GELLIONDALE WIND FARM

EMI Assessment

Synergy Wind Pty Ltd

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Project name:	Gelliondale Wind Farm	DNV Energy Systems
Report title:	EMI Assessment	Level 12, 350 Queen Street
Customer:	Synergy Wind Pty Ltd	Melbourne VIC 3000
	PO Box 146	Australia
	Ballarat Vic 3353	Tel: +61 3 8615 1515
Customer contact:	Adam Gray	ABN: 14 154 635 319
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Prepared by:	Verified by:	Approved by:
N Brammer Senior Engineer Project Development & Analytics	J Jobin Principal Engineer Project Development & Analytics	T Gilbert Principal Engineer, Head of Section Project Development & Analytics

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EXECUTIVE SUMMARY

DNV has been commissioned by Synergy Wind Pty Ltd ("Synergy" or "the Proponent") to independently assess potential electromagnetic interference (EMI) impacts associated with the development and operation of the proposed Gelliondale Wind Farm ("the Project") in southeast Victoria. The results of the EMI assessment are described in this document.

Background and methodology

DNV has assessed the potential EMI impacts for the Project in accordance with the Victorian Planning Guidelines [1] and Draft National Wind Farm Development Guidelines [2]. The methodology used in this study has been informed by these guidelines and various standard industry practices.

A Project layout consisting of 13 wind turbines with a rotor diameter of 164 m and tip height of 210 m has been considered. These dimensions represent the maximum overall tip height within the maximum rotor and tower hub height dimensions.

There are 233 identified dwellings within 5 km of the Project, 12 of which are host dwellings belonging to wind farm host landowners or landowners who have entered into a formal agreement with the Proponent.

Outcomes of the assessment

The results of the EMI assessment are summarised in the table at the end of this section.

Turbines at the Project may interfere with point-to-area style services such as mobile phone signals, radio broadcasting, and terrestrial television broadcasting, particularly in areas with poor or marginal signal coverage. Dwellings in the vicinity of the Project may experience interference to digital television broadcast signals from the Latrobe Valley broadcast transmitter, especially in areas to the immediate northwest, west, and southwest of the Project where dwellings may receive a reflected signal from a turbine that is stronger than the direct signal from the transmitter. If interference to these services is experienced, a range of options are available to rectify difficulties.

Interference is also possible for satellite television and internet signals, although the signals that are likely to be intercepted by turbines in the Project are from satellites that do not provide services designed for Australian audiences.

Since it is not possible to determine the potential EMI impacts on point-to-multipoint links, emergency services, meteorological radar, and wireless internet services without obtaining further information from the relevant operators, DNV has consulted with organisations operating services that may be impacted by the development and operation of the Project. All responses received to date have indicated that the Project is unlikely to have any material impact on these services.

Potential EMI impacts on other services considered in this assessment, including trigonometrical stations and CB radio, are not expected or are considered to be minor.

Summary of EMI assessment results for the proposed Project

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Radio-communication towers	2 towers within 2 km of proposed turbine locations, operated by: Optus Mobile Pty Ltd (Optus) Viasat Australia Pty Ltd (Viasat)	**Viasat:** no concerns raised **Optus:** no concerns raised in relation to mobile phone services, no response received in relation to point-to-point links	**Satellite services:** none **Mobile phone services:** see findings for mobile phones **Point-to-point links:** see findings for point-to-point links	**Satellite services:** none required **Mobile phone services:** as for mobile phones **Point-to-point links:** as for point-to-point links
Fixed point-to-point links	7 links crossing Project boundary, operated by: Optus No turbines in diffraction zones, 1 turbine in potential reflection/scattering zones, no turbines in potential near-field zones	No response received	Low likelihood of interference through reflection or scattering of signals	If required - reroute affected links, install additional towers, replace affected links with alternative technologies
Fixed point-to-multipoint links	120 assignments within 75 km of Project boundary No base stations within 20 km of Project boundary	No concerns raised	Potential for interference if link paths cross the Project near turbines	If required – reroute affected links, install additional towers, replace affected links with alternative technologies
Other licence types	**Point-to-area style communications:** see findings for emergency services, mobile phones, radio broadcasting, and television broadcasting	-	-	-
Emergency services	**Point-to-point links:** no links crossing boundary **Point-to-area style communications:** unlikely to be affected	No concerns raised	**Point-to-point links:** none **Point-to-area style communications:** unlikely to cause interference	**Point-to-point links:** none required **Point-to-area style communications:** if required – increase signal strength from affected tower or alternative towers, install signal repeater, install additional tower

Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Meteorological radar	Nearest radar: 70 km from Project	Impacts are expected to be manageable	Unlikely to cause significant interference	Notify the Bureau of Meteorology prior to any planned shutdown of the Project to allow calibration of systems, collaborate with the Bureau of Meteorology in the event of severe weather conditions
Trigonometrical stations	**Trigonometrical stations:** unlikely to be affected **Survey marks:** unlikely to be affected	No concerns raised – avoid physical disturbance of survey marks along the South Gippsland Highway	Unlikely to cause interference	None required
Citizen's band radio	Unlikely to be affected	Consultation not considered necessary	Unlikely to cause interference	None required
Mobile phones	Unlikely to be affected in areas with good coverage, may experience interference in areas with marginal coverage	**Vodafone:** no concerns raised **Optus:** impacts not expected to be unacceptable **Telstra:** no response received	Low likelihood of interference	If required – increase signal strength from affected tower or alternative towers, install additional tower
Wireless internet	**Wireless broadband service providers:** Aussie Broadband, Telstra, Optus, NBN Co **NBN:** available as a fixed wireless and satellite service	**Aussie Broadband:** no concerns raised **Optus:** impacts not expected to be unacceptable **NBN Co:** no concerns raised **-** details of any radiocommunication equipment for the Project should be provided when known **Telstra:** no response received	**Wireless broadband services**: see findings for mobile phones **NBN:** unlikely to cause interference	**Wireless broadband services:** as for mobile phones **NBN:** if required – redirect antennas at affected dwellings to alternative towers, change location of antenna, install new tower

Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Satellite television and internet	**Services intended for Australian audiences:** unlikely to be affected **Services intended for international audiences:** signals from 22 satellites intercepted at 15 dwellings	Consultation with operators not considered necessary	Unlikely to cause interference	If required – redirect satellite dish to alternative satellite, install larger or higher-quality satellite dish, change location or height of satellite dish
Radio broadcasting	**AM and FM signals:** may experience interference in close proximity to turbines **Digital radio signals:** Project is outside the intended coverage area	Consultation not considered necessary	**AM and FM signals:** low likelihood of interference **Digital radio signals:** none	**AM and FM signals:** if required – install higher-quality antenna at affected location **Digital radio signals:** none required
Television broadcasting	May experience interference in areas with poor or marginal reception **Latrobe Valley transmitter:** *'good' coverage across most of the Project, 'poor' to 'variable' coverage to the immediate northwest and to the west, southwest, and far north* 26 dwellings in potential interference zone, potential for dwellings in the immediate northwest, west, and southwest to receive a reflected signal that is stronger than the direct signal	Low risk of interference for up to 30 residents, high risk of interference for up to 9 residents – rectification of any interference is expected to form part of the Project	High likelihood of interference in areas to the immediate northwest, west, and southwest	If required – re-align antenna at affected dwelling to existing tower, re-direct antenna to alternative tower, install more directional or higher gain antenna, change location of antenna, install cable or satellite television, install relay transmitter

1 INTRODUCTION

Synergy Wind Pty Ltd ("Synergy" or "the Proponent") has commissioned DNV to independently assess the potential electromagnetic interference (EMI) related impacts associated with the proposed Gelliondale Wind Farm ("the Project") in southeast Victoria. The results of this work are reported here. This document has been prepared in accordance with DNV proposal L2C-224266-AUMEL-P-01 Issue A, dated 9 December 2021, and variation order L2C-224266-AUMEL-VO-01 Issue A, dated 24 August 2022, and is subject to the terms and conditions in those agreements.

In accordance with the Policy and Planning Guidelines for Development of Wind Energy Facilities in Victoria (Victorian Guidelines) prepared by the Department of Environment, Land, Water and Planning (DELWP) in November 2021 [1] and the National Wind Farm Development Guidelines – Draft (Draft National Guidelines) prepared by the Environment Protection and Heritage Council (EPHC) in July 2010 [2], this assessment investigates the potential EMI impact of the Project on:

- fixed point-to-point links
- fixed point-to-multipoint links
- radiocommunication assets belonging to emergency services
- meteorological radars
- trigonometrical stations
- Citizen's band (CB) radio and mobile phones
- wireless internet
- satellite television and internet
- broadcast radio and television.

"Radiocommunications" is used as a broad term in this report to encompass all services that rely on microwave or radio frequency electromagnetic waves to transfer information, including those listed above.

2 DESCRIPTION OF THE SITE AND PROJECT

2.1 The site

The Project site is located in the South Gippsland region of Victoria, approximately 7 km southwest of Yarram, 3 km west of Alberton, and 8 km east of Welshpool. The terrain within and surrounding the Project site is relatively flat, and consists mostly of farmland.

The operating Toora Wind Farm is located approximately 15 km to the west of the Project site. The potential cumulative impacts of the Project in conjunction with the Toora Wind Farm have not been considered in this assessment. However, DNV notes that, given the distance between the two wind farms, cumulative impacts to nearby radiocommunication services are likely to be minimal.

2.2 The Project

2.2.1 Proposed wind farm layout

The Project is proposed to consist of 13 wind turbines [3]. A map of the site with the proposed turbine layout is shown in Figure 1, and the coordinates of the proposed turbine locations are presented in Table 7.

2.2.2 Dwelling locations

The locations of dwellings in the vicinity of the Project have been provided by the Proponent [4].

For the purposes of this assessment, DNV has evaluated the potential for EMI-related impacts at identified dwellings within 5 km of the Project boundary. There are 233 dwellings located within 5 km of the Project boundary, 12 of which are host dwellings belonging to wind farm host landowners or landowners who have entered into a formal agreement with the Proponent. The remaining dwellings are neighbour dwellings. The coordinates of these dwellings are presented in Table 8, and the dwellings and Project boundary considered in this assessment are shown in Figure 1.

DNV has not carried out a detailed and comprehensive survey of building locations in the area and is relying on information provided by the Proponent. For the purposes of this assessment, DNV has assumed that all listed dwellings are inhabited.

3 REGULATORY REQUIREMENTS

There are two sets of guidelines that are potentially relevant to the assessment of EMI impacts for wind farms in Victoria.

The Victorian Guidelines [1] state that "*a wind energy facility can affect the amenity of the surrounding area due to … electromagnetic interference*" and that "*[t]he potential for electromagnetic interference from the generation of electricity from a wind energy facility should be minimised, if not eliminated, through appropriate turbine design and siting*".

Although the Victorian Guidelines state that "*potential electromagnetic interference effects can be calculated from information about affected telecommunications transmitting or receiving stations, local conditions, [and] turbine design and location"* they do not provide detailed methodologies for these assessments.

The EPHC, in conjunction with Local Governments and the Planning Ministers' Council released a draft version of the National Wind Farm Development Guidelines in July 2010 (Draft National Guidelines) [2]. The Draft National Guidelines cover a range of issues across the different stages of wind farm development.

In relation to EMI, the Draft National Guidelines provide advice and methodologies to identify likely affected parties, assess EMI impacts, consult with affected parties and develop mitigation steps to address the likely EMI impacts.

DNV considers that the recommendations of the Draft National Guidelines meet, if not exceed, the recommendations of the Victorian Guidelines. Therefore, the Draft National Guidelines have been used to inform the methodology adopted for this assessment.

4 EMI CAUSED BY THE PHYSICAL PRESENCE OF WIND TURBINES

4.1 Assessment approach

If not properly designed, wind farms have the potential to interfere with radiocommunication services. Two services that are most likely to be affected are television broadcast signals and fixed point-to-point signals. Terrestrial broadcast signals are commonly used to transmit domestic television, while point-to-point links are used for line-of-sight connections for data, voice, and video. The interference mechanisms are different for each of these and, hence, there are different ways to avoid interference.

The Proponent has asked DNV to complete this assessment based upon a layout provided for the Project consisting of 13 wind turbines, as outlined in Table 7.

For the purpose of the EMI assessment, a hypothetical turbine with a rotor diameter of 164 m and a tip height of 210 m has been considered. These dimensions represent the maximum tip height and rotor diameter under consideration for the Project. The results generated based on this turbine configuration will be conservative for all turbine configurations with dimensions that remain inside the turbine envelope by satisfying all of the following criteria:

- a rotor diameter of 164 m or less
- an upper tip height of 210 m or less.

The Draft National Guidelines recommend that a radial distance of 50 km to 60 km from the centre of a wind farm would normally capture all of the potentially affected services in the area. However, the methodology for assessing the potential radiocommunications interference used in this assessment is to locate all of the radiocommunication towers within approximately 75 km of the proposed Project, and then assess the radiocommunication licences attached to these towers. This reduces the likelihood that radiocommunication links crossing the Project are inadvertently excluded from the assessment.

To conduct the EMI assessment, information regarding radiocommunications licences in the vicinity of the Project was obtained from a copy of the Australian Communications and Media Authority (ACMA) Register of Radiocommunications Licences (RRL) database dated 1 September 2022 [5].

Other services with the potential to experience interference from the Project have also been identified, and the potential for interference to those services assessed. These services include meteorological radars, trigonometrical stations, CB radio and mobile phones, wireless internet, broadcast radio, satellite television and internet, and broadcast television.

The Draft National Guidelines recommend that consultation with the relevant operator be undertaken if a turbine is located within 2 km of a radiocommunication site, within the second Fresnel zone of a point-to-point link, or within 250 nautical miles of an aeronautical or meteorological radar site. DNV has consulted with organisations operating services that may be impacted by the development and operation of the Project, to disseminate basic information on the Project and request responses from the organisations regarding whether they foresee any potential EMI-related impacts on their operations and services. The organisations that have been contacted and all responses received to date are summarised in Table 17.

The radiocommunication licences and services with potential to experience EMI-related impacts from the proposed Project are considered in the following sections. Each section contains a brief overview of the relevant technology, followed by an assessment of the identified licences and

services in the area around the Project and the expected potential for interference. Details of any feedback obtained from the service operators and potential mitigation options are also included where appropriate.

4.2 Radiocommunication towers

Wind turbines located close to radiocommunication sites have the potential to cause interference through near-field effects or reflection or scattering of the signals. According to the Draft National Guidelines [2], the near-field zone for a transmission tower can vary from several metres to approximately 720 m depending on the service type. The Draft National Guidelines therefore recommend that any radiocommunication site within 1 km of a proposed turbine location be considered as having the potential to be impacted by near-field effects. The potential for a turbine to cause reflection or scattering of signals also depends on a number of factors, including the service type, the required signal-to-noise ratio for the service, and the distances between the user, transmission tower, and turbine. Since there is no single criterion for potential impact on radiocommunication services due to near-field effects and reflection or scattering, the Draft National Guidelines recommend consulting with the service operator if any turbine is to be located within 2 km of a radiocommunication site.

4.2.1 Locations of radiocommunication towers and potential for interference

From the ACMA RRL database, there are 707 radiocommunication towers within a nominal 75 km of the Project boundary. The locations of these radiocommunication towers relative to the Project are shown in Figure 2.

There are two radiocommunication towers located within 2 km of the proposed turbine locations. These towers and the consultation zones recommended by the Draft National Guidelines [2] are shown in Figure 3. Each consultation zone includes the rotor radius for turbines with a 164 m rotor diameter, and an additional buffer of to account for potential inaccuracies in the tower locations given in the ACMA RRL database.

Details of the licences associated with these radiocommunication towers are given in Table 1**.** These licences and services include point-to-point links, point-to-area style licences used for commercial public mobile phone networks, and area-wide fixed satellite service licences used to transmit and receive signals via a network of satellites.

Table 1 Details of radiocommunication towers located within 2 km of turbines at the proposed Project

Site ID	Operator	Licence/service types	Distance to nearest turbine [m]
305900	Optus Mobile Pty Limited (Optus)	Point-to-point links Point-to-area (mobile phone)	1330
10024546	Viasat Australia Pty Ltd (Viasat)	Area-wide fixed satellite service	1118

The potential for the Project to interfere with point-to-point links through reflection or scattering of signals or near-field effects is discussed further in Section 4.3. For the point-to-point links associated with the radiocommunication towers shown in Table 1, DNV has established potential reflection/scattering and near-field interference zones as described in Sections 4.3.1.2 and 4.3.1.3.

Based on these interference zones, it is not expected that the Project will caused interference to the point-to-point links through near-field effects. However, there may be potential for the Project to cause interference to the point-to-point links through reflection or scattering of the signals.

Point-to-area style radiocommunications such as mobile phone signals are typically designed to operate in a range of environments and are generally not affected by the presence of turbines any more than other effects such as terrain, vegetation, and other forms of signal obstruction. However, interference caused by reflection or scattering of signals or near-field effects can be a problem if the turbines are located close to the transmission tower. Previous advice received from mobile phone network operators in Australia has suggested that clearances of between 500 m and 1000 m from their towers may be required to avoid the potential for impacts to mobile phone signals. Given the distance of the proposed wind turbine locations from the mobile phone tower shown in Table 1, it is not expected that the Project will interfere with the associated signals through reflection, scattering, or near field effects.

Fixed satellite services involve the transmission of signals between two or more fixed locations via a geostationary satellite. These satellites orbit the earth directly above the equator at a speed that matches the rotation of the earth, and so each satellite remains at the same point in the sky relative to an observer at a fixed location. For fixed satellite services operated in Australia, the signal paths between the ground-based stations and the corresponding satellites will be directed away from the earth's surface towards the north. Therefore, although satellite signals can be intercepted by structures such as wind turbines, interference is only likely to be a problem if the obstructions are located close to the ground station on the northern side. Given that there are no proposed wind turbine locations to the north of the fixed satellite service tower shown in Table 1, it is not expected that turbines at the Project will obstruct the signals to or from this tower.

4.2.2 Stakeholder consultation and responses

DNV has contacted the operators of the services associated with the towers shown in Table 1 to determine the likelihood that the proposed Project will cause interference to their services through near-field effects or reflection or scattering of signals.

The response received from Optus indicates that they do not expect the Project to cause material impacts to their mobile phone services provided from the tower shown in Table 1. No response has been received from Optus in relation to their point-to-point links to date.

The response received from Viasat indicates that they do not expect the Project to impact on their services. However, Viasat have asked to be advised if the proposed turbine locations change or there are new turbines proposed for the Project, particularly if those changes result in turbines being placed the north of the tower shown in Table 1.

4.3 Fixed licences of point-to-point type

Point-to-point links are often used for line-of-sight connections for data, voice, and video. Such links often exist on mobile phone and television broadcast towers. The frequency of common microwave signals varies from approximately 1 GHz to 30 GHz.

Wind turbines can potentially cause interference to point-to-point microwave links and, in some cases, point-to-point ultra high frequency (UHF) links through three mechanisms: diffraction of the signal, reflection or scattering of the signal, and near-field effects. It is generally possible to design

around these issues as the link paths and potential interference zones for these signals can be determined.

4.3.1 Locations of point-to-point links and potential for interference

DNV has analysed the registered licences for each radiocommunication tower according to the ACMA RRL database to determine the transmission paths of the licenced links. For this analysis, DNV has used a wider and more conservative frequency range of 0 GHz to 50 GHz.

Each individual link was given a unique identifier or "Assignment ID" so that it could be readily distinguished. This Assignment ID was taken as either the Device Registration ID (for spectrum licences associated with the use of certain frequency band within a particular geographic area) or the EFL ID (for apparatus licences associated with the use of a particular device).

The links paths associated with the analysed towers are shown in Figure 4. It can be seen that not all of the identified transmission towers have a fixed licence of point-to-point type transmission vector. Some towers have no active licences associated with them, and some towers are used solely for point-to-area style transmissions, such as some emergency services towers.

There are seven point-to-point links recorded in the ACMA RRL database that pass over the proposed Project boundary, operated by Optus. The details of the links are provided in Table 9, and the link paths are shown in greater detail in Figure 5.

The potential interference mechanisms and interference zones established by DNV for these links are described in Sections 4.3.1.1, 4.3.1.2, and 4.3.1.3, and summarised in Section 4.3.1.4. Feedback obtained from the operators of the links, including their recommended clearance zones to reduce the potential for interference, is summarised in Section 4.3.2.

4.3.1.1 Interference caused by diffraction

The potential for interference to a fixed point-to-point link through diffraction or obstruction of the signal can usually be avoided by keeping clear of an exclusion zone of circular cross-section around the link path from the transmitter to the receiver [2, 6, 7], typically defined in terms of the Fresnel zones for the link. The *n*th Fresnel zone is comprised of all points for which, if the signal travelled in a straight line from the transmitter to the point and then to the receiver, the additional length compared to the straight transmitter-receiver path equals $\frac{n-\lambda}{2}$, where λ = wavelength.

The radius of the *n*th Fresnel zone varies along the length of the signal, and is given by:

$$R_{Fn} = \sqrt{\frac{n\lambda d_1 d_2}{D}}$$

where d_1 is the distance from the transmitter
d_2 is the distance from the receiver
D is the distance from the transmitter to receiver, such that $d_1+d_2 = D$

To avoid interference to point-to-point links caused by signal diffraction, wind turbines, including the blades, should be kept outside of an exclusion zone based on either the second Fresnel zone as recommended in [6], or potentially 60% of the first Fresnel zone for links below 1,000 MHz with a clear line of sight as suggested in [8] (although DNV understands that this zone is under review by the authors of that document). For each of the links crossing the proposed Project boundary, DNV has established a diffraction exclusion zone based on the second Fresnel zone for that link.

It is common practice to have multiple Assignment IDs for the same physical link to cover practicalities such as licensing for sending or receiving signals. Accordingly, the second Fresnel zone for each link has been calculated based on the Assignment ID with the lowest frequency.

The potential diffraction exclusion zones in the horizontal plane are shown in Figure 5. Each exclusion zone includes the rotor radius for turbines with a 164 m rotor diameter, and an additional buffer of 25 m on either side to account for potential inaccuracies in the tower locations given in the ACMA RRL database.

DNV has also assessed the potential for the turbine blades to intersect with the diffraction exclusion zone for each point-to-point link in the vertical plane. This was achieved by examining the elevation and antenna heights at the end of each link, as well as the approximate elevation of areas within the Project boundary over which the link crosses.

The results of this analysis are summarised in Table 2.

There are no turbines located within the diffraction exclusion zones for any of the point-to-point links passing over proposed Project site. Therefore, it is not expected that the Project will cause interference to the point-to-point links through diffraction of the signals.

4.3.1.2 Interference caused by reflection or scattering

Interference due to reflection or scattering of a fixed point-to-point link can occur when the signal produced by the transmitting antenna is reflected, scattered, or re-radiated by an intervening object into the corresponding receiver antenna. If the reflected or scattered signal is sufficiently strong that the ratio of the direct signal to the indirect signal is lower than the required carrier-to-interference (C/I) ratio, or protection ratio, for the link, the link performance can be degraded. The extent to which an object such as a wind turbine will reflect or scatter electromagnetic waves is characterised by its radar cross section (RCS) [6].

Reference [6] describes a methodology for calculating the C/I ratio that might be expected at a receiver in the presence of a reflected or scattered signal from a wind turbine at a specified location. By evaluating the C/I ratio for incremental changes in the distances between the transmitter, receiver, and wind turbine, and comparing this to the required C/I ratio, a potential interference zone can be defined.

For each of the identified links with a transmission tower near the proposed turbine locations, DNV has established a reflection/scattering interference zone based on the antenna gains and length of the link, the worst-case RCS for the turbine calculated according to the equation proposed in [9], and an assumed minimum C/I ratio of 20 dB [9]. The radiation patterns for the antennas were approximated using the reference radiation patterns given in the International Telecommunication Union (ITU) Recommendation F.699-8 [10].

The potential reflection/scattering interference zones are shown in Figure 5. Each interference zone includes the rotor radius for turbines with a 164 m rotor diameter, and an additional buffer of 25 m to account for potential inaccuracies in the tower locations given in the ACMA RRL database. For comparison, Figure 5 also shows the 2 km radius consultation zones for reflection or scattering effects as recommended by the Draft National Guidelines, centred on the transmission towers for the point-to-point links crossing the Project boundary.

The results of this analysis are summarised in Table 2.

There is one turbine located within the potential reflection/scattering interference zones for the point-to-point links passing over the proposed Project boundary.

Nevertheless, DNV notes that the reflection/scattering interference zones shown in Figure 5 are approximations only and may be overly conservative [2]. This is especially true for high frequency links where increased antenna directionality (or gain) and narrower scatter regions can make the signal less susceptible to interference caused by reflection or scattering [8]. The turbine RCS and C/I ratios used to establish the interference zones were based on recommendations developed on behalf of the United Kingdom telecommunications regulator Ofcom [9], and may not be appropriate for point-to-point links operating in Australia. Uncertainties are also associated with the assumptions used to derive the Ofcom recommendations, and the use of ITU reference radiation patterns rather than the actual radiation patterns for the transmitting and receiving antennas. To account for these uncertainties, the potential for the Project to cause interference to fixed point-to-point links passing over the proposed Project boundary through reflection or scattering has been further assessed through consultation with the operators of those links, as described in Section 4.3.2.

4.3.1.3 Interference caused by near-field effects

The potential for interference to fixed point-to-point links caused by near-field effects can generally be avoided by keeping clear of the near-field zone for the transmitting or receiving antenna. Within the near-field zone, local inductive and capacitive effects are significant and it is difficult to predict the potential impacts of other objects on the transmitted or received signal. Although the near-field distance typically varies with direction relative to the link path, for most practical purposes the near-field zone can be approximated as a sphere centred on the transmitting or receiving antenna.

Reference [6] presents an equation for estimating the radius of the near-field zone for a point-to-point link from the properties of the transmitting or receiving antenna.

For each of the identified links with a transmission tower located near the proposed turbine locations, DNV has established a near-field interference zone based on the operating frequency and antenna gain for that link.

The potential near-field interference zones are shown in Figure 5. Each interference zone includes the rotor radius for turbines with a 164 m rotor diameter, and an additional buffer of 25 m to account for potential inaccuracies in the tower locations given in the ACMA RRL database.

The results of this analysis are summarised in Table 2.

