Forest Wind Holdings Pty Limited

Electromagnetic Interference Impact Assessment

Forest Wind

August 2019

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1. Introduction

1.1 Purpose of this Report

The purpose of this report is to assess the potential for radio interference effects caused by a wind farm called Forest Wind (the Project). This report is an update of an earlier Electromagnetic Interference (EMI) Impact Assessment conducted in October 2017, taking into consideration new turbine locations and the current radio frequency (RF) environment.

Forest Wind Holdings (FWH) proposes to construct a wind farm called Forest Wind located within exotic pine plantations in Queensland Government owned Toolara, Tuan and Neerdie State Forests, situated between Gympie and Maryborough in the Wide Bay Region of Queensland. Specifically, the Project comprises a wind farm with up to 226 wind turbines and ancillary infrastructure (herein referred to as the Wind Turbine Area) and an Overhead Transmission Line Corridor in which a high voltage transmission line (the Transmission Line) will be located to transfer the generated electricity to an existing Powerlink Queensland substation located at Woolooga to the west of Gympie. The Project will be located within the Gympie Regional Council and Fraser Coast Regional Council Local Government Areas.

This report assesses potential EMI caused by the proposed wind farm and identifies mitigation measures where required. Services identified within a 50 km radius of the wind farm include:

- Fixed point-to-point microwave radio systems,
- Digital Television Broadcast,
- Aircraft Telecommunications Systems,
- Maritime Radio Systems,
- Defence Radio Systems,
- Meteorological Radar,
- AM/FM Radio Broadcast, and
- Cellular Mobile Phone Systems.

The impact of 50 Hz electromagnetic radiation is also considered in this assessment.

1.2 Abbreviations

The following abbreviations have been used in this report:

Table 1 Definitions

Abbreviation	Definition
ACMA	Australian Communications and Media Authority
AMTA	Australian Mobile Telecommunications Association
BoM	Bureau of Meteorology
FM	Frequency Modulation
FTA	Free-To-Air
GHz	Giga-Hertz (10^9)
kHz	Kilo-Hertz (10^3)
LMR	Land Mobile Radio
MHz	Mega-Hertz (10^6)
PTP	Point to Point
PTMP	Point to Multi-Point

Abbreviation	Definition
RF	Radio Frequency
RFNSA	Radio Frequency National Site Archive
VAST	Viewer Access Satellite Television

1.3 References

Table 2 References

Ref No	Reference
1	Visiwave™, http://www.vias.org/wirelessnetw/wndw_04_08b.html
2	Rat River Technologies, http://www.ratrivertech.ca/archives/tools/fresnel_zone_clearance_calculator.htm
3	Fixed-Link Wind Turbine Exclusion Zone Method, D F Bacon, Radio Communications Agency
4	Kordia, Manhinerangi Wind Farm EMI Report
5	Queensland State Development Assessment Provisions, State code 23: Wind farm development, Department of State Development, Manufacturing, Infrastructure and Planning Guidelines version 2.5, June 2018
6	Queensland State code 23: Wind farm development Planning Guideline, Department of Infrastructure, Local Government and Planning, July 2017 https://dsdmipprd.blob.core.windows.net/general/Statecode23Windfarmdevelopment-PlanningguidelineJuly2017.pdf
7	Draft National Wind Farm Development Guidelines, Environment Protection and Heritage Council of Australia and New Zealand, July 2010
8	International Telecommunications Union Recommendation ITU-R BT.1893, Assessment of impairment caused to digital television reception by a wind turbine
9	ARPANSA Base Station Survey – Base Station Frequency Bands http://www.arpansa.gov.au/RadiationProtection/BaseStationSurvey/spectra.cfm, 9 Feb 2017
10	Radio Frequency National Site Archive (RFNSA), Australian Mobile Telecommunications Association, August 2019
11	AS/NZS 61000.6.4:2012, Electromagnetic compatibility (EMC) Generic standards - Emission standard for industrial environments, Standards Australia, 2012

1.4 Scope and Limitations

This report has been prepared by GHD for Forest Wind Holdings Pty Limited and may only be used and relied on by Forest Wind Holdings Pty Limited for the purpose agreed between GHD and Forest Wind Holdings Pty Limited as set out in section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Forest Wind Holdings Pty Limited arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

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

GHD has prepared this report on the basis of information provided by Forest Wind Holdings Pty Limited, publicly available details on the ACMA radio communications Licence database and information from consultation with other entities impacted by the proposed wind farm, which GHD has not independently verified or checked 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 226 specific turbine locations. Forest Wind Holdings Pty Limited is proposing a corridor in which the turbines may be sited, rather than individual locations. Development approvals typically allow some degree of flexibility in turbine siting. Prior to finalisation and micro siting of the turbine locations and construction, Forest Wind Holdings Pty Limited will geolocate all radio sites and undertake an updated electromagnetic interference assessment, in order to minimise potential impacts on radio link paths.

1.5 Consultation

The following points of contact have been identified and consultation has begun with the respective organisations:

Table 3 Points of Contact

Organisation	Contact Person	Contact Details
Bureau of Meteorology	Andrew Collins	(03) 9669 4860 a.collins@bom.gov.au
Department of Defence	Glenn Odlum	(02) 6144 4110 glenn.odlum@defence.gov.au
McDermott Aviation	Mark Walters	(07) 5447 6600 ops@mcdermottaviation.com.au
Geoscience Australia	Ryan Ruddick	(02) 6249 9426 Ryan.Ruddick@ga.gov.au

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. This may occur by way of radiation of electromagnetic energy by the turbine within the operating band of the radio system, diffraction or partial reflection of the radio system signal by the turbine tower and rotor.

The following sub-sections briefly describe the various types of interference that may affect existing operational telecommunications services near the wind farm development to provide context to the specific findings noted in later sections of this report against each type of radio transmission service.

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 to these standards, the electromagnetic interference due to radiation is negligible.

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.

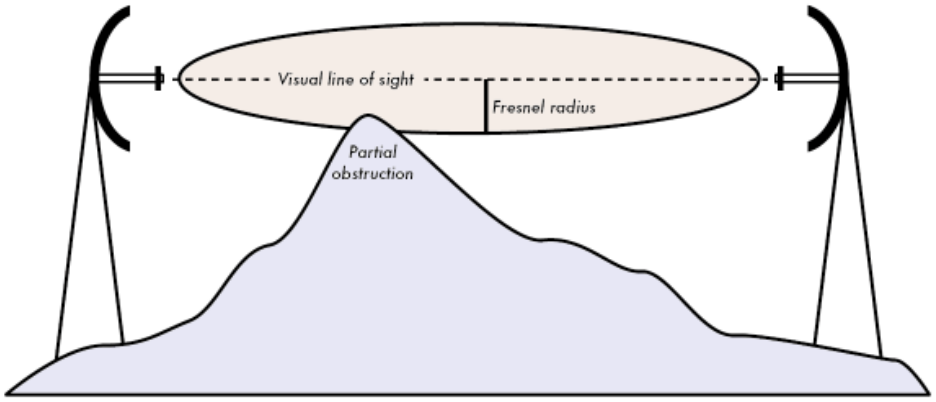


Figure 1 Fresnel Zone over the Radio Path[1]

[1]Source: Visiwave™, http://www.vias.org/wirelessnetw/wndw_04_08b.html

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 Figures 2 and 3 for further details.

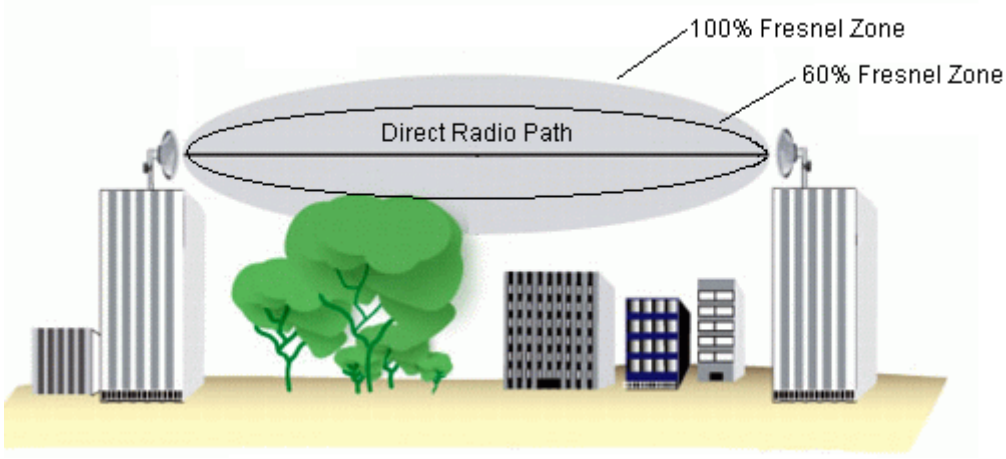


Figure 2 Fresnel Zone Clearance Criteria[2]

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

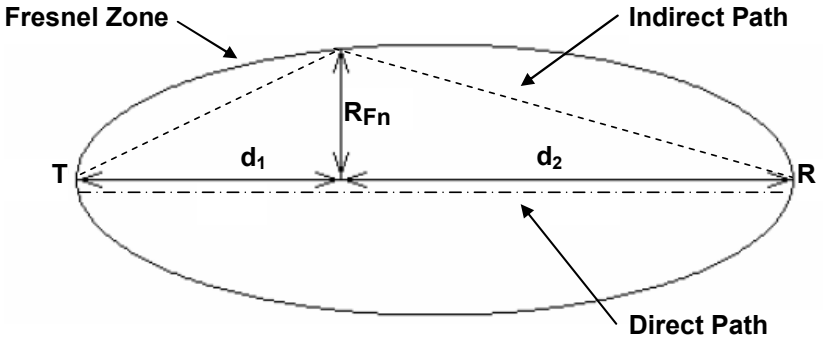


Figure 3 Fresnel Zone Calculation[3]

The Fresnel zone is defined by the formula

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

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

n = the nth Fresnel zone

λ = the wavelength of the transmitted signal in metres

d_1 = the distance from T in metres

d_2 = the distance from R in metres

[2] Rat River Technologies, http://www.ratrivertech.ca/archives/tools/fresnel_zone_clearance_calculator.htm

[3] Fixed-Link Wind Turbine Exclusion Zone Method, D F Bacon, Radio Communications Agency

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

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

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

The drawings included in the appendices 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.

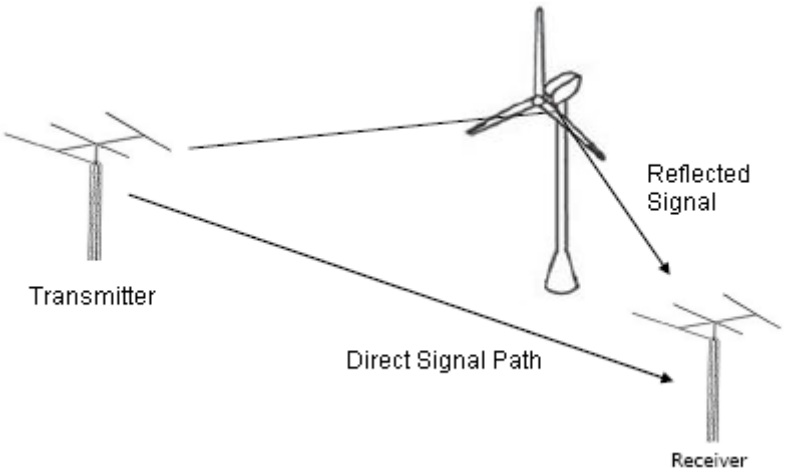


Figure 4 Reflection of Radio Signals by Wind Turbine Infrastructure [4]

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

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.

[4] Kordia, Manhinerangi Wind Farm EMI Report

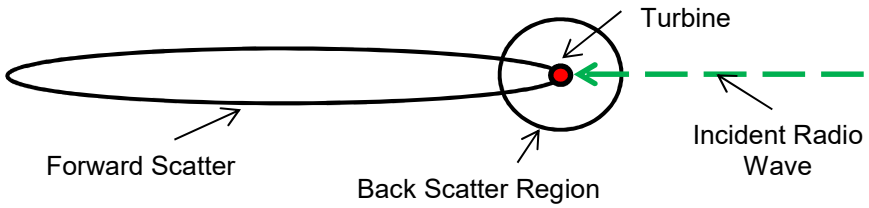


Figure 5 Scattering of Radio Signals by Wind Turbine Infrastructure

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 up to 10 km. Utilising high gain directional antennas at the receiver reduces the scatter region zone significantly.

