STATE COMMISSION ASSESSMENT PANEL
A COMMITTEE OF THE STATE PLANNING COMMISSION

APPLICATION ON NOTIFICATION – s.49 PUBLIC INFRASTRUCTURE

Applicant:	Yorke Peninsula Wind Farm Project Pty Ltd
Development Number:	544/V001/13 V3
Nature of Development:	Variation to current development authorisation – change to number of turbines, maximum tip height of turbines, and generation capacity of turbines.
Type of development:	S49 – Public Infrastructure
Zone / Policy Area:	Primary Production Zone
Subject Land:	Various land holdings – Yorke Peninsula (refer to development application)
Contact Officer:	Lee Webb
Phone Number:	08 7109 7066
Start Date:	20 February 2019
Close Date:	22 March 2019

During the notification period, hard copies of the application documentation can be viewed at the Department of Planning, Transport and Infrastructure, Level 5, 50 Flinders Street, Adelaide during normal business hours. Application documentation may also be viewed at the Minlaton, Maitland and Yorketown offices of the Yorke Peninsula Council.

Written representations must be received by the close date (indicated above) and can either be posted, hand-delivered, or emailed to the State Commission Assessment Panel (SCAP).

Any representations received after the close date will not be considered.

Postal Address:
The Secretary
State Commission Assessment Panel
GPO Box 1815
ADELAIDE SA 5001

Street Address:
Planning and Land Use Services
Department of Planning, Transport and Infrastructure
Level 5, 50 Flinders Street
ADELAIDE

Email Address: scapreps@sa.gov.au

Government of South Australia

Department of Planning, Transport and Infrastructure

DEVELOPMENT ACT 1993

SECTION 49 - PUBLIC INFRASTRUCTURE

NOTICE OF APPLICATION FOR CONSENT TO DEVELOPMENT

Notice is hereby given that an application has been made by **Yorke Peninsula Wind Farm Project Pty Ltd** (previously sponsored as 'public infrastructure' by the Department for Transport, Energy and Infrastructure under Section 49 of the *Development Act 1993*) for consent to vary its current development authorisation for the construction of an integrated windfarm development. **Development Number: 544/V001/13 V3.**

The extent of the variation to the development authorisation comprises the following elements: (a) a reduction in the number of wind turbines from 187 to 170 turbines; (b) an increase in the maximum tip height of each turbine from 163m up to 220 metres (involving an increase in both hub height and blade length); and (c) approval for the use of wind turbines up to 6MW capacity.

The previously approved wind turbine sites are located within four (4) project zones on privately owned land on Yorke Peninsula. The four project zones are located: south-west of Muloowurtie Point [Northern Zone], west of Port Julia [Central East Zone], north-west of Port Vincent [Southern Zone] and north-east of Curramulka [Central West Zone].

A complete list of participating properties and designated project zones is contained in the amended Development Application. No changes are proposed to the approved Port Julia convertor station site, the Globe Derby Park convertor station site or the alignment of the underground / undersea HVDC transmission cable between Port Julia and St Kilda (across Gulf St Vincent).

The overall development area (i.e. subject land) is located across a number of zones, including two council areas and state coastal waters. The proposed variation only applies to those project elements within the Primary Production Zone (Yorke Peninsula Council Development Plan [Consolidated 31 October 2017].

The application may be examined during normal office hours at the office of the State Commission Assessment Panel (SCAP), Level 5, 50 Flinders Street and at the Minlaton, Maitland and Yorketown offices of the Yorke Peninsula Council. Application documentation may also be viewed on the SCAP website http://www.saplanningcommission.sa.gov.au/scap/public_notices.

Any person or body who desires to do so may make representations concerning the application by notice in writing delivered to the Secretary, State Commission Assessment Panel, GPO Box 1815, Adelaide SA 5001 **NOT LATER THAN 22 MARCH 2019.** Submissions may also be emailed to: scapreps@sa.gov.au

Each person or body making a representation should state the reason for the representation and whether that person or body wishes to be given the opportunity to appear before the SCAP to further explain the representation.

Submissions may be made available for public inspection.

Should you wish to discuss the application and the public notification procedure please contact **Lee Webb** on **7109 7066** or lee.webb@sa.gov.au

Alison Gill
SECRETARY
STATE COMMISSION ASSESSMENT PANEL

PN3601

www.sa.gov.au

PN3601
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Yorke Peninsula Country Times
Tuesday 19 February 2019
APPROVAL REQUIRED BY 4PM WED 13 FEB

DEVELOPMENT ACT, 1993
S49/S49A – CROWN DEVELOPMENT
REPRESENTATION ON APPLICATION

Applicant:	Yorke Peninsula Wind Farm Project Pty Ltd
Development Number:	544/V001/13 V3
Nature of Development:	Variation to current development authorisation – change to number of turbines, maximum tip height of turbines, and generation capacity of turbines.
Zone / Policy Area:	Primary Production Zone
Subject Land:	Various land holdings – Yorke Peninsula (refer to development application)
Contact Officer:	Lee Webb
Phone Number:	08 7109 7066
Close Date:	22 March 2019

My Name: ______________________ My phone number: ______________

Primary method(s) of contact: Email: ______________________

Postal Address: ______________________

______________________ Postcode: ________

You may be contacted via your nominated PRIMARY METHOD(s) OF CONTACT if you indicate below that you wish to be heard by the State Commission Assessment Panel in support of your submission.

My interests are:
(please tick one)

- ☐ owner of local property
- ☐ occupier of local property
- ☐ a representative of a company/other organisation affected by the proposal
- ☐ a private citizen

The address of the property affected is: ______________________

______________________ Postcode ________

My interests are:
(please tick one)

- ☐ I support the development
- ☐ I support the development with some concerns
- ☐ I oppose the development

The specific aspects of the application to which I make comment on are: ______________________

____

____

____

____

I: *(please tick one)*

- ☐ wish to be heard in support of my submission
- ☐ do not wish to be heard in support of my submission *(Please tick one)*

By: *(please tick one)*

- ☐ appearing personally
- ☐ being represented by the following person *(Please tick one)*

Signature: ______________________

Date: ______________

Return Address: The Secretary, State Commission Assessment Panel, GPO Box 1815, Adelaide, SA 5001 /or **Email:** scapreps@sa.gov.au

SECTION 49 & 49A – CROWN DEVELOPMENT
DEVELOPMENT APPLICATION FORM

PLEASE USE BLOCK LETTERS

COUNCIL: ~~YORKE PENINSULA COUNCIL~~ CITY OF SALISBURY

APPLICANT: YORKE PENINSULA WIND FARM PROJECT P/L

ADDRESS: C/- SENVION AUSTRALIA LVL 29/80 COLLINS ST, MELBOURNE VIC 3000

CROWN AGENCY: DEPT PLANNING, TRANSPORT AND INFRASTRUCTURE

FOR OFFICE USE

DEVELOPMENT No: 544/V001/13 V3

PREVIOUS DEVELOPMENT No: " V2 "

DATE RECEIVED: 27 / 11 / 18

CONTACT PERSON FOR FURTHER INFORMATION

Name: ADAM GRAY (SENVION)

Telephone: 03 8660 6555 [work] ______ [Ah]

Fax: ______ [work] ______ [Ah]

Email: adam.gray@senvion.com

☐ Complying ☐ Merit ☐ Public Notification ☐ Referrals	Decision: ______ Type: ______ Finalised: / /

NOTE TO APPLICANTS:

(1) All sections of this form must be completed. The site of the development must be accurately identified and the nature of the proposal adequately described. If the expected development cost of this Section 49 or Section 49A application exceeds $100,000 (excl. fit-out) or the development involves the division of land (with the creation of additional allotments) it will be subject to those fees as outlined in Item 1 of Schedule 6 of the *Development Regulations 2008*. Proposals over $4 million (excl. fit-out) will be subject to an advertising fee. (2) Three copies of the application should also be provided.

	Decision required	Fees	Receipt No	Date
Planning:				
Land Division:				
Additional:				
Minister's Approval				

EXISTING USE: GENERAL FARMING AND VACANT LAND

DESCRIPTION OF PROPOSED DEVELOPMENT: VARIATION TO DA 544/V001/13 (REFER ATTACHED)

LOCATION OF PROPOSED DEVELOPMENT: REFER DETAILS ATTACHED

House No: ______ Lot No: ______ Street: ______ Town/Suburb: ______

Section No [full/part] ______ Hundred: ______ Volume: ______ Folio: ______

Section No [full/part] ______ Hundred: ______ Volume: ______ Folio: ______

LAND DIVISION:

Site Area [m²] ______ Reserve Area [m²] ______ No of existing allotments ______

Number of additional allotments [excluding road and reserve]: ______ Lease: YES ☐ NO ☐

DEVELOPMENT COST [do not include any fit-out costs]: $ ______

POWERLINE SETBACKS: Pursuant to Schedule 5 (2a)(1) of the *Development Regulations 2008*, if this application is for a building it will be forwarded to the Office of the Technical Regulator for comment unless the applicant provides a declaration to confirm that the building meets the required setback distances from existing powerlines. The declaration form and further information on electricity infrastructure and clearance distances can be downloaded from sa.gov.au.

I acknowledge that copies of this application and supporting documentation may be provided to interested persons in accordance with the *Development Act 1993* and meet the requirements for lodgement under s.49 of the Development Act 1993.

SIGNATURE: ______ Dated: 16 / 11 / 18

URPS

Yorke Peninsula Wind Farm Project Pty Ltd
2016-0286
16 November 2018

APPLICATION FOR VARIATION TO DEVELOPMENT 544/V001/13

Development Assessment Report

Variation to DA 544/V001/13 Development Application Report

16 November 2018

Lead consultant	URPS
Prepared for	Yorke Peninsula Wind Farm Project Pty Ltd
Consultant Project Manager	Marcus Rolfe, Managing Director Simon Channon, Associate Suite 12/154 Fullarton Road (cnr Alexandra Ave) Rose Park, SA 5067 Tel: (08) 8333 7999 Email: simon@urps.com.au
URPS Ref	R001_v5_181116.docx

Document history and status

Revision	Date	Author	Details
1	2 November 2018	SC/MR	Draft
2	7 November 2018	SC	Draft 2
3	9 November 2018	SC	Draft 3
4	14 November 2018	SC	Final
5	16 November 2018	SC	Final (minor update)

www.urps.com.au
ABN 55 640 546 010

H:\Synergy\Projects\2016\2016-0286 Ceres Wind Farm - Variation Application\Development Application\Draft Documents\R001_v5_181116.docx

Contents

1.0 Introduction

1.1 Introduction

URPS has been engaged by Yorke Peninsula Wind Farm Project Pty Ltd (YPWFP) to prepare this planning report. The report provides an assessment of the proposed variation to its approved Ceres Wind Farm project (development number 544/V001/13 V2).

In 2017, the applicant received approval for a variation to the original development authorisation for the Ceres project. That variation application involved the following amendments to the originally approved proposal:

- the reduction of the number of turbines from a maximum of 197 to a maximum 187 and the removal of five allotments from the site of the development
- an increase in maximum tip height of the turbines from 150 metres to 163 metres
- the relocation of turbines to account for the requirement of an upgraded turbine model to maintain a minimum distance of 1.3 kilometres from non-host dwellings, and
- the construction of the development two stages.

This variation application seeks further changes to the Ceres project, including:

- a reduction in the number of turbines from a maximum of 187 to a maximum of 170 turbines, and
- an increase in tip height of the turbines from 163 metres to up to 220 metres.

The following documents are submitted with this variation application:

- completed development application forms
- OTR Certificate
- title summary
- turbine locations (in table form)
- site and elevation plans prepared by YPWFP
- photomontages prepared by Convergen
- shadow flicker report
- noise assessment
- electromagnetic interference assessment
- fauna risk assessment
- traffic and transport assessment, and
- aviation impact assessment.

1.2 Background

The Ceres project represents the integration of two significant infrastructure investments:

1. An approximately 630 MW Wind Farm (estimated investment ofA$1.1 billion) - a large, diversified and low cost renewable energy power station utilizing wind technology customized for the project that is expected to drive a step change downward in South Australian power prices, plus

2. A High Voltage Direct Current (HVDC) system (estimated investment of A$500m) - an integrated HVDC interconnect comprising two converter stations, more than 80 km of undersea and underground cable and one of the largest investments planned for South Australia's electricity grid in the next five years; this will substantially strengthen the South Australian grid.

1.2.1 The Wind Farm

Wind farm technology has become increasingly more cost effective over recent years, meaning that electricity can be delivered at a lower cost. Additionally, the Ceres wind farm has a unique power generation profile that matches the peak power demands within the state.

For this reason, YPWFP proposes to modify the approved project to use taller but fewer turbines.

For the assessment of the impacts of the proposal, the turbine that has been modelled and assessed is the Senvion 4.2M140 model, which represents a typical turbine of the dimensions that are proposed.

Key technological improvements of this turbine include:

1. The incorporation of “Eco Blade Control” technology which incorporates different blade construction techniques and materials to conventional turbines and also includes serrations on the trailing edge of the blade to reduce noise, and

2. Lower rotational speed of the hub (in comparison to the previously approved turbines), which will reduce aerodynamic noise; the larger rotor diameter/longer blades compensate for this in terms of energy production by delivering higher torque to the generator.

The Ceres wind farm, comprising a large, low cost renewable energy source which generates power correlated to demand, is expected to create a step change downward in power prices for the South Australian market.

1.2.2 The HVDC Transmission Link

The $500m HVDC transmission link will be the first use of this system to connect an Australia wind farm and one of the largest investments in South Australia's electricity grid infrastructure in the coming years. The HVDC system will provide three times the current reactive power support in the market and will help South Australia to avoid system collapse issues. In comparison, the Australian Energy Regulator approved a total forecast capital expenditure of $461m for ElectraNet for the next 5 years (2018-23 regulatory control period).

The project will provide electricity grid support and security benefits through the HVDC connection to the electricity grid.

Infrastructure development of the Ceres project’s scale requires extensive planning, design and engineering. In comparison to a large wind farm, the time frame to deliver and install the HVDC solution is considerably longer. YPWFP has commenced an international market tender to ensure that the optimal HVDC technical solution is implemented. There is considerable local and international interest in the HVDC tender and this process continues.

1.2.3 Progress since Last Variation

Since the 2017 variation application was approved, YPWFP has completed significant works to progress the project. These works have included:

- landowner option agreements extended for a further 3 years
- technical modelling for AEMO's review of grid connection completed
- approval sought from AEMO that the Ceres project is able to connect to the grid
- HVDC market tender commenced, with significant local and international interest
- commenced negotiation with and shortlisting of balance of plant suppliers
- technical due diligence undertaken by third parties to ensure the project is viable for investors and lenders
- initial marketing to local and international investors
- participating in Power Purchase Agreement (PPA) tenders, including SACOME
- continuing optimisation of project design and layout, and
- land purchased for the substation and converter station on the Yorke Peninsula.

1.2.4 Subject Land

The land that is the subject of this variation application is the same as the approved development application. A table outlining the subject land is included in Appendix C of this report.

2.0 Proposed Variation

2.1 Summary

This variation application seeks changes to the approved Ceres project, including:

- a reduction in the number of turbines from a maximum of 187 to a maximum of 170 turbines, and
- an increase in tip height of the turbines from 163 metres to up to 220 metres.

2.2 Reduction in Turbine Numbers

The applicant proposes to reduce the maximum number of turbines from 187 to 170. The reduction in turbine numbers results from the proposed increase in turbine height and blade length. As the proposed turbines are taller and have a greater rotor diameter, they are more efficient at capturing wind energy.

As outlined in the original development application, the proposed wind farm will deliver an estimated 600 Megawatts (MW) of clean energy directly to metropolitan Adelaide. With more efficient turbines, fewer are required to deliver the same amount of energy. The number of turbines ultimately constructed may be lower than 170 following optimisation during the detailed design stage of the proposed development.

The original development application nominated the individual turbine megawatt capacity as 3.2 MW or 3.4 MW (i.e. the 3 MW platform), with the final capacity to be finalised through the detailed design of the proposed development. The candidate turbine used for the modelling in this variation application is the 4.2M140 turbine (i.e. the 4 MW platform). This variation application seeks approval for the use of turbines of up to 6.0 MW capacity.

The variation application approved in 2017 involved a reduction in turbine numbers following a landowner ceasing participation in the proposed development. In this proposed variation, 6 turbines previously proposed to be located in close proximity to that landowner have been completely removed from the proposed development. This has left a potential 181 turbine sites despite the applicant committing to constructing no more than 170 turbines. The applicant will select the final 170 turbine locations through the detailed design of the project.

2.3 Turbine Height

The applicant proposes to increase the height of the turbines from a maximum tip height of 163 metres to up to a maximum tip height of 220 metres.

The approved 163 metre high turbines had a modelled blade length of 70 metres and a hub height of 93 metres.

The proposed turbines will have a maximum tip height of up to 220 metres and a hub height of up to 140 metres. In the event that the hub height is lower than the maximum 140 metres, the turbines are anticipated to have a minimum ground clearance of 55 metres. Blade lengths of up to 80 metres are anticipated (i.e. rotor diameter of 160 metres)

The photomontages included with the application documentation illustrate the differences in turbine heights between the approved development (labelled 2017) and the proposed variation (labelled 2018). They are provided for illustrative purposes only.

3.0 Development Assessment

3.1 Assessment Considerations

The proposed variation application makes no change to the nature of the approved land use. The development remains an “integrated wind farm and associated infrastructure” as originally described by the Development Assessment Commission (now the State Commission Assessment Panel) and approved by the Minister for Planning.

In considering the merits of this variation application, it is necessary to consider the nature of the amendments against the approved development. In this context, the relevant considerations relate to the differences in impact that result from the reduction in the number of the turbines (and consequential micro-siting of turbines), and the increase in tip height of the turbines since the 2017 approved variation.

The key planning issues for assessment are:

- visual impact
- noise impact
- shadow flicker impact
- telecommunications/EMI impact
- fauna impact
- traffic and transport impact, and
- aviation impact.

These matters are assessed against the relevant provisions of the Yorke Peninsula Development Plan (consolidated 31 October 2017). The land affected by this variation is located entirely within the Primary Production Zone of the Yorke Peninsula Council.

3.2 Visual Impact

The Primary Production Zone’s Desired Character statement states that the “visual impacts (of wind farms and associated infrastructure) are to be accepted in pursuit of the benefits derived from increased generation of renewable energy”. The scale of wind farms is recognised as being something that cannot be avoided, and therefore, specific criteria have been established in the Development Plan to manage the visual impact of turbines. Those criteria are described in Principle 2 of the Renewable Energy provisions.

The Primary Production Zone Desired Character statement describes wind farms as “a component of the zone’s desired character” and acknowledges that they may need to be:

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

Renewable Energy Principle 2 states:

General Section - Renewable Energy Facilities

PDC 2 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. (underlining added)

The Ceres project wind turbines:

- are setback at least 1,300 metres from all non-associated dwellings, a distance which exceeds the minimum desired setback of 1,000 metres in part (a)(i) above
- are setback at least 2,000 metres from all defined and zone townships, settlements and urban areas in accordance with part (a)(ii) above
- are regularly spaced within clusters with approximately 600 metres between individual turbines in accordance with part (a)(iii) above
- are all of the same colour, size and shape and will have the same blade rotation direction in accordance with part (a)(iv) above, and
- will incorporate tubular towers as opposed to lattice towers in accordance with part (a)(v) above.

The applicant remains committed to the provision of vegetation buffers around substations and other ancillary structures as proposed in the initial application and required by the approval's Reserved Matters. There is no change to any substations or other ancillary infrastructure by this application.

The height of the turbines continues to comply with the visual impact management techniques outlined in Renewable Energy Principle 2 outlined above.

3.3 Noise Impact

The applicant has engaged Marshall Day Acoustics to prepare a noise assessment of the proposed development.

The noise assessment is based on the assessment of the noise impact of up to 181 turbines. The assessment was based on that number as the final 170 turbine locations are still to be determined and the assessment therefore represents a "beyond worst case scenario" for all nearby sensitive receivers.

The candidate turbine which has been modelled is the 4.2M140 with a 160 metre rotor diameter. Manufacturer sound power level specifications are available for a 4.2M140 turbine model, however, Senvion does not currently manufacture a 4.2M140 turbine with a 160 metre rotor diameter. For this reason, the noise assessment has incorporated a 2dB allowance in the sound power levels used for modelling to counter the potential difference in the turbines used.

The noise assessment has identified that:

- there have been no changes to zoning of the subject land or land within the vicinity of the subject site that would change the base noise limits of previous assessments
- noise predictions have been made in accordance with ISO 9613-2:1996 with SoundPlan version 8.0 noise modelling software
- the base noise limit at all wind speeds at all assessed receivers is 40dB L_{Aeq}
- it is unlikely that there would be a tonal audibility that would attract a penalty for tonality at any receiver location
- all non-associated/stakeholder dwellings within the vicinity of the wind farm will have predicted noise levels of less than 40dB(A), and
- the proposed development complies with the Environment Protection Authority's *Wind Farms Environmental Noise Guidelines* and the *Environment Protection (Noise) Policy 2007.*

The following provisions of the Development Plan are particularly relevant with respect to noise impacts:

General Section - Renewable Energy Facilities

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

General Section - Interface between Land Uses

PDC 7 **Development that emits noise (other than music noise) should include noise attenuation measures that achieve the relevant Environment Protection (Noise) Policy criteria when assessed at the nearest existing noise sensitive premises.**
(underlining added)

As the proposed development complies with the *Wind Farms Environmental Noise Guidelines* and the *Environment Protection (Noise) Policy 2007,* it is considered that the proposed development will not impact adjoining landowners by way of excessive noise.

3.4 Shadow Flicker Impact

The applicant engaged WSP to model the shadow flicker resulting from the proposed taller turbines. This assessment has been conducted incorporating all 181 potential turbine sites.

The modelling has been undertaken in accordance with the Environment Protection and Heritage Council's *National Wind Farm Development Guidelines – Draft July 2010.* The previous shadow flicker assessments undertaken for this development were considered under the same guidelines.

The shadow flicker modelling is undertaken in accordance with the *National Wind Farm Development Guidelines – Draft July 2010* such that it provides for two cases, the first being called "worst case" scenario, and the second being called "realistic" scenario. Under the worst case scenario, the modelling assumes direct sunlight during all daylight hours, that all turbines are operating all the time and that all turbines are angled to provide the worst possible shadow outcome. The realistic scenario modelling is based on average daily sunlight hours per month (based on Bureau of Meteorology data), turbine cut-in and cut-out wind speeds and the direction of wind where turbines would face into the wind rather than being faced for the worst possible shadow outcome.

The *National Wind Farm Development Guidelines – Draft July 2010* recommends guideline levels of "worst case" shadow flicker of 30 hours per year within 50 metres of a dwelling and a "realistic" shadow flicker of 10 hours per year within 50 metres of a dwelling. As the shadow flicker is calculated to within 50 metres of a dwelling, it is a conservative figure.

Table ES.3 within the WSP Shadow Flicker Report provides the worst case shadow flicker results based on the affected building type. Only one dwelling that is not on land within the wind farm site will receive any shadow flicker. That dwelling will receive 45 hours and 20 minutes (45:20) as a worst case and 14 hours and 13 minutes as a realistic case. While these results exceed the Guidelines, that dwelling is owned by a party that is a stakeholder to the project.

Further, the applicant will ensure that the final design of the proposed wind farm will meet the *National Wind Farm Development Guidelines – Draft July 2010* guidelines with respect to shadow flicker. This could be through the incorporation of a shadow flicker management system that shuts off turbines to limit shadow flicker (incorporating a light sensor and software that can automatically shut-off turbines in known flicker events), or through the removal of turbine(s) that contribute to shadow flicker at that dwelling.

The following provisions of the Development Plan are particularly relevant with respect to shadow flicker:

General Section - Renewable Energy Facilities

PDC 3 **<u>Wind farms and ancillary development should avoid or minimise the following impacts on nearby property owners / occupiers,</u> road users and wildlife:**

…

(a) <u>shadowing, flickering</u>, reflection or glint

(underlining added)

All non-stakeholder dwellings will continue to receive less than 30 hours of shadow flicker (worst case) and 10 hours (realistic), and mitigation measures will be in place to address the extent of shadow flicker at affected stakeholder dwellings as needed. On this basis, it is contended that the development appropriately minimises shadow flicker impact on nearby property owners and occupiers to comply with Renewable Energy Facilities PDC 3(a).

Additionally, the proposed development will not increase the potential for reflection or glint as there are no changes to the colours/finish of the turbines.

3.5 Fauna Impact

YPWFP engaged EBS Ecology (EBS) to conduct a further risk assessment to identify the potential collision risk for various bird species associated with the proposed variation to turbine dimensions. EBS has conducted bird surveys between 2011 and 2017 for the proposed wind farm.

The further EBS assessment has been based on the maximum of 170 turbines that will be built at the maximum dimensions specified in the proposed development section of this report (i.e. 140m hub height and 80m blade length).

In comparison with the previous risk assessment, the proposed turbines have an increased total swept area and also have a considerably higher ground clearance (from 23 metres at the blades' lowest point to 60 metres).

The risk assessment incorporates two important figures. Firstly, it calculates the percentage of flights within the lowest and highest blade points of the swept path and, secondly, calculates an "adjusted value" that factors the increase in total swept area of the turbines in comparison to previous iterations of the development.

The increase in hub height (which increases the minimum ground clearance), means there are fewer percentage of flights of all assessed bird types between the lowest and highest tip heights of the proposed turbines. Only aerial insectivores have a greater rotor swept adjusted area value in comparison to the approved development (i.e. for all other bird types, the rotor swept adjusted area value is less for the proposed development). In the case of aerial insectivores, the rotor swept area adjusted value increases from 318 to 326 despite the percentage of flights within the rotor swept area decreasing from 19.8% of flights to 17.3% of flights. Therefore, the potential risk to aerial insectivores is comparable to the recent variation approval.

The change in risk for waterbirds and shorebirds was considered difficult to determine. All recorded waterbird flights occurred along the coast and out to sea and not inland. EBS states that it would be expected that if inland movements were to occur the flight behaviour of these species would change.

Importantly, the risk to birds is reduced due to the incorporation of the following setbacks/buffers as recommended by EBS:

- 1,000 metres from the coastline
- 100 metres from Mallee/Woodland areas where the diversity of bird species is low, and
- 500 metres from known Wedge-tailed Eagle nests.

EBS did not further address the potential risk to bats. In its assessment submitted with the 2017 variation application, EBS stated that no bat species have a conservation rating and that flight height data was not available to determine how they would be impacted by an increase in rotor diameter.

The following Renewable Energy Facilities Principle is relevant in respect of the assessment of the change in potential impact to birds and bats:

General Section - Renewable Energy Facilities

PDC 3 Wind farms and ancillary development should avoid or minimise the following impacts on nearby property owners / occupiers, road users and wildlife:

…

(f) striking of birds and bats.

(underlining added)

The proposed development will increase the total swept path area across the site despite a decrease in the number of turbines. Importantly, however, the increased ground clearance will mean that the potential impact to most bird types will decrease, in many of those cases by a considerable amount. In the case of aerial insectivores, the impact is comparable to the previously approved variation.

Furthermore, while EBS notes that there may be a greater risk to shore birds as a result of the increased turbine height, no shorebirds have been recorded as flying through the wind farm site.

Having regard to the difference in impact, it is contended that there is generally a reduced impact in the risk to birds in comparison with the current approval. On this basis, it is contended that the proposed development is designed to minimise the potential striking of birds.

It is also noted that Condition 13 of the approval requires the establishment of a Bat Monitoring Plan. The applicant remains committed to this condition.

3.6 Telecommunications/EMI Impact

WSP has assessed the potential for the turbines to interfere with existing telecommunication networks within the vicinity of the wind farm (including NBN, Optus Mobile, SA Water and Government Radio networks). There were a number of changes to telecommunications networks between the time the original application was lodged and the approval of the 2017 variation application. In order to avoid interference from the recent variation application, a number of turbines were relocated as part of that application.

There have been no further changes to telecommunication networks that affect the proposed layout. All turbines remain outside of the Australian Communications and Media Authority (ACMA) exclusion area. The proposed development has been designed to avoid impacts to those telecommunication networks.

The increase in turbine heights will not have any further impact on other communication networks (such as AM or FM radio signals, mobile phone coverage, television reception).

Condition 18 of the Approval states:

18. The wind farm shall be designed and operated in a manner so as to not interfere with existing telecommunication facilities. This shall be confirmed by post-operational monitoring to be conducted by a qualified consultant within six months of wind farm commissioning. If post-operational monitoring confirms a diminution of or interruption to pre-development service levels, the implementation of any off-site mitigation measures for affected receivers shall be at the cost of the developer.

The applicant remains committed to complying with this condition.

The following provision is relevant in respect of the impact on telecommunications facilities:

General Section - Renewable Energy Facilities

PDC 3 **<u>Wind farms and ancillary development should avoid or minimise the following impacts on nearby property owners / occupiers,</u> road users and wildlife:**

…

(a) interference with television and <u>radio signals</u> and geographic positioning systems (underlining added)

As the proposed turbines are located outside of the ACMA exclusion zones, and the applicant is committed to post operational monitoring of any impacts to telecommunications facilities, it is considered that the proposed development has been designed to minimise impacts on telecommunication networks.

3.7 Traffic and Transport Impact

WSP has assessed the difference in traffic movements during construction between the original approval and the proposed variation. As the number of turbines is less (up to 170) in this application, there will be fewer traffic movements to and from the site during construction (total two way trips decreases from 23,880 to 22,430).

Construction traffic (including heavy and over-dimensional vehicles) are expected to access the site via:

- Victoria Road
- Port River Expressway
- Salisbury Highway
- Port Wakefield Road
- Copper Coast Highway
- St. Vincent Highway, and
- Yorke Highway.

The roads on the Yorke Peninsula will have the greatest percentage increase in traffic movements as a result of the construction of the wind farm, given the relatively low volumes of traffic that those roads currently carry. The St Vincent Highway and the Yorke Highway will experience the biggest percentage increase in traffic but will continue to operate to the highest level of service (LOS A). LOS A means the roads will have a free flowing condition with a high degree of freedom for drivers to select desired speed and manoeuvre within the traffic stream.

Some intersections may require upgrades to accommodate the turning paths of over-sized vehicles. This remains the same as the approved application.

The applicant remains committed to meeting its conditions and reserved matters with respect to traffic management, including the preparation of a Traffic Construction Management Plan and a Traffic Management Plan and complying with the DPTI Transport Services Division conditions.

The following Transportation and Access provisions are relevant:

General Section – Transportation and Access

PDC 2 **<u>Development should be integrated with existing transport networks</u>, particularly major rail and road corridors as shown on *Location Maps* and *Overlay Maps - Transport*<u>, and designed to minimise its potential impact on the functional performance of the transport networks</u>.**

PDC 8 **<u>Development should provide safe and convenient access for all anticipated modes of transport</u> including cycling, walking, public and community transport, and motor vehicles.**

PDC 23 **<u>Development should be provided with safe and convenient access which</u>:**

(a) <u>avoids unreasonable interference with the flow of traffic on adjoining roads</u>
(b) provides appropriate separation distances from existing roads or level crossings
(c) <u>accommodates the type and volume of traffic likely to be generated by the development or land use</u> and minimises induced traffic through over-provision

(d) is sited and designed to minimise any adverse impacts on the occupants of and visitors to neighbouring properties.
(underlining added)

The number of traffic movements associated with the construction of the development decreases from the approved application. The applicant is also committed to complying with its conditions and the recommendations of the WSP Traffic and Transport Assessment. For these reasons, it is considered that the proposed development will avoid unreasonable interference with the flow of traffic on adjoining roads and that the proposed development can accommodate the type and volume of traffic that will be generated by the proposed development.

3.8 Aviation Impact

Landrum and Brown has prepared an Aeronautical Impact Assessment (AIA) based on the proposed layout and turbines to a maximum tip height of 220 metres.

The AIA has identified:

- that there is a GRID LSALT (Lowest Safe Altitude) of 2,200 ft above the wind farm and 16 turbines infringe its protection surface, which is 1,000 ft lower than the LSALT, although they do not infringe on protection surface for any flight routes above the wind farm site;
- approval from Airservices Australia will be required to lift the GRID LSALT to 2,300 ft (only 100 ft higher than the current GRID LSALT)
- approval from the Department of Defence will be required for the construction of 8 turbines located within a Restricted Area and the turbines will be required to be shown on aeronautical charts; those turbines had always been proposed in that location
- with respect to obstacle marking and lighting:
  - previous experience suggests that obstacle marking of the wind turbines will not be required as the Civil Aviation Safety Authority considers wind turbines to be sufficiently conspicuous by day due to their shape, size and colour
  - formal notification to CASA is required due to the turbine tip heights (and has also previously been required)
  - CASA is currently reviewing guidance for obstacle lighting on wind farms
  - while obstacle lighting is not mandatory, further assessment of the appropriateness of obstacle lighting should be undertaken following notification of the details of the wind farm to CASA and the Department of Defence.

In addition to the above assessment by Landrum and Brown, the applicant has also notified the sole aerial spraying company that operates near the wind farm regarding the increase in turbine height. As per the previous variation, the applicant remains committed to its obligations as per the original approval which requires management of turbines during spraying activities.

General Section - Renewable Energy Facilities

PDC 1 <u>Renewable energy facilities, including wind farms and ancillary development, should be</u>:
(a) located in areas that maximize efficient generation and supply of electricity
(b) <u>designed and sited so as not to impact on the safety of</u> water or <u>air transport and the operation of</u> ports, <u>airfields and designated landing strips</u>.

PDC 3 **Wind farms and ancillary development should avoid or minimise the following impacts on nearby property owners / occupiers, road users and wildlife:**

…

(a) interference with low altitude aircraft movements associated with agriculture (underlining added)

On the basis that the increase in turbine height will not impact the operations of any aerodromes, and the applicant remains committed to meeting its approval conditions that relate to aerial spraying, it is considered that the proposal satisfies Renewable Energy Principles 1(b) and 3(c) as quoted above.

4.0 Summary and Conclusion

The proposed development involves the variation to development approval 544/V001/13 V2. It more specifically involves:

- a reduction in the number of turbines from a maximum of 187 to a maximum of 170 turbines, and
- an increase in tip height of the turbines from 163 metres to up to 220 metres.

Having regard to the provisions of the Yorke Peninsula Development Plan (consolidated 31 October 2017), it is contended that the proposed development has been designed and sited to warrant approval. In particular, it is contended that:

- the applicant will meet all earlier commitments and comply with all conditions of approval
- the taller turbines will continue to comply with the design and siting techniques to manage the visual impact
- the taller turbines have been assessed to comply with the EPA's *Wind Farms Environmental Noise Guidelines* and the *Environment Protection (Noise) Policy 2007*
- shadow flicker will not exceed the "worst case" shadow flicker of 30 hours per year within 50 metres of a dwelling and a "realistic" shadow flicker of 10 hours per year within 50 metres of a dwelling for any dwelling outside the wind farm site, in accordance with the guidance levels in the *National Wind Farm Development Guidelines – Draft July 2010*
- there is a lower risk to birds as a result of the increased ground clearance with the proposed taller turbines
- the taller (and wider) turbines in the proposed locations will not interfere with telecommunication networks
- there will be fewer traffic movements associated with the construction as a result of the reduction in turbine numbers, and
- the increased turbine height will require approval from Airservices Australia to lift the GRID LSALT by 100ft and approval from the Department of Defence for the construction of 8 turbines within a Restricted Area (noting that those turbines had always been proposed in those locations) and the proposed development is designed so as not to impact on the safety of air transport or the operation of airfields or designated landing strips.

Appendix A

Development Application Forms

SECTION 49 & 49A – CROWN DEVELOPMENT
DEVELOPMENT APPLICATION FORM

PLEASE USE BLOCK LETTERS

COUNCIL: YORKE PENINSULA COUNCIL ~~CITY OF SALISBURY~~

APPLICANT: YORKE PENINSULA WIND FARM PROJECT P/L

ADDRESS: C/- SENVION AUSTRALIA LVL 29/80 COLLINS ST, MELBOURNE VIC 3000

CROWN AGENCY: DEP'T PLANNING, TRANSPORT AND INFRASTRUCTURE

FOR OFFICE USE

DEVELOPMENT No: ______

PREVIOUS DEVELOPMENT No: ______

DATE RECEIVED: / /

CONTACT PERSON FOR FURTHER INFORMATION

Name: ADAM GRAY (SENVION)

Telephone: 03 8660 6555 [work] ______ [Ah]

Fax: ______ [work] ______ [Ah]

Email: adam.gray@senvion.com

☐ Complying ☐ Merit ☐ Public Notification ☐ Referrals	Decision: ______ Type: ______ Finalised: / /

NOTE TO APPLICANTS:

(1) All sections of this form must be completed. The site of the development must be accurately identified and the nature of the proposal adequately described. If the expected development cost of this Section 49 or Section 49A application exceeds $100,000 (excl. fit-out) or the development involves the division of land (with the creation of additional allotments) it will be subject to those fees as outlined in Item 1 of Schedule 6 of the *Development Regulations 2008*. Proposals over $4 million (excl. fit-out) will be subject to an advertising fee. (2) Three copies of the application should also be provided.

	Decision required	Fees	Receipt No	Date
Planning:				
Land Division:				
Additional:				
Minister's Approval				

EXISTING USE: GENERAL FARMING AND VACANT LAND

DESCRIPTION OF PROPOSED DEVELOPMENT: VARIATION TO DA 544/V001/13 (REFER ATTACHED)

LOCATION OF PROPOSED DEVELOPMENT: REFER DETAILS ATTACHED

House No: ______ Lot No: ______ Street: ______ Town/Suburb: ______

Section No [full/part] ______ Hundred: ______ Volume: ______ Folio: ______

Section No [full/part] ______ Hundred: ______ Volume: ______ Folio: ______

LAND DIVISION:

Site Area [m^2] ______ Reserve Area [m^2] ______ No of existing allotments ______

Number of additional allotments [excluding road and reserve]: ______ Lease: YES ☐ NO ☐

DEVELOPMENT COST [do not include any fit-out costs]: $ ______

POWERLINE SETBACKS: Pursuant to Schedule 5 (2a)(1) of the *Development Regulations 2008*, if this application is for a building it will be forwarded to the Office of the Technical Regulator for comment unless the applicant provides a declaration to confirm that the building meets the required setback distances from existing powerlines. The declaration form and further information on electricity infrastructure and clearance distances can be downloaded from sa.gov.au.

I acknowledge that copies of this application and supporting documentation may be provided to interested persons in accordance with the *Development Act 1993* and meet the requirements for lodgement under s.49 of the Development Act 1993.

SIGNATURE: ______ Dated: 16 / 11 / 18

Appendix B

OTR Certificate

Government of South Australia
Department for Energy and Mining

Ref: 2017/01873.01 D18140648

Energy and Technical Regulation

Office of the Technical Regulator

Level 8, 11 Waymouth Street
Adelaide SA 5000

GPO Box 320
Adelaide SA 5001

Telephone: 08 8226 5500
Facsimile: 08 8226 5866

www.sa.gov.au/otr

2 November 2018

Jonathon Dahmani
Senvion Australia Pty Ltd
Level 29, 80 Collins Street
Melbourne SA 3000
By email: jonathan.dahmani@senvion.com

Dear Jonathon,

RE: CERTIFICATE FOR DEVELOPMENT OF CERES WIND FARM

The development of Ceres Wind Farm has been assessed by the Office of the Technical Regulator (OTR) under Section 37 of the Development Act 1993.

Regulation 70 of the *Development Regulations 2008* prescribes if the proposed development is for the purposes of the provision of electricity generating plant with a generating capacity of more than 5 MW that is to be connected to the State's power system – a certificate from the Technical Regulator is required, certifying that the proposed development complies with the requirements of the Technical Regulator in relation to the security and stability of the State's power system.

In making a decision on your application, our office has taken the following information into account:

- Senvion's initial application for an OTR Certificate for Ceres Wind Farm, emailed to the OTR on 25 June 2018;
- An initial meeting regarding the proposed project between Senvion and the OTR on 28 June 2018;
- Numerous emails and phone discussions between Senvion and the OTR;
- Follow up meetings between Senvion and the OTR on 16 August 2018 and 25 October 2018;
- A revised application for an OTR Certificate for Ceres Wind Farm, emailed to the OTR on 1 November 2018;
- Further clarification regarding the revised proposal emailed by Senvion to the OTR on 1 November 2018.

After assessing the information provided, I advise that approval is granted for the proposed project.

Should you have any questions regarding this matter, please do not hesitate to call David Bosnakis on (08) 8429 3323.

Yours sincerely

Rob Faunt
TECHNICAL REGULATOR

cc: Travis Neal – Senvion Australia
Peter Boulton - DTTI

Energy and Technical Regulations

Level 8, 11 Waymouth Street Adelaide SA 5000 | GPO Box 320 Adelaide SA 5001 | DX541
Tel (+61) 8 8226 5500 | Fax (+61) 8 8226 5866 | www.energymining.sa.gov.au | ABN 83 768 683 934

Appendix C

Title Summary

Plan	Lot	Title Description	VOL	FOL
D33404	A1	ALLOTMENT 1 DEPOSITED PLAN 33404 OF CURRAMULKA	5064	787
D33404	A2	ALLOTMENT 2 DEPOSITED PLAN 33404 (PREVIOUSLY SECTION 43)	5064	788
D33404	A3	ALLOTMENT 3 DEPOSITED PLAN 33404 (PREVIOUSLY SECTION 46)	5064	789
H130400	S119	SECTION 119 OF CURRAMULKA	5141	930
H130400	S118	SECTION 118 OF CURRAMULKA	5155	760
H131200	S146	SECTION 146 OF MULOOWURTIE	5184	369
F131522	A1	ALLOTMENT 1 FILED PLAN 131522	5239	439
H131200	S150	SECTION 150 OF MULOOWURTIE	5276	552
H131200	S152	SECTION 152 OF MULOOWURTIE	5276	754
H131200	S144	SECTION 144 OF MULOOWURTIE	5276	755
H131200	S151	SECTION 151 OF MULOOWURTIE	5276	756
H130400	S9	SECTION 9 OF CURRAMULKA	5288	395
H130400	S72	SECTION 72 OF CURRAMULKA	5290	810
F162426	A93	ALLOTMENT 93 FILED PLAN 162426	5300	873
H130400	S98	SECTION 98 CURRAMULKA	5308	459
H130400	S99	SECTION 99 OF CURRAMULKA	5308	460
H130400	S129	SECTION 129 HUNDRED OF CURRAMULKA	5316	65
H131200	S131	SECTIONS 123 and 131 OF MULOOWURTIE	5377	36
H131200	S123	SECTIONS 123 and 131 OF MULOOWURTIE	5377	36
D43772	A2	ALLOTMENT 2 DEPOSITED PLAN 43772 OF CURRAMULKA	5396	319
F196586	A354	ALLOTMENT 354 FILED PLAN 196586 OF CURRAMULKA	5410	793
H130400	S17	SECTION 17 OF CURRAMULKA	5417	227
H131200	S124	SECTION 124 HUNDRED OF MULOOWURTIE	5419	214
H131200	S120	SECTION 120 HUNDRED OF MULOOWURTIE	5419	214
H130400	S131	SECTION 131 HUNDRED OF CURRAMULKA	5419	998
H130400	S11	SECTION 11 OF CURRAMULKA	5421	610
H131200	S38	SECTION 38 OF HUNDRED MULOOWURTIE	5424	284
H131200	S11	SECTIONS 11 AND 154 HUNDRED OF MULOOWURTIE	5425	148
H131200	S154	SECTIONS 11 AND 154 HUNDRED OF MULOOWURTIE	5425	148
H131200	S122	SECTION 122 OF MULOOWURTIE	5425	473
H130400	S318	SECTION 318 OF CURRAMULKA	5437	728
H130400	S115	SECTION 115 OF CURRAMULKA	5437	730
H130400	S117W	SECTION 117W OF CURRAMULKA	5448	49
H130400	S88N	SECTION 88N OF CURRAMULKA	5448	89
F196599	A367	ALLOTMENT 367 FILED PLAN 196599	5448	293

F196598	A366	ALLOTMENT 366 FILED PLAN 196599	5448	294
H130400	S100	SECTION 100 OF CURRAMULKA	5448	360
D46762	A201	ALLOTMENT 201 DEPOSITED PLAN 46762 OF CURRAMULKA	5451	587
D46762	A202	ALLOTMENT 202 DEPOSITED PLAN 46762 CURRAMULKA	5451	588
H130400	S19	SECTION 19 OF CURRAMULKA	5455	437
H130400	S74	SECTION 74 HUNDRED OF CURRAMULKA	5460	371
H130400	S69	SECTION 69 OF CURRAMULKA	5491	661
F1254	A2	ALLOTMENT 2 FILED PLAN 1254	5498	726
H130400	S13	SECTION 13 OF CURRAMULKA	5498	726
H130400	S14	SECTION 14 OF CURRAMULKA	5526	212
H130400	S120	SECTION 120 OF CURRAMULKA	5531	451
H131200	S37	SECTION 37 OF HUNDRED MULOOWURTIE	5539	752
H130400	S96	SECTION 96 CURRAMULKA	5550	945
H130400	S97	SECTION 97 CURRAMULKA	5550	945
F17030	A1	ALLOTMENTS 1 AND 2 FILED PLAN 17030	5551	418
F17030	A2	ALLOTMENTS 1 AND 2 FILED PLAN 17030	5551	418
H131200	S121	SECTIONS 113 and 121 OF MULOOWURTIE	5552	831
H131200	S113	SECTIONS 113 and 121 OF MULOOWURTIE	5552	831
H131200	S135	SECTIONS 135 AND 136 HUNDRED OF MULOOWURTIE	5555	574
H131200	S136	SECTIONS 135 AND 136 HUNDRED OF MULOOWURTIE	5555	574
F196539	A307	ALLOTMENT 307 FILED PLAN 196539 OF CURRAMULKA	5562	860
F196661	A100	ALLOTMENT 100 FILED PLAN 196661	5565	925
H131200	S147	SECTION 147 OF MULOOWURTIE	5566	15
H131200	S145	SECTION 145 OF MULOOWURTIE	5581	66
F196654	A93	ALLOTMENT 93 FILED PLAN 196654 OF CURRAMULKA	5583	27
H131200	S134	SECTIONS 134 HUNDRED OF MULOOWURTIE	5623	867
H131200	S130	SECTION 130 OF MULOOWURTIE	5661	214
H131200	S137	SECTION 137 OF MULOOWURTIE	5661	214
D53106	A2	ALLOTMENT 2 DEPOSITED PLAN 53106	5710	771
H131600	S206	SECTION 206 HUNDRED OF WAURALTEE	5728	131
F206515	A100	ALLOTMENT 100 FILED PLAN 206515	5743	830
F196600	A368	ALLOTMENT 368 FILED PLAN 196600	5743	831
H130400	S70	SECTION 70 OF CURRAMULKA	5772	304
H130400	S126	SECTION 126 HUNDRED OF CURRAMULKA	5786	566
H130400	S12	SECTION 12 OF CURRAMULKA	5812	285
F196587	A355	ALLOTMENT 355 FILED PLAN 196587 OF CURRAMULKA	5831	836
D56698	A3	ALLOTMENT 3 DEPOSITED PLAN 56698 OF CURRAMULKA	5844	659

H130400	S15	SECTION 15 OF CURRAMULKA	5854	297
D60530	A2	ALLOTMENT 2 DEPOSITED PLAN 60530 OF CURRAMULKA	5888	598
D74694	A21	ALLOTMENT 21 DEPOSITED PLAN 74694 OF CURRAMULKA	5990	340
D68252	A60	ALLOTMENT 60 DEPOSITED PLAN 68252	5997	537
H130400	S44	SECTION 44 OF CURRAMULKA	6025	865
H130400	S71	SECTION 71 OF CURRAMULKA	6025	994
H130400	S124	ALLOTMENT 6 DEPOSITED PLAN 85469	6068	501
H130400	S21	SECTION 21 OF CURRAMULKA	6088	752
H130400	S61	SECTION 61 OF CURRAMULKA	5719	851

Appendix D

Turbine Locations

Turbine Locations – WTG Layout 012 Rev 2

Turbine ID	Easting	Northing	Latitude	Longitude	Z
001	746367.1136	6167155.1381	-34.6079054487	137.6867574740	115.0979917020
002	746378.2366	6167739.6524	-34.6026374245	137.6867089410	106.3490101070
003	747194.2644	6166590.7279	-34.6127907374	137.6959336230	119.1922391000
004	746948.5501	6167140.1812	-34.6079004193	137.6930965020	109.7202222460
005	747546.0692	6167208.6766	-34.6071394434	137.6995863750	113.8121366050
006	746960.7197	6167723.4882	-34.6026430398	137.6930593220	111.2369243540
007	747561.1327	6167808.1529	-34.6017357334	137.6995755990	105.2755495140
008	747576.6078	6168408.3617	-34.5963253214	137.6995691180	106.9696490330
009	747591.7703	6169007.7679	-34.5909222103	137.6995594900	101.3727261330
011	748325.6886	6162510.5276	-34.6492714724	137.7094565020	148.1773301860
012	748469.3714	6163148.6238	-34.6434887675	137.7108354350	149.5345263580
013	748078.4742	6166421.6987	-34.6140999200	137.7056168840	123.9634821140
014	748678.3232	6166407.0576	-34.6140865797	137.7121568360	128.8259988760
015	748276.1804	6167246.6379	-34.6066211060	137.7075295690	122.4593144240
016	748869.6847	6167158.5888	-34.6072704795	137.7140213360	115.3858357110
017	748385.9693	6167836.5077	-34.6012810362	137.7085530150	116.2867117170
018	748190.2558	6168403.6905	-34.5962192265	137.7062550980	109.9499324190
019	748979.4736	6167748.4586	-34.6019303748	137.7150443670	113.9196605390
020	748988.2741	6168371.4790	-34.5963161454	137.7149574820	117.9048336830
021	748514.4934	6169125.2795	-34.5896407631	137.7095758750	108.5049610280
022	748159.1086	6169599.9906	-34.5854505277	137.7055661940	108.3486338630
023	748912.6907	6162386.3160	-34.6502479071	137.7158913830	136.8243433780
026	749772.6082	6163256.4152	-34.6422010050	137.7250079610	159.5127208300
028	750098.9212	6165349.1888	-34.6232702780	137.7279468050	148.8460226230
030	749219.5111	6166671.1245	-34.6115765830	137.7179757370	130.1443917280
031	749579.0005	6167772.2810	-34.6015701789	137.7215685070	126.0205142580
032	749504.3538	6168679.2662	-34.5934183469	137.7204887390	112.0274086960
035	749614.8808	6163921.8262	-34.6362455696	137.7230928120	158.0854383570
036	750185.3358	6163740.8665	-34.6377365350	137.7293632080	162.8686747940
038	750631.1772	6164900.7123	-34.6271800862	137.7338791300	149.1597642220
039	750647.6989	6165562.6997	-34.6212130617	137.7338634450	143.3959986190
040	750113.8448	6165949.0032	-34.6178636584	137.7279324900	138.5768884250
041	750021.2359	6166547.2305	-34.6124975407	137.7267470880	130.1794118550
042	750609.1496	6166570.7533	-34.6121422174	137.7331455210	136.9776387420
043	749564.4281	6167172.4580	-34.6069768238	137.7215861620	122.4815419470
044	750098.8330	6167472.6575	-34.6041425892	137.7273197220	127.5734622900
045	750624.1482	6167171.2748	-34.6067292177	137.7331315290	124.2257234410
046	749866.9994	6168252.5483	-34.5971739520	137.7245645150	121.6955056650
047	750639.1289	6167771.0839	-34.6013226352	137.7331175780	119.1817569270
048	750654.1229	6168370.8952	-34.5959160252	137.7331037970	117.6418318450
049	750672.5967	6169109.0861	-34.5892620711	137.7330870970	110.1124939850
050	751672.9818	6161119.8190	-34.6609816419	137.7463551130	140.7835723700
052	751716.2718	6163101.9447	-34.6431168721	137.7462376970	148.6150683800
053	750860.6641	6163720.1348	-34.6377582247	137.7367293300	160.0554353790
054	751465.5594	6163731.3416	-34.6375090605	137.7433183450	153.5978472510
055	751198.5421	6166117.8318	-34.6160778544	137.7397010910	139.5984263660
056	751668.4461	6166505.2944	-34.6124725601	137.7447059480	126.6395957630

Turbine ID	Easting	Northing	Latitude	Longitude	Z
057	751703.2236	6167098.9728	-34.6071163867	137.7449087090	137.6672949560
058	751722.3668	6167754.7192	-34.6012049573	137.7449227460	133.0584777490
059	751260.1613	6168164.1284	-34.5976303727	137.7397665010	119.8392561110
060	751729.2501	6168565.3577	-34.5939013128	137.7447573410	119.1516242990
061	751895.2781	6161766.1410	-34.6551052182	137.7485860700	147.6489681040
062	752309.3686	6161192.7047	-34.6601685413	137.7532708050	137.8364342760
063	752488.6091	6161765.3066	-34.6549666610	137.7550539120	133.4650317600
064	752220.7945	6162755.1633	-34.6461164749	137.7518397340	131.7913016240
065	752494.5024	6163309.6672	-34.6410543648	137.7546576490	148.1995363710
066	752054.6867	6163712.3321	-34.6375355943	137.7497444430	150.7293826570
067	752437.9959	6165504.3264	-34.6212997952	137.7533880840	148.9341361540
068	752268.0071	6164855.6083	-34.6271849929	137.7517289130	149.2631367450
069	752371.3939	6166312.0175	-34.6140408490	137.7524220220	137.4450406370
070	752637.9263	6169665.1269	-34.5837718380	137.7543279290	104.6261868910
071	752452.6003	6173321.4005	-34.5508829633	137.7512237800	110.4651914960
072	753104.8878	6161702.1430	-34.6553835186	137.7617904840	113.5458885390
073	753077.6743	6162367.6207	-34.6493959824	137.7612949100	124.9965598740
077	753598.7780	6170753.9325	-34.5737275862	137.7644676730	102.8884398130
078	753629.7173	6171400.8255	-34.5678930287	137.7646115710	113.9608801690
079	753029.0181	6172706.5564	-34.5562795824	137.7576820230	112.8153836540
080	753642.3154	6172020.6877	-34.5623064745	137.7645638370	115.4584119690
081	753656.6572	6172620.5303	-34.5568998133	137.7645410890	116.8139951830
082	753052.4052	6173306.1005	-34.5508733568	137.7577583140	114.8008204840
083	753669.7537	6173200.6953	-34.5516707025	137.7645106790	119.8935198780
084	753708.9849	6173780.0478	-34.5464424598	137.7647650450	117.7557357920
085	753724.5785	6174379.8445	-34.5410358913	137.7647560010	117.3199893520
088	754230.6754	6165194.2370	-34.6236501164	137.7730139830	106.7533534130
089	754191.9515	6170309.0836	-34.5775879840	137.7710602170	108.7005321560
090	754776.2197	6170172.5894	-34.5786727167	137.7774639090	97.3616420779
091	754164.8497	6171149.8106	-34.5700218411	137.7705136470	124.1797246580
092	754611.9263	6170749.6576	-34.5735155317	137.7755018090	116.9235935710
093	754636.2593	6171525.9884	-34.5665167275	137.7755342310	121.3483094790
094	754270.0709	6171995.7991	-34.5623755660	137.7714064120	126.5977952420
095	754251.1931	6172597.0484	-34.5569644722	137.7710211230	123.5576953510
096	754353.1375	6174362.4357	-34.5410374826	137.7716033420	122.6772287380
098	755233.1057	6170795.0700	-34.5729523679	137.7822525480	93.4978001862
099	755236.0222	6171504.1201	-34.5665649331	137.7820714090	110.4750963100
100	755239.1338	6172136.8765	-34.5608646527	137.7819153550	112.0172066540
101	755481.8320	6172685.6000	-34.5558617825	137.7843930020	99.5963116285
102	755698.1321	6173244.0644	-34.5507776965	137.7865800570	94.0223032947
103	754952.9354	6174346.8647	-34.5410292637	137.7781370320	114.6848959330
104	756047.2914	6152388.3778	-34.7385425729	137.7966863800	66.6395902183
105	756421.4378	6151905.2107	-34.7428005928	137.8009156690	65.9616150840
106	756064.1200	6152988.1418	-34.7331362432	137.7966878450	71.6245911362
107	756078.1157	6153587.9785	-34.7277299645	137.7966584080	70.8127965233
109	755899.1656	6164766.5344	-34.6270875917	137.7913230730	84.9346182388
110	756797.5959	6165072.9561	-34.6241029998	137.8010199060	88.6688926494
111	756092.4270	6172669.7035	-34.5558530649	137.7910454500	86.5043558683
112	756297.9270	6173228.4143	-34.5507693514	137.7931144420	81.1699949658

Turbine ID	Easting	Northing	Latitude	Longitude	Z
113	756697.1643	6172748.9977	-34.5549880336	137.7976053720	79.2353031452
114	755514.5036	6173964.8732	-34.5443307019	137.7843645470	102.2330534980
115	755982.4485	6174340.4097	-34.5408317460	137.7893455180	95.7078952242
116	757664.7980	6152693.1264	-34.7353908981	137.8142417150	54.2523653045
118	757545.1140	6162303.8530	-34.6488571642	137.8100065260	83.1033833601
121	757711.0731	6162860.2292	-34.6438041132	137.8116460230	94.7665063819
122	757274.2707	6164731.0581	-34.6270630588	137.8063174900	90.0731984118
123	757417.0536	6164135.1517	-34.6323946332	137.8080542830	94.9650516541
124	757170.5299	6165606.0550	-34.6192078414	137.8049216860	83.6877825542
125	757178.4561	6172391.8677	-34.5580845331	137.8029531520	79.6971736618
126	757710.0844	6172046.6361	-34.5610609878	137.8088457630	79.4939031683
127	757227.2070	6173010.4434	-34.5525006549	137.8032968740	81.4145440309
128	757998.0971	6173434.1733	-34.5484909024	137.8115607370	83.3735602098
130	757980.3947	6152175.4502	-34.7399738863	137.8178434180	57.9077833325
131	758414.6626	6152738.0395	-34.7347969227	137.8224092660	55.6585511753
132	758563.9108	6151990.9142	-34.7414883925	137.8242667500	48.1901098693
136	758284.7450	6158184.8574	-34.6857707489	137.8193253650	55.5931774458
137	758126.1613	6160273.1141	-34.6670018606	137.8169587380	62.8704662492
138	758611.4663	6160691.3277	-34.6631125689	137.8221214180	61.4351144212
139	758656.3987	6160097.9798	-34.6684454838	137.8227926190	59.9861536983
140	758076.3343	6160856.3540	-34.6617611701	137.8162376560	70.4417106852
141	758015.5160	6163340.7906	-34.6393990652	137.8148175950	99.3885680258
142	758377.3810	6162844.7322	-34.6437759236	137.8189124470	82.7237071254
143	758615.3207	6163325.4093	-34.6393864445	137.8213588480	91.3874385441
144	757846.5418	6164527.7693	-34.6287503663	137.8126149540	90.2464562338
145	758034.0574	6163963.6179	-34.6337845509	137.8148299770	97.6410059319
146	758446.4143	6164512.7504	-34.6287346233	137.8191560070	85.4809248169
147	758633.8650	6163948.3152	-34.6337712423	137.8213707950	91.5554232287
148	757623.3379	6165190.2574	-34.6228393593	137.8099814840	80.7770050861
149	758331.5501	6165579.4387	-34.6191558388	137.8175793700	72.2646112286
150	757725.2030	6172651.6321	-34.5556078602	137.8088270490	79.6393794154
151	758586.3981	6173552.0800	-34.5472811478	137.8179291400	80.6020130791
152	758995.3916	6151360.3828	-34.7470581126	137.8291684540	37.5618469643
153	758995.7320	6152507.9250	-34.7367223417	137.8288195630	45.7136755816
154	759149.0665	6151937.0830	-34.7418249013	137.8306679980	38.8538800478
155	759595.5169	6152492.1196	-34.7367124204	137.8353683460	39.1802433135
157	760149.7913	6157220.8469	-34.6939809235	137.8399581360	51.2083106360
158	759673.1941	6156827.5155	-34.6976446871	137.8348818420	54.3176930732
160	758812.5745	6158371.9298	-34.6839524328	137.8250234560	54.6343803612
165	759203.5435	6160243.8321	-34.6669934389	137.8287126520	55.5159619750
166	759143.6887	6160868.7793	-34.6613797368	137.8278687510	58.4164768539
167	758963.5714	6162742.1371	-34.6445520390	137.8253323210	71.5122143548
168	759203.4083	6163312.8000	-34.6393514683	137.8277715360	71.1268038411
169	759568.9292	6162736.1759	-34.6444525811	137.8319315700	58.9672923705
170	759046.2707	6164497.4165	-34.6287213703	137.8256969530	76.7089910879
171	759221.6257	6163934.2017	-34.6337499174	137.8277799480	76.0232055672
172	759658.1526	6164495.8154	-34.6285810305	137.8323646980	68.5520197908
174	760720.3409	6152328.4509	-34.7379000046	137.8476911710	36.3636117453
175	760376.8323	6156654.6335	-34.6990229075	137.8426084770	49.3000436291

Turbine ID	Easting	Northing	Latitude	Longitude	Z
176	760644.6080	6155796.5676	-34.7066830671	137.8457934980	47.7468684416
179	752862.0878	6165929.1903	-34.6173683549	137.7578823080	132.7688778620
180	759796.5367	6160377.8714	-34.6656358830	137.8351358830	51.1429528374
181	760334.8053	6160213.3820	-34.6669807059	137.8410541940	50.1857114455
182	760819.1336	6160637.4532	-34.6630379379	137.8462032200	43.1607748846
183	759807.4235	6163321.8103	-34.6391173917	137.8343511370	60.6552873750
184	760160.5027	6162720.3513	-34.6444451040	137.8383835820	51.1059197054
185	760633.8715	6163320.1543	-34.6389224970	137.8433579240	46.1826593043
186	760779.5326	6162703.6585	-34.6444381185	137.8451350620	41.0257271262
187	759858.2054	6163922.5804	-34.6336934355	137.8347202870	62.7762906311
188	760379.4626	6164480.3249	-34.6285376462	137.8402290100	59.2603097101
189	760503.4416	6163905.8061	-34.6336807712	137.8417565000	54.3707190942
190	761193.6665	6151782.7997	-34.7426935307	137.8530244230	33.8377057502
191	761567.1874	6152523.5943	-34.7359258859	137.8568700610	32.7293848389
192	761024.6556	6152852.8774	-34.7330989504	137.8508490260	35.0385153959
194	761581.9791	6153116.2028	-34.7305847127	137.8568476110	32.8492344666
195	761596.5518	6153708.6930	-34.7252446569	137.8568228370	32.5691504880
197	761757.5764	6154304.5567	-34.7198367120	137.8583945400	37.5596526426
199	761351.1962	6155248.5523	-34.7114384852	137.8536694220	43.0714876035
200	760855.1532	6156358.4134	-34.7015689915	137.8479162260	47.8111795922
201	760910.7800	6157068.9609	-34.6951551027	137.8483034030	48.1612923555
202	761483.0236	6157023.2022	-34.6954211130	137.8545577660	44.8737268937
203	759525.6344	6157361.6895	-34.6928709216	137.8331085650	53.5242596810
205	761685.7672	6158184.3228	-34.6849114442	137.8564090830	43.1567296517
209	761436.8058	6160519.9857	-34.6639384417	137.8529725140	37.8136795908
210	760767.4482	6161297.4657	-34.6571065038	137.8454364490	48.0066186897
211	761254.8461	6161629.1125	-34.6539952469	137.8506466540	42.5054099807
212	761471.2323	6161093.0541	-34.6587681797	137.8531707230	38.9830417404
213	760907.3689	6162125.7056	-34.6496110890	137.8467063120	40.3283089722
214	761345.6688	6162944.6641	-34.6421232178	137.8512305560	44.5667857422
217	761262.0890	6155796.6360	-34.7065248559	137.8525279290	45.1388572326
219	761884.5958	6157609.5168	-34.6900376542	137.8587551010	42.2991548614
225	746355.6981	6166555.2467	-34.6133120569	137.6868073150	111.6974997910
226	751392.0109	6160581.7451	-34.6658973899	137.7434520240	126.6023868860
227	751161.4597	6166833.3061	-34.6096421699	137.7390852100	121.6354463870
228	751236.5524	6167476.1444	-34.6038333014	137.7397129770	127.2164042040

Turbine Locations – Turbines which have been Relocated - WTG Layout 012 Rev 2

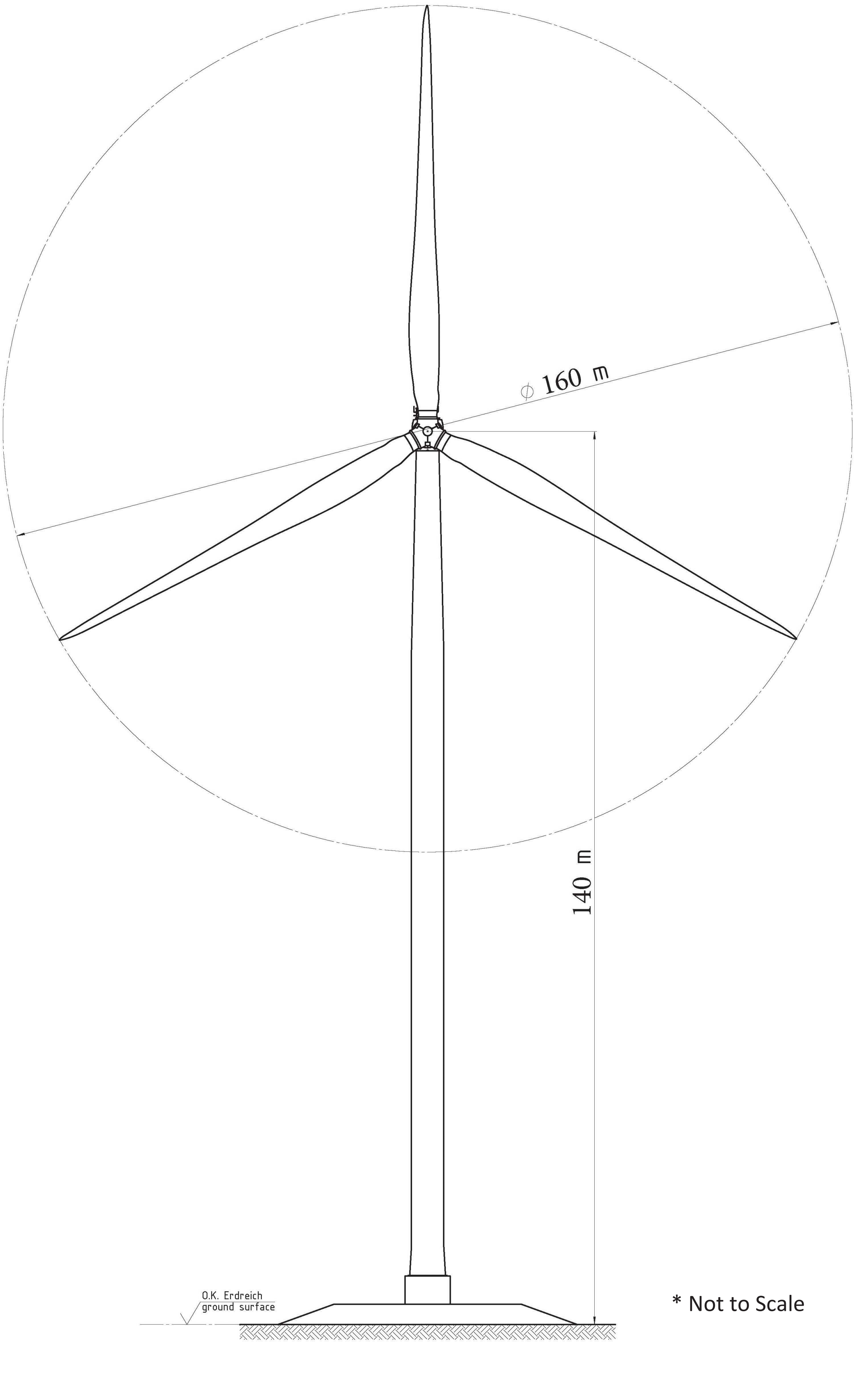
WTG ID - Micro-Siting Required	Approved Location (X)	Approved Location (Y)	Direction	Distance (m)	New Location (X)	New Location (Y)	Reason
162	758922.6995	6158949.274	N/A	N/A	**REMOVED**	**REMOVED**	Noise Compliance
163	758953.1725	6159510.33	N/A	N/A	**REMOVED**	**REMOVED**	Noise Compliance
164	759329.4031	6158156.319	N/A	N/A	**REMOVED**	**REMOVED**	Noise Compliance
177	760604.25602	6157587.611	N/A	N/A	**REMOVED**	**REMOVED**	Noise Compliance
207	761463.8855	6159640.014	N/A	N/A	**REMOVED**	**REMOVED**	Noise Compliance
208	761016.2267	6160054.031	N/A	N/A	**REMOVED**	**REMOVED**	Noise Compliance
118	757550.114	6162303.853	West	5	757545.114	6162303.853	Boundary Setback
121	757706.0731	6162883.229	East	24	757711.0731	6162860.229	Farm Management
122	757265.6107	6164722.398	Nth-East	10	757274.2707	6164731.058	Boundary Setback
124	757170.5299	6165601.055	North	5	757170.5299	6165606.055	Boundary Setback
137	758126.1613	6160278.114	South	5	758126.1613	6160273.114	Boundary Setback
141	758015.516	6163385.791	South	45	758015.516	6163340.791	Farm Management
142	758377.381	6162819.732	North	25	758377.381	6162844.732	Farm Management
143	758615.3207	6163370.409	South	45	758615.3207	6163325.409	Farm Management
144	757846.5418	6164547.769	South	20	757846.5418	6164527.769	Boundary Setback
145	758034.0574	6163978.618	South	15	758034.0574	6163963.618	Farm Management
146	758446.4143	6164522.75	South	10	758446.4143	6164512.75	Boundary Setback
147	758633.865	6163963.315	South	15	758633.865	6163948.315	Farm Management
165	759203.5435	6160248.832	South	5	759203.5435	6160243.832	Boundary Setback
167	758963.5714	6162692.137	North	50	758963.5714	6162742.137	Farm Management
168	759208.4083	6163237.8	North	75	759203.4083	6163312.8	Farm Management
170	759046.2707	6164509.417	South	12	759046.2707	6164497.417	Boundary Setback
171	759226.6257	6163948.202	West	5	759221.6257	6163934.202	Farm Management
180	759796.5367	6160372.871	North	5	759796.5367	6160377.871	Boundary Setback
181	760334.8053	6160218.382	South	5	760334.8053	6160213.382	Boundary Setback
186	760784.5326	6162703.658	West	5	760779.5326	6162703.659	Boundary Setback
213	760912.3689	6162125.706	West	5	760907.3689	6162125.706	Boundary Setback
005	747536.0692	6167208.677	East	10	747546.0692	6167208.677	Boundary Setback
013	748078.4742	6166426.699	South	5	748078.4742	6166421.699	Boundary Setback
014	748678.3232	6166412.058	South	5	748678.3232	6166407.058	Boundary Setback
020	748977.2741	6168371.479	East	11	748988.2741	6168371.479	EMI

