

RATCH-Australia Corporation Pty Ltd

Collector Wind Farm

**Pre-Construction Television & Radio
Assessments**

**Aitken & Partners
Consulting Engineers**

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Contents

1. INTRODUCTION	4
1.1 Scope	4
1.2 Planning Requirements	4
1.3 Consultant's Experience	4
1.4 Radio and Television Service Areas	5
1.5 Local Radio and Television Services	5
1.6 Measurement Parameters	6
1.7 Interference Mitigation Techniques	8
2. MEASUREMENTS	11
2.1 General Comments	11
2.2 Test Equipment	11
2.3 Test Locations	11
2.4 Summary of Results	13
2.5 Location A	14
2.6 Location B	18
2.7 Location C	22
2.8 Location D	26
2.9 Location E	30
2.10 Location F	34
2.11 Location G	38
2.12 Location H	42
2.13 Location I	46
2.14 Location J	50
2.15 Location K	54
2.16 Location L	58
2.17 Location M	62
2.18 Location N	66
2.19 Location O	70
2.20 Location P	74
2.21 Location Q	78
2.22 Location R	82
2.23 Location S	86
2.24 Location T	90
2.25 Location U	94
2.26 Location V	98
2.27 Location W	102
2.28 Location X	106



Introduction



1. INTRODUCTION

1.1 SCOPE

This report documents the pre-construction survey of radio and television frequencies at selected locations in the vicinity of the proposed Collector Farm. The work was commissioned by RATCH-Australia Corporation Pty Ltd and performed by John Aitken, a director of Aitken & Partners.

1.2 PLANNING REQUIREMENTS

The plan must be prepared in accordance with the requirements of the Development Approval, which states:

“Prior to the commencement of commissioning of the Project, the Proponent shall undertake an assessment of the existing quality of the television/radio transmission available at a representative sample of receivers located within five kilometres of any wind turbine.”

1.3 CONSULTANT’S EXPERIENCE

JJ Aitken & Partners Pty Ltd (trading as Aitken & Partners) commenced operations in 1983, practicing in radio communications consultancy. The company was founded by Mr John Aitken and based on the experience and expertise he had gained during ten years with Telecom Australia and two years with another consulting practice.

Aitken & Partners currently practices in the areas of railway communications, broadcasting and electromagnetic compatibility engineering. The company has developed skills in systems engineering and in software engineering, dealing with projects from the conceptual design to implementation.

Aitken & Partners have been active in television coverage design and implementation, radio broadcasting systems and link design. We designed the transmission and rebroadcast system for MVQ6 in Mackay (Queensland), adding a large geographic area and many mining towns to their coverage footprint.

The National Transmission Agency, which was then responsible for ABC and SBS television and radio transmitters throughout Australia, commissioned Aitken & Partners (as part of a multi-discipline team) to perform audits and then supervise upgrades of over twenty AM radio, FM radio and television sites around Australia. The work included coverage tests for many of the transmitters before and after the upgrading.

We have performed many hundreds of radio coverage surveys for a number of clients and have performed pre-construction and post-construction surveys for several projects. For some of these surveys we were engaged by the client to supervise rectification works where necessary and achieved these to the satisfaction of both the client and the residents of the areas.

Aitken & Partners have performed pre-construction surveys for wind farms at Gunning, Mortlake South, Mt Gellibrand, Woodlawn, Newfield, Tarago, Gullen Range, Cherry Tree, Crookwell 2 and Bodangora and have a well-defined process for this work. We have performed post-construction survey work for part of the Capital Wind Farm and for the Gunning Wind Farm.

The Aitken & Partners web site has some reference material on the effects of Wind Farms on television and radio reception. Please refer to jja.com.au.



1.4 RADIO AND TELEVISION SERVICE AREAS

The Australian Communications and Media Authority defines the licence areas and service areas for broadcast and television services. The defined areas are those in which the transmission from a licensed station must achieve a certain level and in which their transmissions will be protected from interference.

It is often the case that transmissions from stations outside the service area of a station will be heard clearly in another service area. This is considered fortuitous reception and it is not guaranteed. Similarly FM radio reception from distant stations may be available in areas where the terrain favours transmission. High areas often have reception from a number of FM radio stations and television stations that are not in the defined service area. This reception is not guaranteed and is not protected from interference.

The coverage information and coverage predictions provided by the ACMA have been used in this report, in conjunction with field surveys.

1.5 LOCAL RADIO AND TELEVISION SERVICES

1.5.1 Television

Television transmitters at Canberra, Goulburn and Bungendore provide television and radio coverage in the area surrounding the Collector Wind Farm.

Network	Channel	Network Owner	MHz	Polarisation
Canberra				
CTC	6	Southern Cross Austereo	177.5	Vertical
SBS	7	SBS	184.5	Vertical
ABC	8	ABC	191.5	Vertical
WIN	11	WIN	219.5	Vertical
CBN	12	Prime	226.5	Vertical
Goulburn				
SBS	40	SBS	613.5	Vertical
ABC	41	ABC	620.5	Vertical
CBN	42	Prime	627.5	Vertical
WIN	43	WIN	634.5	Vertical
CTC	44	Southern Cross Austereo	641.5	Vertical
Bungendore				
SBS	46	SBS	655.5	Vertical
ABC	47	ABC	662.5	Vertical
CBN	48	Prime	669.5	Vertical



Network	Channel	Network Owner	MHz	Polarisation
WIN	49	WIN	676.5	Vertical
CTC	50	Southern Cross Austereo	683.5	Vertical

Table 1 Local Television Frequencies

1.5.2 FM Radio

Since there are many FM and DAB radio stations, the sample of the stations listed below was chosen for measurement.

Call Sign	Area	Service	MHz
FM Radio			
1XXXR	Canberra		98.3
2ABCFM	Canberra	ABC Classic	102.3
1CBR	Canberra		106.3
2SNO	Goulburn/Illawarra		93.5
2ABCFM	Goulburn/Illawarra	ABC Classic	95.7
2JJJ	Goulburn/Illawarra	ABC JJJ	98.9
Digital Audio Broadcasting			
Canberra 1	Canberra	8D	201.072
Canberra 2	Canberra	9C	206.352
Test Broadcast	Canberra	10C	213.360

Table 2 Local DAB and FM Radio Frequencies

No transmissions were observed on DAB channel 8D. There was a test transmission on DAB channel 10C, so this was recorded in the measurements.

1.6 MEASUREMENT PARAMETERS

1.6.1 Television

Television and radio performance can be measured qualitatively and quantitatively. The qualitative assessment of performance is rather subjective, although there are published performance scales that seek to provide standardised assessments. For analogue television services these qualitative assessments are often very important as they identify the quality of the picture as seen by a viewer.

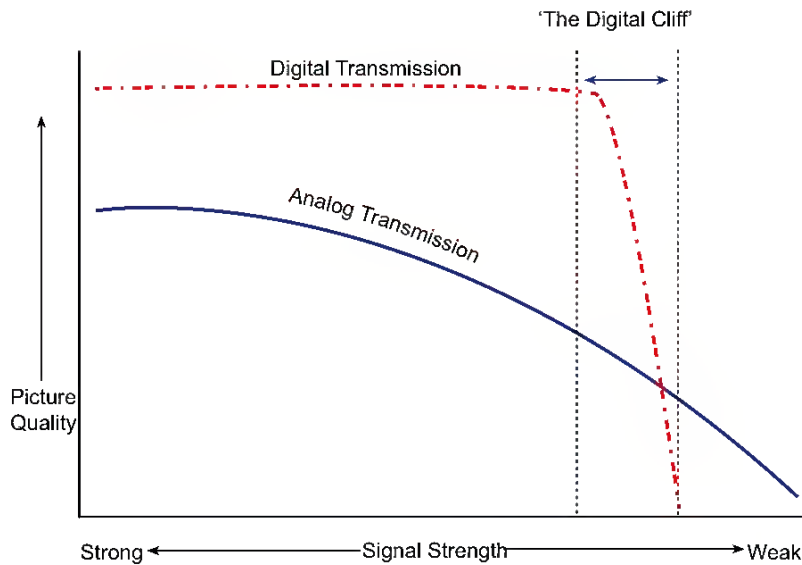


Figure 1 Transmission Quality and Signal Strength

Digital television has rather different characteristics. The transmission systems for digital television can correct for many of the imperfections that occur and deliver an image to the viewer that is of consistently high quality. The subjective rating of the picture is therefore of little benefit. There is a very small margin in signal between having a picture that is “pixellated” and one that is perfect. This is a consequence of the error correction and compensation systems used in digital transmission. The margin is often called the digital cliff and is illustrated in Figure 1¹.

Received Signal

Since qualitative assessment of digital television signals does not indicate the margin of safety in the received signal, some quantitative performance measurements have been developed. The first, as with virtually any system, is the amount of signal available - the received signal strength. This is usually measured as a voltage at the antenna terminals and is expressed in decibels above a reference level. In this report we have expressed the received signal in decibels above one microvolt or dB μ V. The larger the value, the stronger is the signal.

Bit Error Ratio (BER)

Digital signals are transmitted as a sequence of bits of information, which may be received correctly or in error. The ratio of good bits to bits that have errors is called the Bit Error Ratio or BER. The transmission systems include codes that make it possible to measure the BER before and after the television receiver attempts to correct errors. We have measured the bit error ratio for each digital television system where there was sufficient signal for a measurement. The measurement receiver identifies BER values between 1E-1 (unusable) and 1E-7 (excellent). A BER of better than 2E-4 is required for reliable reception¹.

Modulation Error Ratio (MER)

The modulation error ratio takes a further parameter into account to determine the overall quality of the received signal. It includes a measure of the signal to noise ratio

¹ From Digital TV - Antennas for Homes. Australian Government Department of Broadband, Communications and the Digital Economy, Digital Switchover Taskforce. March 2009.



of the digital signal. An MER of better than 25 dB is required for robust reception (with a BER of better than $2E-6$). An MER of 25 dB with a BER of better than $2E-7$ is preferred¹.

1.6.2 FM Radio

FM radio reception in the area surrounding the wind farm is available from a number of radio stations and locations. The quality of reception and stations available varies throughout the area, depending on the strength of the radio transmitter, distance, terrain and the quality of the receiving antenna.

The signal strength of FM radio signals is the primary performance measurement. FM signals may be affected by multipath reflections under some circumstances and AM signals are particularly vulnerable to electrical interference. In this report we have identified the received signal level for FM signals in dB μ V.

1.6.3 Digital Audio Broadcasting

Digital audio broadcasting (DAB) is available from the Canberra transmission site on one of the two identified channels. Both channels 8D and 9C were measured. At some locations a test transmission was observed on channel 10B.

The DAB measurements show the received signal level for each channel, along with the signal to noise ratio and error rate. The signal to noise ratio in dB is shown in the “MER” column in the tables.

1.6.4 AM Radio

AM radio reception is not affected by wind farms because the wavelength of the medium frequency AM transmissions is very much larger than the dimensions of a turbine. No evidence of interference to AM radio reception has been seen in previous studies so AM radio has been excluded from this survey.

1.7 INTERFERENCE MITIGATION TECHNIQUES

Radio and television signals have some very similar characteristics to light. A light bulb will radiate energy equally in all directions unless a reflector and/or lens is used to concentrate the light into a narrow beam.

The same is true of antennas for radio and television: they can be *omnidirectional* (radiating or receiving equally in all directions) or *directional* (radiating or receiving in a particular direction).

A characteristic of radio and television signals that is very similar to light is their ability to be reflected and diffracted. Large conducting surfaces can act like mirrors for radio frequency energy. The receiver will then receive the direct signal from the transmitter and one or more reflected signals. Since the reflected signals have further to travel than the direct signals, they will arrive later than the direct signals, interfering with the original signal. On analogue television systems the reflected signals appear as “ghosts” in the picture. Digital television is more resilient and can tolerate some reflections without any impairment of the picture and sound. However, there are limits to what can be managed and in some areas aircraft flying overhead can reflect sufficient energy to cause the picture to be distorted or lost.



Directional Antennas



A good quality television antenna installation uses a directional antenna that is focused on the transmitting antenna. The directional receiving antenna provides increased energy from the wanted transmitter and reduced energy from unwanted reflections, improving the overall quality of reception.

The antenna in this picture is very directional. The energy is focused by the numerous

elements at the front of the antenna.

To improve directionality and minimise the sensitivity of the antenna to signals from the rear of the antenna there is a reflector at the rear of the antenna (close to the support pole).

Panel Antenna



This type of antenna has a high “gain” as the signal received from this antenna is much higher than the signal from an omnidirectional antenna. It has a good “front to back ratio” because the signal received from the front of the antenna is very much higher than that from the back of the antenna.

The antenna pictured on the left is a set of four antennas connected together to make the antenna very directional. The screen panel at the back of the antenna improves the front-to-back ratio as well as acting as a reflector.

Good installation practice includes keeping the antenna clear from other nearby antennas and reflecting surfaces.



Measurements



2. MEASUREMENTS

2.1 GENERAL COMMENTS

The objective of the pre-construction tests was to establish a baseline of reception at a representative sample of residences within 5 km of any turbine. The method used gives consistency in measurement and provides a reliable reference for comparison after construction has been completed.

2.2 TEST EQUIPMENT

The VHF television measurements (Canberra) were performed with a Kingray KVHFY4 yagi antenna. This four element antenna has 9.5 dB gain and a 15 dB front to back ratio. The antenna was connected to a masthead amplifier, a GME Kingray model MHW35FS. The overall antenna system gain was 33 dB \pm 3 dB overall² and was 30 dB at Channel 6 and 36 dB at Channel 12.

The UHF television measurements were performed with a 12.5 dB gain panel television antenna. The antenna was connected to a masthead amplifier, a GME Kingray model MHW35FS.

The antennas were mounted at approximately 3.5 m above ground level on a tripod for the tests. The antenna system gain was 40 dB \pm 3 dB overall³ and was 43 dB at Channel 34 and 38 dB at Channel 51.

The measurements shown in this report are what was actually measured from the antenna system and are not corrected for antenna factor, feeder loss or amplifier gain. The antenna was used with appropriate polarisation for the measured signal.

Television and FM radio measurements were made with a Promax Prolink – 4C digital television and satellite test receiver and analyser. This instrument provides signal strength, BER and MER data for digital signals.

A short whip antenna on the roof of the test vehicle was used for FM radio reception.

2.3 TEST LOCATIONS

The test locations were all on public land, at locations selected to provide a representative sample of the reception in the area surrounding the wind farm. The locations around Collector are shown in detail in Figure 2, with the overall locations shown in Figure 3.

The UHF and FM radio measurements were performed on 8, 9 and 10 December 2018. The VHF and DAB radio measurements were performed on 23 January 2019.

For each measurement location the ACMA coverage predictions have been obtained and these are presented along with the measurement results. In most cases the coverage from Canberra was less than predicted, while the coverage from Bungendore was greater than predicted.

A map extract showing the relationship of the measurement site, transmitter locations and turbines is provided for each measurement location.

² The antenna is assumed to have the claimed 7.5 dB gain throughout the frequency range.

³ The antenna is assumed to have the claimed 12.5 dB gain throughout the frequency range.

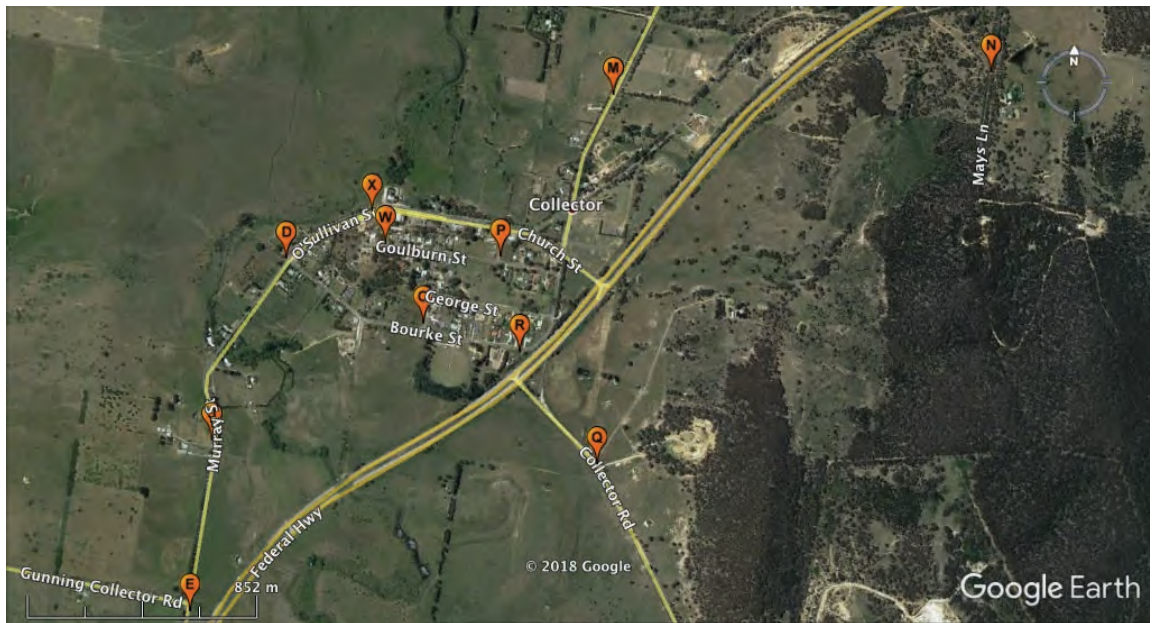
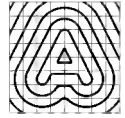


Figure 2 Test locations at Collector

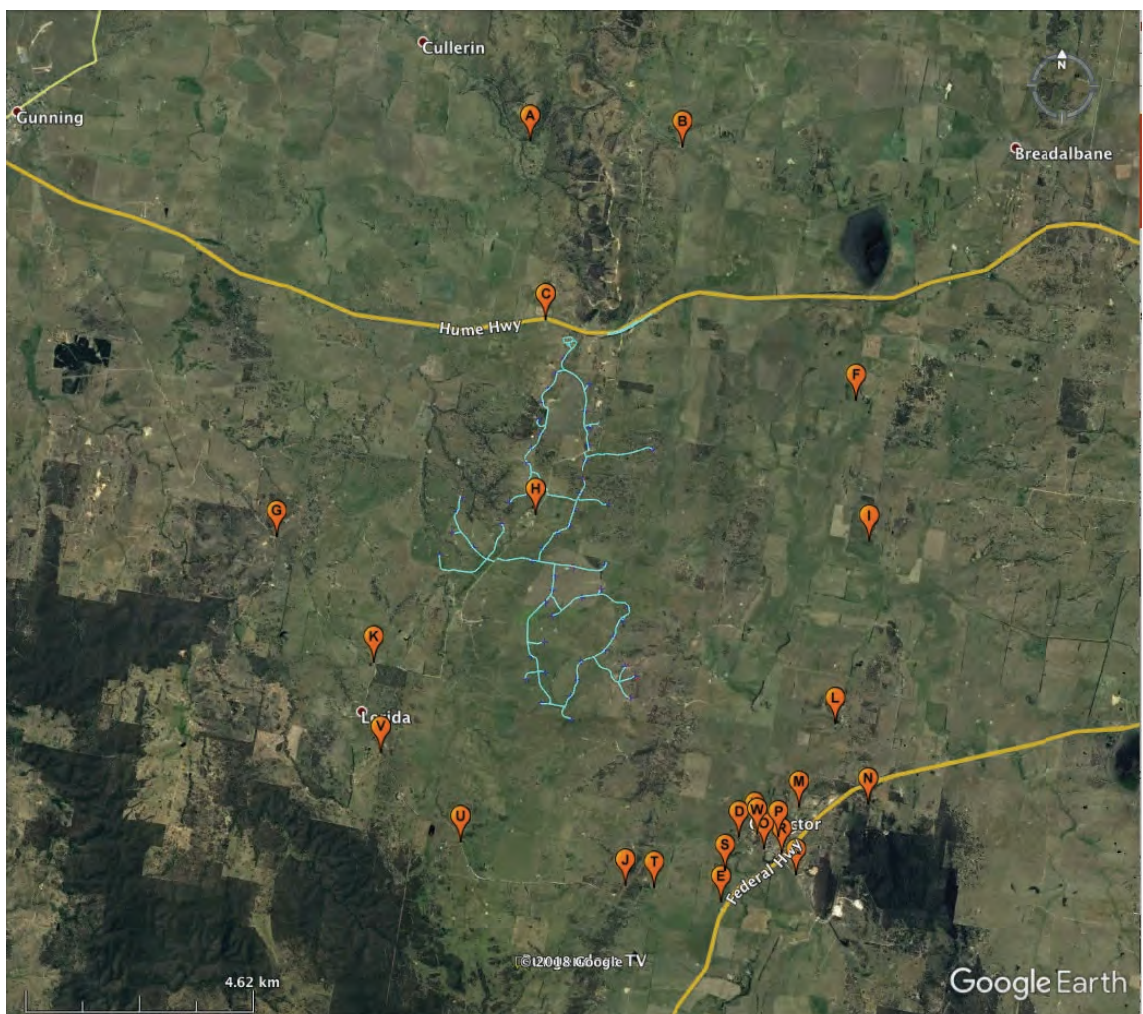


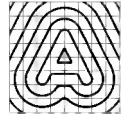
Figure 3 Overview of test locations



2.4 SUMMARY OF RESULTS

Location	Transmitter	Reception	Affected by Wind Farm?
A	Canberra Goulburn	Variable	Possibly No
B	-	-	-
C	Canberra	Good	Yes
D	Canberra Bungendore	Good	No
E	Bungendore	Good	No
F	Canberra Bungendore	Variable	Possibly
G	Canberra	Good	No
H	Canberra	Good	Yes
I	Bungendore	Good	Possibly
J	Bungendore Goulburn	Good	No
K	Goulburn	Poor	Yes
L	Bungendore	Good	No
M	Bungendore	Good	No
N	Bungendore	Good	No
O	Bungendore	Good	No
P	Bungendore	Good	No
Q	Canberra Bungendore	Variable	No
R	Bungendore	Good	No
S	Bungendore	Good	No
T	Canberra	Good	No
U	Bungendore	Good	No
V	Canberra	Variable	No
W	Bungendore	Variable	No
X	Bungendore	Good	No

Table 3 - Summary of observations



2.5 LOCATION A

This location is at Old South Road, Cullerin.

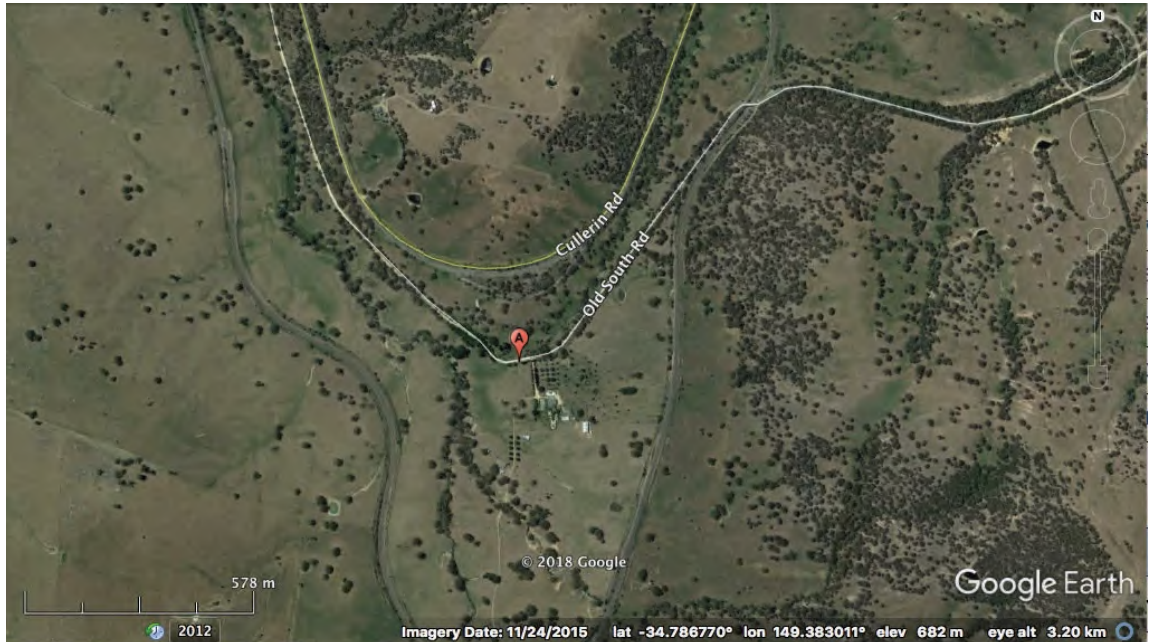


Figure 4 Location A



Figure 5 Test Site - Location A – looking towards Canberra



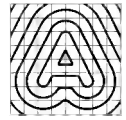
2.5.1 Television and Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	67	29	<1E-7	
SBS	7	63	25	5E-6	
ABC	8	61	24	4E-7	Varies
WIN	11	62	19	3E-3	
CBN	12	66	21	5E-5	
DAB 1	9C	48	16	<1E-3	Varies
DAB 2	10B	57	20	-	Varies
Goulburn					
SBS	40	71	25	<1E-7	
ABC	41	69	24	2E-6	
CBN	42	63	18.5	>1E-1	
WIN	43	64	20	5E-3	
CTC	44	62	17	>1E-1	
Bungendore					
SBS	46	48	-	>1E-1	
ABC	47	45	-	>1E-1	
CBN	48	43	-	>1E-1	
WIN	49	43	-	>1E-1	
CTC	50	44	-	>1E-1	

Table 4 Television & DAB Reception - Location A

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXRX	98.3	8	2SNO	93.5	38
2ABCFM	102.3	16	2ABCFM	95.7	6
1CBR	106.3	8	2JJJ	98.9	13

Table 5 FM Radio – Location A



2.5.2 Observations

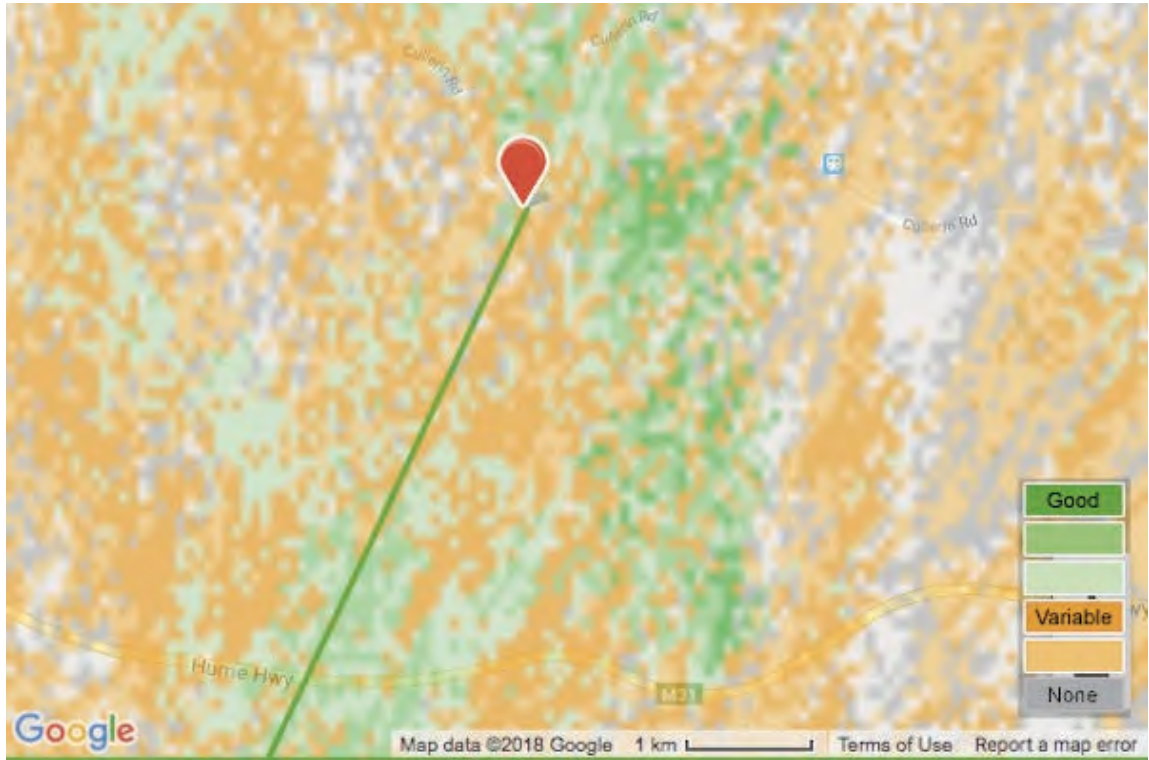


Figure 6 Location A - Predicted coverage

The ACMA coverage predictions for this site show good coverage from Canberra and no predicted coverage from any other site. The measurements on site showed variable coverage from Canberra and variable coverage from Goulburn.