The back scattering region created by the incident signal is generally less than 1 km from the turbine.

Methods to model and analyse the effects of wind farm turbines on digital television signals are highly complex, require measurements at each receive antenna and change with different wind speeds and direction. Research and development for wind farm radio frequency (RF) scatter modelling is ongoing world-wide and effective prediction of the effects before building and testing is not currently feasible.

The zone of where television transmitter signals may be scattered by turbines can be modelled by drawing a 'keyhole' pattern, consisting of the back and forward scattering zones, aligned with a television transmitter on each proposed turbine site and can identify areas which potentially may be affected.

2.5 Near Field Effects

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

Typical near-field exclusion zone radii as suggested by the State Code 23 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 such 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 alignment of the link must be engineered to not point at a turbine.

3. Legislation

The Queensland Department of State Development, Manufacturing, Infrastructure and Planning have created State code 23: Wind farm development[5] to protect individuals, communities and the environment from adverse impacts as a result of the construction, operation and decommissioning of wind farm development. The State Development Assessment Provisions v2.5 State code 23.2 PO3 defines electromagnetic interference performance outcomes and the associated acceptable outcomes as: Development is designed, located and sited to avoid, or minimise and mitigate, electromagnetic interference to pre-existing television, radar and radio transmission and reception.

The Queensland Department of Infrastructure, Local Government and Planning, created a Planning guideline for State code 23: Wind farm development[6] and Appendix 1 - Electromagnetic impact assessment methodology defines the steps recommended to be conducted during the planning stages of wind farm developments.

Additionally, a Draft National Wind Farm Development Guidelines[7] document has been 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.

4. Analysis of Development Impact

4.1 Methodology

4.1.1 Radio System Search

A search was conducted on the Australian Communications and Media Authority (ACMA) radio communications database in July 2019 to identify all licensed radio systems, with operating frequencies above 30 MHz, within 60 km of the proposed wind farm development. The Australian Mobile Telecommunications Association's (AMTA) Radio Frequency National Site Archive (RFNSA) was accessed in August 2019 for additional radio frequency information. This search was conducted in accordance with the methodology stated in Appendix 1 of Queensland State Code 23.

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 will not determine the impact on users of class licence services in the area, as these services are not listed within the database.

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

[5] Queensland State Development Assessment Provisions, State code 23: Wind farm development, Department of State Development, Manufacturing, Infrastructure and Planning version 2.5, June 2018
[6] Queensland State code 23: Wind farm development Planning Guideline, Department of Infrastructure, Local Government and Planning, July 2017
[7] Draft National Wind Farm Development Guidelines, Environment Protection and Heritage Council of Australia and New Zealand, July 2010

Some known class license radio links in the vicinity of the proposed wind farm have been provided to GHD for analysis and are presented in Appendix B.

4.1.2 Assumptions

Based on information provided by Forest Wind Holdings Pty Limited, a maximum blade diameter of 190 metres is assumed for the purpose of this assessment.

4.1.3 Radio Technology Review

The following radio system technologies were considered in this assessment:

- Fixed point-to-point microwave radio systems
- Fixed point-to-point UHF voice and telemetry systems
- Digital Television Broadcasts
- Aircraft Telecommunications Systems
- Maritime Radio Systems
- Defence Radio Systems
- Meteorological Radar
- AM/FM Radio Broadcast
- Cellular Mobile Phone Systems
- Trigonometric Reference Systems
- Citizen Band UHF Repeater 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 Hz – 3 kHz, relies on ground wave (surface wave) propagation.

5. Fixed Point to Point Microwave Links

5.1 Fixed Point-to-Point Microwave

There are four microwave radio systems of interest that operate within the vicinity of the proposed wind farm, as shown in the drawing in Appendix A. For these links, the 200% Fresnel zone (second Fresnel zone) has also been indicated on the point to point link drawing (Appendix A). It is generally understood that the effect of a turbine on the radio link is minimal if the turbine is placed outside of the second Fresnel Zone.

The potentially affected radio system licences are:

Table 4 Existing Fixed Point-to-Point Microwave Links

NBN Co Site Granville Road, MAAROOM QLD 4650							
ID	Frequency	Emission Designator	Azimuth	Transmit / Receive	Client	BSL/Licence No	Endpoint
981005	6.54 GHz	40M0D7W	274.69°	R	NBN CO LIMITED (8129031)	1975926/1	Mungar
981002	6.88 GHz			T			
981013	6.5 GHz			R		1975927/1	
981010	6.84 GHz			T			

Optus Lattice Tower Power Easement Off Poona Road, POONA QLD 4650							
ID	Frequency	Emission Designator	Azimuth	Transmit / Receive	Client	BSL/Licence No	Endpoint
858192	7.821825 GHz	28M0D7W	270.05°	R	Optus Mobile Pty Limited (20017373)	1804792/1	Tiaro
858189	8.133145 GHz			T			
1187379	7.851475 GHz			R		1806595/1	
1187376	8.162795 GHz			T			

Figure 6 NBN Microwave Link Maaroom to Mungar Second Fresnel Zone 10 m from Turbine

Figure 6 NBN Microwave Link Maaroom to Mungar Second Fresnel Zone 10 m from Turbine shows turbines in red with 190 m turbines rotor diameters, and in yellow shows the second Fresnel zone for the NBN microwave link between Maaroom and Mungar, approximately 10 metres from the NBN microwave link's second Fresnel zone. Care should be taken if micro-siting this turbine further north. See Appendix D for distances between radio paths' second Fresnel zones and turbine locations.

5.2 Fixed Point to Point Microwave Link Mitigation Strategies and Recommendations

The table below provides a summary of the potential electromagnetic interference impacts due to the wind farm development, the respective mitigation measures and suggested recommendations.

Table 5 Mitigation Strategies and Recommendations for Fixed Point to Point Microwave Links

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Due to proximity to existing radio link services, continue to review any amendments to the wind farm layout to avoid micro-siting turbines into radio link paths' second Fresnel zone.

6. Fixed Point-to-Point UHF Voice / Telemetry – Government and Public Safety Networks

There are six government and public safety UHF voice and telemetry radio systems of interest that operate within the vicinity of the proposed wind farm, as shown in the drawing in Appendix A. For these links, the 200% Fresnel zone (second Fresnel zone) has also been indicated on the point to point link drawing (Appendix A). It is generally understood that the effect of a turbine on the radio link is minimal if the turbine is placed outside of the second Fresnel Zone.

The potentially affected radio system licences are:

Table 6 Existing Fixed Point-to-Point UHF Voice / Telemetry – Government and Public Safety Networks Links

Forestry Site MARYBOROUGH, BIG ANGLE QLD 4650							
ID	Frequency	Emission Designator	Azimuth	Transmit / Receive	Client	BSL/Licence No	Endpoint
895526	460.025 MHz	16K0F3E	226.67°	R	Queensland Police Service (58050)	1924457/1	Mt Kanigan
895527	450.525 MHz			T			
1509113	413.60625 MHz	10K1F3E	226.7°	R	QUEENSLAND FIRE AND EMERGENCY SERVICES (84379)	9995180/1	
1509114	404.15625 MHz			T			
2039307	451.46875 MHz	10K1F3E	343.5°	R	QUEENSLAND FIRE AND EMERGENCY SERVICES (84379)	10112551/1	Maryborough
2039304	460.96875 MHz			T			
1836174	413.56875 MHz	10K1F3E	301.3°	R	QUEENSLAND FIRE AND EMERGENCY SERVICES (84379)	10084468/1	Seaview Range
1836175	404.11875 MHz			T			
1509117	413.70625 MHz	10K1F3E	290.7°	R	QUEENSLAND FIRE AND EMERGENCY SERVICES (84379)	9995181/1	Tiaro
1509118	404.25625 MHz			T			

Comms Site WIDE BAY, DOUBLE ISLAND POINT QLD 4581							
ID	Frequency	Emission Designator	Azimuth	Transmit / Receive	Client	BSL/Licence No	Endpoint
709340	451.5 MHz	16K0F3E	311.56°	R	Queensland Police Service (58050)	113016/1	Maryborough
709337	461 MHz			T			

Met Bureau Automatic Weather Station WIDE BAY, DOUBLE ISLAND POINT QLD 4581							
ID	Frequency	Emission Designator	Azimuth	Transmit / Receive	Client	BSL/Licence No	Endpoint
1305826	469.975 MHz	16K0F2D	267.4°	R	Bureau of Meteorology (435100)	520955/1	Mt Kanigan
1305829	469.975 MHz			T			

6.1 Fixed Point-to-Point UHF Voice / Telemetry Mitigation Strategies and Recommendations

The table below provides a summary of the potential electromagnetic interference impacts due to the wind farm development, the respective mitigation measures and suggested recommendations.

Table 7 Mitigation Strategies and Recommendations for Fixed Point-to-Point UHF Voice / Telemetry Systems

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Due to proximity to existing radio link services, continue to review any amendments to the wind farm layout to avoid micro-siting turbines into radio link paths.

7. Fixed Point-to-Point UHF Voice / Packet – Private Networks

There are four private UHF voice/packet data radio systems of interest that operate within the vicinity of the proposed wind farm, as shown in the drawing in Appendix A. For these links, the 200% Fresnel zone (second Fresnel zone) has also been indicated on the point to point link drawing (Appendix A). It is generally understood that the effect of a turbine on the radio link is minimal if the turbine is place outside of the second Fresnel Zone.

The potentially affected radio system licences are:

Table 8 Existing Fixed Point-to-Point UHF Voice / Packet Private Networks

Fire Tower BIG ANGLE QLD 4650							
ID	Frequency	Emission Designator	Azimuth	Transmit / Receive	Client	BSL/Licence No	Endpoint
909107	451.38125 MHz	10K1F3E	301.37°	T	HQPLANTATIONS PTY LTD (1149315)	1935203/1	Seaview Range
909106	460.88125 MHz			R			
909111	451.40625 MHz		157.51°	T		1935204/1	Mt Kelly
909110	460.90625 MHz			R			

Fire Tower SF 1004 Toolara MT KELLY QLD 4570							
ID	Frequency	Emission Designator	Azimuth	Transmit / Receive	Client	BSL/Licence No	Endpoint
799027	451.25 MHz	16K0F3E	273.01°	R	HQPLANTATIONS PTY LTD (1149315)	1407714/1	Mt Kanigan
799024	460.75 MHz			T			
909113	460.65625 MHz	10K1F3E	177.43°	T	HQPLANTATIONS PTY LTD (1149315)	1935206/1	Mt Wolvi
909116	451.15625 MHz			R			

7.1 Fixed Point-to-Point UHF Voice / Private Networks Mitigation Strategies and Recommendations

The table below provides a summary of the potential electromagnetic interference impacts due to the wind farm development, the respective mitigation measures and suggested recommendations.

Table 9 Mitigation Strategies and Recommendations for Fixed Point-to-Point UHF Voice / Private Networks

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Due to proximity to existing radio link services, continue to review any amendments to the wind farm layout to avoid micro-siting turbines into radio link paths.

The turbine layout has been revised during the design process to avoid any infringements into the second Fresnel Zone of any of the above radio links

8. Land Mobile Radio Systems

Interference to Land Mobile Radio (LMR) coverage by the proposed wind farm development is anticipated to be minimal, as the LMR transmitters within range of the wind farm are localised services and operating on frequencies that are more resilient to interference.

The LMR transmitter closest to a turbine is located at the Hyne & Son facility in Tuan. The nearest turbine is located approximately 870 m from the transmitter location; well exceeding the suggested 20 m exclusion zone from State Code 23 for this type of transmitter. Figure 7 shows the proposed turbine locations as grey dots and a 1 km radius drawn around the transmitter for scale.

