

# Warracknabeal Energy Park

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## Attachment A.7: Electromagnetic Interference Assessment





# **Warracknabeal Energy Park**

## **Electromagnetic Interference Assessment**

Warracknabeal Energy Park Pty Ltd

22 March 2023

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# Executive Summary

This electromagnetic interference assessment has been undertaken by GHD in response to a request from Warracknabeal Energy Park Pty Ltd to identify and assess the potential impacts of constructing the proposed Warracknabeal Energy Park wind farm development. The assessment is based upon a layout of 211 wind turbines with the maximum tip height up to 280 m, minimum clearance from ground level not less than 50 m, and rotor diameter up to 200 m.

The assessment results include the expected electromagnetic impacts from the wind farm project and feedback from third party consultations.

This assessment finds that the proposed wind farm is unlikely to impact the majority of the radiocommunication services. Some television and radio broadcasting services may be slightly degraded by the turbines but the signal coverage currently propagating across the proposed wind farm site is already negligible and not likely usable for receptors in its current state, meaning the effect of any further degradation is negligible.

The proposed wind farm location is in an area where coverage is available for mobile telephone and broadband from several operators. Telstra, Optus and NBNCo. have advised that they expect no impact to their mobile network. Vodafone has not responded to the consultation request. NBNCo. raised concern whether there would be any RF transmission equipment used during the construction or operation at turbines located near NBN base stations. GHD understands that the Warracknabeal Energy Park Pty Ltd will provide information on the planned RF transmission equipment that will be used during the construction and permanently to all mobile operators.

The proposed wind farm is expected to impact the Bureau of Meteorology radar, specifically the Rainbow radar which provides weather watch services in the vicinity of the proposed wind farm area. GHD understands that Warracknabeal Energy Park Pty Ltd is continuing to consult with the Bureau of Meteorology (BoM) and is taking steps to minimise or negate the impact on the weather watch radar service through technical or operational solutions to be agreed with the Bureau.



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# 1. Introduction

## 1.1 Purpose of this report

The purpose of this report is to assess the potential impacts of the electromagnetic interference caused by wind turbines from the proposed wind farm development. The report is intended to be part of the project's various development applications and offers mitigation measures where required.

GHD has previously undertaken modelling to determine which areas of the project site are unsuitable for installing turbines considering the impacts on radio communications services in the region. The proponent, Warracknabeal Energy Park Pty Ltd, has taken this modelling into account when preparing the proposed turbine layout.

## 1.2 Scope and limitations

GHD has prepared this report for Warracknabeal Energy Park Pty Ltd and it may only be used and relied on by Warracknabeal Energy Park Pty Ltd for the purpose agreed between GHD and Warracknabeal Energy Park Pty Ltd as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Warracknabeal Energy Park Pty Ltd in connection with this report.

GHD also excludes implied warranties and conditions to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in this report and are subject to the scope limitations set out in this report.

The opinions, conclusions, and recommendations in this report are based on conditions encountered, and information reviewed when preparing this report. GHD has no responsibility or obligation to update this report to account for events or changes occurring after the date of preparing this report.

The opinions, conclusions, and recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report based on information provided by Warracknabeal Energy Park Pty Ltd, the information of the radio sites from the ACMA radio communications Licence database, and additional information from the consultations with other entities expected to be impacted by the proposed wind farm, which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

This assessment has been undertaken based on 211 specific turbines. The development approvals typically allow some degree of flexibility in turbine siting. Warracknabeal Energy Park Pty Ltd should geolocate all radio sites and undertake an updated electromagnetic interference assessment to minimise potential impacts on radio link paths before finalisation and micro-siting of the turbine locations and construction.

## 1.3 Abbreviations

The following abbreviations have been used in this report:

*Table 1 Definitions*

Abbreviation	Definition
ABC	Australian Broadcast Corporation
ACMA	Australian Communications and Media Authority
AM	Amplitude Modulation
AMTA	Australian Mobile Telecommunications Association
BoM	Bureau of Meteorology

Abbreviation	Definition
FM	Frequency Modulation
GHz	Giga-Hertz ( $10^9$ )
GNSS	Global Navigation Satellite System
MHz	Mega-Hertz ( $10^6$ )
kHz	Kilo-Hertz ( $10^3$ )
LMR	Land Mobile Radio
MHz	Mega-Hertz ( $10^6$ )
PTP	Point to Point
PTMP	Point to Multi-Point
RFNSA	Radio Frequency National Site Archive
UHF	Ultra High Frequency
VAST	Viewer Access Satellite Television
VHF	Very High Frequency

## 1.4 References

Table 2 References

Ref No	Reference
1	Visiwave™, <a href="http://www.vias.org/wirelessnetw/wndw_04_08b.html">http://www.vias.org/wirelessnetw/wndw_04_08b.html</a>
2	Rat River Technologies, <a href="http://www.ratrivertech.ca/archives/tools/fresnel_zone_clearance_calculator.htm">http://www.ratrivertech.ca/archives/tools/fresnel_zone_clearance_calculator.htm</a>
3	Fixed-Link Wind Turbine Exclusion Zone Method, D F Bacon, Radio Communications Agency
4	Victoria State Government, Department of Environment, Land, Water and Planning: Policy and Planning Guidelines of Wind Energy Facilities in Victoria, DELWP March 2019 <a href="https://www.planning.vic.gov.au/__data/assets/pdf_file/0024/95361/Development-of-Wind-Energy-Facilities-Mar2019.pdf">https://www.planning.vic.gov.au/__data/assets/pdf_file/0024/95361/Development-of-Wind-Energy-Facilities-Mar2019.pdf</a>
5	The Complete Glenelg Planning Scheme, 18 February 2021 <a href="https://planning-schemes.api.delwp.vic.gov.au/__data/assets/pdf_file/0008/463949/Glenelg_PS_Ordinance.pdf">https://planning-schemes.api.delwp.vic.gov.au/__data/assets/pdf_file/0008/463949/Glenelg_PS_Ordinance.pdf</a>
6	Draft National Wind Farm Development Guidelines, Environment Protection and Heritage Council of Australia and New Zealand, July 2010
7	<a href="https://www.acma.gov.au/technical-details-land-mobile-licences">https://www.acma.gov.au/technical-details-land-mobile-licences</a> Technical details for land mobile licences   Accredited persons   ACMA
8	<a href="https://www.acma.gov.au/sites/default/files/2019-08/Chapter-4.docx">https://www.acma.gov.au/sites/default/files/2019-08/Chapter-4.docx</a>
9	International Telecommunications Union Recommendation ITU-R BT.1893, Assessment of impairment caused to digital television reception by a wind turbine
10	AS/NZS 61000.6.4:2012, Electromagnetic compatibility (EMC) Generic standards - Emission standard for industrial environments, Standards Australia, 2012

## 2. Electromagnetic Interference Theory

Electromagnetic fields are a combination of electric fields associated with a voltage source and magnetic fields associated with current flowing through a conductor. These fields increase in strength with voltage and current.

Radio system interference may occur when a wind turbine is located in such a way as to induce an unwanted disturbance to radio waves propagated between a signal source and signal receiver. The interference may occur by way of radiation of electromagnetic energy by the turbine within the operating band of the radio system, diffraction or partial reflection of the radio system signal by the turbine tower and rotor.

The following sections briefly describe the various types of interference that may impact existing operational telecommunications services in the vicinity of the wind farm development area to provide context to the specific findings identified in Section 4 of this report.

### 2.1 Radiation of Electromagnetic Energy

Electromagnetic interference potentially occurs when the wind turbine electrical infrastructure radiates energy with a frequency within the operating frequency of a radio communications system.

Turbines supplied within Australia are required to be compliant with electromagnetic compatibility as defined in relevant Australian Standards. As a result of complying with these standards, the electromagnetic interference due to radiation is negligible.

Battery storage inverters, synchronous condensers, and transformers may cause interference to radio signals due to the emission of electromagnetic fields. These electric fields typically propagate over very short distances (tens of metres) and are limited to “near-field” effects.

### 2.2 Diffraction

Diffraction occurs when the wind turbine infrastructure is positioned such that the signal of a radio communications system is partially or temporarily blocked causing a reduction in the signal power at the radio signal receiver.

For point-to-point radio systems it is understood that the radio signal travels on a path between the signal source and signal receiver defined by an ellipsoid area known as the Fresnel zone.

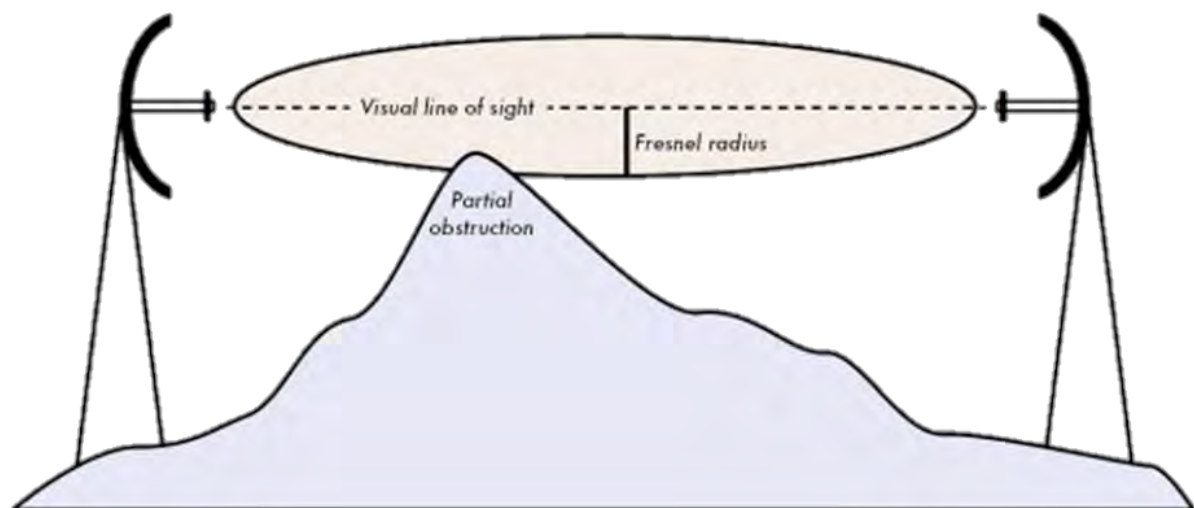


Figure 1 Fresnel Zone over the Radio Path<sup>1</sup>

The Fresnel zone is defined as the locus between two points, such as a radio transmitter and receiver, where the indirect ray path length from the point T to point R is multiple of the half-wavelength distance of the radio signal. Refer to Figure 2 and Figure 3 for further details.

<sup>1</sup> Source: Visiwave™, [http://www.vias.org/wirelessnetw/wndw\\_04\\_08b.html](http://www.vias.org/wirelessnetw/wndw_04_08b.html)

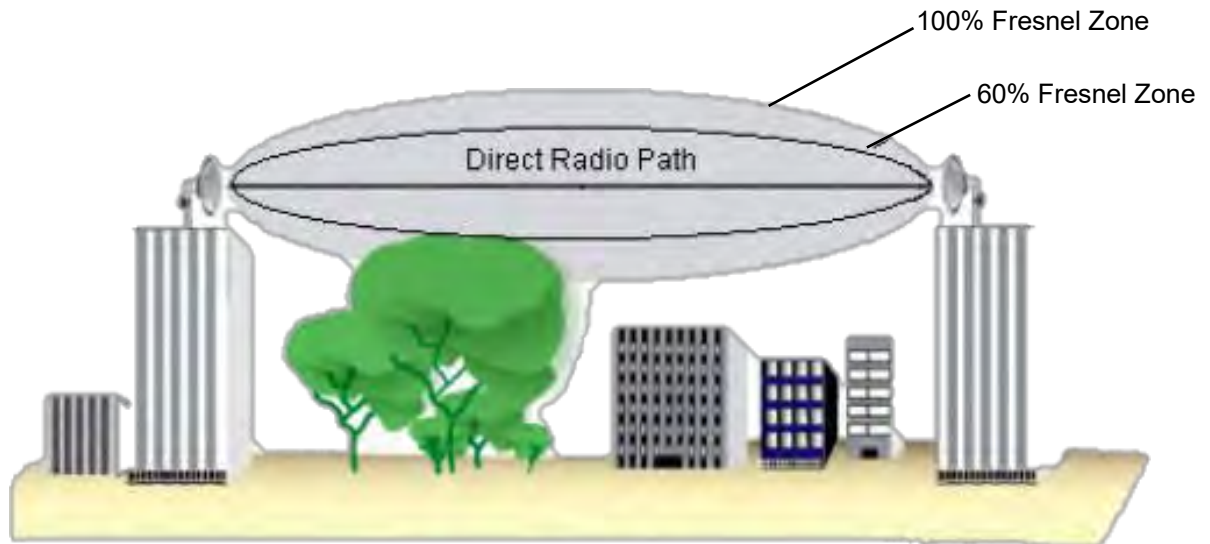


Figure 2 Fresnel Zone Clearance Criteria<sup>2</sup>

In the presence of an obstruction between the signal source and the signal receiver, it is generally accepted that an obstructed path provided with 60% clearance of the first Fresnel zone will operate without degradations to the communications system.

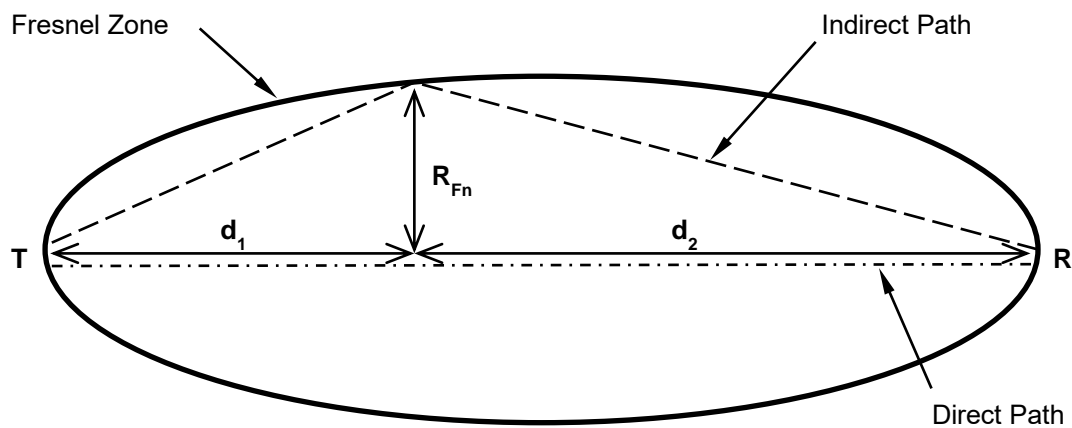


Figure 3 Fresnel Zone Calculation<sup>3</sup>

The Fresnel zone is defined by the formula:

$$R_{Fn} = \sqrt{\frac{n\lambda d_1 d_2}{d_1 + d_2}} \quad (1)$$

$R_{Fn}$  = the nth Fresnel Zone Radius in metres

$n$  = the nth Fresnel zone

$\lambda$  = the wavelength of the transmitted signal in metres

$d_1$  = the distance from T in metres

$d_2$  = the distance from R in metres

F1 may be used to describe the first Fresnel zone between two points. F1 may also be described as the 100% Fresnel zone. In this case, F2 is the second Fresnel zone or the 200% Fresnel zone.

<sup>2</sup> Rat River Technologies, [http://www.ratrivertech.ca/archives/tools/fresnel\\_zone\\_clearance\\_calculator.htm](http://www.ratrivertech.ca/archives/tools/fresnel_zone_clearance_calculator.htm)

<sup>3</sup> Fixed-Link Wind Turbine Exclusion Zone Method, D F Bacon, Radio Communications Agency

According to D F Bacon [Ref 4] it is recommended to design the geographic wind turbine layout such that all infrastructure including turbine blades are located outside the second Fresnel zone of all point-to-point radio systems.

The second Fresnel zone defines the region where an object such as a wind turbine may cause a reflected signal to be transmitted to the receiver at a half wavelength ( $180^\circ$ ) out of phase with the direct ray causing maximum interference potential.

The drawings included in Appendix B plot the ray-line (direct line of sight) and the second Fresnel zone for selected (high-risk) links.

## 2.3 Reflection

Reflection occurs when the wind turbine infrastructure is positioned such that the incident ray of a radio communication system is partially or temporarily reflected from its normal path of propagation. The complex geometrical design of the wind turbine causes the reflected signals to be dispersed or 'scattered' over a wide angle. These reflections have the potential to generate destructive interference to the radio signal resulting in signal power reduction or unwanted duplication of the radio signal as seen in Figure 4.

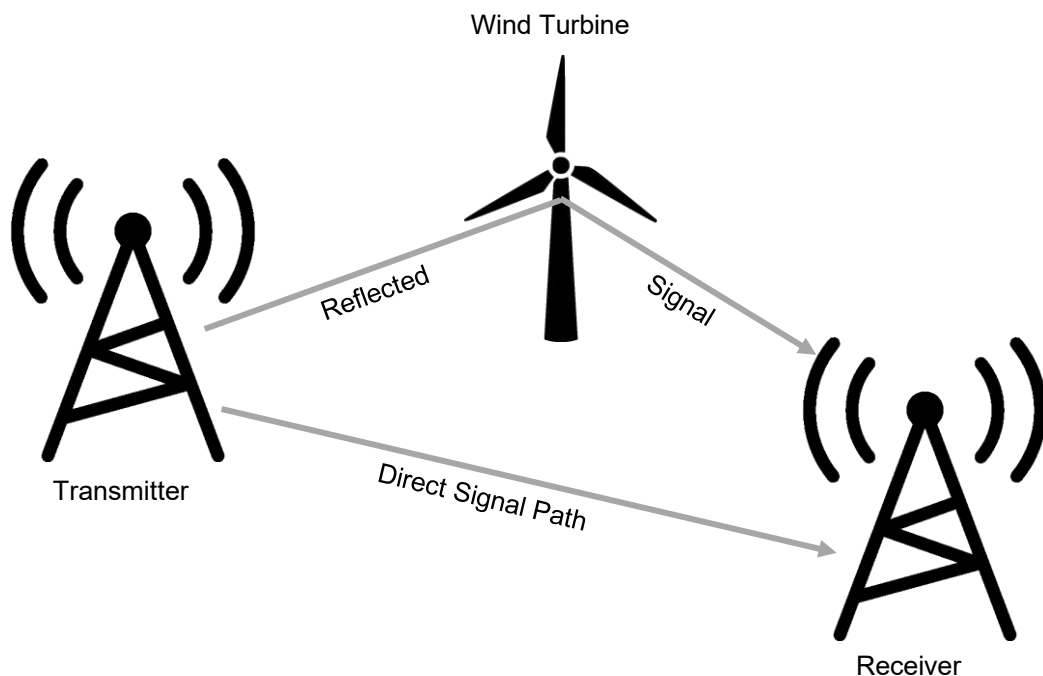


Figure 4 Reflection of Radio Signals by Wind Turbine Infrastructure<sup>4</sup>

At the boundary of the second Fresnel zone, any reflected wave will be  $180^\circ$  out of phase with the direct signal, which can lead to cancellation effects at the receiver. As such, any turbine located along (and near) the F2 boundary has the potential to significantly degrade a radio link.

<sup>4</sup> Kordia, Manhinerangi Wind Farm EMI Report



## 2.4 Scattering

Wind turbines have been observed to cause interference by scattering the incident signal. Scattering is described as either 'forward' or 'back' and is depicted in Figure 5 below.

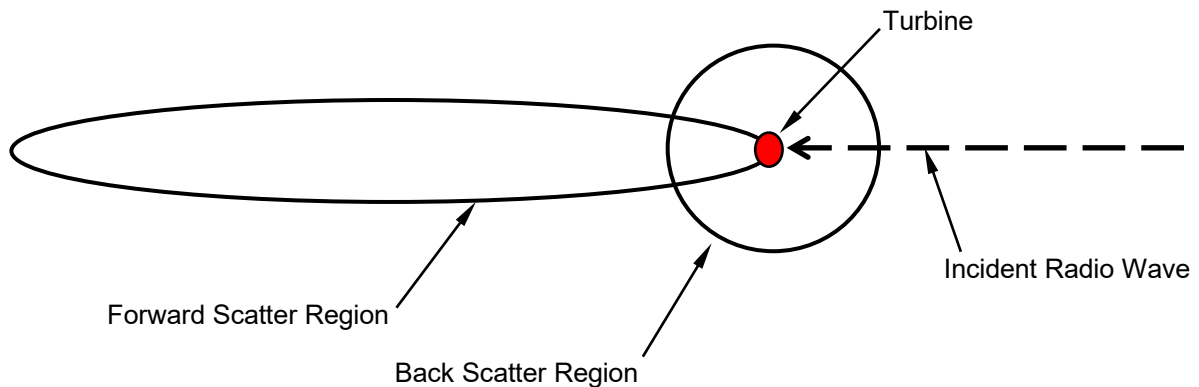


Figure 5 Scattering of Radio Signals by Wind Turbine Infrastructure

The forward scatter region is significant and can extend as far as 5 km forward of the wind turbine. Where the receiver is in direct line of sight of a turbine, but shielded from a direct signal from the transmission tower, the forward scatter region may extend beyond 5 km. The back scattering region created by the incident signal is generally less than 1 km from the turbine.

## 2.5 Near Field Effects

Wind turbine infrastructure located close to a radio communication system, such as within the near field of the radiating antenna, can detrimentally affect the normal radiation pattern of the antenna, causing unwanted signal power reductions to the radio system service area. The result is an alteration of the antenna's impedance.

Typical near-field exclusion zone radius are:

- 2 metres for low band VHF paging systems (i.e. under 50 MHz)
- 20 metres for UHF, LMR and cellular sites (i.e. up to 2.5 GHz)
- 720 metres for point-to-point microwave radio links (in the direction of the link)

Existing transmitters and microwave point to point links in the vicinity of the proposed wind farm have been analysed to aid in turbine micro-siting activities to mitigate the near field effects so that turbines should not be placed in paths of known microwave links. Future transmitter installations should be built outside the exclusion zones noted above. In the case of future PTP microwave links, antennas can be installed within 720 meters of a turbine, but the alignment of the link must be engineered to not point at a turbine.

### 3. Guidelines and Codes

Wind farm developments in Victoria are informed by the *Policy and Planning guidelines for Development of Wind Energy Facilities in Victoria*<sup>5</sup> which aim to inform wind farm developers and Council planners an acceptable level of documentation that wind farm developers must provide. The guidelines also suggests a higher standard of development detail that exceeds the minimum requirements and supports a best practice approach.

The Victorian Department of Environment, Land Water and Planning published guidelines state that the potential for electromagnetic interference from the generation of electricity from a wind energy facility should be minimised, if not eliminated, through appropriate turbine design and siting. The siting of wind turbines in the “line of sight” between transmitters and receivers should be avoid.

Additionally, a *Draft National Wind Farm Development Guidelines*<sup>6</sup> document was created in July 2010 by a working group coordinated by The Environment Protection and Heritage Council of Australia and New Zealand. *Section F – Electromagnetic Interference*, of this guideline details the issues addressed in this EMI assessment and references the relevant Australian Standards and publications surrounding EMI caused by wind farm developments in Australia.

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<sup>5</sup> Victoria State Government Department of Environment, Land, Water and Planning: Policy and Planning Guidelines of Wind Energy Facilities in Victoria, DELWP November 2021

<sup>6</sup> Draft National Wind Farm Development Guidelines, Environment Protection and Heritage Council of Australia and New Zealand, EPHC July 2010

## 4. Analysis of Development Impact

### 4.1 Methodology

Information on radio sites and services in the proximity of the proposed Warracknabeal Energy Park have been obtained from the ACMA Radio Communications Licence Database, covering an area of approximately 50 km radius from the centre of the provided project boundary. This distance is sufficient to capture any potential point-to-point links traversing the development area.

Where point-to-point links have been identified, the Second (200%) Fresnel Zones have been modelled in purple (see Figure 6) to denote an area in which no part of the wind turbine should enter (including the blade extents).

Near-field exclusion zones, (areas in proximity to a radio transmitter which would cause excessive reflections back to the transmitter) have been calculated for radio sites that sit within 3 km of the current site. The current layout shows no wind turbines enter these exclusion zones.

This assessment also includes the impact of 50 Hz electromagnetic radiation which can be caused by high-voltage transmission lines.

### 4.2 Radio System Search

In June 2022, a search was conducted on the Australian Communications and Media Authority (ACMA) radio communications database to identify all licensed radio systems, operating on the frequency above 30 MHz, within 50 km radius from the centre of the proposed wind farm development. Additional radio frequency information was accessed from The Australian Mobile Telecommunications Association's (AMTA) and the Radio Frequency National Site Archive (RFNSA). This search was conducted in accordance with the methodology stated in Section F of the Draft National Wind Farm Development Guidelines.

The results of the ACMA radio communications data extraction were reviewed and presented in graphical format depicting the radio site locations and ray-lines of the radio systems within the vicinity of the wind farm. The map was refined to only show those radio sites and services with the potential impact for radio-interference caused by the proposed wind farm development.

This method does not determine the impact on users of class licence services, as these services are operated on shared frequencies, can be used by member of public, and are not listed within the ACMA database.

The resulting map (for point-to-point radio links) is presented in Appendix B

### 4.3 Assumptions

On 23rd of March 2022, Warracknabeal Energy Park Pty Ltd had provided GHD the indicative location of the 211 wind turbines, including the turbine dimension: rotor diameter of up to 200m, overall tip height of up to 280m and ground clearance of not less than 50m. GHD has notified consulted organisations, and their feedbacks shown in Appendix C.

### 4.4 Radio Technology Review

The following radio systems are considered in this assessment:

- Fixed point-to-point radio systems (Point-to-Point links and Point-to-Multipoint links),
- Land Mobile Radio Systems,
- Digital Television Broadcast,
- AM/FM Radio Narrowcast and Broadcast,
- Mobile Telephone and Broadband Internet Broadcast,
- Aircraft Communications Systems,

- Meteorological Radar,
- Defence Radio Systems,
- Trigonometrical Systems, and
- Maritime Radio Systems.

Radio services below 30 MHz, including AM Radio Broadcast services, were excluded from this assessment as the propagation characteristics of the radio wave does not rely on direct-ray transmission characteristic between the transmitting and receiving antennas. e.g. AM radio broadcast services, operating within the Medium Frequency band of 300 kHz – 3 MHz, relies on ground wave (surface wave) propagation.

## 5. Fixed Point-to-Point Radio Systems

Wind turbines can heavily impact point-to-point radio systems, but the mitigation method is uncomplicated. To avoid the wind turbines downgrading or impacting the service, turbines should not block the exclusion zones of the microwave links. When determining final wind turbine locations, the 200% Fresnel zone (Second Fresnel Zone) shown across the site boundary are considered exclusion zones.

### 5.1 Point-to-Point Microwave Link

The point-to-point radio systems within 50 km radius of the centre of the proposed wind farm are shown on Appendix B – Figure 1 and are listed on Appendix D – Table 5. The exclusion zones of each point-to-point links are shown on Figure 2 of Appendix B.

The current turbine layout shows no turbines that sit inside the point-to-point links' exclusion zones. The closest distance between a turbine's blade tip (at turbine T083) to the second Fresnel zone of a point-to-point link is approximately 300m. GHD does not foresee any electromagnetic interference impact that would degrade the radio signal to point-to-point radio systems as a result of the project.

