

Moreton Hill Wind Farm

Electromagnetic Interference Assessment

31 October 2023



Final

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Executive Summary

This report investigates the potential impacts of Electromagnetic Interference (EMI) caused by the proposed development and operation of Moreton Hill Wind farm (MHWF). The proposed wind farm consists of 62 Wind Turbine Generators (WTG) with a rotor diameter of 172 m, maximum and lower tip height of 252 m and 44 m respectively.

The assessment is carried out under the recommendation by the Victorian Planning Guidelines [1]. A number of different radiocommunication licences have been investigated such as radiocommunication towers, Point-to-Point (P2P), Point-to-Multipoint (P2MP), Point-to-Area (P2A), Radar, Radio and Television broadcasting and wireless internet. These forms were all recommended by the methodology outlined in the Draft National Wind Farm Development Guidelines [2].

The assessment has found that:

- A single radiocommunication tower was found within 2 km of the site boundary. One turbine (T17) may be susceptible for encroaching on the 2 km exclusion zone. Consultation will be undertaken at a later stage with the licence owner by a third-party consultant to determine any potential interferences.
- A total of eight P2P links were found crossing the site boundary. No turbine encroached the 2nd Fresnel exclusion zone with an additional 86 m blade overhang exclusion added. Consultation will also be undertaken for any P2P licence operators located within a radius specified by the third-party consultant.
- 110 P2MP sites were identified within 60 kms of MHWF. There is a low likelihood of interference and consultation by a third-party will be undertaken for any operator with identified potential EMI disturbances.
- A large number of P2A and radar services were found operating within 60 kms of the proposed site. There is a low likelihood for any of the services to be impacted. Consultation will be conducted by a third party consultant for any emergency services, Bureau of Meteorology, Department of Defence and any P2A services that have been identified to be potentially impacted.
- NBN wireless towers may potentially be impacted. Consultation and mitigation strategies are outlined in Section 2.1.9. Given the large number of options to mitigate the interference, the likelihood of the development and operation of MHWF affecting NBN towers is low.
- There are mitigation techniques available for all forms of potential EMI interference and therefore EMI is expected to be a manageable component of the development of MHWF.

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1 Project Overview

This report provides an assessment of the potential Electromagnetic Interference (EMI) impacts of the proposed Moreton Hill Wind Farm (MHWF).

1.1 Wind Farm Overview

MHWF is a proposed wind farm site in Southwest Victoria, located approximately 35 kms Southwest of Ballarat and is situated in the Local Government Areas (LGA) of Corangamite and Golden Plains. The proposed site will consist of 62 wind turbine generators (WTG) with a rotor diameter of 172 m, a maximum tip height of 252 m and a lower tip height of 44 m. A map of the project boundaries and turbine layout are shown in Figure 1 and Figure 2.

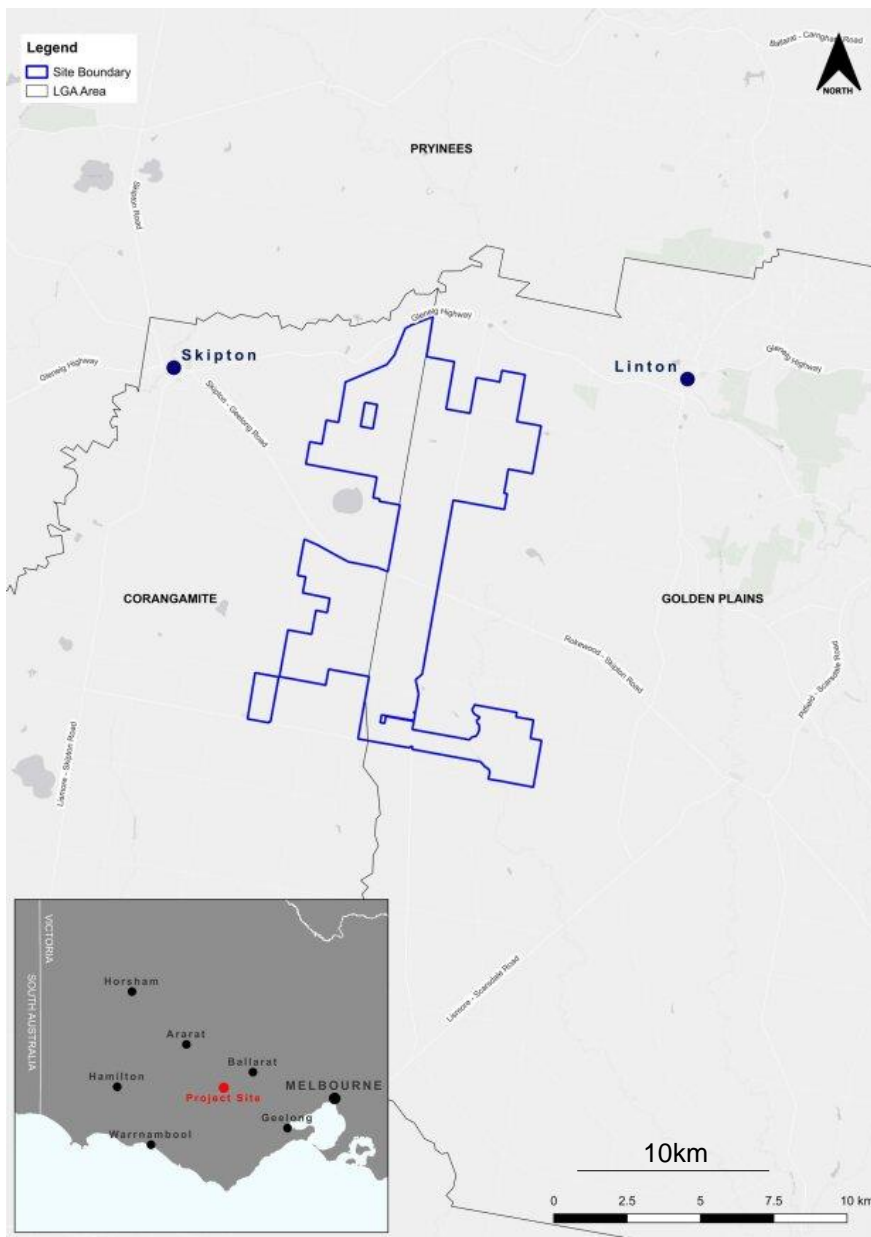


Figure 1.1: MHWF Site Area

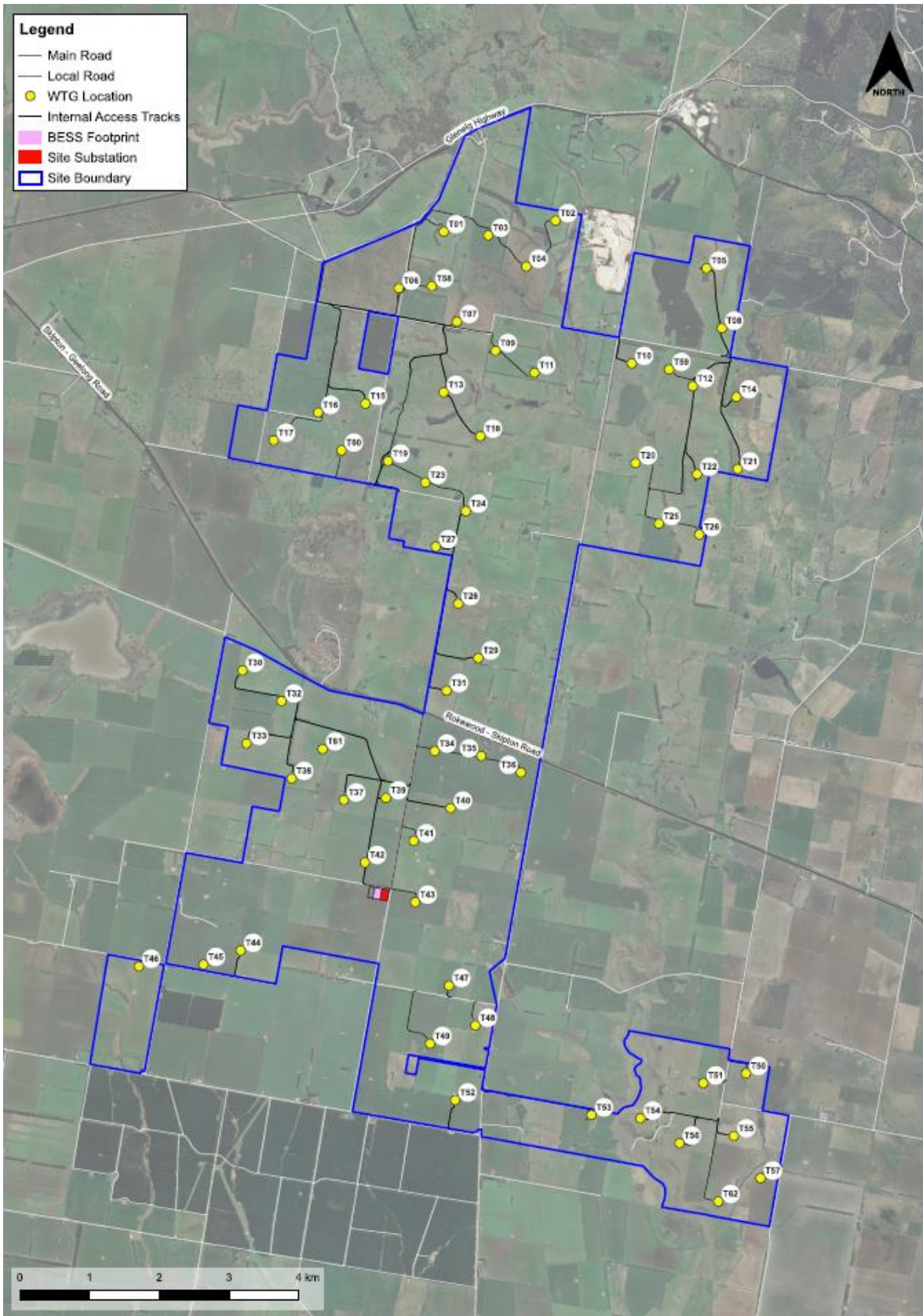


Figure 1.2: MHWF Project Boundary

2 Electromagnetic Interference

The Victorian Planning Guidelines [1] state that potential impacts arising from electromagnetic interference (EMI) must be accounted for when planning a wind farm. A range of radiocommunication forms are considered in typical EMI assessment. These range from radiocommunication towers, fixed point-to-point links, emergency services, mobile phone coverage and television reception.