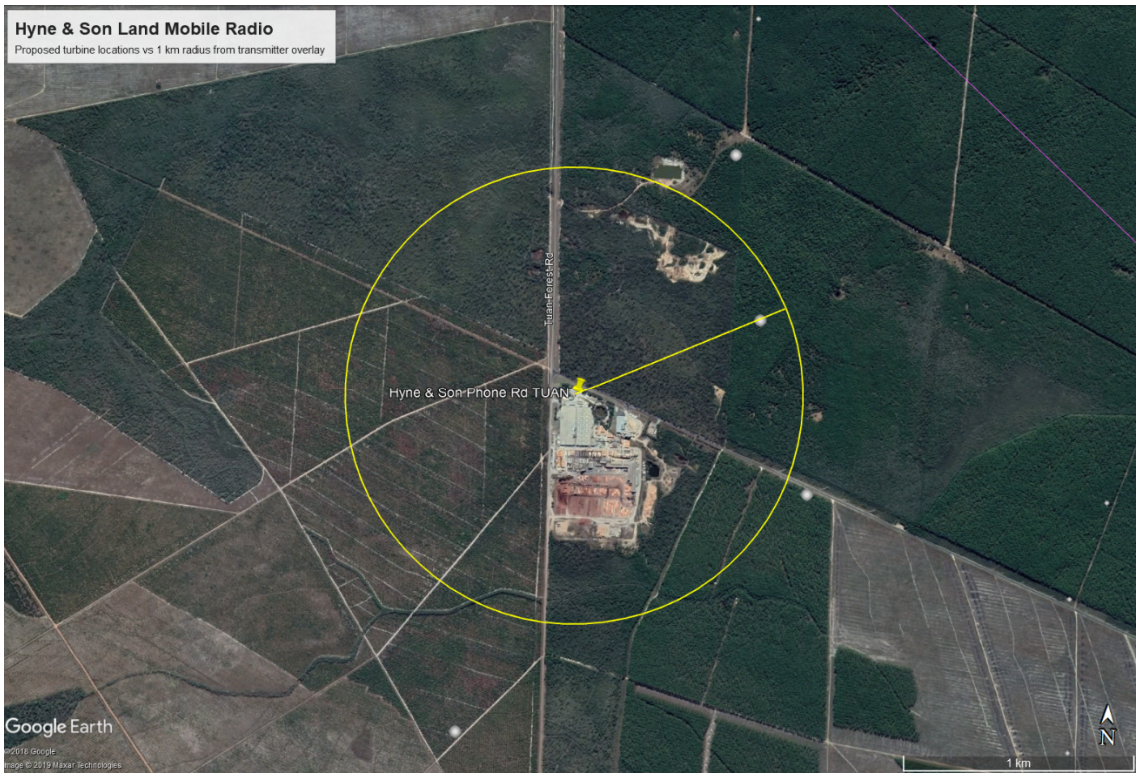


Figure 7 Hyne & Son LMR Transmitter in Wind Farm Area

The turbine is sufficiently clear of the transmitter to avoid reflections from the turbine flooding the receiver (calculated at a distance of less than 1 metre from the transmitter). It is anticipated that the reflections and resulting multipath from the turbine will be similar to the effect of reflections from the buildings at the site, considering the turbine pole and downwards reflections from the angled turbine blades.

Other LMR services, shown in Figure 8 LMR Transmitter Locations in Wind Farm Area, including emergency services, transmitting from Big Angle and Mt Kelly for use within the Tuan Forest area may experience minor service degradation when the receiving unit is close to a turbine. HQ Plantations have three sites either within, or in close proximity to, the wind farm site. Their services in this area include a series of 450 MHz point-to-point links and an LMR system based around 80 MHz.

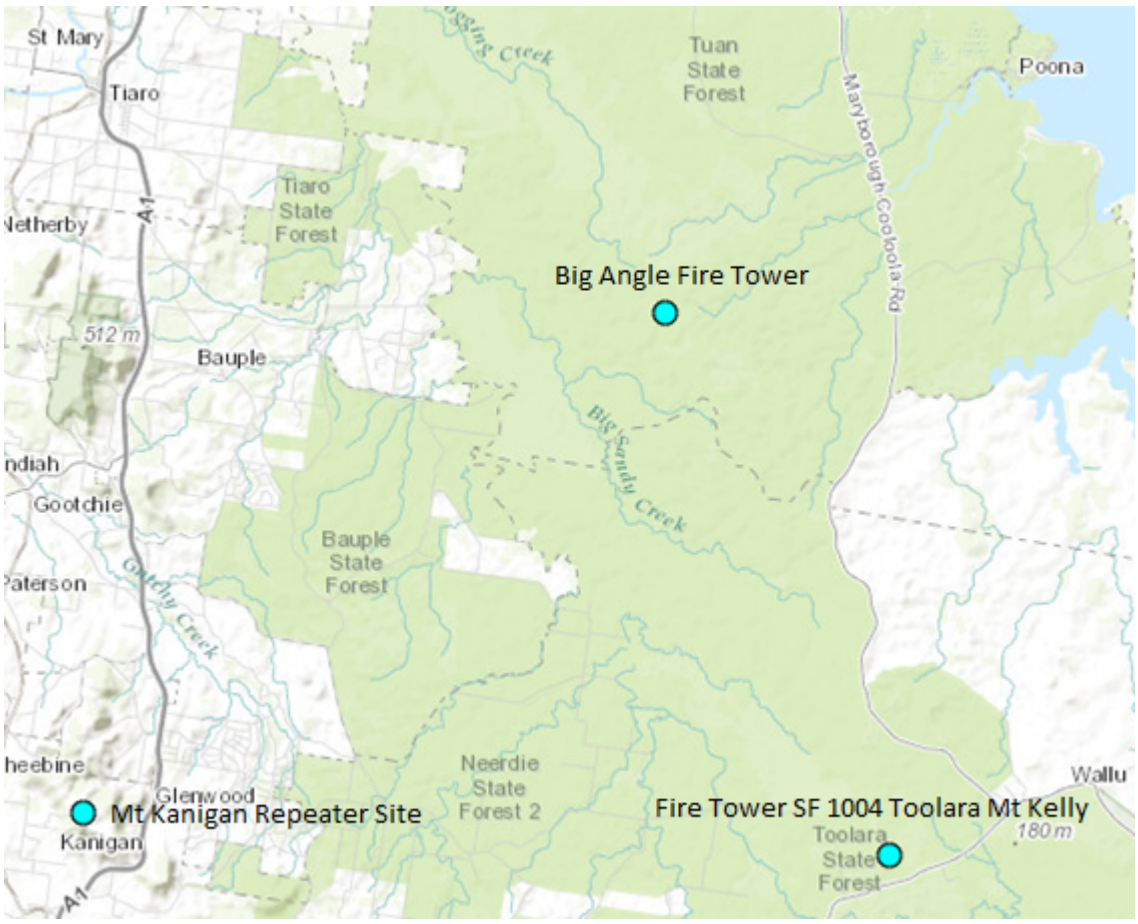


Figure 8 LMR Transmitter Locations in Wind Farm Area

As the LMR system uses a low frequency, it is expected that the system will be fairly resilient to the effects of the wind turbines. It would be expected that any effect on the system would be noticed in situations where the receiver is very close to a wind turbine and therefore subject to strong multi-pathing / reflections.

Both transmitter sites within the wind farm area are located more than 1 km away from the nearest turbine, avoiding any issues from near-field effects.

8.1 LMR Mitigation Strategies and Recommendations

The impact of the wind farm on LMR services may be quantified by performing and recording pre and post installation signal level measurements in and around the radio service operational areas.

Table 10 Mitigation Strategies and Recommendations for LMR Services

Impact	Service Mitigation Strategy	Recommendation
Potential impact anticipated to Hyne & Son mobile radio service.	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.

9. Digital Television Broadcast

Wind farms have the potential to cause signal degradation to TV reception due to scattering, diffraction and near field effects. Digital TV is not susceptible to visible “ghosting” degradation as was experienced with analogue broadcasts; any impact of reflections from the turbines would be a minor reduction of coverage at the limit of the service area.

The zone of potential interference for a wind farm on digital television broadcast is the resultant total of the effects from the individual turbines. The International Telecommunications Union Recommendation ITU-R BT.1893[8] states that impacts beyond 10 km from a wind farm are unlikely.

The key factors listed by this recommendation that lead to degraded TV reception are when the receiver is already at the fringe of television reception zone and when the receiver is located within approximately 2 km of the wind farm (i.e. in the range affected by scattering of signals off the turbine). The biggest effect occurs when the receiver is near the wind farm and in line of sight of the turbines but not in line of sight of the TV transmitter.

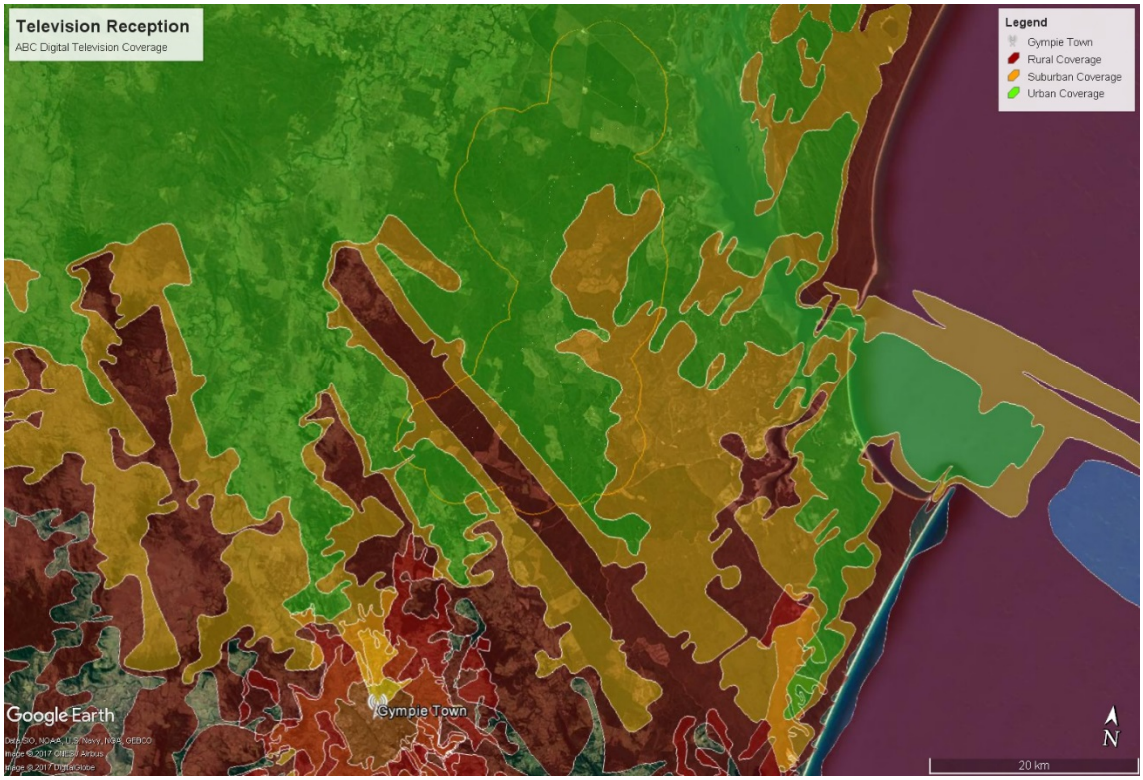


Figure 9 ABC Digital TV Coverage in Wind Turbine Area

Note: Signal level information retrieved from http://reception.abc.net.au/

Figure 9 shows ABC’s expected coverage levels in the wind turbine area.

The impact of the wind farm on digital TV services will be quantified by performing and recording pre-construction base line signal measurements and will be compared to 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.

[8] International Telecommunications Union Recommendation ITU-R BT.1893, Assessment of impairment caused to digital television reception by a wind turbine

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.

Many of the towns in the area, such as Hervey Bay, Gympie, Tin Can Bay, Cooloola Cove, and Rainbow Beach, have their own television signal repeaters in place to service the local areas and will not be affected by the wind farm development as can be shown in Figure 10.

