

**Appendix 3: Survey Unit and Site Mapping**

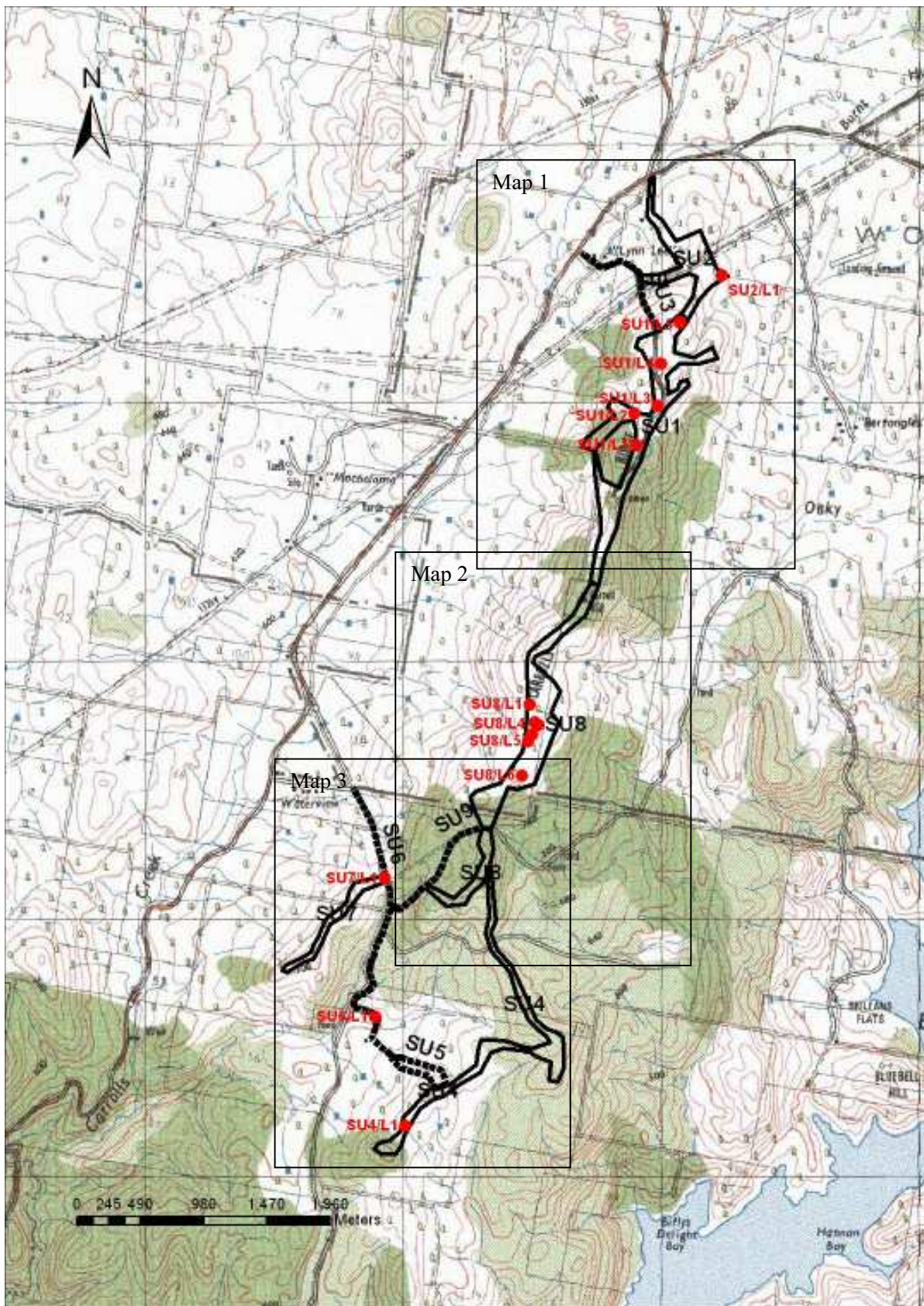


Figure 1. Carrolls Ridge Key Map.



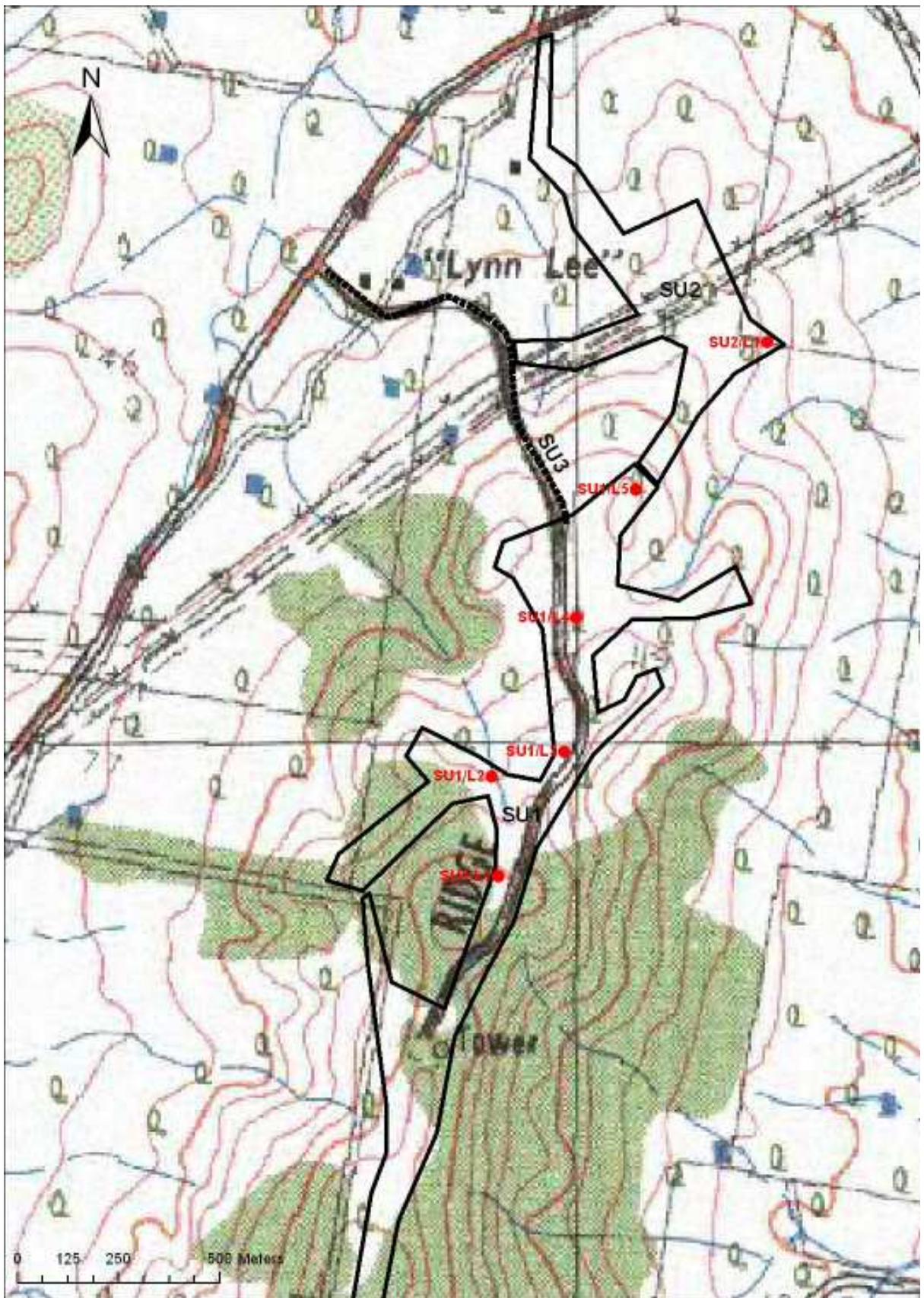


Figure 2. Carrolls Ridge Map 1



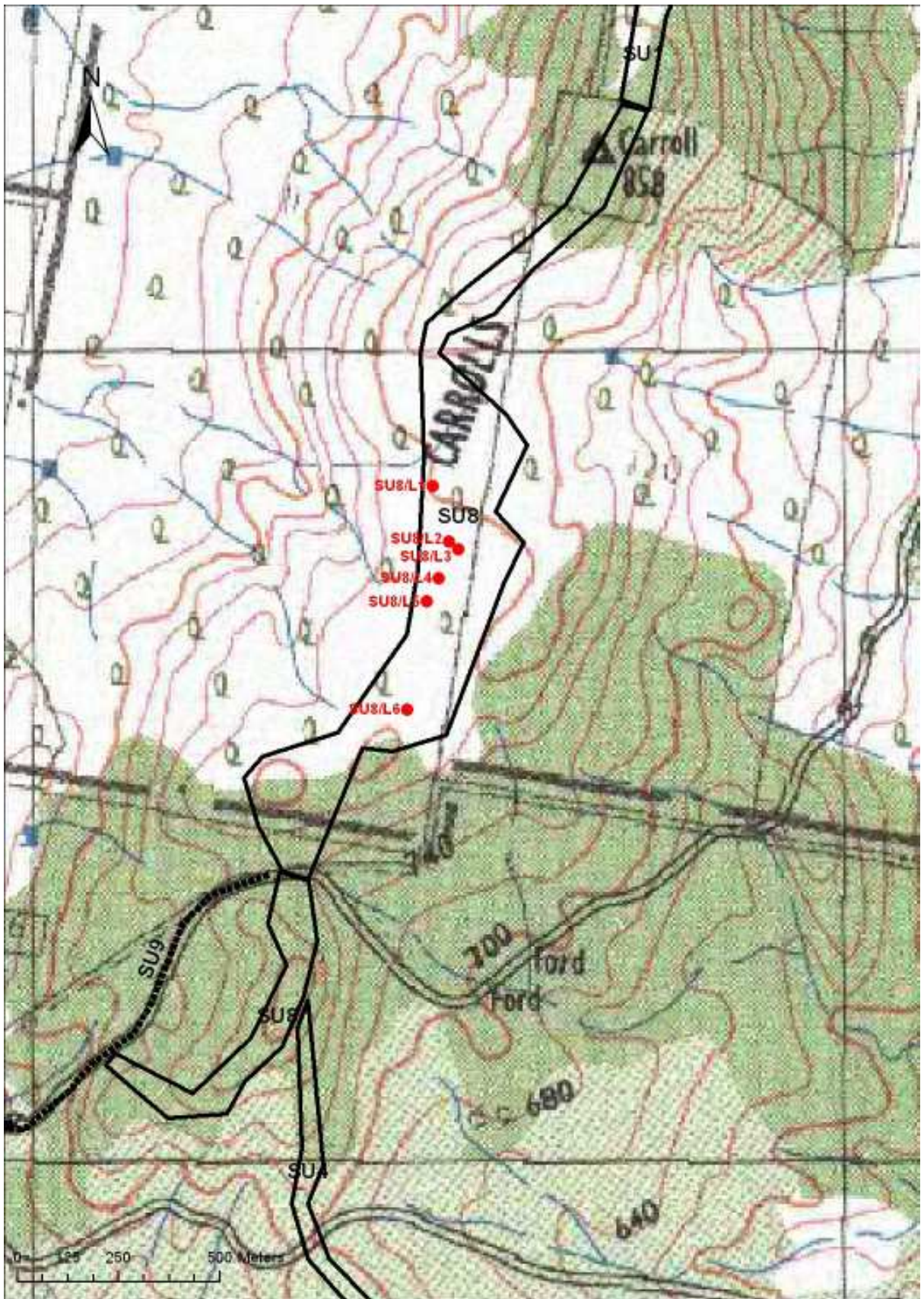


Figure 2. Carrolls Ridge Map 2



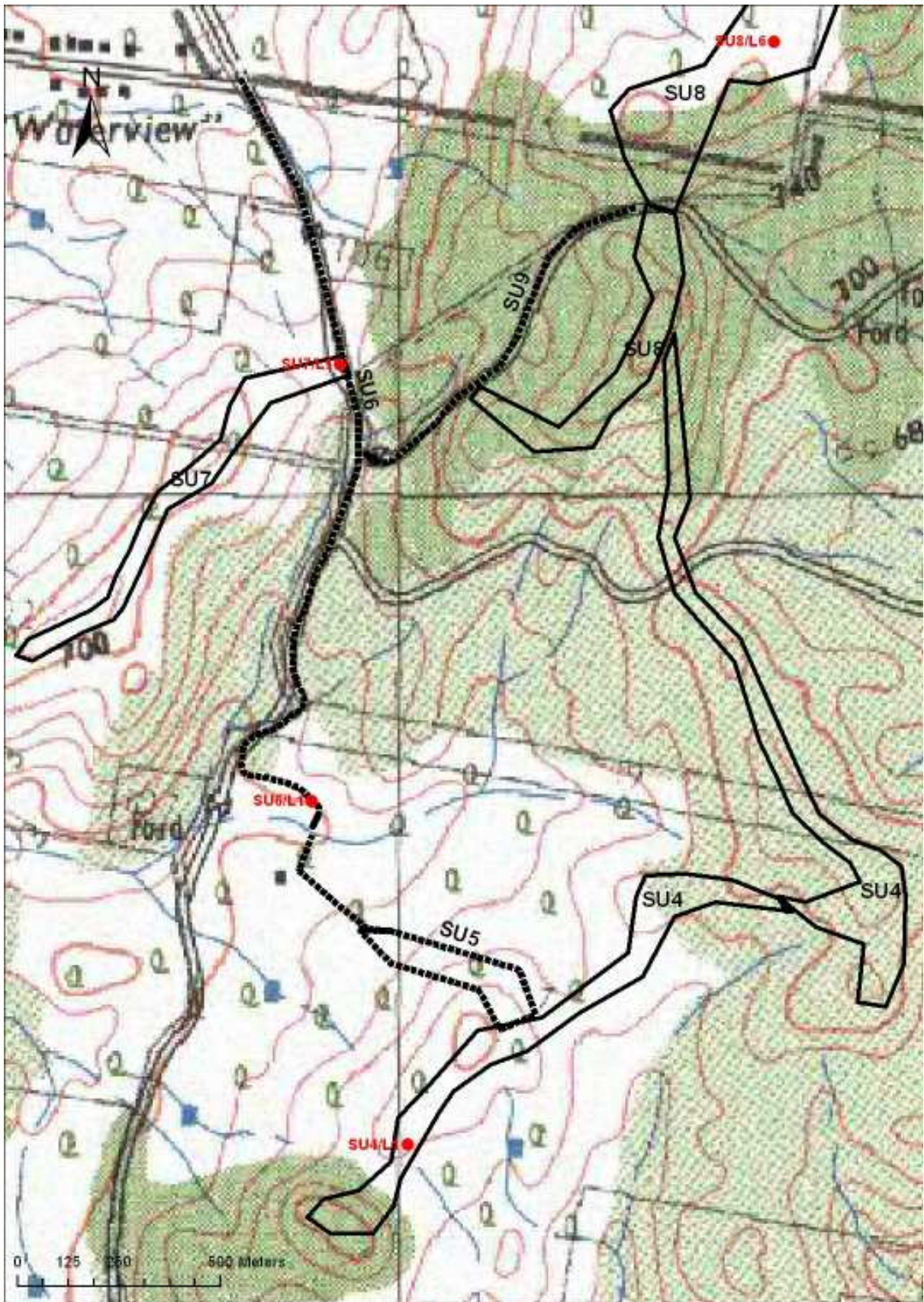


Figure 4. Carrolls Ridge Map 3.



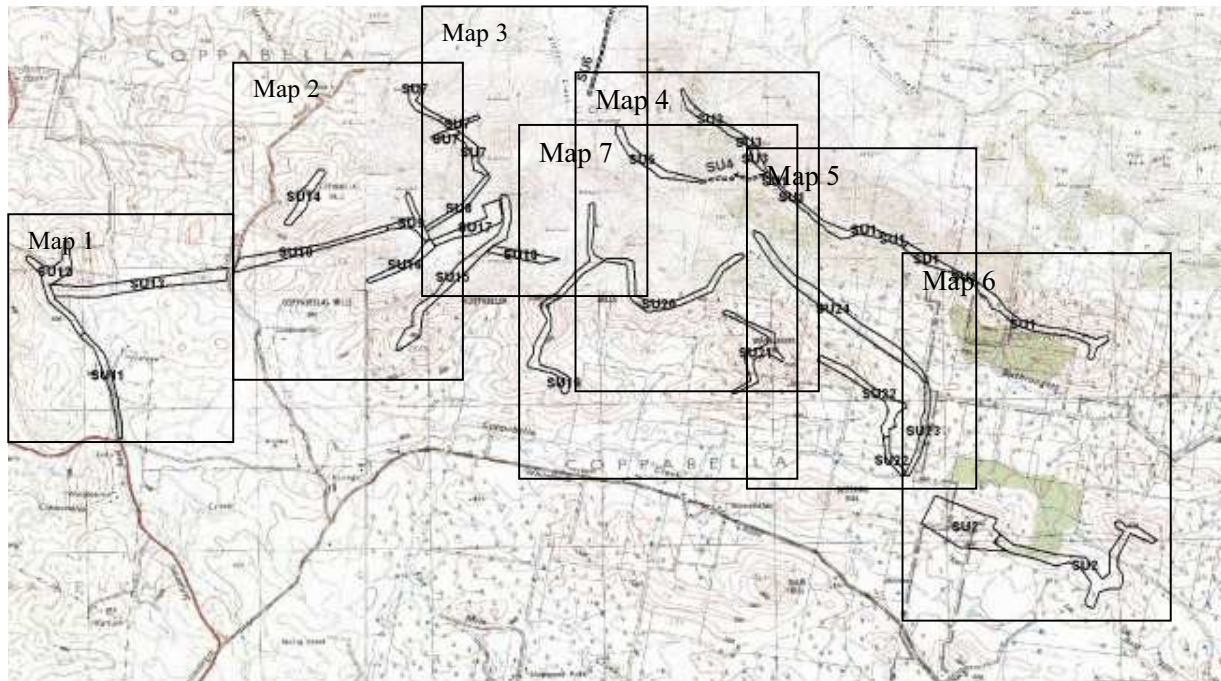


Figure 5. Coppabella Hills Key Map.

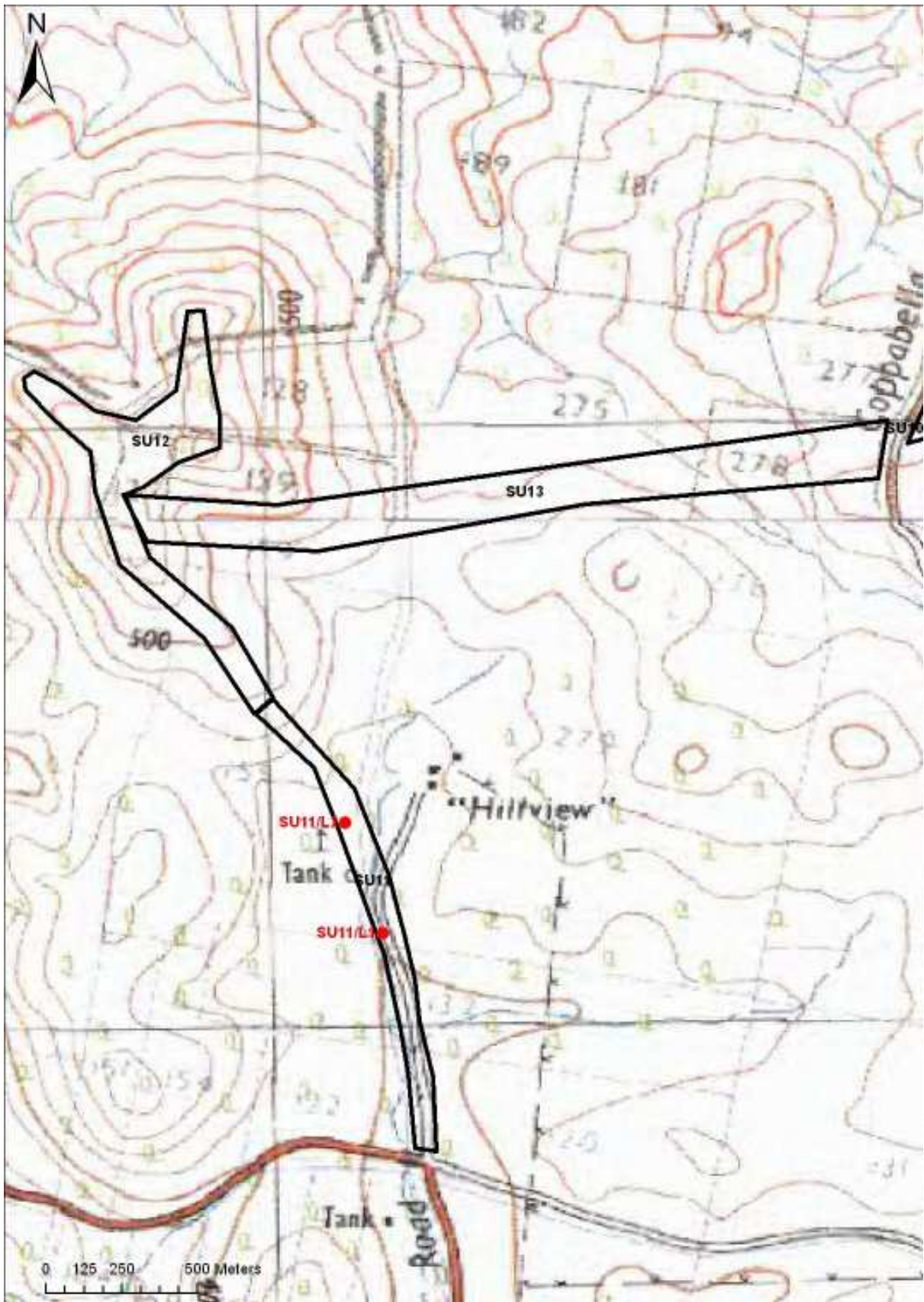


Figure 6. Coppabella Hills Map 1.



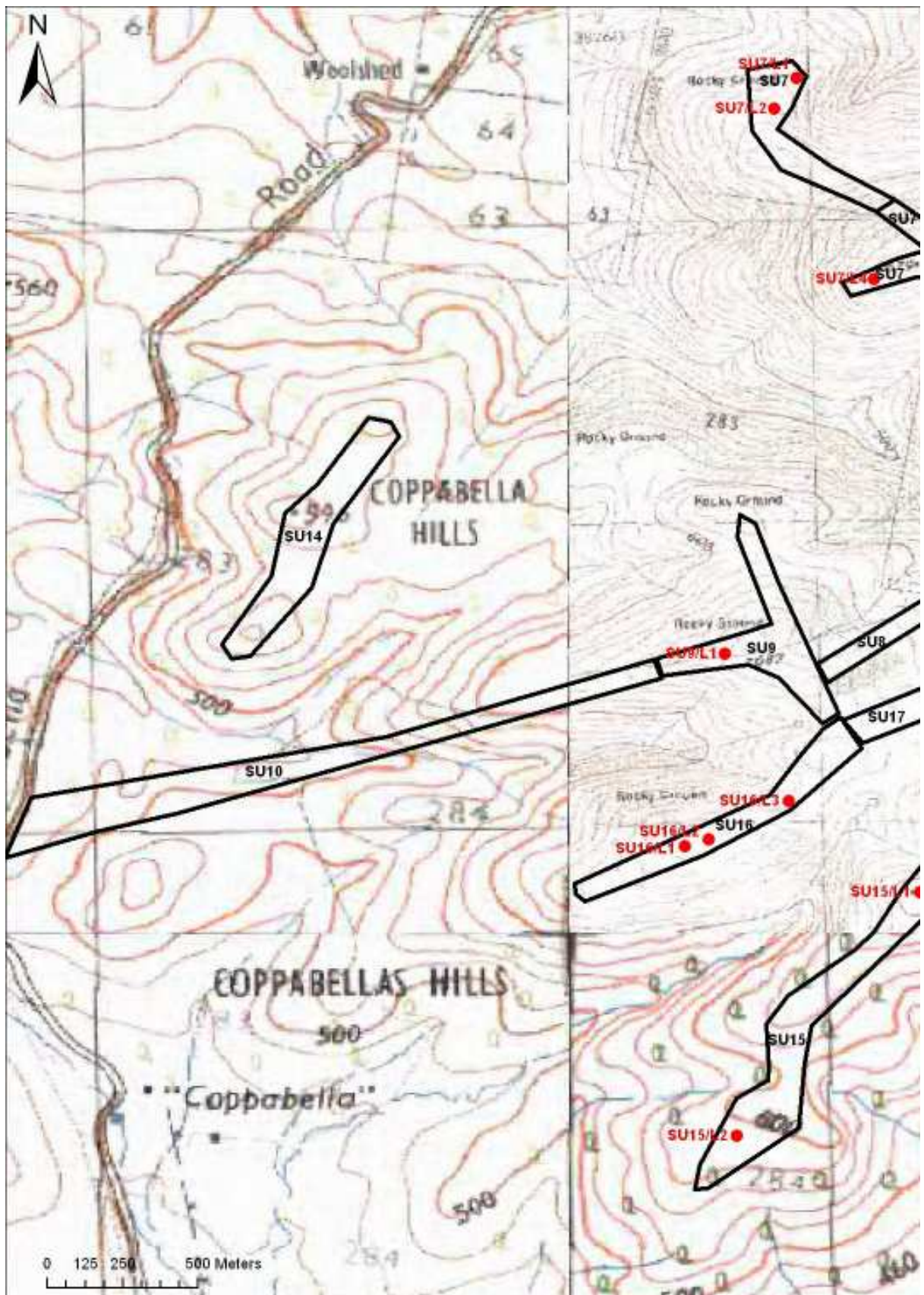


Figure 7. Coppabella Hills Map 2.



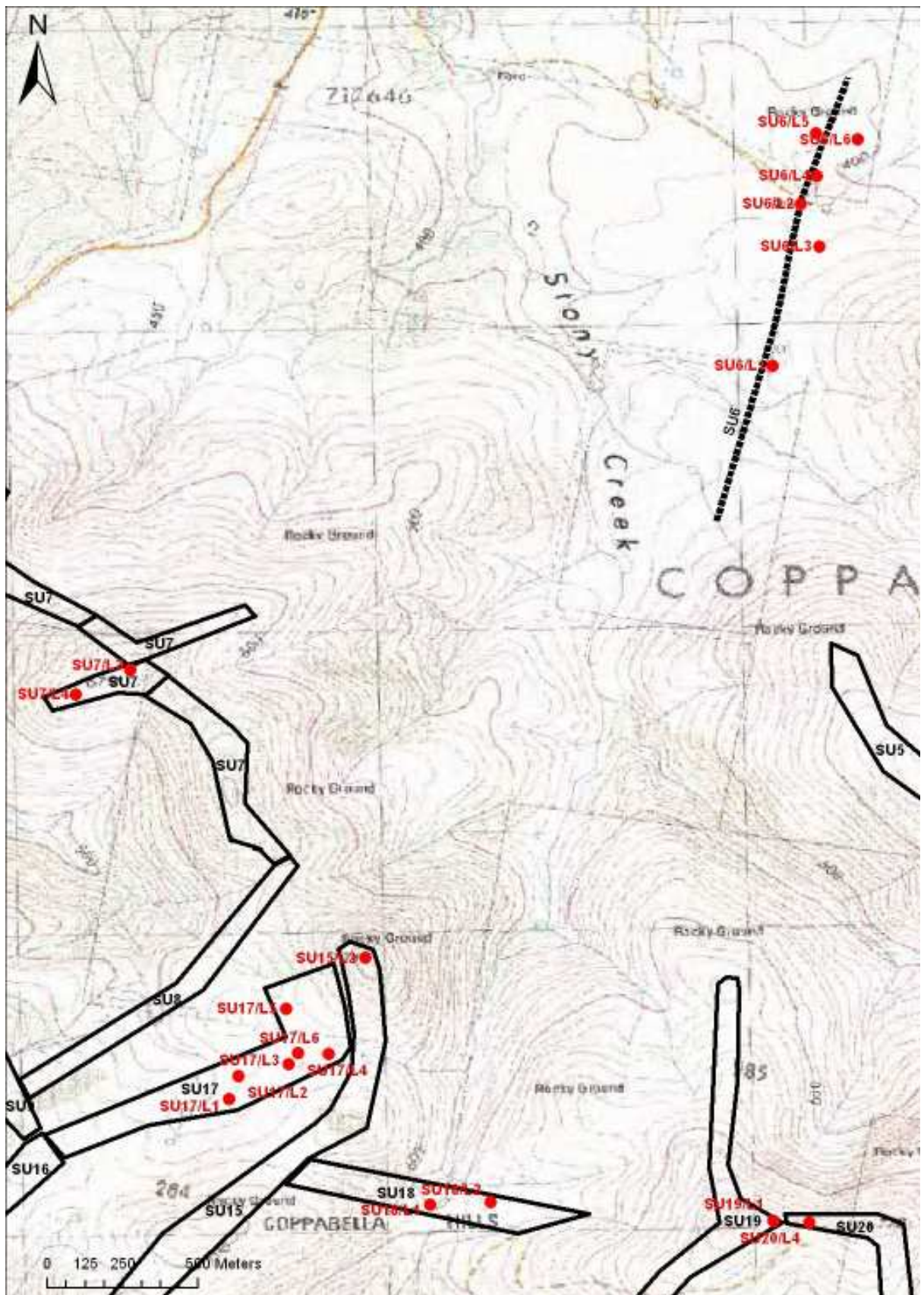


Figure 8. Coppabella Hills Map 3.



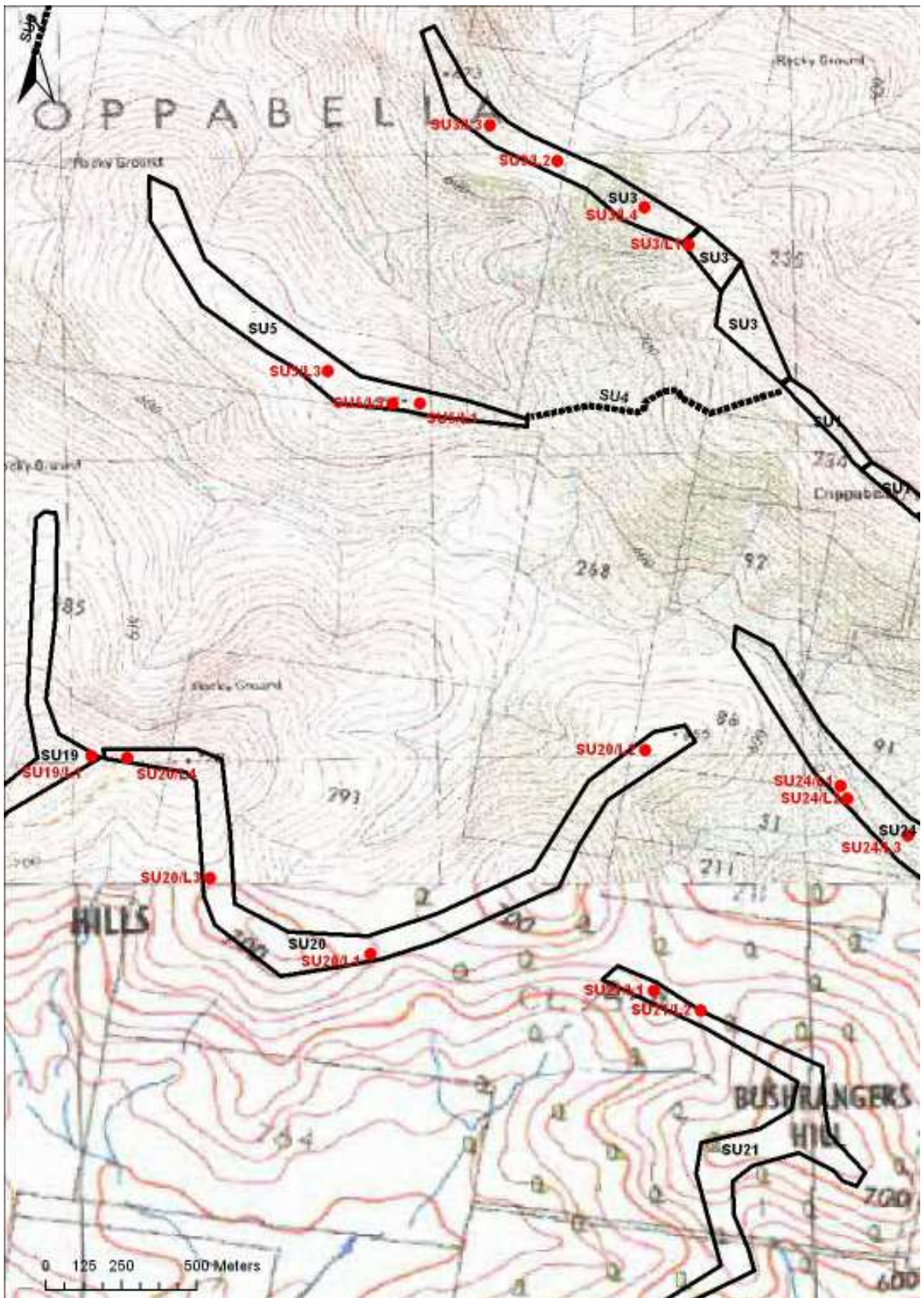


Figure 9. Coppabella Hills Map 4.



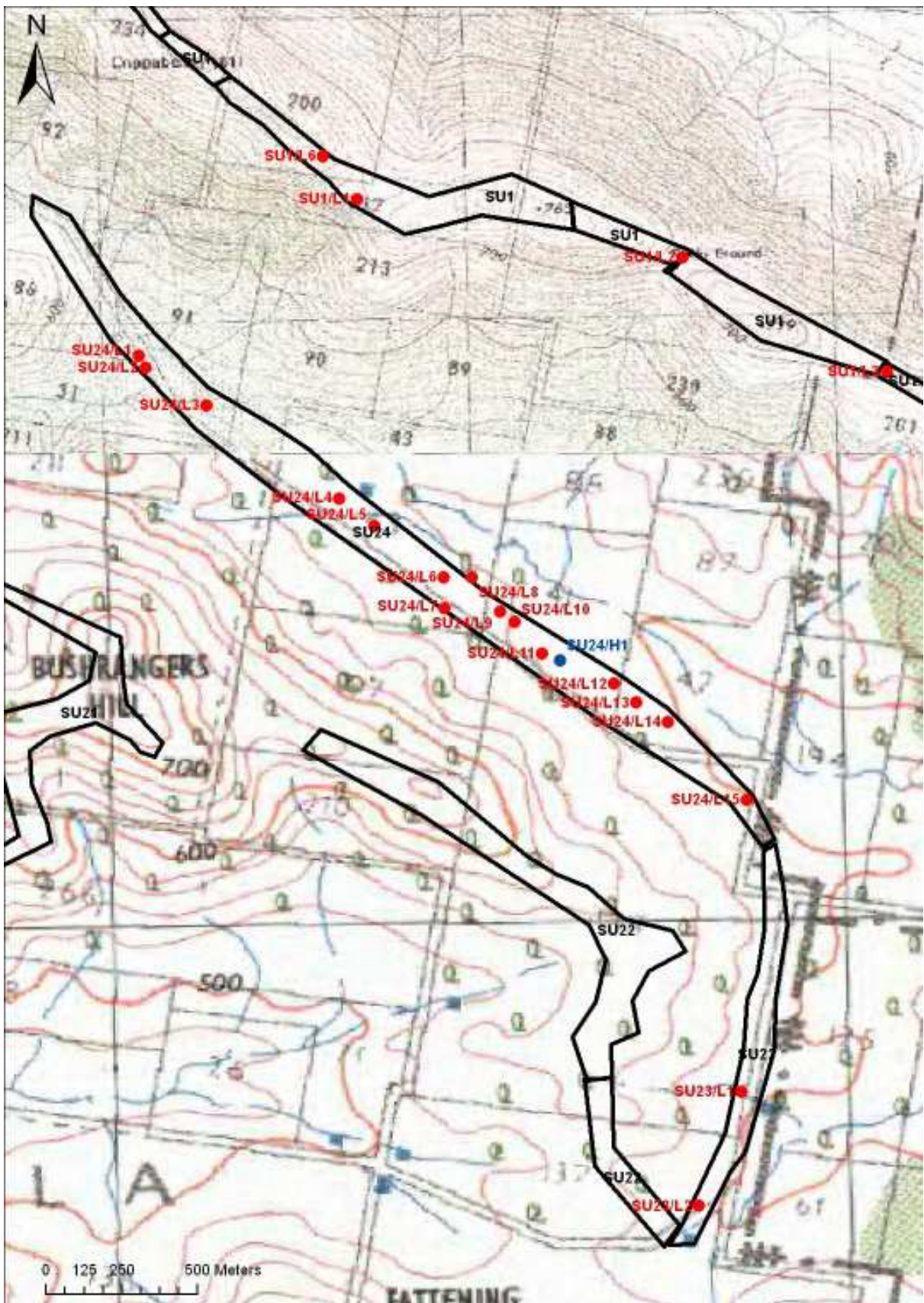


Figure 10. Coppabella Hills Map 5.