There are four types of effects that a WTG can have on radio communication services. These include near field impact, obstruction impact, reflection and scattering impacts and electromagnetic fields/radio frequency interference. The interference of these types of effects are characterised by different methods outlined in the Draft National Wind Farm Development Guidelines [2] and will be discussed further in Section 2.1.

Consultation

Consultation is required per the Draft National Wind Farm Development Guidelines [2] and will be undertaken by a third party consultant for all licence operators and compulsory operators listed by the guidelines that are likely to be impacted.

Mitigation

There are multiple mitigation options available if any service is impacted by the development and operation of MHWF. Options are available for near field exclusion interference such as micrositing the turbines causing interference, upgrading the affected tower and relocation/rerouting of the transmission tower. For Point-to-Point interference, micrositing turbines is an option. If micrositing cannot rectify the issue, then upgrading the transmitter/receiver apparatus or increasing the frequency at which it operates to reduce the 2nd Fresnel Zones exclusion zone is another option. For Point-to-Area or Broadcasting, baseline testing can be conducted pre and post construction to validate any potential interferences. If any service has been found to be impacted, mitigation options exist such as installation of a higher gain antenna, changing the line-of-sight of the antenna or installing a signal amplifier.

2.1 EMI Methodology

As previously mentioned, the four types of potential impacts by a WTG are near field impact, obstruction impact, reflection and scattering impacts and electromagnetic fields/radio frequency interference.

Near field impact refers to a zone around a radiocommunication tower that will impact the service. Near field impacts are typically mitigated by having a 2 km exclusion zone around the radio communication tower. This is recommended for all towers within 1 km of the site boundary. The 2 km exclusion zone is recommended by '*Fixed-link wind-turbine exclusion zone method*' [3].

Obstruction impact refers to the path of a radio communication link being obstructed by an object that will allow the signal to be reflected. This form of impact can be mitigated using an exclusion zone recommended by '*Fixed-link wind-turbine exclusion zone method*' [3] which specifies a zone applied around the link that is equivalent to the 2nd Fresnel Zone. An additional exclusion zone is added to account for blade overhang, this value is typically the turbine blade length.

Reflection and scattering refer to radio waves that have been scattered due to a reflective object obstructing the wave. This assessment has not considered reflection and scattering as the modelling approach is complex and the recommended methodology to mitigate this form of impact requires signal performance that is not readily obtainable as each service is characterised differently. However, every client and licensee within 10 km of the site will be contacted as part of the consultation process outlined in Draft National Wind Farm Development Guidelines [2] to determine if their signals will be impacted and mitigation applied.

Electromagnetic fields/radio frequency interference refers to the impact of electromagnetic emissions from operation of WTGs, collector networks and substation. This is a highly regulated area and wind farm equipment is designed to international standards and it is therefore deemed to have negligible impacts on this assessment.

The ACMA Register of Radiocommunications Licenses (RRL) [4] (accessed 27/10/2023) was used to obtain the details of all licenses within 60 km of MHWF. The RRL databases changes as more communication forms are added and removed, therefore an updated assessment will be conducted by a third-party when the consultation process is undertaken.

2.1.1 Radiocommunication Towers

The ACMA RRL database returned a single radiocommunication tower within 2 km of MHWF. The details for the radiocommunication tower are shown in Table 2.1.

Table 2.1. Radiocommunication Towers within 2 km of MHWF

Site ID	Name	Latitude	Longitude
9023722	The Trustee for NICK SHADY FAMILY TURST (20020860)	-37.716604	143.403516

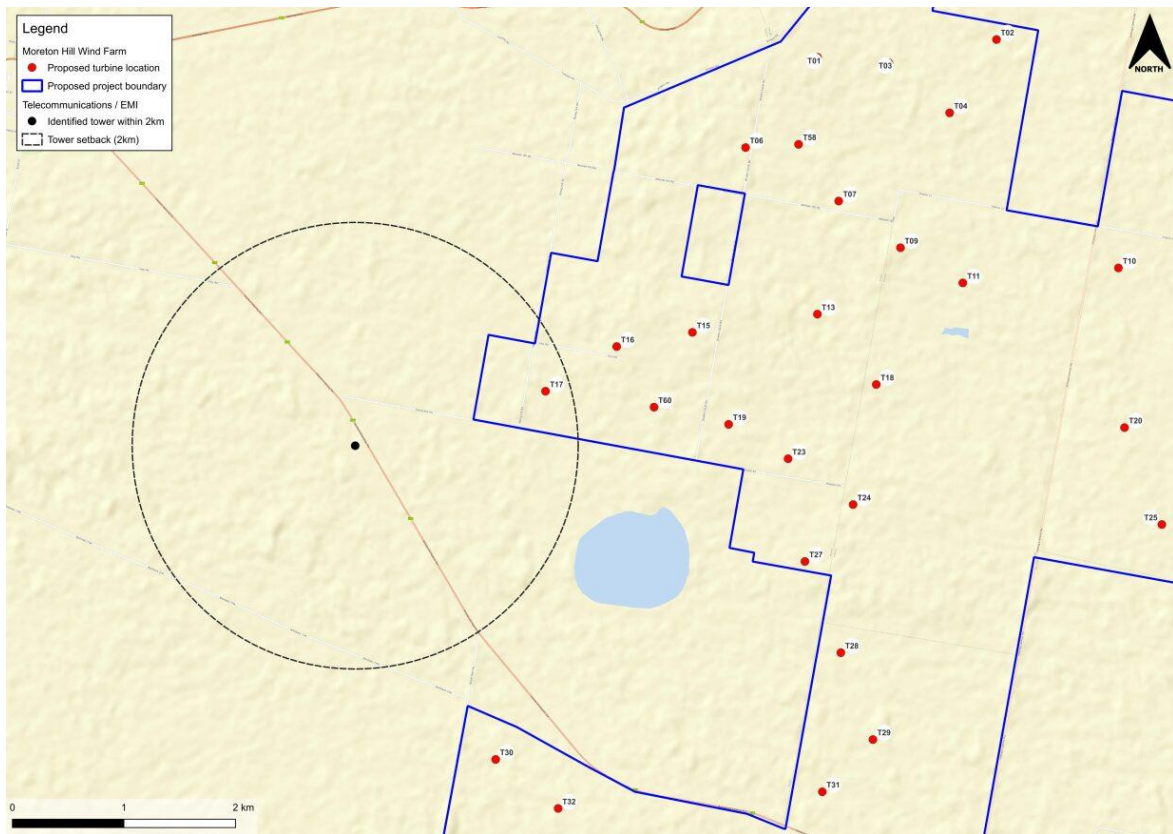


Figure 2.1: Radiocommunication Tower 9023722

It can be seen from Figure 2.1 that T17 is within a 2km radius from the radiocommunication tower. However, the likelihood of interference is low and consultation with the licensee owner will be undertaken to determine the potential impact. There are also many mitigation options available should T17 potentially impact the service.

2.1.2 Fixed Point-to-Point (P2P) links

There were eight P2P links identified that crossed the site boundary. The exclusion zone for P2P links is calculated using the 2nd Fresnel Zone as specified in the Draft National Wind Farm Development Guidelines

[2]. The details of these links are shown in Table 2.2 and a map with the links with the 2nd Fresnel Zone exclusion zone and 86 m blade overhang applied is shown in Figure 2.2.