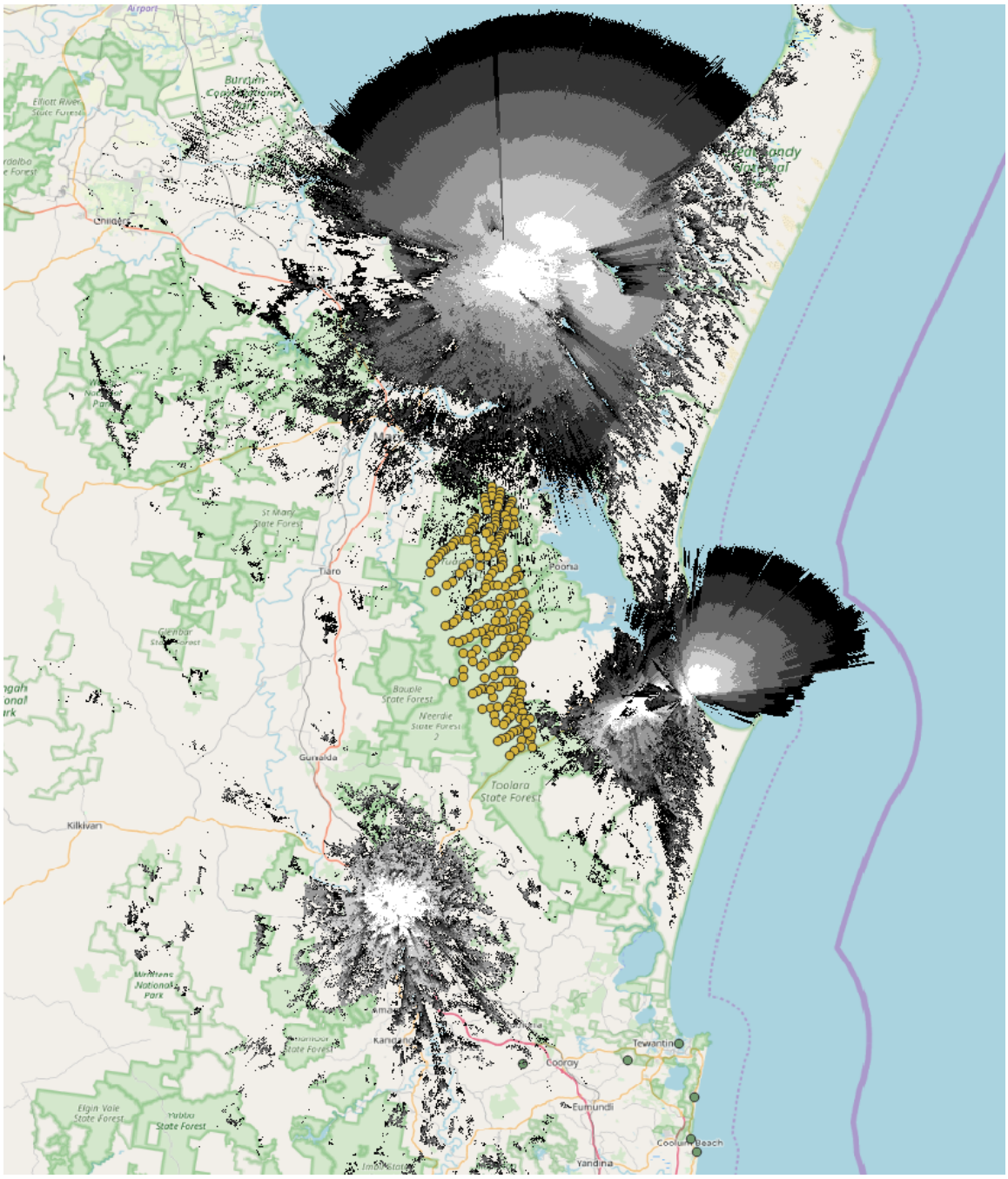


Figure 10 Local Repeater Digital Television Broadcast Coverage

Figure 10 Local Repeater Digital Television Broadcast Coverage shows expected television broadcast coverage zones by local repeaters indicated by white as the strongest signal levels, grey as medium signal level and black as marginal signal level. Proposed wind turbine locations are indicated in yellow.

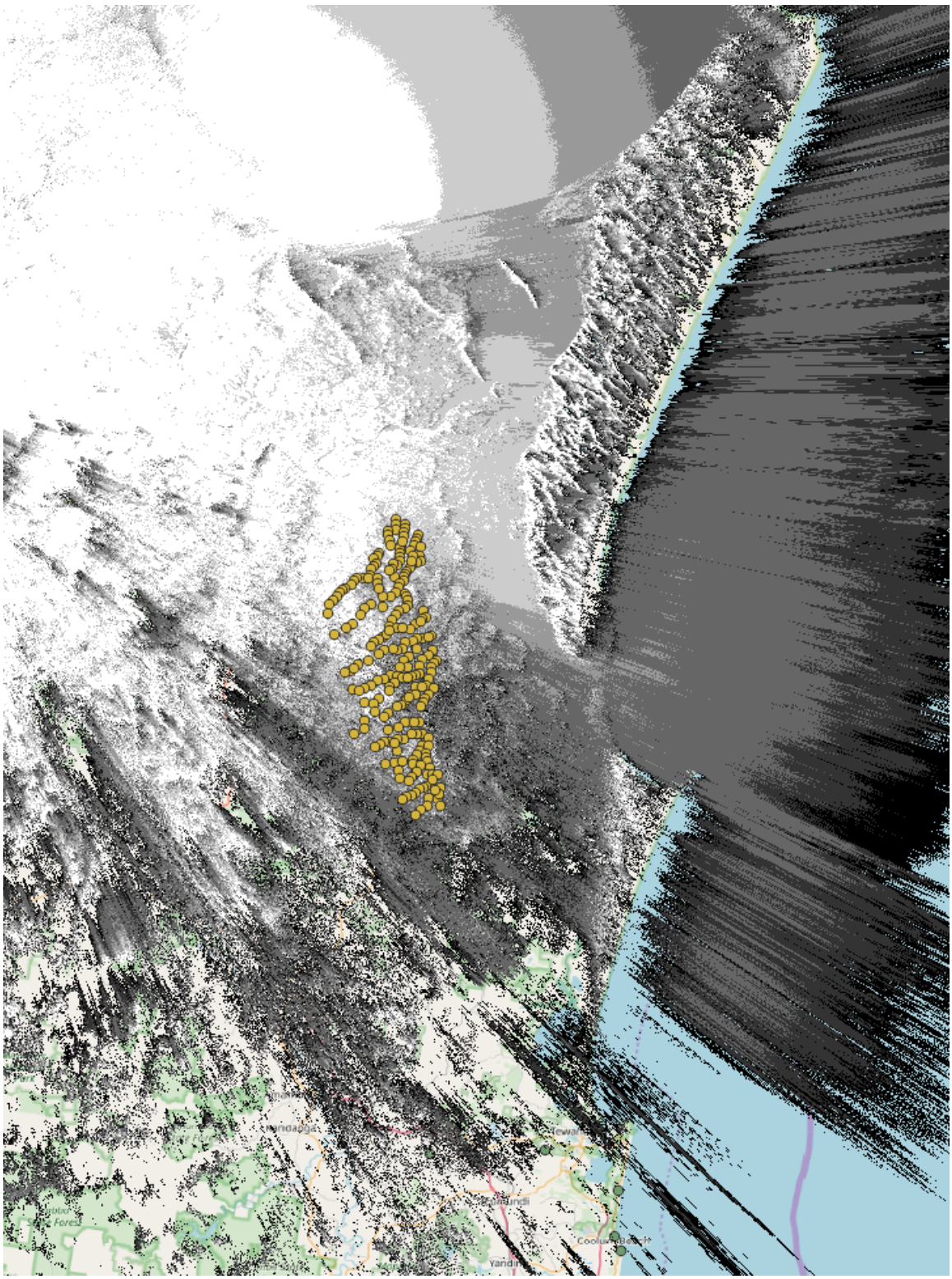


Figure 11 Wide Bay Digital Television (Mt. Goonaneman) Broadcast Coverage Area

Figure 11 Wide Bay Digital Television (Mt. Goonaneman) Broadcast Coverage Area shows expected television broadcast coverage zones by the Wide Bay television transmitter at Mt. Goonaneman, indicated by white as the strongest signal levels, grey as medium signal level and black as marginal signal level. Proposed wind turbine locations are indicated in yellow.

The proposed wind farm has the potential to cause slight degradation of the signal from the Wide Bay digital television transmitter at Mt. Goonaneman, in scatter zones close to the turbines between the coast and the wind farm. Potentially affected areas are marked by plotting forward and backscatter zones in a keyhole shape inline between the transmitter and each turbine and are shown in Appendix C and in Figure 12 Wide Bay Digital Television Transmitter (Mt. Goonaneman) Scatter Zones from Wind Farm.The television signal scatter zones shown in Figure 12 Wide Bay Digital Television Transmitter (Mt. Goonaneman) Scatter Zones from Wind Farm are modelled if the receivers are utilising high gain antennas. If low gain receive antennas are used then the forward scatter zones can extend up to 10 km past each turbine.

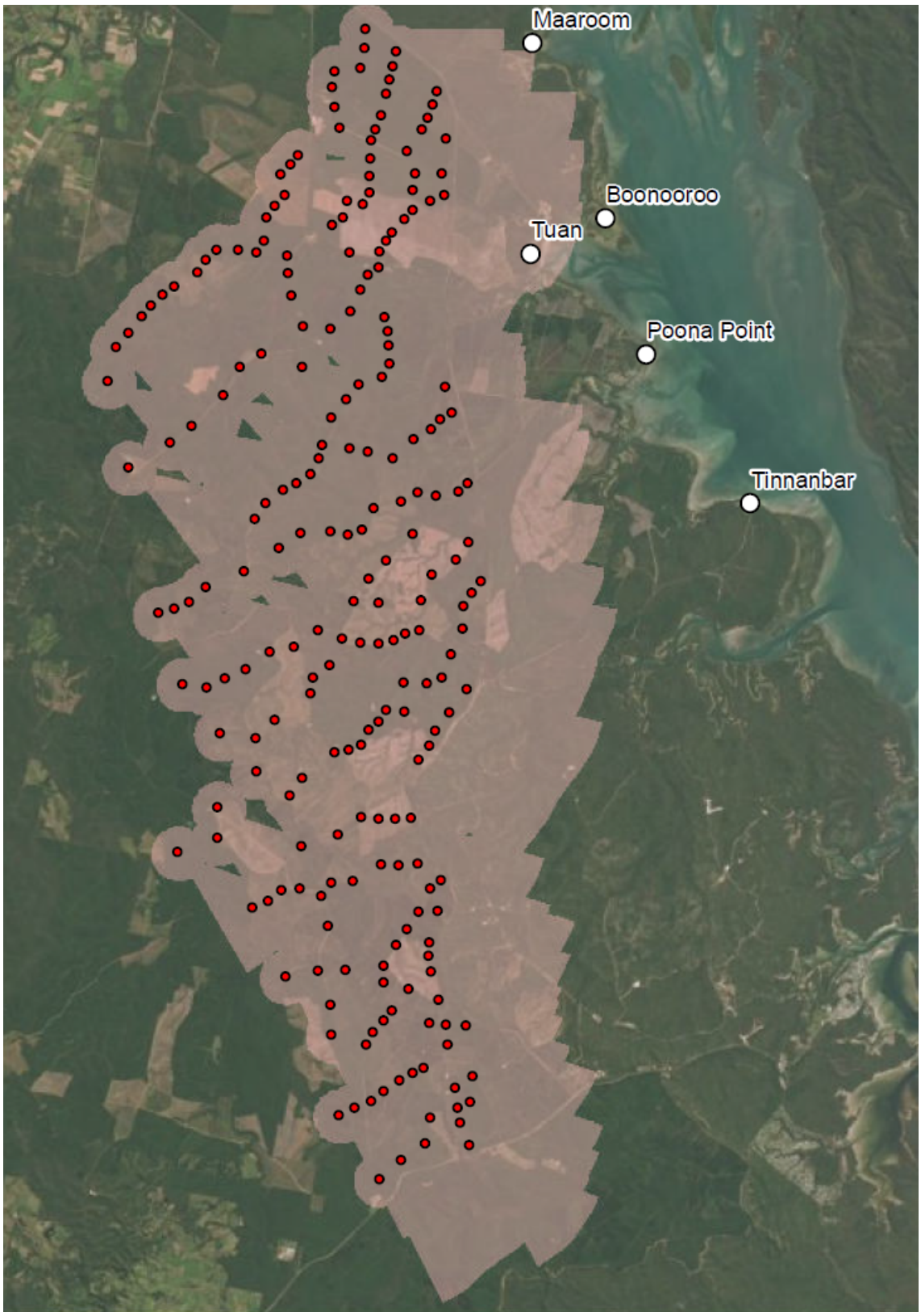


Figure 12 Wide Bay Digital Television Transmitter (Mt. Goonaneman) Scatter Zones from Wind Farm

Maaroom

The television transmitter at Mt. Goonaneman which services the Wide Bay area is in direct line of sight of all the dwellings in Maaroom. However, proposed turbine locations are ~3.5 km to existing dwellings. Television receivers in Maaroom may experience degraded signal levels due to being within the turbines' forward scatter zone.

Boonooroo and Tuan

The proposed wind farm turbines may be placed in direct line of sight of the Mt. Goonaneman television transmitter between dwellings in both Boonooroo and Tuan. The closest proposed turbine location may be ~3.5 km from dwellings in Boonooroo and ~3.8 km from dwellings in Tuan. Receivers in Boonooroo and Tuan may experience degraded signal levels which could affect TV reception due to being in forward scatter zones of turbines.