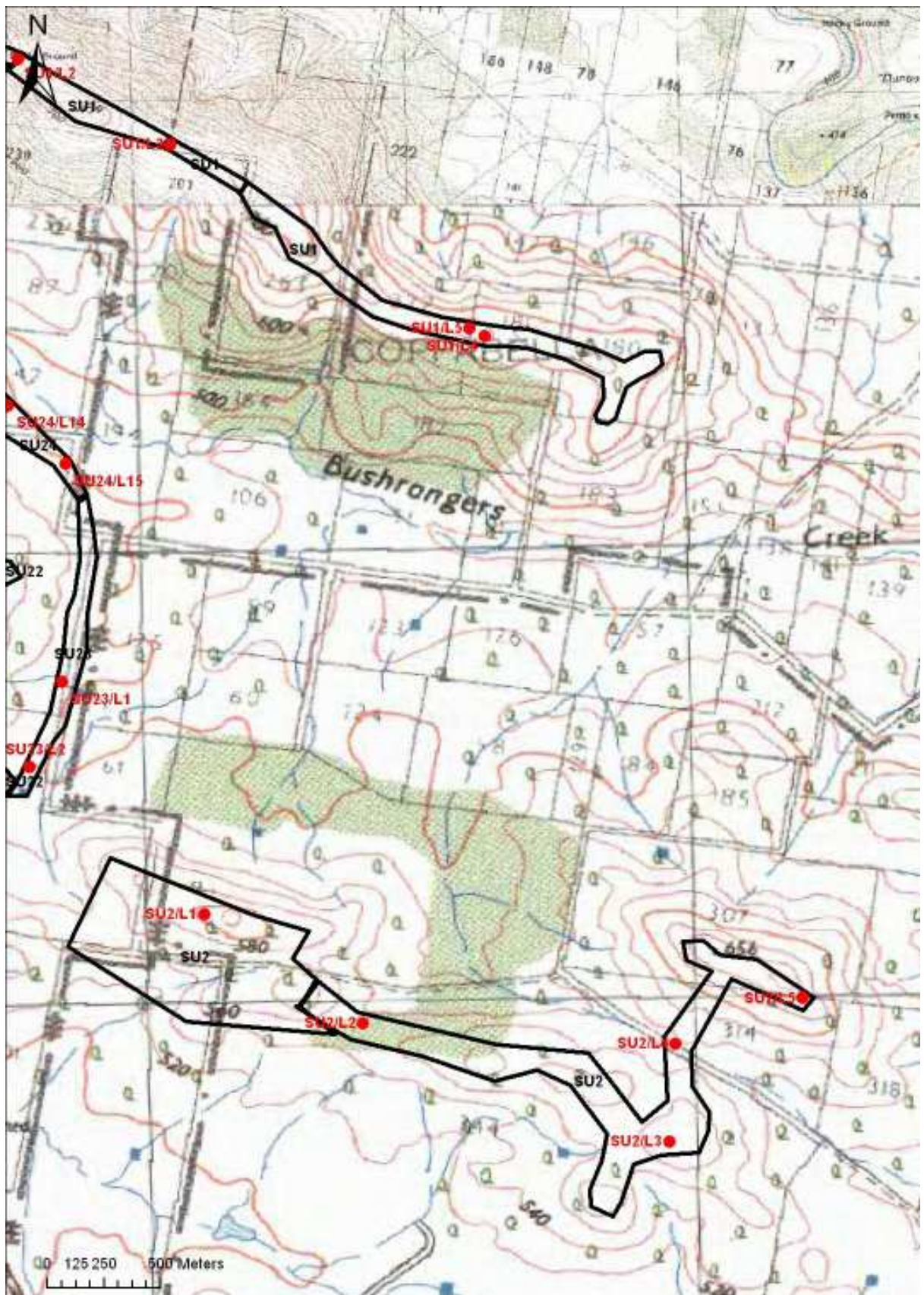


Figure 11. Coppabella Hills Map 6.



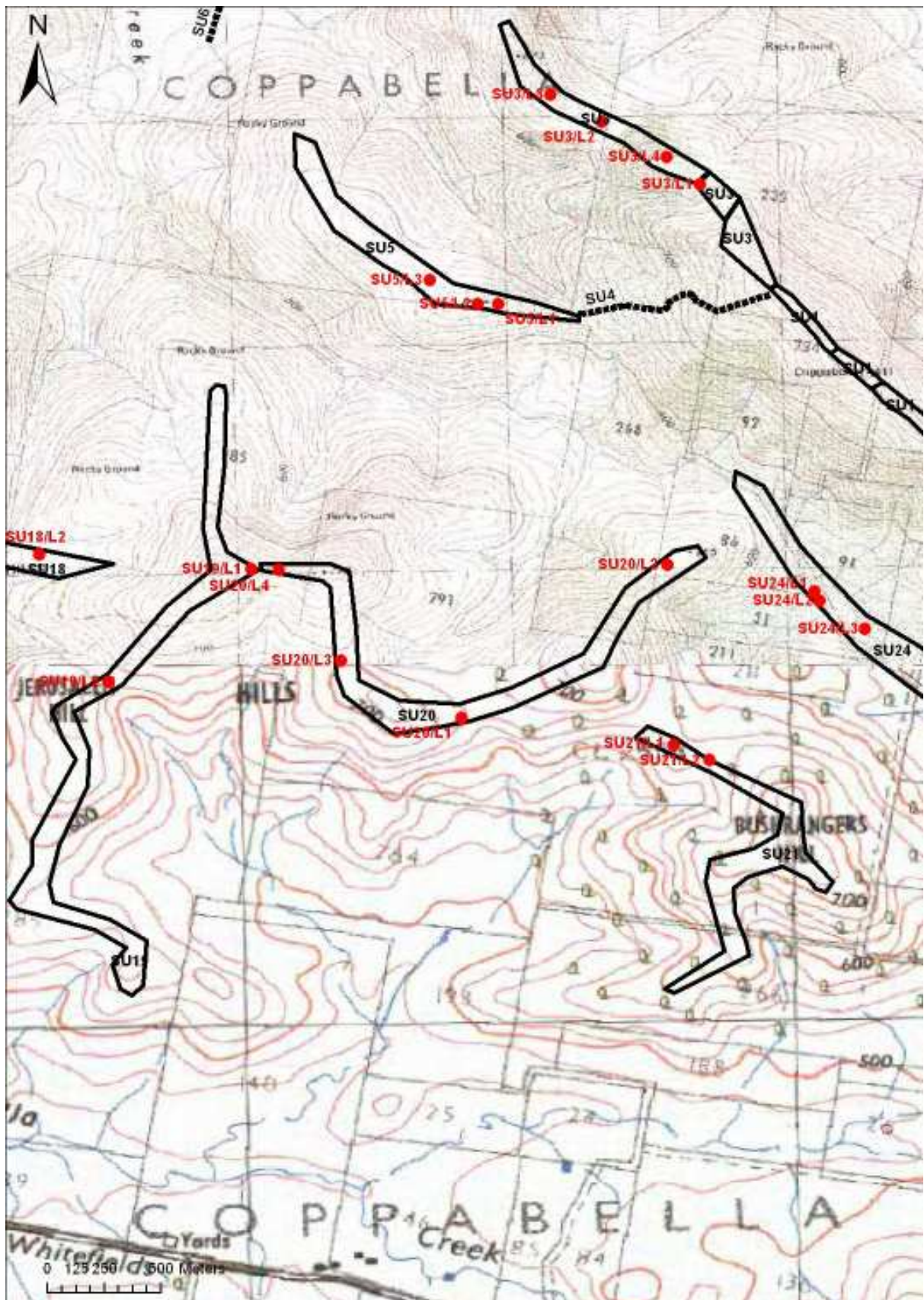


Figure 12. Coppabella Hills Map 7.



# Appendix 5 COMMUNICATIONS AND AIRCRAFT ASSESSMENT



Telecommunications and Aviation Navigation  
Services Assessment

Yass Valley Wind Farm -  
Coppabella Hills Precinct  
May 2009

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## 1 EXECUTIVE SUMMARY

The objective of this report is to investigate the potential impacts of the Coppabella Hills Precinct, part of the Yass Valley Wind Farm proposal, on existing telecommunications services in the vicinity of the proposal and to propose appropriate mitigation strategies for any impacts identified.

Telecommunication services, including television, radio, mobile phone services and other radio communication services occur in proximity to population centres and often utilise the ridgelines that provide optimum locations for wind turbines. As with any large structure, wind turbines have the potential to cause interference with such signals.

In general, VHF and UHF frequency band radio signals, and digital voice based technologies such as GSM mobile, are essentially unaffected by wind turbines. This includes land mobile repeaters, radio, the audio component of analogue television and mobile phones.<sup>1</sup>

Following a review of the radio communication services near the wind farm site, the nature of potential interference and consultation with the service providers, it is considered that the wind farm would have minimal effect on telecommunications services. Mitigation strategies are proposed to ensure any impacts can be managed and mitigated.

## 2 GLOSSARY OF TECHNICAL TERMS

VHF	Very High Frequency
UHF	Ultra High Frequency
EMI	Electromagnetic Interference
VHF Channels	TV Channels 0 to 12 (45 - 230 MHz)
UHF Channels	TV Channels 28 - 46 (526 - 820 MHz)
Band 111	VHF TV Channels 5A - 12
Fresnel Clearance	Clearance to obstructions from the ray line on a radio path which does not produce any additional loss above free space loss
FM	Frequency Modulation
MF	Medium Frequency
LF	Low Frequency
GSM	Global Systems Mobiles
CDMA	Code Division Multiple Access cellular mobile system
ITU	International Telecommunications Union
ABA	Australian Broadcasting Authority
ACMA	Australian Communications & Media Authority
CB Radio	Citizens Band Radio

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<sup>1</sup> <http://www.dungog.nsw.gov.au/files/2142/File/GreenpowerEMIAnalysisIssue.pdf>

### 3 EXISTING ENVIRONMENT



**Coppabella Hills Precinct site**

A review of telecommunication technologies that are in use within the area surrounding the proposed Coppabella Hills Precinct has identified the following:

- TV and radio broadcasting
- Mobile phone services provided by telecommunication companies
- Radio communication systems, including point to point microwave links, licensed by the Australian Communications and Media Authority (ACMA)
- Other radio links including mobile radio, CB radio; and
- Aircraft navigation systems

Electromagnetic Interference (EMI) has the potential to cause degradation or total loss of signal strength and may cause poor TV reception and/or “ghosting” effects. EMI may also result in a reduction in the coverage of mobile phone, radio and aircraft navigation communications in certain instances. There are three principal mechanisms by which wind turbines may cause EMI: reflection or scattering, diffraction and near field effects.<sup>2</sup>

---

<sup>2</sup> D. F. Bacon, A Proposed Method for Establishing an Exclusion Zone around a Terrestrial Fixed Link outside of which a



## Reflection or scattering

When a signal sent between a transmitter and receiver becomes obstructed by an object located within the path of a signal, reflection and/or scattering may occur. If the rotating blade of a wind turbine receives a primary transmitted signal, a scattered time delayed (or out of phase) signal may be produced and transmitted to the receiver. The out of phase signal will be distorted in relation to the primary signal, causing EMI.<sup>3</sup>

## Diffraction

In some instances when an object is located in the path of a signal wave front, the object can both reflect and absorb the signal. This phenomenon is commonly referred to as diffraction.<sup>4</sup>

## Near field effects

Wind turbines may cause interference to radio signals due to the electromagnetic fields emitted by the generator and the switching components within the turbine nacelle. This is referred to as a near field effect.<sup>5</sup>

Due to advances in technology and compliance with the Electromagnetic Emission Standard, EN 61000-6-4 (AS/NZ 4251.2:1999) *Emission standard for industrial environments*, the wind turbines proposed for the project will not cause active EMI due to near field effects.

The level of EMI produced by a wind turbine due to reflection or scattering, diffraction and near field effects is dependant on a number of factors, including placement of the wind turbine in relation to the signal path/s; the signal frequency; the characteristics / composition of the wind turbines rotor blades; the receiver characteristics; and the propagation characteristics of the radio wave in the local atmospheric conditions.<sup>6</sup>

While the site proposed for the development of the wind farm is a rural area, a number of communications links and broadcast networks are present in the surrounding region.

As with any large structure, there may be circumstances where wind turbines can cause disruption to the electromagnetic signals used in a variety of commonly used radar, navigation and telecommunications services. The following approach was adopted to identify the impact of the proposal on telecommunications:

- Identify license holders within a 25km radius of the proposed wind farm site, and point-to-point links in the vicinity of the site, using information provided on the ACMA RADCOM database;
- Provide written notification of the proposal and seek comments from each license holder identified via the ACMA RADCOM database within a 25km radius of the site;
- Record and review all responses received to identify any issues raised by license holders;

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Wind Turbine will cause Negligible Degradation of the Radio Link, Radiocommunications Agency UK Report Ver 1.1, 28 Oct 2002

<sup>3</sup> URS Woodlawn Wind Farm Environmental Impact Statement 2004

<sup>4</sup> *Ibid.*

<sup>5</sup> *Ibid.*

<sup>6</sup> *Ibid.*

- Discuss issues raised with relevant license holder with the aim to resolve or identify mitigation options;
- Carry out an assessment of the “Fresnel zone” associated with each fixed point-to-point communications link in the vicinity of the site;
- Determine appropriate exclusion zones for proposed turbine layout based on Fresnel zone calculations and advice from license holders;
- Confirm that all turbines (including blades) are located outside the exclusion zone;
- Determine appropriate additional mitigation measures which may be required.

### **3.1 Impact assessment**

The possible impact of the proposed Coppabella Hills Precinct on the four most common communications services has been investigated separately. These services are television and radio broadcast services, mobile phone services, radio communication services and aircraft navigation services.

Any impacts would be confined to the *operational phase* of the wind farm. Various measures are available to help mitigate potential impacts and are discussed below.

## **4 TELEVISION AND RADIO BROADCAST SERVICES**

### **4.1 Existing services and facilities**

The ACMA RadCom database lists the following broadcasters for television and radio, under postcode 2582, Yass.

#### Television broadcasting:

Southern New South Wales TV1: ABC, CBN, CTC, SBS and WIN.

#### Radio broadcasting:

Canberra RA1: 1ART, 1CBR, 1CMS, 1WAY, 1XXR, 2ABCFM, 2CA, 2CC, 2CN, 2JJJ, 2PB, 2RN, 2ROC, 2SBSFM

Canberra RA2: 1RPH

Goulburn RA1: 2ABCFM, 2ABCRN, 2ABCRR, 2GN, 2JJJ, 2RN, 2SNO.

Yass RA1: 2YAS

The ACMA RadCom database lists the following broadcasters for television and radio, under postcode 2584, Binalong.

#### Television broadcasting:

Southern New South Wales TV1: ABC, CBN, CTC, SBS and WIN.

#### Radio broadcasting:

No radio broadcasters listed.



Canberra (Black Mountain) is the nearest TV transmission source for the locality of the proposed Coppabella wind farm. Black Mountain is approximately 50km South East of the wind farm site. Details of the Canberra television channels are provided in the table below.

<b>Broadcaster</b>	<b>Channel</b>	<b>Band</b>	<b>Frequency (MHz)</b>
Capital (CTC)	6	VHF	177.5
Capital (CTC)	7	VHF	182.258
ABC	9	VHF	196.26
ABC	9A	VHF	205.625
SBS	28	UHF	527.26
SBS	30	UHF	543.5
WIN	11	VHF	219.5
WIN	31	UHF	548.198
Prime (CBN)	12	VHF	226.5
Prime (CBN)	34	UHF	569.198

License holders identified via the ACMA RadCom database within a 25km radius of the wind farm were notified of the proposal in relation to potential impacts and asked to provide comments.

At the time of writing, no concerns had been raised from the license holders contacted regarding possible impacts to television or radio broadcasting services. EPURON will work with organisations to resolve any issues, should any be identified.

## **4.2 Television broadcasting**

### **4.2.1 Interference and impact analysis**

Television Interference (TVI) is dependent on a range of factors including environmental factors (topography, direct signal strength, transmitter type, and receiver type) and wind farm design factors (turbine elevation, rotor size and orientation, speed of rotation, blade material and pitch). TVI caused by the operation of wind turbines is characterised by video distortion, while the audio component of the signal is not affected.<sup>7</sup> Due to the variability of local conditions and the characteristics of antennae used in particular installations, there is a degree of uncertainty regarding predicted levels of interference.

The level of TVI can be influenced by a number of factors including:

- Where the receiver is located, relative to the TV transmitter and the wind farm;
- The frequency of the transmitted TV signal;
- Whether there are any other tall structures in the vicinity of the receiver;
- The direction of the rotor blades and blade material;

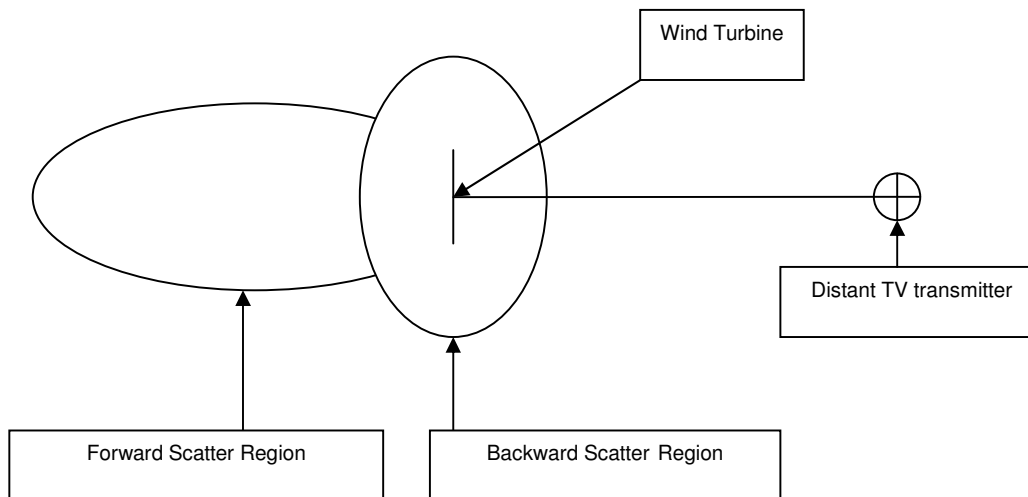
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<sup>7</sup> David E Spera, Wind Turbine Technology, Chapter 9 ASME Press 1994

- The nature of the receiving aerial e.g. design, height, directionality, power.

In general, the potential for interference at receiver locations can increase with distance of the receiver from the transmitter, as signal strength decreases with increasing distance from the source. As such, a wind farm in an area of already poor signal strength may potentially have a greater impact on reception than the same wind farm in an area of relatively strong signal strength. In addition, reception in the vicinity of the wind farm can vary with the degree of topographic obstruction of the signal.

A wind turbine has the potential to scatter analogue television waves both forward and back. Forward scatter will only occur if a wind turbine is located approximately between the dwelling and the broadcast site. The forward scatter region is as shown in the figure below, and generally does not extend further than 5 km for the worst combination of factors. Interference may extend beyond 5 km if the dwellings are screened from the broadcast tower, but do have line-of-sight to the wind turbines. The effect of the forward scatter is to potentially cause the brightness of the television picture to vary with the rotation of each blade. Modern television sets usually incorporate Automatic Gain Compensators (AGC) which act to lessen or eliminate variations in picture gain or brightness.<sup>8</sup>



**Schematic diagram of potential analogue television signal interference zones around a wind turbine<sup>9</sup>**

The zone of potential interference for a wind farm is the resultant total of the effects from the individual turbines. The International Telecommunications Union Recommendation ITU-R BT.805 states that impacts beyond 5 kilometres are unlikely.<sup>10</sup>

It also indicates that interference may extend beyond 5km where the receiver location is shielded from the direct signal, but in direct line-of-sight to the turbine. The form of

<sup>8</sup> <http://www.dungog.nsw.gov.au/files/2142/File/GreenpowerEMIAnalysisIssue.pdf>

<sup>9</sup> Reproduced from the Connell Wagner PPI Gunning Wind Farm Environmental Impact Statement - Chapter 11.

<sup>10</sup> Crookwell II Wind Farm – Environmental Impact Statement - URS

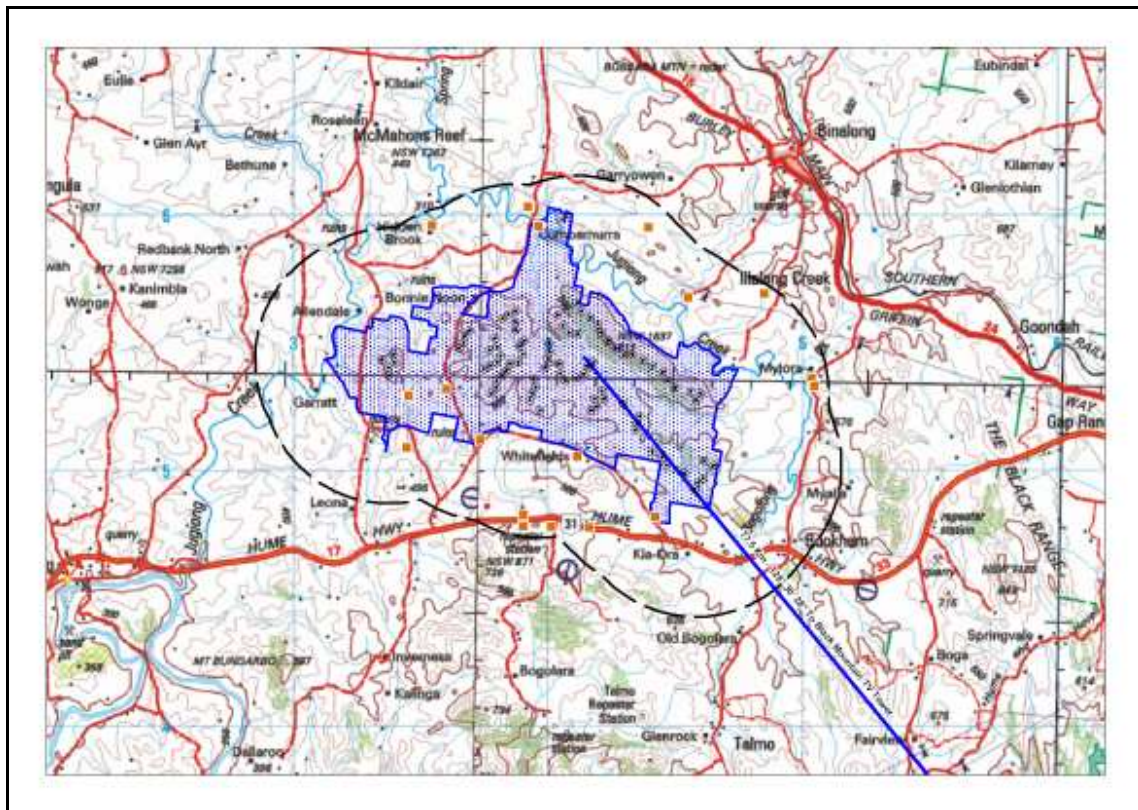


interference, if experienced, will depend on the relative positions of the wind farm, the transmitting station and the receiver.

Television interference can take the form of either a “ghost” image that pulsates horizontally at the “blade pass” frequency or a fluctuation in picture brightness, also at the “blade pass” frequency.<sup>11</sup>

There are approximately 60 houses within a 5km radius of the proposed wind farm site boundary. The location of the wind farm with respect to the Black Mountain communications tower can be seen in the following diagram.

#### 4.2.2 House and television tower locations



It is difficult to assess the likely impact on these specific house locations and once the wind farm is operational it is possible that television reception could be affected at some of these locations unless some form of mitigation is introduced. However, houses further than 5km from the site are unlikely to be affected.

#### 4.3 Mitigation measures

In the design of the project, the proponent will carry out the following mitigation measures to help minimise TVI:

- Use of primarily non-metallic turbine blades;

<sup>11</sup> Connell Wagner Delta Electricity Gunning Environmental Impact Statement 2004

- Use wherever practical of equipment complying with the Electromagnetic Emission Standard, AS/NZS 4251.2:1999;

Once the wind farm is operational, the proponent will offer to undertake a monitoring program of houses within 5km of the wind farm to determine any loss in television signal strength, if requested by the owners. In the event that TVI is experienced by existing receivers in the vicinity of the wind farm, the source and nature of the interference will be investigated by the proponent.

Should investigations determine that the cause of the interference can be reasonably attributable to the wind farm; the proponent will put in place mitigation measures at each of the affected receivers in consultation and agreement with the landowners.

Specific mitigation measures may include:

- Modification to, or replacement of receiving antenna;
- Provision of a land line between the effected receiver and an antenna located in an area of favourable reception;
- Improvement of the existing antenna system;
- Installation of a digital set top box or,
- In the event that interference cannot be overcome by other means, negotiating an arrangement for the installation and maintenance of a satellite receiving antenna at the proponents cost.

#### **4.4 Satellite Pay Television**

Some homesteads in the area may have satellite pay TV service antenna installations.

Unless a particular subscriber's antenna reception direction and elevation is aligned with a turbine, no impacts on TV reception are likely.<sup>12</sup>

#### **4.5 Radio broadcasting**

The level of radio broadcast interference experienced can be influenced by a variety of variables including:

- Abnormal weather conditions;
- Multi-path distortion (reception of a signal directly from a transmitter and also a reflected signal from hills, structures etc.);
- Overloading (occurs when an FM receiver receives too strong a signal);
- Electrical interference from household appliances etc;

#### **4.6 FM sound broadcasting**

Low power national FM stations on 107.7 & 106.9MHz are listed on the Wades Hill TV site at Crookwell. National, community and commercial services on 101.5, 102.3, 105.5,

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<sup>12</sup> Lawrence Derrick & Associates Bannister Wind Farm – Investigation of possible impacts on broadcasting and Radio communication Services September 2003



104.7, 98.3, 99.1, 92.7, 91.9, 91.1, 106.3 and 103.9MHz are located on Black Mountain.<sup>1314</sup>

#### 4.7 MF sound broadcasting

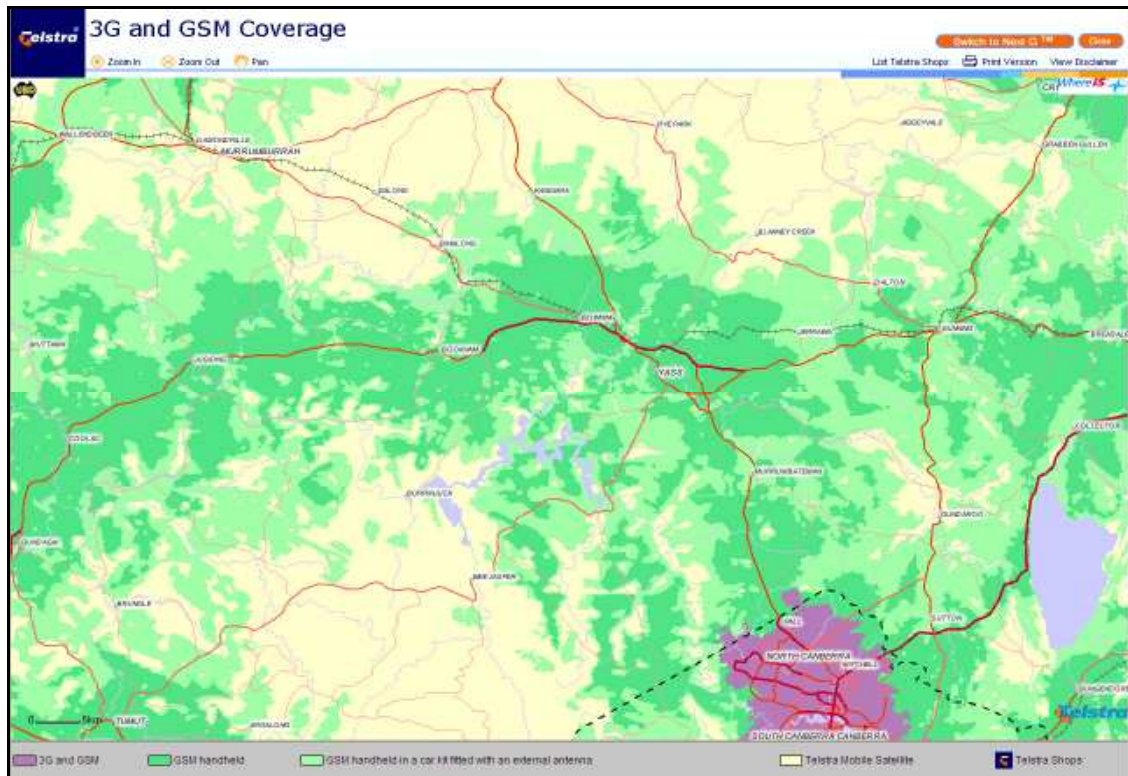
Wind farm effects on MF radio are highly unlikely and therefore the stations serving the area have not been listed.<sup>15</sup>

### 5 MOBILE PHONE SERVICES

#### 5.1 Existing services and facilities

This section covers GSM (2G) and 3G services (high frequency communications links used for mobile transmission networks are discussed in the next section: Radio Communication Services).

Figures below show the existing local mobile phone coverage from the three providers (Source: company websites)

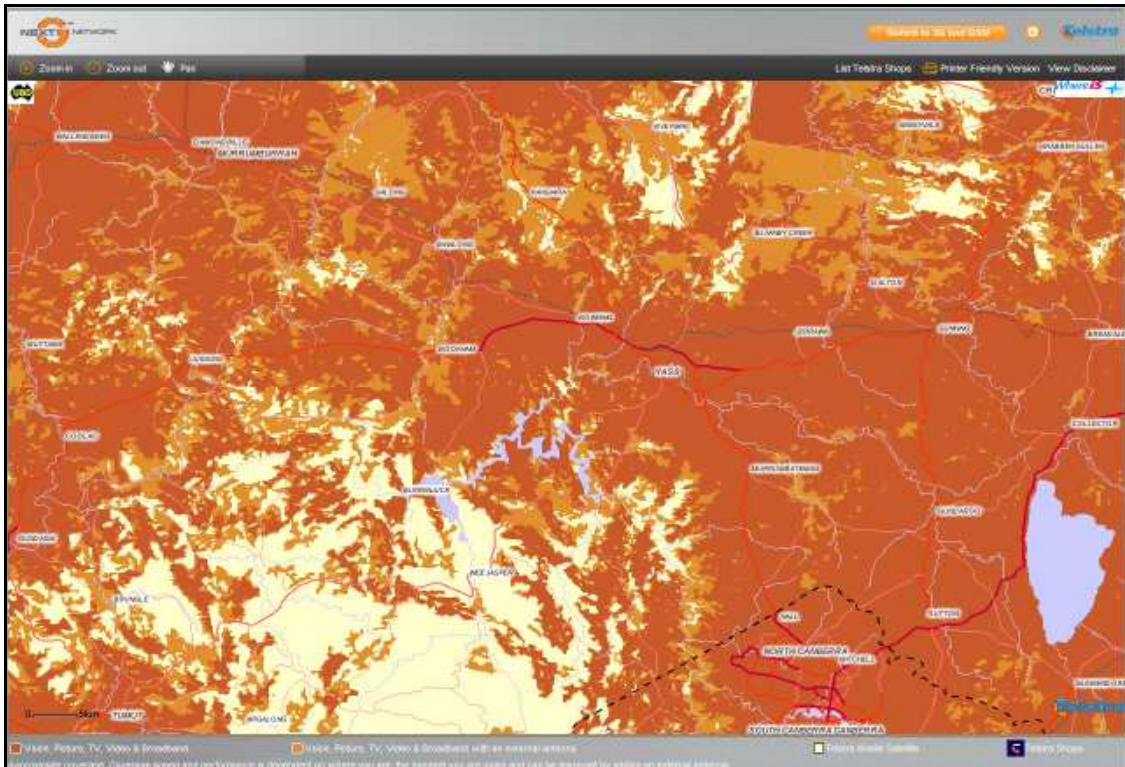


Telstra 3G and GSM (2G) Coverage

<sup>13</sup> Lawrence Derrick & Associates Bannister Wind Farm – Investigation of possible impacts on broadcasting and Radio communication Services September 2003

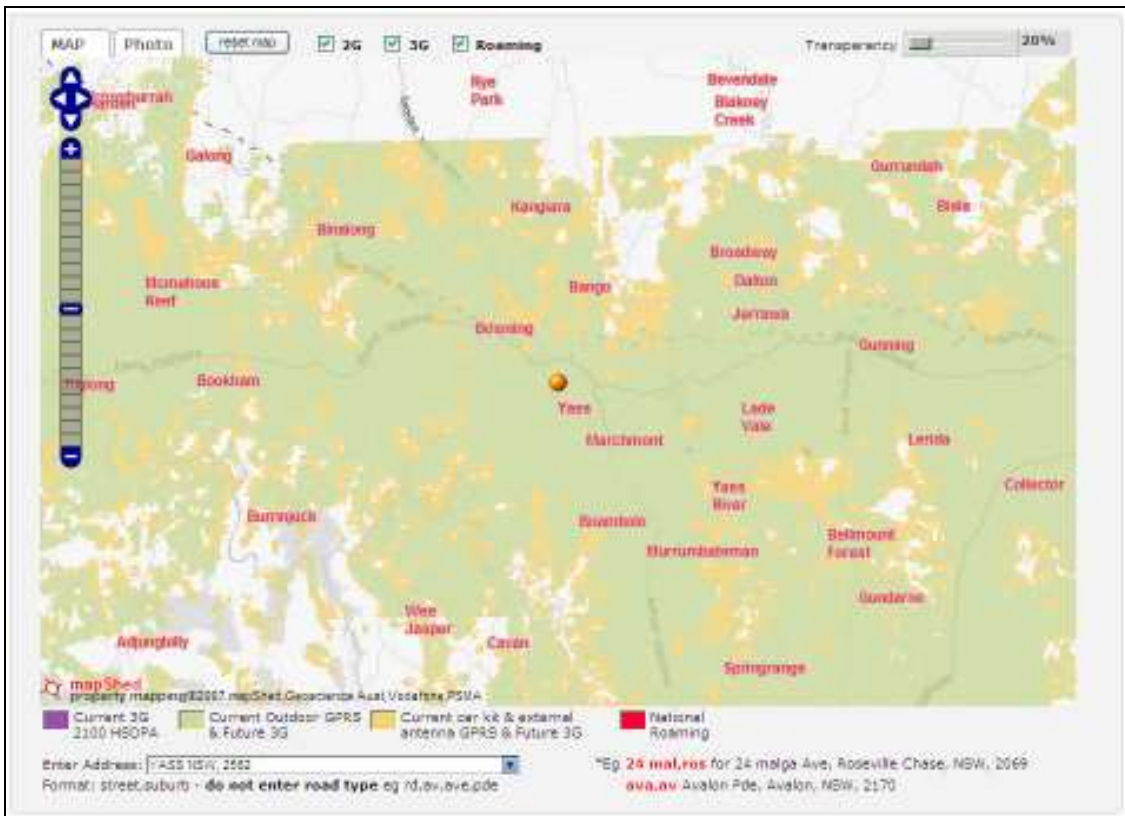
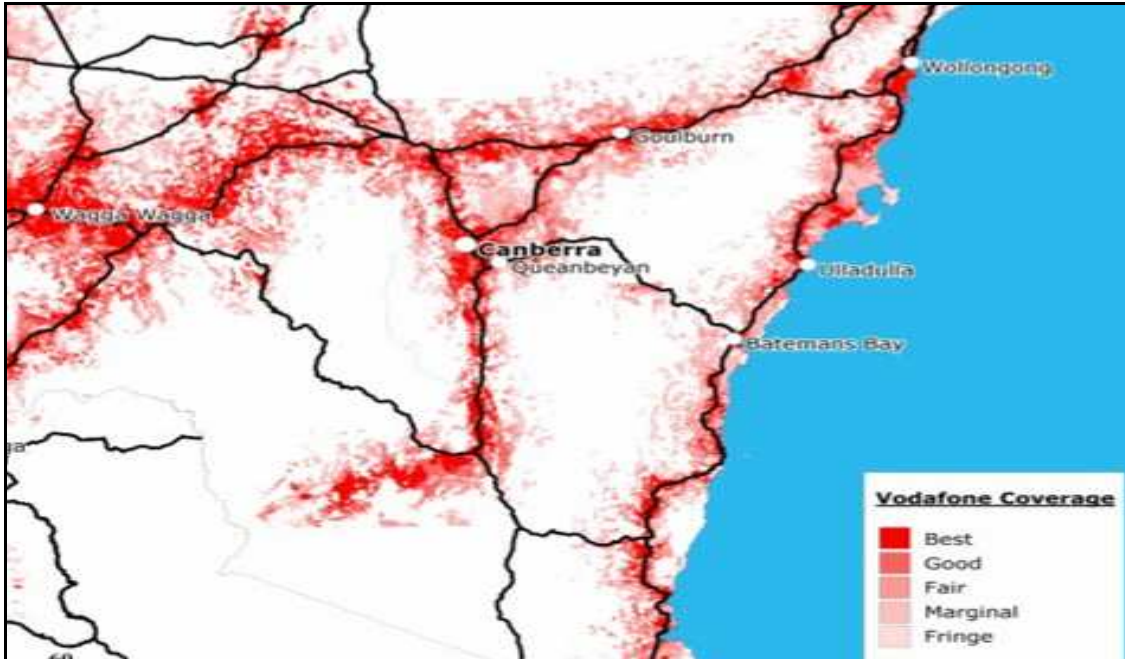
<sup>14</sup> <http://www.ausradiostations.com/fmact.html> and <http://www.ausradiostations.com/fmns.html>

<sup>15</sup> *Ibid*



Telstra Next G





Vodafone GSM Coverage



Optus GSM (2G) Coverage

## 5.2 Interference and Impact Analysis

A mobile phone network consists of a system of adjoining zones called ‘cells’, which vary in size with a radius of 2 - 10 km. Each cell has its own base station that sends and receives radio signals throughout its specified zone. Mobile phone antennas need to be mounted clear of surrounding obstructions such as buildings to reduce ‘dead spots’ and allow the base station to effectively cover its intended cells.<sup>16</sup>

The ACMA RadCom Database identified three mobile phone companies as using base stations within the vicinity of the proposed wind farm. The table below lists the companies and ACMA site ID numbers.

Mobile Phone Companies	ACMA Site ID No.
Optus Mobile Pty Ltd / Singtel Optus Pty Ltd	201821,198028
Telstra Corporation Ltd	130627, 9515, 100784
Vodafone Network Pty Ltd	201821, 198028

<sup>16</sup> URS Crookwell II Wind Farm Environmental Impact Statement ,



All companies were contacted by EPURON regarding potential impacts and asked to provide feedback as to any potential conflicts with their existing networks.

### 5.3 Mitigation measures

No GSM/CDMA mobile services are registered at sites in the close vicinity of the wind farm. The Telstra mobile service from Wades Hill, Crookwell is too distant to be affected by the wind turbines<sup>17</sup> Telstra no longer operates its CDMA network.

No additional mitigation measures are required.

## 6 RADIO COMMUNICATION SERVICES

### 6.1 Existing services and facilities

The Australian Communication and Media Authority (ACMA) issues radio communications licenses in accordance with Part 3.5 of the Commonwealth Radiocommunications Act 1992. The ACMA issues licenses to use specific segments of the radio broadcasting frequency spectrum for different purposes and maintains a register (the ACMA RadCom Database) of all the licenses issued.

The register allows the ACMA to create a 'density' classification of areas across Australia as high, medium or low depending on the number of licenses in operation in a particular area. According to the ACMA RadCom Database, the area in the vicinity of the proposed wind farm is classified as a "Low Density Area".

According to the ACMA RadCom Database, license holders operate a range of radio communications services, primarily fixed link microwave communication and mobile communication systems within a 25km radius of the proposed wind farm. Multiple license holders use some sites, while sole users employ others.