WTG ID - Micro-Siting Required	Approved Location (X)	Approved Location (Y)	Direction	Distance (m)	New Location (X)	New Location (Y)	Reason
021	748519.4934	6169125.279	West	5	748514.4934	6169125.28	Boundary Setback
022	748159.1086	6169604.991	South	5	748159.1086	6169599.991	Boundary Setback
026	749777.6082	6163256.415	West	5	749772.6082	6163256.415	Boundary Setback
035	749614.8808	6163926.826	South	5	749614.8808	6163921.826	Boundary Setback
041	750021.2359	6166542.231	North	5	750021.2359	6166547.231	Boundary Setback
042	750614.1496	6166570.753	West	5	750609.1496	6166570.753	Boundary Setback
045	750629.1482	6167171.275	West	5	750624.1482	6167171.275	Boundary Setback
047	750644.1289	6167771.084	West	5	750639.1289	6167771.084	Boundary Setback
048	750659.1229	6168370.895	West	5	750654.1229	6168370.895	Boundary Setback
049	750677.5967	6169109.086	West	5	750672.5967	6169109.086	Boundary Setback
052	751721.2718	6163101.945	West	5	751716.2718	6163101.945	Boundary Setback
054	751460.5594	6163731.342	East	5	751465.5594	6163731.342	Boundary Setback
056	751668.4461	6166500.294	North	5	751668.4461	6166505.294	Boundary Setback
059	751260.1613	6168159.128	North	5	751260.1613	6168164.128	Boundary Setback
064	752220.7945	6162750.163	North	5	752220.7945	6162755.163	Boundary Setback
065	752499.5024	6163309.667	West	5	752494.5024	6163309.667	Boundary Setback
226	751383.3509	6160590.405	Sth-East	10	751392.0109	6160581.745	Boundary Setback
077	753593.778	6170753.932	East	5	753598.778	6170753.933	Boundary Setback
078	753621.0573	6171409.486	Sth-East	10	753629.7173	6171400.826	Boundary Setback
080	753637.3154	6172020.688	East	5	753642.3154	6172020.688	Boundary Setback
081	753651.6572	6172620.53	East	5	753656.6572	6172620.53	Boundary Setback
083	753664.7537	6173200.695	East	5	753669.7537	6173200.695	Boundary Setback
093	754636.2593	6171520.988	North	5	754636.2593	6171525.988	Boundary Setback
102	755698.1321	6173249.064	South	5	755698.1321	6173244.064	Boundary Setback
112	756297.927	6173233.414	South	5	756297.927	6173228.414	Boundary Setback
113	756687.1643	6172748.998	East	10	756697.1643	6172748.998	Boundary Setback
116	757664.798	6152688.126	North	5	757664.798	6152693.126	Boundary Setback
153	758995.732	6152512.925	South	5	758995.732	6152507.925	Boundary Setback
155	759595.5169	6152497.12	South	5	759595.5169	6152492.12	Boundary Setback
158	759673.1941	6156822.515	North	5	759673.1941	6156827.516	Boundary Setback
175	760376.8323	6156649.634	North	5	760376.8323	6156654.634	Boundary Setback
191	761562.1874	6152523.594	East	5	761567.1874	6152523.594	Boundary Setback

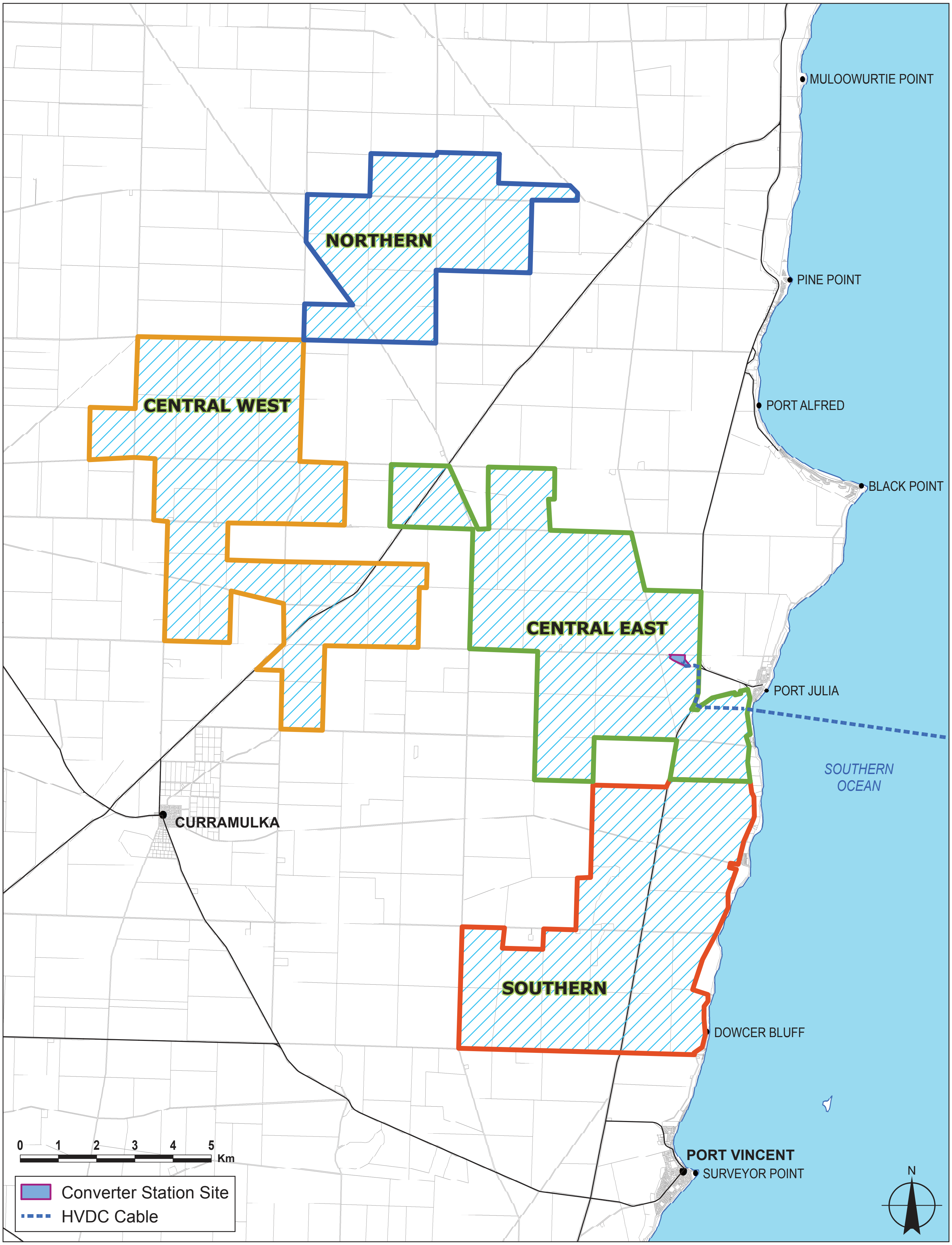
WTG ID - Micro-Siting Required	Approved Location (X)	Approved Location (Y)	Direction	Distance (m)	New Location (X)	New Location (Y)	Reason
194	761576.9791	6153116.203	East	5	761581.9791	6153116.203	Boundary Setback
195	761591.5518	6153708.693	East	5	761596.5518	6153708.693	Boundary Setback
199	761351.1962	6155243.552	North	5	761351.1962	6155248.552	Boundary Setback
205	761685.7672	6158179.323	North	5	761685.7672	6158184.323	Boundary Setback

Appendix E

Site and Elevation Plans

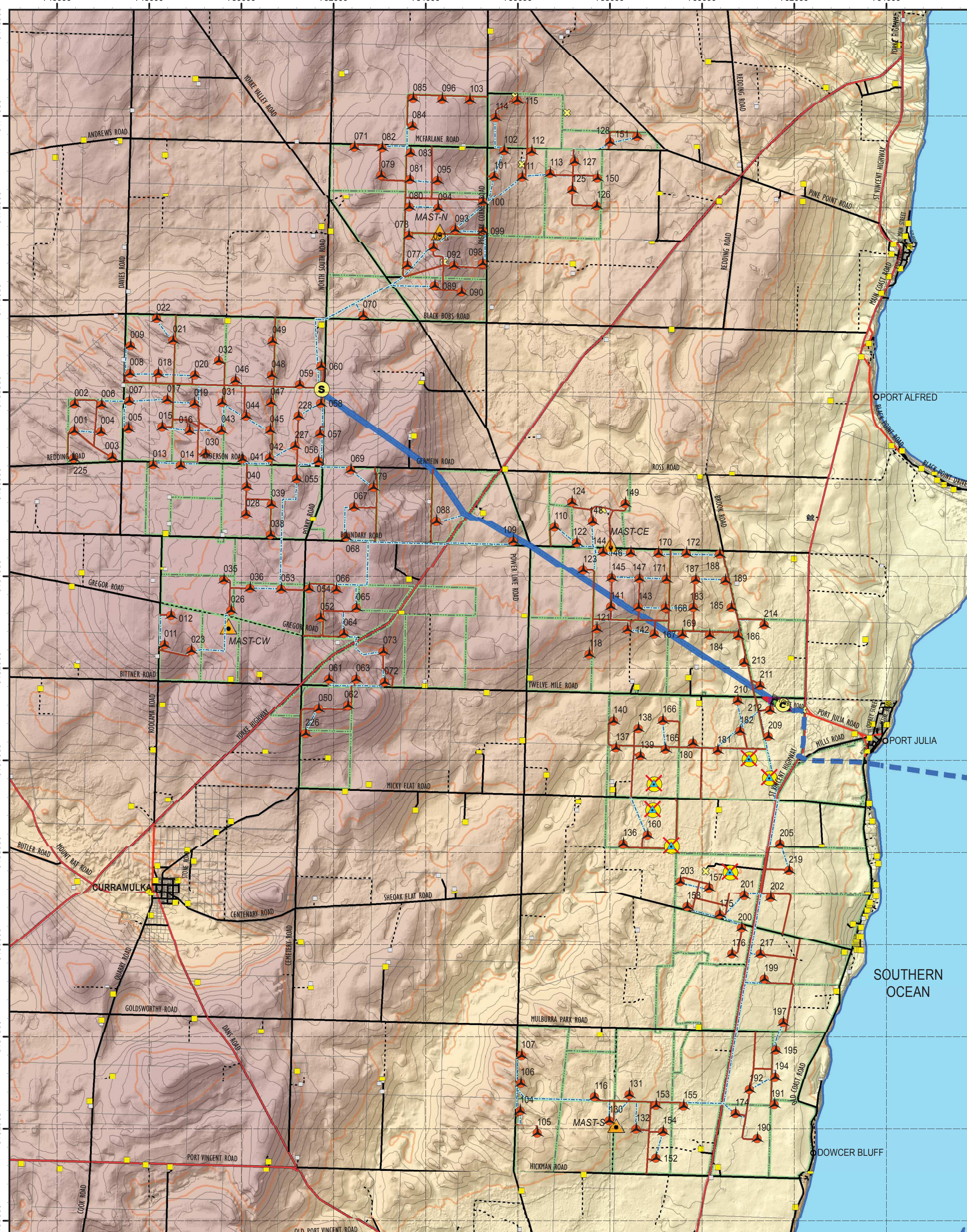


* Not to Scale



WIND FARM ZONES MAP

CERES PROJECT
Clean Energy from Yorke Peninsula



PRODUCT DESCRIPTION:

WIND FARM LAYOUT MAP, DISPLAYING 181 WIND TURBINES AND ASSOCIATED INFRASTRUCTURE, 6 WIND TURBINES REMOVED FOR THIS VARIATION, CADASTRAL BOUNDARIES, DWELLINGS AND OTHER BUILDINGS, PUBLIC ROAD NETWORK; TERRAIN SHADED, 5M CONTOUR INTERVALS.

0 0.5 1 2 3 4 5 Km

DOCUMENT PATH
C:\#DEVELOPMENT\YORKE\MXD 2018\2018_09_18 THE CERES PROJECT A3_DA VARIATION 2018

USER NAME	AUTHOR	DATE SAVED
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LEGEND

- Wind Turbines
- Removed Wind Turbines
- Masts
- Wind Farm Access Tracks
- CW Substation
- Yorke Converter Station
- 33kV Cable
- 132kV Cable
- HVDC Cable
- Leased Parcels

Buildings

- House
- House N/A
- Ruin
- Shed

PAGE TITLE
WIND FARM LAYOUT COMPARISON

THE CERES PROJECT

YORKE PENINSULA WIND FARM PROJECT

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CERES PROJECT
SENVION wind energy solutions

TITLE
CERES LAYOUT 012-04

LOCATION
YORKE PENINSULA, SOUTH AUSTRALIA

SUB-TITLE
TURBINES REMOVED FOR VARIATION

DRAWING NUMBER	REVISION
AU-CERES-180918-02	A-0

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-1 OF 1-	ISO A3

MAP DATUM	MAP SCALE
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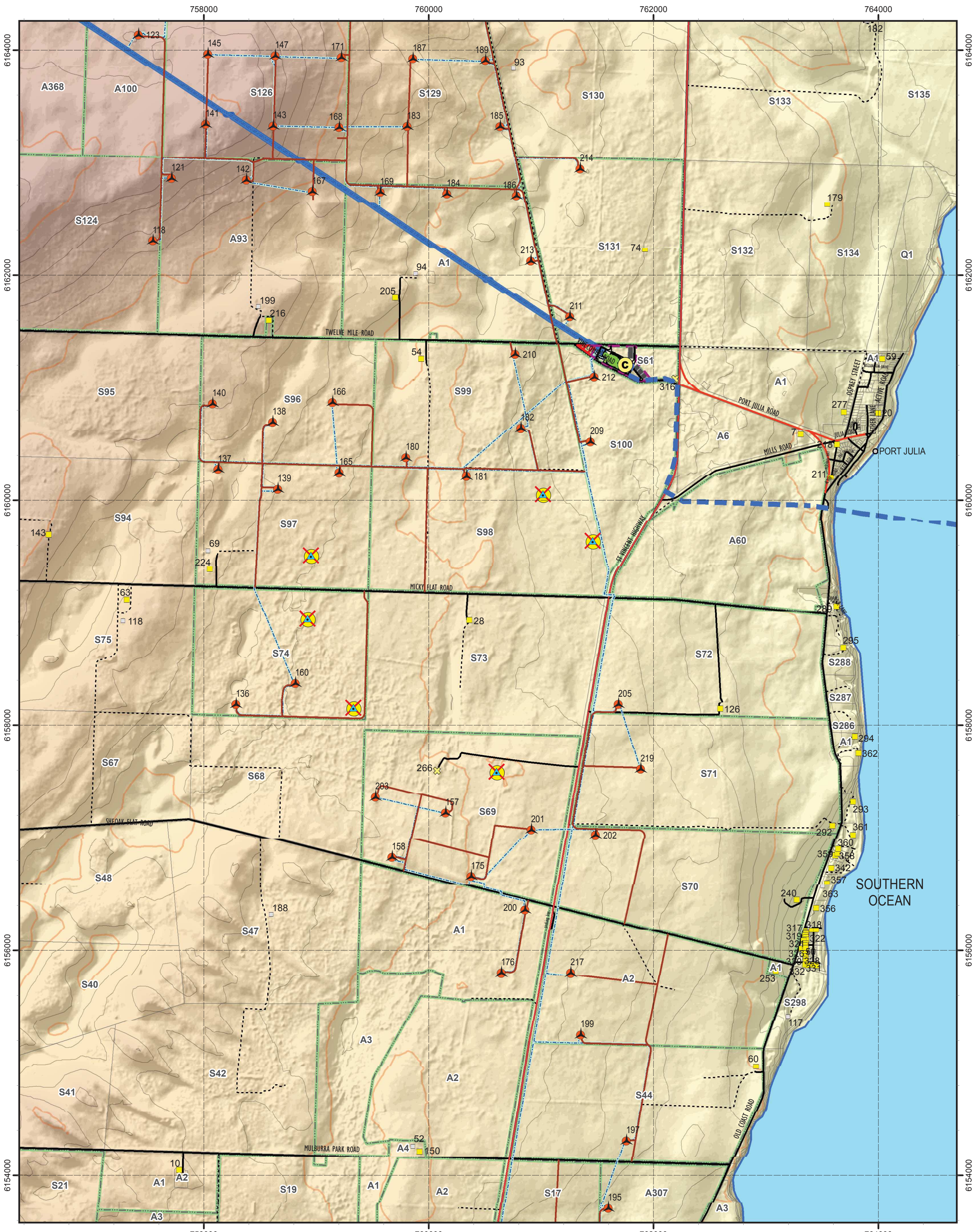

PRODUCT DESCRIPTION:

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LEGEND

- Wind Turbines
- Removed Wind Turbines
- Masts
- Wind Farm Access Tracks
- CW Substation
- Yorke Converter Station
- 33kV Cable
- 132kV Cable
- HVDC Cable
- Leased Parcels

Buildings

- House
- House N/A
- Ruin
- Shed

PAGE TITLE
WIND FARM LAYOUT COMPARISON

THE CERES PROJECT

YORKE PENINSULA WIND FARM PROJECT

CERES PROJECT

SENVION

CONTACT
LEVEL 29, 80 COLLINS ST, MELBOURNE, VICTORIA 3000, AUSTRALIA
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TITLE	**CERES LAYOUT 012-05**
LOCATION	YORKE PENINSULA, SOUTH AUSTRALIA
SUB-TITLE	TURBINES REMOVED FOR VARIATION
DRAWING NUMBER	AU-CERES-180918-03
REVISION	A-0
SHEET NUMBER	- 1 OF 1-
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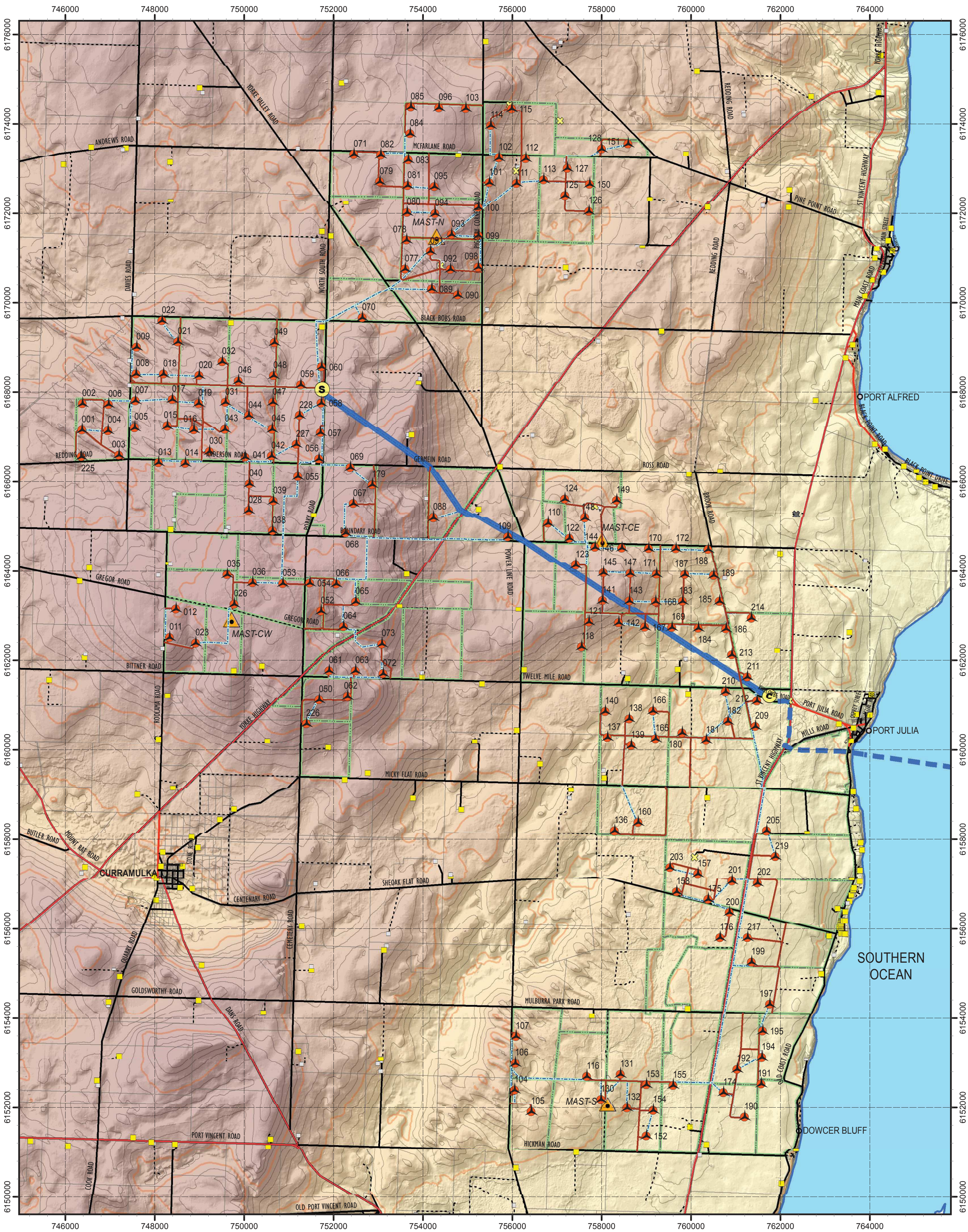

PRODUCT DESCRIPTION:

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N E S W

LEGEND

- Wind Turbines
- Masts
- **Buildings**
  - House
  - House N/A
  - Ruin
  - Shed
- Wind Farm Access Tracks
- CW Substation
- Yorke Converter Station
- 33kV Cable
- 132kV Cable
- HVDC Cable
- Leased Parcels

PAGE TITLE

WIND FARM D.A. VARIATION LAYOUT

THE CERES PROJECT

YORKE PENINSULA WIND FARM PROJECT

CERES PROJECT Clean Energy from Yorke Peninsula

SENVION wind energy solutions

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TITLE

CERES LAYOUT 012-03

LOCATION

YORKE PENINSULA, SOUTH AUSTRALIA

SUB-TITLE

WIND FARM LAYOUT MAP

DRAWING NUMBER	REVISION
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SHEET NUMBER	PAGE SIZE
- 1 OF 1-	ISO A3
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- Masts
- **Buildings**
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  - House N/A
  - Ruin
  - Shed
- Wind Farm Access Tracks
- CW Substation
- Yorke Converter Station
- 33kV Cable
- 132kV Cable
- HVDC Cable
- Leased Parcels

PAGE TITLE
WIND FARM LAYOUT COMPARISON

THE CERES PROJECT

YORKE PENINSULA WIND FARM

CERES PROJECT
Clean Energy from Yorke Peninsula

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U: WWW.THECERESPROJECT.COM.AU

TITLE	
CERES LAYOUT 012-07	
LOCATION: YORKE PENINSULA, SOUTH AUSTRALIA	
SUB-TITLE: WIND FARM LAYOUT MAP SHOWING WIND TURBINES REMOVED FOR THIS VARIATION	
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SHEET NUMBER: - 1 OF 1-	PAGE SIZE: ISO A1
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PRODUCT DESCRIPTION:

WIND FARM LAYOUT MAP, DISPLAYING 181 WIND TURBINES AND ASSOCIATED INFRASTRUCTURE, CADASTRAL BOUNDARIES, DWELLINGS AND OTHER BUILDINGS, PUBLIC ROAD NETWORK; TERRAIN SHADED, 5M CONTOUR INTERVALS.

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LEGEND

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- Masts
- **Buildings**
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  - House N/A
  - Ruin
  - Shed
- Wind Farm Access Tracks
- CW Substation
- Yorke Converter Station
- 33kV Cable
- 132kV Cable
- HVDC Cable
- Leased Parcels

PAGE TITLE: WIND FARM VARIATION APPLICATION LAYOUT

TITLE: CERES LAYOUT 012-06

THE CERES PROJECT

YORKE PENINSULA WIND FARM

CERES PROJECT Clean Energy from Yorke Peninsula

SENVION wind energy solutions

LOCATION: YORKE PENINSULA, SOUTH AUSTRALIA

SUB-TITLE: WIND FARM LAYOUT MAP

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DRAWING NUMBER	REVISION
AU-CERES-181010-01	A-0

SHEET NUMBER	PAGE SIZE
- 1 OF 1-	ISO A1

MAP DATUM	MAP SCALE
GDA 1994 MGA ZONE 53	1:40,000

Appendix F

Photomontages

Photomontage production methodology

Yorke Peninsula Wind Farm

Prepared for URPS

To capture the photomontages for the Yorke Peninsula wind farm imagery, a Canon 6D MkII with a 50mm lens, mounted on a Gigapan Epic Pro V mechatronic head was used. The arrangement captured a full set of images at regular intervals and multiple bracket exposures so that a 360-degree imagery could be constructed.

The photosets were taken at a height of 165cm from ground level to simulate the average eye height of a person. GPS location of each viewpoint was also recorded, as well as time of day.

The photos were then stitched and processed together using Autopano Giga Pro.

A 3D digital scene was created by constructing 3D digital turbine models based off CAD diagrams provided and using terrain information. The rotation of the turbine blades was randomly assigned to each turbine.

Virtual cameras were then placed into the scene based on GPS data, terrain information accurately aligning the distances between the cameras, the turbines, and the terrain. The virtual sun was added to light the turbines to each camera. The angle of the sun was mathematically created from the time of day, the date, as well as the GPS position. This was verified from the 360 degree imagery.

Each turbine was positioned to face each digital camera to maximise the potential visual impact. The closest turbine was then rotated to have the blades pointing directly up to help identify which one is closest and illustrate its maximum height.

The virtual cameras are then rotated to align all the turbines into view, created with a 120 degree horizontal field of view. The turbines and background image are then exported into Adobe Photoshop. Photoshop was used to combine these images, as well as masking out elements that are situated in front of the turbines. These masked elements were verified via satellite photography, the 3D scene and landmark verification.

Final images were delivered as 16 000 pixel x 4 800 pixel images in PDF format.

Viewpoint Locations for Photomontages

2017 TURBINE DIMENSIONS

TIP HEIGHT: 163M | HUB HEIGHT: 93M | ROTOR DIAMETER: 140M

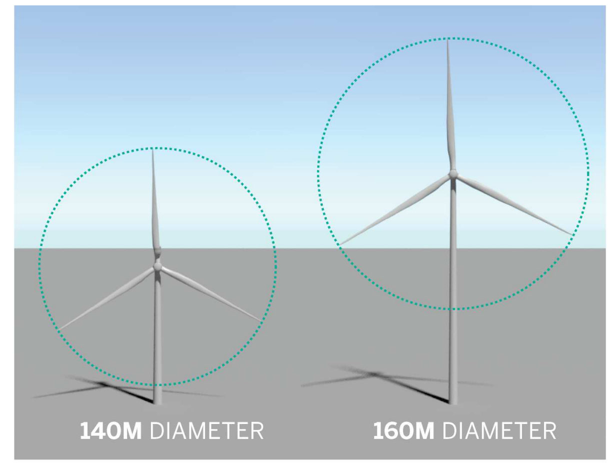
2018 TURBINE DIMENSIONS

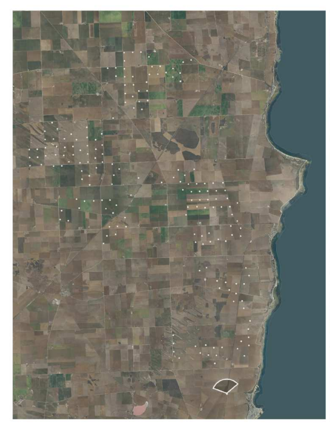
TIP HEIGHT: 220M | HUB HEIGHT: 140M | ROTOR DIAMETER: 160M

CERES PROJECT
Clean Energy from Yorke Peninsula

PHOTOMONTAGES OF TURBINES ON THE CERES 012 REV 2 LAYOUT

IMAGES TAKEN 17/09/2018





2017 TURBINE DIMENSIONS

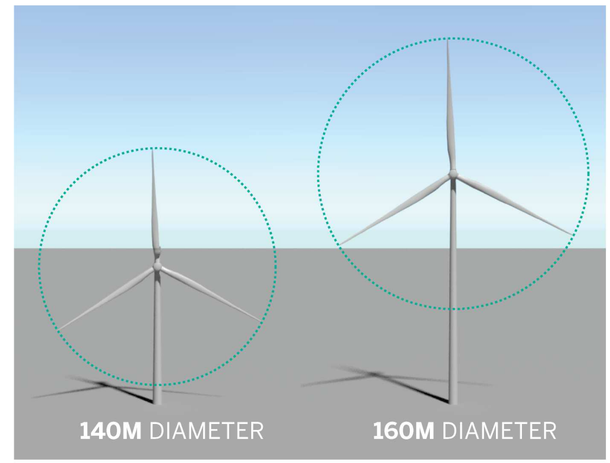
TIP HEIGHT: 163M | HUB HEIGHT: 93M | ROTOR DIAMETER: 140M

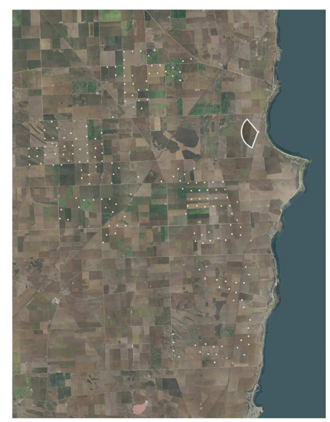
2018 TURBINE DIMENSIONS

TIP HEIGHT: 220M | HUB HEIGHT: 140M | ROTOR DIAMETER: 160M

PHOTOMONTAGES OF TURBINES ON THE CERES 012 REV 2 LAYOUT

IMAGES TAKEN 17/09/2018





P02.2

PHOTOMONTAGES OF TURBINES ON THE CERES 012 REV 2 LAYOUT

IMAGES TAKEN 17/09/2018

Viewpoint H08
Turbines

Turbine Dimensions
Tip Height: 163 m
Hub Height: 93 m
Rotor Diameter: 140 m
Distance to Nearest Turbine: 2.38km

Turbine Dimensions
Tip Height: 220 m
Hub Height: 140 m
Rotor Diameter: 160 m
Distance to Nearest Turbine: 2.38km

Viewpoint H09
Turbines

Turbine Dimensions

Tip Height: 163 m
Hub Height: 93 m

Rotor Diameter: 140 m
Distance to Nearest Turbine: 6.35km

Turbine Dimensions

Tip Height: 220 m
Hub Height: 140 m

Rotor Diameter: 160 m
Distance to Nearest Turbine: 6.35km

Viewpoint P01
Turbines

2017

Turbine Dimensions

Tip Height: 163 m	Rotor Diameter: 140 m
Hub Height: 93 m	Distance to Nearest Turbine: 6.03km

2018

Turbine Dimensions

Tip Height: 220 m	Rotor Diameter: 160 m
Hub Height: 140 m	Distance to Nearest Turbine: 6.03km

Viewpoint P02.1
Turbines

Turbine Dimensions

Tip Height: 163 m | Rotor Diameter: 140 m
Hub Height: 93 m | Distance to Nearest Turbine: 4.48km

Turbine Dimensions

Tip Height: 220 m | Rotor Diameter: 160 m
Hub Height: 140 m | Distance to Nearest Turbine: 4.48km

Viewpoint P02.2
Turbines

Turbine Dimensions
Tip Height: 163 m
Hub Height: 93 m
Rotor Diameter: 140 m
Distance to Nearest Turbine: 4.48km

Turbine Dimensions
Tip Height: 220 m
Hub Height: 140 m
Rotor Diameter: 160 m
Distance to Nearest Turbine: 4.48km

Viewpoint P03
Turbines

Turbine Dimensions
Tip Height: 163 m	Rotor Diameter: 140 m
Hub Height: 93 m	Distance to Nearest Turbine: 5.01km

Turbine Dimensions
Tip Height: 220 m	Rotor Diameter: 160 m
Hub Height: 140 m	Distance to Nearest Turbine: 5.01km

Appendix G

Shadow Flicker Report

YORKE PENINSULA WIND FARM PROJECT PTY LTD

CERES WIND FARM

SHADOW FLICKER ASSESSMENT

OCTOBER 2018

Question today
Imagine tomorrow
Create for the future

Ceres Wind Farm
Shadow Flicker Assessment

Yorke Peninsula Wind Farm Project Pty Ltd

WSP
Level 15, 28 Freshwater Place
Southbank VIC 3006

Tel: +61 3 9861 1111
Fax: +61 3 9861 1144
wsp.com

REV	DATE	DETAILS
A	25/06/2018	WTG scenario 1 worst case scenario results and map (Initial Release)
B	26/06/2018	WTG scenario 1 realistic scenario results added
C	10/09/2018	Updated WTG model parameters, WTG layout and buildings
D	17/09/2018	Appendix A added, minor changes to report
E	27/09/2018	Minor changes to appendix A and B
F	9/10/2018	Minor changes to report and appendix A and B

	NAME	DATE	SIGNATURE
Prepared by:	K. Dippl	9/10/2018	
Reviewed by:	A. Barker	9/10/2018	
Approved by:	H. Hurree	9/10/2018	

TABLE OF CONTENTS

ABBREVIATIONS

BoM	Bureau of Meteorology
CLGR	Central Local Government Region of South Australia
CWF	Ceres Wind Farm
d	Day
EPHC	Environment Protection and Heritage Council
hr	Hour
km	Kilometre
m	Metre
min	Minute
mAGL	Metres above ground level
mASL	Metres above sea level
WSP	WSP Australia Pty Ltd
WTG	Wind Turbine Generator
YPWFP P/L	Yorke Peninsula Wind Farm Project Pty Ltd

EXECUTIVE SUMMARY

Yorke Peninsula Wind Farm Project Pty Ltd (YPWFP P/L) has engaged WSP Australia Pty Ltd (WSP) to undertake a shadow flicker assessment of the proposed Ceres Wind Farm (CWF). CWF is located in South Australia, approximately 20 km south-west of Ardrossan on the Yorke Peninsula. YPWFP P/L has provided a set of Wind Turbine Generator (WTG) model parameters for the assessment of shadow flicker impacts on identified buildings also provided by YPWFP P/L. The WTG model parameters provided to WSP are detailed in Table ES.1.

Table ES.1 WTG model parameters considered in Shadow Flicker Assessment of CWF

HUB HEIGHT [M AGL]	ROTOR DIAMETER [M]	NUMBER OF WTGS	BLADE LENGTH [M]	MAX. CHORD WIDTH [M]	MAXIMUM TIP HEIGHT [M]
140	160	≤ 181	78.4	4.50	220

In assessing the shadow flicker at CWF, WSP has used the supplied WTG layout detailing up to 181 WTG locations for construction. Details for a total of 354 buildings have also been provided by YPWFP P/L. The buildings were categorised into four types, namely: “House”, “House N/A”, “Shed” or “Ruin”. The number of each type of building supplied is as follows:

— 228 buildings of “House” type, including houses owned by project stakeholders and non-stakeholders (i.e. third parties),

— 6 buildings of “House N/A” type, which are houses that will not be occupied during the operation of the wind farm, as informed by YPWFP P/L.

— 119 buildings of “Shed” type, and

— 1 building of “Ruin” type.

The main body of this report focusses on the modelled shadow flicker durations experienced by those buildings of type “House” and “House N/A”, of which there are 234 in total.

The methodology and assumptions included in this assessment are in accordance with the Environment Protection and Heritage Council’s (EPHC) *National Wind Farm Development Guidelines – Draft July 2010.* It is noted that the Central Local Government Region of South Australia (CLGR) has released a set of wind farm development guidelines in June 2014. The latter refers to the EPHC National Wind Farm Development Guidelines for the assessment of shadow flicker at a site. As such, WSP has conducted this assessment in line with the EPHC guidelines.

WSP has modelled both a worst-case and realistic shadow flicker scenario for the single WTG model for CWF. These scenarios were assessed in accordance with the methodology and shadow flicker limits detailed in the *National Wind Farm Development Guidelines – Draft July 2010*, which are outlined below:

— Shadow flicker duration taken as the maximum within 50 m of building centre.

— Worst-case scenario shadow flicker duration limit of 30 hours per year.

— Realistic scenario shadow flicker duration limit of 10 hours per year.

WSP has evaluated shadow flicker for each building location provided by YPWFP P/L. Additional modelling inputs and assumptions for the worst and realistic scenarios are outlined in Table ES.2.

Table ES.2 CWF shadow flicker modelling inputs

MODEL INPUT	WORST-CASE SCENARIO	REALISTIC SCENARIO
Shadow Flicker limit [hrs/year]	30	10

MODEL INPUT	WORST-CASE SCENARIO	REALISTIC SCENARIO
Sunlight cover	Direct sunlight during all daylight hours (i.e. no clouds cover).	Mean daily sunlight hours per month as measured from the Bureau of Meteorology's (BoM) Adelaide Airport climate station.
Reference year	2029 (Recommended year at approximately the middle of the lifespan of the wind farm)	
WTG operational hours	The WTGs are always operating (i.e. it is always windy, and the WTGs are never inoperable due to maintenance/faults).	Cut in wind speed of 3 m/s and cut out wind speed of 25 m/s in conjunction with wind speed data from nearby reanalysis data node[1].
WTG orientation	The WTGs are always oriented in the horizontal plane to face the sun (i.e. rotor casts the maximum possible shadow).	The WTGs are always facing into the wind, with wind direction as measured by nearby reanalysis data node.
Maximum distance for influence	1193 m (Recommended assessment distance of 265 times the maximum blade chord).	
WTG visibility	All the WTGs are visible except those screened by the topography.	
Minimum sun height over horizon for influence [°]	3	
Shadow flicker map resolution [m]	25	
Shadow flicker map/building height [m]	2	
Dimensions of building window	N/a. The shadow flicker duration for each building is taken as the maximum shadow flicker duration within 50 m of the building location based on calculated shadow flicker maps.	

Based on the assumptions described above, the results of the assessment for all buildings of type "House" and "House N/A" are detailed in Table ES.3. WSP has excluded unaffected buildings from this table for simplification, however, a complete set of results for buildings of type "House" and "House N/A" is found in Appendix A. Of the 228 houses, 17 were modelled to experience any level of shadow flicker. Of the six "House N/A" type buildings, all were modelled to experience high levels of shadow flicker.

Table ES.3 CWF affected building shadow flicker results for houses and "House N/A" type buildings

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	STAKEHOLDER BUILDING	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [m]	NORTH [m]			SHADOW HOURS PER YEAR [HR:MIN]	
312	754,410	6,170,814	House N/A	Yes	534:50	216:13
259	756,100	6,172,959	House N/A	Yes	487:00	167:13
300	757,860	6,165,473	House N/A	Yes	185:00	69:16
189	751,575	6,165,259	House	Yes	144:20	57:01
316	762,194	6,161,085	House N/A	Yes	93:00	34:56

[1] WSP has used reanalysis data from the ERA5_S34.707248_E137.666667 data node.

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	STAKEHOLDER BUILDING	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [m]	NORTH [m]			SHADOW HOURS PER YEAR [HR:MIN]	
315	755,949	6,174,446	House N/A	Yes	89:20	38:44
266	760,080	6,157,600	House N/A	Yes	82:30	32:57
72	759,980	6,151,572	House	Yes	76:30	29:58
54	759,940	6,161,256	House	Yes	76:20	29:43
32	751,761	6,169,465	House	Yes	71:10	27:13
310	752,295	6,172,235	House	Yes	70:40	20:47
230	753,996	6,161,630	House	Yes	66:50	24:06
71	754,800	6,173,304	House	Yes	64:30	26:11
29	751,897	6,160,043	House	Yes	64:20	20:75
73	760,346	6,151,192	House	Yes	51:20	14:49
171	749,730	6,169,550	House	Yes	49:40	21:48
160	749,794	6,161,757	House	Yes	45:30	14:54
125	750,540	6,160,202	House	No	45:20	14:13
74	761,926	6,162,224	House	Yes	42:10	16:58
205	759,707	6,161,794	House	Yes	40:40	17:53
48	755,259	6,165,399	House	Yes	35:10	14:11
126	762,594	6,158,143	House	Yes	30:20	12:39
194	753,494	6,163,206	House	Yes	24:30	9:58

1 PROJECT BACKGROUND

Yorke Peninsula Wind Farm Project Pty Ltd (YPWFP P/L) has requested WSP Australia Pty Ltd (WSP) to undertake a shadow flicker assessment of the proposed Ceres Wind Farm (CWF). CWF is located in South Australia, approximately 20 km south-west of Ardrossan on the Yorke Peninsula.

YPWFP P/L has provided a set of Wind Turbine Generator (WTG) model parameters to use for the assessment of shadow flicker impacts on identified buildings also provided by YPWFP P/L. The WTG model parameters are detailed in Table 1.1. The dimensions listed in the following table were provided by YPWFP P/L [1] and formed the basis of WSP's assessment.

Table 1.1 WTG model parameters considered in Shadow Flicker Assessment of CWF

HUB HEIGHT [M AGL]	ROTOR DIAMETER [M]	NUMBER OF WTGS	BLADE LENGTH [M]	MAX. CHORD WIDTH [M]	MAXIMUM TIP HEIGHT [M]
140	160	≤ 181	78.4	4.50	220

WSP has used the supplied WTG layout detailing up to 181 WTG locations for construction at CWF [2]. Details for a total of 354 buildings have also been provided by YPWFP P/L [3] [4], with these discussed in Section 2.

The proposed WTG layout for CWF and its proximity to Adelaide are shown below in Figure 1.1.

Figure 1.1 Location of CWF relative to Adelaide

The methodology and assumptions included in this assessment are in accordance with

- Environment Protection and Heritage Council's National Wind Farm Development Guidelines – Draft July 2010 [5],
- Draft Planning Bulletin – Wind Farms (Planning SA, 2002) [6], and
- CLGR Wind Farm Development Guidelines for Developers and Local Government Planners (CLGR, June 2014) [7].

1.1 DESCRIPTION OF SHADOW FLICKER

Shadow flicker is the fluctuating light levels caused by intermittent (moving or changing) shadows. If a location is in the shadow of a moving object, then there will be a momentary reduction in light intensity as the shadow passes by. This is most noticeable in an enclosed room that is lit by the sun, when the shadow falls across the window that is providing the light. WTGs can cause shadow flicker from the moving shadow of the WTG blades. Shadow flicker can also be caused by any moving object that cast a shadow, such as vehicles or aeroplanes.

Shadow flicker occurs when the sun passes behind the blades of a WTG, casting an intermittent shadow. This effect is known to cause annoyance when this shadow is received at a building.

In order for a WTG to cause shadow flicker at a given location, the following conditions have to be satisfied. If any one of these conditions is not met, then shadow flicker will not occur, or will have a diminished impact, at that location.

- The sun must be in the correct position in the sky to cast a shadow of the WTG onto the location. This will only occur for certain times of day and days of the year.
- Wind direction will have an impact on shadow flicker impact, as the area of the shadow cast by the WTG will depend on which direction the WTG is pointing (yaw), which in turn is dependent on the wind direction.
- There has to be unobstructed line of sight between the WTG and the location.
- The sun must not be significantly obscured by cloud or diffused by the atmosphere (significant diffusion typically occurs for angles of less than 3° above the horizon).
- The WTG has to be operating (i.e. the blades rotating).
- The dimension of the part of the blade causing the shadow has to be large enough to cast significant shadow. The largest dimension of blades is the chord near the root, which may be up to 4.5 m on large WTGs, and the smallest is the depth of the blade near the tip, which may be 0.3 m or less. The latter is not sufficient to cast any noticeable shadow. If the blade is edge-on to the sun, then the shadow will be very small.
- The shadow must fall over most of a room's natural light source, i.e. window or skylight. If the windows are large (compared to the size of the shadow), or do not face the WTG, then the room's light levels will not vary significantly.

The sun's position varies with the time of day and the time of year. This means that the locations affected by shadow flicker from WTGs vary with the time of day and time of the year.

The shadow flicker usually occurs to the east and west of the WTGs or to the south if there is a large height difference between the WTGs and the observer location.

1.2 SCOPE OF WORK

The scope undertaken in this assessment is the standard scope of work involved in shadow flicker assessments completed by WSP, and is as follows:

WSP has performed a shadow flicker assessment based on:

— A refined development layout of up to 181 WTGs;

— A table of WTG model parameters supplied by YPWFP P/L (a single model);

— A list of coordinates of buildings that YPWFP P/L wishes to be included in the assessment.

WSP has detailed the results of this assessment in a single report, which includes:

— A description of shadow flicker phenomenon and potential effects.

— An assessment of the shadow flicker effects on residences within a specified distance of WTGs (based on on-site measurements and publicly available wind and cloud data).

— A shadow flicker map detailing the regions affected by shadow flicker, graded by time durations of shadow flicker.

1.3 INPUT DATA

Table 1.2 details the information supplied by YPWFP P/L for the assessment of shadow flicker at CWF.

Table 1.2 Summary of data received

NAME	DESCRIPTION	REFERENCE
WTG Layout.xlsx	Revised development layout consisting of up to 181 WTG locations	[2]
Housing_updated_June_2018.shp	List of surrounding buildings at CWF to be included in the shadow flicker assessment, and their participation status in the project. Updates to this list were also specified via email.	[3] [4]
CERES-YPWF Parameters_as supplied to WSP_20180718	Table detailing the WTG model parameters to be used in the shadow flicker assessment.	[1]

1.4 LIMITATION STATEMENT

This Report is provided by WSP Australia Pty Limited (WSP) for Yorke Peninsula Wind Farm Project Pty Ltd (Client) in response to specific instructions from the Client and in accordance with WSP's proposal dated 1 June 2018 and agreement with the Client dated [10 July 2018] (Agreement).

1.4.1 PERMITTED PURPOSE

This Report is provided by WSP for the purpose described in the Agreement and no responsibility is accepted by WSP for the use of the Report in whole or in part, for any other purpose (Permitted Purpose).

1.4.2 QUALIFICATIONS AND ASSUMPTIONS

The services undertaken by WSP in preparing this Report were limited to those specifically detailed in the Report and are subject to the scope, qualifications, assumptions and limitations set out in the Report or otherwise communicated to the Client.

Except as otherwise stated in the Report and to the extent that statements, opinions, facts, conclusion and / or recommendations in the Report (Conclusions) are based in whole or in part on information provided by the Client and other parties identified in the report (Information), those Conclusions are based on assumptions by WSP of the reliability,

adequacy, accuracy and completeness of the Information and have not been verified. WSP accepts no responsibility for the Information.

WSP has prepared the Report without regard to any special interest of any person other than the Client when undertaking the services described in the Agreement or in preparing the Report.

1.4.3 USE AND RELIANCE

This Report should be read in its entirety and must not be copied, distributed or referred to in part only. The Report must not be reproduced without the written approval of WSP. WSP will not be responsible for interpretations or conclusions drawn by the reader. This Report (or sections of the Report) should not be used as part of a specification for a project or for incorporation into any other document without the prior agreement of WSP.

WSP is not (and will not be) obliged to provide an update of this Report to include any event, circumstance, revised Information or any matter coming to WSP's attention after the date of this Report. Data reported and Conclusions drawn are based solely on information made available to WSP at the time of preparing the Report. The passage of time; unexpected variations in ground conditions; manifestations of latent conditions; or the impact of future events (including (without limitation) changes in policy, legislation, guidelines, scientific knowledge; and changes in interpretation of policy by statutory authorities); may require further investigation or subsequent re-evaluation of the Conclusions.

This Report can only be relied upon for the Permitted Purpose and may not be relied upon for any other purpose. The Report does not purport to recommend or induce a decision to make (or not make) any purchase, disposal, investment, divestment, financial commitment or otherwise. It is the responsibility of the Client to accept (if the Client so chooses) any Conclusions contained within the Report and implement them in an appropriate, suitable and timely manner.

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1.4.4 DISCLAIMER

No warranty, undertaking or guarantee whether expressed or implied, is made with respect to the data reported or the Conclusions drawn. To the fullest extent permitted at law, WSP, its related bodies corporate and its officers, employees and agents assumes no responsibility and will not be liable to any third party for, or in relation to any losses, damages or expenses (including any indirect, consequential or punitive losses or damages or any amounts for loss of profit, loss of revenue, loss of opportunity to earn profit, loss of production, loss of contract, increased operational costs, loss of business opportunity, site depredation costs, business interruption or economic loss) of any kind whatsoever, suffered on incurred by a third party.

2 METHODOLOGY

WSP used WindPRO v3.2 to assess shadow flicker on supplied buildings at the CWF. The model used for the calculation of flicker effects contains a mathematical model of the sun's position in the sky for a given location and time of year. Also contained in the model is information relating to the three-dimensional positions and size of the WTGs and the distance for which the shadow flicker impacts will be calculated. This information is combined to calculate the times for which the WTG rotors will cast shadows over the locations of interest. Shadow flicker is assumed to occur when the centre of the sun passes behind any part of a WTG rotor.

WSP has modelled both worst-case and realistic shadow flicker scenarios for the WTG model, for which parameters were provided by YPWFP P/L. These scenarios were assessed against the shadow flicker limits detailed in the *National Wind Farm Development Guidelines – Draft July 2010* [5], which are outlined below:

— <u>Shadow flicker duration taken as the maximum within 50 m of building centre:</u>
  "Shadow flicker duration can be very sensitive to location, varying by up to approximately 0.8 hours per metre of horizontal displacement. Thus, in an extreme case, one end of a house may experience no shadow flicker while the other end may exceed the limit. For this reason, the assessment method requires reporting of the maximum value of shadow flicker duration within 50 m of the centre of a dwelling."

— <u>Worst-case scenario shadow flicker duration limit of 30 hours per year:</u>
  "In most circumstances where a dwelling experiences a 'modelled' level of shadow flicker less than 30 hours per year, no further investigation is required. However, if this level is exceeded in the modelled scenario, mitigation measures may be introduced and the 'actual' or 'measured' level of shadow flicker will need to be determined."

— <u>Realistic scenario shadow flicker duration limit of 10 hours per year:</u>
  "The modelling approach includes a number of assumptions and, as such, the 'modelled' exposure limit is set higher to account for these conservatisms. The assumptions used in the modelling approach should produce an outcome equivalent to 10 hours per year actual exposure."

Details for a total of 354 buildings were provided, including ID, locations and type. The buildings were categorised into four types, namely: "House", "House N/A", "Shed" or "Ruin" [3] [4]. The number of each type of building supplied is as follows:

— 228 buildings of "House" type, including houses owned by project stakeholders and non-stakeholders (i.e. third parties),

— 6 buildings of "House N/A" type, which are houses that will not be occupied during the operation of the wind farm, as informed by YPWFP P/L [4].

— 119 buildings of "Shed" type, and

— 1 building of "Ruin" type.

The main body of this report focusses on the modelled shadow flicker durations experienced by those buildings of type "House" and "House N/A", of which there are 234 in total. Section 3 shows the modelled shadow flicker durations for the "House" and "House N/A" type buildings modelled to experience any level of shadow flicker. Appendix A presents the modelled shadow flicker levels at all buildings of type "House" and "House N/A".

A summary of the assumptions and inputs for the worst-case and realistic scenarios is given in Table 2.1 and Table 2.2. Modelling inputs detailed in Table 2.1 have been taken from the national guidelines [5].

Table 2.1 Shadow flicker worst-case and realistic scenario assumptions

MODEL INPUT	WORST-CASE SCENARIO	REALISTIC SCENARIO
Shadow Flicker limit [hrs/year]	30	10

MODEL INPUT	WORST-CASE SCENARIO	REALISTIC SCENARIO
Sunlight cover	Direct sunlight during all daylight hours (i.e. no clouds cover).	Mean daily sunlight hours per month as measured from the Bureau of Meteorology's (BoM) Adelaide Airport climate station [8]. (See Table 2.2)
Reference year	2029 (Recommended year at approximately the middle of the lifespan of the wind farm [5])	
WTG operational hours	The WTGs are always operating (i.e. it is always windy, and the WTGs are never inoperable due to maintenance/faults).	Cut in wind speed of 3 m/s and cut out wind speed of 25 m/s [9] in conjunction with wind speed data from nearby reanalysis data node[2].
WTG orientation	The WTGs are always oriented in the horizontal plane to face the sun (i.e. rotor casts the maximum possible shadow).	The WTGs are always facing into the wind, with wind direction as measured by nearby reanalysis data node.
Maximum distance for influence	1193 m (Recommended assessment distance of 265 times the maximum blade chord [5])	
WTG visibility	All the WTGs are visible except those screened by the topography.	
Minimum sun height over horizon for influence [°]	3	
Shadow flicker map resolution [m]	25 [5]	
Shadow flicker map/building height [m]	2 [5]	
Dimensions of building window	The shadow flicker duration for each building is taken as the maximum shadow flicker duration within 50 m of the building locations based on calculated shadow flicker maps [5].	

Table 2.2 Average sunlight hours per day on a monthly mean basis [8]

BOM STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Adelaide Airport	10.5	10	8.6	7.3	5.6	4.7	5	6.1	7.1	8.5	9.4	9.4

In addition to the assumptions detailed in Table 2.1, these calculations are based on the WTG parameters outlined in Table 1.1.

[2] WSP has used reanalysis data from the ERA5_S34.707248_E137.666667 data node [14].

3 RESULTS

The results of the shadow flicker assessment considering the worst-case and realistic scenarios for buildings of "House" and "House N/A" type are detailed in Table 3.1, showing only those buildings modelled to experience any shadow flicker. A complete set of results including unaffected "House" and "House N/A' type buildings is found in Appendix A. Of the 228 houses, 17 were modelled to experience any level of shadow flicker. Of the six "House N/A" type buildings, all were modelled to experience high levels of shadow flicker.

Table 3.1 CWF Shadow Flicker Worst Case and Realistic Scenario results, houses only

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	STAKEHOLDER BUILDING	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [m]	NORTH [m]			SHADOW HOURS PER YEAR [HR:MIN]	
312	754,410	6,170,814	House N/A	Yes	534:50	216:13
259	756,100	6,172,959	House N/A	Yes	487:00	167:13
300	757,860	6,165,473	House N/A	Yes	185:00	69:16
189	751,575	6,165,259	House	Yes	144:20	57:01
316	762,194	6,161,085	House N/A	Yes	93:00	34:56
315	755,949	6,174,446	House N/A	Yes	89:20	38:44
266	760,080	6,157,600	House N/A	Yes	82:30	32:57
72	759,980	6,151,572	House	Yes	76:30	29:58
54	759,940	6,161,256	House	Yes	76:20	29:43
32	751,761	6,169,465	House	Yes	71:10	27:13
310	752,295	6,172,235	House	Yes	70:40	20:47
230	753,996	6,161,630	House	Yes	66:50	24:06
71	754,800	6,173,304	House	Yes	64:30	26:11
29	751,897	6,160,043	House	Yes	64:20	20:75
73	760,346	6,151,192	House	Yes	51:20	14:49
171	749,730	6,169,550	House	Yes	49:40	21:48
160	749,794	6,161,757	House	Yes	45:30	14:54
125	750,540	6,160,202	House	No	45:20	14:13
74	761,926	6,162,224	House	Yes	42:10	16:58
205	759,707	6,161,794	House	Yes	40:40	17:53
48	755,259	6,165,399	House	Yes	35:10	14:11
126	762,594	6,158,143	House	Yes	30:20	12:39
194	753,494	6,163,206	House	Yes	24:30	9:58

4 REFERENCES

[1] Senvion Australia Pty Ltd, “CERES-YPWF Parameters_as supplied to WSP_20180718.docx,” 18 July 2018.

[2] Senvion Australia Pty Ltd, “WTG_Layout_012_rev_2.zip,” 2018.

[3] Senvion Australia Pty Ltd, “Housing_updated_June_2018.zip”.

[4] A. Gray, “[Email] EMI & Shadow Flicker for YPWF/Ceres, plus updated layout, plus legal stuff,” 17 August 2018.

[5] Environment Protection and Heritage Council, “National Wind Farm Guidelines - Draft July 2010,” 2010.

[6] Planning SA, “Draft Planning Bulletin - Wind Farms,” Planning SA, Adelaide , 2002.

[7] CLGR, “Wind Farm Development Guidelines for Developers and Local Government Planners,” 2014.

[8] Australian Government Bureau of Meteorology, “Climate Statistics for Australian Locations - Summary statistics ADELAIDE AIRPORT,” 2018. [Online]. Available: http://www.bom.gov.au/climate/averages/tables/cw_023034.shtml. [Accessed 14 August 2018].

[9] A. Gray, “[Email] Re: Shadow flicker clarification?,” 8 August 2018.

[10] Senvion Australia, “Housing_updated_June_2018.shp”.

[11] Senvion Australia, “PD-3.25-WT.WT.00-A-EN-C Product Description [3.7M144 EBC_50Hz].pdf”.

[12] B. Nixon, “Email: Ceres Update Proposal,” 22 May 2018.

[13] A. Gray, “[Email] RE: WSP Draft Shadow Flicker Assessment - CERES Wind Farm - WSP Query on Blade Chord,” 10 July 2018.

[14] EMD, “WindPRO v3.2 Online Reanalysis Data, ERA 5,” 2018.

APPENDIX A

SHADOW FLICKER RESULTS

Table A.1 CWF Shadow Flicker Worst-Case and Realistic Scenario results, all dwellings

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [M]	NORTH [m]		SHADOW HOURS PER YEAR [HR:MIN]	
312	754,410	6,170,814	House N/A	534:50	216:13
259	756,100	6,172,959	House N/A	487:00	167:13
300	757,860	6,165,473	House N/A	185:00	69:16
189	751,575	6,165,259	House	144:20	57:01
316	762,194	6,161,085	House N/A	93:00	34:56
315	755,949	6,174,446	House N/A	89:20	38:44
266	760,080	6,157,600	House N/A	82:30	32:57
72	759,980	6,151,572	House	76:30	29:58
54	759,940	6,161,256	House	76:20	29:43
32	751,761	6,169,465	House	71:10	27:13
310	752,295	6,172,235	House	70:40	20:47
230	753,996	6,161,630	House	66:50	24:06
71	754,800	6,173,304	House	64:30	26:11
29	751,897	6,160,043	House	64:20	20:45
73	760,346	6,151,192	House	51:20	14:49
171	749,730	6,169,550	House	49:40	21:48
160	749,794	6,161,757	House	45:30	14:54
125	750,540	6,160,202	House	45:20	14:13
74	761,926	6,162,224	House	42:10	16:58
205	759,707	6,161,794	House	40:40	17:53
48	755,259	6,165,399	House	35:10	14:11
126	762,594	6,158,143	House	30:20	12:39
194	753,494	6,163,206	House	24:30	9:58
1	765,888	6,179,879	House	0:00	0:00
2	743,531	6,165,584	House	0:00	0:00
3	764,470	6,171,674	House	0:00	0:00
4	756,107	6,160,444	House	0:00	0:00
6	760,651	6,166,246	House	0:00	0:00
7	763,307	6,160,586	House	0:00	0:00
8	759,890	6,173,346	House	0:00	0:00
10	757,790	6,154,044	House	0:00	0:00

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [M]	NORTH [m]		SHADOW HOURS PER YEAR [HR:MIN]	
11	754,872	6,158,670	House	0:00	0:00
14	745,672	6,161,563	House	0:00	0:00
15	756,451	6,177,522	House	0:00	0:00
18	763,610	6,169,046	House	0:00	0:00
20	763,998	6,160,778	House	0:00	0:00
21	760,140	6,175,169	House	0:00	0:00
23	765,885	6,165,776	House	0:00	0:00
26	748,366	6,173,148	House	0:00	0:00
28	760,365	6,158,928	House	0:00	0:00
33	757,438	6,150,978	House	0:00	0:00
34	764,499	6,171,138	House	0:00	0:00
35	753,651	6,163,922	House	0:00	0:00
37	752,198	6,174,914	House	0:00	0:00
41	759,886	6,177,315	House	0:00	0:00
42	743,741	6,166,380	House	0:00	0:00
43	765,966	6,180,057	House	0:00	0:00
44	756,093	6,150,648	House	0:00	0:00
45	764,242	6,175,541	House	0:00	0:00
46	747,386	6,173,479	House	0:00	0:00
47	748,061	6,157,101	House	0:00	0:00
50	763,316	6,156,012	House	0:00	0:00
56	748,311	6,161,211	House	0:00	0:00
57	762,181	6,172,121	House	0:00	0:00
59	764,033	6,161,255	House	0:00	0:00
60	762,913	6,154,970	House	0:00	0:00
62	747,545	6,151,344	House	0:00	0:00
63	757,324	6,159,118	House	0:00	0:00
64	761,158	6,148,726	House	0:00	0:00
67	764,104	6,166,842	House	0:00	0:00
68	760,372	6,172,122	House	0:00	0:00
77	748,330	6,164,172	House	0:00	0:00

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [M]	NORTH [m]		SHADOW HOURS PER YEAR [HR:MIN]	
82	765,432	6,178,996	House	0:00	0:00
83	754,918	6,147,900	House	0:00	0:00
85	765,242	6,165,988	House	0:00	0:00
87	758,495	6,179,215	House	0:00	0:00
88	749,327	6,176,832	House	0:00	0:00
90	751,528	6,155,057	House	0:00	0:00
91	764,188	6,174,712	House	0:00	0:00
95	764,338	6,166,730	House	0:00	0:00
96	763,882	6,170,132	House	0:00	0:00
97	750,419	6,161,864	House	0:00	0:00
98	746,565	6,164,055	House	0:00	0:00
102	753,144	6,155,516	House	0:00	0:00
103	755,305	6,177,511	House	0:00	0:00
105	751,763	6,171,608	House	0:00	0:00
106	748,430	6,159,155	House	0:00	0:00
107	754,634	6,157,146	House	0:00	0:00
108	754,741	6,148,859	House	0:00	0:00
109	748,206	6,157,710	House	0:00	0:00
110	762,788	6,167,813	House	0:00	0:00
111	766,054	6,165,666	House	0:00	0:00
113	762,025	6,150,317	House	0:00	0:00
114	752,265	6,159,349	House	0:00	0:00
116	747,635	6,159,002	House	0:00	0:00
119	748,163	6,157,407	House	0:00	0:00
122	750,454	6,154,117	House	0:00	0:00
127	748,992	6,157,803	House	0:00	0:00
129	751,962	6,171,514	House	0:00	0:00
130	757,221	6,176,727	House	0:00	0:00
131	764,044	6,170,514	House	0:00	0:00
133	765,453	6,165,888	House	0:00	0:00
135	746,458	6,162,047	House	0:00	0:00

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [M]	NORTH [m]		SHADOW HOURS PER YEAR [HR:MIN]	
136	743,420	6,162,436	House	0:00	0:00
138	752,085	6,179,970	House	0:00	0:00
139	751,235	6,153,266	House	0:00	0:00
140	745,994	6,173,099	House	0:00	0:00
141	750,558	6,151,129	House	0:00	0:00
143	756,632	6,159,691	House	0:00	0:00
145	759,085	6,172,326	House	0:00	0:00
147	746,612	6,173,497	House	0:00	0:00
150	759,926	6,154,220	House	0:00	0:00
151	755,738	6,166,354	House	0:00	0:00
155	762,686	6,174,628	House	0:00	0:00
157	764,406	6,171,413	House	0:00	0:00
158	753,790	6,158,918	House	0:00	0:00
159	766,279	6,165,695	House	0:00	0:00
161	746,734	6,152,610	House	0:00	0:00
162	748,867	6,156,875	House	0:00	0:00
163	750,610	6,151,304	House	0:00	0:00
166	765,816	6,179,275	House	0:00	0:00
170	755,415	6,175,841	House	0:00	0:00
174	748,852	6,158,026	House	0:00	0:00
177	748,012	6,157,202	House	0:00	0:00
178	753,921	6,168,214	House	0:00	0:00
179	763,543	6,162,625	House	0:00	0:00
181	765,099	6,166,087	House	0:00	0:00
183	764,225	6,179,765	House	0:00	0:00
184	756,274	6,161,782	House	0:00	0:00
185	766,002	6,180,800	House	0:00	0:00
186	751,310	6,156,033	House	0:00	0:00
187	764,150	6,171,190	House	0:00	0:00
190	744,333	6,177,665	House	0:00	0:00
193	766,051	6,180,293	House	0:00	0:00

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [M]	NORTH [m]		SHADOW HOURS PER YEAR [HR:MIN]	
195	752,783	6,159,491	House	0:00	0:00
200	746,090	6,151,162	House	0:00	0:00
201	748,056	6,156,626	House	0:00	0:00
203	759,343	6,169,376	House	0:00	0:00
204	759,962	6,166,170	House	0:00	0:00
206	746,472	6,157,393	House	0:00	0:00
209	748,383	6,164,914	House	0:00	0:00
211	763,578	6,160,210	House	0:00	0:00
212	761,041	6,180,270	House	0:00	0:00
214	752,882	6,149,532	House	0:00	0:00
215	765,845	6,179,549	House	0:00	0:00
216	758,587	6,161,597	House	0:00	0:00
217	745,249	6,151,268	House	0:00	0:00
218	763,631	6,160,497	House	0:00	0:00
220	760,171	6,179,128	House	0:00	0:00
222	757,204	6,170,780	House	0:00	0:00
224	758,063	6,159,381	House	0:00	0:00
225	749,075	6,155,191	House	0:00	0:00
226	757,186	6,179,175	House	0:00	0:00
227	743,512	6,161,152	House	0:00	0:00
231	748,649	6,157,412	House	0:00	0:00
232	762,198	6,172,545	House	0:00	0:00
237	748,383	6,172,286	House	0:00	0:00
239	757,687	6,148,021	House	0:00	0:00
240	763,273	6,156,445	House	0:00	0:00
242	749,005	6,154,399	House	0:00	0:00
244	750,923	6,176,658	House	0:00	0:00
247	747,234	6,153,159	House	0:00	0:00
248	763,453	6,168,764	House	0:00	0:00
249	757,318	6,179,241	House	0:00	0:00
250	747,246	6,154,912	House	0:00	0:00

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [M]	NORTH [m]		SHADOW HOURS PER YEAR [HR:MIN]	
251	764,109	6,170,984	House	0:00	0:00
252	746,348	6,163,768	House	0:00	0:00
253	763,087	6,155,819	House	0:00	0:00
254	761,992	6,164,399	House	0:00	0:00
255	741,088	6,169,323	House	0:00	0:00
256	746,995	6,154,368	House	0:00	0:00
257	749,031	6,174,814	House	0:00	0:00
260	755,170	6,160,190	House	0:00	0:00
263	749,800	6,158,684	House	0:00	0:00
264	748,591	6,156,893	House	0:00	0:00
265	765,033	6,166,243	House	0:00	0:00
269	764,298	6,170,675	House	0:00	0:00
270	755,336	6,161,480	House	0:00	0:00
277	763,692	6,160,786	House	0:00	0:00
278	764,757	6,166,362	House	0:00	0:00
279	753,199	6,179,990	House	0:00	0:00
280	756,149	6,163,135	House	0:00	0:00
281	743,825	6,162,063	House	0:00	0:00
282	755,895	6,147,906	House	0:00	0:00
284	748,478	6,151,198	House	0:00	0:00
287	749,477	6,158,460	House	0:00	0:00
288	756,122	6,177,610	House	0:00	0:00
289	763,626	6,159,059	House	0:00	0:00
292	763,589	6,157,116	House	0:00	0:00
293	763,774	6,157,321	House	0:00	0:00
294	763,788	6,157,906	House	0:00	0:00
295	763,686	6,158,691	House	0:00	0:00
296	762,349	6,151,049	House	0:00	0:00
297	761,266	6,149,013	House	0:00	0:00
299	758,916	6,171,252	House	0:00	0:00
301	753,763	6,167,042	House	0:00	0:00

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [M]	NORTH [m]		SHADOW HOURS PER YEAR [HR:MIN]	
302	753,001	6,178,275	House	0:00	0:00
304	763,957	6,179,671	House	0:00	0:00
305	743,862	6,172,688	House	0:00	0:00
306	753,076	6,153,090	House	0:00	0:00
307	744,056	6,158,429	House	0:00	0:00
308	744,694	6,173,848	House	0:00	0:00
309	746,355	6,177,963	House	0:00	0:00
311	754,661	6,176,630	House	0:00	0:00
313	747,948	6,151,241	House	0:00	0:00
314	749,549	6,178,176	House	0:00	0:00
317	763,359	6,156,176	House	0:00	0:00
318	763,356	6,156,164	House	0:00	0:00
319	763,355	6,156,150	House	0:00	0:00
320	763,354	6,156,141	House	0:00	0:00
321	763,346	6,156,125	House	0:00	0:00
322	763,354	6,156,108	House	0:00	0:00
323	763,357	6,156,090	House	0:00	0:00
324	763,334	6,156,081	House	0:00	0:00
325	763,351	6,156,055	House	0:00	0:00
326	763,343	6,156,039	House	0:00	0:00
327	763,352	6,156,016	House	0:00	0:00
328	763,341	6,155,971	House	0:00	0:00
329	763,353	6,155,946	House	0:00	0:00
330	763,355	6,155,924	House	0:00	0:00
331	763,355	6,155,907	House	0:00	0:00
332	763,348	6,155,876	House	0:00	0:00
333	763,371	6,155,870	House	0:00	0:00
334	763,407	6,155,872	House	0:00	0:00
335	763,419	6,155,873	House	0:00	0:00
336	763,446	6,155,866	House	0:00	0:00
337	763,391	6,156,208	House	0:00	0:00

HID	LOCATION (UTM WGS84 ZONE 53)		BUILDING TYPE	WORST-CASE SCENARIO	REALISTIC SCENARIO
	EAST [M]	NORTH [m]		SHADOW HOURS PER YEAR [HR:MIN]	
338	763,408	6,156,177	House	0:00	0:00
339	763,446	6,156,177	House	0:00	0:00
340	748,110	6,160,250	House	0:00	0:00
342	763,580	6,156,733	House	0:00	0:00
343	761,512	6,148,988	House	0:00	0:00
344	761,879	6,149,269	House	0:00	0:00
345	761,806	6,149,245	House	0:00	0:00
346	761,898	6,149,470	House	0:00	0:00
347	761,960	6,149,418	House	0:00	0:00
348	762,013	6,149,514	House	0:00	0:00
349	761,538	6,148,252	House	0:00	0:00
350	761,500	6,148,374	House	0:00	0:00
351	761,589	6,149,022	House	0:00	0:00
352	761,507	6,148,151	House	0:00	0:00
353	761,405	6,148,791	House	0:00	0:00
354	761,461	6,148,786	House	0:00	0:00
355	761,375	6,148,088	House	0:00	0:00