Table 2.2. Point-to-point links across MHWF site boundary

Link Number	Site 1 ID	Site 2 ID	License Owner	Minimum Frequency [MHz]
1	204824	9004396	CENTRAL HIGHLANDS REGION WATER CORPORATION	404.525
2	204824	305345	Optus Mobile Pty Limited	11075
3	204824	305345		11075
4	204824	305447		10995
5	204824	305447		11075
6	204824	305447		11075
7	9026481	305790		Powercor Australia Ltd
8	9026481	48036	1442.5	

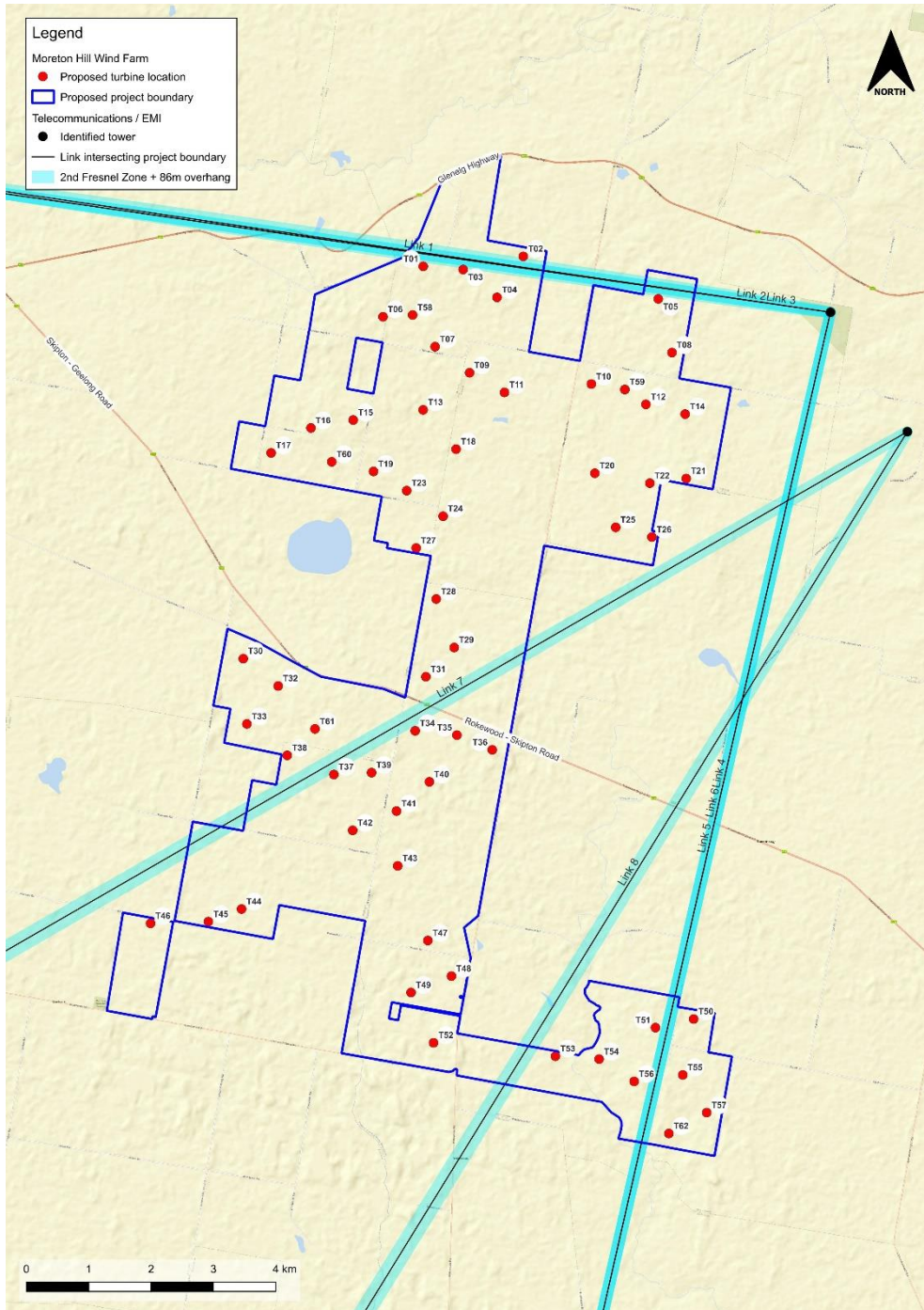


Figure 2.2: P2P links crossing MHWF site boundary

Link 1

Table 2.3 shows assignment ID and details assigned to Link 1. The lowest frequency across all assignment IDs was chosen as this provides the most conservative 2nd Fresnel Zones. Figure 2.3 shows links 1, 2 and 3 crossing the site boundary.

Table 2.3. Table showing Link 1 Assignments

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
204824	9004396	832976	413.975	CENTRAL HIGHLANDS
		832977	413.975	

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
		832978	404.525	REGION WATER CORPORATION
		832979	404.525	

Link 2

Table 2.5 shows assignment ID and details assigned to Link 2. The lowest frequency across all assignment IDs was chosen as this provides the most conservative 2nd Fresnel Zones. **Error! Reference source not found.** shows links 1, 2 and 3 crossing the site boundary.

Table 2.5. Table showing Link 3 Assignments

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
204824	305345	9292509	11565	Optus Mobile Pty Limited
		9292510	11565	
		9292511	11075	
		9292512	11075	

Link 3

Table 2.5 shows assignment ID and details assigned to Link 3. The lowest frequency across all assignment IDs was chosen as this provides the most conservative 2nd Fresnel Zones. **Error! Reference source not found.** shows links 1, 2 and 3 crossing the site boundary.

Table 2.5. Table showing Link 3 Assignments

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
204824	305345	9292509	11565	Optus Mobile Pty Limited
		9292510	11565	
		9292511	11075	
		9292512	11075	

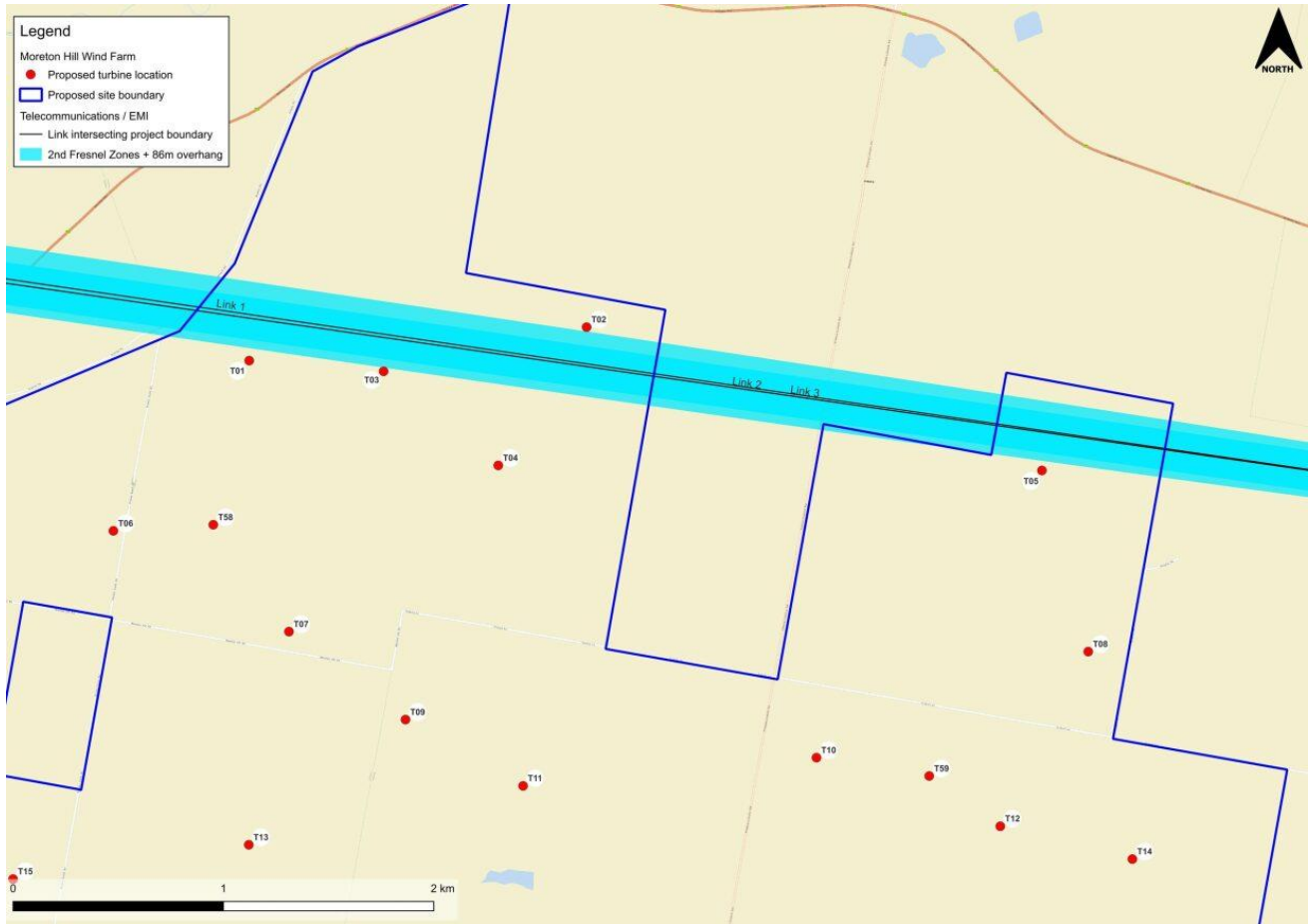


Figure 2.3: Link 1, 2 and 3 P2P shown crossing the site boundary

Link 4

Table 2.6 shows assignment ID and details assigned to Link 4. The lowest frequency across all assignment IDs was chosen as this provides the most conservative 2nd Fresnel Zones. Figure 2.4 shows links 4,5 and 6 crossing the site boundary.