There are no turbines located within the near-field interference zone for any of the point-to-point links passing over the proposed Project boundary. Therefore, it is not expected that the Project will cause interference to the point-to-point links through near-field effects.

4.3.1.4 Summary of point-to-point interference effects

Table 2 summarises the turbines located within the calculated diffraction, reflection/scattering, and near-field interference zones for each of the point-to-point links crossing the Project boundary.

Table 2 Details of turbines located within the interference zones established by DNV for point-to-point links crossing the proposed Project boundary

Link no.	Operator	Turbines within potential interference zone		
		Diffraction	Reflection/ scattering	Near-field
1	Optus Mobile Pty Limited (Optus)	None	None	None
2	Optus Mobile Pty Limited (Optus)	None	1 turbine (GWT12)	None
3	Optus Mobile Pty Limited (Optus)	None	1 turbine (GWT12)	None
4	Optus Mobile Pty Limited (Optus)	None	1 turbine (GWT12)	None
5	Optus Mobile Pty Limited (Optus)	None	None	None
6	Optus Mobile Pty Limited (Optus)	None	None	None
7	Optus Mobile Pty Limited (Optus)	None	1 turbine (GWT12)	None

4.3.2 Stakeholder consultation and responses

DNV has contacted the operator of the point-to-point links crossing the proposed Project boundary to determine the likelihood that the proposed Project will cause interference to their operations and services through diffraction, reflection or scattering, or near-field effects. No response has been received to date. DNV recommends that the Proponent continues to engage with Optus prior to the construction of the Project, to establish an understanding of how any impact to their fixed point-to-point links may be mitigated in the event that interference is encountered following construction of the Project.

4.3.3 Mitigation options

In the event that interference to point-to-point links is experienced after the Project is operational, mitigation options would need to be confirmed through consultation with Optus but may include upgrading the equipment for the affected links, re-routing the links via an existing or new tower, or replacing the links with alternative communication technologies.

4.4 Fixed licences of point-to-multipoint type

Fixed licences of the point-to-multipoint type are a variation of the point-to-point type. The difference between them is administrative. A point-to-point licence permits communication between two static sites, where the locations of the sites are detailed in the ACMA RRL database. A point-to-multipoint licence allows communication between one or more static sites and multiple points or between the points, and is usually licensed for a defined operational area.

Administratively, the ACMA RRL database details the location of the static station for a fixed licence of the point-to-multipoint type but does not include the remote stations that communicate with the static station. Hence, the paths of the transmission vectors are not readily identifiable.

4.4.1 Locations of point-to-multipoint licences and potential for interference

From the ACMA RRL database, DNV has identified 120 point-to-multipoint Assignment IDs within approximately 75 km of the proposed Project boundary. These licences are shown in Figure 6. The details of the licence holders as given in the ACMA RRL database are provided in Table 10.

There are no point-to-multipoint base stations within 20 km of the Project boundary. However, there are several point-to-multipoint base stations located more than 20 km from the Project.

Wind turbines can cause interference to point-to-multipoint links through the same mechanisms as described for point-to-point links in Section 4.3.1. However, as it is not possible to know the link paths in a point-to-multipoint network without obtaining further information about the locations of each station in the network, consultation with the relevant operators is needed to determine the potential for interference.

4.4.2 Stakeholder consultation and responses

DNV has contacted the operators of potentially affected base stations identified within 60 km of the Project, to determine the likelihood that the proposed Project will cause interference to their operations and services. Responses have been received from several operators, as summarised in Table 17, and no specific concerns have been raised.

South Gippsland Water has advised that, while they do not have any assets in the Gelliondale area that they believe will be impacted by the Project, they also operate a fixed radiocommunication link between Toora and Port Albert which passes within approximately 800 m of the nearest proposed turbine location (GWT01). DNV understands that this link is not currently registered with the ACMA. South Gippsland Water has provided maps showing the relevant link path, but has not specified a preferred clearance distance to avoid the potential for interference to that link. Based on the information provided by South Gippsland Water, DNV has observed that the link path is approximately 900 m from the nearest turbine location and the transmission towers for the link are located at least 6 km from the Project boundary. The approximate path for the link operated by South Gippsland Water is shown in Figure 7, along with an indicative buffer of 500 m on either side of the link path to illustrate the location of the link relative to the proposed turbine locations.

Interference to the link operated by South Gippsland Water can be avoided by keeping the wind turbine blades clear of a diffraction exclusion zone around the link, as discussed in Section 4.3.1.1. Interference caused by reflection or scattering of signals or near-field effects is considered unlikely due to the relatively large distance between the transmission towers and the Project. However, further information about the tower locations and the link frequency is required to establish an appropriate diffraction exclusion zone. This information has been requested from South Gippsland Water, but has not yet been received. Nevertheless, based on the link length, DNV expects that the diffraction exclusion zone would be several hundred metres either side of the link path, at most. Therefore, considering that the link path is approximately 800-900 m from the nearest proposed turbine location, DNV considers it unlikely that the Project will cause interference to this link.

4.4.3 Mitigation options

In the event that interference to point-to-multipoint links is experienced after the Project is operational, mitigation options would need to be confirmed through consultation with the relevant operators but may include re-routing the affected links via an existing or new tower, installing additional towers, or replacing the links with alternative communications technologies.

4.5 Other licence types

Besides fixed point-to-point and point-to-multipoint licences, other licence types recorded in the ACMA RRL database include spectrum licences that permit a range of radiocommunications in a specific geographic area and frequency band, private mobile radio and public telecommunications service (PTS) licences, television and radio broadcasting licences, amateur apparatus licences, and aeronautical licences for ground to aircraft communications.

4.5.1 Locations of other licences and potential for interference

DNV has identified a number of other licences in the ACMA RRL database within 75 km of the proposed Project boundary. The locations of these licences and number of associated Assignment IDs for each licence type are shown in Figure 8 and Table 11.

Most of the licences identified can be broadly described as base to mobile station or point-to-area style communications, including commercial and private mobile telephony and radio and television broadcasting. These licence types are generally not affected by the presence of wind turbines any more than other effects such as terrain, vegetation, and other forms of signal obstruction.

The potential for interference to emergency services signals and commercial mobile telephony signals is discussed further in Sections 4.6 and 4.11 respectively, while the potential for interference to radio and television broadcasting services is considered in Sections 4.14 and 4.15.

A number of aeronautical licences, and radiodetermination licences which may be used for aircraft navigation, have been identified. DNV expects that potential impacts to these services will be considered as part of an aviation impact study.

4.6 Emergency services

Licence types operated by emergency services such as state ambulance, police, fire, and rescue services typically comprise fixed point-to-point link and mobile radio communications.

4.6.1 Locations of emergency services licences and potential for interference

DNV has reviewed the ACMA RRL database to identify emergency services with licences for radiocommunication assets operating in the vicinity of the Project. The groups identified are listed in Table 12 along with their contact details. The nearest licence is associated with a tower located approximately 6 km from the Project boundary.

There are no emergency services point-to-point links crossing the proposed Project site, and so there is no potential for interference with point-to-point licences operated by emergency services.

All other licences operated by emergency services in the vicinity of the Project are mobile telephony licences used for mobile radio and paging systems. As discussed in Section 4.5, mobile telephony systems are generally not affected by the presence of wind turbines any more than other forms of signal obstruction. Reference [8] provides general guidance regarding the potential for interference with mobile radio systems, and suggests that a clearance of 500 m from the tower is sufficient to avoid significant impacts to these systems. Other references recommend that turbines be kept outside of clearance zones ranging from a distance of 200 m to 1200 m from the tower for point-to-area style services [11].

Given the distance of the emergency services mobile telephony licences from the Project, DNV considers it unlikely that the Project will cause interference to mobile radio and paging systems operated by emergency services.

4.6.2 Stakeholder consultation and responses

DNV has contacted the operators of potentially affected licences identified within approximately 60 km of the Project, to seek feedback on any potential impact that the Project could have on their operations and services. Responses have been received from several operators, as summarised in Table 17, and no concerns have been raised to date.

4.6.3 Mitigation options

As noted above, there is no potential for impacts to point-to-point links operated by emergency services, and interference with mobile telephony services is considered unlikely. If localised interference to mobile radio or paging system signals is experienced, this can often be mitigated by the user moving a short distance to a new or higher location to receive a clearer signal or by using an external antenna to improve the signal reception. Other mitigation options may include increasing the signal strength from the affected tower or alternative towers, or installing a signal repeater or additional tower on the opposite side of the Project.

4.7 Aircraft navigation systems and radar

DNV expects that a separate aviation impact study will be undertaken to assess the impact of the Project on nearby aviation navigation systems and radar.

4.8 Meteorological radar

The Bureau of Meteorology ("the Bureau") operates a network of weather radars across Australia consisting of high-resolution Doppler radars and standard weather watch or weather surveillance radars. Operation of the Bureau's part-time wind finding radar installations ceased in August 2019 [12].

Standard weather watch radars emit pulsed microwave radiation and use reflections or "echoes" of that radiation from water particles in the atmosphere to detect rain and storm activity. Doppler radar installations operate in the same way but are also able to measure the speed of the moving water particles, and therefore can provide information about wind speed and direction [13, 14].

While the uninhibited operation of meteorological radars may not be as critical as aviation radar, there are implications for public safety if severe weather is not predicted or if its approach is masked due to EMI. Because radar installations monitor the current weather situation over a wide area, the information they provide can be used to indicate the possibility and approach of severe storms, tropical cyclones, and flooding events. Wind profile measurements are also used to ensure the safe and economical operation of aircraft and provide an important source of data for the Bureau's general weather forecasting system.

The optimal coverage area for a weather radar generally extends approximately 200 km from the radar installation at a height of around 3000 m [15, 16], and approximately 100 km at a height of 1000 m [16]. Therefore, wind farms can theoretically impact on weather radar operations when located within several hundred kilometres of an installation. However, due to the curvature of the earth and intervening terrain, the range at or near ground level is generally less.

The World Meteorological Organisation (WMO) currently states that wind turbines should not be located within 5 km of a meteorological radar site, due to the high potential for complete or partial blockage of the radar signal and subsequent loss of weather data [17, 18]. For wind farms located between 5 km and 20 km of a radar, the WMO recommends consultation and analysis to assess the likelihood of turbines causing reflection or scattering of the radar signals or interfering with Doppler velocity measurements. At distances of between 20 km and 45 km, the presence of a wind farm may produce radar echoes or signal clutter that can cause loss of data or be mistaken for rain. Significant impacts are generally not expected for wind farms located more than 45 km from a meteorological radar, since in most cases the turbine will below the radar scan line of sight.

However, the WMO notes that these guidelines are only applicable to typical radar installations in flat terrain and may need to be modified for higher-powered radars or specific situations.

Recent advice received from the Bureau also suggests that there may be potential for interference to meteorological radar operations from wind farms over much greater distances than indicated by the WMO guidelines, depending on the relative elevations of the radar and the wind farm and the intervening terrain.

According to the Draft National Guidelines, operators of weather radars within 250 nautical miles (463 km) of the proposed Project should be consulted [2].

4.8.1 Locations of meteorological radars and potential for interference

DNV has identified that the Bureau operates 17 weather radars within 250 nautical miles of the proposed Project, with the closest radar, at East Sale RAAF Base, located approximately 70 km northeast of the Project. The locations of these radars are shown in Figure 9 and the details of each radar are given in Table 13.

Although the distance between the Project and the nearest Bureau radar is considerably greater than the distances at which the WMO suggests impact may occur, consultation with the Bureau is needed to determine the potential for interference.

4.8.2 Stakeholder consultation and responses

DNV has contacted the Bureau regarding the Project, as recommended by the Draft National Guidelines, to seek feedback on whether interference to their operations and services is likely.

The response received from the Bureau indicates that the potential impact of the Project on their meteorological radars will be manageable, and that the Bureau has no objections to the Project provided that the following conditions are agreed to in writing and met:

- the Bureau is informed of any changes to the Project design, including changes to the turbine locations or height
- the owner or operator of the Project gives the Bureau at least two weeks' notice of any planned shutdown of the Project, to allow the Bureau to calibrate their systems while the turbines are not operating and hence account for the presence of the Project in their signal processing and interpretation
- the owner or operator of the Project collaborates with the Bureau in the event of severe weather conditions in the interests of community safety.

DNV recommends that the Proponent engages again with the Bureau prior to the construction of the Project, to establish an understanding of how a commitment to the conditions outlined above can be formalised.

4.8.3 Mitigation options

According to the WMO, there are currently no automated signal processing techniques available that can be used to effectively filter radar data to remove interference caused by wind farms [18], However, if analysis indicates there is a potential for the wind farm to cause reflection or scattering of radar signals, the WMO suggests it may be possible to reduce the potential impact through the relocation of individual turbines prior to construction. In situations where the expected interference is limited to signal clutter, the radar operator may also be able to mask these effects in the data or train the users to take the locations of the wind farms into account.

Compliance with the conditions specified by the Bureau and outlined in Section 4.8.2 may also help to mitigate any potential impacts to meteorological radar operations.

4.9 Trigonometrical stations

A trigonometrical station, also known as a trig point or a trig beacon, is an observation mark used for surveying or distance measuring purposes.

Some trig points may host surveying equipment such as Global Positioning System (GPS) antennas and electronic distance measuring (EDM) devices. EDM devices measure the distance from the trig point to the target object by means of a beam of known velocity which is reflected back to the unit from the target object. Most EDM devices require the target object to be highly reflective and, accordingly, a reflective prism is placed on the target object being surveyed.

The effective range of EDM devices depends on the wavelength bands used. Light wave and infrared systems have an effective range of 3 km to 5 km, and could be intercepted or obstructed by the presence of turbines. However, the potential for impact is considered low as it is likely to be possible to relocate the target to obtain an unobstructed view of the trig point. Microwave systems can measure distances up to 150 km, but such systems are not limited by the line of sight or affected by visibility [19].

Global navigation satellite system (GNSS) technology is also commonly used for surveying and distance measurements, as it enables users to accurately determine their geographic location using positioning and timing information received from satellite signals. Geoscience Australia currently operates several GNSS networks across Australia, including the Australian Regional GNSS Network (ARGN) and the AuScope GNSS network [20]. The ARGN is comprised of 20 permanent GNSS Continuously Operating Reference Stations (CORS) which provide the geodetic framework for the spatial data infrastructure in Australia and its territories. Eight stations from the ARGN form the Australian Fiducial Network (AFN) [21], through which the Geocentric Datum of Australia (GDA) is defined. The ARGN also provides information for the measurement of geological processes and contributes data to the International GNSS Service. Additional geospatial information aimed at enhancing the accuracy and resolution of the National Geospatial Reference System is provided by the AuScope GNSS network of around 100 CORS strategically distributed across the country, and several private and state-based GNSS CORS networks. GNSS stations are typically equipped with EDM devices and GPS receivers, and transmit data to Geoscience Australia or the relevant state authority via phone lines, internet, or satellite communications.

4.9.1 Locations of trigonometrical stations and potential for interference

According to Geoscience Australia [22], there are eight trig points within 20 km of the Project boundary. The details of these trig points are provided in Table 14 and their locations are illustrated in Figure 10. There are also 54 permanent survey marks within 5 km of the Project boundary [23] as shown in Figure 11. The closest survey mark is located 388 m northeast of the nearest turbine.

DNV has reviewed the primary geodetic network of Australia [24] and observed that the Project is located within the high-density trilateration region. Trilateration depends on distances measured from trigonometrical stations of known positions, baselines and heights, with a high degree of accuracy, to determine the location of the site being surveyed.

The closest GNSS station is located approximately 6 km northeast of the Project, at Yarram [25]. Due to the significant distance between the Project and the GNSS station, it is considered unlikely that the Project will cause interference to the GNSS network.

4.9.2 Stakeholder consultation and responses

Although it is unlikely that the trig points in close proximity to the Project host EDM devices or other equipment that may be subject to EMI, DNV has contacted Geoscience Australia and the Department of Environment, Land, Water and Planning (DELWP) to inform them of the Project, and seek feedback regarding whether interference to their systems is possible.

The responses received from Geoscience Australia and the DELWP indicate that they do not expect the Project to interfere with their operations. However, the DELWP have noted that the survey marks located along the South Gippsland Highway in the vicinity of the Project are the primary source of elevation information in the region and have asked that care be taken to avoid physical disturbance of those marks during the construction or operation of the Project.

4.10 Citizen's band radio

Citizen's band radio, also known as CB radio, is a class-licensed two-way, short distance communication service that can be used by any person in Australia for private or work purposes. It is commonly used in rural areas for emergency communications, road safety information, communication between recreational travellers, and general conversation. The class licence implies that all users of the CB radio operate within the same frequency range on a shared basis and no individual licence is required.

The CB radio service can be used for voice communication activities, telemetry, and telecommand applications. The radio service operates on two frequency bands, namely the high frequency (HF) band between 26.965 MHz and 27.405 MHz and the ultra-high frequency (UHF) band between 476.425 MHz and 477.400 MHz.

The HF CB radio service was legalised in Australia in the 1970s as a temporary move to switch to UHF CB over the following five years, and transmits signals in either AM (amplitude modulation) or SSB (single side band) transmission mode. The actual range over which the signal is transmitted depends on the antenna used, the terrain, and the interference levels. Over the last decade, the use of the HF CB radio service has declined and has been replaced by UHF CB radio service.

The UHF CB radio service is unique in Australia and uses the FM (frequency modulation) transmission mode. It provides clear communication over 5–20 km and is less susceptible to power line noise. However, the UHF CB radio service requires a clear line-of-sight for a strong signal and is easily hindered by hilly terrain and forested areas. Even in the absence of physical obstructions, UHF CB radio signals generally cannot travel beyond the effective radio horizon, which depends on elevation, antenna height, weather, and atmospheric conditions. If located on a hilltop, CB radio signals can be transmitted over at least 50 km. However, under normal conditions on flat ground, signal range is typically limited to around 5 km. CB repeater stations are often set up on hilltops by community groups and commercial organisations to transmit signals from one channel to another.

No individual or organisation owns or has the right to use a channel exclusively. However, out of the 40 channels available, some of them will be allocated to emergency, telemetry, or repeater inputs.

4.10.1 Locations of CB radio devices and potential for interference

Since users of CB radio services do not require a licence, there is no record of users of the service and their locations and the channels are shared among the users and the repeater stations without a right of protection from interference. Given the limitations of UHF radio signals, CB radio services are typically only intended for local or short-range communications. CB radio signals passing through the Project are likely to be intercepted by existing obstructions such as terrain and vegetation, and there is little evidence in the literature to suggest that wind turbines pose a particular risk of interference to these systems. Therefore, the impact of the Project on CB radio services is expected to be minimal.

4.10.2 Mitigation options

If interference to CB radio signals is experienced, simple steps such as moving a short distance to a new or higher location until the signal strength improves may help to mitigate the impact. CB radio users can also increase their signal range and improve reception by switching their equipment to a higher power setting, using a longer antenna, or increasing the antenna mounting height.

4.11 Mobile phones

Mobile phone networks typically operate at frequencies of either between 700 and 900 MHz, or between 1800 MHz and 2600 MHz, however some new services may operate at up to 3500 MHz. At such frequencies, signals may be affected by physical obstructions such as buildings and wind turbines. However, mobile phone networks are designed to operate in such conditions and in most cases, if there is sufficient mobile network coverage and signal strength, the presence of wind turbines is unlikely to cause any interference.

In rural areas, the mobile network coverage may be more susceptible to physical obstructions due to the large distance between the phone towers and the mobile phone user. In that case, it is theoretically possible that wind turbines could cause some interference to the signal. However, there is little evidence in the literature of wind turbines interfering with mobile phone signals, and DNV notes that previous advice received from mobile phone network operators in Australia has generally indicated that they do not expect wind farm developments to interfere with their services provided that appropriate clearances from the mobile phone towers are maintained.

4.11.1 Availability of mobile phone services and potential for interference

DNV has reviewed the locations of mobile phone towers in the vicinity of the proposed Project. The locations of these towers are shown in Figure 12. The nearest mobile phone tower is located approximately 1.3 km from the nearest turbine, as discussed in Section 4.2.1.

Mobile phone network coverage maps have been obtained for Optus and Telstra. There is no Vodafone network coverage in the vicinity of the Project.

Figure 13 and Figure 14 show the Optus Mobile network coverage for the Project area [26]. Outdoor 3G and 4G coverage is available across the Project site and most of the surrounding area, although there are locations along the coast to the south of the Project and in areas to the north and northwest of the Project where Optus Mobile coverage is either not available or requires the use of an external antenna.

Figure 15 and Figure 16 show the Telstra network coverage for the Project area [27]. 3G and 4G coverage is generally good across the Project site and surrounding area, with only very small areas to the immediate northwest and south of the Project site where coverage is not available.

In general, for areas with good coverage, interference to mobile phone signals is unlikely. However, for areas where the reception is likely to be marginal, such as those where an external antenna is required, the possibility for interference exists if a wind turbine intercepts the signal between a mobile phone and the tower.

4.11.2 Stakeholder consultation and responses

DNV has contacted Optus and Telstra to inform them of the proposed Project and to seek feedback on any potential impact that the Project could have on their services. The response received from Optus indicates that although there may be some impacts on their mobile phone services, they do not expect the Project to cause an unacceptable level of interference. No response has been received from Telstra to date.

4.11.3 Mitigation options

As noted above, interference with mobile phone signals is considered unlikely. If localised interference is experienced by mobile phone users, this can often be rectified by the user moving a short distance to a new or higher location until the signal improves, or using an external antenna to improve the signal reception. For interference over a larger area, or in cases where it would not be possible or practical for the user to change their location, mitigation options may include increasing the signal strength from the affected tower or alternative towers, or installing an additional tower on the opposite side of the Project.

4.12 Wireless internet

Wireless internet services in Australia include wireless broadband provided by mobile phone network operators and other internet service providers, and fixed wireless or satellite internet services through the National Broadband Network (NBN).

4.12.1 Wireless broadband services

Wireless broadband services allow the user to connect to the internet without the need for a phone line or cable connection. The wireless signals may operate by line of sight between a base station and the user's antenna as part of a point-to-multipoint network, or may use point-to-area style transmissions such as mobile phone networks.

4.12.1.1 Availability of wireless broadband services and potential for interference

Residents in the vicinity of the Project may use wireless broadband services provided by Optus and Telstra. These wireless broadband services use the same networks as mobile phone services, and therefore the comments made in Section 4.11.1 are applicable here. Specifically, there is a low theoretical potential for interference in areas with marginal reception if a wind turbine intercepts the signal between a receiver and the tower.

Aussie Broadband also holds point-to-multipoint licences in the vicinity of the Project, with the nearest base station located 53 km from the Project. Although the locations of Aussie Broadband customers are not known, it is considered unlikely that stations at these distances will be servicing customers in the vicinity of the proposed Project.

4.12.1.2 Stakeholder consultation and responses

DNV has contacted Aussie Broadband to seek feedback regarding the potential for interference to their services. The response received from Aussie Broadband indicates that they do not expect the Project to impact on their services.

DNV has also contacted Optus and Telstra, as discussed in Section 4.11.2, to seek feedback on any potential impact that the Project could have on their services. The response received from Optus indicates that they do not expect the Project to cause material impacts to services provided through their mobile phone network. No response has been received from Telstra to date.

4.12.1.3 Mitigation options

As noted above, interference with wireless broadband services is considered unlikely. If interference to the wireless broadband services provided by mobile phone networks occurs, the mitigation options given in Section 4.11.3 may be applicable. Specifically, localised interference can often be rectified by the user moving a short distance or using an external antenna to improve signal reception. For interference over a larger area, or in cases where it would not be possible or practical for the user to change their location, mitigation options may include increasing the signal strength from the affected tower or alternative towers, or installing a signal repeater or additional tower on the opposite side of the Project.

4.12.2 National Broadband Network

The NBN is a national wholesale broadband access network, which consists of fixed line, fixed wireless, and satellite internet services.

NBN fixed line services use wired connections to provide internet signals directly to the user. This technology is typically only available in urban areas and is not expected to be affected by wind farm developments.

NBN fixed wireless services are available in many rural and regional areas. The signals operate by line of sight between an NBN tower and the user's antenna, with a maximum range of 14 km [28]. Consequently, the signals may be affected by physical obstructions such as terrain, vegetation, and wind turbines [29].

For rural and remote users in areas that are not able to receive fixed line or fixed wireless services, NBN satellite internet signals are available from the NBN Sky Muster I and II satellites.

4.12.2.1 Availability of NBN services and potential for interference

The NBN website [30] indicates that the network is currently available as a fixed wireless and satellite internet service in the area surrounding the Project. It is therefore likely that some residents are currently accessing the internet via the NBN and that the network will also be available to other residents in the vicinity of the Project in the near future. The locations of NBN fixed wireless internet towers within 75 km of the Project boundaries are shown in Figure 12, and a map of NBN service coverage in the vicinity of the Project is shown in Figure 17.

The NBN fixed wireless towers servicing the Project area are located at Alberton, Welshpool, Port Welshpool, and Yarram. Based on the relative positions of these towers and nearby dwellings, and the fixed wireless coverage areas shown in Figure 17, there is potential for turbines at the Project to intercept the line of sight between these towers and nearby dwellings. Further investigation would be required to determine which dwellings are likely to be receiving NBN fixed wireless signals from each tower, and whether the lines of sight from that tower to those dwellings have potential to be intercepted by turbines at the Project. However, as discussed in Section 4.12.2.2, feedback received from NBN Co indicates that there are no signal lines of sight between the fixed wireless towers and currently connected dwellings that would be intercepted by turbines at the Project.

DNV understands that NBN Co is planning to extend the fixed wireless coverage range for some towers from 14 km to 29 km [31]. In addition to the NBN fixed wireless internet towers at

Alberton, Welshpool, Port Welshpool, and Yarram, there are other NBN fixed wireless internet towers located within 29 km of the proposed turbine locations at Foster, Toora, and Woodside. If the coverage from these towers is extended and additional residents in the vicinity of the Project begin receiving fixed wireless internet signals prior to the construction of the Project, there may be potential for interference to the NBN fixed wireless service at other dwellings. However, the assessment presented here is based on the current network availability, as shown in Figure 17.

The potential for interference to satellite internet signals from the NBN Sky Muster I and II satellites is considered in Section 4.13.

4.12.2.2 Stakeholder consultation and responses

DNV has contacted NBN Co to seek feedback on whether there is potential for the Project to cause interference to their services, and to allow them to take the presence of the Project into account in their coverage planning maps.