APPENDIX B

SHADOW FLICKER MAPS

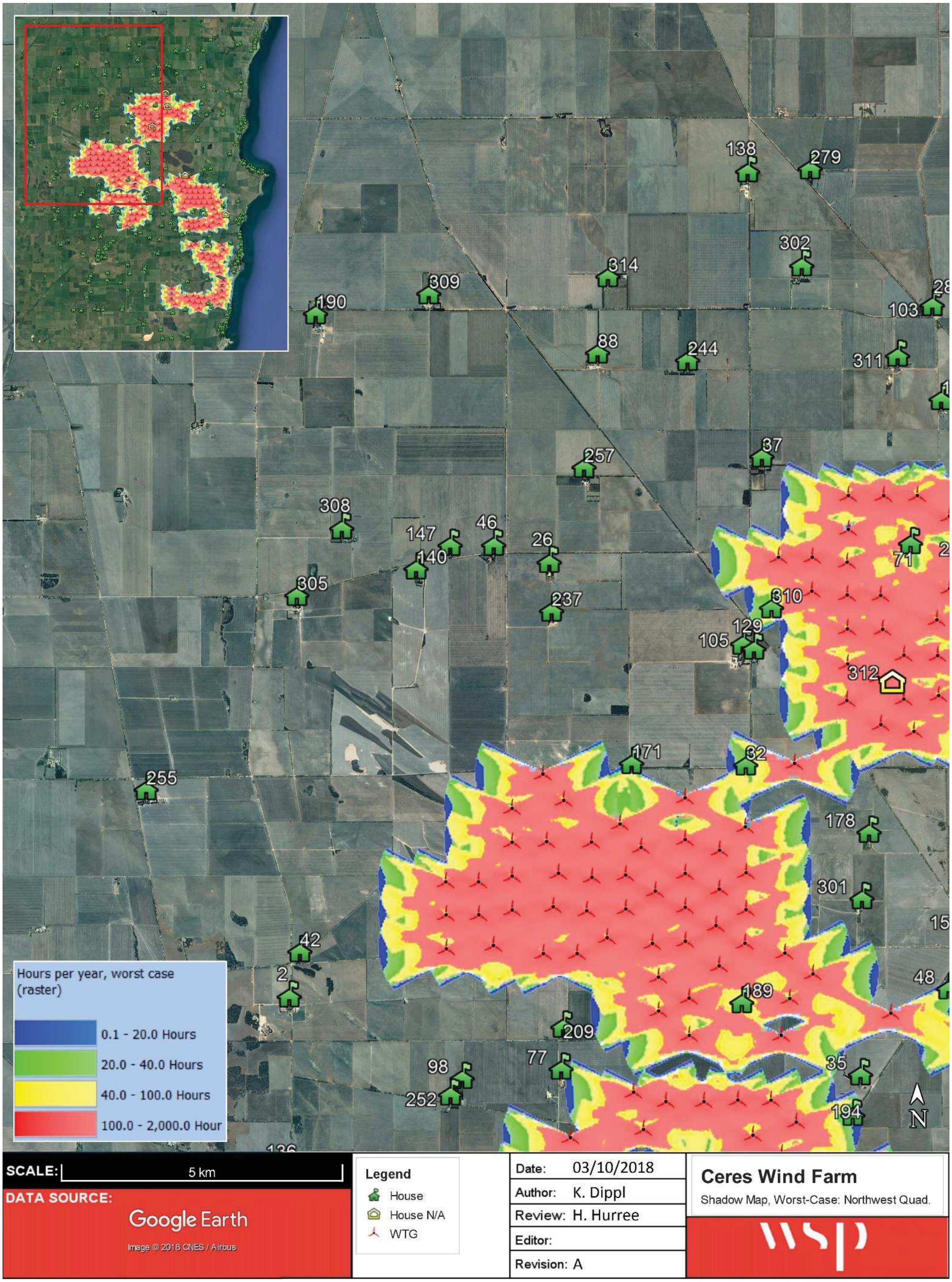

Figure B.1 Shadow flicker map: Worst-case, northwest quadrant, showing buildings “House” and “House N/A”

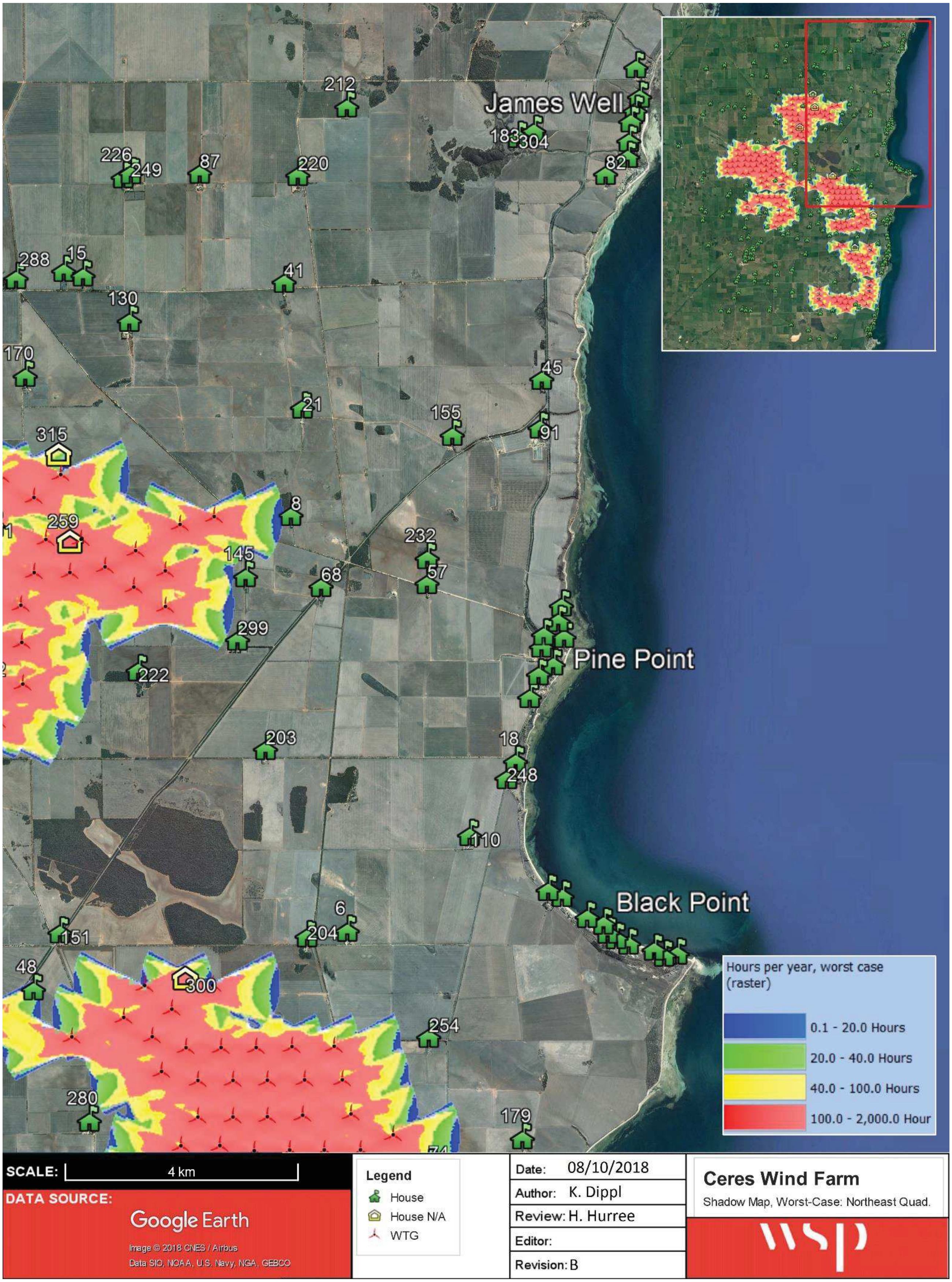

Figure B.2 Shadow flicker map: Worst-case, northeast quadrant, showing buildings “House” and “House N/A”

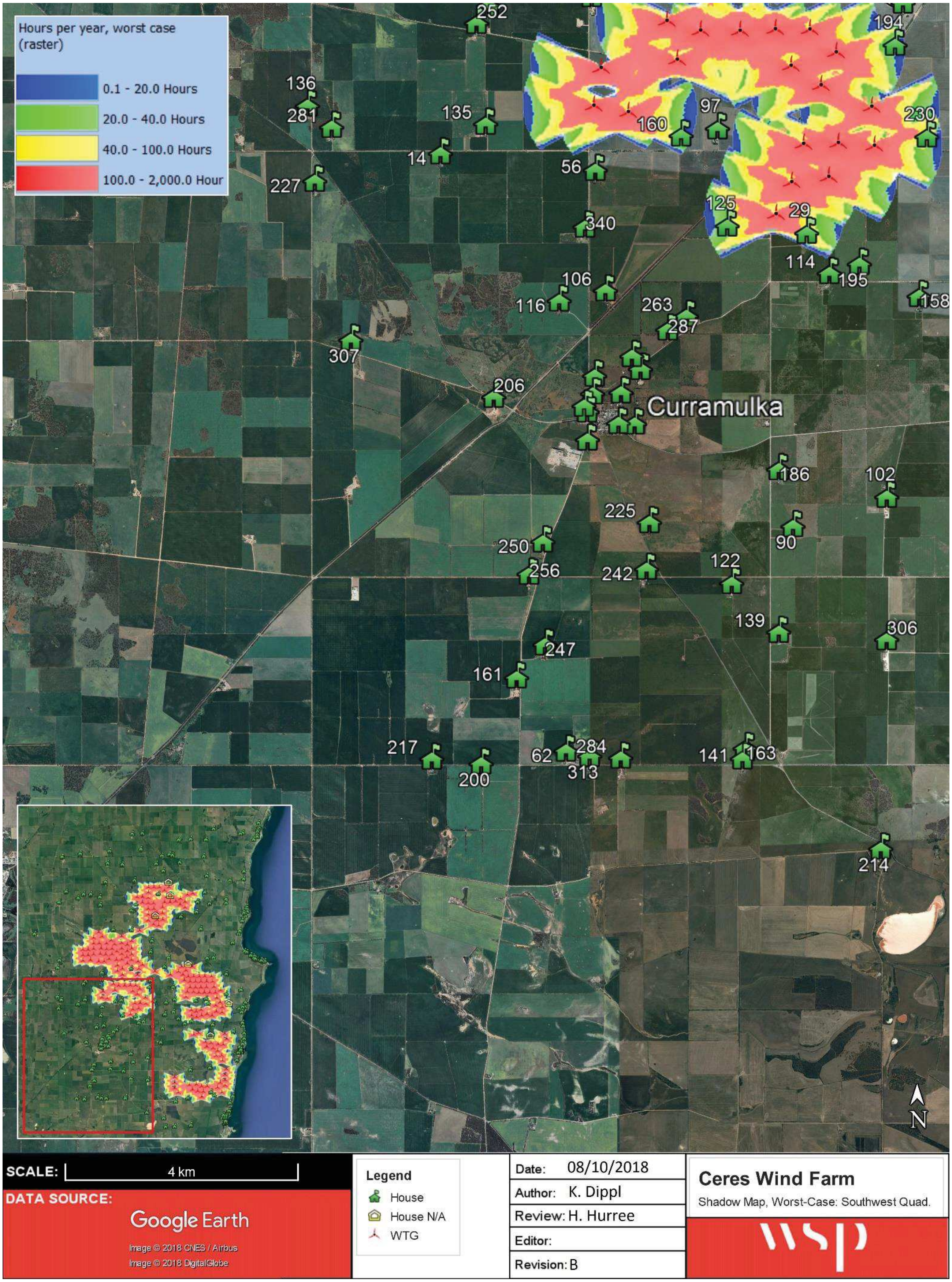

Figure B.3 Shadow flicker map: Worst-case, southwest quadrant, showing buildings “House” and “House N/A”

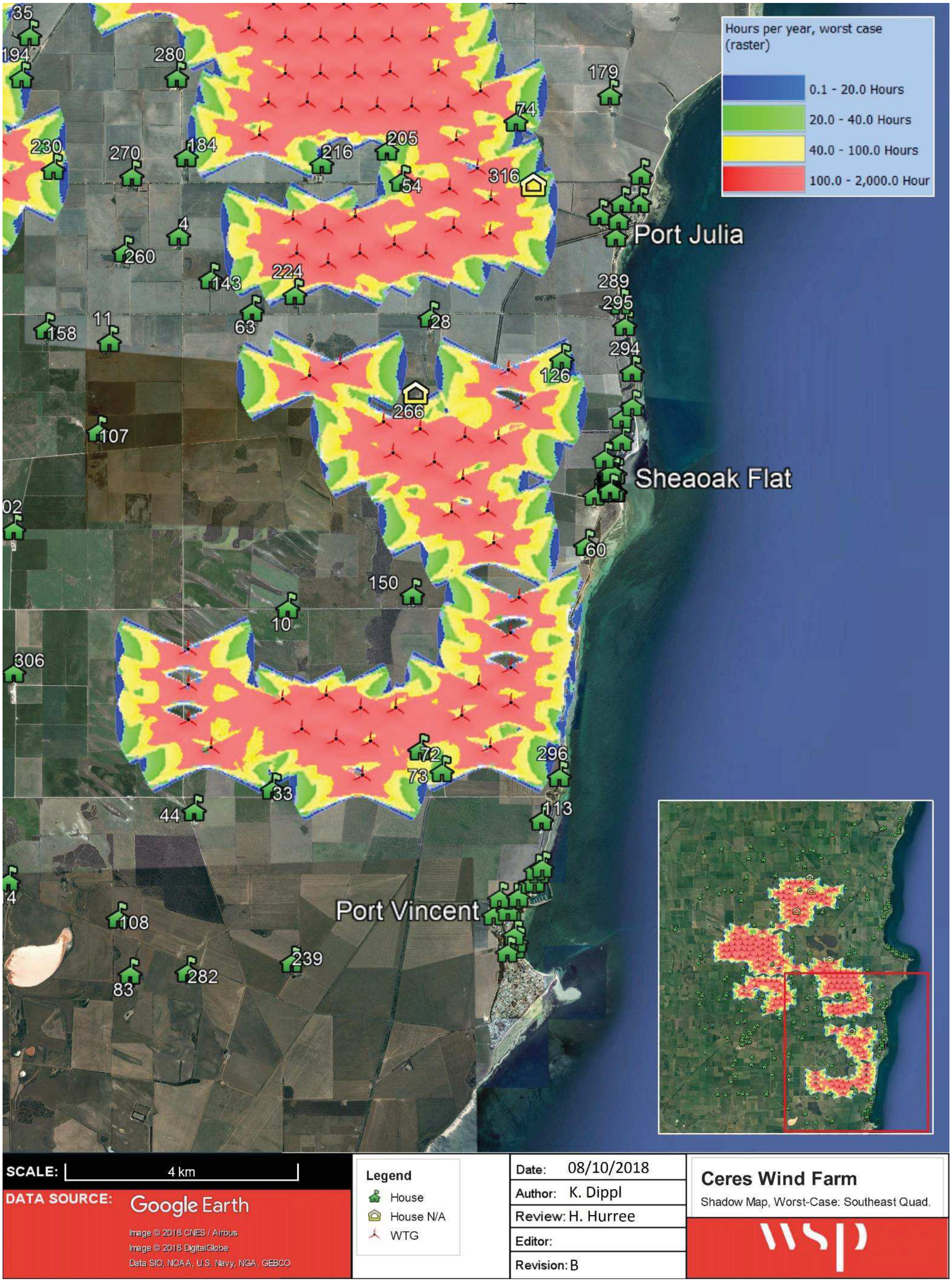

Figure B.4 Shadow flicker map: Worst-case, southeast quadrant, showing buildings "House" and "House N/A"

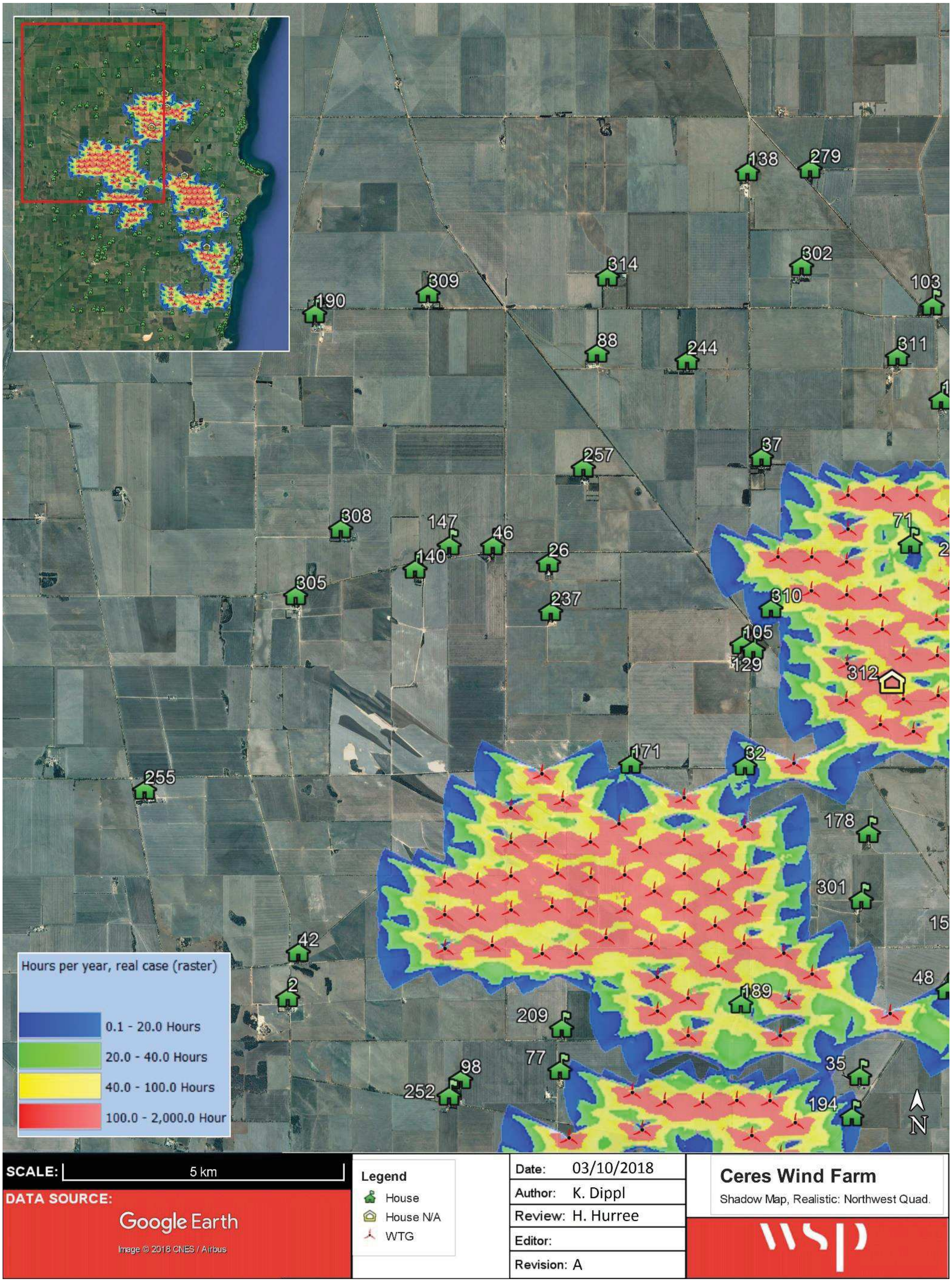

Figure B.5 Shadow flicker map: Realistic, northwest quadrant, showing buildings “House” and “House N/A”

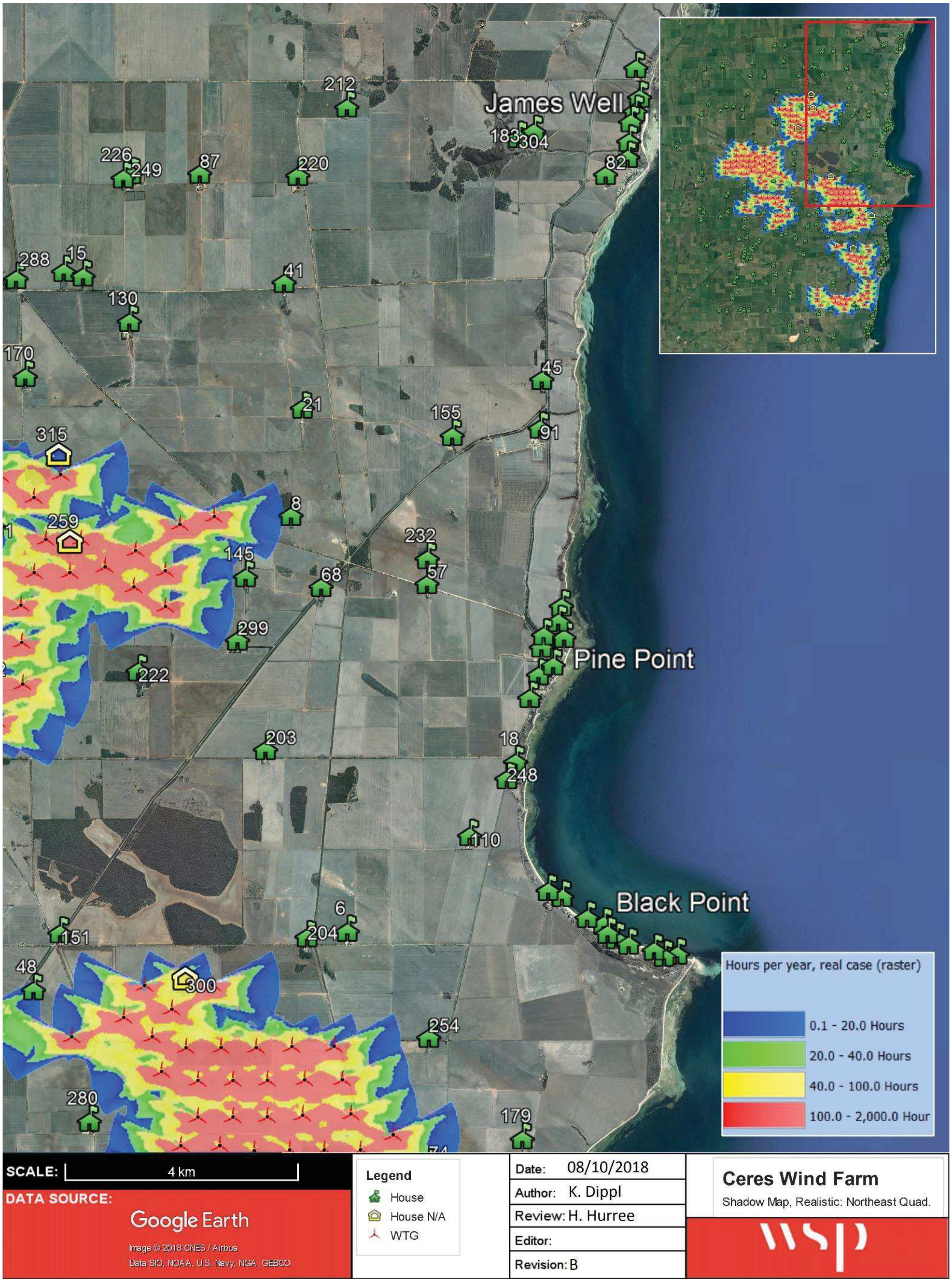

Figure B.6 Shadow flicker map: Realistic, northeast quadrant, showing buildings “House” and “House N/A”

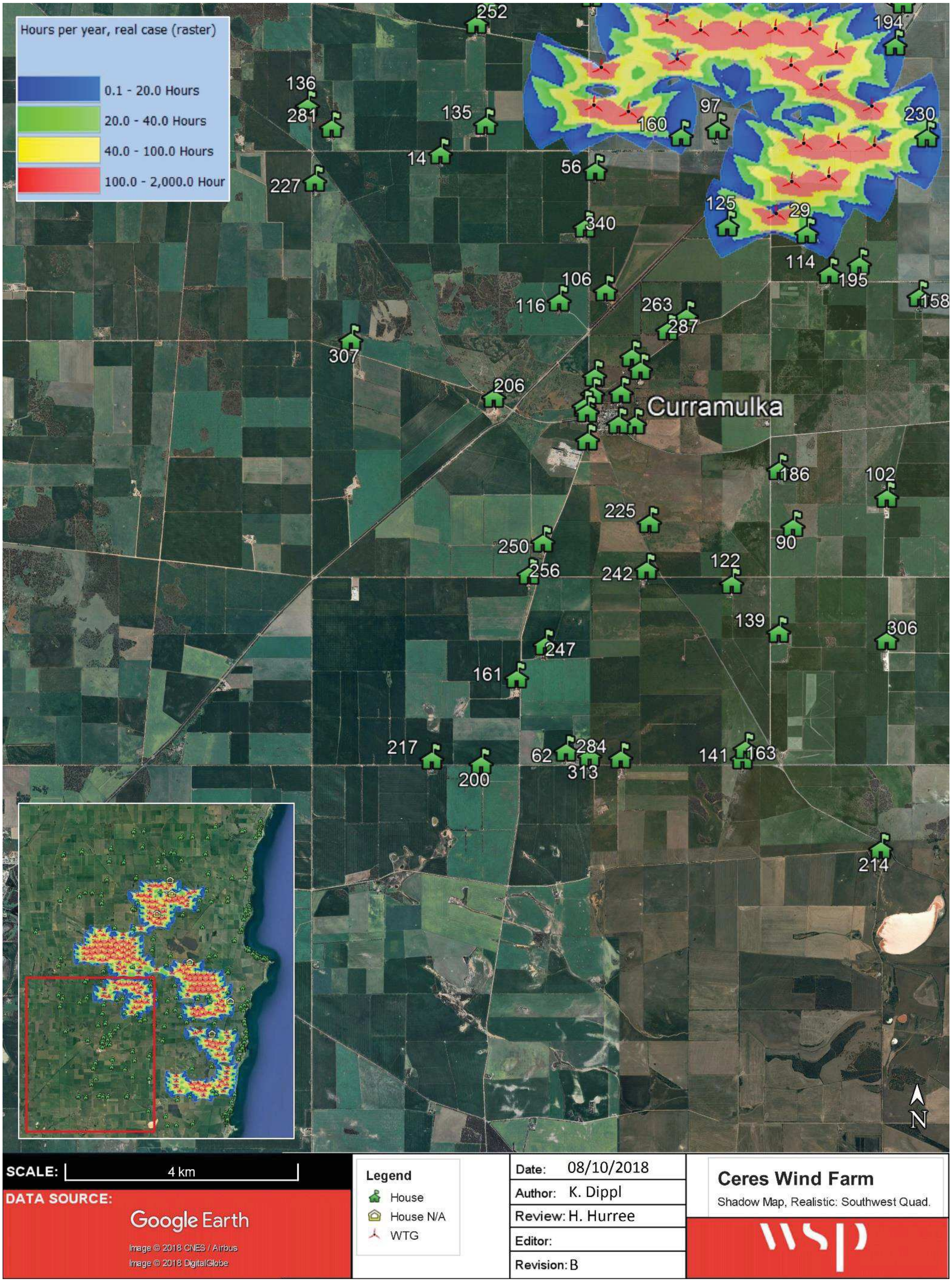

Figure B.7 Shadow flicker map: Realistic, southwest quadrant, showing buildings “House” and “House N/A”

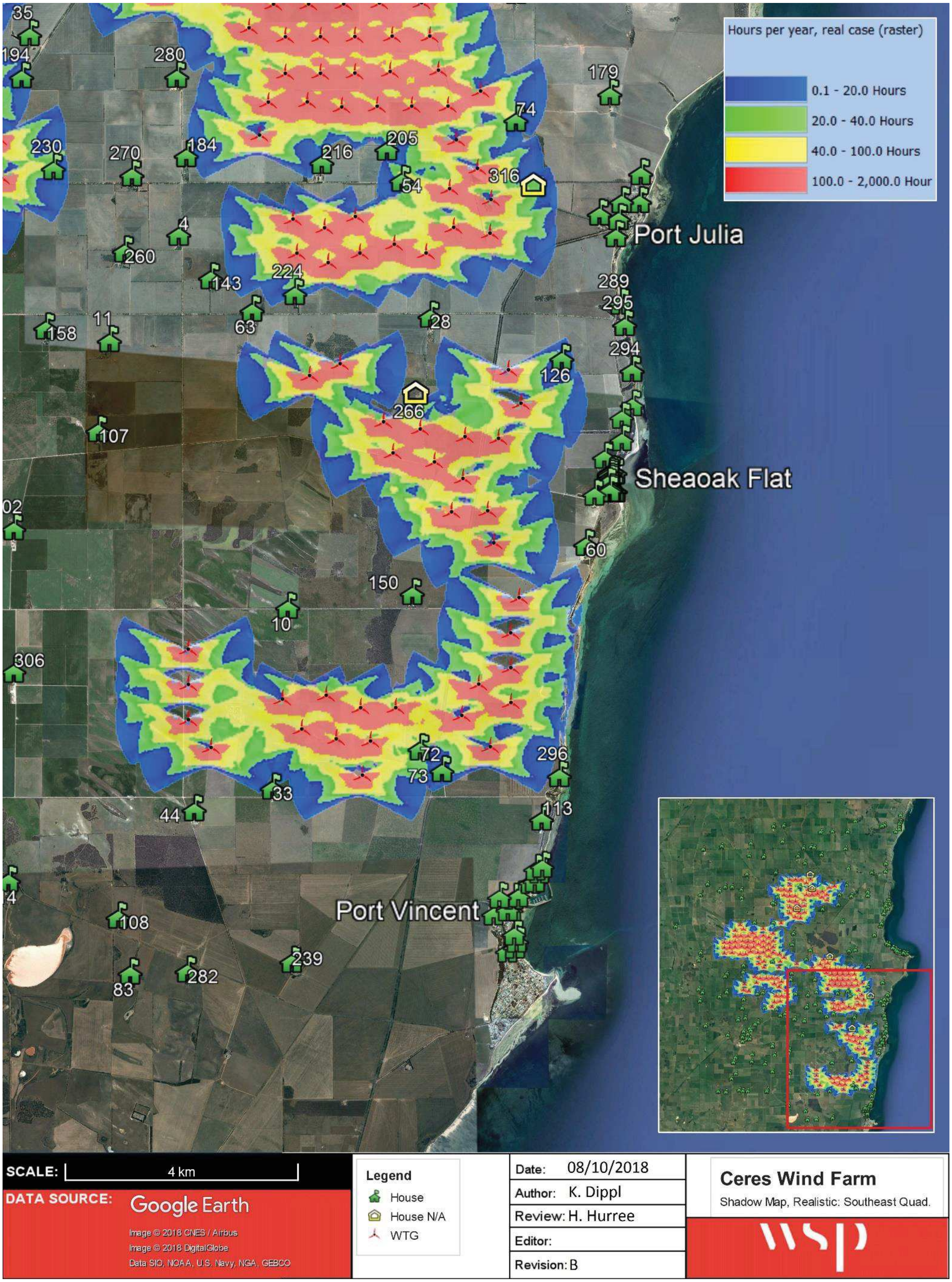

Figure B.8 Shadow flicker map: Realistic, southeast quadrant, showing buildings "House" and "House N/A"

APPENDIX C

WTG LAYOUT

Table C.1 CWF [2] WTG Layout configuration

WTG ID	EASTING [M]	NORTHING [M]	ELEVATION
	UTM WGS84 ZONE 53		MASL [M]
1	746367	6167155	110.2
2	746378	6167740	110.0
3	747194	6166591	120.0
4	746949	6167140	114.9
5	747546	6167209	120.0
6	746961	6167723	110.0
7	747561	6167808	110.0
8	747577	6168408	110.0
9	747592	6169008	104.6
11	748326	6162511	150.0
12	748469	6163149	150.0
13	748078	6166422	125.0
14	748678	6166407	130.0
15	748276	6167247	120.0
16	748870	6167159	120.0
17	748386	6167837	118.7
18	748190	6168404	110.0
19	748979	6167748	120.0
20	748988	6168371	120.0
21	748514	6169125	110.0
22	748159	6169600	110.0
23	748913	6162386	140.0
26	749773	6163256	160.0
28	750099	6165349	150.1
30	749220	6166671	130.0
31	749579	6167772	128.2
32	749504	6168679	114.6
35	749615	6163922	160.0
36	750185	6163741	160.0
38	750631	6164901	150.0
39	750648	6165563	146.1

WTG ID	EASTING [M]	NORTHING [M]	ELEVATION
	UTM WGS84 ZONE 53		MASL [M]
40	750114	6165949	140.0
41	750021	6166547	130.0
42	750609	6166571	140.0
43	749564	6167172	128.6
44	750099	6167473	130.0
45	750624	6167171	129.8
46	749867	6168253	125.2
47	750639	6167771	121.8
48	750654	6168371	120.0
49	750673	6169109	113.3
50	751673	6161120	144.5
52	751716	6163102	150.0
53	750861	6163720	160.0
54	751466	6163731	155.9
55	751199	6166118	140.0
56	751668	6166505	130.0
57	751703	6167099	140.0
58	751722	6167755	135.1
59	751260	6168164	121.9
60	751729	6168565	121.0
61	751895	6161766	150.0
62	752309	6161193	140.0
63	752489	6161765	137.3
64	752221	6162755	140.0
65	752495	6163310	150.0
66	752055	6163712	150.0
67	752438	6165504	150.0
68	752268	6164856	150.0
69	752371	6166312	140.0
70	752638	6169665	107.6
71	752453	6173321	110.0
72	753105	6161702	117.3

WTG ID	EASTING [M]	NORTHING [M]	ELEVATION
	UTM WGS84 ZONE 53		MASL [M]
73	753078	6162368	128.9
77	753599	6170754	106.4
78	753630	6171401	116.6
79	753029	6172707	115.4
80	753642	6172021	118.4
81	753657	6172621	119.6
82	753052	6173306	117.7
83	753670	6173201	120.0
84	753709	6173780	120.0
85	753725	6174380	120.0
88	754231	6165194	110.0
89	754192	6170309	110.0
90	754776	6170173	100.0
91	754165	6171150	124.7
92	754612	6170750	119.2
93	754636	6171526	122.3
94	754270	6171996	129.6
95	754251	6172597	120.0
96	754353	6174362	120.0
98	755233	6170795	99.6
99	755236	6171504	111.3
100	755239	6172137	113.7
101	755482	6172686	100.8
102	755698	6173244	99.0
103	754953	6174347	117.5
104	756047	6152388	70.0
105	756421	6151905	70.0
106	756064	6152988	71.1
107	756078	6153588	80.0
109	755899	6164767	90.0
110	756798	6165073	90.0
111	756092	6172670	89.7

WTG ID	EASTING [M]	NORTHING [M]	ELEVATION
	UTM WGS84 ZONE 53		MASL [M]
112	756298	6173228	85.2
113	756697	6172749	80.0
114	755515	6173965	103.6
115	755982	6174340	100.0
116	757665	6152693	60.0
118	757545	6162304	82.6
121	757711	6162860	96.1
122	757274	6164731	90.6
123	757417	6164135	98.8
124	757171	6165606	90.0
125	757178	6172392	80.0
126	757710	6172047	80.0
127	757227	6173010	80.4
128	757998	6173434	87.1
130	757980	6152175	60.0
131	758415	6152738	60.0
132	758564	6151991	50.0
136	758285	6158185	60.0
137	758126	6160273	63.8
138	758611	6160691	60.0
139	758656	6160098	60.0
140	758076	6160856	70.2
141	758016	6163341	100.0
142	758377	6162845	87.4
143	758615	6163325	94.0
144	757847	6164528	91.3
145	758034	6163964	100.0
146	758446	6164513	87.9
147	758634	6163948	96.0
148	757623	6165190	84.0
149	758332	6165579	74.8
150	757725	6172652	80.0

WTG ID	EASTING [M]	NORTHING [M]	ELEVATION
	UTM WGS84 ZONE 53		MASL [M]
151	758586	6173552	80.0
152	758995	6151360	40.0
153	758996	6152508	50.0
154	759149	6151937	40.0
155	759596	6152492	40.0
157	760150	6157221	50.0
158	759673	6156828	60.0
160	758813	6158372	60.0
165	759204	6160244	60.0
166	759144	6160869	60.0
167	758964	6162742	73.1
168	759203	6163313	75.8
169	759569	6162736	61.0
170	759046	6164497	80.0
171	759222	6163934	80.0
172	759658	6164496	70.0
174	760720	6152328	40.0
175	760377	6156655	50.0
176	760645	6155797	50.0
179	752862	6165929	137.1
180	759797	6160378	51.1
181	760335	6160213	50.0
182	760819	6160637	48.7
183	759807	6163322	61.3
184	760161	6162720	51.7
185	760634	6163320	50.0
186	760780	6162704	45.8
187	759858	6163923	66.1
188	760379	6164480	61.8
189	760503	6163906	60.0
190	761194	6151783	36.6
191	761567	6152524	32.7

WTG ID	EASTING [M]	NORTHING [M]	ELEVATION
	UTM WGS84 ZONE 53		MASL [M]
192	761025	6152853	40.0
194	761582	6153116	36.0
195	761597	6153709	37.9
197	761758	6154305	40.0
199	761351	6155249	48.6
200	760855	6156358	50.0
201	760911	6157069	50.0
202	761483	6157023	50.0
203	759526	6157362	57.2
205	761686	6158184	44.1
209	761437	6160520	40.0
210	760767	6161297	50.0
211	761255	6161629	49.5
212	761471	6161093	40.0
213	760907	6162126	41.9
214	761346	6162945	50.0
217	761262	6155797	50.0
219	761885	6157610	42.4
225	746356	6166555	112.2
226	751392	6160582	129.6
227	751161	6166833	123.9
228	751237	6167476	130.0

Appendix H

Noise Assessment

MARSHALL DAY Acoustics

CERES WIND FARM PROJECT
REVISED NOISE ASSESSMENT

Rp 001 R01 20180604 | 13 November 2018

MARSHALL DAY Acoustics

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Project:	**CERES WIND FARM PROJECT** **Revised Noise Assessment**
Prepared for:	**Yorke Peninsula Wind Farm Project Pty Ltd** **C/-** **Senvion Australia Pty Ltd** **Level 29** **80 Collins Street** **Melbourne VIC 3000**
Attention:	**Adam Gray**
Report No.:	**001 R01 20180604**

Document Control

Status:	Ver:	Comments	Date:	Author:	Reviewer:
Final		issued	31 Oct 2018	A. Morabito	C. Delaire/ J. Adcock
final	R01	Project name update	13 Nov 2018	A. Morabito	-

TABLE OF CONTENTS

1.0 INTRODUCTION

Yorke Peninsula Wind Farm Project Pty Ltd (the Proponent) has commissioned Marshall Day Acoustics Pty Ltd (MDA) to revise the noise predictions for the Ceres Wind Farm Project to reflect the latest wind farm proposal. The proposed layout considered in this assessment comprises one hundred and eighty-one (181) Senvion 4.2M140 wind turbines.

In February 2014, development approval was granted by the South Australian Minister for Planning for the development of the Ceres Wind Farm Project comprising up to one hundred and ninety-seven (197) wind turbines. The MDA report No. 001 R04 2012124ML dated 19 July 2013 (the 2013 Report) formed part of the development application submitted to the South Australian Development Assessment Commission and was based on one hundred and ninety-nine (199) Senvion 3.2M114 wind turbines.

An amended turbine layout comprising one hundred and eighty-seven (187) Senvion 3.4M140 wind turbines was assessed in 2017, and details presented in MDA report No. 002 R01 2012124ML dated 9 March 2017 (the 2017 report). The 2017 report formed part of the amended development application, with development approval subsequently approved in August 2017.

This revised noise assessment has been undertaken in accordance with the South Australia Environment Protection Authority (SA EPA) document *Wind farms environmental noise guidelines* (the Guidelines), which was published in July 2009.

Acoustic terminology used throughout this report is presented in Appendix A.`

2.0 PROJECT DESCRIPTION

2.1 Wind farm layout

The Ceres Wind Farm Project has been approved for development. The amended development approval, DA 544/V001/13 V2 was issued on 29 August 2017 by the Minister for Planning.

The amended development was approved for up to one hundred and eighty-seven (187) wind turbines, however the Proponent has advised that the latest wind farm proposal consists of up to one hundred and eighty-one (181) Senvion 4.2M140 wind turbines.

The site layout used for the purpose of this assessment is presented in Appendix B together with coordinates for the wind turbines and nearby residential properties.

2.2 Wind turbine

2.2.1 Turbine type

To accommodate the physical characteristics of the most suitable wind turbine model available at commencement of construction and application of best-fit technology for the project, the physical parameters of a current available candidate turbine model have been increased to be consistent with the proposed maximum tip height of 220 m. As such, the noise modelling for this assessment is based on a 4.2M140 candidate turbine model with an increased rotor diameter of 160 m (in lieu of 140 m) and a hub height of 140 m.

The turbine model and characteristics modelled for this project is detailed in Table 1.

Table 1: WTG manufacturer specifications

Item	Details
Make	Senvion
Model	4.2M140
Rated power	4.2 MW
Rotor diameter	160 m
Hub height	140 m
Overall tip height	220 m
Rotor speed	5 to 10 rpm
Wind Speed range	3 to 22 (hub height, m/s)

2.2.2 Sound power levels

Sound power levels used in the assessment for the purpose of modelling the 4.2M140 candidate turbine, have been sourced from the Senvion documents presented in Table 2.

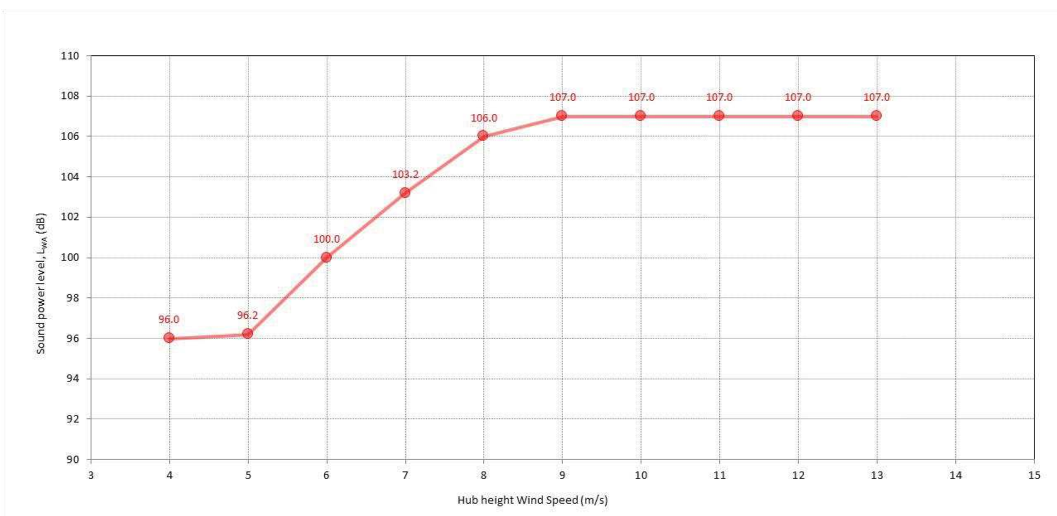
Table 2: Reference documents

Parameter	Reference document
Overall and octave band sound power level	Senvion document No. SD-3.52-WT.PC.01-B-EN-A *Power Curve & Sound Power Level [4.2M140 EBC/50Hz/open mode] (preliminary),* dated 11 April 2018
Tonality	Senvion document No. SD-3.52-WT.PC.01-B-EN-A *Power Curve & Sound Power Level [4.2M140 EBC/50Hz/open mode] (preliminary),* dated 11 April 2018

The Senvion documents in Table 2, state that the reported sound power levels exclude measurement uncertainty. For the purpose of this assessment, 2 dB has been added to the reported sound power levels as an upper allowance for measurement uncertainty, consistent with advice received from Senvion for this assessment.

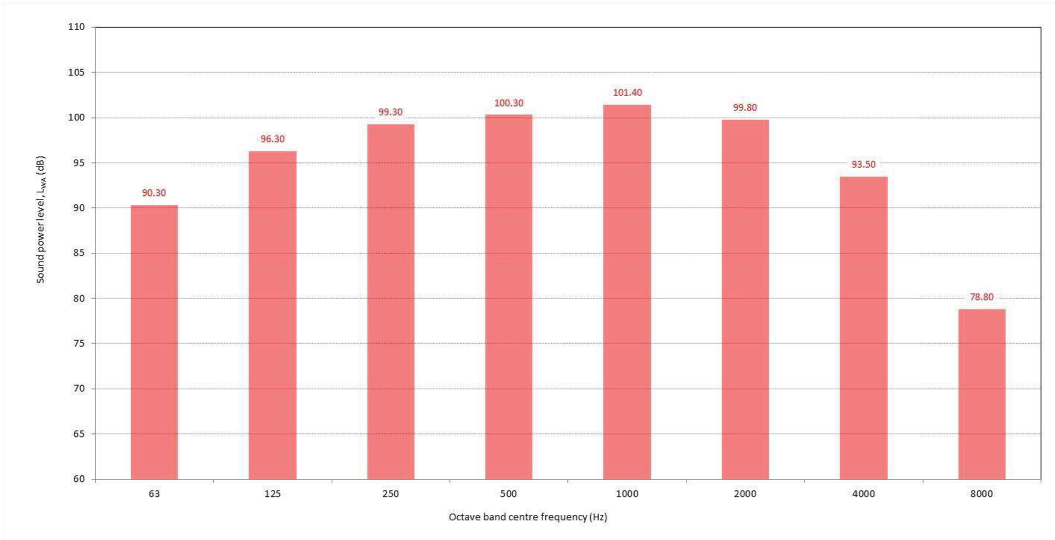
The resulting profile of A-weighted sound power levels as a function of hub height wind speed (including the +2 dB adjustment for uncertainty), are presented in Figure 1.

Figure 1: Sound power level vs. hub height wind speed (including + 2 dB uncertainty)



The octave band values provided in the reference documents, adjusted by the addition of +2 dB for uncertainty, are presented in Figure 2.

Figure 2: A-weighted reference octave band sound power level spectrum (including +2 dB uncertainty)



2.2.3 Tonality

We have been advised by the manufacturer, Senvion, that there is currently no installed prototype of the candidate turbine model and therefore measured data regarding tonality is not yet available.

In the absence of test data, Senvion states, in document No. Senvion document No. *SD-3.52-WT.PC.01-B-EN-A Power Curve & Sound Power Level [4.2M140 EBC/50Hz/open mode] (preliminary)*, dated 11 April 2018the following performance specification for the 4.2M140 turbine:

> *There is no tonal audibility $\Delta L_{a.k} > 2$ dB (for $V_{10} \geq 6$ m/s).*

It is unlikely that a tonal audibility $\Delta L_{a.k}$ less than +2 dB measured in close proximity of a turbine would attract a penalty for tonality at a receiver location.

Therefore, for the purpose of this current assessment, no penalty for tonality has been applied to the predicted wind farm noise levels.

3.0 ASSESSMENT

3.1 Noise limits

A review of the preliminary noise predictions indicated the Ceres Wind Farm Project is expected to comply with the relevant base noise limits at all identified properties. Accordingly, consideration of the background noise dependant noise limits is not required to demonstrate compliance with the Guidelines.

Determination of the relevant base noise limits in accordance with the Guidelines is detailed in Section 3.3 of the 2013 Report which was based on the *Yorke Peninsula Council Development Plan,* consolidated 28 March 2013. A review of the latest Development Plan, consolidated 31 October 2017 showed there has been no change to the land zoning in the vicinity of the subject site. The base noise limits used in the 2013 and 2017 Reports are therefore still applicable.

Notwithstanding this, background noise monitoring has previously been completed as detailed in Section 5.0 of the 2013 Report.

3.2 Noise predictions

Noise levels from the Ceres Wind Farm Project have been predicted using the implementation of ISO 9613-2:1996[1] with SoundPLAN version 8.0 noise modelling software. This latest version of the software considers the corrections for screening and ground effects recommended by the UK Institute of Acoustics[2].

Predictions have been carried out using the sound power level data presented in Section 2.2.2.

Calculations have been performed using octave bands from 63 Hz to 8 kHz and each wind turbine has been modelled as a point source at hub height. All noise predictions use a receiver height of 1.5 m above the local ground level. Possible screening effects from the landscape are considered using level contour information. Atmospheric attenuation has been modelled using a temperature of 10 °C and 80 % humidity as recommended by the Guidelines.

The hardness of the ground between the sources and the receivers needs to be defined in accordance with ISO 9613-2:1996. A surface characterised as 100 % hard ground (G=0) is considered to be fully reflective, as would occur with concrete or asphalt, while 100 % soft ground (G=1) would be considered porous and be appropriate for fields and grass. Our experience is that, in rural areas, it is appropriate to assume that the ground is 50 % hard/50 % soft. 50 % soft ground (G=0.5) has been used in the predictions.

As detailed in Section 2.2.3, it is considered that a tonal correction need not apply for any of the assessed wind speeds.

The revised predicted noise levels are presented in Table 3 for the wind speed corresponding to the highest noise emission of the turbines. The predictions are presented for the receiver locations where the predicted wind farm noise level for this revised layout are above 35 dB. For context, the highest predicted noise levels using the layout presented in the 2017 Report are also provided.

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[1] ISO 9613-2:1996 *Acoustics - Attenuation of sound during propagation outdoors Part 2: General method of calculation* (ISO9613-2:1996)

[2] UK Institute of Acoustics *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise* dated May 2013

Table 3: Highest predicted noise levels, dB L_{Aeq} (10 m/s at hub height) at assessed relevant receivers

House	Revised Layout (assessed in this report)	2017 Report layout
4	35.8	34.1
6	35.8	33.8
10	37.3	35.5
28	39.7	39.7
33	37.5	35.6
35	39.2	37.3
37	36.1	34.2
56	36.0	34.0
63	37.8	36.8
97	39.0	37.1
105	37.8	35.8
114	35.2	33.1
125	37.5	35.6
129	38.3	36.4
143	36.3	34.9
145	37.3	35.4
150	38.2	36.4
151	37.4	35.5
170	36.1	34.1
178	37.5	35.5
195	35.2	33.1
204	37.2	35.3
209	39.4	37.5
222	37.8	35.8
253	35.5	33.6
254	37.3	35.4
270	35.8	33.9
280	38.7	36.9
299	35.5	33.5
301	38.3	36.4

As can be seen in Table 3, predicted wind farm noise are below the base noise limit, 40 dB L_{Aeq} at all wind speeds at all assessed receivers.

Wind farm noise at all remaining properties in the vicinity of the wind farm have been predicted below 35 dB L_{Aeq} and therefore also below the relevant base noise limit at all wind speeds.

Predicted noise levels at all properties identified in the vicinity of the proposed wind farm are presented in Appendix E within the range of assessed wind speeds.

A noise contour map presenting predicted noise levels at the wind speed corresponding to the highest sound power level (10 m/s at hub height) is also provided in Appendix F.

Compliance with the wind dependant noise limits is therefore also demonstrated.

4.0 RESPONSE TO PLANNING CONDITIONS

Development Approval DA 544/V001/13 V2 dated 29 August 2017 details the following noise related conditions:

20. Compliance with the noise limits defined in the Guidelines
21. Maximum sound power level requirements for the considered turbine model
22. Tonality requirements for the considered turbine model
23. Noise contribution from the Port Julia converter station
24. Post-construction noise monitoring requirements
25. Noise mitigations in the event of non-compliance with Clause 24
26. Noise assessment requirement for the Globe Derby Park converter station.

The above clauses are reproduced in Appendix C for reference.

Compliance with Clauses 20, 21 and 22 are discussed in the following sections.

4.1 Condition 20 – Compliance with SA EPA Guidelines

Condition 20 of the Development Approval states the following:

> *Noise levels at the noise sensitive receivers around the Wind Farm development are to meet requirements of the SA EPA Wind Farms: Environmental Noise Guidelines 2009. The noise level at the relevant receivers* must not exceed:*
>
> *a) 40dB(A) for noise sensitive receivers in the Primary Production Zone or zones other than Rural Living,*
>
> *b) 35dB(A) if receivers are situated in the Rural Living zone, or*
>
> *c) the background noise ($L_{A90,10}$) by more than 5dB(A).*
>
> *whichever is the greater, at all relevant receivers for wind speed from cut-in to rated power of the WTG and each integer wind speed in between.*

Compliance with the requirement of Condition 20 is detailed in Section 3.2 of this report.

4.2 Condition 21 – Maximum sound power levels

Condition 21 of the Development Approval states the following:

> *Warranted maximum sound power characteristic for the wind turbine generators installed in accordance with the proposed layout must not exceed levels shown in Tables 4 and 5 of the acoustic report (CERES Project: Revised Noise Assessment, Report No. 002 R01 2012124ML, prepared by Marshall Day Acoustics, 9 March 2017). The warranted sound power levels must be measured and reported in accordance with IEC61400-1, Ed.3.0: Wind turbines - Part 11: Acoustic noise measurements techniques*

Condition 21 establishes a requirement to compare the noise emissions of the turbines documented in the 2017 report with those of the turbines that are to be installed at the site.

It is however noted that the requirement with respect to maximum noise emissions makes specific reference to the warranted sound power characteristics for the *wind turbine generators installed in accordance with the proposed layout*. The layout that the amended Development Approval was provided for, comprised 187 turbines. The layout considered in this assessment has however been reduced to a total of 181 turbines and includes minor location changes as part of the detailed design development of the wind farm layout.

It is therefore unclear if the requirement of Condition 21 remains strictly applicable to the revised layout that is considered in this assessment. In this respect, it is relevant to note that the predicted noise levels at sensitive receiver locations have changed as a result of the net effect of turbine emission changes, the wind farm layout reduction and minor turbine location amendments. In particular, the predictions demonstrate that the highest predicted noise levels associated with the revised wind farm layout and configuration are up to 2.1 dB higher than those of the 2017 report proposal at the receivers detailed in Table 3.

Notwithstanding the above, the following sections provide a comparison of the noise emissions for the turbine type considered in the 2017 report and the currently proposed turbine.

4.2.1 Overall values

The reference sound power levels detailed in Section 2.2.2 are compared in Figure 3 and Table 4 with the sound power levels detailed the 2017 Report.

To provide a meaningful comparison, the data is presented with adjustments for uncertainty, noting the 2017 report values, referred in Condition 21, also included an adjustment for uncertainty.

Figure 3: Comparison of A-weighted reference sound power level

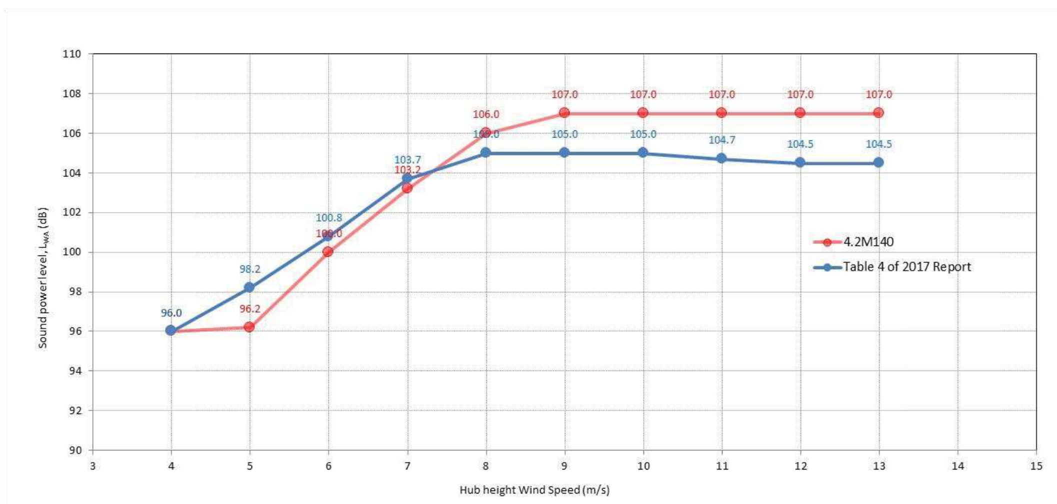


Table 4: Sound power levels vs. hub height wind speed, L_{WA} dB

Turbine	Hub height wind speed (m/s)									
	4	5	6	7	8	9	10	11	12	≥13
3.4M140 (Table 4 of 2017 Report)	96.0	98.2	100.8	103.7	105.0	105.0	105.0	104.7	104.5	104.5
4.2M140 (this assessment)	96.0	96.2	100.0	103.2	106.0	107.0	107.0	107.0	107.0	107.0
Comparison	0.0	-2.0	-0.8	-0.5	1.0	2.0	2.0	2.3	2.5	2.5

The maximum reference sound power level for the Senvion 4.2M140 (107.0 dB L_{WA}) considered in this assessment is 2.0 dB higher than that of the Senvion 3.4M140 (105.0 dB L_{WA}).

4.2.2 Spectral values

The reference A-weighted sound power level spectrum detailed in Section 2.2.2 are compared in Figure 4 and Table 5 with the spectrum detailed in Table 5 of the 2017 Report.

To provide a meaningful comparison, the data is presented with adjustments for uncertainty, noting the 2017 report values, referred in Condition 21, also included an adjustment for uncertainty.

Figure 4: Comparison of A-weighted reference octave band sound power level spectrum

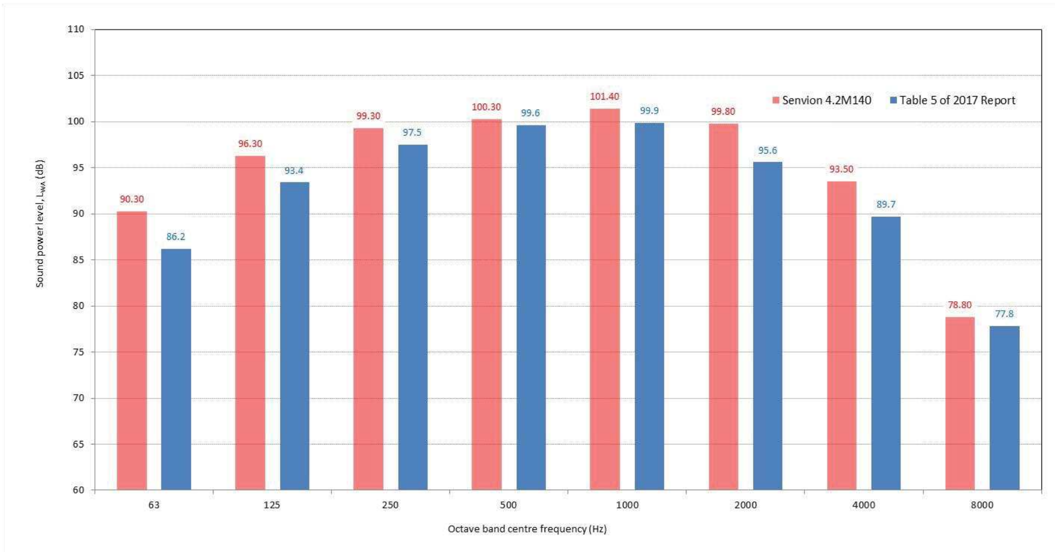


Table 5: Comparison of A-weighted reference octave band sound power level spectrum

Turbine	Octave Band Centre Frequency (Hz)							
	63	125	250	500	1000	2000	4000	8000
3.4M140 (Table 4 of 2017 Report)	86.2	93.4	97.5	99.6	99.9	95.6	89.7	77.8
4.2M140 (this assessment)	90.3	96.3	99.3	100.3	101.4	99.8	93.5	78.8
Comparison	4.1	2.9	1.8	0.7	1.5	4.2	3.8	1.0

The reference octave band sound power levels for the Senvion 4.2M140 considered in this assessment are higher than that of the Senvion 3.4M140.

4.3 Condition 22 – Tonality

Condition 22 of the Planning conditions states the following:

> *Noise emission of wind turbine generators (WTGs) intended for installation must not include tones audible at the noise receivers (Delta ΔLa,k>0). The tonality test procedure is defined in IEC 61400-11, Ed.3.0: Wind turbines - Part 11: Acoustic noise measurement techniques. It is desirable that the applicant confirms the absence of audible tones by submitting relevant technical documentation before commencing construction of the wind farm. In case the applicant is unable to confirm the absence of tones by submitting relevant technical documentation, the absence of the tones must be confirmed by results of the test performed at locality No.189 as shown in the acoustic report (CERES Project: Revised Noise Assessment, Report No. 002 R01 2012124ML, prepared by Marshall Day Acoustics, 9 March 2017).*

Test emission data for the candidate turbines is presently not available. However, the manufacturer warrants that the tonal audibility ($\Delta L_{a,k}$) near to the turbines will be less than or equal to 2 dB at IEC 61400-11 test locations near to the turbines. Based on compliance with this warranty, it is considered unlikely that tones corresponding to tonal audibility ($\Delta L_{a,k}$) greater than 0 dB would occur at receiver locations. However, in the absence of test literature to verify the absence of tonality, in accordance with clause 22, it will be necessary to conduct testing at locality No.189 to verify the emission characteristics of the turbine.

5.0 CONCLUSION

A revised noise assessment for the approved Ceres Wind Farm Project has been performed in accordance with the requirements of the South Australia Environment Protection Authority *Wind farms environmental noise guidelines* for the current proposed layout comprising one hundred and eighty-one (181) Senvion 4.2M140 turbines.

Predicted noise levels have been calculated at all properties identified in the vicinity of the project using the ISO9613-2:1996 algorithm and compared with the relevant base noise limits, which are independent on background noise levels.

Although the proposed wind turbine has higher noise emissions than considered in the previous assessment, with the reduced number of turbines, predicted wind farm noise levels are below the relevant base noise limits at all identified properties.

If the turbine selection and/or layout are to be changed, compliance with the relevant noise limit will need to be reassessed.

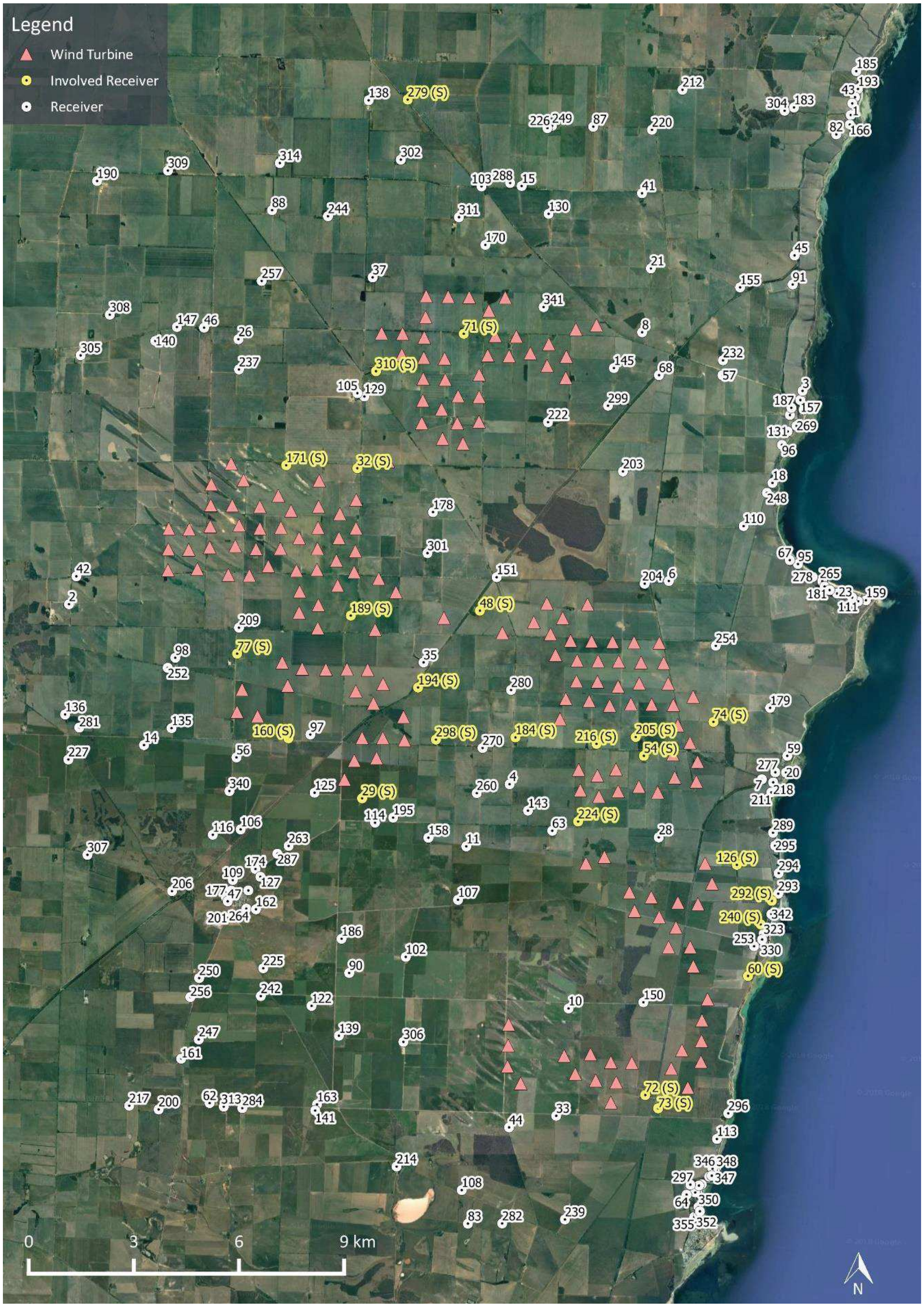
6.0 SUMMARY OF PARAMETERS

Documentation of relevant parameters as required by the Guidelines is contained in Appendix G.

APPENDIX A GLOSSARY OF TERMINOLOGY

Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dB	Decibel. The unit of sound level.
Frequency	The number of pressure fluctuation cycles per second of a sound wave. Measured in units of Hertz (Hz).
Hertz (Hz)	Hertz is the unit of frequency. One hertz is one cycle per second. One thousand hertz is a kilohertz (kHz).
L_{A90}	The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level.
L_{Aeq}	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level.
Octave Band	A range of frequencies where the highest frequency included is twice the lowest frequency. Octave bands are referred to by their logarithmic centre frequencies, these including 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz, and 16 kHz for the audible range of sound.
L_W	Sound Power Level A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.