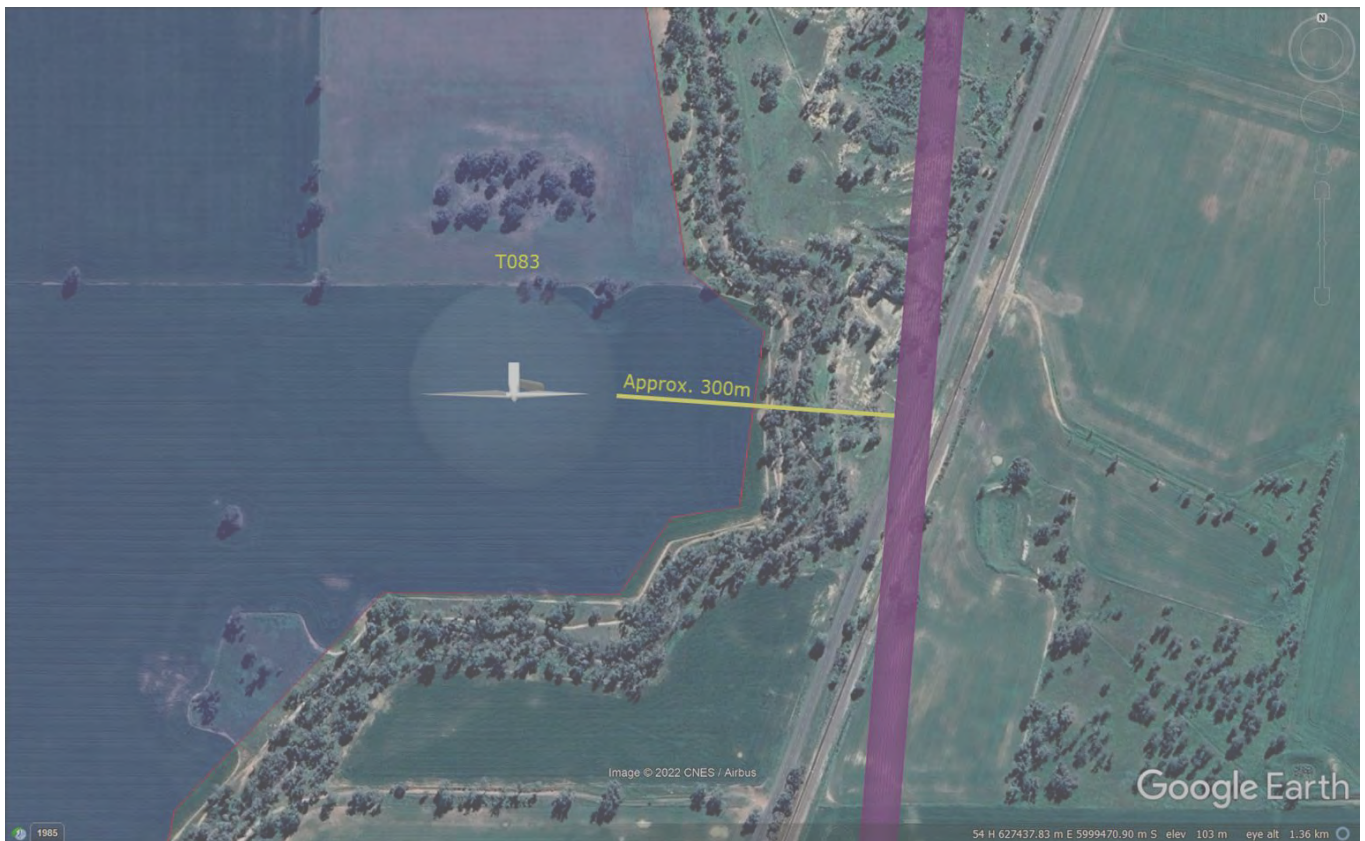


Figure 6 The distance between turbine (T083) to the second Fresnel zone of the point-to-point link (License 10459359/1)

### 5.2 Fixed Point-to-Multipoint Microwave Link

The point-to-multipoint radio systems within 50 km radius of the centre of the proposed wind farm are shown on Appendix B – Figure 1 and are listed on Appendix D - Table 6. The point-to-multipoint transmitters are located further than 20 km from the closest proposed turbine locations. GHD does not foresee any electromagnetic interference impact that would degrade the radio signal to point-to-multipoint radio systems as a result of the project.

## 6. Land Mobile Radio Systems

A land mobile radio system (LMRS) is a person-to-person voice communication system with the transmitter and receiver in one unit. It can be stationary (base station units), mobile (installed in vehicles), or portable (handheld walkie-talkies). In Australia, most land mobile radio systems operate in the VHF Mid Band (70-87.5 MHz), VHF High Band (148-174 MHz), and 400 MHz band<sup>7</sup> which are at a low frequency spectrum and unlikely to be affected by the wind turbines.

Most land mobile radio systems are used exclusively for public safety organisations such as police, firefighters, and other emergency response organisations. The systems are quite resilient as they usually operate on specific reserved frequencies.

The land mobile radio systems within 50 km radius of the proposed wind farm are shown on Appendix B – Figure 3 and are listed on Appendix D - Table 7. There are no LMR transmitters located within 20 m of the current turbine layout, therefore GHD does not foresee any electromagnetic interference impact that would degrade the radio signal to LMRS as a result of the project.

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<sup>7</sup> <https://www.acma.gov.au/technical-details-land-mobile-licences> Technical details for land mobile licences | Accredited persons | ACMA

## 7. Digital Television Broadcast

Wind farms have the potential to cause signal degradation to TV reception due to scattering, diffraction and near field effects. In Australia, analogue television broadcasting ceased on 10 December 2013<sup>8</sup>, so only digital television broadcasting systems are assessed in this report.

Digital television is not susceptible to visible “ghosting” degradation as was experienced from analogue broadcasts; any impact of reflections from the turbines would be a minor reduction of coverage at the limit of the service area. However, the signal can be degraded when the receivers are already at the border of the television reception zone or when the receiver is located within approximately 2 km of the wind farm, in the range affected by scattering of signals off the turbines. The most significant effect occurs when the receivers are near the wind farm and in the line of sight of the turbines but not in the line of sight of the television transmitter.

The zone of potential interference for a wind farm on digital television broadcast is the resultant total of the individual turbines' effects. The International Telecommunications Union Recommendation ITU-R BT.1893<sup>9</sup> states that impacts beyond 10 km from a wind farm are unlikely.

Local digital television broadcast sites within 50 km radius of the proposed wind farm are shown on Appendix B – Figure 4 and are listed on Appendix D - Table 8.

The scattering effect from the wind turbines to radio signals from the Warracknabeal digital television transmitter is shown on Appendix B – Figure 5. The scattering effect from the wind turbines to radio signals from the Ballarat digital television transmitter is shown on Appendix B – Figure 6.

MySwitch data shows coverage of terrestrial digital television transmitters around the wind farm area, the signal propagating through the northern part of the proposed wind farm development is negligible and not likely usable for receptors. On the other hand, the signal propagating through the southern part of the proposed wind farm is well covered from four transmitters (Nhill transmitter from the east, Warracknabeal transmitter from the west, Ballarat transmitter from the southeast and Horsham transmitter from the southwest). The dwellings around the southern part of the wind farm area have options to choose the transmitter that provide the best signal for them.

There is also a possibility that the dwellings around the wind farm area are already use Viewer Access Satellite Television (VAST). The service is designed for television and radio services to viewers in Australia's remote areas who have no access to terrestrial broadcasts. The wind farm development will not have an impact on VAST television services.

There is a small possibility that some receptors may utilise the terrestrial television even with inadequate coverage using tall towers and high gain antennas. For these receptors, there may be signal degradation where signals pass through the wind farm.

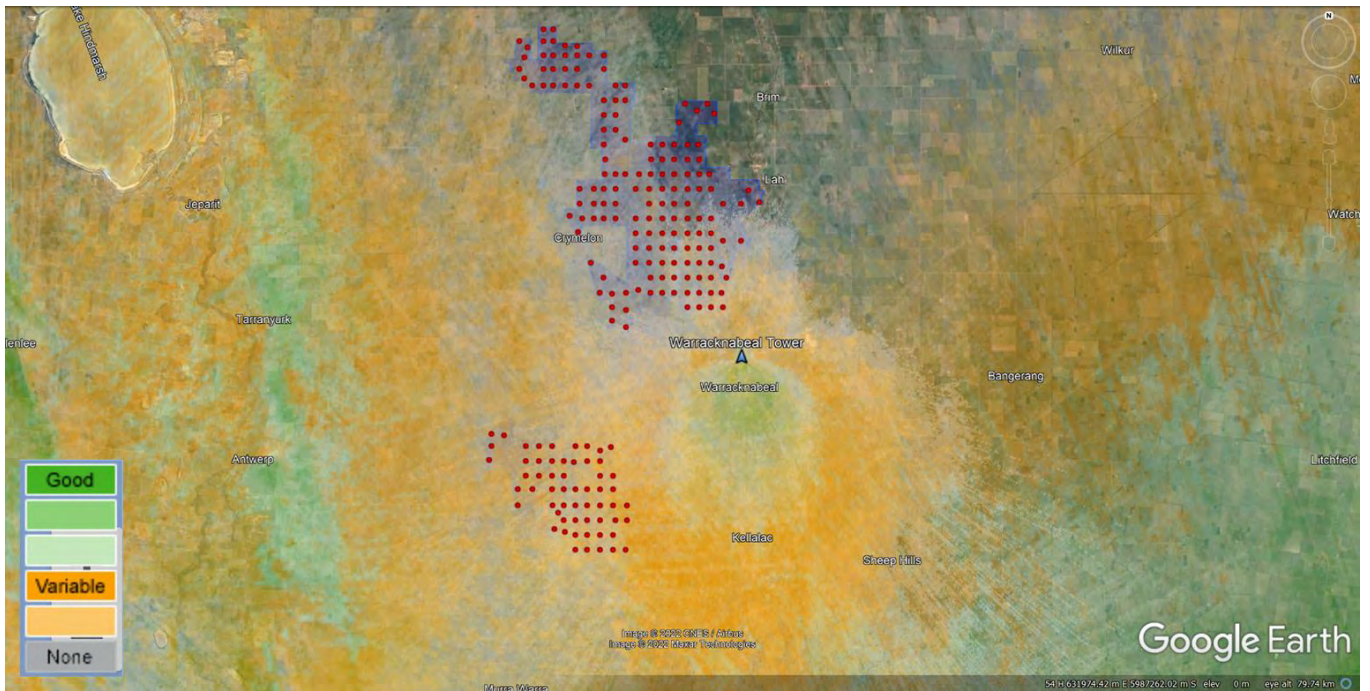
Dwellings identified in the scatter zones could be transferred to the VAST system if signal degradation occurs. It is expected that all the houses in the wind farm vicinity are already using the VAST service and that no dwellings will be impacted. Thus the scatter zones defined in Appendix B are shown for information only as no impact is expected.

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<sup>8</sup> <https://www.acma.gov.au/sites/default/files/2019-08/Chapter-4.docx>

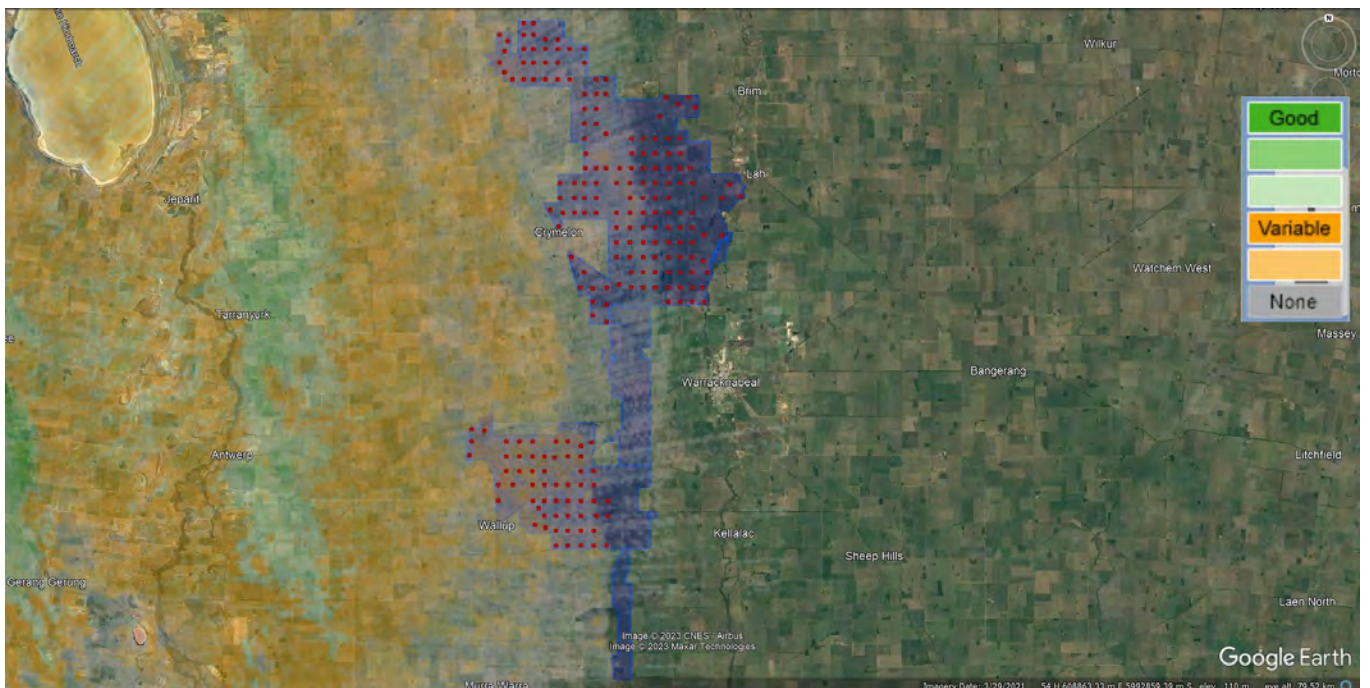
<sup>9</sup> International Telecommunications Union Recommendation ITU-R BT.1893, Assessment of impairment caused to digital television reception by a wind turbine





**Figure 7** *Estimated terrestrial television coverage around the wind farm area*

Figure 7 shows expected television broadcast coverage zones by digital television transmitters around the wind farm, indicated from dark green as the strongest signal levels to light orange as marginal signal level. Proposed wind turbine locations are indicated as red dots. The area around the wind farm is well covered by existing television broadcast tower, except the north of the northern part of the wind farm.

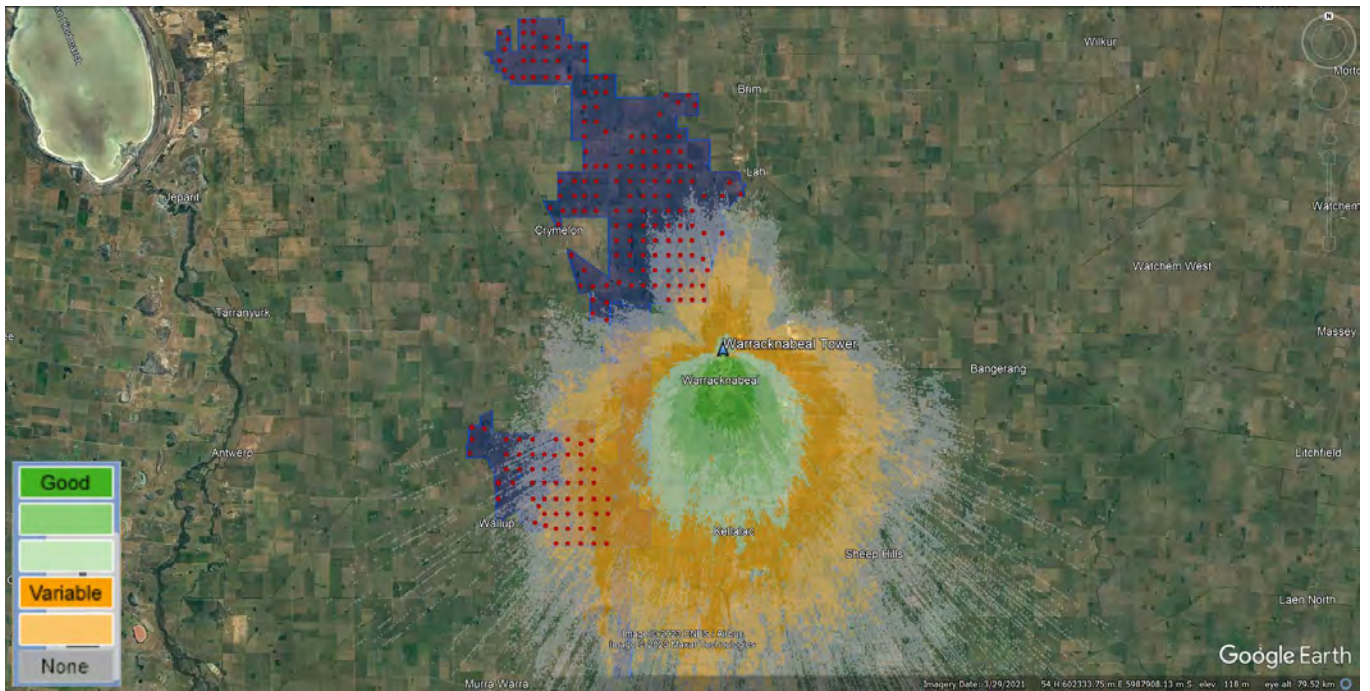


**Figure 8** *Estimated terrestrial television coverage from Nhill transmitter at Lawloit*

Figure 8 shows expected television broadcast coverage zones by the Nhill television transmitter at Lawloit, indicated from dark green as the strongest signal levels to light orange as marginal signal level. Proposed wind turbine locations are indicated as red dots.

Whilst some dwellings are residing on the east side of the proposed wind farm area, the coverage from this digital television transmitter does not cover them. Therefore, the wind farm development will not degrade the signal from the Nhill digital television transmitter at Lawloit.

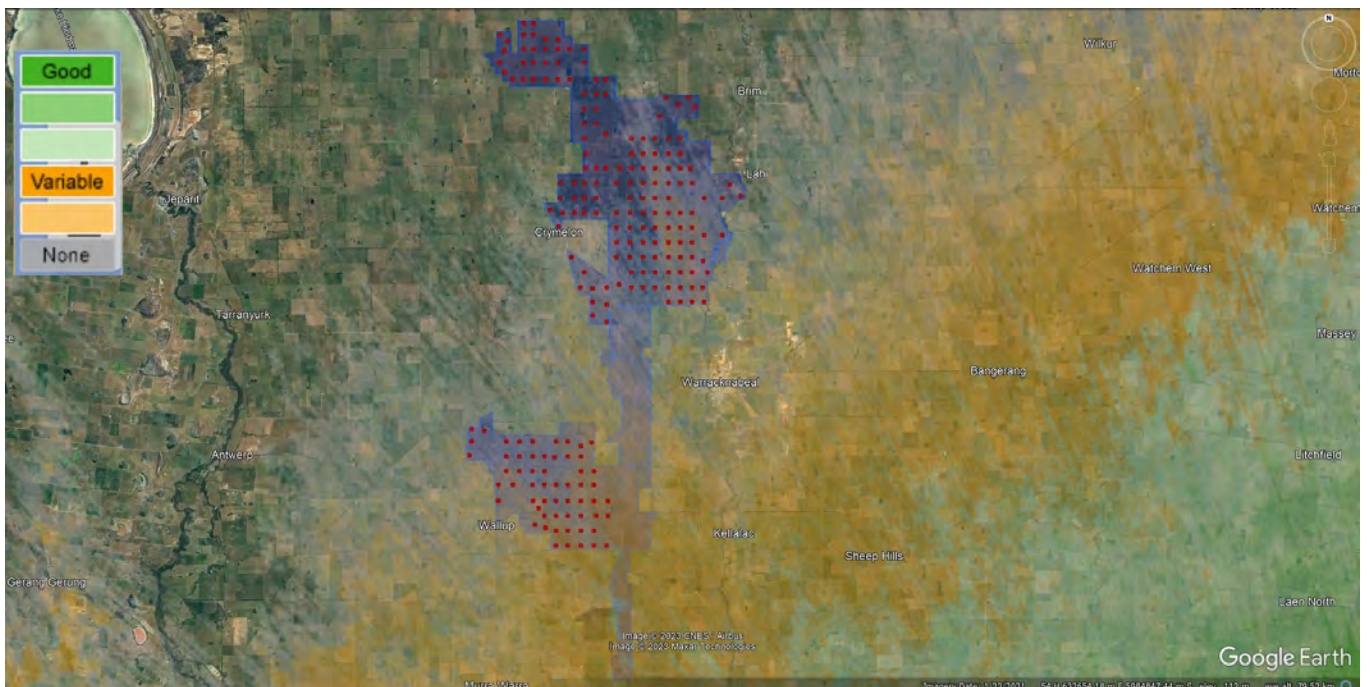




**Figure 9** *Estimated terrestrial television coverage from Warracknabeal transmitter at Warracknabeal*

Figure 9 shows expected television broadcast coverage zones by the Warracknabeal television transmitter at Warracknabeal, indicated from dark green as the strongest signal levels to light orange as marginal signal level. Proposed wind turbine locations are indicated as red dots.

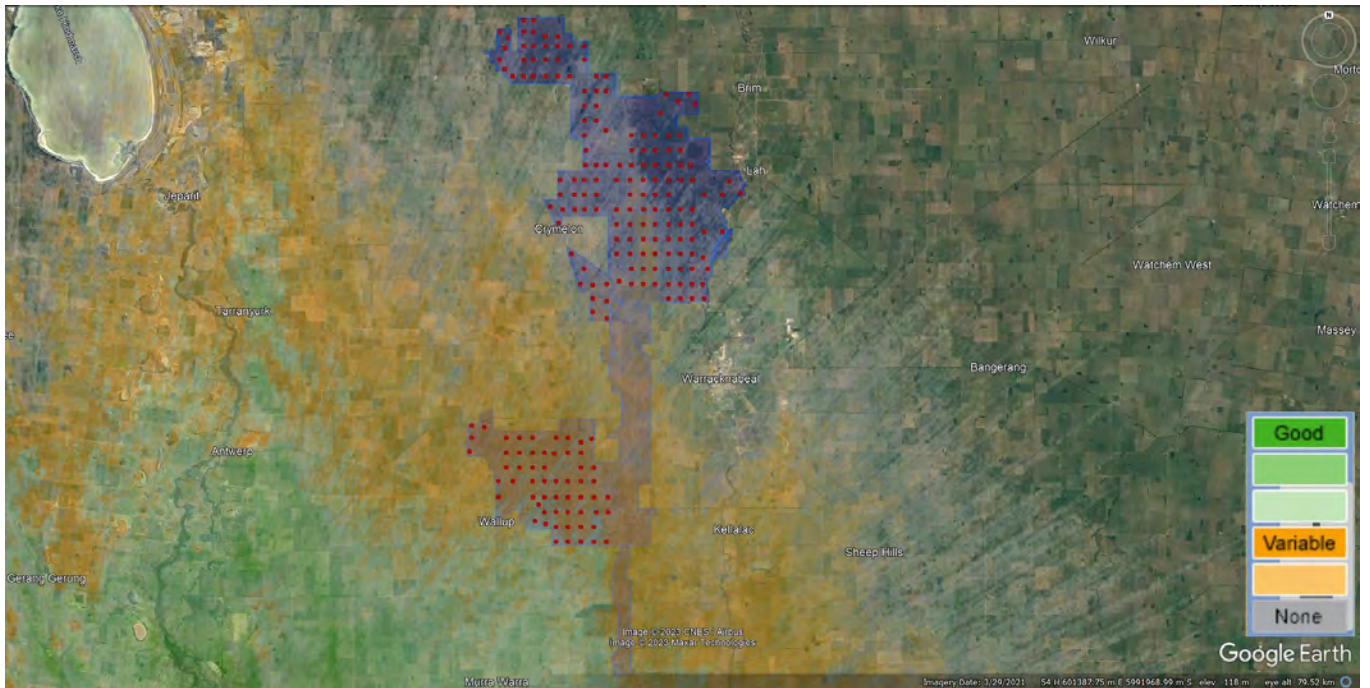
Whilst some dwellings are residing on the southwest side of the proposed wind farm area, the signal from the digital television transmitter might be degraded, but the dwellings can utilise the signal from Horsham digital television transmitter instead.



**Figure 10** *Estimated terrestrial television coverage from Ballarat transmitter at Lookout Hill*

Figure 10 shows expected television broadcast coverage zones by the Ballarat television transmitter at Lookout Hill, indicated from dark green as the strongest signal levels to light orange as marginal signal level. Approximated proposed wind turbine locations are indicated as red dots.

Whilst some dwellings are residing on the east of the proposed wind farm area, the coverage from this digital television transmitter does not cover them. Therefore, the wind farm development will not degrade the signal from the Ballarat digital television transmitter at Lookout Hill.



**Figure 11** *Estimated terrestrial television coverage from Horsham transmitter at Arapiles*

Figure 11 shows expected television broadcast coverage zones by the Horsham television transmitter at Arapiles, indicated from dark green as the strongest signal levels to light orange as marginal signal level. Approximated proposed wind turbine locations are indicated as red dots.

Whilst some dwellings are residing on the northeast side of the proposed wind farm area, the coverage from Horsham digital television transmitter is marginal to none. For dwellings between the northern grouping and the southern grouping of turbines, the signal from the Horsham digital television transmitter may be slightly reduced, however the dwellings can utilise alternative transmissions from Warracknabeal digital television transmitter, and Ballarat digital television transmitters.



## 8. AM / FM Narrowcast and Broadcast

Overseas and local experience indicates that radio reception is unlikely to be affected by operating wind farms. AM signals are not affected due to their low frequency resulting in a wavelength large enough relative to the turbine to not be affected by it. The majority of FM services transmitting in the vicinity of the wind farm are narrowcast services not focussed on servicing the wind turbine area.

Broadcast FM services are in a low frequency range and hence they are more resilient to disturbances. There is a minor chance of signal degradation for services broadcast for receivers in the immediate vicinity of the wind farm.

Some AM / FM narrowcast and broadcast sites within 50 km radius of the proposed wind farm are shown on Appendix B – Figure 4 and are listed on Appendix D - Table 8.