The response received from NBN Co indicates that, although the proposed turbine locations are within the existing coverage areas for their fixed wireless internet service, they do not expect the turbines to intercept any signal lines of sight between the fixed wireless towers and currently connected dwellings. However, NBN Co have asked to be advised if the proposed turbine locations change so that they can reassess the potential for impact to their services if necessary.

NBN Co have also asked to be provided with the details of any radiocommunications equipment planned to be installed or used during the construction or operation of the Project so that they can assess the potential for the associated signals to interfere with their services. DNV recommends that the Proponent engages again with NBN Co prior to construction of the Project, once the details of any such equipment are known, to allow NBN Co to determine the potential for interference and to establish an understanding of how any impacts can be mitigated.

4.12.2.3 Mitigation options

Based on the feedback received from NBN Co, interference with NBN fixed wireless internet services is considered unlikely. If interference to NBN fixed wireless signals is experienced at dwellings in the vicinity of the Project, several mitigation options may be available to improve the signal reception. NBN Co has previously advised that in most instances where the signal line of sight from a given tower is obstructed an alternative tower can be used to service the affected dwelling. If an alternative tower is not available, interference can usually be rectified by moving the outdoor antenna at the affected dwelling a short distance from the building, to a location where the signal is not impacted by the turbines, and connecting that antenna to the dwelling via a cable (described by NBN Co as a "non-standard install process" [32]). It may also be possible to avoid impact by micro-siting the turbines in some cases, or by installing a new NBN tower to service the affected dwellings. Although the NBN Sky Muster satellite internet service is a potential alternative to the fixed wireless internet service, NBN Co have previously advised that the Sky Muster service cannot be considered as a mitigation option for dwellings affected by interference from wind turbines.

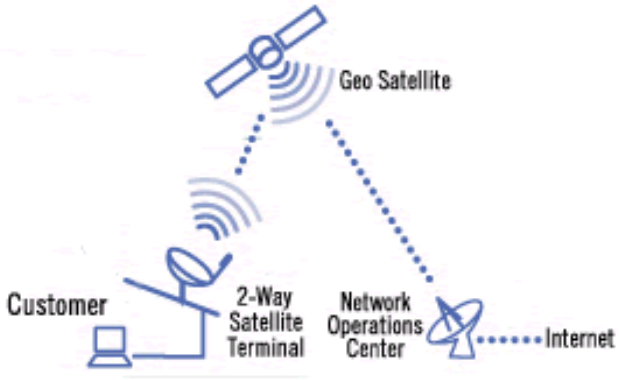
4.13 Satellite television and internet

In some rural or remote areas, television and internet access can only be provided through satellite signals.

Satellite television is delivered via a communication satellite to a satellite dish connected to a set-top box. Satellite television signals are typically transmitted to the user's antenna in one of two

frequency bands: the C-band between 4 GHz and 8 GHz, or the Ku-band between 12 GHz and 18 GHz. Signals in the C-band are susceptible to interference due to radio relay links, radar systems, and other devices operating at a similar frequency. Signals in the Ku-band are most likely to be affected by rain which acts as an excellent absorber of microwave signals at this frequency. The main satellites that transmit Australian free-to-air or subscription television channels are the Optus C1, D1, and D3 satellites and the Intelsat 19 satellite [33, 34].

In the case of satellite internet, the user's computer is connected to a satellite modem which is in turn linked to a satellite dish or antenna mounted on the building roof. When the user accesses the internet, a request is sent to the operation centre of the satellite internet provider via the satellite antenna. Data is then sent back to the user's computer via the same path as shown in the figure below. Satellite internet signals are typically transmitted in the Ku-band, as for satellite television, or the Ka-band, with frequencies ranging from 26.5 GHz to 40 GHz. Like signals in the Ku-band, signals in the Ka-band are susceptible to deterioration caused by moisture in the air, but newer satellites contain technologies that help to minimise the loss of signal quality associated with rain and other weather conditions. The main satellites for providing satellite internet in Australia are the IPSTAR (THAICOM-4) and Optus D2 satellites, and the NBN SkyMuster I and II satellites.



Two-way connection to the internet via satellite [35]

4.13.1 Locations of satellite vectors and potential for interference

Due to marginal coverage of some communication services, some residents in the vicinity of the Project may use satellite television and internet.

A number of satellites transmit television and internet signals that can be received in Australia. Although only a small number of satellites are likely to be providing services specifically intended for Australian audiences, DNV has considered the line of sight to dwellings in the vicinity of the Project from all theoretically viewable satellites.

The results of the analysis are shown in Table 15 and summarised in Table 3. Based on these results, turbines at the Project may intercept signals from 22 satellites at 15 nearby dwellings, two of which are host dwellings.

DNV understands that all the potentially affected satellites shown in Table 15 provide television signals intended for international audiences, and considers it unlikely that residents in the vicinity of the Project will currently be receiving signals from these satellites. Many of the satellites have a

low angle of elevation above the horizon at the wind farm site location, and so degradation caused by atmospheric effects or interference from terrain or other obstacles may already prevent the signals from being received at the affected dwellings. For some of these satellites, the programs transmitted on the beam footprints that cover Australia may also be available through other satellite services which have a higher angle of elevation above the horizon and are not expected to be intercepted by turbines at the Project. If residents are not currently receiving signals from the satellites identified in Table 15, either by choice or because those signals are not available due to existing degradation or interference, there will be no potential for the Project to impact on those services.

Table 3 Number of satellites with potential for signals to nearby dwellings to be intercepted by the proposed Project

Satellite service	Number of potentially affected satellites	Number of potentially affected dwellings
Services intended for Australian audiences	None	None
Services intended for international audiences	22	15 (2 host dwellings)

4.13.2 Stakeholder consultation

As discussed in Section 4.13.1, it is unlikely that nearby residents are currently receiving signals from satellites that may be affected by interference from turbines at the Project. If desired by the Proponent, the potential for impact could be confirmed by engaging with the residents of the dwellings identified in Table 15 prior to construction of the Project to determine if any are currently receiving signals from the potentially affected satellites and to establish an understanding of how any impact to these services may be mitigated.

4.13.3 Mitigation options

If interference to satellite television signals is experienced at dwellings in the vicinity of the Project, several mitigation options may be available. If an alternative source of the same programming is available, the satellite dishes at affected dwellings can simply be re-directed to receive signals from the other satellite. In some cases, residents may also be able to access the affected programs directly over the internet. If an alternative source of programming is not available, it may be possible to rectify interference by installing a larger or higher-quality satellite dish, or by changing the height or location of the dish to obtain a stronger signal.

4.14 Radio broadcasting

Radio stations typically broadcast using one of two forms of transmission: either amplitude modulation (AM) or frequency modulation (FM). In Australia, AM radio operates in the medium wave (MW) band at frequencies between 520 kHz and 1610 kHz, while FM radio operates in the very high frequency (VHF) band between 87.5 MHz and 108 MHz.

4.14.1 AM radio

AM radio signals are diffracted by the ground as they propagate, such that they follow the curvature of the earth, and are also reflected or refracted by the ionosphere at night. This means that AM radio waves are able to travel significant distances under the right conditions. Due to their long wavelength, they can readily propagate around physical obstructions on the surface of the

earth (such as wind turbines), however they do not propagate easily through some dense building materials such as brick, concrete, and aluminium.

The distance over which AM radio signals can travel means that the signal may be weak and susceptible to interference by the time it reaches a receiver. Some of the possible sources of interference to AM radio waves include changes in atmospheric conditions, signals from distant AM broadcasters operating on a similar frequency, electrical power lines, and electrical equipment including electric motors.

However, as noted above, the presence of physical obstructions such as turbines is unlikely to cause significant interference to AM radio signals. Due to the long wavelength of the signal, interference is only likely in the immediate vicinity of a turbine [36].

4.14.1.1 Locations of AM transmitters and potential for interference

The locations of AM broadcast transmitters in the vicinity of the Project were determined from the ACMA Broadcast Transmitter Database [37], and are shown in Figure 18.

It is unlikely that any permanent AM radio receivers will be located sufficiently close to the Project to be affected by interference to the radio signals from the turbines.

4.14.1.2 Mitigation options

In the event that localised interference to AM radio signals is experienced, this can potentially be rectified by installing a high-quality antenna or amplifier at the affected residence.

4.14.2 FM radio

FM radio signals are better suited to short range broadcasting. Unlike lower frequency signals (such as AM signals), they are not reflected or refracted off the ionosphere. Instead, the waves are slightly refracted by the atmosphere and curve back towards the earth, meaning they can propagate slightly beyond the visual horizon. However, FM radio signals may be blocked by significant terrain features. FM radio stations therefore tend to have only local coverage, which means that signals are less susceptible to interference from distant FM broadcasters. FM signals are also less susceptible to interference from changes in atmospheric conditions and electrical equipment than AM signals.

FM radio signals are susceptible to interference from buildings and other structures, although they are less vulnerable than higher frequency signals. Interference to FM signals can occur by two mechanisms: reflection or scattering of the radio waves, or physical obstruction and attenuation of the broadcast signal.

Reflection or scattering of radio waves by physical structures such as wind turbines can reduce the signal strength at a receiver or can cause multi-path errors through reception of a reflected signal in addition to the primary signal from the transmitter. This can result in hissing, fluttering, or distortion being heard by the listener [38]. However, this type of interference is typically only experienced in the immediate vicinity (within several tens of metres) of a wind turbine, where the signal-to-noise ratio is low [36, 39].

Wind turbines located close to an FM transmitter may also present a physical obstruction to the radio signal. If the line-of-sight between the transmitter and a radio receiver is blocked by a turbine, this can cause a noticeable decrease in signal quality or may lower the signal strength below the threshold of the receiver's sensitivity [38]. In these situations, the attenuation of the signal may be as great as 2.5 dB in the direction of the obstructing wind turbine. However, this

type of interference is generally only a problem near the edges of the FM signal coverage area, where the broadcast signal is already weak. For commercial FM broadcast signals, physical obstruction of the signal may occur if the turbines are located within approximately 4 km of the transmitter [40].

4.14.2.1 Locations of FM transmitters and potential for interference

The locations of FM broadcast transmitters in the vicinity of the Project were determined from the ACMA Broadcast Transmitter Database [37], and are shown in Figure 18.

The closest FM broadcast transmitter is located approximately 7 km from the proposed Project boundary. Therefore, it is considered unlikely that the Project will cause interference to the FM radio signals from this transmitter.

It is unlikely that any permanent FM radio receivers will be located sufficiently close to the Project to be affected by reflection or scattering of the radio signals from the turbines.

4.14.2.2 Mitigation options

In the event that localised interference to FM radio signals is experienced, this can potentially be rectified by installing a high-quality antenna or amplifier at the affected residence.

4.14.3 Digital radio

Digital radio services were introduced in metropolitan licence areas in Australia in July 2009. The digital radio services offered use an updated version of the digital audio broadcasting (DAB) digital radio standard, DAB+, to broadcast digital radio to Adelaide, Brisbane, Perth, Melbourne, and Sydney [41]. Digital radio broadcasts in Australia operate in the VHF band at frequencies between 174 MHz and 230 MHz, and therefore tend to have only local coverage within the visual horizon.

The UK telecommunications regulator Ofcom [38] states that *"In contrast [to FM signals], the signal format used for DAB digital radio is designed to offer high levels of robustness in difficult conditions and it is not materially affected by reflections. FM and DAB reception can be affected where a structure blocks signals and both may cease to function if signals are reduced below a certain threshold"*. DNV has therefore concluded that DAB signals are not affected by reflection or scattering from physical structures in the same way as FM signals, and so digital radio broadcasts are generally not susceptible to interference from wind farm developments. However, interference may be experienced if the line-of-sight between a DAB transmitter and a radio receiver is blocked by a wind turbine.

4.14.3.1 Availability of digital radio services and potential for interference

According to the digital radio coverage search function available on the Digital Radio Plus website [42], the Project is outside the intended service area for digital radio broadcasts. Since it is therefore unlikely that residents in the vicinity of the Project are currently receiving digital radio signals, it is not expected that the Project will cause interference to these services.

4.15 Terrestrial television broadcasting

Terrestrial television is broadcast in Australia by a number of networks, both public and commercial. As of December 2013, all television broadcasts in Australia are now digital broadcasts [43]. Digital television (DTV) signals are typically more robust in the presence of interference than analogue television signals, and are generally unaffected by interference from wind turbines. DNV has experience in situations where dwellings were able to receive adequate DTV reception in an area of adequate signal strength where the DTV signal was passing through a wind farm.

The susceptibility of DTV signals to interference from wind turbines is discussed further in Section A.1 of Appendix A.

4.15.1 Availability of DTV broadcasting and potential for interference

The locations of DTV broadcast transmitters in the vicinity of the Project were determined from the ACMA Broadcast Transmitter Database [43], and are shown in Figure 18. The main DTV transmitter used by residents in the vicinity of the Project is the Latrobe Valley transmitter at Mt Tassie [44].

The coverage map for the Latrobe Valley broadcast transmitter is reproduced in Figure 19. DTV coverage is generally good across the Project and most of the surrounding area. However, there areas to the immediate northwest of the Project and to the west, southwest, and far north where coverage is variable or, in some locations, not available.

4.15.1.1 Interference caused by large scale effects

For broadcast signals, large scale interference can generally be avoided by placing the wind turbines at some distance from the transmitter. Broadcast transmitters may be either relay or primary transmitters. Relay transmitters are more commonly found in rural areas. Primary transmitters are higher power and are more commonly located near large urban areas. A clearance of at least 1 km is recommended for relay transmitters, while a clearance of at least 6 km is recommended for primary transmitters [7].

The closest DTV transmitter to the Project is the Latrobe Valley primary transmitter at Mt Tassie, which is approximately 22 km away. Therefore, it is considered unlikely that the Project will cause large scale interference to signals from this transmitter.

4.15.1.2 Interference caused by reflection or scattering

Although DTV signals are generally unlikely to be susceptible to interference from wind turbines in areas of adequate coverage, interference could be encountered in areas where coverage is marginal and antennas at dwellings may receive a reflected signal from a turbine that is of sufficient power to interfere with the signal received directly from the transmitter. Based on the coverage maps for the area around the Project, it is possible that some areas could be deemed to have marginal reception and interference could be encountered.

Due to the lack of an accurate theoretical scattering model, DNV has not performed detailed scatter calculations to predict DTV interference. Instead, dwellings that have increased potential to receive back-scattered or forward-scattered signals from a turbine at the Project (assuming an antenna with a sufficiently narrow beam width and sufficiently high front-to-back ratio is being used) have been highlighted using the 'keyhole' approach described in Section A.3 of Appendix A, with a forward-scatter distance of 5 km and a back-scatter distance of 500 m.

The results of the analysis can be seen in Table 16 and Figure 19. The dwellings most likely to be susceptible to interference include those within the possible interference zone, as summarised in Table 4.

Note that if the signal received at a dwelling from the transmitter is sufficiently weak, or an antenna with insufficient directional discrimination is installed (i.e., a low gain or omni-directional antenna), interference may still occur at dwellings outside of the identified interference zones. Circumstances under which interference may occur outside the interference zones typically established using the 'keyhole' approach are discussed further in Section A.2 of Appendix A. In particular, although DNV has considered the potential for interference to DTV signals at dwellings within 5 km of the proposed turbine locations, previous advice received from BAI Communications,

who are responsible for broadcasting of national public television services in Australia, has indicated that interference to DTV broadcasting may be experienced at distances of up to 10 km from turbines. For comparison, Figure 19 also shows the area within 10 km of the proposed turbine locations, although a more detailed assessment would be required to determine whether there is any potential for interference to DTV signals received at dwellings outside the 'keyhole' interference zones.

The potential interference zones shown in Figure 19 suggest that interference to DTV signals from the Latrobe Valley transmitter is most likely to be experienced in areas within the Project boundary, close to the turbine locations, and to the south and southwest of the Project. Additionally, as discussed in Section 4.15.1, the coverage map reproduced in Figure 19 indicates that the signal coverage from Latrobe Valley transmitter is already variable or poor in areas to the northwest, west, and southwest of the Project. Therefore, there may be a potential for dwellings located to the immediate northwest, west, and southwest of the Project to receive a reflected signal from a turbine that is stronger than the direct signal from the Latrobe Valley transmitter.

Table 4 Number of dwellings located within potential interference zones for digital television broadcast transmitters in the vicinity of the Project

DTV broadcast transmitter	Number of dwellings in potential interference zone	Signal coverage in potential interference zone
Latrobe Valley (Mt Tassie)	26 (5 host dwellings)	Generally good, tending to variable to the west and southwest of the Project

The method used here to assess the potential interference to television signals from the Project represents a simplified approach which is expected to capture locations where interference is most likely to occur. This simplified analysis is deemed appropriate in most cases as the implications of potential television interference are typically low. If reception difficulties are encountered, there are a number of mitigation options available as discussed in further detail in Section 4.15.3.

4.15.2 Stakeholder consultation and responses

DNV has contacted BAI Communications, who are responsible for broadcasting of national public television services in Australia, to inform them of the proposed Project and seek feedback on any potential impact that the Project could have on DTV signals in the surrounding area.

BAI Communications has conducted an assessment of the potential for turbines at the Project to interfere with DTV signals from the Latrobe Valley (Mt Tassie) transmitter [45]. The method used by BAI Communications involved modelling the reflection or scattering of DTV signals from the wind turbines, and identifying locations within 10 km of the Project where the resulting C/I ratio for a directional antenna oriented towards the transmitter of interest would be less than required for adequate signal reception.

From the results of their modelling, BAI Communications have advised that some impacts to DTV signals from the Latrobe Valley transmitter are expected. The number of residents estimated by BAI Communications to be at risk of experiencing interference to DTV signals, based on population density data for the areas identified as potentially affected, are summarised in Table 5. In the event that interference to DTV signals is experienced by residents, BAI Communications have advised that they expect any necessary mitigation to be undertaken as part of the Project.

Table 5 Number of residents predicted by BAI Communications to be at risk of experiencing interference to digital television broadcast signals

DTV broadcast transmitter	Number of residents at risk of experiencing interference	
	Low risk	High risk
Latrobe Valley (Mt Tassie)	30	9

The results of the modelling conducted by BAI Communications for the Latrobe Valley transmitter are compared to the DTV coverage map and interference zones established by DNV in Figure 20. Figure 20 shows that the areas predicted by BAI Communications to be at high risk of experiencing interference to signals from the Latrobe Valley transmitter are located within the Project boundary in the western part of the site, and to the immediate west and northwest of the Project. There is also a low risk of interference further to the west and to the southwest of the Project, and in isolated areas to the north. These areas largely correspond to regions around the Project where the signal coverage from the Latrobe Valley transmitter is already variable or poor, which indicates that there is a potential for dwellings in these areas to receive a reflected signal from a turbine that is stronger than the direct signal from the transmitter.

Compared to the interference zones established by DNV using the 'keyhole' approach described in Section 4.15.1.2, the results obtained by BAI Communications indicate that interference caused by back-scattering of signals may extend over a greater distance, particularly in areas where the signal coverage is already marginal. Conversely, the modelling conducted by BAI Communications suggests that interference caused by forward-scattering of signals is likely to be less significant. Based on the locations of nearby dwellings provided by the Proponent, there are a number of dwellings located within or near the areas modelled by BAI Communications as being at risk of experiencing interference to signals from the Latrobe Valley DTV transmitter.

4.15.3 Mitigation options

In the event that television interference is an issue during construction or after commissioning of the Project, there are several amelioration options available:

1. Realigning the user's television antenna more directly towards their existing transmitter.
2. Tuning the user's antenna into alternative sources of the same television signal or a substitute signal.
3. Installing a more directional or higher gain antenna at the affected dwelling.
4. Relocating the antenna to a less affected position.
5. Installing cable or satellite television at the affected dwelling.
6. Installing a television relay transmitter.

In the event of significant interference in the backscatter region, a more directional antenna should ensure a stronger signal from the transmitter since the backscattered signal will originate from a different direction. However, the effectiveness of this mitigation may be reduced if there is no clear line of sight from the antenna to the transmitter. In the case of forward scatter, the antenna will be pointed towards both the original and scattered signal and hence a more directional antenna may not alleviate a forward scatter issue, however, as noted in [46], DVB-T reception quality may not be substantially affected in the forward scatter region.

The ITU [47] identified that the receiver height can also affect interference. In areas that are relatively flat and free of vegetation, reflections can enhance or decrease the received signal strength relative to the free path signal strength. The ITU found that the received signal strength may not increase monotonically with receiver height. In other words, lowering the receiver height can improve reception in some cases.

In the event that terrestrial DTV reception cannot be improved, satellite television represents another potential amelioration option. Satellite based television comprises of both free to air and subscription-based broadcasts. Residents in areas which are unable to receive DTV through their normal television antenna due to local interference, terrain, or distance from the transmitter in their area may be eligible to access the Australian Government funded Viewer Access Satellite Television (VAST) service [48].

In addition to the mitigation options outlined above, the Victorian Guidelines [1] include example permit conditions stating that, prior to commencing development, a survey must be undertaken to determine the average television and radio reception strength within 5 km of the wind farm site. If a complaint is later received regarding the effect of the wind farm on television or radio reception at a pre-existing dwelling within 5 km of the site, the operator must investigate that complaint. If the investigation finds that the wind farm has had a detrimental impact on the quality of television or radio reception, the operator must then restore reception at the affected dwelling to at least the quality determined in the pre-development survey to the satisfaction of the responsible authority.

5 CONCLUSIONS

Broadcast towers and transmission paths around the Project were investigated to determine if EMI would be experienced as a result of the development and operation of the Project. The Project will involve the installation of 13 wind turbine generators. DNV has considered a turbine geometry that will be conservative for turbine configurations with dimensions satisfying all of the following criteria: a rotor diameter of 164 m or less and an upper tip height of 210 m or less.

The results of this assessment, including feedback obtained from relevant stakeholders, are summarised in Table 6.

Turbines at the Project may interfere with point-to-area style services such as mobile phone signals, radio broadcasting, and terrestrial television broadcasting, particularly in areas with poor or marginal signal coverage. Dwellings in the vicinity of the Project may experience interference to DTV signals from the Latrobe Valley broadcast transmitter, especially in areas to the immediate northwest, west, and southwest of the Project where dwellings may receive a reflected signal from a turbine that is stronger than the direct signal from the transmitter. If interference to these services is experienced, a range of options are available to rectify difficulties.

Interference is also possible for satellite television and internet signals, although the signals that are likely to be intercepted by turbines in the Project are from satellites that do not provide services designed for Australian audiences.

Since it is not possible to determine the potential EMI impacts on point-to-multipoint links, emergency services, meteorological radar, and wireless internet services without obtaining further information from the relevant operators, consultation with the operators has helped to determine the potential for the Project to cause interference to these services. All responses received to date indicate that the Project is unlikely to have any material impact on these services.

Potential EMI impacts on other services considered in this assessment, including trigonometrical stations and CB radio, are not expected or are considered to be minor.

Table 6 Summary of EMI assessment results for the proposed Project

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Radio-communication towers	2 towers within 2 km of proposed turbine locations, operated by: Optus Viasat Nearest tower: 1118 m from turbines	**Viasat:** no concerns raised **Optus:** no concerns raised in relation to mobile phone services, no response received in relation to point-to-point links	**Satellite services:** none **Mobile phone services:** see findings for mobile phones **Point-to-point links:** see findings for point-to-point links	**Satellite services:** none required **Mobile phone services:** as for mobile phones **Point-to-point links:** as for point-to-point links
Fixed point-to-point links	7 links crossing Project boundary, operated by: Optus No turbines in diffraction zones, 1 turbine in potential reflection/scattering zones, no turbines in potential near-field zones	No response received	Low likelihood of interference through reflection or scattering of signals	If required - reroute affected links, install additional towers, replace affected links with alternative technologies
Fixed point-to-multipoint links	120 assignments within 75 km of Project boundary No base stations within 20 km of Project boundary	No concerns raised	Potential for interference if link paths cross the Project near turbines	If required – reroute affected links, install additional towers, replace affected links with alternative technologies
Other licence types	**Point-to-area style communications:** see findings for emergency services, mobile phones, radio broadcasting, and television broadcasting **Aeronautical and radiodetermination:** to be considered as part of an aviation impact assessment	-	-	-
Emergency services	**Point-to-point links:** no links crossing boundary **Point-to-area style communications:** unlikely to be affected	No concerns raised	**Point-to-point links:** none **Point-to-area style communications:** unlikely to cause interference	**Point-to-point links:** none required **Point-to-area style communications:** if required – increase signal strength from affected tower or alternative towers, install signal repeater, install additional tower

Table 6 Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Meteorological radar	Nearest radar: 70 km from Project	Impacts are expected to be manageable	Unlikely to cause significant interference	Notify the Bureau of Meteorology prior to any planned shutdown of the Project to allow calibration of systems, collaborate with the Bureau of Meteorology in the event of severe weather conditions
Trigonometrical stations	8 stations within 20 km of Project boundary **Electronic equipment:** unlikely to be affected **Survey marks:** unlikely to be affected **Sight lines to other stations:** may be blocked by turbines	No concerns raised – avoid physical disturbance of survey marks along the South Gippsland Highway	Unlikely to cause interference	None required
Citizen's band radio	Unlikely to be affected	Consultation not considered necessary	Unlikely to cause interference	None required
Mobile phones	**Optus, Telstra:** generally good coverage in areas surrounding the Project **Vodafone:** coverage not available in areas surrounding the Project Unlikely to be affected in areas with good coverage, may experience interference in areas with marginal coverage	**Vodafone:** no concerns raised **Optus:** impacts not expected to be unacceptable **Telstra:** no response received	Low likelihood of interference	If required – increase signal strength from affected tower or alternative towers, install additional tower
Wireless internet	**Wireless broadband service providers:** Aussie Broadband, Optus, Telstra, NBN Co **NBN:** available as a fixed wireless and satellite service in areas surrounding the Project	**Aussie Broadband:** no concerns raised **Optus:** impacts not expected to be unacceptable **NBN Co:** no concerns raised **-** details of any radiocommunication equipment for the Project should be provided when known **Telstra:** no response received	**Wireless broadband services**: see findings for mobile phones **NBN:** unlikely to cause interference	**Wireless broadband services:** as for mobile phones **NBN:** if required – redirect antennas at affected dwellings to alternative towers, change location of antenna, install new tower

Table 6 Summary of EMI assessment results for the proposed Project (continued)

Licence or service type	Results of DNV assessment	Stakeholder feedback (to date)	Expected impact	Potential mitigation options
Satellite television and internet	**Services intended for Australian audiences:** unlikely to be affected **Services intended for international audiences:** signals from 22 satellites intercepted at 15 dwellings	Consultation with operators not considered necessary	Unlikely to cause interference	If required – redirect satellite dish to alternative satellite, install larger or higher-quality satellite dish, change location or height of satellite dish
Radio broadcasting	**AM and FM signals:** may experience interference in close proximity to turbines **Digital radio signals:** Project is outside the intended coverage area	Consultation not considered necessary	**AM and FM signals:** low likelihood of interference **Digital radio signals:** none	**AM and FM signals:** if required – install higher-quality antenna at affected location **Digital radio signals:** none required
Television broadcasting	May experience interference in areas with poor or marginal reception **Latrobe Valley transmitter:** *'good' coverage across most of the Project, 'poor' to 'variable' coverage to the immediate northwest and to the west, southwest, and far north* 26 dwellings (5 host dwellings) in potential interference zone, potential for dwellings in the immediate northwest, west, and southwest to receive a reflected signal that is stronger than the direct signal	Low risk of interference for up to 30 residents, high risk of interference for up to 9 residents – rectification of any interference is expected to form part of the Project	High likelihood of interference in areas to the immediate northwest, west, and southwest	If required – re-align antenna at affected dwelling to existing tower, re-direct antenna to alternative tower, install more directional or higher gain antenna, change location of antenna, install cable or satellite television, install relay transmitter

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APPENDIX A – TELEVISION INTERFERENCE CAUSED BY REFLECTION OR SCATTERING OF SIGNALS

A.1 Susceptibility of DTV signals to reflection or scattering

The United Kingdom telecommunications regulator Ofcom [38] states the following with regard to interference to DTV reception:

> *"Digital television signals are much better at coping with signal reflections, and digital television pictures do not suffer from ghosting. However a digital receiver that has to deal with reflections needs a somewhat higher signal level than one that has to deal with the direct path only. This can mean that viewers in areas where digital signals are fairly weak can experience interruptions to their reception should new reflections appear… reflections may still affect digital television reception in some areas, although the extent of the problem should be far less than for analogue television."*

DNV has drawn two conclusions from this report:

- Firstly, that DTV is very robust and does not suffer from ghosting. In most cases DTV signals are not susceptible to interference from wind farm developments.
- Secondly, that areas of weak DTV signal can experience interruptions to their reception should new reflections appear, such as those from nearby wind turbines.