APPENDIX B CERES WIND FARM PROJECT LAYOUT



B1 Turbine coordinates (MGA94 Zone 53)

Wind turbine	Easting (m)	Northing (m)
001	746367.1	6167155.1
002	746378.2	6167739.7
003	747194.3	6166590.7
004	746948.6	6167140.2
005	747546.1	6167208.7
006	746960.7	6167723.5
007	747561.1	6167808.2
008	747576.6	6168408.4
009	747591.8	6169007.8
011	748325.7	6162510.5
012	748469.4	6163148.6
013	748078.5	6166421.7
014	748678.3	6166407.1
015	748276.2	6167246.6
016	748869.7	6167158.6
017	748386.0	6167836.5
018	748190.3	6168403.7
019	748979.5	6167748.5
020	748977.3	6168371.5
021	748514.5	6169125.3
022	748159.1	6169600.0
023	748912.7	6162386.3
026	749772.6	6163256.4
028	750098.9	6165349.2
030	749219.5	6166671.1
031	749579.0	6167772.3
032	749504.4	6168679.3
035	749614.9	6163921.8
036	750185.3	6163740.9
038	750631.2	6164900.7
039	750647.7	6165562.7
040	750113.8	6165949.0
041	750021.2	6166547.2
042	750609.1	6166570.8
043	749564.4	6167172.5
044	750098.8	6167472.7
045	750624.1	6167171.3
046	749867.0	6168252.5
047	750639.1	6167771.1
048	750654.1	6168370.9
049	750672.6	6169109.1
050	751673.0	6161119.8
052	751716.3	6163101.9
053	750860.7	6163720.1
054	751465.6	6163731.3
055	751198.5	6166117.8
056	751668.4	6166505.3
057	751703.2	6167099.0
058	751722.4	6167754.7
059	751260.2	6168164.1
060	751729.3	6168565.4
061	751895.3	6161766.1
062	752309.4	6161192.7
063	752488.6	6161765.3
064	752220.8	6162755.2
065	752494.5	6163309.7
066	752054.7	6163712.3
067	752438.0	6165504.3
068	752268.0	6164855.6
069	752371.4	6166312.0
070	752637.9	6169665.1
071	752452.6	6173321.4
072	753104.9	6161702.1
073	753077.7	6162367.6
077	753598.8	6170753.9
078	753629.7	6171400.8
079	753029.0	6172706.6
080	753642.3	6172020.7
081	753656.7	6172620.5
082	753052.4	6173306.1
083	753669.8	6173200.7
084	753709.0	6173780.0
085	753724.6	6174379.8
088	754230.7	6165194.2
089	754192.0	6170309.1
090	754776.2	6170172.6
091	754164.8	6171149.8
092	754611.9	6170749.7
093	754636.3	6171526.0
094	754270.1	6171995.8
095	754251.2	6172597.0
096	754353.1	6174362.4
098	755233.1	6170795.1
099	755236.0	6171504.1
100	755239.1	6172136.9
101	755481.8	6172685.6
102	755698.1	6173244.1
103	754952.9	6174346.9
104	756047.3	6152388.4
105	756421.4	6151905.2
106	756064.1	6152988.1
107	756078.1	6153588.0
109	755899.2	6164766.5
110	756797.6	6165073.0
111	756092.4	6172669.7
112	756297.9	6173228.4
113	756697.2	6172749.0
114	755514.5	6173964.9
115	755982.4	6174340.4
116	757664.8	6152693.1
118	757545.1	6162303.9
121	757711.1	6162883.2
122	757274.3	6164731.1
123	757417.1	6164135.2
124	757170.5	6165606.1
125	757178.5	6172391.9
126	757710.1	6172046.6
127	757227.2	6173010.4
128	757998.1	6173434.2
130	757980.4	6152175.5
131	758414.7	6152738.0
132	758563.9	6151990.9
136	758284.7	6158184.9
137	758126.2	6160273.1
138	758611.5	6160691.3
139	758656.4	6160098.0
140	758076.3	6160856.4
141	758015.5	6163385.8
142	758377.4	6162819.7
143	758615.3	6163370.4
144	757846.5	6164542.8
145	758034.1	6163978.6
146	758446.4	6164522.8
147	758633.9	6163963.3
148	757623.3	6165190.3
149	758331.6	6165579.4
150	757725.2	6172651.6
151	758586.4	6173552.1
152	758995.4	6151360.4
153	758995.7	6152507.9
154	759149.1	6151937.1
155	759595.5	6152492.1
157	760149.8	6157220.8
158	759673.2	6156827.5
160	758812.6	6158371.9
165	759203.5	6160243.8
166	759143.7	6160868.8
167	758963.6	6162692.1
168	759203.4	6163237.8
169	759568.9	6162736.2
170	759046.3	6164509.4
171	759221.6	6163948.2
172	759658.2	6164495.8
174	760720.3	6152328.5
175	760376.8	6156654.6
176	760644.6	6155796.6
179	752862.1	6165929.2
180	759796.5	6160377.9
181	760334.8	6160213.4
182	760819.1	6160637.5
183	759807.4	6163321.8
184	760160.5	6162720.4
185	760633.9	6163320.2
186	760779.5	6162703.7
187	759858.2	6163922.6
188	760379.5	6164480.3
189	760503.4	6163905.8
190	761193.7	6151782.8
191	761567.2	6152523.6
192	761024.7	6152852.9
194	761582.0	6153116.2
195	761596.6	6153708.7
197	761757.6	6154304.6
199	761351.2	6155248.6
200	760855.2	6156358.4
201	760910.8	6157069.0
202	761483.0	6157023.2
203	759525.6	6157361.7
205	761685.8	6158184.3
209	761436.8	6160520.0
210	760767.4	6161297.5
211	761254.8	6161629.1
212	761471.2	6161093.1
213	760907.4	6162125.7
214	761345.7	6162944.7
217	761262.1	6155796.6
219	761884.6	6157609.5
225	746355.7	6166555.2
226	751392.0	6160581.7
227	751161.5	6166833.3
228	751236.6	6167476.1

B2 Dwellings coordinates (MGA94 Zone 53)

House	Easting (m)	Northing (m)
3	764470	6171674
4	756107	6160444
6	760651	6166246
7	763307	6160586
8	759890	6173346
10	757790	6154044
11	754872	6158670
14	745672	6161563
15	756451	6177522
18	763610	6169046
20	763998	6160778
21	760140	6175169
23	765885	6165776
26	748366	6173148
28	760365	6158928
29 (S)	751897	6160043
32 (S)	751761	6169465
33	757438	6150978
34	764499	6171138
35	753651	6163922
37	752198	6174914
41	759886	6177315
42	743741	6166380
44	756093	6150648
45	764242	6175541
46	747386	6173479
47	748061	6157101
48 (S)	755259	6165399
50	763316	6156012
54 (S)	759940	6161256
56	748311	6161211
57	762181	6172121
59	764033	6161255
60 (S)	762913	6154970
62	747545	6151344
63	757324	6159118
64	761158	6148726
67	764105	6166842
68	760372	6172122
71 (S)	754800	6173304
72 (S)	759980	6151572
73 (S)	760346	6151192
74 (S)	761926	6162224
77 (S)	748330	6164172
83	754918	6147900
85	765242	6165988
88	749327	6176832
90	751528	6155057
91	764188	6174712
95	764338	6166730
96	763882	6170132
97	750419	6161864
98	746565	6164055
102	753144	6155516
103	755305	6177511
105	751763	6171608
106	748430	6159155
107	754634	6157146
108	754741	6148859
109	748206	6157710
110	762788	6167813
111	766054	6165666
113	762025	6150317
114	752265	6159349
116	747635	6159002

House	Easting (m)	Northing (m)
119	748163	6157407
122	750454	6154117
125	750540	6160202
126 (S)	762594	6158143
127	748992	6157803
129	751962	6171514
130	757221	6176727
131	764044	6170514
133	765453	6165888
135	746458	6162047
139	751235	6153266
140	745994	6173099
141	750558	6151129
143	756632	6159691
145	759085	6172326
147	746612	6173497
150	759926	6154220
151	755738	6166354
155	762686	6174628
157	764406	6171413
158	753790	6158918
159	766279	6165695
160 (S)	749794	6161757
161	746734	6152610
162	748867	6156875
163	750610	6151304
170	755415	6175841
171 (S)	749730	6169550
174	748852	6158026
177	748012	6157202
178	753921	6168214
179	763543	6162625
181	765099	6166087
184 (S)	756274	6161782
186	751310	6156033
187	764150	6171190
189 (S)	751575	6165259
190	744333	6177665
194 (S)	753494	6163206
195	752783	6159491
200	746090	6151162
201	748056	6156626
203	759343	6169376
204	759962	6166170
205 (S)	759707	6161794
206	746472	6157393
209	748383	6164914
211	763578	6160210
214	752882	6149532
216 (S)	758587	6161598
217	745249	6151268
218	763631	6160497
222	757204	6170780
224 (S)	758063	6159381
225	749075	6155191
231	748649	6157412
232	762198	6172545
237	748383	6172286
239	757687	6148021
240 (S)	763273	6156445
242	749005	6154399
244	750923	6176658
247	747234	6153159
248	763453	6168764
250	747246	6154912

House	Easting (m)	Northing (m)
251	764109	6170984
252	746348	6163768
253	763087	6155819
254	761992	6164399
256	746995	6154368
257	749031	6174814
260	755170	6160190
263	749800	6158684
264	748591	6156893
265	765033	6166243
269	764298	6170675
270	755336	6161480
277	763692	6160786
278	764757	6166362
280	756149	6163135
281	743825	6162063
282	755895	6147906
284	748478	6151198
287	749477	6158460
288	756122	6177610
289	763626	6159059
292 (S)	763589	6157116
293	763774	6157321
294	763788	6157906
295	763686	6158691
296	762349	6151049
297	761266	6149013
298 (S)	754004	6161721
299	758916	6171252
301	753763	6167042
302	753001	6178275
305	743862	6172688
306	753076	6153090
307	744056	6158429
308	744694	6173848
309	746355	6177963
310 (S)	752295	6172235
311	754661	6176630
313	747948	6151241
314	749549	6178176
317	763359	6156176
318	763356	6156164
319	763355	6156150
320	763354	6156141
321	763346	6156125
322	763354	6156108
323	763357	6156090
324	763334	6156081
325	763351	6156055
326	763343	6156039
327	763352	6156016
328	763341	6155971
329	763353	6155946
330	763355	6155924
331	763355	6155907
332	763348	6155876
333	763371	6155870
334	763407	6155872
335	763419	6155873
336	763446	6155866
338	763408	6156177
339	763445.8	6156177
340	748109.8	6160250
338	763408	6156177
339	763445.8	6156177

House	Easting (m)	Northing (m)
340	748109.8	6160250
338	763408	6156177
339	763445.8	6156177
340	748109.8	6160250
342	763579.6	6156734
343	761512.1	6148989
344	761878.7	6149269
345	761805.7	6149246
346	761898	6149470
347	761960	6149418
348	762013	6149514
349	761538.3	6148253
350	761499.7	6148375
351	761589.2	6149023
352	761507.3	6148151
353	761404.5	6148791
354	761460.8	6148786
355	761375.3	6148089
356	763390.5	6156208

(S) Involved receiver

APPENDIX C NOISE RELATED PLANNING CONDITIONS

Noise - General

20. *Noise levels at the noise sensitive receivers around the Wind Farm development are to meet requirements of the SA EPA Wind Farms: Environmental Noise Guidelines 2009. The noise level at the relevant receivers* must not exceed:*

a) *40dB(A) for noise sensitive receivers in the Primary Production Zone or zones other than Rural Living,*

b) *35dB(A) if receivers are situated in the Rural Living zone, or*

c) *the background noise (LA90,10) by more than 5dB(A).*

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

*Note: *For the purposes of these conditions a relevant receiver is an occupied dwelling where the owners do not have an agreement with the wind farm developer. The noise levels should be adjusted in accordance with the Wind Farm Environmental Guidelines 2009 by the inclusion of a penalty for the tonal characteristic.*

21. *Warranted maximum sound power characteristic for the wind turbine generators installed in accordance with the proposed layout must not exceed levels shown in Tables 4 and 5 of the acoustic report (CERES Project: Revised Noise Assessment, Report No. 002 R012012124ML, prepared by Marshall Day Acoustics, 9 March 2017). The warranted sound power levels must be measured and reported in accordance with IEC61400-1, Ed.3.0: Wind turbines - Part 11: Acoustic noise measurements techniques.*

22. *Noise emission of wind turbine generators (WTGs) intended for installation must not include tones audible at the noise receivers (Delta ΔLa,k>0). The tonality test procedure is defined in IEC 61400-11, Ed.3.0: Wind turbines - Part 11: Acoustic noise measurement techniques. It is desirable that the applicant confirms the absence of audible tones by submitting relevant technical documentation before commencing construction of the wind farm. In case the applicant is unable to confirm the absence of tones by submitting relevant technical documentation, the absence of the tones must be confirmed by results of the test performed at locality No.189 as shown in the acoustic report (CERES Project: Revised Noise Assessment, Report No. 002 R01 2012124ML, prepared by Marshall Day Acoustics, 9 March 2017).*

23. *Noise contribution from the converter station and ancillary equipment at the relevant receivers must not exceed allowable levels as indicated in Table 13 in the acoustic report (CERES Wind Farm: Noise Impact Assessment, Report No. 001 R04 2012124ML, prepared by Marshall Day Acoustics, Revision 4 dated 19 July 2013).*

24. *The applicant must appoint an independent acoustical consultancy (other than the company who prepared the predictive acoustical report) to monitor noise levels at five localities at least: No.10, 125, 129, 189 and 222 (as shown on the map in the acoustic report, CERES Project: Revised Noise Assessment, Report No. 002 R01 2012124ML, prepared by Marshall Day Acoustics, 9 March 2017). Monitoring must be executed in accordance with the SA EPA Wind farms environmental noise guidelines (2009) where all of the noise sources associated with the wind farm are in operating mode. The results of the monitoring must be submitted to the EPA not later than three months from the date of the wind farm commissioning.*

25. *In event that the post-construction noise monitoring report reveals non-compliance with the specified noise criteria, the proponent must arrange for the noise monitoring of other relevant noise sensitive receivers. The measures to assure compliance with the specified noise criteria must be undertaken by the proponent for all of the localities where non-compliance with the noise criteria is revealed. Agreement with the land owners of the noise affected premises can be considered as an option in accordance with the SA EPA Wind Farms: Environmental Noise Guidelines 2009.*

Noise – Converter station

26. *Upon completion of detailed design of the converter station, and prior to the commencement of construction, an Environmental Noise Assessment must be prepared by an Acoustic Engineer which demonstrates that noise from operation of the proposed converter station at Globe Derby Park meets the noise goals applicable under the Environment Protection (Noise) Policy 2007 and determined properly in accordance with the Salisbury City Council Development Plan (as current at the time of application) at all noise sensitive receivers. Any noise mitigation measures required to meet the noise goals must be implemented during construction. The report must be submitted to the Development Assessment Commission prior to commencement of construction. Note: An Acoustic Engineer is defined as a person having sufficient qualifications and experience as to be eligible for admission to the grade of 'Member' of the Australian Acoustical Society (MAAS)*

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APPENDIX D NOISE PREDICTION MODEL

Operational wind farm noise levels are predicted at all residential dwellings considered within this assessment using a three-dimensional noise model generated in SoundPLAN® version 8.0 software. Specifically, predictions have been carried out using the SoundPLAN implementation of ISO 9613-2:1996 *Acoustics – Attenuation of sound during propagation outdoors Part 2: General method of calculation* (ISO 9613-2:1996) to calculate noise propagation from the wind farm to each receiver location.

The use of this method is supported by international research publications, measurement studies conducted by Marshall Day Acoustics and direct reference to the standard in the Guidelines.

The standard specifies an engineering method for calculating noise at a known distance from a variety of sources under meteorological conditions favourable to sound propagation. The standard defines favourable conditions as downwind propagation where the source blows from the source to the receiver within an angle of +/-45 degrees from a line connecting the source to the receiver, at wind speeds between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground. Equivalently, the method accounts for average propagation under a well-developed moderate ground based thermal inversion. In this respect, it is noted that at the wind speeds relevant to noise levels from wind turbines, atmospheric conditions do not favour the development of thermal inversions throughout the propagation path from the source to the receiver.

To calculate far-field noise levels according to the ISO 9613-2:1996, the noise levels of each turbine are firstly characterised in the form of octave band frequency levels. A series of octave band attenuation factors are then calculated for a range of effects including:

- Geometric divergence
- Air absorption
- Reflecting obstacles
- Screening
- Vegetation
- Ground reflections

The octave band attenuation factors are then applied to the sound power level data to determine the corresponding octave band and total calculated noise level at relevant receiver locations.

Calculating the attenuation factors for each effect requires a relevant description of the environment into which the sound propagation such as the physical dimensions of the environment, atmospheric conditions and the characteristics of the ground between the source and the receiver.

Wind farm noise propagation has been the subject of considerable research in recent years. These studies have provided support for the reliability of engineering methods such as ISO 9613-2:1996 when a certain set of input parameters are chosen in combination.

A number of Australian and international studies support the assignment of a ground absorption factor of G=0.5 for the source, middle and receiver ground regions between a wind farm and a calculation point. This ground absorption factor of G=0.5 is adopted in combination with several cautious assumptions; specifically, all turbines operating at identical wind speeds, emitting sound levels equal to the test measured levels plus a margin for uncertainty (or guaranteed values), at a temperature of 10 degrees and relative humidity of 70 % (conditions which give rise to low atmospheric absorption). The studies demonstrate that applying the ISO 9613-2:1996 prediction methodology in this way provides a reliable representation of the upper noise levels expected in practice.

The following specific adjustments have been made:

- In instances where the ground terrain provides marginal or partial acoustic screening, the barrier effect should be limited to not more than 2 dB
- Screening attenuation calculated based on the screening expected for the source located at the tip height of the turbine (in contrast to hub height in non-adjusted ISO 9613 predictions)
- In instances where the ground falls away significantly between the source and receiver, such as valleys, an adjustment of 3 dB should be added to the calculated sound pressure level. A terrain profile in which the ground falls away significantly is defined as one where the mean sound propagation height is at least 50 % greater than would occur over flat ground

In support of the use of ISO 9613-2:1996 and the choice of G=0.5 as an appropriate ground characterisation, the following references are noted:

- A factor of G=0.5 is frequently applied in Australia for general environmental noise modelling purposes as a way of accounting for the potential mix of ground porosity which may occur in regions of dry/compacted soils or in regions where persistent damp conditions may be relevant
- In 1998, a comprehensive study, part funded by the European Commission, Development of a Wind Farm Noise Propagation Prediction Model[3] found that the ISO 9613-2:1996 model provided a robust representation of upper noise levels which may occur in practice, and provided a closer agreement between predicted and measured noise levels than alternative standards such as CONCAWE and ENM. Specifically, the report indicated the ISO 9613-2:1996 method generally tends to marginally over predict noise levels expected in practice
- The UK Institute of Acoustics journal dated March/April 2009 published a joint agreement between practitioners in the field of wind farm noise assessment, including consultants routinely employed on behalf of both developers and community opposition groups, and indicated the ISO 9613-2:1996 method as the appropriate standard and specifically designated G=0.5 as the appropriate ground characterisation. It is noted that this publication specifically refers to predictions made to receiver heights of 4m in the interest of representing 2-storey dwellings which are more common in the UK. Predictions in Australia are generally based on a lower prediction height of 1.5 m which tends to result in higher ground attenuation factors, however conversely, predictions in Australia do not generally incorporate a -2 dB factor (as applied in the UK) to represent the relationship between L_{Aeq} and L_{A90} noise levels. The result is that these differences tend to balance out to a comparable approach and thus supports the use of G=0.5 in the context of Australian prediction methodologies.
- A range of comparative measurement and prediction studies[4, 5, 6] for wind farms in which Marshall Day Acoustics' staff have been involved in have provided further support for the use of ISO 9613-2:1996 and G=0.5 as an appropriate representation of typical upper noise levels expected to occur in practice.

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3 Bass, Bullmore and Sloth - *Development of a wind farm noise propagation prediction model*; Contract JOR3-CT95-0051, Final Report, January 1996 to May 1998.

4 Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions: The Risks of Conservatism*; Presented at the Second International Meeting on Wind Turbine Noise in Lyon, France September 2007.

5 Bullmore, Adcock, Jiggins & Cand – *Wind Farm Noise Predictions and Comparisons with Measurements*; Presented at the Third International Meeting on Wind Turbine Noise in Aalborg, Denmark June 2009.

6 Delaire, Griffin, & Walsh – *Comparison of predicted wind farm noise emission and measured post-construction noise levels at the Portland Wind Energy Project in Victoria, Australia*; Presented at the Fourth International Meeting on Wind Turbine Noise in Rome, April 2011.

The key findings of these studies demonstrated the suitability of the ISO 9613-2:1996 method to predict the propagation of wind turbine noise for:

- the types of noise source heights associated with a modern wind farm, extending the scope of application of the method beyond the 30 m maximum source heights considered in the original ISO 9613
- the types of environments in which wind farms are typically developed, and the range of atmospheric conditions and wind speeds typically observed around wind farm sites. Importantly, this supports the extended scope of application to wind speeds in excess of 5 m/s.

ISO 9613-2:1996 is primarily intended for the prediction of total A-weighted noise levels.

APPENDIX E PREDICTED NOISE LEVELS

Predicted noise levels, dB L_{Aeq}

	Hub height wind speed (m/s)									
Receiver	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**≥13**
3	13.7	13.9	17.7	20.9	23.7	24.7	24.7	24.7	24.7	24.7
4	24.8	25.0	28.8	32.0	34.8	35.8	35.8	35.8	35.8	35.8
6	24.8	25.0	28.8	32.0	34.8	35.8	35.8	35.8	35.8	35.8
7	23.9	24.1	27.9	31.1	33.9	34.9	34.9	34.9	34.9	34.9
8	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
10	26.3	26.5	30.3	33.5	36.3	37.3	37.3	37.3	37.3	37.3
11	21.8	22.0	25.8	29.0	31.8	32.8	32.8	32.8	32.8	32.8
14	19.6	19.8	23.6	26.8	29.6	30.6	30.6	30.6	30.6	30.6
15	19.3	19.5	23.3	26.5	29.3	30.3	30.3	30.3	30.3	30.3
18	17.5	17.7	21.5	24.7	27.5	28.5	28.5	28.5	28.5	28.5
20	21.9	22.1	25.9	29.1	31.9	32.9	32.9	32.9	32.9	32.9
21	19.9	20.1	23.9	27.1	29.9	30.9	30.9	30.9	30.9	30.9
23	17.0	17.2	21.0	24.2	27.0	28.0	28.0	28.0	28.0	28.0
26	20.4	20.6	24.4	27.6	30.4	31.4	31.4	31.4	31.4	31.4
28	28.7	28.9	32.7	35.9	38.7	39.7	39.7	39.7	39.7	39.7
29 (S)	28.8	29.0	32.8	36.0	38.8	39.8	39.8	39.8	39.8	39.8
32 (S)	30.3	30.5	34.3	37.5	40.3	41.3	41.3	41.3	41.3	41.3
33	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
34	14.7	14.9	18.7	21.9	24.7	25.7	25.7	25.7	25.7	25.7
35	28.2	28.4	32.2	35.4	38.2	39.2	39.2	39.2	39.2	39.2
37	25.1	25.3	29.1	32.3	35.1	36.1	36.1	36.1	36.1	36.1
41	17.0	17.2	21.0	24.2	27.0	28.0	28.0	28.0	28.0	28.0
42	20.7	20.9	24.7	27.9	30.7	31.7	31.7	31.7	31.7	31.7
44	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
45	14.2	14.4	18.2	21.4	24.2	25.2	25.2	25.2	25.2	25.2
46	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
47	16.9	17.1	20.9	24.1	26.9	27.9	27.9	27.9	27.9	27.9
48 (S)	28.6	28.8	32.6	35.8	38.6	39.6	39.6	39.6	39.6	39.6
50	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
54 (S)	32.6	32.8	36.6	39.8	42.6	43.6	43.6	43.6	43.6	43.6
56	25.0	25.2	29.0	32.2	35.0	36.0	36.0	36.0	36.0	36.0
57	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
59	21.9	22.1	25.9	29.1	31.9	32.9	32.9	32.9	32.9	32.9
60 (S)	25.5	25.7	29.5	32.7	35.5	36.5	36.5	36.5	36.5	36.5

	Hub height wind speed (m/s)									
Receiver	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**≥13**
62	12.7	12.9	16.7	19.9	22.7	23.7	23.7	23.7	23.7	23.7
63	26.8	27.0	30.8	34.0	36.8	37.8	37.8	37.8	37.8	37.8
64	18.4	18.6	22.4	25.6	28.4	29.4	29.4	29.4	29.4	29.4
67	18.3	18.5	22.3	25.5	28.3	29.3	29.3	29.3	29.3	29.3
68	21.3	21.5	25.3	28.5	31.3	32.3	32.3	32.3	32.3	32.3
71 (S)	33.0	33.2	37.0	40.2	43.0	44.0	44.0	44.0	44.0	44.0
72 (S)	30.2	30.4	34.2	37.4	40.2	41.2	41.2	41.2	41.2	41.2
73 (S)	28.1	28.3	32.1	35.3	38.1	39.1	39.1	39.1	39.1	39.1
74 (S)	30.5	30.7	34.5	37.7	40.5	41.5	41.5	41.5	41.5	41.5
77 (S)	28.3	28.5	32.3	35.5	38.3	39.3	39.3	39.3	39.3	39.3
83	15.5	15.7	19.5	22.7	25.5	26.5	26.5	26.5	26.5	26.5
85	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
88	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
90	17.4	17.6	21.4	24.6	27.4	28.4	28.4	28.4	28.4	28.4
91	13.4	13.6	17.4	20.6	23.4	24.4	24.4	24.4	24.4	24.4
95	18.2	18.4	22.2	25.4	28.2	29.2	29.2	29.2	29.2	29.2
96	16.7	16.9	20.7	23.9	26.7	27.7	27.7	27.7	27.7	27.7
97	28.0	28.2	32.0	35.2	38.0	39.0	39.0	39.0	39.0	39.0
98	23.9	24.1	27.9	31.1	33.9	34.9	34.9	34.9	34.9	34.9
102	18.8	19.0	22.8	26.0	28.8	29.8	29.8	29.8	29.8	29.8
103	19.7	19.9	23.7	26.9	29.7	30.7	30.7	30.7	30.7	30.7
105	26.8	27.0	30.8	34.0	36.8	37.8	37.8	37.8	37.8	37.8
106	19.7	19.9	23.7	26.9	29.7	30.7	30.7	30.7	30.7	30.7
107	20.5	20.7	24.5	27.7	30.5	31.5	31.5	31.5	31.5	31.5
108	16.7	16.9	20.7	23.9	26.7	27.7	27.7	27.7	27.7	27.7
109	17.7	17.9	21.7	24.9	27.7	28.7	28.7	28.7	28.7	28.7
110	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
111	16.9	17.1	20.9	24.1	26.9	27.9	27.9	27.9	27.9	27.9
113	22.0	22.2	26.0	29.2	32.0	33.0	33.0	33.0	33.0	33.0
114	24.2	24.4	28.2	31.4	34.2	35.2	35.2	35.2	35.2	35.2
116	18.8	19.0	22.8	26.0	28.8	29.8	29.8	29.8	29.8	29.8
119	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
122	16.1	16.3	20.1	23.3	26.1	27.1	27.1	27.1	27.1	27.1
125	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
126 (S)	28.2	28.4	32.2	35.4	38.2	39.2	39.2	39.2	39.2	39.2
127	18.3	18.5	22.3	25.5	28.3	29.3	29.3	29.3	29.3	29.3

	Hub height wind speed (m/s)									
Receiver	4	5	6	7	8	9	10	11	12	≥13
129	27.3	27.5	31.3	34.5	37.3	38.3	38.3	38.3	38.3	38.3
130	20.5	20.7	24.5	27.7	30.5	31.5	31.5	31.5	31.5	31.5
131	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
133	17.4	17.6	21.4	24.6	27.4	28.4	28.4	28.4	28.4	28.4
135	21.8	22.0	25.8	29.0	31.8	32.8	32.8	32.8	32.8	32.8
139	16.3	16.5	20.3	23.5	26.3	27.3	27.3	27.3	27.3	27.3
140	18.5	18.7	22.5	25.7	28.5	29.5	29.5	29.5	29.5	29.5
141	14.6	14.8	18.6	21.8	24.6	25.6	25.6	25.6	25.6	25.6
143	25.3	25.5	29.3	32.5	35.3	36.3	36.3	36.3	36.3	36.3
145	26.3	26.5	30.3	33.5	36.3	37.3	37.3	37.3	37.3	37.3
147	18.6	18.8	22.6	25.8	28.6	29.6	29.6	29.6	29.6	29.6
150	27.2	27.4	31.2	34.4	37.2	38.2	38.2	38.2	38.2	38.2
151	26.4	26.6	30.4	33.6	36.4	37.4	37.4	37.4	37.4	37.4
155	14.5	14.7	18.5	21.7	24.5	25.5	25.5	25.5	25.5	25.5
157	13.8	14.0	17.8	21.0	23.8	24.8	24.8	24.8	24.8	24.8
158	21.9	22.1	25.9	29.1	31.9	32.9	32.9	32.9	32.9	32.9
159	16.6	16.8	20.6	23.8	26.6	27.6	27.6	27.6	27.6	27.6
160 (S)	27.5	27.7	31.5	34.7	37.5	38.5	38.5	38.5	38.5	38.5
161	12.7	12.9	16.7	19.9	22.7	23.7	23.7	23.7	23.7	23.7
162	16.8	17.0	20.8	24.0	26.8	27.8	27.8	27.8	27.8	27.8
163	14.7	14.9	18.7	21.9	24.7	25.7	25.7	25.7	25.7	25.7
170	25.1	25.3	29.1	32.3	35.1	36.1	36.1	36.1	36.1	36.1
171 (S)	30.6	30.8	34.6	37.8	40.6	41.6	41.6	41.6	41.6	41.6
174	18.5	18.7	22.5	25.7	28.5	29.5	29.5	29.5	29.5	29.5
177	17.0	17.2	21.0	24.2	27.0	28.0	28.0	28.0	28.0	28.0
178	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
179	23.0	23.2	27.0	30.2	33.0	34.0	34.0	34.0	34.0	34.0
181	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
184 (S)	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
186	17.9	18.1	21.9	25.1	27.9	28.9	28.9	28.9	28.9	28.9
187	15.8	16.0	19.8	23.0	25.8	26.8	26.8	26.8	26.8	26.8
189 (S)	32.8	33.0	36.8	40.0	42.8	43.8	43.8	43.8	43.8	43.8
190	13.1	13.3	17.1	20.3	23.1	24.1	24.1	24.1	24.1	24.1
194 (S)	29.5	29.7	33.5	36.7	39.5	40.5	40.5	40.5	40.5	40.5
195	24.2	24.4	28.2	31.4	34.2	35.2	35.2	35.2	35.2	35.2
200	12.0	12.2	16.0	19.2	22.0	23.0	23.0	23.0	23.0	23.0

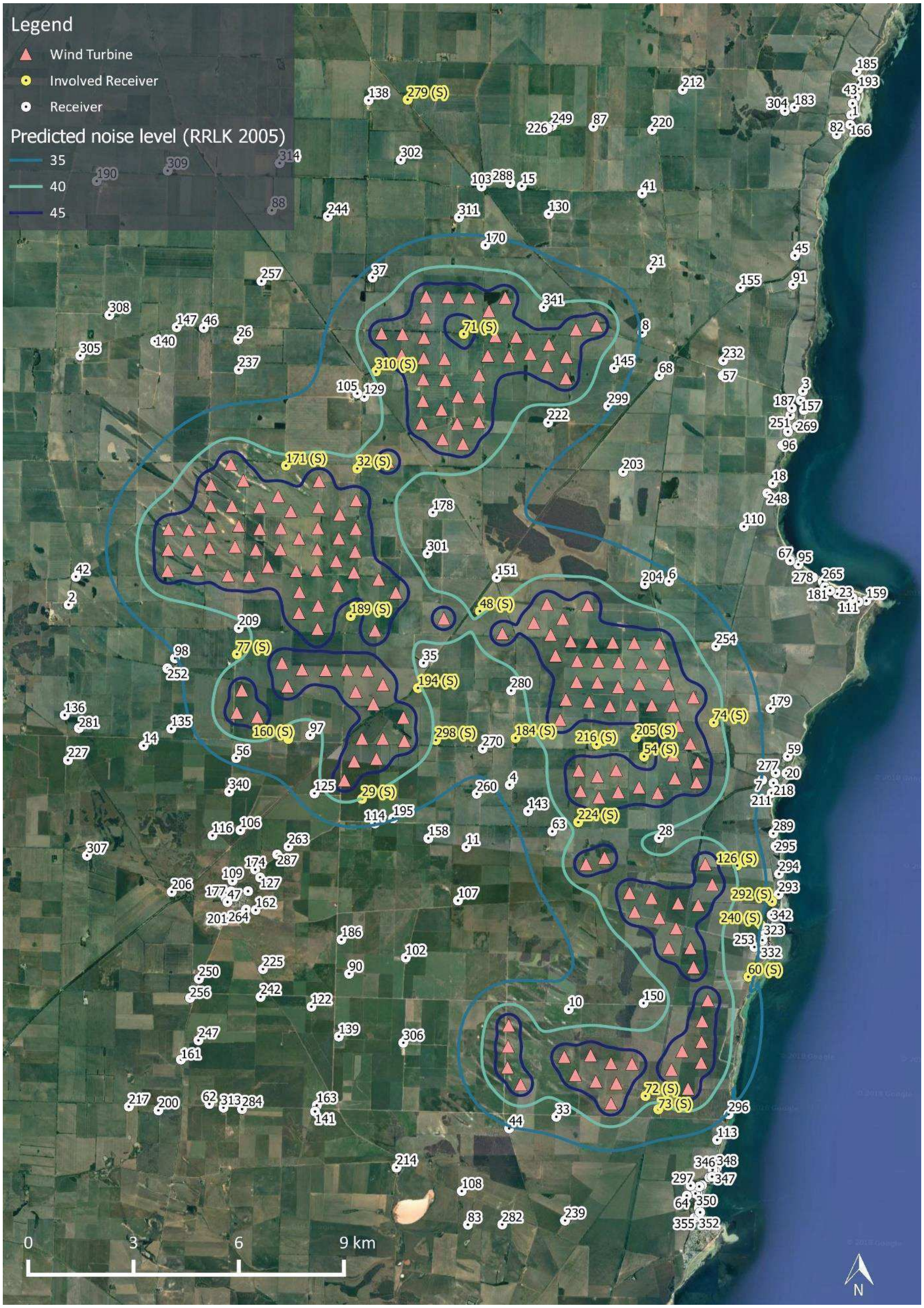
	Hub height wind speed (m/s)									
Receiver	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**≥13**
201	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
203	21.5	21.7	25.5	28.7	31.5	32.5	32.5	32.5	32.5	32.5
204	26.2	26.4	30.2	33.4	36.2	37.2	37.2	37.2	37.2	37.2
205 (S)	32.2	32.4	36.2	39.4	42.2	43.2	43.2	43.2	43.2	43.2
206	16.2	16.4	20.2	23.4	26.2	27.2	27.2	27.2	27.2	27.2
209	28.4	28.6	32.4	35.6	38.4	39.4	39.4	39.4	39.4	39.4
211	22.9	23.1	26.9	30.1	32.9	33.9	33.9	33.9	33.9	33.9
214	15.6	15.8	19.6	22.8	25.6	26.6	26.6	26.6	26.6	26.6
216 (S)	32.1	32.3	36.1	39.3	42.1	43.1	43.1	43.1	43.1	43.1
217	11.7	11.9	15.7	18.9	21.7	22.7	22.7	22.7	22.7	22.7
218	22.8	23.0	26.8	30.0	32.8	33.8	33.8	33.8	33.8	33.8
222	26.8	27.0	30.8	34.0	36.8	37.8	37.8	37.8	37.8	37.8
224 (S)	30.0	30.2	34.0	37.2	40.0	41.0	41.0	41.0	41.0	41.0
225	15.9	16.1	19.9	23.1	25.9	26.9	26.9	26.9	26.9	26.9
231	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
232	17.7	17.9	21.7	24.9	27.7	28.7	28.7	28.7	28.7	28.7
237	21.7	21.9	25.7	28.9	31.7	32.7	32.7	32.7	32.7	32.7
239	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
240 (S)	24.0	24.2	28.0	31.2	34.0	35.0	35.0	35.0	35.0	35.0
242	15.5	15.7	19.5	22.7	25.5	26.5	26.5	26.5	26.5	26.5
244	18.9	19.1	22.9	26.1	28.9	29.9	29.9	29.9	29.9	29.9
247	13.1	13.3	17.1	20.3	23.1	24.1	24.1	24.1	24.1	24.1
248	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
250	14.4	14.6	18.4	21.6	24.4	25.4	25.4	25.4	25.4	25.4
251	16.2	16.4	20.2	23.4	26.2	27.2	27.2	27.2	27.2	27.2
252	23.1	23.3	27.1	30.3	33.1	34.1	34.1	34.1	34.1	34.1
253	24.5	24.7	28.5	31.7	34.5	35.5	35.5	35.5	35.5	35.5
254	26.3	26.5	30.3	33.5	36.3	37.3	37.3	37.3	37.3	37.3
256	14.3	14.5	18.3	21.5	24.3	25.3	25.3	25.3	25.3	25.3
257	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
260	23.5	23.7	27.5	30.7	33.5	34.5	34.5	34.5	34.5	34.5
263	20.4	20.6	24.4	27.6	30.4	31.4	31.4	31.4	31.4	31.4
264	16.7	16.9	20.7	23.9	26.7	27.7	27.7	27.7	27.7	27.7
265	17.7	17.9	21.7	24.9	27.7	28.7	28.7	28.7	28.7	28.7
269	14.9	15.1	18.9	22.1	24.9	25.9	25.9	25.9	25.9	25.9
270	24.8	25.0	28.8	32.0	34.8	35.8	35.8	35.8	35.8	35.8

	Hub height wind speed (m/s)									
Receiver	4	5	6	7	8	9	10	11	12	≥13
277	22.7	22.9	26.7	29.9	32.7	33.7	33.7	33.7	33.7	33.7
278	18.0	18.2	22.0	25.2	28.0	29.0	29.0	29.0	29.0	29.0
280	27.7	27.9	31.7	34.9	37.7	38.7	38.7	38.7	38.7	38.7
281	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
282	16.2	16.4	20.2	23.4	26.2	27.2	27.2	27.2	27.2	27.2
284	12.9	13.1	16.9	20.1	22.9	23.9	23.9	23.9	23.9	23.9
287	19.7	19.9	23.7	26.9	29.7	30.7	30.7	30.7	30.7	30.7
288	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
289	20.9	21.1	24.9	28.1	30.9	31.9	31.9	31.9	31.9	31.9
292 (S)	22.9	23.1	26.9	30.1	32.9	33.9	33.9	33.9	33.9	33.9
293	22.0	22.2	26.0	29.2	32.0	33.0	33.0	33.0	33.0	33.0
294	22.6	22.8	26.6	29.8	32.6	33.6	33.6	33.6	33.6	33.6
295	22.6	22.8	26.6	29.8	32.6	33.6	33.6	33.6	33.6	33.6
296	23.2	23.4	27.2	30.4	33.2	34.2	34.2	34.2	34.2	34.2
297	19.0	19.2	23.0	26.2	29.0	30.0	30.0	30.0	30.0	30.0
298 (S)	28.2	28.4	32.2	35.4	38.2	39.2	39.2	39.2	39.2	39.2
299	24.5	24.7	28.5	31.7	34.5	35.5	35.5	35.5	35.5	35.5
301	27.3	27.5	31.3	34.5	37.3	38.3	38.3	38.3	38.3	38.3
302	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
305	16.9	17.1	20.9	24.1	26.9	27.9	27.9	27.9	27.9	27.9
306	18.6	18.8	22.6	25.8	28.6	29.6	29.6	29.6	29.6	29.6
307	15.3	15.5	19.3	22.5	25.3	26.3	26.3	26.3	26.3	26.3
308	16.5	16.7	20.5	23.7	26.5	27.5	27.5	27.5	27.5	27.5
309	14.2	14.4	18.2	21.4	24.2	25.2	25.2	25.2	25.2	25.2
310 (S)	29.8	30.0	33.8	37.0	39.8	40.8	40.8	40.8	40.8	40.8
311	22.2	22.4	26.2	29.4	32.2	33.2	33.2	33.2	33.2	33.2
313	12.8	13.0	16.8	20.0	22.8	23.8	23.8	23.8	23.8	23.8
314	16.0	16.2	20.0	23.2	26.0	27.0	27.0	27.0	27.0	27.0
317	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
318	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
319	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
320	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
321	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
322	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
323	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
324	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7

	Hub height wind speed (m/s)									
Receiver	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**≥13**
325	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
326	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
327	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
328	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
329	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
330	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
331	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
332	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
333	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
334	23.4	23.6	27.4	30.6	33.4	34.4	34.4	34.4	34.4	34.4
335	23.4	23.6	27.4	30.6	33.4	34.4	34.4	34.4	34.4	34.4
336	23.3	23.5	27.3	30.5	33.3	34.3	34.3	34.3	34.3	34.3
338	23.5	23.7	27.5	30.7	33.5	34.5	34.5	34.5	34.5	34.5
339	23.4	23.6	27.4	30.6	33.4	34.4	34.4	34.4	34.4	34.4
340	21.4	21.6	25.4	28.6	31.4	32.4	32.4	32.4	32.4	32.4
342	23.0	23.2	27.0	30.2	33.0	34.0	34.0	34.0	34.0	34.0
343	17.9	18.1	21.9	25.1	27.9	28.9	28.9	28.9	28.9	28.9
344	17.1	17.3	21.1	24.3	27.1	28.1	28.1	28.1	28.1	28.1
345	17.1	17.3	21.1	24.3	27.1	28.1	28.1	28.1	28.1	28.1
346	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
347	17.4	17.6	21.4	24.6	27.4	28.4	28.4	28.4	28.4	28.4
348	17.5	17.7	21.5	24.7	27.5	28.5	28.5	28.5	28.5	28.5
349	16.6	16.8	20.6	23.8	26.6	27.6	27.6	27.6	27.6	27.6
350	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
351	16.8	17.0	20.8	24.0	26.8	27.8	27.8	27.8	27.8	27.8
352	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
353	18.4	18.6	22.4	25.6	28.4	29.4	29.4	29.4	29.4	29.4
354	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
355	16.1	16.3	20.1	23.3	26.1	27.1	27.1	27.1	27.1	27.1
356	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6

(S) Involved receiver

APPENDIX F NOISE CONTOUR MAP



APPENDIX G SUMMARY OF MODELING PARAMETERS

(a) Wind turbine type: Refer to Section 2.2.1

(b) Octave band sound power level data: Refer to Section 2.2.2

(c) Wind turbine positions: Refer to Table B1 of Appendix B

(d) Residential property locations: Refer to Table B2 Appendix B

(e) Zoning of residential properties: Refer to Section 3.1

(f) Noise level predictions: Refer to Section 3.2 and Appendix E

(g) Noise model and method: Section 3.2

(h) Noise model accuracy: Refer Appendix D

(i) Screening effects: Refer Appendix D

(j) Noise level contour map: Refer Appendix F

(k) Met mast location: Refer to Table 9 of the 2013 Report

Appendix I

Electromagnetic Interference Assessment

YORKE PENINSULA WIND FARM PROJECT PTY LTD

CERES WIND FARM

ELECTROMAGNETIC INTERFERENCE ASSESSMENT

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Question today
Imagine tomorrow
Create for the future

Ceres Wind Farm
Electromagnetic Interference Assessment

Yorke Peninsula Wind Farm Project Pty Ltd

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REV	DATE	DETAILS
A	17/08/2018	Initial Issue - Draft
B	10/09/2018	Updated WTG and receptor layouts
C	20/09/2018	Minor amendments based on YPWFP P/L feedback

	NAME	DATE	SIGNATURE
Prepared by:	K. Dippl	20/09/2018	
Reviewed by:	H. Hurree	20/09/2018	
Approved by:	H. Sick	20/09/2018	

TABLE OF CONTENTS

ABBREVIATIONS

ABBREVIATION	DESCRIPTION
ACMA	Australian Communications and Media Authority
AM	Amplitude Modulation
BoM	Bureau of Meteorology
CWF	Ceres Wind Farm
EMI	Electromagnetic Interference
FM	Frequency Modulation
GIS	Geographic Information System
ISP	Internet Service Provider
RADCOM	ACMA Registry of Licensed Radio Communicators
TV	Television
UHF	Ultra-High Frequency
WSP	WSP Australia Pty Ltd
WTG	Wind Turbine Generator
YPWFP P/L	Yorke Peninsula Wind Farm Project Pty Ltd

EXECUTIVE SUMMARY

At the request of Yorke Peninsula Wind Farm Project Pty Ltd (YPWFP P/L), WSP Australia Pty Ltd (WSP) has undertaken an assessment of the potential electromagnetic interference (EMI) impacts arising from the development and operation of the Ceres Wind Farm (CWF). As part of this study, WSP has considered potential impacts of CWF on registered point-to-point, point-to-multipoint and broadcast services in the vicinity of the wind farm.

YPWFP P/L has provided a WTG layout as well as a table of WTG model parameters to be considered for this updated assessment.

For this investigation, WSP identified existing radio communication services registered within the ACMA database. This database was reviewed by WSP and sites within 75 km of CWF were identified.

1,273 radio communication sites were found within 75 km of the approximate CWF project area, with 81 towers within 30 km of the site. This data was mapped against the proposed wind farm layout, provided by YPWFP P/L. Communication towers and service paths that were seen to cross this approximate project area were selected for further investigation.

A refined search was undertaken to identify any towers located within 2 km of any Wind Turbine Generator (WTG) on site and assessed for potential near-field impacts. Eight (8) towers were identified, with only one (1) site located within 250 m of a proposed WTG location. WSP notes that no assignment IDs nor licences are currently registered to this tower and as such, it is considered unlikely that this tower is currently in operation.

Eight (8) fixed point-to-point links were identified to intersect with the approximate project area of CWF. The 2nd Fresnel zones were calculated for each link and it was observed that no WTGs are located within one blade length of the 2nd Fresnel zone, considering the WTG dimensions provided.

In the case of encroachment, the preferential mitigation technique is to relocate or microsite the WTG such that interference is eliminated. WSP recommends that the WTG exclusion zones established within this report are acknowledged to avoid impact on the services and operations identified. Please refer to Section 3.2.9 for additional information regarding the point-to-point links identified in the vicinity of CWF.

Point-to-multipoint licences, point-to-area licences and broadcast services were assessed in the vicinity of CWF. Based on information publicly available, WSP notes that digital radio services in the CWF region may be very limited. As such, it is recommended that a ground survey is undertaken to assess the current status of digital radio signals in the area prior to the construction and operation of CWF.

Residences close to CWF may experience some interference to their television (TV) services if they are located in a region of marginal coverage. WSP recommends that a ground survey of TV signal strength is undertaken amongst the residences surrounding CWF prior to the construction of the wind farm. Should some residences experience TV interference, a number of mitigation options are available to rectify this issue.

WSP recommends that licensees identified within this report as possibly being adversely affected by the development and operation of CWF are contacted to discuss the potential impact of CWF development and operations on their services.

1 INTRODUCTION

Yorke Peninsula Wind Farm Project Pty Ltd (YPWFP P/L) is developing the Ceres Wind Farm (CWF), located approximately 80 km west-northwest of Adelaide, on the Yorke Peninsula. CWF is proposed to consist of up to 181 Wind Turbine Generators (WTGs) [1], for which YPWFP P/L has provided a table of WTG model parameters [2].

WSP Australia Pty Ltd (WSP) has been engaged by YPWFP P/L to assess the potential Electromagnetic Interference (EMI) impacts on the radio communication services surrounding CWF.

The EMI assessment conducted by WSP has included but is not limited to the analysis of:

- Fixed point-to-point radio communication links in the vicinity of the proposed WTG locations
- Fixed point-to-multipoint licences within 30 km of the site
- Radar operations within 250 nautical miles of the site
- Television (TV) and radio broadcasting services in operation around CWF
- Mobile phone services
- Internet services, and
- Licences operated by emergency services in proximity to the development.

This report details the methodology adopted to assess the potential EMI impact resulting from the development and operation of CWF. It also describes potential mitigation options to manage and minimise likely EMI impacts arising from CWF development and operation.

1.1 CERES WIND FARM

CWF is situated approximately 80 km west-northwest of Adelaide on the Yorke Peninsula in South Australia and is shown in detail in Figure 1.1. The wind farm is proposed to consist of up to 181 WTGs, with the layout supplied by YPWFP P/L [1]. The WTG model parameters currently under consideration for CWF are listed in Table 1-1.

Table 1-1 WTG model parameters considered in EMI Assessment of CWF [2]

HUB HEIGHT [m AGL]	ROTOR DIAMETER [m]	NUMBER OF WTGS	BLADE LENGTH [m]	MAXIMUM TIP HEIGHT [m]
140	160	181	78.4	220

Figure 1.1 Location of CWF in South Australia

1.2 APPLICABLE GUIDELINES

The following industry standard guidelines and references have been used in the EMI assessment:

- Fixed link WTG exclusion zone method [3]
- Draft National Wind Farm Development Guidelines [4]
- Guidelines for Minimizing the Impact of Wind Farms on the SAGRN (Doc: TR049-SA) [5]

1.3 LIMITATION STATEMENT

This Report is provided by WSP Australia Pty Limited (WSP) for Yorke Peninsula Wind Farm Project Pty Ltd (Client) in response to specific instructions from the Client and in accordance with WSP's proposal dated [1 June 2018] and agreement with the Client dated [10 July 2018] (Agreement).

1.3.1 PERMITTED PURPOSE

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2 METHODOLOGY ADOPTED

2.1 WIND FARMS AND ELECTROMAGNETIC INTERFERENCE

Communication systems using radio waves are heavily utilised in Australia. Mobile phones, television (TV), commercial radio, land mobile radio and emergency radio are common examples of systems that rely on radio and telecommunication. These systems generally use radio towers to transmit and receive signals across a wide area. In the context of wind farm development and operation, electromagnetic interference (EMI) is the impact of a wind farm on surrounding communication services resulting in an unacceptably detrimental effect to the communication service. Radar services (civil and weather) can potentially be impacted by wind farms also.

2.1.1 TYPES OF IMPACTS

The different effects wind farms can have on communication services are summarised below.

- *Near field impact*
  A property of a transmitting and/or receiving antenna is a "near field" zone that is present around the antenna. Any object that can conduct or absorb radio waves, placed within the near field zone, can alter the behaviour of the antenna.
- *Obstruction impact*
  If a conductive object is placed in the path of an advancing radio wavefront, wave energy can be absorbed, detrimentally affecting the signal detected at the receiver.
- *Reflection and scattering impacts*
  If an object reflective to radio waves is placed in the path of an advancing radio wavefront, it may reflect energy away. The reflected signal may be reflected to the transmitting or receiving antenna which can interfere with the desired signal.
- *Electromagnetic fields / Radio frequency interference*
  The operation of a WTG and the associated electrical transmission infrastructure creates an electromagnetic emission that can, theoretically, interact with radio communications.

2.1.1.1 CHARACTERISING IMPACT WITH EXCLUSION ZONES

In many cases, impacts can be sufficiently characterised and mitigated using calculated "exclusion zones" and ensuring these zones are free from WTGs. In other cases, such as when exclusion zones are not feasible to calculate or not appropriate for the communication service, other options are available. Details of the calculated exclusion zones are given below [3].

- *Near field impact*
  Recommendations for determining exclusion zones to mitigate near field impacts are given by [3]. Exclusion zones for the CWF site can be calculated using this method. Communication towers in proximity to the site were reviewed, as discussed in Section 3.1.1. In many cases, the required exclusion zones are very small. However, WSP recommends a minimum standard 500 m radio tower exclusion zone as a precautionary measure for any reflection and scattering impacts that may be produced.
- *Obstruction impact*
  Recommendations for determining exclusion zones to mitigate obstruction are given by [3]. Exclusion zones have been calculated at CWF using this method (2^{nd} Fresnel zone method) and are discussed in section 3.2.
- *Reflection and scattering impacts*
  The accepted methods for calculating these impacts generally require information on signal performance

requirements specific to each service and client. Additionally, impact calculations from this effect require complex modelling to determine. The scope of this assessment does not include the calculation of reflection/scattering impacts. WSP has undertaken a qualitative assessment to determine potentially affected licensees within the vicinity of CWF. WSP generally suggests these impacts are calculated, if required, following the receipt of any specific requirements from the potentially impacted radio stakeholders.

- *Electromagnetic fields / Radio frequency interference*
  These effects are not considered in this assessment. Providing appropriate standards and guidelines are observed in the WTG and balance of plant design, these electromagnetic fields are not expected to cause impacts that are relevant to this assessment. WSP's scope does not include assessing this type of interference.

The possible wind farm electromagnetic impacts have only been briefly discussed. See the cited reference for further information.

2.1.2 RELEVANT CATEGORIES OF RADIO COMMUNICATION SERVICES

In assessing EMI impacts resulting from wind farm development and operation, radio systems are commonly broken into several different categories based on type. For the purposes of the current investigation, the following categories of services are considered.

- *Fixed point-to-point*
  Radio links that transmit and receive between two fixed points fall under this category. For example, network backhaul commonly utilises point-to-point communication.
- *Fixed point-to-multipoint*
  A central location transmits to, and sometimes receives from, several independent locations. TV and radio broadcasting and reception, mobile phones (to the cell site mast) and land mobile systems fall under this category.
- *Radar*
  Radar transmits a signal which is reflected back to the transmitting station (some systems involve communication between a radar station and a transponder). Services that utilise radar technology include aircraft detection and weather services.

Point-to-point, point-to-multipoint and radar impacts are considered separately in this assessment. WSP has also considered the impact of the wind farm development on nearby mobile phone networks, internet services, TV broadcasting services and other types of point-to-area licences.

In order to assess the potential EMI impacts arising from CWF development and operation, WSP has adopted the following course of action:

1. Using the Australian Communications and Media Authority (ACMA) radio communication towers and radio services (RADCOM) database, all licences currently in use within 75 km of CWF have been identified
2. All communication towers within 2 km of CWF were investigated and assessed for potential near-field and obstruction effects. Recommended exclusion zones were also established
3. All potential fixed point-to-point licences passing through or near the proposed WTG locations were identified and assessed for potential EMI impacts
4. All fixed point-to-multipoint licences within 30 km of the WTGs were identified and assessed for potential EMI impacts
5. All other remaining licences were assessed for potential impacts within 30 km of CWF
6. Operators of radar services, including the Bureau of Meteorology (BoM) and aviation services, were identified within 250 nautical miles of CWF
7. Network coverage of mobile phone services, internet services and TV broadcast services were assessed in the vicinity of CWF

8 Emergency services operating licences within 30 km of CWF were also identified.

2.2 AUSTRALIAN COMMUNICATIONS AND MEDIA AUTHORITY

ACMA is the Australian government body that regulates the use of Australia's radio spectrum. ACMA maintains a register of radio licences, radio communication towers and radio services (RADCOM). The RADCOM database contains a register of all radio apparatus, each having a unique radio assignment number. WSP accessed the ACMA RADCOM database in July 2018 to conduct the current EMI assessment [6].

The RADCOM database has been known to potentially contain inaccurate information. Additionally, the precision of some tower location coordinates can be considered low for the purposes of this assessment.

2.3 INPUTS TO ASSESSMENT

Several inputs were considered for this assessment. The following details the various files and associated sources used by WSP to determine the potential EMI impacts arising from CWF development and operations:

- WTG layout comprising of up to 181 WTGs [1],
- Generic WTG model, corresponding to a maximum hub height of 140 m and a maximum rotor diameter of 160 m [2],
- List of houses surrounding CWF [7] [8],
- Details of licences in operation in Australia, publicly available in the RADCOM database [6],
- Locations of nearby weather radars and stations as per the BoM website [9] [10] [11],
- Location of nearby TV and radio broadcast towers [12],
- Mobile phone coverage maps as provided by Telstra, Optus and Vodafone [13] [14] [15], and
- TV broadcast coverage maps, publicly available online [16].

2.4 EXCLUSIONS

As mentioned, this assessment does not include the calculation of reflection/scattering impacts. WSP has undertaken a qualitative assessment to determine potential affected licensees within the vicinity of CWF. WSP suggests these impacts are calculated, if required, following the consultation with the potentially impacted radio stakeholders. WSP has not contacted any of the affected parties identified within this analysis. It is recommended that consultation is undertaken with the affected licensees to assess the potential EMI impact arising from CWF development and operation on their services.

3 POTENTIAL IMPACTS

Following the methodology and inputs described above, WSP has undertaken an independent analysis of the potential EMI impacts arising from the development and operation of CWF.

As mentioned previously, the RADCOM database [6] was accessed and used to identify all licences in operation within 75 km of the project. This database formed the basis of WSP's analysis, as described in the following sub-sections.

3.1 RADCOM DATABASE

The ACMA RADCOM database [6] [17] was used to identify all licences within 75 km of CWF. While it is recommended that all licences within 30 km are identified, it is possible that point-to-point licences span over distances greater than 30 km. As such, WSP has considered the larger distance as a first-pass analysis.

1,273 communication towers were identified within 75 km of CWF, with approximately 81 towers within 30 km of the site boundaries. The locations of the identified towers are shown in Figure 3.1.

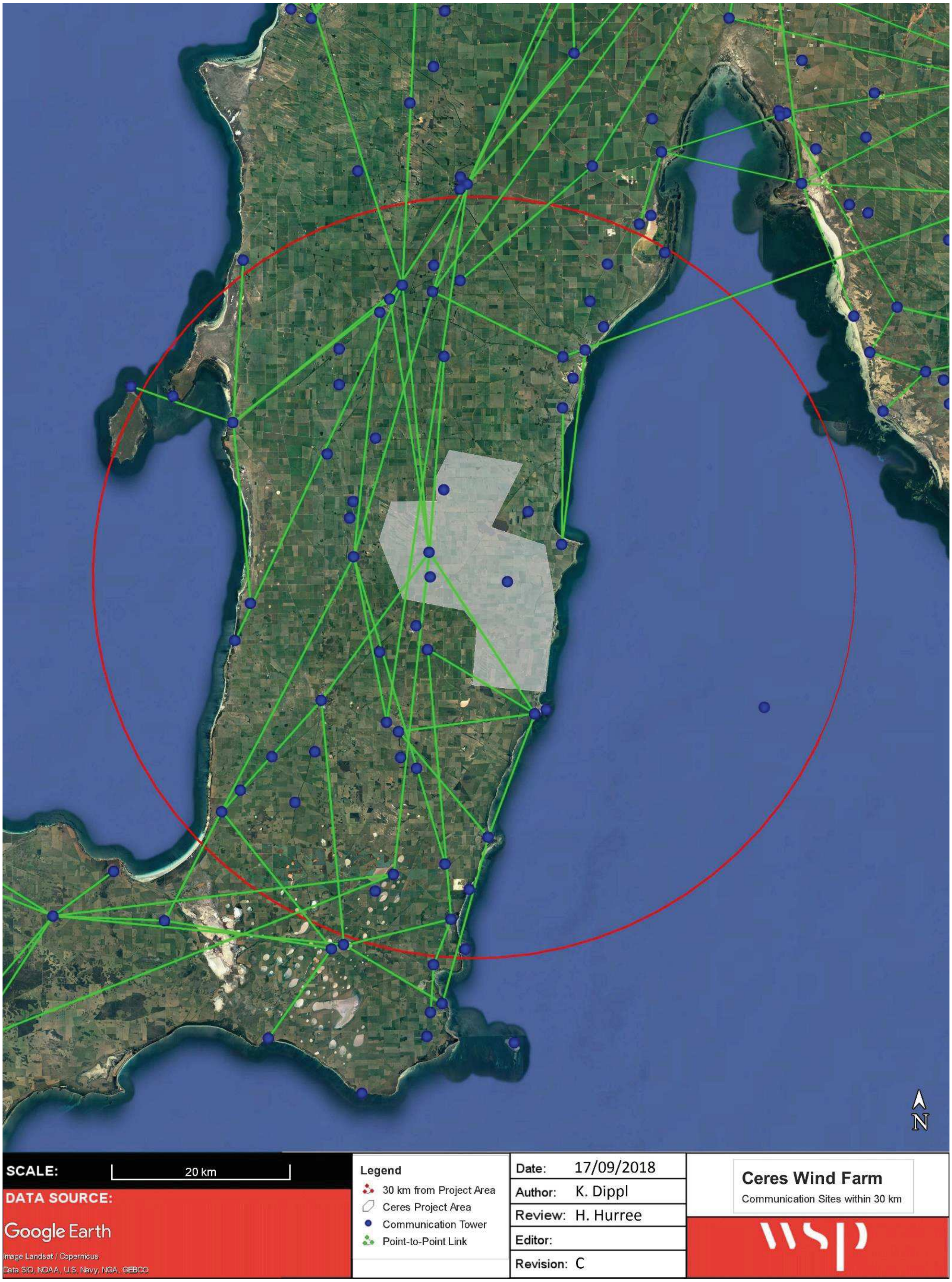

Figure 3.1 Radio communication sites and links within the 30-km area (red circle) surrounding the CWF site

3.1.1 NEAR FIELD EXCLUSION

A refined search was undertaken to identify any towers located within 2 km of any WTG on site and assessed for potential near-field and scattering effects. Eight (8) communication towers were identified and are listed in Table 3-1 below.

Table 3-1 Communication towers within 2 km of CWF

SITE ID	LATITUDE [°]	LONGITUDE [°]	NAME	DISTANCE [m]
2666	-34.6284	137.7223	SAPD site Kenmore Park 8.6 km N of CURRAMULKA	750 m from WTG028
24768	-34.6281	137.7229	Water Tank 7.6 km north of CURRAMULKA	750 m from WTG028
135942	-34.6492	137.7272	Flood Alert Site 5.6 km NNE of CURRAMULKA	800 m from WTG026
136784	-34.6461	137.7380	6.5km North East of Curramulka Adjacent A357 Hundred CURRAMULKA	830 m from WTG052
138326	-34.6542	137.8210	Section 127 3.7 Km West Intersection of B88 and 12 Mile Road Near Port Julia	930 m from WTG140
305297	-34.5620	137.7440	Section 129 Hundred of MULOOWURTLE	1400 m from WTG79
403865	-34.6246	137.7260	Aircare Site Kenmore Park 8.5 km N of CURRAMULKA	250 m from WTG028
9014844	-34.6282	137.7219	Optus Site Curramulka Lot 93 Boundary Road CURRAMULKA	750 m from WTG028

As discussed in section 2.1.1, WSP recommends a WTG-communication tower separation distance equal to the maximum of either the calculated near field exclusion zone or at least 500 m.

It is noted that there is one tower within 500 m of the proposed WTG locations. Tower ID 403865 is approximately 250 m southwest of WTG028. However, according to the RADCOMM database, there are no operators and assignment IDs associated with this tower. It is likely that this tower is currently not in use by the operators servicing this area.

3.2 POINT-TO-POINT LICENCES

As mentioned previously, all registered fixed point-to-point links within 75 km of CWF have been identified and further analysed for potential intersection with the wind farm. Eight (8) point-to-point links were identified in the vicinity of the proposed WTG locations. The details of the links are shown below in Table 3-2.

Table 3-2 Point-to-point links passing nearby CWF

LINK	SITE 1	SITE 2	LICENSEES	MINIMUM FREQUENCY [MHz]
1	2666	24754	South Australian Government Radio Network	11135.000
2	2666	24758	South Australian Government Radio Network	7463.000
3	2666	24786	South Australian Government Radio Network	14504.500
4	24717	24790	South Australian Water Corporation	450.600
5	24728	24768	South Australian Water Corporation	451.325
6	502040	9014844	Optus Mobile Pty Limited	7732.875
7	9014836	9014844	Optus Mobile Pty Limited	7762.525

LINK	SITE 1	SITE 2	LICENSEES	MINIMUM FREQUENCY [MHz]
8	9020866	10008810	NBN Co Limited	10895.000

Figure 3.2 shows all eight (8) fixed point-to-point links that intersect with the approximate CWF project area.

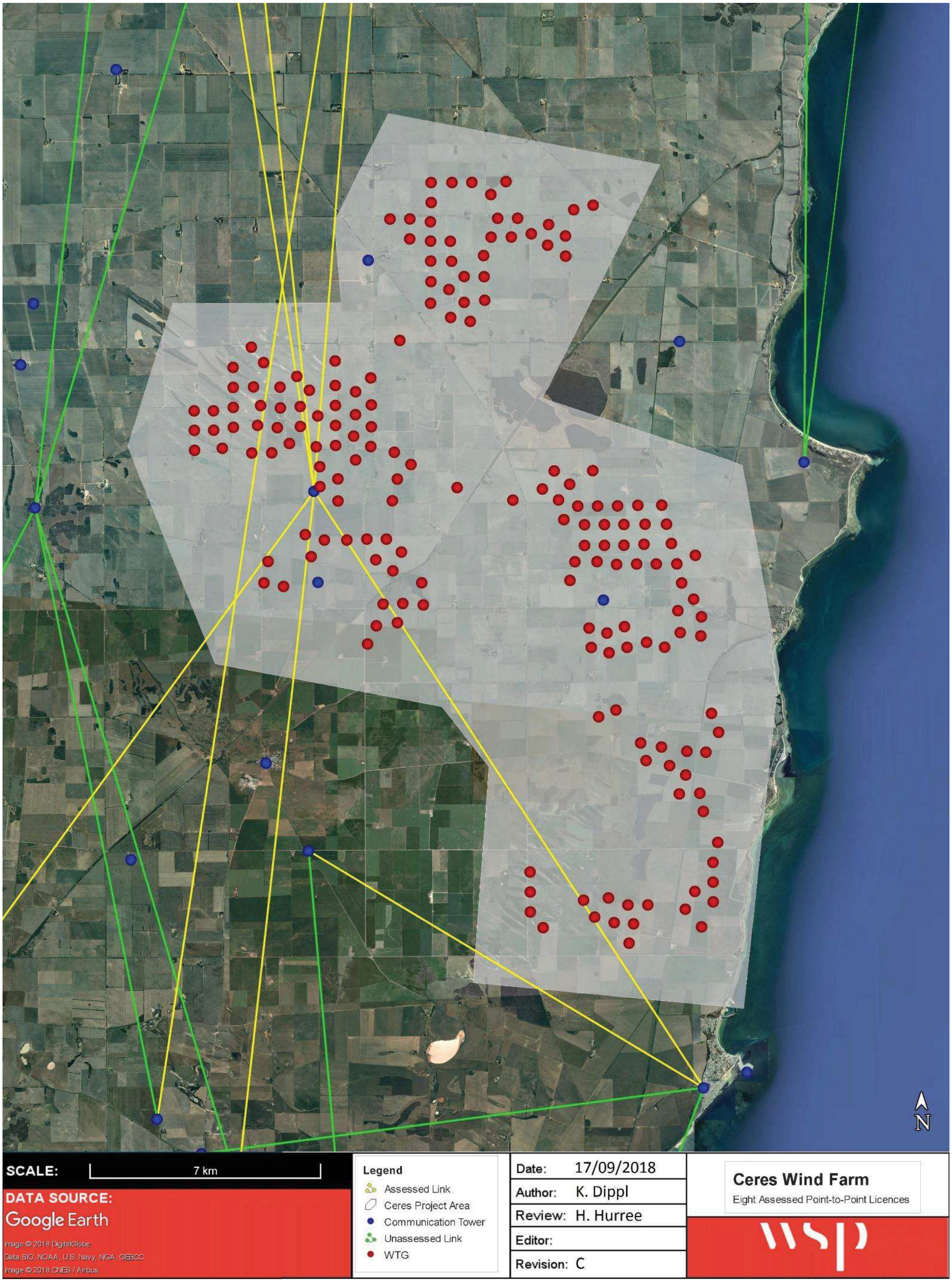

Figure 3.2 The eight identified and analysed point-to-point links nearby CWF

In order to assess the likely impact of the CWF development and operation on the nearby point-to-point links identified, WSP has assessed the 2nd Fresnel exclusion zones for each identified link. As a conservative approach, the lowest frequency associated with each link has been used to develop the 2nd Fresnel zones as this results in the largest Fresnel zone radius.

In order to avoid all potential EMI impacts on the links, WSP recommends that no WTGs encroach the 2nd Fresnel zones of the identified links. A set-back distance of one blade length is also recommended from the 2nd Fresnel zones to avoid blade overhang. For this assessment, a blade length of 78.4 m as supplied by YPWFP P/L has been used.

3.2.1 LINK 1 DETAILS

Table 3-3 lists the details for the first link, between the communication towers 2666 and 24754, including the associated Assignment IDs and frequencies.

Table 3-3 Point-to-point assignments between sites 2666 and 24754

LICENSEE	SITE 1	SITE 2	ASSIGNMENT IDS	FREQUENCY [GHz]
South Australian Government Radio Network	2666 SAPD site Kenmore Park 8.6 km N of CURRAMULKA	24754 Telstra tower 2 km NE of MAITLAND	859034-859033	11.625
			859035-859036	11.135

WSP has calculated the 2nd Fresnel zone for the lowest frequency, shown in Figure 3.3 below. It was observed that no WTGs are currently proposed within the 2nd Fresnel zone. Additionally, the closest WTG is 120 m away from the 2nd Fresnel zone, i.e. more than one blade length.

Figure 3.3 Link 1, Calculated 2nd Fresnel zone (Assignment IDs 859035, 859036)

3.2.2 LINK 2 DETAILS

Table 3-4 lists the details for the second link, between the communication towers 2666 and 24758, including the associated Assignment IDs and frequencies.

Table 3-4 Point-to-point assignments between sites 2666 and 24758

LICENSEE	SITE 1	SITE 2	ASSIGNMENT ID	FREQUENCY [GHz]
South Australian Government Radio Network	2666 SAPD site Kenmore Park 8.6 km N of CURRAMULKA	24758 Police/ETSA/SAGRN tower 10 km SW of Stansbury WEAVER HILL	858537-858538	7.624
			858539-858540	7.463

WSP has calculated the 2nd Fresnel zone for the lowest frequency, shown in Figure 3.4 below. It was observed that no WTGs are currently proposed within the 2nd Fresnel zone. Additionally, the closest WTG is 156 m away from the 2nd Fresnel zone, i.e. more than one blade length.

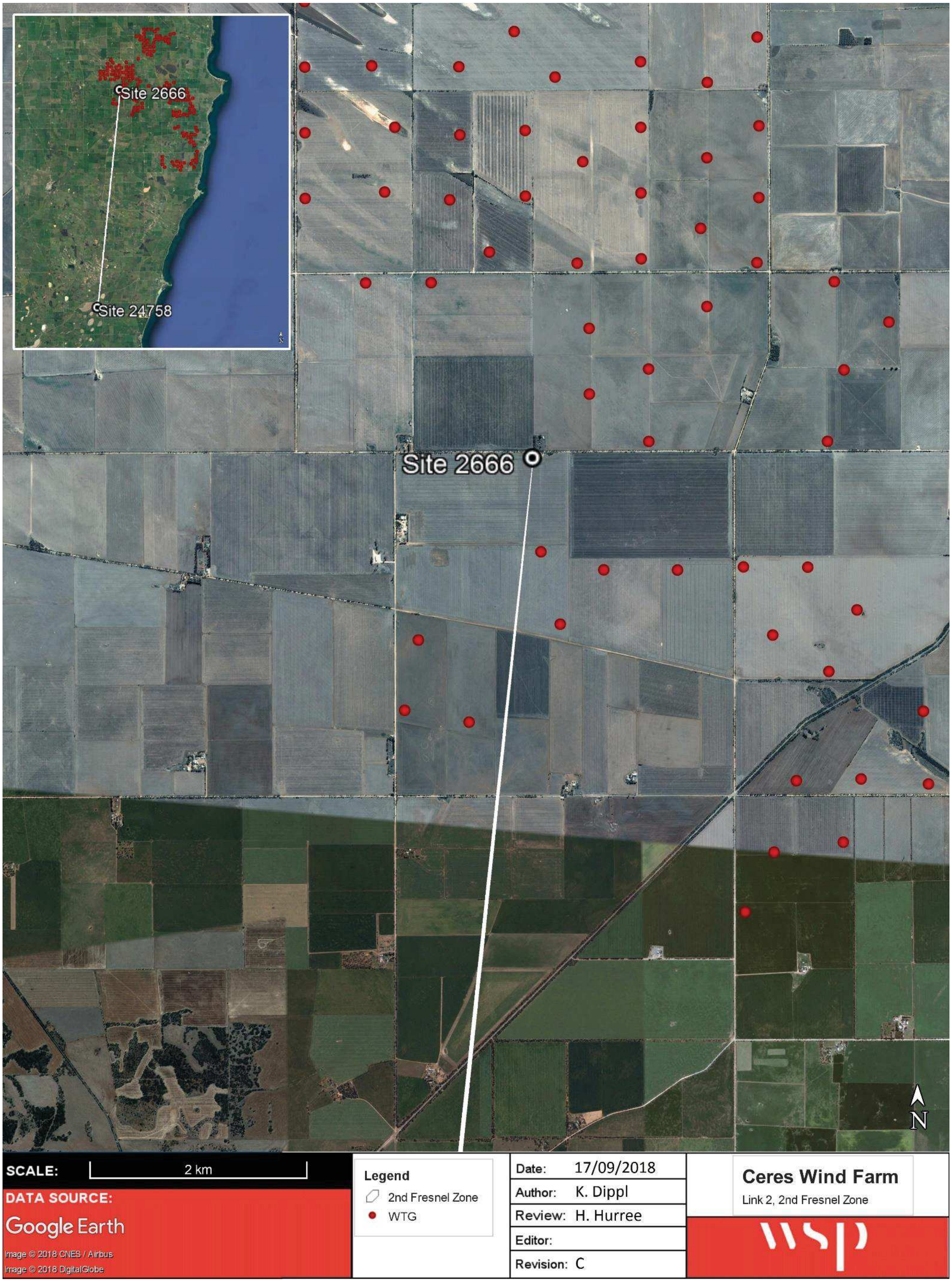

Figure 3.4 Link 2, Calculated 2nd Fresnel Zone (Assignment ID: 858539, 858540)

3.2.3 LINK 3 DETAILS

Table 3-5 lists the details for the third link, between the communication towers 2666 and 24786, including the associated Assignment IDs and frequencies.

Table 3-5 Point-to-point assignments between sites 2666 and 24786

LICENSEE	SITE 1	SITE 2	ASSIGNMENT ID	FREQUENCY [GHz]
South Australian Government Radio Network	2666 SAPD site Kenmore Park 8.6 km N of CURRAMULKA	24786 SA Water tank site Kiln Road PORT VINCENT	859230-859231	15.149
			859232-859233	14.505

WSP has calculated the 2nd Fresnel zone for the lowest frequency, shown in Figure 3.5 and Figure 3.6 below. It was observed that no WTGs are currently proposed within the 2nd Fresnel zone. Additionally, the closest WTG is 110 m away from the 2nd Fresnel zone, i.e. more than one blade length.

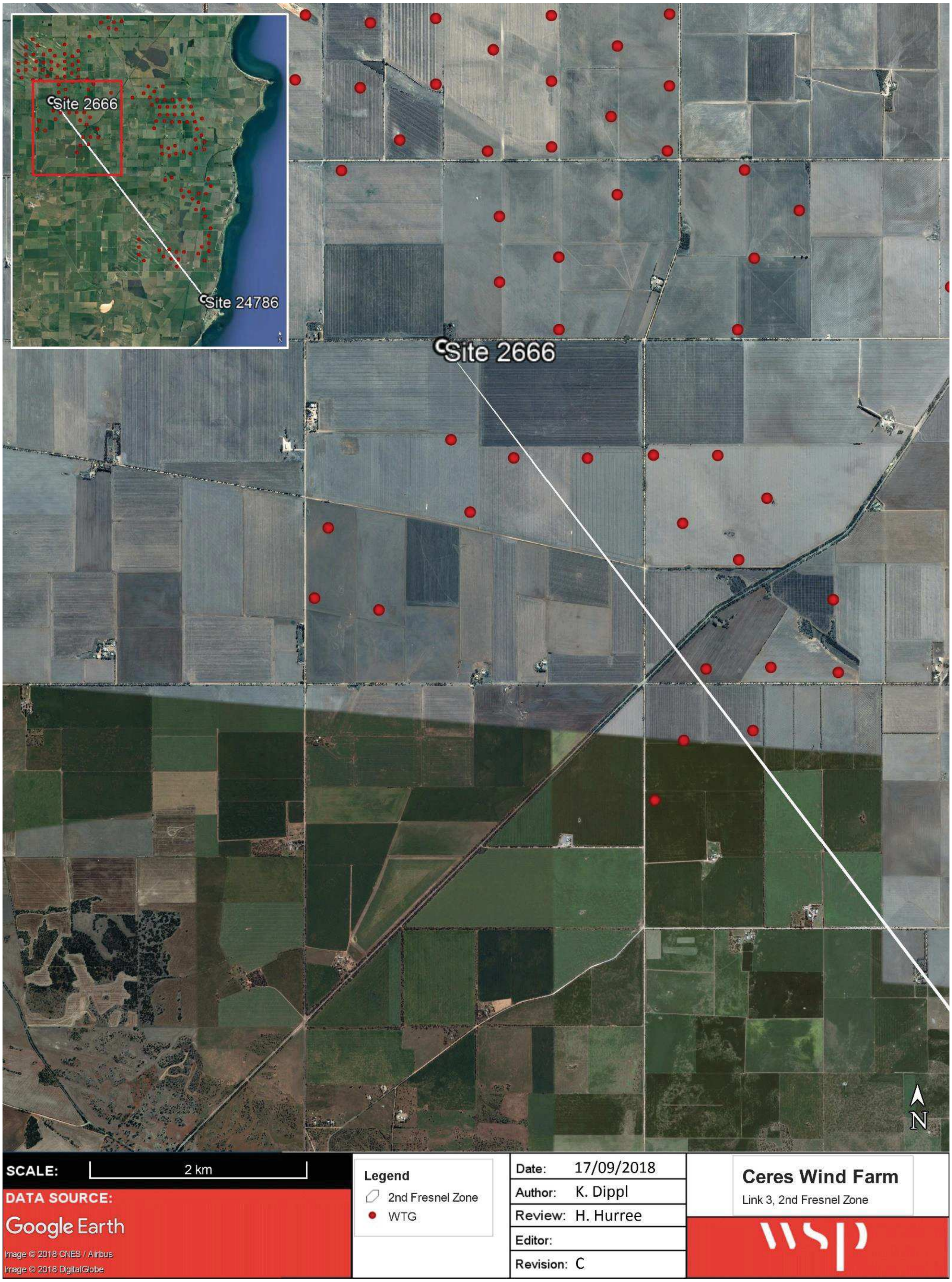

Figure 3.5 Link 3 northwest end, Calculated 2nd Fresnel Zone (Assignment ID: 859232, 859233)

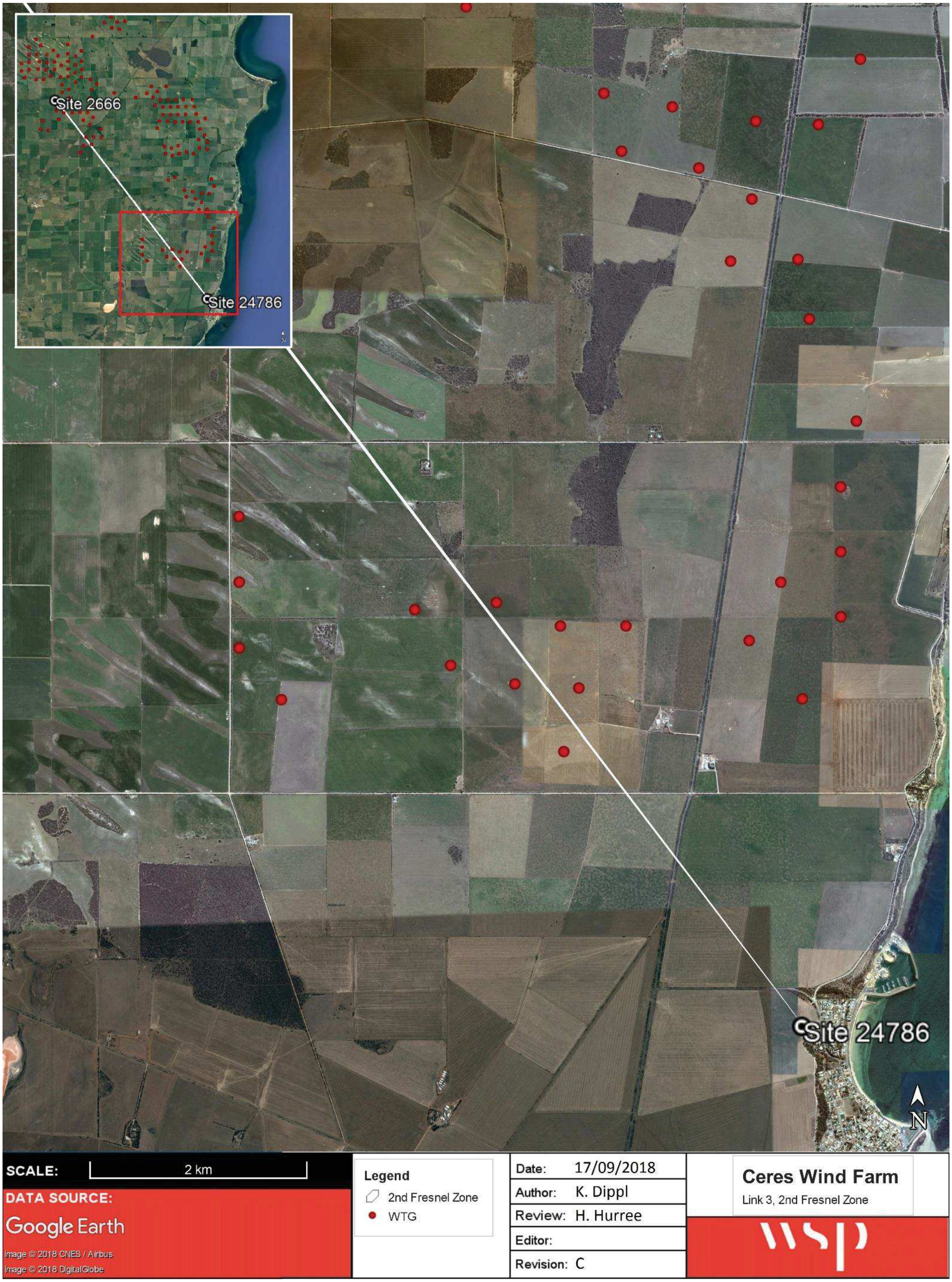

Figure 3.6 Link 3 southeast end, Calculated 2nd Fresnel Zone (Assignment ID: 859232, 859233)

3.2.4 LINK 4 DETAILS

Table 3-6 lists the details for the fourth link, between the communication towers 24717 and 24790, including the associated Assignment IDs and frequencies.