Radio communication license holders within 25km of the Coppabella Hills Precinct  
(Latitude -34 46 52.81, Longitude 148 40 57.9)

ACMA Licence Holder	ACMA Site ID No.
Airservices Australia	9001816, 34921
Ambulance Service of New South Wales	34921
Commissioner of Police NSW Police	35851, 34921, 198028
Country Energy	9542, 404037
Department of Environment and Conservation	9519
Goldenfields Water County	198028

<sup>17</sup> Lawrence Derrick & Associates Bannister Wind Farm – Investigation of possible impacts on broadcasting and Radio communication Services September 2003

<b>ACMA Licence Holder</b>	<b>ACMA Site ID No.</b>
Council	
Harden Shire Council	9542
NSW Department of Commerce – Government Chief Information Office	201821
NSW Department of Primary Industries	40307
NSW Rural Fire Service	9519, 34897, 9542
NSW Volunteer Rescue Association	39030,34921
Optus Mobile Pty Ltd	201821,198028
Roads and Traffic Authority of NSW	9519
Singtel Optus Pty Ltd	201821, 198028
Telstra Corporation Ltd	130627, 9515, 100784
The Info Radio Network Pty Ltd	198028
TransGrid	34921
Vodafone Network Pty Ltd	201821, 198028
W. S Gregory & Associates Pty Ltd	9519
Yass Valley Council	9519

## **6.2 Interference and Impact Analysis**

A fixed link radio transmission is a point-to-point transmission path typically between two elevated topographical features. The transmission path may become compromised if a wind farm is located within the direct line-of-sight or what is known as the 'Fresnel Zone' around the line of sight between the sending and receiving antennae.

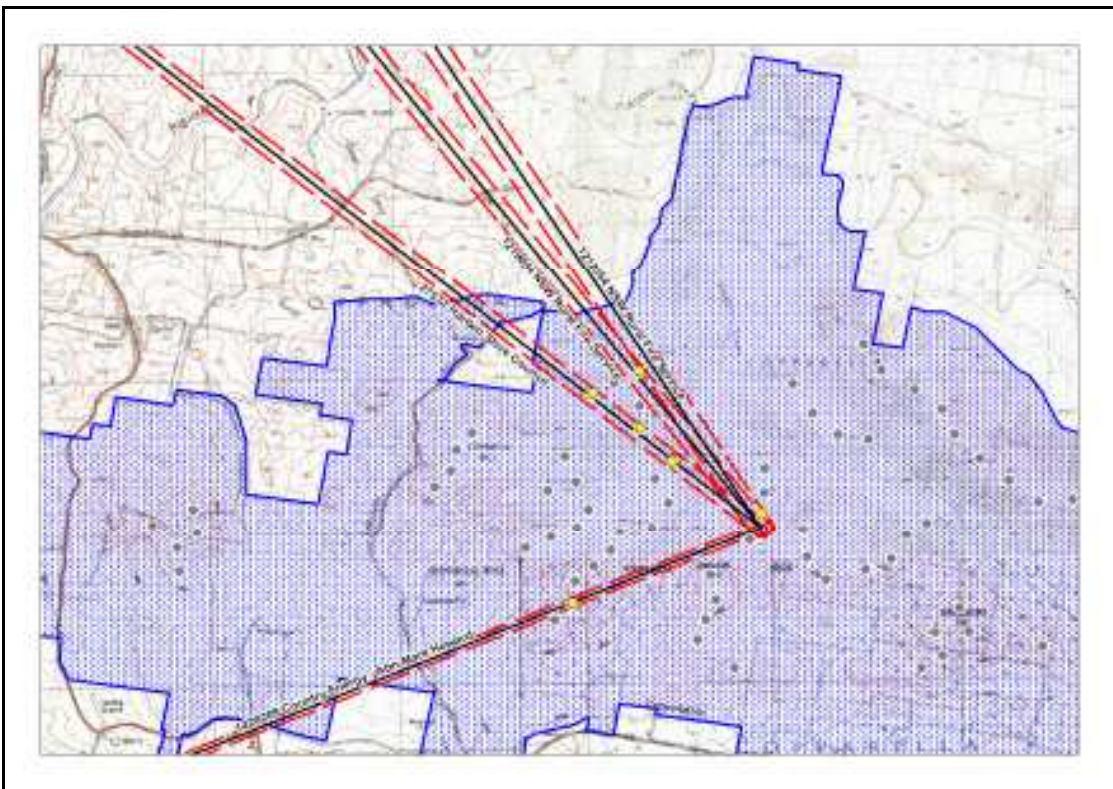
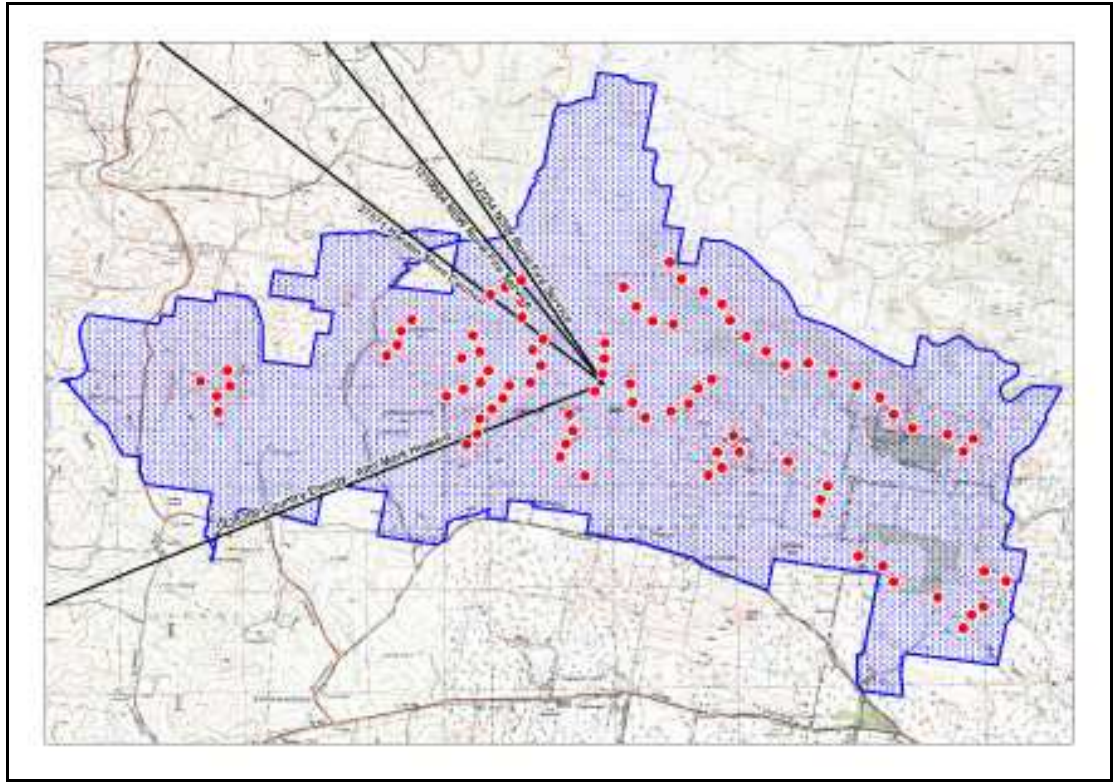
The potential impact zone will vary with the distance between the transmitter and receiver, frequency of transmission and the location of any particular point along its path. Communications are only likely to be affected if a wind farm is in the line-of-sight between two sending and receiving antennae or within a zone of the line-of-sight of these antennae.

Where a potential exists for interference to line-of-sight links, an obstruction analysis can be undertaken to ensure that no part of a wind turbine assembly will enter the Fresnel Zone of the microwave link. The maximum extent of the Fresnel zone occurs at the midpoint along the path of the microwave link.

EPURON identified and mapped the point-to-point communication links in the vicinity of the proposed wind farm site to establish the line-of-sight path.







### 6.3 Radio communication links

In order to ensure that no obstruction to transmission paths occurs, calculations of the 2nd Fresnel zone of the point-to-point communications links in proximity to the site were undertaken.

It is suggested that beyond the 2nd Fresnel zone, the power of a scattered signal from a structure such as a wind turbine would be small enough such that it would not result in significant interference at the receiver.<sup>18</sup>

At the time of writing, five point-to-point communications links were identified as crossing the site.

A link between “Commsite Coppabella Hill” and “Demondrille Hill via Harden”, (License No. 27571) operated by Harden Shire Council, passes across the site. This link operates at 450.625 MHz.

A link between “Commsite Coppabella Hill” and “Shire Council Site Boundary Rd 7km SSE of Young”, (License No. 1212554) operated by the NSW Rural Fire Service, passes across the site. This link operates at 404.875 MHz.

A link between “Commsite Coppabella Hill” and “Rocky Hill via Harden”, (License No. 1219084) operated by NSW Rural Fire Service, passes across the site. This link operates at 450.8725MHz.

A link between “Country Energy Substation JUGIONG” and “Commsite Coppabella Hill”, (License No. 1428209) operated by Country Energy, passes across the site. This link operates at 852.6125 MHz.

A link between “Shire Council Site Boundary Rd 7km SSE of Young” and “Commsite Coppabella Hill”, (License No. 1428213) operated by Country Energy, passes across the site. This link operates at 852.3875 MHz.<sup>19</sup>

In order to determine whether a radio link could be affected by the wind turbines, EPURON defined an ‘exclusion zone’ beyond which the level of interference will not disrupt the radio link, based on the concept of the Fresnel zone, as previously described.

EPURON previously contacted all organisations identified as operating radio communication licences (including fixed link communications) within 25km of the nearby Cullerin wind farm proposal.

Each license holder was asked to provide independent comments / advice on the possibility of the wind farm development interfering with their communications links. At that time, no organisation within the 25km radius raised concerns. Optus, Vodafone and Telstra provided general guidelines to assist in the planning of wind farms.

In response to these enquiries,

Harden Shire Council responded with:

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<sup>18</sup> D. F. Bacon, A Proposed Method for Establishing an Exclusion Zone around a Terrestrial Fixed Link outside of which a Wind Turbine will cause Negligible Degradation of the Radio Link, Radiocommunications Agency UK Report Ver 1.1, 28 Oct 2002

<sup>19</sup> Not shown on the diagram as it shares the same corridor as licence number 1212554



Council has no comments to make at this stage of the proposal, however, wishes to be informed on possible impacts to the communications network. Council also added that they would be happy to work with the proponent to resolve any potential impacts.

Optus Mobile noted:

"Provided wind turbines are located well outside the 2nd Fresnel zone of the point to point microwave links, no interference to communications is expected" (pers. comm. Mr. Trong Ho, Optus Mobile)<sup>20</sup>

Vodafone noted:

"Clearance criteria is the same for all carriers. Please use the same criteria as proposed by Optus" (pers. comm. Mr. Ganesh Ganeswaran, Senior Engineer / Transmission, AAP Communications Services 22/11/05)<sup>21</sup>

Telstra noted:

"Provided wind turbines are greater than 100m away from Mobile tower (or in the case of directional panel antennae) not in direct line of sight for panel antennas, wind turbines will have minimal effect on existing coverage." (pers. comm. Mr. Ivan D'Amico, Area Team Manager (Country) - NSW&ACT, Telstra Services, Wireless Access Solutions, Mobile Coverage Delivery)<sup>22</sup>

These suggestions have been incorporated into the planning of the Yass Valley Wind Farm proposal.

## **6.4 Other radio communication**

### **6.4.1 Two-way mobile**

A small number of mobile bases exist in the area surrounding the wind farm site. These bases potentially provide cover to mobiles in a 360 degree arc from their bases. No significant impact from the wind farm on base coverage beyond normal mobile operational performance is predicted in view of the geographic separation between the base antennas and the turbine structures. Of course a mobile unit communicating with a base station when the mobile is located within metres of the wind turbine structures (or indeed near any large building, silo, tower etc) may experience some very local performance change, however moving a short distance would restore performance to normal.<sup>23</sup>

### **6.4.2 CB radio**

CB radios are not individually licensed, the equipment being subject to class licensing only. Therefore, no records of location or operators of CB radios exist, and the channels are shared without any right of protection from interference. No impact from the wind farm is predicted except perhaps for very local effects to portable or mobile units in the

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<sup>20</sup> Taurus Energy - Cullerin Range Wind Farm Environmental Assessment Report 2006

<sup>21</sup> *Ibid.*

<sup>22</sup> *Ibid.*

<sup>23</sup> Lawrence Derrick & Associates Bannister Wind Farm – Investigation of possible impacts on broadcasting and Radio communication Services September 2003

immediate vicinity of the turbines which could be avoided by a small location change of the unit.<sup>24</sup>

### **6.4.3 Wireless Broadband**

From studies in other areas such as Mahinerangi, NZ<sup>25</sup> it is concluded that the minimum separation required between wind turbines and mobile broadband transmitters is approximately 240m. Turbines will be located outside this distance to avoid any impacts on mobile broadband services.

## **6.5 Mitigation measures**

As a result of the exclusion zones established in planning the wind farm, there is the possibility that impacts could occur to existing point-to-point links, in particular link 27571 operated by Harden Shire Council. The proponent has engaged with council to discuss these impacts and possible mitigation strategies. Both council and the proponent are confident that any potential impacts will be able to be mitigated using the following techniques:

- Modifications to or relocation of the existing antennae;
- Installation of a directional antennae to reroute the existing signal;
- Installation of an amplifier to boost the signal; and/or
- Utilisation of onsite optical cable to reroute the original signal.

## **7 AIRCRAFT NAVIGATION SYSTEMS**

### **7.1 Existing services and facilities**

The closest airports to the proposed wind farm site are Canberra and Goulburn. There is one radar installation in the vicinity of Canberra airport, namely Mt Majura. A secondary radar installation is located at Mt Bobbara.

### **7.2 Interference and impact analysis**

EPURON has consulted with the Civil Aviation Safety Authority (CASA), Airservices Australia and the Department of Defence in relation to the proposal.

Due to the height of the turbines (>110m), the Civil Aviation Safety Authority previously recommended that obstacle lighting be provided as per section 5.5 of Advisory Circular 139-18(0) - *Obstacle Marking and Lighting of Wind Farms*. The Advisory Circular was withdrawn in September 2008 and at the time of writing a recommendation was not available from CASA in relation to Obstacle Marking and Lighting of Wind Farms.

EPURON wrote to Airservices Australia (AA) in relation to the wind farm proposal on 15-7-08. In their response dated 16-12-08, AA suggested that there may be potential for navigational aid issues. Specific details regarding installations affected were not provided in the initial response.

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<sup>24</sup> *Ibid.*

<sup>25</sup> Mahinerangi Wind Farm Compatibility with radio services April 2007 - Kordia

At a meeting at Airservices Australia Brisbane office on 1-4-09 attended by David Cook – Manager Navigation & Surveillance, Matt Kelly – Engineering Specialist, Long Nguyen – Senior Engineering Specialist (video link) and Mitch Sloan – Airport Relations (video link), David Cook suggested that there may be potential impacts to the navigational aids at Mt Bobbara (SSR) and possibly although to a lesser extent Mt Majura (PSR) and (SSR). In his opinion, mitigation measures should be available to overcome or reduce these impacts.

Airservices Australia indicated at the meeting that they would not be able to conduct an internal assessment of the impacts to their navigational aids due to resourcing constraints. Accordingly, it was proposed that EPURON agree on a scope of work acceptable to Airservices Australia so that EPURON could engage a suitable consultant to investigate and prepare a report to assist Airservices Australia in their assessment of the proposal.

EPURON will continue to work closely with AA to mitigate issues discovered with the Mt Bobbara (SSR) and Mt Majura (PSR / SSR) that can be reasonably attributable to the proposed wind farm.

A review of the proposal was undertaken by the Department of Defence. No objection to the proposal was made.

#### Mitigation measures

Obstacle lighting will be provided if required by CASA. Further investigation into Airservices Australia claim that navigational aids may be affected will be required. At the time of writing insufficient information from Airservices Australia was available to enable more work to proceed. No other mitigation measures are required.

## **8 CONCLUSION**

Interference to MF and FM sound broadcasting is not expected.

Conflicts between point to point radio systems and the wind turbines are expected to be avoided with appropriate clearances being established. Also, mobile radio and other radio communication services in the area are not expected to be impacted by the wind farm or its operation.

VHF TV reception at dwellings within about 1 km of the wind farm turbines and with antennas having turbines located with +/- 25 degrees angle of their reception direction will have some probability of noticeable “ghosting” at times. For UHF TV time variant ghosting may be evident out to about 2 km for turbines located +/- 20 degrees from the reception direction.

Digital TV is not susceptible to visible “ghosting” degradation. Any impact of reflections from the turbines would be a minor reduction of coverage at the limit of the service area.

For any confirmed wind farm interference problems where TV antenna system improvements are unsuccessful, the use of the digital TV services in the area may be the best solution, requiring the provision of a digital set top converter.

Overseas experience indicates that electrical interference from wind farm generators and controls is not a problem with established and reputable wind turbine manufacturers and therefore no electrical noise measurements are warranted.



## 9 CORRESPONDENCE:

**From:** Sloan, Mitchell [mailto:Mitchell.Sloan@AirservicesAustralia.com]  
**Sent:** Tuesday, 16 December 2008 1:46 PM  
**To:** Anthony Micallef  
**Cc:** Rogers, Carly  
**Subject:** RE: Notification of Coppabella & Marilba Wind Farm proposals - Telecommunications

Dear Anthony

I regret to advise that at this stage we are unable to approve your proposed windfarm due Navigational Aid issues.

We require a more detailed study to be conducted on this proposal and it's potential impact on radar. This may require us to engage a consultant for this type of assessment, which would have to be at the proponents expense.

I will get back to you shortly with a more detailed response.

Regards

Mitch

---

Senior Adviser  
Airport Relations  
Phone: (02) 62684410  
Mobile: 0408 994410

# Harden Shire Council



Contact: Sharon Langman  
Quote Reference:

9 September 2008

Mr Anthony Micallef  
Epuron Pty Ltd  
Sent by email to [A.Micallef@epuron.com.au](mailto:A.Micallef@epuron.com.au)

PO Box 110  
3 East Street  
HARDEN NSW 2587  
Tel 02 6386 2305  
Fax 02 6386 2083

Email [council@harden.nsw.gov.au](mailto:council@harden.nsw.gov.au)  
Web [www.harden.nsw.gov.au](http://www.harden.nsw.gov.au)

Dear Mr Micallef

**Re: COPPABELLA AND MARILBA WIND FARM**

Council acknowledges the receipt of your letter dated 15 July 2008 and at this stage has no comment to make with regard to the proposal. However Council requests that should the project go ahead that information be provided as to the likely impacts upon the communications network operating in the immediate area.

Should the proposal go ahead Council would be willing to work with you to find solutions to any likely impacts.

Yours sincerely

Sharon Langman  
**DIRECTOR ENVIRONMENTAL SERVICES**

**From:** Cremer Rachel [mailto:Rachel.Cremer@BroadcastAustralia.com.au]  
**Sent:** Thursday, 4 September 2008 5:00 PM  
**To:** Anthony Micallef  
**Cc:** Langridge Emmajane; Freer Peter; Pizzato Bob  
**Subject:** RE: Notification of Coppabella & Marilba Wind Farm proposals - Telecommunications

Hi Anthony

Thanks for your letter regarding the Coppabella & Marilba wind farms and apologies for the delay in replying.

Broadcast Australia (BA) does not operate any broadcast facilities within 50 kilometres of your proposed wind farms and it is therefore unlikely to impact on our services. However we do recommend that Epuron engages an engineering consultancy firm to undertake a detailed study of potential impact on television and radio transmissions in the region as part of your Environmental Impact Study investigations. The Mt Carroll site you mentioned in your letter is not utilised by BA and I suggest you contact WIN Television and Australian Capital Television if you haven't done so already.

Thanks for notifying us of this proposal and please keep us informed of future developments. Please forward any further requests or notifications to Emmajane Langridge who will be BA's wind farm contact in future. Emmajane can be contacted on 02 8113 4718 or [emmajane.langridge@broadcastaustralia.com.au](mailto:emmajane.langridge@broadcastaustralia.com.au).

Please contact me if you need any further information in relation to the above.  
With regards  
Rachel

Rachel Cremer  
Property Co-ordinator  
Broadcast Australia Pty Ltd  
t: 02 6256 8020  
f: 02 6256 8041  
e: [rachel.cremer@broadcastaustralia.com.au](mailto:rachel.cremer@broadcastaustralia.com.au)  
w: [www.broadcastaustralia.com.au](http://www.broadcastaustralia.com.au)





NSW DEPARTMENT OF  
PRIMARY INDUSTRIES

---

02/06111  
OUT08/10594

1 September 2008

Epuron Pty Ltd  
Level 11, 75 Miller Street  
NORTH SYDNEY NSW 2060

Attn: Anthony Micallef

Dear Mr Micallef,

**Re: "Coppabella" & "Marilba" Wind Farms**

I refer to your letter dated 16 July 2008. Thank you for referring this proposal to the Department for comment.

I note that you wish to seek advice on the impact of the proposed wind farms on NSW DPI's radio communications services within the vicinity of the site. Advice from Chris Clarke at NSW DPI's Bathurst Office has confirmed that there will be no anticipated impact of the wind farm on the radio facilities.

Yours faithfully

A handwritten signature in cursive script, appearing to read 'Wendy Goodburn'.

**Wendy Goodburn**  
Resource Management Officer (land use)  
Goulburn

Aquatic Habitat Protection, Fisheries Conservation and Aquaculture Branch  
NSW Department of Primary Industries  
PO Box 17 Batemans Bay NSW 2536  
1<sup>st</sup> Floor, Cnr Beach Road and Orient Street

ABN 51 734 124 190  
www.dpi.nsw.gov.au  
Tel: 02 4478 9103  
Fax: 02 4472 7542

---

**From:** Curtis, Russell J [mailto:Russell.J.Curtis@team.telstra.com]  
**Sent:** Tuesday, 2 September 2008 11:52 AM

**To:** Anthony Micallef  
**Cc:** Turner, Martin V; D'Amico, Ivan D; Souksamlane, Kham; Yaghobzadeh, Sima  
**Subject:** RE: EPURON: Notification of Coppabella & Marilba Wind Farm proposals - Telecommunications

Anthony,

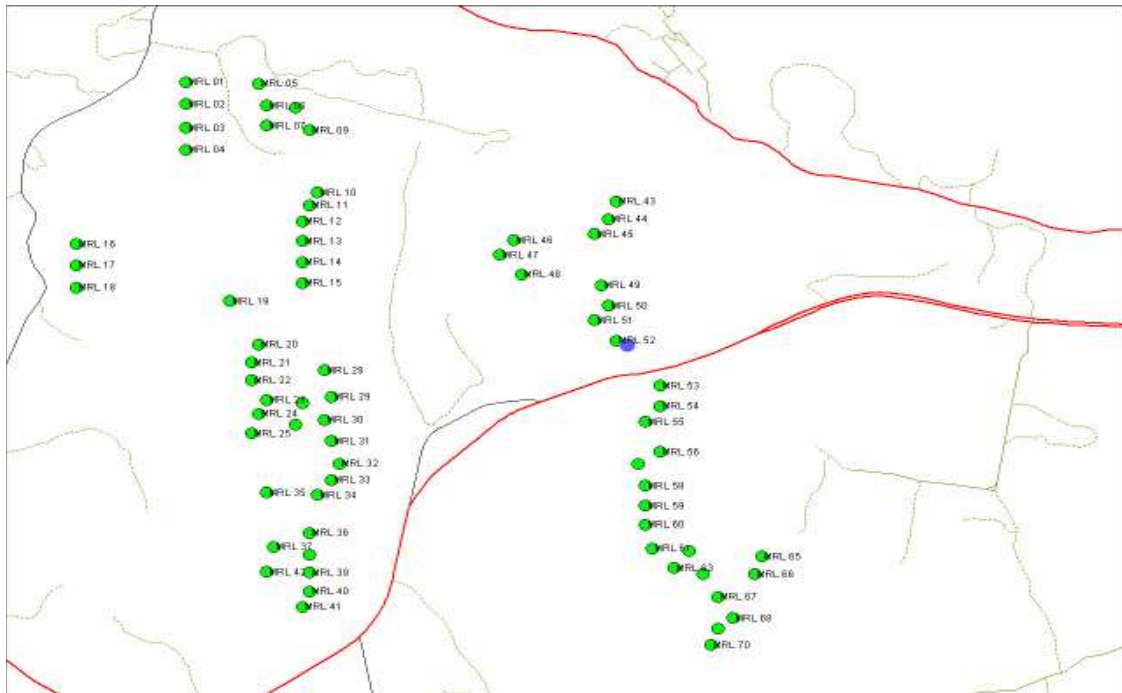
Further to your proposal - Information from our Mobiles department, they have a base station very close to MRL 52. This is "Conroy's Gap BTS". (refer to attachment)

Co-ords are: CGAP Conroy's Gap Latitude\_GDA94: -34.77278 Longitude\_GDA94: 148.72565

You will need to keep a distance greater than 100m away, the further away that you can place the turbines the better so as not to obstruct the BTS.

Yours Sincerely,

Russell Curtis  
Technology Specialist  
Telstra - Radio - Core & Access Technology  
15/242 Exhibition St MELBOURNE 3000  
Phone (03) 9634 7092 / Mobile 0418 387 971



**From:** Patrick Clague [mailto:Patrick@ses.nsw.gov.au]  
**Sent:** Saturday, 23 August 2008 11:25 AM  
**To:** Anthony Micallef  
**Cc:** Kevin Anderson; Abby Mayers; Barrie Miller - SHR  
**Subject:** FW: Epuron Wind farms near Bookham, NSW

Dear Anthony.

The below email fro Mark Pilkington provides the SES response to your letter dated 15 July

Regards  
Patrick Clague  
Manager Communications  
NSW State Emergency Service  
Ph.02 42516555

Fax 02 42516620

Mobile 0419 242250

Email [patrick.clague@ses.nsw.gov.au](mailto:patrick.clague@ses.nsw.gov.au)

This message is intended for the addressee named and may contain confidential information. If you are not the intended recipient, please delete it and notify the sender. Views expressed in this message are those of the individual sender, and are not necessarily the views of the NSW State Emergency Service.

-----Original Message-----

**From:** Mark Pilkington [mailto:[mark.pilkington@tait.com.au](mailto:mark.pilkington@tait.com.au)]

**Sent:** Tuesday, 5 August 2008 1:06 PM

**To:** Patrick Clague

**Cc:** Nicola Holden; Neil.johnson@tait.com.au

**Subject:** Epuron Wind farms near Bookham, NSW

Pat

In relation to the proposed wind farms near Bookham in the NSW SES Southern Highlands region.

The location of the 2 proposed wind farms "Coppabella Windfarm" and "Marilba Windfarm" does not fall within the link paths of the 2 closest NSW SES PMR sites, which are Boundary Road and Muntoonen. The 2 proposed wind farm therefore do not pose an interference issue to linking of these 2 sites.

As for users of NSW SES mobile or portable radios, with any large metallic structures there may be the possibility of local radio interference to users within the boundaries or in the immediate vicinity of those wind farms.

Regards

Mark

P.S - The attached kmz file is used for Google Earth. If you have Google earth installed then when you click on the NSW SES.kmz file it will open Google earth and display the location of all the NSW SES PMR sites

-----  
*Mark Pilkington - Project Manager*  
*Tait Electronics (Aust) Pty Ltd*  
*186 Granite Street Geebung QLD 4017*  
*Ph (+61) 07 3865 7799 [Ext. 19]*  
*Fax (+61) 07 3856 7990*  
*Email [mark.pilkington@tait.com.au](mailto:mark.pilkington@tait.com.au)*  
*Web [www.taitworld.com](http://www.taitworld.com)*  
-----

**From:** Jayantha Wickramasinghe

**Sent:** Tuesday, 12 August 2008 12:12 PM

**To:** 'Anthony Micallef'

**Cc:** Guna Kalugalage

**Subject:** RE: Notification of Coppabella & Marilba Wind Farm proposals - Telecommunications

Dear Anthony

The microwave radio link between Optus Mobile sites namely Yass and Berremangra Hill pass through the Marilba wind farm, refer to attached GIS plot, the Mobile deployment advised that Optus doesn't have any options to relocate the radio link or to connect the sites to fibre network and hence the wind turbines must not obstruct the line of sight path.

Regards

Jayantha

---

**Jayantha Wickramasinghe | Radio Transmission Planning | SingTel Optus Pty Limited | Fixed Networks Engineering |**  
t: +61 2 8082 0353 | m: +61 411 526 668 | f: +61 2 8085 5189 | 1 Lyonpark Road, Macquarie Park NSW 2113 |  
[www.optus.com.au](http://www.optus.com.au)

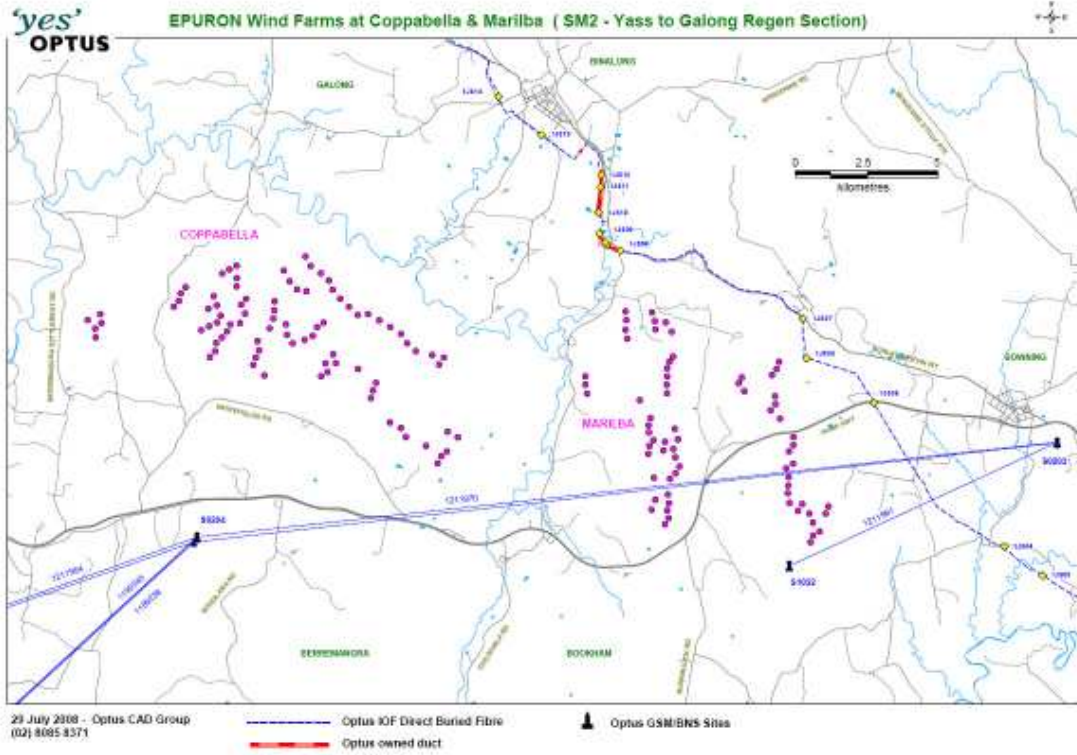
 Please think of the environment before printing this email

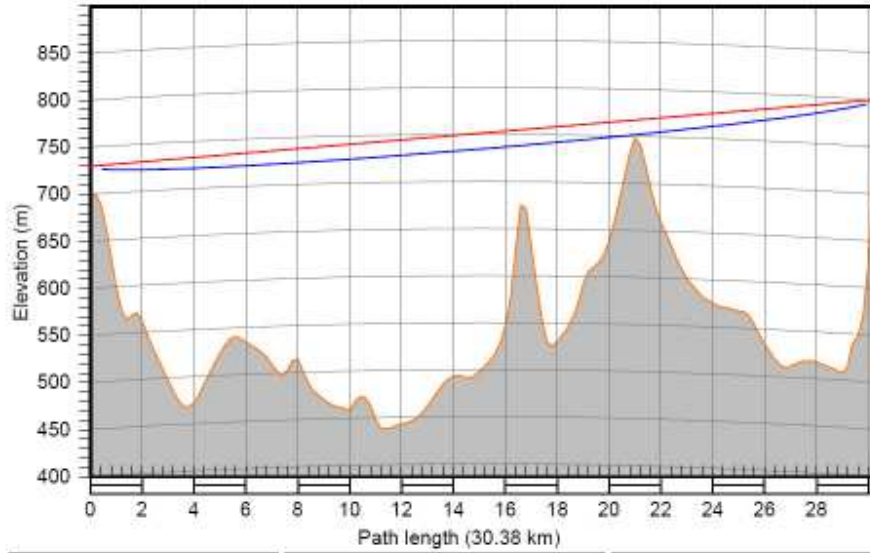
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<b>BERREMANGRA HILL</b>	
Latitude	34 48 51.83 S
Longitude	148 30 01.43 E
Azimuth	82.82°
Elevation	700 m ASL
Antenna CL	30.0 m AGL

Frequency (MHz)	= 8000.0
K	= 1.33
%F1	= 100.00

<b>Yass</b>	
Latitude	34 46 46.92 S
Longitude	148 49 46.92 E
Azimuth	262.63°
Elevation	741 m ASL
Antenna CL	60.0 m AGL



Australian Government  
Department of Defence  
Defence Support Group

2004/1044160/3  
LPSI/OUT/2008/110

Mr Anthony Micallef  
Eupuron Pty Ltd  
Level 11, 75 Miller St  
North Sydney, NSW, 2060

Dear Mr Micallef

**RE: PROPOSED 'COPPABELLA' AND 'MARILBA' WIND FARMS WEST OF YASS, NSW**

Thank you for referring the abovementioned wind energy projects to the Department of Defence (Defence) for comment. Defence understands that these projects will be located at two sites known as 'Coppabella' and 'Marilba' located approximately 20-30km west of the town of Yass, NSW. Defence further understands that the wind farm projects will consist of a total of 90 wind turbines at Coppabella Wind Farm and 80 wind turbines at Marilba Wind Farm.

As per your letter, Defence has performed its assessment based upon the wind turbines being situated atop 80m towers and using 105m diameter blades. The maximum height at the blade tip zenith will be up to 135m above ground level. As discussed in a phone call on 22 July 2008, Defence has also allowed for 1 wind monitoring mast at each site and associated works (including an electrical substation and overhead wiring to connect with the National Electricity Grid).

Defence has assessed the proposal with respect to any impact on the safety of military flying operations and possible interference to Defence communications and radars.

The proposed development will be outside any areas affected by the Defence (Areas Control) Regulations (DACR). The DACR control the height of objects (both man-made structures and vegetation) and the purpose for which they may be used within approximately 15km radius of Defence airfields. In addition, the proposal has been assessed as unlikely to affect existing Defence communications and radars in the region.

However, it should be noted that tall structures present a hazard to flight safety for low level flying operations. Consequently, there is an ongoing need to obtain and maintain accurate information about tall structures so that risks associated with inadvertent collision by low flying aircraft can be reduced. RAAF Aeronautical Information Service (RAAF AIS) in Melbourne is responsible for recording the location and height of tall structures. The information is held in a central database managed by RAAF AIS and relates to the erection, extension or dismantling of tall structures the top measurement of which is:



- a. 30 metres or more above ground level - within 30 kilometres of an aerodrome; or
- b. 45 metres or more above ground level elsewhere.

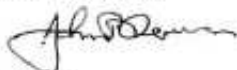
The proposed wind farm development will meet the above definition of tall structure. RAAF AIS has requested that the developer supply them with final design documentation before construction commences. After construction is complete, the Department of Defence requests that the developer provide RAAF AIS with "as constructed" details.

RAAF AIS has a web site with a Vertical Obstruction Report Form at [www.raafais.gov.au/obstr\\_form.htm](http://www.raafais.gov.au/obstr_form.htm) which can be used to enter the location and height details of tall structures. Any queries in regard to information about tall structures or the database should be directed to RAAF AIS.

The Civil Aviation Safety Authority (CASA) has produced an Advisory Circular, AC 139-18(0) *Obstacle Marking and Lighting of Wind Farms* dated July 2007, which provides amongst other things, guidance to proponents of wind farms. Wind turbines are tall structures which can be hazardous objects to aviation and AC 139-18(0) outlines measures on how to reduce the hazard including the use of obstacle marking and lighting. In accordance with the AC 139-18(0) CASA will need to be consulted on this proposal determination.

Overall, the Department of Defence has no concerns with the Coppabella Wind Farm and the Marilba Wind Farm at this time. Should you wish to discuss the content of this advice further, please contact Brenin Presswell, Executive Officer, Land Planning on (02) 6266 8128 or by email at [brenin.presswell@defence.gov.au](mailto:brenin.presswell@defence.gov.au).

Yours sincerely



**John Kerwan**  
Director Land Planning & Spatial Information  
Department of Defence  
BP3-1-A052  
Brindabella Park  
Canberra ACT 2600

5 August 2008

Cc: DSG - ACT/NSW  
RAAF AIS  
CASA



84 Parkes Street (P.O. Box 220)  
TEMORA NSW 2666  
ABN 54 357 453 921  
Telephone (02) 6977 3200  
Facsimile (02) 6977 3299  
E-mail office@gwcc.nsw.gov.au  
ALL HOURS EMERGENCY  
1800 800 917

Our Reference: G25406005:PMW

Your Reference:

25 July 2008

Mr Anthony Michalief  
Project Manager  
Epuron Pty Ltd  
Level 11, 75 Miller St  
NORTH SYDNEY NSW 2060

Dear Anthony,

**Re: Proposed Wind Farm at "Coppabella" and "Marilba"**

I refer to your correspondence of 16 July 2008 regarding the above matter. After investigation I can confirm that Council does not believe that the proposed development will have a detrimental impact on its radio communications installation at Beremangera Hill, Beremangera.

I trust the above meets your requirements however should you require any further information please contact Council's Electrical Services Support Officer, Alan Moston on 0427 232 629.

Yours faithfully,

A handwritten signature in black ink, appearing to read "Paul Wearne".