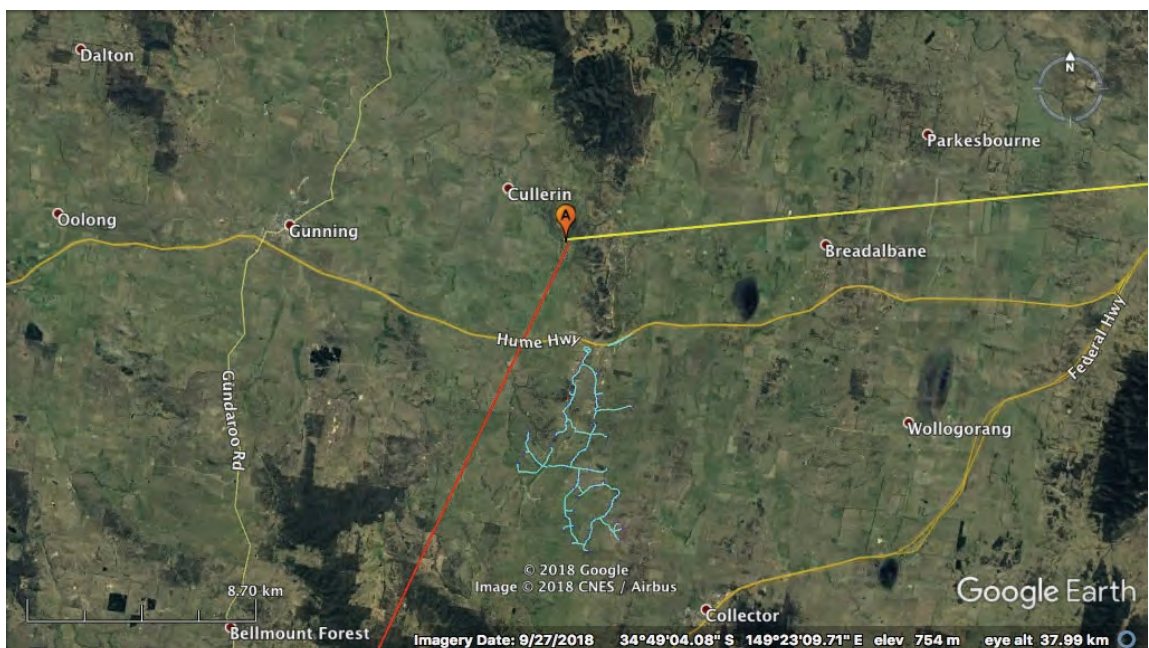


Figure 7 Location A - relationship to turbine locations

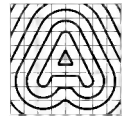


The path to the Canberra transmitters is shown in red and the path to the Goulburn transmitters is shown in yellow. This path may be affected by reflections from the turbines.

The Goulburn path is well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	60 km	205°	Variable	Possibly
Goulburn	35 km	85°	Variable	No
Bungendore	-	-	-	-

Table 6 - Summary of observations for Location A



2.6 LOCATION B

This location is at Fairview, 322 Cullerin Road, Cullerin.



Figure 8 Location B



Figure 9 Test Site - Location B looking towards Canberra



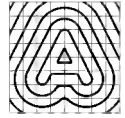
2.6.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	66	-	>1E-1	Varies
SBS	7	59	-	>1E-1	Varies
ABC	8	57	-	>1E-1	Varies
WIN	11	60	-	>1E-1	Varies
CBN	12	60	-	>1E-1	Varies
DAB 1	9C	50	12	4E-2	Varies
DAB 2	10B	44	-	-	Varies
Goulburn					
SBS	40	53	-	>1E-1	
ABC	41	53	-	>1E-1	
CBN	42	50	-	>1E-1	
WIN	43	46	-	>1E-1	
CTC	44	50	-	>1E-1	
Bungendore					
SBS	46	-	-	-	
ABC	47	-	-	-	
CBN	48	-	-	-	
WIN	49	-	-	-	
CTC	50	-	-	-	

Table 7 Television & DAB Reception - Location B

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	12	2SNO	93.5	27
2ABCFM	102.3	23	2ABCFM	95.7	9
1CBR	106.3	24	2JJJ	98.9	8

Table 8 FM Radio – Location B



2.6.2 Observations

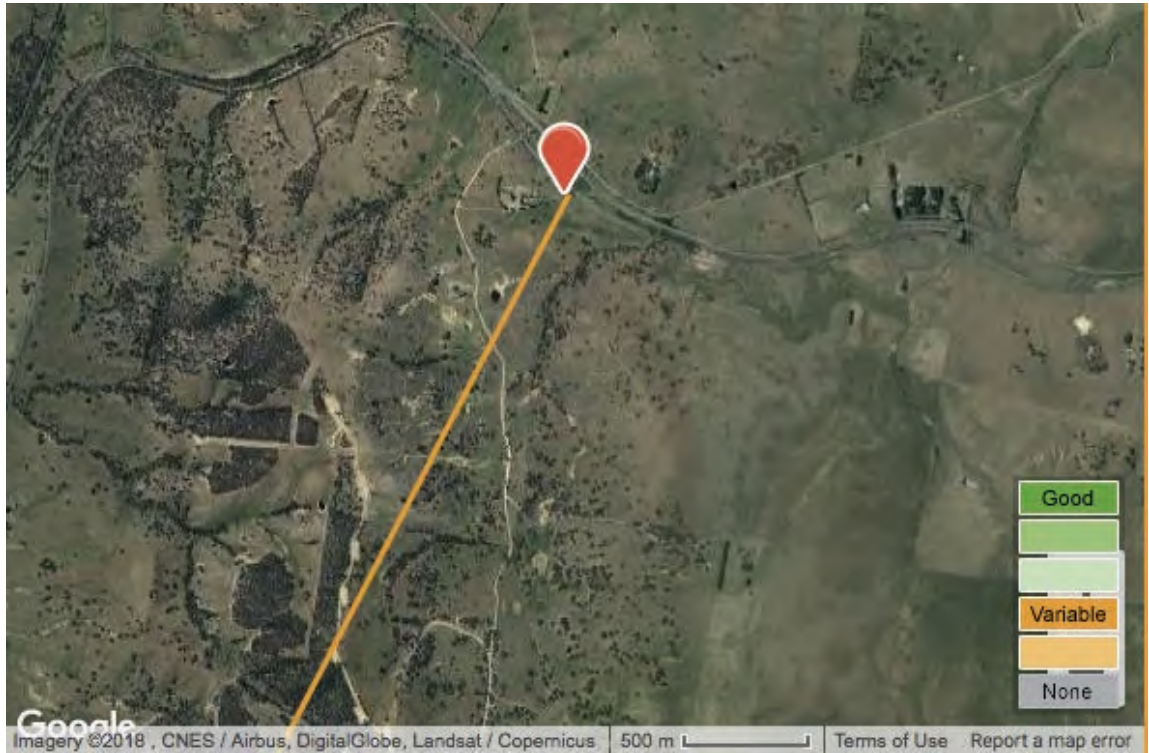


Figure 10 Location B - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Goulburn. There is no usable coverage at the test location.

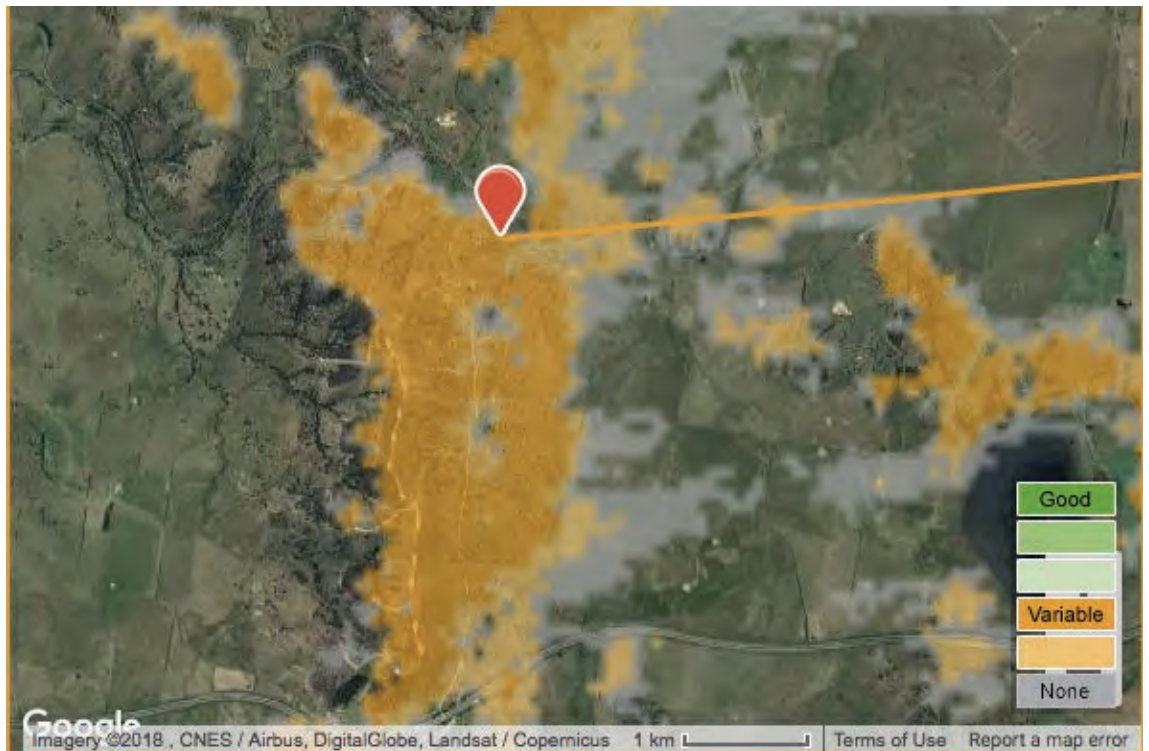


Figure 11 Location B - Predicted coverage from Goulburn

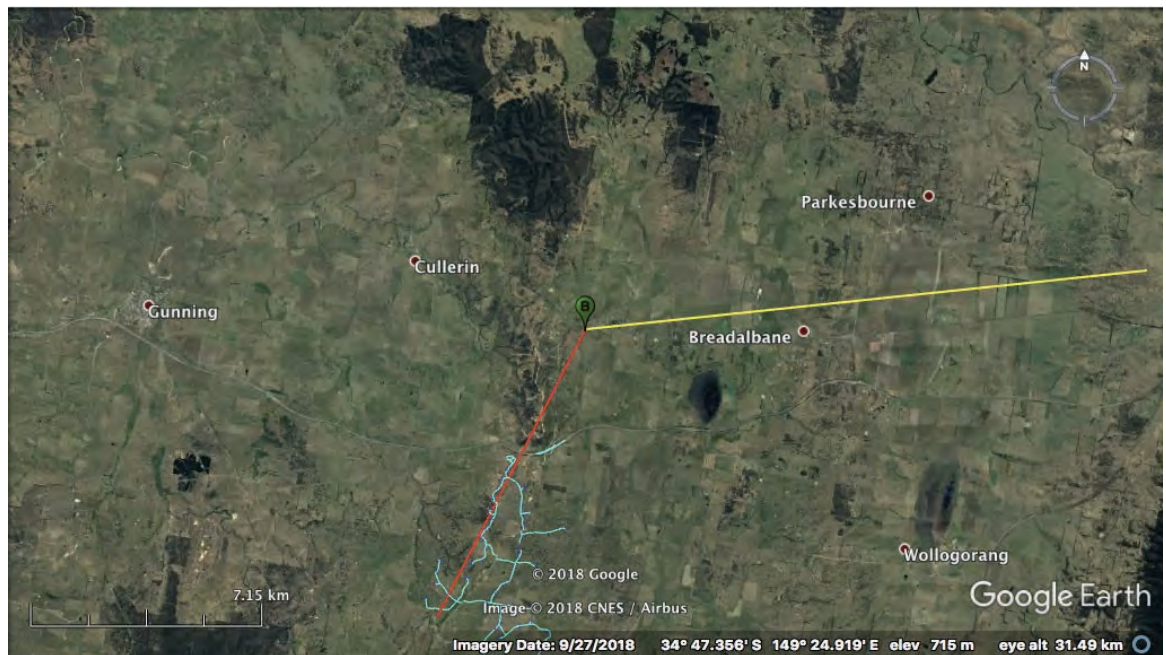
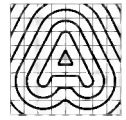


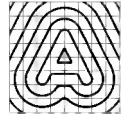
Figure 12 Location B - relationship to turbine locations

The path to the Canberra transmitters is shown in red. This path passes through the wind farm so it is likely that there would be impairment of television reception.

The path to the Goulburn transmitters is shown in yellow. This path is well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	61 km	207°	Unusable	Yes
Goulburn	33 km	84°	Unusable	No
Bungendore	-	-	-	-

Table 9 - Summary of observations for Location B



2.7 LOCATION C

This location is at 21827 Hume Highway, Cullerin.

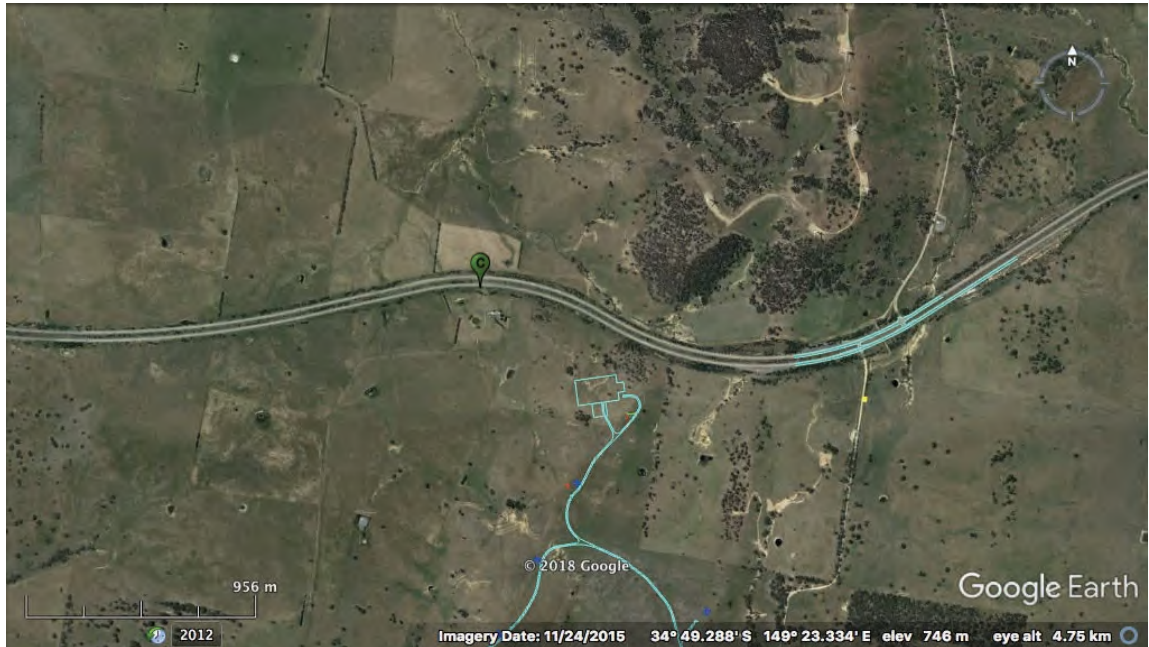


Figure 13 Location C



Figure 14 Test Site - Location C



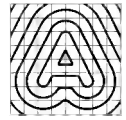
2.7.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	70	30	<1E-7	
SBS	7	68	30	<1E-7	
ABC	8	64	26	<1E-7	
WIN	11	70	29	<1E-7	
CBN	12	72	26	<1E-7	
DAB 1	9C	61	24	<1E-3	
DAB 2	10B	57	24	<1E-3	
Goulburn					
SBS	40	54 – 61	0 to 17	>1E-1	Nearby turbines operating
ABC	41	55 – 62	-	>1E-1	Nearby turbines operating
CBN	42	51 – 60	-	>1E-1	Nearby turbines operating
WIN	43	53 – 58	Varies	>1E-1	Nearby turbines operating
CTC	44	51 – 58	Varies	>1E-1	Nearby turbines operating
Bungendore					
SBS	46	-	-	-	
ABC	47	-	-	-	
CBN	48	-	-	-	
WIN	49	-	-	-	
CTC	50	-	-	-	

Table 10 Television & DAB Reception - Location C

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	9	2SNO	93.5	26 – 32
2ABCFM	102.3	15 – 20	2ABCFM	95.7	7
1CBR	106.3	18	2JJJ	98.9	11

Table 11 FM Radio – Location C



2.7.2 Observations

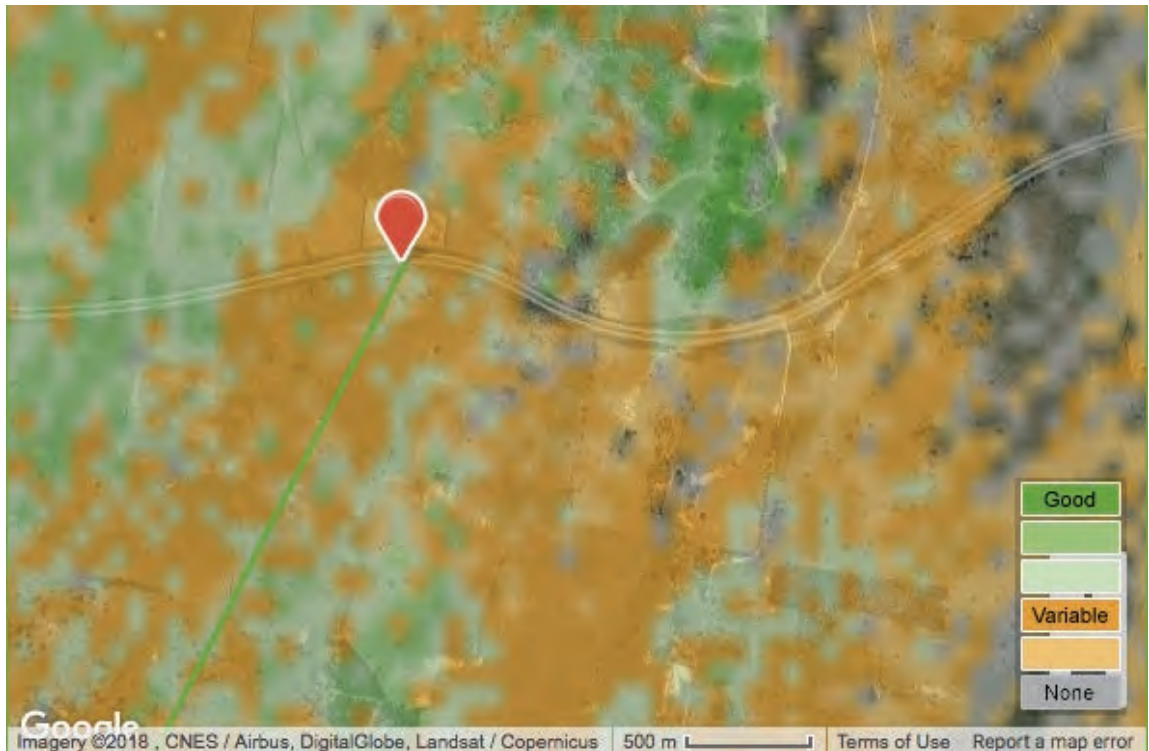


Figure 15 Location C - Predicted coverage

The ACMA coverage predictions for this site show good to variable coverage from Canberra. The measurements at the site showed good signal from Canberra and poor coverage from Goulburn.

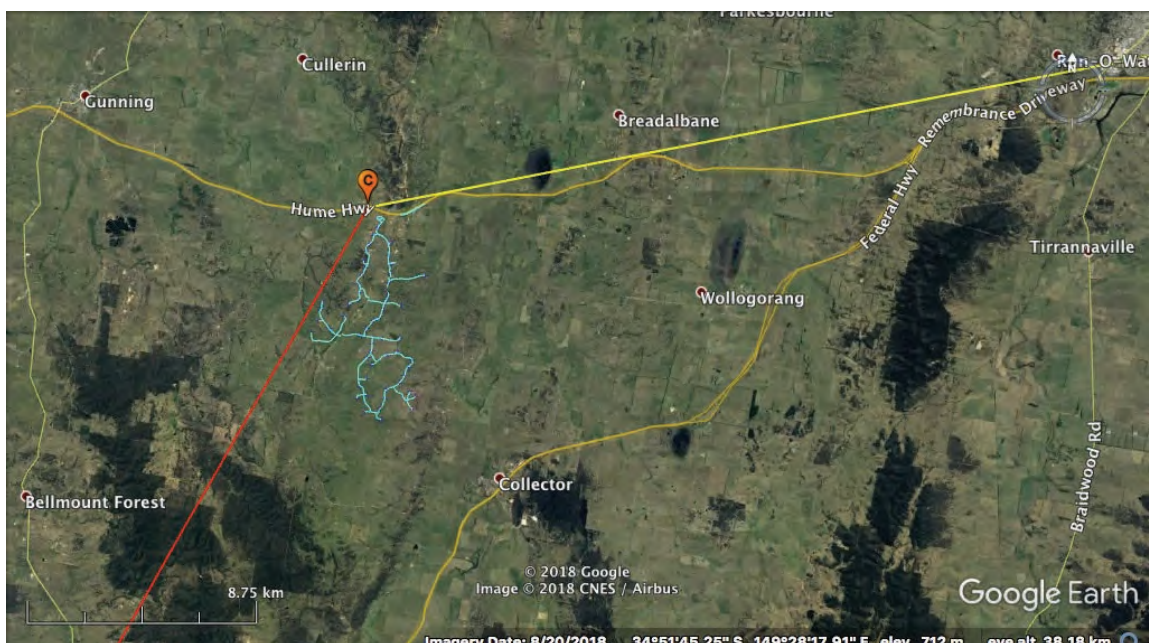


Figure 16 Location C - relationship to turbine locations

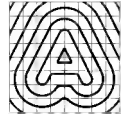
The path to the Canberra transmitters is shown in red. This path is very close to the wind farm is likely to be affected by reflections from the turbines. The path to



Goulburn, shown in yellow, should not be affected by the Collector Wind Farm but is already affected by other wind farms in the area.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	57 km	207°	Good	Yes
Goulburn	35 km	79°	Poor	Affected by existing wind farms
Bungendore	-	-	-	-

Table 12 - Summary of observations for Location C



2.8 LOCATION D

This location is at the corner of Collector Road and Bourke Street, Collector.

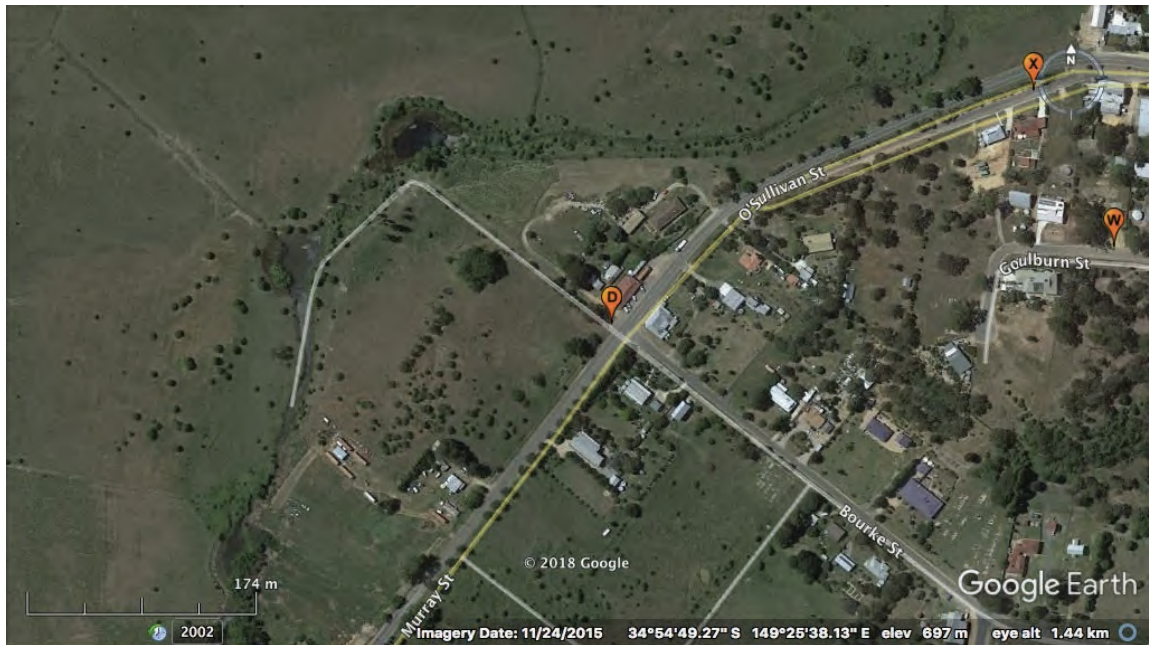


Figure 17 Location D



Figure 18 Test Site - Location D



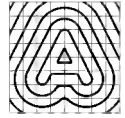
2.8.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	75	34	<1E-7	
SBS	7	70	24	<1E-7	
ABC	8	70	20	1E-3	
WIN	11	78	30	<1E-7	
CBN	12	83	34	<1E-7	
DAB 1	9C	73	25	<1E-3	
DAB 2	10B	66	25	<1E-3	
Goulburn					
SBS	40	48	-	>1E-1	
ABC	41	48	-	>1E-1	
CBN	42	51	-	>1E-1	
WIN	43	50	-	>1E-1	
CTC	44	51	-	>1E-1	
Bungendore					
SBS	46	90	31	<1E-7	
ABC	47	89	30	<1E-7	
CBN	48	86	26	<1E-7	
WIN	49	87	30	<1E-7	
CTC	50	88	33	<1E-7	

Table 13 Television & DAB Reception - Location D

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	15	2SNO	93.5	30
2ABCFM	102.3	26	2ABCFM	95.7	6
1CBR	106.3	18	2JJJ	98.9	6

Table 14 FM Radio – Location D



2.8.2 Observations



Figure 19 Location D - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. The measurements showed variable coverage from Canberra and good coverage from Bungendore.