Table 3-6 Point-to-point assignments between sites 24717 and 24790

LICENSEE	SITE 1	SITE 2	ASSIGNMENT ID	FREQUENCY [MHz]
South Australian Water Corporation	24717 SA Water Corporation Tanks ARTHURTON	24790 SA Water Corporation Tanks Site MINLATON	823158-823159	460.1
			823160-823161	450.6

WSP has calculated the 2nd Fresnel zone for the lowest frequency, shown in Figure 3.7 below. It was observed that no WTGs are currently proposed within the 2nd Fresnel zone. Additionally, the closest WTG is 83 m away from the 2nd Fresnel zone, i.e. more than one blade length.

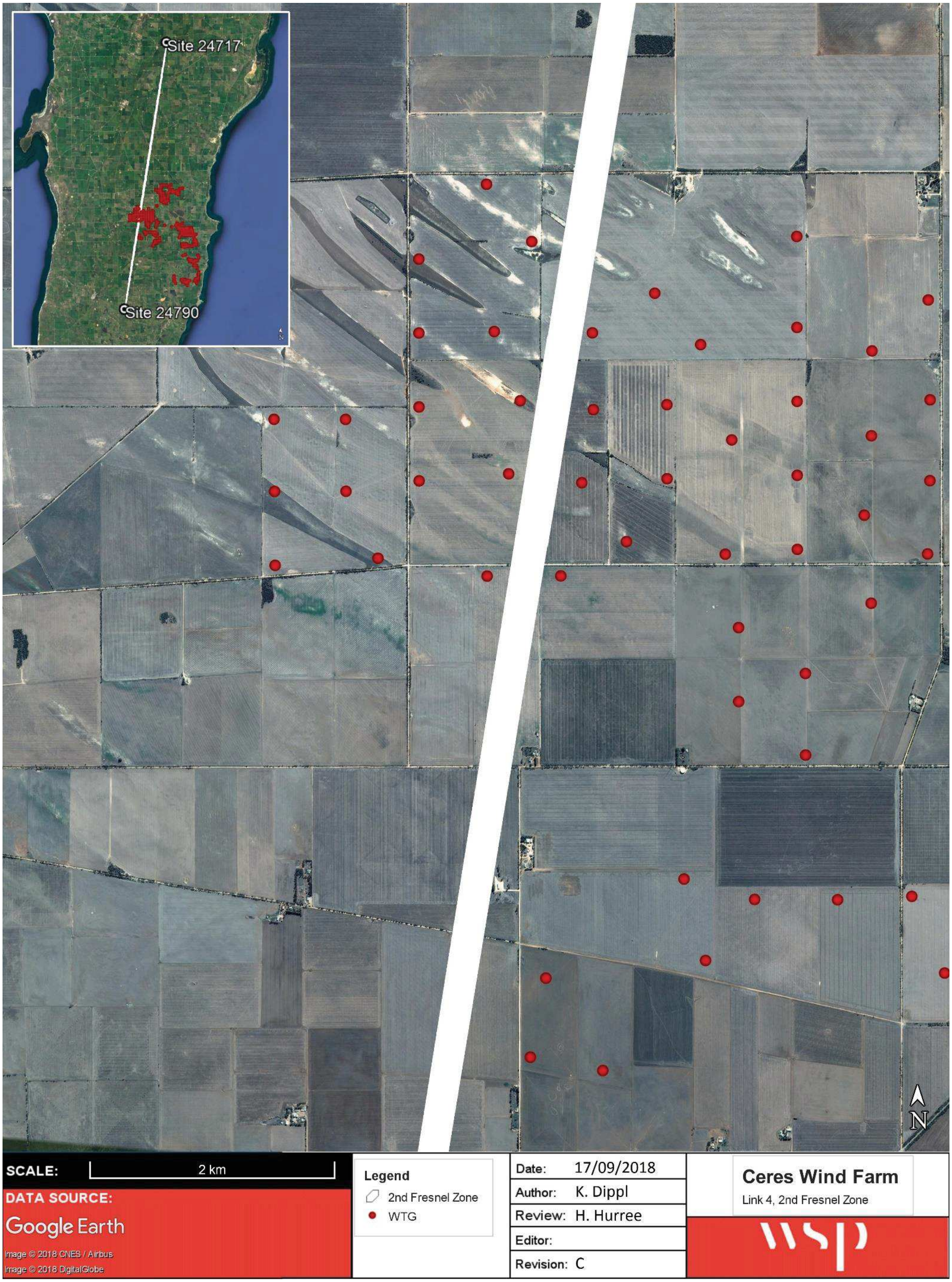

Figure 3.7 Link 4, Calculated 2nd Fresnel Zone (Assignment ID: 823161)

3.2.5 LINK 5 DETAILS

Table 3-7 lists the details for the fifth link, between the communication towers 24728 and 24768, including the associated Assignment IDs and frequencies.

Table 3-7 Point-to-point assignments between sites 24728 and 24768

LICENSEE	SITE 1	SITE 2	ASSIGNMENT ID	FREQUENCY [MHz]
South Australian Water Corporation	24728 Booster Station MAITLAND	24768 Water Tank 7.6 km north of CURRAMULKA	716229-716300	460.825
			716301-716302	451.325

WSP has calculated the 2nd Fresnel zone for the lowest frequency, shown in Figure 3.8 below. It was observed that no WTGs are currently proposed within the 2nd Fresnel zone. Additionally, the closest WTG is 91 m away from the 2nd Fresnel zone, i.e. more than one blade length.

Figure 3.8 Link 5, Calculated 2nd Fresnel Zone (Assignment ID: 716301, 716302)

3.2.6 LINK 6 DETAILS

Table 3-8 lists the details for the sixth link, between the communication towers 502040 and 9014844, including the associated Assignment IDs and frequencies.

Table 3-8 Point-to-point assignments between sites 502040 and 9014844

LICENSEE	SITE 1	SITE 2	ASSIGNMENT ID	FREQUENCY [GHz]
Optus Mobile Pty Limited	502040 Optus Site Correll farm cnr Cemetery & Government Rd MINLATON	9014844 Optus Site Curramulka Lot 93 Boundary Road CURRAMULKA	922296-922297	8.133
			922298-922299	7.821
			973101-973102	8.073
			973103-973104	7.762
			990686-990687	8.044
			990688-990689	7.733

WSP has calculated the 2nd Fresnel zone for the lowest frequency shown in Figure 3.9 below. It was observed that no WTGs are currently proposed within the 2nd Fresnel zone. Additionally, the closest WTG is 146 m away from the 2nd Fresnel zone, i.e. more than one blade length.

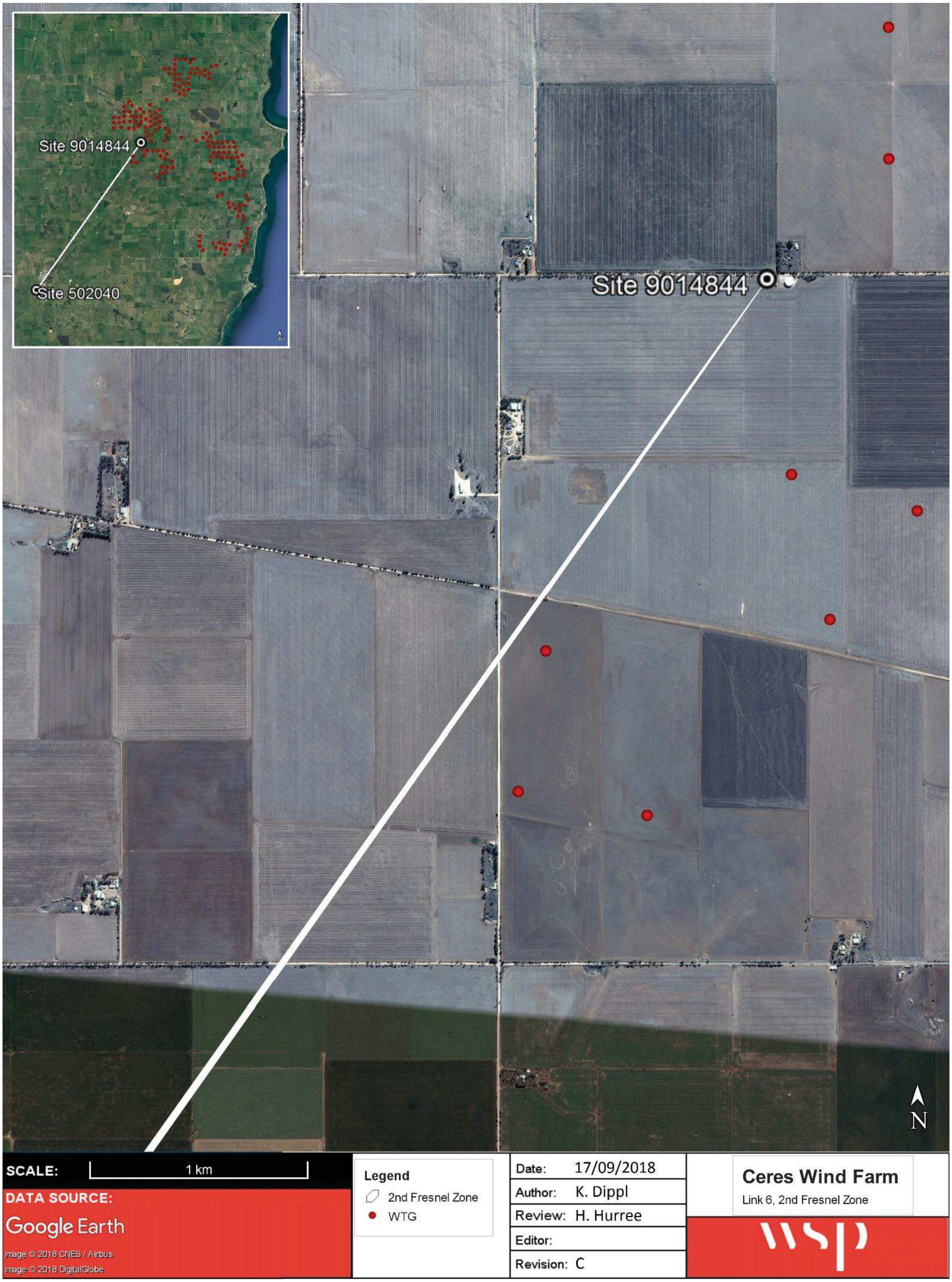

Figure 3.9 Link 6, Calculated 2nd Fresnel Zone (Assignment ID: 990688, 990689)

3.2.7 LINK 7 DETAILS

Table 3-9 lists the details for the seventh link, between the communication towers 9014836 and 9014844, including the associated Assignment IDs and frequencies.

Table 3-9 Point-to-point assignments between sites 9014836 and 9014844

LICENSEE	SITE 1	SITE 2	ASSIGNMENT ID	FREQUENCY [GHz]
Optus Mobile Pty Limited	9014836 Optus Site Maitland Section 365 Rogers terrace MAITLAND	9014844 Optus Site Curramulka Lot 93 Boundary Road CURRAMULKA	922284-922285	8.074
			922286-922287	7.763
			1236309-1236310	8.103
			1236311-1236312	7.792

WSP has calculated the 2nd Fresnel zone for the lowest frequency, shown in Figure 3.10 below. It was observed that no WTGs are currently proposed within the 2nd Fresnel zone. Additionally, the closest WTG is 82 m away from the 2nd Fresnel zone, i.e. more than one blade length.

Figure 3.10 Link 7, Calculated 2nd Fresnel Zone (Assignment ID: 922286, 922287)

3.2.8 LINK 8 DETAILS

Table 3-10 lists the details for the eighth link, between the communication towers 9020866 and 10008810, including the associated Assignment IDs and frequencies.

Table 3-10 Point-to-point assignments between sites 9020866 and 10008810

LICENSEE	SITE 1	SITE 2	ASSIGNMENT ID	FREQUENCY [GHz]
NBN Co Limited	9020866 NBN Co Site Lot 1 Government Road CURRAMULKA	10008810 NBN Co Site Lot 161 Port Vincent Road Port Vincent	3399034-3399035	11.425
			3399036-3399037	10.935
			3399038-3399039	11.385
			339940-3399041	10.895
			3399042-3399043	11.465
			3399044-3399045	10.975

WSP has calculated the 2nd Fresnel zone for the lowest frequency shown in Figure 3.11 below. It was observed that no WTGs are currently proposed within the 2nd Fresnel zone. Additionally, the closest WTG is approximately 1600 m away from the 2nd Fresnel zone, i.e. more than one blade length.

Figure 3.11 Link 8, Calculated 2nd Fresnel Zone (Assignment ID: 3399040, 3399041)

3.2.9 SUMMARY OF POINT-TO-POINT ANALYSIS

Based on the analysis of the eight (8) identified links conducted above, four licensees were identified that operate links passing in the vicinity of CWF WTGs. Based on the 2nd Fresnel zone analysis, it is not expected that any of the four (4) identified licensees will be impacted by the development and operation of CWF. A summary of the findings is shown in Table 3-11.

Table 3-11 Summary of results for point-to-point link analyses

LICENSEE	SITE 1	SITE 2	ASSIGNMENT ID (MINIMUM FREQUENCY)	FREQUENCY [MHz]	WTGS ENCROACHING FRESNEL ZONE
NBN Co Limited	9020866 NBN Co Site Lot 1 Government Road CURRAMULKA	10008810 NBN Co Site Lot 161 Port Vincent Road Port Vincent	3399041	10895.000	0
Optus Mobile Pty Limited	502040 Optus Site Correll farm cnr Cemetery & Government Rds MINLATON	9014844 Optus Site Curramulka Lot 93 Boundary Road CURRAMULKA	990689	7732.875	0
	9014836 Optus Site Maitland Section 365 Rogers terrace MAITLAND	9014844 Optus Site Curramulka Lot 93 Boundary Road CURRAMULKA	922287	7762.525	0
South Australian Water Corporation	24717 SA Water Corporation Tanks ARTHURTON	24790 SA Water Corporation Tanks Site MINLATON	823161	450.600	0
	24728 Booster Station MAITLAND	24768 Water Tank 7.6 km north of CURRAMULKA	716301	451.325	0
South Australian Government Radio Network	2666 SAPD site Kenmore Park 8.6 km N of CURRAMULKA	24754 Telstra tower 2 km NE of MAITLAND	859035	11135.000	0
	2666 SAPD site Kenmore Park 8.6 km N of CURRAMULKA	24758 Police/ETSA/SAGRN tower 10 km SW of Stansbury WEAVER HILL	858539	7463.000	0

LICENSEE	SITE 1	SITE 2	ASSIGNMENT ID (MINIMUM FREQUENCY)	FREQUENCY [MHz]	WTGS ENCROACHING FRESNEL ZONE
	2666 SAPD site Kenmore Park 8.6 km N of CURRAMULKA	24786 SA Water tank site Kiln Road PORT VINCENT	859232	14504.500	0

Should any WTGs to be found to later intrude on exclusion zones, there are a number of mitigation options available. However, before investigating mitigation option for CWF, WSP recommends the coordinates of the transmitting and receiving radio sites, the status of the services and requirements of the licensees are verified during consultation with the identified licensees.

The RADCOM radio site coordinates may not be accurate, the services may not be active or the requirements of the licence holders may influence the requirements for layout adjustment.

3.3 POINT-TO-MULTIPOINT LICENCES

Point-to-multipoint links are similarly susceptible to the types of impacts discussed in sections 3.1.1 and 3.2. However, because of the nature of many uses of point-to-multipoint licences, the likelihood of a wind farm causing unacceptable impacts is generally low.

There may be point-to-multipoint services with fixed receivers that can be impacted. Any registered services will be present and accounted for in the ACMA database used in this assessment [18].

Table 3-12 shows the identified operators of fixed point-to-multipoint licences within 30 km of CWF.

Table 3-12 Point-to-multipoint licences within 30 km of CWF.

LICENSEE	SITE	ASSIGNMENT ID	FREQUENCY [MHz]	DISTANCE FROM CWF AREA [km]
Agile Pty Ltd	136775	829955	3438.33	15.9
		829952	3488.33	15.9
		1307362	3595.00	15.9
		1307359	3595.00	15.9
	136785	831170	3438.33	4.6
		831167	3488.33	4.6
	136805	829960	3488.33	4.0
		829963	3438.33	4.0
	136806	895004	3582.50	16.5
		895001	3582.50	16.5
	306004	893351	3582.50	20.2
		893348	3582.50	20.2
	306005	758134	3488.33	5.3
		758137	3438.33	5.3
		923761	3595.00	5.3

LICENSEE	SITE	ASSIGNMENT ID	FREQUENCY [MHz]	DISTANCE FROM CWF AREA [km]
		923758	3595.00	5.3
		887609	3582.50	5.3
		887612	3582.50	5.3
	306006	893352	3582.50	11.5
		893355	3582.50	11.5
Bureau of Meteorology	135942	1306057	151.50	0.8
		1306054	151.50	0.8
Flinders Ports Pty Ltd	501464	824564	461.54	28.9
		824567	452.04	28.9
South Australian Water Corporation	24732	764009	461.48	19.7
		764012	451.98	19.7
	24790	764027	461.40	7.6
		764030	451.90	7.6
	9000949	764020	452.08	5.2
		764017	461.58	5.2
Spark Infrastructure SA (No2) Pty Limited	24732	754088	452.32	19.7
		754085	461.82	19.7
	24758	914750	452.29	22.4
		914747	461.79	22.4

3.3.1 AM AND FM BROADCASTING

The impact on AM and FM radio broadcasting reception is considered to be negligible beyond the boundary of the wind farm. In general, there are no known effects on AM/FM services caused by the wind farm as the wavelengths of these services are relatively large compared to the size of the WTGs. The locations of the AM and FM broadcast towers in proximity to CWF are shown in Figure 3.12.

It is noted that AM signals can propagate around WTGs and as such, WSP does not expect that the CWF development and operation will adversely impact the AM radio services in the area.

FM signals, however, are more susceptible to interference from nearby obstacles, such as WTGs. However, this can only occur when the receiver is in close proximity to the obstacle. YPWFP P/L has previously supplied WSP with the details of 354 dwellings nearby the CWF project area [19] [8]. WSP has included the dwellings with type ‘house’ in the EMI studies included in this report, of which there are 228 near CWF and several within 1 km of the proposed WTG locations. Dwellings listed as ‘shed’, ‘ruin’ and ‘house NA’ have not been included in the EMI studies due to them not being primary residences. Should these houses be subject to poor FM signals, mitigation measures, such as the installation of high gain antenna, can help to rectify this issue.

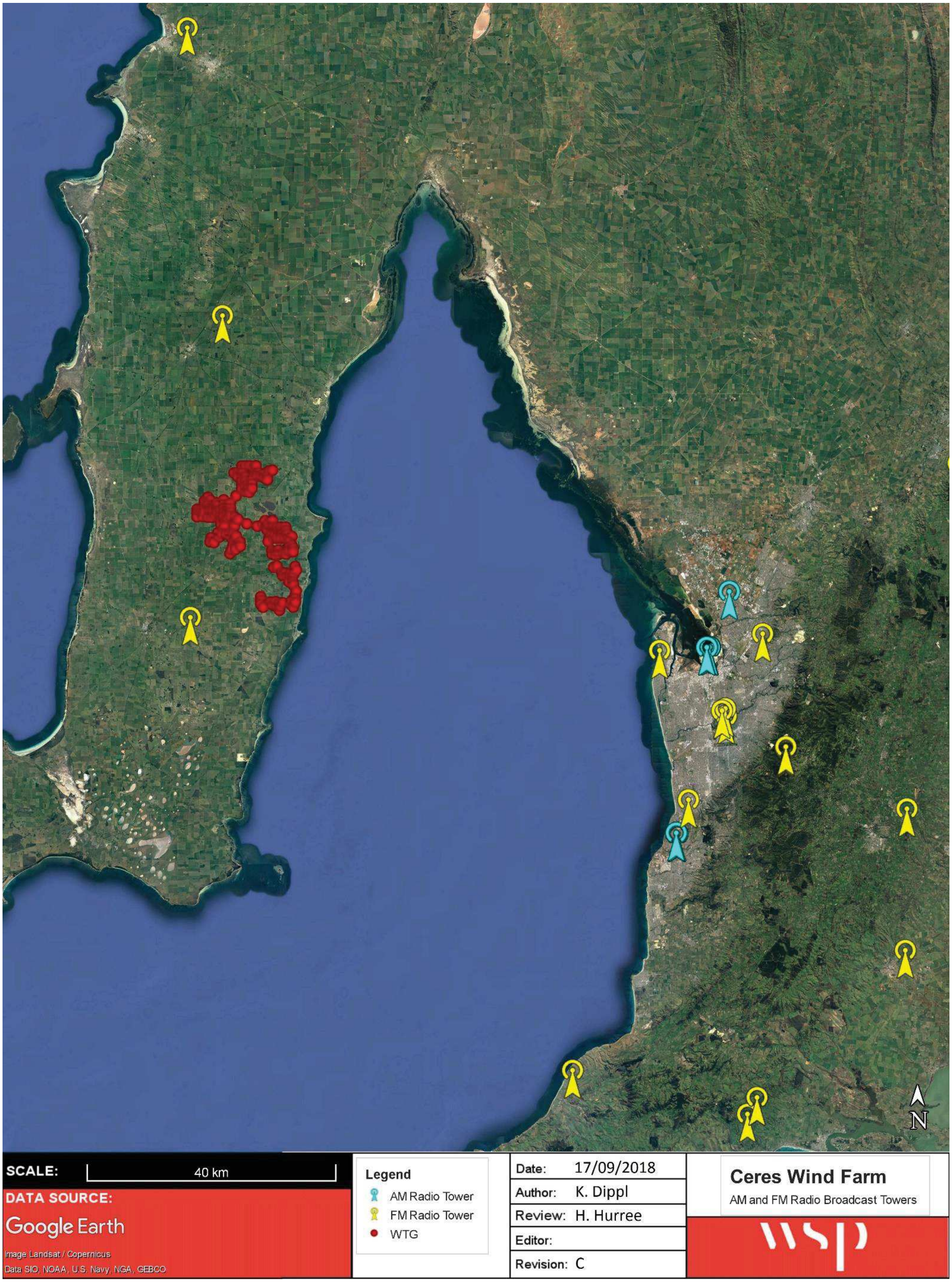

Figure 3.12 AM and FM radio broadcast towers in proximity to CWF

3.3.2 DIGITAL RADIO

Based on the ABC Reception Coverage Estimator [16], ABC Digital Radio services are available to some residences in a small eastern region of Yorke Peninsula, nearby CWF, as shown in Figure 3.13. The coverage estimator suggests that ‘reception may be difficult’ in this region [20], therefore it is possible that the development and operation of CWF may have adverse effects on the already-weak reception.

It should be noted, however, that Digital Radio Plus’s coverage estimator [21] has noted that DAB+ digital radio services are currently unavailable in the CWF area, including the regions outlined as having poor reception using the ABC Reception Coverage Estimator. Due to the conflicting information available, WSP therefore recommends that a ground survey is undertaken at CWF to determine the quality of digital radio services in the area prior to the construction of CWF.

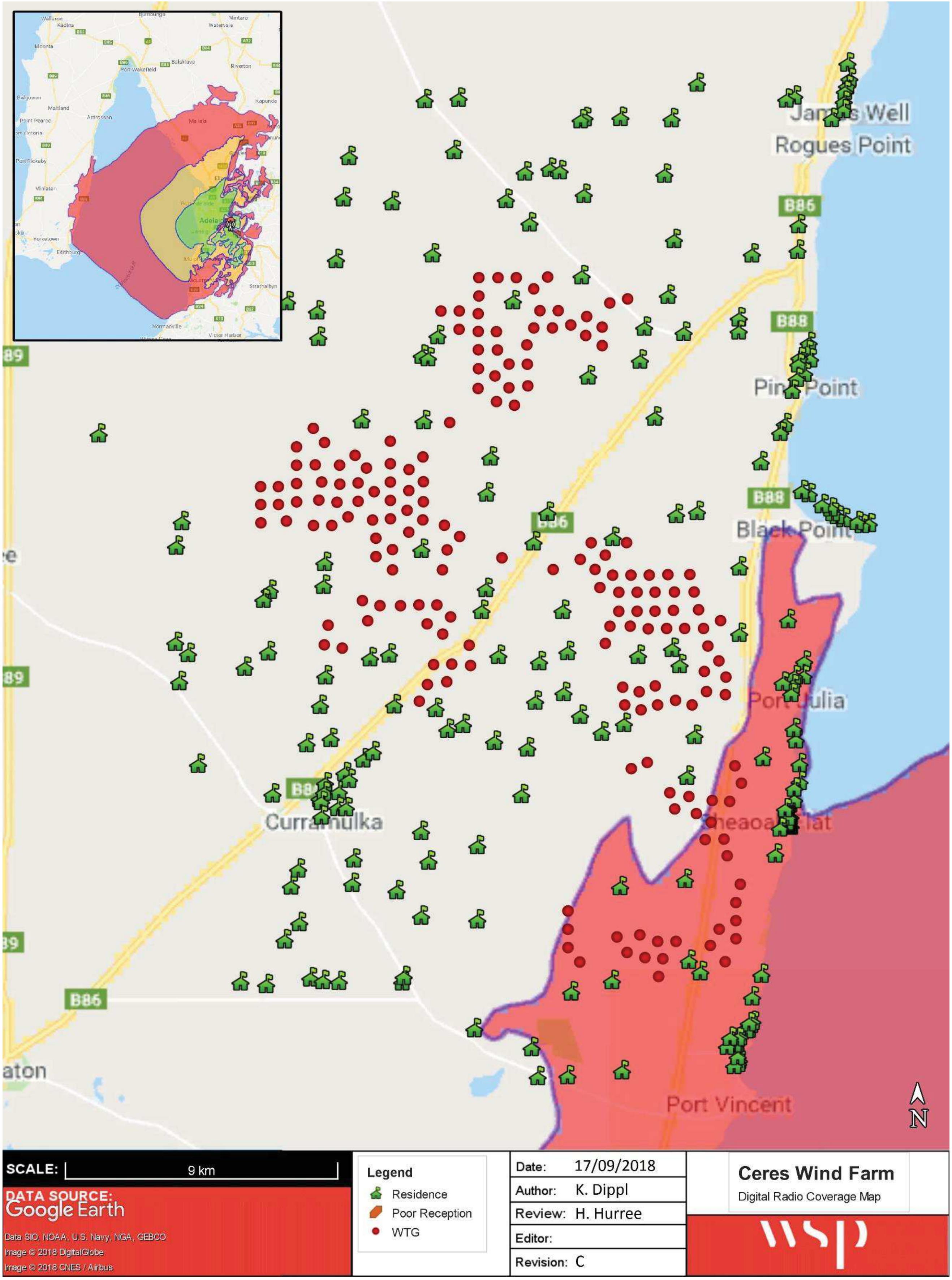

Figure 3.13 ABC Digital Radio coverage

3.3.3 MOBILE RADIO

Mobile radio may be affected by the shadowing effects of the CWF. However, if this is the case, any problems can usually be rectified through a minor adjustment in the position of the receiver.

3.3.4 MOBILE RECEPTION

Mobile reception can be affected by the development and operation of CWF, depending on the level of coverage surrounding CWF. WSP has assessed existing mobile coverage from three (3) common service providers in proximity to CWF, including Telstra, Optus and Vodafone.

The mobile reception coverage map for Telstra in the area surrounding CWF is shown in Figure 3.14. Mobile reception for Telstra has several areas containing houses with limited, 3G-only coverage. Therefore, in areas of currently marginal coverage, it is possible that CWF will impact the mobile reception for Telstra customers. WSP recommends contacting Telstra seeking feedback on potential EMI impacts arising from the development and operation of CWF.

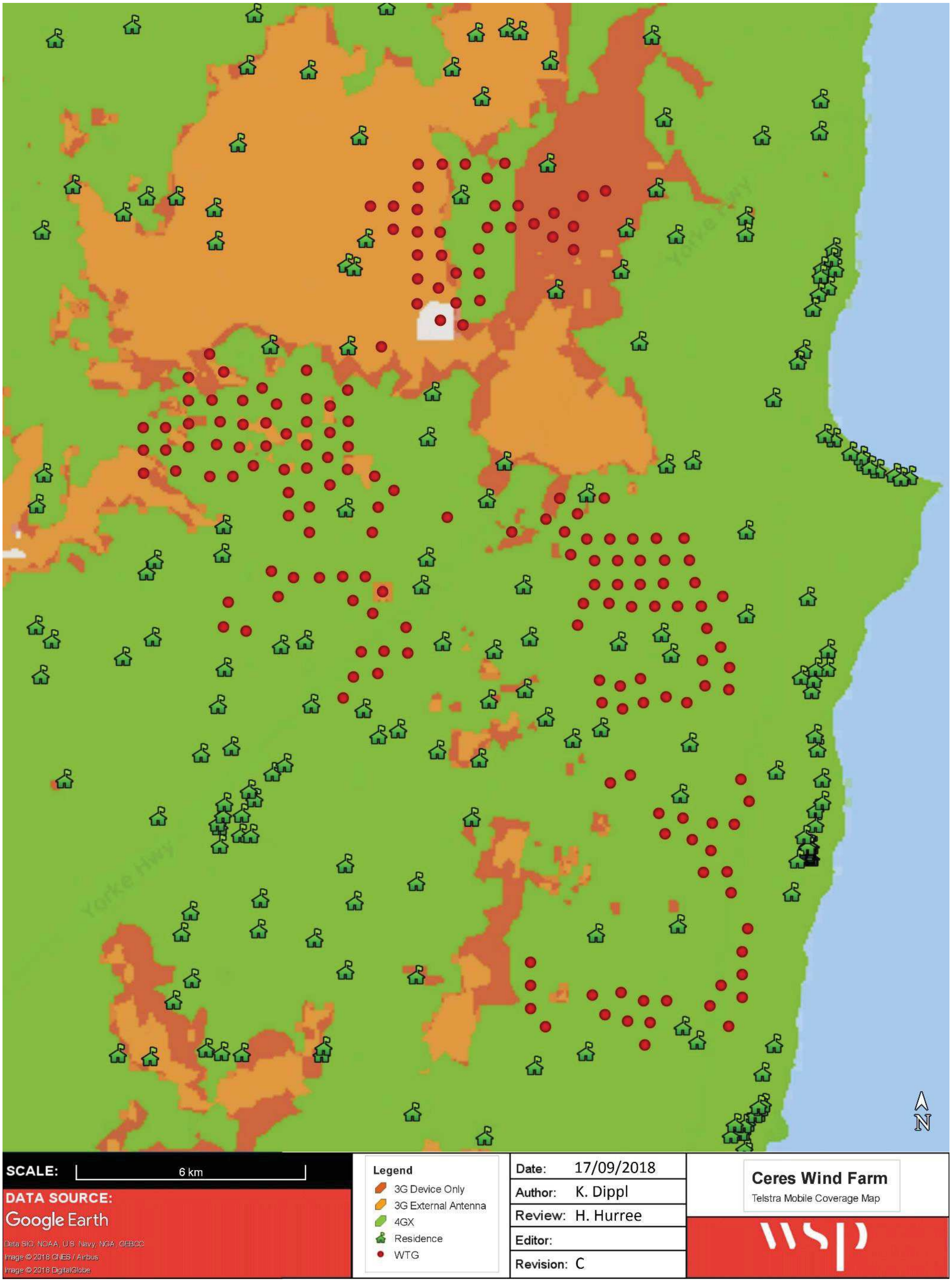

Figure 3.14 Telstra mobile coverage map [13]

The mobile reception coverage map for Optus mobile services in the area around CWF is shown in Figure 3.15. The strength of Optus mobile phone reception varies around CWF, with many residences located in areas of 3G-only coverage. Therefore, in areas of currently marginal coverage, it is possible that CWF will impact the mobile reception for Optus customers. WSP recommends contacting Optus seeking feedback on potential EMI impacts arising from the development and operation of CWF.

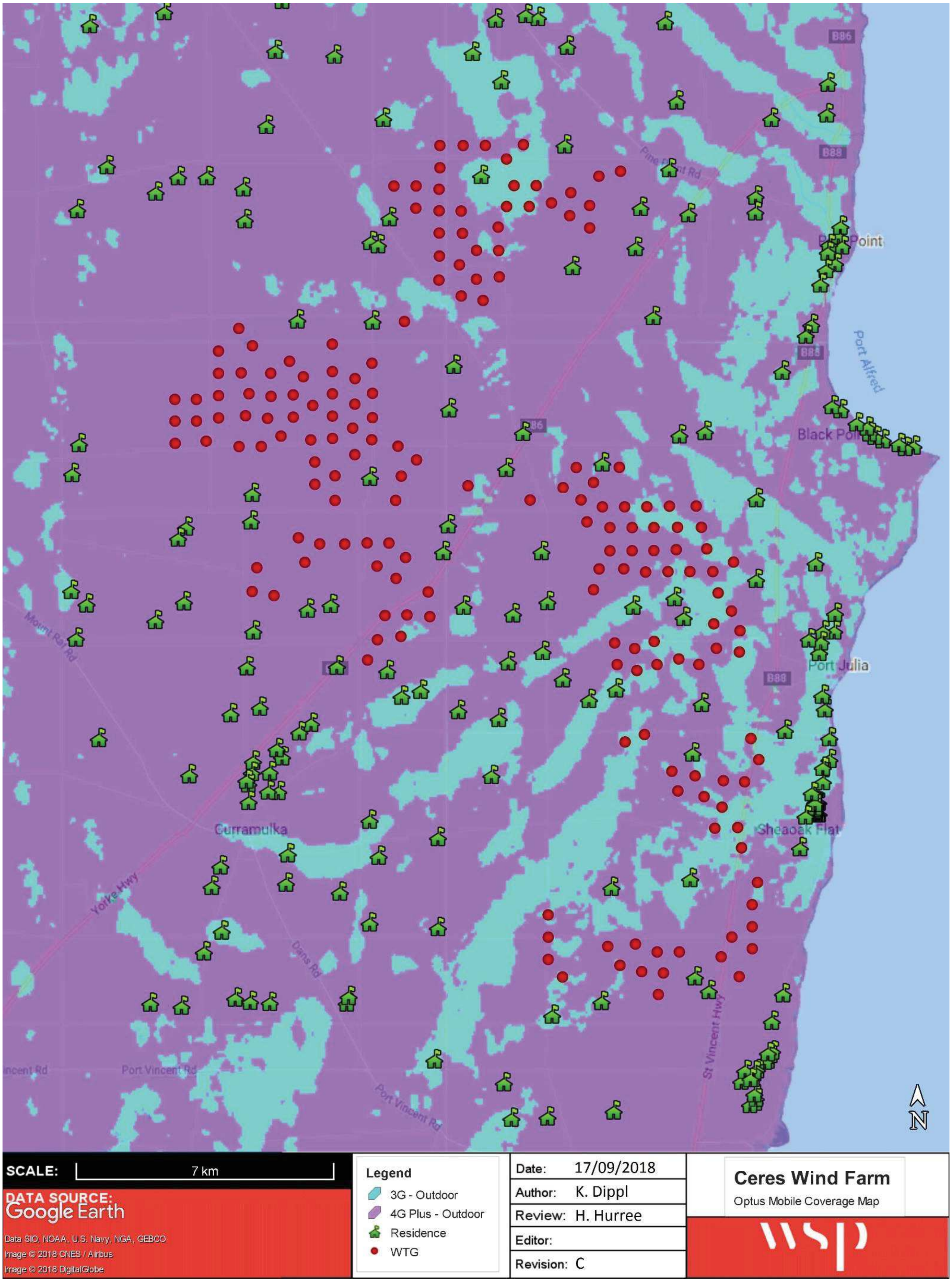

Figure 3.15 Optus mobile coverage map [14]

The mobile reception coverage map for Vodafone in the area around CWF is shown in Figure 3.16. The strength of Vodafone mobile reception varies around CWF, with many residences located in areas of 3G-only coverage. Therefore, in areas of currently marginal coverage, it is possible that CWF will impact the mobile reception for Vodafone customers. WSP recommends contacting Vodafone seeking feedback on potential EMI impacts arising from the development and operation of CWF.

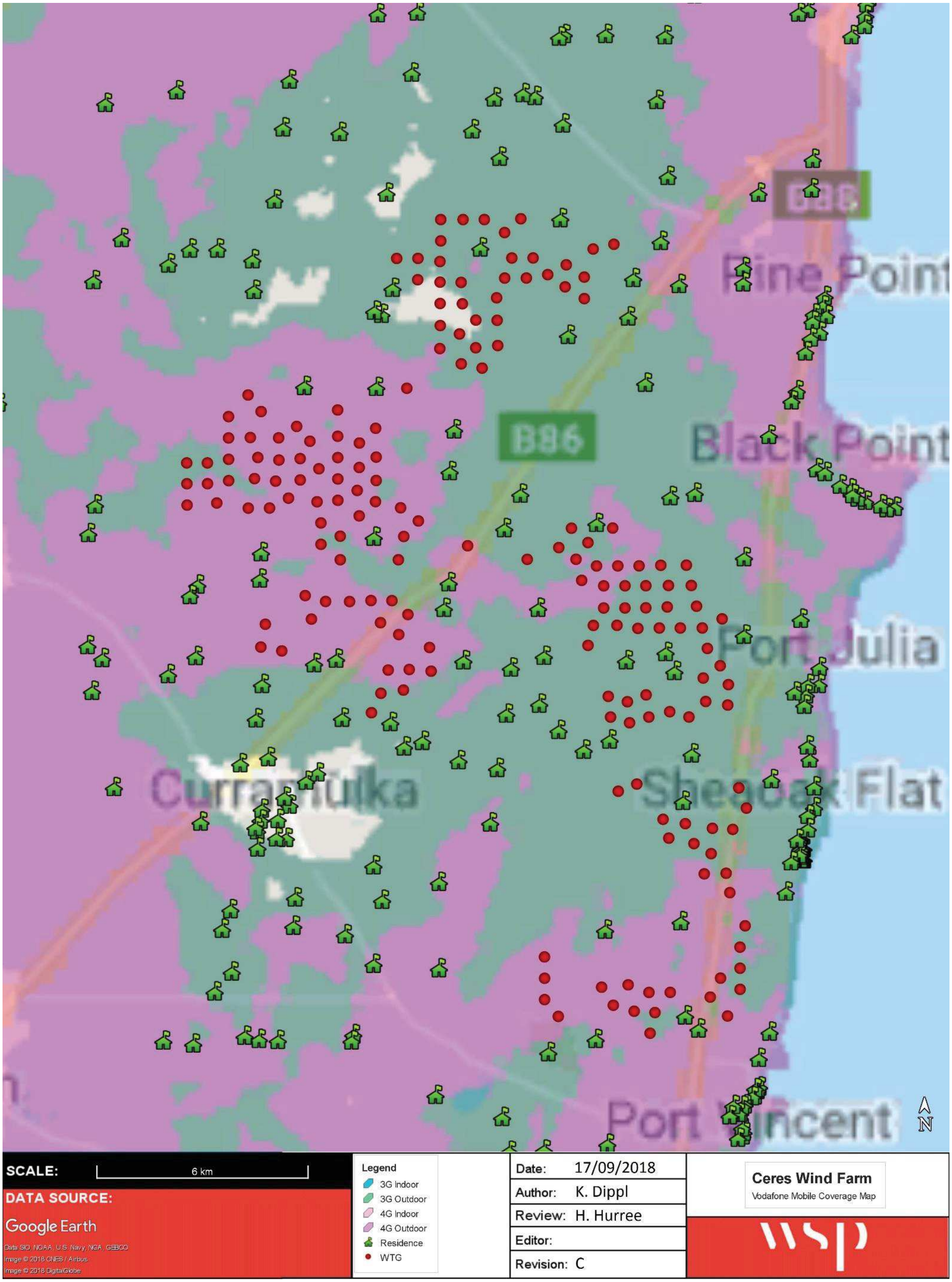

Figure 3.16 Vodafone mobile coverage map [15]

3.3.5 TELEVISION SERVICES

Analog TV signals are known to be affected by interference from WTGs. Analog TV was gradually phased out in Australia since 2010 and completed nation-wide in 2013. At present, digital TV signals are available across the country and are usually less prone to interference, if the signal is strong enough initially. A search of the digital TV broadcast stations was conducted in proximity of CWF. The locations of nearby digital TV broadcast sites are shown in pink in Figure 3.17 [12].

There are a number of residences surrounding the CWF project area that the WTGs can obstruct regarding the line of sight of nearby broadcast stations. If these residences are currently experiencing marginal TV coverage, they may experience interference to their TV services due to CWF. Should this be the case, there are a number of mitigation measures that can be put in place. These are discussed further in section 4.1.3.

According to the MySwitch website [22], the area surrounding CWF is currently serviced by the Crafers Broadcast Tower, located in Adelaide, and the Maitland Broadcast Tower, located approximately 20 km north of CWF in Maitland. WSP has therefore investigated the coverage area services by the Crafers and Maitland towers.

Figure 3.18 shows the Digital TV reception about CWF from site 23139 (Broadcast Australia Site Summit Road CRAFERS), while Figure 3.19 shows the reception from site 24754 (Telstra tower 2 km NE of MAITLAND). Good coverage indicates that good reception in this area is usual possible with the use of an external antenna. Variable coverage indicates that reception may require the use of a good quality external antenna and possibly a low noise amplifier. WSP recommends that a ground survey of TV signal strength is undertaken with the residents surrounding CWF prior to the construction of the wind farm to confirm the TV signal strengths identified.

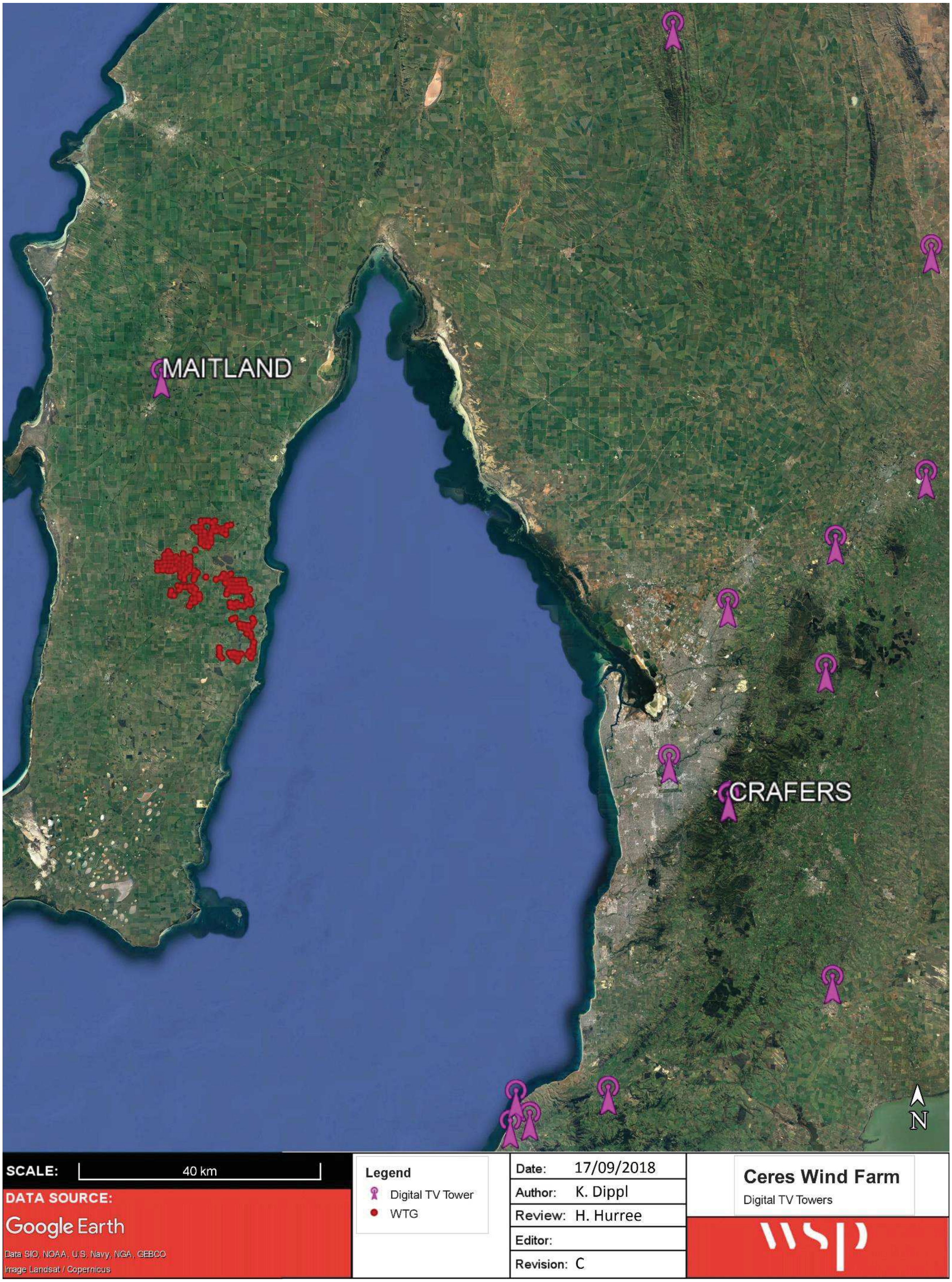

Figure 3.17 Digital TV broadcast sites in proximity to CWF

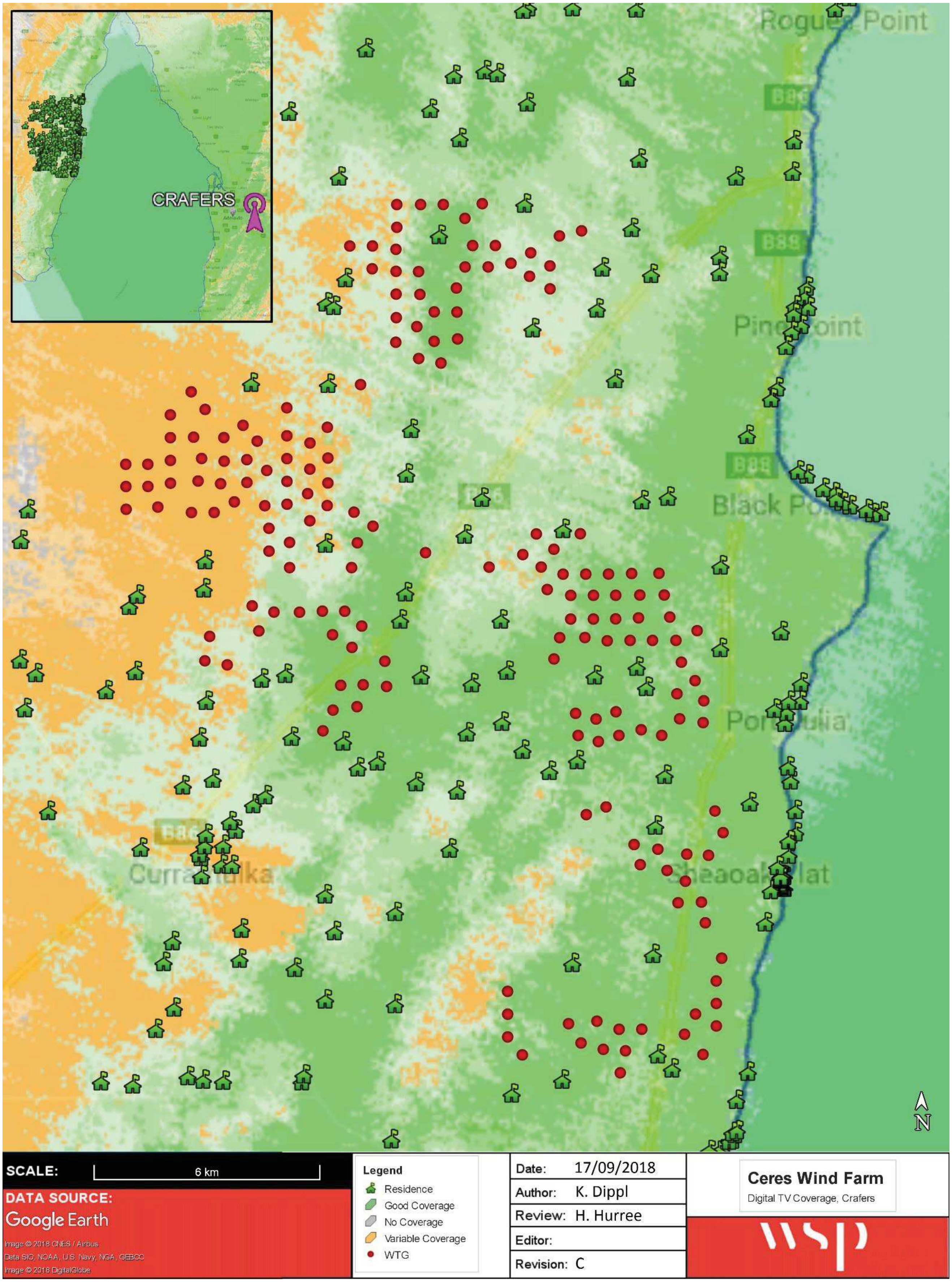

Figure 3.18 ABC Digital TV coverage about CWF from site 9580 (Telecom Tower CRAFERS) [23]

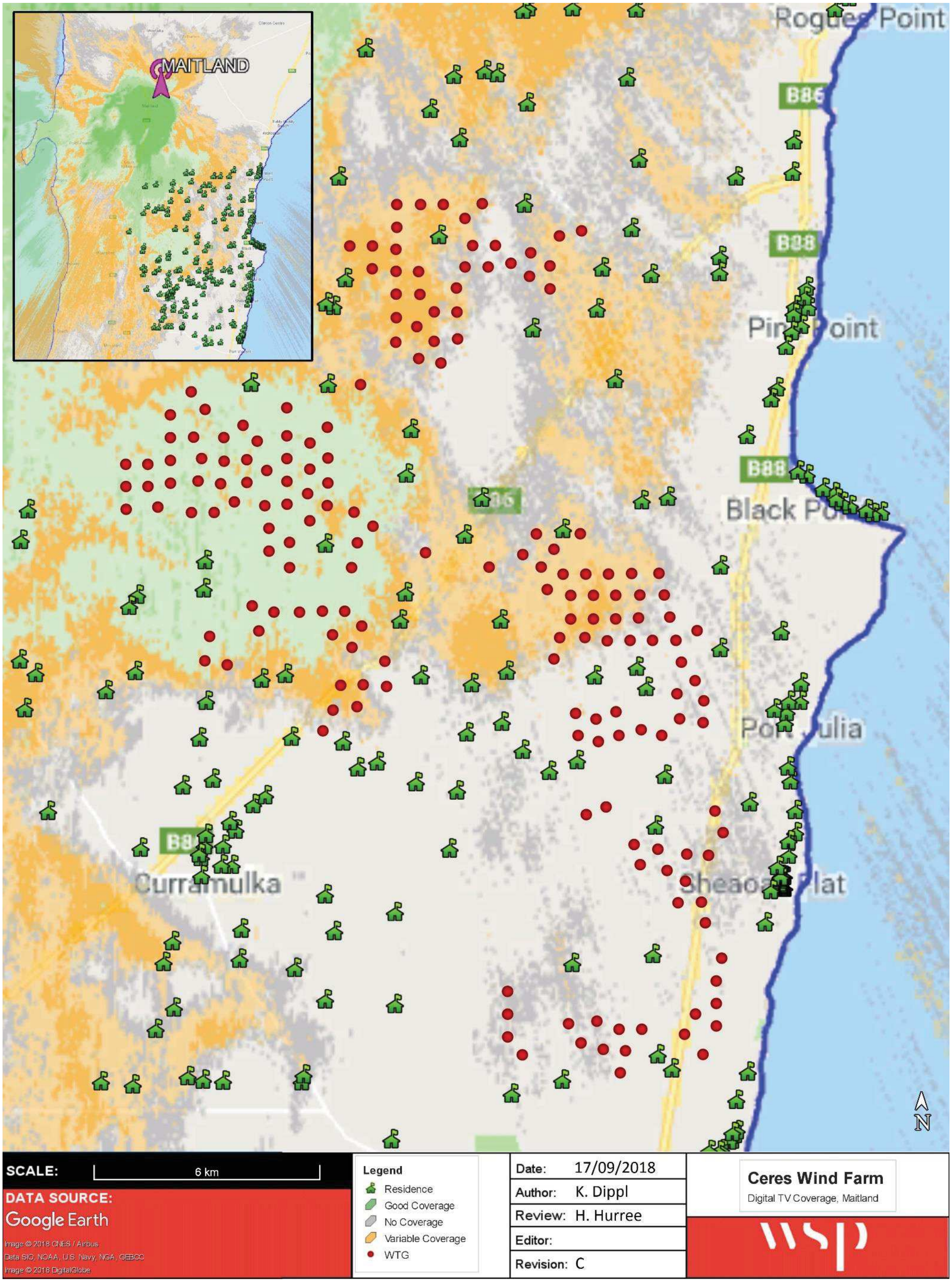

Figure 3.19 ABC Digital TV coverage about CWF from site 24754 (Telecom Tower MAITLAND) [23]

3.4 POINT-TO-AREA SERVICES

Point-to-area services were identified within 30 km of CWF. Table 3-13 lists each licence type and the corresponding number of licences within 30 km of CWF.

Table 3-13 Details of other licences identified within 30 km of CWF

LICENCE TYPE	LICENCE CATEGORY	NUMBER OF ASSIGNMENT IDS	CLOSEST DISTANCE TO CWF [km]
Broadcasting	Commercial Radio	1	20.5
	Narrowcasting Service (LPON)	7	17.3
Land Mobile	Land Mobile System - > 30 MHz	54	4.7
	Paging System – Exterior	3	26.7
Maritime Coast	Limited Coast Assigned System	4	27.9
PTS	PMTS Class B	60	16.1
PTS 900 MHz	PMTS Class B (935-960 MHz)	34	6.7
Spectrum	700 MHz Band	78	16.1
	800 MHz Band	56	10.7
	1800 MHz Band	12	17.6
	2 GHz Band	31	16.2
	2.3 GHz Band	8	9.9
	2.5 GHz Band	16	16.2
	3.4 GHz Band	4	17.6

WSP recommends contacting the organisations operating the licences within 30 km of CWF for comments on potential EMI impacts to their services as a result of the proposed development.

3.4.1 INTERNET SERVICES

As mentioned above, all organisations operating point-to-area licences within 30 km of CWF were identified. The following table shows the Internet Service Providers (ISPs) and telecommunication providers operating within 30 km of CWF. WSP recommends that the licensees listed in Table 3-14 are contacted to comment on any potential impacts to their services as a result of the development and operation or CWF.

Table 3-14 Internet service and telecommunications providers holding licences within 10 km of the CWF

LICENSEE
NBN Co. Limited
NBN Co. Spectrum Pty Ltd
Optus Mobile Pty Limited

LICENSEE
Telstra Corporation Limited
Vodafone Australia Pty Limited
Vodafone Hutchison Australia Pty Limited

WSP notes that NBN Co is a government-owned enterprise that provides the infrastructure for broadband services. However, there are a number of ISPs who are also NBN providers. These include iPrimus, iiNet and Dodo, to name a few. WSP recommends that a ground survey is undertaken to identify the ISPs providing NBN services at CWF.

3.5 RADAR SERVICES AND OPERATION

Radar transmits a signal which is reflected back to the transmitting station (some systems involve communication between a radar station and a transponder). Services that utilise radar technology include aircraft detection and weather services. As per the Draft National Wind Farm Development Guidelines [4], WSP has performed a qualitative assessment to identify radar services within 250 nautical miles of CWF.

3.5.1 METEOROLOGICAL SERVICES

A search of automatic weather stations (AWS) surrounding the CWF was conducted using the BoM's 'Climate Data Online' database [9]. 13 weather stations were found and are listed in Table 3-15.

Table 3-15 BoM stations within 30 km of CWF [9]

STATION NUMBER	NAME	DISTANCE FROM CWF [km]
022055	Curramulka North Rndsup SA	4.9
022003	Curramulka SA	8.3
022054	Pine Point (Amelia Downs) SA	12.5
022016	Sandilands SA	14.3
022014	Port Vincent SA	15.7
022036	Minlaton (Eversley) SA	17.6
022052	Spicer Flat SA	19.5
022009	Minlaton SA	21.6
022033	Ardrossan (Vitana) SA	21.7
022031	Minlaton Aero SA	25.5
022056	Maitland (Carinya Rndsup) SA	27.9
022000	Ardrossan SA	28.0
022017	Stansbury SA	29.1

However, the AWS listed above may not have a radar operating at their locations. Based on the BoM website [10] [11], six (6) meteorological radars have been identified within 250 nautical miles of CWF as shown in Figure 3.20. Details of the locations are listed in Table 3-16.

Figure 3.20 Identified BOM radar transmitters within 250 nautical miles of CWF.

Table 3-16 BoM radar stations within 250 nautical miles of CWF [10] [11]

BOM RADAR SITE	LATITUDE [°]	LONGITUDE [°]	RADAR CATEGORY	APPROXIMATE DISTANCE FROM CWF [km]
Adelaide (Buckland Park)	-34.62	138.47	High resolution Doppler Radar	51
Adelaide (Sellicks Hill)	-35.33	138.50	Dedicated weather watch	88
Woomera	-31.16	136.80	Dedicated weather watch	386
Mildura	-34.23	142.08	Dedicated weather watch	386
Mount Gambier	-37.75	140.77	Dedicated weather watch	425
Ceduna	-32.13	133.70	Dedicated weather watch	459

WSP recommends that the BoM is contacted to seek feedback on any potential EMI impacts on their services and operations.

3.5.2 AVIATION

The nearest major airport to CWF is Adelaide Airport, located approximately 80 km east-southeast of CWF and the nearest regional airport is Ardrossan Airfield, located approximately 15 km north-northeast of CWF. The locations of the closest international and regional airports and the similarly close Yorketown regional airport, are shown in Figure 3.21.

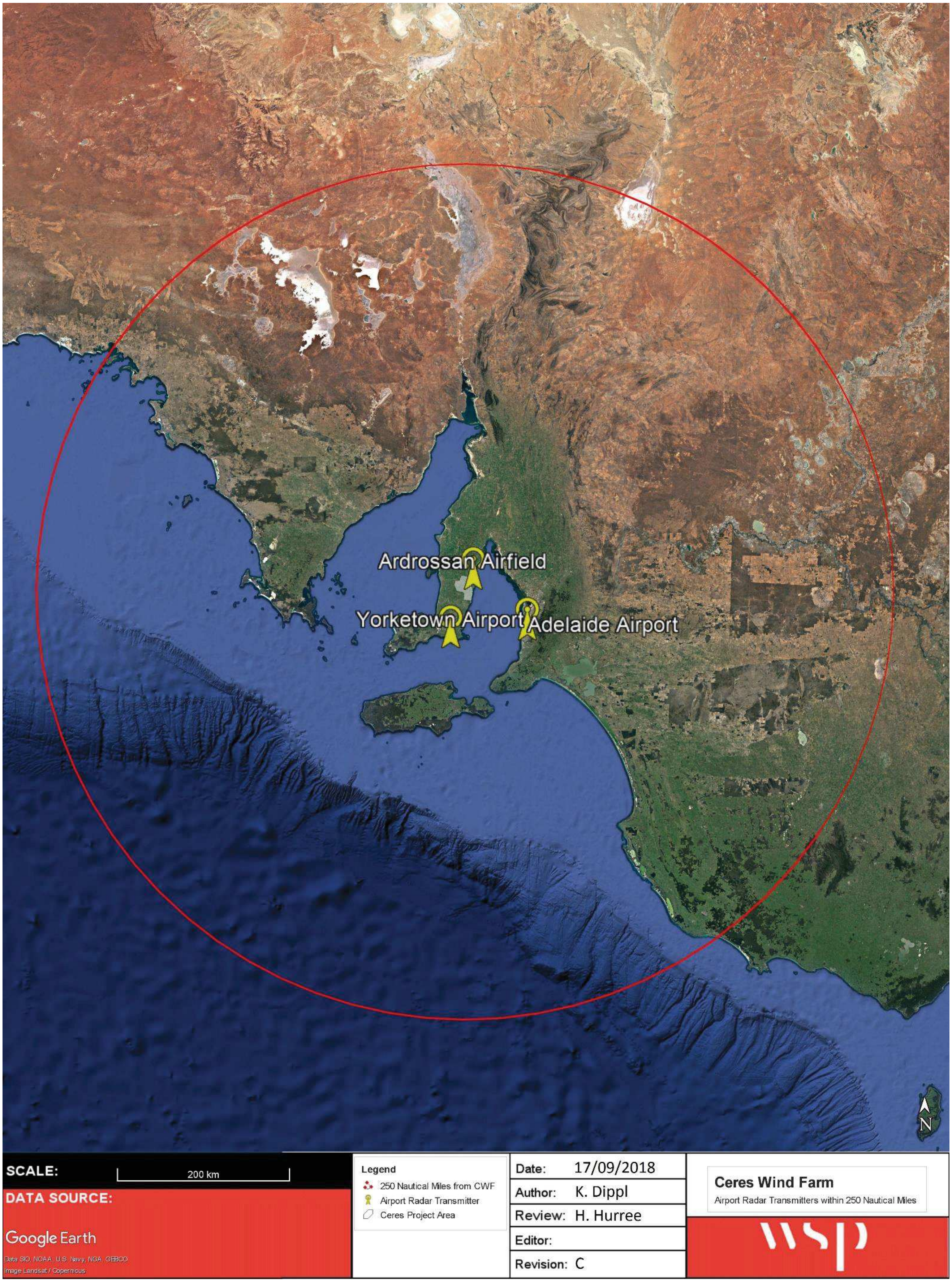

Figure 3.21 International airports within 250 nautical miles of CWF (Adelaide Airport) and closest regional airports

WSP expects the potential impacts on aviation radar services, if any, are not likely to be of operational significance at the distances shown. However, WSP recommends that consultations are undertaken with the relevant airports to assess the potential EMI impact arising from CWF development and operations on their services.

3.6 EMERGENCY SERVICES

Using the ACMA RADCOM database, a search was conducted of radio sites within 30 km of CWF belonging to emergency service providers, finding 11 licences, operated by St John Ambulance Australia Incorporated, Australian Radio Rescue Service Inc. and the Australian Volunteer Coast Guard Association Inc. WSP recommends that all three (3) organisations are consulted to assess the potential EMI impacts of CWF on their operations and services.

4 MANAGEMENT AND MITIGATION MEASURES

Generally, mitigation of radio impacts involves manipulation of the WTG layout so that impacts are acceptably controlled. However, the wind farm proponent's consideration may make other options feasible (providing there is agreement amongst the relevant parties). The Draft National Wind Farm Development Guidelines [4] provides the following hierarchy of mitigation options (in order of most preferable to least preferable):

1. Re-location / removal of WTGs
2. Replacement of existing radio communications service equipment with another less affected type (e.g. replace UHF link with microwave link)
3. Re-location of radio communications services to another existing radio communications site
4. Re-location of radio communications services to a new telecommunications site
5. Substitute radio communication for underground or overhead optical fibre
6. Enhance radar filters

4.1 CONSTRUCTION, MAINTENANCE AND DECOMMISSIONING

It is recommended that the exclusion zones, which are established and applied to the final layout, be respected during construction, maintenance and decommissioning. These exclusion zones should be agreed upon by the licence holders and the wind farm proponent. Crane booms and the raising and lowering of WTG parts may cause interference. It is recommended that management plans for these activities include these considerations.

4.1.1 RECOMMENDATIONS AND MITIGATION OPTIONS FOR NEAR FIELD INTERFERENCE

For the registered assignments identified within 10 km of CWF, WSP recommends the licensees are contacted seeking feedback regarding potential EMI impacts on their services and operations. At this stage, it is deemed unlikely that the proposed CWF layout will cause near field effects to the nearby towers holding registered licences.

However, should the licensees, after consultation, deem CWF to cause potential EMI impacts, the first mitigation technique to be considered should be to microsite or relocate WTGs to locations outside of the near field exclusion zones. The specific requirements of near field zones should be discussed with the affected licensees to minimise disruption to the WTG layout and to avoid radio interference.

In the event that relocation of WTGs is not possible or preferable, it may be possible to modify or upgrade affected services to new apparatus or frequencies with smaller near field zones. If this mitigation technique is not possible, the next option will be to re-locate and/or re-direct services to alternative existing sites.

Further mitigation techniques (including commission of new radio towers and fibre optic cabling) are possible beyond the options discussed; however significant cost may be incurred if these options are undertaken.

4.1.2 RECOMMENDATIONS AND MITIGATION OPTIONS FOR POINT-TO-POINT LINK INTERFERENCE

For the registered point-to-point links identified in the vicinity of the proposed WTGs, WSP recommends that the identified licensees are contacted to seek feedback regarding potential EMI impacts on their services and operations arising from the development and operation of CWF.

Assuming that each of the links (and corresponding assignments) are currently active and the locations given by the ACMA are accurate, the first mitigation technique to be considered is to ensure WTG locations, including their blades and towers, do not intrude on the 2^{nd} Fresnel exclusion zone. It is noted that no WTG is currently encroaching the eight (8) identified links, based on the maximum dimensions provided. WSP recommends that the licensees are consulted to verify the location of the identified towers as well as the frequencies associated with the point-to-point links.

In the event that relocation of WTGs is required but not possible or preferable, it may be possible to modify or upgrade affected services to new apparatus or frequencies with narrower 2^{nd} Fresnel exclusion zones. If this mitigation technique cannot be performed, then the next option will be to re-locate and/or re-direct services to alternative existing sites.

Further mitigation techniques (including commissioning of new radio towers and fibre optic cabling) are possible beyond the options discussed, however, significant cost may be incurred if these options are undertaken.

4.1.3 RECOMMENDATIONS AND MITIGATION OPTIONS FOR TV BROADCASTING SERVICES

As mentioned previously, TV broadcast services across Australia are now digital broadcast. Digital TV signals are usually less prone to interference from WTGs. However, in areas where the digital TV signals are considered as marginal, it is possible that the TV signals can be subject to some interference from nearby obstacles, like WTGs.

For such instances, a number of mitigation options are available such as:

1. Retuning the antenna to another tower, not within the line of sight of the WTGs
2. The use of a higher gain antenna
3. Moving the existing antenna to a less affected position
4. Installation of satellite TV at the affected residence.

WSP notes that a number of dwellings are located in regions of variable coverage from the Crafers and Maitland TV transmitters. It is therefore possible that residents are eligible for the Viewer Access Satellite Television (VAST) service. WSP recommends that a ground survey of TV signal strength is undertaken with the resident surrounding CWF prior to the construction of the wind farm.

5 CONCLUSIONS

WSP has undertaken an analysis of potential EMI impacts on operators of radiocommunication licences within the vicinity of CWF. The licences have been identified using the data registered with the ACMA, which is known to be prone to some inaccuracies.

Eight (8) fixed point-to-point links were identified to intersect with the approximate project area of CWF. The 2nd Fresnel zones were calculated for each link and it was observed that no WTGs are located within one blade length of the 2nd Fresnel zone, considering the WTG dimensions provided. WSP recommends that the WTG exclusion zones established within this report are acknowledged to avoid impact on the services and operations identified. It is also recommended that the licensees are consulted to verify the location of the identified towers as well as the frequencies associated with the point-to-point links.

Point-to-multipoint licences, point-to-area licences and broadcast services were assessed in the vicinity of CWF. Residences close to CWF may experience some interference to their TV services if they are located in a region of marginal coverage. WSP recommends that a ground survey of TV signal strength is undertaken amongst the residences surrounding CWF prior to the construction of the wind farm. Should some residences experience TV interference, a number of mitigation options are available to rectify this issue.

WSP recommends that licensees identified within this report as possibly being adversely affected by the development and operation of CWF are contacted to discuss the potential impact of CWF development and operations on their services.