Paul Wearne  
General Manager

**From:** Souksamlane, Kham [mailto:[Kham.Souksamlane@team.telstra.com](mailto:Kham.Souksamlane@team.telstra.com)]  
**Sent:** Monday, 28 July 2008 10:29 AM  
**To:** Anthony Micallef  
**Cc:** Kouroushis, Pol; Curtis, Russell J  
**Subject:** RE: EPURON: Notification of Coppabella & Marilba Wind Farm proposals - Telecommunications

Anthony,

Some of the Marilba wind farm turbines ( as supplied) seem to fall outside the indicated Zones (18 Turbines are in the Southern side of the Hume Hwy).

Is this correct ?

If the indicative locations as per the attached map is correct, then there will be no impact on Telstra network.

Regards

Kham Souksamlane  
Capacity Planner  
Forecasting & Area Planning - NSW  
Fundamental Planning  
Network & Technology  
Telstra Operations  
Phone: ☎ (02) 9397 2068  
Fax: 📠 (02) 9397 2030  
E-mail : [Kham.Souksamlane@team.telstra.com](mailto:Kham.Souksamlane@team.telstra.com)

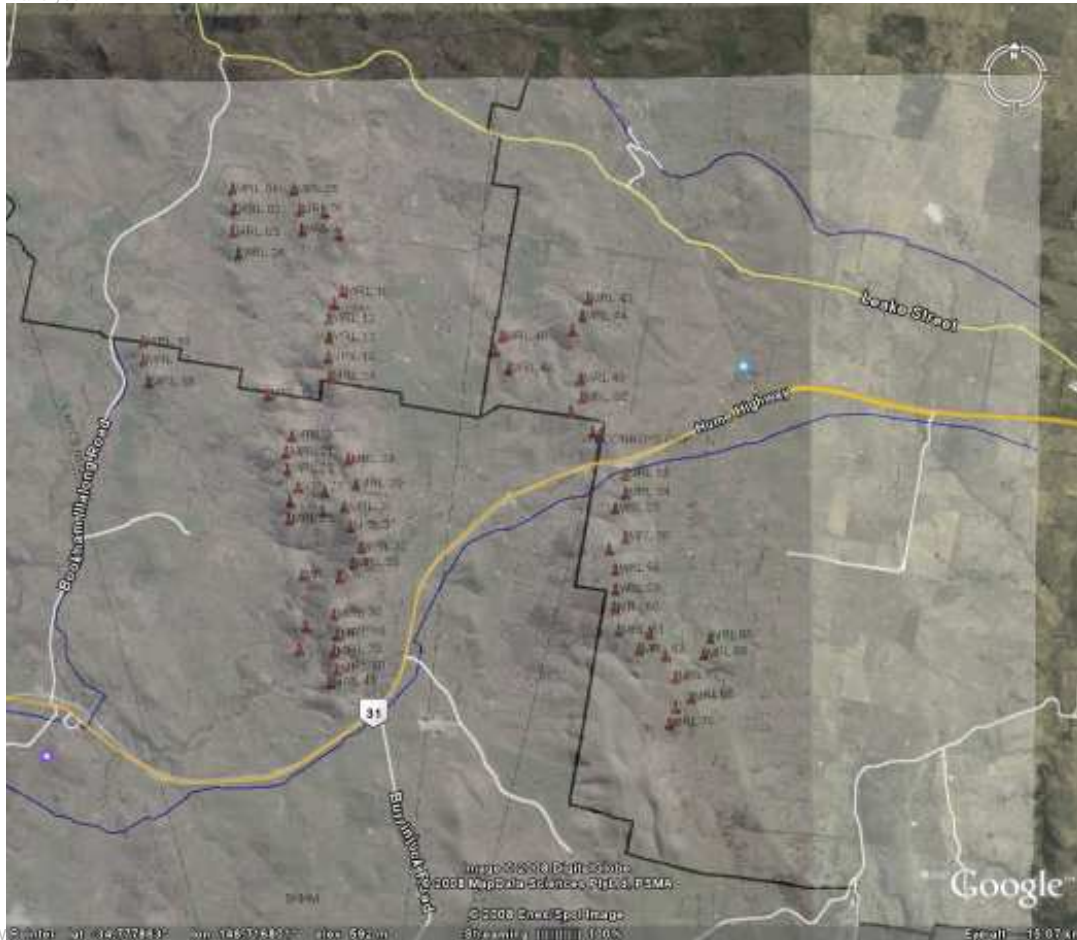
**Fundamental Planning -**

“Supporting Telstra’s Business Success through wise Planning and Investment in the Access Network”

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both it and your



reply Center: 31.4637243° S, 146.328402° E, elev: 592m

**From:** Jensen, Tim I [mailto:Tim.Jensen@team.telstra.com]  
**Sent:** Wednesday, 30 July 2008 4:09 PM  
**To:** Anthony Micallef  
**Cc:** Barton, Paul L  
**Subject:** NSW GRN & "Coppabella" and "Marilba" proposed wind farm sites.

Dear Anthony

I received your letter dated 15th July 2008, regarding "Coppabella" and "Marilba" proposed wind farm sites.

I work for Telstra, and am engaged in the management and operation of the NSW Government Radio Network (GRN) under contract to the NSW Department of Commerce.

I have reviewed your letter, and determined that the operation of the proposed wind farms at "Coppabella" and "Marilba" will not cause the NSW GRN site at Black Trig (Linbrook Property) any detrimental effects.

I have now forwarded your letter to the NSW Department of Commerce as they may wish to comment on any effects that these proposed wind farms may have on a future microwave network that may be installed to link into this NSW GRN site at Black Trig.

Thank you very much for providing the opportunity to comment on your proposal.

Best regards

Tim Jensen

**NSW GRN**

Managed Radio & Wireless Solutions  
Telstra Enterprise and Government

Phone: (02) 9396 6115  
Fax: (02) 9396 6446  
Mob: 0418 360 355  
L14/320 Pitt St, Sydney 2000 NSW  
Locked Bag 6716, Sydney 2001 NSW

**From:** ALLEN, RICHARD [mailto:RICHARD.ALLEN@casa.gov.au]  
**Sent:** Tuesday, 22 July 2008 9:03 AM  
**To:** Anthony Micallef  
**Subject:** FW: Notification of Coppabella & Marilba Wind Farm proposals - CASA [SEC=UNCLASSIFIED]

Anthony

The advice I have been given by CASA Central Office is as follows:

- " - CASA's interest in tall structures relates to the possible hazard to aircraft that the structures could pose.
- Under existing legislation, a person who proposes to construct a building or structure, the top of which will be 110 metres or more above ground level, is required to notify CASA of such development. Civil Aviation Safety Regulations 1998 (CASR) Part 139, **Subpart 139E Obstacles and hazards**, is available on our Web Site at <http://www.casa.gov.au/rules/1998casr/139/139casr.pdf> .
  - CASA has published an Advisory Circular **AC 139-18(0)** titled **Obstacle Marking And Lighting of Wind Farms**. The purpose of the advisory circular is to provide general information and advice to proponents of wind farms and planning authorities with jurisdiction over the approval of such developments. It explains the possible hazardous nature of wind farms to aviation activity, indicates the regulations that are applicable, and provides advice on how the hazard to aviation can be reduced. The usual expectation of wind farms with turbines exceeding 110 metres in height, is that the wind farm should be equipped with obstacle lights in accordance with the Advisory Circular, to reduce the hazard to aviation. AC 139-18(0) is available on our Web Site at: <http://www.casa.gov.au/rules/1998casr/139/139c18.pdf> .
  - You indicate that the total height above ground of your turbines, tower plus blade, will be approximately 135 m. As your turbines will exceed 110 m above ground level, CASA considers that they will likely be hazardous to aviation. You can reduce the hazard by providing obstacle marking and lighting in accordance with our Advisory Circular. If your turbines are located such that they penetrate the Obstacle Limitation Surface of an aerodrome, you should also advise that aerodrome of your proposal. See subsection 5.3 of the Advisory Circular.
  - In due course, you should forward to CASA a scale drawing showing the layout of turbines, clearly indicating which turbines you propose to equip with obstacle lights complying with the Advisory Circular. The scale should be sufficient for CASA to be able to determine longitudinal separation of turbines. You should also include data on turbine height and ground level, so that the turbines that extend furthest into the airspace above your wind farm are identified.
  - Airservices Australia also has an aviation interest in proposed wind farms, including possible adverse effects on defined air traffic routes, lowest safe altitude, and Radar interference. You should advise Airservices Australia of this proposal, if you have not already done so, by the following contact:  
Mr. Joe Doherty  
Manager, Airport Relations  
Airservices Australia  
GPO Box 367  
CANBERRA ACT 2601  
[joseph.doherty@airservicesaustralia.com](mailto:joseph.doherty@airservicesaustralia.com) "

Please let me know if you have any further questions  
Regards

*Richard Allen*

*Aerodromes Coordinator  
Phone 434 757 Ext. 3129  
Fax 02 9669 6151  
GPO Box 2005 Canberra 2601*



NSW National Parks  
and Wildlife Service

Our reference : DOC08/33228  
Enquiries : Andrew Grant (02) 6947 7006

Epuron Pty Ltd  
Attn: Mr A Micallef  
Level 11, 75 Miller St  
North Sydney  
NSW 2060

Dear Anthony,

*Re: 'Coppabella' & 'Marilba' Wind Farms*

I am writing in response to your letter dated 15 July 2008 regarding the proposed development of wind farms at 'Coppabella' & 'Marilba' near Yass, NSW, and the Department of Environment and Climate Change (DECC) communications site on Black Range Trig (Site ID 9519).

DECC has radio base equipment located in the NSW Roads and Traffic Authority facility located at Black Range Trig. Following a review of the proposed wind farm location DECC do not believe there will be any impact on our radio service.

Please feel free to contact me on (02) 6947 7006 or mobile 0427 469 383 should you need any further information. Alternatively my e-mail is: [andrew.grant@environment.nsw.gov.au](mailto:andrew.grant@environment.nsw.gov.au)

Yours sincerely,

**Andrew Grant**  
Senior Ranger Fire  
For: Steve Horsley  
South West Slopes Regional Manager  
Parks Wildlife Division

The Department of Environment and Conservation NSW is now known as  
the Department of Environment and Climate Change NSW

PO Box 472, TUMUT NSW 2720  
7A Adelaide Road, TUMUT NSW 2720  
Tel: (02) 6947 7000 Fax: (02) 6947 4170  
ABN: 841 387 271  
[www.environment.nsw.gov.au](http://www.environment.nsw.gov.au)

Department of **Environment and Climate Change** NSW





Telecommunications and Aviation Navigation  
Services Assessment

Yass Valley Wind Farm –  
Marilba Hills Precinct  
May 2009

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## 1 EXECUTIVE SUMMARY

The objective of this report is to investigate the potential impacts of the Marilba Hills Precinct, part of the Yass Valley Wind Farm, on existing telecommunications services in the vicinity of the proposal and to propose appropriate mitigation strategies for any impacts identified.

Telecommunication services, including television, radio, mobile phone services and other radio communication services occur in proximity to population centres and often utilise the ridgelines that provide optimum locations for wind turbines. As with any large structure, wind turbines have the potential to cause interference with such signals.

In general, VHF and UHF frequency band radio signals, and digital voice based technologies such as GSM mobile, are essentially unaffected by wind turbines. This includes land mobile repeaters, radio, the audio component of analogue television and mobile phones.<sup>1</sup>

Following a review of the radio communication services near the wind farm site, the nature of potential interference and consultation with the service providers, it is considered that the wind farm would have minimal effect on telecommunications services. Mitigation strategies are proposed to ensure any impacts can be managed and mitigated.

## 2 GLOSSARY OF TECHNICAL TERMS

VHF	Very High Frequency
UHF	Ultra High Frequency
EMI	Electromagnetic Interference
VHF Channels	TV Channels 0 to 12 (45 - 230 MHz)
UHF Channels	TV Channels 28 - 46 (526 - 820 MHz)
Band 111	VHF TV Channels 5A - 12
Fresnel Clearance	Clearance to obstructions from the ray line on a radio path which does not produce any additional loss above free space loss
FM	Frequency Modulation
MF	Medium Frequency
LF	Low Frequency
GSM	Global Systems Mobiles
CDMA	Code Division Multiple Access cellular mobile system
ITU	International Telecommunications Union
ABA	Australian Broadcasting Authority
ACMA	Australian Communications & Media Authority
CB Radio	Citizens Band Radio

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<sup>1</sup> <http://www.dungog.nsw.gov.au/files/2142/File/GreenpowerEMIANalysisIssue.pdf>

### 3 EXISTING ENVIRONMENT



**Marilba Hills Precinct site**

A review of telecommunication technologies that are in use within the area surrounding the proposed Marilba Hills Precinct has identified the following:

- TV and radio broadcasting
- Mobile phone services provided by telecommunication companies
- Radio communication systems, including point to point microwave links, licensed by the Australian Communications and Media Authority (ACMA)
- Other radio links including mobile radio, CB radio; and
- Aircraft navigation systems

Electromagnetic Interference (EMI) has the potential to cause degradation or total loss of signal strength and may cause poor TV reception and/or “ghosting” effects. EMI may also result in a reduction in the coverage of mobile phone, radio and aircraft navigation communications in certain instances. There are three principal mechanisms by which wind turbines may cause EMI: reflection or scattering, diffraction and near field effects.<sup>2</sup>

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<sup>2</sup> D. F. Bacon, A Proposed Method for Establishing an Exclusion Zone around a Terrestrial Fixed Link outside of which a Wind Turbine will cause Negligible Degradation of the Radio Link, Radiocommunications Agency UK Report Ver 1.1, 28 Oct 2002



## Reflection or scattering

When a signal sent between a transmitter and receiver becomes obstructed by an object located within the path of a signal, reflection and/or scattering may occur. If the rotating blade of a wind turbine receives a primary transmitted signal, a scattered time delayed (or out of phase) signal may be produced and transmitted to the receiver. The out of phase signal will be distorted in relation to the primary signal, causing EMI.<sup>3</sup>

## Diffraction

In some instances when an object is located in the path of a signal wave front, the object can both reflect and absorb the signal. This phenomenon is commonly referred to as diffraction.<sup>4</sup>

## Near field effects

Wind turbines may cause interference to radio signals due to the electromagnetic fields emitted by the generator and the switching components within the turbine nacelle. This is referred to as a near field effect.<sup>5</sup>

Due to advances in technology and compliance with the Electromagnetic Emission Standard, EN 61000-6-4 (AS/NZ 4251.2:1999) *Emission standard for industrial environments*, the wind turbines proposed for the project will not cause active EMI due to near field effects.

The level of EMI produced by a wind turbine due to reflection or scattering, diffraction and near field effects is dependant on a number of factors, including placement of the wind turbine in relation to the signal path/s; the signal frequency; the characteristics / composition of the wind turbines rotor blades; the receiver characteristics; and the propagation characteristics of the radio wave in the local atmospheric conditions.<sup>6</sup>

While the site proposed for the development of the wind farm is a rural area, a number of communications links and broadcast networks are present in the surrounding region.

As with any large structure, there may be circumstances where wind turbines can cause disruption to the electromagnetic signals used in a variety of commonly used radar, navigation and telecommunications services. The following approach was adopted to identify the impact of the proposal on telecommunications:

- Identify license holders within a 25km radius of the proposed wind farm site, and point-to-point links in the vicinity of the site, using information provided on the ACMA RADCOM database;
- Provide written notification of the proposal and seek comments from each license holder identified via the ACMA RADCOM database within a 25km radius of the site;
- Record and review all responses received to identify any issues raised by license holders;
- Discuss issues raised with relevant license holder with the aim to resolve or identify mitigation options;

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<sup>3</sup> URS Woodlawn Wind Farm Environmental Impact Statement 2004

<sup>4</sup> *Ibid.*

<sup>5</sup> *Ibid.*

<sup>6</sup> *Ibid.*

- Carry out an assessment of the “Fresnel zone” associated with each fixed point-to-point communications link in the vicinity of the site;
- Determine appropriate exclusion zones for proposed turbine layout based on Fresnel zone calculations and advice from license holders;
- Confirm that all turbines (including blades) are located outside the exclusion zone;
- Determine appropriate additional mitigation measures which may be required.

### 3.1 Impact assessment

The possible impact of the proposed Yass Valley Wind Farm on the four most common communications services has been investigated separately. These services are television and radio broadcast services, mobile phone services, radio communication services and aircraft navigation services.

Any impacts would be confined to the *operational phase* of the wind farm. Various measures are available to help mitigate potential impacts and are discussed below.

## 4 TELEVISION AND RADIO BROADCAST SERVICES

### 4.1 Existing services and facilities

The ACMA RadCom database lists the following broadcasters for television and radio, under postcode 2582, Yass.

Television broadcasting:

Southern New South Wales TV1: ABC, CBN, CTC, SBS and WIN.

Radio broadcasting:

Canberra RA1: 1ART, 1CBR, 1CMS, 1WAY, 1XXR, 2ABCFM, 2CA, 2CC, 2CN, 2JJJ, 2PB, 2RN, 2ROC, 2SBSFM

Canberra RA2: 1RPH

Goulburn RA1: 2ABCFM, 2ABCRN, 2ABCRR, 2GN, 2JJJ, 2RN, 2SNO.

Yass RA1: 2YAS

The ACMA RadCom database lists the following broadcasters for television and radio, under postcode 2584, Binalong.

Television broadcasting:

Southern New South Wales TV1: ABC, CBN, CTC, SBS and WIN.

Radio broadcasting:

No radio broadcasters listed.

Canberra (Black Mountain) is the nearest TV transmission source for the locality of the proposed Marilba Hills Precinct. Black Mountain is approximately 50km South East of

the wind farm site. Details of the Canberra television channels are provided in the table below.

<b>Broadcaster</b>	<b>Channel</b>	<b>Band</b>	<b>Frequency (MHz)</b>
Capital (CTC)	6	VHF	177.5
Capital (CTC)	7	VHF	182.258
ABC	9	VHF	196.26
ABC	9A	VHF	205.625
SBS	28	UHF	527.26
SBS	30	UHF	543.5
WIN	11	VHF	219.5
WIN	31	UHF	548.198
Prime (CBN)	12	VHF	226.5
Prime (CBN)	34	UHF	569.198

License holders identified via the ACMA RadCom database within a 25km radius of the wind farm were notified of the proposal in relation to potential impacts and asked to provide comments.

At the time of writing, no concerns had been raised from the license holders contacted regarding possible impacts to television or radio broadcasting services. EPURON will work with organisations to resolve any issues, should any be identified.

## **4.2 Television broadcasting**

### **4.2.1 Interference and impact analysis**

Television Interference (TVI) is dependent on a range of factors including environmental factors (topography, direct signal strength, transmitter type, and receiver type) and wind farm design factors (turbine elevation, rotor size and orientation, speed of rotation, blade material and pitch). TVI caused by the operation of wind turbines is characterised by video distortion, while the audio component of the signal is not affected.<sup>7</sup> Due to the variability of local conditions and the characteristics of antennae used in particular installations, there is a degree of uncertainty regarding predicted levels of interference.

The level of TVI can be influenced by a number of factors including:

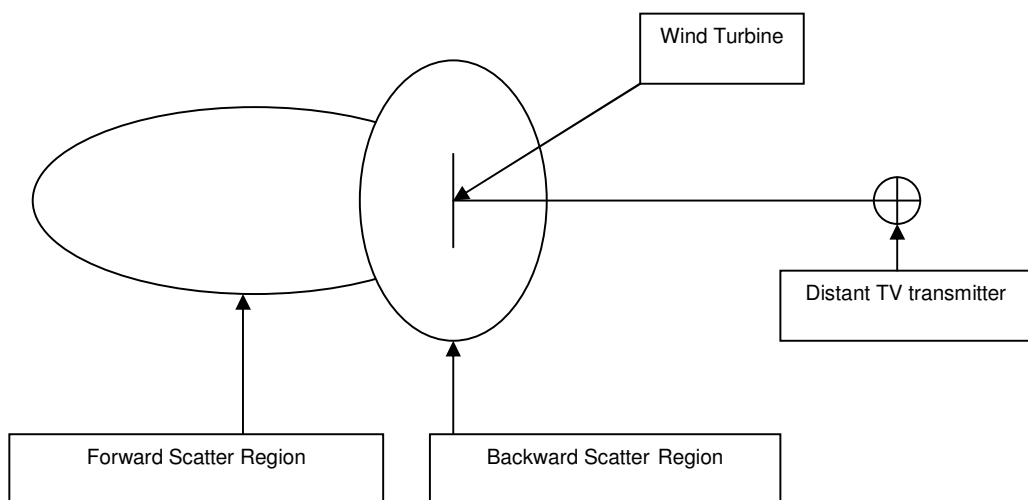
- Where the receiver is located, relative to the TV transmitter and the wind farm;
- The frequency of the transmitted TV signal;
- Whether there are any other tall structures in the vicinity of the receiver;
- The direction of the rotor blades and blade material;
- The nature of the receiving aerial e.g. design, height, directionality, power.

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<sup>7</sup> David E Spera, Wind Turbine Technology, Chapter 9 ASME Press 1994

In general, the potential for interference at receiver locations can increase with distance of the receiver from the transmitter, as signal strength decreases with increasing distance from the source. As such, a wind farm in an area of already poor signal strength may potentially have a greater impact on reception than the same wind farm in an area of relatively strong signal strength. In addition, reception in the vicinity of the wind farm can vary with the degree of topographic obstruction of the signal.

A wind turbine has the potential to scatter analogue television waves both forward and back. Forward scatter will only occur if a wind turbine is located approximately between the dwelling and the broadcast site. The forward scatter region is as shown in the figure below, and generally does not extend further than 5 km for the worst combination of factors. Interference may extend beyond 5 km if the dwellings are screened from the broadcast tower, but do have line-of-sight to the wind turbines. The effect of the forward scatter is to potentially cause the brightness of the television picture to vary with the rotation of each blade. Modern television sets usually incorporate Automatic Gain Compensators (AGC) which act to lessen or eliminate variations in picture gain or brightness.<sup>8</sup>



**Schematic diagram of potential analogue television signal interference zones around a wind turbine<sup>9</sup>**

The zone of potential interference for a wind farm is the resultant total of the effects from the individual turbines. The International Telecommunications Union Recommendation ITU-R BT.805 states that impacts beyond 5 kilometres are unlikely.<sup>10</sup>

It also indicates that interference may extend beyond 5km where the receiver location is shielded from the direct signal, but in direct line-of-sight to the turbine. The form of interference, if experienced, will depend on the relative positions of the wind farm, the transmitting station and the receiver.

<sup>8</sup> <http://www.dungog.nsw.gov.au/files/2142/File/GreenpowerEMIAnalysisIssue.pdf>

<sup>9</sup> Reproduced from the Connell Wagner PPI Gunning Wind Farm Environmental Impact Statement - Chapter 11.

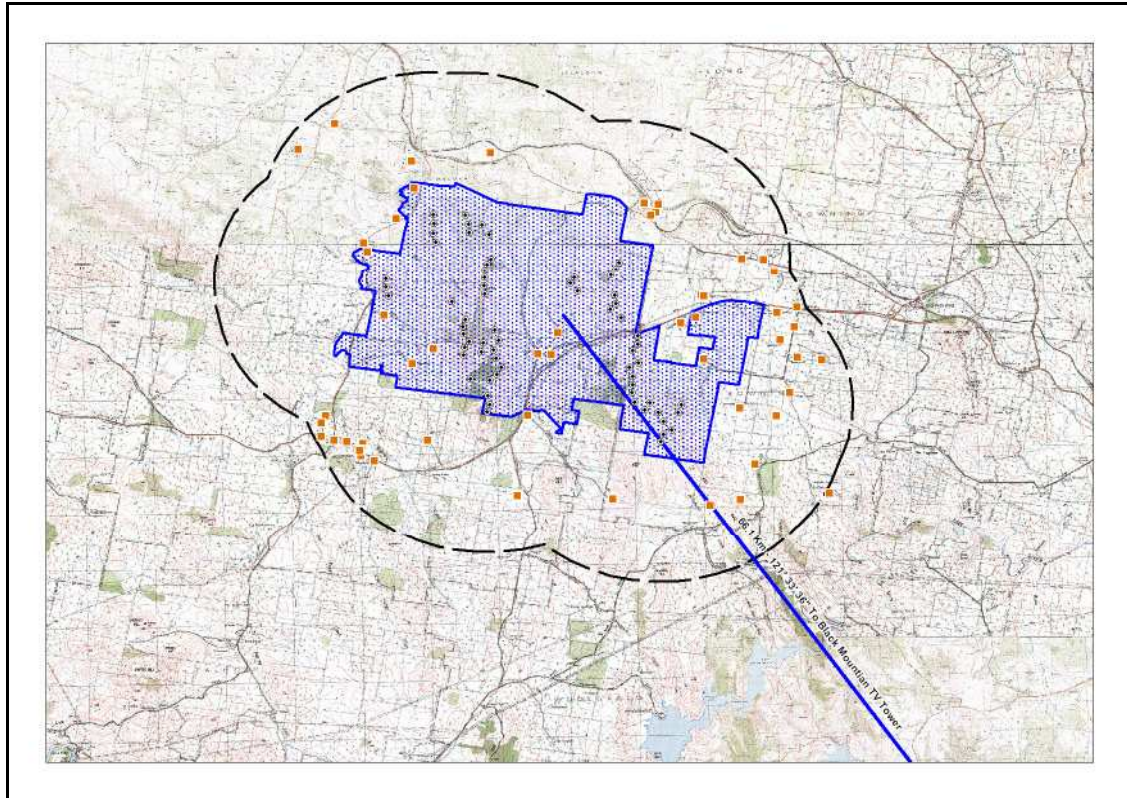
<sup>10</sup> Crookwell II Wind Farm – Environmental Impact Statement - URS



Television interference can take the form of either a “ghost” image that pulsates horizontally at the “blade pass” frequency or a fluctuation in picture brightness, also at the “blade pass” frequency.<sup>11</sup>

Approximately 80 houses were identified within a 5km radius of the proposed wind farm site boundary. The location of the wind farm with respect to the Black Mountain communications tower can be seen in the following diagram.

#### **4.2.2 House and television tower locations**



It is difficult to assess the likely impact on these specific house locations and once the wind farm is operational it is possible that television reception could be affected at some of these locations unless some form of mitigation is introduced. However, houses further than 5km from the site are unlikely to be affected.

#### **4.3 Mitigation measures**

In the design of the project, the proponent will carry out the following mitigation measures to help minimise TVI:

- Use of primarily non-metallic turbine blades;
- Use wherever practical of equipment complying with the Electromagnetic Emission Standard, AS/NZS 4251.2:1999;

<sup>11</sup> Connell Wagner Delta Electricity Gunning Environmental Impact Statement 2004

Once the wind farm is operational, the proponent will offer to undertake a monitoring program of houses within 5km of the wind farm to determine any loss in television signal strength if requested by the owners. In the event that TVI is experienced by existing receivers in the vicinity of the wind farm, the source and nature of the interference will be investigated by the proponent.

Should investigations determine that the cause of the interference can be reasonably attributable to the wind farm; the proponent will put in place mitigation measures at each of the affected receivers in consultation and agreement with the landowners.

Specific mitigation measures may include:

- Modification to, or replacement of receiving antenna;
- Provision of a land line between the effected receiver and an antenna located in an area of favourable reception;
- Improvement of the existing antenna system;
- Installation of a digital set top box or,
- In the event that interference cannot be overcome by other means, negotiating an arrangement for the installation and maintenance of a satellite receiving antenna at the proponents cost.

#### **4.4 Satellite pay television**

Some homesteads in the area may have satellite pay TV service antenna installations.

Unless a particular subscriber's antenna reception direction and elevation is aligned with a turbine, no impacts on TV reception are likely.<sup>12</sup>

#### **4.5 Radio broadcasting**

The level of radio broadcast interference experienced can be influenced by a variety of variables including:

- Abnormal weather conditions;
- Multi-path distortion (reception of a signal directly from a transmitter and also a reflected signal from hills, structures etc.);
- Overloading (occurs when an FM receiver receives too strong a signal);
- Electrical interference from household appliances etc;

#### **4.6 FM sound broadcasting**

Low power national FM stations on 107.7 & 106.9MHz are listed on the Wades Hill TV site at Crookwell. National, community and commercial services on 101.5, 102.3, 105.5, 104.7, 98.3, 99.1, 92.7, 91.9, 91.1, 106.3 and 103.9MHz are located on Black Mountain.<sup>1314</sup>

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<sup>12</sup> Lawrence Derrick & Associates Bannister Wind Farm – Investigation of possible impacts on broadcasting and Radio communication Services September 2003

<sup>13</sup> Lawrence Derrick & Associates Bannister Wind Farm – Investigation of possible impacts on broadcasting and Radio communication Services September 2003

## 4.7 MF sound broadcasting

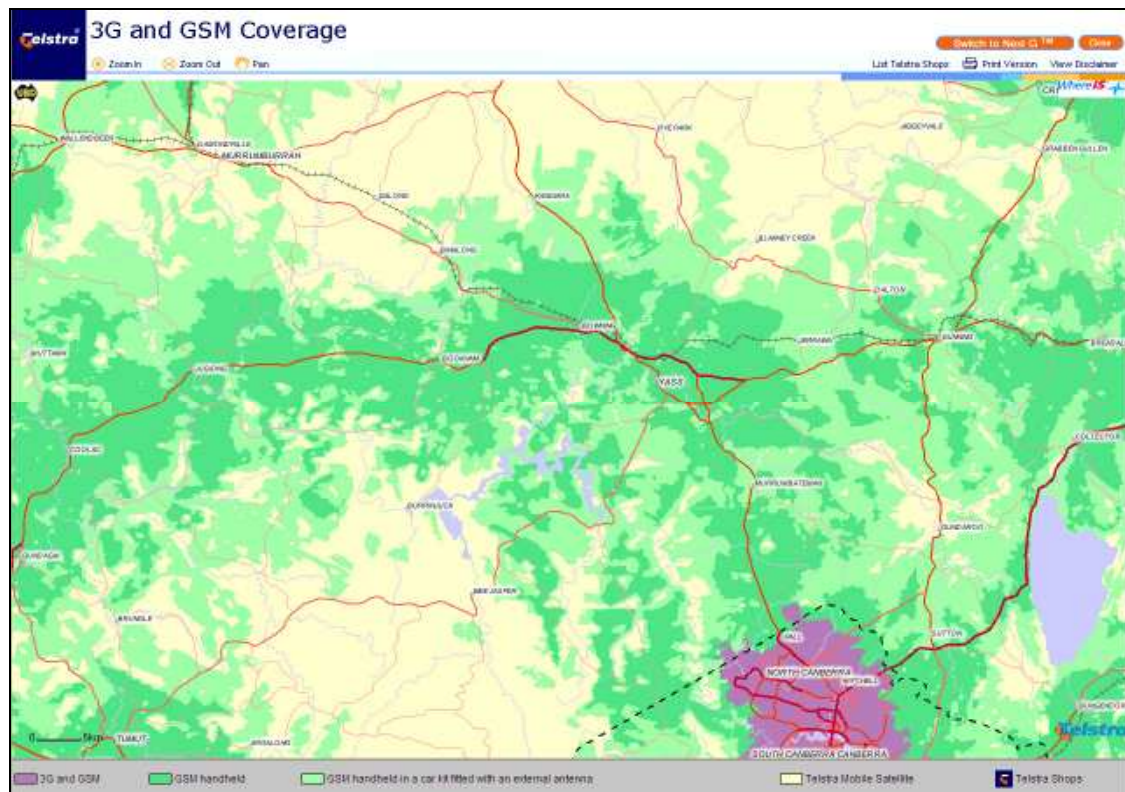
Wind farm effects on MF radio are highly unlikely and therefore the stations serving the area have not been listed.<sup>15</sup>

# 5 MOBILE PHONE SERVICES

## 5.1 Existing services and facilities

This section covers GSM (2G) and 3G services (high frequency communications links used for mobile transmission networks are discussed in the next section: Radio Communication Services).

Figures below show the existing local mobile phone coverage from the three providers (Source: company websites)

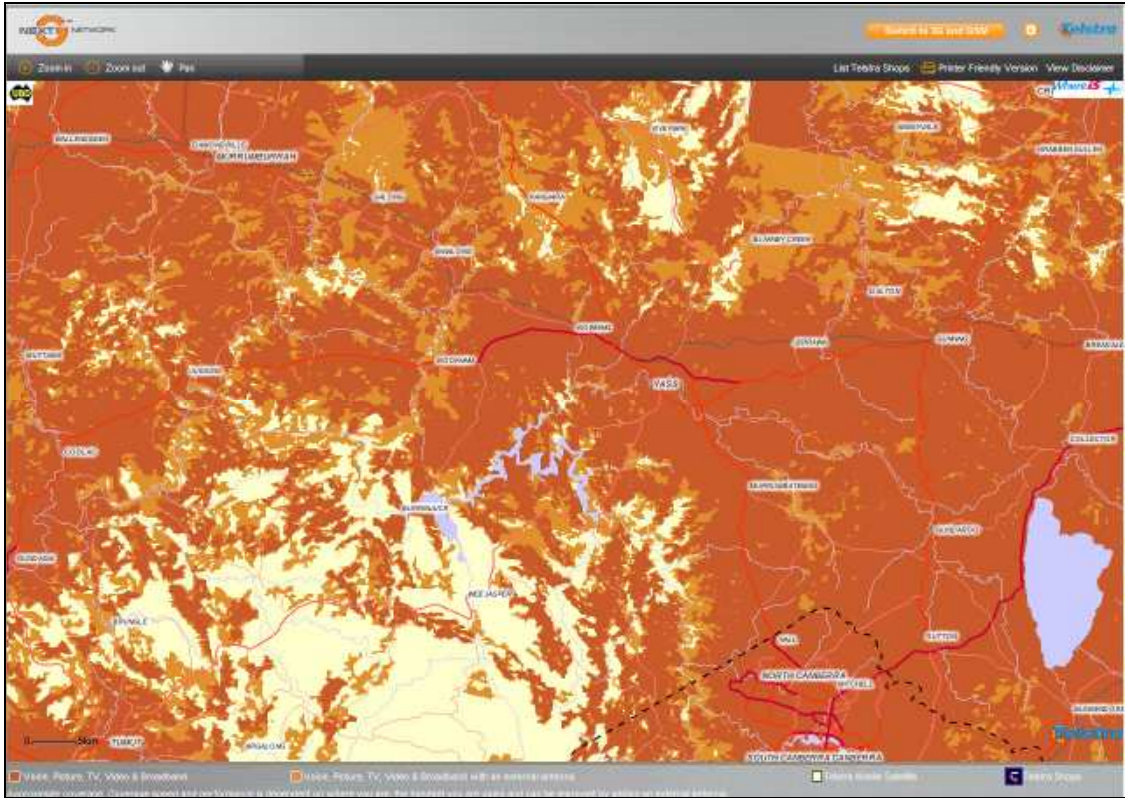


Telstra 3G and GSM (2G) Coverage

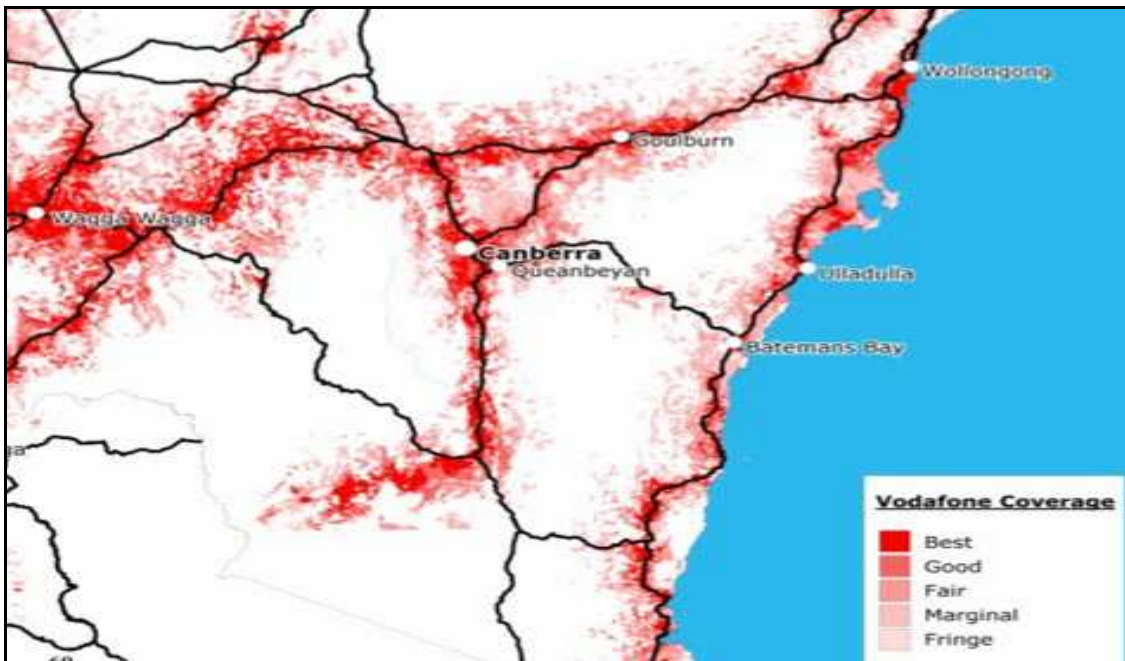
<sup>14</sup> <http://www.ausradiostations.com/fmact.html> and <http://www.ausradiostations.com/fmns.html>

<sup>15</sup> *Ibid*

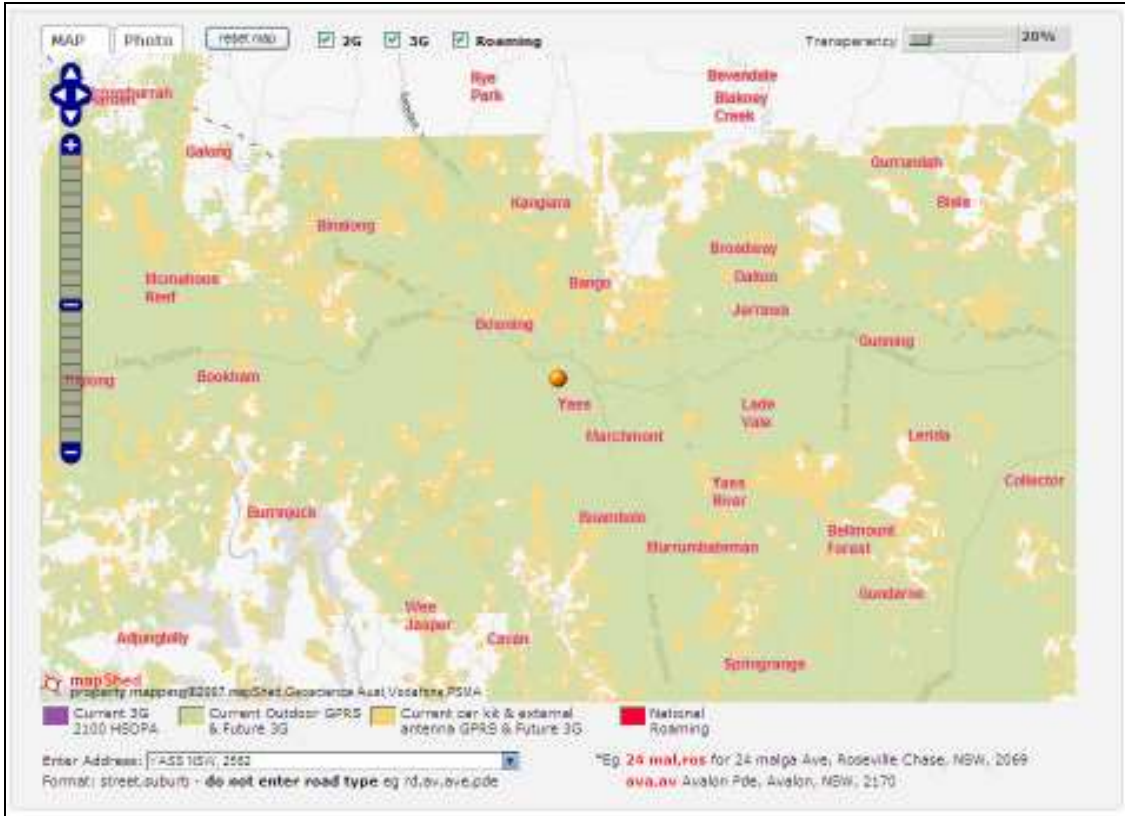




Telstra Next G Coverage







Vodafone GSM Coverage



Optus GSM (2G) Coverage

## 5.2 Interference and Impact Analysis

A mobile phone network consists of a system of adjoining zones called 'cells', which vary in size with a radius of 2 - 10 km. Each cell has its own base station that sends and receives radio signals throughout its specified zone. Mobile phone antennas need to be mounted clear of surrounding obstructions such as buildings to reduce 'dead spots' and allow the base station to effectively cover its intended cells.<sup>16</sup>

The ACMA RadCom Database identified three mobile phone companies as using base stations within the vicinity of the proposed wind farm. The table below lists the companies and ACMA site ID numbers.