For television broadcast signals, which are omni-directional or point-to-area signals, interference from wind turbines is dependent on many factors including:

- the proximity of turbines to the television broadcast transmitter
- the proximity of turbines to receivers (dwellings)
- the location of turbines in relation to dwellings and television broadcast transmitters
- the rotor blade material, rotor speed, and rotor blade direction (always into the wind)
- the properties of the receiving antenna (e.g., type, directionality, and height)
- the location of the television receiver in relation to terrain and other obstacles
- the frequency and power of the television broadcast signal.

A.2 Forward and back scatter of DTV signals

Wind turbines can cause interference to DTV signals by introducing reflections that may be received by the antenna at a dwelling, in addition to the signal received directly from the transmitter, which causes multipath errors. A wind turbine has the potential to scatter electromagnetic waves carrying DTV signals both forward and back.

Forward scatter can occur when the transmitter, one or more turbines, and receiver are almost aligned as shown in Figure A.1. The forward scatter region in this case is characterised by a shadow zone of reduced signal strength behind the turbine, where direct and scattered signals can be received, with the blade rotation introducing a rapid variation in the scattered signal [46]. Both of these effects can potentially degrade the DTV signal quality.

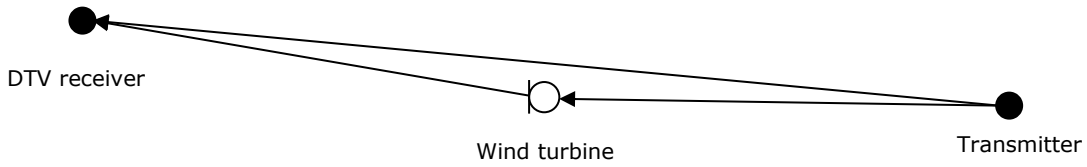

Figure A.1 Forward scatter signal path for DTV signals

Back scatter from wind turbines occurs when DTV signals are reflected from turbine towers and blades onto a receiver as shown in Figure A.2. The reflected signals are attenuated, time-delayed and phase-shifted (due to a longer path from transmitter to receiver) compared to the original signal. The reflected signals are also time-varying due to the rotation of the blades and vary with wind direction. The resultant signal at the receiver includes the original signal (transmitter to receiver) and a series of time-varying multipath signals (transmitter-turbine-receiver).

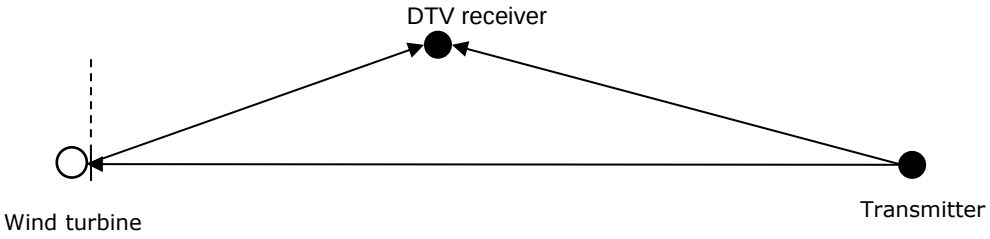

Figure A.2 Back scatter signal path for DTV signals

Interference to DTV signals from wind turbines can potentially occur in both the forward and backward scatter region. The effect of a turbine on a DTV signal can be different depending on the scattering region where the receiver is located [46].

According to Ofcom [38], the forward scatter region does not typically extend further than 5 km for the worst combination of factors [7, 49]. Interference may extend beyond 5 km if the dwellings are screened from the broadcast transmitter, but do have line-of-sight to the turbines [38]. The shape of this region, assuming a relatively high gain, directional antenna, can be represented by a circular segment with an azimuthal range of approximately ±15° to ±20°, corresponding to the beam width of the antenna. If a lower gain or omni-directional antenna is being used, this region is likely to be larger.

Back scattered signals arrive at the dwelling delayed relative to the source signal from the broadcast transmitter. The back scatter region generally does not extend further than 500 m [7, 38], assuming a high gain, directional antenna that has a relatively high front-to-back ratio (meaning the signal received by the front of the antenna is much higher than that received from the back). If an antenna with a lower front-to-back ratio, or an omni-directional antenna is used, this region is likely be larger.

The combination of the forward and back scatter regions, as shown in Figure A.3, resembles a keyhole.

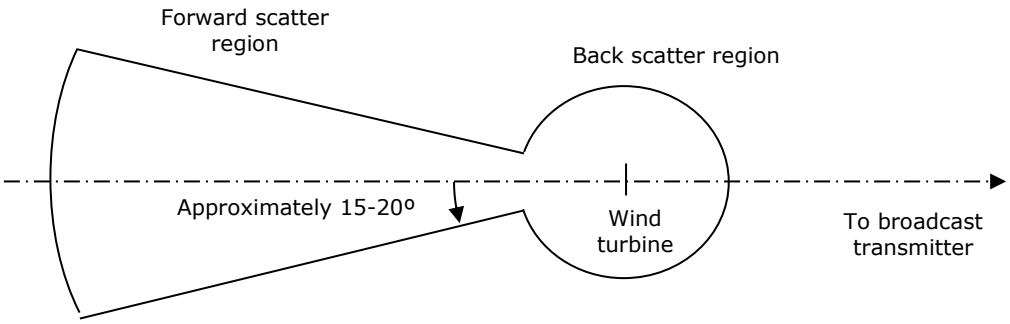

Figure A.3 Potential television interference zones around a wind turbine

Television interference mechanisms rely on many factors (as previously mentioned) and are complex to calculate. Previous experience has shown that even after great effort has been put into performing such calculations, they tend to have limited accuracy, and would require field validation after the wind farm is operational.

In Australia, DTV signals are transmitted using the DVB-T (Digital Video Broadcasting – Terrestrial) standard. The International Telecommunication Union (ITU) Recommendation BT.1893 [50] states the following in regards to the forward scatter region for DVB-T signals:

> *"In most of the situations where the impact of a wind farm to DVB-T reception quality was analyzed, the threshold C/N [carrier-to-noise] ratios obtained were similar to those expected in environments with the absence of wind farms. More precisely, in the forward scattering region of the wind turbines, where the transmit antenna, one or more turbines and the receive antenna are lined-up (±60° behind the wind turbine), the DVB-T reception quality may not be affected though further work of analysis is needed in order to confirm this point, especially in the vicinity of 0°."*

In other words, wind turbines are not generally expected to affect DVB-T DTV signals in the forward scatter region. However, the ITU [47] also highlight that in the case where there is significant blockage of the direct signal, but clear line-of-sight to one or more turbines, interference to the reception of the DTV signal is possible. Results of studies reported by the ITU also suggest that interference may be more likely in areas where the existing DTV signal is already weak or degraded [47].

With regards to back scattering, the ITU states:

> *"In the case of the backscattering region, in those situations where the scattered signals from wind turbines are significant in amplitude and variability, the threshold C/N ratio necessary for quasi error free (QEF) condition is higher."*

In other words, the C/N ratio needs to be higher in the presence of significant back scatter to achieve the same QEF condition as is the case without the presence of turbines, which effectively means that interference is more likely to occur as coverage quality decreases.

A.3 Theoretical models for wind turbine scattering estimation

Various theoretical scatter models to predict scatter of terrestrial television signals have been proposed, some dating back to the late 1970s. A review of these models, as well as a comparison against empirical data has been reported in [51]. This comparison with empirical data found:

> *"…none of the analyzed methods seems to be accurate enough to provide realistic estimations of the signal scattered by the wind turbines. In conclusion, a more complete scattering model is needed in order to provide more practical estimations of the scattered signals and evaluate their potential impact on the broadcasting services."*

Notably, the scattering model proposed by the ITU to specifically address DTV signals [50], was found to be the most inaccurate, and does not provide signal estimations in the forward scattering zone of the blades. Additionally, DNV notes that it only applies to a single wind turbine rather than a wind farm as a whole.

As an alternative to signal scattering models, it is common practice to identify those dwellings or areas that are most likely to experience potential television interference based on likely forward and back scatter regions. As introduced above and shown in Figure A.3, this is often referred to as the 'keyhole' approach and is an established technique for predicting where terrestrial television interference is most likely, based on a number of assumptions regarding receiving antenna characteristics. The approach involves combining multiple keyhole shaped areas that are placed over each turbine location [38]. The combination of these areas forms a region where there is an increased likelihood of interference to television signals occurring.

LIST OF TABLES

Table 7 Proposed turbine layout for the Project [3]

Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation[2] [m]	Turbine ID	Easting[1] [m]	Northing[1] [m]	Base elevation[2] [m]
GWT01	459100	5721210	5	GWT08	464965	5723088	9
GWT02	459315	5721622	6	GWT09	465167	5723719	8
GWT03	459649	5722922	11	GWT10	466839	5726260	11
GWT04	462359	5723610	10	GWT11	467329	5725912	10
GWT05	462850	5723360	10	GWT12	467499	5724918	7
GWT06	463560	5723251	11	GWT13	467573	5724240	6
GWT07	464422	5723400	7				

1. Coordinate system: MGA zone 55, GDA94 datum. Coordinates were provided by the Proponent in a different coordinate system and/or datum and have been converted using mapping software, which may result in small discrepancies depending on the software and transformation approach used.
2. Base elevations have been determined by DNV based on publicly available SRTM1 data.

Table 8 Dwellings in the vicinity of the proposed Project [4]

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Status	Distance to nearest turbine [km]
H01	*458025*	*5721402*	*Host*	*1092*
H02	*458500*	*5721771*	*Host*	*820*
H03	*459349*	*5723516*	*Host*	*665*
H04	*460504*	*5723857*	*Host*	*1266*
H05	*464013*	*5723671*	*Host*	*490*
H06	*465556*	*5724497*	*Host*	*868*
H07	*466861*	*5725603*	*Host*	*561*
H08	*467096*	*5724124*	*Host*	*490*
H09	*467292*	*5724167*	*Host*	*290*
H10	*468091*	*5725645*	*Host*	*807*
H11	*468289*	*5724341*	*Host*	*722*
H12	*468387*	*5725685*	*Host*	*1081*
N001	455488	5722784	Neighbour	3940
N002	455603	5722899	Neighbour	3883
N003	455635	5722747	Neighbour	3790
N004	455713	5722770	Neighbour	3728
N005	455746	5722519	Neighbour	3600
N006	455767	5722749	Neighbour	3670
N007	455812	5722493	Neighbour	3529
N008	455833	5722734	Neighbour	3604
N009	455846	5722643	Neighbour	3555
N010	455885	5722693	Neighbour	3540
N011	455968	5722476	Neighbour	3377
N012	456025	5722687	Neighbour	3411
N013	456080	5722672	Neighbour	3355
N014	456156	5718961	Neighbour	3705
N015	456219	5721292	Neighbour	2882
N016	456273	5723846	Neighbour	3500
N017	456340	5718760	Neighbour	3691
N018	456378	5720235	Neighbour	2891
N019	456459	5722565	Neighbour	2968
N020	456465	5723972	Neighbour	3353
N021	456467	5721687	Neighbour	2675
N022	456507	5718922	Neighbour	3458
N023	456511	5723500	Neighbour	3190
N024	456555	5724751	Neighbour	3594
N025	456626	5723039	Neighbour	3025
N026	456636	5722499	Neighbour	2781
N027	456656	5724913	Neighbour	3594
N028	456670	5722315	Neighbour	2669
N029	456675	5722350	Neighbour	2679
N030	456728	5724110	Neighbour	3153
N031	456731	5722470	Neighbour	2683
N032	456782	5720819	Neighbour	2351
N033	456856	5720072	Neighbour	2516
N034	456932	5719934	Neighbour	2516
N035	456961	5720203	Neighbour	2365
N036	456966	5719951	Neighbour	2477
N037	457059	5719143	Neighbour	2904
N038	457354	5720364	Neighbour	1941
N039	457420	5721300	Neighbour	1683

Table 8 Dwellings in the vicinity of the proposed Project [4] (continued)

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Status	Distance to nearest turbine [km]
N040	457420	5718778	Neighbour	2956
N041	457646	5724220	Neighbour	2387
N042	457690	5718779	Neighbour	2810
N043	457910	5720035	Neighbour	1673
N044	458209	5720223	Neighbour	1330
N045	458254	5724124	Neighbour	1841
N046	458517	5722410	Neighbour	1121
N047	458644	5718548	Neighbour	2701
N048	458733	5723594	Neighbour	1136
N049	458871	5724189	Neighbour	1487
N050	458877	5725243	Neighbour	2445
N051	458998	5719762	Neighbour	1452
N052	459982	5719129	Neighbour	2260
N053	460111	5719589	Neighbour	1910
N054	460407	5718516	Neighbour	2994
N055	461192	5720027	Neighbour	2403
N056	461841	5720193	Neighbour	2902
N057	462018	5721036	Neighbour	2467
N058	462518	5721654	Neighbour	1737
N059	462654	5726675	Neighbour	3079
N060	462982	5726531	Neighbour	2986
N061	463159	5726956	Neighbour	3440
N062	463170	5728866	Neighbour	4500
N063	463205	5728899	Neighbour	4491
N064	463221	5726847	Neighbour	3349
N065	463273	5728824	Neighbour	4392
N067	463348	5724708	Neighbour	1436
N068	463397	5724327	Neighbour	1087
N069	463702	5727703	Neighbour	3452
N070	463709	5728137	Neighbour	3649
N071	463770	5731357	Neighbour	5949
N072	463802	5729939	Neighbour	4770
N073	463821	5725011	Neighbour	1719
N074	463822	5725679	Neighbour	2356
N075	463822	5728074	Neighbour	3520
N076	463853	5730987	Neighbour	5590
N077	463907	5726007	Neighbour	2611
N078	463929	5731319	Neighbour	5836
N079	463958	5724676	Neighbour	1357
N080	464021	5729605	Neighbour	4374
N081	464065	5724475	Neighbour	1132
N082	464218	5727581	Neighbour	2935
N083	464239	5727518	Neighbour	2888
N084	464260	5727381	Neighbour	2812
N085	464278	5724559	Neighbour	1167
N086	464298	5727620	Neighbour	2882
N088	464393	5724552	Neighbour	1137
N089	464402	5727286	Neighbour	2644
N090	464479	5728935	Neighbour	3567
N091	464619	5729289	Neighbour	3755
N092	464632	5727401	Neighbour	2484
N093	464705	5727526	Neighbour	2481

Table 8 Dwellings in the vicinity of the proposed Project [4] (continued)

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Status	Distance to nearest turbine [km]
N094	464723	5727343	Neighbour	2377
N095	464744	5729374	Neighbour	3753
N096	464746	5727333	Neighbour	2352
N097	464805	5727512	Neighbour	2388
N098	464816	5729478	Neighbour	3800
N099	464827	5727265	Neighbour	2248
N100	464830	5727302	Neighbour	2263
N101	464933	5726950	Neighbour	2027
N102	464967	5730567	Neighbour	4695
N103	465012	5727703	Neighbour	2327
N104	465014	5730938	Neighbour	5020
N105	465058	5729121	Neighbour	3369
N106	465104	5728305	Neighbour	2682
N107	465133	5727630	Neighbour	2187
N108	465145	5729289	Neighbour	3470
N109	465158	5726701	Neighbour	1738
N110	465338	5726903	Neighbour	1633
N111	465354	5727001	Neighbour	1659
N112	465362	5727615	Neighbour	2003
N113	465384	5725595	Neighbour	1600
N114	465501	5732364	Neighbour	6248
N115	465624	5725325	Neighbour	1533
N116	465662	5725283	Neighbour	1530
N117	465666	5725356	Neighbour	1481
N118	465711	5728790	Neighbour	2769
N119	465725	5724876	Neighbour	1283
N120	465953	5727553	Neighbour	1567
N121	466041	5724448	Neighbour	1136
N122	466061	5727420	Neighbour	1396
N123	466440	5728060	Neighbour	1843
N124	466491	5727791	Neighbour	1569
N125	466580	5728554	Neighbour	2308
N126	466729	5728008	Neighbour	1750
N127	466778	5728056	Neighbour	1796
N128	466855	5721982	Neighbour	2189
N129	466909	5721988	Neighbour	2233
N130	466928	5727795	Neighbour	1536
N131	466948	5721874	Neighbour	2324
N132	467134	5728107	Neighbour	1869
N133	467278	5722330	Neighbour	1933
N134	467335	5722556	Neighbour	1701
N135	467671	5727003	Neighbour	1115
N136	467727	5729527	Neighbour	3384
N137	467900	5727785	Neighbour	1856
N138	467997	5722524	Neighbour	1767
N139	468130	5723076	Neighbour	1289
N140	468183	5727933	Neighbour	2145
N141	468197	5727025	Neighbour	1411
N142	468221	5727025	Neighbour	1426
N143	468312	5722797	Neighbour	1620
N144	468314	5731598	Neighbour	5538
N145	468397	5729316	Neighbour	3429

Table 8 Dwellings in the vicinity of the proposed Project [4] (continued)

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Status	Distance to nearest turbine [km]
N146	468402	5723336	Neighbour	1226
N147	468413	5723410	Neighbour	1180
N148	468517	5722374	Neighbour	2091
N149	468582	5730328	Neighbour	4424
N150	468737	5730294	Neighbour	4457
N151	468853	5726871	Neighbour	1800
N152	468893	5730194	Neighbour	4437
N153	468913	5730053	Neighbour	4322
N154	469008	5726566	Neighbour	1802
N155	469159	5725200	Neighbour	1683
N156	469198	5724778	Neighbour	1705
N157	469441	5730045	Neighbour	4592
N158	469516	5724608	Neighbour	1976
N159	469709	5724437	Neighbour	2144
N160	469851	5724560	Neighbour	2299
N161	469926	5724571	Neighbour	2375
N162	470000	5724613	Neighbour	2454
N163	470083	5724534	Neighbour	2526
N164	470226	5724438	Neighbour	2659
N165	470239	5724508	Neighbour	2678
N166	470482	5726474	Neighbour	3202
N167	470484	5726228	Neighbour	3171
N168	470495	5726266	Neighbour	3185
N169	470567	5726636	Neighbour	3317
N170	470606	5726504	Neighbour	3330
N171	470671	5726984	Neighbour	3510
N172	470679	5726522	Neighbour	3405
N173	470735	5726465	Neighbour	3451
N174	470749	5726655	Neighbour	3499
N175	470763	5726031	Neighbour	3436
N176	470770	5726224	Neighbour	3454
N177	470799	5725908	Neighbour	3445
N178	470799	5726230	Neighbour	3484
N179	470799	5726697	Neighbour	3558
N180	470802	5726037	Neighbour	3475
N181	470808	5726115	Neighbour	3485
N182	470816	5726163	Neighbour	3496
N183	470826	5725982	Neighbour	3493
N184	470827	5726052	Neighbour	3501
N185	470831	5726246	Neighbour	3517
N186	470832	5726164	Neighbour	3512
N187	470844	5726247	Neighbour	3530
N188	470847	5726126	Neighbour	3524
N189	470849	5726171	Neighbour	3530
N190	470854	5725989	Neighbour	3522
N191	470861	5726248	Neighbour	3547
N192	470866	5726075	Neighbour	3540
N193	470870	5726132	Neighbour	3548
N194	470874	5726174	Neighbour	3554
N195	470885	5726062	Neighbour	3559
N196	470888	5726131	Neighbour	3565
N197	470889	5725498	Neighbour	3439

Table 8 Dwellings in the vicinity of the proposed Project [4] (continued)

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Status	Distance to nearest turbine [km]
N198	470900	5726073	Neighbour	3574
N199	470907	5726213	Neighbour	3590
N200	470908	5725053	Neighbour	3412
N201	470915	5726144	Neighbour	3593
N202	470923	5726176	Neighbour	3603
N203	470923	5726404	Neighbour	3627
N204	470926	5726106	Neighbour	3602
N205	470930	5725550	Neighbour	3489
N206	470934	5725340	Neighbour	3460
N207	470937	5726085	Neighbour	3612
N208	470940	5726329	Neighbour	3634
N209	470952	5726270	Neighbour	3640
N210	470962	5726250	Neighbour	3649
N211	470967	5725974	Neighbour	3625
N212	470977	5725899	Neighbour	3614
N213	470978	5726193	Neighbour	3659
N214	470980	5725875	Neighbour	3610
N215	470982	5725849	Neighbour	3605
N216	470983	5725824	Neighbour	3599
N217	470989	5726112	Neighbour	3665
N218	470994	5725094	Neighbour	3499
N219	471013	5725494	Neighbour	3561
N220	471020	5725718	Neighbour	3610
N221	471151	5725126	Neighbour	3658
N222	462807	5726672	Neighbour	3094
N223	460076	5719521	Neighbour	1950

1. Host dwellings are indicated by *underlined italic text*.
2. Coordinate system: MGA zone 55, GDA94 datum. Coordinates were provided by the Proponent in a different coordinate system and/or datum and have been converted using mapping software, which may result in small discrepancies depending on the software and transformation approach used.

