Proposal to vary the Armidale licence   
area plan

Consultation paper

october 2023

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Executive summary

The ACMA is seeking comments on proposed changes to the [Licence Area Plan – Armidale Radio](https://www.legislation.gov.au/Series/F2005B00587) (Armidale LAP).

We are proposing to vary the Armidale LAP to:

make spectrum available for:

2 new FM transmitters at Armidale Town for the 2AD and 2NEB commercial radio broadcasting services to improve coverage provided by their main transmitters.

2 new FM transmitters at Guyra for the 2AD and 2NEB commercial radio broadcasting services to improve coverage provided by their main transmitters.

2 new FM transmitters at Uralla for the 2AD and 2NEB FM commercial radio broadcasting services to improve coverage provided by their main transmitters.

make other minor amendments.

The draft variation instrument, Variation to Licence Area Plan – Armidale Radio 2023 (No. 1), that would give effect to the proposed changes, is available alongside this paper on the [ACMA website](https://www.acma.gov.au/have-your-say).

# Issues for comment

We welcome your comments on the issues raised in this paper, or on any other issues relevant to the proposed LAP variation.

Details on making a submission can be found in the [Invitation to comment](#_Invitation_to_comment_1) section at the end of this document.

# Introduction

## Planning broadcasting services

Our broadcasting planning functions are set out in Part 3 of the *Broadcasting Services Act 1992* (the BSA). We promote the objects of the BSA (section 3), including the economic and efficient use of radiofrequency spectrum, and consider the planning criteria set out in section 23 of the BSA.

When planning analog broadcasting services, we refer to the [*ACMA approach to broadcast planning and varying LAPs*](https://www.acma.gov.au/broadcast-planning-resources), which provides an overview of the regulatory framework, policy objectives and planning process for analog broadcasting services.

Under section 26 of the BSA, we must prepare licence area plans (LAPs) that determine the number and characteristics, including technical specifications, of broadcasting services that are to be available in particular areas of Australia. The BSA also provides us with a discretionary power to vary LAPs.

In proposing to vary the Armidale LAP, we have considered the planning criteria outlined in section 23 of the BSA. Particular consideration was given to the demographics, social and economic characteristics within the licence area, as well as the technical restraints relating to the delivery or reception of broadcasting services –paragraphs 23(a), (b) and (e).

## AM–FM conversions

Our published guide, [*Principles for planning AM to FM conversions in regional licence areas*](https://www.acma.gov.au/publications/2017-11/guide/principles-planning-am-fm-conversions-regional-licence-areas), informs the way we resolve complex issues regarding AM to FM conversions and infill transmitters for commercial radio broadcasting services.

We will continue to consider and progress current proposals for conversions in   
non-competitive markets, while we open the program for conversions in competitive areas so that more listeners can benefit. We expect to finalise the requests in   
non-competitive markets that are currently underway and where appropriate   
spectrum has already been identified.

More information about the [AM–FM conversion principles](https://www.acma.gov.au/publications/2017-11/guide/principles-planning-am-fm-conversions-regional-licence-areas) can be found on the   
ACMA website.

## Overview of the Armidale LAP

The Armidale LAP currently provides for the Armidale RA1 and Armidale RA2 radio licence areas.

For the Armidale RA1 licence area, the Armidale LAP plans the following services:

5 national radio broadcasting services, to serve the Armidale area

2 national radio broadcasting services, to serve the Walcha area

2 commercial radio broadcasting services, to serve the Armidale and Walcha areas

2 open narrowcasting broadcasting services, to serve the Armidale area

one open narrowcasting broadcasting service, to serve the Walcha area.

For the Armidale RA2 licence area, the Armidale LAP plans the following services:

one community radio broadcasting service, to serve the Armidale area.

# Proposal 1: Commercial radio – Armidale RA1

## Summary

We propose to:

Make spectrum available for an FM infill transmitter for the 2AD commercial   
radio broadcasting service to serve Armidale Town. The proposed technical specifications plan for the FM transmitter to operate on 97.3 MHz with an effective radiated power (ERP) of 100 watts (W), with mixed polarisation, an omnidirectional (OD) antennal pattern and an antenna height of 15 m, from the 2AD Studio Site at   
123 Rusden St, Armidale.

Make spectrum available for an FM infill transmitter for the 2NEB commercial radio broadcasting service to serve Armidale Town. The proposed technical specifications plan for the FM transmitter to operate on 98.1 MHz with an ERP of 100 W, with mixed polarisation, an OD antennal pattern and an antenna height of 15 m, from the 2AD Studio Site at 123 Rusden St, Armidale.

Make spectrum available for an FM infill transmitter for the 2AD commercial broadcasting service to serve Guyra. The proposed technical specifications will plan for an FM transmitter to operate on 105.7 MHz with an ERP of 100 W, with mixed polarisation, an OD antennal pattern and an antenna height of 25 m, from SE Reservoir, Prisk Hill, Georges Close, Guyra.

Make spectrum available for an FM infill transmitter for the 2NEB commercial broadcasting service to serve Guyra. The proposed technical specifications will plan for an FM transmitter to operate on 107.3 MHz with an ERP of 100 W, with mixed polarisation, an OD antennal pattern and an antenna height of 25 m, from SE Reservoir, Prisk Hill, Georges Close, Guyra.

Make spectrum available for an FM infill transmitter for the 2AD commercial broadcasting service to serve Uralla. The proposed technical specifications will plan for an FM transmitter to operate on 105.3 MHz with an ERP of 100 W, with mixed polarisation, an OD antennal pattern and an antenna height of 25 m, from Council Tower, Mt Mutton, Lookout Rd, Uralla.

Make spectrum available for an FM infill transmitter for the 2NEB commercial broadcasting service to serve Uralla. The proposed technical specifications will plan for an FM transmitter to operate on 106.1 MHz with an ERP of 100 W, with mixed polarisation, an OD antennal pattern and an antenna height of 25 m from Council Tower, Mt Mutton, