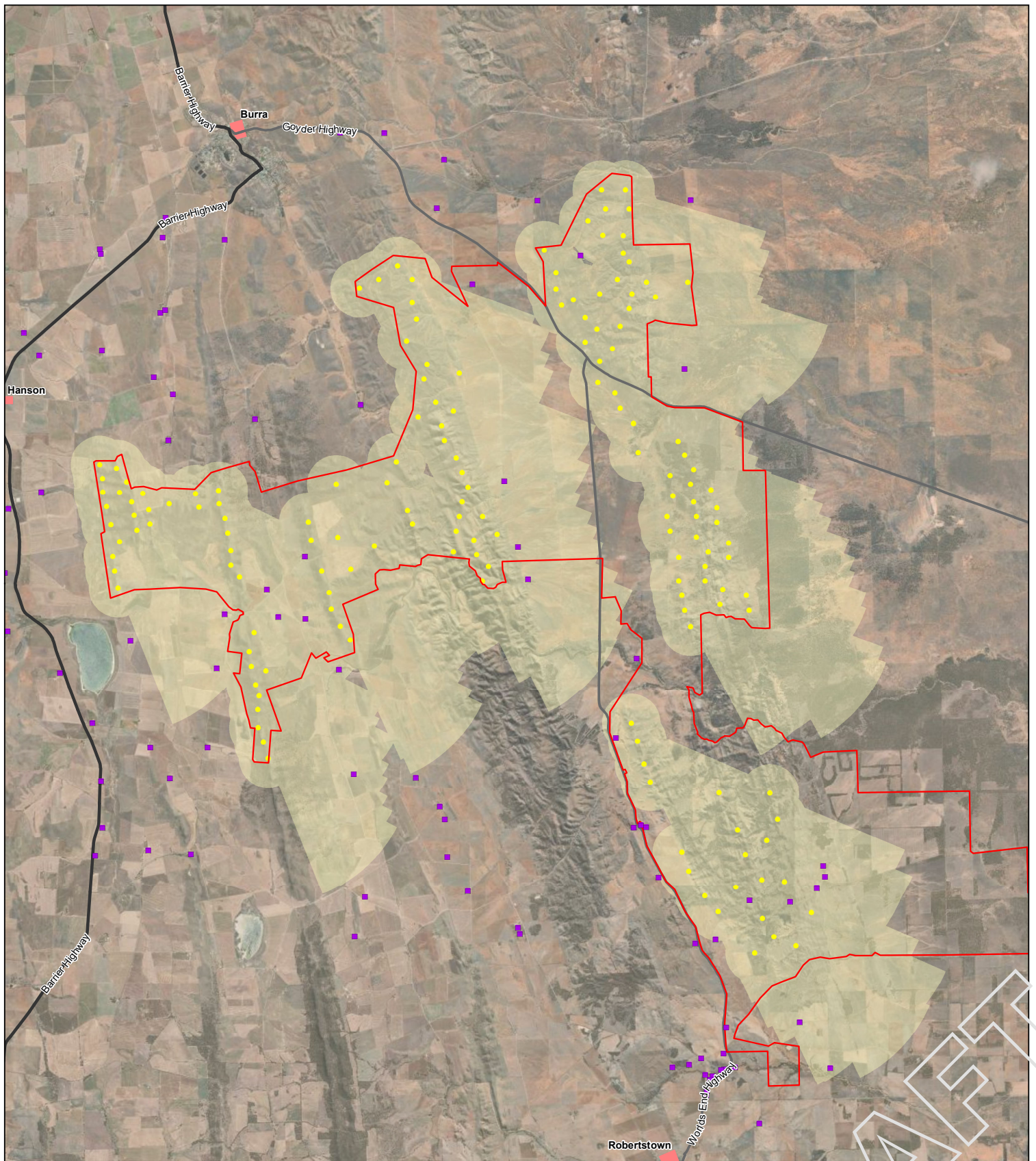
© 2020. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: Data.sa.gov.au, base data, 2019; Neoen, project area, 2020; ACMA, transmitters, 2019; GHD, no-go zones, 2019 Created by: savanables
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com



- Goyder South Project Area
- Dwelling
- Turbine layout (shown at scale, 180m dia)
- Scatter zone
- Highway
- Arterial / Sub Arterial
- Township



□ Goyder South Project Area

— Arterial / Sub Arterial

■ Dwelling

■ Township

■ Turbine layout (shown at scale, 180m dia)

■ Scatter zone

— Highway

Paper Size A3
0 0.5 1 2 3 4
Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54



NEOEN

Neoen
Goyder South Hybrid Renewable Energy Project

Goyder South
Spencer Gulf Transmitter Scatter

Job Number 33-19112
Revision C
Date 29/05/2020

Figure 4

N:\AU\Melbourne\Projects\33\19112\GIS\Maps\Deliverables\33_19112_KBM_A3P_RevB.mxd

© 2020. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

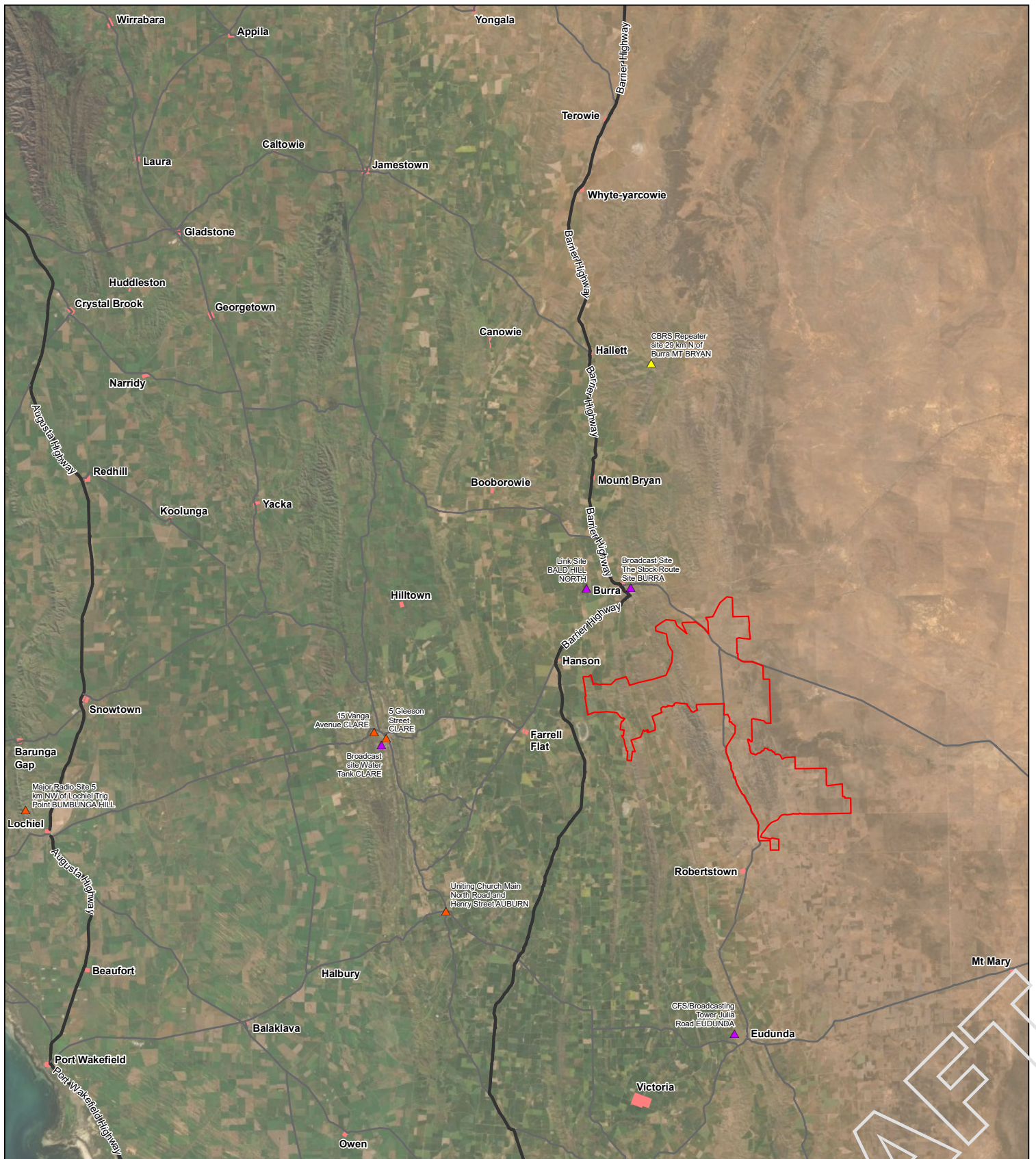
Data source: Data.sa.gov.au, base data, 2019; Neoen, project area, 2020; ACMA, transmitters, 2019; GHD, no-go zones, 2019 Created by: savanables
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Appendix D - Radio Transmitters in Vicinity of Goyder South Hybrid Renewable Energy Facility

Contents

- Electromagnetic Interference Assessment – Figure 5a – Transmitters – TV, Radio and Narrowcast
- Electromagnetic Interference Assessment – Figure 5b – Transmitters – Point-to-Point
- Electromagnetic Interference Assessment – Figure 5c – Transmitters – Point-to-Multipoint
- Electromagnetic Interference Assessment – Figure 5d – Transmitters – Land Mobile Radio
- Electromagnetic Interference Assessment – Figure 5e – Transmitters – Spectrum
- Electromagnetic Interference Assessment – Figure 5f – Transmitters – Goyder Connect



Goyder South Project Area
 Township

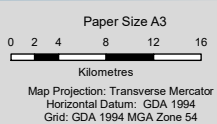
▲ Narrowcast transmitter

▲ Radio transmitter

▲ TV transmitter

Highway

Arterial / Sub Arterial



NEOEN

Neoen
Goyder South Hybrid Renewable Energy Project

TV Radio and Narrowcast
Transmitters

Job Number	33-19112
Revision	B
Date	29/05/2020

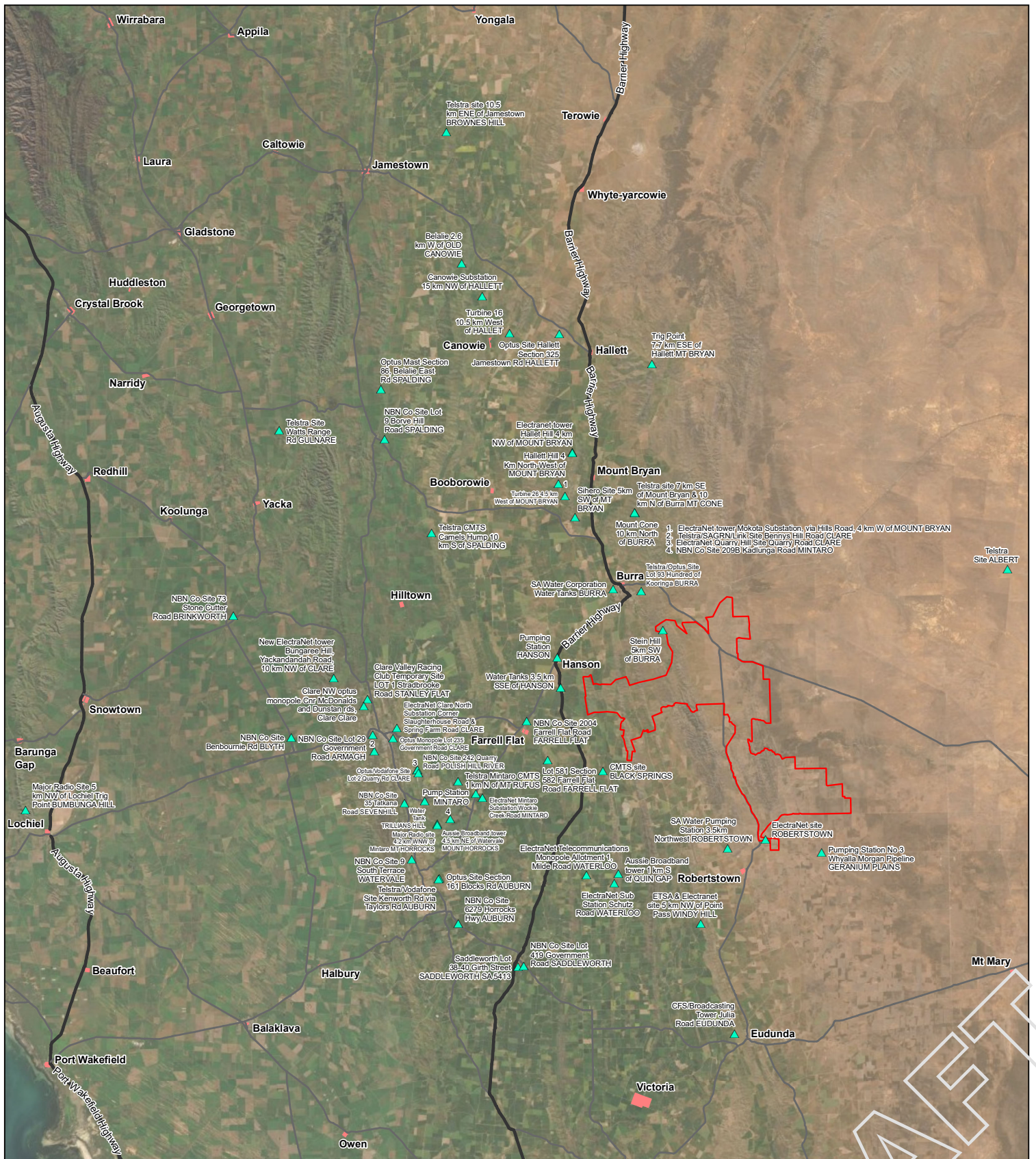
Figure 5a

N:\AU\Melbourne\Projects\33\19112\GIS\Maps\Deliverables\33_19112_KBM_A3P_RevB.mxd

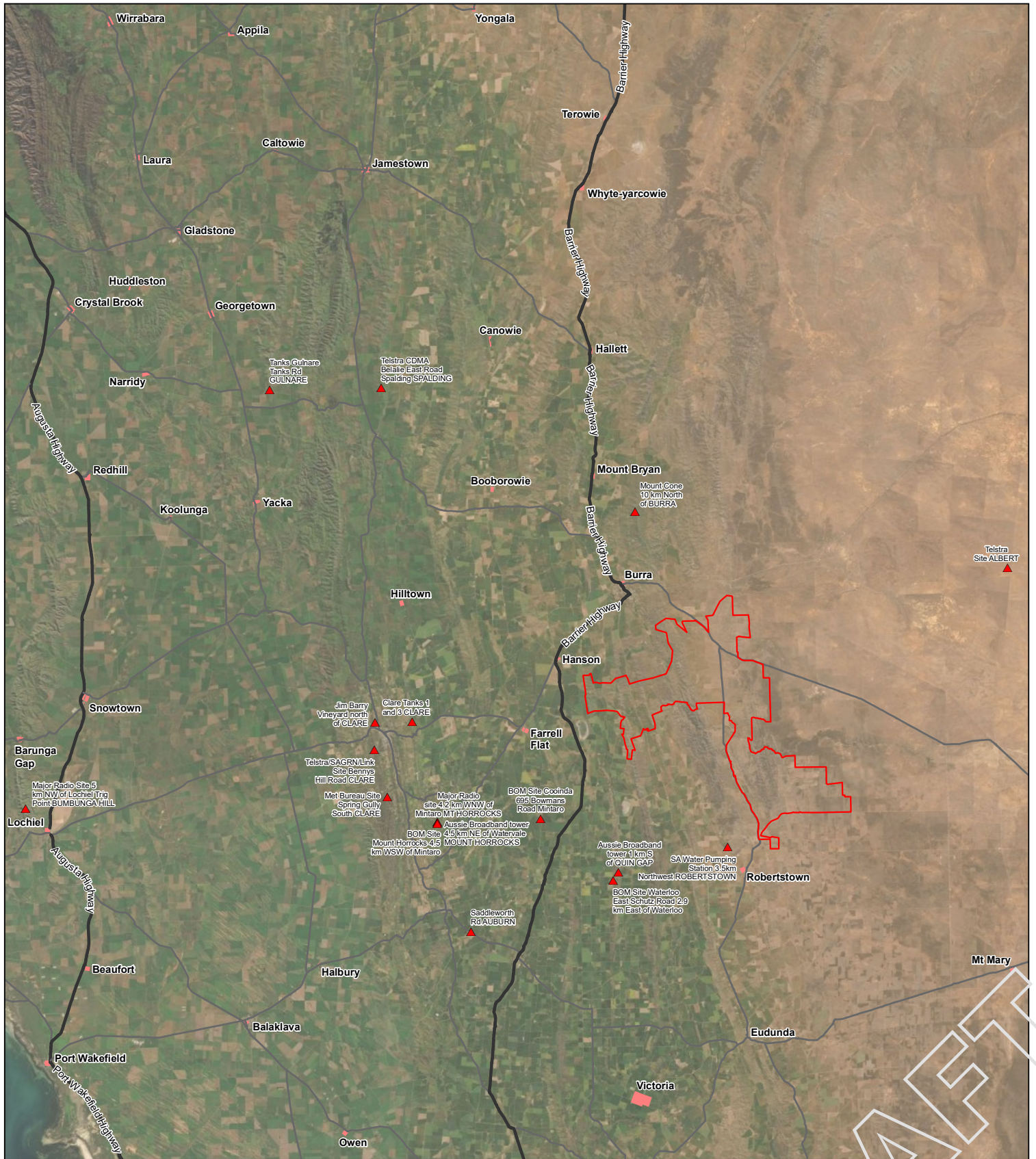
© 2020. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: Data.sa.gov.au, base data, 2019; Neoen, project area, 2020; ACMA, transmitters, 2019; GHD, no-go zones, 2019 Created by: savanables
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com



- ▭ Goyder South Project Area
- ▲ Point to Point transmitter
- Highway
- Arterial / Sub Arterial
- ▭ Township



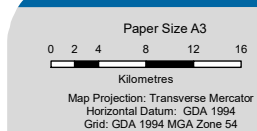
□ Goyder South Project Area

▲ Point to Multipoint transmitter

— Highway

— Arterial / Sub Arterial

■ Township



Neoen
Goyder South Hybrid Renewable Energy Project

Job Number 33-19112
Revision B
Date 29/05/2020

Point to Multipoint Transmitters

Figure 5c

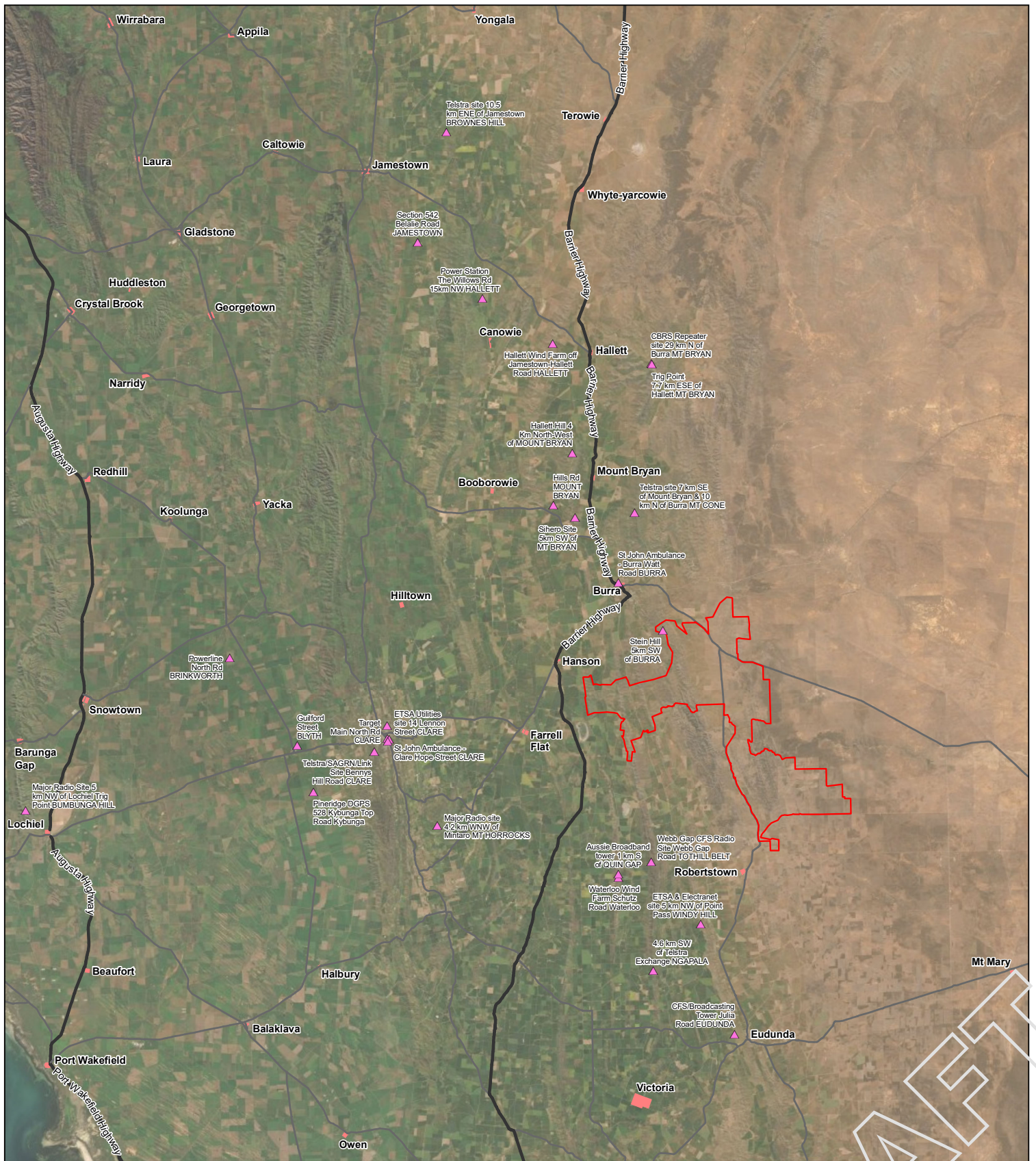
N:\AU\Melbourne\Projects\33\19112\GIS\Maps\Deliverables\33_19112_KBM_A3P_RevB.mxd

© 2020. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: Data.sa.gov.au, base data, 2019; Neoen, project area, 2020; ACMA, transmitters, 2019; GHD, no-go zones, 2019 Created by: savanables

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

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com



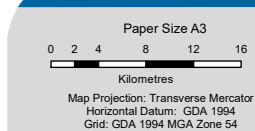
□ Goyder South Project Area

▲ Land mobile radio transmitter

— Highway

— Arterial / Sub Arterial

■ Township



NEOEN

Neoen
Goyder South Hybrid Renewable Energy Project

Land Mobile Radio
Transmitters

Job Number 33-19112
Revision B
Date 29/05/2020

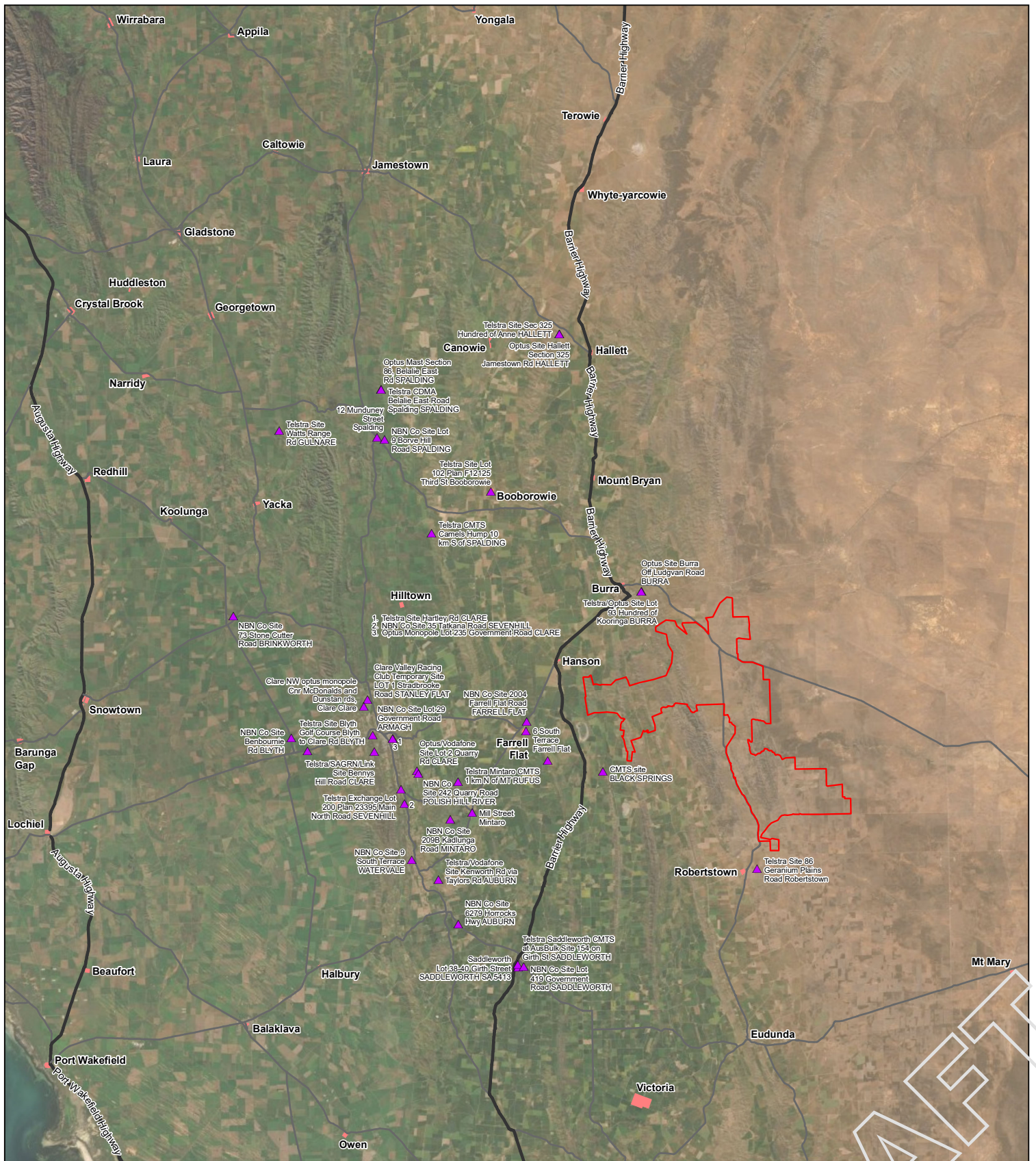
Figure 5d

N:\AU\Melbourne\Projects\33\19112\GIS\Maps\Deliverables\33_19112_KBM_A3P_RevB.mxd

© 2020. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: Data.ssa.gov.au, base data, 2019; Neoen, project area, 2020; ACMA, transmitters, 2019; GHD, no-go zones, 2019 Created by: savanables
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com



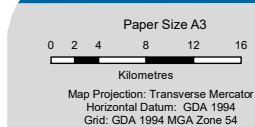
Goyder South Project Area

▲ Spectrum transmitter

Highway

Arterial / Sub Arterial

Township



NEOEN

Neoen
Goyder South Hybrid Renewable Energy Project

Job Number	33-19112
Revision	B
Date	29/05/2020

Spectrum Transmitters

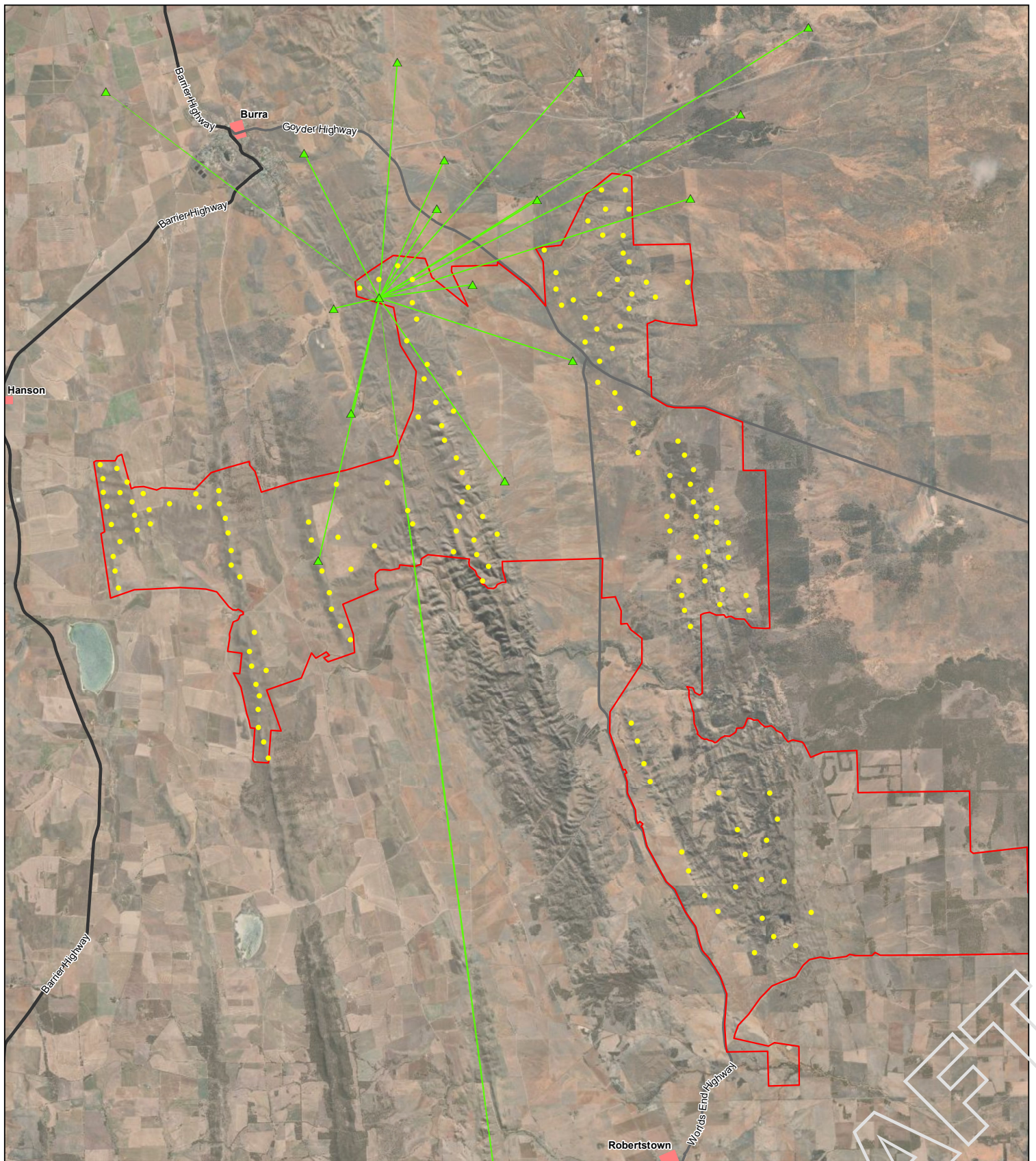
Figure 5e

N:\AU\Melbourne\Projects\33\19112\GIS\Maps\Deliverables\33_19112_KBM_A3P_RevB.mxd

© 2020. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: Data.sa.gov.au, base data, 2019; Neoen, project area, 2020; ACMA, transmitters, 2019; GHD, no-go zones, 2019. Created by: savanables
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com



- Goyder South Project Area
- ▲ Goyder Connect transmitter/receiver
- Goyder Connect Fresnel exclusion zones
- Turbine layout (shown at scale, 180m dia)
- Highway
- Arterial / Sub Arterial
- Township

Paper Size A3
0 0.5 1 2 3 4
Kilometres
Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 54



NEOEN

Neoen
Goyder South Hybrid Renewable Energy Project

**Fixed Wireless
(Goyder Connect)**

Job Number	33-19112
Revision	A
Date	29/05/2020

Figure 5f

N:\AU\Melbourne\Projects\33\19112\GIS\Maps\Deliverables\33_19112_KBM_A3P_RevB.mxd

© 2020. Whilst every care has been taken to prepare this map, GHD (and DATA CUSTODIAN) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.

Data source: Data.sa.gov.au, base data, 2019; Neoen, project area, 2020; ACMA, transmitters, 2019; GHD, no-go zones, 2019 Created by: savanables
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

180 Lonsdale Street Melbourne VIC 3000 Australia T 61 3 8687 8000 F 61 3 8687 8111 E melmail@ghd.com W www.ghd.com

Appendix E – Consultation Reference Letters

Contents

- Geoscience Australia – Potential Impacts of the Proposed Stony Gap Wind Farm on Geoscience Australia Geodetic Infrastructure
- Telstra – Wind Farm EMI Assessment - Goyder North and Goyder South Hybrid Renewable Energy Project
- Government of South Australia Attorney-General's Department Public Safety – Goyder North and Goyder South Hybrid Renewable Energy Project
- Bureau of Meteorology – Re Goyder South Electromagnetic Interference Assessment

HPRM Reference No. D2019-84074

Brendan Siebert
Senior Engineer - Telecommunications
GHD
Level 4, 211 Victoria Square
ADELAIDE SA 5000

August 23, 2019

Dear Brendan

**POTENTIAL IMPACTS OF THE PROPOSED STONY GAP WIND FARM ON GEOSCIENCE AUSTRALIA
GEODETIC INFRASTRUCTURE**

Geoscience Australia do not foresee any impacts to our trigonometrical stations, Global Navigation Satellite System (GNSS) reference stations or associated facilities or services associated with the proposed Stony Gap Wind Farm.

Yours Sincerely,

A handwritten signature in black ink, appearing to be 'R. Ruddick', with a stylized flourish at the end.

Ryan Ruddick
Director GNSS Infrastructure and Informatics
National Positioning Infrastructure
Geoscience Australia

18 September 2019

Network Engineering, Networks and IT
Access Planning SA/NT/Vic West

L4/1 Nash St Perth WA 6000

Telephone (08) 6224 9168

Daniel.W.Wake@team.telstra.com

Brendan Siebert
L4/211 Victoria Square
Adelaide, SA 5000

**Re: Wind Farm EMI Assessment - Goyder North and Goyder South
Hybrid Renewable Energy Project**

Dear Brendan,

In response to your email request on 15-Aug-2019, a desk top study was undertaken of the area and nearby telecommunications infrastructure.

Based on the provided information relating to the proposed wind farm located at Goyder, South Australia, results of rayline analysis investigation reveals that there is a potential for undue interference from the proposed wind farm on or around the Telstra communication tower located at Mount Cone.

Telstra have two active links that are in the concerned region, Clare West – Mount Cone & Mount Cone – Albert.

There are two turbines (circled) that could potentially cause obstruction, on paper we are just missing it (clearance of 40-50m from the ray line) but assumption here is based on the accuracy of Google Earth terrain data and our network overlay. All the other red coloured Turbines are in the clearance range of 40m-150m. As per snapshot below



In order to analyse the full impact of the windfarm on Telstra's radio telecommunication network, Telstra requests that it be allowed to conduct a detailed feasibility study (once detailed design specifications are available).

This detailed study is required to identify and assess the risk to Telstra's radio telecommunication network. It is important that this risk is identified and assessed prior to a planning application being made to minimise costs and delays to both parties. If Telstra cannot undertake a detailed study and Telstra believes there is a potential risk of interference, Telstra will take the necessary action to ensure its radio telecommunication network is protected from the potential impact of the development.

Please note that depending on Telstra deployment policy and any negotiations based on a commercial agreement, there may be a cost involved in performing the feasibility study.

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.

For future correspondence and enquiries regarding this matter, please contact the undersigned on 08 6224 9168.

Yours faithfully,

Daniel Wake
Fundamental Planning Specialist
Norther Territory, South Australia, Vic West



If calling please ask for
David Loy

Telephone
0416 268 284

Reference
qA11331

17 October 2019

Brendan Siebert
Senior Engineer – Telecommunications
GHD Level 4, 211 Victoria Square
Adelaide, SA 5000

Dear Brendan,

Re: Goyder North and Goyder South Hybrid Renewable Energy Project.

I refer to your request for advice relating to the potential effects of this project on SAGRN point-to-point inter-site links.

The network operator (Motorola) has performed an analysis of the project information supplied and concluded that, in relation to Phase 1 of the project, there is one turbine (B017) that obstructs the link path between SAGRN sites at Mt Cone and Windy Hill. There are another three turbines that are close to obstructing the same link path (B005, B008 and B022). The nearest of these turbines is approximately eighty-five metres from the link path.

Regarding Phase 2 of the project, there appears to be several turbines obstructing the link paths between SAGRN sites at Mt Cone to Windy Hill (six in total) and Mt Cone to Clare West (three in total). There are two turbines that are close to the link path between Mt Cone to Jamestown but appear to be more than 100m from the F2 zone.

It is desirable that a minimum of one hundred metres separation is maintained between any SAGRN link path and the outer diameter of any turbine blade that is operating parallel to any link path. We are confident that if this separation is maintained there will be no effect on SAGRN inter-site link performance.

Yours sincerely

A handwritten signature in dark ink, appearing to read "P.D. Sinclair".

Peter Sinclair
A/Director, Public Safety Solutions
Peter.Sinclair@sa.gov.au

Public Safety

Level 16
45 Pirie Street
Adelaide SA 5000

GPO Box 464
Adelaide SA 5001
DX 336

Tel 08 8207 1873
Fax 08 8204 1053

GHD

Level 4, 211 Victoria Square
Adelaide SA 5000



T: 61 8 8111 6600 F: 61 8 8111 6699 E: adlmail@ghd.com

© GHD 2020

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

[https://projects.ghd.com/oc/Digital1/goyderrenewableenerg/Delivery/Documents/Goyder South - Hybrid Renewable Energy Project Electromagnetic Interference Assessment.docx](https://projects.ghd.com/oc/Digital1/goyderrenewableenerg/Delivery/Documents/Goyder%20South%20-%20Hybrid%20Renewable%20Energy%20Project%20Electromagnetic%20Interference%20Assessment.docx)

Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	B. Siebert	B. Leedham		B. Leedham		02/06/2020

www.ghd.com



FINAL REPORT

GOYDER SOUTH HYBRID

RENEWABLE ENERGY PROJECT

AERONAUTICAL IMPACT ASSESSMENT

INCLUDING

AVIATION IMPACT STATEMENT

QUALITATIVE RISK ASSESSMENT

AND

OBSTACLE LIGHTING REVIEW

CCP12

13 November 2019
V2.0

NEOEN



Chiron Aviation Consultants
Essendon Vic 3040
Australia



Chiron Aviation Consultants

ABN 34822570654

27 Hilda Street

Essendon 3040

Australia

+61 (0)402025223

ian_jennings@netspace.net.au

www.chironaviationconsultants.com.au

Goyder South Hybrid Renewable Energy Park

Aeronautical Impact Assessment:

Revised Turbine Layout and Numbers

The design of a renewable energy facility is an iterative process. Consequently, there are often changes made to the number, location, and size of the turbines as well as to the location and size of the solar farm component.

The Goyder South Hybrid Renewable Energy Park (GSHREP) will comprise 162 turbines with a tip height of 240m and two solar farms. The area of the GSHREP has not increased and neither has the height above the Australian Height Datum (AHD) of the tallest turbine tip. Consequently, the volume of airspace occupied by the GSHREP has not increased from that assessed in the report *Goyder South Hybrid Renewable Energy Park, Aeronautical Impact Assessment, Chiron Aviation Consultants, 13 November 2019*.

An Aeronautical Impact Assessment (AIA) considers the likely impact on aviation activity and safety. The AIA assesses the distance from the wind farm boundary to nearby certified, registered, or military aerodromes, the lower limit of associated prescribed airspace, as well as the published lowest safe altitudes for overlying air routes. If the boundary of the renewable energy facility and the maximum tip height AHD of the tallest turbine has not increased, then the relationship to nearby aerodromes and prescribed airspace as well as overlying air routes will not change.

Given that the GSHREP boundary and the maximum turbine tip height AHD, that is the volume of airspace occupied by the wind turbines, has not increased from that used for the Aeronautical Impact Assessment the findings of the November 2019 assessment remain valid.

The GSHREP sits near existing wind farms within airspace used for military flying training and may impact on its use. The Department of Defence is being consulted as a separate process and a response is expected during the State assessment process.

Ian Jennings
Principal Consultant
Chiron Aviation Consultants

26 May 2020

© Chiron Consultants, 2019

All Rights Reserved.

The information contained in this document is confidential and proprietary to Chiron Consultants. Other than for evaluation and governmental disclosure purposes, no part of this document may be reproduced, transmitted, stored in a retrieval system, or translated into any language in any form by any means without the written permission of Chiron Consultants.

The client named in the document release approval page is licenced to use the information contained in this document for the purposes for which it was commissioned.



DOCUMENT RELEASE APPROVAL

Approved for Final Release:

A handwritten signature in black ink, appearing to read 'Ian Jennings'.

Name: Ian Jennings
Title: Principal Consultant
Date: 13 November 2019

Distribution: Tom Jenkins
Neoen Australia.

DOCUMENT CONTROL

Version	Description	Date	Author	QA
V0.1	Draft for Comment	20 Sep 2019	IJ	RJJ
V0.2	Amended Turbine Data	20 Sep 2019	IJ	RJJ
V0.3	Editorial	10 Oct 2019	IJ	RJJ
V0.4	Editorial	11 Oct 2019	IJ	RJJ
V0.5	Amended Location Drawings	14 Oct 2019	IJ	RJJ
V1.0	Final	14 Oct 2019	IJ	RJJ
V2.0	Final Includes AsA Response	13 Nov 2019	IJ	RJJ



TABLE OF CONTENTS

Executive Summary.....	4
1. Introduction	5
1.1 Location	5
1.2 Aerodromes and Airstrips	6
1.3 Aerodromes in the Area.....	7
1.4 Air Routes in the Area	7
1.5 Airspace in the Area	7
2. Scope	9
2.1 Aviation Impact Statement (AIS).....	9
2.2 Qualitative Risk Assessment (QRA)	9
2.3 Obstacle Lighting Review (OLR)	10
3. Methodology.....	11
3.1 Aviation Impact Statement.....	11
3.2 Qualitative Risk Assessment	11
3.3 Obstacle Lighting Review	12
4. Aviation Impact Statement.....	13
4.1 Location	13
4.2 Obstacles	13
4.3 Drawings	14
4.4 Aerodromes within 30nm.....	15
4.4.1 Other aerodromes and airstrips	15
4.5 Air Routes and Lowest Safe Altitudes.....	15
4.6 Airspace	16
4.6.1 Restricted Area R265D	16
4.6.2 Danger Area D258B	17
4.7 Communications, Navigation and Surveillance	17
4.7.1 Communications	18
4.7.2 Navigation	18
4.7.3 Surveillance.....	18
4.8 Solar Farm	18
4.9 AIS Conclusions.....	18
4.10 Airservices Australia Response	19
4.11 Department of Defence Response.....	19
5. Qualitative Risk Assessment	20
5.1 Certified and Registered Aerodromes.....	20
5.2 Uncertified Aerodromes.....	20
5.3 Airspace	20
5.4 Relevant Air Routes	21
5.5 Night Flying	22
5.6 General Aviation Flying Training.....	22
5.7 Recreational and Sport Aviation	22
5.8 Approved Low Flying Activities	22
5.9 Aerial Agricultural Applications Activity.....	23
5.10 Known Highly Trafficked Areas.....	23



5.11	Emergency Services Flying	23
5.11.1	Police Air Wing	23
5.11.2	Helicopter Emergency Medical Services	24
5.11.3	Fixed Wing Air Ambulance	24
5.12	Fire Fighting	24
5.12.1	Aerial Firefighting	25
5.12.2	Ground Based Firefighting	26
5.13	Topographical and Marginal Weather Conditions	27
5.14	Solar Farm	28
5.15	NASF Guidelines	28
5.15.1	Notification to Authorities	29
5.15.2	Risk Assessment	29
5.15.3	Lighting of Wind Turbines	30
5.16	QRA Findings	31
6.	Obstacle Lighting Review	32
6.1	Australian Regulatory Framework for Obstacle Lighting of Wind Farms	32
6.1.1	Civil Aviation Safety Regulations	32
6.1.2	Manual of Standards Part 139	32
6.1.3	National Airports Safeguarding Framework	32
6.2	Obstacle Lighting Summary	34
7.	Wind Monitoring Towers	34
7.1	NASF Guidelines – Marking of Meteorological Monitoring Towers	35
7.2	Federal Aviation Administration – Marking of Met Towers	35
7.3	Reporting of Tall Structures	35
7.4	Recommendations	36
8.	AIA Conclusions	37
8.1	AIS	37
8.1.1	Airservices Response to AIS	37
8.1.2	Department of Defence Response to AIS	37
8.2	Risk Assessment	37
8.3	Obstacle Lighting	37
8.4	Reporting of Tall Structures	38
Appendix A:	Airservices Australia Wind Turbine Assessment Letter	
Appendix B:	Turbine Locations and Heights	
Appendix C:	AFAC, Wind Farms and bushfire Operations	
Appendix D:	Country Fire Service SA, Fact Sheet, Aerial Firefighting	
Appendix E:	Stakeholder List	
Appendix F:	Glossary of Terms and Abbreviations	
Appendix G:	Airservices Australia response to the Aviation Impact Statement	



EXECUTIVE SUMMARY

The proposed wind and solar farm will comprise of 187 turbines with a tip height of 240m Above Ground Level (AGL). The two solar farm areas being considered are either within or adjacent to the wind turbines. The proposed solar farm is in two areas surrounded by wind turbines and the other is adjacent to turbines.

There are no Certified or Registered Aerodromes within 30nm (56km) of the boundary of the GSHREP. There is one known uncertified airstrip within 30nm of the wind farm.

The Aviation Impact Statement concluded that the GSHREP **will not impact** upon the following:

- The Lowest Safe Altitude of nearby published air routes;
- The Obstacle Limitation Surface (OLS) of any registered or certified aerodrome;
- The Procedures for Air Navigation Services – Aircraft Operations (PANS-OPS) surfaces associated with the Instrument Approach Procedures at any Certified or Registered Aerodrome;
- The operation of the Uncertified Aerodrome at Stonefield;
- Restricted Area R265D;
- The performance of Communication, Navigation or Surveillance Facilities.

The proposed solar farm photovoltaic panel arrays of the GSHREP are shielded by adjacent turbines, therefore any aircraft at cruising altitude will be at least 1300ft above ground level over the GSHREP. At that height it is considered that glare or glint will **not be a hazard** to aircraft safety.

The GSHREP sits near existing wind farms within Danger Area D258B, an area used for military flying training and **may impact** on its use.

The Qualitative Risk Assessment demonstrates that for the GSHREP: -

- By day the wind turbines are conspicuous by their size and colour;
- The solar panel arrays will not affect low level aircraft flight as they are shielded by the adjacent turbines;
- Night operations of aircraft do not occur below prescribed airspace;
- Aerodromes equipped for night operations are sufficiently distant; and
- It is assessed as a **LOW risk to aviation** and is therefore **not a hazard to aircraft safety**.

The Obstacle Lighting Review for the GSHREP finds that in accordance with the NASF Guideline D risk assessment:

- **Obstacle lighting is not required** as the risk to aviation is LOW and no additional mitigating strategies are necessary.

The GSHREP wind turbines and meteorological monitoring masts are considered to be tall structures, therefore they must be reported to the Vertical Obstacle Database, managed by Airservices Australia.



1. INTRODUCTION

Neoen Australia. has requested Chiron Aviation Consultants to provide an Aeronautical Impact Assessment (AIA) for the proposed Goyder South Hybrid Renewable Energy Project in South Australia.

1.1 Location

The Goyder South Hybrid Renewable Energy Project (GSHREP) is located between the towns of Hanson, Burra, Black Springs, Robertstown, and Bundy and is approximately 55nm (102km) south east of Port Pirie.

The proposed wind farm will comprise of 187 turbines with a tip height of 240m Above Ground Level (AGL).

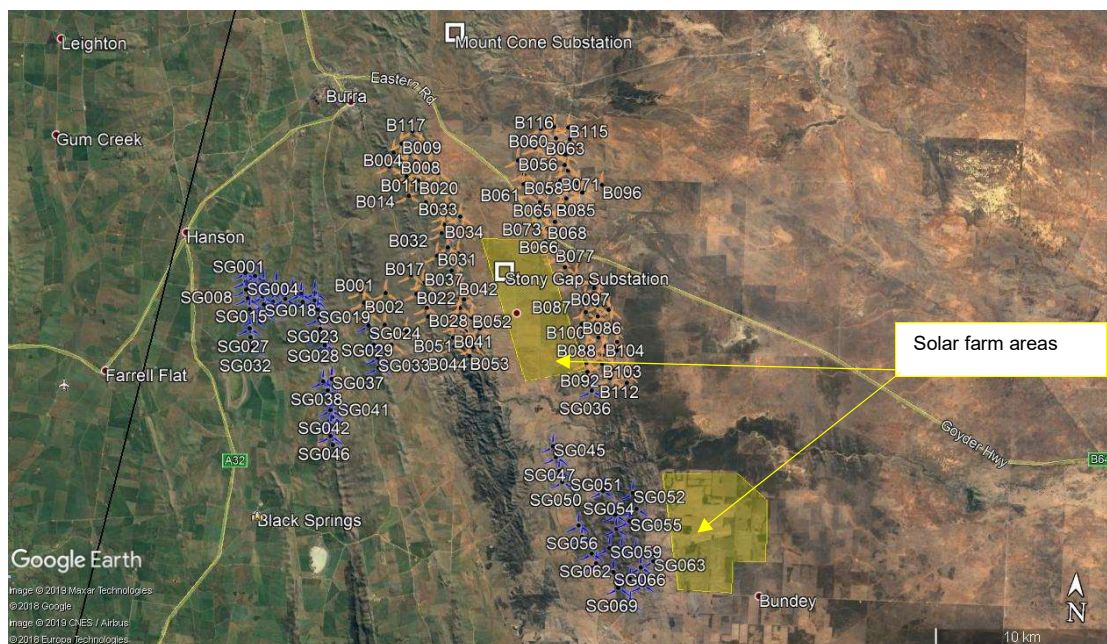


Figure 1 – Goyder South Hybrid Renewable Energy Park Location and Turbine Layout.

The two areas of the proposed solar farm are shown in yellow. One is surrounded by, and the other is adjacent to, wind turbines.



1.2 Aerodromes and Airstrips

Aerodromes fall into four categories:

- Military or Joint (combined military and civilian);
- Certified;
- Registered; and
- Uncertified or Aeroplane Landing Areas

A Military aerodrome is operated by the Department of Defence and is suitable for the operation of military aircraft. A Joint User aerodrome is a Military aerodrome used by both military and civilian aircraft, for example Adelaide Airport and Port Augusta Airports.

A Certified Aerodrome, certified under Civil Aviation Safety Regulation (CASR) 139.040, is available for Regular Public Transport and Charter operations and has a runway suitable for use by an aircraft having a maximum carrying capacity of more than 3,400kg or a passenger seating capacity of more than 30 seats, for example Adelaide Airport, and Port Augusta Airport.

A Registered Aerodrome, registered under CASR 139.260, is one to which CASR 139.040 does not apply and the operator has applied to the Civil Aviation Safety Authority (CASA) to have it registered, for example Port Pirie Airport.

An Uncertified Aerodrome is any other aerodrome or airstrip and is referred to as an Aeroplane Landing Area (ALA). These range in capability and size from having a sealed runway with lighting capable of accommodating corporate jet aircraft to a grass paddock that is smooth enough to land a single engine light aircraft or a purpose built aerial agricultural aircraft.

Certified, Registered and Military aerodromes are listed in the Aeronautical Information Publication¹ (AIP) and are subject to a NOTAM² service that provides the aviation industry with current information on the status of the aerodrome facilities. This information is held in the public domain, is available through aeronautical publications and charts and is kept current by mandatory reporting requirements.

Uncertified aerodromes (ALA) are not required to be listed in the AIP so information about them is not held in the public domain, is not available through aeronautical publications and charts and is not required to be reported. Where ALA information is published in the AIP it is clearly annotated that it is not kept current. A local example is Jamestown Airport. Consequently, ALA can come into use and fall out of use without any formal notification to CASA or any other authority. Airstrips that appear on survey maps often no longer exist; others exist but do not feature on maps. Similarly, a grass paddock used occasionally as an ALA is not usually discernable on satellite mapping services such as Google Earth.

Military, Joint, Certified and Registered aerodromes usually have Obstacle Limitation

¹ AIP; a mandatory worldwide distribution system for the promulgation of aviation rules, procedures and information

² NOTAM (Notice to Airmen); a mandatory reporting service to keep aerodrome and airways information current and available to the aviation industry worldwide



Surfaces (OLS) and Procedures for Air Navigation – Operations (PANS-OPS) surfaces prescribed to protect the airspace associated with published instrument approach and landing procedures. An uncertified aerodrome or ALA cannot have a published instrument approach and landing procedure so cannot have associated prescribed airspace protected by OLS or PANS-OPS. All operations into ALA, therefore, must be conducted in accordance with the Visual Flight Rules (VFR) and in Visual Meteorological Conditions (VMC).

1.3 Aerodromes in the Area

There are no Certified, Registered or Military aerodromes within 30nm (55.56km) of the GSHREP.

There is an Uncertified aerodrome (ALA) within 30nm (55.56km) at Stonefield Gliding (YSFG), 25.97 (48.09km) South Southeast of turbine SG070.

1.4 Air Routes in the Area

The GSHREP sits below air route H246 as shown in the table below.

Route	Segment	Direction	LSALT
GRID			4500
H246	ORBUN to ISROV	Northbound	5100

1.5 Airspace in the Area

The GSHREP is in Class G airspace with Class E airspace above having a lower limit of 8,500ft.

The GSHREP sits within the military flying Danger Area D258B. D258B extends from the surface (SFC) to 9,500ft and is active during daylight hours Monday to Friday (except Public Holidays).

Restricted Area R265D, used for military flying, sits above the GSHREP. R265D has a Lower Limit of 9,500ft and is activated by NOTAM.

Class G airspace is non-controlled airspace where aircraft may operate without an Air Traffic Control (ATC) clearance. Aircraft may operate in accordance with both Instrument Flight Rules (IFR) and Visual Flight Rules (VFR) within Class G airspace.

Class E airspace is controlled airspace open to both IFR and VFR flights. IFR aircraft must have an ATC clearance and communicate with the ATC Centre.

A Control Area (CTA) is defined as a “controlled airspace extending upwards from a



specified limit above the earth.³

A Danger Area is airspace within which activities dangerous to the flight of aircraft may exist at specified times⁴.

Approval for flight within an active Danger Area outside controlled airspace is not required. However, it is the responsibility of the pilot in command to be aware of the dangerous activity and take appropriate precautions.

A Restricted Area is airspace within which the flight of aircraft is restricted in accordance with specified conditions⁵.

To obtain access to a Restricted Area or airspace pilots must request approval from the Controlling Authority (see ERSR PRD). When an ATC service is available within that airspace, approval may be requested from ATC directly, in the same manner as a clearance request to enter controlled airspace.

Within Class G airspace an aircraft flying in accordance with the Visual Flight Rules (VFR) away from a populous area is, when flying below 3000ft, required by Civil Aviation Regulation (CAR) 157 to remain at 500ft above the highest point of the terrain **and any obstacle on it** within a radius of 600m [300m for a helicopter] from a point on the terrain directly below the aircraft. For a wind farm this equates to 500ft above the turbine tip height. For the GSHREP, with a tip height of 240m (788ft), a VFR flight is required to maintain a minimum height of $788 + 500 = 1288\text{ft}$ Above Ground Level (AGL).

³ AIP Enroute, ENR 1.4 – 7, sec 3 dated 28 February 2019,

⁴ AIP Enroute, ENR 1.4 – 10, sec 5.2.1c, dated 7 November 2019

⁵ AIP Enroute, ENR 1.4 – 10, sec 5.2.1b, dated 7 November 2019 available at <http://www.airservicesaustralia.com/aip/current/aip/enroute.pdf> last accessed 18 September 2019



2. SCOPE

To meet the requirements of Neoen Australia, the study required Chiron Aviation Consultants to examine the GSHREP development in relation to any impacts on aviation activity in the area and undertake the following tasks.

2.1 Aviation Impact Statement (AIS)

In August 2014, Airservices Australia (AsA) re-released a letter detailing requirements for an Aviation Impact Statement (AIS) for wind farm developments. The AsA letter requires that all developers of proposed wind farms prepare an Aviation Impact Statement and submit this to AsA for evaluation and consideration. A copy of this letter is shown at Appendix A.

The AIS required the following tasks to be undertaken: -

- Provide the coordinates and elevations of the Obstacles and associated topographical drawings;
- Specify all registered and certified aerodromes within 30nm (55.6km):
 - Nominate all instrument approach and landing procedures;
 - Confirm that the obstacles do not penetrate the Annex 14 OLS;
 - Confirm that the obstacles do not penetrate the PANS-OPS;
- Specify any published air routes over or near the obstacles
- Specify the airspace classification of the airspace surrounding the development
- Investigate any impact on aviation Communications, Navigation and Surveillance (CNS) facilities

Details of Aerodromes, OLS, PANS-OPS procedures, Lowest Safe Altitudes, Navigation and Airspace Surveillance facilities were obtained from the Australian Aeronautical Information Publications (AIP), AsA sources and CASA publications.

2.2 Qualitative Risk Assessment (QRA)

The QRA required the following tasks to be undertaken: -

- The identification and assessment of potential aviation risk elements through:
 - Reference to CASA publications;
 - Reference to the AIP;
 - Reference to the National Airports Safeguarding Framework (NASF) guidelines;
 - Consultations with key relevant stakeholders;
- Assessment of the perceived impacts of the turbines on the operation of aerodromes and airstrips in the immediate vicinity of the wind farm;



- Assessment of the perceived impacts of the turbines on aviation activity including:
 - General Aviation training;
 - Recreational/Commercial flying activity;
 - Air Ambulance Operations;
 - Police Aviation Operations;
 - Aerial Fire Fighting Operations;
 - Aerial Agricultural Operations;
 - Known highly trafficked VFR routes;
 - Night flying for light aircraft;
- Assessment of any implications for the above from topographical, weather and visibility issues;
- Assessment of other issues as identified through stakeholder consultations and the assessment process;
- Conclusions on the degree of aviation risk posed by the above described issues with commensurate recommendations on any mitigating actions; and
- An assessment of the need, against the outcomes of the Qualitative Risk Assessment, for obstacle lighting of the wind farm.

2.3 Obstacle Lighting Review (OLR)

The OLR reviews the outcome of the QRA to determine the need or otherwise for risk mitigation by the lighting of turbines in the wind farm with aviation obstruction lighting.



3. METHODOLOGY

The following methodology was used to complete the tasks outlined in the scope

3.1 Aviation Impact Statement

To meet Airservices Australia requirements for an Aviation Impact Statement the following methodology was used: -

- The obstacle (turbines and meteorological masts) coordinates and elevations were listed to the requisite accuracy and associated drawings and charts were obtained;
- The AIP was reviewed to determine;
 - All registered/certified and military/joint aerodromes located within 30nm (55.6km) of the wind farm
 - Any associated Instrument Departure and Approach Procedures (DAP);
 - The extent of the OLS and PANS-OPS surfaces for the identified DAP;
 - Published air routes located over or near the wind farm;
 - The classification of the airspace surrounding the wind farm;
- Ascertain the locations of CNS facilities that may be impacted and analyse the impact on;
 - Communications facilities;
 - Navigation facilities;
 - Surveillance facilities (in accordance with EUROCONTROL Guidelines); and
- Compile a report for review by Airservices Australia and the Department of Defence.

3.2 Qualitative Risk Assessment

A Qualitative Risk Assessment is the analysis for risks, through facilitated interviews or meetings with stakeholders and outside experts, as to their probability of occurrence and impact expressed using non-numerical terminology; for example, low, medium and high. The basis for the QRA is ASNZS ISO 31000-2018 *Risk Management –Guidelines*.

The methodology for the Qualitative Risk Assessment was as follows:

- The Australian AIP and CASA documents were reviewed to identify relevant physical and operational aviation issues that may impact on the requirement for lighting of the wind farm;
- Current topographical maps were studied to assess the local terrain and identify any local airstrips and any other relevant features;



- Key stakeholders, including local operators, recreational aviation groups and State Government Police Air Wing, Air Ambulance and Fire Services, were identified, contacted and interviewed to ascertain the extent of local aviation activity in the vicinity of the proposed wind farm. See Appendix E for a Stakeholder List. This included any informal low flying areas and highly trafficked unpublished air routes that may exist within the vicinity of the proposed wind farm;
- Based on the above, the nature of any impacts as a consequence of the operation of the wind farm was considered and discussed in regard to;
 - General Aviation training;
 - Recreational and sport aviation activities;
 - Approved low flying activities (including aerial agricultural applications)
 - Any known highly trafficked VFR routes; and
 - Emergency Services (air ambulance, police and fire service);
- In addition, further consideration was given to the consequences (for the above elements) of the potential influence of topography and poor weather; and

Consideration of the NASF, Guideline D Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers in relation to the QRA findings.

3.3 Obstacle Lighting Review

The Obstacle Lighting Review investigates the current Australian standards and regulatory requirements for obstacle lighting of wind farms. From this review an assessment of the need or otherwise for aviation obstruction lighting is made.

The methodology for the Obstacle Lighting Review was as follows: -

- Review the Australian regulatory requirements and standards;
- Review the NASF Guidelines for wind farms; and

From the QRA, assess the need for aviation obstruction lighting as a risk mitigator.



4. AVIATION IMPACT STATEMENT

The Aviation Impact Statement meets the requirements of Airservices Australia for their assessment of the GSHREP potential impact on the items listed in Section 3. The AIS is submitted to both Airservices Australia and the Department of Defence for assessment in relation to civil and military facilities.

4.1 Location

As noted in section 1.1 the Goyder South Hybrid Renewable Energy Project (GSHREP) is located between the towns of Hanson, Burra, Black Springs, Robertstown, and Bundy and is approximately 55nm (102km) south east of Port Pirie.

4.2 Obstacles

The proposed wind farm will comprise of 187 turbines with a tip height of 240m (788ft) Above Ground Level (AGL).

The tallest turbine is SG013 at 902m (2959.44ft) AHD. Rounded up this gives a tip height of 2960ft; add the Minimum Obstacle Clearance (MOC) of 1000ft gives a LSALT of 3960ft. Rounded up to the nearest hundred the LSALT over the GSHREP is 4000ft.

The turbine locations and elevations are shown at Appendix B.



4.3 Drawings

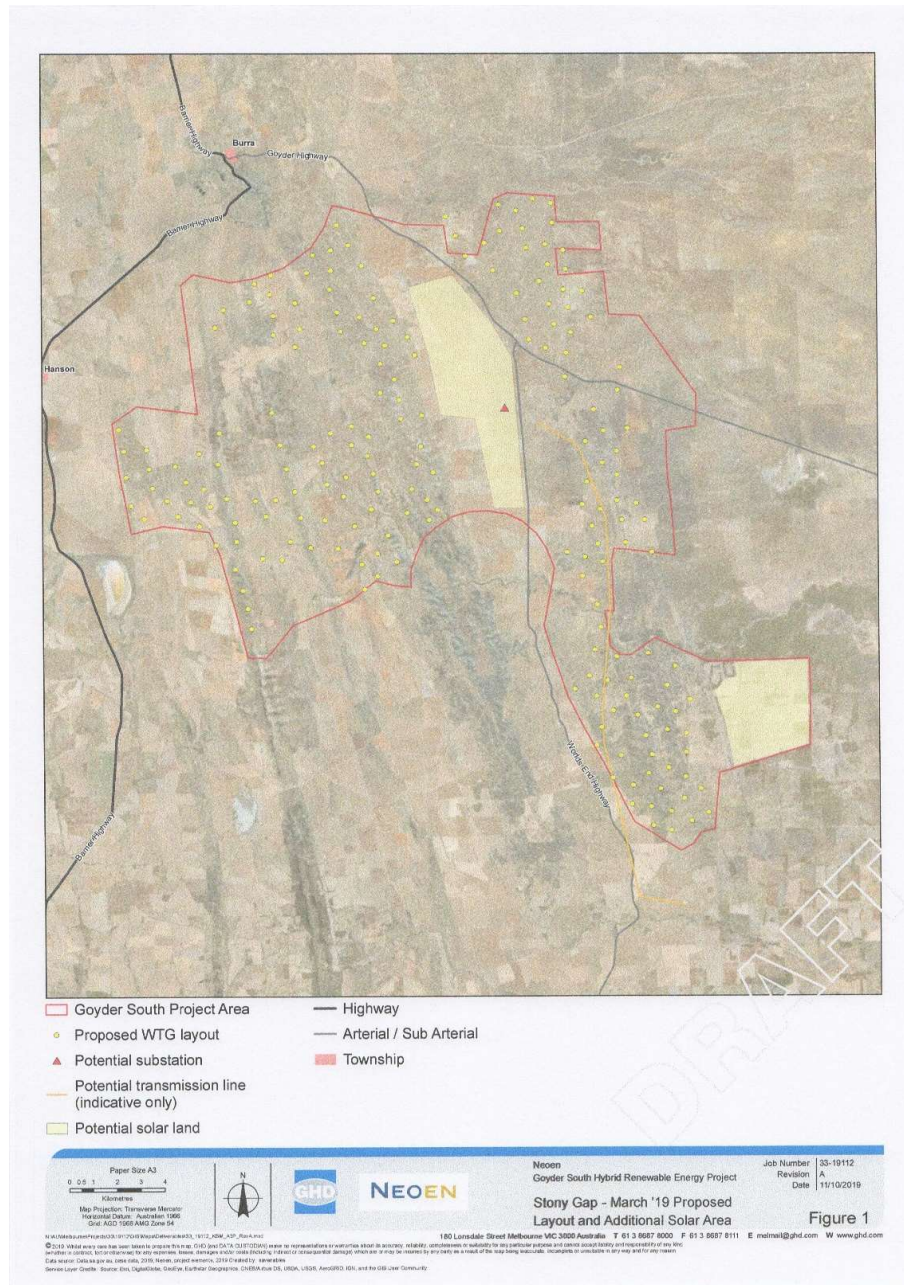


Figure 3 – Location of Goyder South Hybrid Energy Park⁶

⁶ Supplied by Neoen Energy



The drawings above shows the location of the GSHREP between Hanson, Burra, Black Springs, Robertstown, and Bundy and is approximately 55nm (102km) south east of Port Pirie.

4.4 Aerodromes within 30nm

There are no Certified, Registered or Military Aerodromes within 30nm (56km) of the proposed GSHREP.

4.4.1 Other aerodromes and airstrips

There is a known Uncertified Aerodrome (Aeroplane Landing Area [ALA]) within 30nm (56km) of the GSHREP at Stonefield. This ALA is known as Stonefield Gliding (YSFG) and is 25.97nm (48.09km) south southeast of turbine SG030. The AIP ERSA⁷ entry shows the aerodrome Operator to be Stonefield Aviation Association c/- Adelaide University Sports Association. YSFG is used by the Barossa Valley Gliding Club and the Adelaide University Sport Gliding Club.

4.5 Air Routes and Lowest Safe Altitudes

The published air routes within 10nm of the GSHREP and their LSALT are shown in Table 1 and Figure 6 below.

Route	Segment	Direction	LSALT
GRID			4500
H246	ORBUN to ISROV	Northbound	5100

Table 1 – Published LSALT

The tallest turbine tip is SG013 at 902m (2959.44ft) AHD. Rounded up this gives a tip height of 2960ft; add the Minimum Obstacle Clearance (MOC) of 1000ft gives a LSALT of 3960ft. Rounded up to the nearest hundred the LSALT over the GSHREP is 4000ft.

The GSHREP **does not impact** the published LSALT for any air route in the vicinity.

⁷ AIP EnRoute Supplement Australia (ERSA), dated 7 November 2019

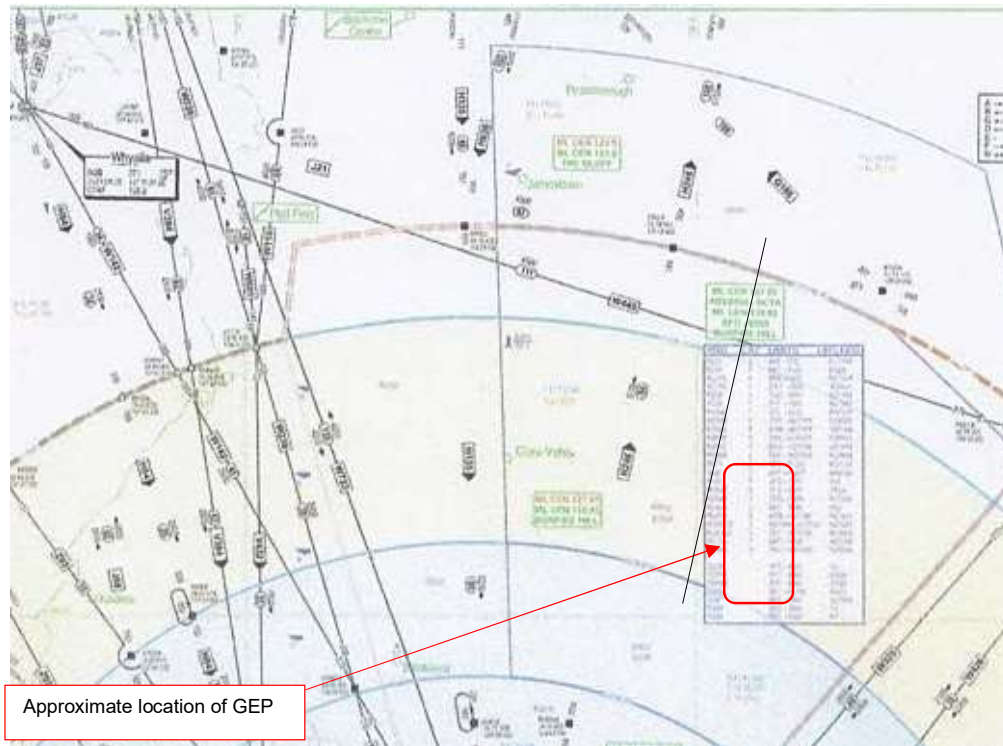


Figure 6 – Nearby Air Routes⁸

4.6 Airspace

The GSHREP is in Class G airspace below Class E airspace with a lower limit of FL180.

There are **no published civil flying training areas** in the vicinity of the GSHREP.

There is a **Danger Area** and a **Restricted Area (PRD)** overlying the GSHREP.

- D258B SFC - 9500 – JO/HJ Military flying training⁹.
- R265D 9500 to NOTAM¹⁰.

4.6.1 Restricted Area R265D

The LSALT over the GSHREP is below the Lower Limit of Restricted Area R265D, therefore **does not impact** R265D.

⁸ AIP ERC L2, dated 23 May 2019

⁹ AIP ERSA, PRD-10, dated 15 Aug 2019

¹⁰ AIP ERSA, PRD-3, dated 15 Aug 2019



4.6.2 Danger Area D258B

Danger Area D258B is active Monday to Friday except on Public Holidays (JO) during daylight hours (HJ). The area is used for military flying training.

There are existing wind farms within D258B near Mt Bryan and further north around Canowie (Hallett WF) continuing into D258C around Jamestown (Hornedale WF).

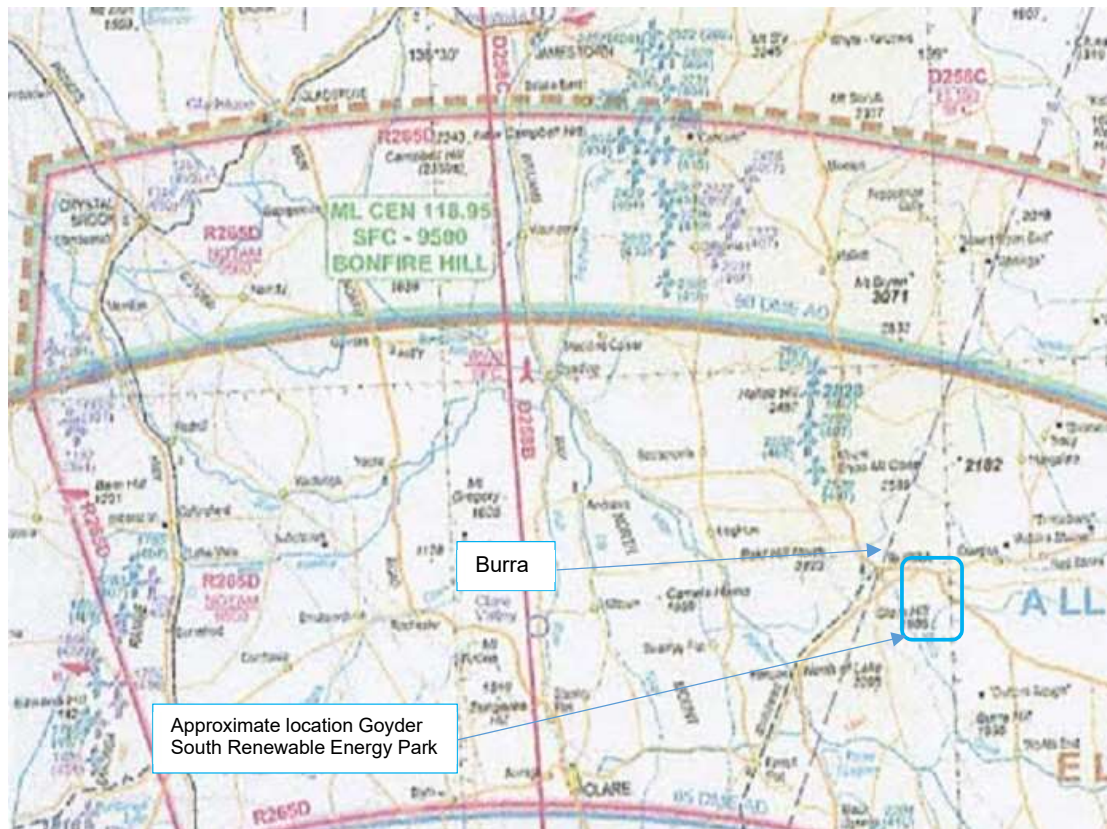


Figure 7 – GSHREP Location in relation to D258B¹¹

Note the existing wind farms in the vicinity

The GSHREP is within D258B and **may impact** on its use for military flying training.

4.7 Communications, Navigation and Surveillance

Wind turbines by their size and construction may cause interference to air traffic control communications, navigation and surveillance (CNS) facilities. Airservices Australia (AsA) recommends the use of the *EuroControl Guidelines on How to Assess the*

¹¹ AIP VNC Adelaide 23 May 2019



Potential Impact of Wind Turbines on Surveillance Sensors¹².

The CASR Part 139 Manual of Standards – Aerodromes, Chapter 11, sets out the general requirements for navigation aid sites and air traffic control (ATC) facilities, including the clearance planes for planned and existing facilities.

4.7.1 Communications

There are no known civil or military ATC communications facilities in area of the GSHREP.

4.7.2 Navigation

There are no known radio navigation aids in the area of the GSHREP.

4.7.3 Surveillance

There are no known civil or military surveillance facilities in the area of the GSHREP.

4.8 Solar Farm

The proposed solar farm component will utilise single axis tracking low reflection photovoltaic panels (PV) mounted on frames less than 4m AGL.

The proposed solar farm photovoltaic panel arrays of the GSHREP are shielded by adjacent turbines, therefore any aircraft at cruising altitude will be at least 1300ft above ground level over the GSHREP. At that height it is considered that glare or glint **will not be a hazard** to aircraft safety.

4.9 AIS Conclusions

The AIS concluded that the GSHREP **will not impact** upon the following:

- The LSALT of any nearby published air routes;
- The OLS surfaces of any registered or certified aerodrome;
- The PANS-OPS surfaces associated with the Instrument Approach Procedures at Port Pirie;
- The operation of the Uncertified Aerodrome at Stonefield;
- Restricted Area R265D;
- The performance of Communication Facilities and Navigation Aids; or
- The performance of any surveillance radars.

¹² Available at <http://www.eurocontrol.int/sites/default/files/publication/files/20140909-impact-wind-turbines-sur-sensors-guid-v1.2.pdf> last accessed 10 January 2018



The solar component of the GSHREP **will not impact** on aviation safety.

The GSHREP sits near existing windfarms within Danger Area D258B, an area used for military flying training and **may impact** on its use.

4.10 Airservices Australia Response

Airservices Australia have advised by email that the GSHREP, at a maximum height of 902m (2960ft) AHD will not affect any sector or circling altitude, nor any instrument approach or departure procedure at any airport. It will not affect any air routes nor adversely impact the performance of any Communications, Navigation or Surveillance facilities. A copy of the response is at Appendix G.

4.11 Department of Defence Response

Awaiting a response from Department of Defence



5. QUALITATIVE RISK ASSESSMENT

The expression “in the vicinity of the aerodrome” is considered by CASA to mean within the boundaries of either the OLS or the PANS-OPS surfaces for a certified or registered aerodrome.

The NASF Guideline D considers 30km (16.2nm) from a certified or registered aerodrome to be “in the vicinity.”

Planning Authorities generally refer to aerodromes within 15km (8nm) of a wind farm for consideration.

More generally the impact on any certified, registered or military aerodrome within 56km (30nm) of a wind farm is considered.

5.1 Certified and Registered Aerodromes

There are no Certified, Registered or Military aerodromes within 30nm (55.56km) of the GSHREP.

5.2 Uncertified Aerodromes

There is a known Uncertified Aerodrome (Aeroplane Landing Area [ALA]) within 30nm (56km) of the GSHREP at Stonefield. This ALA is known as Stonefield Gliding (YSFG) and is 25.97nm (48.09km) south southeast of turbine SG070. The AIP ERSA¹³ entry shows the aerodrome Operator to be Stonefield Aviation Association c/- Adelaide University Sports Association. YSFG is used by the Barossa Valley Gliding Club and the Adelaide University Sport Gliding Club. Attempts to contact the listed Aerodrome Operator have been unsuccessful.

5.3 Airspace

The GSHREP is in Class G airspace with Class E airspace above having a lower limit of 8,500ft.

The GSHREP, along with existing wind farms, sits within Danger Area D258B. D258B, is used for military flying training, extends from the surface (SFC) to 9,500ft and is active during daylight hours Monday to Friday (except Public Holidays).

A Danger Area is airspace within which activities dangerous to the flight of aircraft may exist at specified times.

Approval for flight within an active Danger Area outside controlled airspace is not

¹³ AIP EnRoute Supplement Australia (ERSA), dated 7 November 2019



required. However, it is the responsibility of the pilot in command to be aware of the dangerous activity and take appropriate precautions.

Restricted Area R265D, used for military flying, sits above the GSHREP. R265D has a Lower Limit of 9,500ft and is activated by NOTAM.

5.4 Relevant Air Routes

The GSHREP sits below air route H246 as shown in the table below.

Route	Segment	Direction	LSALT
GRID			4500
H246	ORBUN to ISROV	Northbound	5100

Table 1 – Published LSALT

The tallest turbine tip is SG013 at 902m (2959.44ft) AHD. Rounded up this gives a tip height of 2960ft; add the Minimum Obstacle Clearance (MOC) of 1000ft gives a LSALT of 3960ft. Rounded up to the nearest hundred the LSALT over the GSHREP is 4000ft.

The GSHREP **does not impact** the published LSALT for any air route in the vicinity.



Figure 6 – Nearby Air Routes¹⁴

¹⁴ AIP ERC L2, dated 23 May 2019



5.5 Night Flying

Aircraft flying at night, both IFR or VFR, are required to operate at or above the published or calculated LSALT. Descent below the LSALT for a VFR at Night flight is restricted to within 3nm (5.4km) of the aerodrome and with it in sight. Where an IFR aircraft is using a published instrument approach it is protected by PANS-OPS surfaces.

Given the location of the GSHREP, away from any aerodromes and nearby to existing wind farms aircraft operating at night in the area will be flying at or above the LSALT.

5.6 General Aviation Flying Training

Wind turbines, by their size and colour are considered to be highly conspicuous and therefore not an issue for VFR flight by day. Flying training is conducted in accordance with VFR for the major part of the course. In the latter stages of training student airline pilots progress to night flying in accordance with VFR at Night procedures and then to IFR training. Flying training is usually conducted in light General Aviation (GA) aircraft such as Cessna C182 or Diamond DA40 aircraft. As discussed previously night flying is undertaken at or above the LSALT and therefore is above the GSHREP.

5.7 Recreational and Sport Aviation

Recreational and Sport aircraft, particularly ultra-lights registered with Recreational Aviation Australia (RA-Aus) are limited to daytime flight in accordance with the Visual Flight Rules (VFR). This requires the aircraft to remain clear of cloud and a minimum of 500ft above the highest obstacle on the ground. Ultra-light aircraft have a Maximum Take-Off Weight (MTOW) of 600kgs or less. A small General Aviation aircraft such as a Cessna C172 has a MTOW of 1110kg. The cruising speed of these aircraft is generally lower than for a GA aircraft thus giving more time to see and avoid obstacles. *The photo shows an Australian built Lightwing ultra-light aircraft.*



5.8 Approved Low Flying Activities

The GSHREP sits within the military flying Danger Area D258B and **may impact** on its use for military flying training. D258B extends from the surface (SFC) to 9,500ft and is active during daylight hours Monday to Friday (except Public Holidays).

There are existing wind farms within D258B near Mt Bryan and further north around Canowie (Hallett WF) continuing into D258C around Jamestown (Hornedale WF).



5.9 Aerial Agricultural Applications Activity

The Aerial Agricultural Association of Australia opposes wind farm developments unless the developer has (inter alia):

- Consulted in detail with local operators;
- Received independent expert advice on safety and economic impacts; and
- Considered the impacts on the aerial application industry.¹⁵

An aerial agricultural operator made the comment that *“the decision to host wind turbines is one made by the landholder who must accept that there will most probably be limitations to any aerial applications on the property”*¹⁶.

Another operator made the comment that *“wind farms are becoming common, they’re a fact of life, we know more about them and can operate safely in their vicinity.”*¹⁷

All the operators consider meteorological monitoring masts to be “killers” because they are very difficult to see. The agreement amongst them was that as a minimum the masts should be marked in accordance with the NASF Guideline D, except for the strobe light, and that the base around the outer guy wires should be marked in a contrasting colour to the ground.



5.10 Known Highly Trafficked Areas

There are no known highly trafficked areas in the vicinity of the GSHREP

5.11 Emergency Services Flying

All Emergency Services flying is subject to ongoing dynamic risk assessment throughout the flight. The safety of the aircraft and its crew is paramount.

5.11.1 Police Air Wing

SA Police operate fixed wing aircraft and advise that the GSHREP will not impact on these operations. Helicopter operations are provided by the State Rescue Helicopter Service. This service is operated by the same organisation providing the Helicopter Emergency Medical Service.

¹⁵ <http://www.aerialag.com.au/ResourceCenter/Policies.aspx>

¹⁶ Expert opinion obtained by the author during previous QRA work

¹⁷ Stakeholder interview with aerial agricultural applications operator. Reiterated by other operators during additional interviews



The operator of the State Rescue Helicopter Service, Babcock Australia, advise “*that most of the Police helicopter work is conducted in accordance with the VFR, and rarely at low level*”. As such the GSHREP will not impact on these operations. There are existing wind farms in the general area, so the pilots are familiar with operating near them.

5.11.2 Helicopter Emergency Medical Services

The Helicopter Emergency Medical Service (HEMS) utilise helicopters capable of IFR flight. For low level night operations, the aircraft are equipped with Night Vision equipment (NVG) enabling the pilot “to see” in reduced light conditions. For the final descent and landing the “night sun” searchlight is used to illuminate the landing area. All HEMS operations are subject to a dynamic risk assessment and the pilot in command has the final say as to whether the operation is aborted due to the risk to the aircraft and crew.

It was also noted that any LED type obstacle lights need to be within a specific wavelength spectrum for successful use of NVG. Comment was also made about the need to suitably mark meteorological monitoring towers.

5.11.3 Fixed Wing Air Ambulance

Fixed wing Air Ambulance operations in South Australia are contracted to the Royal Flying Doctor Service (RFDS) and are undertaken in turbo-prop aircraft in accordance with IFR. The aircraft are usually Pilatus PC12 which has a MTOW of 4740kg and use suitable aerodromes. RFDS also operate the Pilatus PC24 twin jet aircraft which has an MTOW of 8300kg and uses suitable, usually sealed, aerodromes. The primary use of these aircraft is for patient transfer from regional to major city hospitals. The GSHREP will not affect RFDS Air Ambulance operations due to the nature of the operations and the aircraft size.

The nearest aerodrome to the GSHREP used by the RFDS is Jamestown which is sufficiently distant from the wind farm for there to be no impact on aircraft operations at the aerodrome.

The GSHREP will **not affect** the operations of the RFDS aircraft.

5.12 Fire Fighting

Firefighting is a multi-faceted operation utilising multiple resources and equipment appropriate to the circumstances. A fire ground is a dynamic place where resources are continually being reassigned to have the best effect. Aerial firefighting is just one of the resources available and its use may or may not be appropriate to the current fire ground situation. There will be times when aerial firefighting is not possible due to turbulence, smoke and erratic fire behaviour.



5.12.1 Aerial Firefighting

At all times the pilot in command has the ultimate responsibility for the safety of the aircraft.¹⁸

Aerial firefighting flying is conducted at low level using specialist aircraft flown by appropriately rated pilots in accordance with the Visual Flight Rules. The pilot is required to maintain forward visibility with the ground, therefore they will remain clear of smoke so that they can accurately and safely drop the fire retardant.

“It is important to remember that aircraft alone do not extinguish fires.”¹⁹



From previous work undertaken by the author regarding firefighting within wind farms it is noted that the rural firefighting agencies in Victoria, New South Wales, South Australia and Western Australia all view wind turbines and wind farms to be ‘just another hazard’ that has to be considered in the risk management process associated with aerial firefighting.

The photograph (left) shows a Hercules Large Air Tanker operating in Waubra wind farm²⁰.

The State rural firefighting agencies made submissions to the Senate Select Committee on Wind Turbines. These submissions attached the Australian Fire and Emergency Service Authorities Council (AFAC) *Wind Farms and Bushfire Operations Position Paper 30 October 2014* document. See Appendix C for a copy of this paper.

The AFAC paper states:

“Aerial firefighting operations will treat the turbine towers similar to other tall obstacles. Pilots and Air Operations Managers will assess these risks as part of routine procedures. Risks due to wake turbulence and the moving blades should also be considered. Wind turbines are not expected to pose unacceptable risks.”²¹

All these agencies make the point that firefighting aircraft operate to the Visual Flight Rules and must remain clear of smoke in order to maintain the required visibility of the ground and obstacles such as trees, power lines, radio masts, houses and ground based

¹⁸ A point reiterated in an interview by the author with a Victorian Forest Fire Management Fire Ground Manager, 6 August 2019. This is part of the Civil Aviation Regulations 1988.

¹⁹ NSW Rural Fire Service submission to the Senate Select Committee on Wind Turbines, 6 March 2015, page 2

²⁰ Hercules Large Air Tanker operating in Waubra Wind Farm, Ballarat Courier, January 2019.

²¹ AFAC *Wind Farms and Bushfire Operations Position version 2.0 30 October 2014*, page 2



fire fighters. The Victorian Country Fire Authority (CFA) recommends:

“... a minimum distance between turbines of 300 metres. This provides adequate distance for aircraft to operate around a wind energy facility given the appropriate weather and terrain conditions. Fire suppression aircraft operate under the ‘Visual Flight Rules’. As such, fire suppression aircraft only operate in areas where there is no smoke and can operate during the day or night.”²²

There have been trials of night flying for aerial firefighting conducted in Victoria. At present there are only two organisations authorised by CASA to conduct aerial firefighting at night. Both organisations utilise specific helicopters equipped for night flight that are flown as a two-pilot operation who are both appropriately rated. Night aerial firefighting is not currently undertaken by fixed wing aircraft.

The South Australian Country Fire Service has published a Fact Sheet titled *Aerial Firefighting* which explains the use and limitations of aircraft in firefighting. The major point made is that:

“Although aircraft are often the most visible part of the response to fire, and therefore believed to be the most important, almost all fires are still extinguished by ground crews.”²³

A further point made by the CFS is that firefighting aircraft

“... may not be able to fly if wind speeds are too high, dust or smoke covers the fire, or when daylight is fading, and

Firefighting aircraft will be grounded if Remotely Piloted Aircraft (drones) are flown without permission over the fireground.”

See Appendix D for a copy of the Fact Sheet.

5.12.2 Ground Based Firefighting



From previous work done regarding firefighting within wind farms it is noted that the rural fire fighting agencies in Victoria, New South Wales, South Australia, and Western Australia all make the point that access for fire trucks and personnel, and consequently their ability to fight the fire within a wind farm, is greatly enhanced by the access roads built for the construction and

maintenance of the turbines. These roads also act as fire breaks which can slow or contain the fire spread across the open ground. The area around the base of each tower

²² CFA Guidelines for Renewable Energy Facilities, February 2019 section 5.1.2

²³ SA CFS Fact Sheet *Aerial Firefighting*, July 2019



is kept clear of vegetation and as such offers a refuge for fire fighters and their vehicles.

The CFA recommends:

“To enable access for fire appliances the following provisions should be considered:

- *Constructed roads should be a minimum of 3.5 metres in trafficable width (with 0.5m each side) with a four (4) metre vertical clearance for the width of the formed road surface*
- *Roads should be of all-weather and capable of accommodating a vehicle of 15 tonnes.”²⁴*

The CFA further recommends:

Facility operators are to undertake the following fuel management measures are included in their plans during the Fire Danger Period:

- *Grass to be maintained at below 100mm in height during the declared Fire Danger Period;*
- *A fire break area of ten (10) metres width is to be maintained around the perimeter of the facilities, electricity compounds and substations.”²⁵*

5.13 Topographical and Marginal Weather Conditions

The topography of the area of the GSHREP is an extensive ridge on the eastern side of the Clare Valley. The area is generally avoided by light aircraft, particularly in marginal VMC, due to the high terrain and the associated cloud and turbulence. Access to the north is available via the Spencer Gulf coast.

VMC are the weather conditions required for VFR flight at or below either 3000ft AMSL or 1000ft AGL, namely: -

- Clear of cloud;
- In sight of the ground or water; and
- With a forward visibility of 5000m²⁶.

The rules governing VFR flight require that pilots remain clear of cloud and not get into such situations by turning away from the low cloud and terminating the flight at the nearest suitable aerodrome.

²⁴ CFA Guidelines for Renewable Energy Installations February 2019 section 3

²⁵ CFA Guidelines for Renewable Energy Installations February 2019 section 4

²⁶ AIP ENROUTE, page ENR 1.2 – 4 date 9 NOV 2017. <http://www.airservicesaustralia.com/aip/current/aip/enroute.pdf> last accessed 25 January 2018



Aircraft operating under Instrument Flight Rules (IFR) can operate in poor weather conditions and in cloud which precludes visual acquisition of obstacles and terrain. These operations are protected by PANS OPS surfaces and LSALT's that are designed to keep the aircraft clear of obstacles and terrain.

Otherwise CAR 157 states (in part) that an aircraft operating under VFR must not fly lower than 152m/500ft over a non-populated area **being terrain or obstacles on that terrain** and within, for an aircraft other than a helicopter, 600m horizontally and, in the case of a helicopter, 300m horizontally to the same, unless:

- Due stress of weather or any other unavoidable cause it is essential that a lower height be maintained; or
- It is engaged in approved low flying private or aerial work; or
- It is engaged in flying training and flies over part of a flying training area in respect of which low flying is authorised by CASA under sub regulation 141(1); or
- It is undertaking a baulked approach; or
- It is flying in the course of actually taking-off or landing at an aerodrome.

In regard to the first bullet point above it is possible that due to lowering cloud base, and if through poor airmanship the aircraft had pressed on to the point that it was unable to execute a turn and fly away from the weather, an aircraft could find itself lower than 152m/500ft above the terrain or obstacles. The operative word is unavoidable. Flying into marginal or non VMC weather is entirely avoidable. It should be noted that a non-instrument rated pilot flying in cloud almost always has a fatal outcome²⁷.

5.14 Solar Farm

The proposed solar farm component of the GSHREP will utilise single axis tracking low reflection photovoltaic panels (PV) mounted on frames less than 4m AGL.

The proposed solar farm photovoltaic panel arrays of the GSHREP are shielded by adjacent turbines, therefore any aircraft at cruising altitude will be at least 1300ft above ground level over the GSHREP. At that height it is considered that glare or glint **will not be a hazard** to aircraft safety.

5.15 NASF Guidelines

The National Airports Safeguarding Framework – Guideline D *Managing the Risk to Aviation Safety of Wind Turbine Installations (Wind Farms)/Wind Monitoring Towers* provides guidance for the siting and marking of the turbines and meteorological monitoring towers associated with wind farms.

²⁷ Accidents involving Visual Flight Rules pilots in Instrument Meteorological Conditions, Australian Transport Safety Bureau, 22 August 2019, available at <http://www.atsb.gov.au/publications/2019/avoidable-accidents-4-vfr-into-imc/>



5.15.1 Notification to Authorities

Paragraph 20 of Guideline D advises that:

When wind turbines over 150m above ground level are to be built within 30km (16.2nm) of a certified or registered aerodrome, the proponent should notify the Civil Aviation Safety Authority and Airservices. If the wind farm is within 30km of a military aerodrome, Defence should be notified.

The turbines are greater than 150m and are not within 30km of a military, certified or registered aerodrome.

The turbines and meteorological monitoring towers used in the GSHREP must be reported to the vertical obstruction database held by Airservices Australia in accordance with AC 139-08(1) *Reporting of Tall Structures* to ensure their position and height is marked on aeronautical charts and known to aviation industry.

5.15.2 Risk Assessment

The NASF Guideline has the following requirements for a risk assessment.

26. Following preliminary assessment by an aviation consultant of potential issues, proponents should expect to commission a formal assessment of any risks to aviation safety posed by the proposed development. This assessment should address any issues identified during stakeholder consultation.

The risk assessment for the GSHREP indicates that the overall risk to aviation is LOW. A risk assessment of LOW indicates that the wind farm is 'not a hazard to aircraft safety'.

27. The risk assessment should address the merits of installing obstacle marking or lighting. The risk assessment should determine whether or not a proposed structure will be a hazardous object. CASA may determine, and subsequently advise a proponent and relevant planning authorities that the structures have been determined as:

- (a) Hazardous but that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking; or*
- (b) Hazardous and should not be built, either in the location and/or to the height proposed as an unacceptable risk to aircraft safety will be created; or*
- (c) Not a hazard to aircraft safety.*

By day the GSHREP turbines are conspicuous by their size and colour. The GSHREP does not impact on any LSALT in the area. Night operations for aircraft do not occur below the LSALT for IFR and VFR at night. IFR aircraft are protected by the LSALT and



PANS-OPS prescribed airspace at each aerodrome. Where an approach to land is undertaken operating to VFR at night, descent below the LSALT does not occur until within 3nm of the airport and in VMC. The nearest aerodrome equipped for night operations is Port Pirie 54.61nm (101.13km) to the northwest.

Given the above, the GSHREP does not require obstacle lighting as the risk to aviation is LOW and no additional mitigating strategies are required.

Overall the risk assessment demonstrates that the GSHREP is a LOW risk to aviation and is therefore *not a hazard to aircraft safety*.

28 If CASA advice is that the proposal is hazardous and should not be built, planning authorities should not approve the proposal. If a wind turbine will penetrate a PANS-OPS surface, CASA will object to the proposal. Planning decision makers should not approve a wind turbine to which CASA has objected.

The GSHREP does not penetrate any OLS or PANS-OPS surfaces either civil or military, therefore CASA has no reason to determine that it is hazardous.

29 In the case of military aerodromes, Defence will conduct a similar assessment to the process described above if required. Airservices, or in the case of a military aerodrome, Defence, may object to a proposal if it will adversely impact on Communications, Navigation or Surveillance (CNS) infrastructure. Airservices/Defence will provide detailed advice to proponents on request regarding the requirements that a risk assessment process must meet from the CNS perspective.

There is no civil or known military CNS infrastructure that will be impacted by the GSHREP.

30 During the day, large wind turbines are sufficiently conspicuous due to their shape and size, provided the colour of the turbine is of a contrasting colour to the background. 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. Other colours are also acceptable, unless the colour of the turbine is likely to blend in with the background.

The GSHREP turbines will be appropriately painted to ensure they are conspicuous by day.

5.15.3 Lighting of Wind Turbines

33 Where a wind turbine 150m or taller in height is proposed away from aerodromes, the proponent should conduct an aeronautical risk assessment.

34. The risk assessment, to be conducted by a suitably qualified



person(s), should examine the effect of the proposed wind turbines on the operation of aircraft. The study must be submitted to CASA to enable an assessment of any potential risk to aviation safety. CASA may determine that the proposal is:

(a) hazardous, but that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking; or

(b) not a hazard to aircraft safety.

The GSHREP is not sited within the vicinity of any certified or registered aerodrome, does not penetrate any OLS or PANS-OPS airspace and is assessed as a **LOW risk to aviation** and is therefore **not a hazard to aircraft safety**.

5.16 QRA Findings

Risk Element	Assessed Level of Risk	Comment
Airport Operations	LOW	
Aircraft Landing Area Operations	LOW	Suitability for use is a pilot responsibility.
Known Highly Trafficked Routes	LOW	None identified
Published Air Routes	LOW	Nil impact
Restricted Airspace	LOW	Sits below and clear of R265D
Danger Area	LOW	Sits within D258B near existing wind farms
Promulgated Flying Training Areas	LOW	D258B for military flying. Nil for civil flying
GA Flying	LOW	
Night Flying	LOW	
Emergency Services Flying	LOW	
Commercial Flying	LOW	
Recreational and Sport Aviation	LOW	
Recreational Pilot Training (RA-AUS)	LOW	
GA Pilot Training	LOW	
Weather and Topographical Issues	LOW	
Solar Glare	LOW	

Table 2 – Risk Assessment Summary



6. OBSTACLE LIGHTING REVIEW

6.1 Australian Regulatory Framework for Obstacle Lighting of Wind Farms

The Civil Aviation Safety Authority (CASA) has limited regulatory authority to require the lighting of obstacles (tall structures) away from an aerodrome. This is particularly applicable to wind farms, which are generally beyond the Obstacle Limitation Surface (OLS) of certified or registered aerodromes. It must be noted that Civil Aviation Safety Regulations (CASR) Part 139 – Aerodromes are applicable to certified and registered aerodromes only [Military and Joint User apply the same general form].

CASA can only make recommendations regarding the lighting of wind farms, and not determinations/directions mandating lighting of wind farms that are not in the vicinity [beyond the OLS] of a certified or registered aerodrome. It is noted that in the Senate Select Committee on Wind Turbines (2015) CASA provided evidence to the Committee about the limited role it plays in regulating airspace around wind farms.

We know our responsibilities and the power of our legislation, which is very limited. For the most part, wind turbines are built away from aerodromes and certainly away from federally leased aerodromes. So, the only power we have is to make a recommendation to the planning authority about whether the turbine is going to be an obstacle and, if we decide it is an obstacle, we can make a recommendation as to whether it should be lighted and marked. This is the extent of our power.²⁸

In my experience, CASA has emphasised that “it is a matter for the appropriate Land Use Planning Authority to consider the implementation of our recommendations²⁹” regarding aviation obstacle lighting of wind farms.

6.1.1 Civil Aviation Safety Regulations

The Civil Aviation Safety Regulations (CASR) Part 139 – Aerodromes, Section E contains the regulations governing obstacles. These regulations are applicable to the protection of airspace and aircraft operations in the vicinity of certified or registered aerodromes. They are not applicable to obstacles that are beyond the vicinity of aerodromes; that is, beyond the OLS.

6.1.2 Manual of Standards Part 139

The Manual of Standards (MOS) Part 139 provides amplification and methods of compliance to the CASR Part 139 Aerodromes. As the GSHREP is beyond the vicinity of any military, certified or registered aerodrome MOS 139 does not apply.

6.1.3 National Airports Safeguarding Framework

The Australian National Airports Safeguarding Advisory Group (NASAG) produced a set

²⁸ Senate Select Committee on Wind Turbines, Final Report, August 2015, paragraph 5.38

²⁹ Correspondence from CASA to the Author



of guidelines called the National Airports Safeguarding Framework (NASF) in 2012.

The purpose of the National Airports Safeguarding Framework (the Safeguarding Framework) is to enhance the current and future safety, viability and growth of aviation operations at Australian airports, by supporting and enabling:

- 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; and
- the publication and dissemination of information on best practice in land use and related planning that supports the safe and efficient operation of airports.

Guideline D *Managing the Risk to Aviation Safety of Wind Turbine Installations [Wind Farms] / Wind Monitoring Towers* provides information regarding wind farms. This guideline provides the following information: -

20 When wind turbines over 150m above ground level are to be built within 30km (16.2nm) of a certified or registered aerodrome, the proponent should notify the Civil Aviation Safety Authority and Airservices. If the wind farm is within 30km of a military aerodrome, Defence should be notified.

33 Where a wind turbine 150m or taller in height is proposed away from aerodromes, the proponent should conduct an aeronautical risk assessment.

34. The risk assessment, to be conducted by a suitably qualified person(s), should examine the effect of the proposed wind turbines on the operation of aircraft. The study must be submitted to CASA to enable an assessment of any potential risk to aviation safety. CASA may determine that the proposal is:

(a) hazardous, but that the risks to aircraft safety would be reduced by the provision of approved lighting and/or marking; or

(b) not a hazard to aircraft safety.

The GSHREP is not sited within the vicinity of any certified, registered or military aerodrome and does not penetrate any OLS or PANS-OPS airspace; consequently, it is assessed as a LOW risk to aviation and is therefore *not a hazard to aircraft safety*.

Given the above, the GSHREP does not require obstacle lighting as the risk to aviation is LOW and no additional mitigating strategies are required.



6.2 Obstacle Lighting Summary

The GSHREP, which is not sited within any OLS or PANS-OPS airspace **does not require obstacle lighting** as the risk to aviation is LOW and **no additional mitigating strategies are required**.

7. WIND MONITORING TOWERS

Meteorological Monitoring Masts are very difficult to see due to their slender construction and thin guy wires. The masts are often a grey (galvanised steel) colour that readily blends with the background.

The photograph in Figure 7 shows a Meteorological Monitoring Mast as seen from the ground.

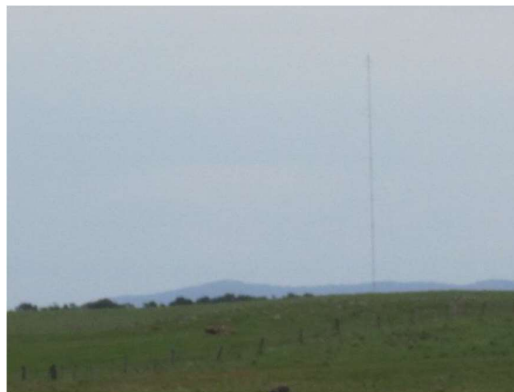


Figure 7 – A Meteorological Monitoring Mast photographed from the ground³⁰

The aerial applications operators and the emergency services pilots all note the danger of meteorological monitoring masts to low flying aircraft. These pilots all made comment that “met masts are extremely dangerous.” Each of these stakeholders requested that the NASF Guidelines, except for the strobe light, be used to make the masts more visible and that the markings be maintained in a serviceable condition.

The aerial applications pilots all requested that the outer guy wire ground anchor points be painted a contrasting colour to enhance their visibility. When low flying, particularly when spraying, the pilot is looking at the ground as their reference point. The contrasting ground anchor point is the most valuable visual cue in this situation.

It is generally considered by aerial applications pilots that a flashing strobe light is ineffective and as such should not be used.

³⁰ Author photo, Yorke Peninsular SA.



All the markings used to make the masts more visible must be maintained in a serviceable condition. This is particularly important for balls, flaps and sleeves that deteriorate due to wind and sun damage.

7.1 NASF Guidelines – Marking of Meteorological Monitoring Towers

The NASF guideline also refers to the marking and lighting of wind monitoring towers. The relevant points are summarised as:

Wind monitoring towers are very difficult to see from the air due to their slender construction and guy wires. This is a particular problem for low flying aircraft, particularly aerial agricultural and emergency services operations.

Measures to be considered to improve visibility include:

- *The top one third of wind monitoring towers be painted in alternating contrasting bands of colour. Examples can be found in the CASA MOS 139 sections 8 and 9;*
- *Marker balls, high visibility flags or high visibility sleeves placed on the outer guy wires;*
- *Ensuring the guy wire ground attachment points have contrasting colours to the surrounding ground and vegetation; or*
- *A flashing strobe light during daylight hours.*

7.2 Federal Aviation Administration – Marking of Met Towers

It is noted that the Federal Aviation Administration (FAA) has issued guidance material for the marking of Meteorological Evaluation Towers (METs) of less than 200ft (61m) in height to enhance visibility to low flying aircraft. The FAA recommends that the entire tower be painted in alternating contrasting bands of colour, the guy wires have high visibility balls or sleeves and that the markings are replaced when faded or otherwise deteriorated.

7.3 Reporting of Tall Structures

The turbines proposed for the GSHREP have a tip height of 240m (788ft) AGL; therefore, they must be reported as per CASR 175.480.

CASR Part 175E requires that obstacles having a height of 100m AGL (turbines and meteorological monitoring masts) be reported as tall structures for inclusion in the vertical obstacle database and on appropriate aeronautical charts.



The procedure for reporting tall structures is contained in Advisory Circular AC 139-08 *Reporting of Tall Structures*³¹.

Meteorological Monitoring Masts for the GSHREP must also be reported as per AC 139-08 and to the Aerial Agricultural Association of Australia (admin@aaaa.org.au).

Consideration should be given to ensuring a NOTAM that provides the height and location of the structure is issued. This is due to the current lead time between reporting tall structures and the information appearing on aeronautical charts.

7.4 Recommendations

It is recommended that Neoen Australia Pty Ltd ensure the wind monitoring towers used in the GSHREP are:

- Appropriately marked as per guidelines above except for strobe light;
- Reported as tall structures in accordance with AC139-08;
- Notified to the Aerial Agricultural Association of Australia;
- Subject to a NOTAM specifying their location and height.

³¹ Advisory Circular AC 139-08 v2.0 March 2018 available at <https://www.casa.gov.au/files/139c08pdf>



8. AERONAUTICAL IMPACT ASSESSMENT - CONCLUSIONS

8.1 Aviation Impact Statement

The GSHREP development **will not impact** upon the following:

- The OLS and PANS-OPS surfaces published for any registered, certified or military aerodrome;
- Any published air route Lowest Safe Altitudes;
- The operation of any Communications, Navigation or Surveillance facilities.

The GSHREP is sufficiently distant from any aerodrome for there to be no glint or glare issues for aircraft in the take-off or landing phase of flight. Any aircraft at cruising altitude will be at least 1300ft above ground level over the GSHREP and at that height it is considered that any glare or glint will not be a hazard to aircraft safety.

8.1.1 Airservices Response to AIS

Airservices Australia have advised by email that the GSHREP, at a maximum height of 902m (2960ft) AHD will not affect any sector or circling altitude, nor any instrument approach or departure procedure at any airport. It will not affect any air routes nor adversely impact the performance of any Communications, Navigation or Surveillance facilities. A copy of the response is at Appendix G.

8.1.2 Department of Defence Response to AIS

The Department of Defence is yet to respond. Their assessment will be included in a supplementary report.

8.2 Risk Assessment

The QRA demonstrates that the GSHREP will “**not be a hazard to aircraft safety**” and therefore “**not of operational significance**” to aircraft operations.

8.3 Obstacle Lighting

The GSHREP turbines have a tip height of 240m AGL and therefore can be regarded as an obstacle and be subject to a Risk Assessment to ascertain whether they constitute a hazard to aviation safety.

The Risk Assessment finds that the overall risk to aviation in the area of the GSHREP is LOW. On this basis no further mitigation is required.

Obstacle lighting is not required.



8.4 Reporting of Tall Structures

The GSHREP wind turbines and meteorological monitoring masts are considered to be tall structures, therefore they must be reported to the Vertical Obstacle Database, managed by Airservices Australia. The procedure for reporting tall structures is contained in Advisory Circular AC 139-08 V2.0.

Consideration should be given to ensuring a NOTAM that provides the height and location of the structure is issued.



APPENDIX A

Airservices Australia
Aviation Assessments for Wind Farm Developments
19 August 2014



APPENDIX A



Corporate & International Affairs
25 Constitution Avenue
(GPO Box 367)
CANBERRA ACT 2600
t 02 6268 5101
f 02 6268 4233
www.airservicesaustralia.com
ABN 59 698 720 886

To Whom It May Concern

Airservices Aviation Assessments for Wind Farm Developments

Guidelines to manage the risk to aviation safety from wind turbine installations (Wind Farms/Wind Monitoring Towers) are under development by the National Airports Safeguarding Advisory Group (NASAG). NASAG is comprised of high-level Commonwealth, State and Territory transport and planning officials and has been formed to develop a national land use planning regime to apply near airports and under flight paths.

The wind farm guidelines will provide information to proponents and planning authorities to help identify any potential safety risks posed by wind turbine 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.

To facilitate these assessments all wind farm proposals submitted to Airservices must include an Aviation Impact Statement (AIS) prepared by an aeronautical consultant in accordance with the AIS criteria set out below.

AIS must be undertaken by an aeronautical consultant with suitable knowledge and capabilities to provide a reliable and comprehensive report. All data is to be supplied in electronic form. If you are not familiar with any aeronautical consultants, you may wish to view the list on the Civil Aviation Safety Authority (CASA) website:

http://www.casa.gov.au/scripts/nc.dll?WCMS:STANDARD::pc=PC_90412



AIS Criteria

The AIS must provide a detailed analysis covering, as a minimum:

Airspace Procedures:

1. Obstacles
 - Co-ordinates in WGS 84 (to 0.1 second of arc or better)
 - Elevations AMSL (to 0.3 metres)
2. Drawings
 - Overlayed on topographical base not less than 1:250,000. Details of datum and level of charting accuracy to be noted.
 - Electronic format compatible with Microstation version 8i.
3. Aerodromes
 - Specify all registered/certified aerodromes that are located within 30nm (55.56km) from any obstacle referred to in (1) above.
 - Nominate all instrument approach and landing procedures at these aerodromes.
 - Confirmation that the obstacles do not penetrate Annex 14 or OLS for any aerodrome. If an obstacle does penetrate, specify the extent.
4. Air Routes
 - Nominate air routes published in ERC-L & ERC-H which are located near/over any obstacle referred to in (1) above.
 - Specify two waypoint names located on the routes which are located before and after the obstacles.
5. Airspace
 - Airspace classification – A, B, C, D, E, G etc where the obstacles are located.

Navigation/Radar:

1. Detect the presence of dead zones
2. False target analysis
3. Target positional accuracy
4. Probability of detection
5. Radar coverage implications
6. We would expect the analysis to follow the guidelines outlined in the EUROCONTROL Guidelines on How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors.

http://www.eurocontrol.int/sites/default/files/field_tabs/content/documents/events/guidelines-to-assess-potential-impact-of-wind-turbines.pdf



NOTE: Within the Eurocontrol Guidelines there are specific assumptions about the type of Wind Turbine for which the Guidelines are applicable (i.e. 3 blades, 30-200 m height, and horizontal rotation axis). For any deviations to the Wind Turbine characteristics listed within the Eurocontrol Guidelines, the proponent should justify to Airservices why the Eurocontrol Guidelines are still applicable.

Airservices Review of AIS

Airservices will review the quality and completeness of an AIS and will undertake limited modelling and analysis to confirm the findings and recommendations of the report.

Provided the AIS is of sound quality and is complete in accordance with the above criteria, there will be no charge for the review or limited modelling and analysis.

If the AIS is not of sound quality or is not complete in accordance with the above criteria, no modelling or analysis will be undertaken. Airservices will advise the proponent that the AIS does not meet the requirements and that the proposal cannot be assessed by Airservices.

If Airservices review of an AIS confirms impacts identified in the report (or identifies additional impacts), Airservices will advise the proponent of the impacts and the required mitigating actions (where mitigation is feasible). The proponent will also be advised that there will be charges for any mitigation actions to be undertaken by Airservices.

These charges may be advised at the time but it is likely that a detailed quote will be needed and this will only be provided on request from the proponent.

Please contact Airport Relations on 02 6268 4725 or airport.developments@airservicesaustralia.com if you have any questions.