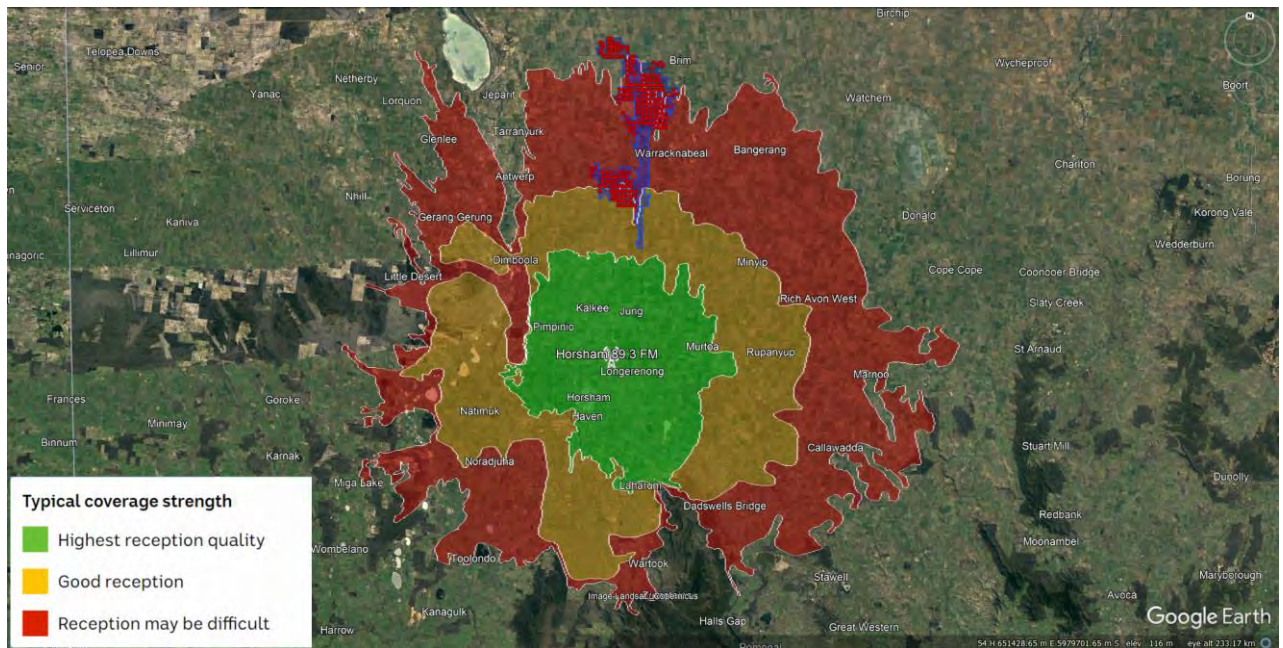


Figure 12 Horsham AM/FM Radio Transmitter Coverage

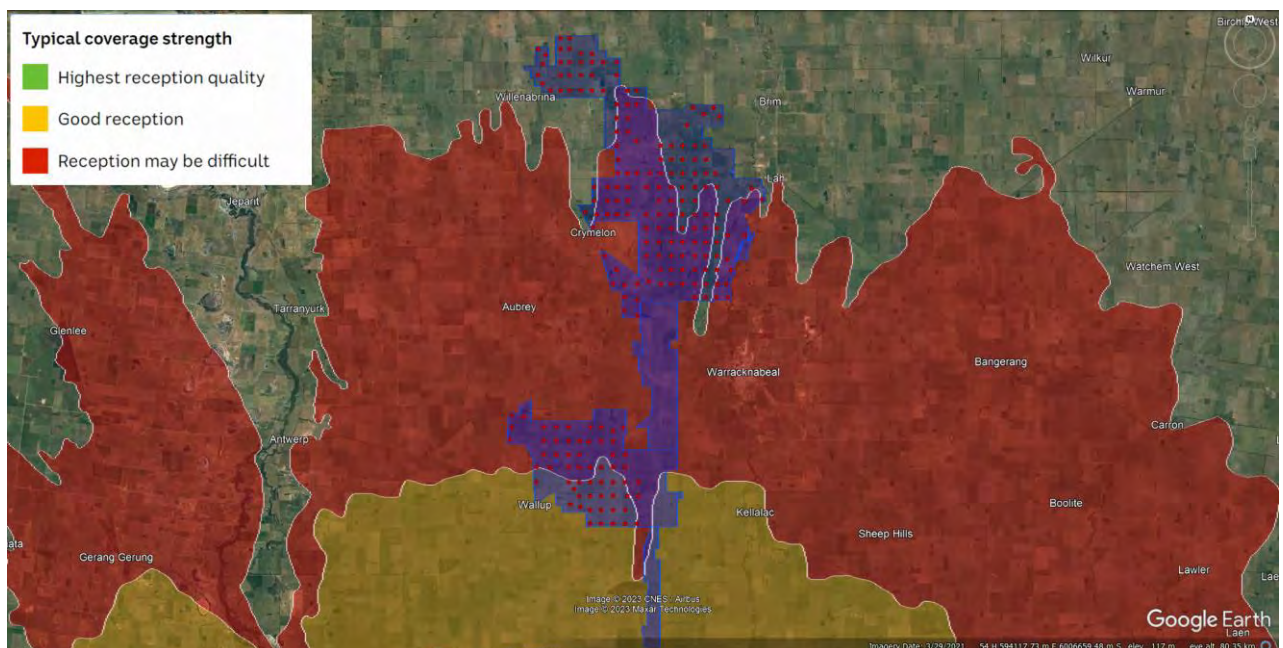


Figure 13 Horsham Am/FM Radio Transmitter Coverage (Zoom in)

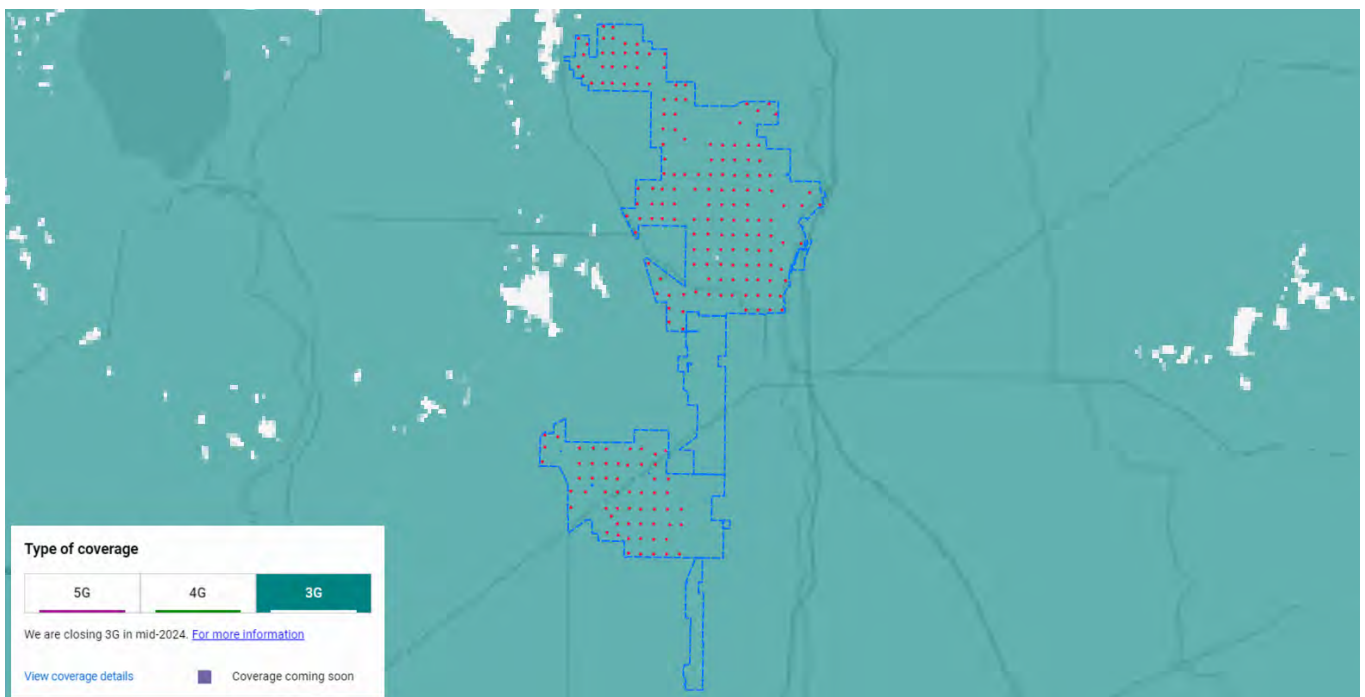
Figure 12 and Figure 13 show that while existing ABC's AM and FM reception are unlikely to experience significant effects from the current turbine locations, minor degradation may be experienced if dwellings are located in the middle of the group of turbines at the southern part of the wind farm area.

## 9. Mobile Telephone and Broadband Internet Broadcast

Cellular mobile phone technologies provide robust communications in areas of significant obstruction via multipath communications between customer equipment and the network base station sites. The four carrier networks (Telstra, Optus, Vodafone and NBN fixed wireless) have transmitter sites covering the main population areas around the greater wind farm area.

Interference to cellular phone coverage and NBN fixed wireless coverage is anticipated to be minimal except for those operating close to the proposed wind farm infrastructure (such as maintenance staff), or where existing coverage is already inadequate according to the carrier's publicly available coverage maps.

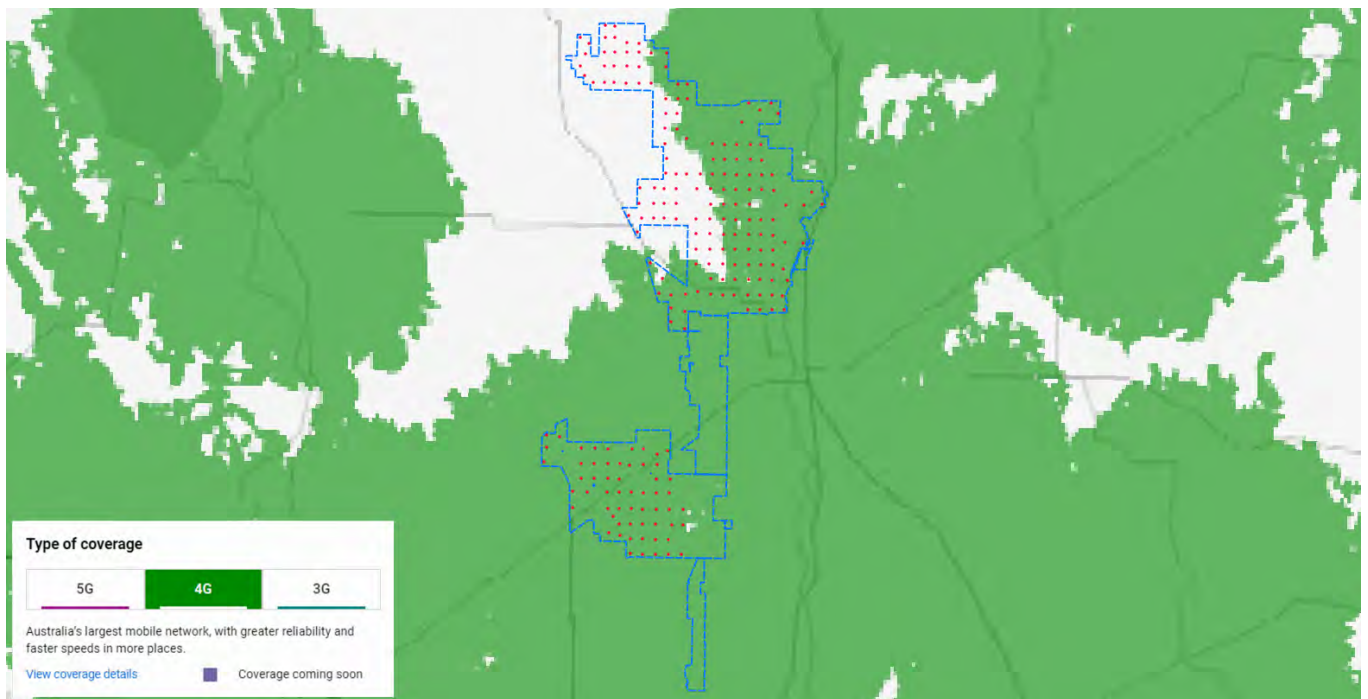
Mobile telephone and fixed wireless broadband sites within 50 km radius of the proposed wind farm are shown on Appendix B – Figure 7 and are listed on Appendix D - Table 9



**Figure 14** *Telstra 3G Coverage near the wind farm area*

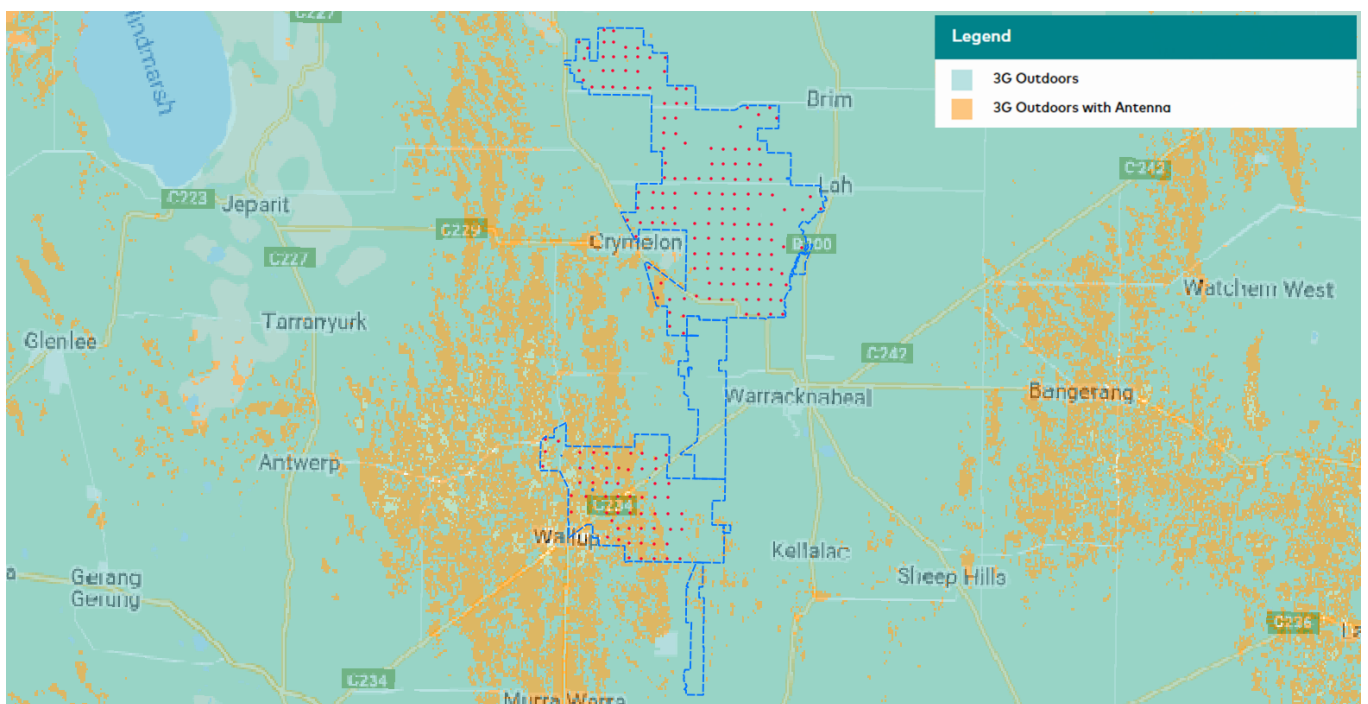
Figure 14 shows existing Telstra 3G coverage around the wind farm area, with aqua overlay defining estimated available signal with the wind farm boundary area shown in blue. The marginal regions of the wind farm may be slightly affected directly beneath and around the turbines to the Telstra 3G signal. Note that Telstra 3G services are expected to be closing mid-2024.





**Figure 15** *Telstra 4G Coverage near the wind farm area*

Figure 15 shows existing Telstra 4G coverage around the wind farm area, with green overlay defining estimated available signal with the wind farm boundary area shown in blue. The marginal regions of the wind farm may be slightly affected directly beneath and around the turbines. No Telstra 5G coverage is available in the vicinity of the wind farm.



**Figure 16** *Optus 3G Coverage near the wind farm area*

Figure 16 shows existing Optus 3G coverage in the wind farm area as per coloured legend with the wind farm boundary area shown in blue. The marginal regions of the wind farm may be slightly affected directly beneath and around the turbines to the Optus 3G signal.

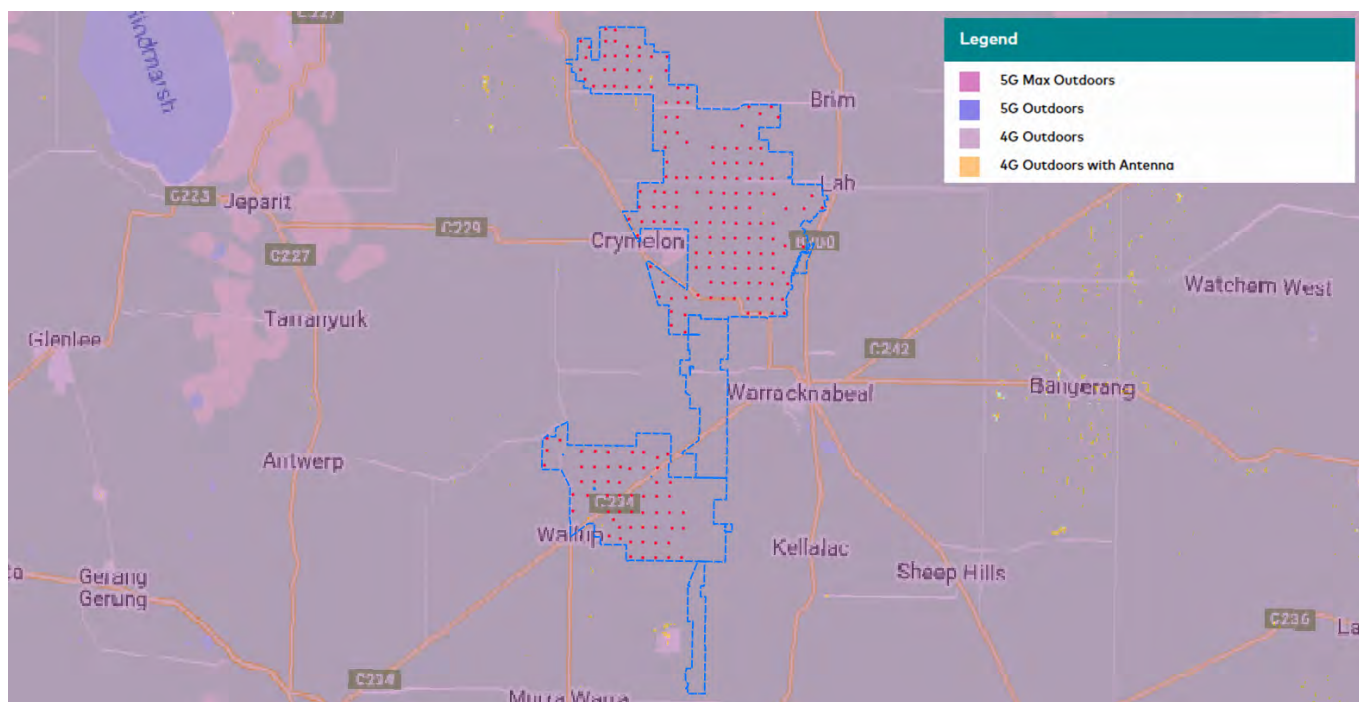


Figure 17 Optus 4G / 5G Coverage near the wind farm area

Figure 17 shows existing Optus 4G / 5G coverage in the wind farm area as per coloured legend with the wind farm boundary area shown in blue. The whole regions of the wind farm may be slightly affected directly beneath and around the turbines to the Optus 4G signal. (No Optus 5G coverage in the vicinity of the wind farm area)

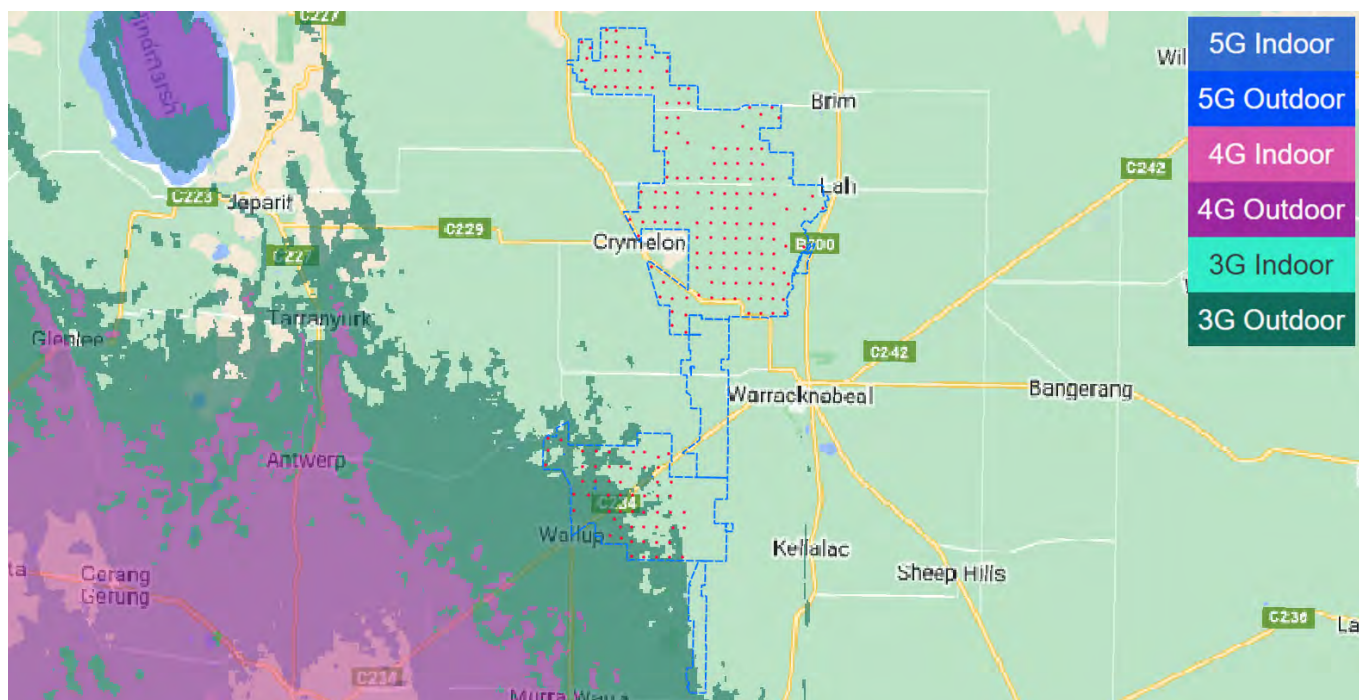
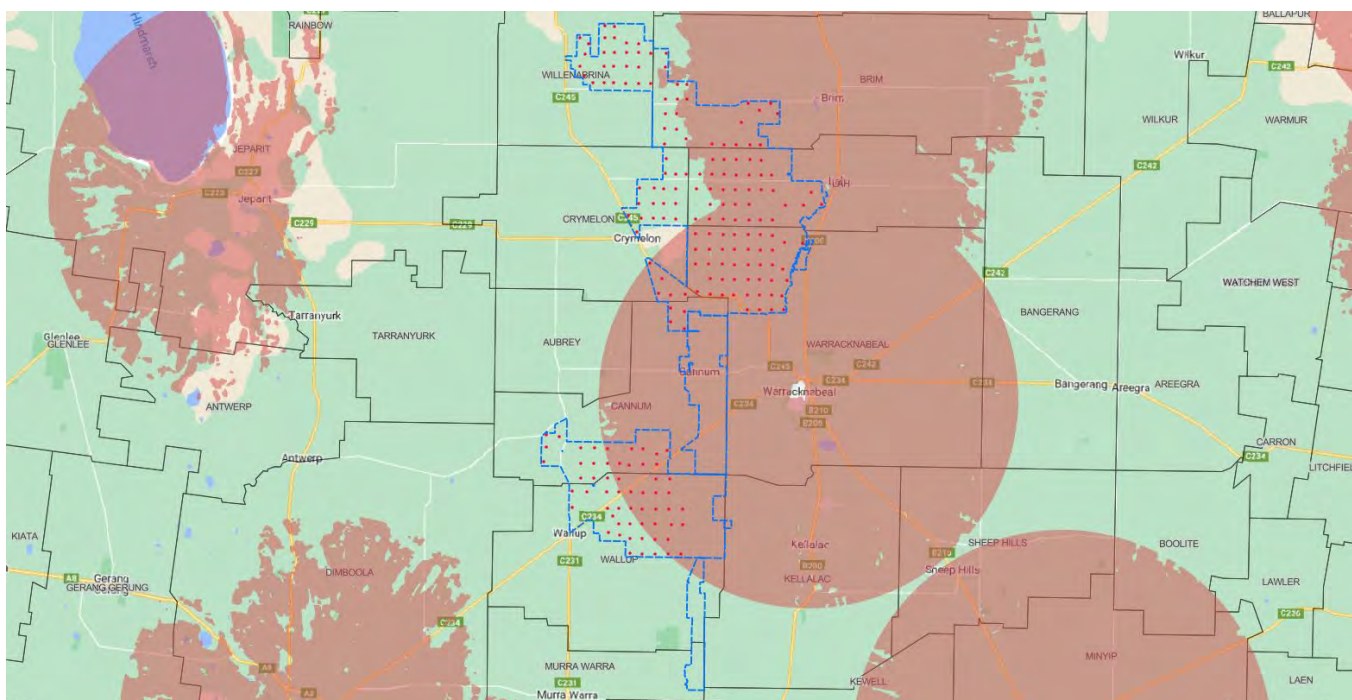


Figure 18 Vodafone mobile Coverage near the wind farm area

Figure 18 shows existing Vodafone coverage in the wind farm area as per coloured legend with the wind farm boundary area shown in blue. The marginal regions of the wind farm may be slightly affected directly beneath and around the turbines to the Vodafone 3G signal.





**Figure 19** *NBN Fixed Wireless Coverage near the wind farm area*

Figure 19 shows NBN fixed wireless coverage in red with the wind farm boundary area shown in blue. The marginal regions of the wind farm may be slightly affected directly beneath and around the turbines to the NBN fixed wireless signal.



## 10. Aircraft Communications Systems

Wind farms have the potential to disturb navigational signals, which can distort the accuracy of the aircraft positioning systems and introduce 'false targets'.

The Aircraft communications systems within 50 km radius of the proposed wind farm are shown on Appendix B – Figure 8 and are listed on Appendix D - Table 10.

Warracknabeal Aerodrome VHF Airband CTAF operates on 126.7 MHz and a NAVAID (WKB) on 209 MHz. These transmitters are located approximately 9 km to the nearest turbine, the wind farm's effect on navigation signals will be negligible. The service will not be impacted unless the ground receiver is next to a turbine, blocking the line of sight from an aircraft to the airport. In this case, there may be a reduction in signal quality, however the likelihood of this for non-windfarm related maintenance aircraft is negligible.

However, the National Airport Safeguarding Framework: Guideline D recommends that "When wind turbines over 150 metres above ground level are to be built within 30 km of a certified or registered aerodrome, the proponent should notify the Civil Aviation Safety Authority (CASA) and Airservices." GHD understands that a separate aviation impact study has been undertaken to assess the impact of the wind farm on the navigation systems and radar at Warracknabeal airport.

## 11. Meteorological Radar

The meteorological radar is a critical radio infrastructure operated by the Bureau of Meteorology (BoM). It provides data to be computationally analysed and give a precise prediction on the wind speeds and weather conditions around the radar. The radar typically has capability to indicate the weather at 250 km or more. The meteorological radar is also called the weather watch radar.

The Meteorological radar within 50 km radius of the proposed wind farm is shown on Appendix B – Figure 9 and is listed on Appendix D - Table 11

The Rainbow radar is a C-Band radar, located approximately 20 km to the proposed wind farm. By this distance, the proposed wind farm is likely to impact the capability of the Rainbow radar. There are no other weather watch radars that can be utilised to minimise the impact that the wind farm will cause the Rainbow radar.

Initial consultation with the BoM has indicated that the current location of the wind farm will put a major risk on the Rainbow radar and will significantly reduce the radar services at a large area (more than 50 degrees azimuth angle). GHD understands that Warracknabeal Energy Park Pty Ltd is continuing to consult with BoM and take steps to minimise or negate the impact on this service through technical or operational solutions to be agreed with the BoM.

## 12. Defence Radio Systems

Defence radio systems are not required to be recorded in the ACMA radio communications database and therefore direct consultation with the Department of Defence is required to determine the impact of the wind farm on the Defence's operations around the wind farm area.

Typically, the Defence Spectrum Office (DSO), raises the following concerns to Defence HF transmissions and wind farm development projects:

- Defence use HF in both a fixed and itinerant nature on their ranges and bases. They can use this equipment anywhere in country, but typical high tempo use of the itinerant variation could be at the range boundaries.
- Impact to HF systems is often manifested in an increase in the HF noise within the near locational environment. It is a known issue that many wind farms (not all) with their switching systems can generate a large increase in the radio noise in the environment. If it is not known what the system impact is on the HF noise, the only other "layout" consideration is physical separation, which could be in the 10 – 100km.

- As the wind farm conforms to AS/NZS 61000.6.4:2012<sup>10</sup>, the wind farm will reduce, as much as is practicable, the emission of HF noise from the turbines, substation(s) and electronic control equipment.

Consultation with the Defence Security and Estate Group (Land Planning and Regulation Directorate, Estate Planning Branch, Infrastructure Division) has been initiated and, at the time of writing, Defence is awaiting the finalised Aviation Impact Statement (AIS) outcome for assessment, refer Appendix C. Once Defence's assessment of the AIS assessment is complete, this section of the EMI assessment can be finalised. However, note that preliminary assessment of Defence radio communications systems, that are publicly available, indicate that the proposed wind farm development will have negligible to no impact on these systems.

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<sup>10</sup> AS/NZS 61000.6.4:2012, Electromagnetic compatibility (EMC) Generic standards - Emission standard for industrial environments, Standards Australia, 2012

## 13. Trigonometrical Systems

Trigonometrical systems operate across Australia are operated and maintained by Geoscience Australia. The GNSS networks of approximately 100 Continuously Operating Reference Stations (CORS) across the Australian region and the South Pacific, including: Australian Regional GNSS Network (ARGN), South Pacific Regional GNSS Network (SPRGN), and AuScope Network.

The closest trigonometrical system to the proposed wind turbine development area is the ANTW APREF permanent geodetic quality Global Navigation Satellite System (GNSS) receiver approximately 15.8 km west of the proposed wind farm area. The distance between the wind farm and the GNSS station has enough clearance and unlikely that the turbines will cause any electromagnetic interference to the GNSS network.

GHD consulted with Geoscience Australia and the consultation states no foreseeable impact from the proposed turbines on the Commonwealth owned trigonometrical stations or Global Navigation Satellite System. (refer Appendix C for the consultation letter)

## 14. Maritime Radio Systems

The proposed wind farm location is sited inland to the maritime transmitter MRV (Marine Radio Victoria) locations, hence it is anticipated that there will be no impact on the VHF and HF maritime services by the wind farm development. GHD does not foresee any electromagnetic interference impact that would degrade the radio signal to this radio systems.

## 15. 50 Hz Radiation (Transmission Lines)

The primary sources of electromagnetic fields associated with wind farms are the substations and transmission lines. While not explicitly included in this study, the transmission line and substation will be equivalent to others in the electricity transmission network, with comparable electromagnetic field levels.

Designing to the standards utilised by the local transmission and distribution authorities will ensure safe levels of electromagnetic radiation are achieved.

GHD does not foresee any electromagnetic interference impact that would degrade the radio signal to this radio systems.

## 16. General Mitigation Strategies

All types of radio communications can benefit from general mitigation through the design of the turbine and the choice of materials used in its construction.