Figure 20 Location D - Predicted coverage from Bungendore

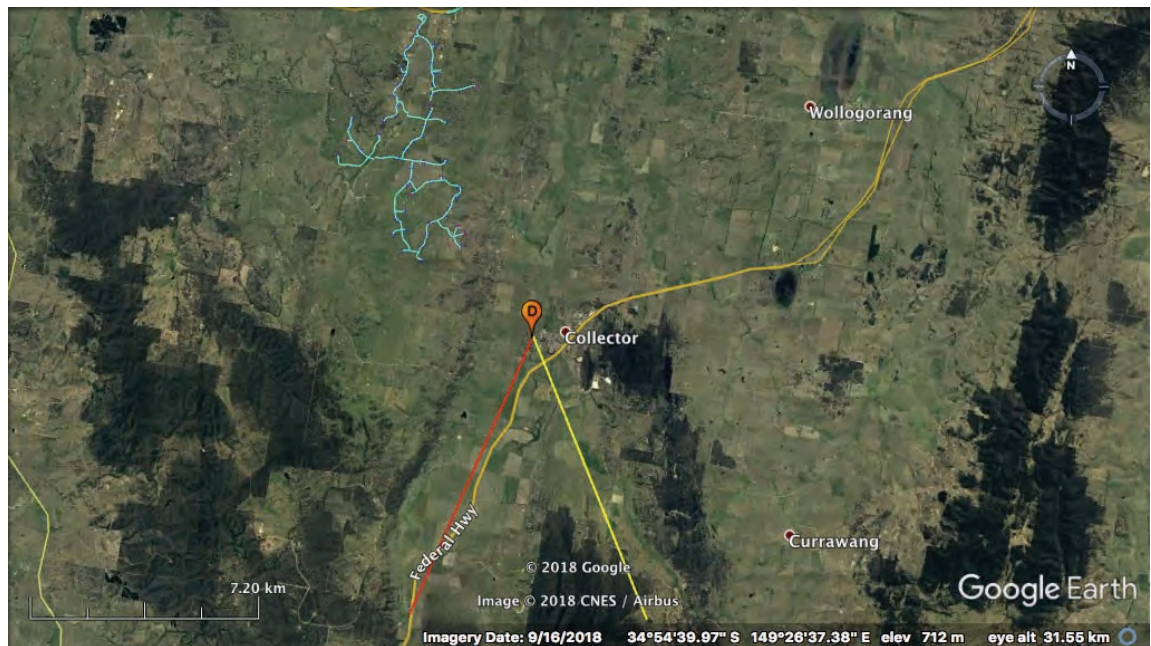
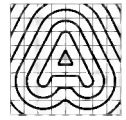
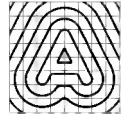


Figure 21 Location D - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to the Bungendore transmitters is shown in yellow. Both paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	50 km	217°	Variable	No
Goulburn	-	-	-	-
Bungendore	5 km	244°	Good	No

Table 15 - Summary of observations for Location D



2.9 LOCATION E

This location is at the corner of Murray Street and Gunning-Collector Road, Collector.

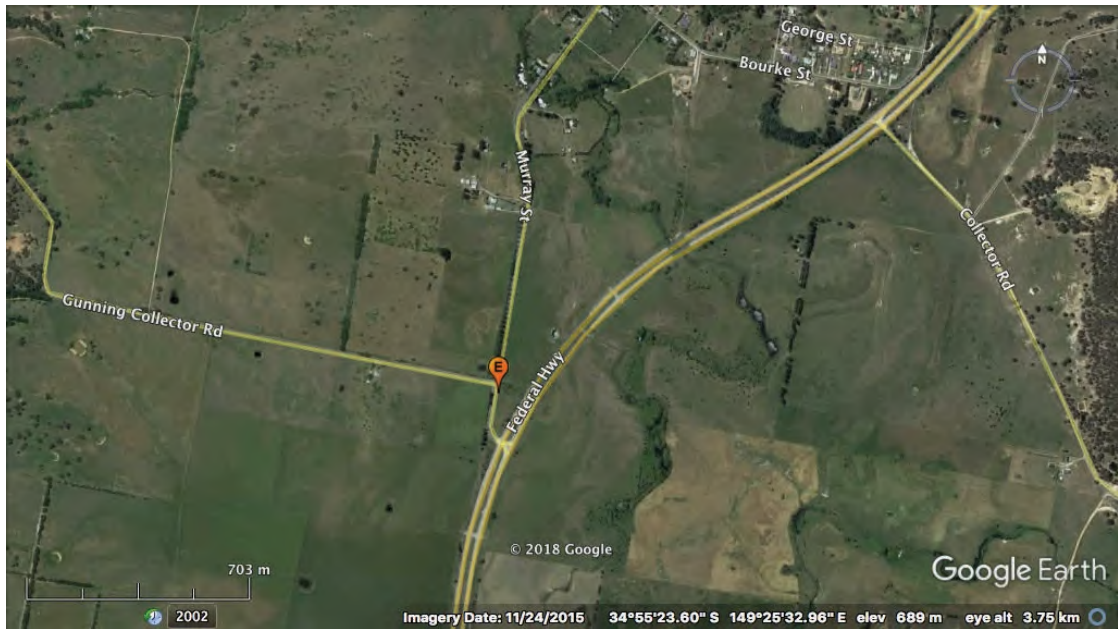


Figure 22 Location E



Figure 23 Test Site - Location E



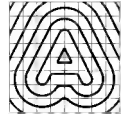
2.9.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	77	28	<1E-7	
SBS	7	76	26	<1E-7	
ABC	8	77	27	<1E-7	
WIN	11	79	29	<1E-7	
CBN	12	83	34	<1E-7	
DAB 1	9C	70	>25	<1E-3	
DAB 2	10B	65	23	<1E-3	
Goulburn					
SBS	40	47	-	>1E-1	
ABC	41	47	-	>1E-1	
CBN	42	47	-	>1E-1	
WIN	43	45	-	>1E-1	
CTC	44	48	-	>1E-1	
Bungendore					
SBS	46	87	28	<1E-7	
ABC	47	85	26	<1E-7	
CBN	48	83	24	<1E-7	
WIN	49	87	28	<1E-7	
CTC	50	87	29	<1E-7	

Table 16 Television & DAB Reception - Location E

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	14	2SNO	93.5	24
2ABCFM	102.3	23	2ABCFM	95.7	15
1CBR	106.3	23	2JJJ	98.9	17

Table 17 FM Radio – Location E



2.9.2 Observations

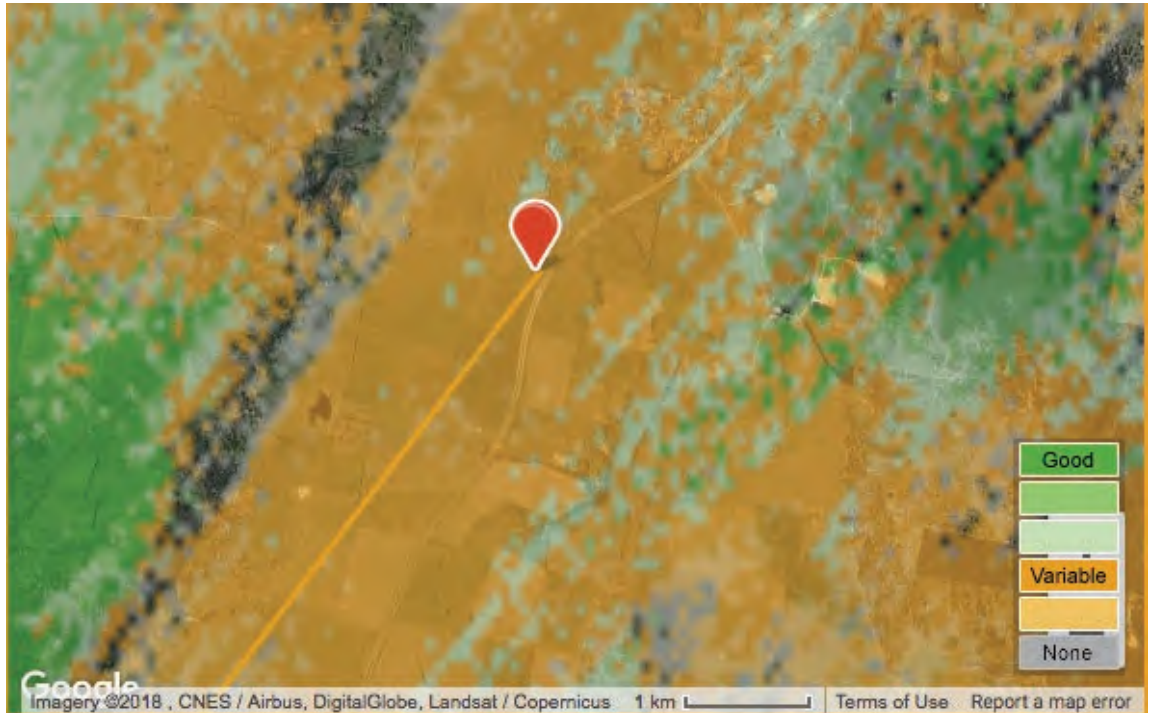


Figure 24 Location E - Predicted coverage from Canberra

The ACMA coverage prediction for this site shows variable coverage from Canberra and Bungendore. The measurements showed good coverage from Canberra and Bungendore.



Figure 25 Location E - Predicted coverage from Bungendore

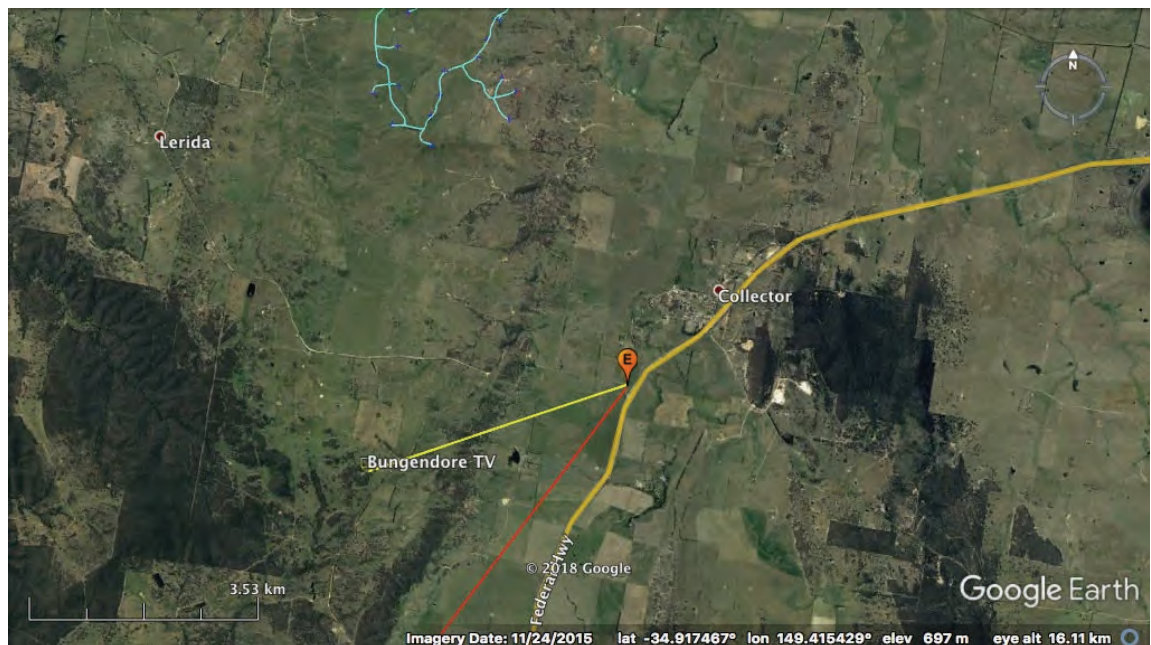
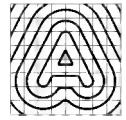
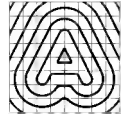


Figure 26 Location E - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to the Bungendore transmitters is shown in yellow. Both paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	49 km	217°	Good	No
Goulburn	-	-	-	No
Bungendore	4 km	252°	Good	No

Table 18 - Summary of observations for Location E



2.10 LOCATION F

This location is at Maryfield, 978 – 980 Breadalbane Road, Collector.

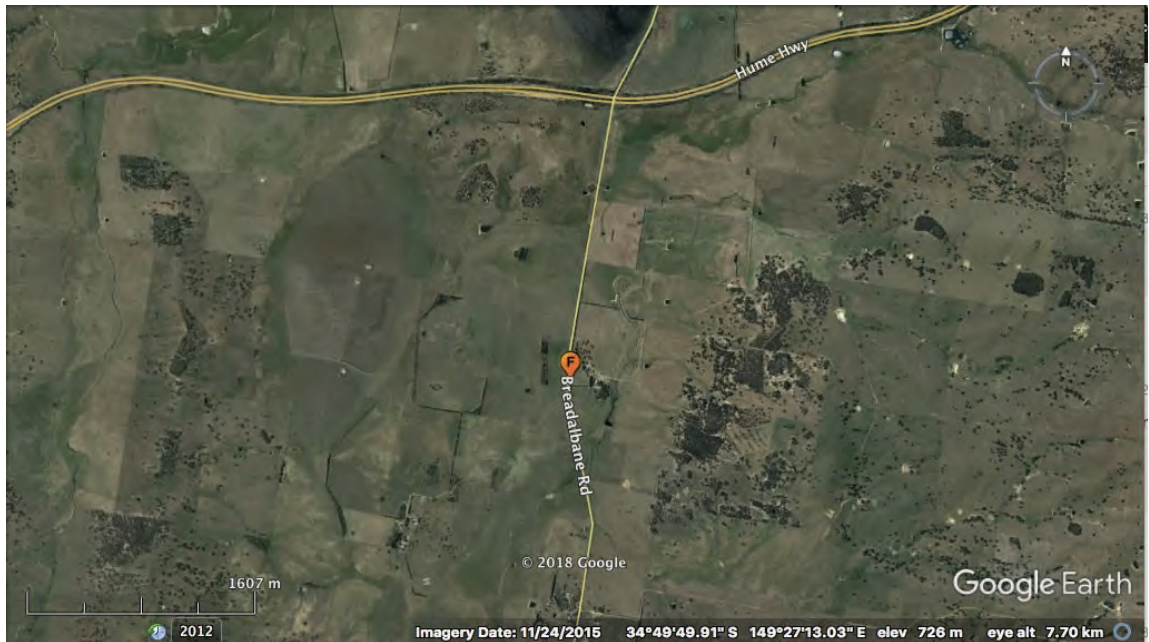


Figure 27 Location F



Figure 28 Test Site - Location F



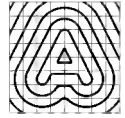
2.10.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	86	34	<1E-7	
SBS	7	82	20	7E-4	
ABC	8	80	17	>1E-1	
WIN	11	84	33	<1E-7	
CBN	12	88	34	<1E-7	
DAB 1	9C	76	>25	<1E-3	
DAB 2	10B	73	21	<1E-3	
Goulburn					
SBS	40	46	-	>1E-1	
ABC	41	44	-	>1E-1	
CBN	42	44	-	>1E-1	
WIN	43	44	-	>1E-1	
CTC	44	45	-	>1E-1	
Bungendore					
SBS	46	81	29	<1E-7	
ABC	47	80	27	<1E-7	
CBN	48	79	26	1E-6	Varies
WIN	49	79	27	3E-6	Varies
CTC	50	80	27	<1E-7	Varies

Table 19 Television & DAB Reception - Location F

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	9	2SNO	93.5	27
2ABCFM	102.3	23	2ABCFM	95.7	6
1CBR	106.3	22	2JJJ	98.9	6

Table 20 FM Radio – Location F



2.10.2 Observations

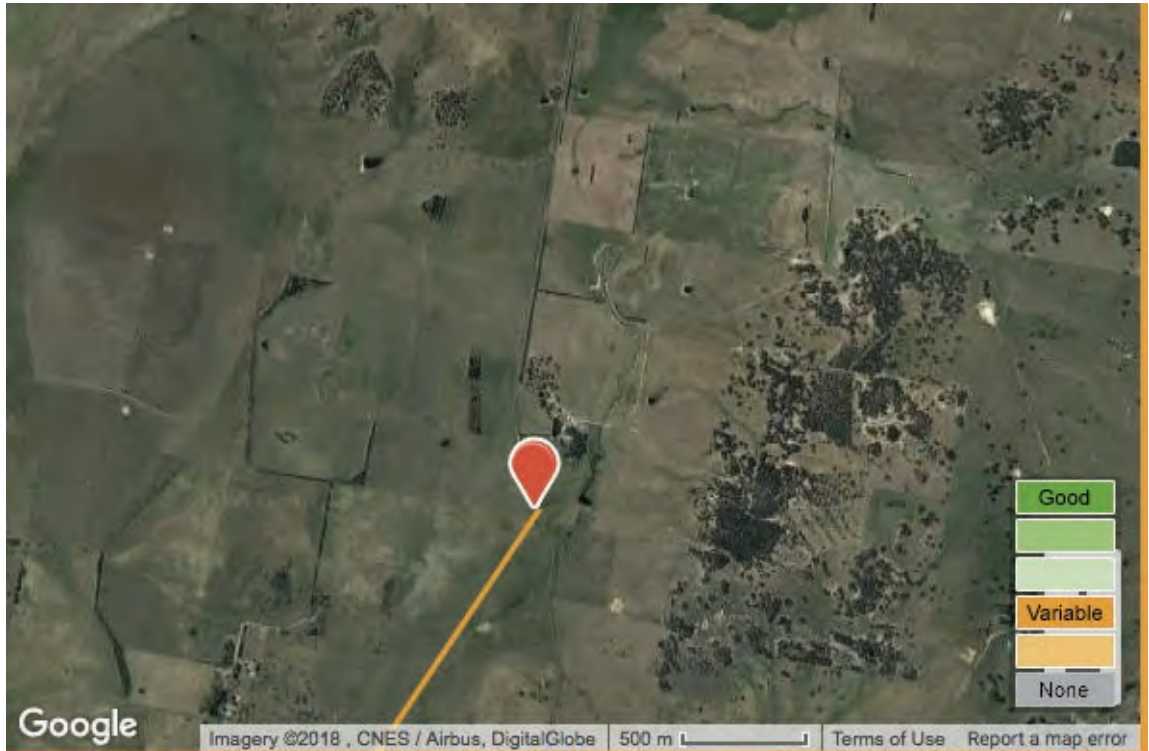


Figure 29 Location F - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. The measurements for Canberra and Bungendore were consistent with these predictions.

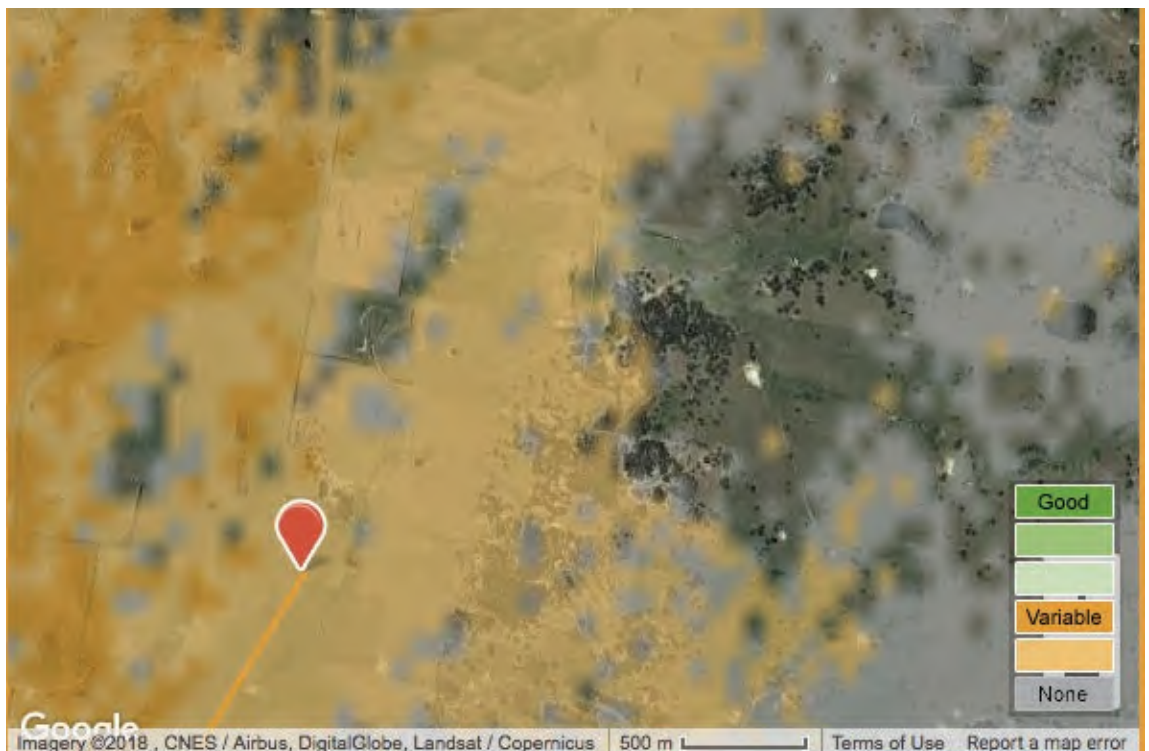


Figure 30 Location F - Predicted coverage from Bungendore

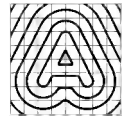
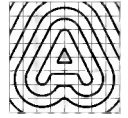


Figure 31 Location F - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to the Bungendore transmitters is shown in yellow. Both paths pass close to the wind farm so there is potential for interference with reception at this location.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	59 km	214°	Variable	Possibly
Goulburn	-	-	-	-
Bungendore	13 km	211°	Variable	Possibly

Table 21 - Summary of observations for Location F



2.11 LOCATION G

This location is at 1058 Collector Road, Gunning.

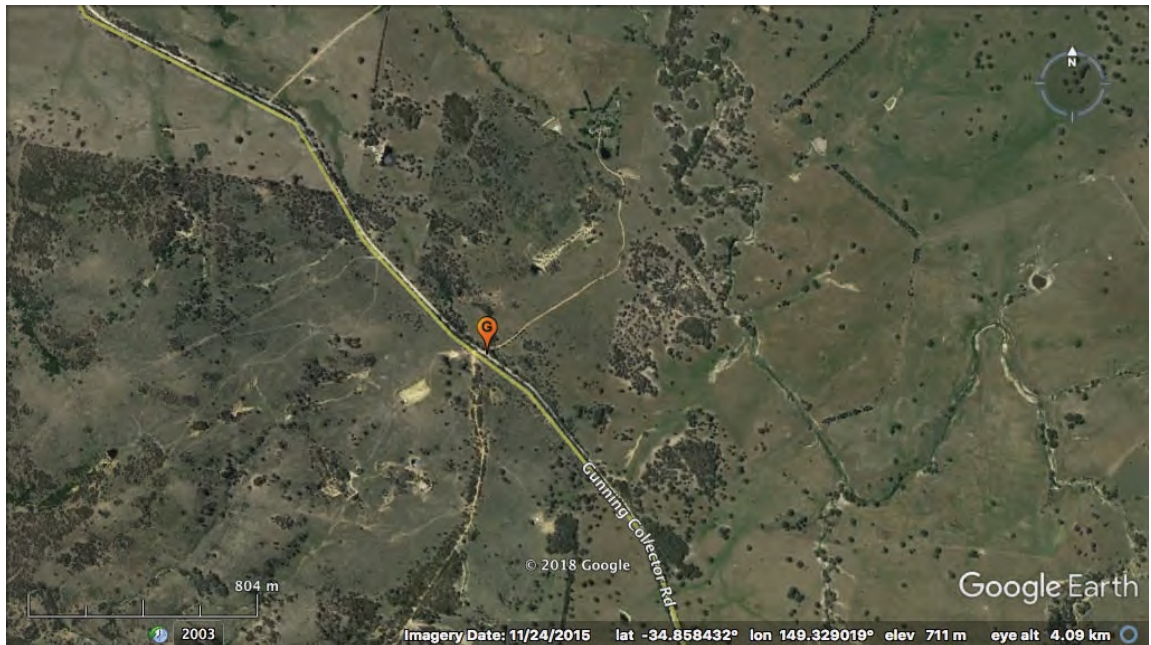


Figure 32 Location G



Figure 33 Test Site - Location G



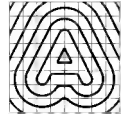
2.11.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	79	34	<1E-7	
SBS	7	75	31	<1E-7	
ABC	8	70	30	<1E-7	
WIN	11	71	29	<1E-7	
CBN	12	73	28	<1E-7	
DAB 1	9C	66	>25	<1E-3	
DAB 2	10B	61	25	<1E-3	
Goulburn					
SBS	40	49 – 52	-	>1E-1	
ABC	41	50	-	>1E-1	
CBN	42	49	-	>1E-1	
WIN	43	48	-	>1E-1	
CTC	44	50	-	>1E-1	
Bungendore					
SBS	46	-	-	-	
ABC	47	-	-	-	
CBN	48	-	-	-	
WIN	49	-	-	-	
CTC	50	-	-	-	

Table 22 Television & DAB Reception - Location G

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXRX	98.3	9	2SNO	93.5	20
2ABCFM	102.3	12	2ABCFM	95.7	7
1CBR	106.3	11	2JJJ	98.9	7

Table 23 FM Radio – Location G



2.11.2 Observations



Figure 34 Location G - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra. The measurements showed good coverage from Canberra and unusable coverage from Goulburn.

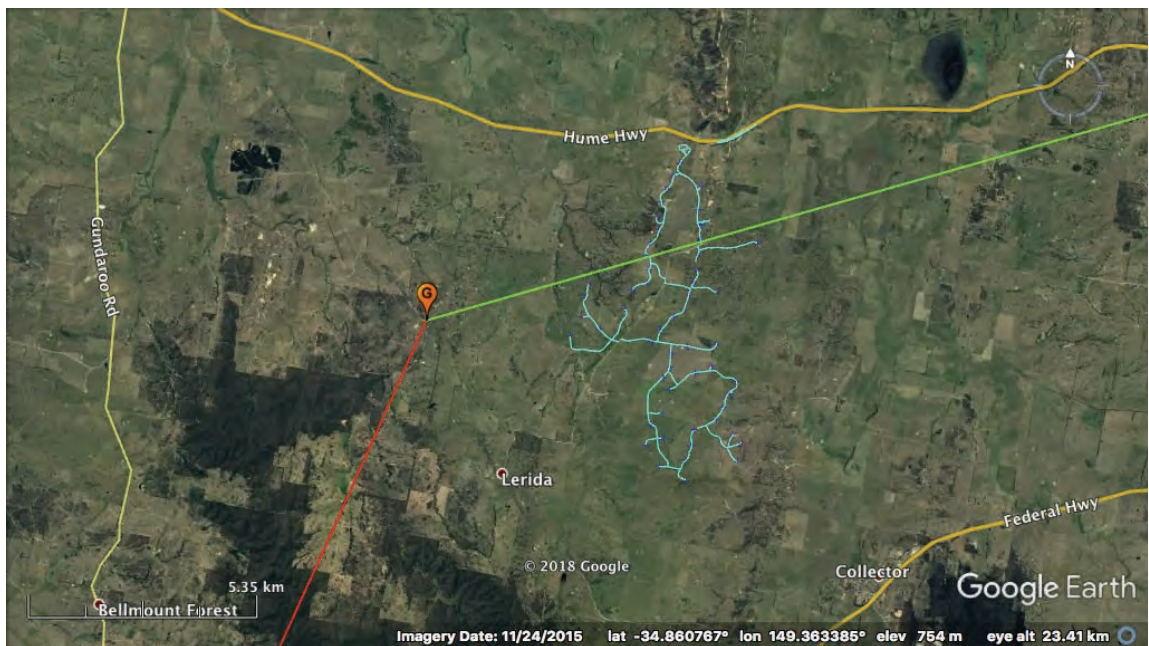


Figure 35 Location G - relationship to turbine locations

The path to the Canberra transmitters is shown in red. This path is well removed from the turbines and there should not be any interference with reception if an appropriate



television antenna is used. The path to Goulburn is shown in green. This path passes through the wind farm and is likely to be affected by the turbines.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	51 km	204°	Good	No
Goulburn	42 km	74°	-	Yes
Bungendore	-	-	-	-

Table 24 - Summary of observations for Location G



2.12 LOCATION H

This location is at Wood Park, Lerida Road South, Lerida.

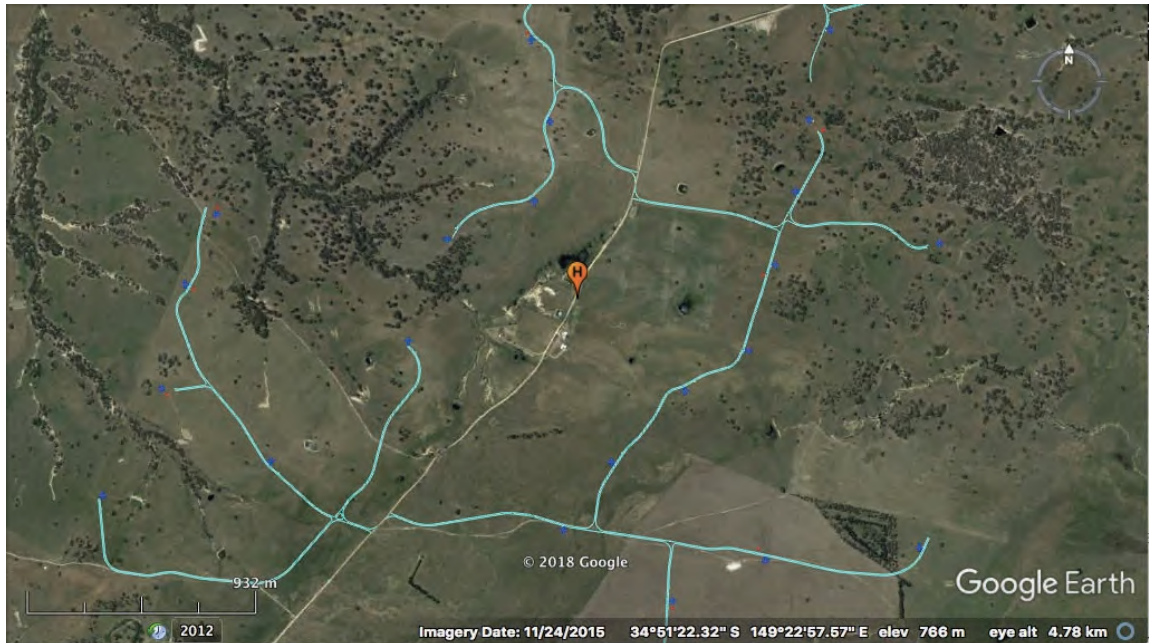


Figure 36 Location H



Figure 37 Test Site - Location H



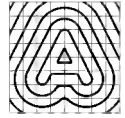
2.12.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	74	32	<1E-7	
SBS	7	71	30	<1E-7	
ABC	8	68	27	<1E-7	
WIN	11	73	28	<1E-7	
CBN	12	78	29	<1E-7	
DAB 1	9C	68	>25	<1E-3	
DAB 2	10B	63	>25	<1E-3	
Goulburn					
SBS	40	51	-	>1E-1	
ABC	41	50	-	>1E-1	
CBN	42	54	-	>1E-1	
WIN	43	54	-	>1E-1	
CTC	44	52	-	>1E-1	
Bungendore					
SBS	46	65	21	2E-5	
ABC	47	65	23	3E-7	
CBN	48	63	22	2E-6	
WIN	49	64	24	<1E-7	
CTC	50	64	24	<1E-7	

Table 25 Television & DAB Reception - Location H

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	14	2SNO	93.5	20
2ABCFM	102.3	23	2ABCFM	95.7	6
1CBR	106.3	23	2JJJ	98.9	5

Table 26 FM Radio – Location H



2.12.2 Observations



Figure 38 Location H - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. The measurements showed good coverage from Canberra and variable coverage from Bungendore.



Figure 39 Location H - Predicted coverage from Bungendore

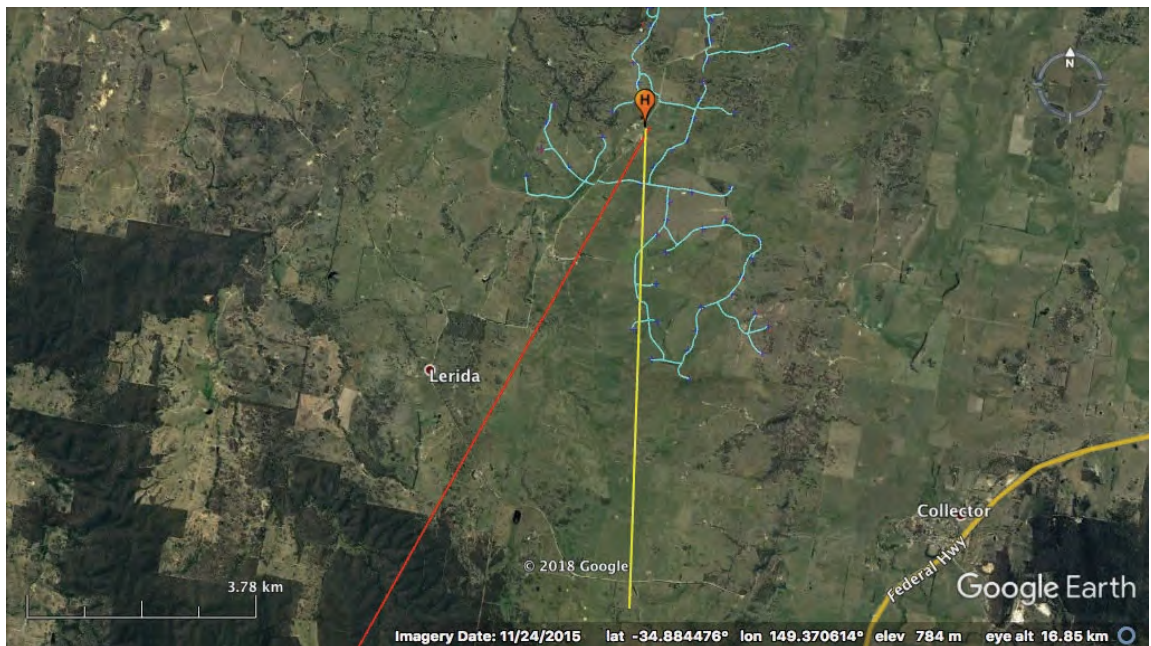
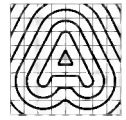
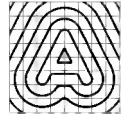


Figure 40 Location H - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to Bungendore is shown in yellow. The turbines that surround this location will affect television reception from both Canberra and Bungendore.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	53 km	209°	Good	Yes
Goulburn	-	-	-	-
Bungendore	9 km	182°	Variable	Yes

Table 27 - Summary of observations for Location H



2.13 LOCATION I

This location is near 640 Breadalbane Road, Collector.

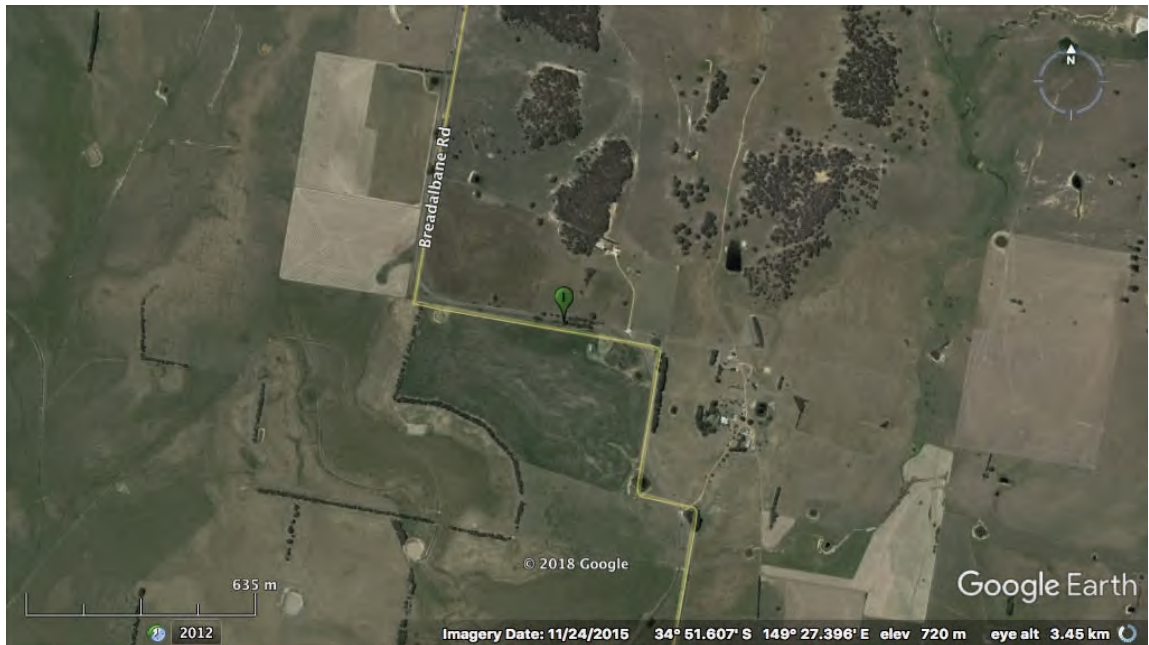


Figure 41 Location I



Figure 42 Test Site - Location I



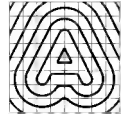
2.13.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	93	34	<1E-7	
SBS	7	88	18	>1E-1	
ABC	8	86	-	-	
WIN	11	88	30	<1E-7	
CBN	12	93	34	<1E-7	
DAB 1	9C	83	>25	<1E-3	
DAB 2	10B	78	16	<1E-3	
Goulburn					
SBS	40	57	-	>1E-1	
ABC	41	47	-	>1E-1	
CBN	42	49	-	>1E-1	
WIN	43	50	-	>1E-1	
CTC	44	50	-	>1E-1	
Bungendore					
SBS	46	74	27	<1E-7	
ABC	47	73	30	<1E-7	
CBN	48	70	27	<1E-7	
WIN	49	69	28	<1E-7	
CTC	50	69	23	4E-6	

Table 28 Television & DAB Reception - Location I

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	25	2SNO	93.5	27
2ABCFM	102.3	35	2ABCFM	95.7	7
1CBR	106.3	30	2JJJ	98.9	7

Table 29 FM Radio – Location I



2.13.2 Observations



Figure 43 Location I - Predicted coverage

The ACMA coverage predictions for this site show variable coverage from Canberra. This is consistent with the measurements. There was good coverage from Bungendore.



Figure 44 Location I - Predicted coverage from Bungendore

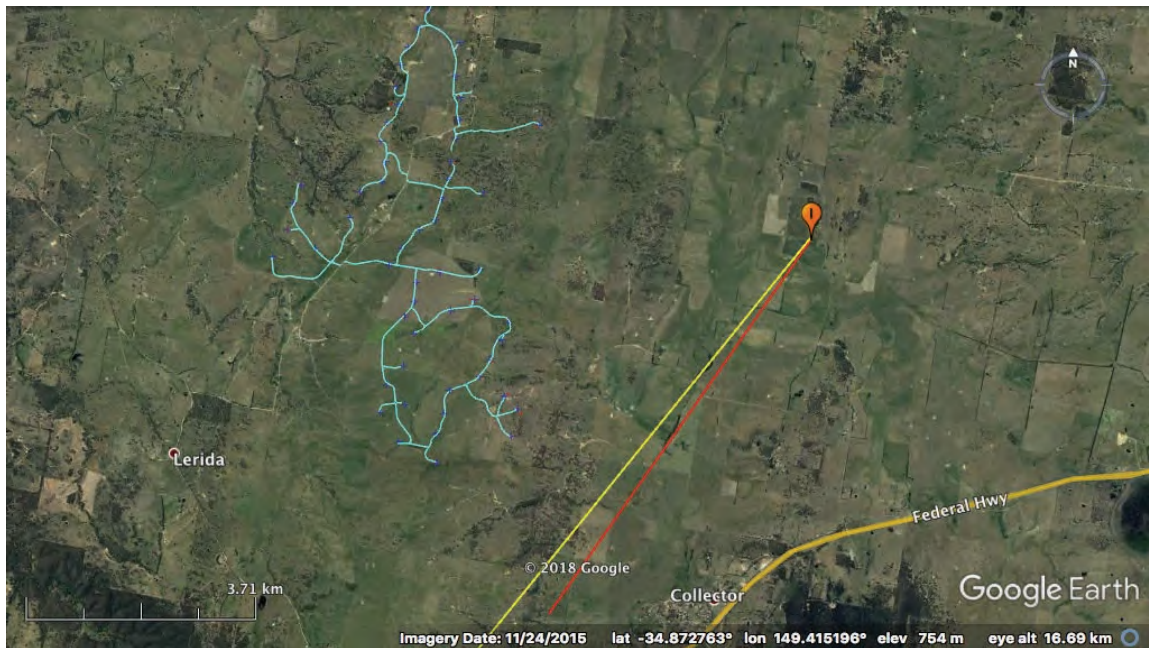
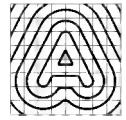


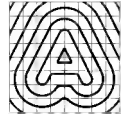
Figure 45 Location I - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to the Bungendore transmitters is in yellow.

The path to the nearest turbine is at 237°, 17° from the path to Bungendore. With suitable antenna engineering reflections from the turbine could be reduced. The path to Canberra is further removed.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	57 km	215°	Variable	Possibly
Goulburn	-	-	-	-
Bungendore	11 km	220°	Good	Possibly

Table 30 - Summary of observations for Location I



2.14 LOCATION J

This location is at 2232 Gunning - Collector Road, Collector.

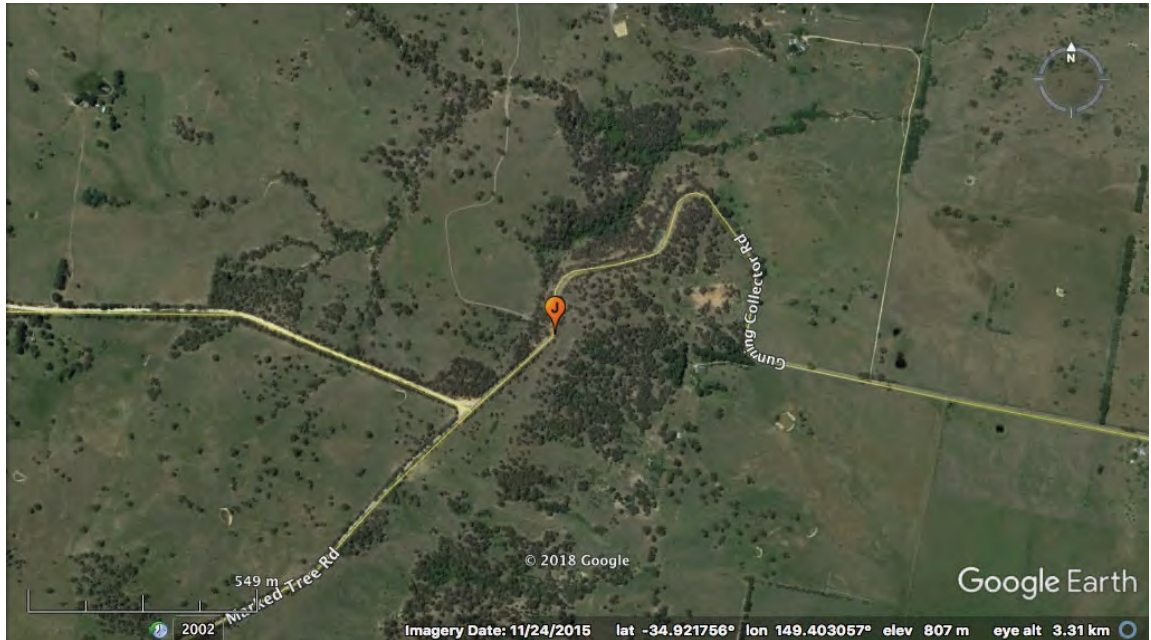


Figure 46 Location J



Figure 47 Test Site - Location J



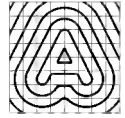
2.14.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	66	24	3E-7	
SBS	7	64	23	2E-5	
ABC	8	61	21	2E-4	
WIN	11	65	20	9E-3	
CBN	12	66	20	2E-3	
DAB 1	9C	59	22	<1E-3	
DAB 2	10B	53	21	<1E-3	Varies
Goulburn					
SBS	40	84	31	<1E-7	
ABC	41	84	29	<1E-7	
CBN	42	86	31	<1E-7	
WIN	43	85	32	<1E-7	
CTC	44	83	31	<1E-7	
Bungendore					
SBS	46	75	30	<1E-7	
ABC	47	73	28	<1E-7	
CBN	48	70	28	<1E-7	
WIN	49	71	29	<1E-7	
CTC	50	71	30	<1E-7	

Table 31 Television & DAB Reception - Location J

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXRX	98.3	11	2SNO	93.5	48
2ABCFM	102.3	19	2ABCFM	95.7	18
1CBR	106.3	20	2JJJ	98.9	25

Table 32 FM Radio – Location J



2.14.2 Observations

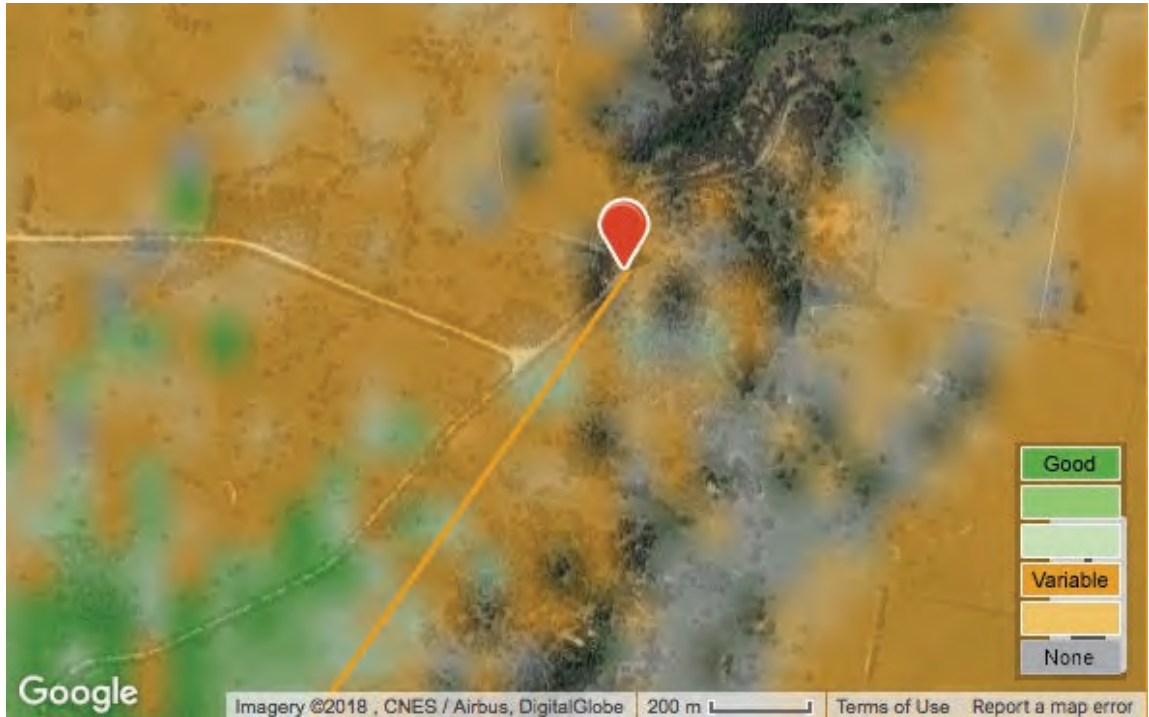


Figure 48 Location J - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Goulburn. The measurements on site showed poor coverage from Canberra and good coverage from Goulburn and Bungendore.

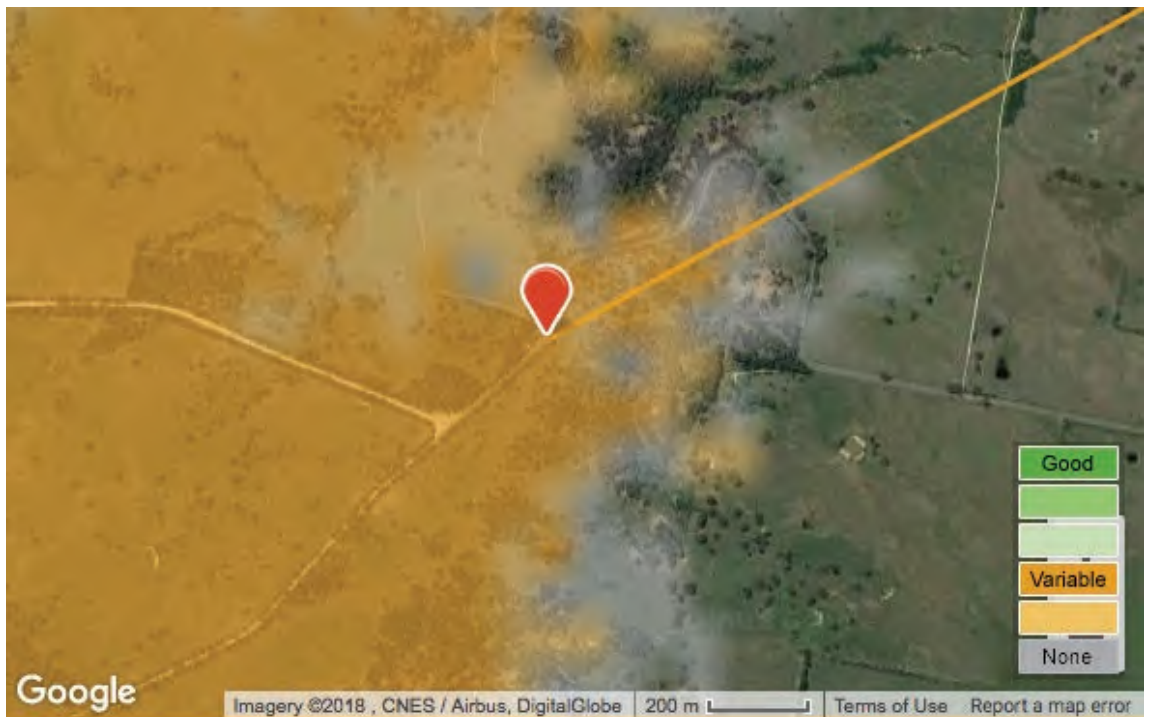


Figure 49 Location J - Predicted coverage from Goulburn

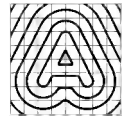
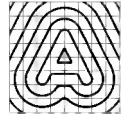


Figure 50 Location J - relationship to turbine locations

The path to the Canberra transmitters is shown in red, the path to Bungendore is in yellow and the path to Goulburn is in green. All paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	48 km	216°	Poor	No
Goulburn	38 km	61°	Good	No
Bungendore	3 km	231°	Good	No

Table 33 - Summary of observations for Location J



2.15 LOCATION K

This location is at the corner of Lerida Road and Collector Road.

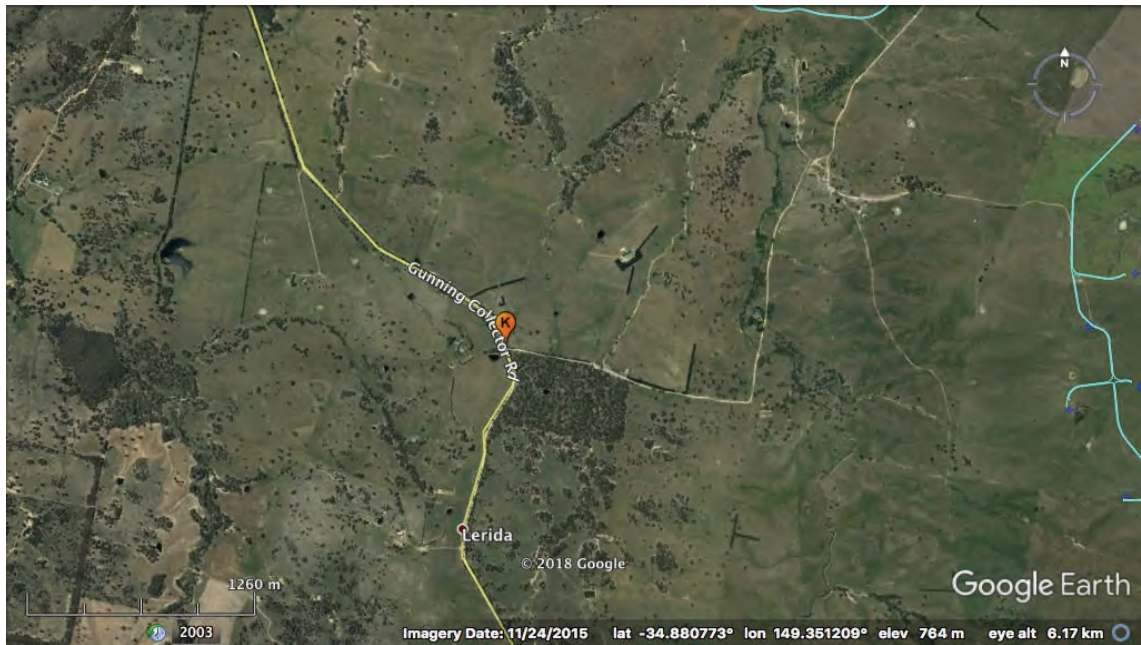


Figure 51 Location K



Figure 52 Test Site - Location K



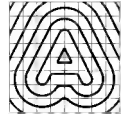
2.15.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	61	17	>1E-1	
SBS	7	54	15	>1E-1	Varies
ABC	8	56	19	>1E-1	
WIN	11	58	16	>1E-1	
CBN	12	63	17	>1E-1	
DAB 1	9C	44	8	>1E-1	
DAB 2	10B	43	12	2E-2	
Goulburn					
SBS	40	61	16	>1E-1	
ABC	41	62	16	>1E-1	
CBN	42	64	19	3E-3	
WIN	43	64	19	4E-3	
CTC	44	64	18	>1E-1	
Bungendore					
SBS	46	58	-	>1E-1	
ABC	47	56	-	>1E-1	
CBN	48	54	-	>1E-1	
WIN	49	54	17	>1E-1	
CTC	50	54	-	>1E-1	

Table 34 Television & DAB Reception - Location K

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	8	2SNO	93.5	23
2ABCFM	102.3	10	2ABCFM	95.7	8
1CBR	106.3	12	2JJJ	98.9	7

Table 35 FM Radio – Location K



2.15.2 Observations

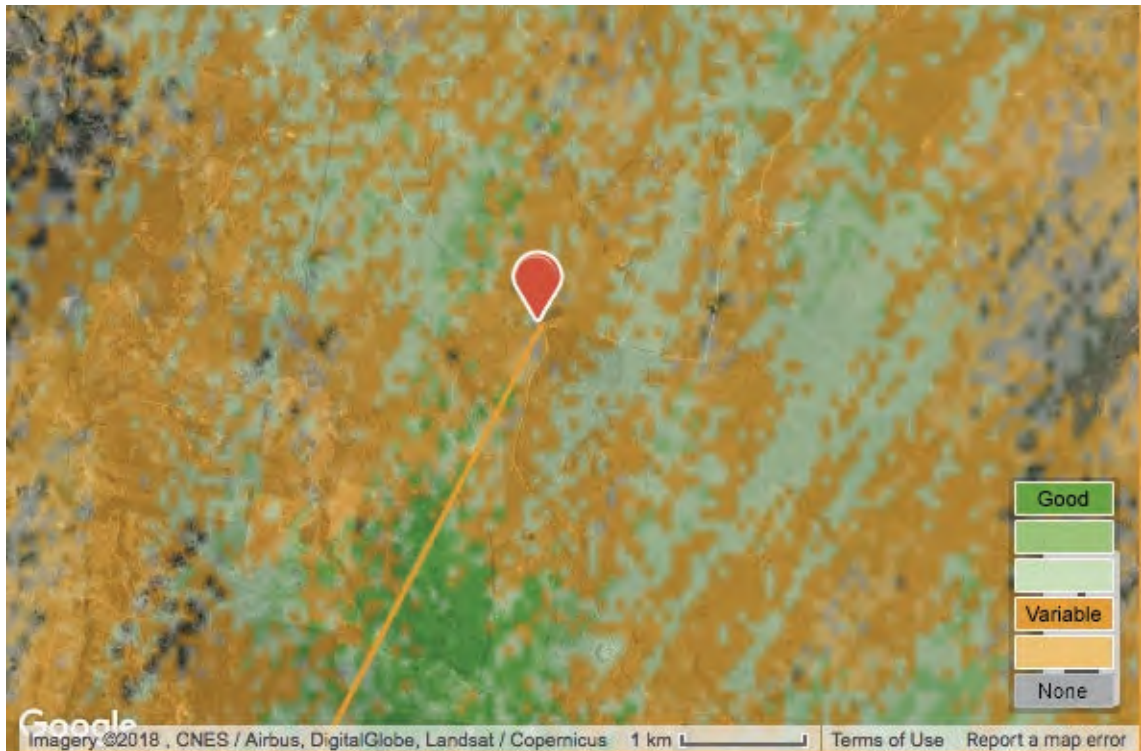


Figure 53 Location K - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and patches of coverage from the South West Slopes transmitters.