Table 9 Details of point-to-point links crossing the proposed Project

Link no.	Licence number	Assignment ID	Frequency [Hz]	Licence owner
1	11283421/1	8202271	11565000000	Optus Mobile Pty Limited 1 Lyonpark Road MACQUARIE PARK NSW 2113
		8202272	11565000000	
		8202273	11075000000	
		8202274	11075000000	
2	11287982/1	8206586	8073845000	
		8206587	8073845000	
		8206588	7762525000	
		8206589	7762525000	
3	11287983/1	8206590	8192445000	
		8206591	8192445000	
		8206592	7881125000	
		8206593	7881125000	
4	11287984/1	8206594	8192445000	
		8206595	8192445000	
		8206596	7881125000	
		8206597	7881125000	
5	11289281/1	8208690	8118320000	
		8208691	8118320000	
		8208692	7807000000	
		8208693	7807000000	
6	11289282/1	8208694	8118320000	
		8208695	8118320000	
		8208696	7807000000	
		8208697	7807000000	
7	1978806/1	986463	8073845000	Optus Mobile Pty Limited PO Box 888 NORTH RYDE NSW 1670
		986464	8073845000	
		986465	7762525000	
		986466	7762525000	

Table 10 Details of point-to-multipoint licences within 75 km of the proposed Project

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
1245497	51143	1564676/1	-38.5699	146.3066	20	AUSNET ELECTRICITY SERVICES PTY LTD Locked Bag 1405 Licensing-ICT Business Office MELBOURNE CITY MAIL CENTRE VIC 8001
1245500	51143	1564676/1	-38.5699	146.3066	20	
1245493	302113	1564674/1	-38.4057	146.6387	21	
1245496	302113	1564674/1	-38.4057	146.6387	21	
1245541	47952	1565029/1	-38.3457	146.4745	30	
1245544	47952	1565029/1	-38.3457	146.4745	30	
1245525	53019	1565024/1	-38.2793	146.0497	57	
1245528	53019	1565024/1	-38.2793	146.0497	57	
1245613	53019	1900011/1	-38.2793	146.0497	57	
1245616	53019	1900011/1	-38.2793	146.0497	57	
7985042	300310	1975738/2	-38.2616	146.3920	42	AUSTRALIAN POWER PARTNERS B V & Others Atten Accounts Payable PO Box 195 IT Manager MORWELL VIC 3840
7985045	300310	1975738/2	-38.2616	146.3920	42	
7985046	300310	9872738/2	-38.2616	146.3920	42	
7985049	300310	9872738/2	-38.2616	146.3920	42	
9367261	300310	11714415/1	-38.2616	146.3920	42	
9367264	300310	11714415/1	-38.2616	146.3920	42	
892086	54736	1922866/1	-38.1304	146.4841	53	Aussie Broadband Pty Ltd PO Box 3351 GIPPSLAND MC VIC 3841
892089	54736	1922866/1	-38.1304	146.4841	53	
892134	306018	1922870/1	-37.9345	146.6418	74	
892137	306018	1922870/1	-37.9345	146.6418	74	
4767922	10011060	10605410/1	-38.1944	146.5315	45	Bureau of Meteorology GPO Box 1289 MELBOURNE VIC 3001
4767925	10011060	10605410/1	-38.1944	146.5315	45	
813995	305763	1433620/1	-38.3738	146.6771	25	CENTRAL GIPPSLAND REGION WATER CORPORATION GIPPSLAND WATER PO Box 348 TRARALGON VIC 3844
813998	305763	1433620/1	-38.3738	146.6771	25	
832504	305763	1565581/1	-38.3738	146.6771	25	
832507	305763	1565581/1	-38.3738	146.6771	25	
1399788	305763	9896648/1	-38.3738	146.6771	25	
1399789	305763	9896648/1	-38.3738	146.6771	25	
2527171	305763	10220582/1	-38.3738	146.6771	25	
2527172	305763	10220582/1	-38.3738	146.6771	25	
2527175	305763	10220583/1	-38.3738	146.6771	25	
2527176	305763	10220583/1	-38.3738	146.6771	25	
2600595	305763	10231253/1	-38.3738	146.6771	25	
2600596	305763	10231253/1	-38.3738	146.6771	25	
920285	9014501	1942092/1	-38.3881	146.2693	35	
920288	9014501	1942092/1	-38.3881	146.2693	35	
5964731	10005987	1934759/5	-38.2127	146.5256	43	
5964734	10005987	1934759/5	-38.2127	146.5256	43	
1005198	9023520	1987417/1	-38.2343	146.4238	43	
1005201	9023520	1987417/1	-38.2343	146.4238	43	
1399783	42773	9896646/1	-38.2103	146.5255	44	
1399786	42773	9896646/1	-38.2103	146.5255	44	
4322391	42773	10543600/1	-38.2103	146.5255	44	
4322392	42773	10543600/1	-38.2103	146.5255	44	
874504	9009530	1911224/1	-38.1944	146.4458	47	

Table 10 Details of point-to-multipoint licences within 75 km of the proposed Project

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
874507	9009530	1911224/1	-38.1944	146.4458	47	
813991	9011755	1433619/1	-38.2183	146.2475	52	
813994	9011755	1433619/1	-38.2183	146.2475	52	
913034	9011755	1937848/1	-38.2183	146.2475	52	
913037	9011755	1937848/1	-38.2183	146.2475	52	
4278666	9011755	1300996/2	-38.2183	146.2475	52	
4278667	9011755	1300996/2	-38.2183	146.2475	52	
792393	42768	1325578/1	-38.2007	146.2601	53	
792396	42768	1325578/1	-38.2007	146.2601	53	
744385	42764	1143457/1	-38.1586	146.3472	54	
744388	42764	1143457/1	-38.1586	146.3472	54	
1400404	42764	9896649/1	-38.1586	146.3472	54	
1400405	42764	9896649/1	-38.1586	146.3472	54	
4372695	9004436	10548618/1	-38.3604	147.1783	55	
4372696	9004436	10548618/1	-38.3604	147.1783	55	
715435	301089	197125/1	-38.1083	147.0525	66	
715438	301089	197125/1	-38.1083	147.0525	66	
975443	301089	1973297/1	-38.1083	147.0525	66	CENTRAL GIPPSLAND REGION WATER CORPORATION GIPPSLAND WATER PO Box 348 TRARALGON VIC 3844
975446	301089	1973297/1	-38.1083	147.0525	66	
981764	301089	1976255/1	-38.1083	147.0525	66	
981767	301089	1976255/1	-38.1083	147.0525	66	
2527159	301089	10220579/1	-38.1083	147.0525	66	
2527160	301089	10220579/1	-38.1083	147.0525	66	
2527183	301089	10220585/1	-38.1083	147.0525	66	
2527184	301089	10220585/1	-38.1083	147.0525	66	
832520	461630	1565583/1	-38.1124	147.0613	67	
832523	461630	1565583/1	-38.1124	147.0613	67	
792401	305231	1325579/1	-38.1071	147.0535	67	
792404	305231	1325579/1	-38.1071	147.0535	67	
2527187	305231	10220586/1	-38.1071	147.0535	67	
2527188	305231	10220586/1	-38.1071	147.0535	67	
790502	304548	1323500/1	-38.2543	147.2973	70	
790505	304548	1323500/1	-38.2543	147.2973	70	
832548	305769	1565584/1	-38.2112	147.2932	72	
832551	305769	1565584/1	-38.2112	147.2932	72	
2527179	305769	10220584/1	-38.2112	147.2932	72	
2527180	305769	10220584/1	-38.2112	147.2932	72	
786335	100232	1312078/1	-38.1845	145.9288	72	
786338	100232	1312078/1	-38.1845	145.9288	72	
792377	305228	1325576/1	-37.9599	146.7927	72	
792380	305228	1325576/1	-37.9599	146.7927	72	
1268090	50859	494323/1	-38.0991	147.1507	72	Department of Defence Director Defence Spectrum Office D DSO APW-GF-173, Anzac Park West PO Box 7953 CANBERRA BC ACT 2610
1268093	50859	494323/1	-38.0991	147.1507	72	

Table 10 Details of point-to-multipoint licences within 75 km of the proposed Project

Assignment ID	Site ID	Licence no.	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]	Licence owner
727424	52632	491772/1	-38.2084	146.3662	48	ENERGYAUSTRALIA YALLOURN PTY LTD Attn: Neil Firmin PO Box 444 MOE VIC 3825
727427	52632	491772/1	-38.2084	146.3662	48	
757177	12029	1187159/1	-38.4060	146.6382	21	ESSO Australia Pty Ltd GPO Box 400C Lvl 4 EMIT Invoice Management MELBOURNE VIC 3001
757180	12029	1187159/1	-38.4060	146.6382	21	
715320	12041	191259/1	-38.3724	146.6775	26	
715323	12041	191259/1	-38.3724	146.6775	26	
789685	42394	1322428/1	-38.2207	147.1559	63	
789688	42394	1322428/1	-38.2207	147.1559	63	
868045	42394	1905840/1	-38.2207	147.1559	63	
868048	42394	1905840/1	-38.2207	147.1559	63	
989326	42394	1980218/1	-38.2207	147.1559	63	
989329	42394	1980218/1	-38.2207	147.1559	63	
1220124	403605	1425351/1	-38.0001	146.6584	66	GIPPSLAND SOUTHERN RURAL WATER CORPORATION SOUTHERN RURAL WATER Accounts Payable PO Box 153 MAFFRA VIC 3860
1220127	403605	1425351/1	-38.0001	146.6584	66	
787803	302912	1317096/1	-38.3967	146.5624	23	LATROBE CITY COUNCIL PO Box 264 MORWELL VIC 3840
787806	302912	1317096/1	-38.3967	146.5624	23	
4052206	10011059	10502978/1	-38.3545	146.4379	31	
4052209	10011059	10502978/1	-38.3545	146.4379	31	
2399897	9003020	10182410/1	-38.2410	146.5597	40	Loy Yang Power Management Pty Ltd PO Box 1799 Attn: Rob Benson TRARALGON VIC 3844
2399900	9003020	10182410/1	-38.2410	146.5597	40	
4047023	52625	10501450/1	-38.2380	146.5613	40	
4047026	52625	10501450/1	-38.2380	146.5613	40	
787359	302666	1316032/1	-38.2521	146.4095	42	
787362	302666	1316032/1	-38.2521	146.4095	42	
1009809	9024061	1989850/1	-38.6450	146.2103	27	SOUTH GIPPSLAND REGION WATER CORPORATION SOUTH GIPPSLAND WATER PO Box 102 FOSTER VIC 3960
1009812	9024061	1989850/1	-38.6450	146.2103	27	
5164219	9001159	10670426/1	-38.4422	145.8365	64	
5164222	9001159	10670426/1	-38.4422	145.8365	64	
5163052	10016609	10670139/1	-38.3553	145.7860	72	
5163053	10016609	10670139/1	-38.3553	145.7860	72	
1395520	9027170	9891130/1	-38.0153	146.8149	67	W C AND T L WARREN 2057 Sale-Heyfield Rd DENISON VIC 3858
1395523	9027170	9891130/1	-38.0153	146.8149	67	

Table 11 Details of other licences identified within 75 km of the proposed Project

Licence category	Licence type	Number of assignment IDs
1800 MHz Band	Spectrum	669
2 GHz Band	Spectrum	592
2.3 GHz Band	Spectrum	10491
2.5 GHz Band	Spectrum	286
3.4 GHz Band	Spectrum	9172
700 MHz Band	Spectrum	890
800 MHz Band	Spectrum	574
AWL - FSS Only	Spectrum	73
Aeronautical Assigned System	Aeronautical	79
Amateur Repeater	Amateur	60
Ambulatory - Initial	Land Mobile	10
Ambulatory System	Land Mobile	182
CBRS Repeater	Land Mobile	8
Commercial Radio	Broadcasting	4
Commercial Television	Broadcasting	9
Community Broadcasting	Broadcasting	6
Earth Receive	Earth Receive	6
Fixed Earth	Earth	4
Fixed Receive	Fixed Receive	3
Land Mobile System - > 30MHz	Land Mobile	1144
Land Mobile System 0-30MHz	Land Mobile	190
Limited Coast Assigned System	Maritime Coast	32
Narrowband Area Service station(s)	Broadcasting	3
Narrowcasting Service (Fixed Tax)	Broadcasting	4
Narrowcasting Service (LPON)	Broadcasting	13
National Broadcasting	Broadcasting	12
PMTS Class B	PTS	290
PMTS Class B (935-960 MHz)	PTS 900 MHz	125
Paging System - Exterior	Land Mobile	24
Paging System - Interior	Land Mobile	16
Radiodetermination	Radiodetermination	42
Retransmission	Broadcasting	26

Table 12 Emergency services with radiocommunication assets in the vicinity of the proposed Project

Emergency service	Contact details	Distance from closest site to Project boundary [km]
Ambulance Victoria	Ambulance Victoria Attn: Tim McCallum 303 Gillies Street North WENDOUREE VIC 3355	23
Australian Maritime Safety Authority	Australian Maritime Safety Authority GPO Box 2181 Attn: Response Division Administration Canberra ACT 2601	32
Country Fire Authority	Country Fire Authority PO Box 701 MOUNT WAVERLEY VIC 3149	6
Department of Justice and Community Safety	Department of Justice and Community Safety RMR Regional Mobile Radio C/- Level 2 Bld M5 30 Henderson Rd CLAYTON VIC 3168	20
Department of Justice and Community Safety	Department of Justice and Community Safety Visionstream Australia Locked Bag 4001 Attn: Phillip Minopoulos Heatherton VIC 3202	7
Department of Environment Land Water and Planning	Department of Environment Land Water and Planning Dept of Sustainability and Environment Attn Paul Rofe DELWP Accounts Payable Locked Bag 32017 Collins Street East MELBOURNE VIC 8003	6
Life Saving Victoria Limited	Life Saving Victoria Limited 200 The Boulevard PORT MELBOURNE VIC 3207	30
St. John Ambulance Australia Incorporated	St. John Ambulance Australia Incorporated Technical Services 170 Forster Road MOUNT WAVERLEY VIC 3149	20
The Australian Volunteer Coast Guard Association Inc	The Australian Volunteer Coast Guard Association Inc PO Box 64 SANDRINGHAM VIC 3191	7
Victoria State Emergency Service	Victoria State Emergency Service 168 Sturt St SOUTHBANK VIC 3006	7

Table 13 Bureau of Meteorology radar sites in the vicinity of the proposed Project

Site ID	Site name	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]
136780	Wind Profiler Radar Site RAAF Base EAST SALE	-38.1156	147.1329	70
136953	Weather Radar site Bairnsdale Aerodrome Aerodrome Road BAIRNSDALE	-37.8875	147.5755	115
134173	Met Bureau S1 Doppler Radar Training Facility Glenlitta Avenue BROADMEADWS	-37.6911	144.9480	174
49837	Met Bureau BMTC Annex Glenlitta Ave BROADMEADOWS	-37.6905	144.9470	174
49837	Met Bureau BMTC Annex Glenlitta Ave BROADMEADOWS	-37.6905	144.9470	174
49723	Met Bureau Glenlitta Ave BROADMEADOWS	-37.6902	144.9435	174
49723	Met Bureau Glenlitta Ave BROADMEADOWS	-37.6902	144.9435	174
49834	Met Bureau Radar Site RAAF Base LAVERTON	-37.8552	144.7552	178
49834	Met Bureau Radar Site RAAF Base LAVERTON	-37.8552	144.7552	178
302559	Met Rd MELBOURNE AIRPORT	-37.6735	144.8433	182
304566	Met Bureau Site YARRAWONGA AIRPORT	-36.0297	146.0227	290
700224	Weather Radar Site WEST TAKONE	-41.1791	145.5797	291
10017533	Bureau of Meteorology Wind Profiler Launceston Airport Evandale Road EVANDALE	-41.5475	147.2160	326
201025	Meteorological Office WAGGA WAGGA	-35.1582	147.4563	389
204400	BOM 27m Radar Tower, Mount Cowangerong Off Captains Flat Rd Jingera	-35.6615	149.5123	415
201743	IPS Radio Site MOUNT STROMLO	-35.3159	149.0011	422
49736	Bureau of Meteorology CANBERRA AIRPORT	-35.3084	149.2007	432

Table 14 Trigonometrical stations in the vicinity of the proposed Project

Station name	Datum	Latitude [GDA94]	Longitude [GDA94]	Distance to Project [km]
Beech Hill	AGD66, AGD84, GDA94	-38.5296	146.3919	17
Christensen	AGD66	-38.6743	146.5312	2
Gelliondale	AGD66, AGD84, GDA94	-38.6166	146.5578	1
Hunter	AGD66, AGD84, GDA94	-38.8239	146.4487	19
Kjergaard	AGD66, AGD84, GDA94	-38.4375	146.6178	18
Silcocks Hill	AGD66	-38.6568	146.3440	15
Slades Hill	AGD66	-38.6549	146.4159	9
Weeroona	AGD66	-38.6492	146.4225	9

Table 15 Satellite vectors with potential to be intercepted by the proposed Project

Intercepted satellite	Services provided [52]	Affected dwellings[1]
Eutelsat 70B (E70B, W5A, Eutelsat W5A)	Programs intended for international audiences	*H12*, N138, N143, N158, N160, N161, N162, N163, N164, N165, N206, N220
Intelsat 22 (IS-22)	Programs intended for international audiences	*H12*, N138, N158, N160, N161, N163, N164, N165, N206
G-Sat 11, G-Sat 14, G-Sat 18, G-Sat 7 (Insat 4F, Rukmini)	Programs intended for international audiences	*H12*, N134, N158, N159
ABS 2 (ST 3, Koreasat 8, Condosat 2), ABS 2A (Mongolosat-1), Apstar 7	Programs intended for international audiences	*H12*
Express 80, Thaicom 6 (Africom 1), Thaicom 8	Programs intended for international audiences	*H10*, *H12*
ChinaSat 12 (ZX-15A, Chinasat 15A, ZX-12, Apstar 7B, SupremeSat 1), G-Sat 10, G-Sat 12, G-Sat 30, G-Sat 6 (Insat 4E), Horizons 2, Insat 4B, Intelsat 15 (IS-15, JCSat 85), Kazsat 2, ST 2	Programs intended for international audiences	*H10*

1. Host dwellings are indicated by *underlined italic text*.

Table 16 Dwellings with increased potential to experience EMI to DTV from television broadcast transmitters

Dwelling ID[1]	Easting[2] [m]	Northing[2] [m]	Located in potential interference zone Latrobe Valley
H05	*464013*	*5723671*	*X*
H07	*466861*	*5725603*	*X*
H08	*467096*	*5724124*	*X*
H09	*467292*	*5724167*	*X*
H11	*468289*	*5724341*	*X*
N047	458644	5718548	X
N051	458998	5719762	X
N052	459982	5719129	X
N053	460111	5719589	X
N054	460407	5718516	X
N055	461192	5720027	X
N056	461841	5720193	X
N057	462018	5721036	X
N058	462518	5721654	X
N128	466855	5721982	X
N129	466909	5721988	X
N131	466948	5721874	X
N133	467278	5722330	X
N134	467335	5722556	X
N138	467997	5722524	X
N139	468130	5723076	X
N143	468312	5722797	X
N146	468402	5723336	X
N147	468413	5723410	X
N148	468517	5722374	X
N223	460076	5719521	X

1. Host dwellings are indicated by *underlined italic text*.
2. Coordinate system: MGA zone 55, GDA94 datum. Coordinates were provided by the Proponent in a different coordinate system and/or datum and have been converted using mapping software, which may result in small discrepancies depending on the software and transformation approach used.

Table 17 Summary of service operators contacted by DNV and responses received to date

	Licence/service type and distance of closest site	Operator name and DNV reference	Response received to date
1	Fixed point-to-point: 7 links crossing the Project site No turbines in diffraction exclusion zones established by DNV, 1 turbine (GWT12) in potential reflection/scattering interference zone established by DNV, no turbines in potential near-field interference zone established by DNV PMTS/spectrum (mobile phone): 1.3 km from nearest turbine	Optus Mobile Pty Limited (Optus) 10326979-AUMEL-L-01	Partial response received by email on 20 September 2022: *"Thanks for sharing the details for Gelliondale Wind Farm.* *While there may be some impacts on Optus mobile coverage in the area, the impacts [are] not expected to be unacceptable from [a] radio access perspective."*
2	Fixed point-to-multipoint: 20 km from Project boundary	Ausnet Electricity Services Pty Ltd (AusNet Services) 10326979-AUMEL-L-02	Response received by email on 13 October 2022: *"After reviewing the attached KML files, I can confirm that AusNet's radio comms assets are clear from the location of the proposed Gelliondale Wind Farm."*
3	Fixed point-to-multipoint: 53 km from Project boundary	Aussie Broadband Pty Ltd (Aussie Broadband) 10326979-AUMEL-L-03	Response received by email on 14 October 2022: *"Upon reviewing the information provided we have determined that the proposed wind farm will not interfere with our assets."*

Table 17 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site	Operator name and DNV reference	Response received to date
4	Fixed point-to-multipoint: 45 km from Project boundary Meteorological radar: 70 km from Project boundary	Bureau of Meteorology (the Bureau) 10326979-AUMEL-L-04	Response received by email on 4 October 2022: *"We have finalized our assessment through desktop analysis for the proposed Gelliondale windfarm.* *The windfarm is about 120 km from the Bureau of Meteorology's weather radar at Bairnsdale and about 50 km from a radio site at Traralgon.* *The assessment indicates that the presence of windfarm will not affect the performance of the radar and there is no P2P radio-link that passes through windfarm."* Follow-up response received by email on 4 October 2022: *"The assessment shows manageable impact on the Bureau's assets specifically on its weather radar network on normal weather conditions. As such, the Bureau could conditionally agree to the project.* *The Bureau requires a letter from the farm developer/owner to acknowledge that the operation of the proposed wind farm will include the following commitments:* *1. Informing the BoM of significant variation of turbine layout (i.e. by more than 100m in any lateral direction, or alteration of tip height) between the initial plan and construction.* *2. Provide advanced notice (one week preferably) to the BoM of any planned wind farm shutdown events for more than 12 hours, to allow the recalibration of radar systems.* *3. Collaborate with the BoM in the event of severe weather conditions to assist in endeavours of community safety."*
5	Fixed point-to-multipoint: 21 km from Project boundary	Esso Australia Pty Ltd (ExxonMobil) 10326979-AUMEL-L-05	Response received by email on 25 November 2022: *" I have reviewed the documents provided and do not have any concerns that wind farm will cause interference with ExxonMobil radio communication assets identified or any other services we use in the area. Any future developments that are east of our assets would need to be reviewed as this may cause interference with radio communications from Onshore assets identified and our Offshore facilities (off 90 Mile Beach)."*
6	Fixed point-to-multipoint: 23 km from Project boundary	Latrobe City Council 10326979-AUMEL-L-06	Response received by email on 19 October 2022: *"Looking at the licences I don't see it being an issue at all.* *…it won't impact any microwave services as we do not operate in the area. Also the Mt Tassie site is a relay, a 151 MHz service using omni antennas for stations further inland and well away from the area."*

Table 17 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site	Operator name and DNV reference	Response received to date
7	Fixed point-to-multipoint: 27 km from Project boundary	South Gippsland Region Water Corporation (South Gippsland Water) 10326979-AUMEL-L-07	Response received by email on 28 November 2022: *"I don't believe that we have any radio assets around the Gelliondale area specifically that will be impacted by your project, however we [have] a direct radio link from Toora to Port Albert with is quite close to your proposed site…* *This looks to cut within about 800m of the proposed GWT01 turbine and is crucial to communications between our devices in the Yarram / Port Albert area and the wider South Gippsland Water network. I don't believe at present that is part of a licenced microwave spectrum however the entire area will be undergoing a network uplift in the next 6 months at which point we will be acquiring a licenced network for all links."*
8	Emergency services point-to-area: 23 km from Project boundary	Ambulance Victoria 10326979-AUMEL-L-08	No response received to date
9	Emergency services point-to-area: 6 km from Project boundary	Country Fire Authority (CFA) 10326979-AUMEL-L-09	Response received by email on 21 October 2022: *"I confirm that the CFA radio services are not affected by the proposed wind turbines at Gelliondale Wind Farm. This conclusion was based on the provided windfarm locations and site boundary."*
10	Emergency services point-to-area: 6 km from Project boundary	Department of Environment, Land, Water and Planning (DELWP) 10326979-AUMEL-L-12	Response received by email on 26 October 2022: *"…DELWP owns no fixed radio communication equipment within the immediate vicinity of the proposed Gelliondale Wind Farm Project, South West of Yarram.* *DELWP also has no RF point to point communications that pass through the proposed site area nor any individual wind tower.* *This proposed Wind Farm Installation should not impact any DELWP owned radio communications infrastructure in the area.* *Please note:* *DELWP does rely on communications networks provided by other organisations in the form of infrastructure such as (but not necessarily limited to) the SMR radio network, the RMR radio network and Incident Channel sites.* *As there are installations that DELWP may rely on (for day to day operations and incident management) that are not DELWP owned, similar checks should be conducted with other agencies/organisations potentially impacted such as (but not necessarily limited to) the CFA and Telstra."*

Table 17 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site	Operator name and DNV reference	Response received to date
11	Emergency services point-to-area: 20 km from Project boundary	Department of Justice and Community Safety – Regional Mobile Radio (RMR) 10326979-AUMEL-L-10	No response received to date
12	Emergency services point-to-area: 7 km from Project boundary	Department of Justice and Community Safety – VisionStream 10326979-AUMEL-L-11	Response received by email on 17 October 2022: *"There are 3 Fire Brigades located close to the proposed Wind farm:* • *Hedley – 3.5km WSW,* • *Alberton West – 2.75km W, and* • *Port Albert – 7.3km SE* *The EAS is provided to the 3 Brigades through a combination of coverage from the following sites:* • *Mt Fatigue – Site ID 38361* • *Blackwarry – Site ID 9001669* • *Jack River – Site ID 9002325 (Stacey's Bridge)* • *Tarra Valley – Site ID 9011783* *Based on past experience, with Wind Farms located near Agency locations and EAS sites, we have not experienced any degradation to signal levels around existing locations with Wind Farm turbines. I am also unaware of any examples or evidence to support any interference claims.* *As with previous Wind Turbine Farms installations constructed across the State and having no examples or evidence of interference to the EAS network, I would expect that the proposed Gelliondale Wind Farm would also not have any impact to coverage of the EAS network to the Emergency Service Organisations based in the area surrounding the turbine locations."*
13	Emergency services point-to-area: 20 km from Project boundary	St John Ambulance Australia Incorporated (St John Ambulance) 10326979-AUMEL-L-13	No response received to date

Table 17 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site	Operator name and DNV reference	Response received to date
14	Emergency services point-to-area: 7 km from Project boundary	The Australian Volunteer Coast Guard Association Inc 10326979-AUMEL-L-14	<u>Response received by email on 22 October 2022:</u> *" I have consulted with my colleagues and can see little potential for interference with our radio communications systems at Port Albert, Port Welshpool or Mount Oberon.* *The frequencies in use (marine VHF) are sufficiently low that although your rotors are several wavelengths long we can see no potential for doppler interference, In addition the primary direction of transmission is to the south (ie away from the planned wind farm) and our radio bases are well outside the recommended 1200 metre zone."*
15	Emergency services point-to-area: 7 km from Project boundary	Victoria State Emergency Service (VICSES) 10326979-AUMEL-L-15	No response received to date
16	Trigonometrical station: 1 km from Project boundary GNSS station: 6 km from Project boundary	Geoscience Australia 10326979-AUMEL-L-16	<u>Response received by email on 19 September 2022:</u> *"Geoscience Australia do not foresee any impacts on our Trigonometrical or GNSS assets in relation to the proposed Gelliondale Wind Farm.* *The GNSS station identified at Yarram, is owned and operated by the Victorian Department of Environment, Land, Water and Planning."*
17	Trigonometrical station: 1 km from Project boundary Permanent survey mark: 0.4 km from nearest turbine GNSS station: 6 km from Project boundary	Department of Environment, Land, Water and Planning (DELWP) 10326979-AUMEL-L-17	<u>Response received by email on 28 September 2022:</u> *"I have reviewed the proposed Gelliondale Wind Farm area boundary and nearby survey control and positioning infrastructure.* *Based on the information provided, the proposed wind farm development will not impact the existing survey control or positioning infrastructure in the nearby vicinity.* *My only concern relates to a series of survey control marks that run along the South Gippsland Hwy. Although disturbance is extremely unlikely, it is important that as part of the wind farm construction that these survey marks are not physically disturbed as they are the primary source of height information in this region.* *Thank you for the opportunity to review the proposal and considering the impacts on surrounding survey control and positioning infrastructure."*
18	PMTS/spectrum (mobile phone): 4 km from Project boundary	Telstra Corporation Limited (Telstra) 10326979-AUMEL-L-18	No response received to date