Table 2.6. Table showing Link 4 Assignments

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
204824	305447	9262533	11485	Optus Mobile Pty Limited
		9262534	11485	
		9262535	10995	
		9262536	10995	

Link 5

Table 2.7 shows assignment ID and details assigned to Link 5. The lowest frequency across all assignment IDs was chosen as this provides the most conservative 2nd Fresnel Zones. Figure 2.5 shows links 4,5 and 6 crossing the site boundary.

Table 2.7. Table showing Link 5 Assignments

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
204824	305447	9463918	11565	

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
		9463919	11565	Optus Mobile Pty Limited
		9463920	11075	
		9463921	11075	

Link 6

Table 2.8 shows assignment ID and details assigned to Link 6. The lowest frequency across all assignment IDs was chosen as this provides the most conservative 2nd Fresnel Zones. Figure 2.4 shows links 4,5 and 6 crossing the site boundary.

Table 2.8. Table showing Link 6 Assignments

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
204824	305447	9463914	11565	Optus Mobile Pty Limited
		9463915	11565	
		9463916	11075	
		9463917	11075	

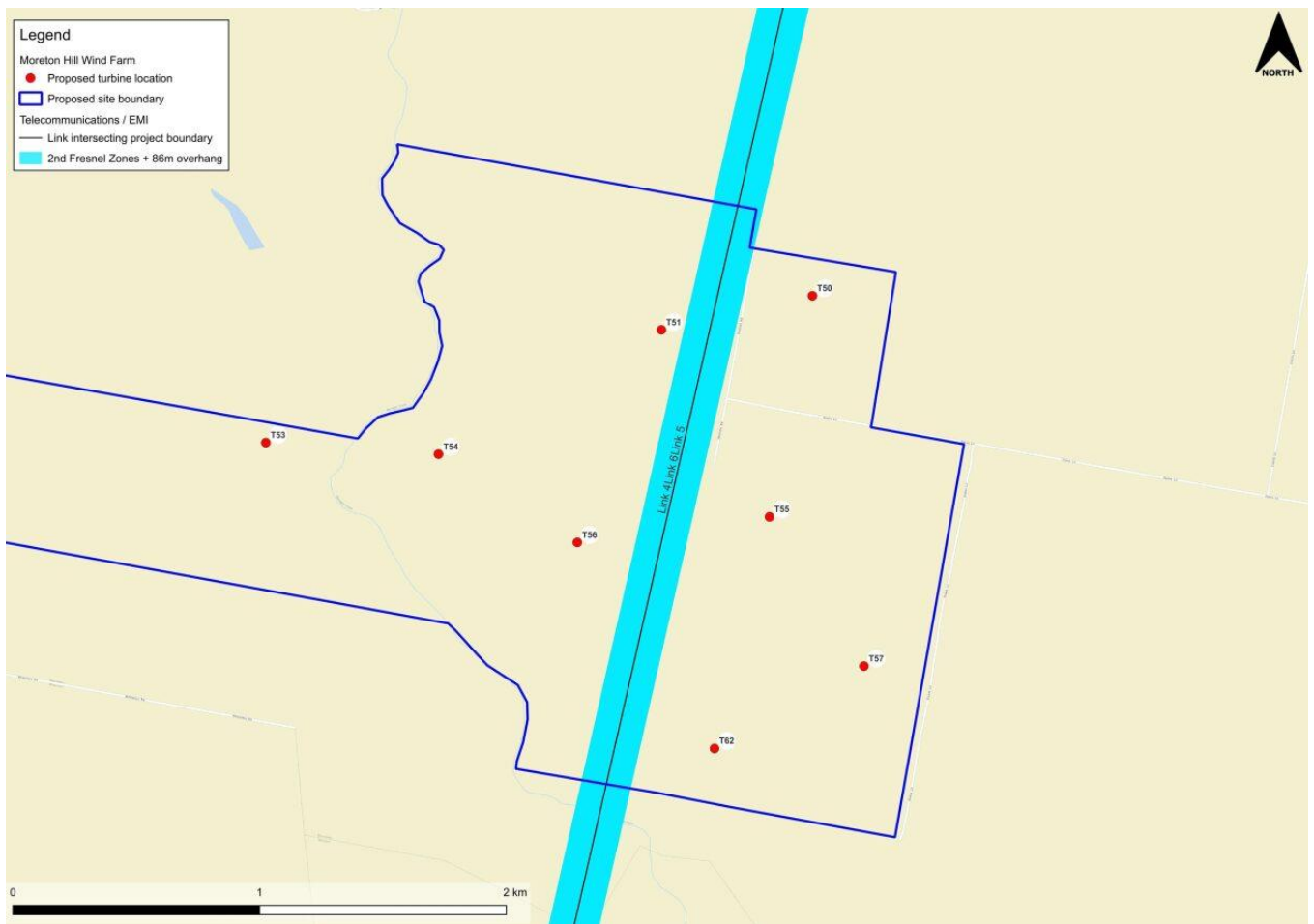


Figure 2.4: Link 4, 5, 6 shown crossing the site boundary

Link 7

Table 2.9 shows assignment ID and details assigned to Link 7. The lowest frequency across all assignment IDs was chosen as this provides the most conservative 2nd Fresnel Zones. Figure 2.5 shows the link crossing the site boundary.

Table 2.9. Table showing Link 7 Assignments

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
9026481	305790	1382076	1523	Powercor Australia Ltd
		1382077	1523	
		1382078	1430.5	
		1382079	1430.5	

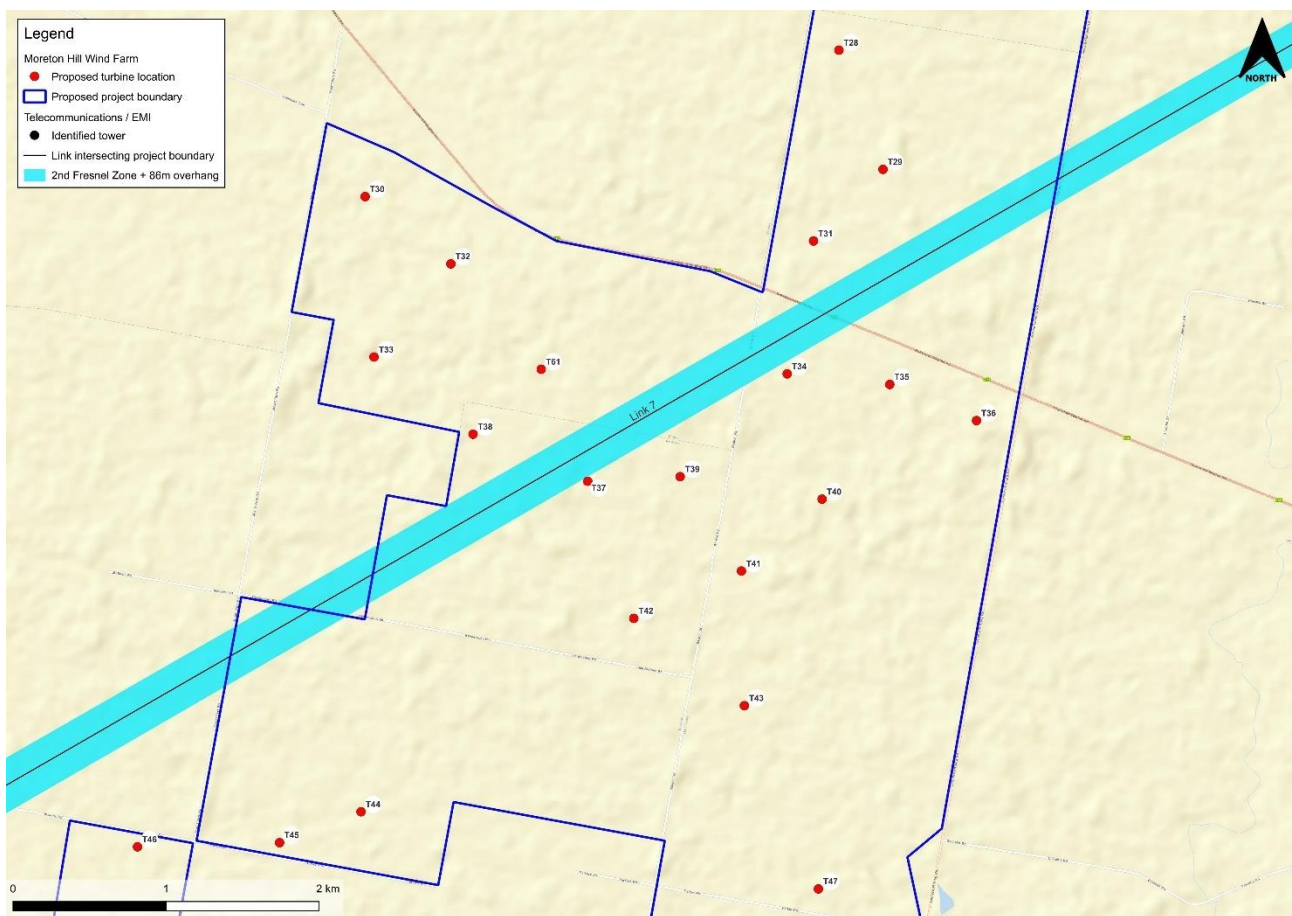


Figure 2.5: Link 7 shown crossing the site boundary

Link 8

Table 2.10 shows assignment ID and details assigned to Link 8. The lowest frequency across all assignment IDs was chosen as this provides the most conservative 2nd Fresnel Zones. Figure 2.6 shows the link crossing the site boundary.