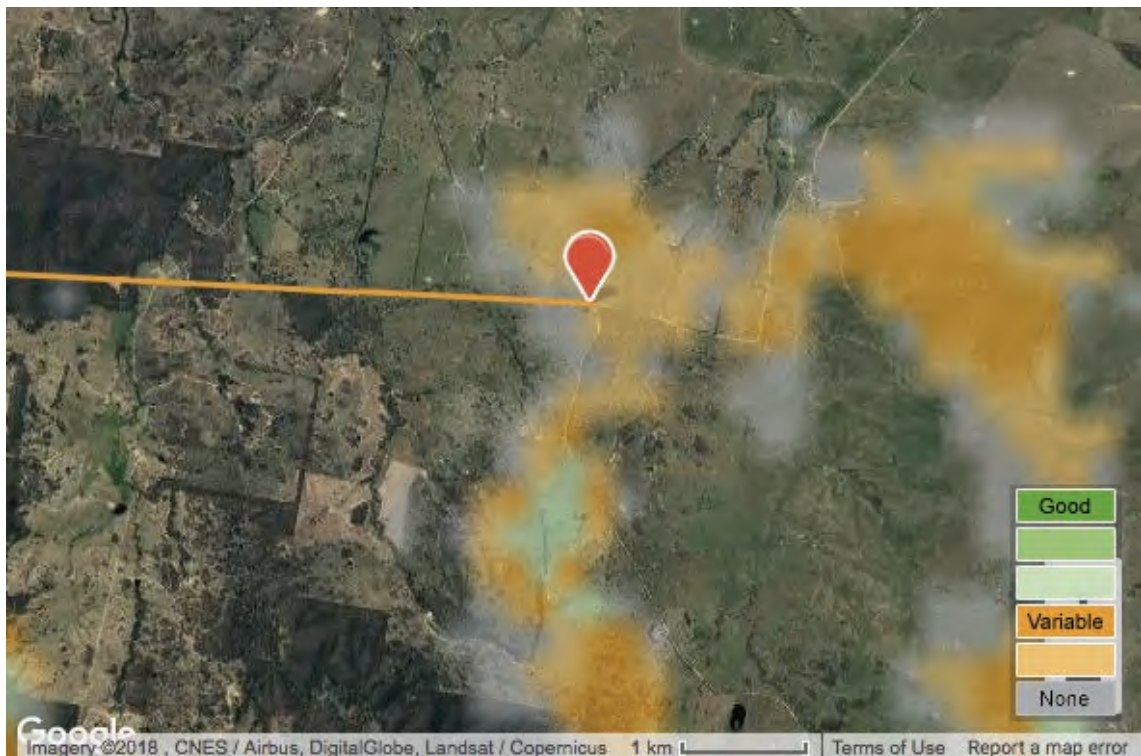
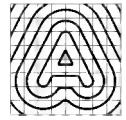


Figure 54 Location K - Predicted coverage from South West Slopes



The measurements showed poor coverage from Goulburn and no usable coverage from Canberra or Bungendore.

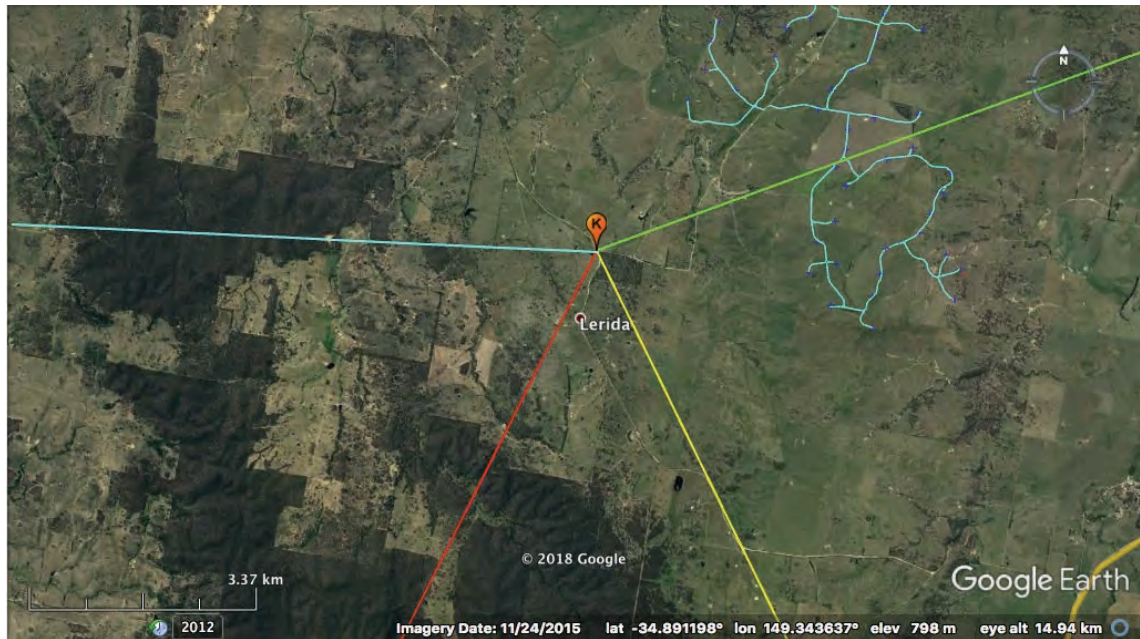


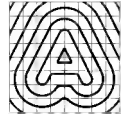
Figure 55 Location K - relationship to turbine locations

The path to the Canberra transmitters is shown in red, Bungendore in yellow, Goulburn in green and South West Slopes in cyan.

With the exception of Goulburn, the paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used. Reception from Goulburn is likely to be affected by the wind farm.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	49 km	207°	-	No
Goulburn	40 km	70°	Poor	Yes
Bungendore	7 km	155°	-	No
South West Slopes	132 km	273°	Variable	No

Table 36 - Summary of observations for Location K



2.16 LOCATION L

This location is at Werriwa, 256 Breadalbane Road, Collector.

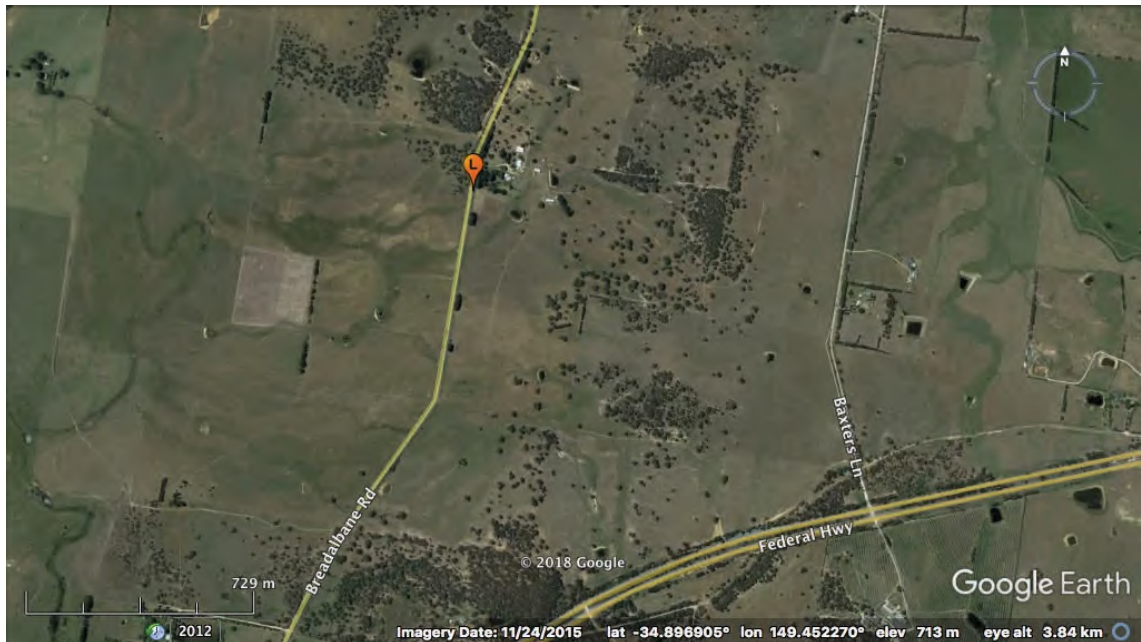


Figure 56 Location L



Figure 57 Test Site - Location L



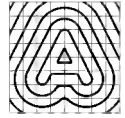
2.16.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	75	31	5E-4	Varies
SBS	7	71	25	2E-5	
ABC	8	74	21	5E-5	
WIN	11	77	24	3E-5	Varies
CBN	12	83	34	<1E-7	
DAB 1	9C	68	>25	<1E-3	
DAB 2	10B	60	22	<1E-3	Varies
Goulburn					
SBS	40	51	-	>1E-1	
ABC	41	48	-	>1E-1	
CBN	42	50	-	>1E-1	
WIN	43	51	-	>1E-1	
CTC	44	50	-	>1E-1	
Bungendore					
SBS	46	89	30	<1E-7	
ABC	47	88	31	<1E-7	
CBN	48	86	28	<1E-7	
WIN	49	84	29	<1E-7	
CTC	50	85	31	<1E-7	

Table 37 Television & DAB Reception - Location L

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	27	2SNO	93.5	27
2ABCFM	102.3	29	2ABCFM	95.7	6
1CBR	106.3	23	2JJJ	98.9	7

Table 38 FM Radio – Location L



2.16.2 Observations

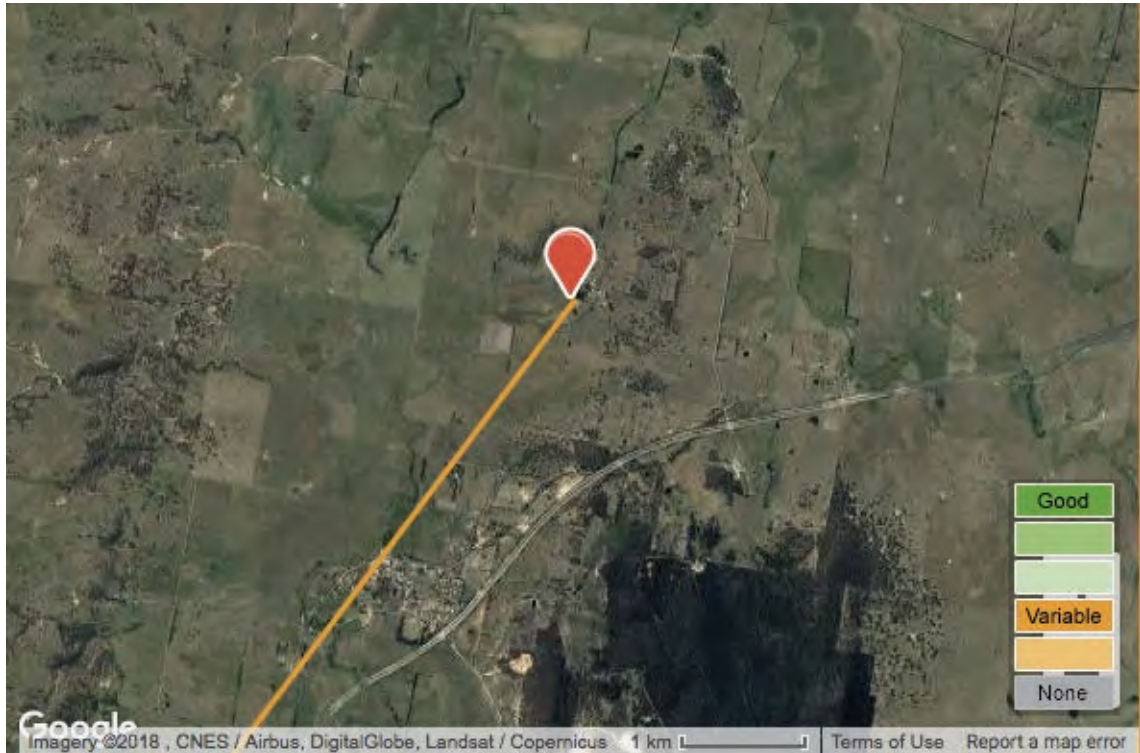


Figure 58 Location L - Predicted coverage from Canberra

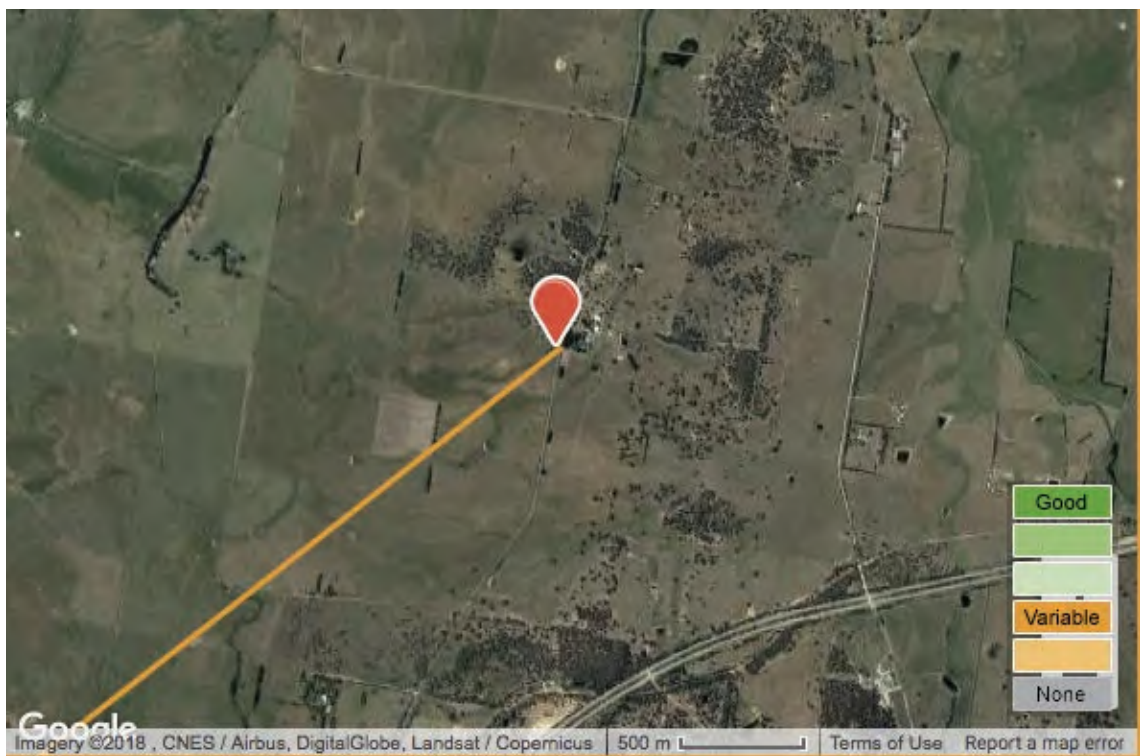
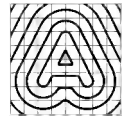


Figure 59 Location L - Predicted coverage from Bungendore



The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. The measurements showed good coverage from Bungendore and variable coverage from Canberra.

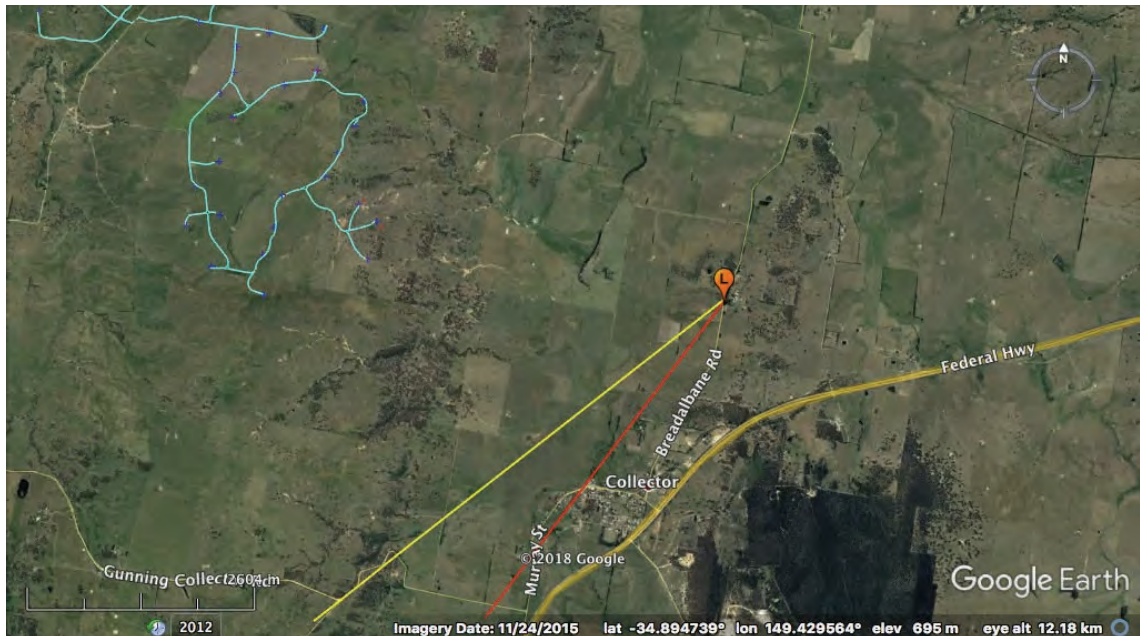
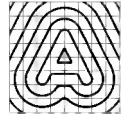


Figure 60 Location L - relationship to turbine locations

The path to the Canberra transmitters is shown in red and that to Bungendore is in yellow. These paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	53 km	217°	Variable	No
Goulburn	-	-	-	-
Bungendore	8 km	232°	Good	No

Table 39 - Summary of observations for Location L



2.17 LOCATION M

This location is at 67 Breadalbane Road, Collector.

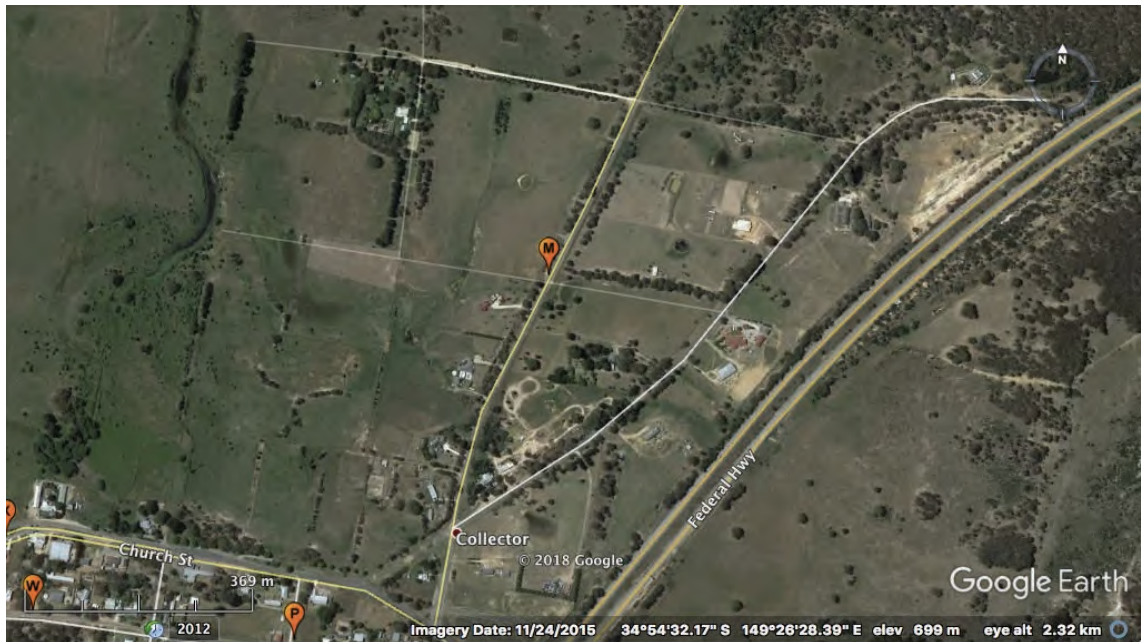


Figure 61 Location M



Figure 62 Test Site - Location M



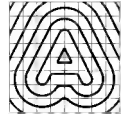
2.17.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	73	29	2E-5	
SBS	7	67	26	3E-5	
ABC	8	62	22	3E-4	
WIN	11	66	22	3E-4	
CBN	12	73	26	1E-4	Varies
DAB 1	9C	58	20	2E-2	
DAB 2	10B	54	19	-	Varies
Goulburn					
SBS	40	56	-	>1E-1	
ABC	41	55	-	>1E-1	
CBN	42	57	-	>1E-1	
WIN	43	57	-	>1E-1	
CTC	44	57	-	>1E-1	
Bungendore					
SBS	46	95	30	<1E-7	
ABC	47	94	29	<1E-7	
CBN	48	91	26	<1E-7	
WIN	49	92	30	<1E-7	
CTC	50	93	31	<1E-7	MER Varies

Table 40 Television & DAB Reception - Location M

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	10	2SNO	93.5	30
2ABCFM	102.3	11	2ABCFM	95.7	6
1CBR	106.3	18	2JJJ	98.9	7

Table 41 FM Radio – Location M



2.17.2 Observations



Figure 63 Location M - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. The measurements showed variable coverage from Canberra and good coverage from Bungendore.

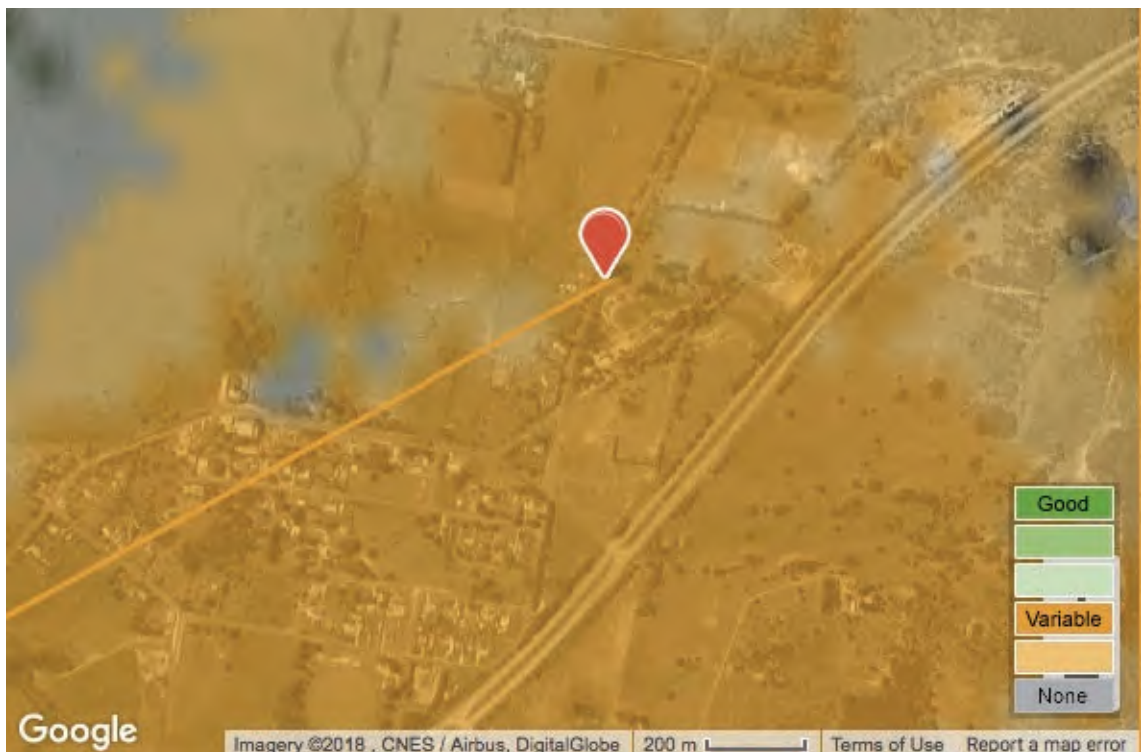


Figure 64 Location M - Predicted coverage from Bungendore

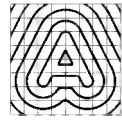
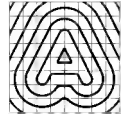


Figure 65 Location M - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to Bungendore is in yellow. Both paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	51 km	217°	Variable	No
Goulburn	-	-	-	-
Bungendore	6 km	241°	Good	No

Table 42 - Summary of observations for Location M



2.18 LOCATION N

This location is at 67 Mays Lane, Collector.