Current as at 19 August 2014



APPENDIX B

Goyder Energy Park Turbine Locations and Heights 240m Turbines



APPENDIX B

Turbine ID	Latitude	Longitude	Easting	Northing	Elevation	Tip (m)	Tip (ft)	Add MOC	LSALT
B001	-33.779518	138.949097	310100	6260400	640	880	2888.75	3888.75	3,900
B002	-33.78517	138.951165	310304	6259777	550	790	2590.51	3590.51	3600
B003	-33.790528	138.954536	310628	6259189	545	785	2574.74	3574.74	3600
B004	-33.714835	138.963585	311300	6267600	526	766	2512.48	3512.48	3600
B005	-33.70766	138.965912	311500	6268400	578	818	2682.80	3682.80	3700
B006	-33.779768	138.964208	311500	6260400	501	741	2431.91	3431.91	3500
B007	-33.796057	138.964438	311557	6258594	506	746	2446.42	3446.42	3500
B008	-33.711336	138.970141	311900	6268000	574	814	2671.18	3671.18	3700
B009	-33.702875	138.970524	311917	6268939	544	784	2572.04	3572.04	3600
B010	-33.805997	138.968988	312000	6257500	493	733	2406.02	3406.02	3500
B011	-33.715013	138.974371	312300	6267600	566	806	2645.68	3645.68	3700
B012	-33.719519	138.974265	312300	6267100	529	769	2521.80	3521.80	3600
B013	-33.707819	138.975618	312400	6268400	563	803	2635.84	3635.84	3700
B014	-33.72947	138.976189	312500	6266000	527	767	2516.88	3516.88	3600
B015	-33.711495	138.979848	312800	6268000	544	784	2573.58	3573.58	3600
B016	-33.798928	138.977795	312800	6258300	491	731	2398.81	3398.81	3400
B017	-33.770102	138.979553	312900	6261500	495	735	2411.06	3411.06	3500
B018	-33.71693	138.981339	312950	6267400	537	777	2548.51	3548.51	3600
B019	-33.70432	138.982174	313000	6268800	533	773	2537.34	3537.34	3600
B020	-33.721446	138.981773	313000	6266900	581	821	2695.11	3695.11	3700
B021	-33.72597	138.982746	313100	6266400	578	818	2684.20	3684.20	3700
B022	-33.779608	138.98299	313239	6260452	472	712	2335.50	3335.50	3400
B023	-33.73235	138.986914	313500	6265700	567	807	2647.42	3647.42	3700
B024	-33.712844	138.988448	313600	6267866	523	763	2502.38	3502.38	3600
B025	-33.773831	138.987023	313600	6261100	473	713	2339.78	3339.78	3400
B026	-33.736026	138.991145	313900	6265300	544	784	2573.38	3573.38	3600
B027	-33.786503	138.989967	313900	6259700	480	720	2361.83	3361.83	3400
B028	-33.791027	138.990941	314000	6259200	490	730	2396.09	3396.09	3400
B029	-33.717132	138.993743	314100	6267400	486	726	2382.40	3382.40	3400
B030	-33.724343	138.993576	314100	6266600	497	737	2417.04	3417.04	3500
B031	-33.759532	138.994915	314300	6262700	472	712	2336.37	3336.37	3400
B032	-33.747849	138.997346	314500	6264000	491	731	2398.92	3398.92	3400
B033	-33.738853	138.998634	314600	6265000	497	737	2416.91	3416.91	3500
B034	-33.74336	138.99853	314600	6264500	506	746	2447.90	3447.90	3500
B035	-33.734363	138.999818	314700	6265500	472	712	2336.96	3336.96	3400
B036	-33.75513	139.001495	314900	6263200	495	735	2411.18	3411.18	3500
B037	-33.762376	139.003486	315100	6262400	556	796	2613.02	3613.02	3700
B038	-33.7669	139.00446	315200	6261900	533	773	2536.95	3536.95	3600
B039	-33.73901	139.008345	315500	6265000	432	672	2205.83	3205.83	3300
B040	-33.757939	139.007907	315500	6262900	457	697	2285.66	3285.66	3300
B041	-33.801205	139.006904	315500	6258100	500	740	2427.42	3427.42	3500



Turbine ID	Latitude	Longitude	Easting	Northing	Elevation	Tip (m)	Tip (ft)	Add MOC	LSALT
B042	-33.772378	139.008652	315600	6261300	501	741	2429.85	3429.85	3500
B043	-33.794913	139.00813	315600	6258800	516	756	2479.60	3479.60	3500
B044	-33.805729	139.00788	315600	6257600	506	746	2448.02	3448.02	3500
B045	-33.746256	139.010336	315700	6264200	433	673	2206.80	3206.80	3300
B046	-33.790423	139.009314	315700	6259300	487	727	2385.28	3385.28	3400
B047	-33.77692	139.010707	315800	6260800	507	747	2450.04	3450.04	3500
B048	-33.785934	139.010498	315800	6259800	510	750	2462.13	3462.13	3500
B049	-33.781462	139.012761	316000	6260300	547	787	2580.76	3580.76	3600
B050	-33.797722	139.014546	316200	6258500	566	806	2645.50	3645.50	3700
B051	-33.802246	139.015521	316300	6258000	589	829	2718.97	3718.97	3800
B052	-33.790563	139.017951	316500	6259300	546	786	2578.17	3578.17	3600
B053	-33.810393	139.017494	316500	6257100	532	772	2533.75	3533.75	3600
B054	-33.805921	139.019757	316700	6257600	574	814	2671.57	3671.57	3700
B055	-33.796057	139.023224	317000	6258700	469	709	2325.24	3325.24	3400
B056	-33.708897	139.042488	318600	6268400	374	614	2015.57	3015.57	3100
B057	-33.715871	139.046667	319002	6267634	387	627	2058.12	3058.12	3100
B058	-33.720965	139.046616	319008	6267069	367	607	1990.84	2990.84	3000
B059	-33.725918	139.048511	319194	6266523	358	598	1960.77	2960.77	3000
B060	-33.701944	139.052668	319529	6269189	361	601	1973.32	2973.32	3000
B061	-33.724392	139.052927	319600	6266700	369	609	1998.56	2998.56	3000
B062	-33.729868	139.05712	320000	6266100	370	610	1999.91	2999.91	3000
B063	-33.700139	139.058869	320100	6269400	359	599	1965.40	2965.40	3000
B064	-33.733542	139.061355	320400	6265700	378	618	2028.88	3028.88	3100
B065	-33.737467	139.05696	320001	6265257	359	599	1966.38	2966.38	3000
B066	-33.749882	139.061419	320440	6263888	318	558	1829.97	2829.97	2900
B067	-33.722742	139.062677	320500	6266900	363	603	1977.86	2977.86	3000
B068	-33.743474	139.06221	320500	6264600	358	598	1960.96	2960.96	3000
B069	-33.704649	139.064162	320600	6268909	369	609	1997.96	2997.96	3000
B070	-33.696635	139.065421	320700	6269800	358	598	1963.43	2963.43	3000
B071	-33.718336	139.06925	321100	6267400	350	590	1934.33	2934.33	3000
B072	-33.732776	139.070006	321200	6265800	358	598	1961.78	2961.78	3000
B073	-33.739645	139.066981	320934	6265033	339	579	1898.37	2898.37	2900
B074	-33.762761	139.074214	321652	6262482	302	542	1776.58	2776.58	2800
B075	-33.704849	139.07171	321300	6268900	363	603	1979.50	2979.50	3000
B076	-33.710257	139.071589	321300	6268300	348	588	1927.76	2927.76	3000
B077	-33.753251	139.067539	321014	6263525	314	554	1819.15	2819.15	2900
B078	-33.696769	139.074048	321500	6269800	340	580	1903.76	2903.76	3000
B079	-33.712995	139.073686	321500	6268000	349	589	1933.09	2933.09	3000
B080	-33.727418	139.073363	321500	6266400	360	600	1968.24	2968.24	3000
B081	-33.722927	139.074543	321600	6266900	344	584	1914.91	2914.91	3000
B082	-33.766934	139.081646	322349	6262032	300	540	1771.33	2771.33	3800
B083	-33.719406	139.080017	322100	6267300	321	561	1839.68	2839.68	2900



Turbine ID	Latitude	Longitude	Easting	Northing	Elevation	Tip (m)	Tip (ft)	Add MOC	LSALT
B084	-33.75806	139.069439	321200	6262995	307	547	1794.62	2794.62	2800
B085	-33.723963	139.083153	322400	6266800	313	553	1815.33	2815.33	2900
B086	-33.791637	139.085966	322800	6259300	359	599	1964.11	2964.11	3000
B087	-33.779034	139.087326	322900	6260700	346	586	1921.80	2921.80	3000
B088	-33.796161	139.086945	322900	6258800	364	604	1981.20	2981.20	3000
B089	-33.78536	139.088265	323000	6260000	349	589	1932.36	2932.36	3000
B090	-33.768515	139.09054	323176	6261872	318	558	1829.85	2829.85	2900
B091	-33.804324	139.090004	323200	6257900	355	595	1952.35	2952.35	3000
B092	-33.811535	139.089843	323200	6257100	366	606	1987.64	2987.64	3000
B093	-33.816059	139.090823	323300	6256600	370	610	2001.93	3001.93	3100
B094	-33.772807	139.092863	323400	6261400	329	569	1868.08	2868.08	2900
B095	-33.820583	139.091803	323400	6256100	372	612	2008.18	3008.18	3100
B096	-33.71964	139.095119	323500	6267300	281	521	1709.08	2709.08	2800
B097	-33.781855	139.094822	323600	6260400	352	592	1941.17	2941.17	3000
B098	-33.777364	139.096002	323700	6260900	362	602	1974.03	2974.03	3000
B099	-33.78728	139.095782	323700	6259800	370	610	2002.17	3002.17	3100
B100	-33.791804	139.096762	323800	6259300	374	614	2014.49	3014.49	3100
B101	-33.798114	139.096622	323800	6258600	369	609	1999.50	2999.50	3000
B102	-33.807178	139.099662	324100	6257600	362	602	1975.33	2975.33	3000
B103	-33.811685	139.099562	324100	6257100	371	611	2005.84	3005.84	3100
B104	-33.802688	139.100842	324200	6258100	388	628	2059.19	3059.19	3100
B105	-33.783774	139.102339	324300	6260200	356	596	1956.07	2956.07	3000
B106	-33.789216	139.104379	324500	6259600	327	567	1860.74	2860.74	2900
B107	-33.793723	139.10428	324500	6259100	336	576	1889.58	2889.58	2900
B108	-33.81898	139.104803	324600	6256300	382	622	2041.87	3041.87	3100
B109	-33.814489	139.105982	324700	6256800	336	576	1889.75	2889.75	2900
B110	-33.800099	139.108459	324900	6258400	323	563	1845.76	2845.76	2900
B111	-33.804607	139.10836	324900	6257900	335	575	1887.34	2887.34	2900
B112	-33.816424	139.114582	325500	6256600	310	550	1803.06	2803.06	2900
B113	-33.820948	139.115563	325600	6256100	307	547	1793.03	2793.03	2800
B114	-33.690725	139.064086	320564	6270453	371	611	2004.13	3004.13	3100
B115	-33.690836	139.072908	321382	6270456	333	573	1880.20	2880.20	2900
B116	-33.692164	139.055791	319798	6270279	358	598	1961.39	2961.39	3000
B117	-33.696289	138.976914	312495	6269681	549	789	2587.55	3587.55	3600
SG001	-33.772261	138.877253	303430	6261070	559	799	2622.66	3622.66	3700
SG002	-33.773539	138.883376	304000	6260940	585	825	2705.85	3705.85	3800
SG003	-33.776335	138.888706	304500	6260640	600	840	2755.63	3755.63	3800
SG004	-33.776532	138.878119	303520	6260598	558	798	2618.62	3618.62	3700
SG005	-33.777375	138.896779	305250	6260540	575	815	2672.84	3672.84	3700
SG006	-33.780485	138.906831	306188	6260214	579	819	2687.16	3687.16	3700
SG007	-33.781047	138.920823	307485	6260178	660	900	2954.01	3954.01	4000
SG008	-33.780798	138.878187	303536	6260125	583	823	2701.18	3701.18	3800



Turbine ID	Latitude	Longitude	Easting	Northing	Elevation	Tip (m)	Tip (ft)	Add MOC	LSALT
SG009	-33.78102	138.884282	304101	6260112	590	830	2723.07	3723.07	3800
SG010	-33.781411	138.892879	304898	6260085	595	835	2738.94	3738.94	3800
SG011	-33.781868	138.912348	306702	6260071	598	838	2748.97	3748.97	3800
SG012	-33.783927	138.88866	304513	6259798	619	859	2817.48	3817.48	3900
SG013	-33.784997	138.920889	307500	6259740	662	902	2959.44	3959.44	4000
SG014	-33.784686	138.902539	305800	6259740	569	809	2653.50	3653.50	3700
SG015	-33.785193	138.879461	303664	6259640	595	835	2739.96	3739.96	3800
SG016	-33.785927	138.913491	306817	6259623	592	832	2730.39	3730.39	3800
SG017	-33.786379	138.894982	305104	6259538	589	829	2718.50	3718.50	3800
SG018	-33.788071	138.889498	304600	6259340	613	853	2800.06	3800.06	3900
SG019	-33.78954	138.922939	307700	6259240	632	872	2860.19	3860.19	3900
SG020	-33.790821	138.895327	305146	6259046	578	818	2684.28	3684.28	3700
SG021	-33.790717	138.880825	303803	6259030	593	833	2733.79	3733.79	3800
SG022	-33.792596	138.890466	304700	6258840	616	856	2807.07	3807.07	3900
SG023	-33.794065	138.92391	307800	6258740	613	853	2797.10	3797.10	3800
SG024	-33.79674	138.954518	310640	6258500	577	817	2679.68	3679.68	3700
SG025	-33.79609	138.883901	304100	6258440	595	835	2738.04	3738.04	3800
SG026	-33.799491	138.924859	307900	6258140	606	846	2775.22	3775.22	3800
SG027	-33.800554	138.881307	303870	6257940	585	825	2706.90	3706.90	3800
SG028	-33.803998	138.92475	307900	6257640	569	809	2652.57	3652.57	3700
SG029	-33.806359	138.958178	311000	6257440	562	802	2630.20	3630.20	3700
SG030	-33.805071	138.881843	303930	6257440	555	795	2607.21	3607.21	3700
SG031	-33.807657	138.927902	308200	6257240	526	766	2513.54	3513.54	3600
SG032	-33.810357	138.882977	304047	6256856	531	771	2528.60	3528.60	3600
SG033	-33.81313	138.960825	311260	6256694	547	787	2582.07	3582.07	3600
SG034	-33.813084	138.928852	308300	6256640	505	745	2443.45	3443.45	3500
SG035	-33.818136	138.961463	311330	6256140	550	790	2590.94	3590.94	3600
SG036	-33.825619	139.093852	323600	6255545	377	617	2024.10	3024.10	3100
SG037	-33.824873	138.932889	308700	6255340	503	743	2437.61	3437.61	3500
SG038	-33.826222	138.927832	308235	6255181	537	777	2550.17	3550.17	3600
SG039	-33.83072	138.930933	308532	6254688	533	773	2537.05	3537.05	3600
SG040	-33.835266	138.931558	308600	6254185	543	783	2568.57	3568.57	3600
SG041	-33.836663	138.936927	309100	6254040	483	723	2372.38	3372.38	3400
SG042	-33.840835	138.933001	308746	6253570	555	795	2607.25	3607.25	3700
SG043	-33.844409	138.934255	308870	6253176	553	793	2600.50	3600.50	3700
SG044	-33.848665	138.93371	308829	6252703	569	809	2653.55	3653.55	3700
SG045	-33.855025	139.071302	321574	6252245	367	607	1991.26	2991.26	3000
SG046	-33.854147	138.933697	308840	6252095	563	803	2634.20	3634.20	3700
SG047	-33.860595	139.073468	321786	6251631	379	619	2031.53	3031.53	3100
SG048	-33.858648	138.935426	309010	6251599	614	854	2803.45	3803.45	3900
SG049	-33.867618	139.075699	322007	6250856	383	623	2045.36	3045.36	3100
SG050	-33.873153	139.07791	322223	6250246	403	643	2108.45	3108.45	3200



Turbine ID	Latitude	Longitude	Easting	Northing	Elevation	Tip (m)	Tip (ft)	Add MOC	LSALT
SG051	-33.877027	139.103282	324578	6249860	385	625	2050.25	3050.25	3100
SG052	-33.877395	139.121955	326306	6249851	354	594	1947.86	2947.86	3000
SG053	-33.88547	139.124622	326569	6248960	356	596	1956.35	2956.35	3000
SG054	-33.889058	139.111601	325372	6248540	400	640	2099.62	3099.62	3100
SG055	-33.891899	139.120491	326200	6248240	366	606	1988.85	2988.85	3000
SG056	-33.895067	139.089064	323300	6247835	443	683	2240.10	3240.10	3300
SG057	-33.896186	139.112493	325469	6247751	415	655	2149.54	3149.54	3200
SG058	-33.900902	139.091453	323533	6247192	447	687	2254.39	3254.39	3300
SG059	-33.906138	139.108791	325147	6246641	418	658	2159.46	3159.46	3200
SG060	-33.906689	139.116446	325856	6246593	403	643	2109.82	3109.82	3200
SG061	-33.907525	139.125155	326663	6246515	369	609	1998.60	2998.60	3000
SG062	-33.909226	139.097908	324147	6246280	429	669	2194.98	3194.98	3200
SG063	-33.91205	139.136326	327705	6246032	356	596	1954.86	2954.86	3000
SG064	-33.914223	139.100923	324436	6245731	400	640	2098.48	3098.48	3100
SG065	-33.915468	139.128626	327000	6245640	375	615	2018.38	3018.38	3100
SG066	-33.918366	139.111744	325445	6245290	418	658	2158.46	3158.46	3200
SG067	-33.921614	139.122478	326444	6244948	388	628	2060.46	3060.46	3100
SG068	-33.924515	139.130592	327200	6244640	356	596	1953.81	2953.81	3000
SG069	-33.926463	139.115265	325787	6244398	374	614	2013.46	3013.46	3100
SG070	-33.934093	139.123026	326520	6243565	365	605	1983.80	2983.80	3000

Note: Tallest turbine is SG013 at 902m (2960ft) AHD.

LSALT over GSHREP is 4000ft.



APPENDIX C

Australian Fire and Emergency Services Authorities Council Wind Farms and Bushfire Operations



APPENDIX C



Wind Farms and Bushfire Operations





Version Control

Version	Author	Edits	Date
0.1	Gary Featherston	First draft requested by the Rural and Land Management Group at its meeting of 7 May 2013	28 August 2013
0.2	Gary Featherston	Updated wind farm numbers and included comments from earlier reviewers.	30 August 2013
0.3	Gary Featherston	Approved by the RLM group before edits to include EMR and Total fire ban legislation.	9 September 2013
0.4	Gary Featherston	Added comments provided by the Clean Energy Council.	19 September 2013
1.0	Gary Featherston	Approved by Council	24 October 2013
1.1	Gary Featherston	Minor revision to add monitoring towers.	15 September 2014
2.0	Gary Featherston	Approved by Council, published.	30 October 2014



Copyright © 2014, Australasian Fire and Emergency Service Authorities Council Limited

All rights reserved. Copyright in this publication is subject to the operation of the Copyright Act 1968 and its subsequent amendments. Any material contained in this document can be reproduced, providing the source is acknowledged and it is not used for any commercialisation purpose whatsoever without the permission of the copyright owner.

Australasian Fire and Emergency Service Authorities Council Limited (ABN 52 060 049 327)
Level 5, 340 Albert Street
East Melbourne Victoria 3002
Telephone: 03 9419 2388
Facsimile: 03 9419 2389

Email: afac@afac.com.au
Internet: <http://www.afac.com.au>

Disclaimer:

This document is constructed from consultation and research between Australasian Fire and Emergency Service Authorities Council Limited (**AFAC**), its member agencies and stakeholders. It is intended to address matters relevant to fire, land management and emergency services across Australia and New Zealand.

The information in this document is for general purposes only and is not intended to be used by the general public or untrained persons. Use of this document by AFAC member agencies, organisations and public bodies does not derogate from their statutory obligations. It is important that individuals, agencies, organisations and public bodies make their own enquiries as to the currency of this document and its suitability to their own particular circumstances prior to its use.

AFAC does not accept any responsibility for the accuracy, completeness or relevance of this document or the information contained in it, or any liability caused directly or indirectly by any error or omission or actions taken by any person in reliance upon it.

Before using this document or the information contained in it you should seek advice from the appropriate fire or emergency services agencies and obtain independent legal advice.



Table of Contents

1 Introduction..... 1

2 Purpose..... 1

3 Scope 1

4 Position..... 1

5 Supporting Documentation 2



1 Introduction

Wind power is a rapidly expanding mode of renewable energy production in Australia with installed capacity doubling in the past five years. As of September 2013, Australia has 64 wind farms with an installed capacity of 3058 megawatts (MW), with another ten wind farms under construction.

The increasing number of wind farms makes it important for AFAC member agencies to clarify their position and to identify those issues important for their operations in and around these facilities.

2 Purpose

This is a position to state AFAC member agencies attitude towards wind farms and their development. It aims to clarify the risks in order to inform stakeholders including regulators, members of the community and the wind farm industry.

3 Scope

The scope of this paper is limited to the issues relating to planning for bushfire prevention, preparedness, response and to recovery operations in and around existing and planned wind farms.

It excludes the environmental, social and economic issues associated with wind farms. It does not provide any judgments on the values or otherwise of wind farms.