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APPENDIX A

PROPOSED CERES WIND FARM LAYOUT

Table A.1 Ceres Wind Farm layout coordinates (UTM WGS84 Zone 53H)

WTG ID	EASTING [m]	NORTHING [m]	WTG ID	EASTING [m]	NORTHING [m]	WTG ID	EASTING [m]	NORTHING [m]
1	746367	6167155	73	753078	6162368	150	757725	6172652
2	746378	6167740	77	753599	6170754	151	758586	6173552
3	747194	6166591	78	753630	6171401	152	758995	6151360
4	746949	6167140	79	753029	6172707	153	758996	6152508
5	747546	6167209	80	753642	6172021	154	759149	6151937
6	746961	6167723	81	753657	6172621	155	759596	6152492
7	747561	6167808	82	753052	6173306	157	760150	6157221
8	747577	6168408	83	753670	6173201	158	759673	6156828
9	747592	6169008	84	753709	6173780	160	758813	6158372
11	748326	6162511	85	753725	6174380	162	758923	6158949
12	748469	6163149	88	754231	6165194	163	758953	6159510
13	748078	6166422	89	754192	6170309	164	759329	6158156
14	748678	6166407	90	754776	6170173	165	759204	6160244
15	748276	6167247	91	754165	6171150	166	759144	6160869
16	748870	6167159	92	754612	6170750	167	758964	6162692
17	748386	6167837	93	754636	6171526	168	759203	6163238
18	748190	6168404	94	754270	6171996	169	759569	6162736
19	748979	6167748	95	754251	6172597	170	759046	6164509
20	748977	6168371	96	754353	6174362	171	759222	6163948
21	748514	6169125	98	755233	6170795	172	759658	6164496
22	748159	6169600	99	755236	6171504	174	760720	6152328
23	748913	6162386	100	755239	6172137	175	760377	6156655
26	749773	6163256	101	755482	6172686	176	760645	6155797
28	750099	6165349	102	755698	6173244	177	760604	6157588
30	749220	6166671	103	754953	6174347	179	752862	6165929
31	749579	6167772	104	756047	6152388	180	759797	6160378
32	749504	6168679	105	756421	6151905	181	760335	6160213
35	749615	6163922	106	756064	6152988	182	760819	6160637
36	750185	6163741	107	756078	6153588	183	759807	6163322
38	750631	6164901	109	755899	6164767	184	760161	6162720
39	750648	6165563	110	756798	6165073	185	760634	6163320

WTG ID	EASTING [m]	NORTHING [m]	WTG ID	EASTING [m]	NORTHING [m]	WTG ID	EASTING [m]	NORTHING [m]
40	750114	6165949	111	756092	6172670	186	760780	6162704
41	750021	6166547	112	756298	6173228	187	759858	6163923
42	750609	6166571	113	756697	6172749	188	760379	6164480
43	749564	6167172	114	755515	6173965	189	760503	6163906
44	750099	6167473	115	755982	6174340	190	761194	6151783
45	750624	6167171	116	757665	6152693	191	761567	6152524
46	749867	6168253	118	757545	6162304	192	761025	6152853
47	750639	6167771	121	757711	6162883	194	761582	6153116
48	750654	6168371	122	757274	6164731	195	761597	6153709
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56	751668	6166505	130	757980	6152175	205	761686	6158184
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59	751260	6168164	136	758285	6158185	209	761437	6160520
60	751729	6168565	137	758126	6160273	210	760767	6161297
61	751895	6161766	138	758611	6160691	211	761255	6161629
62	752309	6161193	139	758656	6160098	212	761471	6161093
63	752489	6161765	140	758076	6160856	213	760907	6162126
64	752221	6162755	141	758016	6163386	214	761346	6162945
65	752495	6163310	142	758377	6162820	217	761262	6155797
66	752055	6163712	143	758615	6163370	219	761885	6157610
67	752438	6165504	144	757847	6164543	225	746356	6166555
68	752268	6164856	145	758034	6163979	226	751392	6160582
69	752371	6166312	146	758446	6164523	227	751161	6166833
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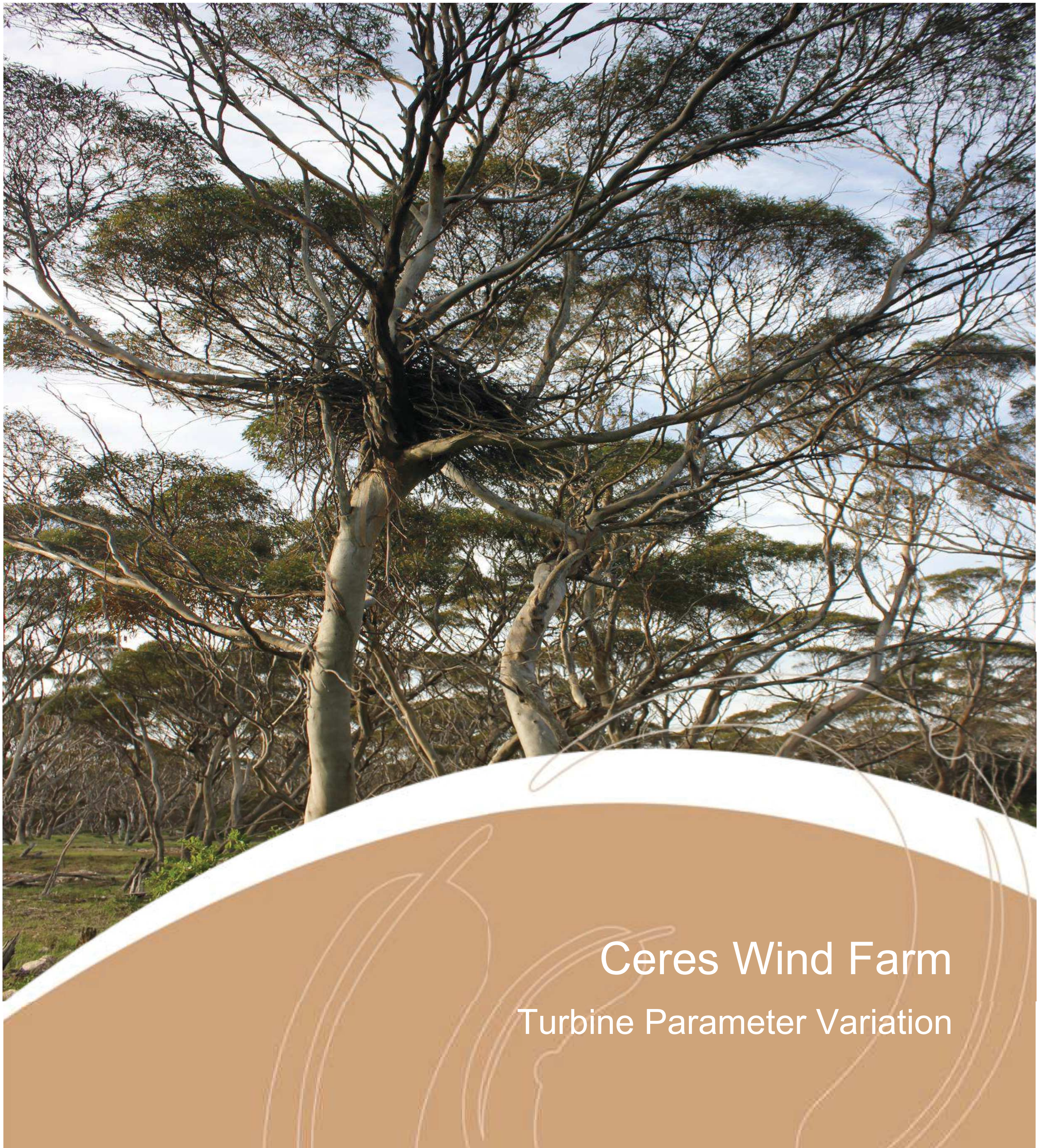
Appendix J

Fauna Risk Assessment



Ceres Wind Farm

Turbine Parameter Variation

Ceres Wind Farm Turbine Parameter Variation

08 November 2018

Version Final

Prepared by EBS Ecology for Senvion

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Cover photograph: Wedge-tailed Eagle Nest (*Aquila audax*) located within the Ceres Wind Farm Project area.

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1 INTRODUCTION

1.1 Objectives

EBS Ecology (EBS) have conducted bird surveys for Senvion Pty Ltd (Senvion) from 2011 to 2017 for the proposed Ceres Wind Farm, located along the central eastern flank of the Yorke Peninsula, South Australia (Figure 1). The surveys determined bird usage of the Project area as well as the adjacent coastline with the aim of identifying whether any species were at risk of collision with turbine rotors. To limit the risk of collision, Senvion has incorporated the following environmental buffers recommended by the EBS into their layout:

- Coastline (1000 m);
- Mallee/Woodland (100 m); and
- Wedge-tailed Eagle nest (500 m).

Senvion have altered their turbine parameters twice since the original Development Application (DA) for the Project (Table 1). In August 2017, the DA was updated (Revised DA) to include fewer turbines (197 to 187) of a larger size (rotor radius increased from 57 m to 70 m). Most recent, in 2018, the DA was proposed to change a second time (DA Variation) to reduce the number of turbines (from 187 to 181 turbines) and increase the rotor radius (rotor radius increased from 70 m to 80 m) and hub height (93 m to 140 m).

This report addresses whether the turbine parameters in the DA Variation (2018) will change the risk of bird collision with respect to the Original DA and Revised DA.

Table 1. Comparison of the total rotor-swept area within the Ceres Wind Farm between the three DA variations.

Turbine parameters	Original DA	Revised DA (Aug 17)	DA Variation (2018)
Rotor radius	57 m	70 m	80 m
Hub height	93 m	93 m	140 m
Rotor swept area	34-150 m	23-163 m	60-220 m
Total rotor swept area per turbine	10,207 m^2	15,394 m^2	20,106 m^2
Number of turbines	197	187	170
Total rotor swept area across wind farm	2,010,785 m^2	2,878,678 m^2	3,418,020 m^2

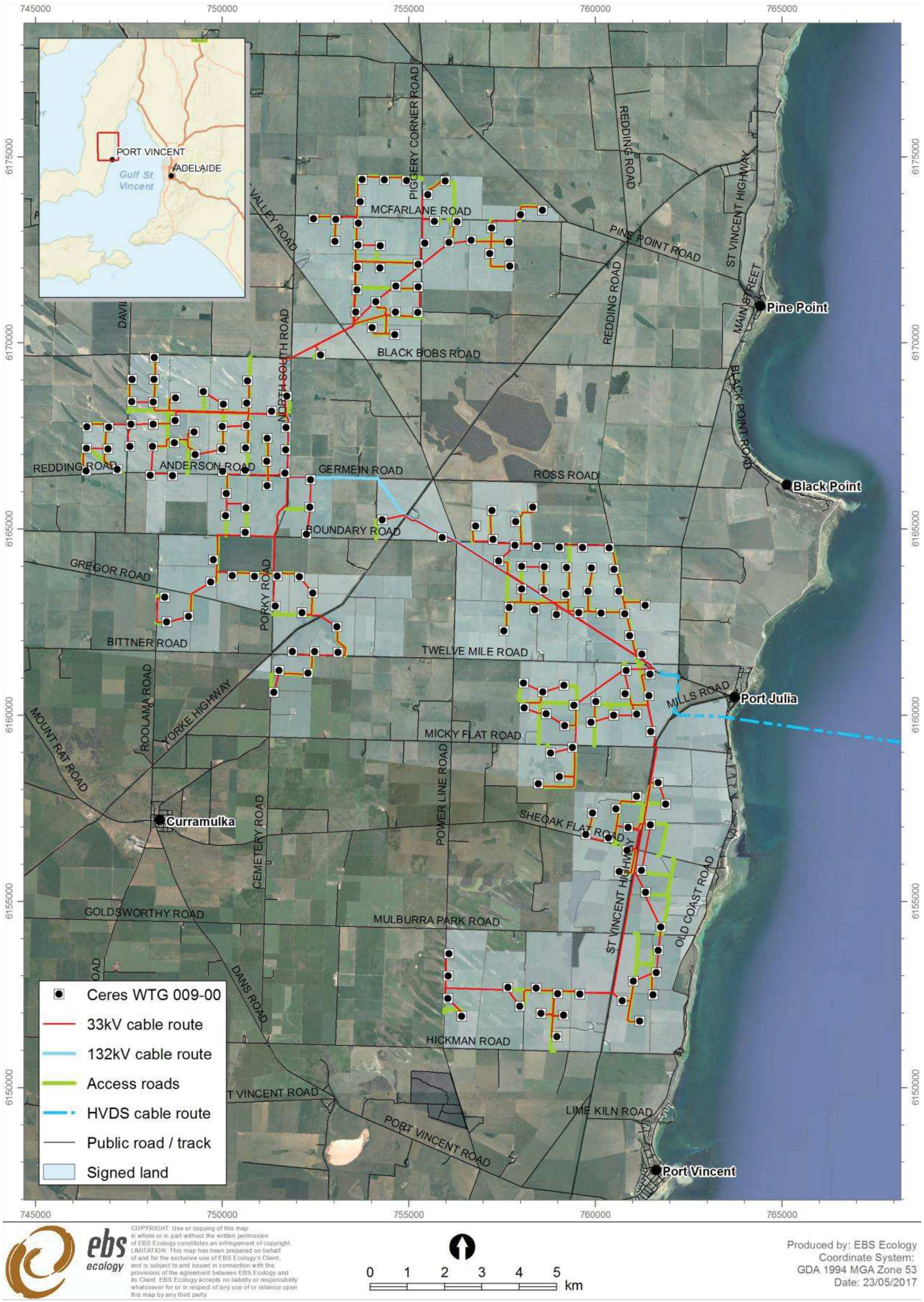

Figure 1. Location and layout of the proposed Ceres Wind Farm in South Australia.

2 METHODS

2.1 Flight height data

To determine the risk of collision, flight heights of birds were obtained within the Project area and regionally. For each bird flight observed the following information was recorded:

- Species;
- Number of individuals;
- Number of movements;
- Minimum flight height (m); and
- Maximum flight height (m).

The regional data was collected from Yorke Peninsula in the south, to Port Augusta in the north. The bird species for which data was collected are either known to occur or would be expected to occur in the Project area. Data collected within the Project area was analysed to determine the change in collision risk to terrestrial and waterbirds associated with the DA Variation. In addition to this, regional data was analysed to determine how the risk of collision has changed for different bird groups with respect to the new turbine parameters associated with the DA variation.

Bird species were assigned to one of five groups:

- Raptors group included species of kite, falcon, eagle, osprey, hawks and harriers.
- Corvids and cractids (excluding woodswallows) group included all species of magpie, raven, currawong and butcherbird.
- Parrots group included species of rosella, grass parrots, lorikeets and cockatoos
- Aerial passerines (including woodswallows) group included species of swallow, martin and woodswallow.
- Pigeons group was comprised of two species: Crested Pigeon (*Ocyphaps lophotes*) and the introduced Rock Dove (*Columba livia*).
- Small to medium sized passerines group included species of wren, honeyeater, songlarks, whistlers, starlings and thornbills
- Waterbirds group included species of shorebird, cormorant, tern, gull and heron.

A risk analysis was performed to determine the change in the number and percentage of at-risk flights with each turbine parameters proposed for over the three DAs (Table 1). At-risk flights are those that are conducted at heights swept by the turbine, named herein as the **Rotor Swept Area** (RSA) (Figure 2). The total RSA values over the Ceres wind farm are different for each DA (Table 1), due to the alteration in turbine parameters. Therefore, an adjusted number of at-risk flights value, named **RSA adjusted value**, was calculated to enable comparison between the three DAs. As the total RSA over the windfarm of the Revised DA is 143% greater than the Original DA and the DA Variation is 170% greater than the Original DA, the number of at-risk flights determined for the Original DA were multiplied by 1.43 for the Revised DA

and 1.70 for the DA Variation to calculate an RSA adjusted value (Table 1). By accounting for the proposed number of turbines and the area swept by each of these turbines, the risk of bird strike for each DA can be determined.

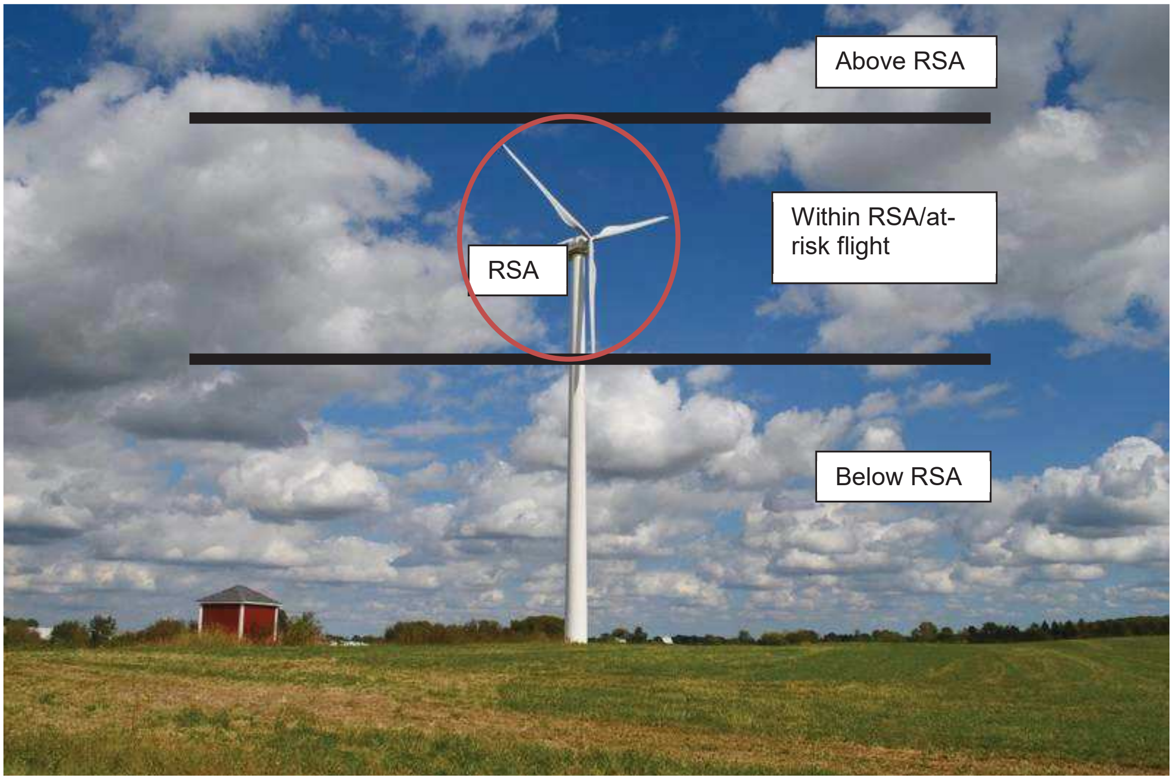

Figure 2. Schematic diagram providing a visual representation of the RSA and how flights were determined to be below, within (at-risk) and above the RSA.

2.2 At-risk flight distance for shorebirds

The distance of at-risk migratory flights for shorebirds were calculated based upon their flight speed and rate of elevation gain and assumed a direct flight path from the coast. During migratory flights, shorebirds have been recorded to have a rate of vertical gain of 1 m s^{-1} (Alerstam *et al.* 1990), while the flight speed of shorebirds species was determined to be approximately 17 m s^{-1} (Pennycuick *et al.* 2013). The minimum and maximum heights of the RSA for each DA were compared against the flight speed and elevation rates of shorebirds to determine the distances from the coast at which they may occur within the RSA. This is illustrated in Figure 3.

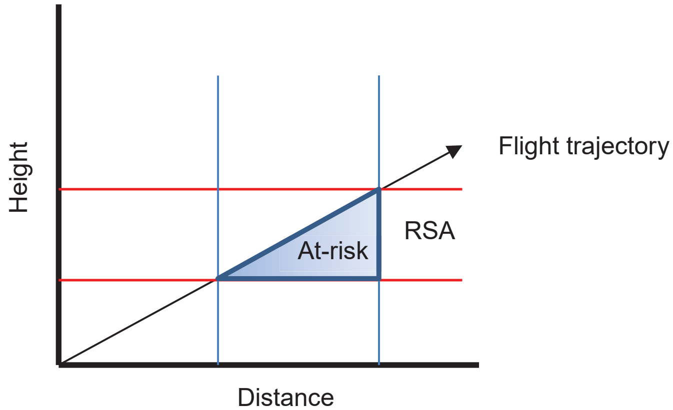

Figure 3. Schematic diagram showing how the distance of at-risk migratory flights have been calculated for shorebirds assuming direct flight from the coast, flight speed of 17 ms^{-1} and elevation gain of 1 ms^{-1}.

3 RESULTS

3.1 Regional data

3.1.1 Raptors

The turbine parameters proposed in the DA Variation (2018) resulted in the lowest percentage (32.4%) of at-risk raptor flights (Table 2). The RSA Adjusted value for at-risk flights for the DA Variation (2018) was higher than the Original DA but substantially lower than the Revised DA (Aug 17). Raptors are one of the most at-risk groups of birds from wind farm construction, due to their prevalence of flight within rotor swept areas, matched with their low fecundity and long lifespans (Beston *et al.* 2016).

Table 2. Comparison in the percentage (%) of at-risk flights (n = 680) by raptors, regionally, between the proposed turbine parameters for the current DA Variation (2018) and the former DAs (Original and August 2017).

Rotor Swept Area	Original DA			Revised DA (Aug 17)			DA Variation (2018)		
	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value
Below	347	51.0	**347**	124	18.2	**178**	452	66.5	**768**
Within	315	46.3	**315**	538	79.1	**770**	220	32.4	**374**
Above	18	2.6	**18**	18	2.6	**26**	8	1.2	**14**

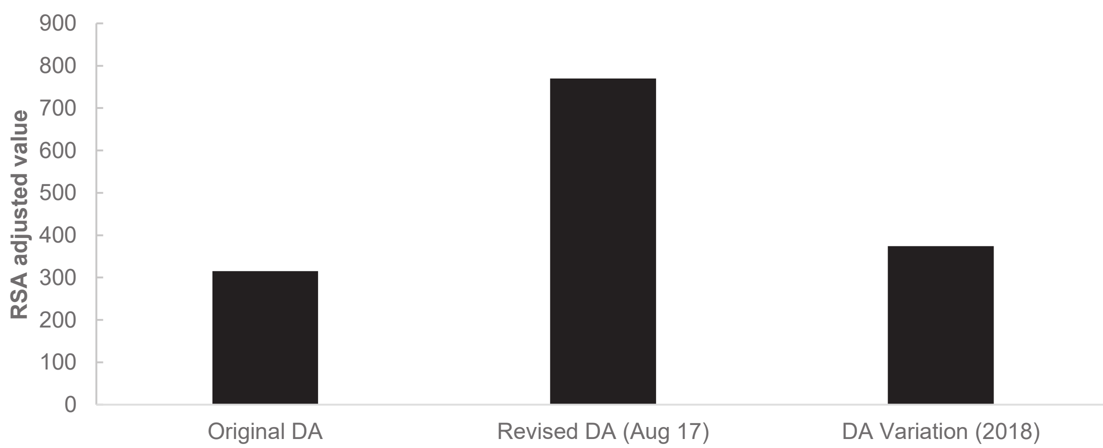

Figure 4. The RSA adjusted value for the number of at-risk raptor flights (within RSA) for each of the three development applications.

3.1.2 Corvids and cractids

The turbine parameters proposed in the DA Variation (2018) resulted in the lowest percentage (4.5%) of at-risk corvid and cractid flights (Table 3). The RSA Adjusted value for at-risk flights for the DA Variation (2018) was higher than the Original DA but lower than the Revised DA (Aug 17). At-risk flights for this group of species would occur when individuals or small groups are making long flights between difference patches of habitat. While corvids and cractids regularly make at-risk flights at other wind farms, they rarely collide with turbines (Beston *et al.* 2016).

Table 3. Comparison in the percentage (%) of at-risk flights (n = 2408) by corvids and cractids, regionally, between the proposed turbine parameters for the current DA Variation (2018) and the former DAs (Original and August 2017).

Rotor Swept Area	Original DA			Revised DA (Aug 17)			DA Variation (2018)		
	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value
Below	2275	94.5	**2275**	2195	91.2	**3142**	2296	95.3	**3903**
Within	129	5.4	**129**	209	8.7	**299**	108	4.5	**184**
Above	4	0.2	**4**	4	0.2	**6**	4	0.2	**7**

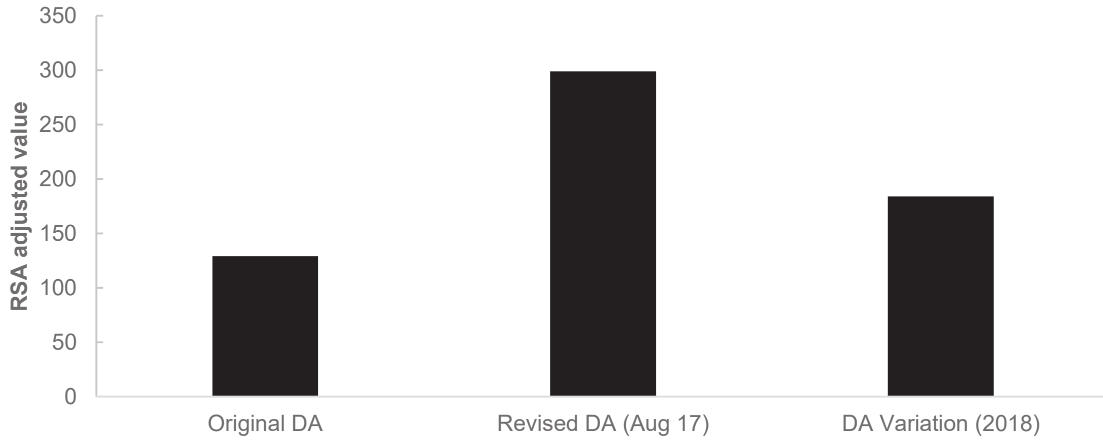

Figure 5. The RSA adjusted value for the number of at-risk corvid and cractid flights (within RSA) for each of the three development applications.

3.1.3 Parrots

The turbine parameters proposed in the DA Variation (2018) resulted in the lowest percentage (4.1%) of at-risk parrot flights (Table 4). The RSA Adjusted value for at-risk flights for the DA Variation (2018) was higher than the Original DA but lower than the Revised DA (Aug 17). The low percentage of at-risk flights under the currently proposed turbine dimensions was expected as parrots typically fly direct and between 20-30 m in height.

Table 4. Comparison in the percentage (%) of at-risk flights (n = 3856) by parrots, regionally, between the proposed turbine parameters for the current DA Variation (2018) and the former DAs (Original and August 2017).

Rotor Swept Area	Original DA			Revised DA (Aug 17)			DA Variation (2018)		
	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value
Below	3637	94.3	**3637**	3158	81.9	**4521**	3698	95.9	**6287**
Within	179	4.6	**179**	658	17.1	**942**	158	4.1	**269**
Above	40	1.0	**40**	40	1.0	**57**	0	0	**0**

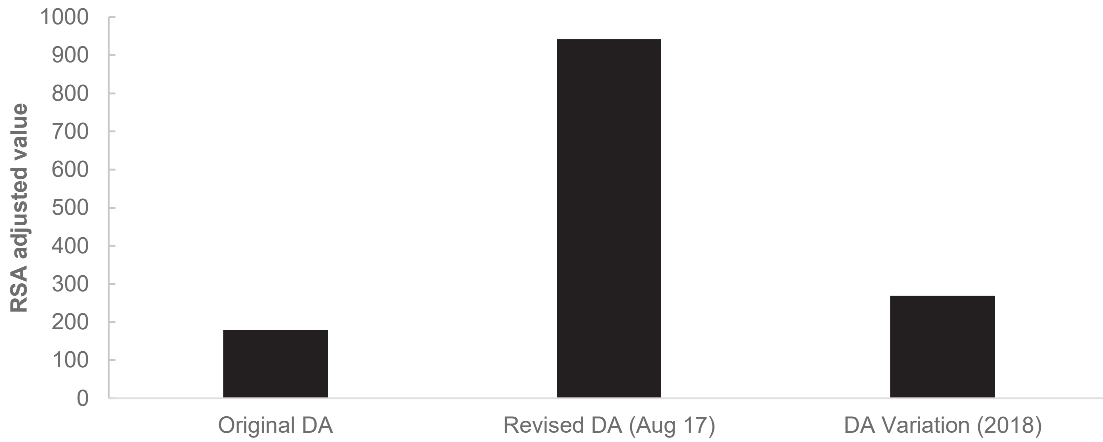

Figure 6. The RSA adjusted value for the number of at-risk parrot flights (within RSA) for each of the three development applications.

3.1.4 Aerial insectivores

The turbine parameters proposed in the DA Variation (2018) will result in the lowest percentage (17.3%) of at-risk aerial insectivore flights (Table 5). The RSA Adjusted value for at-risk flights for the DA Variation (2018) was higher than the Original DA and Revised DA (Aug 17). Aerial insectivores will regularly make flights above 50 m to forage upon aerial insects and utilise thermals.

Table 5. Comparison in the percentage (%) of at-risk flights (n = 1108) by aerial insectivores, regionally, between the proposed turbine parameters for the current DA Variation (2018) and the former DAs (Original and August 2017).

Rotor Swept Area	Original DA			Revised DA (Aug 17)			DA Variation (2018)		
	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value
Below	880	79.4	**880**	872	77.7	**1248**	916	82.7	**1557**
Within	214	19.3	**214**	222	19.8	**318**	192	17.3	**326**
Above	14	1.3	**14**	14	1.2	**20**	0	0	**0**

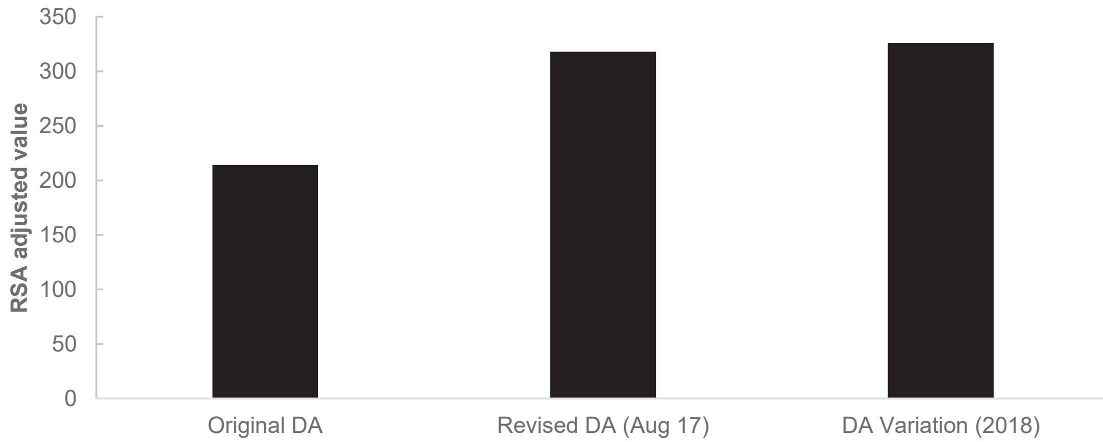

Figure 7. The RSA adjusted value for the number of at-risk aerial insectivore flights (within RSA) for each of the three development applications.

3.1.5 Pigeons

There were no at-risk flights by pigeons within the RSA for the turbine parameters proposed for the DA Variation (2018). At-risk flights were common (40.4%) within the parameters proposed for the Revised DA and rare for the parameters proposed for the Original DA (11.1%) (Table 6). The RSA Adjusted value for at-risk flights for the DA Variation (2018) was lower than the Original DA and substantially lower than the Revised DA (Aug 17). The at-risk flights for the Original DA and Revised DA were primarily performed by the Rock Dove, which exhibits flocking behaviour, particularly when flying at height. It is possible that the individuals recorded flying within the rotor swept area were domesticated homing pigeons.

Table 6. Comparison in the percentage (%) of at-risk flights (n = 361) by pigeons, regionally, between the proposed turbine parameters for the current DA Variation (2018) and the former DA's (Original and August 2017).

Rotor Swept Area	Original DA			Revised DA (Aug 17)			DA Variation (2018)		
	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value
Below	321	88.9	**321**	215	59.6	**308**	361	100	**614**
Within	40	11.1	**40**	146	40.4	**209**	0	0	**0**
Above	0	0	**0**	0	0	**0**	0	0	**0**

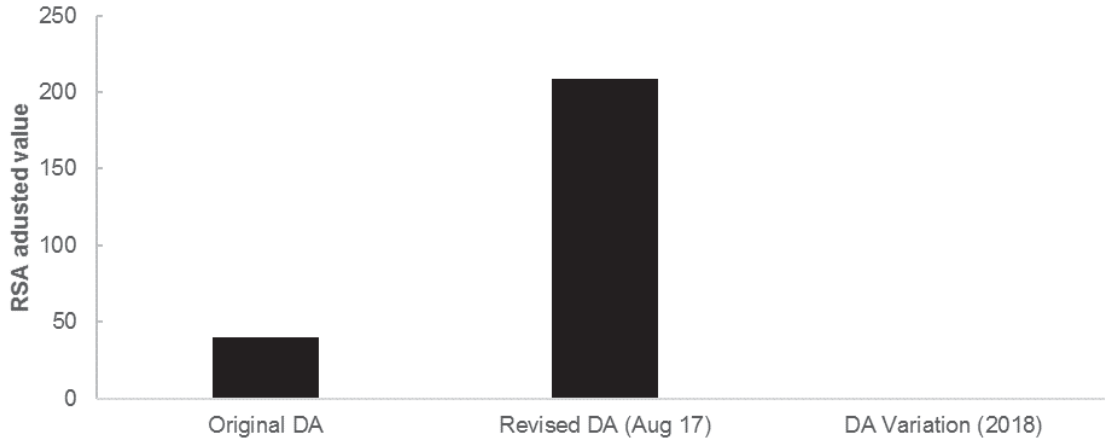

Figure 8. The RSA adjusted value for the number of at-risk pigeon flights (within RSA) for each of the three development applications.

3.1.6 Small to medium sized passerines

Small to medium sized passerines typically make short and low movements within their habitat. The turbine parameters proposed in the DA Variation (2018) will result in the lowest percentage (0.4%) of at-risk flights (Table 7). The RSA Adjusted value for at-risk flights for the DA Variation (2018) was substantially lower than the Original DA and Revised DA (Aug 17). At-risk flights recorded were predominantly performed by the Common Starling (*Sturnus vulgaris*), an introduced species which will flock and fly at heights greater than 100 m.

Table 7. Comparison in the percentage (%) of at-risk flights (n = 6020) by small to medium sized passerines, regionally, between the proposed turbine parameters for the current DA Variation (2018) and the former DA's (Original and August 2017).

Rotor Swept Area	Original DA			Revised DA (Aug 17)			DA Variation (2018)		
	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value
Below	5725	95.1	**5725**	5647	93.8	**8084**	5998	99.6	**10197**
Within	295	4.9	**295**	373	6.2	**534**	22	0.4	**38**
Above	0	0	**0**	0	0	**0**	0	0	**0**

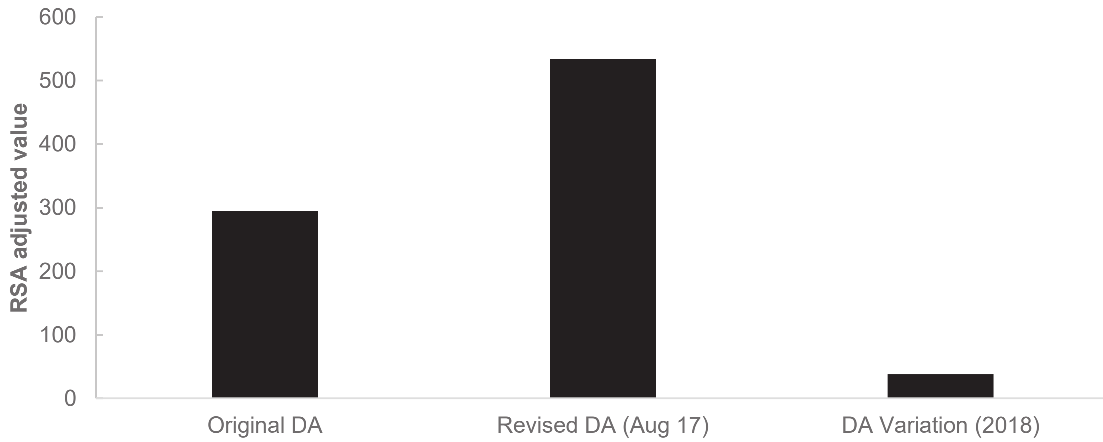

Figure 9. The RSA adjusted value for the number of at-risk small to medium sized passerine flights (within RSA) for each of the three development applications.

3.1.7 Waterbirds

The turbine parameters proposed in the DA Variation (2018) will result in the lowest percentage (0.9%) of at-risk waterbird flights (Table 8). The RSA Adjusted value for at-risk flights for the DA Variation (2018) was substantially lower than the Original DA and the Revised DA (Aug 17).

Table 8. Comparison in the percentage (%) of at-risk flights (n = 1159) by waterbirds, regionally, between the proposed turbine parameters for the current DA Variation (2018) and the former DA's (Original and August 2017).

Rotor Swept Area	Original DA			Revised DA (Aug 17)			DA Variation (2018)		
	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value
Below	1099	94.8	**1099**	1031	89.0	**1476**	1148	99.1	**1952**
Within	60	5.2	**60**	128	11.0	**183**	11	0.9	**19**
Above	0	0	**0**	0	0	**0**	0	0	**0**

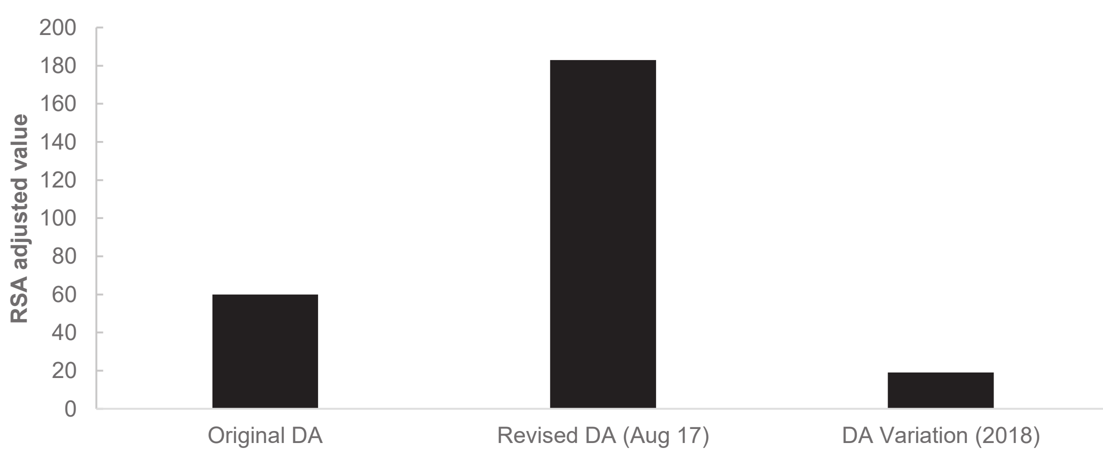

Figure 10. The RSA adjusted value for the number of at-risk waterbird flights (within RSA) for each of the three development applications.

3.2 Project area data

3.2.1 Terrestrial birds

The turbine parameters proposed in the DA Variation (2018) will result in the lowest percentage (0.1%) of at-risk terrestrial bird flights (Table 9). The RSA Adjusted value for the DA Variation (2018) was substantially lower than the Original DA and the Revised DA (Aug 17).

Table 9. Comparison in the number and percentage (%) of at-risk flights (n = 7269) by terrestrial birds within the Ceres Project area between the proposed turbine parameters for the current DA Variation (2018) and the former DA's (Original and August 2017).

Rotor Swept Area	Original DA			Revised DA (Aug 17)			DA Variation (2018)		
	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value
Below	6923	95.2	**6923**	6763	93.0	**9682**	7261	99.9	**12344**
Within	344	4.7	**344**	504	6.9	**722**	8	0.1	**14**
Above	2	0.0	**2**	2	0.0	**3**	0	0	**0**

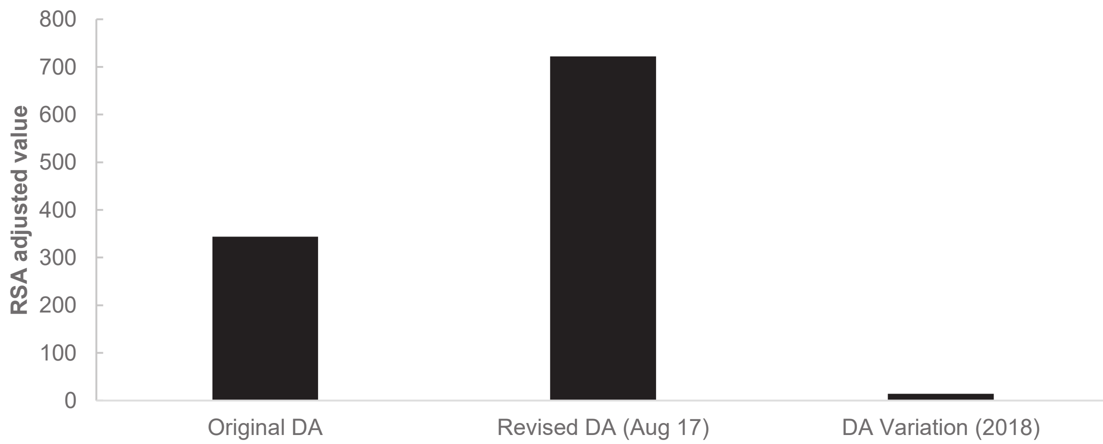

Figure 11. The RSA adjusted value for the number of at-risk terrestrial bird flights (within RSA) for each of the three development applications.

3.2.2 Waterbirds

The turbine parameters proposed in the DA variation (2018) resulted in the lowest percentage (0.4%) of at-risk flights by waterbirds (Table 10). The RSA Adjusted value for at-risk flights was comparable between the DA Variation (2018), Original DA and the Revised DA (Aug 17).

Table 10. Comparison in the number and percentage (%) of at-risk flights (n = 1031) by waterbirds within the Ceres Project area between the proposed turbine parameters for the current DA Variation (2018) and former DA's (Original and August 2017).

Rotor Swept Area	Original DA			Revised DA (Aug 17)			DA Variation (2018)		
	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value	# of flights	% of flights	RSA adjusted value
Below	1025	99.4	**1025**	1025	99.4	**1467**	1027	99.6	**1746**
Within	6	0.6	**6**	6	0.6	**9**	4	0.4	**7**
Above	0	0	**0**	0	0	**0**	0	0	**0**

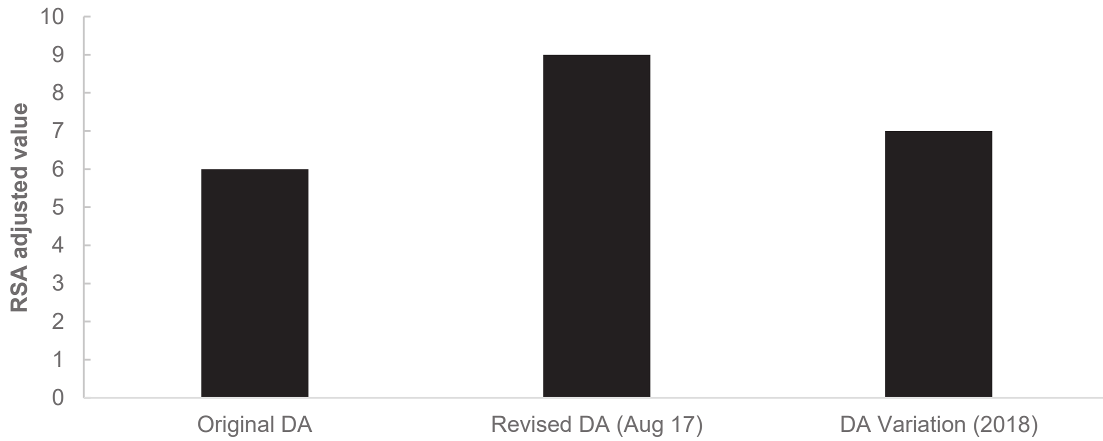

Figure 12. The RSA adjusted value for the number of at-risk waterbird flights (within RSA) for each of the three development applications.

3.2.3 Recorded at-risk flights

A total of 12 at-risk flights were recorded within the Ceres Project area under the dimensions proposed for the DA Variation (2018) (Table 11). Two species; the Nankeen Kestrel (*Falco cenchroides*) and Crested Tern (*Thalasseus bergii*) conducted multiple at-risk flights, while the remaining four species conducted one at-risk flight each.

Table 11. At-risk movements from bird species observed in the Ceres Project area.

Functional group	Scientific name	Common Name	# of flights
Raptor	*Aquila audax*	Wedge-tailed Eagle	1
Raptor	*Falco berigora*	Brown Falcon	1
Raptor	*Falco cenchroides*	Nankeen Kestrel	4
Corvids and cractids	*Gymnorhina tibicen*	Australian Magpie	1
Corvids and cractids	*Corvus mellori*	Little Raven	1
Marine/Waterbirds	*Thalasseus bergii*	Crested Tern	4

3.3 At-risk flight distance for shorebirds

The DA Variation (2018) was determined to have the greatest at-risk flight distance over the windfarm, while the at-risk flight distance was substantially lower for the Original DA and Revised DA (Aug 17) (Table 12). This result is attributed to the higher and greater RSA of the DA Variation (2018) with respect to the former DAs (Table 1).

Table 12. The minimum and maximum distances from the coastal where shorebirds would be flying at heights within the RSA for each DA, assuming a direct flight path, flight speed of 17 ms^{-1} and elevation rate of 1 ms^{-1}.

DA	Minimum	Maximum	At-risk distance
Original DA	1000 m*	2550 m	1550 m
Revised DA (Aug 17)	1000 m*	2771 m	1771 m
DA Variation (2018)	1020 m	3740 m	2740 m

*Note: there are no turbines within 1000 m of the coast.

4 DISCUSSION

4.1 Impact of a variation to turbine parameters on bird strike risk

The analysis of regional data determined that the Original DA turbine parameters resulted in the lowest number of at-risk flights for raptors, corvids and cractids, parrots and aerial insectivores, while the DA Variation (2018) resulted in the fewest at-risk flights for pigeons, small to medium sized passerines and waterbirds. The turbine dimensions proposed in DA (Aug 17) resulted in the greatest number of at-risk flights for all bird functional groups.

The analysis of flight data from the Ceres Project area determined that the turbine parameters proposed for the DA Variation (2018) resulted in the lowest risk of bird strike for terrestrial birds with respect to the turbine parameter proposed in the DA Original and DA (Aug 17).

The impact of a change on turbine parameters on waterbirds is difficult to determine despite the available flight height data from the region and Project area, as all recorded movements have occurred along the coast and out to sea, and therefore, individuals have not entered to the wind farm area. If waterbirds were to fly over terrestrial land, then it is likely they would be conducting long distance flights, and as such, their flight heights would be expected to be higher than the heights presented in Table 8 and Table 10.

An attempt to determine the risk to shorebirds making migratory flights across the windfarm was conducted due to their listing under the *Environment Protection and Biodiversity Act 1999* (see report by EBS 2017 for details). It was determined that the DA Variation (2018) would result in the greatest risk to shorebirds as it would result in the greatest distance of at-risk movement (Table 12). However, the behavioural adaptions of this suite of species were not taken in to consideration, which could include (1) using gaps between turbines and (2) flying north up the Yorke Peninsula prior to heading inland.

4.2 Impact of the Project layout on bird strike risk

Senvion has incorporated numerous recommendations from EBS relating to the layout of the wind farm to reduce the likelihood of bird strike. The recommendations that have been included in the DA Variation 2018 layout are as follows:

- A coastal buffer of 1000 m, to assist with limiting the possible interactions of species such as the Eastern Osprey (*Pandion cristatus*) (EPBC Act: migratory, National Parks and Wildlife Act (SA): rare) and migratory shorebirds (EPBC Act: migratory) with turbines;
- A 100 m buffer from patches of woodland, to reduce bird activity around turbines;
- A 500 m buffer around Wedge-tailed Eagle (*Aquila audax*) nests to reduce the risk of collision by fledged juveniles and breeding pairs; and
- A reduction of 27 turbines from the original DA. This has created a gap between turbines (~ 2 km) in the centre of the Project area, which may offer a corridor for bird movement through the wind farm.

5 CONCLUSION

The turbine parameters proposed for the DA Variation (2018) will substantially reduce the risk of bird strike with respect to the DA (Aug 17). When comparing the risk of bird strike between the DA Variation (2018) and the Original DA, it was determined that the risk of bird strike would be marginally higher for raptors, corvids and cractids, parrots and aerial insectivores, and substantially lower for small to medium sized passerines and pigeons.

The change in strike risk for waterbirds, including migratory shorebirds, associated with a change in turbine parameters proposed for the DA Variation (2018) is difficult to determine. All recorded waterbird movements have occurred along the coast and out to sea, and it is expected that if inland movements were to occur, the flight behaviour of these species would change. As such, the impact to the waterbirds with respect to the changes in turbine parameters associated with the DA Variation (2018) remains speculative.

Senvion have incorporated numerous recommendations by EBS relating to the layout of the windfarm to reduce the risk of bird strike. These layout changes have aimed at reducing the level of bird activity within proximity of turbines. The recommendations incorporated will reduce the threat of bird strike, especially to species that are migratory, threatened or that are flagship species, including the Osprey and Wedge-tailed Eagle.

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Appendix K

Traffic and Transport Assessment

YORKE PENINSULA WIND FARM PROJECT PTY LTD

CERES WIND FARM

AMENDED TRAFFIC AND TRANSPORT ASSESSMENT

NOVEMBER 2018

Question today

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Ceres Wind Farm
Amended Traffic and Transport Assessment

Yorke Peninsula Wind Farm Project Pty Ltd

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REV	DATE	DETAILS
00	14/12/2012	Report prepared for Repower in support of original development application
01	17/09/2018	Report updated to reflect changes to original development application (Variation 1)
02	19/09/2018	Final draft
03	13/11/2018	Final report

	NAME	DATE	SIGNATURE
Prepared by:	Mona Mosallanejad	13/11/2018	
Reviewed by:	Andrew Leedham	13/11/2018	
Approved by:	Andrew Leedham	13/11/2018	

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GLOSSARY

AADT	Average Annual Daily Traffic
DPTI	Department of Planning, Transport and Infrastructure
LV	Light vehicle (cars, vans etc)
LOS	Level of Service
HV	Heavy vehicle
YPWFP P/L	Yorke Peninsula Wind Farm Project Pty Ltd

1 TRAFFIC AND TRANSPORT ASSESSMENT

1.1 CONTEXT

In 2012 REpower Pty Ltd submitted a Development Application to construct and operate a windfarm on the Yorke Peninsula. A Traffic and Transport Assessment Report was prepared in support of the Development Application. The application was approved subject to several conditions. The development has not proceeded and since that time several variations to the proposal have been submitted (mainly time extensions and references to company/project name changes. Yorke Peninsula Wind Farm Project (YPWFP) Pty Ltd has submitted the most recent variation to reduce the number of turbines from 187 to 181 and increase the tip height of the towers from 163 metres to 220 metres This current variation will influence previously reported traffic generation and impacts reported in the original Traffic and Transport Assessment Report. It is quite possible that a maximum of only 170 wind turbines are to be built. This being the case, the traffic impacts assessed and report in this document will represent a conservative estimate.

Accordingly, the report presented herein reflects the changes to the proposed development and is intended to again support the Development Application (as amended). The opportunity has been taken to review previously reported traffic volumes and crash statistic based on currently available data and to incorporate comments on the traffic related Conditions placed on approval of the Development Application (and subsequent variations).

1.2 THE DEVELOPMENT PROPOSAL

The report documents the traffic and transport related impacts of the proposed Ceres Windfarm Project on the surrounding transport network and suggests appropriate mitigation measures. The project will include 181 wind turbine generators located in four clusters (northern, southern, central east and central west) on the Yorke Peninsula, in South Australia. There is also proposed a cable route across the Gulf St Vincent which will connect the western and eastern convertor stations and to the electricity grid at Parafield Gardens.

The site of the proposed wind turbine farm and western convertor station is on the corner of Twelve Mile Road and St Vincent Highway located within the Yorke Peninsula Council. The eastern convertor station is to be located adjacent to Port Wakefield Road at Parafield Gardens West (within the City of Salisbury).

This assessment is based on the site layout plans, dated 27 August 2018.

This assessment excludes assessment of marine transport impacts associated with the installation of the high voltage direct current (HVDC) submarine cable across Gulf St Vincent.

1.3 EXISTING CONDITIONS

The wind turbines will be grouped into four turbine clusters and are bounded by the townships of Sandilands, Pine Point, Black Point, Port Julia, Port Vincent and Curramulka, with the western convertor station adjacent the site of the wind turbines. The majority of the project area on Yorke Peninsula is agricultural land generally used for cropping and livestock grazing.

The land area on the eastern side of Gulf St Vincent, where cables will be laid and the eastern convertor station constructed, is used for residential, agricultural, horticultural, and commercial purposes, including the Bolivar Waste Water Treatment Plant.

1.3.1 ROAD NETWORK

1.3.1.1 ARTERIAL ROADS

Access to the proposed site on the Yorke Peninsula from Port Adelaide, from where a majority of the wind turbine components will be transported by road, is via Port Wakefield Road and then the St Vincent Highway and Ardrossan-Minlaton Road, which both abut the wind farm site. These roads are owned by the Commissioner of Highways and maintained by the Department of Planning, Transport and Infrastructure (DPTI).

Port Wakefield Road, Salisbury Highway, Port River Expressway, and Victoria Road form part of the National Land Transport Network, which provide access from Outer Harbor. The National Land Transport Network is a single integrated road network of strategic national importance.

Access to the proposed eastern convertor station is via Port Wakefield Road, with access provided from a service road (providing access to a weigh station).

Road characteristics for roads within the vicinity of the substation upgrade project are summarised in Table 1.1 below.

Table 1.1 Road characteristics

ROAD	SECTION	SPEED LIMIT	COMMENTS
Port Wakefield Road (RN3500)	Salisbury Highway to Port Wakefield	70–110 km/h	Sealed, divided 4-6 lanes south of Port Wakefield, sealed shoulder
Copper Coast Highway (RN4141)	Port Wakefield to Port Wakefield-Yorketown Road	100 km/h	Sealed, undivided 2 lane road north of Port Wakefield, partially sealed shoulder
St Vincent Highway (RN4009)	Copper Coast Highway to Port Vincent	100 km/h (except through towns)	Sealed, undivided 2 lane road, pavement width 6-7m, partially sealed shoulder. Some pavement edge cracking.
Ardrossan-Minlaton Road (RN4027)	Port Wakefield-Yorketown Road to Curramulka	100 km/h (except through towns)	Sealed, undivided 2 lane road, pavement width 6-7m, unsealed shoulder. Some pavement edge cracking.

1.3.1.2 LOCAL ROADS

Local roads on Yorke Peninsula in the vicinity of the proposed Ceres Project are generally unsealed and have widths of 7-8m, with road reserves approximately 20m wide. Where local roads intersect arterial roads, the local roads are generally sealed for 10-20m from the edge of the main carriageway. The local roads on Yorke Peninsula are owned and maintained by Yorke Peninsula Council.

1.3.1.3 RESTRICTED ACCESS VEHICLE ROUTES

Large components and items of plant may be transported to the project site by Restricted access vehicles (RAVs). RAV's are vehicles which, including loads are one or more of the following:

- over 4.3 m high
- over 19 m long
- over 2.5 m wide
- over 42.5 tonnes (total mass).

Vehicles and loads with dimensions and masses greater than those mentioned above are required to either travel on a Government Gazetted RAV route, or apply for a permit to use a particular non-gazetted route (including Council roads).

Information on oversize and overmass vehicle routes has been sourced from DPTI's RAVNET website (http://www.dpti.sa.gov.au/ravnet/).

Port Wakefield Road (from Salisbury Highway to Copper Coast Highway) is a gazetted route for the following restricted access vehicles (RAVs):

- 19m semi-trailers (higher mass limits)
- 23m and 25 m B-doubles (general mass limits and higher mass limits)
- 32m and 36.5m road trains (general mass limits and higher mass limits)
- 35m B-triple (general mass limits)
- 23m (49.5 tonnes) and 25m (59.5 tonnes) long low loaders.

The Port Wakefield-Yorketown Road, Ardrossan-Minlaton Road and Copper Coast Highway (from Port Wakefield Road to Port Wakefield-Yorketown Road) are gazetted routes for the following restricted access vehicles:

- 19m semi-trailers (higher mass limits)
- 23m and 25 m B-doubles (general mass limits and higher mass limits)
- 23m (49.5 tonnes) and 25m (59.5 tonnes) long low loaders.

The majority of local roads surrounding the project site are gazetted as B-double commodity routes.

1.3.2 TRAFFIC DATA

Existing traffic data is summarised in Table 1.2 below, including Annual Average Daily Traffic (AADT) and volumes of heavy vehicles. Traffic volumes using Port Wakefield Road range from 58,600 vehicles per day at its southern end to 8,600 vehicles per day near Port Wakefield, and comprise a high proportion of heavy vehicles (up to 20%). Roads in proximity to the proposed project site have lower traffic volumes, with roads south of Ardrossan currently exhibiting less than 2,200 vehicles daily.

Table 1.2 Existing traffic volumes

ROAD	SECTION	ANNUAL AVERAGE DAILY TRAFFIC (AADT)	HEAVY VEHICLES (% HEAVY VEHICLES)
Port Wakefield Road	Copper Coast Highway to Port Wakefield	8,600	1,600 (18.5%)
	Port Wakefield to Angle Vale Road	8,600-13,300	1,400 - 2,700 (17.5 - 20.5%)
	Angle Vale Road to Northern Expressway	13,300-16,100	2,500 - 2,700 (15.5 - 20.5%)
	Northern Expressway to Bolivar Road	39,300-48,800	5,200 - 7,500 (13-15.5%)
	Bolivar Road to Salisbury Highway	54,200-58,600	7,400-7,500 (12-15.5%)
Copper Coast Highway	Yorke Highway to Port Augusta - Port Wakefield Road	4,900	700 (14.5%)

ROAD	SECTION	ANNUAL AVERAGE DAILY TRAFFIC (AADT)	HEAVY VEHICLES (% HEAVY VEHICLES)
St Vincent Highway	Copper Coast Highway to Ardrossan	2,200	260 - 350 (12-16%)
	Ardrossan to Ardrossan-Minlaton Road	2,300	430 (18.5%)
	Ardrossan-Minlaton Road to Port Vincent	1,000 - 1,100	130-210 (12-21%)
Ardrossan-Minlaton Road	Ardrossan to Curramulka	550-900	50-85 (9-9.5%)

Source: DPTI website (http://location.sa.gov.au/viewer/)

Volumes along local roads are estimated to be less than 500 vehicles per day.

1.3.3 CRASH HISTORY

Crash statistics have been obtained from Data.SA.gov.au for roads surrounding the proposed Ceres project for the five-year period between 2012-2016. The tables below summarise the crashes on each road by severity and by crash type. Overall, crash numbers have increased (mainly on the Port Wakefield Highway) over those previously reported for the period 2007-2011.

Table 1.3 2012-2016 crash statistics by severity

ROAD NAME	FATAL CRASHES	SERIOUS INJURY CRASHES	MINOR INJURY CRASHES	PROPERTY DAMAGE CRASHES	TOTAL CRASHES
Port Wakefield Hwy (including Copper Coast intersection)	10	35	327	643	980
Copper Coast Hwy (including St Vincent Highway intersection)	2	0	2	6	10
St Vincent Highway (including Ardrossan – Minlaton Road intersection)	2	6	19	40	61
Ardrossan – Minlaton Road	1	2	5	9	15
Total	**15**	**43**	**353**	**698**	**1,066**

Table 1.4 2012-2016 crash statistics by crash type

ROAD	HEAD ON	HIT FIXED OBJECT / ANIMAL	REAR END	RIGHT ANGLE	RIGHT TURN	ROLL OVER	SIDE SWIPE	OTHER	TOTAL
Port Wakefield Road	3	171	440	100	37	55	124	50	980
Copper Coast Highway	2	2	2	3	0	0	1	0	10
St Vincent Highway	3	22	3	9	0	7	5	12	61
Ardrossan – Minlaton Road	0	6	0	1	1	2	3	2	13

The above two tables show a high number of crashes on Port Wakefield Road compared to the other roads, due primarily to its greater length and higher daily traffic volumes. There appears to be a significant number of rear end, hit fixed object, right angle and side swipe crashes which are generally associated with intersections.

The average annual casualty crash rate per 100 million vehicle kilometres travelled for the various roads is shown below. A rating of less than 6.85 average annual casualty crashes per 100 million vehicle kilometres travelled is considered low, 6.85-9.56 low-medium, and 9.56-12.34 medium, 12.34-16.44 medium-high and greater than 16.44 considered high (Australian Road Assessment Program – AusRAP, individual crash risk ratings).

Average annual casualty crashes per 100 million vehicle kilometres:

- Port Wakefield Road: 15.49 (MEDIUM risk)
- Copper Coast Highway: 7.18 (LOW risk)
- St Vincent Highway: 25.06 (HIGH risk)
- Ardrossan – Minlaton Road: 17.47 (HIGH risk)

The assessment of crash history indicates significant safety issues with the current roads and treatments may need to be considered for intersections with significant additional turning traffic generated by the project.

1.3.4 PUBLIC TRANSPORT

Currently there are no public transport services on local roads in the proximity of the project site with the exception of school buses servicing schools in Curramulka and Ardrossan.

The school bus services operate from 7.30 am to 9.00 am and 3.30 pm to 5.00 pm on school days. There are generally no designated bus stops along the route with children being picked up and dropped off at property driveways. It is assumed that buses stop on the road shoulder (unsealed) for school children pickup and drop off, whilst allowing traffic to pass a stationary bus.

York Peninsula Coaches offer limited services (five days per week) between Yorketown and Adelaide. This coach runs the service from Yorketown to Adelaide central bus station (Franklin Street).

Copper Coast Passenger Service is also available for travel between Moonta Bay and Adelaide Central Bus Station which operates daily including public holidays with some exceptions. More information on coach services is available on Yorketown Coach Service website (http://ypcoaches.com.au/services/).

1.3.5 PEDESTRIANS AND CYCLISTS

Walking and bicycle networks and facilities are limited on the Yorke Peninsula.

On the eastern side of Gulf St Vincent, there are numerous walking and cycling paths in the area surrounding the proposed works associated with cabling and eastern convertor station. Walk the Yorke leisure trail has been constructed by Yorke Peninsula Council (through local, state and federal government funding) in recent years. Over 500kms of continuous shared walking and cycling leisure trail along the coast of Yorke Peninsula.

An off-road cycle and walking track within the Bolivar area follows the Little Para River linear park.

Port Wakefield Road in the vicinity of the eastern convertor station is classified as a Secondary Arterial Road cycling route, with the sealed shoulder used by cyclists (SA Government Bike Direct Maps).

The proposed Northern Connector includes creation of shared cyclist/pedestrian path which will further enhance cyclist facilities in the region.

1.4 TRAFFIC GENERATION

1.4.1 DURING CONSTRUCTION

The proposed Ceres Project construction is expected to occur over a period of approximately 26 months, commencing in late 2018/early 2019. The construction phase comprises construction of:

- 181 wind turbine generators
- the eastern convertor station (near Bolivar)
- the western convertor station and adjacent administration facilities and workshops (near Port Julia)
- laying of associated underground cables.

1.4.1.1 CONSTRUCTION WORKFORCE

Construction personnel for the works on Yorke Peninsula (wind farm, western convertor station and cabling) could be accommodated at any of the inland or coastal towns within proximity of the project site (either permanent residents or temporary rentals/borders). It is also possible that a temporary construction camp could be established to accommodate remote workers (this is yet to be determined). The location of workers' residence is important in the estimation of vehicle trips and trip patterns associated with the construction activities and hence the impacts of on the existing road network.

For the sake of this Traffic Impact Assessment it has been assumed that construction workers will be accommodated in the vicinity of, or in Ardrossan and Maitland or at portable camps on-site. It is further assumed that the number of construction personnel will be evenly at the three locations. Personnel are expected will be transported to site by light vehicles, with an average of two personnel per vehicle.

Construction personnel working on the eastern convertor station and cabling on the east side of Gulf St Vincent will be accommodated within the Adelaide area.

Table 1.5 summarises the forecast construction workforce traffic movements, in terms of peak daily, average daily and total trips expected over the 26-month construction period.

Table 1.5 Forecast construction workforce traffic movements

LOCATION	PEAK DAILY TRIPS	AVERAGE DAILY TRIPS (TWO WAY)	TOTAL TRIPS[2] (OVER 26 MONTHS)
Yorke Peninsula	500 light vehicles per day (months 2-19)	100 light vehicles per day (months 2-19) 80 light vehicles per day (months 1-27)	45,300
Eastern convertor station and cabling	NA	50 light vehicles per day[1]	

Note: assumes 2 personnel per vehicle, one trip to site and one trip from site;

[1]Normal operations at the station post completion

[2] (A reduction of about 1.5% to the previous proposal)

There are likely to be additional random short trips on local roads between wind farm sections, which are conservatively estimated to be less than 40 light vehicle movements per day.

Carpooling between staff accommodation and the project site might be encouraged by the contractor to reduce overall traffic generation during construction and its impact on the local road network.

The contractor may also consider using buses to transport staff between the accommodation and the project site. This would reduce the number of staff driving on unfamiliar roads and further reduce the volume of traffic movements generated by the project.

1.4.1.2 EQUIPMENT AND MATERIALS

Components of the wind turbine generators, including blades, tower sections, nacelles, hubs and steel reinforcing are expected to be transported from Outer Harbor, where the components are expected to arrive by ship.

Cranes, earth moving equipment, temporary batching plant, temporary buildings, and other miscellaneous convertor equipment and materials are also expected to be sourced from Adelaide (and surrounds).

The existing concrete batching plant located in Curramulka is expected to be utilised for the project. A temporary batching plant is also expected to be assembled on site for the project. It is assumed half of the volume of concrete (including quarry material and cement) will be sourced from Curramulka and the other half from the on-site batching plant (with quarry material and cement sourced from Ardrossan).

The estimated daily traffic generated by the delivery of equipment and materials to the Yorke Peninsula site (wind farm, western convertor station and administration/maintenance workshops) is summarised in Table 1.6 below. The table summarises the average and peak daily, and the total number of deliveries expected to the site from Outer Harbor / Adelaide and locally.

Estimates of traffic generated during the construction phase of the wind farm are based on information provided by Yorke Peninsula Wind Farm Project (YPWFP P/L), and on information from the construction of other wind farms in Australia (including the Hallett wind farms).

The delivery of plant, component and materials is estimated will generate almost 22, 430 vehicle trips (two way) over the 26 month construction program, with an average of 85 heavy vehicle trips (two way) to and from site per day. During construction months 2-13, the frequency of deliveries to the site will peak at approximately 400 heavy vehicle trips to and from the site each day. These estimate of trips is across the four wind turbine clusters.

Table 1.6 Daily construction traffic generated by the site

TRANSPORTABLE ITEM	VEHICLE TYPE	AVERAGE DAILY DELIVERIES[1]	PEAK DAILY DELIVERIES	MONTH	TOTAL DELIVERIES (OVER 26 MONTHS)
Mobilisation and construction					
Tower sections	Over dimensional, 52 tonne	3	10	4 - 19	950
Nacelles	Over dimensional, 52 - 58 tonne	1	5	5 - 19	375
Blades	Over dimensional, 20 tonne	2	10	5 - 19	550
Hub	General Mass Limit heavy vehicle	1	5	5 - 19	190
Steel reinforcing	General Mass Limit heavy vehicle	2	10	2 - 13	375
Cables and controllers	General Mass Limit heavy vehicle	1	10	5 - 21	375
Convertor station and equipment	Over dimensional, 52 tonne	<1	5	12-14	160
Convertor Misc.	General Mass Limit heavy vehicle	<1	2	5 - 21	20
Cranes	Over dimensional, 52 tonne	<1	2	3 - 19	20
Earth moving equipment	Over dimensional	<1	5	1 - 13	240
Plant and buildings	Over dimensional	<1	10	1 - 13	240
Miscellaneous Equipment	General Mass Limit heavy vehicle	<1	10	1 - 21	200
Quarry materials and cement	General Mass Limit heavy vehicle	23	100	1 - 13	5,980
Water	General Mass Limit heavy vehicle	3	15	1 - 13	
Retic cables and support	General Mass Limit heavy vehicle	1	5	3 - 21	650
Demobilisation					
Earth moving equipment	Over dimensional	2	15	21 - 27	250
Plant and buildings	Over dimensional	2	20	21 - 27	250
Total deliveries (one way trips)		**43**	**-**	**-**	**11,215**
Total trips (two way trips)		**85**	**-**	**-**	**22,430[2]**

(1) Initial estimates based on information from YPWFP P/L; to be confirmed at the time of detailed design stage

(2) A reduction of 6% compared to original proposal

The volume of traffic generated by the construction of the eastern convertor station (adjacent Port Wakefield Road) and cable laying is expected to be in the order of 375 heavy vehicle trips, with an expected peak of approximately 40 heavy vehicle trips to and from per day.

1.4.1.3 SUMMARY TRAFFIC GENERATION

The average daily traffic generated by the site is summarised in Figure 1.1. It shows that, during the peak of the civil and installation works in months 5-13, there will be an estimate 175 vehicle trips per day. During the peak of construction, up to 900 trips could be expected to and from the site per day, spread across the various access roads (Ardrossan-Minlaton Road and Port Wakefield-Yorketown Road) and local roads.