Table 2.10. Table showing Link 8 Assignments

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
9026481	48036	4067327	1503	

Site 1 ID	Site 2 ID	Assignment ID	Frequency [MHz]	License Owner
		4067328	1503	Powercor Australia Ltd
		4067329	1442.5	
		4067330	1442.5	

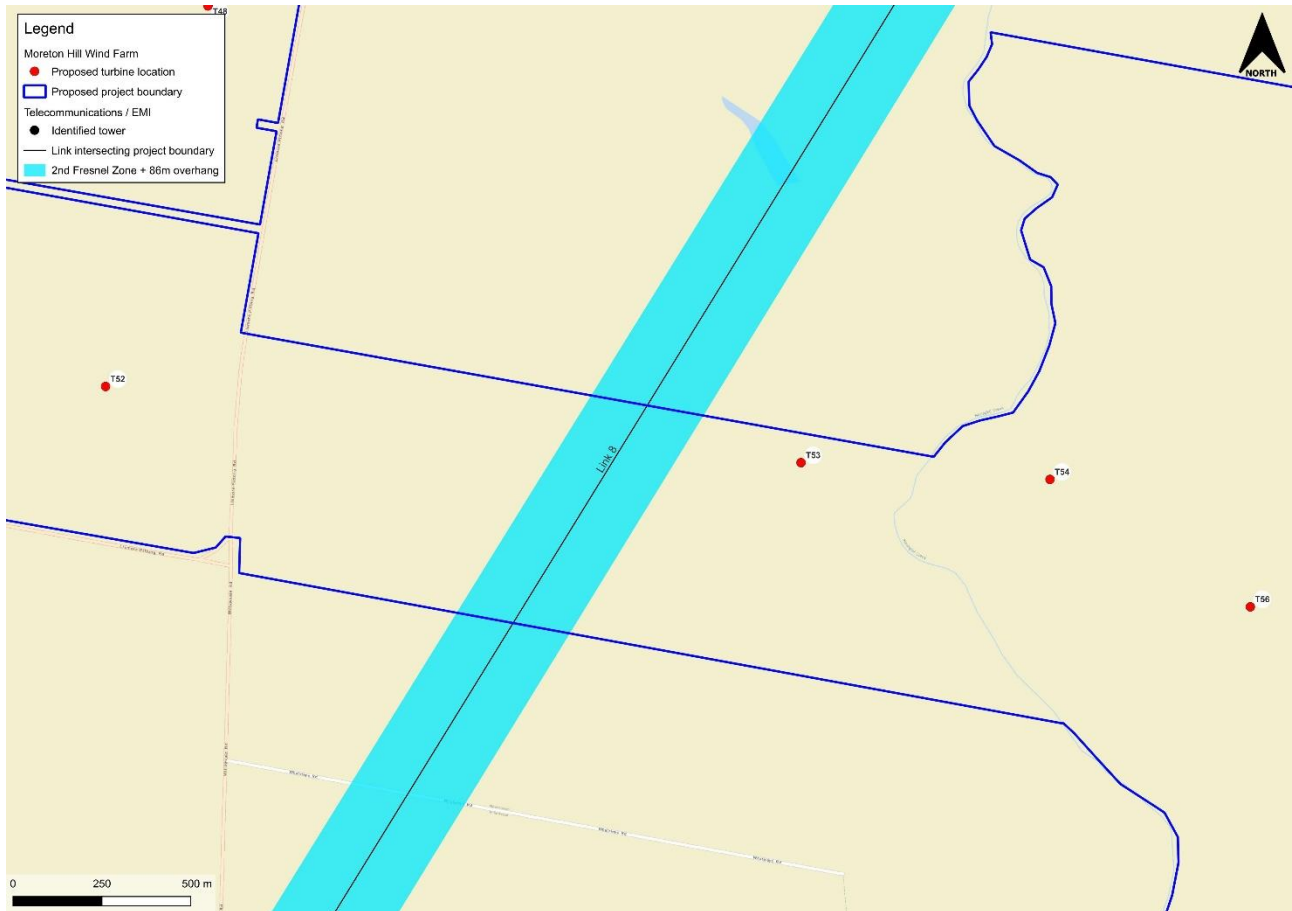


Figure 2.6: Link 8 shown crossing the site boundary

Taking into consideration the 2nd Fresnel zone and an 86 m blade overhang buffer there are no expected impact on Point-to-Point services operating over MHWF. As the project progresses, the license owners for each P2P link identified will be consulted to determine any potential impacts on their service as per the Draft National Wind Farm Development Guidelines[2].

2.1.3 Fixed Point-to-Multipoint (P2MP) links

From the ACMA RRL database, a total of 110 P2MP links were identified within 60 km of MHWF. Figure 2.8 below shows the 110 P2MP sites. P2MP links are affected in the same manner as P2P links, however, it is not possible to determine the radiocommunication pathways of P2MP without consultation. Consultation will be taken at a further date – the likelihood of impact from P2MP is low with many mitigation options available if any interference does occur.

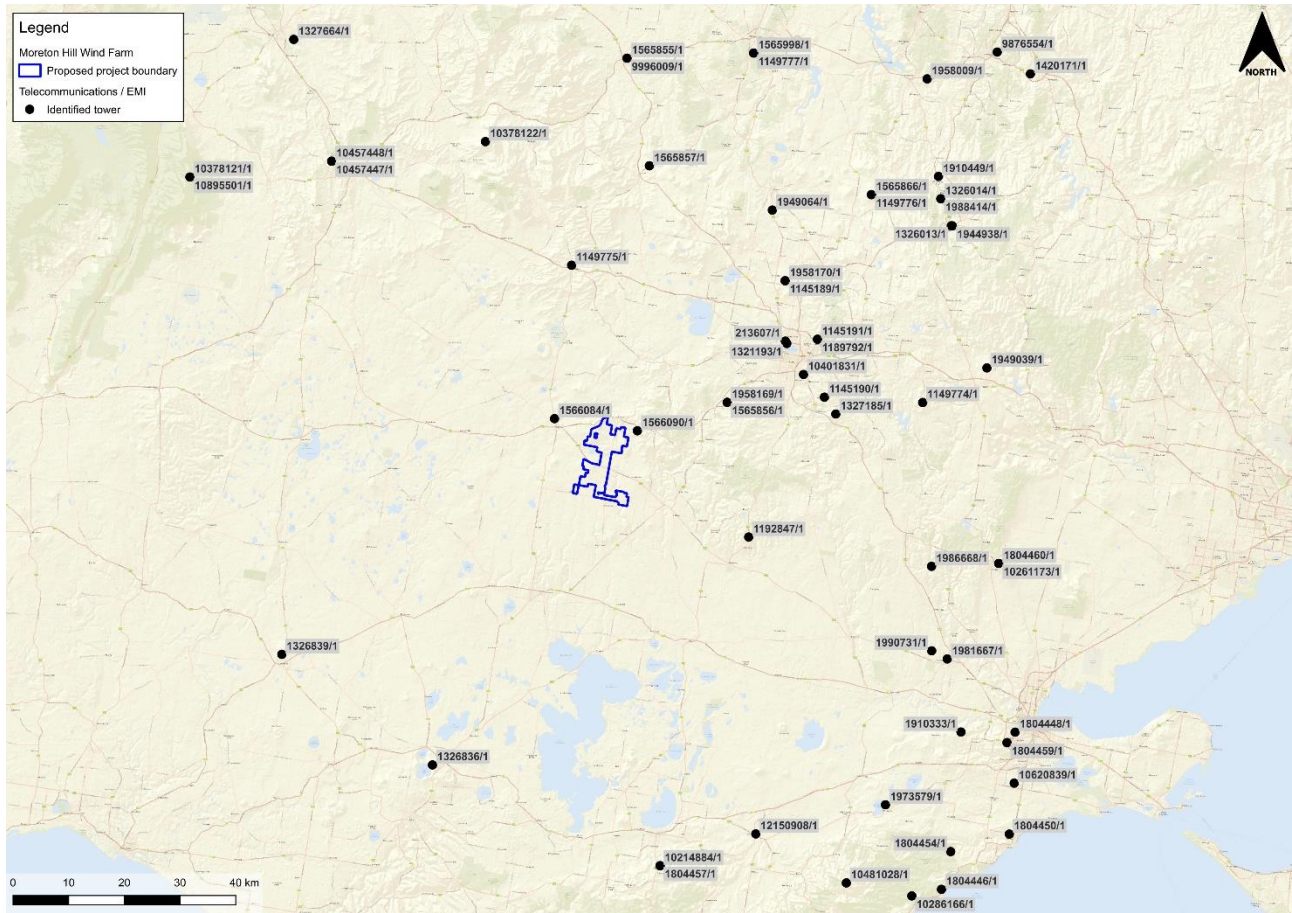


Figure 2.7: P2MP sites located within 60 km of MHWF

2.1.4 Miscellaneous RRL (P2A and Radar)

There are a number of licence types in the ACMA RRL database that are not P2P or 2MP. Table 2.11 below provides a summary of these types within 60 km of the site boundary.