Poona and Tinnanbar

The proposed wind farm turbines may be placed in direct line of sight of the Mt. Goonaneman television transmitter between dwellings in both Poona and Tinnanbar. The closest proposed turbine location may be ~5.6 km from dwellings in Poona and ~9.5 km from dwellings in Tinnanbar. Forward scatter TV interference should not be significant more than 5 km from a turbine, unless the receiver does not have line-of-sight to the transmitter or if receivers are using low gain antennas, then degraded television signal may occur at dwellings up to 10 km from a turbine.

A small amount of reception degradation may occur due to the wind farm, but it is likely to have minimal impact. There is the potential for signal degradation to those between the wind farm and the coastline. These properties are already in an area of marginal reception and will likely be eligible for the government-funded VAST (Viewer Access Satellite Television) service, utilised to provide television coverage to areas of Australia with poor to no TV transmitter coverage, should their existing over the air reception be significantly impacted by the wind farm development.

The VAST service utilises common channels across entire states; however localised news and radio services are provided by additional channels to ensure access to these services is not lost in transitioning from FTA antenna to VAST satellite service.

9.1 Digital Television Reception Mitigation Strategies

The table below provides a summary of the potential electromagnetic interference impacts due to the wind farm development identified in this report, the respective mitigation measures and suggested recommendations.

Table 11 Mitigation Strategies and Recommendations for Digital Television

Impact	Service Mitigation Strategies	Recommendation
Potential minor service degradation to local community, i.e. TV reception within 10 km of wind farm may be affected.	Mitigation options for affected dwellings in the townships of Maaroom, Boonooroo, Tuan, Poona and Tinnanbar, are identical: Realign antennas on affected dwellings in a more direct path to Mt. Goonaneman Realign antennas on affected dwellings to another television transmitter, such as Hervey Bay Replace antennas on affected dwellings with a higher gain antenna Relocate antennas on affected dwellings to another position on the property that is less affected Install satellite television on affected dwellings Install a television relay station in or near the townships.	Forest Wind Holdings will undertake a pre- and post-construction assessment of the television and radio reception strength at the location of any existing or approved dwellings as at the date of development approval that are within 5 kilometres of any turbine. The assessments will be undertaken by an independent television and radio monitoring specialist, and include testing at locations to be determined by the television and radio monitoring specialist to enable the average television and radio reception strength to be determined. If the post-construction assessment establishes an unacceptable increase in interference to reception as a result of the wind farm, as determined by

		the independent television and radio monitoring specialist, measures to restore the affected reception to pre-construction quality will be undertaken.

10. 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.

Table 12 Mitigation Strategies and Recommendations for AM / FM Services

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Measure signal levels in wind farm vicinity to establish a baseline, as per TV signal mitigation recommendation.

11. Point to Multipoint Services

No point-to-multipoint (PTMP) sites were identified in the vicinity of the wind farm during the radio services search as outlined in Section 3.1.

12. Mobile Telephone and Broadband Internet Broadcast Sites

Cellular mobile phone technologies provide for robust communications in areas of significant obstruction via multi-path communications between customer equipment and the network base station sites. The three carrier networks (Optus, Telstra and Vodafone) have transmitter sites covering the main population areas around the wind farm area.

Interference to cellular phone coverage is anticipated to be minimal except for those users operating in close proximity to the proposed wind farm such as maintenance staff, where existing coverage is already poor or none according to the carrier's publicly available coverage maps. Figure 13, as an example, shows the marginal areas in the wind farm that mobile phone operations may be slightly affected directly beneath and around the turbines.

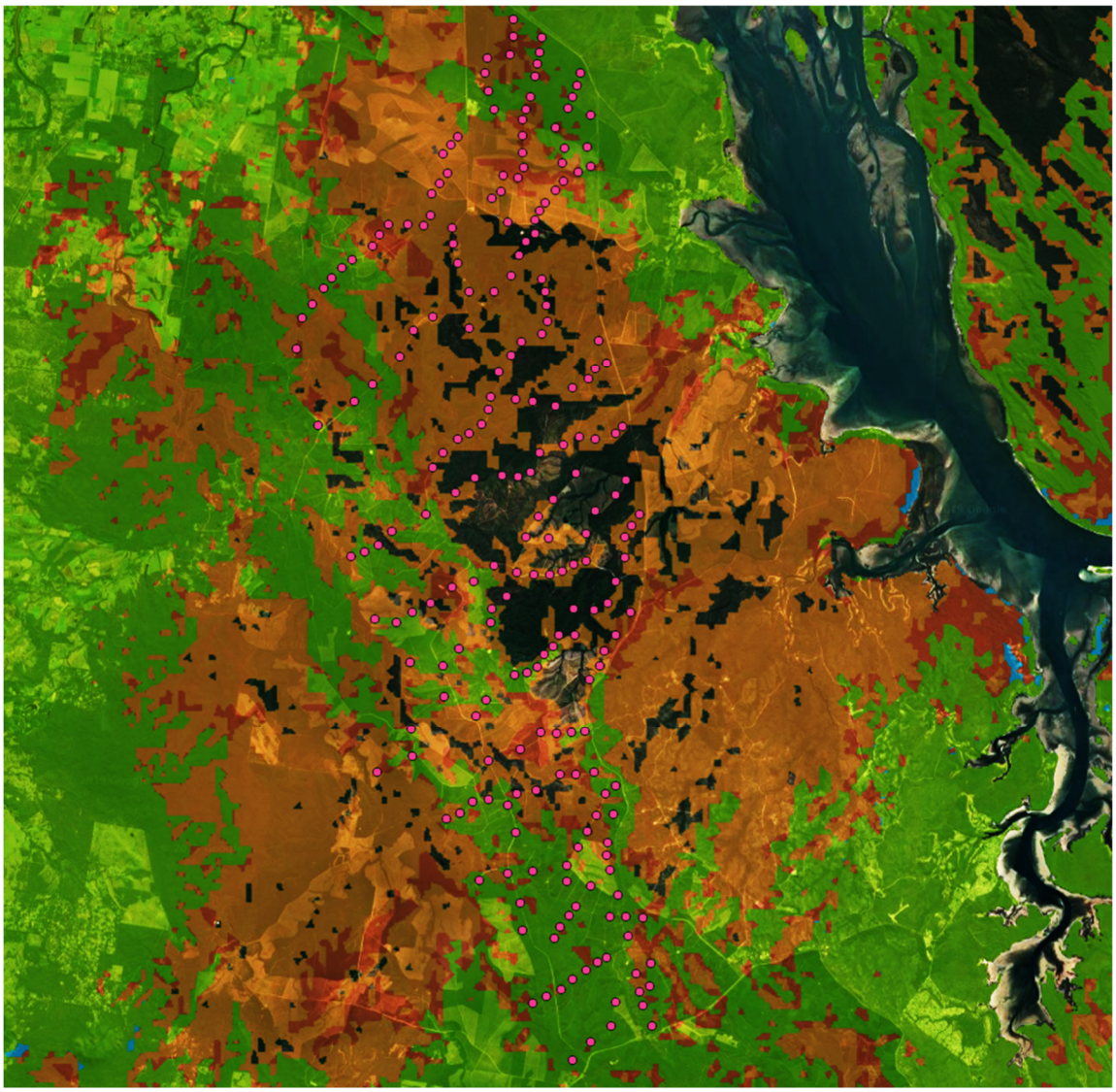


Figure 13 Existing Telstra Coverage in Wind Farm Area

Figure 13 Existing Telstra Coverage in Wind Farm Area shows existing Telstra 4G coverage in the wind farm area, with green overlay defining high quality signal, orange overlay defining medium quality signal and no overlay colour defining no signal coverage, with pink dots showing proposed wind turbine locations.

Fixed wireless broadband internet transmitters, including NBN, are focussed on the town areas around the wind farm area. With minimal properties around the forest area, the impact is expected to be minimal.

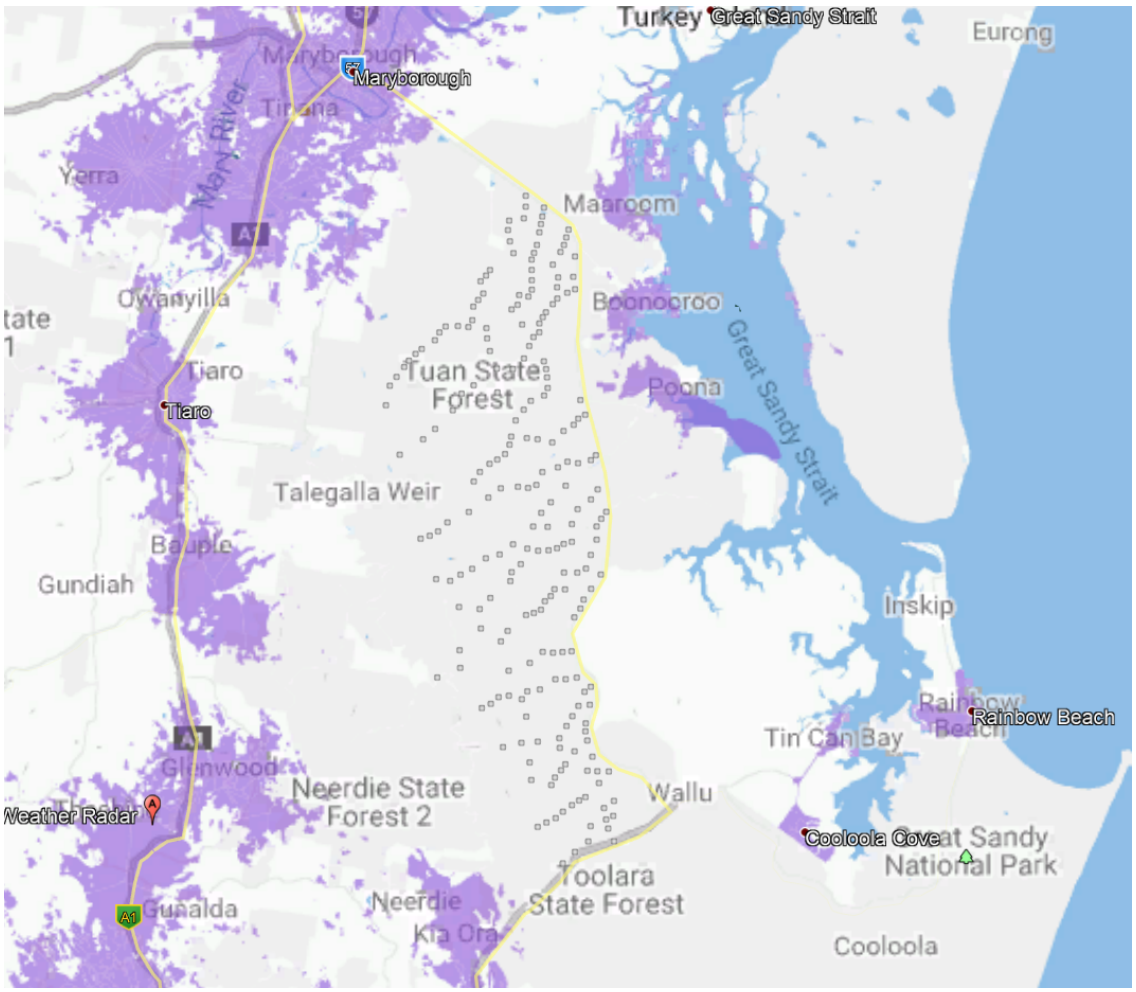


Figure 14 NBN Coverage in Wind Farm Area

Figure 14 shows NBN fixed wireless coverage in purple and proposed wind turbine, and that there are no NBN services within the wind turbine area, and the wind farm development will have no impact on NBN services. Properties within the Tuan Forest region have been selected for alternative connection methods to the NBN via the SkyMuster satellite system, which also will not be affected by the presence of nearby wind turbines.

13. Aircraft Communications Systems

Wind farms have the potential to disturb navigational signals, which can distort the accuracy of the aircraft positioning systems and/or introduce 'false targets'. It is not expected that the wind farm development will cause issues due to the distance from Maryborough Airport and the Gympie Hospital helicopter landing pad.

The only listed service at any of the four Maryborough Airport sites listed in the ACMA database is an Aeronautical Mobile type service owned / operated by Fraser Coast Regional Council, operating at 133.55 MHz. This transmitter is located a sufficient distance from the wind farm to avoid any significant impact from the turbines.