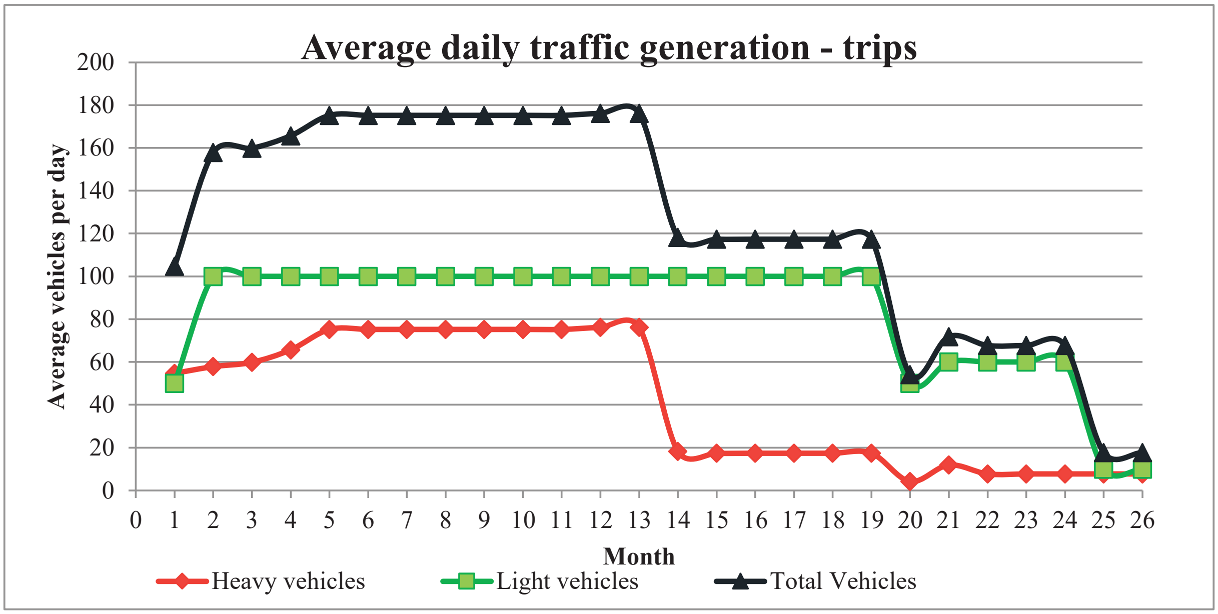


Figure 1.1 Average daily traffic generation

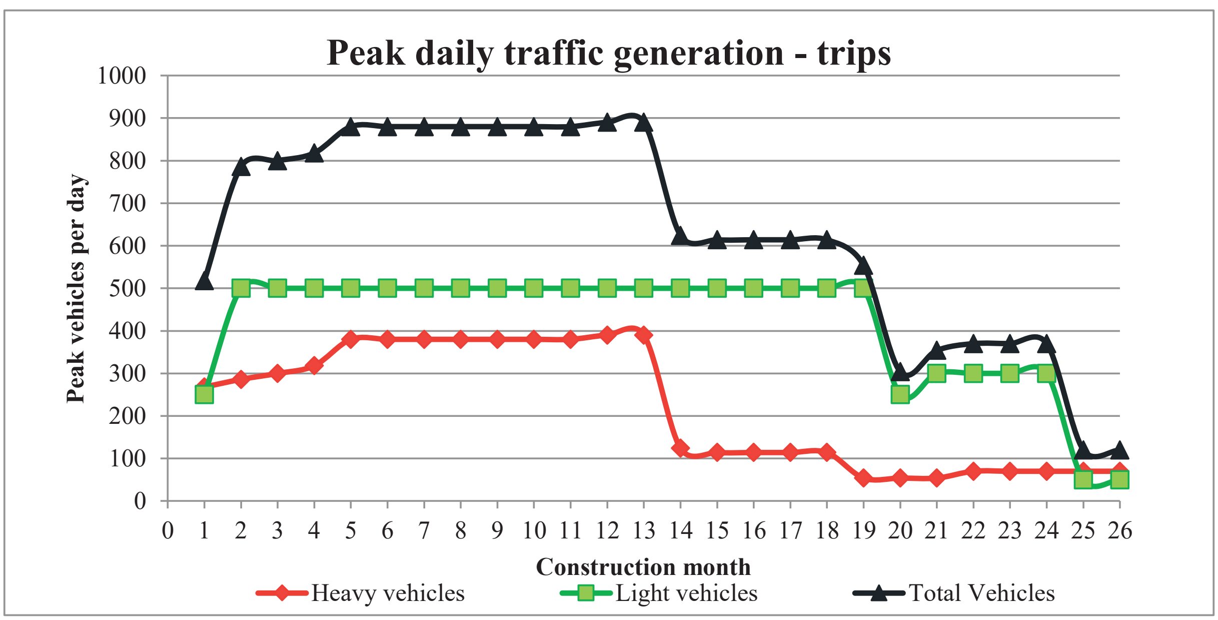


Figure 1.2 Peak daily traffic generation

1.4.2 NORMAL OPERATION

During normal operation of the completed wind farm, there is expected to be 50 people employed at the administration and maintenance workshops adjacent the western convertor station on the Yorke Peninsula. These employees will likely be based locally and generate about 100 trips per day (assuming one person per vehicle) to and from the site.

Wind turbine generator routine inspections and maintenance will also be required on a regular basis, with each wind turbine generator requiring access by light vehicles at least on a weekly basis, from the administration and maintenance workshops. Heavy vehicles will also access the site on a less frequent basis for major maintenance.

1.5 PROPOSED ACCESS

This section describes the proposed transport routes and alternative transport routes from Outer Harbour to the project site.

1.5.1 CONSTRUCTION TRAFFIC ROUTES

A majority of the wind turbine generator components are expected to be shipped into Outer Harbor and then transported by road to the project site. From Outer Harbor, the proposed route to the site is as follows:

- Victoria Road
- Port River Expressway
- Salisbury Highway
- Port Wakefield Road
- Copper Coast Highway
- St Vincent Highway , and
- Ardrossan – Minlaton Road.

Alternative routes are not considered to be feasible as these include sections of road that are not gazetted for use by over-dimensional vehicles. It is unlikely that the State Government would give approval for such vehicles to use these non-gazetted routes in preference to the existing gazetted oversize and over-mass heavy vehicle routes. The site is proposed to have multiple access points from the local road network (more than 70 locations), which will be accessible from St Vincent Highway and Ardrossan-Minlaton Road.

The proposed route from Outer Harbor to site is shown in Figure 1.3 below.

Access to the various sections of the wind farm site from St Vincent Highway and Ardrossan – Minlaton Road will be via local roads. There will be 11 locations where construction vehicles access local roads, six from St Vincent Highway and five from Ardrossan – Minlaton Road, dispersing traffic along the two routes. From these local roads, access will then then be provided to approximately 70 site access points. Each access point from a local road will provide access for up to ten wind turbine generators, with some sections of wind turbine generators having more than one access point. The high number of site accesses will distribute the traffic generated by the construction activities.

Numerous purpose-built access roads will be constructed on private property within the wind farm site to provide direct access to the individual wind turbine generators.

Access to the eastern convertor station (adjacent Port Wakefield Road) will be via a service road from Port Wakefield Road (this currently provides access to a weighbridge). Access to St Kilda where the underground cables will be laid will also be directly from Port Wakefield Road.

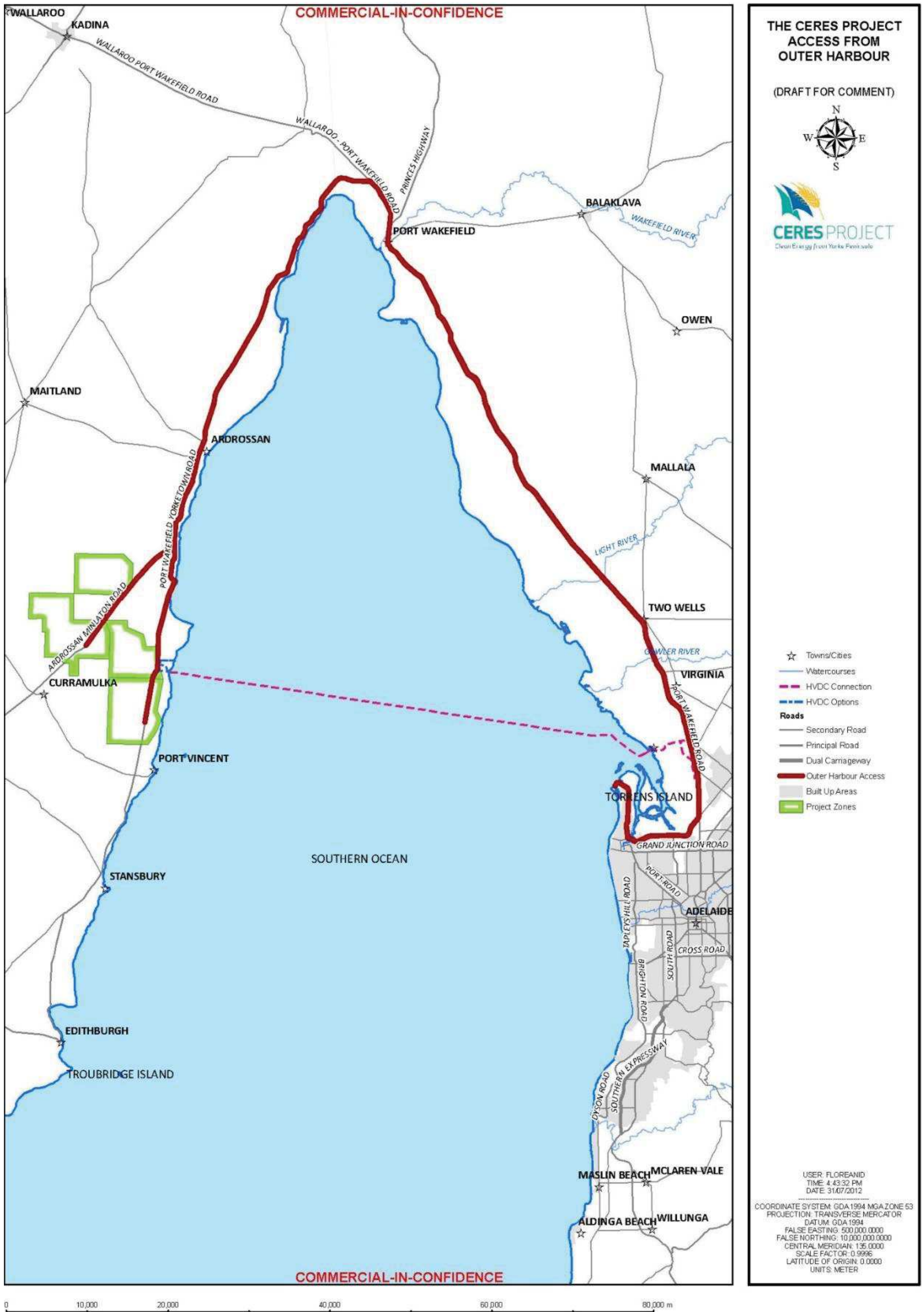


Figure 1.3 Construction vehicle access routes

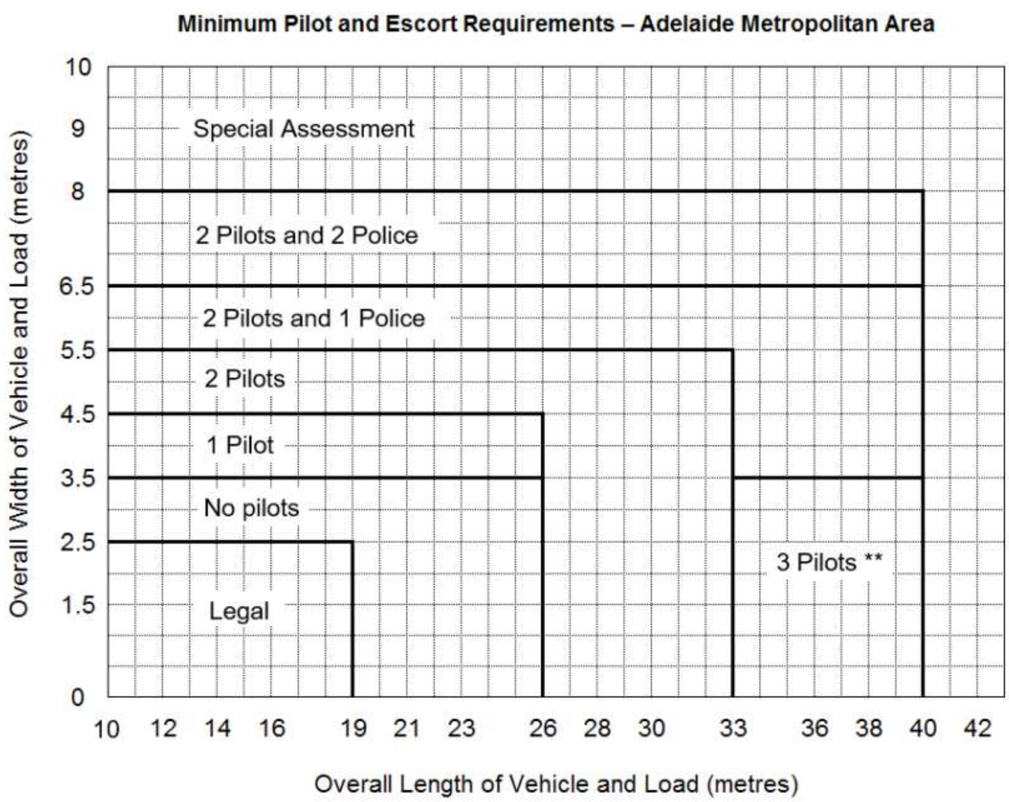
1.5.1.1 OVERSIZE AND OVERMASS VEHICLE ROUTES

A transportation company will be contracted to undertake the transportation of the wind turbine generators to the site (including blades and towers). The contractor will be required to gain approvals from DPTI to transport large indivisible items as required (Pilot and Escort Requirements - Changes to Pilot and Escort Requirements DPTI, July 2018, and Code of Practice for the Transport of Indivisible Items in South Australia, DPTI, 2006).

DPTI may request a detailed route assessment to support individual applications for permits. It is understood that some of these roads have in the past been used by restricted access vehicles, and it is envisaged that this will be permitted again for the Ceres project.

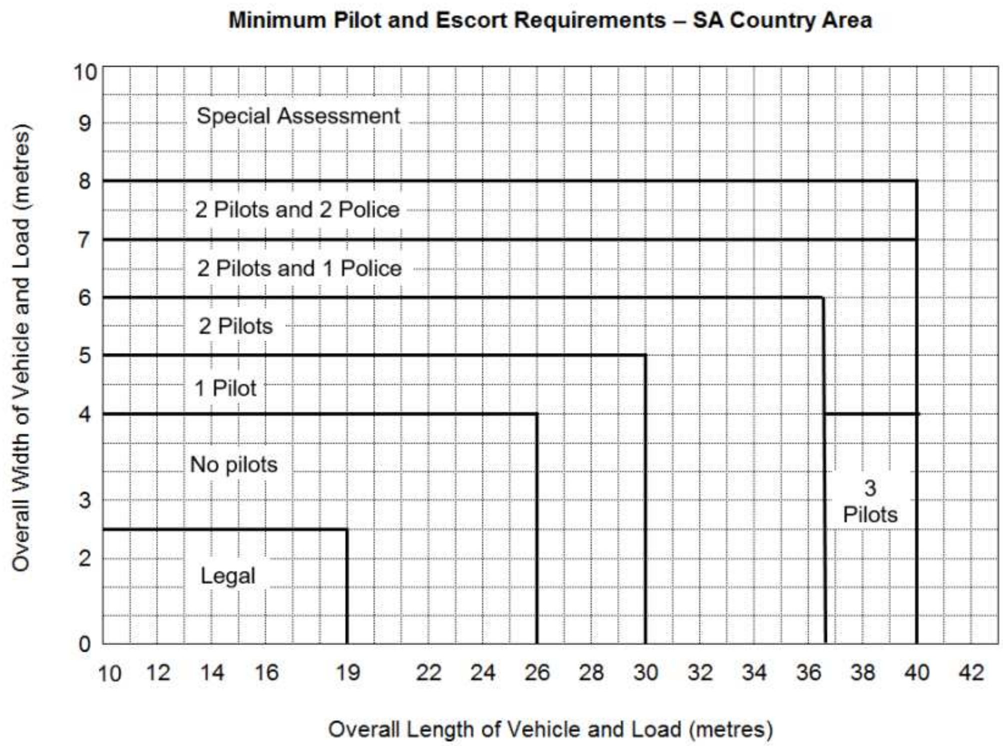
It is likely the oversize and over-mass loads will require police escort, which will assist the heavy vehicles accessing the site safely (Pilot and Escort Requirements - Changes to Pilot and Escort Requirements, DPTI, July 2018). Figure 1.4 and Figure 1.5 below summarise the requirements for escorts for transporting oversize loads to site, within Adelaide Metropolitan Area and SA Country Area respectively. Escorts of over-mass vehicles and loads may also be required. Restriction to times and days of travel by oversize and over-mass loads may also be imposed on the transportation contractor to minimise impacts on other road users.

A detailed engineering report (route audit) may be required to determine impacts on and exact upgrade requirements (mitigation measures) for roads and intersections to accommodate oversize and over-mass vehicles.



Source: Pilot and Escort Requirements – Changes to Pilot and Escort Requirements, DPTI, July 2018

Figure 1.4 Daytime escort requirements in metropolitan Adelaide



Source: Pilot and Escort Requirements – Changes to Pilot and Escort Requirements, DPTI, July 2018

Figure 1.5 Pilot and escort requirements in country SA

1.5.2 MID-BLOCK ROAD PERFORMANCE

1.5.2.1 DAILY PERFORMANCE

The estimated volume of peak daily construction traffic on various roads is summarised in Table 1.7 below. The peak daily construction traffic along Port Wakefield Road and Copper Coast Highway is expected to be less than 4% of the existing daily traffic volumes.

Along St Vincent Highway , percentage increases are expected to be between 8 and 36%, depending on road section, albeit percentage increases are based on relatively low existing traffic volumes (1,000-3,000 vehicles per day, two way).

The table shows increases in peak daily traffic volumes of up to 62% on Ardrossan-Minlaton Road, where existing volumes are low (500-550). The percentage increase is significant, but the actual number is approximately only 308 additional vehicles per day.

Local roads will experience higher percentage increases due to the currently low traffic volumes.

The eastern convertor station construction and cable laying is expected to generate up to 40 vehicle movements per day, which is not considered significant given the high traffic volumes along Port Wakefield Road.

Table 1.7 Peak daily mid-block traffic volume impacts (two-way volumes)

ROAD	SECTION	ANNUAL AVERAGE DAILY TRAFFIC (AADT)	CONSTRUCTION TRAFFIC – PEAK DAILY	% INCREASE
Port Wakefield Road	Copper Coast Highway to Port Wakefield	8,600	180	2.09%
	Port Wakefield to Angle Vale Road	8,600-13,300	180	0.02%
	Angle Vale Road to Northern Expressway	13,300-16,100	180	1.35%
	Northern Expressway to Bolivar Road	39,300-48,800	180	0.46%
	Bolivar Road to Salisbury Highway	54,200-58,600	180	0.33%
Copper Coast Highway	Yorke Highway to Port Augusta - Port Wakefield Road	4,900	180	3.67%
St Vincent Highway	Copper Coast Highway to Ardrossan	2,200	180	8.18%
	Ardrossan to Ardrossan-Minlaton Road	2,300	495	21.52%
	Ardrossan-Minlaton Road to Port Vincent	1,000 - 1,100	355	35.50%
Ardrossan-Minlaton Road	Ardrossan to site	500-550	308	61.50%
	Curramulka to site	700-900	115	16.43%

1.5.2.2 PEAK HOUR PERFORMANCE

Estimates of peak hour traffic volumes are based on the following assumptions:

- one hour daily peak represents 10% of the existing AADT (adopting the lower volume where a range is provided)
- 60% of two-way trips are considered will travel in the peak direction (based on existing Port Wakefield Road traffic counts)
- the one hour peak of the wind farm generated construction traffic 20% of the peak daily site deliveries and 40% of the construction personnel peak daily traffic (refer Table 1.8).

Forecast increases in traffic due to construction are shown in Table 1.8.

Table 1.8 Mid-block traffic volume impacts peak hour

ROAD	SECTION	EXISTING PEAK DIRECTION VOLUME	CONSTRUCTION TRAFFIC	% INCREASE
Port Wakefield Road	Copper Coast Highway to Port Wakefield	516	42	8.1%
	Port Wakefield to Angle Vale Road	516	42	8.1%
	Angle Vale Road to Northern Expressway	798	42	5.3%
	Northern Expressway to Bolivar Road	2,358	42	1.8%
	Bolivar Road to Salisbury Highway	3,252	42	1.3%
Copper Coast Highway	Yorke Highway to Port Augusta - Port Wakefield Road	294	42	14.3%

ROAD	SECTION	EXISTING PEAK DIRECTION VOLUME	CONSTRUCTION TRAFFIC	% INCREASE
St Vincent Highway	Copper Coast Highway to Ardrossan	132	42	31.8%
	Ardrossan to Ardrossan-Minlaton Road	138	168	121.7%
	Ardrossan-Minlaton Road to Port Vincent	60	106	176.6%
Ardrossan-Minlaton Road	Ardrossan to site	30	96	320%
	Curramulka to site	42	28	66.6%

The table shows that Port Wakefield Road and Copper Coast Highway are expected to experience an increase in peak volumes of 42 vehicles (8%).

St Vincent Highway is expected to experience increases in traffic volumes of up to 170 vehicles in the peak hour (up to 177%) in sections, on existing low traffic volumes (60 vehicles per hour).

A description of road mid-block Level of Service thresholds and descriptions is provided in Table 1.9 and Table 1.10 below and is based upon traffic volumes and the number of traffic lanes.

Table 1.9 Mid-block level of service and threshold peak hour flow for rural roads

TERRAIN	LEVEL OF SERVICE	THRESHOLD PEAK HOUR FLOW (VEH/HR)			
		0% HEAVY VEHICLES	5% HEAVY VEHICLES	10% HEAVY VEHICLES	15% HEAVY VEHICLES
Level	A	540	490	440	380
	B	850	770	680	600
	C	1,220	1,100	980	860
	D	1,560	1,400	1,250	1,100
	E	1,700	1,530	1,360	1,190

Source: Adapted from Austroads Guide to Traffic Management Part 3

Table 1.10 Mid-block level of service descriptions

LEVEL OF SERVICE	DESCRIPTION
A	Free flow condition, high degree of freedom for drivers to select desired speed and manoeuvre within traffic stream.
B	Zone of stable flow, reasonable freedom of drivers to select desired speed and manoeuvres within traffic stream.
C	Zone of stable flow, restricted freedom of drivers to select desired speed and manoeuvres within traffic stream.
D	Approaching unstable flow condition, severely restricted freedom for drivers to select desired speed and manoeuvre within traffic stream.
E	Condition close to capacity, virtually no freedom for drivers to select desired speed and manoeuvre with traffic stream, Small increases in flow would generally cause operational problems.

Source: Austroads Guide to Traffic Management

St Vincent Highway is expected to experience increases in traffic volumes of up to 177% but will maintain an operating level of service (LOS) A with a combined (existing + construction) peak traffic flow less than 200 vehicles/hour.

Ardrossan-Minlaton Road between Ardrossan and Curramulka currently exhibits a peak direction volume of approximately 30 vehicles per hour, and is expected to experience increases in traffic volumes of up to 96 vehicles in the peak hour (an increase of up to 320%). Despite the estimated increase in peak hour traffic due to construction activity at the windfarm site, the road is still expected to maintain an operating level of service (LOS) A.

1.5.3 INTERSECTION ASSESSMENT

The number of additional vehicle movements expected through the key intersections during the peak of the construction phase of the project is as follows:

- Additional 190 vehicles daily and 42 vehicles in the peak hour through the Copper Coast Highway/Port Wakefield-Yorketown Road junction.
- Additional 503 vehicles daily and 168 vehicles in the peak hour through the Port Wakefield-Yorketown Road/Ardrossan-Minlaton Road junction.

There will be a significant increase in both light vehicle and heavy vehicle turning movements at numerous intersections and junctions along St Vincent Highway and Ardrossan-Minlaton Road, providing access to the wind farm clusters on Yorke Peninsula.

The increase in the number of vehicles turning at key intersections along the transport route (Port Wakefield – Yorketown) is likely to require upgrading to accommodate the wind farm generated traffic, in particular large truck carrying turbines parts requiring wider intersections to negotiate turns.

1.6 CONSTRUCTION ACTIVITIES MANAGEMENT

The construction of the wind towers, convertor stations and associated underground cabling will result in increased traffic movements along the arterial roads and local roads within the Yorke Peninsula region and near St Kilda, Bolivar and Parafield Gardens West.

1.6.1 HEAVY VEHICLE ACCESS

Transportation of wind turbine generator components including blades, nacelles and tower sections may constitute oversize and over-mass loads and require larger vehicles, which will require permits from DPTI to travel on DPTI maintained roads, and will generally require escorts. Liaison with Councils will also be required to ensure suitability of specific local roads. This process has been used on other wind farms in the region and it is understood there were no major issues with the process.

General mass limit heavy vehicles for transporting other construction equipment and materials are permitted to travel on DPTI roads without special permits.

1.6.2 RISKS AND MITIGATION

Mitigation measures and strategies may be required to minimise traffic impacts (noise, dust and other problems) created by and during the construction of the wind farm. While it is difficult to completely avoid these impacts, measures can be implemented to reduce the severity of them.

There are several identified transport related risks associated with the proposed project. These are summarised in the table below, with accompanying mitigation measures. These issues may need to be addressed in detail in a Traffic Management Plan (including but not limited to locations of specific access points to the arterial roads, road and intersection upgrade treatments, road sign types and placement and any permits required). A Traffic Construction Management Plan (TCMP) will also be prepared to provide details of monitoring and maintenance activities to ensure the roads are intersections are maintained at an appropriate level).

Table 1.11 Risks and mitigation

RISK	MITIGATION
A lengthy approval process with DPTI for oversize and over-mass vehicles.	— Engage transportation contractor early in construction phase to commence approval process.
Underestimating forecast traffic flows during the construction phases.	— Regularly inspect local road conditions being utilised by construction traffic and provide maintenance to damaged areas as required.
Damage to local road pavements.	— Repair at commencement and monitor condition. — Communication program to keep local community informed. — A maintenance plan should be created to keep the roads at a consistent quality. It is of particular importance that, after wet weather, the road condition is reviewed to ensure the surface is still adequate to drive on. — Other methods such as contractor imposed speed limits on unsealed roads and contractor inductions to educate contractors, to minimise damage may also be put into place. — Reinstatement of roads post construction where damage has occurred, including cabling (to an equal or better higher condition than prior to the works being undertaken, which may require DPTI or Council signoff. Cost sharing arrangements between the contractor and local council (Yorke Peninsula Council) may be possible.
Narrow local roads to site.	— Local roads providing access to the wind farm sections are generally 7-8m wide. Where local roads are less than 7m wide, road widening should be undertaken to provide a 7m carriageway to safely allow two-way traffic.
Cable laying traffic impacts	— Where laying of cables is required along/across local roads, appropriate traffic management plans need to be developed and implemented to minimise impacts to local residents. The road shall be re-constructed such that it is in equal or better condition than prior to the works being undertaken.
Dust from construction traffic.	— Use water-cart to suppress dust along local roads if required (due to nearby dwellings). — Ensure that drivers adhere to reduced speed limits on unsealed roads.
Noise from construction traffic.	— Limit hours of construction traffic to day time only. — Ensure a clearly defined access road is available and that the road surface is adequately maintained. — Ensure that drivers adhere to speed limits (contractor imposed speed limits).
Spread of mud and weeds.	— A vehicle washing bay to clean trucks. — The use of metal brushes to scrape mud off tyres. — Providing a hose for drivers to manually clean vehicles.

1.6.3 RESPONSIBILITIES AND ACCOUNTABILITIES

YPWFP P/L and its construction contractors will be responsible for ensuring compliance with the below inspections, monitoring and maintenance during the construction phase of the Ceres Wind Farm project.

YPWFP P/L and contractors will be responsible for ensuring that all activities on the site and access roads comply with the relevant laws, regulations, standards and codes of practice, including but not limited to:

- the transportation company contracted to undertake the transportation of the transformers to the site will be required to gain approvals through DPTI to transport large indivisible items as required
- *Road Traffic Act 1961* and Regulations 2014
- Motor Vehicles Act 1959 and Regulations 2010
- Escorting Guidelines for Oversize and Over-mass Vehicles and Loads (DPTI, 2006)
- Pilot and Escort Requirements - Changes to Pilot and Escort Requirements, DPTI, July 2018
- Code of Practice for the Transport of Indivisible Items in South Australia (DPTI, 2006)
- relevant Australian, DPTI and Austroads Standards.

The applicant will collaborate with DPTI to ensure all proposed road improvements comply with all relevant standards and guidelines and meet the approval of DPTI. The cost of all treatments required as a result of the construction activities will be borne by YPWFP.

1.7 OPERATIONAL ACTIVITIES MANAGEMENT

During the normal operation phase of the wind farm, impacts by additional traffic generated by these activities are expected to be minimal. The administration and maintenance facility adjacent the western convertor station is forecast to generate approximately 100 light vehicle trips per day in addition to a small number of heavy vehicle movements for wind turbine maintenance, which are not envisaged to be significant.

It is expected that the eastern convertor station will generate less than 1 vehicle trip per day (i.e. negligible trips and impacts).

ABOUT US

WSP is one of the world's leading engineering professional services consulting firms. We are dedicated to our local communities and propelled by international brainpower. We are technical experts and strategic advisors including engineers, technicians, scientists, planners, surveyors, environmental specialists, as well as other design, program and construction management professionals. We design lasting Property & Buildings, Transportation & Infrastructure, Resources (including Mining and Industry), Water, Power and Environmental solutions, as well as provide project delivery and strategic consulting services. With 36,000 talented people in more than 500 offices across 40 countries, we engineer projects that will help societies grow for lifetimes to come.

Appendix L

Aviation Impact Assessment

Aeronautical Impact Assessment

Ceres Wind Farm – Revised Layout
Yorke Peninsula, South Australia

Client

Yorke Peninsula
Wind Farm Project P/L

LB00040

Final Version 2
31 October 2018

Version No.	Basis of issue	Author	Date	Reviewers
001	Draft report for submission to Client	PWW	28 August 2018	JW & CA
002	Revised draft	PWW	6 September 2018	CA
1	Final	PWW	24 September 2018	JW
2	Final V2	PWW	31 October 2018	JW

Contents

1 Introduction

1.1 The Development

In December 2016, The Ambidji Group Pty Ltd (Ambidji) was engaged by Yorke Peninsula Wind Farm Project P/L to provide an Aviation Impact Statement (AIS) for the proposed Ceres Wind Farm development involving wind turbine generators (WTGs) of 163m height above ground level (AGL).

Yorke Peninsula Wind Farm Project P/L have now advised that they propose to use larger WTGs with turbine tip heights increased from 163m AGL to 220m AGL, and that a revised AIS is required. The highest WTG has an elevation of 382.869 m /1257 ft Australian Height Datum (AHD).

Figure 1 maps the development in relation to Adelaide, with the wind farm on the western side of Gulf St Vincent.

Figure 1: Development site in relation to Adelaide

There are no airports with published instrument approach procedures within 55 km (30 nautical miles (nm)) of the boundary of the Ceres Wind Farm.

Adelaide Airport is approximately 66 km (35 nm) east of the wind farm, with Parafield airport and RAAF Base Edinburgh being slightly further away. Port Lincoln and Whyalla airports are located on the Eyre Peninsular, more than 60 km west of the wind farm.

There may be other privately owned airstrips in the area that are not published in the Aeronautical Information Publication (AIP) documents. The owners of these airstrips and the pilots that use them are responsible for ensuring that the condition of the airstrip and the surrounding terrain and obstacle environment are suitable for their safe operation.

Ongoing consultation by the developer should also have created a community awareness of any impact the wind farm will have on these airstrips.

Several Instrument Flight Rules (IFR) air routes exist in the vicinity of the Ceres Wind Farm. These routes and the clearances from the wind farm are discussed in detail later in this report.

2 Airspace Protection

2.1 Overview

Protected airspace for an airport is the airspace above any part of either an Obstacle Limitation Surface (OLS), a PANS OPS (Procedures for Air Navigation Services – Aircraft Operations) surface.

The OLS are conceptual surfaces associated with an airport's runways that are designed to protect aircraft operations at the airport from unrestricted obstacle growth that could restrict flight operations at the particular airport. Depending on the type of instrument flight procedures provided at the airport, the OLS can extend to a maximum of 15 km from the airport.

All of the local airports with OLS are in excess of 15 km from the wind farm and therefore their OLS are not infringed.

PANS OPS surfaces are designed around instrument approach and departure flight paths with a prescribed minimum obstacle clearance from terrain and structures. They designate an obstacle-free flight path to enable safe and efficient aircraft operations in Instrument Meteorological Conditions (IMC), where the pilot is not guaranteed to be able to see the ground, water or obstacles on or near their flight path.

Airspace within the lateral navigation tolerances of an air route, and the vertical allowance is also protected from terrain or obstacle intrusion to ensure safe flight operations during IFR flight on those routes.

Infringement by an infrastructure development or crane into protected airspace requires the approval of the aerodrome operator or Airservices Australia, and the Civil Aviation Safety Authority (CASA).

Infringement of PANS OPS protection surfaces are not supported by the aviation authorities.

2.2 PANS OPS Surfaces

PANS OPS protection surfaces extend to 55 km (30 nm) from the relevant point on or near the airports with published IFPs.

There are no PANS OPS surfaces overlying the layout of the Ceres Wind Farm.

2.3 Air Routes

Six air routes have navigation tolerances overhead the Ceres Wind Farm. The applicable navigation tolerance is 5 nm either side of the air route.

The Lowest Safe Altitude (LSALT) published for each route is the lowest altitude that an IFR aircraft can fly on that route, without visual reference to the ground or water.

A Grid LSALT of 2200 ft is above the wind farm. The grid is based on a whole 1-degree longitude x 1-degree latitude square. This provides IFR pilots with an LSALT when they are not tracking on a designated air route.

LSALT protection surfaces for these routes and the Grid LSALT, with the relevant clearances above the wind farm are detailed in Table 1.

The wind farm does not infringe the LSALT protection surfaces for the air routes above the proposed revision to the WTG height of the Ceres Wind Farm.

The Grid LSALT protection surface of 365 m/1200 ft AHD is infringed by 16 of the WTGs. These WTGs are shown in green at Appendix A.

The highest of these WTG is T036 at 382.9 m/ 1256 ft will only cause an increase of 100 ft to 2300 ft for the Grid LSALT. (LSALT figures are rounded to the next highest 100 ft increment)

Approval from Airservices Australia to increase the GRID LSALT to 2300 ft will be required. Whilst L&B cannot anticipate this approval being provided, there does not appear to be any other activity that would preclude the Grid LSALT not to increase to 2300 ft.

Air Route (LSALT)	Height of Protection Surface (m/ft AHD)	Result
A585 – Adelaide to HAWKY (914 m/3000 ft)	610/2000	The WTGs do not infringe the protection surface for the LSALT
A585 – HAWKY to MUTHA (914 m/3000 ft)	610/2000	The WTGs do not infringe the protection surface for the LSALT
V238 PANKI to HAWKY (670 m/2200 ft)	365/1200	The WTGs do not infringe the protection surface for the LSALT
N640 – Adelaide to RIKAB then V621 to SPENA (609 m/2000 ft)	304/1000	The WTGs do not infringe the protection surface for the LSALT
Grid LSALT (671 m/2200 ft)	365/1200	16 WTGs infringe the protection surface for the GRID LSALT. The highest is T036 @ 382.9 m/1256 ft AHD + 300 m/1000 ft = 682.9 m/2256 ft.

Table 1: Air Routes Clearances and Infringements

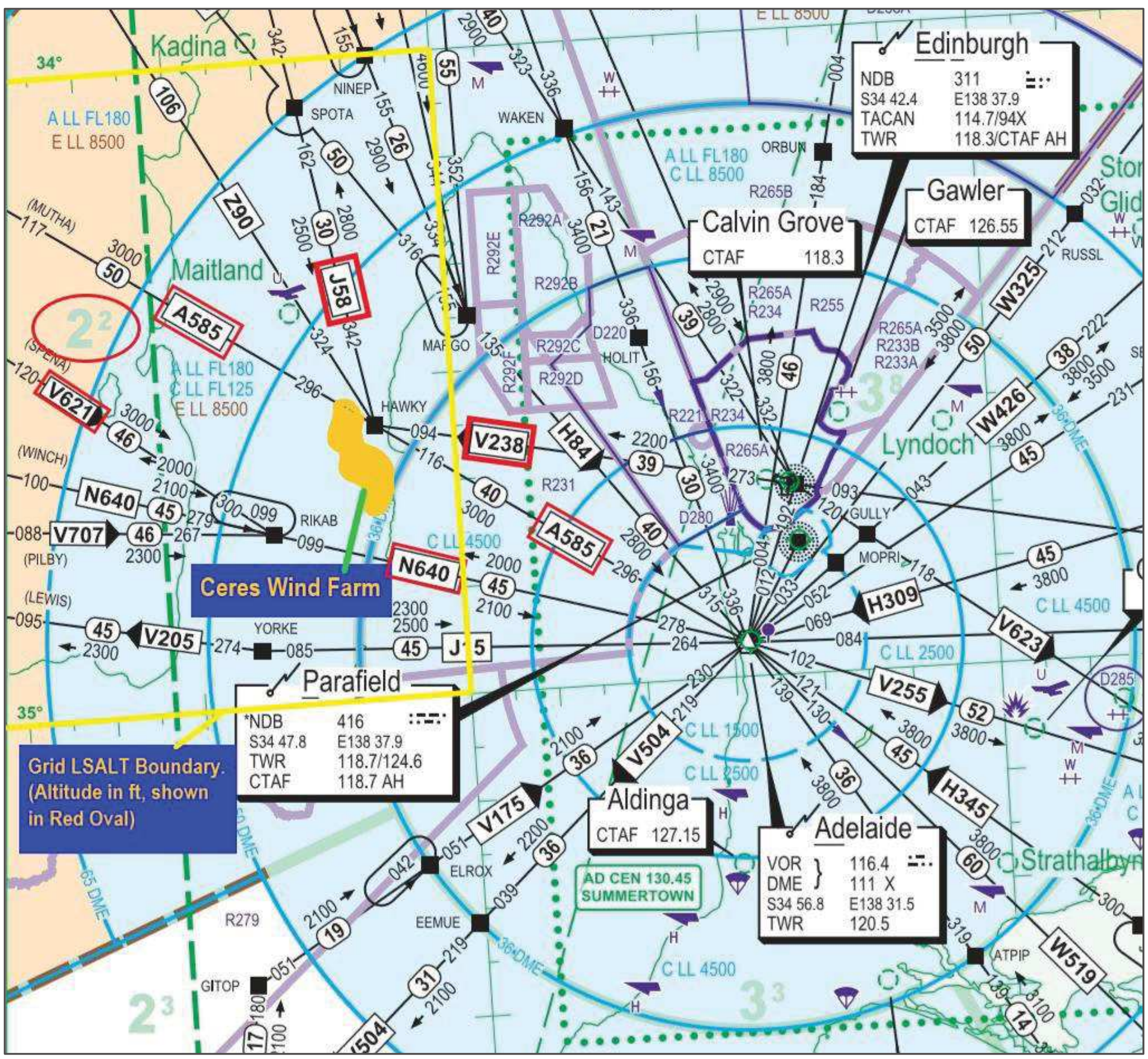


Figure 2: Air Routes and development site (AIP ERC 2 - 24 May 2018)

2.4 Military Restricted Airspace

RAAF Base Edinburgh conducts operational testing and evaluation for every type of military aircraft used by the Australian Defence Force. These flight operations are normally conducted in airspace that is restricted to their own use and termed Restricted Areas.

R231 is such a Restricted Area that encompasses an area from 11 miles west of Adelaide (11DME) to 36 miles west of Adelaide (36 DME) with vertical limits from the Surface (ground or sea level) up to 2500 ft Above Mean Sea Level (AMSL). It is active during operational hours at Edinburgh and should be considered active 24 hours per day as they can operate at any time if required.

Eight WTGs are located within R231 between Port Julia and Port Vincent: T174, T190, T191, T192, T194, T195, T197 and T199. Refer to Appendix A for WTG details.

It is unlikely that these WTGs will impact on aircraft operations within R231, however, approval from the Department of Defence will be required for their construction and they will be required to be shown on aeronautical charts.

Figure 3 is an extract from Airservices Australia's Aeronautical Information Publication (AIP), Visual Navigation Chart (VNC) – Adelaide dated 24 May 2018, showing R231 and its boundaries.

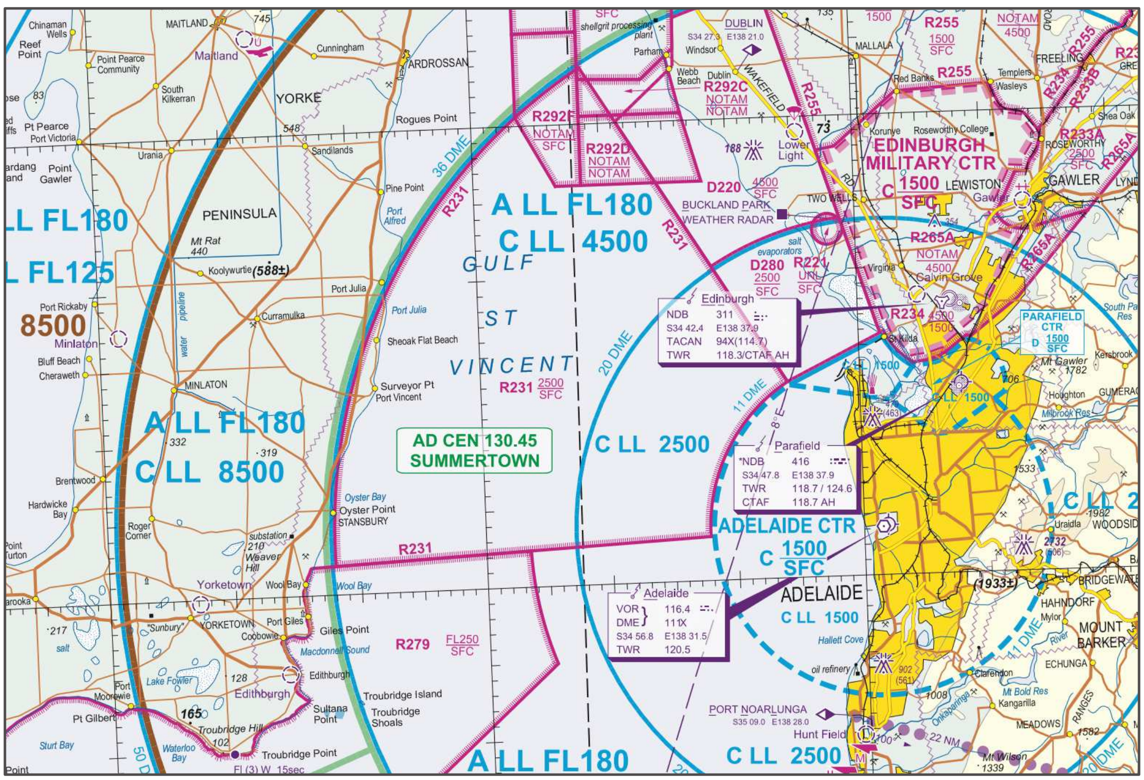


Figure 3: R231 depiction VNC Adelaide (Airservices Australia)

3 ATC Surveillance System and Navigation Aids

Wind farms have the potential to cause both electro-magnetic and reflective type interference to ATC surveillance systems and to the accuracy of aeronautical navigation aids.

The nearest ATC surveillance system is located at Adelaide Airport, approximately 66 km east of the wind farm. A clearance plane of 0.5 degree above the radar antenna is related. At 66 km, this clearance plane is approximately 603 m AHD.

The wind farm will not infringe this clearance plane.

Another ATC radar is located at Summertown, in the Adelaide Hills. It has a higher antenna and is located further away than the Adelaide radar. The wind farm does not infringe the Summertown radar clearance plane.

The nearest aeronautical navigation aid is also located at Adelaide Airport, (AD VOR/DME) approximately 66 km east of the wind farm.

The Ceres Wind Farm will not have an impact on the clearance planes, which extend to approximately 3 km from the individual navigation aid, of any aviation navigation aids.

Referral to Airservices Australia to enable their radar engineers to confirm this assessment is required.

4 Aviation Activity in the Vicinity of the Wind Farm

4.1 VFR operations

It is difficult to assess the level of aviation activity near the Ceres Wind Farm due to the lack of reporting requirements for VFR flights in this area.

It would be reasonable to consider that there are low numbers of VFR flight operations in the vicinity of the Ceres Wind Farm.

It is also worth considering that VFR aircraft transiting from the Adelaide area to the west of Spencer Gulf would consider using more northerly routes to limit their exposure to longer overwater flights. This would further limit the number of VFR flights likely to be in the vicinity of the wind farm.

Airfields on the Yorke Peninsula, which are shown on the Adelaide VNC are:

- Minlaton – 19 km southwest of the wind farm boundary; and
- Maitland – 17 km northwest of the wind farm boundary.

The Ceres Wind Farm will not have an impact upon take-off and landing operations at these airports due to the distance of the wind farm from them.

Other private airfields on the Yorke Peninsula may exist but pilots conducting aircraft operations conducted at them must comply with Civil Aviation Safety Regulations in that the condition of the airfield and the surrounding terrain or man-made obstacles must allow for the safe conduct of flight operations to/from them.

VFR flights between airports in the Adelaide region, and airports to the west of Adelaide, normally operate at a comfortable altitude above terrain for their transit over this area of remote terrain and water to their destinations. They are required to maintain visual reference to the ground or water at all times. The presence of R231 (para 2.4 refers) requires these aircraft to be at or above 2500 ft AMSL over the Gulf St Vincent and it is unlikely that they would descend below that altitude once clear of R231 in most circumstances.

VFR scenic and local flights might operate at lower altitudes in calm and clear conditions, but the prominent wind farm turbines will be readily identifiable and avoidable and will serve as a navigation feature.

Wind conditions conducive to productive wind farms also produce mechanical turbulence from the surrounding terrain that most prudent pilots avoid, by either remaining out of the area in windy conditions or flying above the mechanical turbulence.

4.2 Low level operations

Pilots undertaking or conducting training for authorised low level operations such as crop dusting, aerial firefighting, aerial cattle mustering, search and rescue, power line survey, gas pipe line monitoring and military low level flying in the area undergo specialised training and are required to take account of obstacles when planning and conducting low level operations.

Depiction of the Ceres Wind Farm on aeronautical charts will provide sufficient information for pilots planning to operate in the vicinity of the wind farm, to be aware of its presence and to plan their flights in order to either avoid the location altogether or consider its impact upon their proposed flight operations.

4.3 Contingency Procedures – Engine Inoperative Flight Paths

In the context of the aircraft and airport operations near the proposed development of the Ceres Wind Farm and the physical environment, the wind farm is considered sufficient distance from nearby airports to have no impact on contingency procedures and engine inoperative flight paths in the area.

5 Obstacle Marking and Lighting

Previous experience suggests that obstacle marking of the wind turbines will not be required as CASA considers that WTGs are sufficiently conspicuous by day due to their shape, size and colour, providing the WTGs are painted in a colour that is visually conspicuous against the prevailing background.

If obstacle lighting is required by CASA or the Department of Defence (DoD), shielding of the lights to avoid distraction to residents may be installed, however the lights must remain visible above a horizontal plane.

Discussion notes regarding the lighting of wind farms can be found in Appendix C.

As the Ceres Wind Farm turbine tip heights will exceed 110m AGL, formal notification to CASA and the DoD is required in accordance with:

- CASA Advisory Circular AC 139-08(0) “Reporting of Tall Structures” to enable inclusion of the wind farm location and height of turbines in relevant aeronautical information publications; and
- CASA Form 406 – “Operational Assessment of Existing and Proposed Structures”.

This aeronautical impact assessment and review of obstacle marking and lighting requirements supports this formal notification requirement.

CASA are considering their requirement to light wind farms that are remote from aerodromes that are provided with instrument approach procedures.

L&B cannot predict whether CASA will require obstacle lighting to be provided on the Ceres Wind Farm. Appendix C provides some information related to obstacle lighting.

Formal notification of the intention to extend the Ceres wind farm should be provided to local aviation parties and relevant aviation stakeholders.

6 Conclusion

The proposed Ceres Wind Farm development on the Yorke Peninsula to the west of Adelaide, to a maximum height of 382.9/1256 ft AHD:

- will infringe the Grid LSALT in that area;
- will exist within the boundary of R231 between Port Julia and Port Vincent;
- will not infringe any OLS;
- will not infringe the PANS OPS surfaces of any airport;
- will not impact on contingency procedures;
- is located outside the clearance zones associated with all ATC surveillance systems;
- will not infringe the LSALT protection surfaces for any air routes;
- is outside the clearance zones associated with all aeronautical navigation aids;
- will not have a significant impact upon local flying activities; and
- will provide a significant visual navigation feature in the region.

Approval for construction of the Ceres Wind Farm from the Department of Defence will be required.

Notification of the details of the wind farm to CASA and the Department of Defence, for assessment of the need for obstacle lighting will be required.

Notification to Airservices Australia for assessment of the infringement to the Grid LSALT and for inclusion on aeronautical charts will be required.

Appendix A

Site Coordinates and Terrain Elevations

WTG Number	Easting	Northing	OLD_OID	Lat	Long	Ground Elevation (m)	WTG Tip AGL (m)	TIP AHD (m)
T001	746367	6167155	10	-34.608	137.687	115.098	220	335.098
T002	746378	6167740	11	-34.603	137.687	106.349	220	326.349
T003	747194	6166591	12	-34.613	137.696	119.1922	220	339.192
T004	746949	6167140	13	-34.608	137.693	109.7202	220	329.72
T005	747546	6167209	45	-34.607	137.7	113.8121	220	333.812
T006	746961	6167723	14	-34.603	137.693	111.2369	220	331.237
T007	747561	6167808	46	-34.602	137.7	105.2756	220	325.276
T008	747577	6168408	49	-34.596	137.7	106.9696	220	326.97
T009	747592	6169008	50	-34.591	137.7	101.3727	220	321.373
T011	748326	6162511	137	-34.649	137.709	148.1773	220	368.177
T012	748469	6163149	138	-34.643	137.711	149.5345	220	369.535
T013	748078	6166422	183	-34.614	137.706	123.9635	220	343.963
T014	748678	6166407	184	-34.614	137.712	128.826	220	348.826
T015	748276	6167247	47	-34.607	137.708	122.4593	220	342.459
T016	748870	6167159	179	-34.607	137.714	115.3858	220	335.386
T017	748386	6167837	48	-34.601	137.709	116.2867	220	336.287
T018	748190	6168404	51	-34.596	137.706	109.9499	220	329.95
T019	748979	6167748	180	-34.602	137.715	113.9197	220	333.92
T020	748988	6168371	125	-34.596	137.715	117.9048	220	337.905
T021	748514	6169125	52	-34.59	137.71	108.505	220	328.505
T022	748159	6169600	53	-34.585	137.706	108.3486	220	328.349
T023	748913	6162386	139	-34.65	137.716	136.8243	220	356.824
T026	749773	6163256	70	-34.642	137.725	159.5127	220	379.513
T028	750099	6165349	26	-34.623	137.728	148.846	220	368.846
T030	749220	6166671	181	-34.612	137.718	130.1444	220	350.144
T031	749579	6167772	182	-34.602	137.722	126.0205	220	346.021
T032	749504	6168679	126	-34.593	137.72	112.0274	220	332.027
T035	749615	6163922	153	-34.636	137.723	158.0854	220	378.085
T036	750185	6163741	18	-34.638	137.729	162.8687	220	382.869
T038	750631	6164901	27	-34.627	137.734	149.1598	220	369.16
T039	750648	6165563	28	-34.621	137.734	143.396	220	363.396
T040	750114	6165949	29	-34.618	137.728	138.5769	220	358.577
T041	750021	6166547	30	-34.612	137.727	130.1794	220	350.179
T042	750609	6166571	31	-34.612	137.733	136.9776	220	356.978
T043	749564	6167172	32	-34.607	137.722	122.4815	220	342.482
T044	750099	6167473	33	-34.604	137.727	127.5735	220	347.573
T045	750624	6167171	34	-34.607	137.733	124.2257	220	344.226
T046	749867	6168253	5	-34.597	137.725	121.6955	220	341.696

T047	750639	6167771	35	-34.601	137.733	119.1818	220	339.182
T048	750654	6168371	6	-34.596	137.733	117.6418	220	337.642
T049	750673	6169109	7	-34.589	137.733	110.1125	220	330.112
T050	751673	6161120	159	-34.661	137.746	140.7836	220	360.784
T052	751716	6163102	55	-34.643	137.746	148.6151	220	368.615
T053	750861	6163720	19	-34.638	137.737	160.0554	220	380.055
T054	751466	6163731	56	-34.638	137.743	153.5978	220	373.598
T055	751199	6166118	144	-34.616	137.74	139.5984	220	359.598
T056	751668	6166505	66	-34.612	137.745	126.6396	220	346.64
T057	751703	6167099	67	-34.607	137.745	137.6673	220	357.667
T058	751722	6167755	68	-34.601	137.745	133.0585	220	353.058
T059	751260	6168164	154	-34.598	137.74	119.8393	220	339.839
T060	751729	6168565	155	-34.594	137.745	119.1516	220	339.152
T061	751895	6161766	140	-34.655	137.749	147.649	220	367.649
T062	752309	6161193	160	-34.66	137.753	137.8364	220	357.836
T063	752489	6161765	141	-34.655	137.755	133.465	220	353.465
T064	752221	6162755	78	-34.646	137.752	131.7913	220	351.791
T065	752495	6163310	79	-34.641	137.755	148.1995	220	368.2
T066	752055	6163712	80	-34.638	137.75	150.7294	220	370.729
T067	752438	6165504	133	-34.621	137.753	148.9341	220	368.934
T068	752268	6164856	134	-34.627	137.752	149.2631	220	369.263
T069	752371	6166312	135	-34.614	137.752	137.445	220	357.445
T070	752638	6169665	69	-34.584	137.754	104.6262	220	324.626
T071	752453	6173321	100	-34.551	137.751	110.4652	220	330.465
T072	753105	6161702	142	-34.655	137.762	113.5459	220	333.546
T073	753078	6162368	143	-34.649	137.761	124.9966	220	344.997
T077	753599	6170754	91	-34.574	137.764	102.8884	220	322.888
T078	753630	6171401	92	-34.568	137.765	113.9609	220	333.961
T079	753029	6172707	101	-34.556	137.758	112.8154	220	332.815
T080	753642	6172021	86	-34.562	137.765	115.4584	220	335.458
T081	753657	6172621	122	-34.557	137.765	116.814	220	336.814
T082	753052	6173306	102	-34.551	137.758	114.8008	220	334.801
T083	753670	6173201	123	-34.552	137.765	119.8935	220	339.894
T084	753709	6173780	127	-34.546	137.765	117.7557	220	337.756
T085	753725	6174380	128	-34.541	137.765	117.32	220	337.32
T088	754231	6165194	163	-34.624	137.773	106.7534	220	326.753
T089	754192	6170309	16	-34.578	137.771	108.7005	220	328.701
T090	754776	6170173	17	-34.579	137.777	97.36164	220	317.362
T091	754165	6171150	93	-34.57	137.771	124.1797	220	344.18
T092	754612	6170750	94	-34.574	137.776	116.9236	220	336.924
T093	754636	6171526	87	-34.567	137.776	121.3483	220	341.348
T094	754270	6171996	88	-34.562	137.771	126.5978	220	346.598
T095	754251	6172597	124	-34.557	137.771	123.5577	220	343.558
T096	754353	6174362	129	-34.541	137.772	122.6772	220	342.677
T098	755233	6170795	95	-34.573	137.782	93.4978	220	313.498
T099	755236	6171504	89	-34.567	137.782	110.4751	220	330.475

T100	755239	6172137	90	-34.561	137.782	112.0172	220	332.017
T101	755482	6172686	1	-34.556	137.784	99.59631	220	319.596
T102	755698	6173244	2	-34.551	137.787	94.0223	220	314.022
T103	754953	6174347	130	-34.541	137.778	114.6849	220	334.685
T104	756047	6152388	41	-34.739	137.797	66.63959	220	286.64
T105	756421	6151905	42	-34.743	137.801	65.96162	220	285.962
T106	756064	6152988	131	-34.733	137.797	71.62459	220	291.625
T107	756078	6153588	132	-34.728	137.797	70.8128	220	290.813
T109	755899	6164767	54	-34.627	137.791	84.93462	220	304.935
T110	756798	6165073	58	-34.624	137.801	88.66889	220	308.669
T111	756092	6172670	3	-34.556	137.791	86.50436	220	306.504
T112	756298	6173228	4	-34.551	137.793	81.17	220	301.17
T113	756697	6172749	60	-34.555	137.798	79.2353	220	299.235
T114	755515	6173965	38	-34.544	137.784	102.2331	220	322.233
T115	755982	6174340	39	-34.541	137.789	95.7079	220	315.708
T116	757665	6152693	157	-34.735	137.814	54.25237	220	274.252
T118	757545	6162304	36	-34.649	137.81	83.10338	220	303.103
T121	757711	6162860	75	-34.644	137.812	94.76651	220	314.767
T122	757274	6164731	96	-34.627	137.806	90.0732	220	310.073
T123	757417	6164135	8	-34.632	137.808	94.96505	220	314.965
T124	757171	6165606	97	-34.619	137.805	83.68778	220	303.688
T125	757178	6172392	61	-34.558	137.803	79.69717	220	299.697
T126	757710	6172047	62	-34.561	137.809	79.4939	220	299.494
T127	757227	6173010	40	-34.553	137.803	81.41454	220	301.415
T128	757998	6173434	64	-34.548	137.812	83.37356	220	303.374
T130	757980	6152175	85	-34.74	137.818	57.90778	220	277.908
T131	758415	6152738	59	-34.735	137.822	55.65855	220	275.659
T132	758564	6151991	103	-34.741	137.824	48.19011	220	268.19
T136	758285	6158185	175	-34.686	137.819	55.59318	220	275.593
T137	758126	6160273	81	-34.667	137.817	62.87047	220	282.87
T138	758611	6160691	72	-34.663	137.822	61.43511	220	281.435
T139	758656	6160098	82	-34.668	137.823	59.98615	220	279.986
T140	758076	6160856	73	-34.662	137.816	70.44171	220	290.442
T141	758016	6163341	112	-34.639	137.815	99.38857	220	319.389
T142	758377	6162845	76	-34.644	137.819	82.72371	220	302.724
T143	758615	6163325	113	-34.639	137.821	91.38744	220	311.387
T144	757847	6164528	114	-34.629	137.813	90.24646	220	310.246
T145	758034	6163964	115	-34.634	137.815	97.64101	220	317.641
T146	758446	6164513	116	-34.629	137.819	85.48093	220	305.481
T147	758634	6163948	117	-34.634	137.821	91.55542	220	311.555
T148	757623	6165190	98	-34.623	137.81	80.77701	220	300.777
T149	758332	6165579	99	-34.619	137.818	72.26461	220	292.265
T150	757725	6172652	63	-34.556	137.809	79.63938	220	299.639
T151	758586	6173552	65	-34.547	137.818	80.60201	220	300.602
T152	758995	6151360	104	-34.747	137.829	37.56185	220	257.562
T153	758996	6152508	105	-34.737	137.829	45.71368	220	265.714

T154	759149	6151937	106	-34.742	137.831	38.85388	220	258.854
T155	759596	6152492	57	-34.737	137.835	39.18024	220	259.18
T157	760150	6157221	145	-34.694	137.84	51.20831	220	271.208
T158	759673	6156828	146	-34.698	137.835	54.31769	220	274.318
T160	758813	6158372	176	-34.684	137.825	54.63438	220	274.634
T165	759204	6160244	84	-34.667	137.829	55.51596	220	275.516
T166	759144	6160869	74	-34.661	137.828	58.41648	220	278.416
T167	758964	6162742	77	-34.645	137.825	71.51221	220	291.512
T168	759203	6163313	118	-34.639	137.828	71.1268	220	291.127
T169	759569	6162736	171	-34.644	137.832	58.96729	220	278.967
T170	759046	6164497	119	-34.629	137.826	76.70899	220	296.709
T171	759222	6163934	120	-34.634	137.828	76.02321	220	296.023
T172	759658	6164496	20	-34.629	137.832	68.55202	220	288.552
T174	760720	6152328	110	-34.738	137.848	36.36361	220	256.364
T175	760377	6156655	147	-34.699	137.843	49.30004	220	269.3
T176	760645	6155797	151	-34.707	137.846	47.74687	220	267.747
T179	752862	6165929	166	-34.617	137.758	132.7689	220	352.769
T180	759797	6160378	107	-34.666	137.835	51.14295	220	271.143
T181	760335	6160213	167	-34.667	137.841	50.18571	220	270.186
T182	760819	6160637	108	-34.663	137.846	43.16078	220	263.161
T183	759807	6163322	21	-34.639	137.834	60.65529	220	280.655
T184	760161	6162720	172	-34.644	137.838	51.10592	220	271.106
T185	760634	6163320	22	-34.639	137.843	46.18266	220	266.183
T186	760780	6162704	173	-34.644	137.845	41.02573	220	261.026
T187	759858	6163923	23	-34.634	137.835	62.77629	220	282.776
T188	760379	6164480	24	-34.629	137.84	59.26031	220	279.26
T189	760503	6163906	25	-34.634	137.842	54.37072	220	274.371
T190	761194	6151783	111	-34.743	137.853	33.83771	220	253.838
T191	761567	6152524	136	-34.736	137.857	32.72939	220	252.729
T192	761025	6152853	170	-34.733	137.851	35.03852	220	255.039
T194	761582	6153116	43	-34.731	137.857	32.84923	220	252.849
T195	761597	6153709	44	-34.725	137.857	32.56915	220	252.569
T197	761758	6154305	9	-34.72	137.858	37.55965	220	257.56
T199	761351	6155249	164	-34.711	137.854	43.07149	220	263.071
T200	760855	6156358	152	-34.702	137.848	47.81118	220	267.811
T201	760911	6157069	149	-34.695	137.848	48.16129	220	268.161
T202	761483	6157023	121	-34.695	137.855	44.87373	220	264.874
T203	759526	6157362	150	-34.693	137.833	53.52426	220	273.524
T205	761686	6158184	156	-34.685	137.856	43.15673	220	263.157
T209	761437	6160520	187	-34.664	137.853	37.81368	220	257.814
T210	760767	6161297	109	-34.657	137.845	48.00662	220	268.007
T211	761255	6161629	161	-34.654	137.851	42.50541	220	262.505
T212	761471	6161093	37	-34.659	137.853	38.98304	220	258.983
T213	760907	6162126	174	-34.65	137.847	40.32831	220	260.328
T214	761346	6162945	162	-34.642	137.851	44.56679	220	264.567
T217	761262	6155797	165	-34.707	137.853	45.13886	220	265.139

T219	761885	6157610	158	-34.69	137.859	42.29916	220	262.299
T225	746356	6166555	15	-34.613	137.687	111.6975	220	331.698
T226	751392	6160582	71	-34.666	137.743	126.6024	220	346.602
T227	751161	6166833	185	-34.61	137.739	121.6354	220	341.635
T228	751237	6167476	186	-34.604	137.74	127.2164	220	347.216

WTG Coordinates and Terrain Elevations
Source: CWP Renewables

Note:

– T036 is the highest WTG in the wind farm. WTGs marked in green also infringe the Grid LSALT protection surface as discussed in para 2.3;

– WTGs marked in blue and referred to in para 2.4 are within R231.

Appendix B

Assessment Methodology

In preparing aeronautical impact assessments associated with airport safeguarding and protection, it is necessary to observe the requirements of the relevant aviation authorities including:

- The Department of Infrastructure, Regional Development and Cities (DIRDC);
- The Civil Aviation Safety Authority of Australia (CASA);
- Airservices Australia (ASA);
- Airport Operators; and
- Department of Defence where appropriate.

Relevant Acts and Regulations applicable to developments near airports and air traffic routes were referenced during this assessment.

The major relevant documents include:

- The Airports Act 1996, Airports (Protection of Airspace) Regulations 1996;
- Civil Aviation Safety Regulation (CASR) Part 139 Manual of Standards – Aerodromes;
- Aeronautical Information Publication (AIP);
- Airservices Australia's Airways Engineering Instruction – Navigation Aid Building Restricted Areas and Siting Guidance (BRA);
- International Civil Aviation Organisation (ICAO) DOC 8168 Procedures for Air Navigation – Aircraft Operations (PANS OPS).

A Glossary of Aeronautical Terms and Abbreviations is shown at Appendix C.

Appendix C

Discussion Regarding Obstacle Lighting

The aeronautical requirements for marking and lighting of wind farms are currently undergoing review by the International Civil Aviation Organization (ICAO), the Department of Infrastructure, Regional Development and Cities (DIRDC) and CASA.

It is understood that ICAO will be issuing an amendment to ICAO Annex 14 (Aerodromes) later this year that addresses, inter alia, wind farms.

DIRDC recently issued a Discussion Paper “Safeguards for airports and the communities around them” that implies an amendment to the criteria for wind turbine heights from 110m to 152m AGL as being applicable to wind farms in the vicinity of aerodromes. In addition, CASA is currently reviewing its withdrawn Advisory Circular AC139-181 “Obstacle Marking and Lighting of Wind Farms”. The outcomes of these various reviews may result in:

- Revised criteria for wind farms; and
- Wind farms such as Ceres Wind Farm not requiring obstacle lighting, depending on the findings of a qualitative risk assessment to be undertaken by the proponent.

While the DIRDC Discussion Paper applies specifically to wind farms within the vicinity (generally accepted as 30km) of aerodromes, CASA is also currently reviewing the requirements for marking and lighting of obstacles and hazards remote from aerodromes. CASA has informally advised the wind farm industry that a qualitative risk assessment approach to the potential hazards, as presented by wind farms, may be considered.

CASA’s current position on obstacle lighting of wind farms that are remote from an aerodrome (which is the situation for Ceres Wind Farm) is summarised as:

- CASA cannot mandate obstacle lighting for wind farms that are not within the vicinity of an aerodrome;
- provision of obstacle lighting is the responsibility of the proponent;
- any associated requirements placed on proponents by planning authorities, insurers or financiers are beyond CASA’s scope;
- a wind farm proponent may have a duty of care to the aviation industry and local operators in terms of ensuring obstacles are made conspicuous; and
- obstacle marking and lighting requirements as specified in the CASA Manual of Standards Part 139, Chapters 8 and 9 applies.

CASA Manual of Standards (MOS) 139, Chapter 9, Section 9.4 indicates that for structures more than 110m AGL, the proponent should expect that obstacle lighting will be required unless there are unusual circumstances. The turbines to be installed at the Ceres Wind Farm will have a maximum height of 220m AGL. However, there have been situations where CASA has acknowledged non-provision of obstacle lighting of wind farms in Australia where the turbine height exceeds 110m AGL. Such installations have been the subject of a hazard risk assessment that takes into account such factors as location of the wind farm with respect to nearby airfields and air routes, potential impact on navigable airspace, surrounding terrain, local aviation activity in the area, and environmental considerations. The wind farms concerned are Capital Wind Farm and Gunning Wind Farm, both of which are sited in mountainous area to the north of Goulburn in NSW, are remote from regulated airports, and were assessed as not presenting a hazard to aircraft operations.

As indicated above, Australian policy, standards and recommended practices for obstacle marking and lighting of wind farms are currently under review. A current proposal includes a change to the criterion height of 110m (361ft) to 152m (500ft) AGL for wind farms within the vicinity of a certified or registered aerodrome.

Appendix D

Glossary of Aeronautical Terms and Abbreviations

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.

Advisory Circulars (AC) 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 Information Publication (AIP) 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 within the applicable country. AIP Australia is produced by Airservices Australia under contract to CASA.

Aeronautical study is a tool used to review aerodrome and airspace processes and procedures to ensure that safety criteria are appropriate.

Air routes exist between navigation aids or waypoints to facilitate the regular and safe flow of aircraft operating under the IFR.

Airservices Australia (ASA) is the Australian government-owned corporation Air Navigation Service Provider (ANSP) providing safe, secure, efficient and environmentally sound air traffic management and related airside services including telecommunications, aeronautical data, navigation services and aviation rescue and firefighting services to the aviation industry within the Australian flight information region.

Air Traffic Control (ATC) service is a service provided in controlled airspace for the purpose of preventing collisions between aircraft and between aircraft and obstructions on the manoeuvring area of controlled aerodromes whilst maintaining an expeditious and orderly flow of air traffic.

Altitude is the vertical distance of a level, a point or an object, considered as a point, measured from mean sea level.

Area navigation (RNAV) A method of navigation which permits aircraft operation on any desired flight path within the coverage of the station-referenced navigation aids or within the limits of the capability of self-contained aids, or a combination of these.

Circling approach An extension of an instrument approach procedure which provides for visual circling of the aerodrome prior to landing.

Civil Aviation Safety Authority (CASA) 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.

Civil Aviation Safety Regulations (CASR) 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.

Decision altitude (DA) or decision height (DH) A specified altitude or height in a 3D instrument approach operation at which a missed approach must be initiated if the required visual reference to continue the approach has not been established. *Note— Decision altitude (DA) is referenced to mean sea level and decision height (DH) is referenced to the threshold elevation.*

Elevation The vertical distance of a point or a level, on or affixed to the surface of the earth, measured from mean sea level.

Height The vertical distance of a level, a point or an object considered as a point, measured from a specified datum.

Instrument Flight Rules (IFR) 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 available due to cloud cover or restricted visibility. IFR flight depends upon a qualified instrument rated pilot flying by reference to instruments located in the flight deck. 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. IFR flights can and do regularly operate in VMC but remain an IFR flight for rule and ATC requirements. Regular Public Transport flights are required to file an IFR flight plan, irrespective of the weather conditions.

Instrument Meteorological Conditions (IMC) are meteorological conditions that are less than the minimum specified for visual meteorological conditions.

International Civil Aviation Organization (ICAO) 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.*

Lowest Safe Altitude (LSALT) 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.

Manual of Standards (MOS) comprises specifications (Standards) prescribed by CASA, of uniform application, determined to be necessary for the safety of air navigation in relation to a particular segment of the aviation regulations. For example, MOS 139 relates to CASR Part 139 – Aerodromes.

Minimum descent altitude (MDA) or minimum descent height (MDH) A specified altitude or height in a 2D instrument approach operation or circling approach operation below which descent must not be made without the required visual reference. Note: Minimum descent altitude (MDA) is referenced to mean sea level and minimum descent height (MDH) is referenced to the aerodrome elevation or to the threshold elevation if that is more than 2 m (7 ft) below the aerodrome elevation. A minimum descent height for a circling approach is referenced to the aerodrome elevation.

Minimum Obstacle Clearance (MOC) is the minimum distance above an obstacle or terrain that aircraft conducting instrument approach or departure procedures are not allowed to fly below in IMC. The MOC varies depending on the distance from the runway or in mountainous areas.

Notices to Airmen (NOTAMs) 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.

Obstacle assessment surface (OAS) is a defined surface intended for the purpose of determining those obstacles to be considered in the calculation of obstacle clearance altitude/height for a specific APV or precision approach procedure.

Obstacle Limitation Surfaces (OLS) 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.

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.

Procedures for Air Navigation Services - Aircraft Operations (PANS-OPS) is an ICAO 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) using the 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, below the nominal flight path of the aircraft, which guarantee a certain minimum obstacle clearance above the ground or man-made obstacles. 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 in IMC an obstacle free descent or climb path for a given approach, holding procedure or departure.

Regulations (Civil Aviation Safety Regulations)

Threshold (THR). The beginning of that portion of the runway usable for landing.

Visual Flight Rules (VFR) are rules applicable to the conduct of flights that are only permitted in VMC due to aircraft equipment and pilot qualifications. The visual flight rules allow a pilot to operate an aircraft in weather conditions that allow the pilot to navigate by visual reference to the ground or water by maintaining visual contact with the terrain and obstacle environment in order to be able to see and avoid other aircraft, terrain, obstacles or other hazards. Specifically, the weather must be equal to or better than basic VFR weather minima. If the weather is worse than VFR minima, IFR qualified pilots operating an IFR qualified aircraft are able to operate under the IFR.

Visual Meteorological Conditions (VMC) are meteorological conditions expressed in terms of visibility, distance from cloud and ceiling, equal or better than specified minima.

Visual Segment Surface (VSS) A PANS-OPS design segment of a straight-in instrument approach procedure, which needs to be monitored and kept clear of any penetrations by obstacles.