Mobile Phone Companies	ACMA Site ID No.
Optus Mobile Pty Ltd / Singtel Optus Pty Ltd	201821, 55601, 198028
Telstra Corporation Ltd	130627, 9515, 55601, 9518, 131404, 131407, 101537, 38513, 100784
Vodafone Network Pty Ltd	201821, 198028

<sup>16</sup> URS Crookwell II Wind Farm Environmental Impact Statement ,

All companies were contacted by EPURON regarding potential impacts and asked to provide feedback as to any potential conflicts with their existing networks.

### 5.3 Mitigation measures

No GSM/CDMA mobile services are registered at sites in the close vicinity of the wind farm. The Telstra mobile service from Wades Hill, Crookwell is too distant to be affected by the wind turbines<sup>17</sup> Telstra no longer operates its CDMA network.

No additional mitigation measures are required.

## 6 RADIO COMMUNICATION SERVICES

### 6.1 Existing services and facilities

The Australian Communication and Media Authority (ACMA) issues radio communications licenses in accordance with Part 3.5 of the Commonwealth Radiocommunications Act 1992. The ACMA issues licenses to use specific segments of the radio broadcasting frequency spectrum for different purposes and maintains a register (the ACMA RadCom Database) of all the licenses issued.

The register allows the ACMA to create a 'density' classification of areas across Australia as high, medium or low depending on the number of licenses in operation in a particular area. According to the ACMA RadCom Database, the area in the vicinity of the proposed wind farm is classified as a "Low Density Area".

According to the ACMA RadCom Database, license holders operate a range of radio communications services, primarily fixed link microwave communication and mobile communication systems within a 25km radius of the proposed wind farm. Multiple license holders use some sites, while sole users employ others.

Radio communication license holders within 25km of the Marilba Hills Precinct  
(Latitude -34 46 52.81, Longitude 148 40 57.9)

ACMA Licence Holder	ACMA Site ID No.
Airservices Australia	9001816, 34921
Ambulance Service of New South Wales	34921
Australian Capital Television Pty Ltd	9514
Commissioner of Police NSW Police	55601,35851, 34921, 198028
Country Energy	36149, 9542, 34921
Department of Environment and Conservation	9519

<sup>17</sup> Lawrence Derrick & Associates Bannister Wind Farm – Investigation of possible impacts on broadcasting and Radio communication Services September 2003

<b>ACMA Licence Holder</b>	<b>ACMA Site ID No.</b>
Goldenfields Water County Council	198028
Harden Shire Council	9542
NSW Department of Commerce – Government Chief Information Office	201821
NSW Department of Primary Industries	40307
NSW Rural Fire Service	9519, 34897, 9542
NSW State Emergency Service	201458
NSW Volunteer Rescue Association	39030,34921
Optus Mobile Pty Ltd	201821, 55601, 198028,
Prime Television Southern Pty Ltd.	9514
Roads and Traffic Authority of NSW	9519
Robinvale District Health Services	304511
Singtel Optus Pty Ltd	201821, 55601, 198028
Telstra Corporation Ltd	130627, 9515, 55601, 9518, 131404, 131407, 101537,38513, 100784
The Info Radio Network Pty Ltd	55601, 198028
TransGrid	34921
Vodafone Network Pty Ltd	201821, 198028
W. S Gregory & Associates Pty Ltd	9519
Yass Valley Council	9519

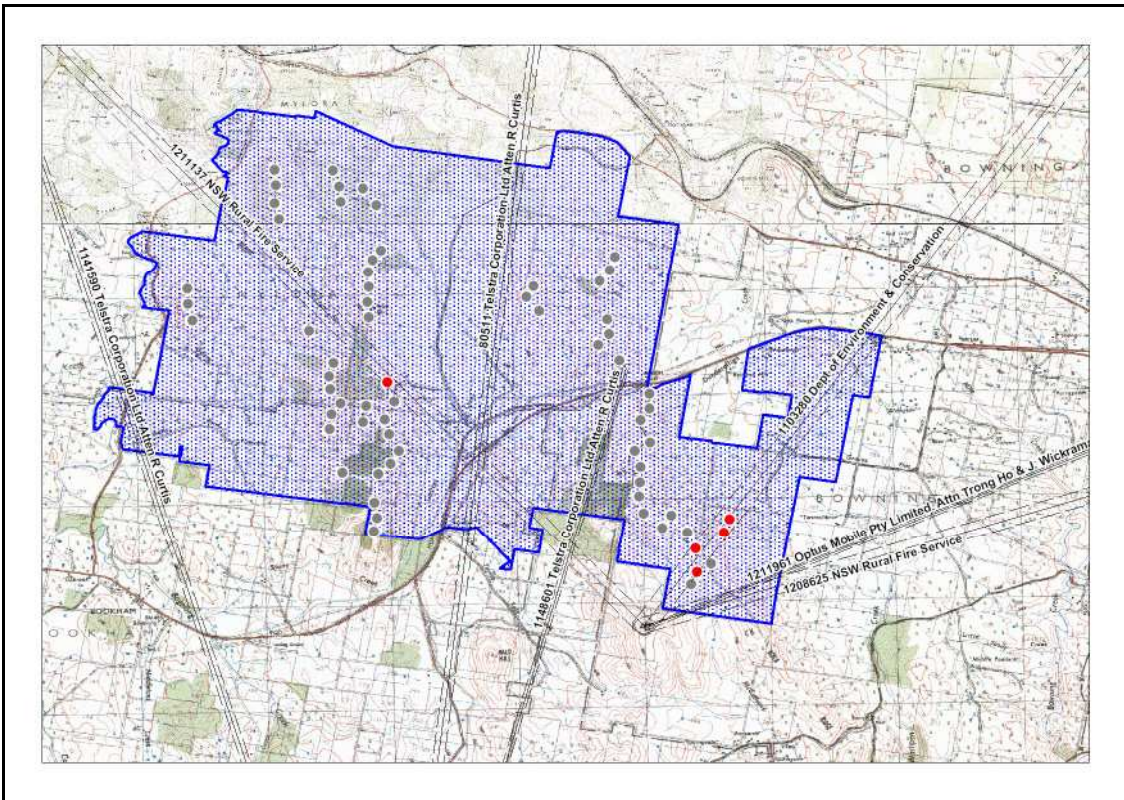
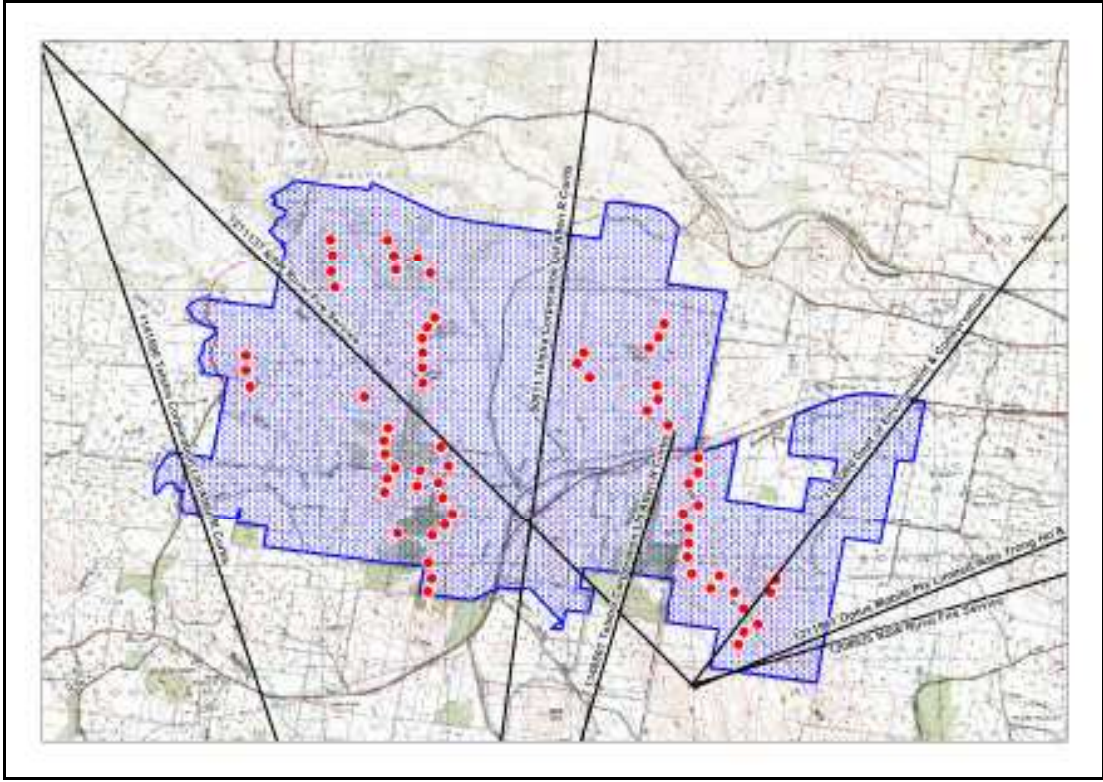
## **6.2 Interference and Impact Analysis**

A fixed link radio transmission is a point-to-point transmission path typically between two elevated topographical features. The transmission path may become compromised if a wind farm is located within the direct line-of-sight or what is known as the 'Fresnel Zone' around the line of sight between the sending and receiving antennae.

The potential impact zone will vary with the distance between the transmitter and receiver, frequency of transmission and the location of any particular point along its path. Communications are only likely to be affected if a wind farm is in the line-of-sight between two sending and receiving antennae or within a zone of the line-of-sight of these antennae.









### 6.3 Radio communication links

In order to ensure that no obstruction to transmission paths occurs, calculations of the 2nd Fresnel zone of the point-to-point communications links in proximity to the site were undertaken.

It is suggested that beyond the 2nd Fresnel zone, the power of a scattered signal from a structure such as a wind turbine would be small enough such that it would not result in significant interference at the receiver.<sup>18</sup>

At the time of writing, seven point-to-point communications links were identified as crossing the site.

A link between "Australian Space Office Site Mt Canemumbola Boorowa" and "Telstra Site Mt Carroll", (License No 80511) operated by Telstra Corporation, passes across the site. This link operates at 1.0 GHz. (54.73km)

A link between "Commsite Black Trig" and "Comm Site 12km SE of Bigga Snowy Mountain", (License No. 1103280) operated by the Department of Environment and Conservation, is shown as passing across the site. This link operates at 404.25 MHz. (86.68 km)

A link between "Commsite Black Trig" and "Commsite Mt Mary", (License No. 1208625) operated by the NSW Rural Fire Service, is shown as passing across the site. This link operates at 404.35 MHz. (60.36 km)

A link between "Vodafone Linbrook Property Black Trig" and "Bowning Hill Trig Yass", (License No. 1211961) operated by Optus Mobile Pty Ltd, is shown as passing across the site. This link operates at 1 GHz. (10.37 km)

A link between "Commsite Black Trig" and "Shire Council Site Boundary Rd 7km SSE", (License No. 1211137) operated by the NSW Rural Fire Service, is shown as passing across the site. This link operates at 404.875 MHz. (64.41 km)

A link between "Telstra Site Mt Carroll" and "Commsite Mt Bobbara", (License No. 1141590) operated by Telstra Corp, is shown as passing across the site. This link operates at 1.0GHz. (31.56 km)

A link between "Telstra Site Mt Carroll" and "Telstra Site Conroys Gap", (License No.1148601) operated by Telstra Corp, is shown as passing across the site. This link operates at 1.0GHz. (15.85 km)

In order to determine whether a radio link could be affected by the wind turbines, EPURON defined an 'exclusion zone' beyond which the level of interference will not disrupt the radio link, based on the concept of the Fresnel zone, as previously described.

EPURON previously contacted all organisations identified as operating radio communication licences (including fixed link communications) within 25km of the nearby Cullerin wind farm proposal.

Each license holder was asked to provide independent comments / advice on the possibility of the wind farm development interfering with their communications links. At

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<sup>18</sup> D. F. Bacon, A Proposed Method for Establishing an Exclusion Zone around a Terrestrial Fixed Link outside of which a Wind Turbine will cause Negligible Degradation of the Radio Link, Radiocommunications Agency UK Report Ver 1.1, 28 Oct 2002

that time, no organisation within the 25km radius raised concerns. Optus, Vodafone and Telstra provided general guidelines to assist in the planning of wind farms.

In response to these enquiries,

Optus Mobile noted:

"Provided wind turbines are located well outside the 2nd Fresnel zone of the point to point microwave links, no interference to communications is expected" (pers. comm. Mr. Trong Ho, Optus Mobile)<sup>19</sup>

Vodafone noted:

"Clearance criteria is the same for all carriers. Please use the same criteria as proposed by Optus" (pers. comm. Mr. Ganesh Ganeswaran, Senior Engineer / Transmission, AAP Communications Services 22/11/05)<sup>20</sup>

Telstra noted:

"Provided wind turbines are greater than 100m away from Mobile tower (or in the case of directional panel antennae) not in direct line of sight for panel antennas, wind turbines will have minimal effect on existing coverage." (pers. comm. Mr. Ivan D'Amico, Area Team Manager (Country) - NSW&ACT, Telstra Services, Wireless Access Solutions, Mobile Coverage Delivery)<sup>21</sup>

These suggestions have been incorporated into the planning of the Yass Valley Wind Farm proposal.

## **6.4 Other radio communication**

### **6.4.1 Two-way mobile**

A small number of mobile bases exist in the area surrounding the wind farm site. These bases potentially provide cover to mobiles in a 360 degree arc from their bases. No significant impact from the wind farm on base coverage beyond normal mobile operational performance is predicted in view of the geographic separation between the base antennas and the turbine structures. Of course a mobile unit communicating with a base station when the mobile is located within metres of the wind turbine structures (or indeed near any large building, silo, tower etc) may experience some very local performance change, however moving a short distance would restore performance to normal.<sup>22</sup>

### **6.4.2 CB radio**

CB radios are not individually licensed, the equipment being subject to class licensing only. Therefore, no records of location or operators of CB radios exist, and the channels are shared without any right of protection from interference. No impact from the wind farm is predicted except perhaps for very local effects to portable or mobile units in the

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<sup>19</sup> Taurus Energy - Cullerin Range Wind Farm Environmental Assessment Report 2006

<sup>20</sup> *Ibid.*

<sup>21</sup> *Ibid.*

<sup>22</sup> Lawrence Derrick & Associates Bannister Wind Farm – Investigation of possible impacts on broadcasting and Radio communication Services September 2003



immediate vicinity of the turbines which could be avoided by a small location change of the unit.<sup>23</sup>

### **6.4.3 Wireless Broadband**

From studies in other areas such as Mahinerangi, NZ<sup>24</sup> it is concluded that the minimum separation required between wind turbines and mobile broadband transmitters is approximately 240m. Turbines will be located outside this distance to avoid any impacts on mobile broadband services.

## **6.5 Mitigation measures**

As a result of the exclusion zones established in planning the wind farm, no significant impacts will occur to existing point-to-point links and therefore no mitigation will be required. In the event that any issues with additional license links are identified as a result of the wind farm, whether prior to or post construction, EPURON will consult with the operator and undertake appropriate remedial measures, which may include:

- Modifications to or relocation of the existing antennae;
- Installation of a directional antennae; and/or
- Installation of an amplifier to boost the signal.

## **7 AIRCRAFT NAVIGATION SYSTEMS**

### **7.1 Existing services and facilities**

The closest airports to the proposed wind farm site are Canberra and Goulburn. There is one radar installation in the vicinity of Canberra airport, namely Mt Majura. A secondary radar installation is located at Mt Bobbara.

### **7.2 Interference and impact analysis**

EPURON has consulted with the Civil Aviation Safety Authority (CASA), Airservices Australia and the Department of Defence in relation to the proposal.

Due to the height of the turbines (>110m), the Civil Aviation Safety Authority previously recommended that obstacle lighting be provided as per section 5.5 of Advisory Circular 139-18(0) - *Obstacle Marking and Lighting of Wind Farms*. The Advisory Circular was withdrawn in September 2008 and at the time of writing a recommendation was not available from CASA in relation to Obstacle Marking and Lighting of Wind Farms.

EPURON wrote to Airservices Australia (AA) in relation to the wind farm proposal on 15-7-08. In their response dated 16-12-08, AA suggested that there may be potential for navigational aid issues. Specific details regarding installations affected were not provided in the initial response.

At a meeting at Airservices Australia Brisbane office on 1-4-09 attended by David Cook – Manager Navigation & Surveillance, Matt Kelly – Engineering Specialist, Long

---

<sup>23</sup> *Ibid.*

<sup>24</sup> Mahinerangi Wind Farm Compatibility with radio services April 2007 - Kordia

Nguygen – Senior Engineering Specialist (video link) and Mitch Sloan – Airport Relations (video link), David Cook suggested that there may be potential impacts to the navigational aids at Mt Bobbara (SSR) and possibly although to a lesser extent Mt Majura (PSR) and (SSR). In his opinion, mitigation measures should be available to overcome or reduce these impacts.

Airservices Australia indicated at the meeting that they would not be able to conduct an internal assessment of the impacts to their navigational aids due to resourcing constraints. Accordingly, it was proposed that EPURON agree on a scope of work acceptable to Airservices Australia so that EPURON could engage a suitable consultant to investigate and prepare a report to assist Airservices Australia in their assessment of the proposal.

EPURON will continue to work closely with AA to mitigate issues discovered with the Mt Bobbara (SSR) and Mt Majura (PSR / SSR) that can be reasonably attributable to the proposed wind farm.

A review of the proposal was undertaken by the Department of Defence no objection to the proposal was made.

### **7.3 Mitigation measures**

Obstacle lighting will be provided if required by CASA. No other mitigation measures are required.

## **8 CONCLUSION**

Interference to MF and FM sound broadcasting is not expected.

Conflicts between point to point radio systems and the wind turbines are expected to be avoided with appropriate clearances being established. Also, mobile radio and other radio communication services in the area are not expected to be impacted by the wind farm or its operation.

VHF TV reception at dwellings within about 1 km of the wind farm turbines and with antennas having turbines located with +/- 25 degrees angle of their reception direction will have some probability of noticeable “ghosting” at times. For UHF TV time variant ghosting may be evident out to about 2 km for turbines located +/- 20 degrees from the reception direction.

Digital TV is not susceptible to visible “ghosting” degradation. Any impact of reflections from the turbines would be a minor reduction of coverage at the limit of the service area.

For any confirmed wind farm interference problems where TV antenna system improvements are unsuccessful, the use of the digital TV services in the area may be the best solution, requiring the provision of a digital set top converter.

Overseas experience indicates that electrical interference from wind farm generators and controls is not a problem with established and reputable wind turbine manufacturers and therefore no electrical noise measurements are warranted.

## 9 CORRESPONDENCE

**From:** Sloan, Mitchell [mailto:Mitchell.Sloan@AirservicesAustralia.com]  
**Sent:** Tuesday, 16 December 2008 1:46 PM  
**To:** Anthony Micallef  
**Cc:** Rogers, Carly  
**Subject:** RE: Notification of Coppabella & Marilba Wind Farm proposals - Telecommunications

Dear Anthony

I regret to advise that at this stage we are unable to approve your proposed windfarm due Navigational Aid issues.

We require a more detailed study to be conducted on this proposal and it's potential impact on radar. This may require us to engage a consultant for this type of assessment, which would have to be at the proponents expense.

I will get back to you shortly with a more detailed response.

Regards

Mitch

---

Senior Adviser  
Airport Relations  
Phone: (02) 62684410  
Mobile: 0408 994410

# Harden Shire Council



Contact: Sharon Langman  
Quote Reference:

9 September 2008

Mr Anthony Micallef  
Epuron Pty Ltd  
Sent by email to [A.Micallef@epuron.com.au](mailto:A.Micallef@epuron.com.au)

PO Box 110  
3 East Street  
HARDEN NSW 2587  
Tel 02 6386 2305  
Fax 02 6386 2083

Email [council@harden.nsw.gov.au](mailto:council@harden.nsw.gov.au)  
Web [www.harden.nsw.gov.au](http://www.harden.nsw.gov.au)

Dear Mr Micallef

**Re: COPPABELLA AND MARILBA WIND FARM**

Council acknowledges the receipt of your letter dated 15 July 2008 and at this stage has no comment to make with regard to the proposal. However Council requests that should the project go ahead that information be provided as to the likely impacts upon the communications network operating in the immediate area.

Should the proposal go ahead Council would be willing to work with you to find solutions to any likely impacts.

Yours sincerely

Sharon Langman  
**DIRECTOR ENVIRONMENTAL SERVICES**



**From:** Cremer Rachel [mailto:Rachel.Cremer@BroadcastAustralia.com.au]  
**Sent:** Thursday, 4 September 2008 5:00 PM  
**To:** Anthony Micallef  
**Cc:** Langridge Emmajane; Freer Peter; Pizzato Bob  
**Subject:** RE: Notification of Coppabella & Marilba Wind Farm proposals - Telecommunications

Hi Anthony

Thanks for your letter regarding the Coppabella & Marilba wind farms and apologies for the delay in replying.

Broadcast Australia (BA) does not operate any broadcast facilities within 50 kilometres of your proposed wind farms and it is therefore unlikely to impact on our services. However we do recommend that Epuron engages an engineering consultancy firm to undertake a detailed study of potential impact on television and radio transmissions in the region as part of your Environmental Impact Study investigations. The Mt Carroll site you mentioned in your letter is not utilised by BA and I suggest you contact WIN Television and Australian Capital Television if you haven't done so already.

Thanks for notifying us of this proposal and please keep us informed of future developments. Please forward any further requests or notifications to Emmajane Langridge who will be BA's wind farm contact in future. Emmajane can be contacted on 02 8113 4718 or [emmajane.langridge@broadcastaustralia.com.au](mailto:emmajane.langridge@broadcastaustralia.com.au).

Please contact me if you need any further information in relation to the above.  
With regards  
Rachel

Rachel Cremer  
Property Co-ordinator  
Broadcast Australia Pty Ltd  
t: 02 6256 8020  
f: 02 6256 8041  
e: [rachel.cremer@broadcastaustralia.com.au](mailto:rachel.cremer@broadcastaustralia.com.au)  
w: [www.broadcastaustralia.com.au](http://www.broadcastaustralia.com.au)



NSW DEPARTMENT OF  
**PRIMARY INDUSTRIES**

---

02/06111  
OUT08/10594

1 September 2008

Epuron Pty Ltd  
Level 11, 75 Miller Street  
NORTH SYDNEY NSW 2060

Attn: Anthony Micallef

Dear Mr Micallef,

**Re: "Coppabella" & "Marilba" Wind Farms**

I refer to your letter dated 16 July 2008. Thank you for referring this proposal to the Department for comment.

I note that you wish to seek advice on the impact of the proposed wind farms on NSW DPI's radio communications services within the vicinity of the site. Advice from Chris Clarke at NSW DPI's Bathurst Office has confirmed that there will be no anticipated impact of the wind farm on the radio facilities.

Yours faithfully

A handwritten signature in cursive script, appearing to read 'Wendy Goodburn'.

**Wendy Goodburn**  
Resource Management Officer (land use)  
Goulburn

Aquatic Habitat Protection, Fisheries Conservation and Aquaculture Branch  
NSW Department of Primary Industries  
PO Box 17 Batemans Bay NSW 2536  
1<sup>st</sup> Floor, Cnr Beach Road and Orient Street

ABN 51 734 124 190  
www.dpi.nsw.gov.au  
Tel: 02 4478 9103  
Fax: 02 4472 7542

---

**From:** Curtis, Russell J [mailto:Russell.J.Curtis@team.telstra.com]  
**Sent:** Tuesday, 2 September 2008 11:52 AM

**To:** Anthony Micallef  
**Cc:** Turner, Martin V; D'Amico, Ivan D; Souksamlane, Kham; Yaghobzadeh, Sima  
**Subject:** RE: EPURON: Notification of Coppabella & Marilba Wind Farm proposals - Telecommunications

Anthony,

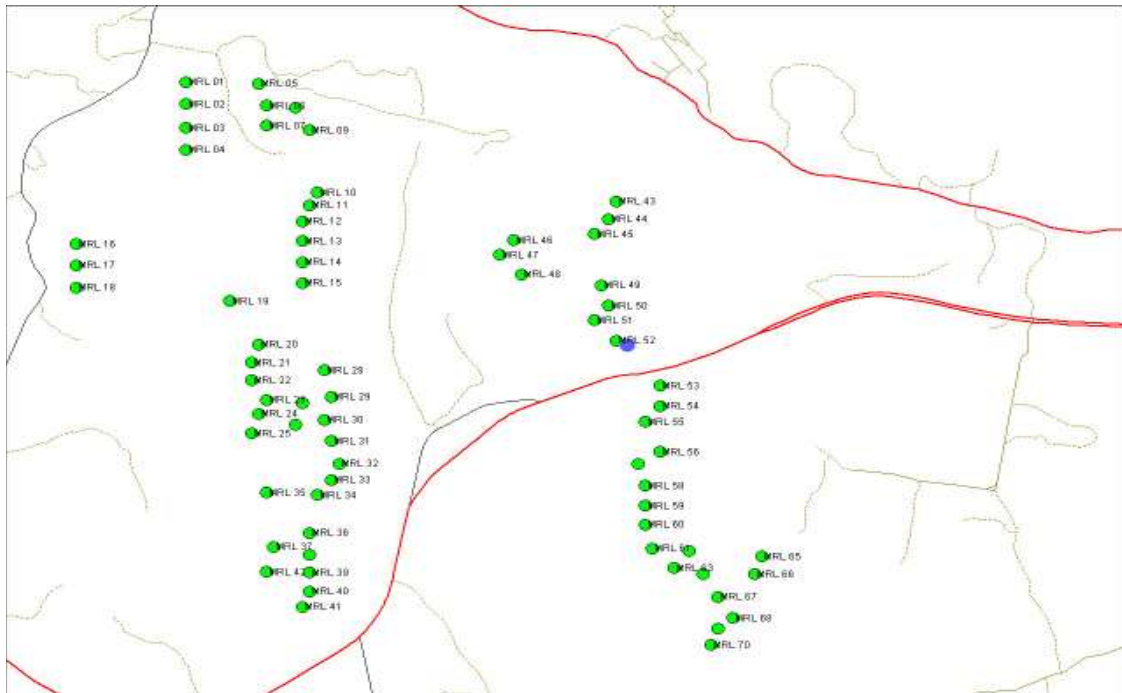
Further to your proposal - Information from our Mobiles department, they have a base station very close to MRL 52. This is "Conroy's Gap BTS". (refer to attachment)

Co-ords are: CGAP Conroy's Gap Latitude\_GDA94: -34.77278 Longitude\_GDA94: 148.72565

You will need to keep a distance greater than 100m away, the further away that you can place the turbines the better so as not to obstruct the BTS.

Yours Sincerely,

Russell Curtis  
Technology Specialist  
Telstra - Radio - Core & Access Technology  
15/242 Exhibition St MELBOURNE 3000  
Phone (03) 9634 7092 / Mobile 0418 387 971



**From:** Patrick Clague [mailto:Patrick@ses.nsw.gov.au]  
**Sent:** Saturday, 23 August 2008 11:25 AM  
**To:** Anthony Micallef  
**Cc:** Kevin Anderson; Abby Mayers; Barrie Miller - SHR  
**Subject:** FW: Epuron Wind farms near Bookham, NSW

Dear Anthony.

The below email fro Mark Pilkington provides the SES response to your letter dated 15 July

Regards  
Patrick Clague  
Manager Communications  
NSW State Emergency Service  
Ph.02 42516555

Fax 02 42516620

Mobile 0419 242250

Email [patrick.clague@ses.nsw.gov.au](mailto:patrick.clague@ses.nsw.gov.au)

This message is intended for the addressee named and may contain confidential information. If you are not the intended recipient, please delete it and notify the sender. Views expressed in this message are those of the individual sender, and are not necessarily the views of the NSW State Emergency Service.

-----Original Message-----

**From:** Mark Pilkington [mailto:[mark.pilkington@tait.com.au](mailto:mark.pilkington@tait.com.au)]

**Sent:** Tuesday, 5 August 2008 1:06 PM

**To:** Patrick Clague

**Cc:** Nicola Holden; [Neil.johnson@tait.com.au](mailto:Neil.johnson@tait.com.au)

**Subject:** Epuron Wind farms near Bookham, NSW

Pat

In relation to the proposed wind farms near Bookham in the NSW SES Southern Highlands region.

The location of the 2 proposed wind farms "Coppabella Windfarm" and "Marilba Windfarm" does not fall within the link paths of the 2 closest NSW SES PMR sites, which are Boundary Road and Mundoonen. The 2 proposed wind farm therefore do not pose an interference issue to linking of these 2 sites.

As for users of NSW SES mobile or portable radios, with any large metallic structures there may be the possibility of local radio interference to users within the boundaries or in the immediate vicinity of those wind farms.

Regards

Mark

P.S - The attached kmz file is used for Google Earth. If you have Google earth installed then when you click on the NSW SES.kmz file it will open Google earth and display the location of all the NSW SES PMR sites

-----  
*Mark Pilkington - Project Manager*  
*Tait Electronics (Aust) Pty Ltd*  
*186 Granite Street Geebung QLD 4017*  
*Ph (+61) 07 3865 7799 [Ext. 19]*  
*Fax (+61) 07 3856 7990*  
*Email [mark.pilkington@tait.com.au](mailto:mark.pilkington@tait.com.au)*  
*Web [www.taitworld.com](http://www.taitworld.com)*  
-----

**From:** Jayantha Wickramasinghe

**Sent:** Tuesday, 12 August 2008 12:12 PM

**To:** 'Anthony Micallef'

**Cc:** Guna Kalugalage

**Subject:** RE: Notification of Coppabella & Marilba Wind Farm proposals - Telecommunications

Dear Anthony

The microwave radio link between Optus Mobile sites namely Yass and Berremangra Hill pass through the Marilba wind farm, refer to attached GIS plot, the Mobile deployment advised that Optus doesn't have any options to relocate the radio link or to connect the sites to fibre network and hence the wind turbines must not be obstruct the line of sight path.

Regards

Jayantha

---

**Jayantha Wickramasinghe | Radio Transmission Planning | SingTel Optus Pty Limited | Fixed Networks Engineering |**  
t: +61 2 8082 0353 | m: +61 411 526 668 | f: +61 2 8085 5189 | 1 Lyonpark Road, Macquarie Park NSW 2113 |  
[www.optus.com.au](http://www.optus.com.au)

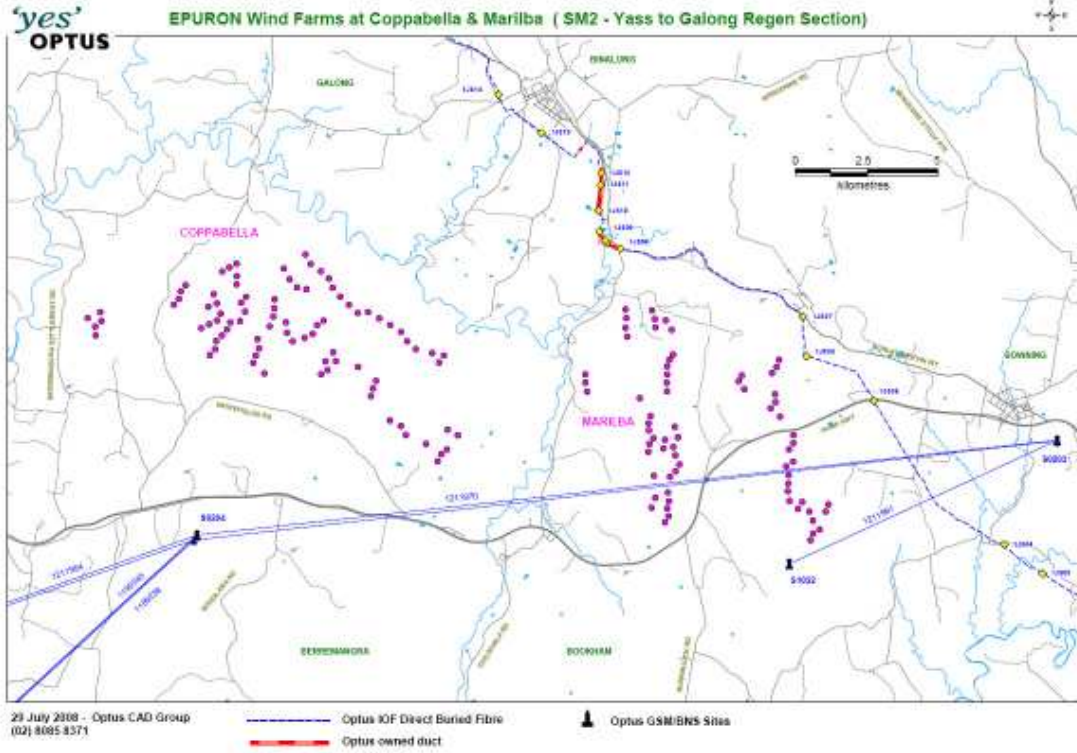
 **Please think of the environment before printing this email**

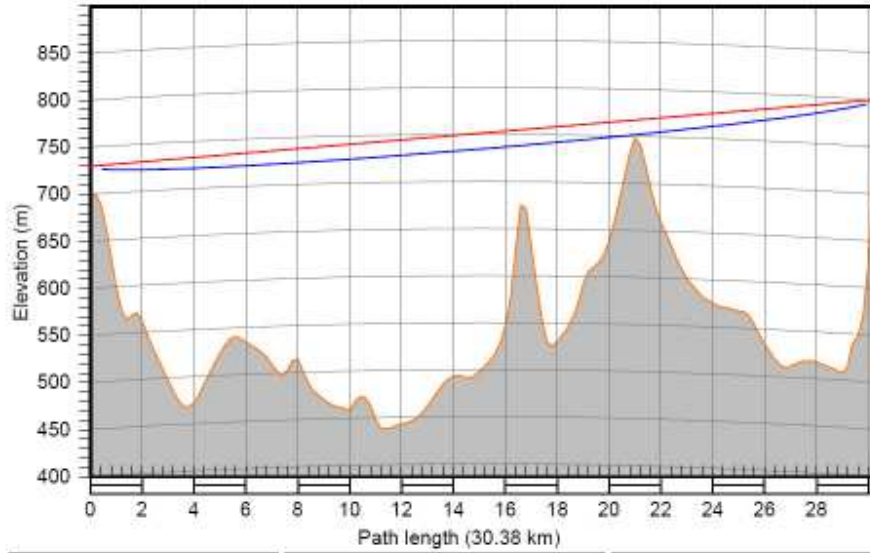
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<b>BERREMANGRA HILL</b>	
Latitude	34 48 51.83 S
Longitude	148 30 01.43 E
Azimuth	82.82°
Elevation	700 m ASL
Antenna CL	30.0 m AGL

Frequency (MHz)	= 8000.0
K	= 1.33
%F1	= 100.00

<b>Yass</b>	
Latitude	34 46 46.92 S
Longitude	148 49 46.92 E
Azimuth	262.63°
Elevation	741 m ASL
Antenna CL	60.0 m AGL



Australian Government  
Department of Defence  
Defence Support Group

2004/1044160/3  
LPSI/OUT/2008/110

Mr Anthony Micallef  
Eupuron Pty Ltd  
Level 11, 75 Miller St  
North Sydney, NSW, 2060

Dear Mr Micallef

**RE: PROPOSED 'COPPABELLA' AND 'MARILBA' WIND FARMS WEST OF YASS, NSW**

Thank you for referring the abovementioned wind energy projects to the Department of Defence (Defence) for comment. Defence understands that these projects will be located at two sites known as 'Coppabella' and 'Marilba' located approximately 20-30km west of the town of Yass, NSW. Defence further understands that the wind farm projects will consist of a total of 90 wind turbines at Coppabella Wind Farm and 80 wind turbines at Marilba Wind Farm.

As per your letter, Defence has performed its assessment based upon the wind turbines being situated atop 80m towers and using 105m diameter blades. The maximum height at the blade tip zenith will be up to 135m above ground level. As discussed in a phone call on 22 July 2008, Defence has also allowed for 1 wind monitoring mast at each site and associated works (including an electrical substation and overhead wiring to connect with the National Electricity Grid).