McDermott Aviation, who perform various forestry activities utilising helicopters in the region, advised that their communications are a combination of UHF CB radio for communications with Forestry, and a combination of low-band and high-band VHF. The choice of channel is dictated by who they need to contact, which changes depending if they are engaged to assist with firefighting or herbicide application activities. This service will not be impacted, unless the ground receiver is next to a turbine, which is blocking line of site to the helicopter. In this case,

there may be some reduction in signal quality. Table 13 Mitigation Strategies and Recommendations for Aircraft Communications Systems describes that there are no mitigation activities possible for this unlikely negligible degradation in service.

Table 13 Mitigation Strategies and Recommendations for Aircraft Communications Systems

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Nil.

14. Meteorological Radar

The results of the radio services search indicated that the Bureau of Meteorology (BoM) operates an S-band radar facility at Gympie (Mt. Kanigan), which is 19.7 km away from the closest turbine, in the south section of the wind farm. Depending on wind direction and hence rotor blade orientation, the wind farm location has the potential to affect some direct radar views in the northeast to eastern sectors.

A number of turbines fall within the 30 km range to trigger an impact study by the BoM. Consultation with the BoM is ongoing and they are working on determining effects and mitigations to reduce the effect of reflections from the turbines.

The three main effects exhibited by wind turbines on weather radars are:

- Beam blocking
- Clutter
- Doppler mode false artefacts

The largest impact on the radar is caused by the Doppler mode. To minimise this effect, there should be no turbines constructed within 10 km of an S-band radar, as advised by the Bureau of Meteorology. The nearest turbine planned for this project is double this exclusion zone distance.

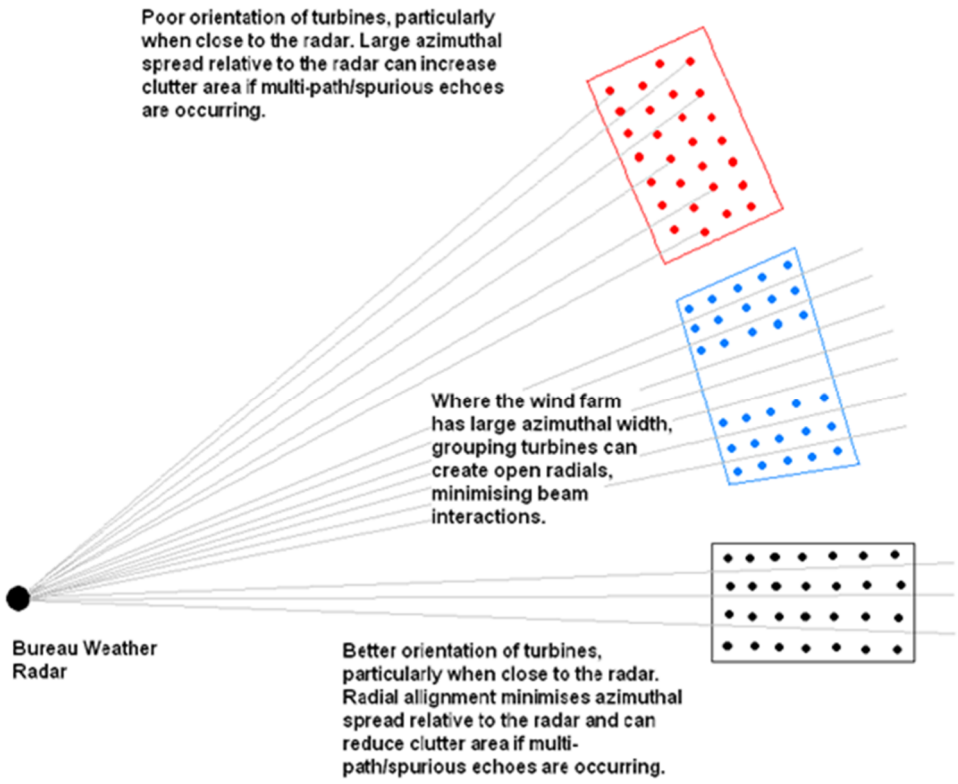


Figure 15 Wind Turbine Layout Examples to Minimise Adverse Effects to Bureau Weather Radar Operation

The turbines in the north of the site are aligned loosely to radials radiating from the radar transmitter at Mt. Kanigan, which may allow radar signals to pass through the wind farm. The turbines in the southern area are likely to cause some blockage of the radar signal.

A number of turbines fall within the 30 km range to trigger an impact study by BoM. The BoM was consulted and the following feedback was provided:

a. BoM would prefer not have wind turbines near radar, however accept that wind farm developments will occur.

b. Due to terrain interference, Mt Kanigan blocks part of this radar's scan out over the central part of the wind farm, however there is a risk of impact on this central area as well as the southern and northern parts of the project.

c. It is common for wind farms to be built near radars and the users of the radar can tolerate minor impacts that may be caused on the system.

d. In the event that the radar system owner/operator cannot tolerate acceptable impact in their use of the radar, it is possible to apply technical fixes to improve performance of the radar. Forest Wind Holdings Pty Ltd will liaise closely with the BoM and provide sufficient information to allow them to reconfigure their systems.

Table 14 Mitigation Strategies and Recommendations for Meteorological Radar

Impact	Service Mitigation Strategy	Recommendation
Possible impact anticipated to weather-watch radar systems.	Take the radar impact into consideration where possible for any micro siting of the layout.	Liaise closely with BoM and provide sufficient information to allow them to reconfigure their radar systems.

15. 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 their operations in the area.

During consultation with the Defence Spectrum Office (DSO), the following concerns were raised by the DSO:

a. 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.

b. 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's – 100km.

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

Table 15 Mitigation Strategies and Recommendations for Defence Radio Systems

Impact	Service Mitigation Strategy	Recommendation
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.	Nil.

16. Trigonometrical Systems

Trigonometrical systems operate across Australia are administered by Geoscience Australia. The closest trigonometrical system to the proposed wind turbine development area is the BNDY AGRN permanent geodetic quality Global Navigation Satellite System (GNSS) receiver approximately 95 km north of the proposed wind turbine area.

Consultation was conducted with Geosciences Australia to confirm that there are no foreseeable impacts to their trigonometrical stations, GNSS reference stations or associated facilities or services associated with the proposed Forest Wind development.

17. Maritime Radio Systems

Since the wind farm location is not sited between the maritime transmitter locations identified (both at Tin Can Bay) and the coastline, it is anticipated that there will be no impact upon Limited Coast Assigned System maritime services caused by the wind farm development.

18. 50 Hz Radiation (Transmission Lines)

The main sources of electromagnetic fields associated with wind farms are the substations and transmission lines. The transmission line and substation, while not specifically included in this study, 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.

19. 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.

20. Conclusion

As demonstrated earlier in this report, Forest Wind Holdings Pty Limited have made several endeavours to reduce the impact on existing radio services in the region through the choice of turbine materials and the layout of the turbines. This report demonstrates compliance with Performance Outcome, PO3, of Queensland State Development Assessment Provisions v2.5 and that with the implementation of the proposed mitigation measures, that the wind farm development is designed, located and sited to avoid, minimise and mitigate electromagnetic interference to pre-existing television, radar and radio transmission and reception services.

21. Summary of Mitigation Strategies and Recommendations

Table 16 Mitigation Strategies and Recommendations for Fixed Point to Point Microwave Links

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Due to proximity to existing radio link services, continue to review any amendments to the wind farm layout to avoid micro-siting turbines into radio link paths’ second Fresnel zone.

Table 17 Mitigation Strategies and Recommendations for Fixed Point-to-Point UHF Voice / Telemetry Systems

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Due to proximity to existing radio link services, continue to review any amendments to the wind farm layout to avoid micro-siting turbines into radio link paths.

Table 18 Mitigation Strategies and Recommendations for Fixed Point-to-Point UHF Voice / Private Networks

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Due to proximity to existing radio link services, continue to review any amendments to the wind farm layout to avoid micro-siting turbines into radio link paths.

Table 19 Mitigation Strategies and Recommendations for LMR Services

Impact	Service Mitigation Strategy	Recommendation
Potential impact anticipated to Hyne & Son mobile radio service.	Avoid micro-siting to within 20 m of the transmitter location; 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.

Table 20 Mitigation Strategies and Recommendations for Digital Television

Impact	Service Mitigation Strategies	Recommendation
Potential minor service degradation to local community, i.e. TV reception within 10 km of wind farm may be affected.	Mitigation options for affected dwellings in the townships of Maaroom, Boonooroo, Tuan, Poona and Tinnanbar, are identical: Realign antennas on affected dwellings in a more direct path to Mt. Goonaneman Realign antennas on affected dwellings to another television transmitter, such as Hervey Bay Replace antennas on affected dwellings with a higher gain antenna Relocate antennas on affected dwellings to another position on the property that is less affected Install satellite television on affected dwellings Install a television relay station in or near the townships.	Forest Wind Holdings will undertake a pre- and post-construction assessment of the television and radio reception strength at the location of any existing or approved dwellings as at the date of development approval that are within 5 kilometres of any turbine. The assessments will be undertaken by an independent television and radio monitoring specialist, and include testing at locations to be determined by the television and radio monitoring specialist to enable the average television and radio reception strength to be determined. If the post-construction assessment establishes an unacceptable increase in interference to reception as a result of the wind farm, as determined by the independent television and radio monitoring specialist, measures to restore the affected reception to pre-construction quality will be undertaken.

Table 21 Mitigation Strategies and Recommendations for AM / FM Services

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Measure signal levels in wind farm vicinity to establish a baseline, as per TV signal mitigation recommendation

Table 22 Mitigation Strategies and Recommendations for Aircraft Communications Systems

Impact	Service Mitigation Strategy	Recommendation
Minor to no impact anticipated to services.	Nil.	Nil.

Table 23 Mitigation Strategies and Recommendations for Meteorological Radar

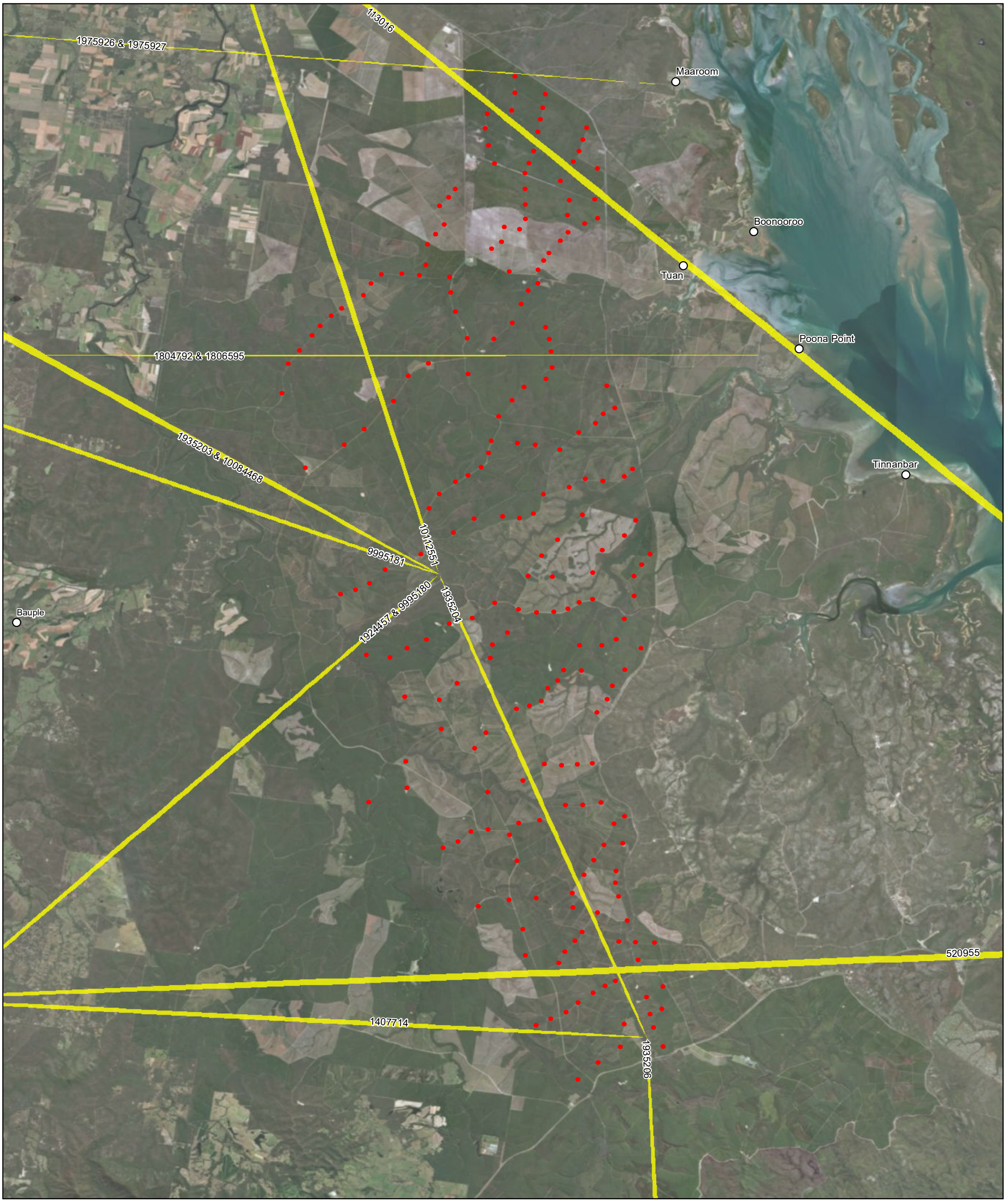
Impact	Service Mitigation Strategy	Recommendation
Possible impact anticipated to weather-watch radar systems.	Take the radar impact into consideration where possible for any micro siting of the layout.	Liaise closely with BoM and provide sufficient information to allow them to re-configure their radar systems.