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 CAR 1998)
ACFT	Aircraft
AD	Aerodrome
ADS-B	Automatic Dependent Surveillance - Broadcast
AHD	Australian Height Datum
AIP	Aeronautical Information Publication
Airports Act	Airports Act 1996, as amended
AIS	Aeronautical Information Service
ALT	Altitude
AMSL	Above Mean Sea Level
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
BARO-VNAV	Barometric Vertical Navigation
BRA	Building Restricted Area
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
DME	Distance Measuring Equipment
Doc nn	ICAO Document Number nn
DIT	Department of Infrastructure and Transport. (Formerly Dept. of Infrastructure, Transport, Regional Development and Local Government and Department of Transport and Regional Services (DoTARS))
DOTARS	See DIT above
ELEV	Elevation (above mean sea level)
ENE	East North East
ERSA	Enroute Supplement Australia
FAF	Final Approach Fix

Abbreviation	Meaning
FAP	Final Approach Point
FAS	Final Approach Surface of a BARO-VNAV approach
ft	feet
GBAS	Ground Based Augmentation System (satellite precision landing system)
GNSS	Global Navigation Satellite System
GP	Glide Path
IAS	Indicated Airspeed
ICAO	International Civil Aviation Organization
IHS	Inner Horizontal Surface, an Obstacle Limitation Surface
ILS	Instrument Landing System
ISA	International Standard Atmosphere
km	kilometres
kt	Knot (one nautical mile per hour)
LAT	Latitude
LLZ	Localizer
LONG	Longitude
LNAV	Lateral Navigation criteria
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
MVA	Minimum Vector Altitude
NASAG	National Airports Safeguarding Advisory Group
NDB	Non Directional Beacon
NE	North East
NM	Nautical Mile (= 1.852 km)
nnDME	Distance from the DME (in nautical miles)
NNE	North 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
PBN	Performance Based Navigation
PRM	Precision Runway Monitor
QNH	An altimeter setting relative to height above mean sea level
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
RTCC	Radar Terrain Clearance Chart
RWY	Runway
SFC	Surface
SID	Standard Instrument Departure
SOC	Start Of Climb
STAR	STandard ARrival
SGHAT	Solar Glare Hazard Analysis Tool
TAR	Terminal Approach Radar
TAS	True Air Speed
THR	Threshold (Runway)
TNA	Turn Altitude
TODA	Take-Off Distance Available
VNAV	Vertical Navigation criteria
V_n	aircraft critical Velocity reference
VOR	Very high frequency Omni directional Range
WAC	World Aeronautical Chart

Thursday, 10 January 2019

Yorke Peninsula Wind Farm Project Pty. Ltd.
Level 29, 80 Collins Street
Melbourne, Victoria
3000, Australia

To:
Client Services Officer
Attention: Kellie Hofmeyer
Development Applications Science and Assessment Division Environment Protection Authority
GPO Box 2607
ADELAIDE SA 5001
DX 228
epa.planning@sa.gov.au

Cc:
Simon Neldner
Team Leader - Development Assessment
State Commission Assessment Panel L5
50 FLINDERS Street
ADELAIDE SA 5000
simon.neldner@sa.gov.au

Dear Kellie,

RE: Development Application Information Request (544/V001/13 V2)

Thank you for your letter dated 12 December 2018, requesting further information regarding our Development Variation Application (544/V001/13 V2). Responses to each request in your letter are provided below and in related attachments.

EPA Request 1

"*Provide the documents referenced in Table 2 of the acoustic report (Marshall Day, RP 001 R01 20180604).*"

Response

Please find the document attached in the accompanying folder labelled 'Request 1. Provide the documents referenced in Table 2 of RP 001 R01 20180604'.

EPA Request 2

"*Provide an updated acoustic report with the extra 11 turbines removed. This should include an updated model with the final location of the proposed 170 turbine locations.*"

Response

The proposed variation seeks approval for up to 170 turbines. The final number of turbines that may be constructed will not exceed this number and may even be fewer than 170 turbines, based on the generator capacity of the selected wind turbine model and the approx. 600MW constraint imposed by the HVDC transmission system. The proposal plans and the acoustic report illustrate up to 181 turbine positions, as the final 170 (or fewer) sites have not been determined at this stage in the design process.

On this basis, the acoustic report represents a "beyond worst case scenario" for all nearby receivers.

Like the approved application, and as required by Reserved Matters and Conditions, the final design and specification will comply with the South Australian Environment Protection Authority Wind Farms Noise Guidelines 2009.

EPA Request 3

"*Further clarification of the noise impact at receiver number 341 as it was not included in the tables within Appendix E. There is a potential that the noise contribution by the wind farm does not meet the criterion at this location. Alternatively, if the 40dB(A) baseline at this location is not achieved, including this receiver as a stakeholder may be a possible solution.*"

Response

Receiver number 341 refers to a dwelling that was granted Development Plan Consent in July 2013. That dwelling has not been constructed and the Yorke Peninsula Council has advised that the Consent has lapsed. This was confirmed in July 2018. As the dwelling does not exist it was removed from the list of assessed receivers, and therefore also does not appear in the relevant tables.

An updated noise contour map, with receiver 341 removed, has also been provided by Marshall Day, and this can be found at Appendix 2 of the response to Request 4, below.

EPA Request 4

"*Update the tables within Appendix E to clearly compare the noise criterion required to be met at each sensitive receiver with the predicted noise levels*"

Response

Please find the updated tables attached in the accompanying folder labelled 'Request 4. Update the tables within Appendix E of RP 001 R01 20180604'.

I trust that the information provided in response to your request is adequate for the EPA to undertake its referral assessment of our application.

Please do not hesitate to contact me if you require any additional information or clarification.

Regards,

Adam Gray
Project Development Planner

Senvion Australia Pty Ltd
Level 29, 80 Collins Street
Melbourne, Victoria, 3000, Australia

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Telephone: +61 3 8660 6555
adam.gray@senvion.com

Attachments Enclosed:

1. *SD-3.52-WT.PC.01-B-EN-A Power Curve & Sound Power Level [4.2M140 EBC/50Hz/open mode] (preliminary)* – response to SA EPA request 1 of 4
2. *Lt 001 20180604 - Ceres Wind Farm Project - Response to SA EPA query* – response to SA EPA request 4 of 4

MARSHALL DAY Acoustics

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8 January 2019

Yorke Peninsula Wind Farm Project Pty Ltd
C/-
Senvion Australia Pty Ltd
Level 29
80 Collins Street
Melbourne VIC 3000Y

Attention: Mr Adam Gray

Dear Adam

CERES WIND FARM PROJECT: REPSONSE TO SA EPA QUERY

The following letter details predicted noise levels associated with the Ceres Wind Farm Project in response to item 4 in the South Australia Environment Protection Authority (SA EPA) letter, *EPA Reference: 34514*, dated 12 December 2018.

The predictions are based on the input information as described in the Marshall Day Acoustics report, *Ceres Wind Farm Project Revised Noise Assessment*, Rp 001 R01 20180604, dated 13 November 2018.

As requested in item 4 of the SA EPA letter, the predicted noise levels detailed in A1, are compared with the relevant base noise limits. The base noise limits have been determined in accordance with the SA EPA document, *Wind farms environmental noise guidelines*, published in July 2009 and the *Yorke Peninsula Council Development Plan,* consolidated on 31 October 2017.

An area-wide noise contour map presenting predicted noise levels at the wind speed corresponding to the highest sound power level (10 m/s at hub height) is also provided in A2.

We trust this information is satisfactory. If you have any further questions please do not hesitate to contact us.

Yours faithfully

MARSHALL DAY ACOUSTICS PTY LTD

Alex Morabito

Alex Morabito

Associate

Certified System ISO 9001

A1 PREDICTED WIND FARM NOISE LEVELS

Table 1: Predicted noise levels at assessed relevant receivers, dB L_{Aeq}

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
3	40	13.7	13.9	17.7	20.9	23.7	24.7	24.7	24.7	24.7	24.7
4	40	24.8	25.0	28.8	32.0	34.8	35.8	35.8	35.8	35.8	35.8
6	40	24.8	25.0	28.8	32.0	34.8	35.8	35.8	35.8	35.8	35.8
7	40	23.9	24.1	27.9	31.1	33.9	34.9	34.9	34.9	34.9	34.9
8	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
10	40	26.3	26.5	30.3	33.5	36.3	37.3	37.3	37.3	37.3	37.3
11	40	21.8	22.0	25.8	29.0	31.8	32.8	32.8	32.8	32.8	32.8
14	40	19.6	19.8	23.6	26.8	29.6	30.6	30.6	30.6	30.6	30.6
15	40	19.3	19.5	23.3	26.5	29.3	30.3	30.3	30.3	30.3	30.3
18	40	17.5	17.7	21.5	24.7	27.5	28.5	28.5	28.5	28.5	28.5
20	40	21.9	22.1	25.9	29.1	31.9	32.9	32.9	32.9	32.9	32.9
21	40	19.9	20.1	23.9	27.1	29.9	30.9	30.9	30.9	30.9	30.9
23	40	17.0	17.2	21.0	24.2	27.0	28.0	28.0	28.0	28.0	28.0
26	40	20.4	20.6	24.4	27.6	30.4	31.4	31.4	31.4	31.4	31.4
28	40	28.7	28.9	32.7	35.9	38.7	39.7	39.7	39.7	39.7	39.7
33	40	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
34	40	14.7	14.9	18.7	21.9	24.7	25.7	25.7	25.7	25.7	25.7
35	40	28.2	28.4	32.2	35.4	38.2	39.2	39.2	39.2	39.2	39.2
37	40	25.1	25.3	29.1	32.3	35.1	36.1	36.1	36.1	36.1	36.1
41	40	17.0	17.2	21.0	24.2	27.0	28.0	28.0	28.0	28.0	28.0
42	40	20.7	20.9	24.7	27.9	30.7	31.7	31.7	31.7	31.7	31.7
44	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
45	40	14.2	14.4	18.2	21.4	24.2	25.2	25.2	25.2	25.2	25.2
46	40	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
47	40	16.9	17.1	20.9	24.1	26.9	27.9	27.9	27.9	27.9	27.9
50	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
56	40	25.0	25.2	29.0	32.2	35.0	36.0	36.0	36.0	36.0	36.0
57	40	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
59	40	21.9	22.1	25.9	29.1	31.9	32.9	32.9	32.9	32.9	32.9
62	40	12.7	12.9	16.7	19.9	22.7	23.7	23.7	23.7	23.7	23.7
63	40	26.8	27.0	30.8	34.0	36.8	37.8	37.8	37.8	37.8	37.8
64	40	18.4	18.6	22.4	25.6	28.4	29.4	29.4	29.4	29.4	29.4

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
67	40	18.3	18.5	22.3	25.5	28.3	29.3	29.3	29.3	29.3	29.3
68	40	21.3	21.5	25.3	28.5	31.3	32.3	32.3	32.3	32.3	32.3
83	40	15.5	15.7	19.5	22.7	25.5	26.5	26.5	26.5	26.5	26.5
85	40	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
88	40	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
90	40	17.4	17.6	21.4	24.6	27.4	28.4	28.4	28.4	28.4	28.4
91	40	13.4	13.6	17.4	20.6	23.4	24.4	24.4	24.4	24.4	24.4
95	40	18.2	18.4	22.2	25.4	28.2	29.2	29.2	29.2	29.2	29.2
96	40	16.7	16.9	20.7	23.9	26.7	27.7	27.7	27.7	27.7	27.7
97	40	28.0	28.2	32.0	35.2	38.0	39.0	39.0	39.0	39.0	39.0
98	40	23.9	24.1	27.9	31.1	33.9	34.9	34.9	34.9	34.9	34.9
102	40	18.8	19.0	22.8	26.0	28.8	29.8	29.8	29.8	29.8	29.8
103	40	19.7	19.9	23.7	26.9	29.7	30.7	30.7	30.7	30.7	30.7
105	40	26.8	27.0	30.8	34.0	36.8	37.8	37.8	37.8	37.8	37.8
106	40	19.7	19.9	23.7	26.9	29.7	30.7	30.7	30.7	30.7	30.7
107	40	20.5	20.7	24.5	27.7	30.5	31.5	31.5	31.5	31.5	31.5
108	40	16.7	16.9	20.7	23.9	26.7	27.7	27.7	27.7	27.7	27.7
109	40	17.7	17.9	21.7	24.9	27.7	28.7	28.7	28.7	28.7	28.7
110	40	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
111	40	16.9	17.1	20.9	24.1	26.9	27.9	27.9	27.9	27.9	27.9
113	40	22.0	22.2	26.0	29.2	32.0	33.0	33.0	33.0	33.0	33.0
114	40	24.2	24.4	28.2	31.4	34.2	35.2	35.2	35.2	35.2	35.2
116	40	18.8	19.0	22.8	26.0	28.8	29.8	29.8	29.8	29.8	29.8
119	40	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
122	40	16.1	16.3	20.1	23.3	26.1	27.1	27.1	27.1	27.1	27.1
125	40	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
127	40	18.3	18.5	22.3	25.5	28.3	29.3	29.3	29.3	29.3	29.3
129	40	27.3	27.5	31.3	34.5	37.3	38.3	38.3	38.3	38.3	38.3
130	40	20.5	20.7	24.5	27.7	30.5	31.5	31.5	31.5	31.5	31.5
131	40	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
133	40	17.4	17.6	21.4	24.6	27.4	28.4	28.4	28.4	28.4	28.4
135	40	21.8	22.0	25.8	29.0	31.8	32.8	32.8	32.8	32.8	32.8
139	40	16.3	16.5	20.3	23.5	26.3	27.3	27.3	27.3	27.3	27.3
140	40	18.5	18.7	22.5	25.7	28.5	29.5	29.5	29.5	29.5	29.5

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
141	40	14.6	14.8	18.6	21.8	24.6	25.6	25.6	25.6	25.6	25.6
143	40	25.3	25.5	29.3	32.5	35.3	36.3	36.3	36.3	36.3	36.3
145	40	26.3	26.5	30.3	33.5	36.3	37.3	37.3	37.3	37.3	37.3
147	40	18.6	18.8	22.6	25.8	28.6	29.6	29.6	29.6	29.6	29.6
150	40	27.2	27.4	31.2	34.4	37.2	38.2	38.2	38.2	38.2	38.2
151	40	26.4	26.6	30.4	33.6	36.4	37.4	37.4	37.4	37.4	37.4
155	40	14.5	14.7	18.5	21.7	24.5	25.5	25.5	25.5	25.5	25.5
157	40	13.8	14.0	17.8	21.0	23.8	24.8	24.8	24.8	24.8	24.8
158	40	21.9	22.1	25.9	29.1	31.9	32.9	32.9	32.9	32.9	32.9
159	40	16.6	16.8	20.6	23.8	26.6	27.6	27.6	27.6	27.6	27.6
161	40	12.7	12.9	16.7	19.9	22.7	23.7	23.7	23.7	23.7	23.7
162	40	16.8	17.0	20.8	24.0	26.8	27.8	27.8	27.8	27.8	27.8
163	40	14.7	14.9	18.7	21.9	24.7	25.7	25.7	25.7	25.7	25.7
170	40	25.1	25.3	29.1	32.3	35.1	36.1	36.1	36.1	36.1	36.1
174	40	18.5	18.7	22.5	25.7	28.5	29.5	29.5	29.5	29.5	29.5
177	40	17.0	17.2	21.0	24.2	27.0	28.0	28.0	28.0	28.0	28.0
178	40	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
179	40	23.0	23.2	27.0	30.2	33.0	34.0	34.0	34.0	34.0	34.0
181	40	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
186	40	17.9	18.1	21.9	25.1	27.9	28.9	28.9	28.9	28.9	28.9
187	40	15.8	16.0	19.8	23.0	25.8	26.8	26.8	26.8	26.8	26.8
190	40	13.1	13.3	17.1	20.3	23.1	24.1	24.1	24.1	24.1	24.1
195	40	24.2	24.4	28.2	31.4	34.2	35.2	35.2	35.2	35.2	35.2
200	40	12.0	12.2	16.0	19.2	22.0	23.0	23.0	23.0	23.0	23.0
201	40	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
203	40	21.5	21.7	25.5	28.7	31.5	32.5	32.5	32.5	32.5	32.5
204	40	26.2	26.4	30.2	33.4	36.2	37.2	37.2	37.2	37.2	37.2
206	40	16.2	16.4	20.2	23.4	26.2	27.2	27.2	27.2	27.2	27.2
209	40	28.4	28.6	32.4	35.6	38.4	39.4	39.4	39.4	39.4	39.4
211	40	22.9	23.1	26.9	30.1	32.9	33.9	33.9	33.9	33.9	33.9
214	40	15.6	15.8	19.6	22.8	25.6	26.6	26.6	26.6	26.6	26.6
217	40	11.7	11.9	15.7	18.9	21.7	22.7	22.7	22.7	22.7	22.7
218	40	22.8	23.0	26.8	30.0	32.8	33.8	33.8	33.8	33.8	33.8
222	40	26.8	27.0	30.8	34.0	36.8	37.8	37.8	37.8	37.8	37.8

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
225	40	15.9	16.1	19.9	23.1	25.9	26.9	26.9	26.9	26.9	26.9
231	40	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
232	40	17.7	17.9	21.7	24.9	27.7	28.7	28.7	28.7	28.7	28.7
237	40	21.7	21.9	25.7	28.9	31.7	32.7	32.7	32.7	32.7	32.7
239	40	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
242	40	15.5	15.7	19.5	22.7	25.5	26.5	26.5	26.5	26.5	26.5
244	40	18.9	19.1	22.9	26.1	28.9	29.9	29.9	29.9	29.9	29.9
247	40	13.1	13.3	17.1	20.3	23.1	24.1	24.1	24.1	24.1	24.1
248	40	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
250	40	14.4	14.6	18.4	21.6	24.4	25.4	25.4	25.4	25.4	25.4
251	40	16.2	16.4	20.2	23.4	26.2	27.2	27.2	27.2	27.2	27.2
252	40	23.1	23.3	27.1	30.3	33.1	34.1	34.1	34.1	34.1	34.1
253	40	24.5	24.7	28.5	31.7	34.5	35.5	35.5	35.5	35.5	35.5
254	40	26.3	26.5	30.3	33.5	36.3	37.3	37.3	37.3	37.3	37.3
256	40	14.3	14.5	18.3	21.5	24.3	25.3	25.3	25.3	25.3	25.3
257	40	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
260	40	23.5	23.7	27.5	30.7	33.5	34.5	34.5	34.5	34.5	34.5
263	40	20.4	20.6	24.4	27.6	30.4	31.4	31.4	31.4	31.4	31.4
264	40	16.7	16.9	20.7	23.9	26.7	27.7	27.7	27.7	27.7	27.7
265	40	17.7	17.9	21.7	24.9	27.7	28.7	28.7	28.7	28.7	28.7
269	40	14.9	15.1	18.9	22.1	24.9	25.9	25.9	25.9	25.9	25.9
270	40	24.8	25.0	28.8	32.0	34.8	35.8	35.8	35.8	35.8	35.8
277	40	22.7	22.9	26.7	29.9	32.7	33.7	33.7	33.7	33.7	33.7
278	40	18.0	18.2	22.0	25.2	28.0	29.0	29.0	29.0	29.0	29.0
280	40	27.7	27.9	31.7	34.9	37.7	38.7	38.7	38.7	38.7	38.7
281	40	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
282	40	16.2	16.4	20.2	23.4	26.2	27.2	27.2	27.2	27.2	27.2
284	40	12.9	13.1	16.9	20.1	22.9	23.9	23.9	23.9	23.9	23.9
287	40	19.7	19.9	23.7	26.9	29.7	30.7	30.7	30.7	30.7	30.7
288	40	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
289	40	20.9	21.1	24.9	28.1	30.9	31.9	31.9	31.9	31.9	31.9
293	40	22.0	22.2	26.0	29.2	32.0	33.0	33.0	33.0	33.0	33.0
294	40	22.6	22.8	26.6	29.8	32.6	33.6	33.6	33.6	33.6	33.6
295	40	22.6	22.8	26.6	29.8	32.6	33.6	33.6	33.6	33.6	33.6

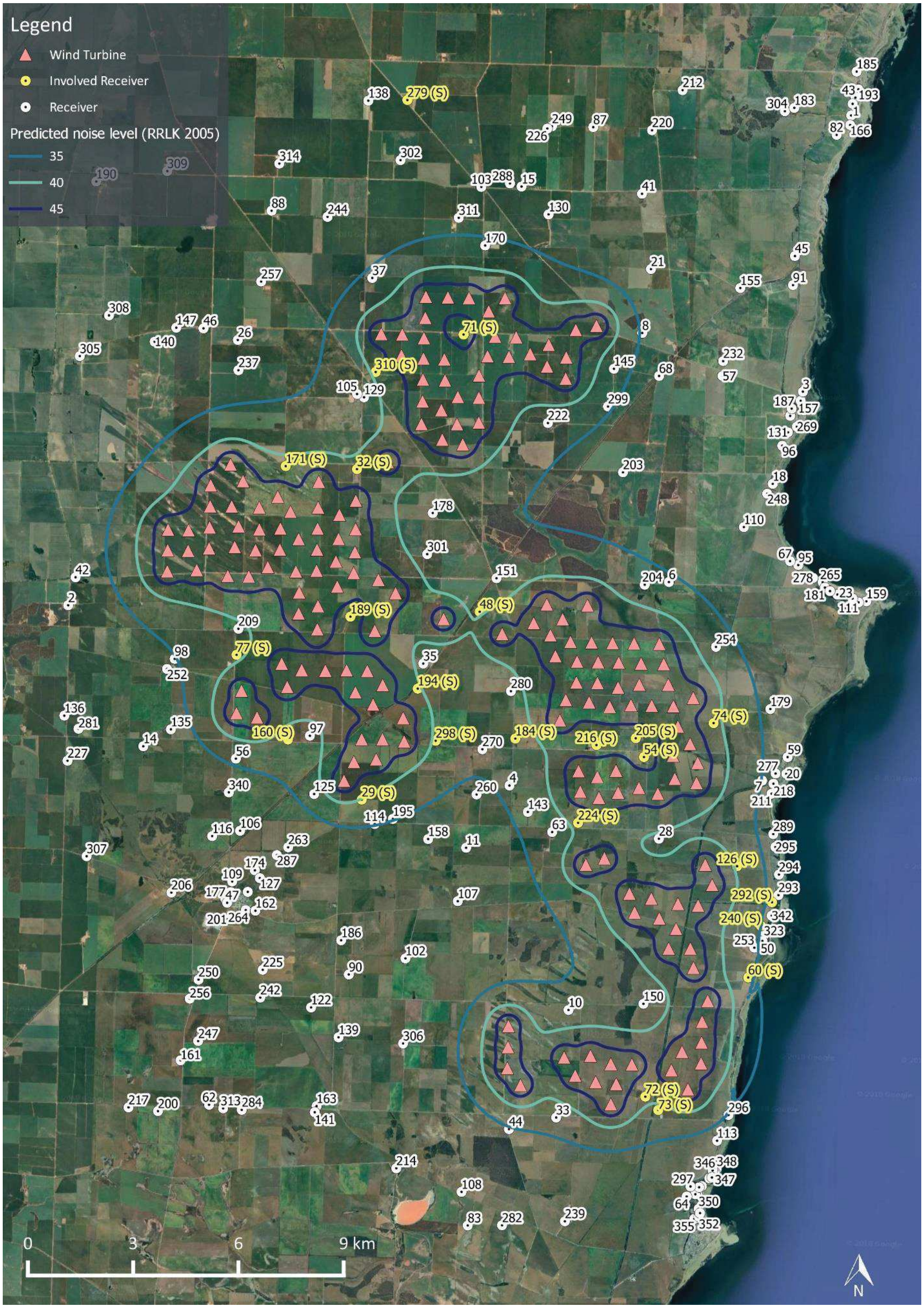
Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
296	40	23.2	23.4	27.2	30.4	33.2	34.2	34.2	34.2	34.2	34.2
297	40	19.0	19.2	23.0	26.2	29.0	30.0	30.0	30.0	30.0	30.0
299	40	24.5	24.7	28.5	31.7	34.5	35.5	35.5	35.5	35.5	35.5
301	40	27.3	27.5	31.3	34.5	37.3	38.3	38.3	38.3	38.3	38.3
302	40	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
305	40	16.9	17.1	20.9	24.1	26.9	27.9	27.9	27.9	27.9	27.9
306	40	18.6	18.8	22.6	25.8	28.6	29.6	29.6	29.6	29.6	29.6
307	40	15.3	15.5	19.3	22.5	25.3	26.3	26.3	26.3	26.3	26.3
308	40	16.5	16.7	20.5	23.7	26.5	27.5	27.5	27.5	27.5	27.5
309	40	14.2	14.4	18.2	21.4	24.2	25.2	25.2	25.2	25.2	25.2
311	40	22.2	22.4	26.2	29.4	32.2	33.2	33.2	33.2	33.2	33.2
313	40	12.8	13.0	16.8	20.0	22.8	23.8	23.8	23.8	23.8	23.8
314	40	16.0	16.2	20.0	23.2	26.0	27.0	27.0	27.0	27.0	27.0
317	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
318	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
319	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
320	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
321	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
322	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
323	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
324	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
325	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
326	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
327	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
328	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
329	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
330	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
331	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
332	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
333	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
334	40	23.4	23.6	27.4	30.6	33.4	34.4	34.4	34.4	34.4	34.4
335	40	23.4	23.6	27.4	30.6	33.4	34.4	34.4	34.4	34.4	34.4
336	40	23.3	23.5	27.3	30.5	33.3	34.3	34.3	34.3	34.3	34.3
338	40	23.5	23.7	27.5	30.7	33.5	34.5	34.5	34.5	34.5	34.5

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
339	40	23.4	23.6	27.4	30.6	33.4	34.4	34.4	34.4	34.4	34.4
340	40	21.4	21.6	25.4	28.6	31.4	32.4	32.4	32.4	32.4	32.4
342	40	23.0	23.2	27.0	30.2	33.0	34.0	34.0	34.0	34.0	34.0
343	40	17.9	18.1	21.9	25.1	27.9	28.9	28.9	28.9	28.9	28.9
344	40	17.1	17.3	21.1	24.3	27.1	28.1	28.1	28.1	28.1	28.1
345	40	17.1	17.3	21.1	24.3	27.1	28.1	28.1	28.1	28.1	28.1
346	40	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
347	40	17.4	17.6	21.4	24.6	27.4	28.4	28.4	28.4	28.4	28.4
348	40	17.5	17.7	21.5	24.7	27.5	28.5	28.5	28.5	28.5	28.5
349	40	16.6	16.8	20.6	23.8	26.6	27.6	27.6	27.6	27.6	27.6
350	40	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
351	40	16.8	17.0	20.8	24.0	26.8	27.8	27.8	27.8	27.8	27.8
352	40	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
353	40	18.4	18.6	22.4	25.6	28.4	29.4	29.4	29.4	29.4	29.4
354	40	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
355	40	16.1	16.3	20.1	23.3	26.1	27.1	27.1	27.1	27.1	27.1
356	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6

Table 2: Predicted noise levels at involved receiver locations, dB L_{Aeq}

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
29 (S)	45	28.8	29.0	32.8	36.0	38.8	39.8	39.8	39.8	39.8	39.8
32 (S)	45	30.3	30.5	34.3	37.5	40.3	41.3	41.3	41.3	41.3	41.3
48 (S)	45	28.6	28.8	32.6	35.8	38.6	39.6	39.6	39.6	39.6	39.6
54 (S)	45	32.6	32.8	36.6	39.8	42.6	43.6	43.6	43.6	43.6	43.6
60 (S)	45	25.5	25.7	29.5	32.7	35.5	36.5	36.5	36.5	36.5	36.5
71 (S)	45	33.0	33.2	37.0	40.2	43.0	44.0	44.0	44.0	44.0	44.0
72 (S)	45	30.2	30.4	34.2	37.4	40.2	41.2	41.2	41.2	41.2	41.2
73 (S)	45	28.1	28.3	32.1	35.3	38.1	39.1	39.1	39.1	39.1	39.1
74 (S)	45	30.5	30.7	34.5	37.7	40.5	41.5	41.5	41.5	41.5	41.5
77 (S)	45	28.3	28.5	32.3	35.5	38.3	39.3	39.3	39.3	39.3	39.3
126 (S)	45	28.2	28.4	32.2	35.4	38.2	39.2	39.2	39.2	39.2	39.2
160 (S)	45	27.5	27.7	31.5	34.7	37.5	38.5	38.5	38.5	38.5	38.5
171 (S)	45	30.6	30.8	34.6	37.8	40.6	41.6	41.6	41.6	41.6	41.6
184 (S)	45	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
189 (S)	45	32.8	33.0	36.8	40.0	42.8	43.8	43.8	43.8	43.8	43.8
194 (S)	45	29.5	29.7	33.5	36.7	39.5	40.5	40.5	40.5	40.5	40.5
205 (S)	45	32.2	32.4	36.2	39.4	42.2	43.2	43.2	43.2	43.2	43.2
216 (S)	45	32.1	32.3	36.1	39.3	42.1	43.1	43.1	43.1	43.1	43.1
224 (S)	45	30.0	30.2	34.0	37.2	40.0	41.0	41.0	41.0	41.0	41.0
240 (S)	45	24.0	24.2	28.0	31.2	34.0	35.0	35.0	35.0	35.0	35.0
292 (S)	45	22.9	23.1	26.9	30.1	32.9	33.9	33.9	33.9	33.9	33.9
298 (S)	45	28.2	28.4	32.2	35.4	38.2	39.2	39.2	39.2	39.2	39.2
310 (S)	45	29.8	30.0	33.8	37.0	39.8	40.8	40.8	40.8	40.8	40.8

A2 NOISE CONTOUR MAP



Power Curve & Sound Power Level

[4.2M140 EBC/50Hz/open mode]
(preliminary)

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Table of Contents

1 Introduction

This document shows the power curve and sound power level of the Senvion 4.2M140 EBC and the corresponding measurement conditions.

2 Conditions for the measurement and scope of the power curve and sound power level

2.1 General information

Rotor diameter:	140 m
Cut in wind speed:	3.0 m/s
Cut out wind speed:	26.0 m/s
Wind speed at hub height:	10 min. mean value

2.2 Conditions for the measurement and scope of the power curve

Verification according to IEC 61400-12-1: 2005

Turbulence intensity:	6 to 12 %
Terrain:	not complex acc. to IEC 61400-12-1: 2005
Vertical wind shear coefficient (measured between hub height and lower blade tip):	0 to 0.3
Air density at location (10 min. mean value):	≥ 1.13 kg/m^3
Inflow angle (vertical)	±2°
Temperature range:	acc. to related standard conditions of use
Anemometer type:	Thies First Class Advanced
Blades:	clean, without ice or snow formation

For obstacle assessment, IEC 61400-12-1: 2005 Annex A.2 together with the MEASNET procedure “Power Performance Measurement Procedure – Version 5, December 2009” chapter 3.9 has to be followed. In addition, no obstacles with a height greater than 1/3 of the distance between the ground and the lowest blade tip position shall exist in the measurement sector within 0-4 rotor diameters of the WTG or met mast.

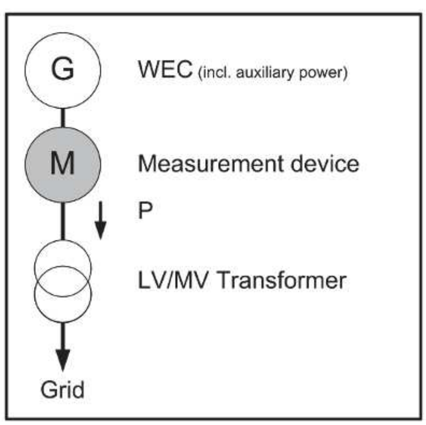

Fig. 1: Arrangement of a measuring unit for the PC measurement

2.3 Conditions for the measurement and scope of the sound power level

Verification acc. to:	IEC 61400-11 Ed.3
Roughness length (average peak):	0.05 m
Turbulence intensity:	6 to 12 %
Terrain:	not complex acc. to IEC 61400-12-1: 2005
Vertical wind shear coefficient (measured between hub height and lower blade tip):	0 to 0.3
Blades:	clean, without ice or snow formation

3 Electrical power curve and sound power level

3.1 Electrical power curve

Values related to an air density of 1.225 kg/m³

Wind speed v [m/s]	Power P [kW]	Thrust coefficient c_T [-]	Power coefficient c_P [-]
3.0	33	0.87	0.130
4.0	215	0.82	0.356
5.0	494	0.79	0.419
6.0	911	0.80	0.447
7.0	1456	0.79	0.450
8.0	2159	0.78	0.447
9.0	3058	0.72	0.445
10.0	3808	0.61	0.404
11.0	4182	0.47	0.333
12.0	4200	0.36	0.258
13.0	4200	0.27	0.203
14.0	4200	0.21	0.162
15.0	4200	0.17	0.132
16.0	4200	0.14	0.109
17.0	4200	0.12	0.091
18.0	4200	0.10	0.076
19.0	4200	0.09	0.065
20.0	4200	0.08	0.056
21.0	4200	0.07	0.048
22.0	3948	0.06	0.039
23.0	3360	0.04	0.029
24.0	2520	0.03	0.019
25.0	1680	0.02	0.011
26.0	840	0.01	0.005

The electrical power is valid for pure active power set points.

The electrical power is valid for the low-voltage side of the transformer.

3.2 Electrical power curve dependent on the Air Density

The tables below show the power curve dependent on different air densities applicable at the low-voltage side of the transformer and the related thrust curve.

Power curves at the low-voltage side of the transformer (excludes transformer losses)

Wind speed (at hub height) v [m/s]	Electrical power P [kW]									
	1.00 kg/m³	1.03 kg/m³	1.06 kg/m³	1.09 kg/m³	1.12 kg/m³	1.15 kg/m³	1.18 kg/m³	1.21 kg/m³	1.24 kg/m³	1.27 kg/m³
3	15	17	20	22	24	27	29	31	34	36
4	164	171	178	184	191	198	205	211	218	225
5	391	405	419	432	446	460	474	487	501	515
6	734	758	781	805	829	852	876	899	923	946
7	1182	1219	1256	1292	1329	1365	1401	1438	1474	1510
8	1764	1817	1870	1922	1975	2028	2080	2133	2186	2238
9	2506	2580	2654	2728	2802	2875	2949	3022	3094	3164
10	3267	3355	3437	3517	3591	3659	3722	3780	3835	3887
11	3879	3943	4001	4054	4097	4131	4155	4174	4189	4200
12	4166	4188	4200	4200	4200	4200	4200	4200	4200	4200
13	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
14	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
15	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
16	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
17	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
18	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
19	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
20	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
21	4200	4200	4200	4200	4200	4200	4200	4200	4200	4200
22	3948	3948	3948	3948	3948	3948	3948	3948	3948	3948
23	3360	3360	3360	3360	3360	3360	3360	3360	3360	3360
24	2520	2520	2520	2520	2520	2520	2520	2520	2520	2520
25	1680	1680	1680	1680	1680	1680	1680	1680	1680	1680
26	840	840	840	840	840	840	840	840	840	840

Thrust curves according to the power curves shown above

Wind speed (at hub height) v [m/s]	Thrust coefficient c_T [-]									
	1.00 kg/m³	**1.03 kg/m³**	**1.06 kg/m³**	**1.09 kg/m³**	**1.12 kg/m³**	**1.15 kg/m³**	**1.18 kg/m³**	**1.21 kg/m³**	**1.24 kg/m³**	**1.27 kg/m³**
3	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
4	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
5	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
6	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
7	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
8	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78	0.78
9	0.73	0.73	0.73	0.73	0.73	0.73	0.72	0.72	0.72	0.72
10	0.66	0.65	0.65	0.64	0.63	0.63	0.62	0.61	0.60	0.60
11	0.56	0.55	0.54	0.53	0.52	0.50	0.49	0.48	0.47	0.45
12	0.44	0.42	0.41	0.40	0.39	0.38	0.37	0.36	0.35	0.34
13	0.34	0.33	0.32	0.31	0.30	0.29	0.28	0.28	0.27	0.26
14	0.26	0.26	0.25	0.24	0.23	0.23	0.22	0.22	0.21	0.21
15	0.21	0.21	0.20	0.19	0.19	0.18	0.18	0.18	0.17	0.17
16	0.17	0.17	0.16	0.16	0.16	0.15	0.15	0.15	0.14	0.14
17	0.15	0.14	0.14	0.13	0.13	0.13	0.12	0.12	0.12	0.12
18	0.12	0.12	0.12	0.11	0.11	0.11	0.11	0.10	0.10	0.10
19	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.08
20	0.09	0.09	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.07
21	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.07	0.06
22	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
23	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
24	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
25	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
26	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

This overview is for information only in order to illustrate the influence of the air density on the power curve.

Please note: For a power curve out of the range of the air density given in this document special project specific considerations are required. In this case please refer to your Senvion GmbH sales representative.

3.3 Sound power level according to IEC

The sound power level given below exclude measurement uncertainty. With the established sound measurement methods [► Page 6] there might be deviations of around +/- 2 dB(A) due to the measurement uncertainty.

In case an approving authority or an external consultant does not consider uncertainty or considers an uncertainty of less than 2 dB(A) for the sound propagation modelling, a measurement uncertainty of at least 2 dB(A) shall be added instead to the sound power levels provided below. The measurement uncertainty has to be taken into account for the maximum sound power level within permits.

There is no tonal audibility $\Delta L_{a,k}$ >2 dB (for $V_{10} \geq$ 6m/s).

Sound Power Level according to IEC for wind speed at hub height

Wind speed v [m/s]	Sound Power Level L_{WA} [dB(A)]
3.0	94.0
3.5	94.0
4.0	94.0
4.5	94.0
5.0	94.2
5.5	96.2
6.0	98.0
6.5	99.7
7.0	101.2
7.5	102.6
8.0	104.0
8.5	105.0
9.0	105.0
9.5	105.0
10.0	105.0
10.5	105.0
11.0	105.0
11.5	105.0
12.0	105.0
12.5	105.0
13.0	105.0
13.5	105.0
14. 0 – 26.0	105.0

Sound Power Level according to IEC for wind speed at 10 m height

Wind speed v_{10} [m/s]	Sound Power Level L_{WA} [dB(A)]		
	110 m	130 m	165 m
3.0	94.0	94.0	94.0
3.5	94.4	94.9	95.6
4.0	97.4	97.8	98.4
4.5	99.8	100.3	100.9
5.0	102.0	102.4	103.0
5.5	103.9	104.3	104.9
6.0	105.0	105.0	105.0
6.5	105.0	105.0	105.0
7.0	105.0	105.0	105.0
7.5	105.0	105.0	105.0
8.0	105.0	105.0	105.0
8.5	105.0	105.0	105.0
9.0	105.0	105.0	105.0
9.5	105.0	105.0	105.0
10.0	105.0	105.0	105.0
10.5	105.0	105.0	105.0
11.0	105.0	105.0	105.0
11.5	105.0	105.0	105.0
12.0 - v_{out}	105.0	105.0	105.0

3.4 Sound power level at 95 % of rated power

Independently of the hub height, the sound power level at 95 % of the rated power is:

$$L_{WA,95\%} = 105.0 \text{ dB(A)}$$

This sound power level excludes measurement uncertainty. With the established sound measurement methods [▶ Page 6] there might be deviations of around +/- 2 dB(A) due to the measurement uncertainty.

In case an approving authority or an external consultant does not consider uncertainty or considers an uncertainty of less than 2 dB(A) for the sound propagation modelling, a measurement uncertainty of at least 2 dB(A) shall be added instead to the sound power level provided above. The measurement uncertainty has to be taken into account for the maximum sound power level within permits.

There is no tonal audibility $\Delta L_{a,k}$ >2 dB (for $V_{10} \geq$ 6m/s).

4 Octave band data

4.1 Introduction

Octave and third octave bands give a more detailed description of the frequency content of the turbine noise.

This document describes the expected octave band and third octave band data for a Senvion 4.2M140 EBC.

Please note that measurement uncertainties are not included in the values presented in this document.

This document is intended to provide information only and therefore acts only as a preliminary non-committal guide. All values mentioned below can be subject to a change based on subsequent calculations or measurements. No rights and obligations of any nature whatever can be derived from general information given in this document. Senvion is not responsible for any claims in conjunction with this information.

4.2 Methodology

The described octave bands and third octave bands are derived from measurements which have been performed on a Senvion 3.XM turbine with serrations of a similar length compared to 4.2M140 EBC . The values are average values for each band and have been standardized to the guaranteed sound power level (L_{WA} [dB(A)]).

The data processing of the noise level has been performed in accordance with the requirements of the IEC 61400-11: 2002 + A1: 2006.

4.3 Octave Bands from 31.5 Hz to 8,000 Hz

Octave sound power spectrum for wind speeds referenced to hub height

Frequency	Octave Band Data in dB(A) for wind speed at hub height						
	6.0 m/s	6.5 m/s	7.0 m/s	7.5 m/s	8.0 m/s	8.5 m/s	9.0 m/s
31.5 Hz	72.3	72.5	74.1	76.5	77.9	79.2	79.4
63 Hz	80.9	81.3	83.8	85.3	86.8	88.3	88.4
125 Hz	84.3	86.0	88.9	90.8	92.4	94.3	94.1
250 Hz	87.4	89.1	92.6	94.6	96.0	97.3	97.1
500 Hz	90.2	91.9	93.8	95.6	97.1	98.3	98.1
1000 Hz	94.1	95.8	96.4	97.5	98.5	99.4	99.4
2000 Hz	91.2	92.9	94.1	95.3	96.9	97.8	97.9
4000 Hz	86.6	88.3	89.6	90.4	92.4	91.5	92.2
8000 Hz	66.8	68.6	71.2	72.4	75.8	76.8	77.3
L_{WA} [dB(A)]	98.0	99.7	101.2	102.6	104.0	105.0	105.0

Frequency	Octave Band Data in dB(A) for wind speed at hub height						
	9.5 m/s	10.0 m/s	10.5 m/s	11.0 m/s	11.5 m/s	12.0 m/s	12.5 m/s
31.5 Hz	79.2	79.2	79.2	78.9	79.5	78.4	78.4
63 Hz	88.6	88.5	88.2	88.0	87.9	87.1	87.1
125 Hz	94.2	94.2	93.8	93.1	93.5	93.0	93.0
250 Hz	97.0	96.8	96.6	96.3	96.2	96.0	96.0
500 Hz	98.0	97.9	97.8	97.6	97.6	97.6	97.6
1000 Hz	99.4	99.3	98.9	98.7	98.8	99.0	99.0
2000 Hz	98.1	98.2	98.4	98.6	98.5	98.5	98.5
4000 Hz	92.6	93.1	94.8	96.0	95.9	96.3	96.3
8000 Hz	78.0	79.2	81.0	81.9	81.6	80.5	80.5
L_{WA} [dB(A)]	105.0	105.0	105.0	105.0	105.0	105.0	105.0

SENVION wind energy solutions

4.4 Third Octave Bands from 20 Hz to 10,000 Hz

Third octave sound power spectrum for wind speeds referenced to hub height

Fre-quency	Third Octave Band Data in dB(A) for wind speed at hub height						
	6.0 m/s	6.5 m/s	7.0 m/s	7.5 m/s	8.0 m/s	8.5 m/s	9.0 m/s
20 Hz	57.8	58.0	59.3	61.6	62.9	64.4	64.4
25 Hz	62.1	62.3	63.4	65.8	67.3	68.6	68.8
31.5 Hz	66.5	66.7	68.1	70.7	72.0	73.4	73.4
40 Hz	70.4	70.6	72.3	74.6	76.1	77.4	77.6
50 Hz	73.5	73.7	75.4	77.6	79.2	80.7	80.8
63 Hz	76.5	76.7	78.2	80.4	81.8	83.5	83.6
80 Hz	77.5	78.2	81.5	82.4	83.8	85.2	85.4
100 Hz	78.0	79.7	82.7	85.1	86.6	88.7	88.2
125 Hz	79.0	80.7	83.4	86.0	88.1	89.7	89.7
160 Hz	81.0	82.7	85.8	86.7	88.0	90.0	90.0
200 Hz	81.5	83.2	86.8	89.1	90.2	90.9	90.7
250 Hz	81.9	83.7	87.8	89.0	90.4	91.9	91.9
315 Hz	84.0	85.7	88.7	91.1	92.6	94.1	93.9
400 Hz	84.1	85.9	88.5	90.9	92.6	94.1	93.7
500 Hz	85.7	87.5	88.4	89.3	90.9	92.0	91.8
630 Hz	86.1	87.8	90.1	91.8	93.1	94.1	94.1
800 Hz	88.9	90.6	91.0	92.0	93.2	94.1	94.0
1000 Hz	89.7	91.4	92.1	93.0	94.0	94.9	94.9
1250 Hz	89.2	91.0	91.7	93.1	94.0	94.7	94.9
1600 Hz	87.8	89.5	90.7	92.1	93.6	94.6	94.7
2000 Hz	85.1	86.8	88.7	90.2	91.8	92.7	92.8
2500 Hz	86.0	87.7	88.1	88.7	90.4	91.0	91.4
3150 Hz	85.5	87.3	88.3	88.8	90.1	89.5	90.0
4000 Hz	78.8	80.5	83.1	84.6	87.4	86.1	87.0
5000 Hz	73.7	75.4	76.1	77.2	81.7	81.0	81.6
6300 Hz	66.4	68.2	70.5	71.6	75.0	75.8	76.3
8000 Hz	55.4	57.1	62.2	64.2	67.3	69.3	69.8
10000 Hz	45.4	47.2	53.6	55.8	58.4	61.2	61.8
L_{WA} [dB(A)]	98.0	99.7	101.2	102.6	104.0	105.0	105.0

Frequency	Third Octave Band Data in dB(A) for wind speed at hub height						
	9.5 m/s	10.0 m/s	10.5 m/s	11.0 m/s	11.5 m/s	12.0 m/s	12.5 m/s
20 Hz	64.1	64.0	64.0	63.8	64.2	63.3	63.3
25 Hz	68.5	68.4	68.7	68.3	68.7	68.0	68.0
31.5 Hz	73.3	73.2	73.2	73.1	73.6	72.6	72.6
40 Hz	77.4	77.4	77.4	77.1	77.7	76.5	76.5
50 Hz	80.9	80.7	80.7	80.5	80.8	80.3	80.3
63 Hz	83.7	83.5	83.3	83.2	83.3	82.2	82.2
80 Hz	85.6	85.7	85.2	84.9	84.5	83.7	83.7
100 Hz	88.3	88.4	88.3	87.5	88.5	87.7	87.7
125 Hz	89.8	89.8	89.2	88.7	88.8	88.4	88.4
160 Hz	89.9	90.0	89.4	88.8	88.9	88.4	88.4
200 Hz	90.6	90.5	90.5	90.3	90.2	89.8	89.8
250 Hz	91.7	91.5	91.2	90.9	90.6	90.5	90.5
315 Hz	93.7	93.5	93.3	93.0	93.0	92.7	92.7
400 Hz	93.7	93.6	93.5	93.2	93.3	93.0	93.0
500 Hz	91.7	91.7	91.5	91.4	91.4	91.1	91.1
630 Hz	94.0	93.8	93.8	93.7	93.6	93.9	93.9
800 Hz	93.9	93.9	93.4	93.2	93.3	93.4	93.4
1000 Hz	94.8	94.7	94.4	94.2	94.3	94.7	94.7
1250 Hz	95.0	94.9	94.5	94.3	94.3	94.5	94.5
1600 Hz	94.8	94.8	95.0	94.9	95.0	95.0	95.0
2000 Hz	93.0	93.1	93.0	93.2	92.9	92.8	92.8
2500 Hz	91.7	92.0	92.5	93.1	92.9	93.0	93.0
3150 Hz	90.3	90.7	92.4	93.7	93.7	94.3	94.3
4000 Hz	87.5	88.0	89.9	91.0	90.8	91.1	91.1
5000 Hz	82.5	83.3	84.9	85.8	85.5	84.9	84.9
6300 Hz	77.0	78.2	80.1	81.0	80.7	79.6	79.6
8000 Hz	70.6	71.5	73.3	73.9	73.8	72.7	72.7
10000 Hz	62.7	63.5	65.3	65.6	65.6	64.5	64.5
L_{WA} [dB(A)]	105.0	105.0	105.0	105.0	105.0	105.0	105.0

CERES PROJECT
Clean Energy from Yorke Peninsula

Friday, 8 February 2019

Yorke Peninsula Wind Farm Project Pty. Ltd.
Level 29, 80 Collins Street
Melbourne, Victoria
3000, Australia

To:
Client Services Officer
Attention: Kellie Hofmeyer
Development Applications Science and Assessment Division Environment Protection Authority
GPO Box 2607
ADELAIDE SA 5001
DX 228
epa.planning@sa.gov.au

Cc:
Simon Neldner
Team Leader - Development Assessment
State Commission Assessment Panel L5
50 FLINDERS Street
ADELAIDE SA 5000
simon.neldner@sa.gov.au

Dear Kellie,

RE: Development Application Information Request (544/V001/13 V2)

Thank you for your letter dated 22 January 2019, requesting further information regarding our Development Variation Application (544/V001/13 V2). Responses to each request in your letter are provided below and in related attachments.

EPA Request 1

"*Confirmation that receivers located in between Port Julia and Sheoak Flat are located within the Rural Living Zone (such as, but not limited to, receivers 293, 294, 295, 342, 356, 357, 359, 360, 361, 362, 363). If so, please update the provided results table to reflect the correct criterion to be applied at these receivers.*"

Response

I can confirm that those receivers you listed, plus one other, are in the Rural Living Zone. The full list of relevant receivers is: 293, 294, 295, 342, 356, 357, 358, 359, 360, 361, 362. Receiver 363 is a shed, not a dwelling.

Please find the revised table in the attached letter from Marshall Day Acoustics, *Lt 001 r01 20180604 - Ceres Wind Farm Project - Response to SA EPA query.pdf*.

EPA Request 2

"*Receivers numbered higher than 356 are not reflected in the provided table. There is potential that these receivers are located in the Rural Living Zone and are required to meet the strict 35dB(A) noise criterion.*"

Response

This omission has now been rectified, and this is reflected in the attached letter from Marshall Day Acoustics, *Lt 001 r01 20180604 - Ceres Wind Farm Project - Response to SA EPA query.pdf*, which has also been updated with the correct 35dB(A) noise criterion for those receivers located in the Rural Living Zone.

I can confirm that predicted noise levels at all receivers comply with the South Australian Environment Protection Authority Wind Farms Noise Guidelines 2009.

I trust that the information provided in response to this Information Request is adequate for the EPA to complete its referral assessment of our application.

Please do not hesitate to contact me if you require any additional information or clarification.

Regards,

Adam Gray
Project Development Planner

Senvion Australia Pty Ltd
Level 29, 80 Collins Street
Melbourne, Victoria, 3000, Australia

Mobile: +61 447 313 875
Telephone: +61 3 8660 6555
adam.gray@senvion.com

Attachment Enclosed: 1. *Lt 001 r01 20180604 - Ceres Wind Farm Project - Response to SA EPA query.pdf*

Marshall Day Acoustics Pty Ltd
ABN: 53 470 077 191
GPO Box 1066, Adelaide 5001
31 Vardon Avenue
Adelaide SA 5000
Australia
T: +618 6189 1400
www.marshallday.com

7 February 2019

Yorke Peninsula Wind Farm Project Pty Ltd
C/-
Senvion Australia Pty Ltd
Level 29
80 Collins Street
Melbourne VIC 3000Y

Attention: Mr Adam Gray

Dear Adam

CERES WIND FARM PROJECT: REPSONSE TO SA EPA QUERY

The following letter details predicted noise levels associated with the Ceres Wind Farm Project in response to item 4 and items 1 and 2 in the South Australia Environment Protection Authority (SA EPA) letters, *EPA Reference: 34514*, dated 12 December 2018 and 22 January 2019, respectively.

The predictions are based on the input information as described in the Marshall Day Acoustics report, *Ceres Wind Farm Project Revised Noise Assessment*, Rp 001 R01 20180604, dated 13 November 2018.

The predicted noise levels detailed in A1, are compared with the relevant base noise limits. The base noise limits have been determined in accordance with the SA EPA document, *Wind farms environmental noise guidelines*, published in July 2009 and the *Yorke Peninsula Council Development Plan,* consolidated on 31 October 2017.

An area-wide noise contour map presenting predicted noise levels at the wind speed corresponding to the highest sound power level (10 m/s at hub height) is also provided in A2.

For all assessed receiver locations, the highest predicted noise level achieves the relevant base noise limits.

We trust this information is satisfactory. If you have any further questions please do not hesitate to contact us.

Yours faithfully

MARSHALL DAY ACOUSTICS PTY LTD

Alex Morabito

Alex Morabito

Associate

Certified System
ISO 9001

A1 PREDICTED WIND FARM NOISE LEVELS

Table 1: Predicted noise levels at assessed relevant receivers, dB L_{Aeq}

Receiver	Base noise limit	Hub height wind speed (m/s) 4	5	6	7	8	9	10	11	12	≥13
3	40	13.7	13.9	17.7	20.9	23.7	24.7	24.7	24.7	24.7	24.7
4	40	24.8	25.0	28.8	32.0	34.8	35.8	35.8	35.8	35.8	35.8
6	40	24.8	25.0	28.8	32.0	34.8	35.8	35.8	35.8	35.8	35.8
7	40	23.9	24.1	27.9	31.1	33.9	34.9	34.9	34.9	34.9	34.9
8	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
10	40	26.3	26.5	30.3	33.5	36.3	37.3	37.3	37.3	37.3	37.3
11	40	21.8	22.0	25.8	29.0	31.8	32.8	32.8	32.8	32.8	32.8
14	40	19.6	19.8	23.6	26.8	29.6	30.6	30.6	30.6	30.6	30.6
15	40	19.3	19.5	23.3	26.5	29.3	30.3	30.3	30.3	30.3	30.3
18	40	17.5	17.7	21.5	24.7	27.5	28.5	28.5	28.5	28.5	28.5
20	40	21.9	22.1	25.9	29.1	31.9	32.9	32.9	32.9	32.9	32.9
21	40	19.9	20.1	23.9	27.1	29.9	30.9	30.9	30.9	30.9	30.9
23	40	17.0	17.2	21.0	24.2	27.0	28.0	28.0	28.0	28.0	28.0
26	40	20.4	20.6	24.4	27.6	30.4	31.4	31.4	31.4	31.4	31.4
28	40	28.7	28.9	32.7	35.9	38.7	39.7	39.7	39.7	39.7	39.7
33	40	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
34	40	14.7	14.9	18.7	21.9	24.7	25.7	25.7	25.7	25.7	25.7
35	40	28.2	28.4	32.2	35.4	38.2	39.2	39.2	39.2	39.2	39.2
37	40	25.1	25.3	29.1	32.3	35.1	36.1	36.1	36.1	36.1	36.1
41	40	17.0	17.2	21.0	24.2	27.0	28.0	28.0	28.0	28.0	28.0
42	40	20.7	20.9	24.7	27.9	30.7	31.7	31.7	31.7	31.7	31.7
44	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
45	40	14.2	14.4	18.2	21.4	24.2	25.2	25.2	25.2	25.2	25.2
46	40	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
47	40	16.9	17.1	20.9	24.1	26.9	27.9	27.9	27.9	27.9	27.9
50	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
56	40	25.0	25.2	29.0	32.2	35.0	36.0	36.0	36.0	36.0	36.0
57	40	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
59	40	21.9	22.1	25.9	29.1	31.9	32.9	32.9	32.9	32.9	32.9
62	40	12.7	12.9	16.7	19.9	22.7	23.7	23.7	23.7	23.7	23.7
63	40	26.8	27.0	30.8	34.0	36.8	37.8	37.8	37.8	37.8	37.8
64	40	18.4	18.6	22.4	25.6	28.4	29.4	29.4	29.4	29.4	29.4

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
67	40	18.3	18.5	22.3	25.5	28.3	29.3	29.3	29.3	29.3	29.3
68	40	21.3	21.5	25.3	28.5	31.3	32.3	32.3	32.3	32.3	32.3
83	40	15.5	15.7	19.5	22.7	25.5	26.5	26.5	26.5	26.5	26.5
85	40	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
88	40	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
90	40	17.4	17.6	21.4	24.6	27.4	28.4	28.4	28.4	28.4	28.4
91	40	13.4	13.6	17.4	20.6	23.4	24.4	24.4	24.4	24.4	24.4
95	40	18.2	18.4	22.2	25.4	28.2	29.2	29.2	29.2	29.2	29.2
96	40	16.7	16.9	20.7	23.9	26.7	27.7	27.7	27.7	27.7	27.7
97	40	28.0	28.2	32.0	35.2	38.0	39.0	39.0	39.0	39.0	39.0
98	40	23.9	24.1	27.9	31.1	33.9	34.9	34.9	34.9	34.9	34.9
102	40	18.8	19.0	22.8	26.0	28.8	29.8	29.8	29.8	29.8	29.8
103	40	19.7	19.9	23.7	26.9	29.7	30.7	30.7	30.7	30.7	30.7
105	40	26.8	27.0	30.8	34.0	36.8	37.8	37.8	37.8	37.8	37.8
106	40	19.7	19.9	23.7	26.9	29.7	30.7	30.7	30.7	30.7	30.7
107	40	20.5	20.7	24.5	27.7	30.5	31.5	31.5	31.5	31.5	31.5
108	40	16.7	16.9	20.7	23.9	26.7	27.7	27.7	27.7	27.7	27.7
109	40	17.7	17.9	21.7	24.9	27.7	28.7	28.7	28.7	28.7	28.7
110	40	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
111	40	16.9	17.1	20.9	24.1	26.9	27.9	27.9	27.9	27.9	27.9
113	40	22.0	22.2	26.0	29.2	32.0	33.0	33.0	33.0	33.0	33.0
114	40	24.2	24.4	28.2	31.4	34.2	35.2	35.2	35.2	35.2	35.2
116	40	18.8	19.0	22.8	26.0	28.8	29.8	29.8	29.8	29.8	29.8
119	40	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
122	40	16.1	16.3	20.1	23.3	26.1	27.1	27.1	27.1	27.1	27.1
125	40	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
127	40	18.3	18.5	22.3	25.5	28.3	29.3	29.3	29.3	29.3	29.3
129	40	27.3	27.5	31.3	34.5	37.3	38.3	38.3	38.3	38.3	38.3
130	40	20.5	20.7	24.5	27.7	30.5	31.5	31.5	31.5	31.5	31.5
131	40	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
133	40	17.4	17.6	21.4	24.6	27.4	28.4	28.4	28.4	28.4	28.4
135	40	21.8	22.0	25.8	29.0	31.8	32.8	32.8	32.8	32.8	32.8
139	40	16.3	16.5	20.3	23.5	26.3	27.3	27.3	27.3	27.3	27.3
140	40	18.5	18.7	22.5	25.7	28.5	29.5	29.5	29.5	29.5	29.5

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
141	40	14.6	14.8	18.6	21.8	24.6	25.6	25.6	25.6	25.6	25.6
143	40	25.3	25.5	29.3	32.5	35.3	36.3	36.3	36.3	36.3	36.3
145	40	26.3	26.5	30.3	33.5	36.3	37.3	37.3	37.3	37.3	37.3
147	40	18.6	18.8	22.6	25.8	28.6	29.6	29.6	29.6	29.6	29.6
150	40	27.2	27.4	31.2	34.4	37.2	38.2	38.2	38.2	38.2	38.2
151	40	26.4	26.6	30.4	33.6	36.4	37.4	37.4	37.4	37.4	37.4
155	40	14.5	14.7	18.5	21.7	24.5	25.5	25.5	25.5	25.5	25.5
157	40	13.8	14.0	17.8	21.0	23.8	24.8	24.8	24.8	24.8	24.8
158	40	21.9	22.1	25.9	29.1	31.9	32.9	32.9	32.9	32.9	32.9
159	40	16.6	16.8	20.6	23.8	26.6	27.6	27.6	27.6	27.6	27.6
161	40	12.7	12.9	16.7	19.9	22.7	23.7	23.7	23.7	23.7	23.7
162	40	16.8	17.0	20.8	24.0	26.8	27.8	27.8	27.8	27.8	27.8
163	40	14.7	14.9	18.7	21.9	24.7	25.7	25.7	25.7	25.7	25.7
170	40	25.1	25.3	29.1	32.3	35.1	36.1	36.1	36.1	36.1	36.1
174	40	18.5	18.7	22.5	25.7	28.5	29.5	29.5	29.5	29.5	29.5
177	40	17.0	17.2	21.0	24.2	27.0	28.0	28.0	28.0	28.0	28.0
178	40	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
179	40	23.0	23.2	27.0	30.2	33.0	34.0	34.0	34.0	34.0	34.0
181	40	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
186	40	17.9	18.1	21.9	25.1	27.9	28.9	28.9	28.9	28.9	28.9
187	40	15.8	16.0	19.8	23.0	25.8	26.8	26.8	26.8	26.8	26.8
190	40	13.1	13.3	17.1	20.3	23.1	24.1	24.1	24.1	24.1	24.1
195	40	24.2	24.4	28.2	31.4	34.2	35.2	35.2	35.2	35.2	35.2
200	40	12.0	12.2	16.0	19.2	22.0	23.0	23.0	23.0	23.0	23.0
201	40	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
203	40	21.5	21.7	25.5	28.7	31.5	32.5	32.5	32.5	32.5	32.5
204	40	26.2	26.4	30.2	33.4	36.2	37.2	37.2	37.2	37.2	37.2
206	40	16.2	16.4	20.2	23.4	26.2	27.2	27.2	27.2	27.2	27.2
209	40	28.4	28.6	32.4	35.6	38.4	39.4	39.4	39.4	39.4	39.4
211	40	22.9	23.1	26.9	30.1	32.9	33.9	33.9	33.9	33.9	33.9
214	40	15.6	15.8	19.6	22.8	25.6	26.6	26.6	26.6	26.6	26.6
217	40	11.7	11.9	15.7	18.9	21.7	22.7	22.7	22.7	22.7	22.7
218	40	22.8	23.0	26.8	30.0	32.8	33.8	33.8	33.8	33.8	33.8
222	40	26.8	27.0	30.8	34.0	36.8	37.8	37.8	37.8	37.8	37.8

Receiver	Base noise limit	Hub height wind speed (m/s) 4	5	6	7	8	9	10	11	12	≥13
225	40	15.9	16.1	19.9	23.1	25.9	26.9	26.9	26.9	26.9	26.9
231	40	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
232	40	17.7	17.9	21.7	24.9	27.7	28.7	28.7	28.7	28.7	28.7
237	40	21.7	21.9	25.7	28.9	31.7	32.7	32.7	32.7	32.7	32.7
239	40	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
242	40	15.5	15.7	19.5	22.7	25.5	26.5	26.5	26.5	26.5	26.5
244	40	18.9	19.1	22.9	26.1	28.9	29.9	29.9	29.9	29.9	29.9
247	40	13.1	13.3	17.1	20.3	23.1	24.1	24.1	24.1	24.1	24.1
248	40	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
250	40	14.4	14.6	18.4	21.6	24.4	25.4	25.4	25.4	25.4	25.4
251	40	16.2	16.4	20.2	23.4	26.2	27.2	27.2	27.2	27.2	27.2
252	40	23.1	23.3	27.1	30.3	33.1	34.1	34.1	34.1	34.1	34.1
253	40	24.5	24.7	28.5	31.7	34.5	35.5	35.5	35.5	35.5	35.5
254	40	26.3	26.5	30.3	33.5	36.3	37.3	37.3	37.3	37.3	37.3
256	40	14.3	14.5	18.3	21.5	24.3	25.3	25.3	25.3	25.3	25.3
257	40	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
260	40	23.5	23.7	27.5	30.7	33.5	34.5	34.5	34.5	34.5	34.5
263	40	20.4	20.6	24.4	27.6	30.4	31.4	31.4	31.4	31.4	31.4
264	40	16.7	16.9	20.7	23.9	26.7	27.7	27.7	27.7	27.7	27.7
265	40	17.7	17.9	21.7	24.9	27.7	28.7	28.7	28.7	28.7	28.7
269	40	14.9	15.1	18.9	22.1	24.9	25.9	25.9	25.9	25.9	25.9
270	40	24.8	25.0	28.8	32.0	34.8	35.8	35.8	35.8	35.8	35.8
277	40	22.7	22.9	26.7	29.9	32.7	33.7	33.7	33.7	33.7	33.7
278	40	18.0	18.2	22.0	25.2	28.0	29.0	29.0	29.0	29.0	29.0
280	40	27.7	27.9	31.7	34.9	37.7	38.7	38.7	38.7	38.7	38.7
281	40	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
282	40	16.2	16.4	20.2	23.4	26.2	27.2	27.2	27.2	27.2	27.2
284	40	12.9	13.1	16.9	20.1	22.9	23.9	23.9	23.9	23.9	23.9
287	40	19.7	19.9	23.7	26.9	29.7	30.7	30.7	30.7	30.7	30.7
288	40	19.2	19.4	23.2	26.4	29.2	30.2	30.2	30.2	30.2	30.2
289	40	20.9	21.1	24.9	28.1	30.9	31.9	31.9	31.9	31.9	31.9
293[1]	35	22.0	22.2	26.0	29.2	32.0	33.0	33.0	33.0	33.0	33.0
294[1]	35	22.6	22.8	26.6	29.8	32.6	33.6	33.6	33.6	33.6	33.6
295[1]	35	22.6	22.8	26.6	29.8	32.6	33.6	33.6	33.6	33.6	33.6

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
296	40	23.2	23.4	27.2	30.4	33.2	34.2	34.2	34.2	34.2	34.2
297	40	19.0	19.2	23.0	26.2	29.0	30.0	30.0	30.0	30.0	30.0
299	40	24.5	24.7	28.5	31.7	34.5	35.5	35.5	35.5	35.5	35.5
301	40	27.3	27.5	31.3	34.5	37.3	38.3	38.3	38.3	38.3	38.3
302	40	17.8	18.0	21.8	25.0	27.8	28.8	28.8	28.8	28.8	28.8
305	40	16.9	17.1	20.9	24.1	26.9	27.9	27.9	27.9	27.9	27.9
306	40	18.6	18.8	22.6	25.8	28.6	29.6	29.6	29.6	29.6	29.6
307	40	15.3	15.5	19.3	22.5	25.3	26.3	26.3	26.3	26.3	26.3
308	40	16.5	16.7	20.5	23.7	26.5	27.5	27.5	27.5	27.5	27.5
309	40	14.2	14.4	18.2	21.4	24.2	25.2	25.2	25.2	25.2	25.2
311	40	22.2	22.4	26.2	29.4	32.2	33.2	33.2	33.2	33.2	33.2
313	40	12.8	13.0	16.8	20.0	22.8	23.8	23.8	23.8	23.8	23.8
314	40	16.0	16.2	20.0	23.2	26.0	27.0	27.0	27.0	27.0	27.0
317	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
318	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
319	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
320	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
321	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
322	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
323	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
324	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
325	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
326	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
327	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
328	40	23.7	23.9	27.7	30.9	33.7	34.7	34.7	34.7	34.7	34.7
329	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
330	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
331	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
332	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
333	40	23.6	23.8	27.6	30.8	33.6	34.6	34.6	34.6	34.6	34.6
334	40	23.4	23.6	27.4	30.6	33.4	34.4	34.4	34.4	34.4	34.4
335	40	23.4	23.6	27.4	30.6	33.4	34.4	34.4	34.4	34.4	34.4
336	40	23.3	23.5	27.3	30.5	33.3	34.3	34.3	34.3	34.3	34.3
338	40	23.5	23.7	27.5	30.7	33.5	34.5	34.5	34.5	34.5	34.5

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
339	40	23.4	23.6	27.4	30.6	33.4	34.4	34.4	34.4	34.4	34.4
340	40	21.4	21.6	25.4	28.6	31.4	32.4	32.4	32.4	32.4	32.4
342[1]	35	23.0	23.2	27.0	30.2	33.0	34.0	34.0	34.0	34.0	34.0
343	40	17.9	18.1	21.9	25.1	27.9	28.9	28.9	28.9	28.9	28.9
344	40	17.1	17.3	21.1	24.3	27.1	28.1	28.1	28.1	28.1	28.1
345	40	17.1	17.3	21.1	24.3	27.1	28.1	28.1	28.1	28.1	28.1
346	40	17.6	17.8	21.6	24.8	27.6	28.6	28.6	28.6	28.6	28.6
347	40	17.4	17.6	21.4	24.6	27.4	28.4	28.4	28.4	28.4	28.4
348	40	17.5	17.7	21.5	24.7	27.5	28.5	28.5	28.5	28.5	28.5
349	40	16.6	16.8	20.6	23.8	26.6	27.6	27.6	27.6	27.6	27.6
350	40	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
351	40	16.8	17.0	20.8	24.0	26.8	27.8	27.8	27.8	27.8	27.8
352	40	16.4	16.6	20.4	23.6	26.4	27.4	27.4	27.4	27.4	27.4
353	40	18.4	18.6	22.4	25.6	28.4	29.4	29.4	29.4	29.4	29.4
354	40	17.3	17.5	21.3	24.5	27.3	28.3	28.3	28.3	28.3	28.3
355	40	16.1	16.3	20.1	23.3	26.1	27.1	27.1	27.1	27.1	27.1
356[1]	35	23.4	23.6	27.4	30.6	33.4	34.4	34.4	34.4	34.4	34.4
357[1]	35	23.2	23.4	27.2	30.4	33.2	34.2	34.2	34.2	34.2	34.2
358[1]	35	22.9	23.1	26.9	30.1	32.9	33.9	33.9	33.9	33.9	33.9
359[1]	35	22.8	23.0	26.8	30.0	32.8	33.8	33.8	33.8	33.8	33.8
360[1]	35	22.8	23.0	26.8	30.0	32.8	33.8	33.8	33.8	33.8	33.8
361[1]	35	22.3	22.5	26.3	29.5	32.3	33.3	33.3	33.3	33.3	33.3
362[1]	35	22.5	22.7	26.5	29.7	32.5	33.5	33.5	33.5	33.5	33.5

Note: (1) receiver located within Rural Living Zone and subject to lower base noise limit

Table 2: Predicted noise levels at involved receiver locations, dB L_{Aeq}

Receiver	Base noise limit	Hub height wind speed (m/s)									
		4	5	6	7	8	9	10	11	12	≥13
29 (S)	45	28.8	29.0	32.8	36.0	38.8	39.8	39.8	39.8	39.8	39.8
32 (S)	45	30.3	30.5	34.3	37.5	40.3	41.3	41.3	41.3	41.3	41.3
48 (S)	45	28.6	28.8	32.6	35.8	38.6	39.6	39.6	39.6	39.6	39.6
54 (S)	45	32.6	32.8	36.6	39.8	42.6	43.6	43.6	43.6	43.6	43.6
60 (S)	45	25.5	25.7	29.5	32.7	35.5	36.5	36.5	36.5	36.5	36.5
71 (S)	45	33.0	33.2	37.0	40.2	43.0	44.0	44.0	44.0	44.0	44.0
72 (S)	45	30.2	30.4	34.2	37.4	40.2	41.2	41.2	41.2	41.2	41.2
73 (S)	45	28.1	28.3	32.1	35.3	38.1	39.1	39.1	39.1	39.1	39.1
74 (S)	45	30.5	30.7	34.5	37.7	40.5	41.5	41.5	41.5	41.5	41.5
77 (S)	45	28.3	28.5	32.3	35.5	38.3	39.3	39.3	39.3	39.3	39.3
126 (S)	45	28.2	28.4	32.2	35.4	38.2	39.2	39.2	39.2	39.2	39.2
160 (S)	45	27.5	27.7	31.5	34.7	37.5	38.5	38.5	38.5	38.5	38.5
171 (S)	45	30.6	30.8	34.6	37.8	40.6	41.6	41.6	41.6	41.6	41.6
184 (S)	45	26.5	26.7	30.5	33.7	36.5	37.5	37.5	37.5	37.5	37.5
189 (S)	45	32.8	33.0	36.8	40.0	42.8	43.8	43.8	43.8	43.8	43.8
194 (S)	45	29.5	29.7	33.5	36.7	39.5	40.5	40.5	40.5	40.5	40.5
205 (S)	45	32.2	32.4	36.2	39.4	42.2	43.2	43.2	43.2	43.2	43.2
216 (S)	45	32.1	32.3	36.1	39.3	42.1	43.1	43.1	43.1	43.1	43.1
224 (S)	45	30.0	30.2	34.0	37.2	40.0	41.0	41.0	41.0	41.0	41.0
240 (S)	45	24.0	24.2	28.0	31.2	34.0	35.0	35.0	35.0	35.0	35.0
292 (S)	45	22.9	23.1	26.9	30.1	32.9	33.9	33.9	33.9	33.9	33.9
298 (S)	45	28.2	28.4	32.2	35.4	38.2	39.2	39.2	39.2	39.2	39.2
310 (S)	45	29.8	30.0	33.8	37.0	39.8	40.8	40.8	40.8	40.8	40.8

A2 NOISE CONTOUR MAP