The turbines have been spaced to mitigate the effect of creating a "virtual wall" or turbines. A virtual wall is an electromagnetic barrier between a TV transmitter and households serviced by that transmitter.

In addition, wind farm developers should utilise (wherever practical) equipment complying with the Electromagnetic Emission Standard, AS/NZS 61000.6.4:2012 to avoid the creation of excessive noise at frequencies that interfere with radio communication signals. Electrical insulation and shielding should be considered in the turbine design to reduce the RF noise emitted from the electronic control systems located in the nacelle.

## 17. Summary of Mitigation Strategies and Recommendations

**Table 3** Summary of Mitigation Strategies and Recommendations

Impact	Service Mitigation Strategy	Recommendation
<b>Fixed Point-to-Point Microwave</b>		
Nil to negligible	Avoid micro-siting turbines within 2nd Fresnel zone exclusion zones.	When lifting turbines into place. If entering the exclusion zone is unavoidable, the link operator should be consulted before the construction, so the link operator can anticipate the potential temporary service degradation and take steps to minimise or negate the impact to their services.
<b>Fixed Point-to-Multipoint Microwave</b>		
No impact anticipated to other services if turbines are kept out of the nominated exclusion zones.	Propose wind turbine location to be out of the exclusion zones	Ensure micro-siting of the wind turbines such that blade tips do not enter the second Fresnel exclusion zones of existing radio systems.
<b>Land Mobile Radio Systems</b>		
Nil	Avoid micro-siting to within 20 m of transmitter locations; ideally avoiding moving any closer than 100 m away.	Record signal levels in the affected areas of LMR operations prior to the construction of the wind turbines to establish a baseline.
<b>Digital Television Broadcast</b>		
Minor to no impact anticipated to services	The wind farm's impact on digital TV services can be quantified by recording and comparing pre-construction baseline signal measurements and post-construction signal level measurements in and around the wind farm areas by an independent radio monitoring specialist; however, the mitigation measures remain the same. Realigning, repositioning or replacing existing antennas to higher gain alternatives can remedy the majority of forward scatter signal degradation effects and should be the first mitigation strategy performed.	Warracknabeal Energy Park Pty Ltd (WAEPL) should undertake a pre- and post-construction assessment of the television reception strength at the location of any existing or approved dwellings as at the date of development approval that are within 5 km of any turbine. The assessments should be undertaken by an independent television and radio monitoring specialist and include testing at locations to be determined by the television and radio monitoring specialist to enable the average television and radio reception strength to be determined.

Impact	Service Mitigation Strategy	Recommendation
		If the post-construction assessment establishes an unacceptable increase in interference to reception as a result of the wind farm, as determined by the independent television and radio monitoring specialist, measures to restore the affected reception to pre-construction quality will be undertaken (e.g. receiver's antenna upgraded, or receiver transferred to VAST system).
<b>AM / FM Narrowcast and Broadcast</b>		
Minor to no impact anticipated to services.	Mitigation options may include installing high-quality antennas or amplifiers at the affected dwellings, increasing broadcast signal strength from the transmission tower, moving the tower to a new location further away from the turbines, or installing a signal repeater or additional tower on the opposite side of the wind farm.	<p>Warracknabeal Energy Park Pty Ltd (WAEPPPL) should undertake a pre- and post-construction assessment of the radio reception strength at the location of any existing or approved dwellings as at the date of development approval that are within 5 km of any turbine. The assessments should be undertaken by an independent television and radio monitoring specialist and include testing at locations to be determined by the television and radio monitoring specialist to enable the average television and radio reception strength to be determined.</p> <p>If the post-construction assessment establishes an unacceptable increase in interference to reception as a result of the wind farm, as determined by the independent television and radio monitoring specialist, measures to restore the affected reception to pre-construction quality will be undertaken</p>
<b>Aircraft Communications Systems</b>		
Minor to no impact anticipated to services.	Nil.	Warracknabeal Energy Park Pty Ltd (WAEPPPL) should provide the Aviation Impact Statement (AIS) report to Airservices Australia, following the guidelines "Developments at and around airports – Airservices" and submit the information to Airport Developments mailbox (airport.developments@airservicesaustralia.com)
<b>Meteorological Radar</b>		
Feedback from the BoM has confirmed that there is a likelihood that the project will affect the Rainbow radar	Consider installing a new radar on the east side of the wind farm and consider operational limits and/or other technical solutions for the project.	Warracknabeal Energy Park Pty Ltd (WAEPPPL) should continue consulting with BoM on the exact terms of the operational limits and/or other technical solutions for the project to ensure that the radar can maintain operational efficiency.
<b>Defence Radio Systems</b>		
Possible impact on systems due to HF noise introduced by wind farm equipment.	Construction materials and conformance to AS/NZS IEC 61000.6.4:2012.	Direct consultation with the Department of Defence is recommended. Defence generally requires the proponent to provide an aeronautical risk assessment report to Airservices Australia. The result will then be

Impact	Service Mitigation Strategy	Recommendation
		forwarded to the Civil Aviation Safety Authority (CASA) as a record for Defence to determine any additional requirement.

# Appendices

# Appendix A

## Turbine Locations

Table 4 Turbine Locations

Turbine ID	Easting	Northing
T001	612350	6011500
T002	613006.1	6011490
T003	610692.5	6010723
T004	612338.1	6010699
T005	612994.2	6010689
T006	613807.2	6010380
T007	614624	6010320
T008	611245.5	6010289
T009	612323.9	6009740
T010	612980	6009731
T011	613797.4	6009718
T012	614614.9	6009706
T013	615432.3	6009694
T014	616435.5	6009679
T015	611023.8	6009621
T016	610664.5	6008836
T017	612310.1	6008811
T018	612966.2	6008801
T019	613783.6	6008789
T020	614601.1	6008777
T021	616421.7	6008750
T022	610992.7	6008192
T023	611530.2	6007710
T024	612293.6	6007699
T025	612949.7	6007689
T026	613767.1	6007677
T027	614584.6	6007665
T028	615402	6007653
T029	617203.3	6007626
T030	617853.4	6007617



Turbine ID	Easting	Northing
T031	616390.4	6006638
T032	617188.5	6006626
T033	617840.8	6006617
T034	621916.5	6006327
T035	623433.9	6006305
T036	622716.5	6005845
T037	616375.6	6005638
T038	623886.8	6005635
T039	617175.5	6005627
T040	621474.4	6005065
T041	616360.7	6004638
T042	617160.6	6004627
T043	617807	6003953
T044	616345.9	6003639
T045	619532	6003591
T046	620331.9	6003579
T047	621131.8	6003568
T048	622043.3	6003554
T049	622769.7	6003543
T050	616433.2	6002637
T051	619548.1	6002591
T052	620317.1	6002580
T053	621117	6002568
T054	622028.5	6002554
T055	622828.4	6002542
T056	616378.8	6001638
T057	617116.1	6001627
T058	617774.3	6001617
T059	618716.9	6001603
T060	619502.3	6001592
T061	620302.3	6001580
T062	621102.2	6001568
T063	622013.7	6001554
T064	622814.2	6001542
T065	623484.8	6001532
T066	614655.4	6000663
T067	615630.6	6000649
T068	616301.4	6000639
T069	617101.3	6000627
T070	618472.1	6000607
T071	619387.8	6000593

Turbine ID	Easting	Northing
T072	620287.4	6000580
T073	621087.3	6000568
T074	621998.8	6000554
T075	622798.7	6000543
T076	623599.8	6000531
T077	626138.5	6000401
T078	614640.6	5999663
T079	615615.7	5999649
T080	616286.6	5999639
T081	617086.5	5999627
T082	619372.9	5999593
T083	626866.3	5999588
T084	620272.6	5999580
T085	621072.5	5999568
T086	621985.2	5999556
T087	624396.8	5999519
T088	625623.4	5999501
T089	613949.9	5998847
T090	614804.9	5998661
T091	615600.9	5998649
T092	616271.7	5998639
T093	617071.6	5998627
T094	618442.4	5998607
T095	619358.1	5998593
T096	620257.8	5998580
T097	621057.7	5998568
T098	621969.2	5998555
T099	622769.1	5998543
T100	623569	5998531
T101	614510.8	5997749
T102	618427.6	5997607
T103	619343.3	5997593
T104	620242.9	5997580
T105	621042.8	5997568
T106	621954.3	5997555
T107	622754.2	5997543
T108	623554.2	5997531
T109	624359.7	5997019
T110	625586.3	5997001
T111	618412.7	5996607
T112	619328.4	5996594

Turbine ID	Easting	Northing
T113	620228.1	5996580
T114	621028	5996568
T115	621939.5	5996555
T116	622739.4	5996543
T117	623539.3	5996531
T118	615351.8	5995652
T119	618397.9	5995607
T120	619313.6	5995594
T121	620213.3	5995580
T122	621013.2	5995568
T123	621924.7	5995555
T124	622724.6	5995543
T125	623524.5	5995531
T126	624264.2	5995283
T127	616194.8	5994640
T128	619398.5	5994592
T129	620198.4	5994580
T130	620998.3	5994568
T131	621909.8	5994555
T132	622709.7	5994543
T133	623509.7	5994531
T134	624556.9	5994516
T135	618551.9	5993768
T136	615924.2	5993614
T137	617714.8	5993587
T138	619383.2	5993562
T139	620183.2	5993551
T140	620983.1	5993539
T141	616765.4	5993535
T142	621895	5993525
T143	622694.5	5993513
T144	623496	5993501
T145	624211.6	5993491
T146	616752.4	5992631
T147	621881.3	5992555
T148	622681.2	5992543
T149	623481.1	5992532
T150	624290.3	5992520
T151	617697.5	5992425
T152	616738.8	5991718
T153	617680.3	5991263

Turbine ID	Easting	Northing
T154	608431.2	5984163
T155	609279.4	5984058
T156	608418.6	5983348
T157	610753.2	5983312
T158	611647.4	5983298
T159	612541.5	5983284
T160	614135.2	5983260
T161	614929	5983247
T162	616543.8	5983165
T163	615807.1	5982939
T164	608246.6	5982407
T165	610737.7	5982305
T166	611631.8	5982292
T167	612526	5982278
T168	613325.9	5982265
T169	614913.5	5982241
T170	615796.1	5982227
T171	614007.1	5982185
T172	610722.2	5981306
T173	611616.3	5981292
T174	612510.5	5981278
T175	613310.4	5981266
T176	615780.7	5981227
T177	616663.3	5981214
T178	610169.7	5980407
T179	611164.1	5980392
T180	612496.5	5980371
T181	613296.1	5980359
T182	614090.2	5980347
T183	614884	5980334
T184	615766.6	5980321
T185	616649.3	5980307
T186	610152.8	5979314
T187	612518	5979278
T188	613279.5	5979266
T189	614073.3	5979254
T190	614867.1	5979241
T191	615749.7	5979226
T192	616632.4	5979214
T193	617581	5979199
T194	612891	5978772

Turbine ID	Easting	Northing
T195	613264	5978266
T196	614057.8	5978254
T197	614851.6	5978241
T198	615734.3	5978228
T199	616779.7	5978212
T200	617565.6	5978199
T201	612622.7	5977674
T202	613334.3	5977470
T203	614042.4	5977254
T204	614836.2	5977241
T205	615718.5	5977228
T206	616601.4	5977214
T207	614026.9	5976254
T208	614820.7	5976242
T209	615703.3	5976228
T210	616586	5976214
T211	617445.5	5976201

# Appendix B

## Reference Figures

Electromagnetic Interference Assessment – Figure 1 – Transmitters – Fixed Point-to-Point Radio Systems

Electromagnetic Interference Assessment – Figure 2 – Exclusion Zones - Point-to-Point Radio Link (Project Area)

Electromagnetic Interference Assessment – Figure 3 – Transmitters – Land Mobile Radio Systems

Electromagnetic Interference Assessment – Figure 4 – Transmitters – Broadcasting

Electromagnetic Interference Assessment – Figure 5 – Scatter Zones – Warracknabeal TV Transmitter

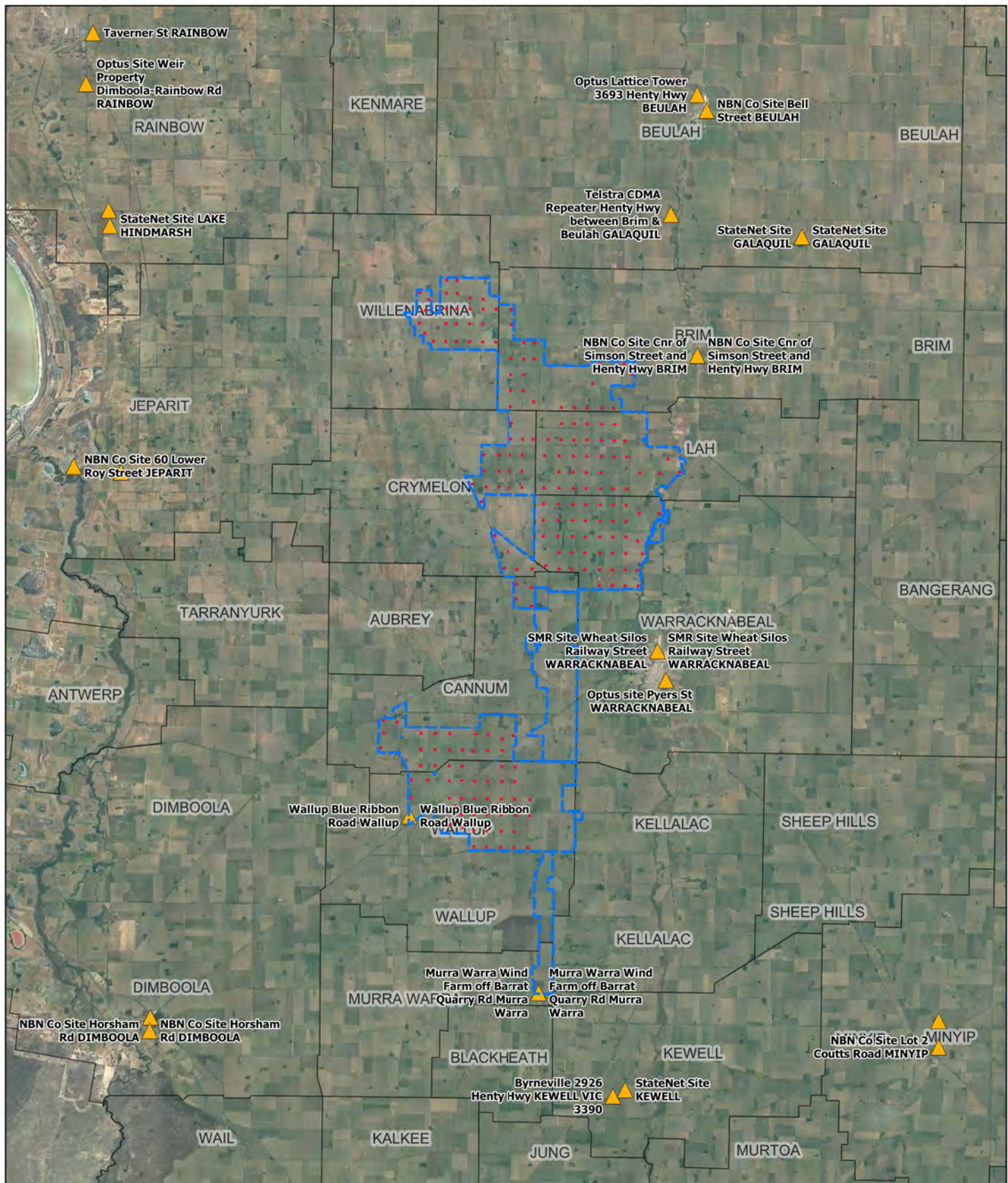
Electromagnetic Interference Assessment – Figure 6 – Scatter Zones – Ballarat TV Transmitter

Electromagnetic Interference Assessment – Figure 7 – Transmitters – Spectrum

Electromagnetic Interference Assessment – Figure 8 – Transmitters – Aircraft Communications Systems

Electromagnetic Interference Assessment – Figure 9 – Transmitters – Meteorological Radar

Electromagnetic Interference Assessment – Figure 10 – Transmitters – Amateur

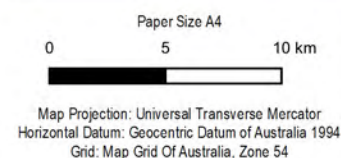


#### LEGEND

Proposed wind farm boundary

Point to point transmitter

Turbines



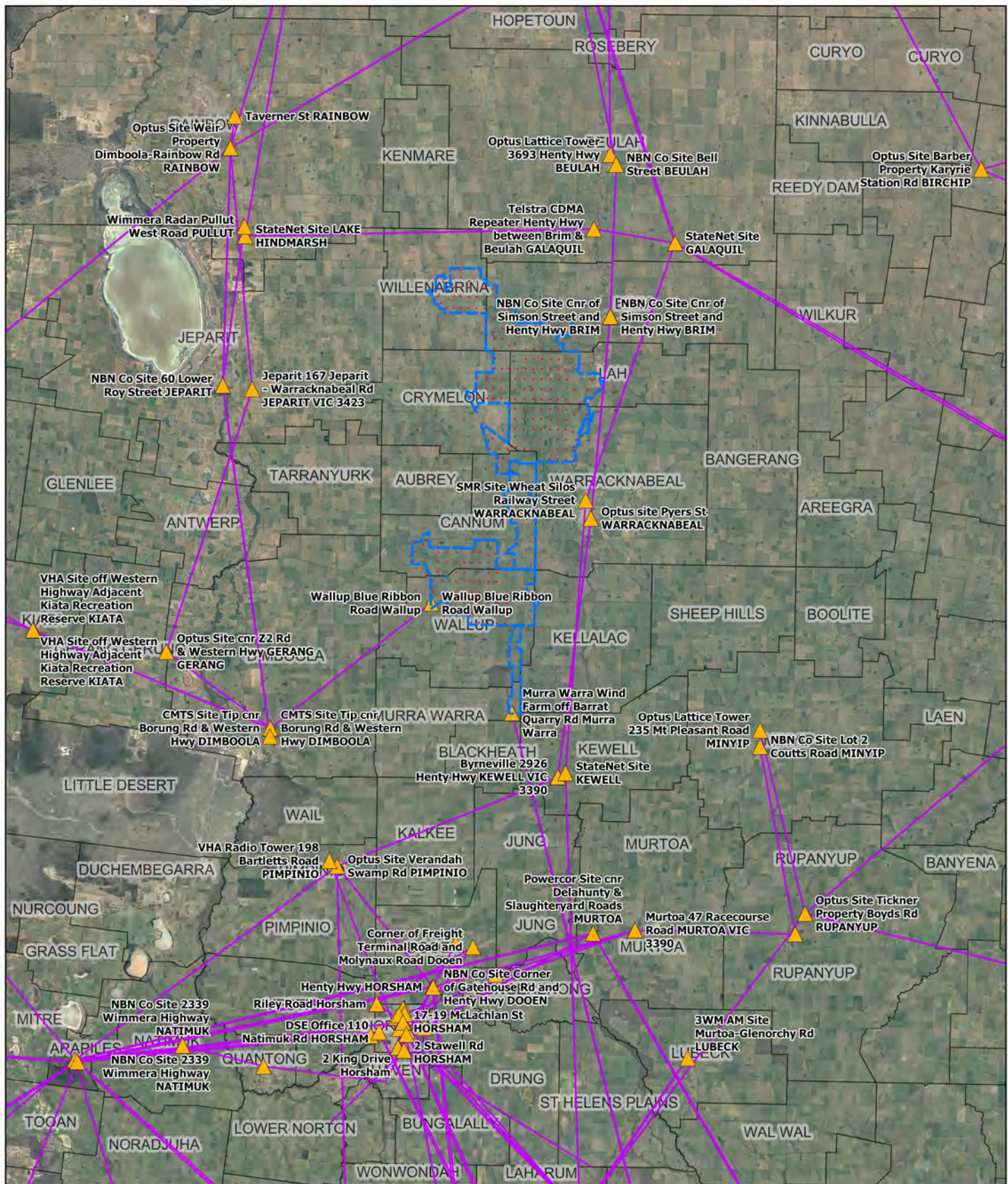
Warracknabeal Energy Park  
EMI Impact Assessment

Project No. 12537583  
Revision No. 2  
Date. 22/03/2023

Point to point transmitters.

FIGURE 1





#### LEGEND

- ▭ Proposed wind farm boundary
- ▭ Exclusion zones
- ▲ Point to point transmitter
- Turbines

Paper Size A4  
 0 10 20 km  
 Map Projection: Universal Transverse Mercator  
 Horizontal Datum: Geocentric Datum of Australia 1994  
 Grid: Map Grid Of Australia, Zone 54



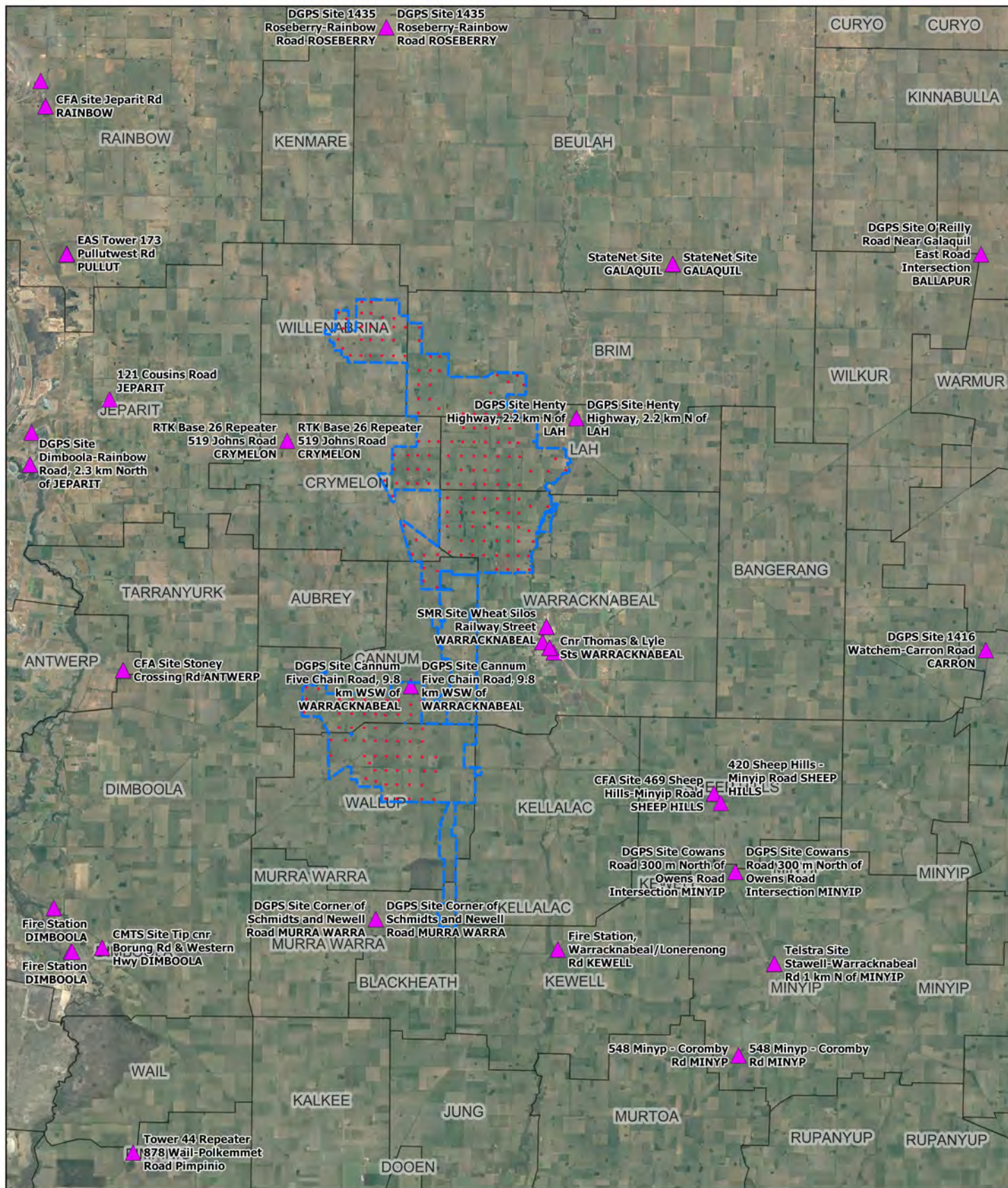
Warracknabeal Energy Park  
 EMI Impact Assessment

Project No. 12537583  
 Revision No. 2  
 Date. 22/03/2023

Point to Point Exclusion Zone.

FIGURE 2





#### LEGEND

- Proposed wind farm boundary
- ▲ Land mobile radio transmitter
- Turbines

Paper Size A4  
0 5 10 km  
Map Projection: Universal Transverse Mercator  
Horizontal Datum: Geocentric Datum of Australia 1994  
Grid: Map Grid Of Australia, Zone 54



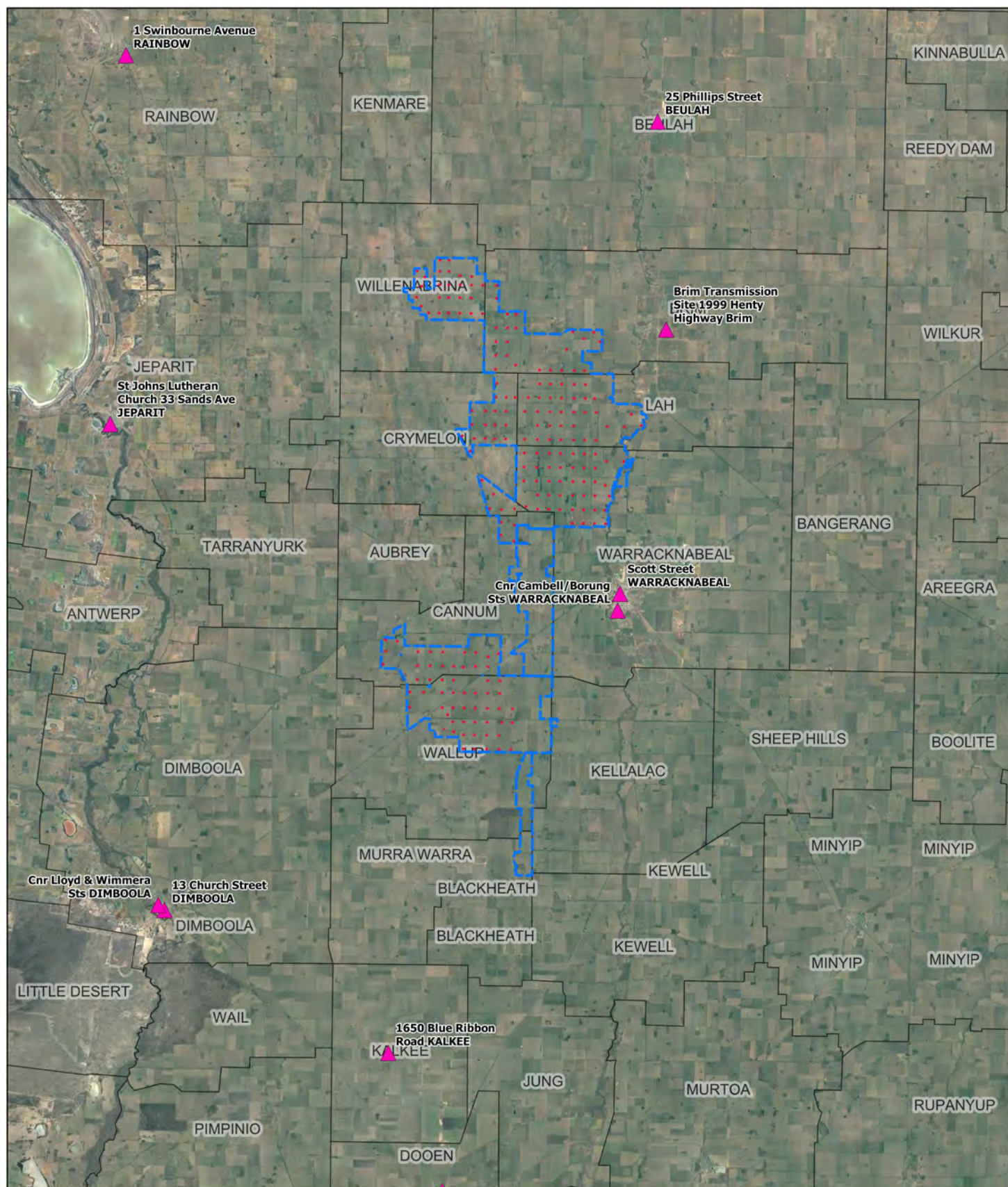
Warracknabeal Energy Park  
EMI Impact Assessment

Land Mobile Transmitters.