Defence has assessed the proposal with respect to any impact on the safety of military flying operations and possible interference to Defence communications and radars.

The proposed development will be outside any areas affected by the Defence (Areas Control) Regulations (DACR). The DACR control the height of objects (both man-made structures and vegetation) and the purpose for which they may be used within approximately 15km radius of Defence airfields. In addition, the proposal has been assessed as unlikely to affect existing Defence communications and radars in the region.

However, it should be noted that tall structures present a hazard to flight safety for low level flying operations. Consequently, there is an ongoing need to obtain and maintain accurate information about tall structures so that risks associated with inadvertent collision by low flying aircraft can be reduced. RAAF Aeronautical Information Service (RAAF AIS) in Melbourne is responsible for recording the location and height of tall structures. The information is held in a central database managed by RAAF AIS and relates to the erection, extension or dismantling of tall structures the top measurement of which is:

- a. 30 metres or more above ground level - within 30 kilometres of an aerodrome; or
- b. 45 metres or more above ground level elsewhere.

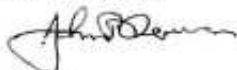
The proposed wind farm development will meet the above definition of tall structure. RAAF AIS has requested that the developer supply them with final design documentation before construction commences. After construction is complete, the Department of Defence requests that the developer provide RAAF AIS with "as constructed" details.

RAAF AIS has a web site with a Vertical Obstruction Report Form at [www.raafais.gov.au/obstr\\_form.htm](http://www.raafais.gov.au/obstr_form.htm) which can be used to enter the location and height details of tall structures. Any queries in regard to information about tall structures or the database should be directed to RAAF AIS.

The Civil Aviation Safety Authority (CASA) has produced an Advisory Circular, AC 139-18(0) *Obstacle Marking and Lighting of Wind Farms* dated July 2007, which provides amongst other things, guidance to proponents of wind farms. Wind turbines are tall structures which can be hazardous objects to aviation and AC 139-18(0) outlines measures on how to reduce the hazard including the use of obstacle marking and lighting. In accordance with the AC 139-18(0) CASA will need to be consulted on this proposal determination.

Overall, the Department of Defence has no concerns with the Coppabella Wind Farm and the Marilba Wind Farm at this time. Should you wish to discuss the content of this advice further, please contact Brenin Presswell, Executive Officer, Land Planning on (02) 6266 8128 or by email at [brenin.presswell@defence.gov.au](mailto:brenin.presswell@defence.gov.au).

Yours sincerely



**John Kerwan**  
Director Land Planning & Spatial Information  
Department of Defence  
BP3-1-A052  
Brindabella Park  
Canberra ACT 2600

5 August 2008

Cc: DSG - ACT/NSW  
RAAF AIS  
CASA





84 Parkes Street (P.O. Box 220)  
TEMORA NSW 2666  
ABN 54 357 453 921  
Telephone (02) 6977 3200  
Facsimile (02) 6977 3299  
E-mail office@gwcc.nsw.gov.au  
ALL HOURS EMERGENCY  
1800 800 917

Our Reference: G25406005:PMW

Your Reference:

25 July 2008

Mr Anthony Michalief  
Project Manager  
Epuron Pty Ltd  
Level 11, 75 Miller St  
NORTH SYDNEY NSW 2060

Dear Anthony,

**Re: Proposed Wind Farm at "Coppabella" and "Marilba"**

I refer to your correspondence of 16 July 2008 regarding the above matter. After investigation I can confirm that Council does not believe that the proposed development will have a detrimental impact on its radio communications installation at Beremangera Hill, Beremangera.

I trust the above meets your requirements however should you require any further information please contact Council's Electrical Services Support Officer, Alan Moston on 0427 232 629.

Yours faithfully,

A handwritten signature in black ink, appearing to read "Paul Wearne".

Paul Wearne  
General Manager

**From:** Souksamlane, Kham [mailto:[Kham.Souksamlane@team.telstra.com](mailto:Kham.Souksamlane@team.telstra.com)]  
**Sent:** Monday, 28 July 2008 10:29 AM  
**To:** Anthony Micallef  
**Cc:** Kouroushis, Pol; Curtis, Russell J  
**Subject:** RE: EPURON: Notification of Coppabella & Marilba Wind Farm proposals - Telecommunications

Anthony,

Some of the Marilba wind farm turbines ( as supplied) seem to fall outside the indicated Zones (18 Turbines are in the Southern side of the Hume Hwy).

Is this correct ?

If the indicative locations as per the attached map is correct, then there will be no impact on Telstra network.

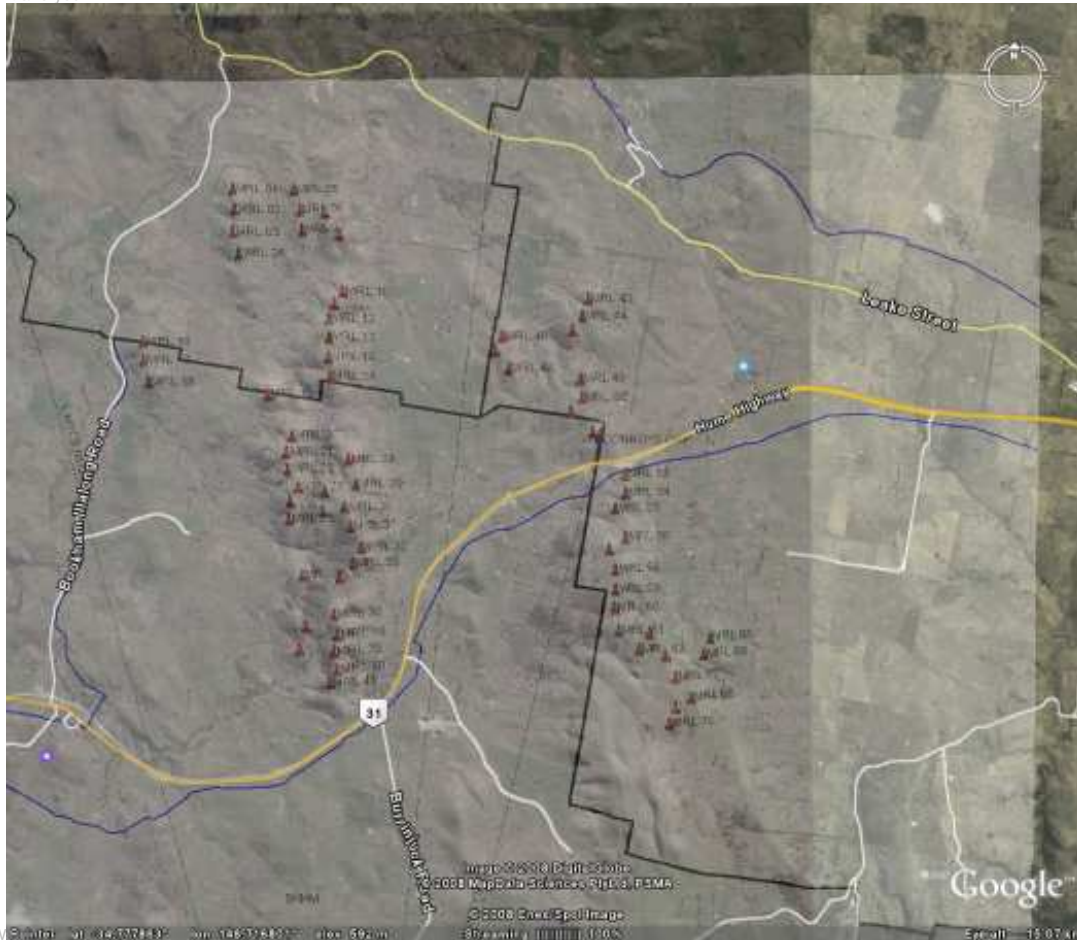
Regards

Kham Souksamlane  
Capacity Planner  
Forecasting & Area Planning - NSW  
Fundamental Planning  
Network & Technology  
Telstra Operations  
Phone: ☎ (02) 9397 2068  
Fax: 📠 (02) 9397 2030  
E-mail : [Kham.Souksamlane@team.telstra.com](mailto:Kham.Souksamlane@team.telstra.com)

**Fundamental Planning -**  
"Supporting Telstra's Business Success through wise Planning and Investment in the Access Network"

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both it and your



reply Center: 31.4637843° S, 146.328402° E, elev: 592m

**From:** Jensen, Tim I [mailto:Tim.Jensen@team.telstra.com]  
**Sent:** Wednesday, 30 July 2008 4:09 PM  
**To:** Anthony Micallef  
**Cc:** Barton, Paul L  
**Subject:** NSW GRN & "Coppabella" and "Marilba" proposed wind farm sites.

Dear Anthony

I received your letter dated 15th July 2008, regarding "Coppabella" and "Marilba" proposed wind farm sites.

I work for Telstra, and am engaged in the management and operation of the NSW Government Radio Network (GRN) under contract to the NSW Department of Commerce.

I have reviewed your letter, and determined that the operation of the proposed wind farms at "Coppabella" and "Marilba" will not cause the NSW GRN site at Black Trigg (Linbrook Property) any detrimental effects.

I have now forwarded your letter to the NSW Department of Commerce as they may wish to comment on any effects that these proposed wind farms may have on a future microwave network that may be installed to link into this NSW GRN site at Black Trigg.

Thank you very much for providing the opportunity to comment on your proposal.

Best regards

Tim Jensen

**NSW GRN**

Managed Radio & Wireless Solutions  
Telstra Enterprise and Government

Phone: (02) 9396 6115  
Fax: (02) 9396 6446  
Mob: 0418 360 355  
L14/320 Pitt St, Sydney 2000 NSW  
Locked Bag 6716, Sydney 2001 NSW

**From:** ALLEN, RICHARD [mailto:RICHARD.ALLEN@casa.gov.au]  
**Sent:** Tuesday, 22 July 2008 9:03 AM  
**To:** Anthony Micallef  
**Subject:** FW: Notification of Coppabella & Marilba Wind Farm proposals - CASA [SEC=UNCLASSIFIED]

Anthony

The advice I have been given by CASA Central Office is as follows:

- " - CASA's interest in tall structures relates to the possible hazard to aircraft that the structures could pose.
- Under existing legislation, a person who proposes to construct a building or structure, the top of which will be 110 metres or more above ground level, is required to notify CASA of such development. Civil Aviation Safety Regulations 1998 (CASR) Part 139, **Subpart 139E Obstacles and hazards**, is available on our Web Site at <http://www.casa.gov.au/rules/1998casr/139/139casr.pdf> .
- CASA has published an Advisory Circular **AC 139-18(0)** titled **Obstacle Marking And Lighting of Wind Farms**. The purpose of the advisory circular is to provide general information and advice to proponents of wind farms and planning authorities with jurisdiction over the approval of such developments. It explains the possible hazardous nature of wind farms to aviation activity, indicates the regulations that are applicable, and provides advice on how the hazard to aviation can be reduced. The usual expectation of wind farms with turbines exceeding 110 metres in height, is that the wind farm should be equipped with obstacle lights in accordance with the Advisory Circular, to reduce the hazard to aviation. AC 139-18(0) is available on our Web Site at: <http://www.casa.gov.au/rules/1998casr/139/139c18.pdf> .
- You indicate that the total height above ground of your turbines, tower plus blade, will be approximately 135 m. As your turbines will exceed 110 m above ground level, CASA considers that they will likely be hazardous to aviation. You can reduce the hazard by providing obstacle marking and lighting in accordance with our Advisory Circular. If your turbines are located such that they penetrate the Obstacle Limitation Surface of an aerodrome, you should also advise that aerodrome of your proposal. See subsection 5.3 of the Advisory Circular.
- In due course, you should forward to CASA a scale drawing showing the layout of turbines, clearly indicating which turbines you propose to equip with obstacle lights complying with the Advisory Circular. The scale should be sufficient for CASA to be able to determine longitudinal separation of turbines. You should also include data on turbine height and ground level, so that the turbines that extend furthest into the airspace above your wind farm are identified.
- Airservices Australia also has an aviation interest in proposed wind farms, including possible adverse effects on defined air traffic routes, lowest safe altitude, and Radar interference. You should advise Airservices Australia of this proposal, if you have not already done so, by the following contact:  
Mr. Joe Doherty  
Manager, Airport Relations  
Airservices Australia  
GPO Box 367  
CANBERRA ACT 2601  
[joseph.doherty@airservicesaustralia.com](mailto:joseph.doherty@airservicesaustralia.com) "

Please let me know if you have any further questions  
Regards

*Richard Allen*

*Aerodromes Coordinator  
Phone 434 757 Ext. 3129  
Fax 02 9669 6151  
GPO Box 2005 Canberra 2601*





NSW National Parks  
and Wildlife Service

Our reference : DOC08/33228  
Enquiries : Andrew Grant (02) 6947 7006

Epuron Pty Ltd  
Attn: Mr A Micallef  
Level 11, 75 Miller St  
North Sydney  
NSW 2060

Dear Anthony,

*Re: 'Coppabella' & 'Marilba' Wind Farms*

I am writing in response to your letter dated 15 July 2008 regarding the proposed development of wind farms at 'Coppabella' & 'Marilba' near Yass, NSW, and the Department of Environment and Climate Change (DECC) communications site on Black Range Trig (Site ID 9519).

DECC has radio base equipment located in the NSW Roads and Traffic Authority facility located at Black Range Trig. Following a review of the proposed wind farm location DECC do not believe there will be any impact on our radio service.

Please feel free to contact me on (02) 6947 7006 or mobile 0427 469 383 should you need any further information. Alternatively my e-mail is: [andrew.grant@environment.nsw.gov.au](mailto:andrew.grant@environment.nsw.gov.au)

Yours sincerely,

**Andrew Grant**  
Senior Ranger Fire  
For: Steve Horsley  
South West Slopes Regional Manager  
Parks Wildlife Division

The Department of Environment and Conservation NSW is now known as  
the Department of Environment and Climate Change NSW

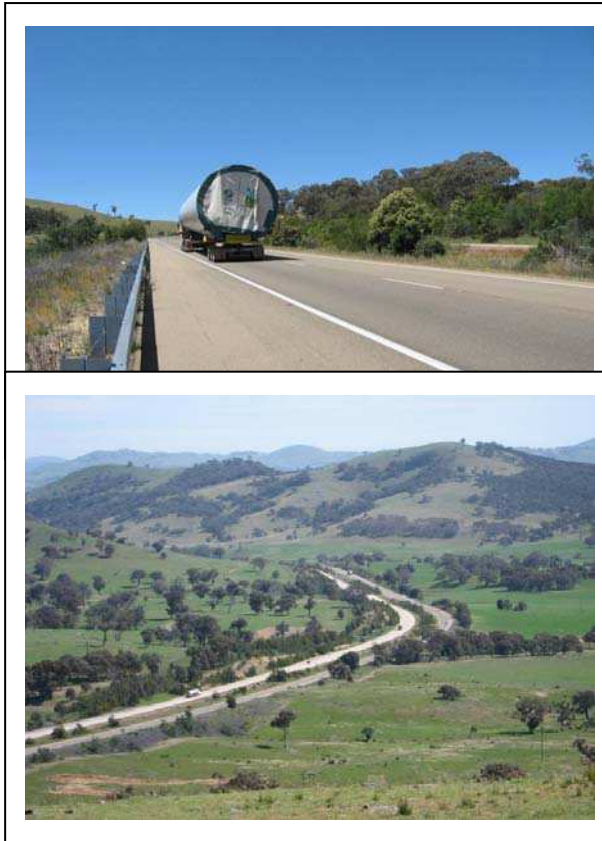
PO Box 472, TUMUT NSW 2720  
7A Adelaide Road, TUMUT NSW 2720  
Tel: (02) 6947 7000 Fax: (02) 6947 4170  
ABN: 841 387 271  
[www.environment.nsw.gov.au](http://www.environment.nsw.gov.au)

Department of **Environment and Climate Change** NSW



## Appendix 6 TRAFFIC IMPACT ASSESSMENT

# TRAFFIC IMPACT STUDY



## **PROPOSED YASS WIND FARM** **Coppabella Hills, Marilba Hills &** **Carrolls Ridge Precincts**

Prepared for Epuron Pty Ltd  
December 2008  
By Rodger Ubrihien  
Bega Duo Designs

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## **APPENDICES**

**Appendix A: Location of the proposal and relevant access roads**

**Appendix B: Photographic Plates**

**Appendix C: Hume Highway Junction Layout**

**Appendix D: Shadow Flicker Diagram**

# 1 INTRODUCTION

## 1.1 Scope of this Assessment

Bega Duo Designs was commissioned by **ngh**environmental to complete the Traffic Impact Study for inclusion in the Environmental Assessment of the proposed Yass Wind Farm.

This report conforms to the *Guide to Traffic Generating Developments* as recommended by the NSW Roads and Traffic Authority and provides a technical appraisal of the traffic and safety implications arising from the proposal. The report also develops measures and makes recommendations for the minimisation of traffic impacts during the construction and operation of the wind farm. This report focuses primarily on the construction phase of the project which would generate the maximum traffic impact.

This report considers the general impact of the heavy and oversized vehicles on the public road network and immediate surrounds. It does not include a detailed route assessment for the transportation of the over-mass and over-dimension turbine and transformer components along the routes from the major manufacturing centres and ports to Yass. This assessment would be required to be produced by the haulage contractor and approved by the relevant roads authorities prior to the commencement of the construction phase.

An assessment prepared by URS for the Crookwell 2 wind farm details the available routes from Port Kembla to the Hume Highway in Goulburn, information which is not repeated in this assessment. The assessment also discussed types of vehicles which may be used. The URS assessment concluded that feasible routes exist from Port Kembla to the Hume Highway. The Hume Highway is within 10 kilometres of all precincts and is currently in use by heavy vehicles transporting wind farm components to wind farms under construction near Canberra and Goulburn. This report examines routes along the Hume Highway in the vicinity of the proposed wind farm as well as routes along local roads to access the precincts under consideration.

The proposal outlines a three year period for the construction phase of the wind farm. Planning has commenced for the preparation of an Environmental Assessment for submission to the NSW Department of Planning, in March 2009.

This assessment examines the projected traffic impacts for the construction of up to 185 wind turbines within three precincts, referred to as Coppabella Hills, Marilba Hills & Carrolls Ridge. The combined three precincts will generally be referred to as the 'Yass Wind farm' in this report.

The final location of internal access roads has not been determined at this stage of the planning and therefore assumptions have been made about the most likely access points based on terrain, existing road condition, and cooperation with the relevant property managers. Changes to the locations of the access points should not significantly affect the conclusions of this report.

This report does not include details of the operational maintenance or hand over requirements of onsite access roads or alterations to existing local roads. These details would require the involvement of the local roads authorities and land holders, in the detailed design planning stage.

## 1.2 Proposal Overview

The three precincts are located between 20 and 50 kilometres west and southwest of Yass. The Coppabella and Marilba precincts are generally north of the Hume highway, whilst the Carrolls Ridge Precinct is 10 kilometres to the south of Hume Highway, near Burrinjuck Dam (refer to Appendix A).

The estimated generation of the Yass Wind Farm (all three precincts) is over 1.5 million Megawatt Hours of energy, sufficient for the average consumption of up to 210,000 homes (pers. comm. S. Davey, Epuron, Yass Wind Farm Planning Focus Meeting 14-15 October 2008).

The proposed Coppabella Hills Precinct is located within both the Harden and Yass Valley Shires. The Marilba Hills and Carrolls Ridge precincts are located entirely within the Yass Valley Shire. Most construction would be located in open grazing land with the exception of Carrolls Ridge where some bushland may be affected.

Construction at all precincts would involve roads, substations and electrical connections (overhead and underground electrical cables).

The Coppabella Precinct would contain up to 86 turbines located on the high ridges extending approximately 13 kilometres in a generally east to west direction. Electrical connection would be to the Transgrid 132KV Transmission line between Harden and Yass, pending further investigation, which is located to the north of the precinct. Vehicular access from the Hume Highway would be via minor local roads.

The Marilba Precinct would contain up to 66 turbines located on two sets of ridges running generally in a north to south direction approximately 20 kilometres west of Yass with the majority of turbines located north of the Hume Highway. The eastern section of the Marilba Precinct on Black Range has approximately 18 proposed turbine locations south of the Hume Highway. Electrical connection would be to the Transgrid 132KV Transmission line between Harden and Yass. The major access points proposed are from the Hume Highway at Conroys Gap and Marilba Station. Secondary access may be provided from Illalong Road and Burley Griffin Way at the northern end of the precinct.

The Carrolls Ridge Precinct would contain up to 33 turbines and is located on a ridge parallel and east of the Burrinjuck Road from 9 to 15 kilometres south of the Hume Highway. The precinct generally overlooks Burrinjuck Dam. Electrical connection would be to the 132kV Tumut to Yass transmission line. Access would be via Burrinjuck Road from the Hume Highway. Access to the southern section of the precinct may be from Waterview Road.

## 1.3 Key Issues and Objectives

The issues outlined in Table 2.1 of the Roads and Traffic Authority's *Guide to Traffic Generating Developments* are considered in this study. Additional issues have been included because of the unique nature of the development. These include the structural condition of the existing road surfaces as observed during precinct inspections.

## Key Issues

- Existing road hierarchy and proposals for improvement
- Impact on road safety
- Impact of traffic noise
- Traffic volumes and trends
- Traffic generation
- Safety and efficiency of internal roads
- Impact on intersections and surrounding developments
- Safety and efficiency of access routes (including capacity) between the precinct and adjacent road networks

## 1.4 Methodology

- Base project information was obtained from **ngh**environmental and Epuron
- Further information and feedback was received from key stakeholders at the Yass Wind Farm Planning Focus Meeting, held on site on the 14<sup>th</sup> & 15<sup>th</sup> of October, 2008
- Existing mapping was used to identify features during the precinct inspection
- Planning documentation for other wind farm proposals was reviewed
- All roads were inspected, inventories prepared and photographs taken. Road junction and intersections were inspected and photographed
- Approximate traffic count information was obtained from observations at all precincts during November 2008. Roads & Traffic Authority data was used to establish the existing traffic volumes (vehicles per day) on the main roads.
- Discussions were held with representatives from **ngh**environmental, Epuron, Roads & Traffic Authority, Harden and Yass Valley Councils.
- Information on road conditions was obtained from property owners and interested residents at the Open House Community Consultation Day on 10<sup>th</sup> of December 2008.
- Methods of wind turbine construction and programming of the works were investigated to estimate the proposed vehicle trips.

## Note

In accordance with the *Guide to Traffic Generating Developments*, a 'trip' is defined as a one-way vehicle movement from one point to another, excluding the return journey.

The general method of measuring traffic volume is 'vehicles per day'. This is the total of all trips made in either direction per day.

## 2 PROPOSED DEVELOPMENT

### 2.1 Precinct Descriptions

The largest precinct, Coppabella Hills, has steep rocky ridges which rise to 800 metres above sea level and up to 300 metres above the surrounding landform. Access tracks are very steep and travel for 6 to 8 kilometres from an existing road may be necessary to access the turbine locations. The primary land use is sheep grazing.

The Marilba Hills Precinct is generally lower, less rocky, less steep and the main land use is sheep and cattle grazing. Most of this precinct is within 4 kilometres of an existing road.

Carrolls Ridge Precinct rises to 850 metres and is steep and wooded on the side slopes. The access tracks into Carrolls Ridge at each end of the ridge are of lesser gradient than most tracks on the other precincts and access to the turbine locations is generally within one kilometre of Burrinjuck Road. The cleared land on the ridge contains communications towers and is mainly used for grazing.

### 2.2 Precinct Access

Existing access roads are shown on the Plan, Appendix 1.

The roads are generally classified as follows:

- National Highways - Hume Highway which is owned and maintained by the Roads & Traffic Authority
- State Roads – Burley Griffin Way which is maintained by Yass Valley Council under contract to the Roads & Traffic Authority
- Regional Roads – Burrinjuck Road which is part funded by a grant agreement administered by the Roads & Traffic Authority
- Local Roads – All other roads which are owned by the Council (either Harden or Yass Valley). Council may choose to maintain or not maintain any of these roads under its control

All three wind farm precincts are between 20 and 50 kilometres west of Yass, a major country town and service centre. The Hume Highway provides a safe road connection with up to 110km/h travel speed. The village of Binalong provides some services and is within 10 kilometres of the northern extremity of the Marilba Hills and Coppabella Hills Precincts.

Access to the wind farm infrastructure (turbines, substation etc) would be via a road network, most likely constructed along existing tracks within the leased properties. Access points for this road network are shown on the Plan, Appendix 1. The concept planning of the proposed access roads within the precinct has not been completed at this stage and therefore access on established roads up to the most likely access track locations is evaluated in this study.

The currently favoured access points are shown on the Plan, Appendix 1.

The Bogo Quarry on Paynes Road is currently preparing an environmental assessment for the expansion of the Quarry which would include a mobile concrete batch plant and a mobile asphalt plant (Department of Planning 2008). Access to this batch plant for the supply of concrete to all precincts has been considered as a desirable planning option. This quarry could also provide road construction materials.

Access requirements for the wind farm can be separated into the following categories:



- Standard road vehicles from 2 wheel drive cars to B-Double trucks. These vehicles are required to access the precinct usually as far as the depot or storage compound precinct. They represent the largest proportion of vehicles.
- 4 wheel drive vehicles which may be required for most transport to the turbine locations and would provide ongoing maintenance.
- Specialist vehicles may include off-road construction vehicles, for example with nonstandard axle combinations. These may include tracked vehicles and reconfigured trailers used to tow components into position onsite. These would not generally be able to be used on sealed local roads.
- Over-dimensional vehicles transporting turbine components and oversize construction machinery. These vehicles would generally be wider and longer but weights of loads would not be excessive (generally up to 70 tonnes carried over 7 axles) and they would be able to cross most drainage structures without damage.
- Over-mass and over-dimensional vehicles transporting electrical transformers of up to 200 tonnes. These vehicles would possibly require the strengthening of bridges and drainage structures because of the close spacing of axles. There would be only a small number of these vehicles and the delivery location would be at a substation.

Many of the access roads under consideration could be described as farm access tracks and would not be suitable for a large number of vehicles without complete reconstruction. Considering the differing vehicle requirements, it may be necessary to adopt some access points along these tracks for over-mass deliveries only, or for future maintenance tracks.

### **Coppabella Precinct**

The major access points being considered for the Coppabella Precinct are from Whitefields Road to the south of the precinct. Whitefields Road connects with the Hume Highway, 38 kilometres from Yass. The western end of Whitefields Road connects with the Hume Highway via Coppabella and Berramangra Road. Additional access points may be available from Coppabella for low volumes of 4 wheel drive or specialist vehicles. The five turbines at the western end of the precinct would be accessed from Berramangra Road which junctions with the Hume Highway, 47.3 kilometres from Yass.

### **Marilba Precinct**

Access points under consideration for the eastern section of the Marilba Precinct are from the Hume Highway, via the truck rest areas on each side of Conroys Gap, 20.9 kilometres from Yass. Access to the majority of turbines would be from the Marilba Station access road, 23.0 and 25.2 kilometres from Yass. An access to the northern section from Illalong Road at 1.6 kilometres from Burley Griffin Way is being considered. An access off Burley Griffin Way at 3.5 kilometres from the Hume Highway could provide access to the eastern section of the precinct and the proposed connection to the 132kV transmission line.

### **Carrolls Ridge Precinct**

Access to Carrolls Ridge Precinct is likely to be via an existing access track at 10.0 kilometres from the Hume Highway on Burrinjuck Road. The southern section of the precinct may obtain access from Waterview Road.

## **2.3 Future Road Proposals**

The Roads and Traffic Authority, Harden and Yass Valley Councils have ongoing maintenance and improvement programmes for the roads and bridges under their control.

There are no current proposals for major road improvements on the access roads under consideration.

The Director of Operations at Yass Valley Council has advised that plans are being prepared for the replacement of the timber bridge on Illalong Road. No funding is presently available for the construction.

## 3 EXISTING TRAFFIC CONDITIONS

### 3.1 General

Traffic safety is dependant on many variables such as driver behaviour and weather conditions. This section of the report examines the physical constraints which could have an impact on traffic safety, as observed on an inspection of the roads carried out in November 2008. This work included observations of traffic volumes.

### 3.2 Specific Routes

#### Hume Highway

The Hume Highway provides access to Melbourne and Adelaide to the south and south west and Sydney and Port Kembla to the east. Locally, it provides access between the precincts as well as Yass, Burley Griffin Way and Paynes Road (Bogo Quarry).

The Hume Highway is a high speed four lane dual carriageway road with a high standard of access at all of the major junctions (Plate 1, Appendix B).

An examination of the Roads and Traffic Authority Accident Data Base was made for the section of Hume Highway within Yass Valley and Harden Shire Councils. There were four fatal accidents in the three years from December 2005 and available information suggests that none of these accidents were related to road deficiencies.

The major junctions are similar to the layout shown in Appendix C with full length deceleration lanes for traffic turning right from the high speed lane. The minor junctions are constructed to a slightly lower standard, with a reduced length deceleration lane and a reduced width on the side road. The minor junctions do not have advance signposting and therefore, prior knowledge of their location is required to undertake a safe approach. The junctions with the Hume Highway are described in the comments below, for each particular access road.

#### Burley Griffin Way

The Burley Griffin Way (Main Road 84) is a sealed high standard two lane road with marked centreline and edge lines (Plate 2 shows Burley Griffin Way 6.5 kilometres from the Hume Highway). This is a regional route connecting south east New South Wales with Griffith and the Riverina. It departs from the Hume Highway 18.3 kilometres west of Yass. This major junction has been recently reconstructed to a high standard with separate turn lanes to and from the Hume Highway.

A road on the left at 3.5 kilometres from the Hume Highway could provide access to the north eastern end of the Marilba Precinct and the 132 kV transmission line. The junction has a gravel surface and the turning radii may restrict long loads. The sight distance along Burley Griffin Way is slightly restricted towards the west (refer to Plates 3 & 4).

Illalong Road departs the Burley Griffin Way at 11.19 kilometres from the Hume Highway. Binalong is located on the Burley Griffin Way, 16.6 kilometres from the Hume Highway. Garry Owen Road departs westward from Burley Griffin Way on the northern side of Binalong.

## Access from Hume Highway at Conroy's Gap Truck Rest Areas

Conroy's Gap at 21.5 kilometers from Yass has two large truck rest areas for travel in both directions. Deceleration and acceleration lanes provide safe entry and exit. The Hume Highway is a controlled access road and access to adjacent properties would be via licensed access points. Plates 39 & 40 show the eastbound rest area and Plates 41 & 42 show the westbound rest area.

The existing access to the ridge from the northern rest area (eastbound traffic) is on the deceleration lane at a point where entering traffic are still traveling at speed.

The truck rest areas are designed for traffic entry and exist in one direction only; there is no provision for eastbound vehicles to rejoin the highway, travelling westbound, or vice versa, for their return journey.

## Illalong Road

This road provides an important link to and from Binalong. It is the major route for local traffic accessing western localities along the Hume Highway (refer to the Plan, Appendix 1). The surface is sealed to approximately 5.5m wide and the section up to 3.1 kilometres from Burley Griffin Way appears to have been recently re-surfaced. The route is posted with a 10 tonne load limit. The Director of Engineering Services for Yass Valley Council indicated that the load limit was in place to protect the pavement from deterioration caused by large numbers of heavy vehicles.

The junction with Burley Griffin Way has good sight distance and turning radii (Plate 5). A possible access point on the left at Weilora Woolshed is at 1.60 kilometres (Plate 6) from the Burley Griffin Way. This access has good sight distance in both directions. The following distances are measured from the junction with Burley Griffin Way.

The timber bridge at 3.13 kilometres (Plate 7) has a 4.8 metre width between kerbs. A concrete bridge at 6.09 kilometres (Plate 8) has a width of 7.0 metres between kerbs.

Campbells Road is at 8.5 kilometres on the left (Plate 9). Sight distance at Campbells Road along Illalong Road is good in both directions however use by long vehicles would require improvements to turning radii. The gravel surface would be expected to deteriorate rapidly with increased traffic. A concrete bridge at 10.27 kilometres has a width of 7.0 metres between kerbs (Plate 10).

The junction with the Hume Highway is at 11.01 kilometres. This intersection also provides access to Childowa Road and the village of Bookham on the southern side of the highway. The intersection is of a high standard with raised islands to control turning movements (Plate 11).

## Marilba Access Roads

The access roads to Marilba Station are located off the Hume Highway at 23.0 and 25.2 kilometres from Yass. These minor junctions are generally constructed in accordance with the layout shown in Appendix C (Hume Highway Junction Layout), except for the provision of a short deceleration distance for traffic from the east. Turning radii and the width in the 'throat' of the junction are also reduced. Plates 29 to 33 show the southern junction and Plates 34 to 37 show the northern junction. The distances referred to below are measured from the southern junction toward the north.

The 'Marilba' Road is part of the old highway and has a bitumen seal. Large 6.0 metre wide cattle grids are provided at 0.19 kilometres and 2.52 kilometres. Plate 38 shows the grid at 0.19 looking north. A smaller grid is at 1.29 kilometres. Sheep utilise the shade of the roadside trees and graze on the roadside for the full length between the large grids. Access to the turbine precincts from Marilba Road is likely to be located close to each end of the link road.

## Paynes Road

Paynes Road provides access to the Bogo Quarry which may be utilised for concrete batching as well as a supplier of road base material and asphalt.

The junction with the Hume Highway at 26.3 kilometres from Yass (Plate 12) is 0.8 kilometres north of Burrinjuck Road. The junction is of a high standard, designed for the use of heavy vehicles to and from the Quarry.

Paynes Road has a bitumen surface 6.0 metres wide (Plate 13) as far as the Quarry entrance, located 1.34 kilometres from the Hume Highway (Plate 14).

## Burrinjuck Road

Burrinjuck Road commences at the Hume Highway 27.21 kilometres from Yass. The junction is of a high standard two stage crossing (Plate 15) as shown in Appendix C. The sight distance to the north for right turn traffic from the south is obscured by vegetation in the central median area (Plate 16). Distances shown for this road are in kilometres from Hume Highway. Burrinjuck Road forms part of the Hume and Hovel recreational trail.

The bitumen surface of Burrinjuck Road is approximately 6.0 metres wide with painted centreline marking. The road pavement appears to be failing in some areas as indicated by the deformation of the surface (Plate 17). Large trees overhang the road in many locations and there is insufficient width to maintain the road shoulder (Plate 18). Shoulder widening has been provided at some locations which could provide safer pull over areas. The existing alignment, width and grading is generally not suitable for high travel speeds and a speed restriction of 80 kilometres per hour is in place.

Sutton Grange Road is on the left at 4.35 kilometres and a large drainage culvert is located at 4.37 kilometres. Woolgarlo Road is on the left at 9.1 kilometres.

A proposed access road to Carrolls Ridge is on the left at 10.0 kilometres. The sight distance in both directions is partially restricted by the presence of trees close to the road (Plates 19 and 20). Turning movements by long vehicles would be restricted by the narrow road formation combined with the narrow gate and grid. The gate has insufficient setback from Burrinjuck Road (Plate 21).

## Waterview Road

Access to the southern section of Carrolls Ridge would be via Waterview Road (not signposted) at 14.25 kilometres along the Burrinjuck Road from the Hume Highway (the distances are measured from the junction of the Hume Highway and Burrinjuck Road). The road is unsealed. The first 1.73 kilometres is maintained by Yass Valley Shire Council.

The junction with Burrinjuck Road is at an acute angle and whilst sight distance to the north is good, the sight distance to the south is restricted by the combination of curved alignment and roadside trees (Plates 22 & 23).

Plate 24 shows the first section of Waterview Road looking back towards the Junction. Plate 25 shows an access on the left at 14.6 and the road narrowing to approximately 4.0 metres wide. Trees close to the road commence at 15.2 kilometres and the standard of alignment reduces. (Plate 26) The road crosses a stock grid at 15.8 kilometres (Plate 27).

The track divides at 16.1 kilometres and inspection of the left fork of the track continued to the top of the ridge at 17.0 kilometres. The track narrows to approximately 3.0 metres and is poorly drained which has resulted in severe erosion of the road edges (Plate 28).



## Whitefields Road

Whitefields Road departs from the Hume Highway at 38 kilometres from Yass. The signposting incorrectly indicates 'Whitfields' Road. Advance signposting is not present for this junction. The distances referred to are in kilometres from the eastern junction with the Hume Highway.

The junction with Hume Highway is of the type shown in Appendix C with a short deceleration for traffic turning from the east. The left turn into Whitefields Road from the west is restricted by the width and the alignment of the 'throat' of the junction (Plates 43 to 46).

The gravel road commences at the stock grid which is located at 0.03 kilometres. Plate 47 shows the gravel road at 0.13 kilometres. A property access is on the right at 1.16 kilometres (Plate 48). The gravel road reduces in alignment and width at 1.4 kilometres with large trees close to the road (Plate 49). The trees remain close to the road as far as the gate at 2.65 kilometres.

The road towards the west has been provided with culverts and the gravel surface has had some maintenance. The road is basically a farm access track with gates between the properties. The gradients are undulating and road access towards the proposed wind farm in the north would be possible from several locations along the route.

An access track toward the north departs at 2.75 kilometres. Plate 50 shows the gate at 2.65 kilometres. Plate 51 shows the causeway at 2.87 kilometres and some erosion is evident. Roadside erosion at 3.33 kilometres is shown in Plate 52 (some erosion control measures are in place).

Plate 53 shows the gate at 3.57 kilometres. A sign at this gate indicates the shire boundary between Yass Valley & Harden Shire Councils. The road up to this point is maintained by Yass Valley Council. (The location of this boundary would appear to contradict the boundary location shown on some of the available mapping data).

A track on the left at 4.92 kilometres provides access to a residence which is several hundred metres from the road. An access to the ranges in the north appears to be available near the buildings at 5.95 kilometres (see Plate 54). The road and gate at 8.41 kilometres is shown in Plate 55 and a causeway at 8.69 kilometres is shown in Plate 56. Plate 57 shows the gates at 9.36 kilometres. An access on the right at 9.37 kilometres is to a residence.

The road widens to 4 to 5 metres wide between 9.37 kilometres and the junction with Coppabella Road at 9.78 kilometres. Plate 58 taken from 9.64 kilometres and shows the junction with Coppabella Road ahead. The section of road between Whitefields Road and Berramangra Roads is signposted as Coppabella Road which turns at the junction with Whitefields Road.