Table 17 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site	Operator name and DNV reference	Response received to date
19	PMTS/spectrum (mobile phone): 36 km from Project boundary	Vodafone Australia Pty Limited (Vodafone) 10326979-AUMEL-L-19	Response received by email on 17 October 2022: *"I have had a quick look and there is no issue with regards to Vodafone Transmission, however I can see one of our 3G roaming sites is within the wind farm boundary, I would suggest getting the same input from Optus regarding this area as we do not know what transmission they are using in this region."* Follow-up response received by email on 17 October 2022: *"The advised location will not impact any of our current radio sites."*
20	Spectrum (wireless internet): 3 km from Project boundary	NBN Co 10326979-AUMEL-L-20	Response received by email on 21 September 2022: *"I have reviewed the data provided based on the proposed wind farm location; all of the proposed towers are inside existing nbn wireless coverage boundaries however following analysis of the existing wireless customer locations, none of the proposed wind towers pose a risk of introducing a physical obstruction to existing wireless customer's RF Path Profiles from their respective eNB. Nor are any boresight paths of existing nbn microwave links impacted.* *Of great interest to nbn is any potential impact of RF Interference from the wind farms operations from any telecommunication equipment operating within nbn licensed spectrum…* *Once known, please provide information on any RF transmission equipment planned to be used during construction or permanently installed so a potential interference impact can be assessed. This information should include as a minimum the operating transmission frequencies and transmit power, channel bandwidths, antenna types and radiation patterns as well as the exact location with antenna height, boresight azimuth and tilt [mechanical and electrical tilt].* *A standard nbn response for wind farm applications regarding potential interference impact on the nbn Fixed Wireless network is as follows;* *Potential Impacts of the Proposed Gelliondale Wind Farm on NBN Co Spectrum Communication Assets…* *We confirm that NBN Co Spectrum Pty Ltd (nbn Spectrum) has a number of spectrum licenses within 75 km of the proposed Gelliondale Wind Farm.* *nbn have strict obligations to provide internet services to the community, and this area has been determined as a FW service area where the footprint of this service is now in place.* *nbn will be forced to consider its position as part of the planning should there an interference issue.*

Table 17 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site	Operator name and DNV reference	Response received to date
			If the Application is amended before it is lodged we request that we are sent any amended Application so we can determine whether we have any objections to the amended Application. *We note that, as you would be aware, under section 197 of the Radiocommunications Act 1992 (Cth) it is an offence to knowingly or recklessly do anything likely to interfere substantially with radiocommunications or otherwise substantially disrupt or disturb radiocommunications."*
21	DTV broadcasting: 22 km from Project boundary	BAI Communications 10326979-AUMEL-L-21	<u>Response received by email on 26 October 2022:</u> *"Our analysis concluded that Mt Tassie [Latrobe Valley] DTV services will be affected by the presence of the proposed Gelliondale Wind Farm in the current configuration. Most of the impact for Mt Tassie will be confined to the wind farm boundary. Population analysis was done on the potentially impacted area (ABS Census 2021 Data) and showed 30 people at low risk and 9 people are at high risk of having degraded DTV reception. Whilst there are minimal persons predicted to be impacted by the proposed Gelliondale wind Farm, any degradation of DTV services caused by the wind farm development would be expected to be rectified as part of the project."* <u>Extract from detailed report received by email on 26 October 2022:</u> *"BAI Communications (BAI) has done a study on the proposed Gelliondale wind farm… The analysis shows that the DTV coverage from Mt Tassie is predicted to experience scatter interference due to the proposed Gelliondale wind farm. Up to 30 persons are predicted to be at low risk and 9 persons are predicted to be at high risk of interference to digital television services due to the scatter interference effects of the wind farm. If there is any impact, remediation that is required to rectify DTV degradation to the viewers is expected to form part of the wind farm project.* *…The broadcast site that has been identified to provide coverage around the area of the wind farm is… Latrobe Valley (Mt Tassie).* *BAI has conducted field tests on existing wind farms in the past for the impact on FM services. The field test measurements concluded that FM radio had some minor reflections observed but these would not be expected to cause any noticeable effect on reception. Thus, this report will not consider further impacts on FM broadcast.* *[The attached data] shows the interference affected area to Mt Tassie DTV coverage. Population analysis was done on the potentially impacted area (ABS Census 2021 Data) and showed 30 people are at low risk… of having degraded television reception and 9 people to be in the high-risk area…*

Table 17 Summary of service operators contacted by DNV and responses received to date (continued)

	Licence/service type and distance of closest site	Operator name and DNV reference	Response received to date
			Conclusion
			BAI have modelled the proposed Gelliondale Wind Farm…
			Analysis concluded that Mt Tassie DTV services will be affected by the presence of the proposed Gelliondale Wind Farm in the current configuration. Most of the impact for Mt Tassie will be confined to the wind farm boundary. Population analysis was done on the potentially impacted area… and showed 30 people are at low risk and 9 people are at high risk of having degraded DTV reception.
			Whilst there are minimal persons predicted to be impacted by the proposed Gelliondale Wind Farm, any degradation of DTV services caused by the wind farm development would be expected to be rectified as part of the project."
22	Area-wide fixed satellite service: 1.1 km from nearest turbine	Viasat Australia Pty Ltd (Viasat) 10326979-AUMEL-L-22	Response received by email on 7 October 2022: *"We've looked at the proposed tower positions and for the particular Viasat AWL (11204122) that sits adjacent to them we don't see any interference happening. If there are any new towers in the future (in particular north of our licenced area) please advise and we'll revisit."*

LIST OF FIGURES

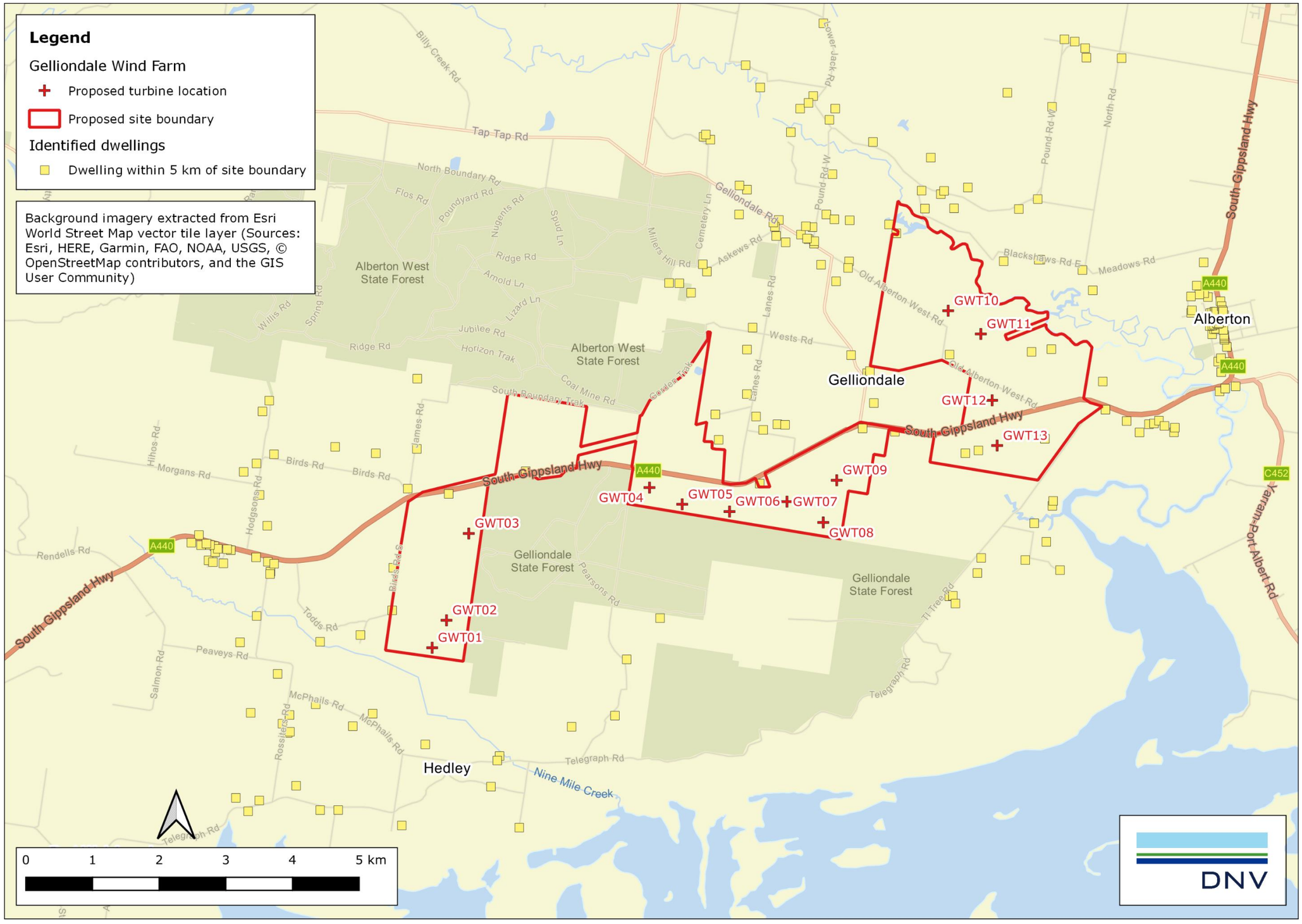

Figure 1 Map of the proposed Project, showing proposed boundary, turbine locations, and locations of nearby dwellings

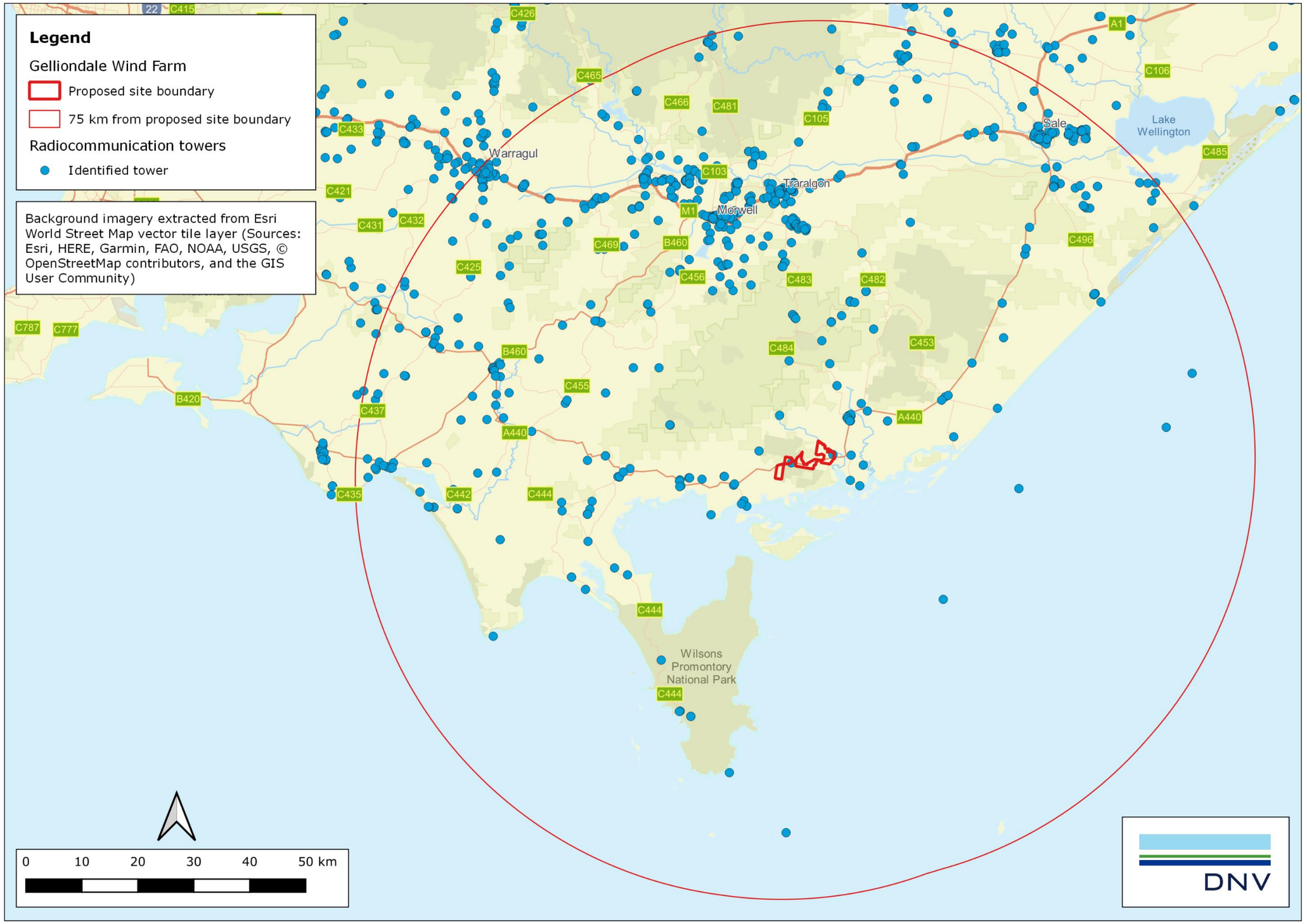

Figure 2 Location of the proposed Project and identified nearby radiocommunication sites

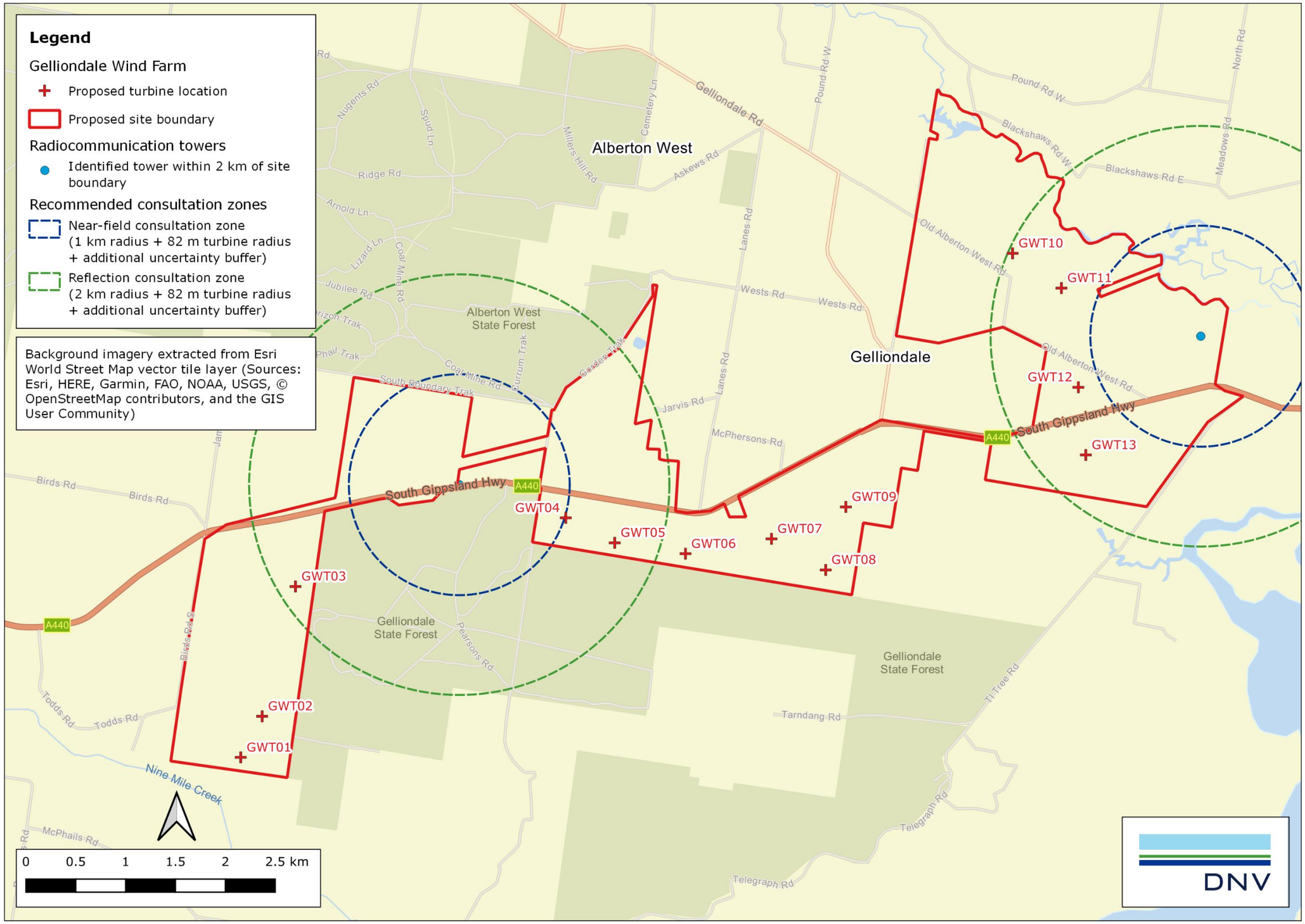

Figure 3 Identified radiocommunication sites within 2 km of the turbine locations for the proposed Project

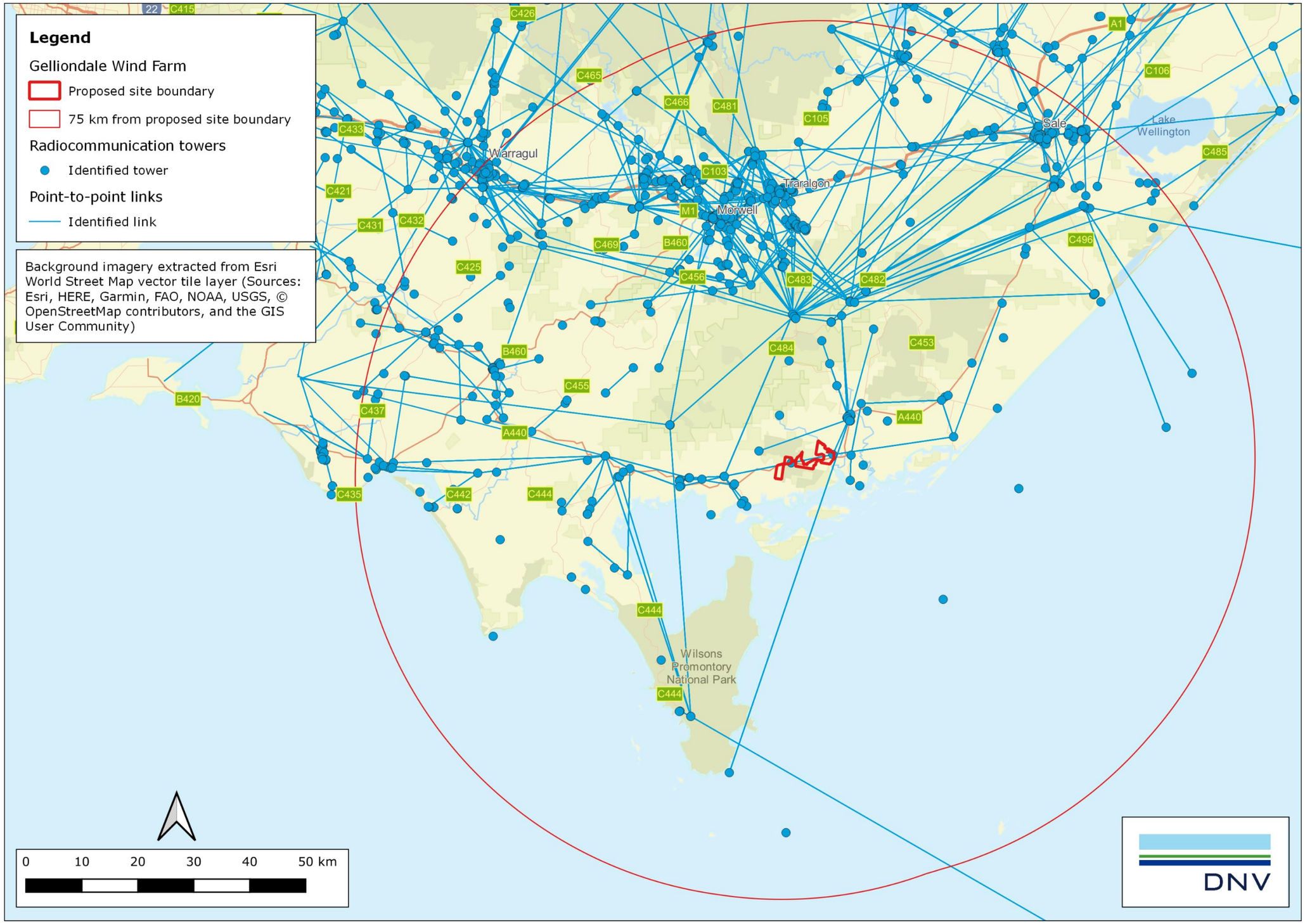

Figure 4 Identified transmission vectors for fixed licences of point-to-point type in the vicinity of the proposed Project

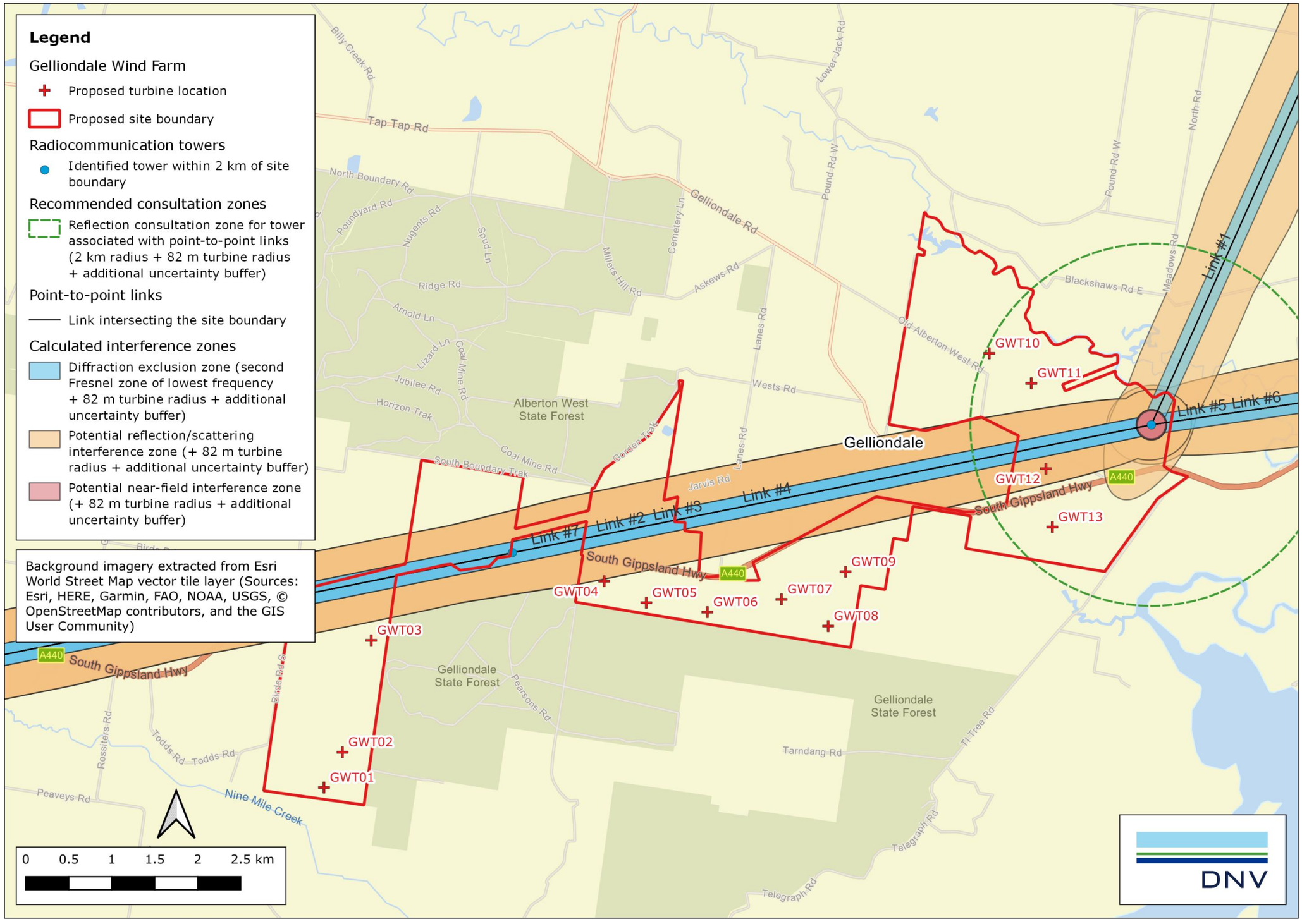

Figure 5 Identified point-to-point radiocommunication vectors crossing the proposed Project and calculated interference zones