Table 2.11 Miscellaneous RRL’s from ACMA Database within 60 km of the site boundary

Licence Category	Licence Type	Number of Assignments
1800 MHz Band	Spectrum	1462
2 GHz Band	Spectrum	1274
2.3 GHz Band	Spectrum	12649
2.5 GHz Band	Spectrum	700
26 GHz Band	Spectrum	6
3.4 GHz Band	Spectrum	15942
700 MHz Band	Spectrum	1547
800 MHz Band	Spectrum	854
Aeronautical Assigned System	Aeronautical	51
Amateur Beacon	Amateur	4
Amateur Repeater	Amateur	163
Ambulatory - Initial	Land Mobile	8
Ambulatory System	Land Mobile	136

Licence Category	Licence Type	Number of Assignments
AWL - FSS Only	Spectrum	130
AWL - Standard	Spectrum	48
CBRS Repeater	Land Mobile	8
Commercial Radio	Broadcasting	9
Commercial Television	Broadcasting	12
Community Broadcasting	Broadcasting	9
Land Mobile System - > 30MHz	Land Mobile	2170
Land Mobile System 0-30MHz	Land Mobile	262
Narrowband Area Service station(s)	Broadcasting	1
Narrowcasting Service (Fixed Tax)	Broadcasting	4
Narrowcasting Service (LPON)	Broadcasting	45
National Broadcasting	Broadcasting	13
Paging System - Exterior	Land Mobile	39
Paging System - Interior	Land Mobile	12
PMTS Class B	PTS	666
PMTS Class B (935-960 MHz)	PTS 900 MHz	644
Radiodetermination	Radiodetermination	2
Retransmission	Broadcasting	22

A number of the licence categories above can be characterised as Point-to-Area (P2A) and are not generally affected by the presence of a wind farm. The effects of MHWF for emergency services, radar systems, commercial phone reception, wireless internet, radio and TV broadcasting are investigated in the sections below. Figure 2.9 below shows a map of all the identified P2A and radar RRL's found within 60 km of the site.

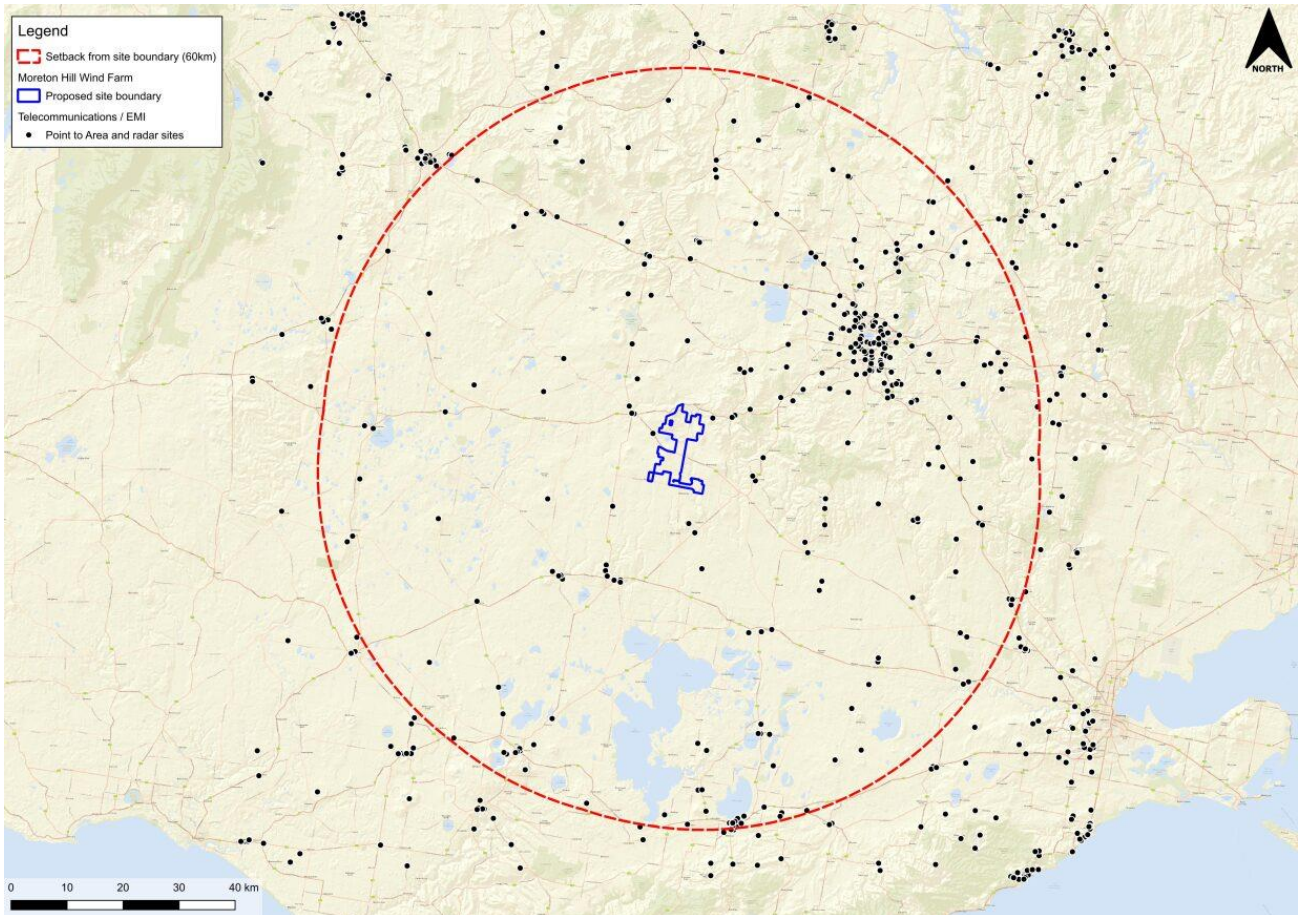


Figure 2.8: P2A and Radar RRL's within 60 km of MHWF

2.1.5 Emergency Services

Emergency services refers to licences operated by fire, police, rescue and ambulance services. They are typically P2P and mobile telephony licences. There are no P2P links crossing the site boundary and therefore no potential P2P impact on licences that are operated by emergency services. Mobile telephony licences that are being operated by emergency services are not likely not be impacted by the development of MHWF. Consultation will be undertaken to all licence holders within 60 kms to ensure there is no impact. In the case where there is impact, there are multiple mitigations available.

2.1.6 Aircraft Navigation Systems and Radar

An aviation impact statement will need to be completed to determine any potential impacts on aviation systems and radar. An Aviation Impact Assessment conducted by Aviation Projects has shown that the closest Air Traffic Control radar is 55 nm and is expected to not be impacted by the development and operation of MWHF. The report has also shown that the project is outside clearances zones for civil aviation navigation and communication facilities.

2.1.7 Meteorological Radar

Similar to Section 2.1.6, an assessment would need to be carried out by the Bureau of Meteorology to determine any potential impacts on their services. This is undertaken in the consultation process. There are a total of 15 identified weather stations within 250 nm of the project. Impacts on meteorological radars are typically manageable and can be mitigated, and so the likelihood of impact is low as there are plenty of methods to account for the impact.

2.1.8 Mobile Phones

Mobile phone networks are rarely impacted by the development and operation of a wind farm if there is adequate signal strength and signal coverage. The figures below show the coverage maps for Telstra [5], Optus [6], and Vodafone [7].