Table 24 Mitigation Strategies and Recommendations for Defence Radio Systems

Impact	Service Mitigation Strategy	Recommendation
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.	Nil.

Appendices

Appendix A –
ACMA Licensed Point-to-Point Radio Link Exclusion Zones



- Turbine locations – rotor diameter 190 m drawn to scale
- Town
- Point-to-Point Fresnel exclusion zones – labelled by ACMA Licence No.

Paper Size A3

0 1.25 2.5 5 7.5

Kilometres

Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

N

GHD

Forest Wind Pty Ltd
Forest Wind – EMI Assessment

ACMA Licensed Point-to-Point Radio Link Exclusion Zones

Job Number	61-38468
Revision	0
Date	06 Sep 2019

Appendix A1

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180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com

Data source: Clean Sight, turbine locations, 2019; GeoScience Australia, populated places, 2019. ACMA, transmission point data, 2019. Created by:savenables
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

- Turbine locations – rotor diameter 190 m drawn to scale
- Town
- Other populated place
- Point-to-Point Fresnel exclusion zones – labelled by ACMA Licence No.

Paper Size A3

0 2.5 5 10 15

Kilometres

Horizontal Datum: WGS 1984
Grid: GCS WGS 1984

N

GHD

Forest Wind Pty Ltd
Forest Wind – EMI Assessment

ACMA Licensed Point-to-Point Radio Link Exclusion Zones

Job Number	61-38468
Revision	0
Date	06 Sep 2019

Appendix A2

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180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com

Data source: Clean Sight, turbine locations, 2019; GeoScience Australia, populated places, 2019. ACMA, transmission point data, 2019. Created by:savenables
Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Appendix B - Confidential Information
Pages extracted

Appendix C –
TV Signal Scatter Zones from Wide Bay Broadcast Transmitter

Biggenden
Brooweena
Yerra
Maryborough
Maaroom
Boonooroo
Tuan
Poona Point
Tinnanbar
Tiaro
Bauple
Gootchie
Theebine
Gunalda

Paper Size A3

0 2.5 5 10 15

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

- Turbine locations – rotor diameter 190 m drawn to scale
- Wide Bay TV Transmitter (Mt. Goonaneman)
- Scatter zone
- Town
- Other populated place

Forest Wind Pty Ltd
Forest Wind – EMI Assessment

Job Number	61-38468
Revision	0
Date	06 Sep 2019

TV Signal Scatter Zones from Wide Bay Broadcast Transmitter

Appendix C

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Data source: Clean Sight, turbine locations, 2019; GeoScience Australia, populated places, 2019. Created by:savenables

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com **W** www.ghd.com

Appendix D –
Turbine Location Clearance Distance to Nearest Point-to-Point Radio Link Second Fresnel Zone

Turbine modelling was based on location data in WTG_Layout 029 R04 All Stages_190607.mkz and advised to model turbine diameters of 190 meters provided by and advised by CleanSight as conservative data.

Fresnel zones were calculated based on communication link locations supplied by CleanSight and ACMA public radcomm database, and then visually confirmed and updated based on Google Maps / Google Earth imagery accessed on 9/7/2019.

Layer	Label	Easting	Northing	Distance to Nearest Link (m)	Nearest Link ID
FW_Layout 26 R04 190610 Stage 2	**2_1**	**481141.5862**	**7167641.345**	**10.26386842**	**1975926 & 1975927**
FW_Layout 26 R04 190610 Stage 2	**2_28**	**482522.8324**	**7156134.458**	**46.43470009**	**1804792 & 1806595**
FW_Layout 26 R04 190610 Stage 2	**2_129**	**484997.2621**	**7129814.665**	**57.63312629**	**1935204**
FW_Layout 26 R04 190610 Stage 2	**2_118**	**484310.9115**	**7132670.233**	**66.38671732**	**1935204**
FW_Layout 28 R03 190607 Stage 4	**4_25**	**472996.6561**	**7156161.213**	**66.43894128**	**Internal Confidential**
FW_Layout 26 R04 190610 Stage 2	**2_138**	**481998.4049**	**7127953.28**	**83.66319905**	**1407714**
FW_Layout 24 R02 190607 Stage 1A	**1A_4**	**483358.6483**	**7164072.998**	**89.7720037**	**113016**
FW_Layout 24 R02 190607 Stage 1A	**1A_6**	**484171.3651**	**7162498.264**	**93.47203941**	**113016**
FW_Layout 27 R02 190607 Stage 3	**3_14**	**477608.7703**	**7147649.245**	**95.44225971**	**Internal Confidential**
FW_Layout 26 R04 190610 Stage 2	2_100	481484.1587	7138185.849	123.0936378	1935204
FW_Layout 26 R04 190610 Stage 2	2_14	481857.5409	7164517.769	126.0328517	113016
FW_Layout 26 R04 190610 Stage 2	2_9	482015.108	7165319.473	134.9542899	113016
FW_Layout 26 R04 190610 Stage 2	2_127	485851.5915	7130693.581	136.1572728	520955
FW_Layout 26 R04 190610 Stage 2	2_5	481019.7182	7166211.345	145.2046982	113016
FW_Layout 26 R04 190610 Stage 2	2_128	482852.2733	7130564.508	145.7486797	520955
FW_Layout 27 R02 190607 Stage 3	3_9	478300.8031	7150164.627	146.7379143	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_6	480092.5446	7166065.086	147.1107423	113016
FW_Layout 25 R03 190607 Stage 1B	1B_4	486801.3188	7127070.304	149.9489229	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_97	482294.9633	7138880.237	152.8859079	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_106	483097.061	7137168.46	155.9210929	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_1	479349.199	7156682.959	156.2764755	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_108	484171.5107	7134863.774	157.0780577	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_35	482120.9632	7136528.965	158.3896834	1935204
FW_Layout 28 R03 190607 Stage 4	4_21	478898.9851	7157794.375	160.3887429	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_20	474588.5686	7157923.464	162.5956429	10112551
FW_Layout 26 R04 190610 Stage 2	2_113	483357.1909	7133487.603	167.377304	1935204
FW_Layout 26 R04 190610 Stage 2	2_94	481236.6673	7141186.588	170.8264119	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_86	480244.2622	7143313.227	174.3046219	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_110	483802.0796	7134248.979	185.5136117	1935204
FW_Layout 26 R04 190610 Stage 2	2_134	486171.0864	7129137.062	191.0269429	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_50	478910.752	7150677.326	196.7285122	Internal Confidential
FW_Layout 25 R03 190607 Stage 1B	1B_1	486306.4652	7128427.197	197.5069892	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_123	485751.8785	7131429.813	199.3669189	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_2	477883.0836	7155629.389	213.7635776	1804792 & 1806595

FW_Layout 26 R04 190610 Stage 2	2_122	485120.4763	7131460.746	214.2863513	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_26	472574.4162	7155608.361	223.0579042	1804792 & 1806595
FW_Layout 25 R03 190607 Stage 1B	1B_3	486437.7711	7127867.093	228.4801039	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_119	485438.415	7132337.963	244.6927635	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_5	476566.6732	7154050.974	246.3482827	10112551
FW_Layout 27 R02 190607 Stage 3	3_22	479560.0719	7144981.914	264.4741133	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_23	478687.1889	7144743.782	270.4549106	1935204
FW_Layout 27 R02 190607 Stage 3	3_10	477916.0055	7149566.991	278.7303064	10112551
FW_Layout 27 R02 190607 Stage 3	3_6	475453.7182	7152878.166	279.5396868	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_12	478838.6314	7148554.036	298.3073446	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_3	479384.5583	7155188.198	308.7872784	Internal Confidential
FW_Layout 25 R03 190607 Stage 1B	1B_5	485183.3845	7127056.447	313.8545207	Internal Confidential
FW_Layout 25 R03 190607 Stage 1B	1B_2	485327.7969	7128009.353	357.0277982	1407714
FW_Layout 26 R04 190610 Stage 2	2_114	485111.5724	7133346.614	370.9887478	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_116	483383.0945	7132883.43	373.3970324	1935204
FW_Layout 26 R04 190610 Stage 2	2_15	482871.0244	7163268.851	383.4773498	113016
FW_Layout 26 R04 190610 Stage 2	2_137	482551.534	7128228.977	393.0364648	1407714
FW_Layout 26 R04 190610 Stage 2	2_29	482569.5318	7155462.026	394.2766693	1804792 & 1806595
FW_Layout 27 R02 190607 Stage 3	3_16	476259.124	7146997.379	395.595104	9995181
FW_Layout 28 R03 190607 Stage 4	4_24	473474.4325	7156791.005	402.0385069	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_26	475553.0491	7143434.458	402.4033211	1924457 and 9995180
FW_Layout 28 R03 190607 Stage 4	4_19	475415.1037	7158475.371	403.3342007	10112551
FW_Layout 28 R03 190607 Stage 4	4_18	478721.1361	7158596.767	403.9263749	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_130	484601.6199	7129605.518	425.184836	520955
FW_Layout 26 R04 190610 Stage 2	2_121	483735.0269	7131859.374	438.7045576	1935204
FW_Layout 27 R02 190607 Stage 3	3_7	474697.8146	7152223.491	456.1429634	Internal Confidential
FW_Layout 25 R03 190607 Stage 1B	1B_6	484341.1186	7126398.712	458.1646529	Internal Confidential
FW_Layout 24 R02 190607 Stage 1A	1A_5	484274.6906	7163790.502	484.5122427	113016
FW_Layout 26 R04 190610 Stage 2	2_83	480324.6137	7143872.654	484.675758	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_111	484991.0463	7133917.829	501.873506	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_16	478675.7339	7159245.153	503.5662622	Internal Confidential
FW_Layout 25 R03 190607 Stage 1B	1B_7	483583.7154	7125686.648	507.0758481	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_126	481589.0344	7130877.503	517.1635789	520955
FW_Layout 26 R04 190610 Stage 2	2_131	486790.1538	7129580.52	549.0050043	520955
FW_Layout 26 R04 190610 Stage 2	2_27	482459.4033	7156654.093	566.1621698	1804792 & 1806595
FW_Layout 24 R02 190607 Stage 1A	1A_3	483573.8295	7164519.354	566.773392	113016
FW_Layout 26 R04 190610 Stage 2	2_26	480359.6127	7156657.988	573.4410578	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_7	482108.4122	7165844.189	590.1258409	113016
FW_Layout 26 R04 190610 Stage 2	2_125	483078.4675	7131033.598	603.8439182	520955
FW_Layout 24 R02 190607 Stage 1A	1A_7	484283.9799	7161710.932	606.3879832	113016
FW_Layout 26 R04 190610 Stage 2	2_11	481679.2637	7164011.054	622.8183777	113016
FW_Layout 28 R03 190607 Stage 4	4_22	474196.4887	7157612.784	627.6864652	10112551
FW_Layout 26 R04 190610 Stage 2	2_8	480015.4786	7165465.372	645.7508226	113016
FW_Layout 26 R04 190610 Stage 2	2_42	479393.4412	7150947.36	656.0050571	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_2	482297.0012	7166892.53	665.2543965	1975926 & 1975927
FW_Layout 26 R04 190610 Stage 2	2_95	480085.672	7140189.725	666.2509026	1935204

FW_Layout 26 R04 190610 Stage 2	2_92	481727.9333	7141313.977	669.7787992	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_133	486750.5413	7128646.857	673.5249129	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_132	484153.1066	7129313.62	696.6151154	520955
FW_Layout 26 R04 190610 Stage 2	2_3	481142.358	7166949.242	700.1245034	1975926 & 1975927
FW_Layout 26 R04 190610 Stage 2	2_136	483130.5012	7128504.295	704.1269039	1407714
FW_Layout 26 R04 190610 Stage 2	2_61	482945.1217	7138829.106	720.3599824	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_109	485013.5312	7134414.225	731.2548942	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_4	477121.8676	7155103.154	738.1183557	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_103	483747.0543	7137173.112	747.0078108	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_17	483211.4025	7162460.367	760.4667532	113016
FW_Layout 26 R04 190610 Stage 2	2_104	484554.5913	7135504.066	774.4446299	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_17	475701.8939	7158968.957	819.3914282	10112551
FW_Layout 26 R04 190610 Stage 2	2_124	486469.9129	7131416.874	830.2976932	520955
FW_Layout 26 R04 190610 Stage 2	2_64	483463.1766	7131488.88	831.5119395	1935204
FW_Layout 28 R03 190607 Stage 4	4_23	473778.6269	7157187.139	858.2108543	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_30	482337.0921	7154986.865	868.7121044	1804792 & 1806595
FW_Layout 28 R03 190607 Stage 4	4_11	480266.7054	7160430.76	913.2600193	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_28	478986.6899	7142255.2	913.8930627	1935204
FW_Layout 27 R02 190607 Stage 3	3_36	481329.5511	7136412.078	935.3069852	1935204
FW_Layout 27 R02 190607 Stage 3	3_8	473225.019	7151255.453	995.319265	10084468
FW_Layout 26 R04 190610 Stage 2	2_4	482196.3903	7166323.972	1008.082268	113016
FW_Layout 24 R02 190607 Stage 1A	1A_2	483719.6142	7164997.629	1021.76064	113016
FW_Layout 26 R04 190610 Stage 2	2_60	479619.6472	7149140.089	1028.42664	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_13	481527.2125	7163589.978	1038.252475	113016
FW_Layout 26 R04 190610 Stage 2	2_25	482318.1817	7157148.881	1061.15667	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_135	483584.2827	7128905	1079.288371	520955
FW_Layout 26 R04 190610 Stage 2	2_10	480146.0021	7164748.052	1093.877247	113016
FW_Layout 27 R02 190607 Stage 3	3_27	476445.9624	7143326.683	1098.979994	1924457 and 9995180
FW_Layout 24 R02 190607 Stage 1A	1A_8	483790.8332	7161487.176	1101.509977	113016
FW_Layout 26 R04 190610 Stage 2	2_45	479882.3569	7151295.155	1115.27274	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_20	475667.5193	7146430.889	1129.937968	9995181
FW_Layout 26 R04 190610 Stage 2	2_53	482174.7351	7141516.655	1160.367315	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_32	484637.0827	7154702.057	1161.101466	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_31	481503.7961	7154649.706	1203.341832	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_81	480893.9059	7144375.415	1213.656299	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_24	481055.1855	7157327.914	1242.175972	1804792 & 1806595
FW_Layout 27 R02 190607 Stage 3	3_25	477094.8749	7143716.153	1268.771007	1924457 and 9995180
FW_Layout 26 R04 190610 Stage 2	2_19	483145.0187	7161835.035	1271.460183	113016
FW_Layout 26 R04 190610 Stage 2	2_99	483543.9111	7138871.115	1280.710517	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_14	476091.0551	7159348.497	1300.938797	10112551
FW_Layout 26 R04 190610 Stage 2	2_72	480407.5823	7145620.235	1303.132721	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_96	479656.1695	7139535.147	1309.850221	1935204
FW_Layout 27 R02 190607 Stage 3	3_24	477828.0941	7144082.266	1312.721811	1935204
FW_Layout 26 R04 190610 Stage 2	2_47	480166.8587	7151886.285	1351.315353	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_9	480645.7914	7160719.938	1381.588851	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_40	480266.6329	7152396.869	1409.841743	Internal Confidential

FW_Layout 26 R04 190610 Stage 2	2_63	484439.8908	7137272.673	1417.043178	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_12	477779.7714	7159749.279	1439.519387	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_38	480984.4385	7135921.795	1440.087457	1935204
FW_Layout 26 R04 190610 Stage 2	2_105	485263.2943	7135574.398	1446.69657	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_27	472334.5957	7154371.396	1459.567773	1804792 & 1806595
FW_Layout 28 R03 190607 Stage 4	4_7	478144.8532	7161031.565	1477.868566	Internal Confidential
FW_Layout 24 R02 190607 Stage 1A	1A_1	483862.7446	7165490.779	1486.153091	113016
FW_Layout 26 R04 190610 Stage 2	2_51	484933.4762	7136385.881	1490.020793	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_12	480372.5351	7163997.977	1502.590267	113016
FW_Layout 26 R04 190610 Stage 2	2_115	481995.3118	7133271.588	1509.094961	1935204
FW_Layout 26 R04 190610 Stage 2	2_16	481534.6398	7162932.294	1524.11594	113016
FW_Layout 28 R03 190607 Stage 4	4_10	477837.7402	7160607.866	1525.766225	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_20	480938.5441	7159474.495	1528.024749	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_101	480155.0744	7137701.628	1536.685499	1935204
FW_Layout 27 R02 190607 Stage 3	3_19	475141.5383	7146156.496	1539.154961	1924457 and 9995180
FW_Layout 28 R03 190607 Stage 4	4_6	478471.1	7161438.725	1574.634404	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_107	481266.5278	7134832.52	1591.116292	1935204
FW_Layout 26 R04 190610 Stage 2	2_37	480546.252	7153415.255	1607.285864	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_55	482422.8942	7142049.956	1611.174407	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_120	481489.565	7131972.559	1615.667657	520955
FW_Layout 28 R03 190607 Stage 4	4_15	477532.8972	7159315.635	1648.266368	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_34	481052.5071	7154090.164	1761.555114	1804792 & 1806595
FW_Layout 24 R02 190607 Stage 1A	1A_9	483165.0643	7161120.211	1791.792198	113016
FW_Layout 27 R02 190607 Stage 3	3_21	474570.1902	7145973.299	1794.655666	1924457 and 9995180
FW_Layout 27 R02 190607 Stage 3	3_30	478315.7656	7141559.128	1795.865856	1935204
FW_Layout 26 R04 190610 Stage 2	2_98	484111.4036	7138917.633	1814.622048	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_8	480748.0435	7161339.25	1831.173519	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_102	485328.0085	7136699.056	1979.872329	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_73	481306.8883	7145350.698	2002.145494	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_18	481542.802	7162279.845	2005.622719	113016
FW_Layout 26 R04 190610 Stage 2	2_23	481389.4579	7158116.102	2029.813735	1804792 & 1806595
FW_Layout 28 R03 190607 Stage 4	4_13	476869.9179	7159377.9	2055.599659	10112551
FW_Layout 26 R04 190610 Stage 2	2_90	482793.6091	7142373.235	2083.978026	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_35	484941.7815	7153772.586	2091.649994	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_59	480703.8312	7149235.421	2101.160417	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_37	480169.395	7136140.552	2112.088741	1935204
FW_Layout 27 R02 190607 Stage 3	3_31	478394.5606	7140344.355	2176.454512	1935204
FW_Layout 28 R03 190607 Stage 4	4_5	481326.9904	7161244.994	2234.644747	Internal Confidential
FW_Layout 24 R02 190607 Stage 1A	1A_10	482874.8427	7160765.229	2249.89842	113016
FW_Layout 26 R04 190610 Stage 2	2_22	481654.9655	7158681.092	2301.314219	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_36	484505.8729	7153526.694	2335.997073	1804792 & 1806595
FW_Layout 28 R03 190607 Stage 4	4_4	478293.3831	7162213.318	2340.654009	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_43	481256.5549	7152302.078	2404.174512	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_3	481549.3781	7161679.895	2449.027073	113016
FW_Layout 26 R04 190610 Stage 2	2_76	483023.4486	7142807.576	2476.29659	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_112	480967.9533	7133196.738	2487.835207	1935204

FW_Layout 28 R03 190607 Stage 4	4_2	478637.0205	7162576.596	2560.887014	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_75	481990.7591	7145218.893	2565.025414	Internal Confidential
FW_Layout 24 R02 190607 Stage 1A	1A_13	482029.9722	7159546.731	2611.537758	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_117	479805.2103	7132926.649	2647.463048	520955
FW_Layout 26 R04 190610 Stage 2	2_21	482025.6415	7158982.571	2648.326493	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_29	477008.5752	7141688.319	2670.001175	1924457 and 9995180
FW_Layout 26 R04 190610 Stage 2	2_38	484214.7227	7153139.935	2721.746083	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_57	481339.7346	7149163.613	2740.807504	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_39	479520.8263	7136050.105	2746.802047	1935204
FW_Layout 24 R02 190607 Stage 1A	1A_12	482241.3104	7159939.618	2800.302232	Internal Confidential
FW_Layout 28 R03 190607 Stage 4	4_1	478886.5701	7162925.746	2849.602639	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_93	484284.2459	7141043	2870.613907	Internal Confidential
FW_Layout 24 R02 190607 Stage 1A	1A_11	482440.7452	7160250.392	2923.069751	113016
FW_Layout 27 R02 190607 Stage 3	3_18	481672.0318	7146740.046	2924.277091	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_88	483690.0539	7142791.793	3073.322536	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_44	481933.722	7152228.292	3085.074896	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_33	483579.0928	7152750.341	3109.19753	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_79	482645.3797	7145245.93	3169.048534	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_56	481866.6374	7149352.017	3250.54654	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_40	479033.5586	7135632.585	3355.64445	1935204
FW_Layout 26 R04 190610 Stage 2	2_91	484667.7423	7141591.625	3450.352831	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_80	483622.8318	7143846.461	3459.74795	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_54	482247.4989	7150162.529	3564.210937	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_78	483178.2477	7145375.55	3706.484429	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_15	482182.1726	7147596.369	3709.975622	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_17	482589.2872	7146717.053	3744.217371	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_41	482864.2109	7152026.82	3830.395652	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_89	484865.767	7142153.92	3867.910583	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_32	477055.2623	7138982.045	3928.40056	1935204
FW_Layout 27 R02 190607 Stage 3	3_41	478468.7281	7135365.224	3979.617828	1935204
FW_Layout 26 R04 190610 Stage 2	2_74	483604.8657	7145642.287	4206.019981	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_84	484464.0201	7143845.295	4220.99855	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_13	482784.4923	7148264.949	4254.559243	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_33	477096.7642	7137875.97	4304.901668	1935204
FW_Layout 26 R04 190610 Stage 2	2_52	483222.1841	7150460.904	4511.537574	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_87	485337.2652	7142828.854	4580.960864	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_46	485618.7748	7151222.859	4643.847963	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_71	484113.8714	7145775.604	4723.430896	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_82	485010.6558	7144100.513	4824.278202	Internal Confidential
FW_Layout 27 R02 190607 Stage 3	3_34	475653.9686	7137274.755	4922.805445	1924457 and 9995180
FW_Layout 26 R04 190610 Stage 2	2_48	485305.773	7150914.312	4951.228361	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_49	483830.043	7150812.901	5047.462806	1804792 & 1806595
FW_Layout 27 R02 190607 Stage 3	3_11	483722.5181	7149304.223	5104.136539	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_39	484494.8715	7150721.574	5141.061876	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_68	484115.6101	7146889.827	5198.823946	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_77	485311.6845	7144955.209	5459.494275	Internal Confidential

FW_Layout 26 R04 190610 Stage 2	2_85	485947.9403	7143726.479	5514.519661	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_66	484477.2353	7147827.752	5925.478537	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_70	485680.8251	7145914.25	6200.864064	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_69	485677.8252	7146744.018	6550.686602	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_62	485316.2584	7148439.175	6763.350678	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_58	485742.9821	7149074.689	6792.469085	1804792 & 1806595
FW_Layout 26 R04 190610 Stage 2	2_67	485968.047	7147224.552	7017.67371	Internal Confidential
FW_Layout 26 R04 190610 Stage 2	2_65	486285.9898	7147664	7492.33719	Internal Confidential

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