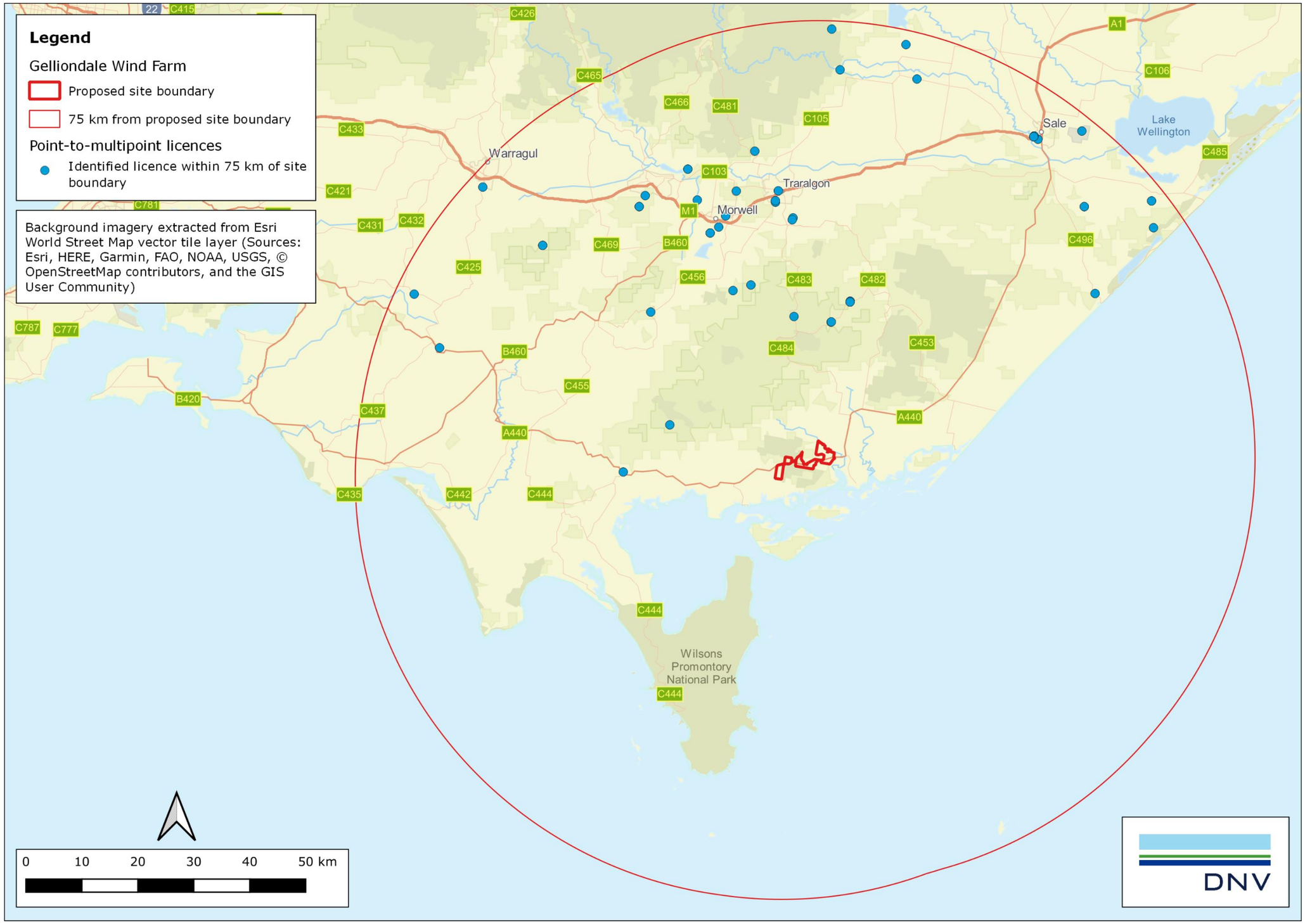

Figure 6 Location of point-to-multipoint licences in the vicinity of the proposed Project

Figure 7 Approximate link path for link between Toora and Port Albert operated by South Gippsland Water

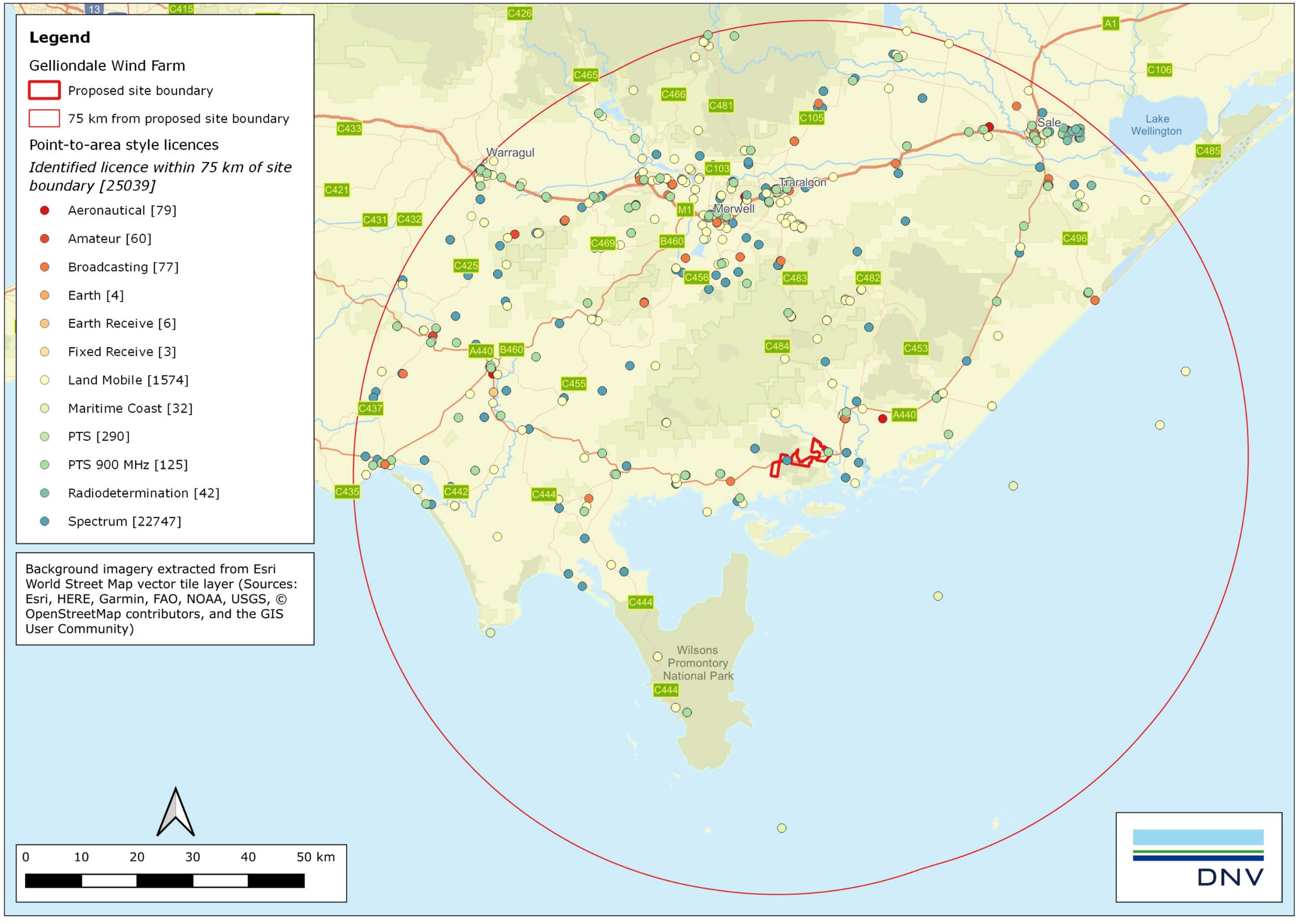

Figure 8 Location of general point-to-area style licences within 75km of the proposed Project

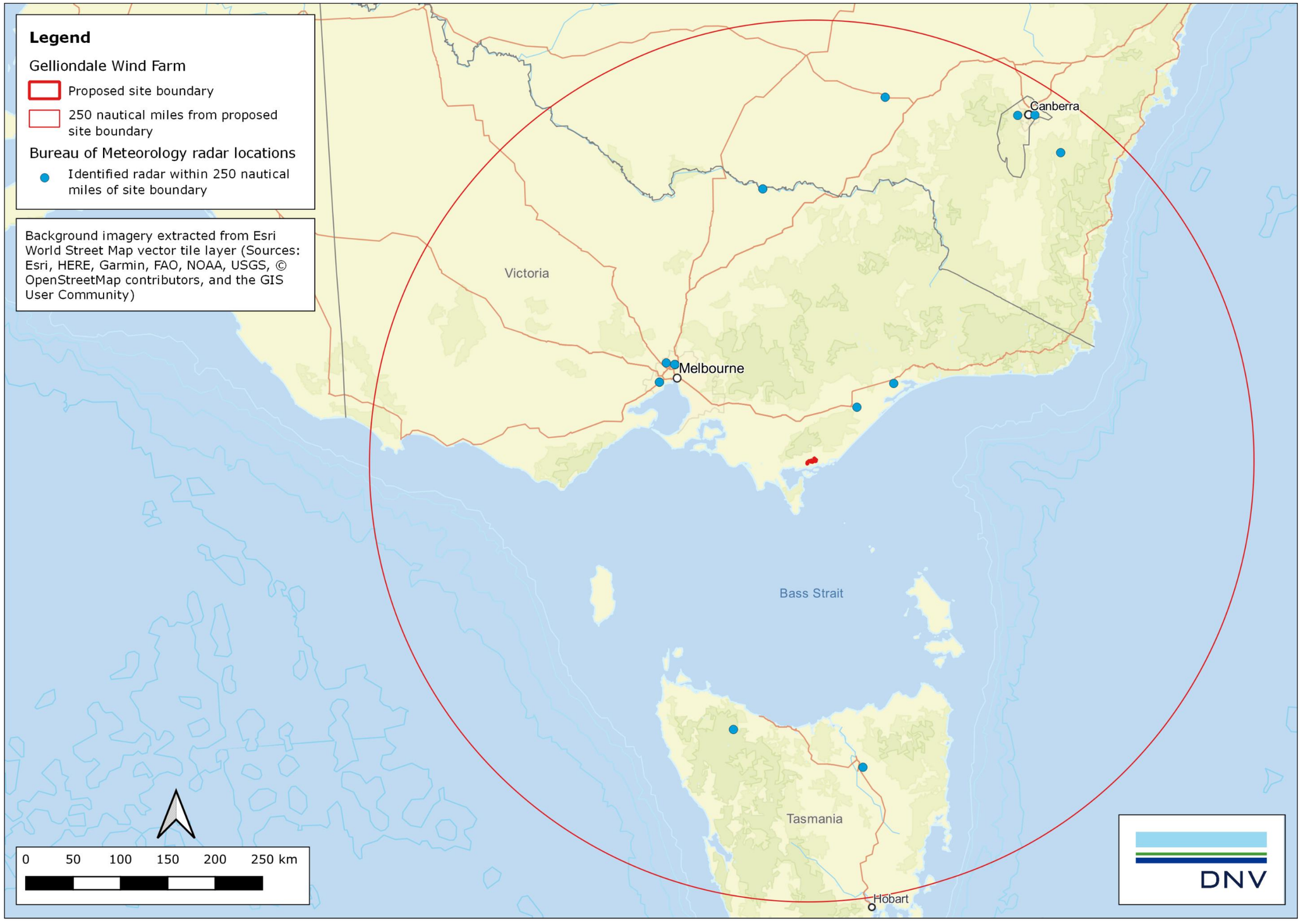

Figure 9 Location of meteorological radar sites within 250 nautical miles of the proposed Project

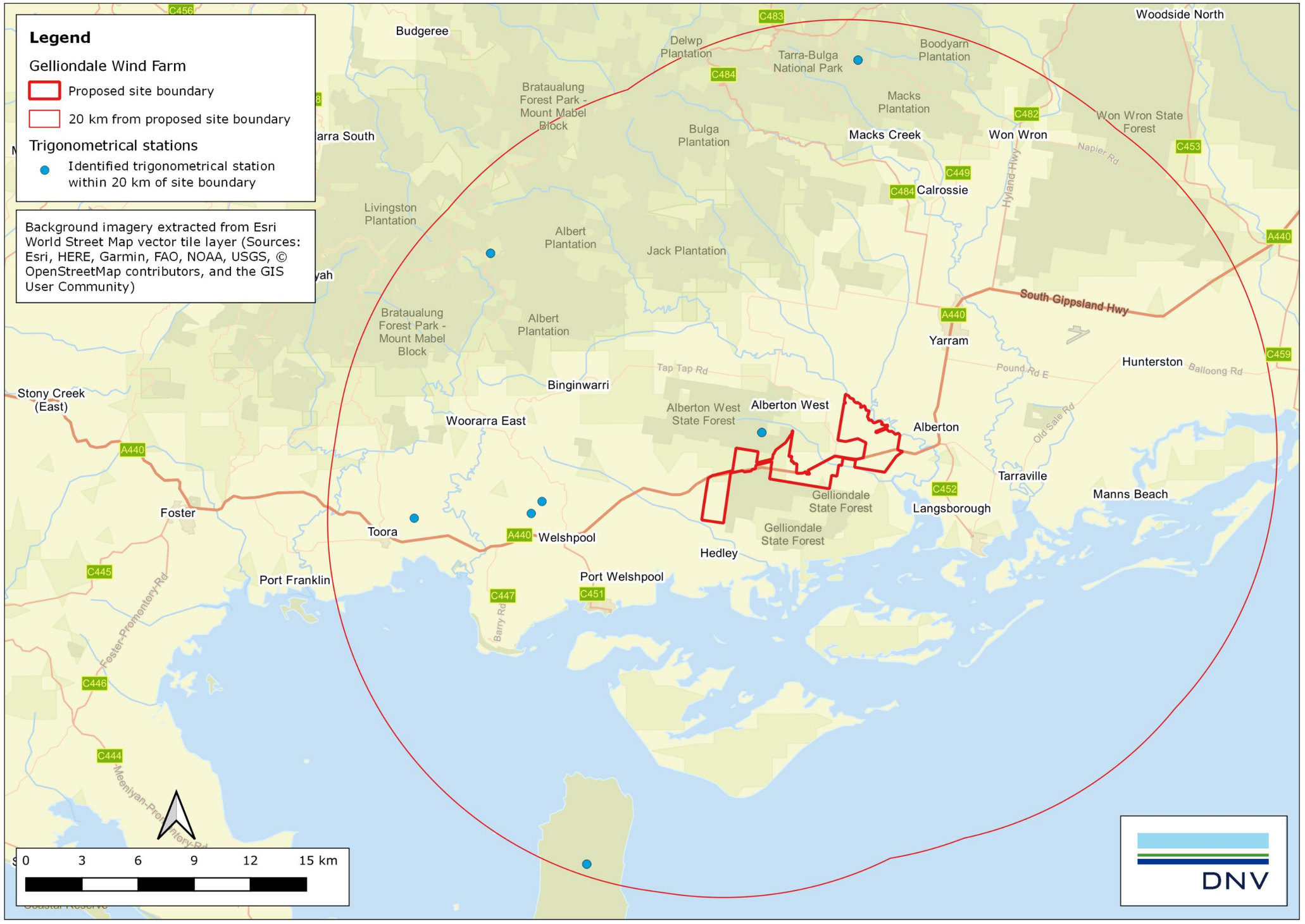

Figure 10 Location of trigonometrical stations within 20 km of the proposed Project

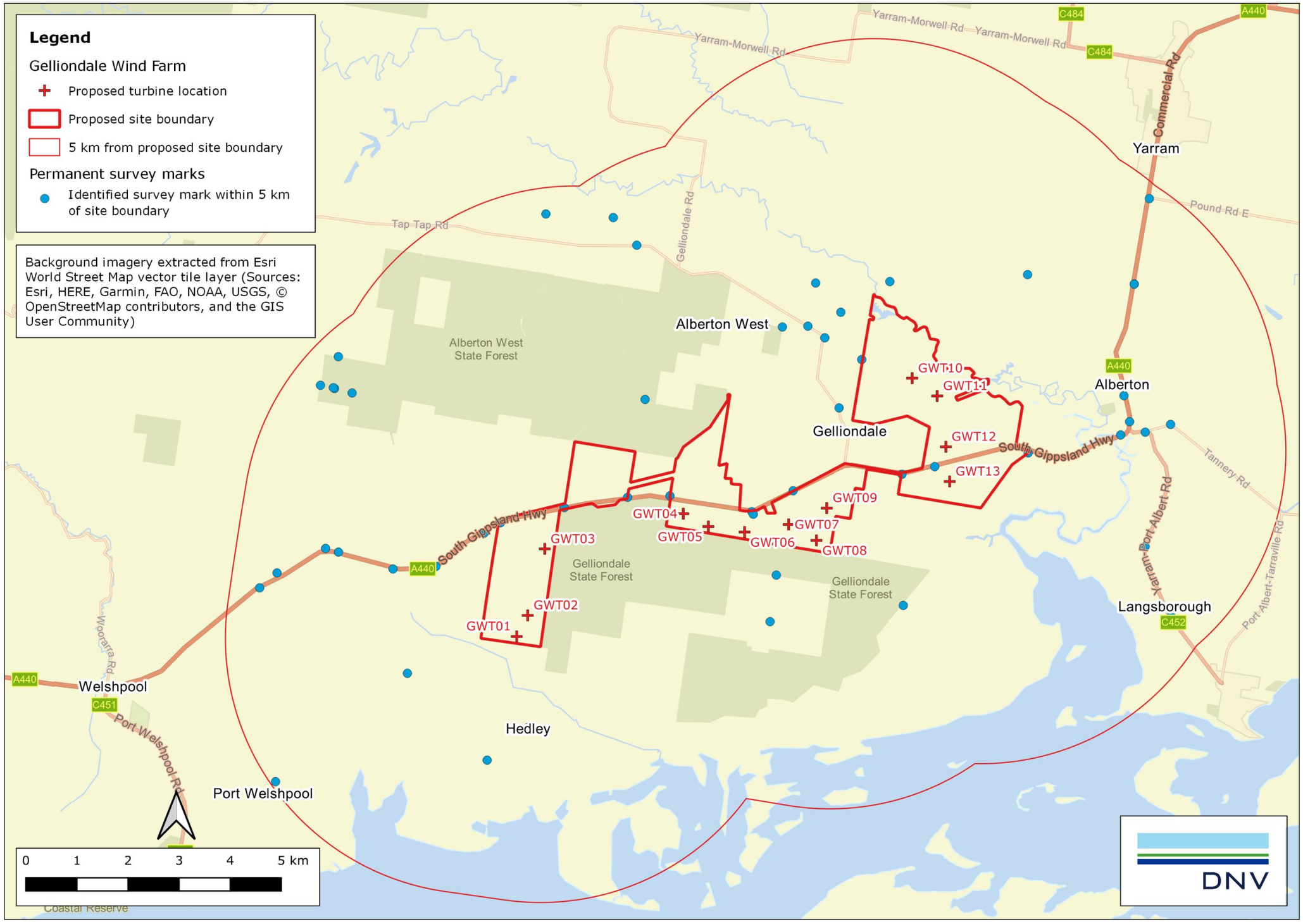

Figure 11 Location of permanent survey marks within 5 km of the proposed Project boundary

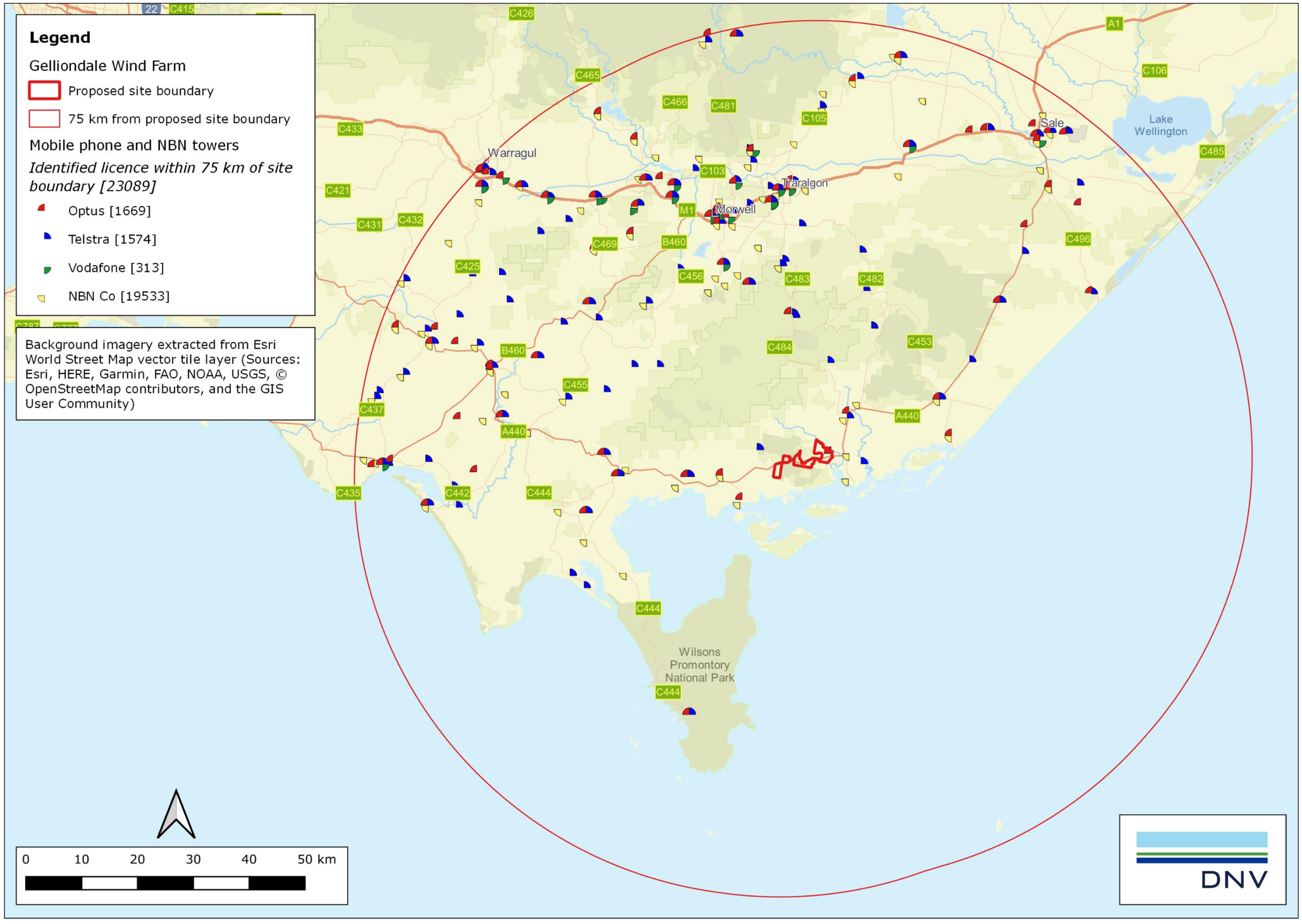

Figure 12 Location of mobile phone and NBN towers within 75 km of the proposed Project