Project No. 12537583  
Revision No. 2  
Date. 22/03/2023

FIGURE 3

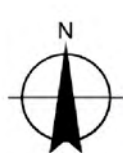




#### LEGEND

- Proposed wind farm boundary
- ▲ Broadcasting
- Turbines

Paper Size A4  
 0 5 10 km  
 Map Projection: Universal Transverse Mercator  
 Horizontal Datum: Geocentric Datum of Australia 1994  
 Grid: Map Grid Of Australia, Zone 54



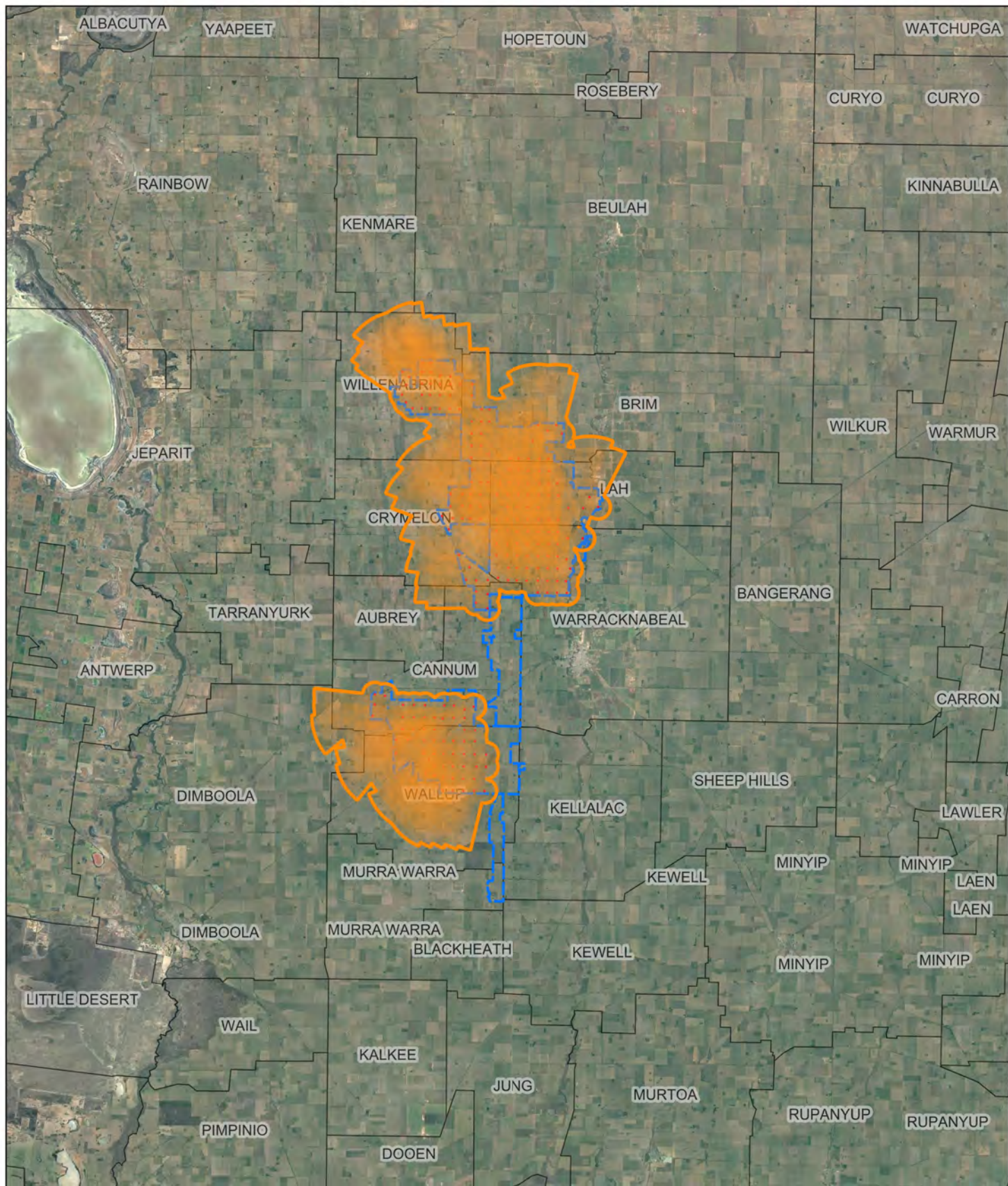
Warracknabeal Energy Park  
 EMI Impact Assessment

Project No. 12537583  
 Revision No. 2  
 Date. 22/03/2023

**Broadcasting Transmitters.**

**FIGURE 4**





#### LEGEND

- Proposed wind farm boundary
- Scatter zones
- Scatter zone boundary
- ▲ Warracknabeal Transmitter
- Turbine

Paper Size A4  
0 5 10 km  
Map Projection: Universal Transverse Mercator  
Horizontal Datum: Geocentric Datum of Australia 1994  
Grid: Map Grid Of Australia, Zone 54



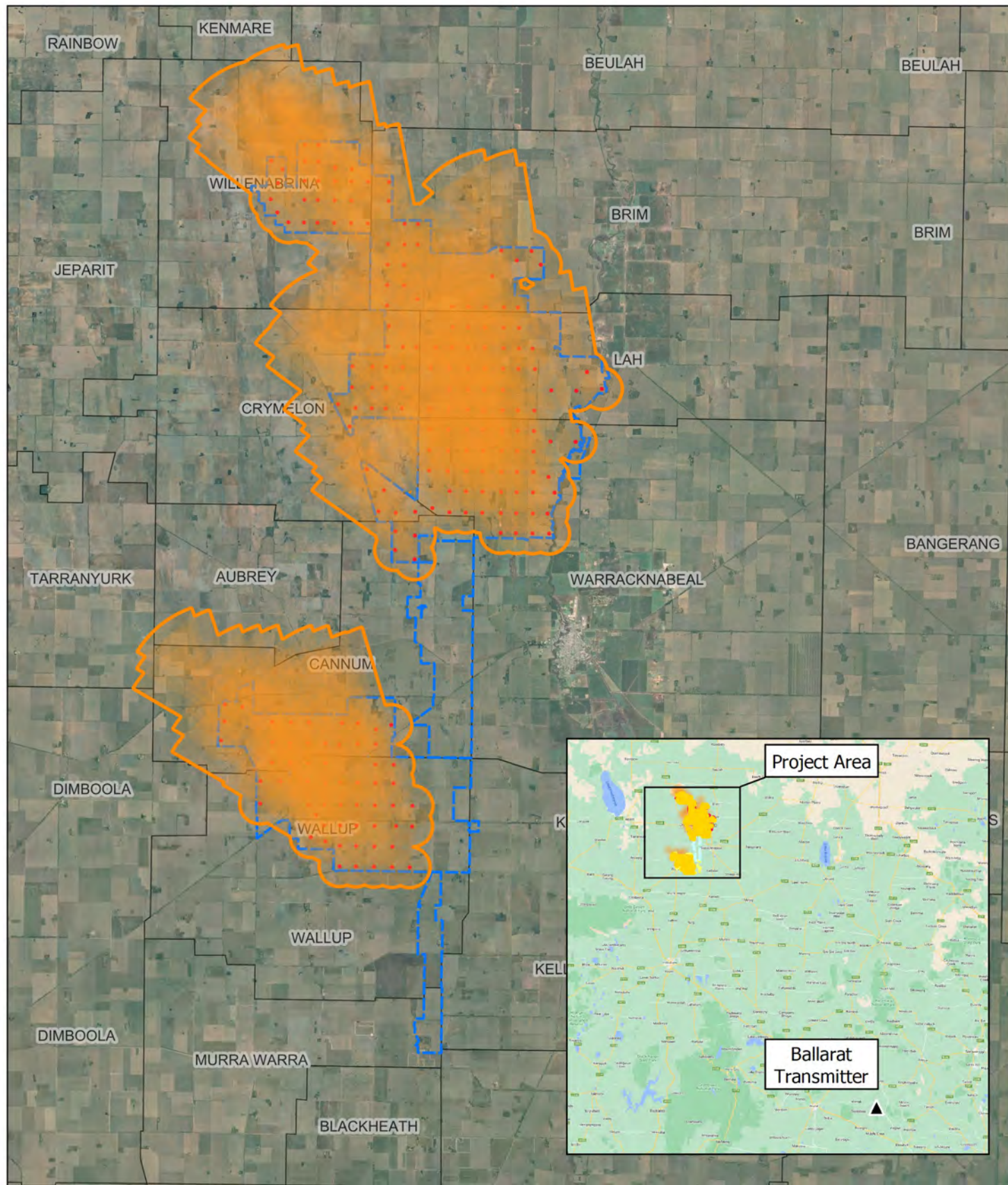
Warracknabeal Energy Park  
EMI Impact Assessment

Project No. 12537583  
Revision No. 2  
Date. 22/03/2023

**Warracknabeal TV Transmitter  
Scatter Zones.**

**FIGURE 5**





#### LEGEND

- ▬ Proposed wind farm boundary
- ▬ Scatter zones
- ▬ Scatter zone edge
- ▲ Ballarat Transmitter
- Turbine

Paper Size A4  
0 2.5 5 km

Map Projection: Universal Transverse Mercator  
Horizontal Datum: Geocentric Datum of Australia 1994  
Grid: Map Grid Of Australia, Zone 54



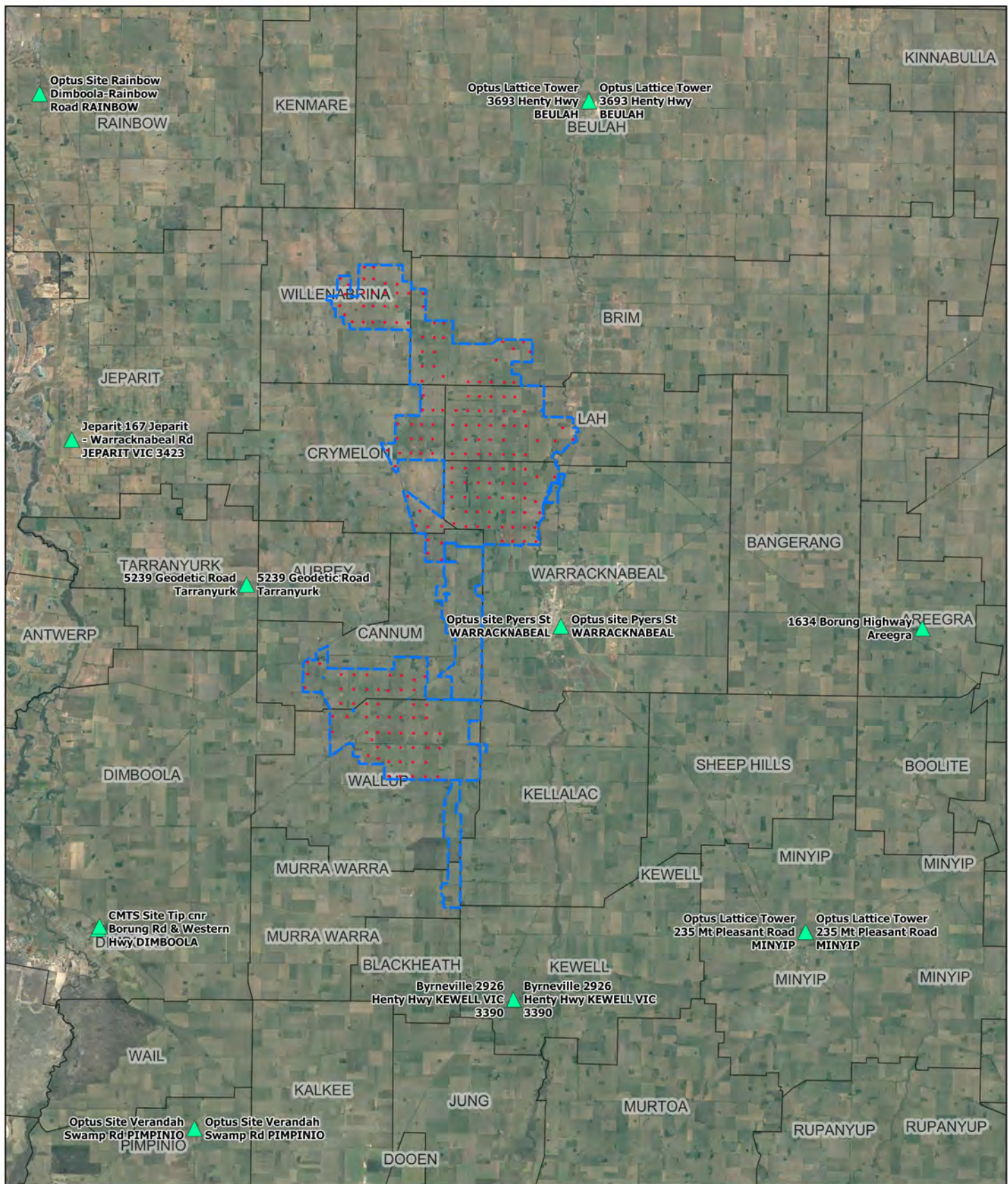
Warracknabeal Energy Park  
EMI Impact Assessment

Project No. 12537583  
Revision No. 2  
Date. 22/03/2023

**Ballarat TV Transmitter Scatter  
Zones.**

**FIGURE 6**



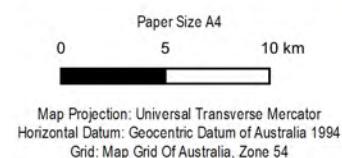


#### LEGEND

--- Proposed wind farm boundary

● Turbine

▲ Spectrum transmitter



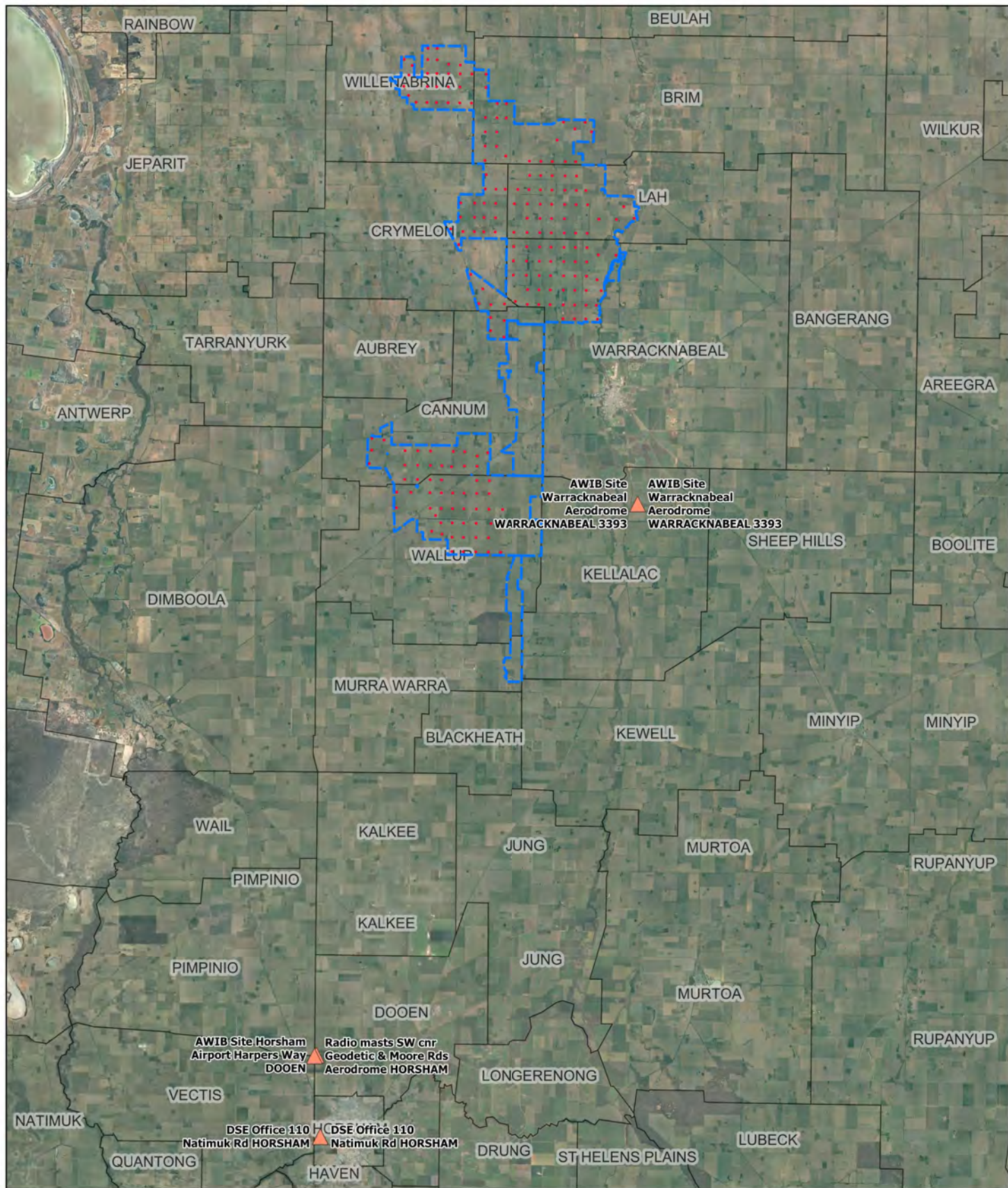
Warracknabeal Energy Park  
EMI Impact Assessment

**Spectrum Transmitters.**

Project No. 12537583  
Revision No. 2  
Date. 22/03/2023

**FIGURE 7**





#### LEGEND

■ Proposed wind farm boundary

● Turbine

▲ Aeronautical

Paper Size A4  
0 5 10 km  
Map Projection: Universal Transverse Mercator  
Horizontal Datum: Geocentric Datum of Australia 1994  
Grid: Map Grid Of Australia, Zone 54



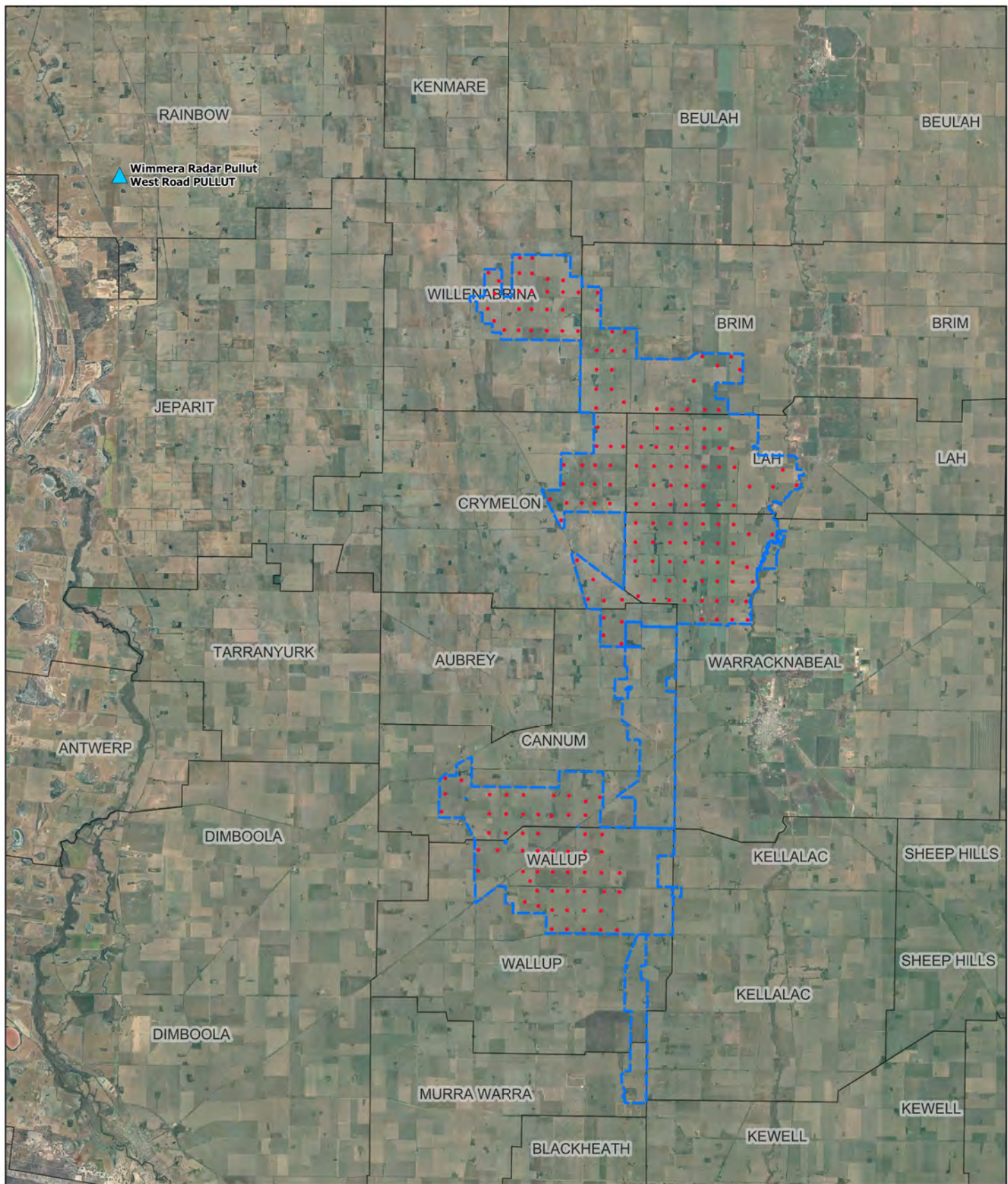
Warracknabeal Energy Park  
EMI Impact Assessment

Project No. 12537583  
Revision No. 2  
Date. 22/03/2023

**Aeronautical Transmitters.**

**FIGURE 8**



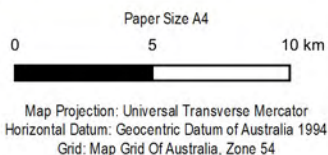


#### LEGEND

▬ Proposed wind farm boundary

● Turbine

▲ Meteorological Radar Transmitter.



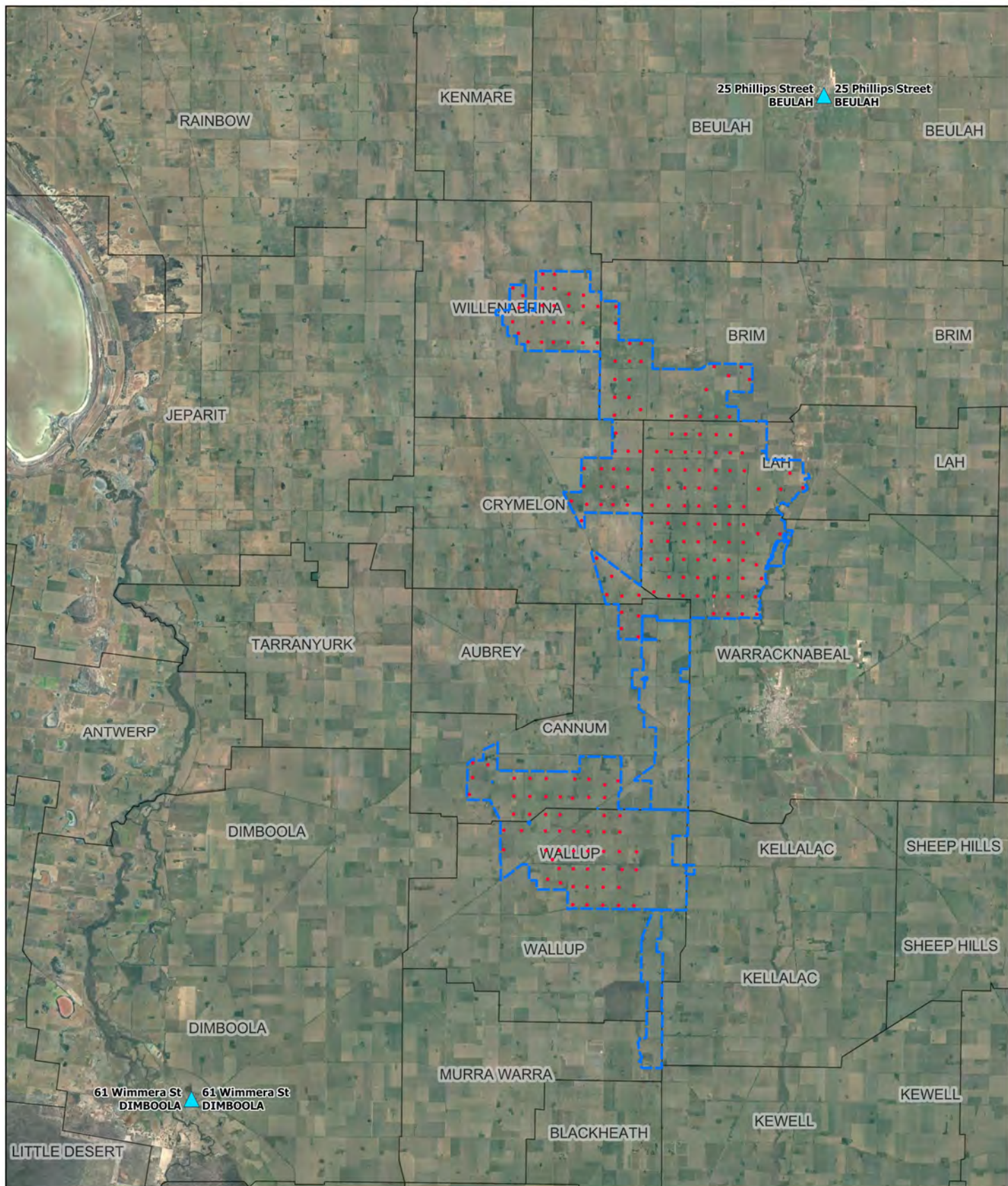
Warracknabeal Energy Park  
EMI Impact Assessment

**Meteorological Radar  
Transmitters.**

Project No. 12537583  
Revision No. 2  
Date. 22/03/2023

**FIGURE 9**





#### LEGEND

▬ Proposed wind farm boundary

● Turbine

▲ Amateur repeater transmitter

Paper Size A4  
0 5 10 km  
Map Projection: Universal Transverse Mercator  
Horizontal Datum: Geocentric Datum of Australia 1994  
Grid: Map Grid Of Australia, Zone 54



Warracknabeal Energy Park  
EMI Impact Assessment

Project No. 12537583  
Revision No. 2  
Date. 22/03/2023

**Amateur Transmitters.**

**FIGURE 10**



# Appendix C

## Consultation Reference Letters

Consultation Reference Response - Defence

Consultation Reference Response - Telstra

Consultation Reference Response - NBN

Consultation Reference Response - Optus

Consultation Reference Response - Geoscience Australia

Consultation Reference Response – Bureau of Meteorology

## Whan Khamthara

---

**From:** Murray, Adam MR 3 <adam.murray3@defence.gov.au>  
**Sent:** Wednesday, 21 September 2022 8:57 AM  
**To:** Whan Khamthara; SEG-EstatePlanningBranchExternalLandPlanning&Regulation  
**Cc:** Brendan Siebert  
**Subject:** RE: WestWind - Warracknabeal - Request advice on the potential impact of wind farm development on Defence services [SEC=OFFICIAL]

### OFFICIAL

Good morning Whan,

The Aviation Impact Assessment for this development is currently circulating among Defence stakeholders for comment, one of those stakeholders is our Spectrum office. Once we receive their assessment we will then advise you of the outcome.

Kind regards,  
Adam

**Adam Murray**



Estate Strategic Planner - Land Planning and Regulation Directorate  
Estate Planning Branch | Infrastructure Division | Security and Estate Group

Department of Defence | BP26-1-A004 | Brindabella Business Park | Canberra Airport | ACT 2609  
P: (02) 5109 5509 | E: [adam.murray3@defence.gov.au](mailto:adam.murray3@defence.gov.au)

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**From:** Whan Khamthara <Whan.Khamthara@ghd.com>  
**Sent:** Monday, 19 September 2022 3:03 PM  
**To:** SEG-EstatePlanningBranchExternalLandPlanning&Regulation <land.planning@defence.gov.au>  
**Cc:** Brendan Siebert <Brendan.Siebert@ghd.com>; Murray, Adam MR 3 <adam.murray3@defence.gov.au>  
**Subject:** FW: WestWind - Warracknabeal - Request advice on the potential impact of wind farm development on Defence services

 **EXTERNAL EMAIL:** Do not click any links or open any attachments unless you trust the sender and know the content is safe. 

Hi Estate Planning Branch,

I am following up on the request regarding the defence response on the EMI assessment of the Warracknabeal Energy Park.