## Coppabella Road from Cumbamurra Road South to Berramangra Road

Most of this section of Coppabella Road (refer to the Plan, Appendix A) can be considered as a farm access road with gates, grids and few drainage structures and it is unlikely that it would become a major access route. As indicated in Section 2.2 of this report, parts of the route may be utilised for the access of small numbers of specialist equipment. Distances on this part of the report are in kilometres from the junction with Cumbamurra Road. Plate 59 is taken from the junction towards the gates at 0.02 kilometres.

Plates 60 to 63 show the road 0.30, 1.76, 2.47 & 3.34 kilometres. Plate 64 shows a stream crossing at 3.6 kilometres. Plate 65 shows the road ahead from 4.0 kilometres. A concrete stream crossing approximately 5m wide is located at 5.93 kilometres (shown in Plate 66).

Plate 67 shows the gate at 6.23 kilometres. The road condition improves from 6.5 kilometres and the width of pavement at 7.3 kilometres is 4.0 metres (Plate 68). A residence is on the right at 7.72 kilometres and the road appears to be used regularly. There are cattle grids at 7.82, 8.78 & 9.97 kilometres. Plate 69 shows the road at 7.83 kilometres. Plate 70 shows the low level bridge (approximately 5m wide) ahead at 10.01 kilometres.

The junction with Whitefields Road and the next section of Coppabella Road is shown in Plate 71. The road is in good condition and approximately 5.0 metres wide with a causeway crossing of the

same width at 12.50 kilometres (Plate 72). The road is not fenced and stock grids are crossed at 11.24, 12.29 & 12.90 kilometres.

The junction with Berramangra Road is at 12.91 kilometres (Plates 73 & 74). The junction is at an acute angle and the sight distance to the north is restricted by a crest in Berramangra Road.

## **Berramangra Road**

Berramangra Road commences at the Hume Highway 47.33 kilometres from Yass. The junction is a high standard two stage crossing, as shown in Appendix C and Plates 75 to 77. Distances shown for this road are in kilometres from the Hume Highway. Berramangra is a sealed road approximately 5.5 metres wide. Safe travel speeds are estimated to be 60 to 70 kilometres per hour, due to sharp crests and curves.

Plate 78 shows the road at 1.1 kilometres. The junction with Coppabella Road is at 1.5 kilometres. The concrete bridge at 3.59 kilometres is shown in Plate 79. The width between kerbs is 5.5 metres.

Plate 80 shows the road at 4.32 kilometres. Lack of shoulder maintenance and low traffic volumes have resulted in grass growing onto the pavement.

A gate on the right at 4.52 kilometres gives access to Hillview Road. Plates 81 & 82 show the available sight distance to south and north respectively. The sight distance is adequate for the travel speeds expected on Berramangra Road, however the turning radius from the north could be improved.

Westbourne Road is on the left at 6.31 kilometres. Plate 83 shows the junction looking north along Berramangra Road. The sight distance is adequate for safe travel speeds. The turning radii should be larger to accommodate large vehicles.

There is a possibility of an access point to the five most western turbine precincts at approximately 8.5 kilometres. The standard of road alignment reduces to approximately 40 to 50 kilometres per hour at 9.3 kilometres due to sharp crests and curves. A sharp crest on straight alignment at 11.8 kilometres is considered to be dangerous.

A stock grid at 13.44 kilometres marks the end of the fenced road reserve. The junction with Cumbarmurra Road is at 13.60 kilometres (Plates 84 & 85). This junction is at an acute angle as shown in Plate 83 (looking back south along Berramangra Road).

## **Westbourne Road**

Westbourne Road provides a link between Hume Highway at 50.19 kilometres west of Yass to Berramangra Road, approximately 5 kilometres to the north. The distances referred to are in kilometres south from Berramangra Road.

The road has a gravel surface approximately 4 to 5 metres wide with steep gradients and relatively straight alignment. Plate 102 shows Westbourne Road from 0.05 kilometres. There are two concrete causeways on the route. Plate 103 shows the causeway at 0.42 kilometres.

The junction with Hume Highway is of a high standard and is shown in Plates 104 & 105.

## **Coppa Creek Road**

Coppa Creek Road is 2.3 kilometres long and connects Coppabella and Berramangra Road at the Hillview Road Junction. This road was constructed to provide a flood free connection during flooding of the causeway on Coppabella Road. The route is not currently in use except for property access between the four properties along the route. There are six gates on the route.

## **Cumbamurra Road**

Cumbamurra Road provides a 7.5 kilometre link between Berramangra Road and Coppabella Road. The pavement is gravel, approximately 4.0 m wide, and the road is unfenced with three gates and two stock grids. The travel speed is often restricted by stock on the road, however the alignment in several of the gullies reduces travel speed to approximately 30 kilometres per hour. Distances quoted are in kilometres from Berramangra Road.

There is a 5 m wide concrete causeway crossing at 3.64 kilometres which is in poor condition (Plate 86) and an open crossing at 6.04 kilometres. There are large trees overhanging the road at several locations. Plate 87 shows the road at 4.57 kilometres.

The junction with Coppabella Road is at 7.5 kilometres. At this junction, the Cumbamurra Road leg proceeds to become Coppabella Road to the north and Coppabella Road joins on the right at an acute angle to the south. Plates 88 to 90 show this junction.

## **Coppabella Road from Cumbamurra North to Garry Owen Road**

This section of Coppabella Road 3.12 kilometres long and provides a part of the link to and from Binalong for properties in the vicinity and would be unlikely to operate as a through road because of faster links via Illalong Road and the Hume Highway. This section has a 4.0m wide gravel surface is unfenced and has a large concrete causeway of the same width at 1.0 kilometre (Plates 91 & 92).

Garry Owen Road joins on the right at 3.12 kilometres from Cumbamurra Road (Plate 93). This junction is 9.66 kilometres from Binalong.

## **Garry Owen Road**

Garry Owen Road is 9.66 kilometres long and provides access to properties west of Binalong. The surface is mostly gravel, 4 to 5 metres in width and the boundaries are fenced. The initial 4.84 kilometres are in Yass Valley Shire, the remainder being in Harden Shire.

The alignment allows safe travel speeds of up to 70 kilometres per hour reducing to 50 kilometres per hour in areas of poor alignment and grading. There no guideposts, bridge width markers or regulatory speed signs in place. Distances shown are in kilometres from Burley Griffin Way in Binalong.

Plates 94 & 95 show the junction with Burley Griffin Way. This junction has adequate sight distance and turning radii.

The 5.5 metre wide pavement is bitumen sealed up to 0.81 kilometres. A timber bridge at 0.69 kilometres is 3.9 metres between kerbs (Plates 96 & 97). There is a causeway at 3.54 kilometres (Plate 98) and a concrete box culvert with wearing surface at 8.28 kilometres (Plate 99).

Low branches overhang the road at 2.0, 4.4, 6.4 & 7.3 kilometres. Plate 100 shows the trees at 7.3 kilometres. The alignment approaching Coppabella Road is shown in Plate 101.

### 3.3 Existing Traffic Volumes

Traffic observations were made during mornings and afternoons on 3<sup>rd</sup> and 4<sup>th</sup> of November 2008.

Volumes obtained from RTA counts (Roads and Traffic Authority) are average, annual, daily traffic counts and have been adjusted to represent numbers of vehicles. The volumes were based on counts collected in 2006. The figures include vehicle numbers in both directions and can be adjusted if required, assuming that the peak hour represents 10% of the annual average daily traffic volumes (AADT). The volumes on the main are lower generally than shown in RTA published data for other years. Precise volumes are not considered to be critical in the examination of traffic Impacts and therefore the 2006 volumes have been adopted.

Observations on most of the minor roads revealed hourly counts approaching zero. The traffic on these roads is generated primarily by the occupied properties. The numbers adopted below have been adjusted based on the number of properties multiplied by traffic generation rates for dwellings given in the RTA Guide to Traffic Generating Developments.

The traffic volumes on Paynes Road at Bogo Quarry are dependant on the production rate on that particular day and can reach up to 20 vehicles per hour. For the purposes of this report, this maximum rate is assumed over a 7 hour day (as per Bega Duo Designs 2006).

The accuracy of the adopted traffic counts on the minor roads is not significant in the assessment of traffic impacts whilst the volumes remain low. Impacts on these roads are considered based on observed defects in each road.

**Table 3-1 Traffic Volumes (AADTs) for Roads in the Study Area.**

Road	AADT (vehicles per day)	Information source
Hume Highway at Bowning	7223	Obtained from RTA records
Burley Griffin Way Stn 94.085	1661	Obtained from RTA records
Burrinjuck Road	114	Obtained from RTA records
Illalong Road	70	Adjusted from counts taken
Berramangra Road	Less than 50	Adjusted from counts taken
Garry Owen Road	Less than 50	Adjusted from counts taken
Paynes Road to Bogo Quarry	Less than 200	Adjusted from quarry production rates
Cumbamurra, Coppabella, Coppa Ck, Waterview & Whitefields Road	Less than 30	Adjusted from counts taken and discussions with landholders

\* AADTs represent the total traffic volume in both directions (they also equate to the number of trips)

## 4 FACTORS RELATING TO TRAFFIC GENERATION AND TRAFFIC IMPACT

### 4.1 Traffic Generation

#### Construction phase of the project

The maximum traffic volume is expected to occur during the civil construction phase of the wind farm which includes the pouring of concrete for the foundations. Each footing may contain up to 310 cubic metres of concrete to be poured over an eight hour period. This results in a rate of up to 12 mixer truck trips per hour. It is likely that a concrete batching plant would be located at a central location (possibly at Bogo Quarry on Paynes Road). Location of the batching plant on site may reduce the maximum traffic generation rate on the major roads. For the purpose of predicting maximum probable traffic generation, the concrete trucks would be included in the number of vehicles generated on all of the major routes.

#### Operation phase of the project

The location of the three precincts in the current development (see Plan of Access Roads in Appendix 1) would result in major access links being along the Hume Highway, Burrinjuck Road, Paynes Road and Burley Griffin Way.

Major routes along existing low traffic roads which are being considered include Illalong Road, Berramanga Road, Whitefields Road, Coppabella Road and Waterview Road. These routes are identified as routes which would be required to carry relatively large volumes of traffic during the construction phase and would continue to carry traffic for the ongoing maintenance of the wind farm.

Once operational, the wind farm would be managed and operated by several crews of technicians, based at Yass. The precincts would be accessed regularly for operational and maintenance activities. It is estimated that the operational phase would generate up to 8 trips per day into the Coppabella Precinct from Whitefields Road. It is assumed that there would be at least four permanent access points into the Marilba Precinct, generating approximately 4 trips per day from the access points at Conroys Gap and Marilba Station. The Carrolls Ridge Precinct would most likely have two access points which would generate 4 trips per day.

### 4.2 Construction Program

The project would be constructed over a 3 year period. The following major activities are expected to take place at all three precincts.

- Civil works for upgrading of access roads and establishment of precinct offices
- Civil works for construction of internal tracks, excavation for footings and trenching for cables
- Pouring of concrete in turbine footings
- Transportation to precinct, erection and commissioning of wind turbines
- Construction of substation and associated power lines



### 4.3 Working Hours

Normal construction industry working hours are assumed for the purposes of this report, as specified in the EPA Environmental Noise Control Manual (7am-6pm Mon-Fri, 7am or 8am – 1pm Sat). EPA Guidelines would apply for noise emissions from construction works.

### 4.4 Assumed Design Traffic Volumes

The traffic volumes contained within this section would be used to design traffic management devices, such as junctions, required for the proposal. They are also used to quantify the traffic impact, for example, on residents living adjacent to the haulage routes, and possible damage to the road pavements.

The daily rate of traffic movements, rather than total number of movements, is the critical factor in determining the level of impact. The daily rate is derived from Table 4.1, which estimates the predicted maximum number of one way traffic movements (trips) per day for the various construction activities.

**Table 4-1 Predicted Daily Rates of Traffic (trips) for one precinct.**

*For the purposes of predicting traffic on major route the following table is based on the construction of 86 wind turbines at one location (the maximum number of turbines that would be installed at any precinct). This represents the maximum traffic load which could occur at any one point on the major access routes shown on the Plan, Appendix 1. The table is based on the Coppabella Precinct which may require access for the construction of up to 86 turbines from Whitefields Road.*

*Information in the table is generally based around continuous pouring one footing in a day and installation of approximately 2.5 towers per week to complete the whole project (all locations) within 3 years.*

Activities	Approximate duration (months)	Maximum number of trips per day	Comments
Construction and management staff	20	<b>54</b>	Assuming approx. 3 employees per vehicle.
Precinct set up	1	10	
Road construction	6	30	
Foundation construction	12	<b>102</b>	Includes reinforcing steel delivery
Dust suppression	20	<b>4</b>	
Substation & Powerline construction	6	<b>26</b>	Includes overmass vehicle deliveries of transformers.
Internal Cabling	6	6	
Turbines erection	9	<b>58</b>	Includes up to 550 oversize and overmass vehicle deliveries.

The trips shown in **bold** could be concurrent, resulting in a maximum 240 trips per day.

This table indicates that the maximum daily rate of traffic at any point on the major access route may increase by 250 vehicles per day during the peak construction period.

The peak volumes may apply for periods of up to 12 to 18 months at the major access point for the Coppabella Precinct whilst the peak period for the access from Berramangra Road may apply for several months only. The period of high traffic volumes would vary at each precinct depending on the number of turbines, substations, depots, and administrative facilities at each precinct.

The estimated hourly rate during the peak hour (based on 15% of the daily volume) is approximately 40 vehicles per hour. This figure would be used in the design of new junctions and is applicable when estimating the impacts on residents adjacent to the proposed routes.

#### 4.5 Design for Heavy Vehicles

The standard design vehicle for the construction of intersections and the design of parking and turning areas as a minimum would be the 'Austroads' Single Unit Truck/Bus 12.2m long. However, provision would be made wherever possible to allow for a 'B-Double' template, which requires a wider path. This wider path would allow for the turning of semi trailers and oversize vehicles.

There is a requirement to transport turbine blades to the precinct, which could be up to 50 metres long. These would be transported on purpose designed steerable trailers making approximately 300 deliveries in total (all precincts). These vehicles would be capable of negotiating small radius curves provided that areas free of obstructions are available on the inside of curves. The transport of tower sections up to 25 metres long and weighing up to 50 tonnes would require a total of 1200 oversize vehicle deliveries. The nacelles would require 300 over-mass (up to 75 tonnes) vehicle deliveries.

The design of access roads and junctions would need to allow for widths of up to 4.2 metres and weights complying with Roads and Traffic Authority maximum loading.

#### 4.6 Traffic Circulation

Hardstand areas would be required around each turbine for the safe operation of large cranes. These areas would also provide turning opportunities for delivery vehicles.

No vehicles would reverse onto the public road network.

#### 4.7 Road Capacity (Level of Service)

Road capacity is normally described as 'Level of Service' and based on Austroads '*Guide to Traffic Engineering Practice, Part 2 Roadway Capacity*'. Capacity is expressed in total vehicles per day. The level of service descriptions are as follows:

**Table 4-2 Level of Service (LOS) Descriptions.**

LOS A :	Free flow condition, high degree of freedom for drivers to select desired speed and manoeuvre within traffic stream.
LOS B :	Zone of stable flow, reasonable freedom for drivers to select desired speed and manoeuvre within traffic stream.
LOS C :	Zone of stable flow, restricted freedom for drivers to select desired speed and manoeuvre within traffic stream.
LOS D :	Approaching unstable flow condition, severely restricted freedom for drivers to select desired speed and manoeuvre within traffic stream.
LOS E :	Condition close to capacity, virtually no freedom for drivers to select desired speed and manoeuvre within traffic stream. Small increases in flow would generally cause operational problems.

Tables contained in Austroads 'Guide to Traffic Engineering Practice', Sec. 3.4 & Sec 4 Roadway Capacity, have been used for the following determinations based on the traffic volumes shown in Section 3.1:

- Hume Highway at approximately 7,200 vehicles per day (vpd) operates at LOS A and would not reach LOS B until the volume reaches approximately 20,000 vpd. The estimated maximum design volume (see Section 4.4 of this report) is 7,450 vpd.
- Burley Griffin Way with approximately 1660 vehicles is operating at LOS B and the level of service would no drop to LOS C until volumes reach 2800 vehicles per day.
- Burrinjuck Road, Illalong Road, and Berramangra Road operate at LOS A and the level of service would not drop to LOS B until volumes reach at least 500 vehicles per day.

The determinations above show that the increase in traffic volumes of 250 vehicles per day would have a negligible effect on the capacity of the major routes shown above.

The single lane gravel roads which comprise the remainder of the roads under consideration perform their function as property access roads however **would not** perform satisfactorily with an increase in traffic of 250 vehicles per day. Upgrades would be required on any of these sections carrying increased traffic loads.

The Roads & Traffic Authority design guidelines suggest that roads with volumes between 150 and 500 vehicles per day should be provided with two lanes of 3.0 metres minimum width each (6.0m pavement). This is generally the minimum standard adopted by councils for smaller rural subdivisions.

## 4.8 Safety Considerations

Traffic generation calculations indicate that the maximum hourly increase in traffic at any location would be approximately 40 vehicles per hour (equivalent to 250 vpd) during the construction phase of the project.

The following safety issues have been considered:

- Risk of vehicle collisions
- Collisions with stock
- Traffic noise
- Dust from unsealed roads
- Driver distraction
- Obstruction by long loads
- Wet weather
- Road surface deterioration
- Structural failure of road structures
- Shadow Flicker
- Protection of walkers and horse riders

The impacts of these issues are discussed in Section 5.

## 5 IMPACT ASSESSMENT AND ASSOCIATED SAFEGUARDS

### 5.1 Traffic Impacts on Over-mass and Over-dimensional Haulage Routes

This section of the report considers all route options, including some alternative routes for the over-mass and over-dimensional vehicles. Decisions on the final routes for these vehicles would be the subject of negotiations between the haulage contractor and the road authorities.

Because of the potentially large increase in the number of vehicles using these routes there are many impacts to be considered. The larger vehicles would occupy most of the width of the roadway at many locations increasing the chance of 'head on' collisions. For nearby property owners, there would be an increase in traffic noise and dust nuisance and a need to control stock from straying on the roads which are not fenced. Dust would be generated on the unsealed roads affecting visibility and resulting in the loss of pavement materials. The gravel road surfaces would deteriorate and potholes would form under the increased traffic loads, particularly during wet weather when water ponds or floods across the road. Structural damage may occur to some of the culverts, concrete causeway crossings, stock grids and traffic islands. The location of trees and other roadside objects have the potential of obstructing the passage of long wide loads and high loads. Lack of roadside delineation in some locations may impact traffic safety during periods of poor visibility. Some intersections have inadequate pavement width to safely accommodate the turning man oeuvres of the over-size vehicles.

These impacts would be temporary, as the equipment haulage is not a continuous program. Most of the heavy haulage would be in the form of convoys and would be managed through a number of specific mitigation measures developed and implemented in conjunction with both RTA and local Councils. These measures usually include escort vehicles.

#### Safeguards

- Use of a licensed haulage contractor with experience in transporting similar loads, to be responsible for obtaining all required approvals and permits from the RTA and Councils and for complying with conditions specified in the approvals.
- Development of a Traffic Management Plan in conjunction with the haulage contractor to include but not be limited to the following:
  - Scheduling of deliveries,
  - Managing timing of transport,
  - Limiting the number of trips per day,
  - Undertaking community consultation before and during all haulage activities,
  - Designing and implementing temporary modifications to intersections and roadside furniture,
  - Managing the haulage process, including the erection of warning signs and/or advisory speed posting prior to isolated curves, crests, narrow bridges and changes of road conditions,
  - A speed limit would be placed on all of the roads that would be used primarily by construction traffic to reduce the severity of any accidents and reduce maintenance costs,
  - A Transport Code Of Conduct should be prepared and made available to all contractors and staff detailing traffic routes, behavioural requirements and speed limits.

- A procedure should be established to monitor the traffic impacts during construction, such as noise, dust nuisance and travel times and work methods modified to reduce the impacts.
  - Providing a dedicated telephone contacts list to enable any issues or concerns to be rapidly identified and addressed,
  - Reinstating pre-existing conditions after temporary modifications to the roads and pavement along the route.
- Implementation of all aspects of the Traffic Management Plan in coordination with the Council and RTA.
  - Reconstruction of gravel pavements. The decision to provide a seal needs to be balanced against the cost of maintenance on the gravel surface. Sealing would help address dust suppression and sediment control as well as road deterioration. The environmental impacts of this work should also be considered in the decision.
  - The Proponent would prepare road dilapidation reports covering pavement and drainage structures in consultation with the RTA and Council for the route prior to the commencement of construction and after construction is complete. Any damage resulting from the construction traffic, except that resulting from normal wear and tear, would be repaired at the Proponent's cost. Alternatively, the Proponent may negotiate an alternative for road damage with the relevant roads authority.

## 5.2 Traffic Impacts at Specific Locations

### Hume Highway

Additional traffic would be turning to and from the Hume Highway at seven locations between Burley Griffin Way and Westbourne Road (18.3 to 50.2 kilometres West of Yass).

The junctions at Burley Griffin Way, Paynes Road, Burrinjuck Road, Illalong Road and Berramangra Road are of a high standard and the relatively small increase in traffic volumes would not have any significant impacts on safety for turning traffic.

The junctions with Burley Griffin Way and Burrinjuck Road have advance signposting allowing traffic departing from the Highway to select the appropriate lane and decelerate smoothly in preparation for the turn. This facility is not available on the other junctions and drivers who are unfamiliar with the locality are often required to make sudden manoeuvres at high speed when they approach their departure point at a minor junction.

The effects of shadow flicker have been examined for the proposed turbine precincts adjacent to the highway at Conroys Gap (refer to Appendix D). Information from the Danish Wind Industry Association (2003) suggests that the shadow flicker effect diminishes beyond 500metres from the wind tower precinct and is not noticed beyond 1000 metres. The effect is only present when the sun is directly behind the turbine blades within the driver's cone of vision. The final location of the turbines has not been determined and Appendix D is based on the closest turbine being approximately 200 metres south of the highway formation. The diagram in Appendix D indicates that the sun position would not be intersected by the turbine precincts within the driver's cone of vision.

#### *Safeguards*

- Safeguards identified in Section 5.1 are also applicable.
- Traffic Management Plan should include measures along Hume Highway for providing advance warning of the proposed access points.



- The Transport Code of Conduct should detail the location of all access points and rest areas and should be prepared in consultation with the Roads and Traffic Authority.
- The distance from the closest tower to the Hume Highway should be sufficient so that in the event of a collapse of a tower or crane no part would fall within the 'clear zone' of the Highway. In the case of the large cut batter on south side of Conroys Gap, it may be preferable to ensure that any potential collapse would be clear of the cutting slope.

### **Hume Highway Rest areas at Conroys Gap**

The existing access track from the rest area on the northern side departs from the deceleration lane at a point where travel speeds have not sufficiently reduced to permit safe access. The existing access on the southern side does not have sufficient setback from the rest area formation and turning radii are insufficient for large vehicles.

The rest areas do not permit safe turning for return travel.

#### *Safeguards*

- Safeguards identified in Section 5.1 are also applicable.
- The Transport Code of Conduct should contain methods for reducing noise and other disturbance to the users of the rest areas.
- The Traffic Management Plan and Transport Code of Conduct should contain information on the location of safe turning locations for return travel along the Hume Highway.
- As part of the Traffic Management Plan Road, rest area users should be made aware of the construction programme for the turbines to be accessed from the rest areas.
- Designs need to be prepared in consultation with the Roads and Traffic Authority for the construction of safe access roads from both rest areas.

### **Illalong Road**

Increased vehicle movements particularly by heavy vehicles would increase the potential of vehicle conflicts.

Yass Valley Council has imposed a weight restriction of ten tonnes on the full length of Illalong road as the pavement is considered to be of insufficient strength to withstand large volumes of heavy traffic.

An old timber bridge at 3.3 kilometres from Burley Griffin Way is currently under repair. The width between kerbs is 4.8 metres. The bridge and the concrete bridges at 6.09 and 10.27 kilometres may be of insufficient strength and width for use by heavy vehicles.

#### *Safeguards*

- Safeguards identified in Section 5.1 are also applicable.
- Implementation of speeds limits along Illalong Road should be considered to reduce the accident potential.
- Yass Valley Council should be consulted about use of the northern section of Illalong Road as a major access route from Burley Griffin Way to the first potential access point at approximately 1.6 kilometres. Access along Illalong Road from the Hume Highway to Campbells Road should also be considered. The improvements required to the pavement should be investigated and discussed with Council and appropriate construction planned.
- The strength of the bridges should be checked and appropriate repairs or weight restrictions implemented for the timber bridge at 3.32 kilometres and the concrete bridges at 6.09 & 10.27 kilometres from Burley Griffin Way.

- Junctions at the proposed access points at Weilora and Campbells Road should be upgraded to provide safe turning movements, if they are required for access.

### **Marilba Access Roads**

The increased volumes of traffic at these junctions may result in vehicle conflicts in the 'throat' of the junction, between vehicles departing and entering at peak periods.

#### *Safeguards*

- Safeguards identified in Section 5.1 are also applicable.
- The layout of the junctions should be checked and plans prepared for upgrading to provide sufficient area for departing vehicles to stand clear of entering vehicles.
- Speed limits and warning signs should be installed, and should indicate potential hazards along the route.

### **Burrinjuck Road**

The junction with the Hume Highway has restricted sight distance due to vegetation in the central median area.

The significant increase in traffic on Burrinjuck Road would increase the potential for traffic conflicts, particularly during summer holiday periods when recreational activities are at a peak for the year.

Tree branches which overhang the road could conflict with high loads.

Deformation of the road surface at some locations indicates that the surface may fail when subject to an increase in heavy traffic.

#### *Safeguards*

- Safeguards identified in Section 5.1 are also applicable.
- The Roads & Traffic Authority should be contacted in regard to the clearing of sight lines at the Hume Highway Junction.
- Proposed peak construction periods on Burrinjuck should be programmed where possible to avoid the summer holiday periods. Recreational groups which organise horse riding and walking activities should be informed about the timing of construction works, as part of the community consultation required by the Traffic Management Plan.
- The need to lop overhanging branches along Burrinjuck Road should be investigated as part of the Traffic Management Plan.
- The condition of the road pavement should be assessed and measures for repair and or monitoring discussed with Yass Valley Council.
- The road junction at the proposed access at 10 kilometres from Hume Highway requires reconstruction including setback from the existing road formation.

## **Waterview Road**

The junction with Burrinjuck Road has insufficient sight distance to the south.

Waterview Road has insufficient width and sight distance for most of its length to operate as a two lane access road carrying increased traffic.

The gradients towards the main crest would be difficult for vehicles in wet weather due to the combination of steep grades and inadequate roadside drainage.

### *Safeguards*

- Safeguards identified in Section 5.1 are also applicable.
- The junction with Burrinjuck Road should be realigned to improve sight distance.
- The road requires reconstruction and widening to provide a minimum of 6.0 metres width. A bitumen seal is required on the steep grades. Erosion protection of the roadside drains will be required.

## **Whitefields Road.**

The increased volumes of traffic at the junction with Hume Highways may result in vehicle conflicts in the 'throat' of the junction between vehicles departing and entering at peak periods.

Whitefields Road has insufficient width for most of its length to operate as a two lane access road carrying construction traffic. Trees overhang the road at many locations which would restrict high loads. The proximity of many trees to the roadside could restrict the passage of long wide loads.

The road reserve is not fenced for stock control and properties are separated by gates at six locations along the 10 kilometre length.

### *Safeguards*

- Safeguards identified in Section 5.1 are also applicable.
- The layout of the junction with Hume Highway should be checked and plans prepared for upgrading to provide sufficient area for departing vehicles to stand clear of entering vehicles.
- The road requires reconstruction and widening to provide a minimum of 6.0 metres width. A bitumen seal should be considered in order to reduce the dust nuisance.
- The road reserve should be fenced or other arrangements made with the property owners for stock control.
- The gates should be replaced with stock grids of sufficient width and strength for heavy vehicles.
- Erosion protection of the roadside drains at some locations is required.
- The Traffic Management Plan should favour access to Whitefields Road from the West via Berramangra and Coppabella Roads as the junction with Hume Highway at Berramangra is of a higher standard than the Whitefields Road Junction.

## **Coppabella Road (Southern section from Whitefields Road to Berramangra Road).**

The 2.6 kilometer section of Coppabella Road from Whitefields Road to Berramangra Road is of insufficient width for part of a major access route and is not fenced.

The relatively straight alignment could result in excessive speed on this section.

### *Safeguards*

- Safeguards identified in Section 5.1 are also applicable.

- The road requires widening to provide a minimum of 6.0 metres width. A bitumen seal should be considered in order to reduce the dust nuisance and increase safety at junctions. Guide posts should be erected.
- Establish speed limits and erect warning signs for potential hazards along the route.
- The road reserve should be fenced or other arrangements made with the property owners for stock control.
- Stock grids of sufficient width and strength for heavy vehicles should be provided.

### **Berramangra Road**

Berramangra Road has inadequate delineation of the alignment and insufficient warning of the poorly aligned sections and roadside hazards. The available width of bitumen is reduced at some locations by roadside vegetation.

The junction with Coppabella Road has insufficient sight distance to the north along Berramangra Road.

A old concrete bridge at 3.6 kilometers has an available width of 5.5 meters between kerbs.

The junction with Hillview Road has inadequate turning radius to the north. The Westbourne Road Junction requires larger turning radii for safe turning by larger vehicles.

Berramangra Road beyond 9.3 kilometers from Hume Highway has a low standard of alignment which reduces safe travel speed on some sections to 40 to 50 kilometers per hour.

#### *Safeguards*

- Safeguards identified in Section 5.1 are also applicable.
- Increase available width of formation by clearing and widening road shoulders.
- Install guideposts and bridge width markers.
- Speed limits and warning signs should be installed, and should indicate potential hazards along the route.
- Investigate the load limits for the bridge at 3.59 kilometres and establish alternative routes if applicable. Other routes may be established via Coppa Ck Road or Westbourne Road.

### **5.3 Impacts on Minor Roads**

There are potential impacts on Westbourne Road, Coppa Creek Road, Cumbarmurra Road, Garry Owen Road and Coppabella Road (Northern Section). These routes are not covered specifically in Section 5.2. Although it is not anticipated that the minor roads identified in this section would become primary access routes, it is probable that some of these routes would experience a small increase in traffic volumes. A relatively small increase in traffic volumes would require improvements to ensure the safety of road users particularly in relation to conflicts between vehicles and stock.

The road reserves are fenced on Westbourne Road and Garry Owen Road and therefore can support small increases in traffic without the level of improvement required on the other minor roads.

Isolated curves and crests on looser gravel surfaces could result in drivers losing control. Many drainage structures may need upgrading to ensure continued access in wet weather.

### *Safeguards*

- Safeguards identified in Section 5.1 are also applicable.
- A programme should be prepared in conjunction with Council to allow for the installation of guideposts bridge width markers, warning signs and speed restriction signs on Garry Owen and Westbourne Roads.
- Closely monitor the traffic volumes on all minor routes in close cooperation with property owners and establish a procedure for the identification and implementation of required improvements. This programme should be capable of a short response period and be prepared in consultation with the relevant councils.
- Investigate the load limits for the bridge at 0.69 kilometres on Garry Owen Road and signpost if required.

## 5.4 Summary of Key Safeguards

**Table 5-1 Summary of the type and extent of key safeguards required to reduce traffic impacts**

Shading indicates the action is applicable. This table indicates key areas only and is not considered to be a comprehensive list of all safeguards recommended. Refer to text in Sections 5.1, 5.2, 5.3 and 5.5 for a full discussion of all recommended safeguards.

Key safeguards	Hume Highway	Burley Griffin Way	Illalong Road	Marilba access road	Paynes Road	Burrinjuck Road	Waterview Road	Whitefield's Road	Coppabella Road	Berramanga Road	Westbourne Road	Coppa Creek Road	Cumbamurr a Road	Garry Owen Road
<i>Reconstruction and/or realignment to provide 6m wide pavement &amp; consider bitumen seal</i>	-	-	-	-	-	-	1.55 km of reconstruction	9.8 km of reconstruction	2.6 km of reconstruction on the southern section only	-	-	-	-	-
<i>Improve turning radii and advance signposting on junctions<sup>1</sup></i>	5 junctions	1 junction	2 junctions	(see Hume Highway)	-	2 junctions	(see Burrinjuck Road)	(see Hume Highway)	-	2 junctions	(see Berramanga Road)	-	-	-
<i>Check bridges and pavement condition on sealed roads in consultation with road authorities</i>	-	-	3 bridges & 11 km of pavement	-	-	14 km of pavement	-	-	-	1 bridge & 8.5 km of pavement	-	-	-	1 bridge
<i>Repair and maintain road shoulders on sealed roads</i>	-	-	-	-	-	14 km of sealed pavement	-	-	-	13.8 km of sealed pavement	-	-	-	0.81km of sealed pavement
<i>Provide warning signs and guideposts</i>	-	-	-	-	-	-	1.55 km length of council road	9.8 km length	3.12 km length in the northern section	13.8 km length	5.0 km length	-	-	9.7km length
<i>Discuss with roads authority and land holders level of usage and improvements required</i>	2 junctions at Conroys Gap Rest Areas	-	11 km length	2.2 km length	1.34 km length	-	-	9.8 km length	10.33 km length	13.8 km length	5.0 km length	2.3 km length	7.5 km length	9.7km length

<sup>1</sup> The road indicated is the more major road of the junction



## **5.5 General Safeguards**

Additional to the specific safeguards outlined above, it is recommended that a transport carpool be organised for construction workers. This would minimise the number of vehicles travelling to and from the precincts, with resultant safety and environmental benefits.

The safeguards listed in Sections 5.1 to 5.3 of this report have not been discussed in any detail with road authorities or property owners and are presented for further discussion and assessment. The decision on the extent and standard of road improvements to be provided would be subjective and related to the economies of construction for short term use.

## 6 CONCLUSION

The Yass Wind Farm Project stretches westward for approximately 30 kilometres north of the Hume Highway, requiring access from this major interstate route for the Marilba Hills and Coppabella Hills precincts which contain 152 potential turbine locations. Burrinjuck Road junctions with the Hume Highway and provides access to the southern portion of the Marilba Precinct and all of the Carrolls Ridge Precinct.

The area proposed for the Yass Wind Farm is sparsely populated and the introduction of an additional 250 vehicles per day during the construction period could have a significant impact on the existing road users on the minor and unsealed roads.

Safeguards considered necessary to address the traffic impacts of the proposal are outlined in this report. These safeguards should be implemented in consultation with the Harden and Yass Valley Councils. Safeguards on the Hume Highway should be discussed with the Roads and Traffic Authority.

Adoption of all the safeguards for minimising traffic impacts outlined in this study should reduce community disruption and the risk of traffic accidents to an acceptable level and minimise structural and environmental damage. Key issues are summarised, as follows:

### Hume Highway and Junctions

The Hume Highway alignment has been designed for travel speeds of 110 kilometres per hour. A high level of road safety is maintained by ensuring that sufficient sight distance is available between all vehicles especially at junctions and intersections. The vehicle conflict points resulting from speed differences at junctions are minimised by providing deceleration lanes. Vehicle conflicts between approaching vehicles are minimised by the separation of the opposing carriageways. Conflicts for turning manoeuvres are reduced by the provision of large turning radii and wide sealed shoulders. Rest areas are provided at regular intervals to reduce accidents due to driver fatigue. Advance signposting is provided prior to the major junctions to minimise late vehicle manoeuvres.

Experienced drivers of standard vehicles would negotiate the Hume Highway including all of the junctions with a high degree of safety. The addition of up to 250 vehicles per day would have a negligible impact on this level of safety. Drivers unaware of the location of junctions have potential to produce conflicts with sudden lane changes and deceleration on the approach to junctions.

The safeguards included in this report aim to review the widths for entry into the minor junctions and carry out improvements where required.

Education of drivers using the Hume Highway and its various junctions and side roads with the assistance of signposting and codes of driver conduct are seen as being the major initiatives which would reduce the traffic impacts for this project.

### Burrinjuck Road

The potential impacts on Burrinjuck Road are much greater in comparison to the Hume Highway, as the traffic volumes could increase by as much as three times during the peak construction period. As Burrinjuck Road is a tourist route, the traffic is seasonally affected. Every attempt should be made to carry out the construction works outside school holidays.

Adoption of the safeguards contained in this study should reduce the impacts on Burrinjuck to an acceptable level.

### **Burley Griffin Way, Illalong Road and Berramangra Road**

Access from these roads may only be required for access to a small number of turbines. Traffic impacts should not be significant, provided that the general safeguards listed in Section 5 of this report are implemented.

### **Whitefields Road and southern portion of Coppabella Road**

These roads require reconstruction and provision of a two lane road with a minimum width of 6.0 metres. The roads should be bitumen sealed to increase safety and reduce erosion.

### **Other Minor Roads**

As the traffic impacts on these roads could be substantial if utilised, their use should be carefully monitored and measures adopted for prompt improvements to be carried out as required prior to and during the construction period, as detailed in Section 5.3 of this study.

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- URS 2004, Assessment of Transport Feasibility and Traffic Impact Crookwell 2 Wind Farm, prepared for Wind Farm Joint Venture, 30 April 2004.
- The assistance of the following in obtaining information for this study is recognised :
- Yass Valley Council Director of Operations, *Simon Cassidy*.
- Harden Shire Council Director of Technical Services, *Simon Miller*.
- Roads and Traffic Authority Development Assessment Officer, *Maurice Morgan*
- Roads and Traffic Authority A/ Road Safety & Traffic Officer, *Suzie Lyons*

## 8 AUTHOR

Rodger John Ubrihien

Road Design Consultant,

Cert. Engineering Surveying

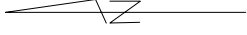
Member of the Institute of Engineering and Mining Surveyors NSW.

Rodger has been involved in the survey, planning and design of road projects since commencing work with the Department of Main Roads NSW in 1966. Rodger gained knowledge in Traffic Engineering with the Roads and Traffic Authority Traffic Section in Sydney. Since opening his own business 'Bega Duo Designs' in 1993, Rodger has completed the planning of a wide variety of civil engineering and related projects throughout NSW and ACT including wind farms at Crookwell and Silverton.