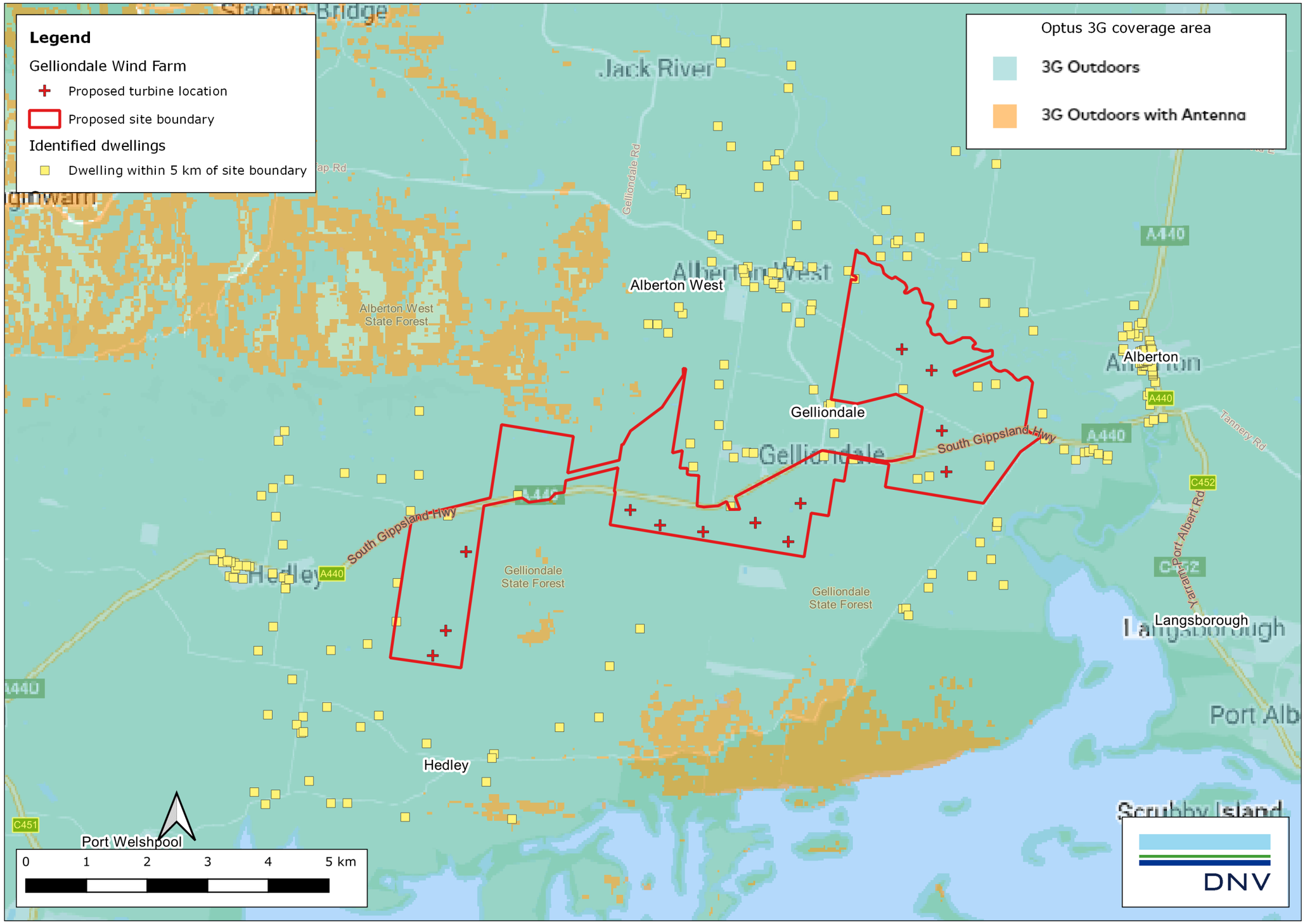

Figure 13 Optus Mobile 3G network coverage for the proposed Project

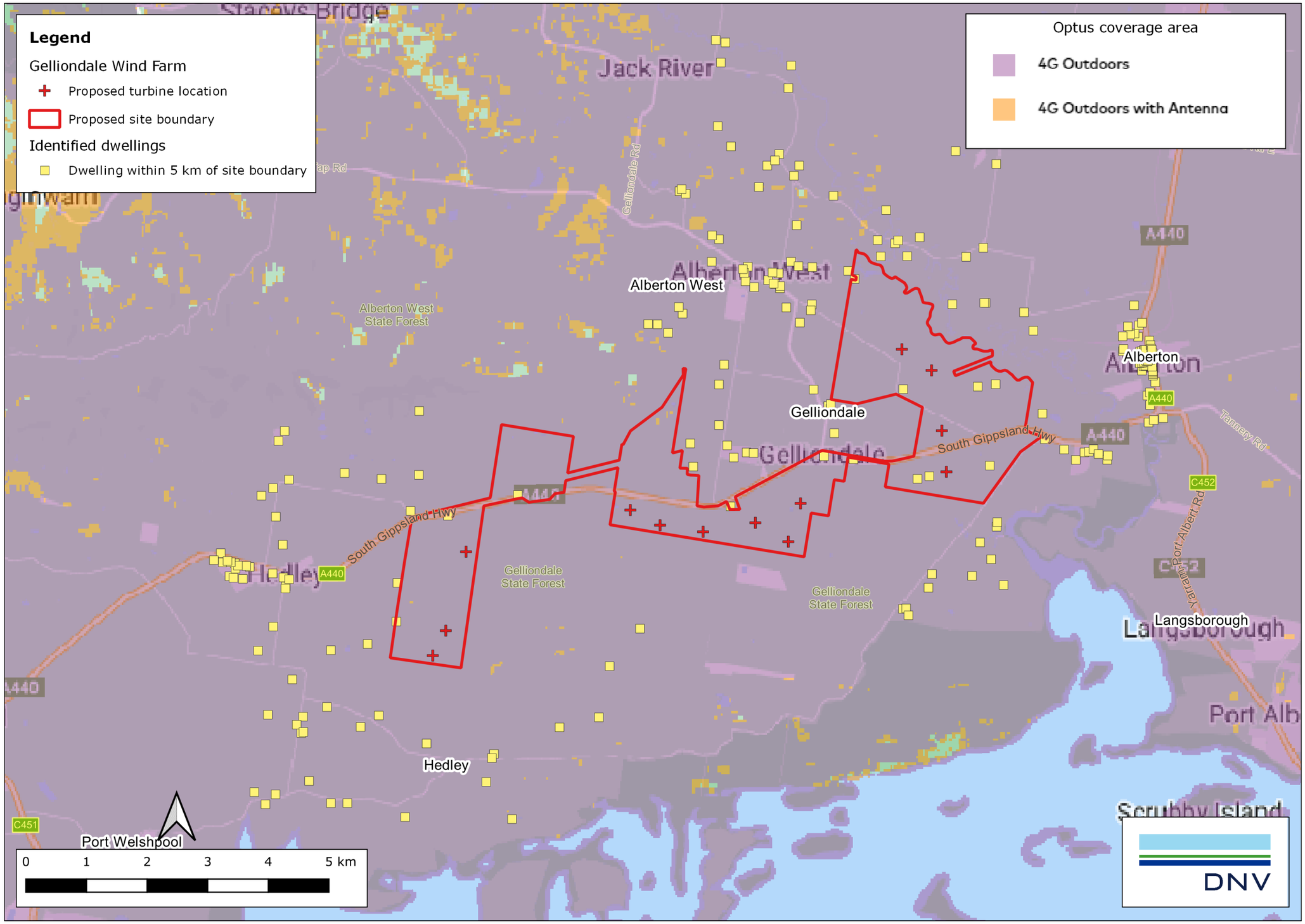

Figure 14 Optus Mobile 4G network coverage for the proposed Project

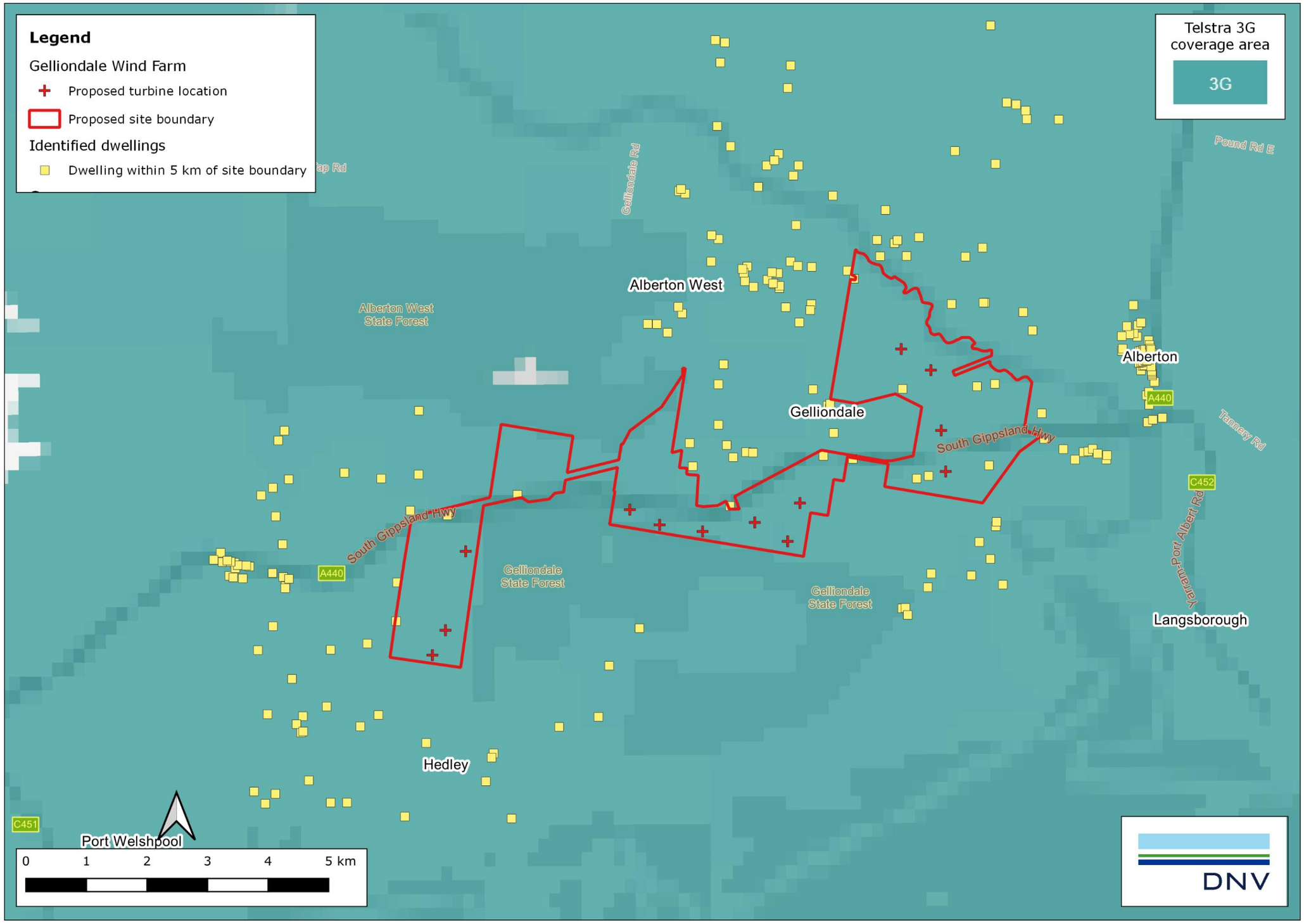

Figure 15 Telstra 3G network coverage for the proposed Project

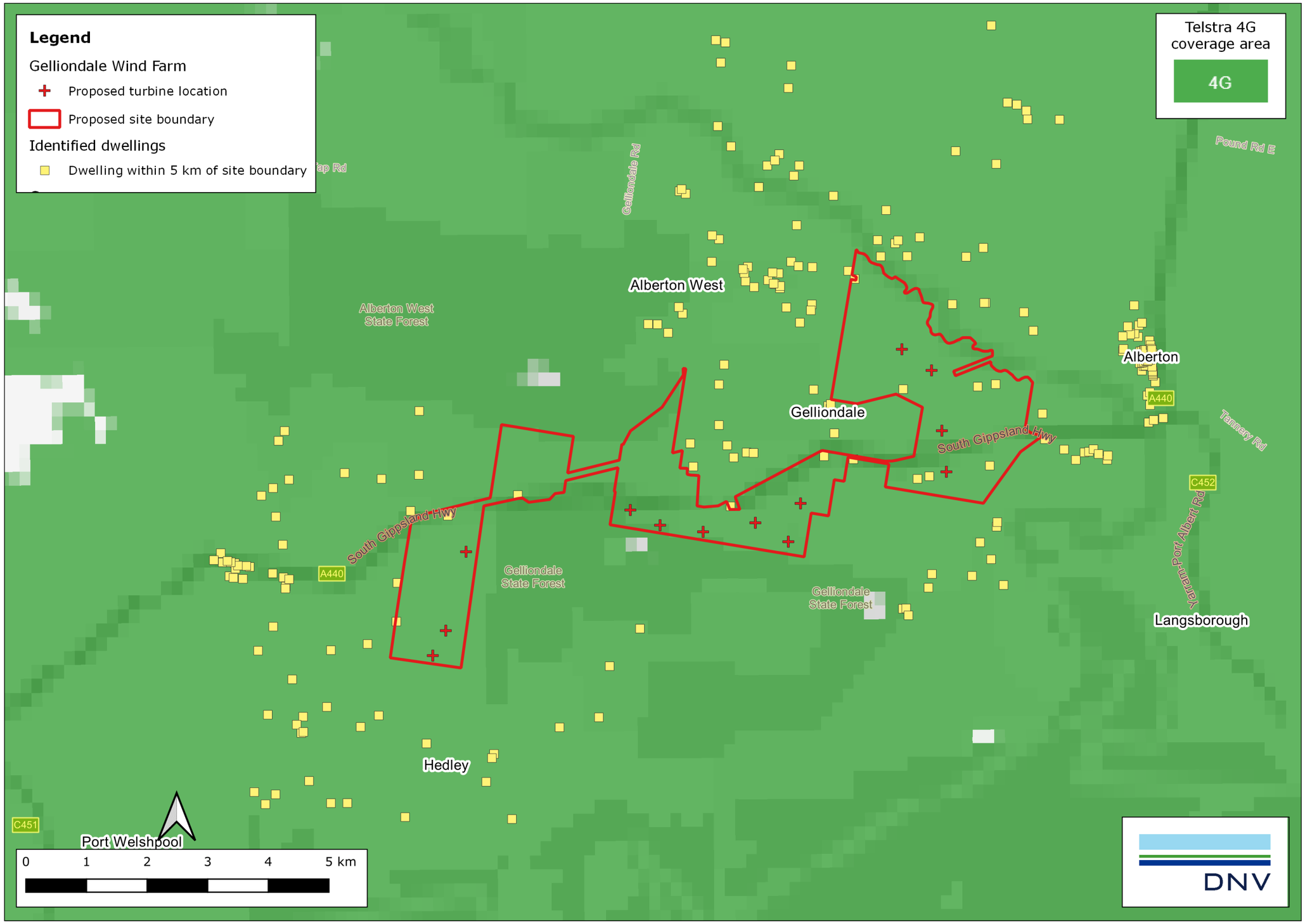

Figure 16 Telstra 4G network coverage for the proposed Project

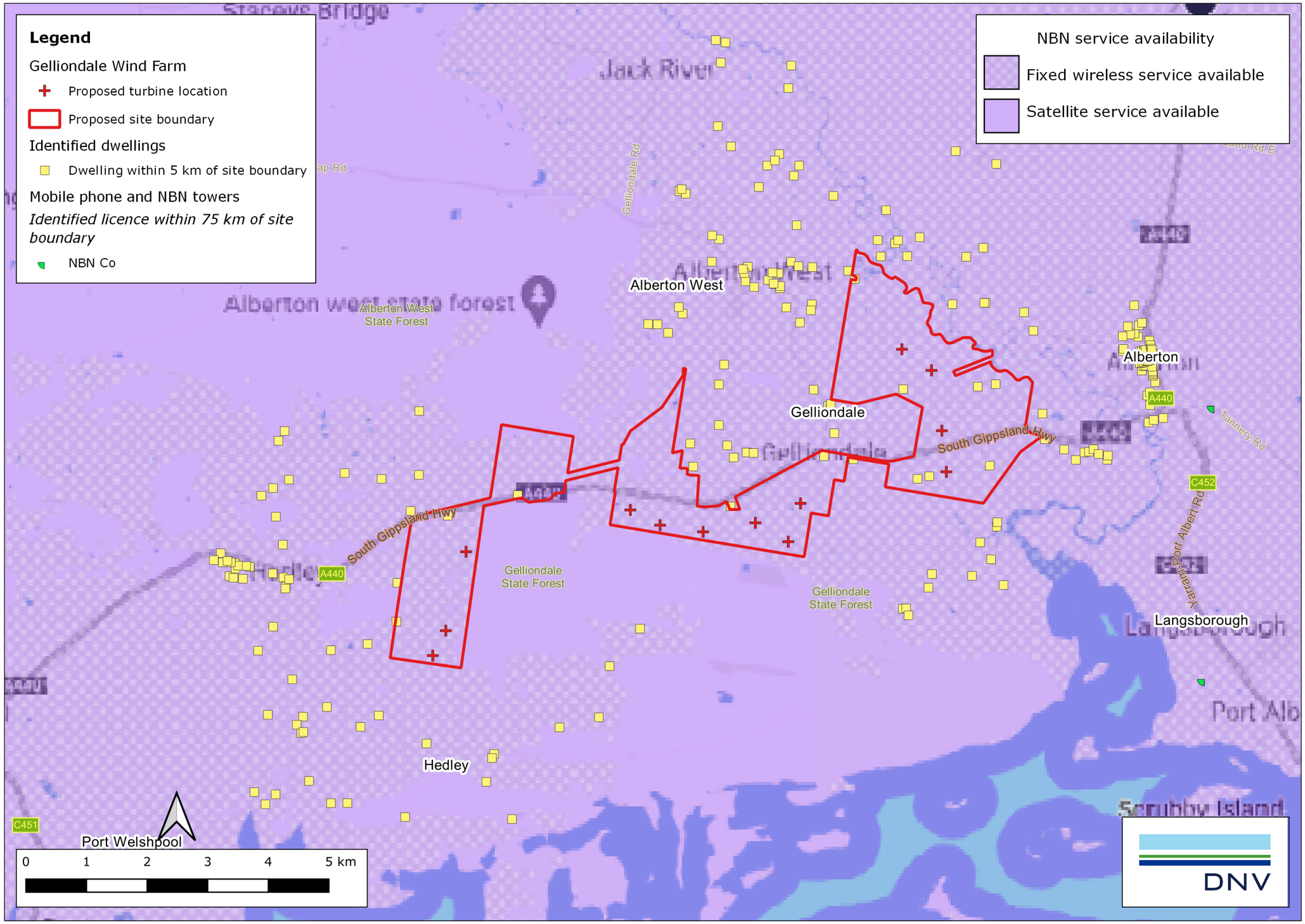

Figure 17 NBN internet coverage in the vicinity of the proposed Project

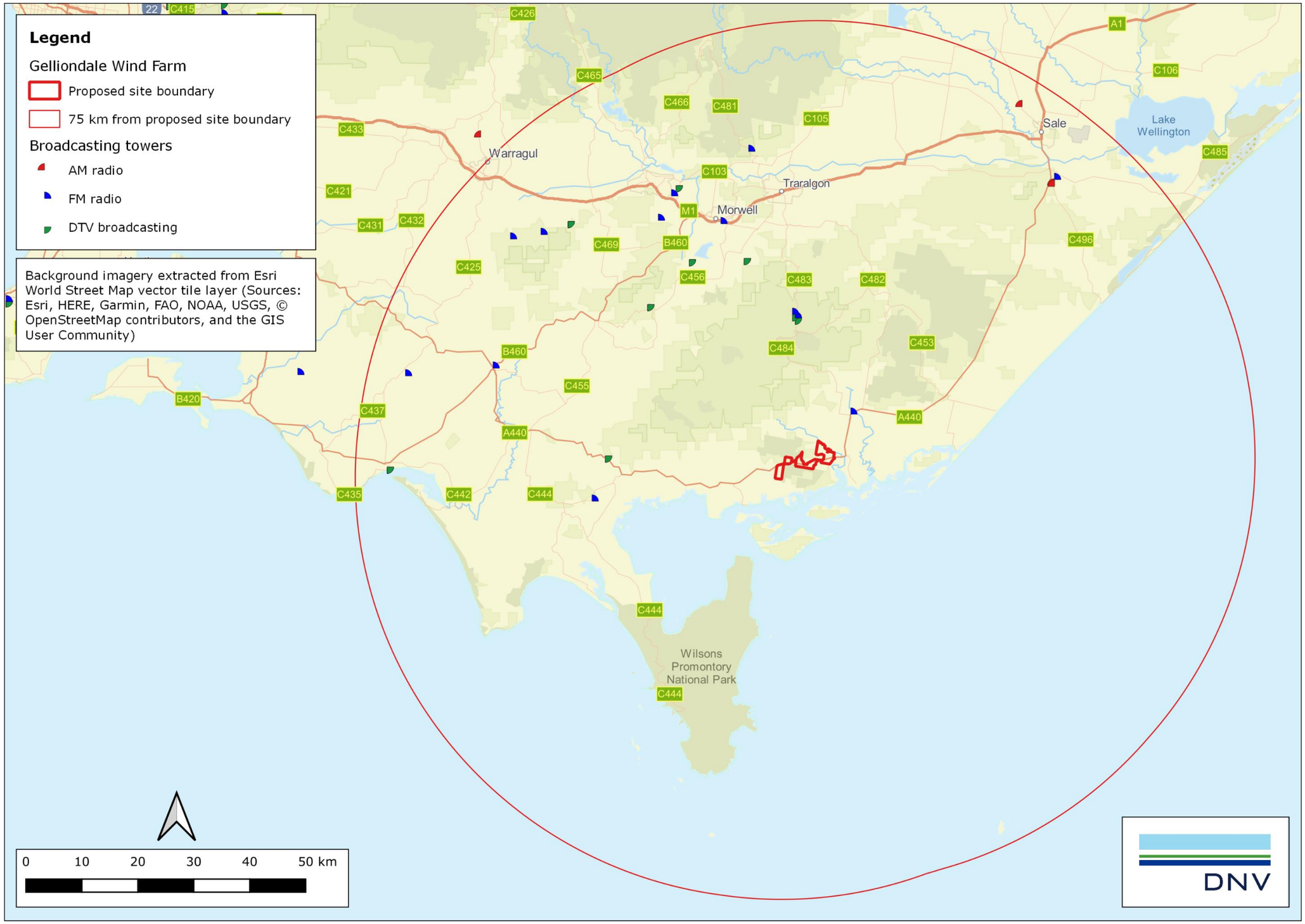

Figure 18 Location of broadcast transmitters in the vicinity of the proposed Project

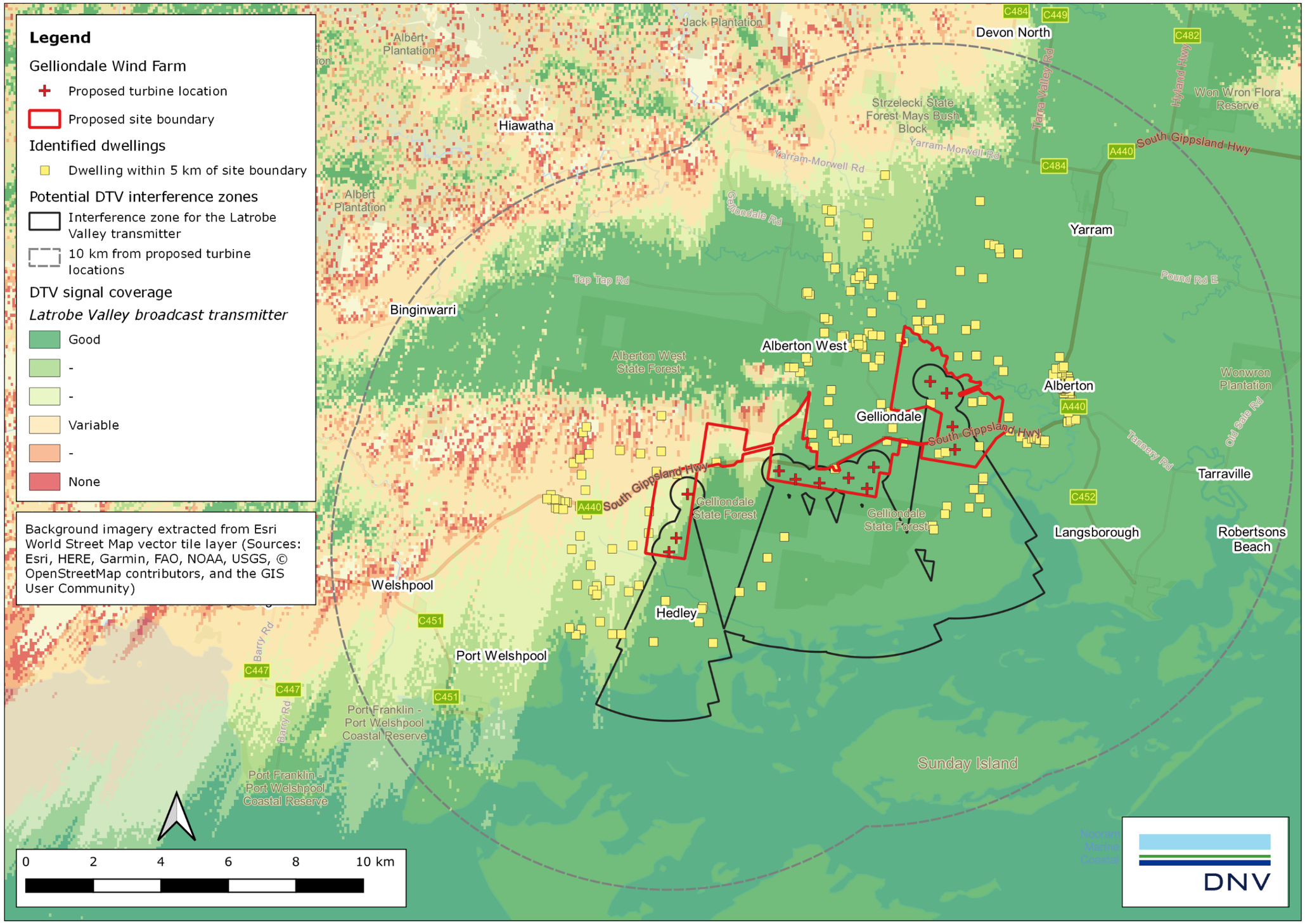

Figure 19 Potential television EMI zones for the Latrobe Valley broadcast transmitter from the proposed Project

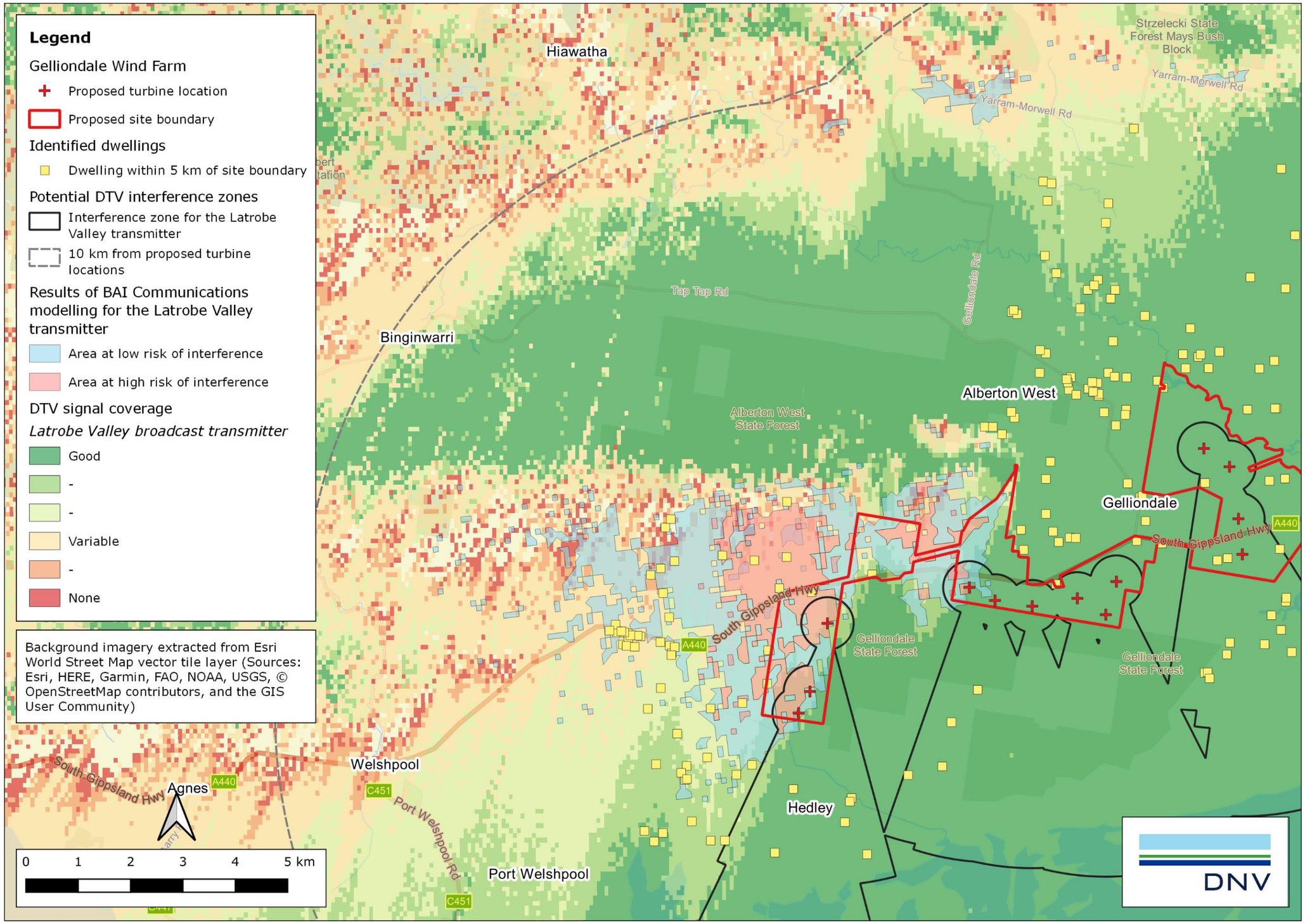

Figure 20 Results of BAI Communications modelling of potential television EMI zones for the Latrobe Valley broadcast transmitter from the proposed Project

About DNV

DNV is the independent expert in risk management and assurance, operating in more than 100 countries. Through its broad experience and deep expertise DNV advances safety and sustainable performance, sets industry benchmarks, and inspires and invents solutions.

Whether assessing a new ship design, optimising the performance of a wind farm, analysing sensor data from a gas pipeline or certifying a food company's supply chain, DNV enables its customers and their stakeholders to make critical decisions with confidence.

Driven by its purpose, to safeguard life, property, and the environment, DNV helps tackle the challenges and global transformations facing its customers and the world today and is a trusted voice for many of the world's most successful and forward-thinking companies.