Regards,

**Kaveewat Khamthara (Whan)**  
BEng(Electrical)  
Senior Engineer - Telecommunications

**GHD**

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---

**From:** Whan Khamthara

**Sent:** Tuesday, 10 May 2022 10:51 AM

**To:** [adam.murray3@defence.gov.au](mailto:adam.murray3@defence.gov.au)

**Cc:** Brendan Siebert <[Brendan.Siebert@ghd.com](mailto:Brendan.Siebert@ghd.com)>

**Subject:** WestWind - Warracknabeal - Request advice on the potential impact of wind farm development on Defence services

Hi Adam,

GHD is conducting the Electromagnetic Interference Assessment report on behalf of WestWind for the wind farm development application in Warracknabeal, Victoria.

Could you please help shade some light on who should we reach to begin discussions regarding Defence radio services that might be impacted in this area?

I have attached the site boundary and turbine layout in the .kmz file. You can find their coordinates in the attached excel spreadsheet. At the moment the turbine specifications are as below, but there might be some minor changes to the specification in the future:

- Maximum tip height: Up to 280m
- Minimum clearance from ground level: No less than 50m
- Rotor diameter: Up to 200m

Please do not hesitate to contact me if you have any questions.

Regards,

**Kaveewat Khamthara (Whan)**

BE(Electrical)

Telecommunications Engineer

**GHD**

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Level 4 211 Victoria Square Adelaide SA 5000 Australia

D +61 8 8111 6755 O +61 8 8111 6600 E [whan.khamthara@ghd.com](mailto:whan.khamthara@ghd.com)

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4 August 2022

Whan Khamthara  
GHD  
Melbourne Vic 3000

**Re: Proposed Warracknabeal Wind Farm**

Dear Whan,

To provide a better understanding of potential impacts to Telstra infrastructure a simulated analysis was carried out. Based on this research, to minimise potential interference to Telstra's telecommunications network Telstra requires the developer to confirm its agreement to the conditions and matters set out below:

- 1) There are no expected impacts to Telstra's Mobile network due to this wind farm based on the turbine locations provided. The nearest Telstra mobile tower is 1.3 Km away which we consider to be an adequate distance to ensure negligible disruption or distortion of Telstra's coverage footprint.
- 2) Based on the turbine locations provided and information regarding Telstra existing point to point radio links obtained from Waypoint and maprad.io, the proposed wind farm should not impact on any of Telstra existing point to point radio links.
- 3) Based on the limited information provided there does not appear to be any power coordination issues with the Telstra copper distribution cables that are situated near the proposed wind farm.

**Note:** For a detailed analysis of the full power coordination impact of the wind farm development further information is required. This includes location of the wind farm switch yard, the route and potential of any associated HV transmissions lines and the EPR impact on any Telstra plant they may affect.

The developer also confirms its role as the proponent and ultimate owner of the proposed wind farm and that it has the authority to ensure that the conditions set out above are implemented and complied with. If the agreement of any other person or entity is required to ensure the conditions set out in this letter are complied with, the developer undertakes to obtain that agreement in writing and to provide it to Telstra prior to lodging a development application for the wind farm.

If the proposed plans and specifications of the development are altered or amended, Telstra reserves the right to request further conditions and amendments to the development.

Should you wish to discuss any aspect of this letter please do not hesitate to contact the undersigned. Otherwise, I would appreciate you responding to me confirming the developer's agreement to the conditions and matters set out above.



Yours faithfully,

David Jonas  
Senior Access Planner  
Fixed Access Planning  
[david.jonas@team.telstra.com](mailto:david.jonas@team.telstra.com)

## Whan Khamthara

---

**From:** Shante Craven <shantecraven@nbnco.com.au>  
**Sent:** Thursday, 4 August 2022 11:19 AM  
**To:** Whan Khamthara; Network\_Capacity\_Enquiries  
**Cc:** Brendan Siebert  
**Subject:** RE: nbn case reference number 15643621

Some people who received this message don't often get email from shantecraven@nbnco.com.au. [Learn why this is important](#)

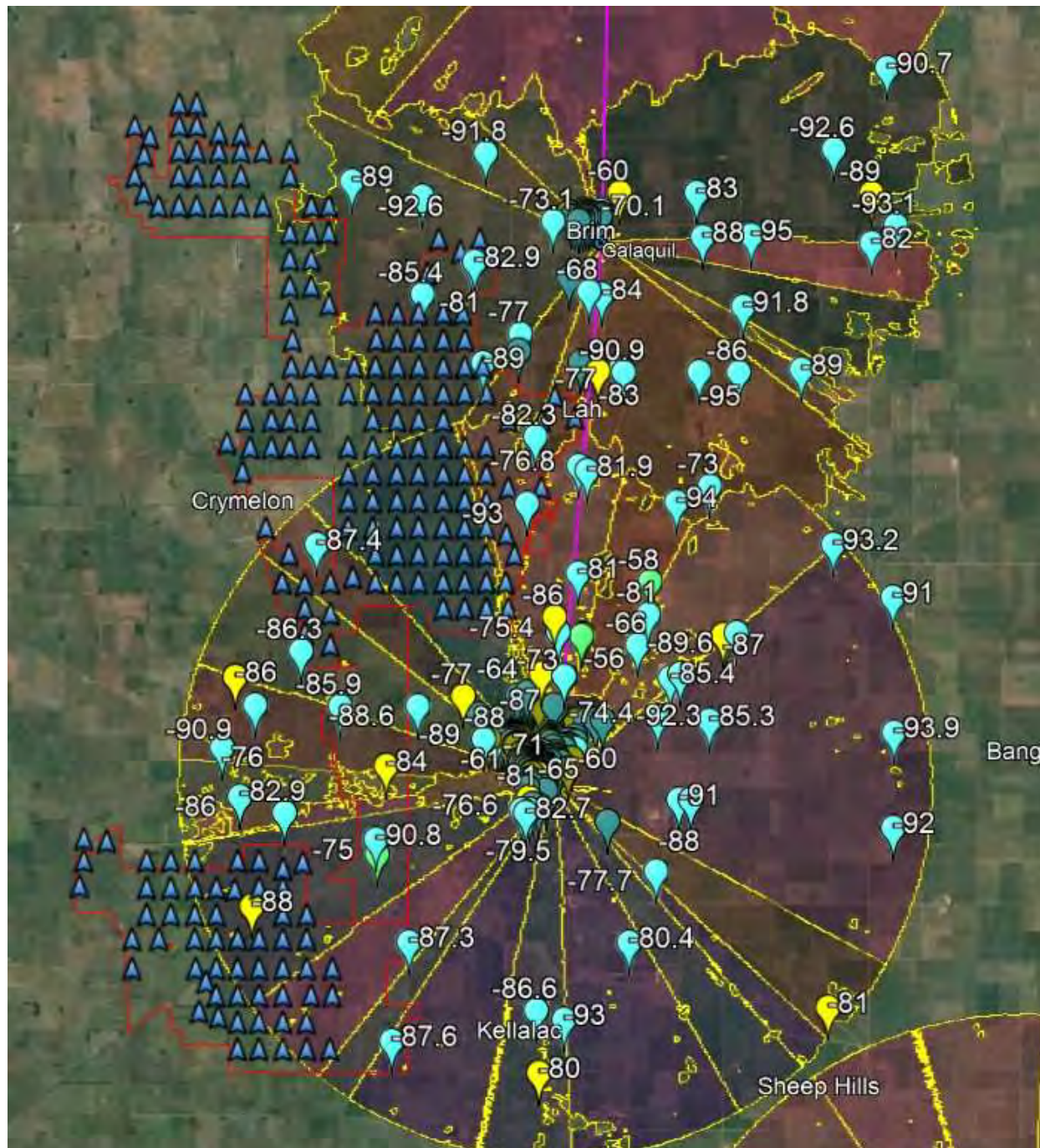
Hi Kaveewat,

Please see Engineering feedback below:

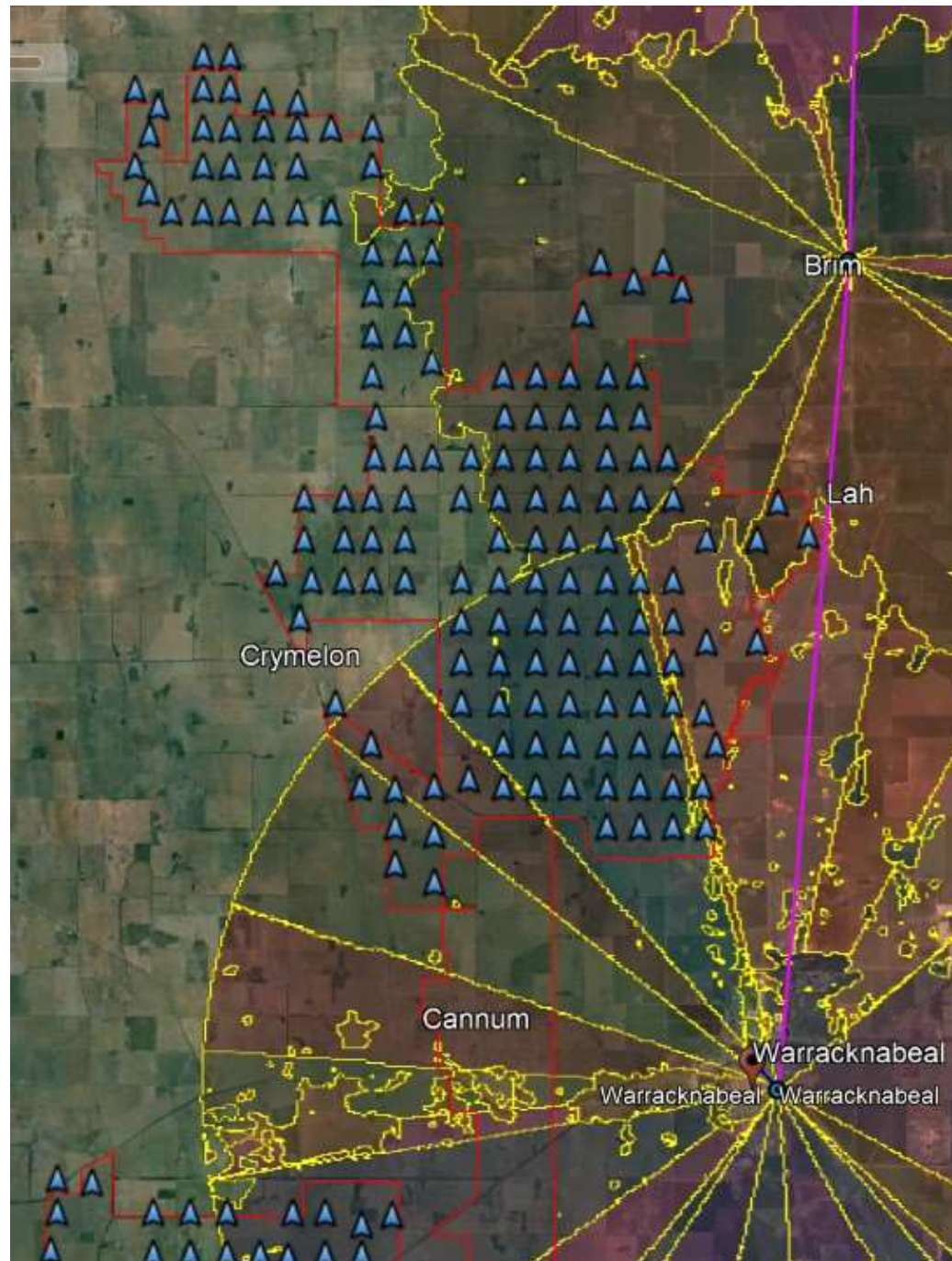
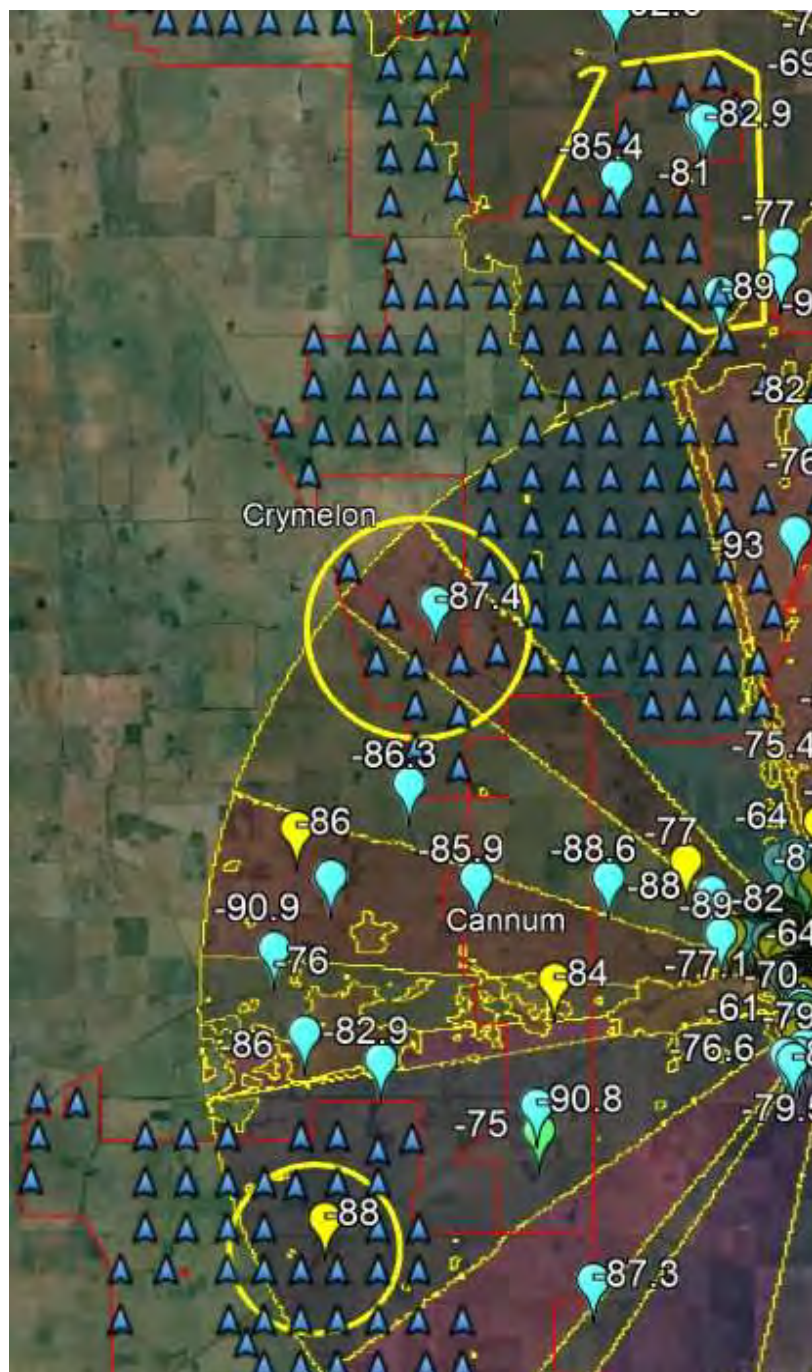
### Desktop Analysis

I have reviewed the data provided based on the proposed wind farm location ;

- A significant number of the proposed towers are inside existing nbn wireless coverage boundaries and the proposed wind tower locations pose a low risk of introducing a physical obstruction to a few existing wireless customer RF Path Profiles.
  - This risk will increase as nbn is to extend the coverage boundary from 14 to 29 km to connect locations not currently within the coverage boundary.
- There appear to be no current risks however to any boresight paths of existing nbn microwave transmission links.
- The greatest concern, given the proximity of the wind towers to nbn base stations, is the introduction of RF interference to the nbn spectrum. Refer to the notes below on this point.







Images show current operational wireless coverage areas relative to wind farm location and turbines to 14 km from nbn base station. The coverage boundary will be extended within coming months to 29 km. Some wind towers are ~4 km from nbn eNB.

*Legend: blue triangle = wind turbine, yellow line = nbn Wireless Coverage Boundary, purple line = nbn microwave link, blue, green & yellow icons = active nbn wireless customer installation*

Once known, please provide information on any RF transmission equipment planned to be used during construction or permanently installed so a potential interference impact can be assessed. This information should include as a minimum the operating transmission frequencies and transmit power, channel bandwidths, antenna types and radiation patterns as well as the exact location with antenna height, boresight azimuth and tilt [mechanical and electrical tilt ].

A standard nbn response for wind farm applications regarding potential interference impact on the nbn Fixed Wireless network is as follows ;

### Potential Impacts of the Proposed Warracknabeal Wind Farm [version 2] on NBN Co Spectrum Communication Assets

Referring to your email dated 26<sup>th</sup> July 2022 regarding the application for the Warracknabeal Wind Farm.

We confirm that NBN Co Spectrum Pty Ltd (**nbn Spectrum**) has a number of spectrum licenses within 75 km of the proposed Warracknabeal Wind Farm.

nbn have strict obligations to provide internet services to the community, and this area has been determined as a FW service area where the footprint of this service is now in place.

nbn will be forced to consider its position as part of the planning should there an interference issue.

If the Application is amended before it is lodged we request that we are sent any amended Application so we can determine whether we have any objections to the amended Application.

We note that, as you would be aware, under section 197 of the *Radiocommunications Act 1992* (Cth) it is an offence to knowingly or recklessly do anything likely to interfere substantially with radiocommunications or otherwise substantially disrupt or disturb radiocommunications.

*regards,*

*Frank*

**Frank van Rooden**      *M.B.A. , B.Eng (Hons) Electronics*

**Manager, National Wireless Technical Specialist**

Planning, Governance & Business Enablement | Fixed Wireless Engineering | Regional Development & Engagement

**M** +61 448 803 520 | **E** [frankvanrooden@nbnco.com.au](mailto:frankvanrooden@nbnco.com.au)

---

**From:** Shante Craven

**Sent:** Thursday, 4 August 2022 9:36 AM

**To:** Whan Khamthara <Whan.Khamthara@ghd.com>; Network\_Capacity\_Enquiries <Network\_Capacity\_Enquiries@nbnco.com.au>

**Cc:** Brendan Siebert <Brendan.Siebert@ghd.com>

**Subject:** RE: nbn case reference number 15643621

Hi Kaveewat,

Thank you for your email.

This is being reviewed by our Engineering team and I will provide response within 5 business days.

Thanks

Regards,

**Shante Craven**

**Escalations and Complaints Business Partner**

Regional Development & Engagement

**M** +61 409 044 072 | **E** [shantecraven@nbnco.com.au](mailto:shantecraven@nbnco.com.au)

Tower Five, Level 19, 727 Collins St, Melbourne VIC 3008

---

**From:** Whan Khamthara <[Whan.Khamthara@ghd.com](mailto:Whan.Khamthara@ghd.com)>

**Sent:** Tuesday, 26 July 2022 10:06 AM

**To:** Network\_Capacity\_Enquiries <[Network\\_Capacity\\_Enquiries@nbnco.com.au](mailto:Network_Capacity_Enquiries@nbnco.com.au)>



**Cc:** Brendan Siebert <[Brendan.Siebert@ghd.com](mailto:Brendan.Siebert@ghd.com)>

**Subject:** [External] FW: nbn case reference number 15643621

Hi NBNCo,

GHD is conducting the Electromagnetic Interference Assessment report on behalf of WestWind for the wind farm development application in Warracknabeal, Victoria.

An initial desktop investigation found NBN's fixed wireless servicing marginal area of the proposed wind farm. Could NBN please help investigate any potential impact that might occur on this service?

I have attached the site boundary and turbine layout in the .kmz file. You can find their coordinates in the attached excel spreadsheet. At the moment the turbine specifications are as below, but there might be some minor changes to the specification in the future:

- Maximum tip height: Up to 280m
- Minimum clearance from ground level: No less than 50m
- Rotor diameter: Up to 200m

Please do not hesitate to contact me if you have any questions.

Regards,

**Kaveewat Khamthara (Whan)**

**BEng(Electrical)**

**Senior Engineer - Telecommunications**

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## Whan Khamthara

---

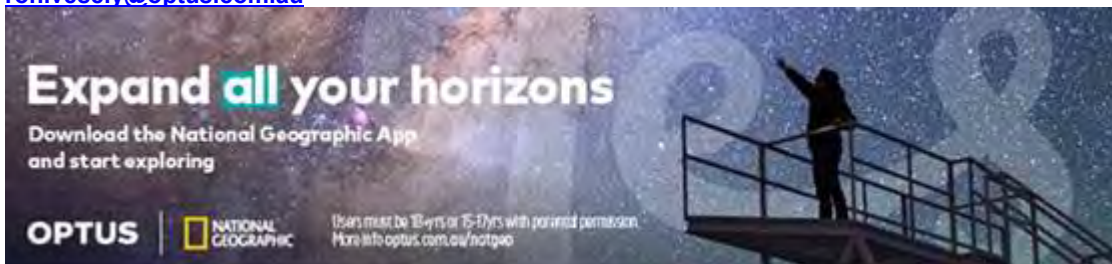
**From:** Ron Vesely <Ron.Vesely@optus.com.au>  
**Sent:** Monday, 27 June 2022 2:39 PM  
**To:** Brendan Siebert  
**Cc:** Whan Khamthara  
**Subject:** FW: Windfarm: Microwave Impact: Query about the contact details of the Optus team in VIC, responsible for state radio planning

Hi Brendan,

Looks all good from Optus Transmission team (Jayantha) and Performance Team. What type of Electromagnetic Interference Assessment do you do? Does it cover out of band transmission / Interference into the 700, 900, 2100, 1800, 3500 MHz band?

Regards,

**Ron Vesely**  
**Manager State Radio Planning and Quality VIC/TAS | Access Network Planning and Quality | Networks Team Teal**  
03 9033 8326  
0403 500 650  
Level 3, 271 Collins Street, Melbourne VIC 3000  
[ron.vesely@optus.com.au](mailto:ron.vesely@optus.com.au)



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**From:** Jayantha Perera  
**Sent:** Monday, 27 June 2022 2:37 PM  
**To:** Ron Vesely <Ron.Vesely@optus.com.au>; Alan Pak-Lon Ao <Alan.Pak-Lon.Ao@optus.com.au>; Michael Odogwu <Michael.Odogwu@optus.com.au>  
**Subject:** RE: Windfarm: Microwave Impact: Query about the contact details of the Optus team in VIC, responsible for state radio planning

Ron,

There are no existing Optus Microwave links crossing the wind farm as per the attached.

Jay

---

**From:** Ron Vesely <[Ron.Vesely@optus.com.au](mailto:Ron.Vesely@optus.com.au)>

**Sent:** Monday, 27 June 2022 1:21 PM

**To:** Jayantha Perera <[Jayantha.Perera@optus.com.au](mailto:Jayantha.Perera@optus.com.au)>; Alan Pak-Lon Ao <[Alan.Pak-Lon.Ao@optus.com.au](mailto:Alan.Pak-Lon.Ao@optus.com.au)>; Michael Odogwu <[Michael.Odogwu@optus.com.au](mailto:Michael.Odogwu@optus.com.au)>

**Subject:** RE: Windfarm: Microwave Impact: Query about the contact details of the Optus team in VIC, responsible for state radio planning

Hi Jayantha,  
Details attached.

Thanks,

**Ron Vesely**

**Manager State Radio Planning and Quality VIC/TAS | Access Network Planning and Quality | Networks**

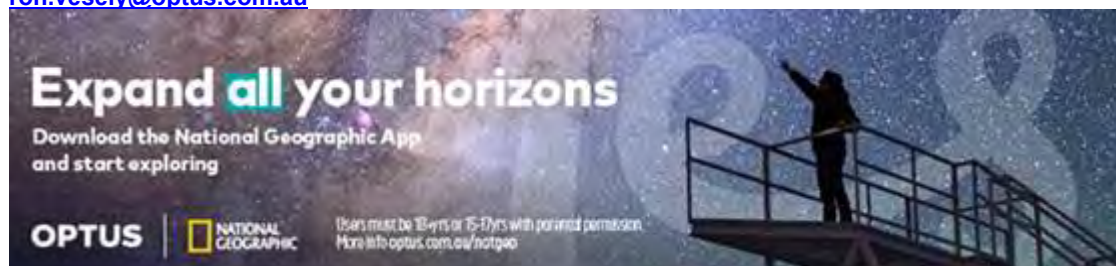
**Team Teal**

03 9033 8326

0403 500 650

Level 3, 271 Collins Street, Melbourne VIC 3000

[ron.vesely@optus.com.au](mailto:ron.vesely@optus.com.au)



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**From:** Jayantha Perera

**Sent:** Monday, 27 June 2022 12:57 PM

**To:** Alan Pak-Lon Ao <[Alan.Pak-Lon.Ao@optus.com.au](mailto:Alan.Pak-Lon.Ao@optus.com.au)>; Ron Vesely <[Ron.Vesely@optus.com.au](mailto:Ron.Vesely@optus.com.au)>; Michael Odogwu <[Michael.Odogwu@optus.com.au](mailto:Michael.Odogwu@optus.com.au)>

**Subject:** RE: Windfarm: Microwave Impact: Query about the contact details of the Optus team in VIC, responsible for state radio planning

Ron

Can you please send me klm file with site locations .. thanks..

---

**From:** Alan Pak-Lon Ao <[Alan.Pak-Lon.Ao@optus.com.au](mailto:Alan.Pak-Lon.Ao@optus.com.au)>

**Sent:** Monday, 27 June 2022 12:12 PM

**To:** Ron Vesely <[Ron.Vesely@optus.com.au](mailto:Ron.Vesely@optus.com.au)>; Michael Odogwu <[Michael.Odogwu@optus.com.au](mailto:Michael.Odogwu@optus.com.au)>; Jayantha Perera <[Jayantha.Perera@optus.com.au](mailto:Jayantha.Perera@optus.com.au)>

**Subject:** FW: Windfarm: Microwave Impact: Query about the contact details of the Optus team in VIC, responsible for state radio planning

Hi Ron,  
for similar check in future, please consult Michael/Jay

Hi Michael/Jay,



please check and advise below

Regards,

**Alan Pak-Lon Ao**

Manager, Core Transport Capacity Mgt

Shared Core Planning | Transport Engineering | IPNE

Consumer | Optus

1 Lyonpark Road, Macquarie Park NSW 2113

t: 02 8082 1227 | m: 0402 201 127 | e: [Alan.Pak-Lon.Ao@optus.com.au](mailto:Alan.Pak-Lon.Ao@optus.com.au)



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**From:** Ron Vesely <[Ron.Vesely@optus.com.au](mailto:Ron.Vesely@optus.com.au)>

**Sent:** Friday, 24 June 2022 1:56 PM

**To:** Alan Pak-Lon Ao <[Alan.Pak-Lon.Ao@optus.com.au](mailto:Alan.Pak-Lon.Ao@optus.com.au)>

**Subject:** Windfarm: Microwave Impact: Query about the contact details of the Optus team in VIC, responsible for state radio planning

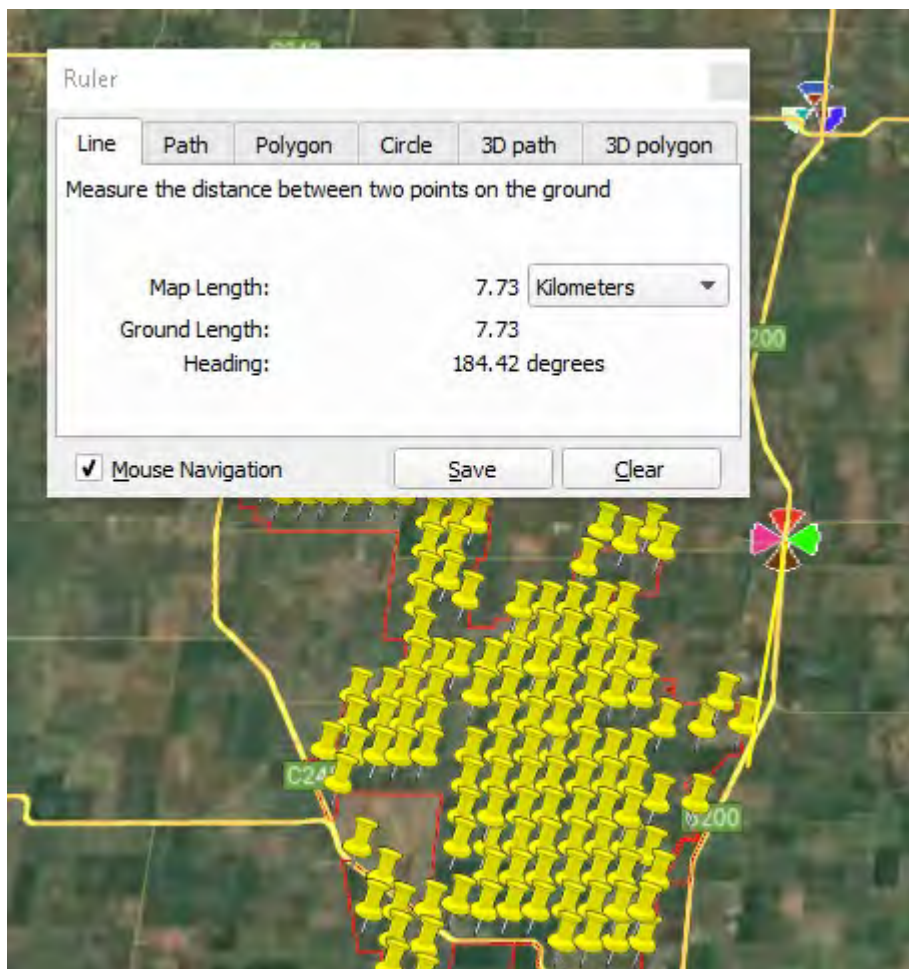
Hi Alan,

Regarding the wind farm proposal at Warracknabeal/Brim would there be any issues on LOS for our microwave dishes ?