Contact:        Bega Duo Designs  
                    Office 1 Main Street  
                    Merimbula NSW 2548  
                    Ph Fax 02 64945456  
                    Mobile 0417292170

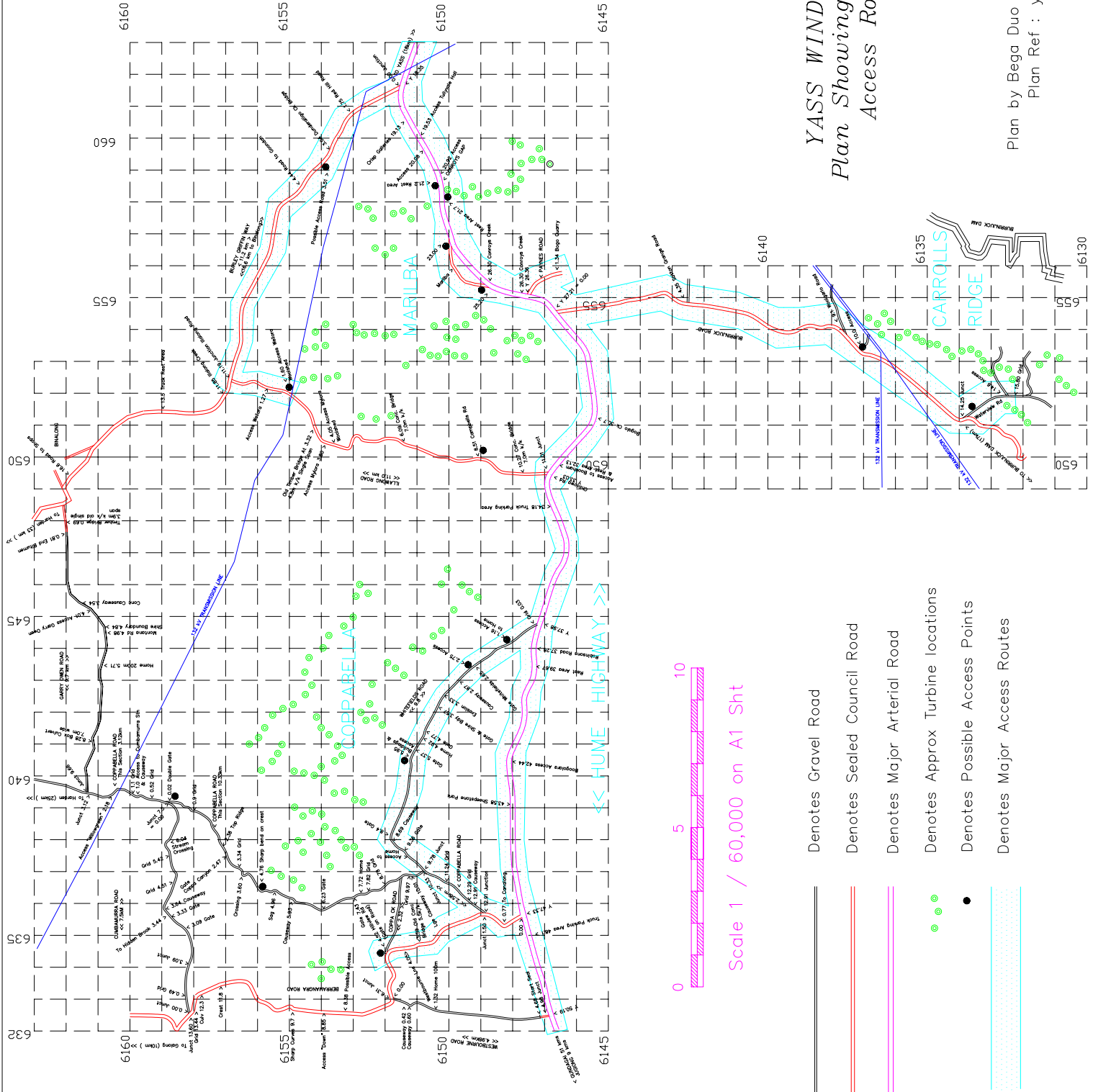
## **Appendix A: Location of the proposal and relevant access roads**








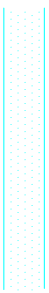


# YASS WIND FARM Plan Showing Details of Access Roads

Plan by Bega Duo Designs 29/02/09  
Plan Ref : yass.dwg



Scale 1 / 60,000 on A1 Sht

-  Denotes Gravel Road
-  Denotes Sealed Council Road
-  Denotes Major Arterial Road
-  Denotes Approx Turbine locations
-  Denotes Possible Access Points
-  Denotes Major Access Routes

## **Appendix B: Photographic Plates**



**PLATE 1**  
Hume Highway at Conroy's Gap.



**PLATE 2**  
Burley Griffin Way at 6.5km.



**PLATE 3**  
Burley Griffin Way Junction at 3.5km.



**PLATE 4**  
Burley Griffin Way Junction at 3.5km.



**PLATE 5**  
Illalong Rd/Burley Griffin Way Junction



**PLATE 6**  
Illalong Rd/Burley Griffin Way Junction



**PLATE 7**  
Illalong Road Bridge at 3.13km.



**PLATE 8**  
Illalong Road Bridge at 6.09 km



**PLATE 9**  
Illalong Rd/ Cambbells Road at 8.5km.



**PLATE 10**  
Illalong Road Conc. Bridge at 10.27.



**PLATE 11**  
Illalong Road /Hume Hwy Junct.



**PLATE 12**  
Paynes Rd/Hume Hwy Junct.





**PLATE 13**  
Paynes Rd.



**PLATE 14**  
Paynes Rd/Quarry Entrance.



**PLATE 15**  
Burrinjuck Road/Hume Highway Junction.



**PLATE 16**  
Burrinjuck Road/Hume Highway Junction Sight Obscured.



**PLATE 17**  
Burrinjuck Road failing pavement



**PLATE 18**  
Burrinjuck Road Trees over road.



**PLATE 19**  
Burrinjuck Road access at 10.0km.



**PLATE 20**  
Burrinjuck Road/ access at 10.0km.



**PLATE 21**  
Burrinjuck Road/ access at 10.0km.



**PLATE 22**  
Burrinjuck Road Junction with Waterview Rd.



**PLATE 23**  
Burrinjuck Road Junction with Waterview Road



**PLATE 24**  
Waterview Road looking south.





**PLATE 25**  
Waterview Road access on left at 14.6km.



**PLATE 26**  
Waterview Road at 15.2km.



**PLATE 27**  
Waterview Road at 15.8 km.



**PLATE 28**  
Waterview Road at 15.8 km..



**PLATE 29**  
Marilba Access/Hume highway at 23.0km.



**PLATE 30**  
Marilba Access/Hume highway at 23.0km..



**PLATE 31**  
Marilba Access/Hume highway at 23.0km.



**PLATE 32**  
Marilba Access/Hume highway at 23.0km.



**PLATE 33**  
Marilba Access/Hume highway at 23.0km.



**PLATE 34**  
Marilba Access/Hume highway at 25.2km.



**PLATE 35**  
Marilba Access/Hume highway at 25.2km.



**PLATE 36**  
Marilba Access/Hume highway at 25.2km.





**PLATE 37**  
Marilba Access/Hume highway at 25.2km.



**PLATE 38**  
Marilba Access/Grid at 0.19km looking Nth.



**PLATE 39**  
Eastbound rest area Conroy's Gap.



**PLATE 40**  
Eastbound rest area Conroy's Gap.



**PLATE 41**  
Westbound rest area Conroy's Gap.



**PLATE 42**  
Westbound rest area Conroy's Gap.



**PLATE 43**  
Whitefields Road/Hume highway junction.



**PLATE 44**  
Whitefields Road/Hume highway junction.



**PLATE 45**  
Whitefields Road/Hume highway junction.



**PLATE 46**  
Whitefields Road/Hume highway junction.



**PLATE 47**  
Whitefields Road at 0.13km.



**PLATE 48**  
Whitefields Road property access at 1.16km.





**PLATE 49**  
Whitefields Road large trees close to road at 1.4km



**PLATE 50**  
Whitefields Road gate at 2.65km.



**PLATE 51**  
Whitefields Road causeway at 2.87km.



**PLATE 52**  
Whitefields Road erosion at 3.33km.



**PLATE 53**  
Whitefields Road gate at 3.57km.



**PLATE 54**  
Whitefields Road access at 5.95km.



**PLATE 55**  
Whitefields Road and gate at 8.41km



**PLATE 56**  
Whitefields Road causeway at 8.69km.



**PLATE 57**  
Whitefields Road gates at 9.36km.



**PLATE 58**  
Whitefields Road Coppabella Road ahead.



**PLATE 59**  
Coppabella Road gate at 0.02km.



**PLATE 60**  
Coppabella Road at 0.30km.





**PLATE 61**  
Coppabella Road at 1.76km.



**PLATE 62**  
Coppabella Road at 2.47km.



**PLATE 63**  
Coppabella Road at 3.34km.



**PLATE 64**  
Coppabella Road at 3.60km.



**PLATE 65**  
Coppabella Road at 4.00km.



**PLATE 66**  
Coppabella Road stream crossing 5.93km.



**PLATE 67**  
Coppabella Road Gate at 6.23km.



**PLATE 68**  
Coppabella Road at 7.3km.



**PLATE 69**  
Coppabella Road at 7.83km.



**PLATE 70**  
Coppabella Road low level bridge ahead.



**PLATE 71**  
Coppabella Road Junct with Whitefields Road ahead



**PLATE 72**  
Coppabella Road causeway at 12.50km.





**PLATE 73**  
Coppabella Road junct with Berramangra Rd.



**PLATE 74**  
Coppabella Road junct with Berramangra Rd.



**PLATE 75**  
Berramangra Rd/Hume Hwy junct.



**PLATE 76**  
Berramangra Rd/Hume Hwy junct.



**PLATE 77**  
Berramangra Rd/Hume Hwy junct.



**PLATE 78**  
Berramangra Road at 1.1 km.



**PLATE 79**  
Berramangra Road Bridge at 3.59km.



**PLATE 80**  
Berramangra Road at 4.32km.



**PLATE 81**  
Berramangra Rd/Hillview Road junct.



**PLATE 82**  
Berramangra Rd/Hillview Road junct.



**PLATE 83**  
Berramangra Rd/Westbourne Road junct.



**PLATE 84**  
Berramangra Rd/Cumbamurra Road junct.





**PLATE 85**  
Berramangra Rd/Cumbamurra Road junct.



**PLATE 86**  
Cumbamurra Road causeway at 3.64km.



**PLATE 87**  
Cumbamurra Road trees over road at 4.57km.



**PLATE 88**  
Cumbamurra/Garry Owen Road junct.



**PLATE 89**  
Cumbamurra/Garry Owen Road junct.



**PLATE 90**  
Cumbamurra/Garry Owen Road junct.





**PLATE 91**  
Coppabella Road Nth at 1.00km.



**PLATE 92**  
Coppabella Road Nth causeway at 1.0km.



**PLATE 93**  
Coppabella Road/Garry Owen Road junct.



**PLATE 94**  
Garry Owen Rd/Burley Griffin Way junct.



**PLATE 95**  
Garry Owen Rd/Burley Griffin Way junct.



**PLATE 96**  
Garry Owen Road Bridge at 0.69km.



**PLATE 97**  
Garry Owen Road Bridge at 0.69km.



**PLATE 98**  
Garry Owen Road causeway at 3.54km.



**PLATE 99**  
Garry Owen Road culvert at 8.28km.



**PLATE 100**  
Garry Owen Road trees at 7.30km.



**PLATE 101**  
Garry Owen Road approaching Coppabella Rd.



**PLATE 102**  
Westbourne Road at 0.05km





**PLATE 103**  
Westbourne Road at 0.05km.



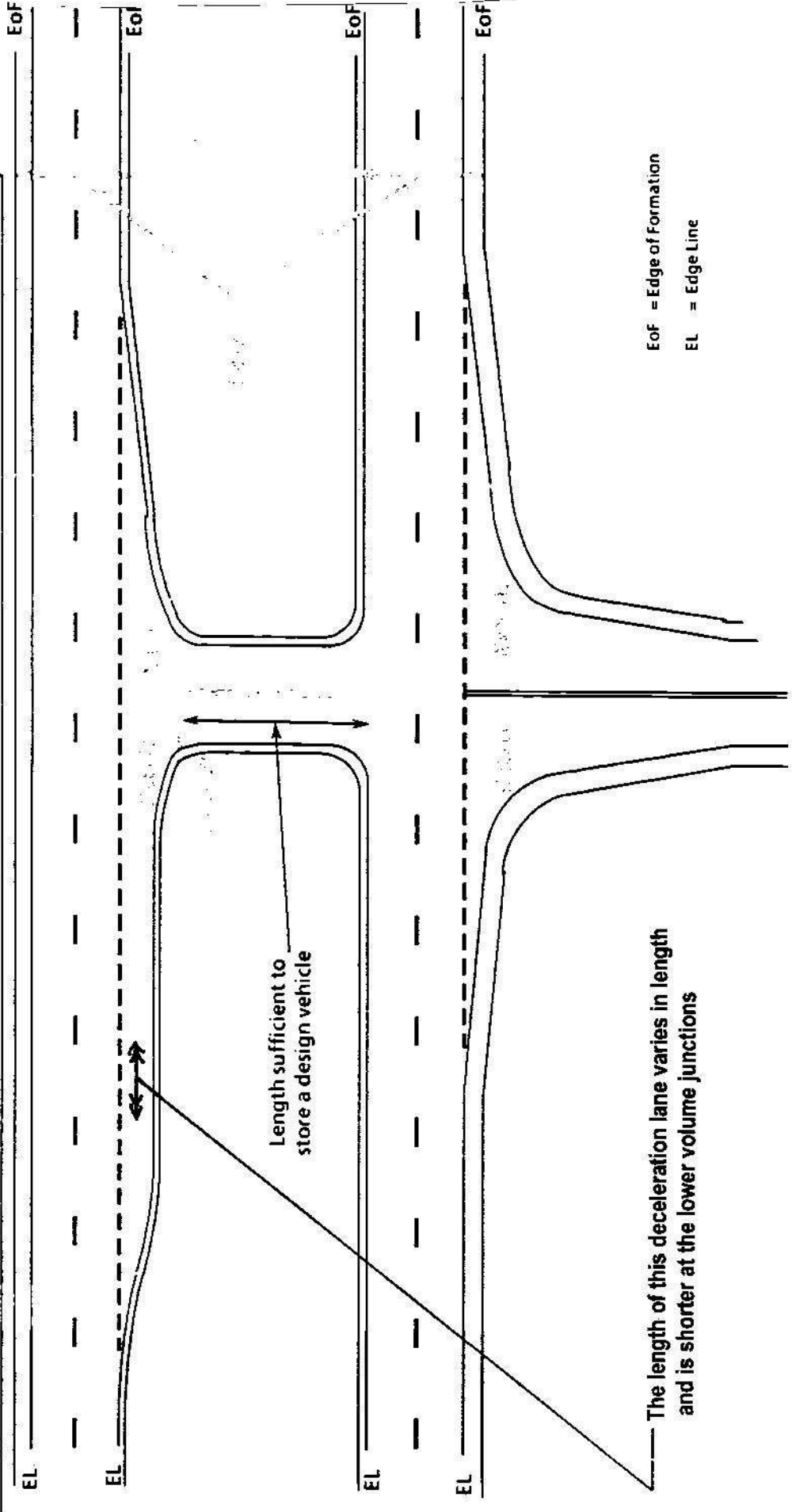
**PLATE 104**  
Westbourne Rd/Hume Highway junct.



**PLATE 105**  
Westbourne Rd/Hume Highway junct.

## Appendix C – Hume Highway Junction Layout

This layout allows right turning traffic to undertake the manoeuvre in two stages, which has benefits when volumes on the through route are high and the turning movement small. The lanes used for storage on the through road are preferred, but not essential.



EoF = Edge of Formation  
 EL = Edge Line

The length of this deceleration lane varies in length and is shorter at the lower volume junctions

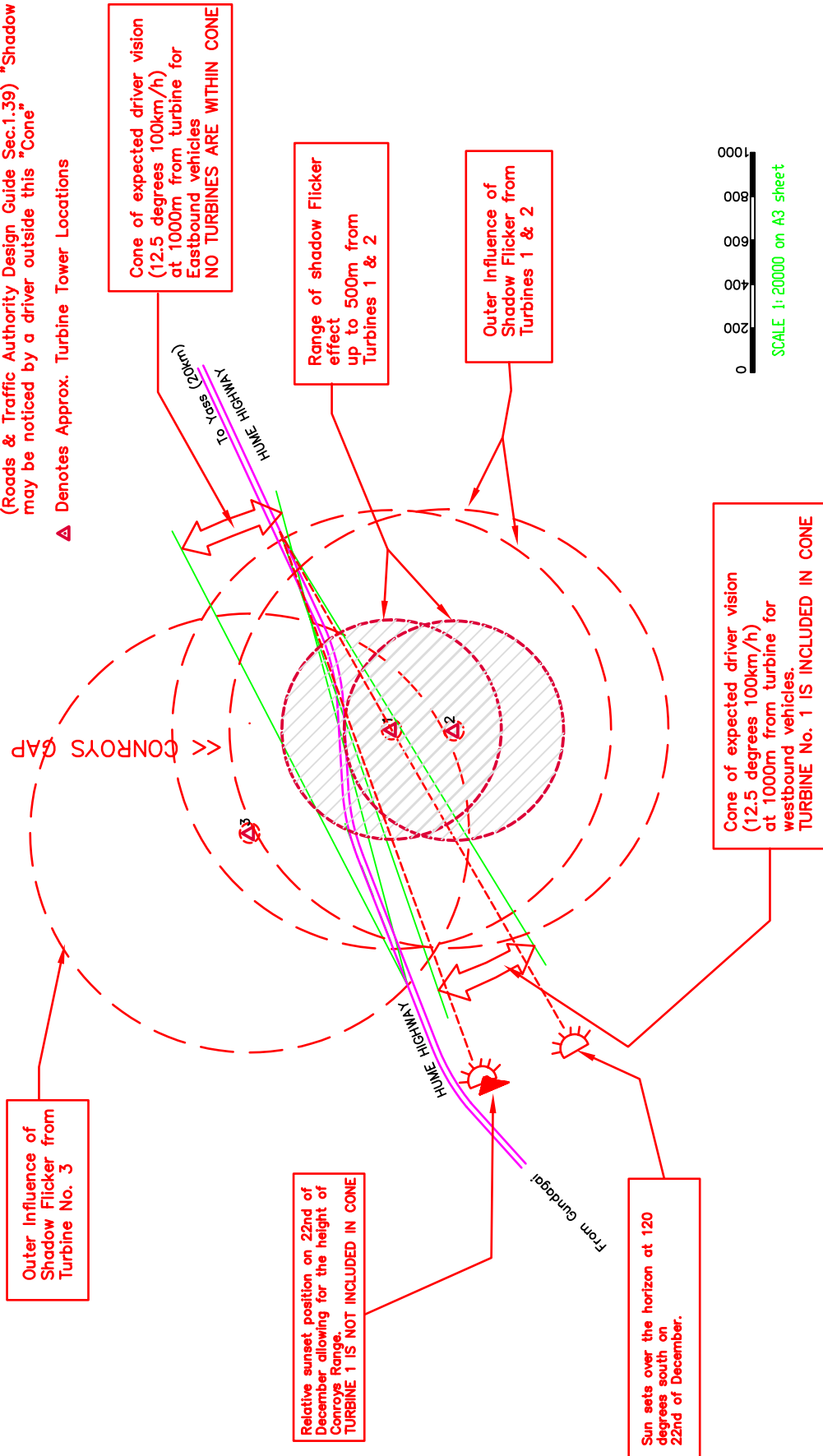


## Appendix D – Shadow Flicker Diagram

**\*\* NOTES \*\***

- 1/ The "Flicker Effect" attenuates with distance and is not considered to be noticed beyond 500 – 100 metres from a Turbine. (Ref. Danish Wind Energy Association.)
- 2/ The "Cone of Visual Perception" widens at slower speeds and 12.5 degrees (100km/h) has been adopted for this diagram. (Roads & Traffic Authority Design Guide Sec.1.39) "Shadow Flicker" may be noticed by a driver outside this "Cone"

▲ Denotes Approx. Turbine Tower Locations



## Appendix 7 SHADOW FLICKER ASSESSMENT

# Shadow Flicker Assessment

Yass Valley Wind Farm  
Coppabella Hills and Marilba Hills Precincts  
May 2009

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## Introduction

Shadow flicker is the name given to describe the effect caused by the shadow created as the sun passes directly through the rotating blades of a turbine at a stationary viewpoint. Due to their height, wind turbines can cast shadows on the areas around them. Coupled with this, the moving blades create moving shadows. When viewed from a stationary position the moving shadows appear as a flicker giving rise to the phenomenon of 'shadow flicker'. For a particular position, shadow flicker will only occur during periods when the sun's rays pass directly through the swept area of the turbine blades to the viewpoint. The extent of the shadow flicker is dependent on the time of day, geographical location, meteorological conditions of the site and local vegetation.

The purpose of this assessment is to determine the impact that the proposal will have regarding the following questions:

- Is there a potential health risk to the public?
- Will any residence within the vicinity of the project be unacceptably affected by shadow flicker?
- What measures will be taken to ensure that shadow flicker is not a significant issue?

## Background

There are a number of factors influencing the effect and duration of shadow flicker, including:

- Position of the sun in relation to the turbine
- Time of year (season) and time of day
- Turbine height and rotor diameter
- Viewer's distance from turbine
- Topography of the area
- Vegetation cover
- Weather patterns, number of cloudy days per year, and
- Airborne particles, haze

In NSW there are no guidelines on which to assess shadow flicker generated by wind turbines. To carry out the shadow flicker assessment we have drawn on the Victorian Planning Guidelines [1] that limit the duration of shadow flicker to 30 hours a year. The South Australian Planning Bulletin [5] suggests that shadow flicker is insignificant once a separation of 500m between the turbine and house is exceeded. However, a conservative distance of 1 km has been used for this assessment.

## Assessment

Modelling of the shadow flicker was conducted for each precinct using specialist industry software, assessing the largest turbine (maximum tip height) proposed for the project to represent the worst case impact scenario. This is a GE 2.5xl with 100m diameter blades on a 100m tower with a maximum tip height of 150m.

The number of annual hours of shadow flicker at a given location can be calculated using simple geometrical models incorporating data such as the sun path, the topographic variation and wind turbine details such as rotor diameter and hub height. In such models, the wind turbine rotor is modelled as a disc and assumed to be in the worst case (i.e. perpendicular) to sun-turbine vector. Furthermore, the sun is assumed to be a point light source.

Shadow flicker calculated in this manner overestimates the number of annual hours of shadow flicker experienced at a specified location [2, 3] due to several reasons.

1. The occurrence of cloud cover has the potential to significantly reduce the number of hours of shadow flicker.
2. The probability of wind turbines consistently yawing to the 'worst case' scenario where the wind turbine is facing into or away from the sun- wind turbine vector is less than 1 (i.e. less than 100% of the time).
3. The amount of aerosols in the atmosphere has the ability to influence shadows cast due to the following reasons.

Firstly, the distance from a wind turbine that a shadow can be cast is dependent on the degree to which direct sunlight is diffused, which is in turn dependent on the amount of dispersants (humidity, smoke and other aerosols) in the path between the light source (sun) and the receiver [2].

Secondly, the quantity of aerosols in the air is known to vary with time and it has the potential to vary the air density, thereby affecting the refraction of light. This in turn affects the intensity of direct light to cause shadows.

4. The modelling of the wind turbine blades as discs to determine shadow path overestimates the shadow flicker effect.

The blades are of non-uniform width with the thickest viewable blade width (maximum chord) occurring closer to the hub and the thinnest being located at the tip of the blade. As outlined in point 3 above, the direct sunlight is diffused resulting in a maximum distance from the wind turbine that a shadow can be cast. This maximum distance is dependent on the human threshold which variation in light intensity can be perceived [2]. When the blade tip causes shadow, the diffusion of direct sunlight means that the light variation threshold occurs closer to the wind turbine than when a shadow is caused by the maximum chord. That is, the maximum shadow length cast by the blade tip is less than by the maximum chord.

5. Modelling the sun as a point light source rather than a disc has an effect similar to that of point 4 above.

Firstly, situations arise where the light rays from different portions of the sun disc superimpose around a shadow resulting in light intensity variations less than human perception.

Secondly, when the sun is positioned directly behind the wind turbine hub, there is no variation in light intensity at the receiver location and therefore no shadow flicker. However, when the sun is modelled as a point source, shadow flicker still arises.

6. The presence of vegetation shields incidences of shadow flicker.
7. Periods where the wind turbine is not in operation due to low winds, high winds or operational and maintenance reasons.

Taking the above issues into account, the modelling of shadow flicker has been conducted using simple geometric analyses. The wind turbine has been modelled assuming all wind turbines are disc objects positioned in the worst case with respect to shadow flicker. The sun has been assumed to be a point light source.

Due to points 3 and 4 above, an approximation for the maximum length of shadow flicker cast has been used. Guidance from the South Australian Government indicates that this distance is 500 m [5]. We have adopted a more conservative approach and have limited the length that a shadow can be cast to 1 km [4].

Therefore, the modelling conducted here represents a very conservative scenario and is believed to overestimate the actual annual hours of shadow flicker experienced at a location.

## **Actual Conditions**

When the actual conditions of the region are taken into consideration, the number of hours of shadow flicker should be reduced. The major consideration in this respect is the weather patterns and particularly the number of cloudy days experienced that result in no shadow flicker.

Based on 43 years (1965 – 2008) of daily weather observations in Yass (Yass, Linton Hostel, Bureau of Meteorology [6]), the nearest source of data, the average number of cloudy days experienced is 109/year. The average number of clear days experienced is 92.3/year. These are based on observations at 9am and 3pm each day.

**Table 1: Average daily conditions in Yass (1965-2008)**

	<b>Mean Clear Days</b>	<b>Mean Cloudy Days</b>
<b>Jan</b>	10.2	7.5
<b>Feb</b>	8	6.5
<b>Mar</b>	9.4	7.2
<b>Apr</b>	8.8	7.2
<b>May</b>	6.6	10.3
<b>Jun</b>	4.3	12.2
<b>Jul</b>	5.1	12.5
<b>Aug</b>	6.7	11.3
<b>Sep</b>	7.3	9.3
<b>Oct</b>	8	8.9
<b>Nov</b>	7.5	9
<b>Dec</b>	10.4	7.1
<b>Total</b>	<b>92.3</b>	<b>109</b>

***Cloudy days are defined Bureau of Meteorology as:***

Average number of cloudy days in a calendar month or year, calculated over the period of record. This statistic is derived from cloud cover observations, which are measured in oktas (eighths). The sky is visually inspected to produce an estimate of the number of eighths of the dome of the sky covered by cloud. A completely clear sky is recorded as zero okta, while a totally overcast sky is 8 oktas. The presence of any trace of cloud in an otherwise blue sky is recorded as 1 okta, and similarly any trace of blue on an otherwise cloudy sky is recorded as 7 oktas. A cloudy day is recorded when the mean of the 9 am and 3 pm cloud observations is greater than or equal to 6 oktas. This definition has changed slightly over time. Prior to this, a cloudy day was defined as having greater than or equal to 5.5 oktas averaged over the 9 am and 3 pm observations.

***Clear days are defined by the Bureau of Meteorology as:***

Average number of clear days in a calendar month or year, calculated over the period of record. This statistic is derived from cloud cover observations, which are measured in oktas (eighths). The sky is visually inspected to produce an estimate of the number of eighths of the dome of the sky covered by cloud. A completely clear sky is recorded as zero okta, while a totally overcast sky is 8 oktas. The presence of any trace of cloud in an otherwise blue sky is recorded as 1 okta, and similarly any trace of blue on an otherwise cloudy sky is recorded as 7 oktas. A clear day is recorded when the mean of the 9 am and 3 pm cloud observations is less than or equal to 2 oktas. This definition has changed slightly over time. Prior to this, a clear day was defined as having less than or equal to 2.5 oktas averaged over the 9 am and 3 pm observations.

Accordingly based on 109 days/year of cloud the number of shadow flicker hours should be reduced by 29.86%. Further reductions for vegetation screening should be considered and applied where appropriate on a case by case basis.

## Results

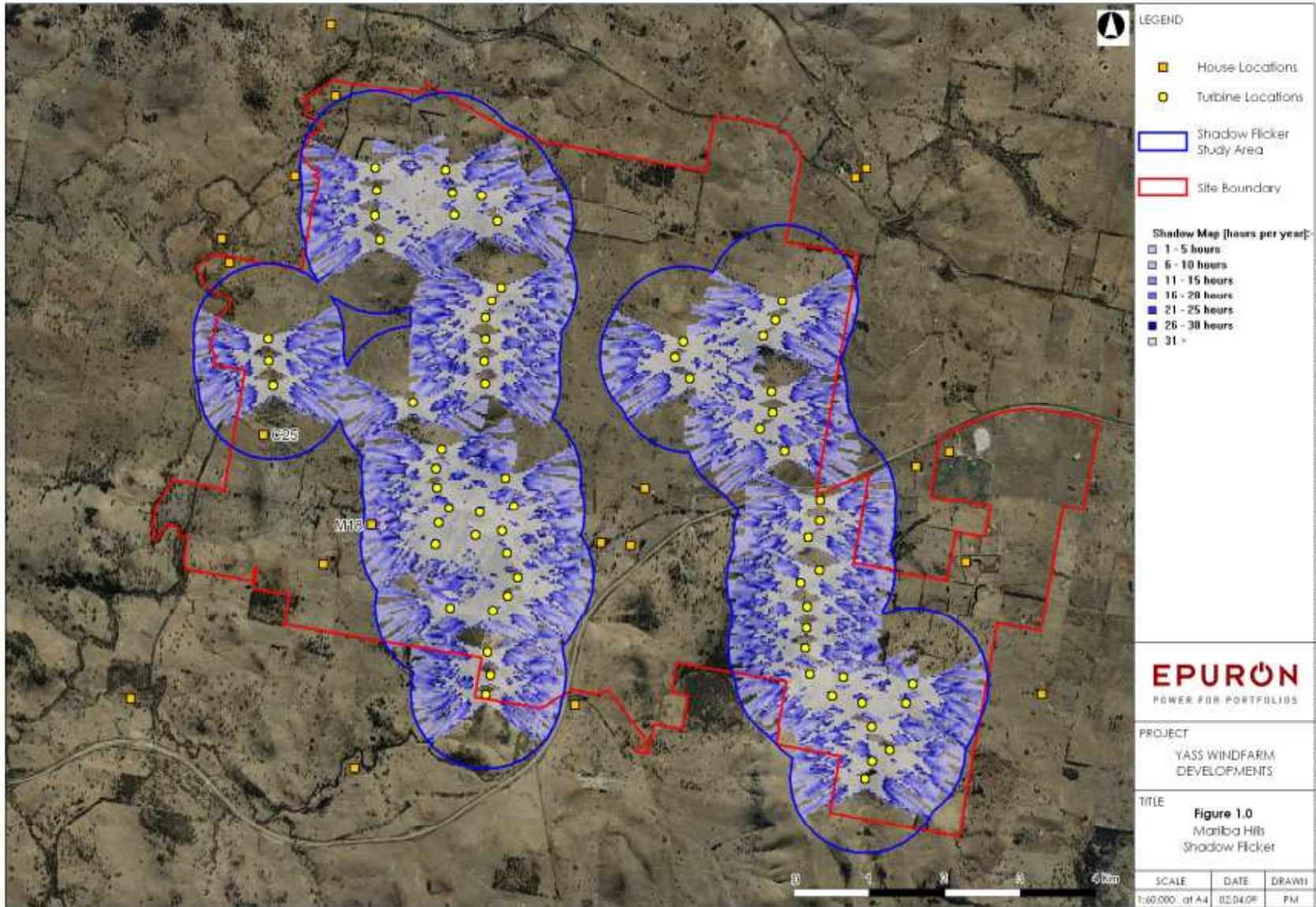
The modelling has calculated the number of annual hours at each of the nearby houses and the results are presented below. A reduction of the theoretical maximum number of hours can be assumed based on the long term observation of cloudy days.

<b>Residence No.</b>	<b>Precinct</b>	<b>Theoretical maximum shadow flicker (hrs/year)</b>	<b>Actual (reduced) shadow flicker (hrs/year)</b>	<b>Maximum shadow flicker (mins/day)</b>	<b>Compliance with Victorian Planning Guidelines</b>
M18	MRL	7	2.1	21	Yes
C25	MRL	0	N/A	0	Yes

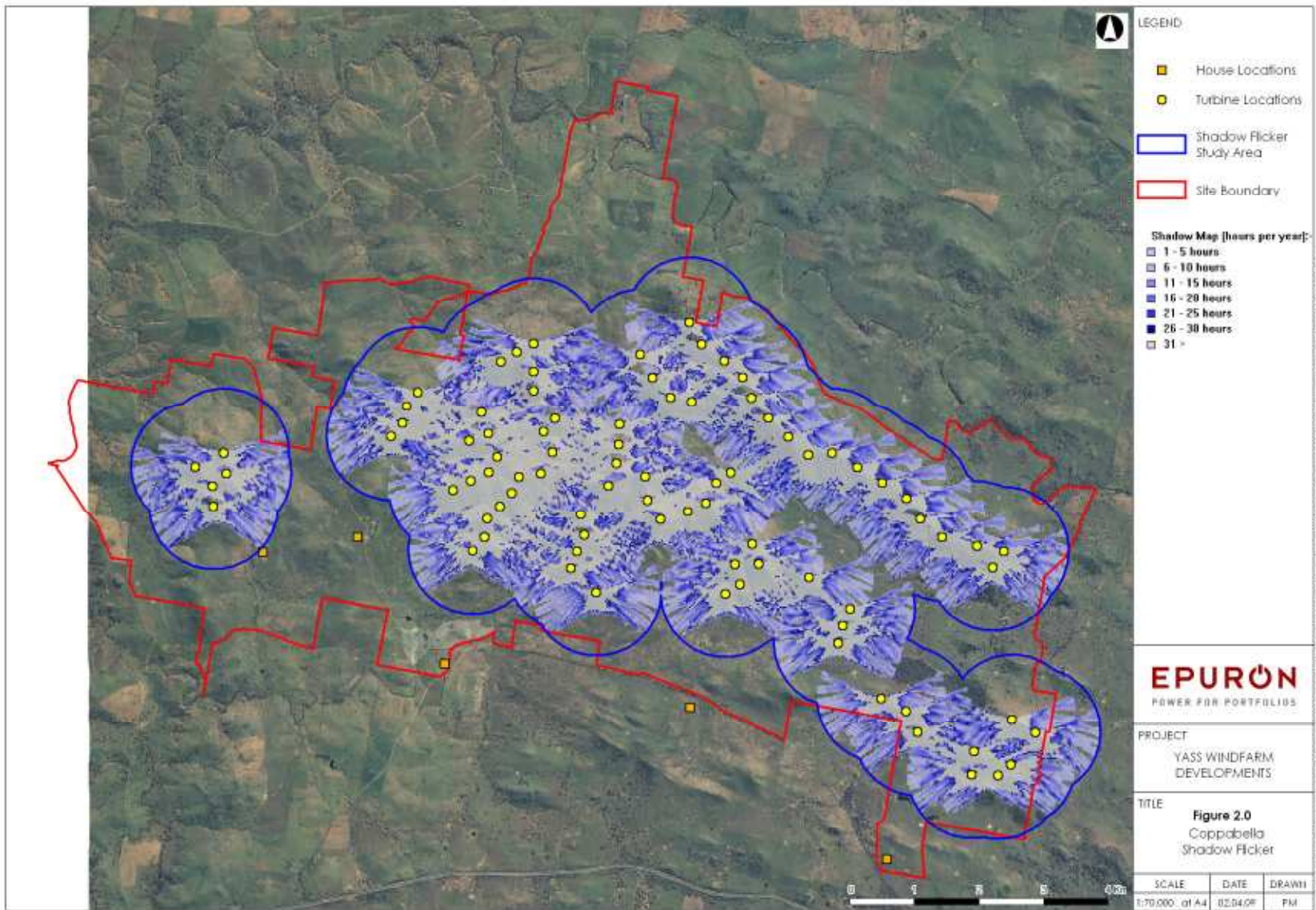
MRL = Marilba Hills

The results show compliance with the Victorian Guidelines of a maximum of 30hrs/year and no more than 30 minutes per day at all nearby residences.









## **Health effects from shadow flicker**

Flicker vertigo is an imbalance in brain cell activity caused by exposure to low frequency flickering or flashing of a light or sunlight seen through a rotating propeller (Rash 2004). It can result in nausea, dizziness, headache, panic, confusion and – in rare cases – loss of consciousness. Flicker vertigo is usually associated with a light flashing sequence, or flicker frequency, of between approximately 4 hertz (cycles per second) and 20 hertz [7,8].

Shadow flicker frequencies of between 8-30 hertz can trigger epileptic seizures for photosensitive epileptics. Less than 5% of cases involve photosensitive epilepsy, and only a portion of these photosensitive cases have experienced a seizure triggered by flickering light (Epilepsy Association of Australia).

Flicker frequency of rotating propellers, including wind farm rotors, is derived by multiplying the hub rotation frequency by the number of blades. Based on the rotation speed of the 3 bladed wind turbines proposed for the project, the maximum shadow flicker frequency would be 1 cycle per second (1 hertz), well outside the frequency range associated with flicker vertigo or photosensitive epilepsy.

The proposal is therefore unlikely to represent a health risk to local residents in relation to flicker vertigo or photosensitive epilepsy.

## **Blade Glint**

Blade glint occurs when sunlight is reflected off turbines blades and is visible to a person. The concern is that this may, under rare circumstances, affect some motorists or cause annoyance at dwellings.

In reality, turbine manufacturers around the world have acknowledged the possibility of blade glint and use a low reflectivity gel finish to reduce any reflectivity. The turbines proposed for this project will be finished in a matte, non-reflective finish to ensure blade glint impacts do not occur.

## **Conclusion**

A detailed analysis of the potential for shadow flicker and blade glint to affect dwellings has been carried out.

All residences comply with the Victorian Planning Guidelines of a maximum shadow flicker of 30 hours/year with no more than 30 mins/day.

Blade glint will be avoided by the use of non-reflective coatings on the turbine blades.

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