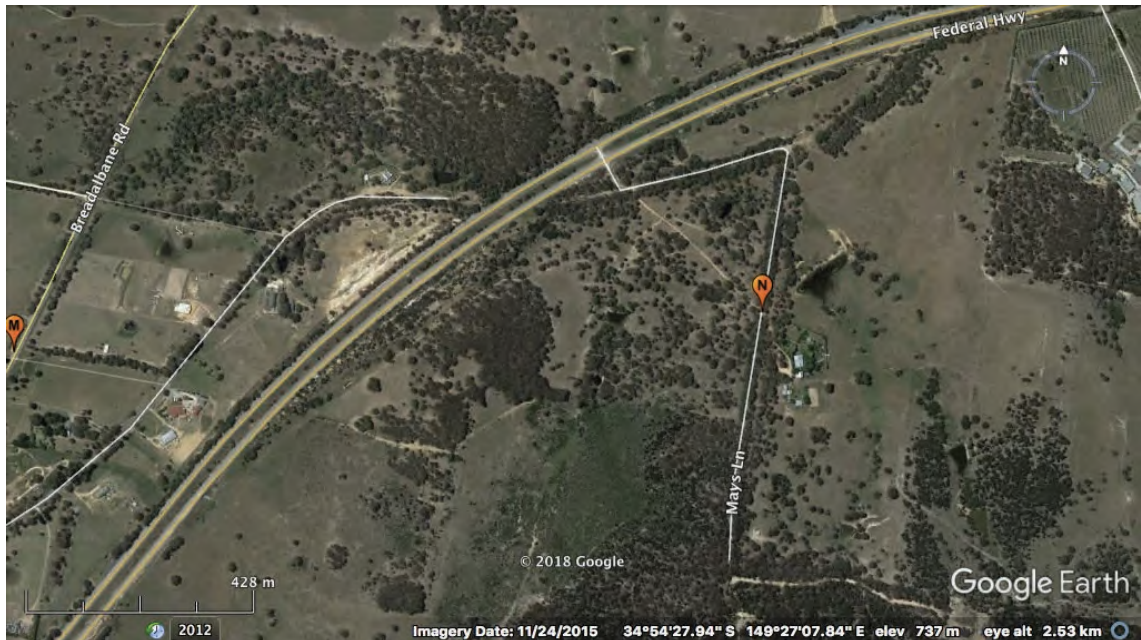


Figure 66 Location N



Figure 67 Test Site - Location N



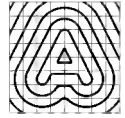
2.18.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	66	27	<1E-7	
SBS	7	64	25	<1E-7	
ABC	8	61	24	<1E-7	
WIN	11	62	20	4E-4	
CBN	12	67	24	<1E-7	
DAB 1	9C	57	20	<1E-3	
DAB 2	10B	51	20	<1E-3	
Goulburn					
SBS	40	47	-	>1E-1	
ABC	41	47	-	>1E-1	
CBN	42	50	-	>1E-1	
WIN	43	52	-	>1E-1	
CTC	44	53	-	>1E-1	
Bungendore					
SBS	46	69	25	<1E-7	
ABC	47	67	25	<1E-7	
CBN	48	64	23	<1E-7	
WIN	49	64	26	<1E-7	
CTC	50	66	25	<1E-7	

Table 43 Television & DAB Reception - Location N

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	13	2SNO	93.5	33
2ABCFM	102.3	19	2ABCFM	95.7	8
1CBR	106.3	17	2JJJ	98.9	11

Table 44 FM Radio – Location N



2.18.2 Observations

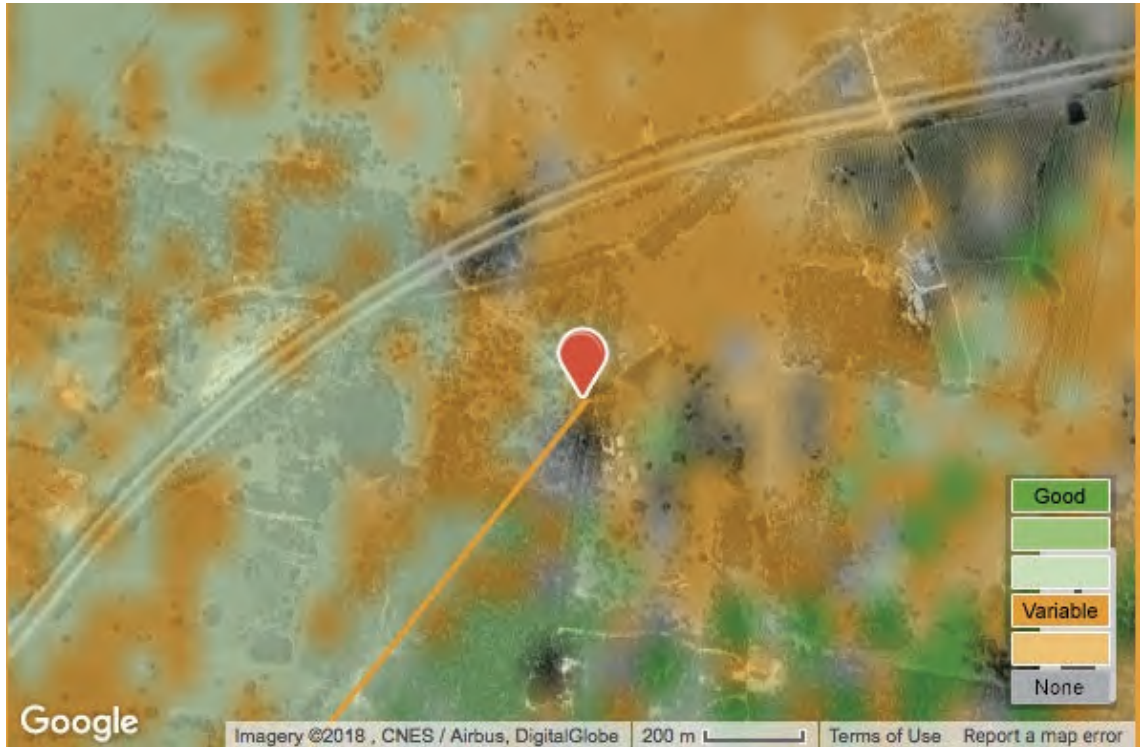


Figure 68 Location N - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. The measurements showed variable coverage from Canberra and good coverage from Bungendore.



Figure 69 Location N - Predicted coverage from Bungendore

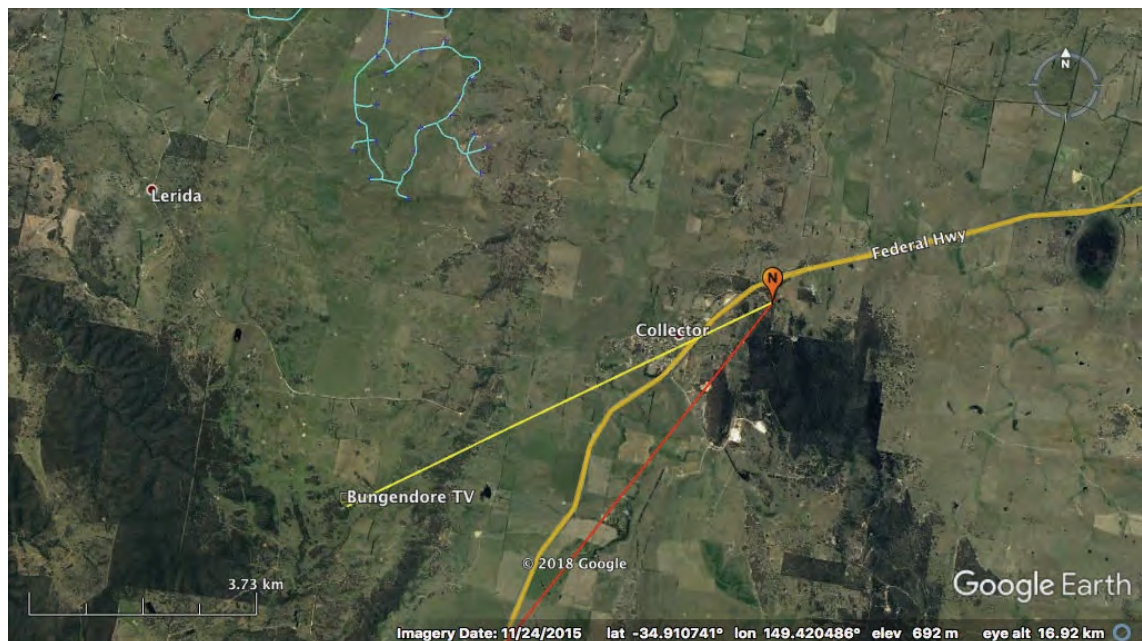
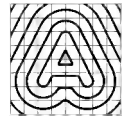
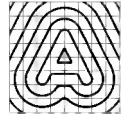


Figure 70 Location N - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to the Bungendore transmitters is in yellow. Both paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	52 km	218°	Variable	No
Goulburn	-	-	-	-
Bungendore	8 km	245°	Good	No

Table 45 - Summary of observations for Location N



2.19 LOCATION O

This location is at Lorn Street, near Bourke Street, Collector

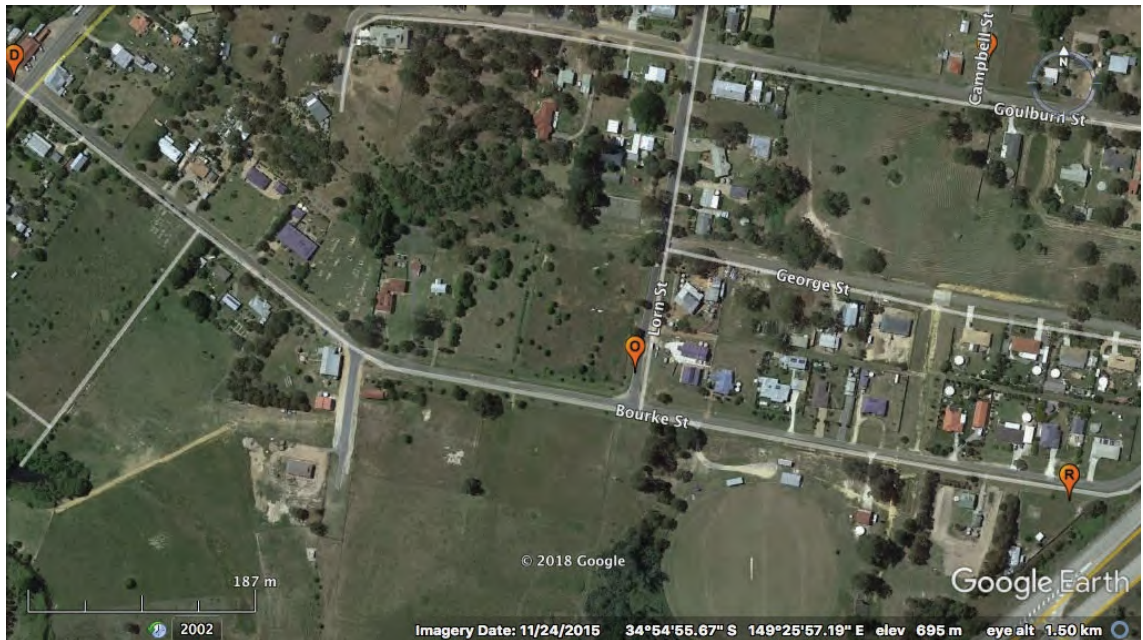


Figure 71 Location O



Figure 72 Test Site - Location O



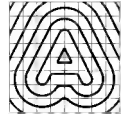
2.19.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	87	34	<1E-7	
SBS	7	84	21	3E-4	
ABC	8	82	18	>1E-1	
WIN	11	84	29	<1E-7	
CBN	12	89	34	<1E-7	
DAB 1	9C	79	>25	<1E-3	
DAB 2	10B	74	22	<1E-3	
Goulburn					
SBS	40	47	-	>1E-1	
ABC	41	45	-	>1E-1	
CBN	42	46	-	>1E-1	
WIN	43	46	-	>1E-1	
CTC	44	47	-	>1E-1	
Bungendore					
SBS	46	93	30	<1E-7	
ABC	47	91	30	<1E-7	
CBN	48	88	27	<1E-7	
WIN	49	88	30	<1E-7	
CTC	50	88	30	<1E-7	

Table 46 Television & DAB Reception - Location O

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	19	2SNO	93.5	21
2ABCFM	102.3	20	2ABCFM	95.7	12
1CBR	106.3	24	2JJJ	98.9	12

Table 47 FM Radio – Location O



2.19.2 Observations



Figure 73 Location O - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. The measurements showed good coverage from Bungendore and variable coverage from Canberra.

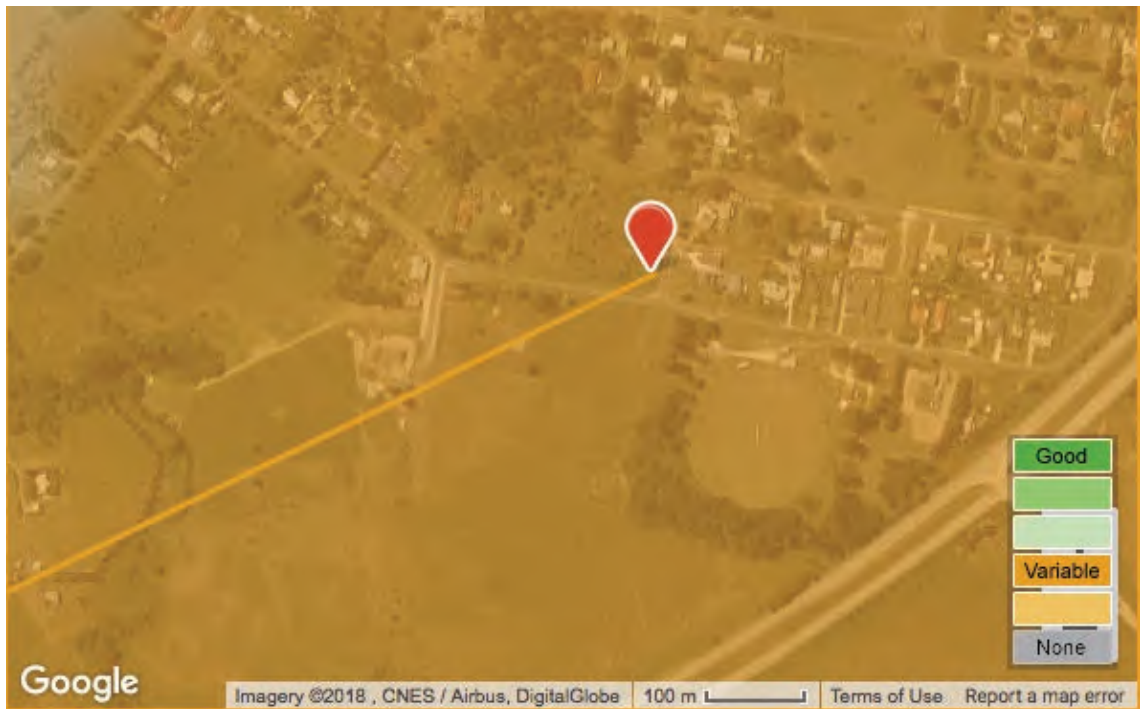


Figure 74 Location O - Predicted coverage from Bungendore

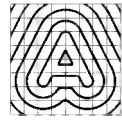
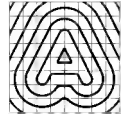


Figure 75 Location O - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to the Bungendore transmitters is in yellow. These paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	50 km	217°	Variable	No
Goulburn	-	-	-	-
Bungendore	5 km	244°	Good	No

Table 48 - Summary of observations for Location O



2.20 LOCATION P

This location is at Campbell Street, near Goulburn Street, Collector.



Figure 76 Location P



Figure 77 Test Site - Location P



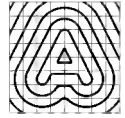
2.20.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	42	34	<1E-7	
SBS	7	81	24	2E-6	
ABC	8	78	19	3E-3	
WIN	11	81	31	<1E-7	
CBN	12	85	34	<1E-7	
DAB 1	9C	77	>25	<1E-3	
DAB 2	10B	77	22	<1E-3	
Goulburn					
SBS	40	46	-	>1E-1	
ABC	41	45	-	>1E-1	
CBN	42	47	-	>1E-1	
WIN	43	50	-	>1E-1	
CTC	44	50	-	>1E-1	
Bungendore					
SBS	46	87	30	<1E-7	
ABC	47	85	29	<1E-7	
CBN	48	83	26	<1E-7	
WIN	49	86	29	<1E-7	
CTC	50	88	32	<1E-7	

Table 49 Television & DAB Reception - Location P

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	15	2SNO	93.5	29
2ABCFM	102.3	31	2ABCFM	95.7	8
1CBR	106.3	26	2JJJ	98.9	7

Table 50 FM Radio – Location P



2.20.2 Observations

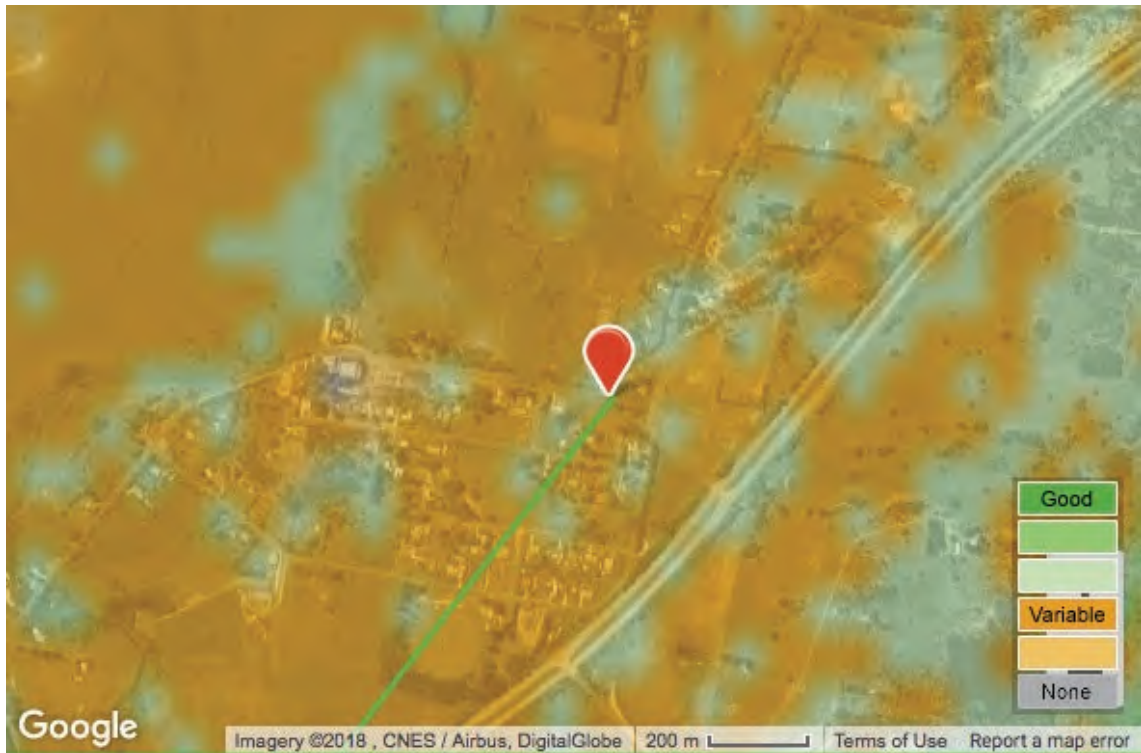


Figure 78 Location P - Predicted coverage from Canberra

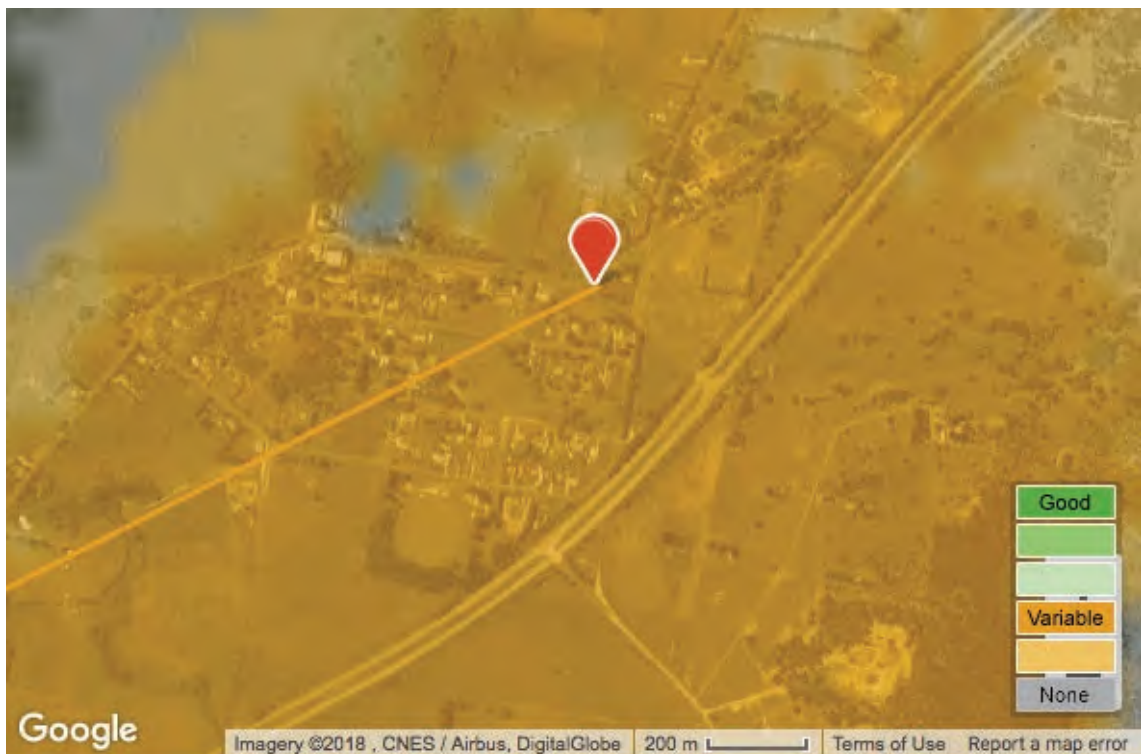
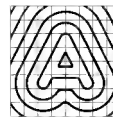


Figure 79 Location P - Predicted coverage from Bungendore



The ACMA coverage predictions for this show good coverage from Canberra and variable coverage from Bungendore. The measured coverage from Bungendore was good, while there was variable coverage from Canberra.

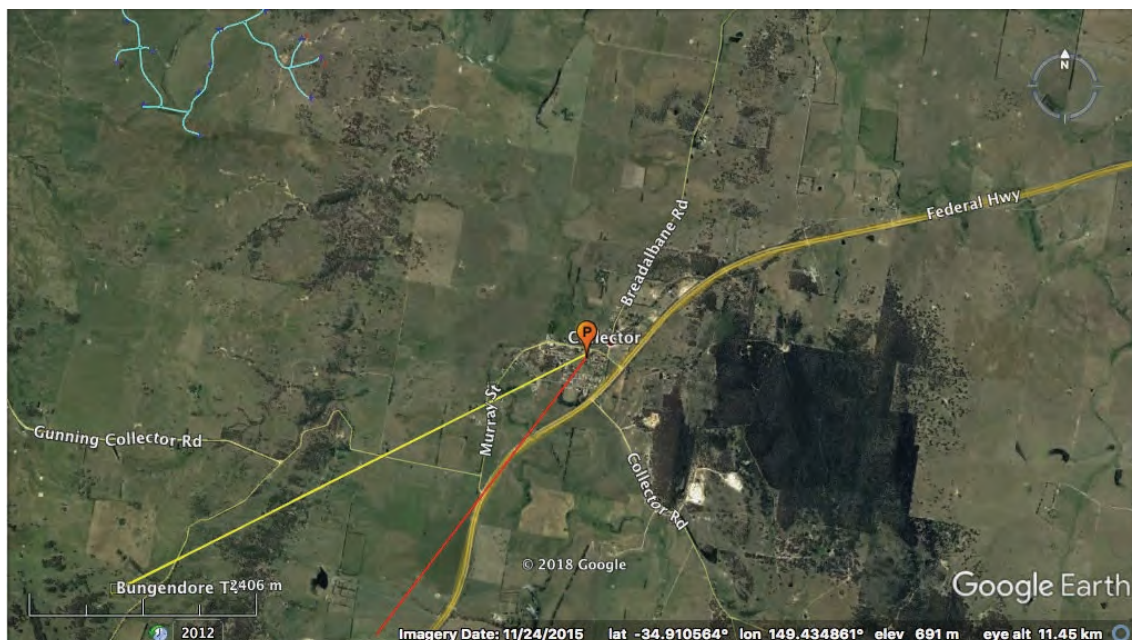
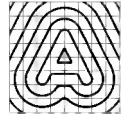


Figure 80 Location P - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to Bungendore is in yellow. Both paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	51 km	217°	Variable	No
Goulburn	-	-	-	-
Bungendore	6 km	243°	Good	No

Table 51 - Summary of observations for Location P



2.21 LOCATION Q

This location is on Collector Road South, Collector.

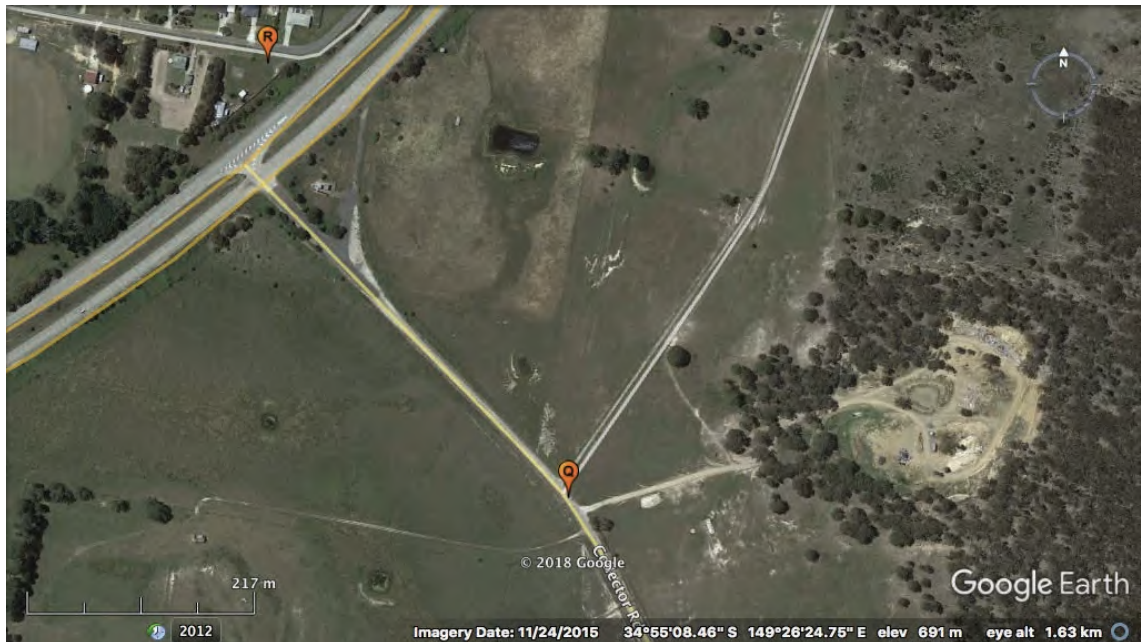


Figure 81 Location Q



Figure 82 Test Site - Location Q



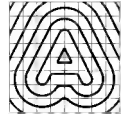
2.21.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	86	34	<1E-7	
SBS	7	82	22	8E-6	
ABC	8	80	17	>1E-1	
WIN	11	84	31	<1E-7	
CBN	12	87	34	<1E-7	
DAB 1	9C	77	>25	<1E-3	
DAB 2	10B	72	20	<1E-3	
Goulburn					
SBS	40	50	-	>1E-1	
ABC	41	48	-	>1E-1	
CBN	42	51	-	>1E-1	
WIN	43	48	-	>1E-1	
CTC	44	49	-	>1E-1	
Bungendore					
SBS	46	80	25	<1E-7	
ABC	47	85	24	<1E-7	
CBN	48	85	22	3E-6	
WIN	49	85	28	<1E-7	Amplitude varies
CTC	50	88	31	<1E-7	

Table 52 Television & DAB Reception - Location Q

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	10	2SNO	93.5	17
2ABCFM	102.3	16	2ABCFM	95.7	7
1CBR	106.3	23	2JJJ	98.9	7

Table 53 FM Radio – Location Q



2.21.2 Observations



Figure 83 Location Q - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra, which was confirmed by the measurements. The measured coverage from Bungendore was better than predicted.



Figure 84 Location Q - Predicted coverage from Bungendore

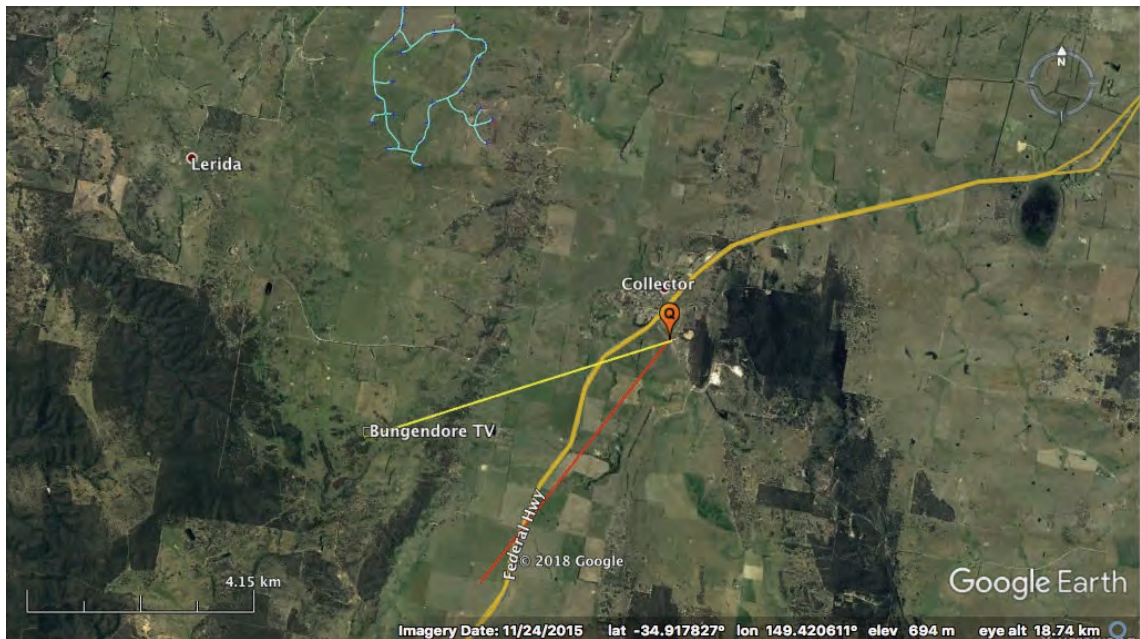
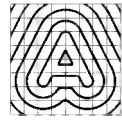
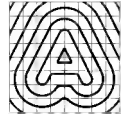


Figure 85 Location Q - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to Bungendore is in yellow. Both paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	50 km	218°	Variable	No
Goulburn	-	-	-	-
Bungendore	6 km	251°	Variable	No

Table 54 - Summary of observations for Location Q



2.22 LOCATION R

This location is at 15 Bourke Street, Collector.