Warracknabeal-O:M0583  
BRIM-O:M2393

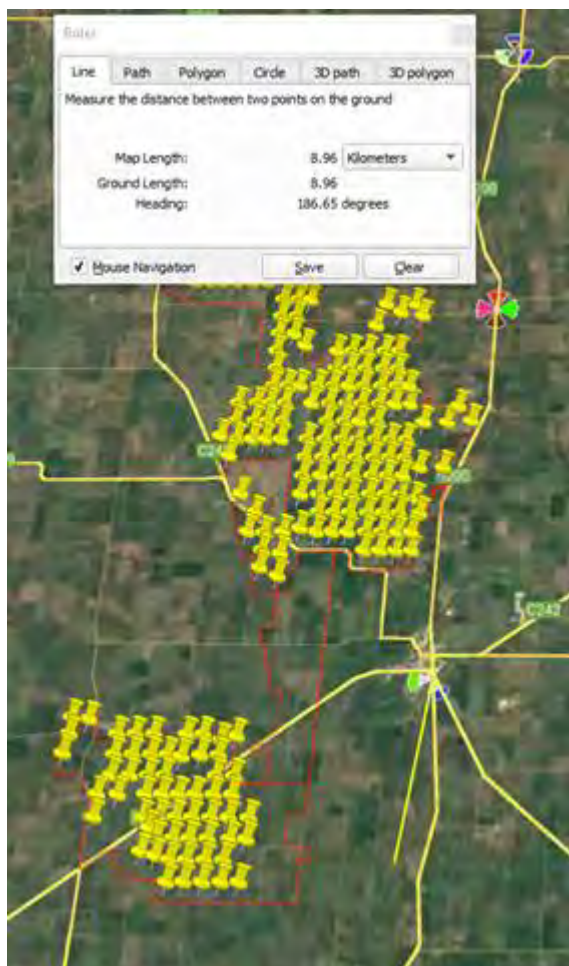
M2393 Brim . Wind farm near Microwave bearing at 184 degrees @7.7km. Would this be a issue?

Optus				
Existing Only Antennas				
Carrier Ref No.	Antenna Model	Carrier / System	Antenna Power	Be (°)
OA	Huawei A11D12HS	Optus / Microwave Link	1.1 W	1
11-O	Huawei ASI4517R1	Optus / LTE700 Optus / WCDMA900	150.4 W	
21-O	Huawei ASI4517R1	Optus / LTE700 Optus / WCDMA900	150.4 W	
31-O	Huawei ASI4517R1	Optus / LTE700 Optus / WCDMA900	150.4 W	
41-O	Huawei ASI4517R1	Optus / LTE700 Optus / WCDMA900	150.4 W	



M0583 WARRACKNABEAL VIC 3393. Microwave bearing at 186 degrees is not near the proposed wind farm.

 <b>Optus</b> <div> <input type="checkbox"/> Existing Only Antennas           <input type="checkbox"/> Existing Antennas with Proposed Changes         </div>		
Carrier Ref No.	Antenna Model	Carrier / System
1	Andrew VHLPX4-7W	<a href="#">Optus / Microwave Link</a>



Regards,

**Ron Vesely**

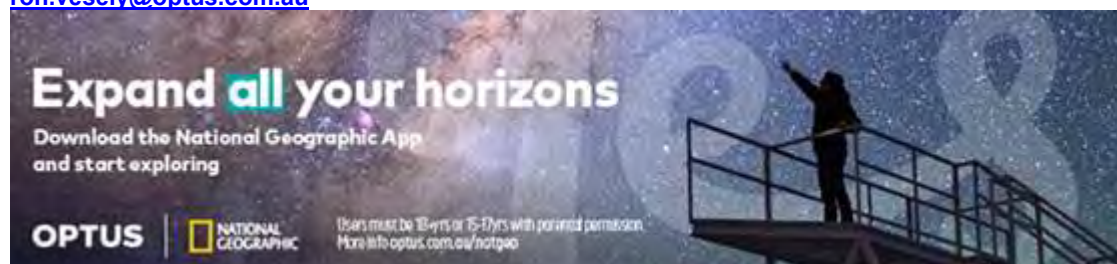
**Manager State Radio Planning and Quality VIC/TAS | Access Network Planning and Quality | Networks Team Teal**

03 9033 8326

0403 500 650

Level 3, 271 Collins Street, Melbourne VIC 3000

[ron.vesely@optus.com.au](mailto:ron.vesely@optus.com.au)



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**From:** Whan Khamthara <[Whan.Khamthara@ghd.com](mailto:Whan.Khamthara@ghd.com)>

**Sent:** Friday, 20 May 2022 3:52 PM

**To:** Ron Vesely <[Ron.Vesely@optus.com.au](mailto:Ron.Vesely@optus.com.au)>

**Cc:** Brendan Siebert <[Brendan.Siebert@ghd.com](mailto:Brendan.Siebert@ghd.com)>

**Subject:** RE: Query about the contact details of the Optus team in VIC, responsible for state radio planning

[External email] Please be cautious when clicking on any links or attachments.

---

Hi Ron,

GHD is conducting the Electromagnetic Interference Assessment report on behalf of WestWind for the wind farm development application in Warracknabeal, Victoria.

An initial desktop investigation found no Optus's Point to Point link crossing the wind farm development boundary and suggested there is no impact from the current wind turbine location.

However, it would be great if Optus could also investigate any potential impact that might occur on their services.

I have attached the site boundary and turbine layout in the .kmz file. You can find their coordinates in the attached excel spreadsheet.

At the moment the turbine specifications are as below, but there might be some minor changes to the specification in the future:

- Maximum tip height: Up to 280m
- Minimum clearance from ground level: No less than 50m
- Rotor diameter: Up to 200m

Please do not hesitate to contact me if you have any questions.

Regards,

**Kaveewat Khamthara (Whan)**

**BEng(Electrical)**

**Telecommunications Engineer**

**GHD**

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**From:** Greg Dunn <[Greg.Dunn@optus.com.au](mailto:Greg.Dunn@optus.com.au)>

**Sent:** Monday, 16 May 2022 9:52 AM

**To:** Whan Khamthara <[Whan.Khamthara@ghd.com](mailto:Whan.Khamthara@ghd.com)>; Ron Vesely <[Ron.Vesely@optus.com.au](mailto:Ron.Vesely@optus.com.au)>

**Cc:** Brendan Siebert <[Brendan.Siebert@ghd.com](mailto:Brendan.Siebert@ghd.com)>

**Subject:** RE: Query about the contact details of the Optus team in VIC, responsible for state radio planning

Hi Whan,

My counterpart in Victoria, Ron Vesely can help.

Best Regards

**Greg Dunn**

Manager State Radio Planning and Quality QLD | Mobile Radio Planning & Quality | Networks  
Consumer | Optus  
OCB Level 6  
15 Green Square Close  
Fortitude Valley QLD 4006  
m: 0411077156 | e: [greg.dunn@optus.com.au](mailto:greg.dunn@optus.com.au)

---

**From:** Whan Khamthara <[Whan.Khamthara@ghd.com](mailto:Whan.Khamthara@ghd.com)>

**Sent:** Tuesday, 10 May 2022 11:31 AM

**To:** Greg Dunn <[Greg.Dunn@optus.com.au](mailto:Greg.Dunn@optus.com.au)>

**Cc:** Brendan Siebert <[Brendan.Siebert@ghd.com](mailto:Brendan.Siebert@ghd.com)>

**Subject:** Query about the contact details of the Optus team in VIC, responsible for state radio planning

[External email] Please be cautious when clicking on any links or attachments.

---

Hi Greg,

Hope you are doing well.

I used to contact you regarding the potential impact of the wind farm development on Optus services in Upper Burdekin area, QLD.

However, this time GHD is conducting the Electromagnetic Interference Assessment report on behalf of WestWind for the wind farm development application in Warracknabeal, Victoria.

We would like to discuss about potential impact from the wind farm toward Optus services. Could you please help shade some light on who should we reach to begin discussions regarding this matter?

Regards,

**Kaveewat Khamthara (Whan)**

BE(Electrical)

Telecommunications Engineer

**GHD**

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## Whan Khamthara

---

**From:** Ryan Ruddick <Ryan.Ruddick@ga.gov.au>  
**Sent:** Monday, 27 June 2022 12:51 PM  
**To:** Whan Khamthara  
**Cc:** Geodesy; Brendan Siebert  
**Subject:** RE: WestWind - Warracknabeal - Request advice on the potential impact of wind farm development on GNSS [SEC=OFFICIAL]

Dear Whan,

Apologies for the delay in response.

Geoscience Australia do not foresee any impact to Commonwealth owned trigonometrical stations or Global Navigation Satellite System (GNSS) reference stations or associated assets from the proposed Warracknabeal Wind Farm development.

Could I request that you address future enquires to [clientservices@ga.gov.au](mailto:clientservices@ga.gov.au) and cc' in [gnss@ga.gov.au](mailto:gnss@ga.gov.au) this way the requests will be logged and tracked within our system.

Kind regards,

**Ryan Ruddick** | Director  
GNSS Infrastructure and Informatics Section | National Positioning Infrastructure Branch  
Place, Space and Communities Division

t +61 2 6249 9426 m +61 429 771 069 [ga.gov.au](http://ga.gov.au)



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---

**From:** Whan Khamthara <Whan.Khamthara@ghd.com>  
**Sent:** Tuesday, 10 May 2022 11:43 AM  
**To:** Ryan Ruddick <Ryan.Ruddick@ga.gov.au>  
**Cc:** Geodesy <geodesy@ga.gov.au>; Brendan Siebert <Brendan.Siebert@ghd.com>  
**Subject:** WestWind - Warracknabeal - Request advice on the potential impact of wind farm development on GNSS

Hi Ryan,

GHD is conducting the Electromagnetic Interference Assessment report on behalf of WestWind for the wind farm development application in Warracknabeal, Victoria.

An initial desktop investigation suggested there is no impact from the current wind turbine location to the GNSS service. However, it would be great if Geoscience Australia could also investigate any potential impact that might occur on their services.



I have attached the site boundary and turbine layout in the .kmz file. You can find their coordinates in the attached excel spreadsheet.

At the moment the turbine specifications are as below, but there might be some minor changes to the specification in the future:

- Maximum tip height: Up to 280m
- Minimum clearance from ground level: No less than 50m
- Rotor diameter: Up to 200m

Please do not hesitate to contact me if you have any questions.

Regards,

**Kaveewat Khamthara (Whan)**

**BE(Electrical)**

**Telecommunications Engineer**

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## Whan Khamthara

---

**From:** Mohammad Zomorodi <Mohammad.Zomorodi@bom.gov.au>  
**Sent:** Monday, 30 May 2022 2:46 PM  
**To:** Whan Khamthara  
**Cc:** Marc Keppler; Brendan Siebert; Muhammad Afzal; windfarmenquiries  
**Subject:** RE: WestWind - Warracknabeal - Request advice on the potential impact of wind farm development on BoM services [SEC=OFFICIAL]

Hi Kaveewat,

Thanks for the submitted proposal for the Warracknabeal WF in VIC.

We investigated the proposed WF and found that it puts a major risk on the Rainbow radar. The distance between the closest Turbine and the radar is only 20 km and hence the interference from the proposed farm significantly reduces the radar capability on providing its vital services for a large area, more than 50 degree.

Should you have any further question or if need more discussion please don't hesitate to contact me.

Regards  
Mohammad

**Dr. Mohammad Zomorodi | Spectrum Manager**  
**Observing Systems and Operations Program**



**Australian Government**  
**Bureau of Meteorology**

Bureau of Meteorology  
GPO Box 1289 Melbourne VIC 3001  
Level 7, 700 Collins Street, Docklands VIC 3008  
Tel: (03) 9669 4413 | [mohammad.zomorodi@bom.gov.au](mailto:mohammad.zomorodi@bom.gov.au)  
[www.bom.gov.au](http://www.bom.gov.au)

---

**From:** Whan Khamthara <Whan.Khamthara@ghd.com>  
**Sent:** Tuesday, 10 May 2022 3:48 PM  
**To:** Mohammad Zomorodi <Mohammad.Zomorodi@bom.gov.au>  
**Cc:** Marc Keppler <Marc.Keppler@bom.gov.au>; Brendan Siebert <Brendan.Siebert@ghd.com>; Muhammad Afzal <Muhammad.Afzal@bom.gov.au>; windfarmenquiries <windfarmenquiries@bom.gov.au>  
**Subject:** RE: WestWind - Warracknabeal - Request advice on the potential impact of wind farm development on BoM services [SEC=OFFICIAL]

Hi Mohammad,

Thank you for your prompt response. Please find the filled form attached.

Regards,

**Kaveewat Khamthara (Whan)**  
**BE(Electrical)**  
**Telecommunications Engineer**

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**From:** Mohammad Zomorodi <[Mohammad.Zomorodi@bom.gov.au](mailto:Mohammad.Zomorodi@bom.gov.au)>

**Sent:** Tuesday, 10 May 2022 2:26 PM

**To:** Whan Khamthara <[Whan.Khamthara@ghd.com](mailto:Whan.Khamthara@ghd.com)>

**Cc:** Marc Keppler <[Marc.Keppler@bom.gov.au](mailto:Marc.Keppler@bom.gov.au)>; Brendan Siebert <[Brendan.Siebert@ghd.com](mailto:Brendan.Siebert@ghd.com)>; Muhammad Afzal <[Muhammad.Afzal@bom.gov.au](mailto:Muhammad.Afzal@bom.gov.au)>; windfarmenquiries <[windfarmenquiries@bom.gov.au](mailto:windfarmenquiries@bom.gov.au)>

**Subject:** RE: WestWind - Warracknabeal - Request advice on the potential impact of wind farm development on BoM services [SEC=OFFICIAL]

Hi Whan,

Thanks for reaching us for Warracknabeal wind farm proposal.

Would you please complete the attached form and send it back to me?

Regards

Mohammad

---

**From:** Whan Khamthara <[Whan.Khamthara@ghd.com](mailto:Whan.Khamthara@ghd.com)>

**Sent:** Tuesday, 10 May 2022 10:19 AM

**To:** Mohammad Zomorodi <[Mohammad.Zomorodi@bom.gov.au](mailto:Mohammad.Zomorodi@bom.gov.au)>

**Cc:** Marc Keppler <[Marc.Keppler@bom.gov.au](mailto:Marc.Keppler@bom.gov.au)>; Brendan Siebert <[Brendan.Siebert@ghd.com](mailto:Brendan.Siebert@ghd.com)>

**Subject:** WestWind - Warracknabeal - Request advice on the potential impact of wind farm development on BoM services

Hi Mohammad,

Hope you are doing well.

GHD is producing the Electromagnetic Interference report for a proposed wind farm in Warracknabeal and as usual, it would be great if you could help investigate any potential impact that might occur on the weather watch radars.

I have attached the site boundary and turbine layout in the .kmz file. You can find their coordinates in the attached excel spreadsheet.

At the moment the turbine specifications are as below, but there might be some minor changes to the specification in the future:

- Maximum tip height: Up to 280m
- Minimum clearance from ground level: No less than 50m
- Rotor diameter: Up to 200m

Please do not hesitate to contact me if you have any questions.

Regards,

## **Kaveewat Khamthara (Whan)**

**BE(Electrical)**

**Telecommunications Engineer**

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# Appendix D

## ACMA Radio Licence within 50 km radius of the wind farm area, sourced from ACMA Database

Table 5 Point-to-Point Microwave Links

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10081888/1	7866300000	301287	-36.44964	142.048205	Telstra Corporation Limited
10081888/1	7866300000	10000891	-36.335237	142.22606	Telstra Corporation Limited
10081888/1	8177620000	301287	-36.44964	142.048205	Telstra Corporation Limited
10081888/1	8177620000	10000891	-36.335237	142.22606	Telstra Corporation Limited
10107864/3	10995000000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
10107864/3	11485000000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
10120005/3	405550000	47989	-36.007567	142.491816	Powercor Australia Ltd
10120005/3	415000000	47989	-36.007567	142.491816	Powercor Australia Ltd
10143681/1	410050000	47989	-36.007567	142.491816	Powercor Australia Ltd
10143681/1	419500000	47989	-36.007567	142.491816	Powercor Australia Ltd
10160334/2	5960025000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
10160334/2	6212065000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
10195930/1	7762525000	301287	-36.44964	142.048205	Vodafone Australia Pty Limited
10195930/1	8073845000	301287	-36.44964	142.048205	Vodafone Australia Pty Limited
10195931/1	7792175000	301287	-36.44964	142.048205	Vodafone Australia Pty Limited
10195931/1	8103495000	301287	-36.44964	142.048205	Vodafone Australia Pty Limited
10215930/2	10775000000	9008556	-36.627658	142.458775	NBN CO LIMITED
10215930/2	11265000000	9008556	-36.627658	142.458775	NBN CO LIMITED
10215933/2	7747700000	9008556	-36.627658	142.458775	NBN CO LIMITED
10215933/2	7747700000	9018938	-36.6288	142.637847	NBN CO LIMITED
10215933/2	8059020000	9008556	-36.627658	142.458775	NBN CO LIMITED
10215933/2	8059020000	9018938	-36.6288	142.637847	NBN CO LIMITED
10218550/1	7881125000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
10218550/1	8192445000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
10301076/1	10855000000	10007107	-36.568792	142.115776	Vodafone Australia Pty Limited
10301076/1	11345000000	10007107	-36.568792	142.115776	Vodafone Australia Pty Limited

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10323519/1	7925600000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
10323519/1	8236920000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
10371963/1	10775000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10371963/1	10775000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10371963/1	11265000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10371963/1	11265000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10371964/1	10815000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10371964/1	10815000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10371964/1	11305000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10371964/1	11305000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10371965/2	7925600000	9000178	-36.256772	142.402675	NBN CO LIMITED
10371965/2	7925600000	9018943	-36.074886	142.421105	NBN CO LIMITED
10371965/2	8236920000	9000178	-36.256772	142.402675	NBN CO LIMITED
10371965/2	8236920000	9018943	-36.074886	142.421105	NBN CO LIMITED
10371966/3	7866300000	9000178	-36.256772	142.402675	NBN CO LIMITED
10371966/3	7866300000	9018943	-36.074886	142.421105	NBN CO LIMITED
10371966/3	8177620000	9000178	-36.256772	142.402675	NBN CO LIMITED
10371966/3	8177620000	9018943	-36.074886	142.421105	NBN CO LIMITED
10423487/1	7925600000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
10423487/1	8236920000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
10459359/1	7807000000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
10459359/1	7807000000	9018943	-36.074886	142.421105	Optus Mobile Pty Limited
10459359/1	8118320000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
10459359/1	8118320000	9018943	-36.074886	142.421105	Optus Mobile Pty Limited
10505689/2	7543500000	10011628	-36.433244	142.317753	Vertical Telecoms Pty Limited
10505689/2	7704500000	10011628	-36.433244	142.317753	Vertical Telecoms Pty Limited
10533093/1	10735000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533093/1	11225000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533094/1	10775000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533094/1	11265000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533095/1	10855000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533095/1	11345000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533096/1	10855000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533096/1	10855000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10533096/1	11345000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533096/1	11345000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10533097/1	11055000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533097/1	11055000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10533097/1	11545000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533097/1	11545000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10533098/1	11095000000	9018947	-35.937692	142.425086	NBN CO LIMITED



LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10533098/1	11095000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10533098/1	11585000000	9018947	-35.937692	142.425086	NBN CO LIMITED
10533098/1	11585000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10533099/1	10735000000	9000178	-36.256772	142.402675	NBN CO LIMITED
10533099/1	10735000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10533099/1	11225000000	9000178	-36.256772	142.402675	NBN CO LIMITED
10533099/1	11225000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10533100/1	10775000000	9000178	-36.256772	142.402675	NBN CO LIMITED
10533100/1	10775000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10533100/1	11265000000	9000178	-36.256772	142.402675	NBN CO LIMITED
10533100/1	11265000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10579258/4	6640000000	9008556	-36.627658	142.458775	NBN CO LIMITED
10579258/4	6980000000	9008556	-36.627658	142.458775	NBN CO LIMITED
10579259/3	6720000000	9008556	-36.627658	142.458775	NBN CO LIMITED
10579259/3	7060000000	9008556	-36.627658	142.458775	NBN CO LIMITED
10580045/2	6480000000	9022107	-36.457168	142.047833	NBN CO LIMITED
10580045/2	6480000000	9022106	-36.141113	141.99121	NBN CO LIMITED
10580045/2	6820000000	9022107	-36.457168	142.047833	NBN CO LIMITED
10580045/2	6820000000	9022106	-36.141113	141.99121	NBN CO LIMITED
10580046/2	6560000000	9022107	-36.457168	142.047833	NBN CO LIMITED
10580046/2	6560000000	9022106	-36.141113	141.99121	NBN CO LIMITED
10580046/2	6900000000	9022107	-36.457168	142.047833	NBN CO LIMITED
10580046/2	6900000000	9022106	-36.141113	141.99121	NBN CO LIMITED
10580047/1	7807000000	9022106	-36.141113	141.99121	NBN CO LIMITED
10580047/1	7807000000	206087	-35.927018	141.997012	NBN CO LIMITED
10580047/1	8118320000	9022106	-36.141113	141.99121	NBN CO LIMITED
10580047/1	8118320000	206087	-35.927018	141.997012	NBN CO LIMITED
10580048/1	7747700000	9022106	-36.141113	141.99121	NBN CO LIMITED
10580048/1	7747700000	206087	-35.927018	141.997012	NBN CO LIMITED
10580048/1	8059020000	9022106	-36.141113	141.99121	NBN CO LIMITED
10580048/1	8059020000	206087	-35.927018	141.997012	NBN CO LIMITED
10580049/1	18580000000	206087	-35.927018	141.997012	NBN CO LIMITED
10580049/1	19590000000	206087	-35.927018	141.997012	NBN CO LIMITED
10580050/1	18525000000	206087	-35.927018	141.997012	NBN CO LIMITED
10580050/1	19535000000	206087	-35.927018	141.997012	NBN CO LIMITED
10771644/1	10995000000	305199	-36.573418	142.124461	NBN CO LIMITED
10771644/1	11485000000	305199	-36.573418	142.124461	NBN CO LIMITED
10771653/1	10735000000	10012512	-35.997652	142.013441	Bureau of Meteorology
10771653/1	10735000000	10017376	-36.14172	141.990747	Bureau of Meteorology
10771653/1	11225000000	10012512	-35.997652	142.013441	Bureau of Meteorology
10771653/1	11225000000	10017376	-36.14172	141.990747	Bureau of Meteorology

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10896556/1	7925600000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
10896556/1	7925600000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
10896556/1	8236920000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
10896556/1	8236920000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
10906134/1	11075000000	9018940	-36.460294	142.595061	NBN CO LIMITED
10906134/1	11075000000	9018938	-36.6288	142.637847	NBN CO LIMITED
10906134/1	11565000000	9018940	-36.460294	142.595061	NBN CO LIMITED
10906134/1	11565000000	9018938	-36.6288	142.637847	NBN CO LIMITED
10906135/1	11155000000	9018940	-36.460294	142.595061	NBN CO LIMITED
10906135/1	11155000000	9018938	-36.6288	142.637847	NBN CO LIMITED
10906135/1	11645000000	9018940	-36.460294	142.595061	NBN CO LIMITED
10906135/1	11645000000	9018938	-36.6288	142.637847	NBN CO LIMITED
10906136/1	7747700000	9008556	-36.627658	142.458775	NBN CO LIMITED
10906136/1	7747700000	9018938	-36.6288	142.637847	NBN CO LIMITED
10906136/1	8059020000	9008556	-36.627658	142.458775	NBN CO LIMITED
10906136/1	8059020000	9018938	-36.6288	142.637847	NBN CO LIMITED
10906137/1	7866300000	9008556	-36.627658	142.458775	NBN CO LIMITED
10906137/1	7866300000	9018938	-36.6288	142.637847	NBN CO LIMITED
10906137/1	8177620000	9008556	-36.627658	142.458775	NBN CO LIMITED
10906137/1	8177620000	9018938	-36.6288	142.637847	NBN CO LIMITED
10906138/1	7866300000	9008556	-36.627658	142.458775	NBN CO LIMITED
10906138/1	7866300000	9018938	-36.6288	142.637847	NBN CO LIMITED
10906138/1	8177620000	9008556	-36.627658	142.458775	NBN CO LIMITED
10906138/1	8177620000	9018938	-36.6288	142.637847	NBN CO LIMITED
10942188/1	10915000000	305199	-36.573418	142.124461	NBN CO LIMITED
10942188/1	11405000000	305199	-36.573418	142.124461	NBN CO LIMITED
10964560/1	10815000000	9000178	-36.256772	142.402675	NBN CO LIMITED
10964560/1	10815000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10964560/1	11305000000	9000178	-36.256772	142.402675	NBN CO LIMITED
10964560/1	11305000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10964561/1	10855000000	9000178	-36.256772	142.402675	NBN CO LIMITED
10964561/1	10855000000	9018943	-36.074886	142.421105	NBN CO LIMITED
10964561/1	11345000000	9000178	-36.256772	142.402675	NBN CO LIMITED
10964561/1	11345000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11143287/1	10915000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11143287/1	10915000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11143287/1	11405000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11143287/1	11405000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11143288/1	10915000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11143288/1	10915000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11143288/1	11405000000	9018947	-35.937692	142.425086	NBN CO LIMITED

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
11143288/1	11405000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11143289/1	10995000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11143289/1	10995000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11143289/1	11485000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11143289/1	11485000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11143290/1	10995000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11143290/1	10995000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11143290/1	11485000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11143290/1	11485000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11288404/1	7529500000	10011628	-36.433244	142.317753	Vertical Telecoms Pty Limited
11288404/1	7690500000	10011628	-36.433244	142.317753	Vertical Telecoms Pty Limited
11289284/1	7866300000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
11289284/1	7866300000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
11289284/1	8177620000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
11289284/1	8177620000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
11290616/1	7747700000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
11290616/1	7747700000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
11290616/1	8059020000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
11290616/1	8059020000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
11290617/1	7866300000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
11290617/1	7866300000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
11290617/1	8177620000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
11290617/1	8177620000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
11290618/1	7866300000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
11290618/1	7866300000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
11290618/1	8177620000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
11290618/1	8177620000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
11290619/1	7925600000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
11290619/1	8236920000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
11290620/1	7925600000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
11290620/1	8236920000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
11551964/1	6640000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11551964/1	6980000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11551965/1	6720000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11551965/1	7060000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11551966/1	6480000000	9022107	-36.457168	142.047833	NBN CO LIMITED
11551966/1	6480000000	9022106	-36.141113	141.99121	NBN CO LIMITED
11551966/1	6820000000	9022107	-36.457168	142.047833	NBN CO LIMITED
11551966/1	6820000000	9022106	-36.141113	141.99121	NBN CO LIMITED
11551967/1	6560000000	9022107	-36.457168	142.047833	NBN CO LIMITED
11551967/1	6560000000	9022106	-36.141113	141.99121	NBN CO LIMITED