4 Position

Bushfire management issues are best treated at the planning stage of a wind farm project. This includes the impact of bushfires on the wind farm and the potential for fires to start within the development boundaries. Local planning controls are in place to regulate these issues with respect to any infrastructure development and some local planning controls refer specifically to wind farms.

Wind monitoring towers associated with wind farm investigations and planning can be very much taller than the planned turbines and can be less visible. The location and height of monitoring towers should be noted during aerial firefighting operations.

Wind farms can interfere with local and regional radio transmissions by physical obstruction and radio frequency electromagnetic radiation. Any interference can be minimised or eliminated through appropriate turbine siting at the planning stage and by moving away from the tower if experiencing local interference during operations.

Wind farms are an infrastructure development that must be considered in the preparation of Incident Action Plans for the suppression of bushfires in their vicinity. These considerations are routine and wind farms are not expected to present elevated risks to operations compared to other electrical infrastructure.



Aerial fire fighting operations will treat the turbine towers similar to other tall obstacles. Pilots and Air Operations Managers will assess these risks as part of routine procedures. Risks due to wake turbulence and the moving blades should also be considered. Wind turbines are not expected to pose unacceptable risks.

Wind farms are not expected to adversely affect fire behaviour in their vicinity. Local wind speeds and direction are already highly variable across landscapes affected by turbulence from ridge lines, tall trees and buildings.

Turbine towers are not expected to start fires by attracting lightning.

Turbines can malfunction and start fires within the unit. Automatic shutdown and isolation procedures are installed within the system. Although such fires may start a grass fire within the wind farm, planning for access and fire breaks can reduce the likelihood of the fire leaving the property. This risk from such fires is less than that of many other activities expected in these rural environments.

Wind farms may operate on days of Total Fire Ban subject to relevant national, state and territory legislation.

Liaison with wind farm operators and energy industry representatives during and after bushfires should aim to ensure minimal disruption to generation capacity and rapid resumption of essential services to the community.

5 Supporting Documentation

There's power in the wind: national snapshot.
Clean Energy Council, April 2012

There's power in the wind: fact sheet.
Clean Energy Council, June 2011

Both sourced from
<http://www.cleanenergycouncil.org.au/resourcecentre/factsheets.html>
on 29 August 2013

Emergency Management Guidelines for Wind Farms
Country Fire Authority, April 2007

Fact Sheet 10. Wind Farming, Electromagnetic Radiation & Interference.
Australian Wind Energy Association.
Sourced from
<http://www.synergy-wind.com/documents/10Electromagnetic.pdf>
9 September 2013



APPENDIX D


Country Fire Service South Australia

Fact Sheet

Aerial Firefighting



APPENDIX D



CFS FACT SHEET Aerial firefighting

Although aircraft are often the most visible part of the response to a fire, and therefore believed to be the most important, almost all fires are still extinguished by ground crews.

The Country Fire Service (CFS) currently has a base fleet of 26 aircraft which can be relocated across several airstrips across the state to offer aerial firefighting support to ground crews.


Aircraft are particularly valuable for fires in difficult terrain or fast moving fires that are too dangerous for ground crews to be placed in front of.

They may not be able to fly if wind speeds are too high, dust or smoke covers the fire, or when daylight is fading.

Firefighting aircraft will also be grounded if Remotely Piloted Aircraft (drones) are flown without permission over a fire ground.


Although other places in the world may be experimenting with night aerial firefighting, the Country Fire Service can only legally and safely operate during daylight hours.

Single Engine Air Tanker (SEAT)




The CFS currently contracts 14 SEATs, or fire bombers, throughout South Australia. The SEATs can fly at almost 300kph and carry 3,200 litres of water and firefighting chemicals.

Tactical Coordination aircraft




Four helicopters and one airplane make up the CFS tactical coordination fleet. These aircraft help to coordinate SEATs to specifically support firefighters at problematic parts of the fire ground where ground crews may not be able to access the fire, or where people, homes and buildings may be in danger.



Government of South Australia

**South Australian
Country Fire Service**
cfs.sa.gov.au

Contact the Bushfire
Information Hotline
1800 362 361 (TTY 133 677)
@Countryfireservice
@CFSAlerts





Aerial firefighting

Page 2
CFS FACT SHEET

Crews can also help to advise bomber crews of the type of fire retardants best suited to the fire's behaviour and fuels.

Tactical and Strategic Overview aircraft

Four helicopters and two airplanes make up the CFS tactical and strategic overview fleet.

These aircraft are used to observe, collect information to help predict the path of the fire, gather and relay information, and map the perimeter of the fire.



Erickson Airplane (S-64E)

The Erickson Airplane can carry 7,500 litres of water and firefighting chemicals and can use its pump to refill from open water sources in just 45 seconds.

The Erickson is based in the Mount Lofty Ranges, where it is close to multiple open water supplies.



Large Air Tankers (LATs)

As part of a national firefighting agreement LATs may be requested from interstate.

LATs are currently operated by the New South Wales and Victorian firefighting organisations, and may carry up to 20,000 litres of water and firefighting chemicals.

CFS air support teams work with the support of the Royal Australian Air Force at Edinburgh to refill LATs at the airbase if multiple drops are required.

Cleaning up if firefighting chemicals are used on your property

The concentrations of chemicals used in drops are not harmful to animals or humans and are biodegradable.

It is recommended that you wash in cold water with a mild soap as a precaution to avoid possible skin irritation if you come in contact with the products.

If your house is doused and your gutters run off to a rainwater tank, you should drain and flush the gutters and tank, then refill with fresh water.

The concentrations of chemicals used by the CFS do not pose health risks but may change the taste and potability of drinking water.

Water mixed with aerial drops in rainwater tanks can still be used for cleaning and firefighting.

Animals, cars or buildings that are doused in firefighting drops can also be washed with water and appropriate shampoos or soaps to remove residue.

If fruit trees or vegetables are doused it is recommended they are washed thoroughly before consuming to remove any possible residue taste.



**South Australian
Country Fire Service**
cfs.sa.gov.au

Contact the Bushfire
Information Hotline
1800 362 361 (TTY 133 677)
@Countryfireservice
@CFSAlerts





APPENDIX E

Stakeholder List



APPENDIX E Stakeholder List

The following organisations were contacted.

Stakeholder	Contact
Stonefield Gliding Aerodrome (ALA)	Unable to contact listed Aerodrome Operator
Aerotech – Aerial Agricultural Operator	Hoyleton Base - Senior Pilot
State Helicopter Rescue Service	Babcock Adelaide Base – Senior Base Pilot
RFDS	Adelaide Base – Senior Base Pilot
SA Police Air Wing	Officer in Charge

Stakeholder List.



APPENDIX F

Glossary of Terms And Abbreviations



APPENDIX F

Glossary of Terms and Abbreviations

AERONAUTICAL STUDY GLOSSARY

To facilitate the understanding of aviation terminology used in this report, the following is a glossary of terms and acronyms that are commonly used in aeronautical impact assessments and similar aeronautical studies. A full list of terms and abbreviations used in this report is included as an Appendix.

AC (Advisory Circulars) are issued by CASA and are intended to provide recommendations and guidance to illustrate a means, but not necessarily the only means, of complying with the *Regulations*.

Aeronautical study is a tool used to review aerodrome and airspace processes and procedures to ensure that safety criteria are appropriate.

AHD (Australian Height Datum) is the datum to which all vertical control for mapping is to be referred. The datum surface is that which passes through mean sea level at the 30 tide gauges and through points at zero AHD height vertically below the other basic junction points.

AIP (Aeronautical Information Publication) is a publication promulgated to provide operators with aeronautical information of a lasting character essential to air navigation. It contains details of regulations, procedures and other information pertinent to flying and operation of aircraft. In Australia, the AIP may be issued by CASA or Airservices Australia.

Air routes exist between navigation aid equipped aerodromes or waypoints to facilitate the regular and safe flow of aircraft operating under Instrument Flight Rules (IFR).

Airservices Australia is the Australian government-owned corporation providing safe and environmentally sound air traffic management and related airside services to the aviation industry.

Altitude is the vertical distance of a level, a point or an object, considered as a point, measured from mean sea level.

AMSL (Above Mean Sea Level) is the elevation (on the ground) or altitude (in the air) of any object, relative to the average sea level datum. In aviation, the ellipsoid known as World Geodetic System 84 (WGS 84) is the datum used to define mean sea level.

ATC (Air Traffic Control) service is a service provided for the purpose of:

- a. preventing collisions:
 1. between aircraft; and
 2. on the manoeuvring area between aircraft, vehicles and obstructions; and
- b. expediting and maintaining an orderly flow of air traffic.

CASA (Civil Aviation Safety Authority) is the Australian government authority responsible under the *Civil Aviation Act 1988* for developing and promulgating appropriate, clear and concise aviation



safety standards. As Australia is a signatory to the ICAO *Chicago Convention*, CASA adopts the standards and recommended practices established by ICAO, except where a difference has been notified.

CASR (Civil Aviation Safety Regulations) are promulgated by CASA and establish the regulatory framework (*Regulations*) within which all service providers must operate.

Civil Aviation Act 1988 (the Act) establishes the CASA with functions relating to civil aviation, in particular the safety of civil aviation and for related purposes.

ICAO (International Civil Aviation Organization) is an agency of the United Nations which codifies the principles and techniques of international air navigation and fosters the planning and development of international air transport to ensure safe and orderly growth. The ICAO Council adopts standards and recommended practices concerning air navigation, its infrastructure, flight inspection, prevention of unlawful interference, and facilitation of border-crossing procedures for international civil aviation. In addition, the ICAO defines the protocols for air accident investigation followed by transport safety authorities in countries signatory to the Convention on International Civil Aviation, commonly known as the *Chicago Convention*. Australia is a signatory to the *Chicago Convention*.

IFR (Instrument Flight Rules) are rules applicable to the conduct of flight under IMC. IFR are established to govern flight under conditions in which flight by outside visual reference is not safe. IFR flight depends upon flying by reference to instruments in the flight deck, and navigation is accomplished by reference to electronic signals. It is also referred to as, “a term used by pilots and controllers to indicate the type of flight plan an aircraft is flying,” such as an IFR or VFR flight plan.

IMC (Instrument Meteorological Conditions) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, less than the minimum specified for visual meteorological conditions.

LSALT (Lowest Safe Altitudes) are published for each low level air route segment. Their purpose is to allow pilots of aircraft that suffer a system failure to descend to the LSALT to ensure terrain or obstacle clearance in IMC where the pilot cannot see the terrain or obstacles due to cloud or poor visibility conditions. It is an altitude that is at least 1,000 feet above any obstacle or terrain within a defined safety buffer region around a particular route that a pilot might fly.

MOS (Manual of Standards) comprises specifications (*Standards*) prescribed by CASA, of uniform application, determined to be necessary for the safety of air navigation.

NASAG (National Airports Safeguarding Advisory Group) set up in May 2010 to implement the Australian Government’s National Aviation Policy White Paper, *Flight Path to the Future* initiatives relating to safeguarding airports and surrounding communities from inappropriate development. NASAG comprises representatives from state and territory planning and transport departments, the Civil Aviation Safety Authority (CASA), Airservices Australia, the Department of Defence and the Australian Local Government Association (ALGA) and is chaired by the Department of Infrastructure and Transport (DoIT).

NASF (National Airports Safeguarding Framework) is the published guidelines from the NASAG.

NOTAMs (Notices to Airmen) are notices issued by the NOTAM office containing information or instruction concerning the establishment, condition or change in any aeronautical facility, service, procedure or hazard, the timely knowledge of which is essential to persons concerned with flight operations.



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.

OLS (Obstacle Limitation Surfaces) are a series of planes associated with each runway at an aerodrome that defines the desirable limits to which objects may project into the airspace around the aerodrome so that aircraft operations may be conducted safely.

PANS-OPS (Procedures for Air Navigation Services - Aircraft Operations) is an Air Traffic Control term denominating rules for designing instrument approach and departure procedures. Such procedures are used to allow aircraft to land and take off under Instrument Meteorological Conditions (IMC) or Instrument Flight Rules (IFR). ICAO document 8168-OPS/611 (volumes 1 and 2) outlines the principles for airspace protection and procedure design which all ICAO signatory states must adhere to. The regulatory material surrounding PANS-OPS may vary from country to country.

PANS OPS Surfaces. Similar to an Obstacle Limitation Surface, the PANS-OPS protection surfaces are imaginary surfaces in space which guarantee the aircraft a certain minimum obstacle clearance. These surfaces may be used as a tool for local governments in assessing building development. Where buildings may (under certain circumstances) be permitted to penetrate the OLS, they cannot be permitted to penetrate any PANS-OPS surface, because the purpose of these surfaces is to guarantee pilots operating under IMC an obstacle free descent path for a given approach.

Prescribed airspace is an airspace specified in, or ascertained in accordance with, the Regulations, where it is in the interests of the safety, efficiency or regularity of existing or future air transport operations into or out of an airport for the airspace to be protected. The prescribed airspace for an airport is the airspace above any part of either an OLS or a PANS OPS surface for the airport and airspace declared in a declaration relating to the airport.

Regulations (Civil Aviation Safety Regulations)

VFR (Visual Flight Rules) are rules applicable to the conduct of flight under VMC. VFR allow a pilot to operate an aircraft in weather conditions generally clear enough to allow the pilot to maintain visual contact with the terrain and to see where the aircraft is going. Specifically, the weather must be better than basic VFR weather minima. If the weather is worse than VFR minima, pilots are required to use instrument flight rules.

VMC (Visual Meteorological Conditions) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, equal or better than specified minima



ABBREVIATIONS

Abbreviations used in this report, and the meanings assigned to them for the purposes of this report are detailed in the following table:

Abbreviation	Meaning
AC	Advisory Circular (document support CASR 1998)
ACFT	Aircraft
AD	Aerodrome
AHD	Australian Height Datum
AHT	Aircraft height
AIP	Aeronautical Information Publication
Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Service
ALA	Aircraft Landing Area
Alt	Altitude
AMSL	Above Minimum Sea Level
A(PofA)R	Airports (Protection of Airspace) Regulations, 1996 as amended
APARs	Airports (Protection of Airspace) Regulations, 1996 as amended
ARP	Aerodrome Reference Point
AsA	Airservices Australia
ATC	Air Traffic Control(ler)
ATM	Air Traffic Management
CAO	Civil Aviation Order
CAR	Civil Aviation Regulation
CASA	Civil Aviation Safety Authority
CASR	Civil Aviation Safety Regulation
Cat	Category
DAP	Departure and Approach Procedures (charts published by AsA)
DER	Departure End of (the) Runway
DEVELMT	Development
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DITCRD	Department of Infrastructure, Transport, Cities and Regional Development
DIRDC	Department of Infrastructure, Regional Development and Cities. See DIRCRD above
DIRD	Department of Infrastructure and Regional Development. See DIRDC above
DoIT	Department of Infrastructure and Transport. Also called “Infrastructure”. (Formerly Department of Infrastructure, Transport, Regional Development and Local Government (DITRD LG) and previously the Department of Transport and Regional Services (DoTARS)). See DIRD above
DITRD LG	See DoIT above
DOTARS	See DITRD LG above
ELEV	Elevation (above mean sea level)



Abbreviation	Meaning
ENE	East North East
ERSA	Enroute Supplement Australia
FAF	Final Approach Fix
FAP	Final Approach Point
ft	feet
GA	General Aviation
GNSS	Global Navigation Satellite System
GP	Glide Path
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organisation
IFR	Instrument Flight Rules
IHS	Inner Horizontal Surface, an Obstacle Limitation Surface
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
ISA	International Standard Atmosphere
km	kilometres
kt	Knot (one nautical mile per hour)
LAT	Latitude
LLZ	Localizer
LONG	Longitude
LSALT	Lowest Safe Altitude
m	metres
MAPt	Missed Approach Point
MDA	Minimum Descent Altitude
MGA94	Map Grid Australia 1994
MOC	Minimum Obstacle Clearance
MOS	Manual of Standards, published by CASA
MSA	Minimum Sector Altitude
SSR	Monopulse Secondary Surveillance Radar
MVA	Minimum Vector Altitude
NASAG	National Airports Safeguarding Advisory Group
NASF	National Airports Safeguarding Framework
NDB	Non Directional Beacon
NE	North East
NM or nm	Nautical Mile (= 1.852 km)
nnDME	Distance from the DME (in nautical miles)
NNE	North East
NOTAM	NOtice To AirMen
OAS	Obstacle Assessment Surface
OCA	Obstacle Clearance Altitude
OCH	Obstacle Clearance Height
OHS	Outer Horizontal Surface
OIS	Obstacle Identification Surface



Abbreviation	Meaning
OLS	Obstacle Limitation Surface
PANS-OPS	Procedures for Air Navigation Services – Aircraft Operations, ICAO Doc 8168
PRM	Precision Runway Monitor
PROC	Procedure
PSR	Primary Surveillance Radar
QNH	An altimeter setting relative to height above mean sea level
Rnnn	Restricted Airspace – promulgated in AIP as R with 3 numbers
REF	Reference
RL	Relative Level
RNAV	aRea NAVigation
RNP	Required Navigation Performance
RPA	Rules and Practices for Aerodromes — replaced by the MOS Part 139 — Aerodromes
RPT	Regular Public Transport
RWY	Runway
SFC	Surface
SID	Standard Instrument Departure
SOC	Start Of Climb
SSR	Secondary Surveillance Radar
STAR	Standard ARrival
TAR	Terminal Area Radar
TAS	True Air Speed
THR	Threshold (Runway)
TNA	Turn Altitude
TODA	Take-Off Distance Available
VFR	Visual Flight Rules
VMC	Visual Meteorological Conditions
V _n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range



APPENDIX G

Airservices Australia Response to the Aviation Impact Statement



APPENDIX G

ian_jennings@netspace.net.au

From: Airport Developments <Airport.Developments@AirservicesAustralia.com>
Sent: Tuesday, 12 November 2019 2:58 PM
To: 'ian_jennings@netspace.net.au'
Cc: Airspace Protection; Vertical Obstruction Data
Subject: AIRSERVICES RESPONSE: SA-WF-019 - Wind Farm, Goyder South Hybrid Renewable Energy Project [SEC=UNCLASSIFIED]

Hi Ian,

I refer to your request for an Airservices assessment of the wind farm for the Goyder South Hybrid Renewable Energy Project.

Airspace Procedures

With respect to procedures designed by Airservices in accordance with ICAO PANS-OPS and Document 9905, at a maximum height of 902m (2960ft) AHD, the wind farm will not affect any sector or circling altitude, nor any instrument approach or departure procedure at any airport.

The wind turbines will not affect any air route.

Note that procedures not designed by Airservices were not considered in this assessment.

Communications/Navigation/Surveillance (CNS) Facilities

This wind farm, to a maximum height of 902m (2960ft) AHD, will not adversely impact the performance of Precision/Non-Precision Navigational Aids, HF/VHF Communications, A-SMGCS, Radar, PRM, ADS-B, WAM or Satellite/Links.

Vertical Obstacle Notification

As soon as construction commences, the proponent must complete the Vertical Obstacle Notification Form for tall structures and submit the completed form to VOD@airservicesaustralia.com. For further information regarding the reporting of tall structures, please contact (02) 6268 5622, email VOD@airservicesaustralia.com or refer to the web link below:
<http://www.airservicesaustralia.com/services/aeronautical-information-and-management-services/part-175/>

Kind regards,

William Zhao

Advisor Airport Development
Tower Road, Melbourne Airport, Tullamarine VIC 3043
t 03 9339 2182