Figure 86 Location R



Figure 87 Test Site - Location R



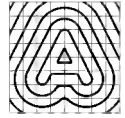
2.22.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	71	22	2E-4	
SBS	7	65	22	5E-5	
ABC	8	64	24	5E-5	
WIN	11	66	20	1E-3	
CBN	12	73	33	2E-5	Varies with road traffic
DAB 1	9C	63	>25	<1E-3	
DAB 2	10B	52	20	<1E-3	
Goulburn					
SBS	40	44	-	>1E-1	
ABC	41	44	-	>1E-1	
CBN	42	45	-	>1E-1	
WIN	43	45	-	>1E-1	
CTC	44	45	-	>1E-1	
Bungendore					
SBS	46	80	30	<1E-7	
ABC	47	80	30	<1E-7	
CBN	48	78	29	<1E-7	
WIN	49	79	31	<1E-7	
CTC	50	81	32	<1E-7	

Table 55 Television & DAB Reception - Location R

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	18	2SNO	93.5	25
2ABCFM	102.3	25	2ABCFM	95.7	7
1CBR	106.3	24	2JJJ	98.9	6

Table 56 FM Radio – Location R



2.22.2 Observations



Figure 88 Location R - Predicted coverage from Canberra

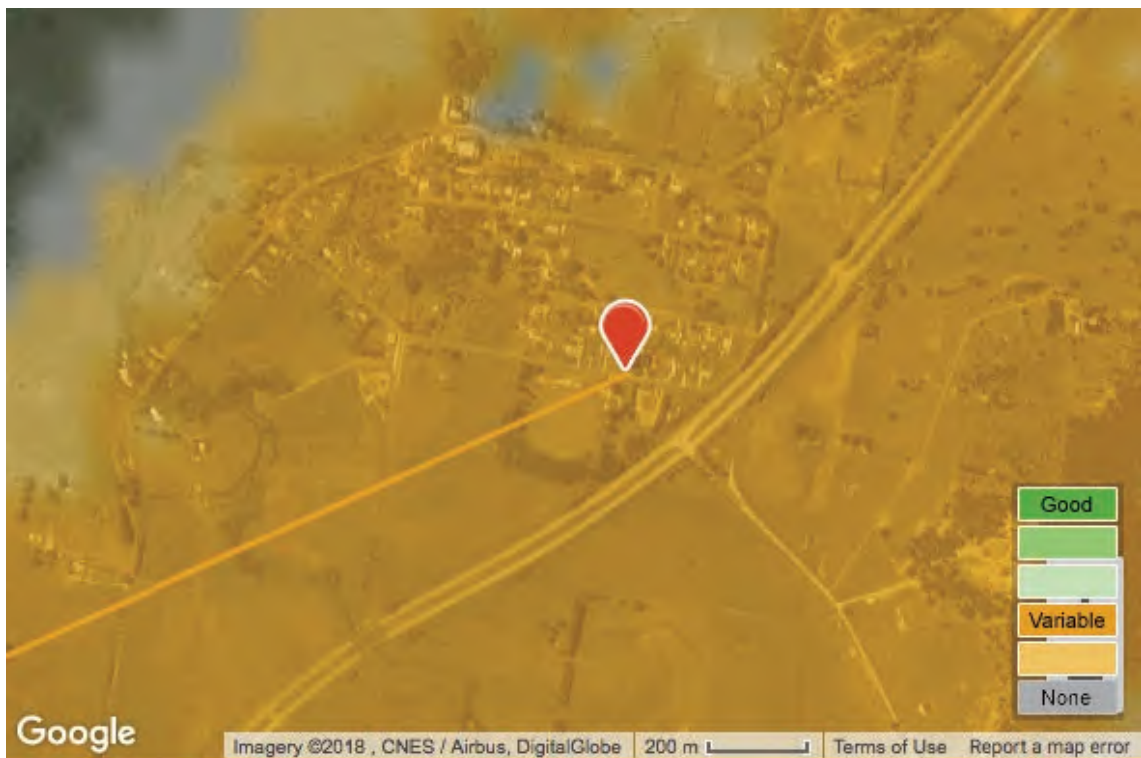
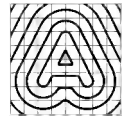


Figure 89 Location R - Predicted coverage from Bungendore



The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. The measurements showed variable coverage from Canberra and good coverage from Bungendore.

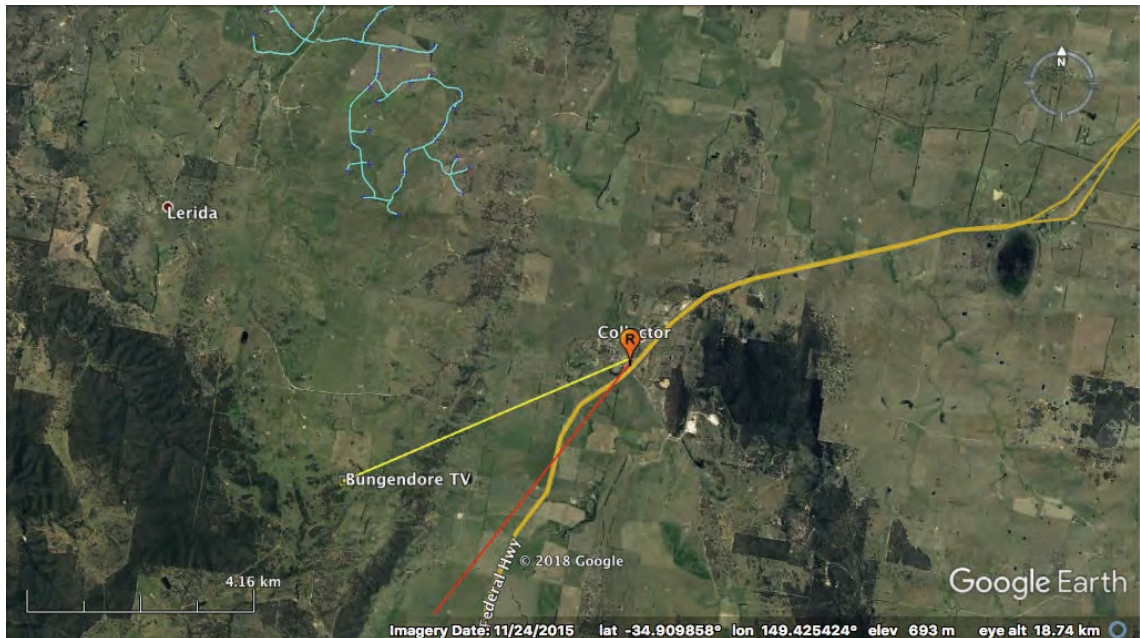
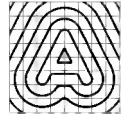


Figure 90 Location R - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to Bungendore is in yellow. These paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	50 km	218°	Variable	No
Goulburn	-	-	-	-
Bungendore	6 km	246°	Good	No

Table 57 - Summary of observations for Location R



2.23 LOCATION S

This location is at Dunroamin, 206 Collector Road, Collector

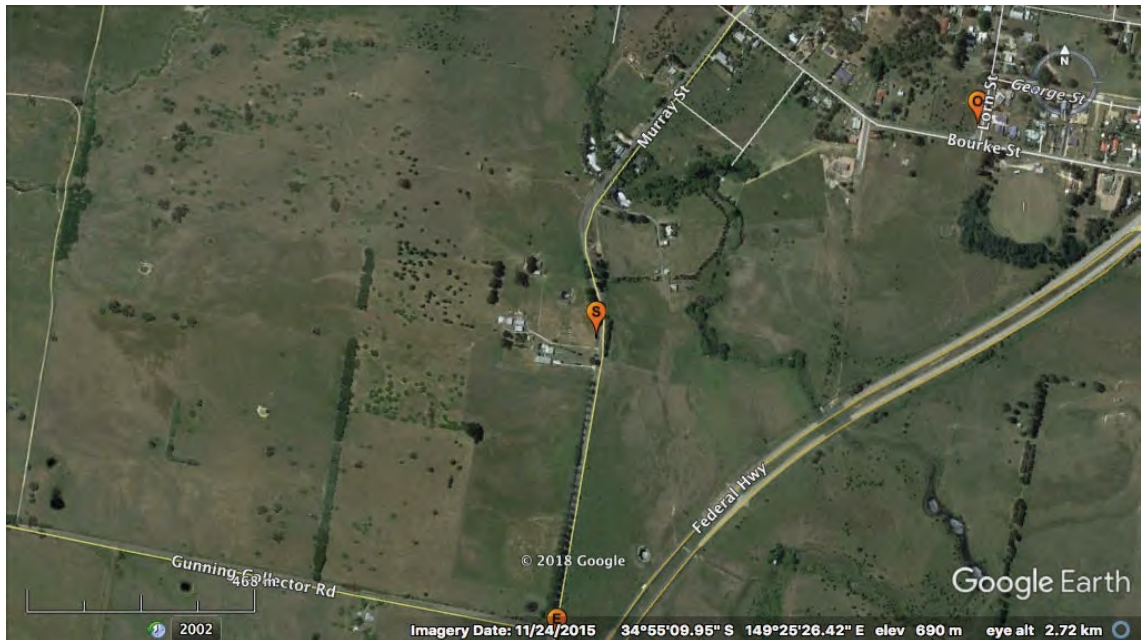


Figure 91 Location S



Figure 92 Test Site - Location S



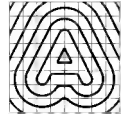
2.23.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	77	27	<1E-7	
SBS	7	77	25	3E-6	
ABC	8	78	18	Varies	
WIN	11	80	30	<1E-7	
CBN	12	86	34	<1E-7	
DAB 1	9C	76	>25	<1E-3	Varies
DAB 2	10B	68	22	<1E-7	
Goulburn					
SBS	40	49	-	>1E-1	
ABC	41	47	-	>1E-1	
CBN	42	53	-	>1E-1	
WIN	43	52	-	>1E-1	
CTC	44	51	-	>1E-1	
Bungendore					
SBS	46	86	30	<1E-7	
ABC	47	85	29	<1E-7	
CBN	48	83	28	<1E-7	
WIN	49	83	30	<1E-7	
CTC	50	85	31	<1E-7	

Table 58 Television & DAB Reception - Location S

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	5	2SNO	93.5	28
2ABCFM	102.3	16	2ABCFM	95.7	5
1CBR	106.3	19	2JJJ	98.9	4

Table 59 FM Radio – Location S



2.23.2 Observations



Figure 93 Location S - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. The measurements showed good coverage from Bungendore.



Figure 94 Location S - Predicted coverage from Bungendore

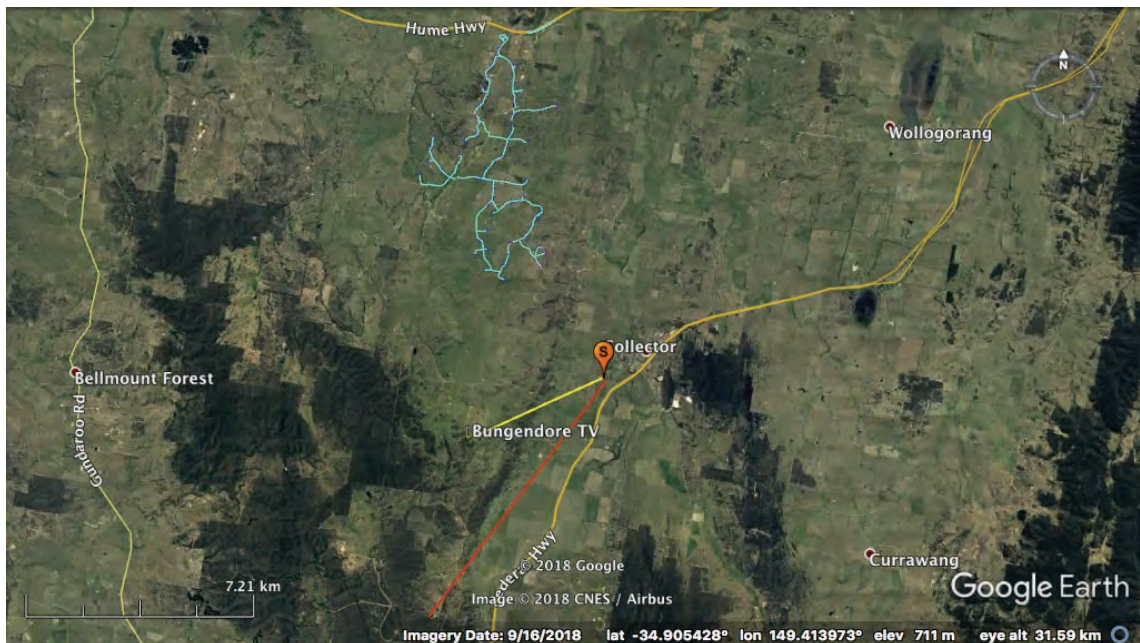
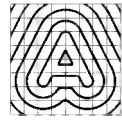
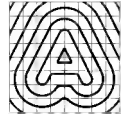


Figure 95 Location S - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to the Bungendore transmitters is in yellow. Both paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	50 km	217°	Variable	No
Goulburn	-	-	-	-
Bungendore	5 km	241°	Good	No

Table 60 - Summary of observations for Location S



2.24 LOCATION T

This location is on the Gunning – Collector Road, Collector.

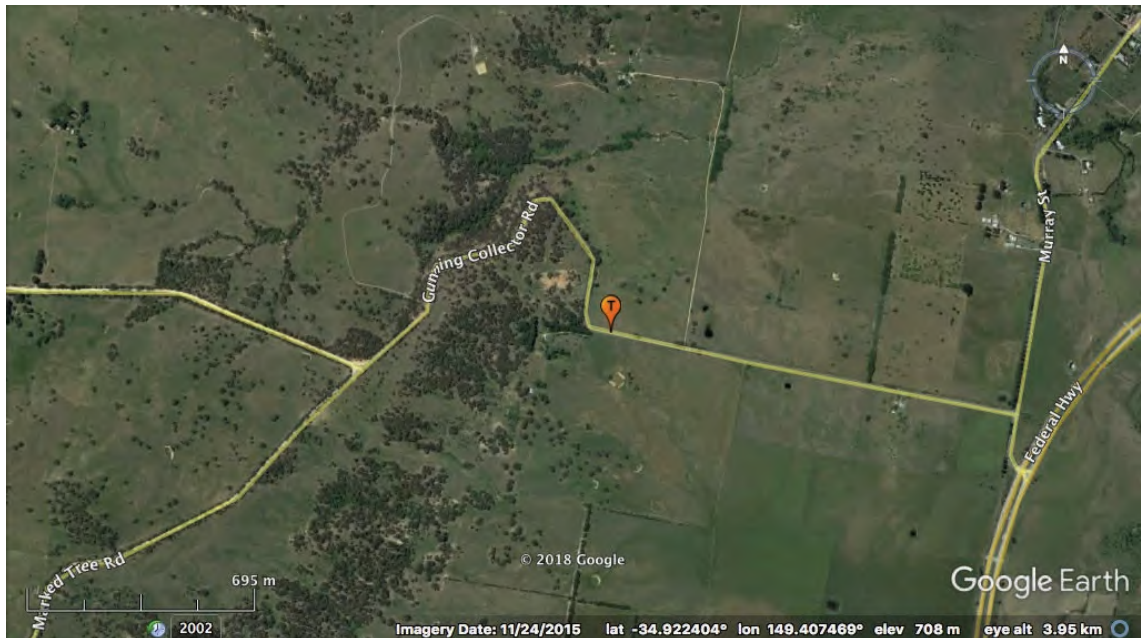


Figure 96 Location T



Figure 97 Test Site - Location T



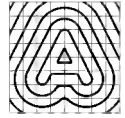
2.24.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	76	34	<1E-7	
SBS	7	72	29	<1E-7	
ABC	8	72	37	<1E-7	
WIN	11	75	31	<1E-7	
CBN	12	78	34	<1E-7	
DAB 1	9C	69	>25	<1E-3	
DAB 2	10B	63	25	<1E-3	
Goulburn					
SBS	40	66	22	9E-6	
ABC	41	65	20	5E-4	
CBN	42	66	22	3E-3	Varies
WIN	43	66	21	2E-5	
CTC	44	66	21	2E-5	
Bungendore					
SBS	46	65	18	>1E-1	
ABC	47	64	19	>1E-1	
CBN	48	62	19	>1E-1	
WIN	49	63	20	2E-3	
CTC	50	63	20	2E-3	Varies

Table 61 Television & DAB Reception - Location T

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	12	2SNO	93.5	35
2ABCFM	102.3	23	2ABCFM	95.7	16
1CBR	106.3	23	2JJJ	98.9	17

Table 62 FM Radio – Location T



2.24.2 Observations



Figure 98 Location T - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra, with patches of no coverage. Good coverage was measured from Canberra, variable coverage from Goulburn and unusable coverage from Bungendore.



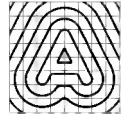
Figure 99 Location T - relationship to turbine locations

The path to the Canberra transmitters is shown in red, to Bungendore in yellow and to Goulburn in green. All paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.



Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	48 km	216°	Good	No
Goulburn	37 km	60°	Variable	No
Bungendore	3 km	240°	Unusable	No

Table 63 - Summary of observations for Location T



2.25 LOCATION U

This location is at Leridan, on the Gunning - Collector Road.



Figure 100 Location U



Figure 101 Test Site - Location U



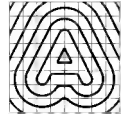
2.25.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	66	25	<1E-7	
SBS	7	66	25	<1E-7	
ABC	8	64	25	<1E-7	
WIN	11	71	26	5E-7	
CBN	12	72	22	2E-3	
DAB 1	9C	66	>25	2E-2	
DAB 2	10B	58	24	<1E-3	
Goulburn					
SBS	40	69	22	3E-6	
ABC	41	67	20	1E-6	
CBN	42	69	4	<1E-7	
WIN	43	66	22	2E-4	
CTC	44	64	17	>1E-1	
Bungendore					
SBS	46	76	24	<1E-7	
ABC	47	75	23	<1E-7	
CBN	48	75	26	<1E-7	
WIN	49	75	31	<1E-7	
CTC	50	73	28	<1E-7	

Table 64 Television & DAB Reception - Location U

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	14	2SNO	93.5	32
2ABCFM	102.3	20	2ABCFM	95.7	12
1CBR	106.3	26	2JJJ	98.9	18

Table 65 FM Radio – Location U



2.25.2 Observations

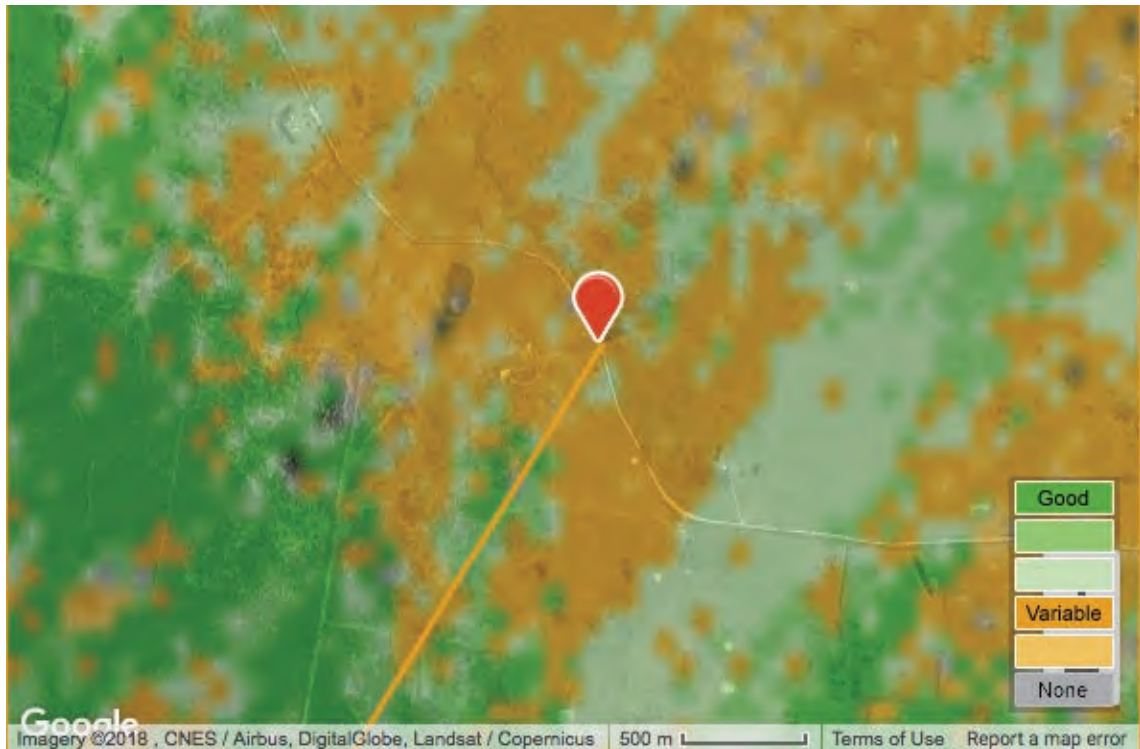


Figure 102 Location U - Predicted coverage from Canberra

The ACMA coverage predictions for this site show good coverage from Canberra, however the measured coverage was variable. Variable coverage was observed from Goulburn and good coverage from Bungendore.

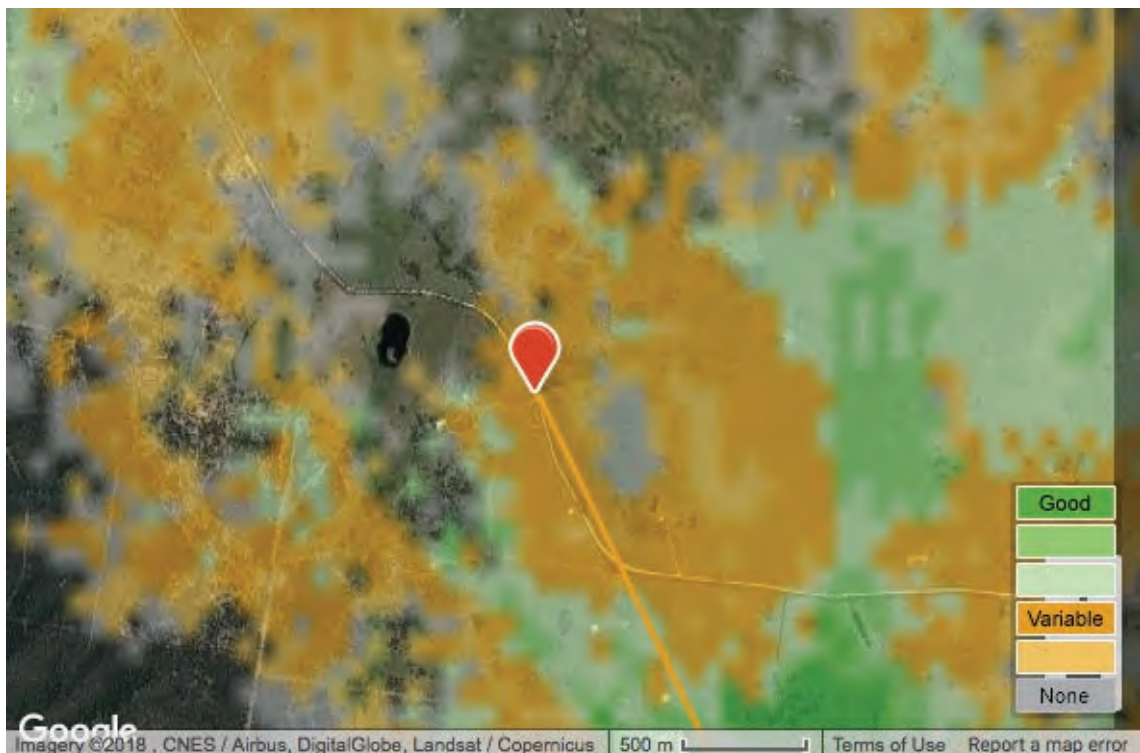


Figure 103 Location U - Predicted coverage from Bungendore

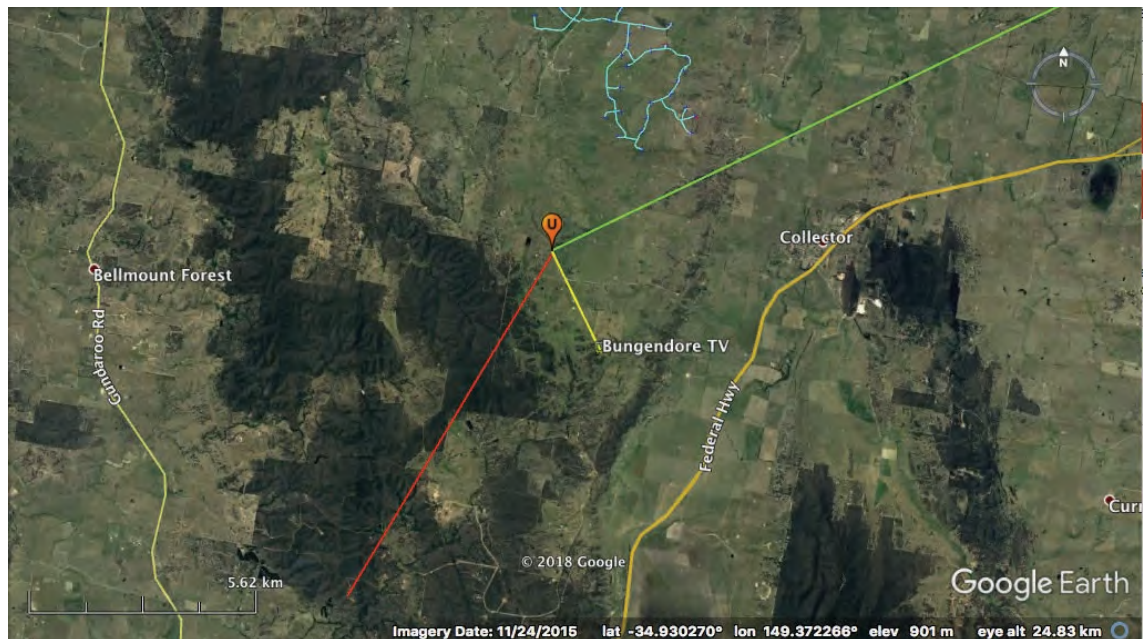
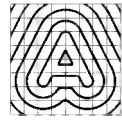


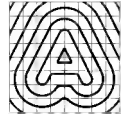
Figure 104 Location U - relationship to turbine locations

The path to the Canberra transmitters is shown in red, with the path to Bungendore in yellow and the path to Goulburn in green. The Canberra and Bungendore paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

The Goulburn path is some 10 degrees from the nearest turbine so there may be interference with reception from Goulburn. The measured reception from Bungendore was better than that from Goulburn.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	47 km	211°	Variable	No
Goulburn	40 km	65°	Variable	Possibly
Bungendore	3 km	154°	Good	No

Table 66 - Summary of observations for Location U



2.26 LOCATION V

This location is at The Towers, on the Gunning – Collector Road.