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
11551967/1	6900000000	9022107	-36.457168	142.047833	NBN CO LIMITED
11551967/1	6900000000	9022106	-36.141113	141.99121	NBN CO LIMITED
11574651/1	10855000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11574651/1	11345000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11574652/1	10815000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11574652/1	11305000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11574668/1	10735000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11574668/1	11225000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11574703/1	10775000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11574703/1	11265000000	9008556	-36.627658	142.458775	NBN CO LIMITED
11574734/1	11095000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11574734/1	11095000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11574734/1	11585000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11574734/1	11585000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11575158/1	10735000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11575158/1	10735000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11575158/1	11225000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11575158/1	11225000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11575160/1	10815000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11575160/1	11305000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576475/1	10775000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576475/1	10775000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576475/1	11265000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576475/1	11265000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576476/1	10815000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576476/1	10815000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576476/1	11305000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576476/1	11305000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576542/1	10735000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576542/1	11225000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576543/1	10775000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576543/1	11265000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576544/1	10855000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576544/1	11345000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576545/1	10855000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576545/1	10855000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576545/1	11345000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576545/1	11345000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576546/1	11055000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11576546/1	11055000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576546/1	11545000000	9018947	-35.937692	142.425086	NBN CO LIMITED

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
11576546/1	11545000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576547/1	10735000000	9000178	-36.256772	142.402675	NBN CO LIMITED
11576547/1	10735000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576547/1	11225000000	9000178	-36.256772	142.402675	NBN CO LIMITED
11576547/1	11225000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576548/1	10775000000	9000178	-36.256772	142.402675	NBN CO LIMITED
11576548/1	10775000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11576548/1	11265000000	9000178	-36.256772	142.402675	NBN CO LIMITED
11576548/1	11265000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11591820/1	11075000000	9018940	-36.460294	142.595061	NBN CO LIMITED
11591820/1	11075000000	9018938	-36.6288	142.637847	NBN CO LIMITED
11591820/1	11565000000	9018940	-36.460294	142.595061	NBN CO LIMITED
11591820/1	11565000000	9018938	-36.6288	142.637847	NBN CO LIMITED
11591821/1	11155000000	9018940	-36.460294	142.595061	NBN CO LIMITED
11591821/1	11155000000	9018938	-36.6288	142.637847	NBN CO LIMITED
11591821/1	11645000000	9018940	-36.460294	142.595061	NBN CO LIMITED
11591821/1	11645000000	9018938	-36.6288	142.637847	NBN CO LIMITED
11591833/1	10815000000	9000178	-36.256772	142.402675	NBN CO LIMITED
11591833/1	10815000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11591833/1	11305000000	9000178	-36.256772	142.402675	NBN CO LIMITED
11591833/1	11305000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11591834/1	10855000000	9000178	-36.256772	142.402675	NBN CO LIMITED
11591834/1	10855000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11591834/1	11345000000	9000178	-36.256772	142.402675	NBN CO LIMITED
11591834/1	11345000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11594775/1	10915000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11594775/1	10915000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11594775/1	11405000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11594775/1	11405000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11594776/1	10915000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11594776/1	10915000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11594776/1	11405000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11594776/1	11405000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11594777/1	10995000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11594777/1	10995000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11594777/1	11485000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11594777/1	11485000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11594778/1	10995000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11594778/1	10995000000	9018943	-36.074886	142.421105	NBN CO LIMITED
11594778/1	11485000000	9018947	-35.937692	142.425086	NBN CO LIMITED
11594778/1	11485000000	9018943	-36.074886	142.421105	NBN CO LIMITED

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
1324505/1	1442500000	304769	-36.631045	142.411753	Powercor Australia Ltd
1324505/1	1515000000	304769	-36.631045	142.411753	Powercor Australia Ltd
1324506/1	1434500000	304769	-36.631045	142.411753	Powercor Australia Ltd
1324506/1	1495000000	304769	-36.631045	142.411753	Powercor Australia Ltd
1562662/3	1446500000	304769	-36.631045	142.411753	Powercor Australia Ltd
1562662/3	1507000000	304769	-36.631045	142.411753	Powercor Australia Ltd
1569052/1	7762525000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1569052/1	8073845000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1803565/1	7732875000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1803565/1	8044195000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1900883/1	7792175000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1900883/1	8103495000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1906320/1	7792175000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
1906320/1	8103495000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
1914218/1	7807000000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
1914218/1	8118320000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
1916723/1	7881125000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1916723/1	8192445000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1917606/1	7762525000	9010526	-36.445529	142.59479	Optus Mobile Pty Limited
1917606/1	7762525000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
1917606/1	8073845000	9010526	-36.445529	142.59479	Optus Mobile Pty Limited
1917606/1	8073845000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
1920990/1	7762525000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1920990/1	8073845000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1920993/1	7821825000	9011022	-35.928878	142.418386	Optus Mobile Pty Limited
1920993/1	8133145000	9011022	-35.928878	142.418386	Optus Mobile Pty Limited
1922456/1	7792175000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1922456/1	8103495000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1925151/1	7762525000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1925151/1	8073845000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1937718/1	14511500000	51204	-36.006291	142.014407	Telstra Corporation Limited
1937718/1	15155500000	51204	-36.006291	142.014407	Telstra Corporation Limited
1946060/1	14504500000	51210	-36.486843	142.378544	Telstra Corporation Limited
1946060/1	14504500000	51201	-36.240498	142.396609	Telstra Corporation Limited
1946060/1	15148500000	51210	-36.486843	142.378544	Telstra Corporation Limited
1946060/1	15148500000	51201	-36.240498	142.396609	Telstra Corporation Limited
1950501/1	14504500000	131961	-35.996081	142.401462	Telstra Corporation Limited
1950501/1	14504500000	51204	-36.006291	142.014407	Telstra Corporation Limited
1950501/1	15148500000	131961	-35.996081	142.401462	Telstra Corporation Limited
1950501/1	15148500000	51204	-36.006291	142.014407	Telstra Corporation Limited
1950502/1	7442000000	47989	-36.007567	142.491816	Telstra Corporation Limited



LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
1950502/1	7442000000	51201	-36.240498	142.396609	Telstra Corporation Limited
1950502/1	7603000000	47989	-36.007567	142.491816	Telstra Corporation Limited
1950502/1	7603000000	51201	-36.240498	142.396609	Telstra Corporation Limited
1950503/1	14504500000	131961	-35.996081	142.401462	Telstra Corporation Limited
1950503/1	14504500000	47989	-36.007567	142.491816	Telstra Corporation Limited
1950503/1	15148500000	131961	-35.996081	142.401462	Telstra Corporation Limited
1950503/1	15148500000	47989	-36.007567	142.491816	Telstra Corporation Limited
1954103/1	7435000000	51210	-36.486843	142.378544	Telstra Corporation Limited
1954103/1	7596000000	51210	-36.486843	142.378544	Telstra Corporation Limited
1965716/4	10855000000	9008556	-36.627658	142.458775	NBN CO LIMITED
1965716/4	11345000000	9008556	-36.627658	142.458775	NBN CO LIMITED
1965717/4	10815000000	9008556	-36.627658	142.458775	NBN CO LIMITED
1965717/4	11305000000	9008556	-36.627658	142.458775	NBN CO LIMITED
1965719/1	10895000000	305199	-36.573418	142.124461	NBN CO LIMITED
1965719/1	11385000000	305199	-36.573418	142.124461	NBN CO LIMITED
1965751/2	10735000000	9018947	-35.937692	142.425086	NBN CO LIMITED
1965751/2	10735000000	9018943	-36.074886	142.421105	NBN CO LIMITED
1965751/2	11225000000	9018947	-35.937692	142.425086	NBN CO LIMITED
1965751/2	11225000000	9018943	-36.074886	142.421105	NBN CO LIMITED
1965754/2	10815000000	9018947	-35.937692	142.425086	NBN CO LIMITED
1965754/2	11305000000	9018947	-35.937692	142.425086	NBN CO LIMITED
1971038/1	11155000000	301287	-36.44964	142.048205	Optus Mobile Pty Limited
1971038/1	11155000000	305193	-36.381515	141.93136	Optus Mobile Pty Limited
1971038/1	11645000000	301287	-36.44964	142.048205	Optus Mobile Pty Limited
1971038/1	11645000000	305193	-36.381515	141.93136	Optus Mobile Pty Limited
1971039/1	11075000000	301287	-36.44964	142.048205	Optus Mobile Pty Limited
1971039/1	11075000000	305193	-36.381515	141.93136	Optus Mobile Pty Limited
1971039/1	11565000000	301287	-36.44964	142.048205	Optus Mobile Pty Limited
1971039/1	11565000000	305193	-36.381515	141.93136	Optus Mobile Pty Limited
1974033/1	7851475000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1974033/1	8162795000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1974045/1	11155000000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
1974045/1	11155000000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1974045/1	11645000000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
1974045/1	11645000000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1974187/1	7881125000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1974187/1	8192445000	206087	-35.927018	141.997012	Optus Mobile Pty Limited
1974189/2	7747700000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
1974189/2	7747700000	305193	-36.381515	141.93136	Optus Mobile Pty Limited
1974189/2	8059020000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
1974189/2	8059020000	305193	-36.381515	141.93136	Optus Mobile Pty Limited

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
1974190/2	7866300000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
1974190/2	7866300000	305193	-36.381515	141.93136	Optus Mobile Pty Limited
1974190/2	8177620000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
1974190/2	8177620000	305193	-36.381515	141.93136	Optus Mobile Pty Limited
1978398/1	7732875000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
1978398/1	8044195000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
1987060/1	7925600000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
1987060/1	8236920000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
1988574/1	7807000000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1988574/1	8118320000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
9971828/3	10735000000	9008556	-36.627658	142.458775	NBN CO LIMITED
9971828/3	11225000000	9008556	-36.627658	142.458775	NBN CO LIMITED

**Table 6** *Point-to-Multipoint Radio Links*

LICENCE NO	FREQUENCY (Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
11235147/1	461193750	10024999	-36.3206	142.4131	GE AUSTRALIA PTY LTD
11235147/1	451693750	10024999	-36.3206	142.4131	GE AUSTRALIA PTY LTD

**Table 7** *Land Mobile Radio Systems*

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10097549/1	463387500	10001286	-36.424611	142.00968	CSE CROSSCOM PTY LTD
10097549/1	453387500	10001286	-36.424611	142.00968	CSE CROSSCOM PTY LTD
10097550/1	454387500	10001286	-36.424611	142.00968	CSE CROSSCOM PTY LTD
10097550/1	464387500	10001286	-36.424611	142.00968	CSE CROSSCOM PTY LTD
10188835/1	462550000	10004144	-36.513	142.5535	Dale Petering
10188835/1	452550000	10004144	-36.513	142.5535	Dale Petering
10273432/1	171450000	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273432/1	166850000	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273435/1	170750000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273435/1	166150000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273445/1	171987500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273445/1	167387500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273454/1	171525000	132606	-36.453977	142.580666	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273454/1	166925000	132606	-36.453977	142.580666	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273473/1	171275000	132524	-36.62041	142.477726	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273473/1	166675000	132524	-36.62041	142.477726	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273474/1	170825000	132524	-36.62041	142.477726	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273474/1	166225000	132524	-36.62041	142.477726	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273475/1	170675000	132524	-36.62041	142.477726	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273475/1	166075000	132524	-36.62041	142.477726	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273476/1	170075000	132524	-36.62041	142.477726	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273476/1	165475000	132524	-36.62041	142.477726	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273480/1	170362500	51201	-36.240498	142.396609	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
10273480/1	165762500	51201	-36.240498	142.396609	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1182816/1	170350000	51204	-36.006291	142.014407	Telstra Corporation Limited
1182816/1	165750000	51204	-36.006291	142.014407	Telstra Corporation Limited
1182922/1	170212500	51201	-36.240498	142.396609	Telstra Corporation Limited
1182922/1	165612500	51201	-36.240498	142.396609	Telstra Corporation Limited

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
1186431/1	148912500	9002562	-36.447091	142.409285	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1306194/1	161225000	46058	-36.452466	142.023533	Country Fire Authority
1306195/1	161150000	46058	-36.452466	142.023533	Country Fire Authority
1306196/1	161000000	46058	-36.452466	142.023533	Country Fire Authority
1306197/1	161225000	46072	-36.6164	142.467396	Country Fire Authority
1306198/1	161150000	46072	-36.6164	142.467396	Country Fire Authority
1306199/1	161000000	46072	-36.6164	142.467396	Country Fire Authority
1306200/1	161225000	46076	-36.632573	142.632189	Country Fire Authority
1306201/1	161150000	46076	-36.632573	142.632189	Country Fire Authority
1306202/1	161000000	46076	-36.632573	142.632189	Country Fire Authority
1306227/1	161225000	43701	-36.140847	141.987238	Country Fire Authority
1306228/1	161150000	43701	-36.140847	141.987238	Country Fire Authority
1306229/1	161000000	43701	-36.140847	141.987238	Country Fire Authority
1306291/1	161225000	46079	-36.250394	142.393746	Country Fire Authority
1306292/1	161150000	46079	-36.250394	142.393746	Country Fire Authority
1306293/1	161000000	46079	-36.250394	142.393746	Country Fire Authority
1314948/1	161225000	302453	-36.271826	142.062363	Country Fire Authority
1314949/1	161150000	302453	-36.271826	142.062363	Country Fire Authority
1314950/1	161000000	302453	-36.271826	142.062363	Country Fire Authority
1327642/2	148912500	46072	-36.6164	142.467396	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1327642/2	148912500	10006764	-36.637471	142.631833	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1328833/1	148912500	9000268	-36.005875	142.014535	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1329472/1	148912500	9000178	-36.256772	142.402675	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1563201/1	162650000	46079	-36.250394	142.393746	Country Fire Authority
1563201/1	158050000	46079	-36.250394	142.393746	Country Fire Authority
1800277/2	148687500	46072	-36.6164	142.467396	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800277/2	148687500	10006764	-36.637471	142.631833	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800317/1	148687500	9000268	-36.005875	142.014535	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800376/2	148687500	9000178	-36.256772	142.402675	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800376/2	148687500	9002562	-36.447091	142.409285	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800419/1	148687500	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800558/1	171112500	51201	-36.240498	142.396609	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800558/1	166512500	51201	-36.240498	142.396609	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
1800559/1	170512500	51201	-36.240498	142.396609	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800559/1	165912500	51201	-36.240498	142.396609	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800560/1	170062500	51201	-36.240498	142.396609	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800560/1	165462500	51201	-36.240498	142.396609	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800570/1	172737500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800570/1	168137500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800571/1	172137500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800571/1	167537500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800572/1	171837500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800572/1	167237500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800573/1	166937500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800573/1	171537500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800622/1	172725000	132606	-36.453977	142.580666	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800622/1	168125000	132606	-36.453977	142.580666	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800623/1	172425000	132606	-36.453977	142.580666	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800623/1	167825000	132606	-36.453977	142.580666	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800624/1	172125000	132606	-36.453977	142.580666	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800624/1	167525000	132606	-36.453977	142.580666	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800640/1	172650000	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800640/1	168050000	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800641/1	172350000	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800641/1	167750000	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800642/1	172050000	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1800642/1	167450000	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1804473/1	169912500	51201	-36.240498	142.396609	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
1804473/1	165312500	51201	-36.240498	142.396609	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1804474/1	170000000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1804474/1	165400000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1804478/1	171825000	132606	-36.453977	142.580666	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1804478/1	167225000	132606	-36.453977	142.580666	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1804479/1	171750000	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1804479/1	167150000	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
190044/1	148337500	42345	-36.452456	142.024649	Wimmera Health Care Group
1901055/1	148912500	301287	-36.44964	142.048205	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1910756/1	153150000	9009498	-36.098623	142.049474	SST Development Group Australia Pty Ltd
1910757/1	153100000	9009499	-36.351685	142.536265	SST Development Group Australia Pty Ltd
1917201/1	162112500	46076	-36.632573	142.632189	Country Fire Authority
1917201/1	157512500	46076	-36.632573	142.632189	Country Fire Authority
1953291/1	161000000	140690	-36.345778	142.530811	Country Fire Authority
1953292/1	161150000	140690	-36.345778	142.530811	Country Fire Authority
1953293/1	161225000	140690	-36.345778	142.530811	Country Fire Authority
1955613/1	464900000	9016961	-35.9981	142.733993	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1955613/1	454900000	9016961	-35.9981	142.733993	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1955618/1	465200000	9016956	-36.120339	141.988193	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1955618/1	455200000	9016956	-36.120339	141.988193	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1955618/1	465200000	9021007	-36.123773	142.189589	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1955618/1	455200000	9021007	-36.123773	142.189589	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1955619/1	454975000	9016957	-36.388452	141.871166	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1955619/1	464975000	9016957	-36.388452	141.871166	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1955620/1	464875000	9016959	-36.395641	142.548693	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1955620/1	454875000	9016959	-36.395641	142.548693	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1960464/1	466275000	9017787	-36.279662	142.289607	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED



LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
1960464/1	456275000	9017787	-36.279662	142.289607	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1960465/1	465762500	9017792	-36.429279	142.264367	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1960465/1	455762500	9017792	-36.429279	142.264367	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1960467/1	463800000	9017789	-36.106829	142.41778	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1960467/1	453800000	9017789	-36.106829	142.41778	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1960470/1	464987500	9017788	-36.625596	142.636795	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1960470/1	454987500	9017788	-36.625596	142.636795	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1964033/2	466512500	10003976	-36.580185	142.074518	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1964033/2	456512500	10003976	-36.580185	142.074518	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1964033/2	466512500	9018581	-36.624461	142.177464	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1964033/2	456512500	9018581	-36.624461	142.177464	EMMETT MOTORS (HORSHAM) PROPRIETARY LIMITED
1966081/1	171387500	51204	-36.006291	142.014407	Telstra Corporation Limited
1966081/1	166787500	51204	-36.006291	142.014407	Telstra Corporation Limited
1966292/1	171200000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1966292/1	166600000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1966293/1	170900000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1966293/1	166300000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1966294/1	170600000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1966294/1	166000000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1966295/1	170300000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1966295/1	165700000	47989	-36.007567	142.491816	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1984396/1	171687500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
1984396/1	167087500	51204	-36.006291	142.014407	DEPARTMENT OF JUSTICE AND COMMUNITY SAFETY
211949/1	2570500	43957	-36.253934	142.399374	Victoria State Emergency Service
211949/1	2576500	43957	-36.253934	142.399374	Victoria State Emergency Service
211949/1	3730500	43957	-36.253934	142.399374	Victoria State Emergency Service
211949/1	3733500	43957	-36.253934	142.399374	Victoria State Emergency Service
211949/1	3736500	43957	-36.253934	142.399374	Victoria State Emergency Service

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
211949/1	3744500	43957	-36.253934	142.399374	Victoria State Emergency Service
211949/1	4568500	43957	-36.253934	142.399374	Victoria State Emergency Service
211949/1	4574500	43957	-36.253934	142.399374	Victoria State Emergency Service
464005/1	164800000	51201	-36.240498	142.396609	Telstra Corporation Limited
464005/1	160200000	51201	-36.240498	142.396609	Telstra Corporation Limited
464006/1	164575000	51201	-36.240498	142.396609	Telstra Corporation Limited
464006/1	159975000	51201	-36.240498	142.396609	Telstra Corporation Limited
464008/1	163962500	47989	-36.007567	142.491816	Telstra Corporation Limited
464008/1	159250000	47989	-36.007567	142.491816	Telstra Corporation Limited
464008/1	159362500	47989	-36.007567	142.491816	Telstra Corporation Limited
464054/1	165150000	51204	-36.006291	142.014407	Telstra Corporation Limited
464054/1	160550000	51204	-36.006291	142.014407	Telstra Corporation Limited
464055/1	164900000	51204	-36.006291	142.014407	Telstra Corporation Limited
464055/1	160300000	51204	-36.006291	142.014407	Telstra Corporation Limited
464056/1	164675000	51204	-36.006291	142.014407	Telstra Corporation Limited
464056/1	160075000	51204	-36.006291	142.014407	Telstra Corporation Limited
464057/1	164237500	51204	-36.006291	142.014407	Telstra Corporation Limited
464057/1	159637500	51204	-36.006291	142.014407	Telstra Corporation Limited
464058/1	163850000	51204	-36.006291	142.014407	Telstra Corporation Limited
464058/1	159362500	51204	-36.006291	142.014407	Telstra Corporation Limited
464058/1	159250000	51204	-36.006291	142.014407	Telstra Corporation Limited
464098/1	164362500	51201	-36.240498	142.396609	Telstra Corporation Limited
464098/1	159762500	51201	-36.240498	142.396609	Telstra Corporation Limited
464099/1	164137500	51201	-36.240498	142.396609	Telstra Corporation Limited
464099/1	159537500	51201	-36.240498	142.396609	Telstra Corporation Limited
464100/1	164037500	51201	-36.240498	142.396609	Telstra Corporation Limited
464100/1	159437500	51201	-36.240498	142.396609	Telstra Corporation Limited
464100/1	159250000	51201	-36.240498	142.396609	Telstra Corporation Limited
520416/1	165012500	51201	-36.240498	142.396609	Telstra Corporation Limited
520416/1	160412500	51201	-36.240498	142.396609	Telstra Corporation Limited
520418/1	164462500	51204	-36.006291	142.014407	Telstra Corporation Limited
520418/1	159862500	51204	-36.006291	142.014407	Telstra Corporation Limited

**Table 8** *Digital Television Broadcast and AM/FM Narrowcast and Broadcast*

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10606525/1	87600000	10014293	-36.077586	142.428731	Peter Stewart
1151001/1	87600000	150220	-36.24948	142.394843	Suzette Munro
1905693/1	1611000	137784	-36.639333	142.258719	Anton Vanderlely
1911418/1	88000000	47439	-36.45584	142.027361	3UZ PTY. LTD.
1951261/2	87600000	140473	-36.45906	142.032481	United Christian Broadcasters Australia Limited
1951663/1	87600000	140474	-35.942707	142.419533	Peter Stewart
1965326/1	87600000	141372	-36.550097	142.213696	HORSHAM MOTOR SPORTS CLUB INC (A0022818D)
483574/1	88000000	52206	-36.260407	142.393145	Seventh-day Adventist Church (Australian Union Conf.) Ltd
9862019/1	87600000	142581	-36.143401	141.984869	United Christian Broadcasters Australia Limited

**Table 9** *Mobile Telephone and Internet Broadcast Sites*

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10094269/80	2142500000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
10094269/80	1952500000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
10094269/80	2147500000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
10094269/80	1957500000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
10094269/80	2142500000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
10094269/80	1952500000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
10094269/80	2147500000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
10094269/80	1957500000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
10094269/80	2147500000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
10094269/80	1957500000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
10094269/80	2142500000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
10094269/80	1952500000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
10094269/80	2142500000	9011022	-35.928878	142.418386	Optus Mobile Pty Limited
10094269/80	2147500000	9011022	-35.928878	142.418386	Optus Mobile Pty Limited
10094269/80	1957500000	9011022	-35.928878	142.418386	Optus Mobile Pty Limited
10094269/80	1952500000	9011022	-35.928878	142.418386	Optus Mobile Pty Limited
10094269/80	2142500000	135825	-35.928563	141.996565	Optus Mobile Pty Limited
10094269/80	1952500000	135825	-35.928563	141.996565	Optus Mobile Pty Limited
10094269/80	2147500000	135825	-35.928563	141.996565	Optus Mobile Pty Limited
10094269/80	1957500000	135825	-35.928563	141.996565	Optus Mobile Pty Limited
10094269/80	1952500000	134823	-36.381344	141.93128	Optus Mobile Pty Limited
10094269/80	2147500000	134823	-36.381344	141.93128	Optus Mobile Pty Limited
10094269/80	1957500000	134823	-36.381344	141.93128	Optus Mobile Pty Limited
10094269/80	2142500000	134823	-36.381344	141.93128	Optus Mobile Pty Limited
10094269/80	2147500000	9010526	-36.445529	142.59479	Optus Mobile Pty Limited
10094269/80	1952500000	9010526	-36.445529	142.59479	Optus Mobile Pty Limited
10094269/80	2142500000	9010526	-36.445529	142.59479	Optus Mobile Pty Limited
10094269/80	1957500000	9010526	-36.445529	142.59479	Optus Mobile Pty Limited
10094269/80	2147500000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
10094269/80	1957500000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
10094269/80	2142500000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
10094269/80	1952500000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
10094269/80	2147500000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
10094269/80	2142500000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
10094269/80	1952500000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
10094269/80	1957500000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
10094269/80	2142500000	135338	-36.447957	142.049414	Optus Mobile Pty Limited
10094269/80	1952500000	135338	-36.447957	142.049414	Optus Mobile Pty Limited
10094269/80	2147500000	135338	-36.447957	142.049414	Optus Mobile Pty Limited
10094269/80	1957500000	135338	-36.447957	142.049414	Optus Mobile Pty Limited

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10094269/80	2142500000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
10094269/80	1952500000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
10094269/80	2147500000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
10094269/80	1957500000	9010998	-36.490472	142.370165	Optus Mobile Pty Limited
1136355/1	956300000	10007107	-36.568792	142.115776	Vodafone Australia Pty Limited
1136355/1	911300000	10007107	-36.568792	142.115776	Vodafone Australia Pty Limited
1136355/1	911200000	301287	-36.44964	142.048205	Vodafone Australia Pty Limited
1136355/1	956200000	301287	-36.44964	142.048205	Vodafone Australia Pty Limited
1136358/1	947600000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
1136358/1	902600000	9008556	-36.627658	142.458775	Optus Mobile Pty Limited
1136358/1	947600000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1136358/1	902600000	305199	-36.573418	142.124461	Optus Mobile Pty Limited
1136358/1	947600000	9011022	-35.928878	142.418386	Optus Mobile Pty Limited
1136358/1	902600000	9011022	-35.928878	142.418386	Optus Mobile Pty Limited
1136358/1	947600000	135825	-35.928563	141.996565	Optus Mobile Pty Limited
1136358/1	902600000	135825	-35.928563	141.996565	Optus Mobile Pty Limited
1136358/1	947600000	134823	-36.381344	141.93128	Optus Mobile Pty Limited
1136358/1	902600000	134823	-36.381344	141.93128	Optus Mobile Pty Limited
1136358/1	947600000	9018506	-36.492163	142.369515	Optus Mobile Pty Limited
1136358/1	902600000	9018506	-36.492163	142.369515	Optus Mobile Pty Limited
1136358/1	947600000	9010526	-36.445529	142.59479	Optus Mobile Pty Limited
1136358/1	902600000	9010526	-36.445529	142.59479	Optus Mobile Pty Limited
1136358/1	947600000	301287	-36.44964	142.048205	Optus Mobile Pty Limited
1136358/1	902600000	301287	-36.44964	142.048205	Optus Mobile Pty Limited
1136358/1	947600000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
1136358/1	902600000	9010835	-36.144155	142.023948	Optus Mobile Pty Limited
1136358/1	947600000	9018943	-36.074886	142.421105	Optus Mobile Pty Limited
1136358/1	902600000	9018943	-36.074886	142.421105	Optus Mobile Pty Limited
1136358/1	947600000	135338	-36.447957	142.049414	Optus Mobile Pty Limited
1136358/1	902600000	135338	-36.447957	142.049414	Optus Mobile Pty Limited
1136358/1	947600000	135926	-36.608524	142.64984	Optus Mobile Pty Limited
1136358/1	902600000	135926	-36.608524	142.64984	Optus Mobile Pty Limited
1136358/1	947600000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
1136358/1	902600000	9000178	-36.256772	142.402675	Optus Mobile Pty Limited
1136358/1	947600000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
1136358/1	902600000	206071	-36.610228	142.648546	Optus Mobile Pty Limited
9934765/1	2115000000	301287	-36.44964	142.048205	Vodafone Hutchison Australia Pty Limited
9934765/1	1925000000	301287	-36.44964	142.048205	Vodafone Hutchison Australia Pty Limited

**Table 10**      *Aircraft Communications Systems*

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10175520/1	133650000	10003101	-36.3204	142.416	Yarriambiack Shire Council

**Table 11**      *Meteorological Radar*

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10547311/1	562500000	10012512	-35.997652	142.013441	Bureau of Meteorology

**Table 12**      *Amateur*

LICENCE NO	FREQUENCY(Hz)	SITE ID	LATITUDE	LONGITUDE	LICENCEE
10604333/2	147075000	140474	-35.942707	142.419533	Peter Stewart
10604333/2	147675000	140474	-35.942707	142.419533	Peter Stewart
10604333/2	438125000	140474	-35.942707	142.419533	Peter Stewart
10604333/2	431125000	140474	-35.942707	142.419533	Peter Stewart
1192706/2	439925000	136764	-36.452161	142.034844	Douglas J Kay
1192706/2	434925000	136764	-36.452161	142.034844	Douglas J Kay
1192706/2	147200000	136764	-36.452161	142.034844	Douglas J Kay
1192706/2	147800000	136764	-36.452161	142.034844	Douglas J Kay





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