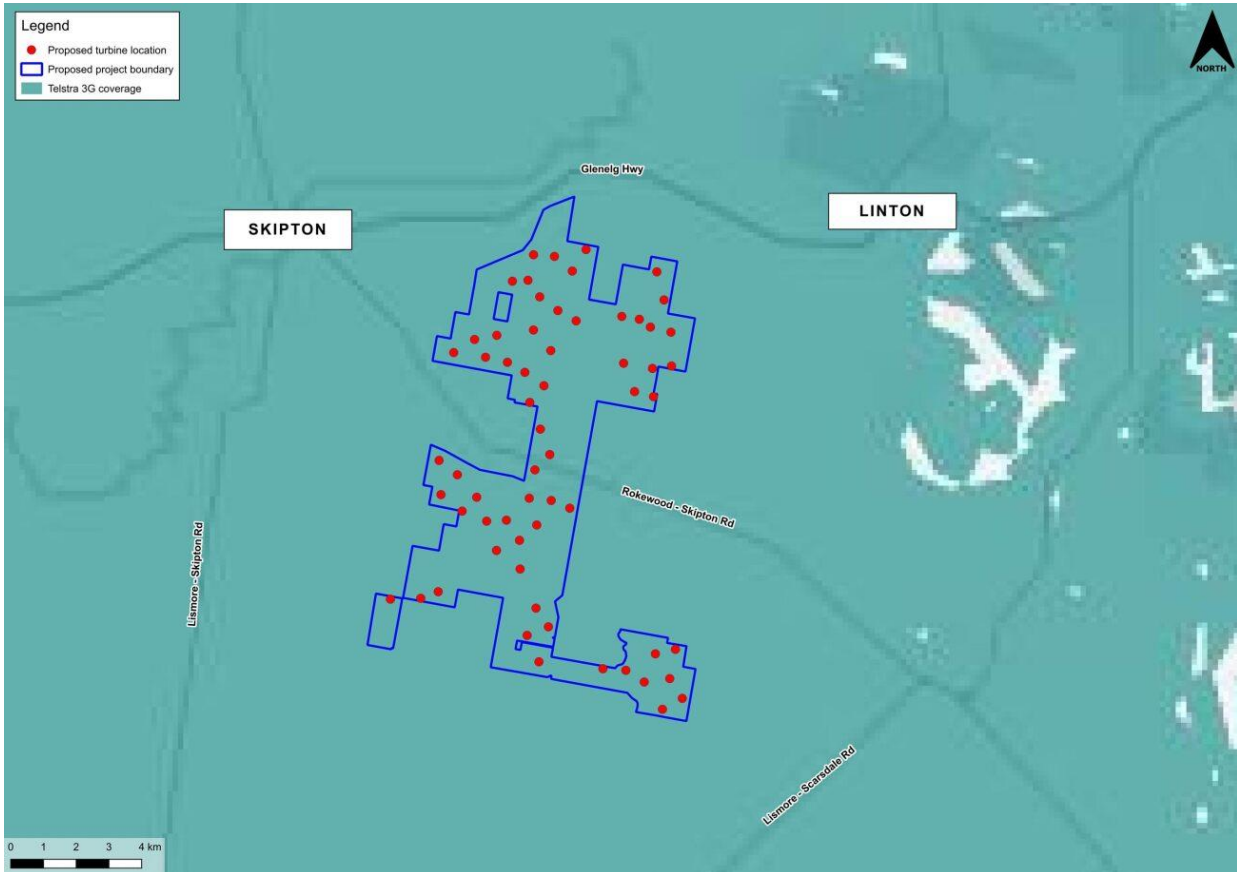


Figure 2.9: Telstra 3G Coverage across the proposed MHWF project

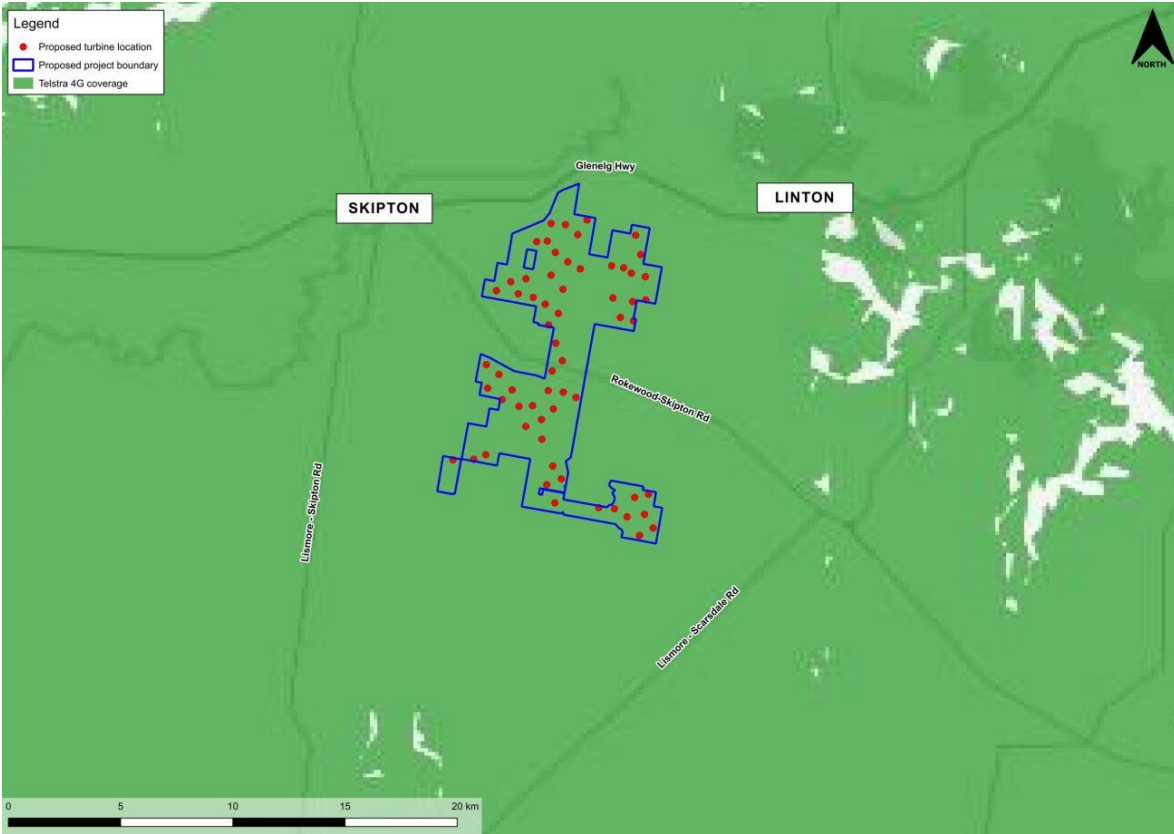


Figure 2.10: Telstra 4G Coverage across the proposed MHWF project

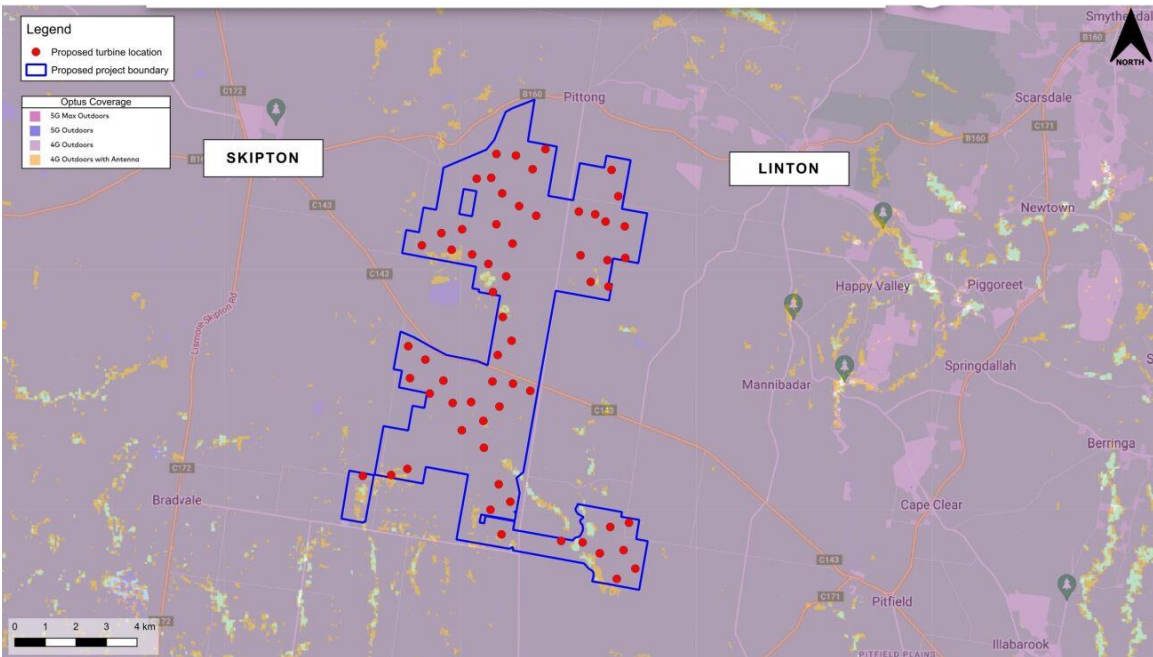


Figure 2.112: Optus 4G and 5G coverage across the proposed MHWF project

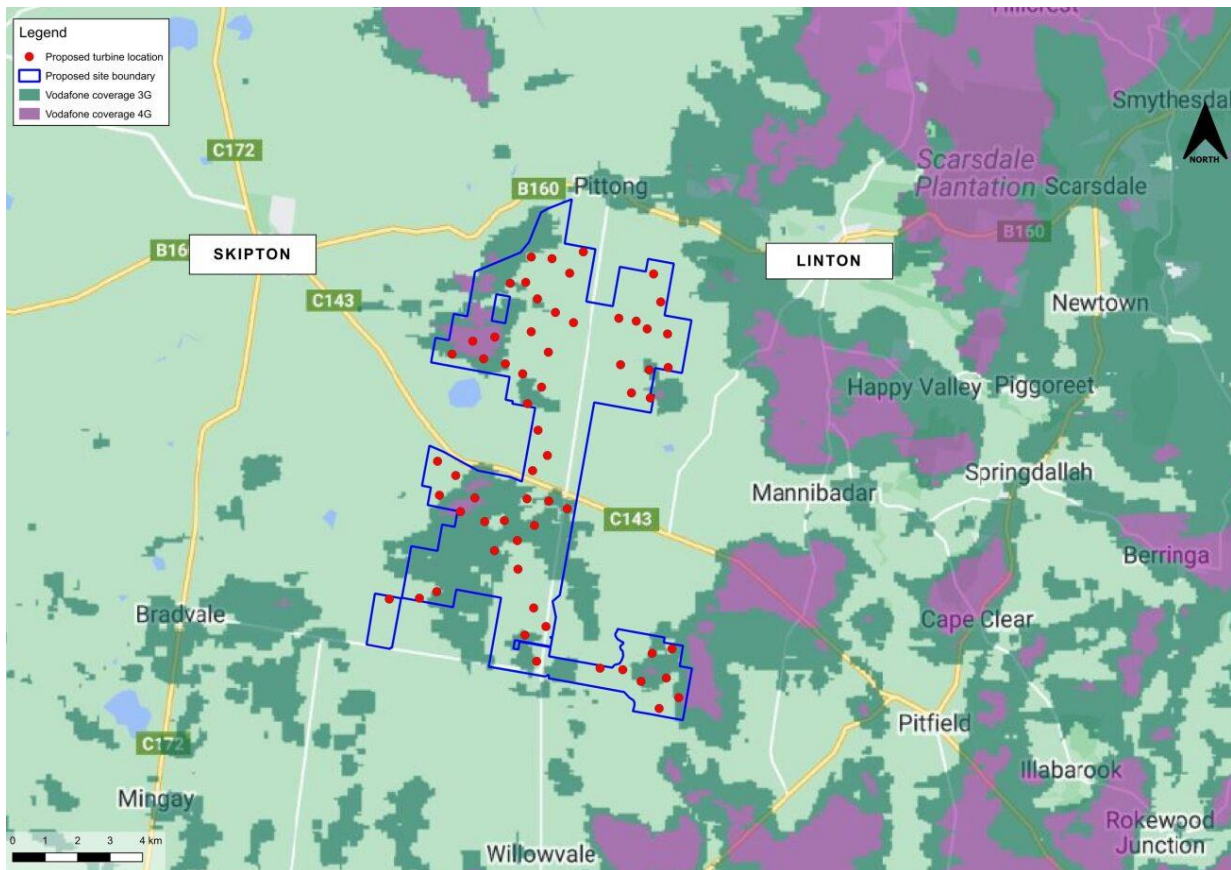


Figure 2.12: Vodafone 3G and 4G Coverage across the proposed MHWF project

It can be seen from Figures 2.10, Figure 2.11 and Figure 2.12 that Telstra and Optus have sufficient 3G and 4G availability across the site. There may be a need for external antennas in areas outside the project boundary for 3G and 4G services belonging to Optus. However, from Figure 2.13 it can be seen that there is limited coverage for Vodafone but this can be mitigated with external antennas. Consultation will be undertaken to with Optus, Telstra and Vodafone to determine potential impacts on their services. The likelihood of impacts resulting from the development of MHWF is very low.

2.1.9 Wireless Internet

Wireless internet in rural areas is predominately supplied by NBN or in some cases Starlink. Starlink satellite operates completely differently to NBN and is discussed in Section 2.1.10.

In rural areas, NBN does not always use fixed line for dwellings. Instead NBN uses a fixed wireless service. As this uses line-of-sight to connect receivers to the internet, there is potential for interference. The typical range for a NBN wireless transmitter tower is approximately 14 kms. There are 3 NBN towers that have the capacity to have their services impacted. These are Linton (Bute Scenic Reserve), Linton (Brooke St) and Cape Clear.

There may be potential disruptions to these services, there are multiple mitigation options available. For example, NBN are able to redirect the signal from another tower to a dwelling if a turbine is causing an interference or moving the antenna that receives the signal from the NBN tower to a different location within the dwelling and then connecting the antenna to the premise via cable. Micrositing can also be done to mitigate the impact as well as the installation of a new NBN tower.

2.1.10 Satellite Television and Internet

Satellites that orbit the Earth provide Satellite TV and internet to rural areas. Most of the services are intended for international audiences and therefore the proposed project is unlikely to have any impact on these services. Since the satellite service is line-of-sight transmission, there is a possibility that any dwellings using these services will be impacted.

Starlink internet connectivity requires a satellite dish that has no obstruction to the sky. All dwellings within the project except 2 derelict buildings are able to receive Starlink with no interference since the turbines that are being developed are below the horizon by an elevation angle of 25 degrees.

It is recommended that consultation with dwellings be undertaken pre-construction to determine if they are using these Satellite TV and internet services and if there are any disturbances. This is to aid in mitigation options if there is any interference post construction.

2.1.11 Radio Broadcasting

AM radio broadcasting is unlikely to be affected by the development of a wind farm. The only circumstance in which an AM radio broadcast will be impacted is if the signal is in close proximity of the turbine itself. In the case of MHWF, there are no AM radio broadcasts services in the vicinity of the project boundary.

FM radio broadcasting has the potential to be impacted by a WTG. The nearest FM radio broadcasting service is located 42 km away from MHWF and therefore is unlikely to cause any impact.

Therefore, there is no predicted potential impact on AM and FM radio broadcasting services with the development and operation of MHWF.

2.1.12 Television Broadcasting