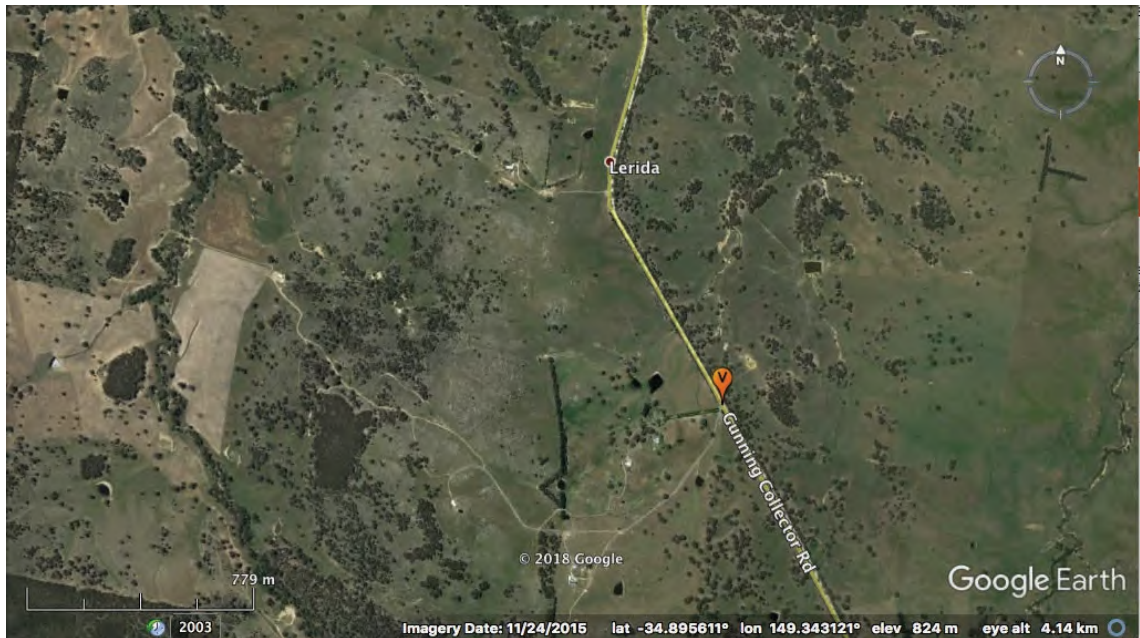


Figure 105 Location V



Figure 106 Test Site - Location V



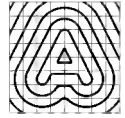
2.26.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	68	28	<1E-7	
SBS	7	61	20	2E-3	
ABC	8	60	20	3E-3	
WIN	11	74	29	<1E-7	
CBN	12	77	32	<1E-7	
DAB 1	9C	63	>25	<1E-3	
DAB 2	10B	58	24	<1E-3	
Goulburn					
SBS	40	54	-	>1E-1	
ABC	41	48	-	>1E-1	
CBN	42	49	-	>1E-1	
WIN	43	51	-	>1E-1	
CTC	44	51	-	>1E-1	
Bungendore					
SBS	46	65	18	>1E-1	
ABC	47	61	19	>1E-1	
CBN	48	57	16	>1E-1	
WIN	49	60	19	4E-4	
CTC	50	59	17	>1E-1	

Table 67 Television & DAB Reception - Location V

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	8	2SNO	93.5	30
2ABCFM	102.3	16	2ABCFM	95.7	8
1CBR	106.3	24	2JJJ	98.9	8

Table 68 FM Radio – Location V



2.26.2 Observations

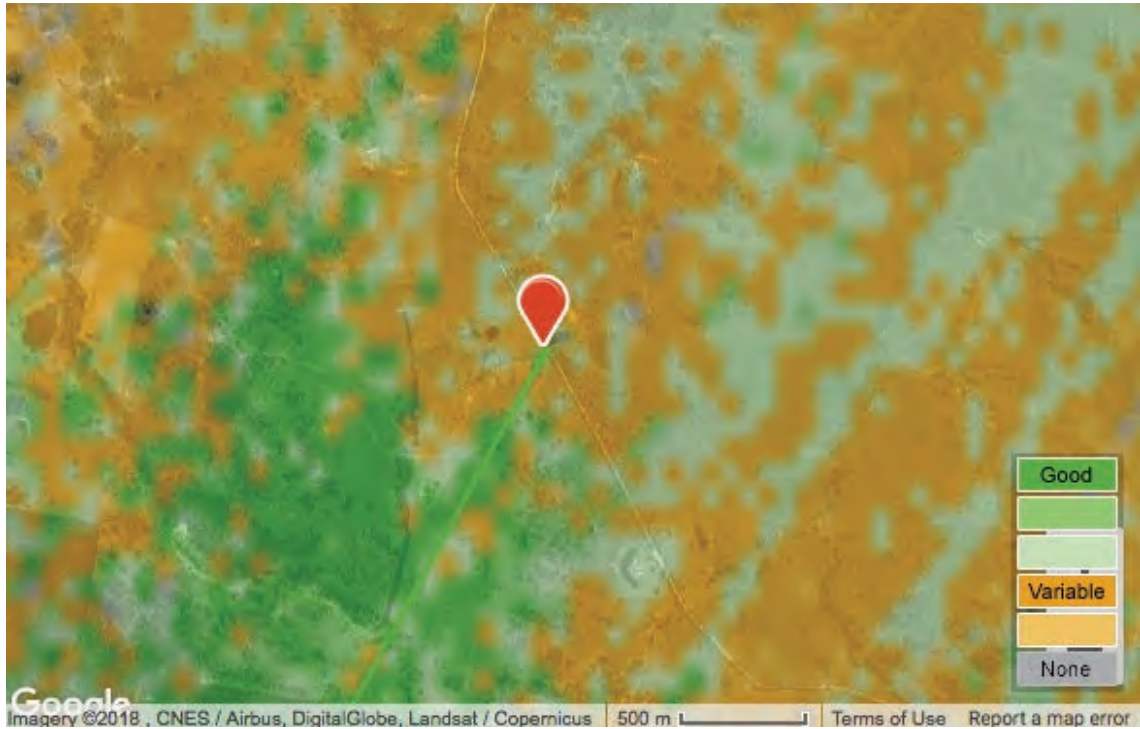


Figure 107 Location V - Predicted coverage from Canberra

The ACMA coverage predictions for this site show good coverage from Canberra, with variable coverage in the surrounding areas. Variable coverage is predicted from Bungendore.

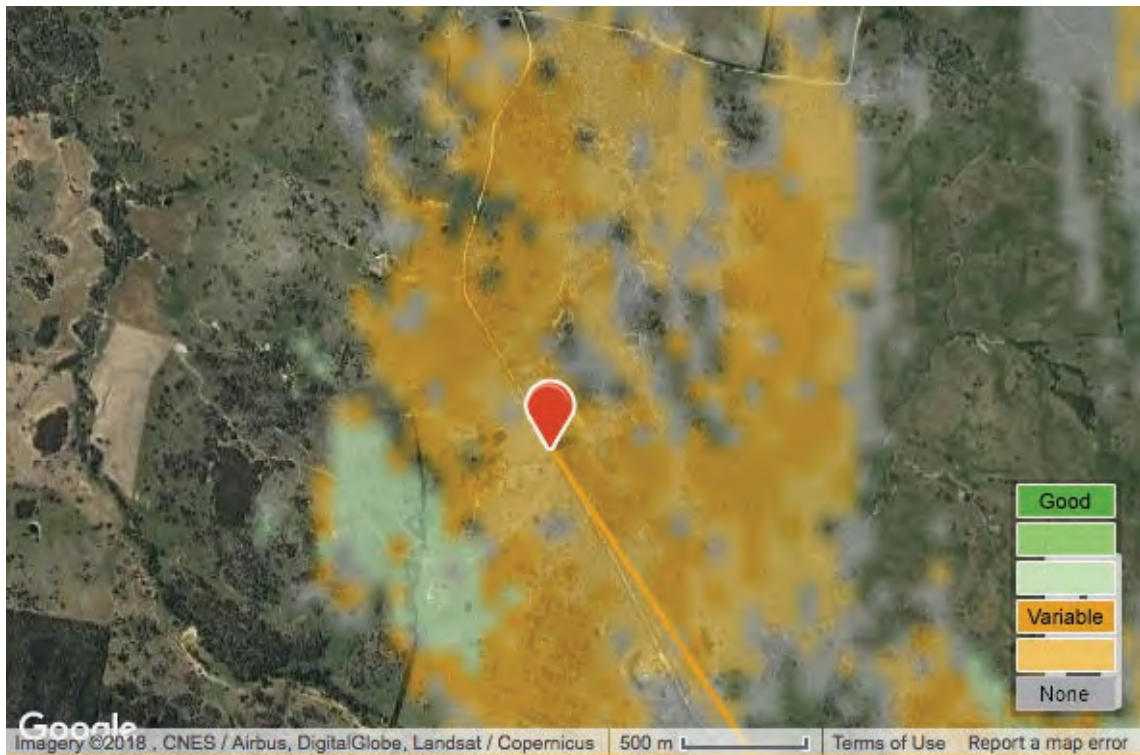


Figure 108 Location V - Predicted coverage from Bungendore

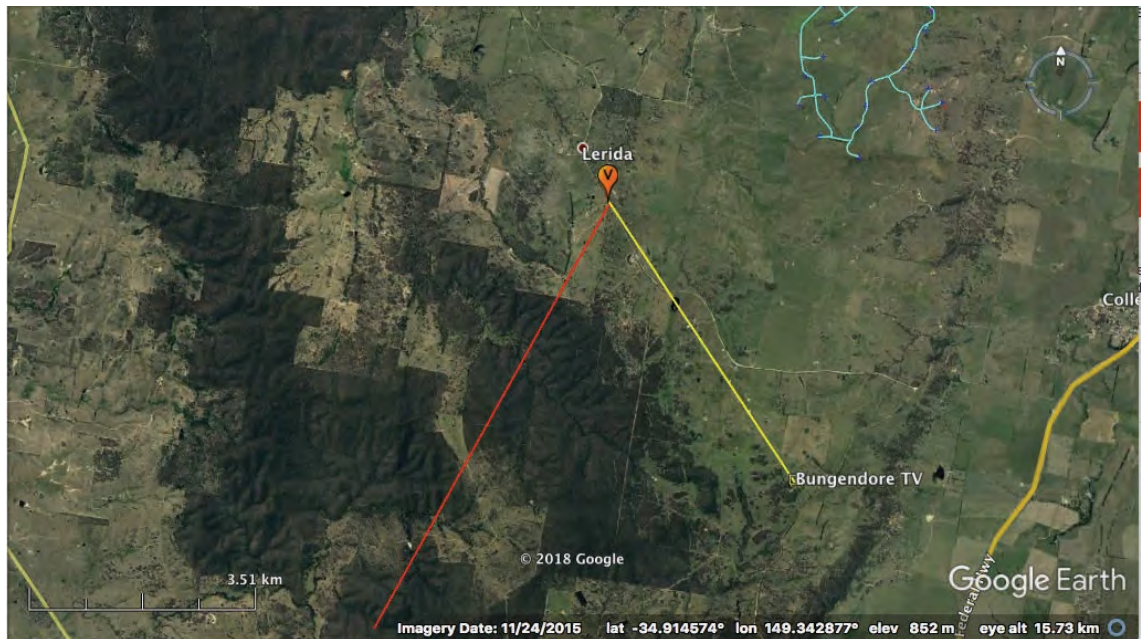
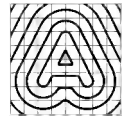
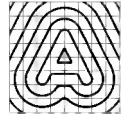


Figure 109 Location V - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to Bungendore in yellow. Both paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	48 km	209°	Variable	No
Goulburn	-	-	-	-
Bungendore	5 km	147°	-	No

Table 69 - Summary of observations for Location V



2.27 LOCATION W

This location is at 37 Goulburn Street, Collector.

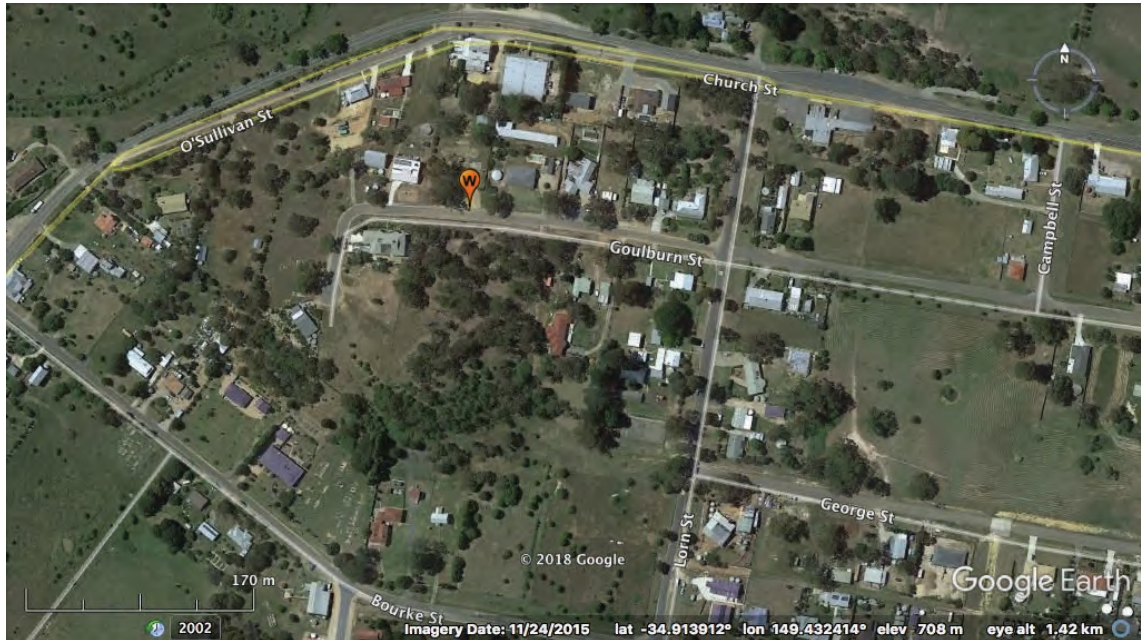


Figure 110 Location W



Figure 111 Test Site - Location W



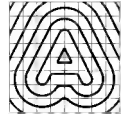
2.27.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	68	23	4E-5	
SBS	7	63	21	1E-4	
ABC	8	32	25	2E-5	Varies
WIN	11	34	24	7E-5	Varies5
CBN	12	35	20	9E-4	
DAB 1	9C	60	21	<1E-3	
DAB 2	10B	54	22	<1E-3	
Goulburn					
SBS	40	60	17	>1E-1	
ABC	41	57	15	>1E-1	
CBN	42	62	20	1E-3	
WIN	43	60	17	>1E-1	
CTC	44	61	18	>1E-1	
Bungendore					
SBS	46	68	22	<1E-7	Varies
ABC	47	67	25	2E-6	Varies
CBN	48	65	24	8E-7	Varies
WIN	49	66	27	<1E-7	Varies
CTC	50	68	29	<1E-7	Varies

Table 70 Television & DAB Reception - Location W

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	19	2SNO	93.5	39
2ABCFM	102.3	31	2ABCFM	95.7	12
1CBR	106.3	25	2JJJ	98.9	12

Table 71 FM Radio – Location W



2.27.2 Observations

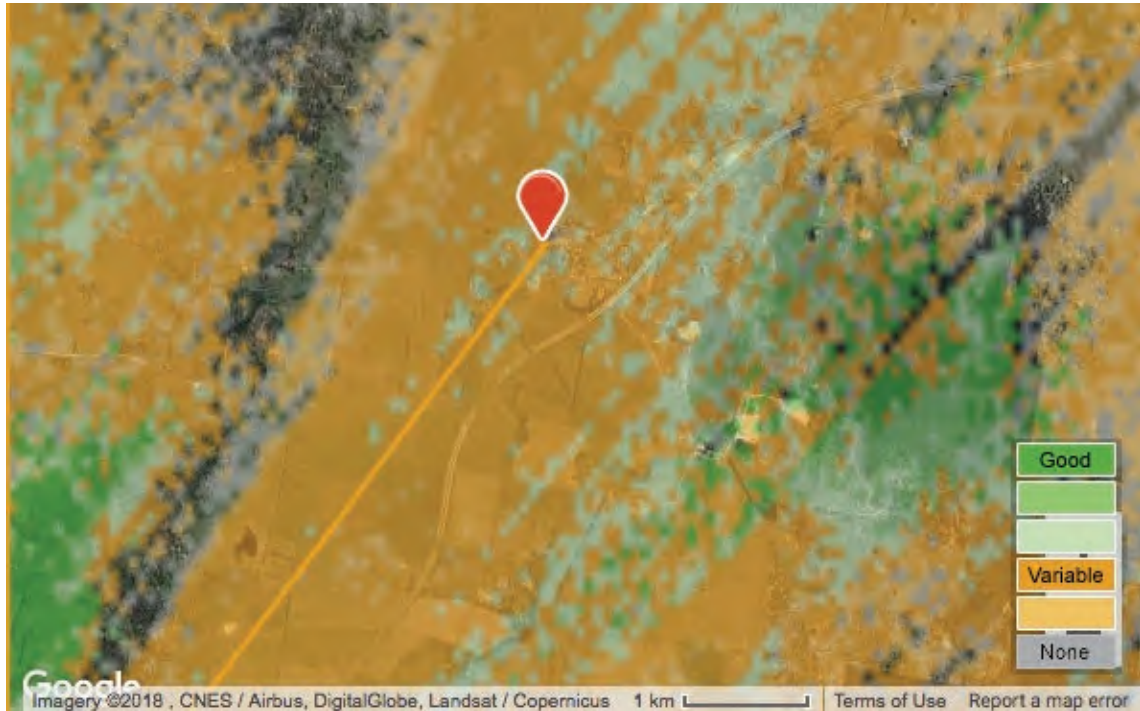


Figure 112 Location W - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. Variable coverage was measured from Canberra and Bungendore.



Figure 113 Location W - Predicted coverage from Canberra

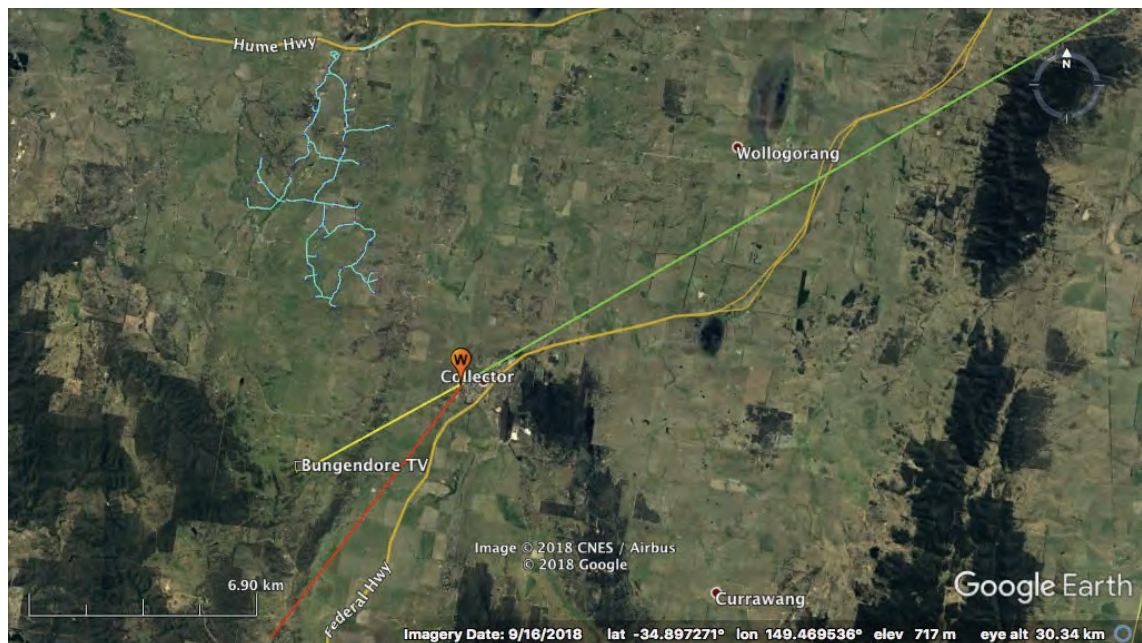
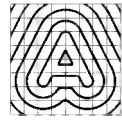
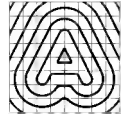


Figure 114 Location W - relationship to turbine locations

The path to the Canberra transmitters is shown in red, that to Goulburn in green and the path to Bungendore in yellow. All paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	50 km	217°	Variable	No
Goulburn	35 km	60°	-	No
Bungendore	5 km	240°	Variable	No

Table 72 - Summary of observations for Location W



2.28 LOCATION X

This location is at 3 O'Sullivan Street, Collector.



Figure 115 Location X



Figure 116 Test Site - Location X



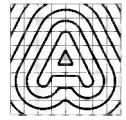
2.28.1 Television and FM Radio Measurements

Call Sign	Channel	dB μ V	MER dB	BER	Comments
Canberra					
CTC	6	62	17	>1E-1	
SBS	7	59	17	>1E-1	
ABC	8	53	-	>1E-1	
WIN	11	59	16	>1E-1	
CBN	12	66	20	2E-2	
DAB 1	9C	56	19	<1E-3	
DAB 2	10B	47	14	2E-2	
Goulburn					
SBS	40	51	-	>1E-1	
ABC	41	47	-	>1E-1	
CBN	42	49	-	>1E-1	
WIN	43	48	-	>1E-1	
CTC	44	48	-	>1E-1	
Bungendore					
SBS	46	83	30	<1E-7	
ABC	47	82	30	<1E-7	
CBN	48	80	28	<1E-7	
WIN	49	80	31	<1E-7	
CTC	50	81	38	<1E-7	

Table 73 Television & DAB Reception - Location X

Station	MHz	dB μ V	Station	MHz	dB μ V
1XXXR	98.3	10	2SNO	93.5	33
2ABCFM	102.3	18	2ABCFM	95.7	6
1CBR	106.3	14	2JJJ	98.9	6

Table 74 FM Radio – Location X



2.28.2 Observations

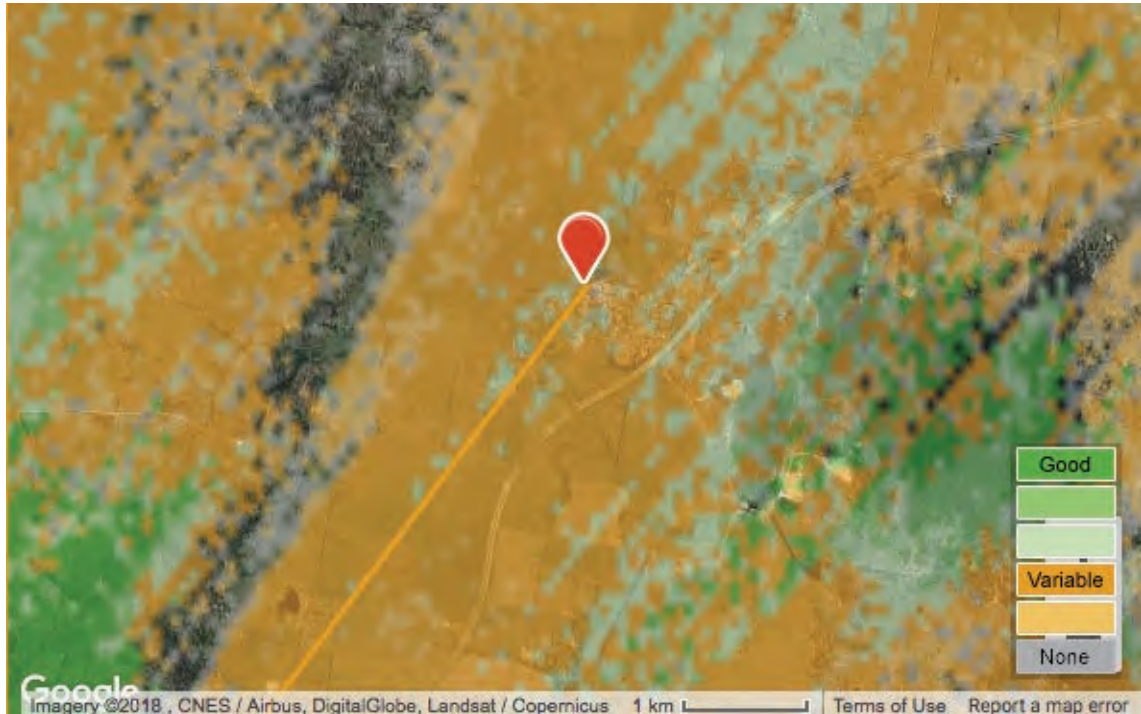


Figure 117 Location X - Predicted coverage from Canberra

The ACMA coverage predictions for this site show variable coverage from Canberra and Bungendore. The measurements showed good coverage from Bungendore.



Figure 118 Location X - Predicted coverage from Canberra

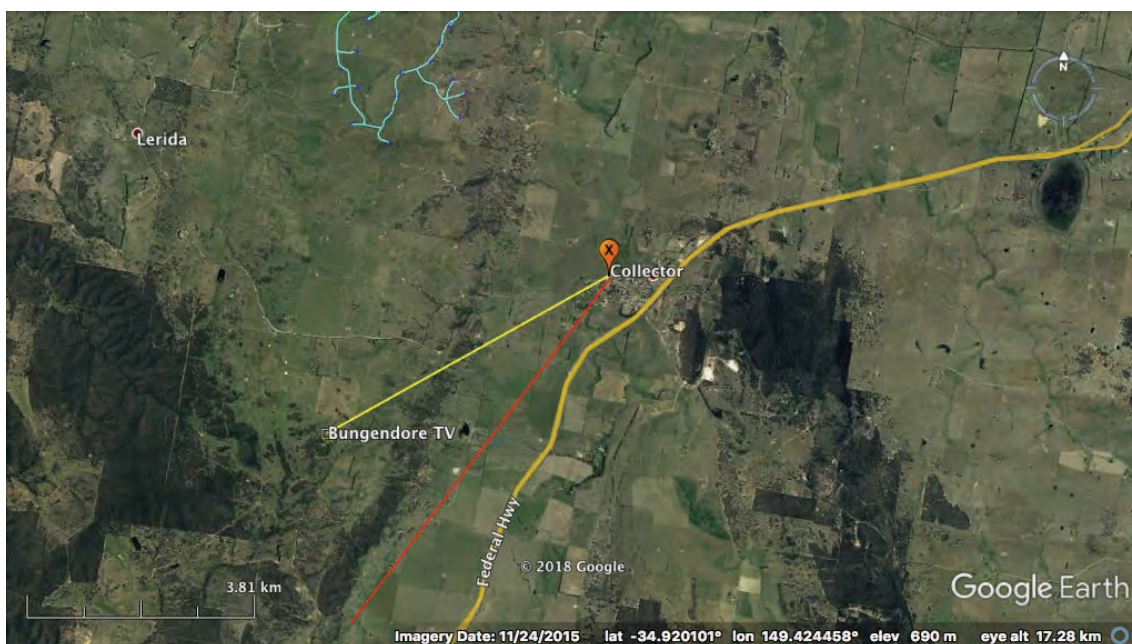
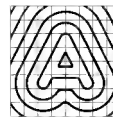


Figure 119 Location X - relationship to turbine locations

The path to the Canberra transmitters is shown in red and the path to the Bungendore transmitters is in yellow. Both paths are well removed from the turbines and there should not be any interference with reception if an appropriate television antenna is used.

Transmitter	Distance	Bearing	Reception	Affected by Wind Farm?
Canberra	51 km	217°	-	No
Goulburn	-	-	-	No
Bungendore	5 km	239°	Good	No

Table 75 - Summary of observations for Location X