Television broadcasting is typically not going to be impacted by a wind farm. An exclusion zone of 1 km is recommended around TV broadcasting transmitters. The closest transmitter is 36 km north from the site boundary and will not be impacted. Reflection or scattering may affect services however there is no scattering models that are readily available to assess any potential impacts. Consultation will be undertaken with BAI Communications to determine any potential impacts. In the case where there are any potential impacts, there are multiple options to mitigate the impacts and therefore the likelihood of impact is low.

3 Conclusion

Upon an assessment of the potential EMI that would be caused as a result of the development and operation of MHWF, the following have been found:

- A single radiocommunication tower was found within 2 km of the site boundary. One turbine (T17) may be susceptible for encroaching on the 2 km exclusion zone. Consultation will be undertaken at a later stage with the licence owner by a third-party consultant to determine any potential interferences.
- A total of eight P2P links were found crossing the site boundary. No turbine encroached the 2nd Fresnel exclusion zone with an additional 86 m blade overhang exclusion added. Consultation will also be undertaken for any P2P licence operators located within a radius specified by the third party consultant.
- 110 P2MP sites were identified within 60 kms of MHWF. There is a low likelihood of interference and consultation by a third-party will be undertaken for any operator with identified potential EMI disturbances.
- A large number of P2A and radar services were found operating within 60 kms of the proposed site. There is a low likelihood for any of the services to be impacted. Consultation will must be conducted by a third party for any emergency services, Bureau of Meteorology, Department of Defence and any P2A services that have been identified to be potentially impacted.
- NBN wireless towers may potentially be impacted. Consultation and mitigation strategies are outlined in Section 2.1.9. Given the large number of options to mitigate the interference, the likelihood of the development and operation of MHWF affecting NBN towers is low.
- There are mitigation techniques available for all forms of potential EMI interference and therefore EMI seems to be a manageable component of the development of MHWF.

4 References

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Appendix A MHWF Turbine Coordinates

Appendix A.1 Zone 54S

ID	Easting [m]	Southing [m]
T01	715995	5826389
T02	717599	5826548
T03	716634	5826338
T04	717179	5825891
T05	719764	5825867
T06	715349	5825580
T07	716184	5825101
T08	719984	5825006
T09	716738	5824683
T10	718692	5824502
T11	717297	5824368
T12	719566	5824176
T13	715993	5824088
T14	720194	5824020
T15	714872	5823925
T16	714193	5823798
T17	713555	5823398
T18	716521	5823458
T19	715197	5823101
T20	718747	5823072
T21	720212	5822987
T22	719629	5822913
T23	715730	5822793
T24	716313	5822383
T25	719082	5822204
T26	719661	5822049
T27	715881	5821873
T28	716203	5821056
T29	716491	5820278
T30	713108	5820100
T31	716037	5819810
T32	713668	5819661
T33	713166	5819053
T34	715865	5818943
T35	716535	5818874

ID	Easting [m]	Southings [m]
T36	717102	5818638
T37	714562	5818242
T38	713813	5818549
T39	715166	5818272
T40	716093	5818125
T41	715566	5817656
T42	714863	5817347
T43	715585	5816777
T44	713081	5816085
T45	712549	5815883
T46	711621	5815856
T47	716069	5815581
T48	716448	5815010
T49	715799	5814748
T50	720331	5814322
T51	719719	5814184
T52	716160	5813941
T53	718115	5813727
T54	718815	5813680
T55	720157	5813426
T56	719378	5813322
T57	720540	5812821
T58	715824	5825609
T59	719228	5824415
T60	714528	5823255
T61	714258	5818973
T62	719934	5812487

Squadron Energy is Australia's leading renewable energy company. Proudly Australian owned, our mission is to be a driving force in Australia's transition to a clean energy future by providing green power to our customers.

We develop, operate and own renewable energy assets in Australia, with 1.1 gigawatts (GW) of renewable energy in operation and a development pipeline of 20GW.

With proven experience and expertise across the project lifecycle, we work with local communities and our customers to lead the transition to Australia's clean energy future.

Squadron Energy acknowledges the Traditional Owners of Country throughout Australia. We pay our respects to Elders past, present, and emerging.

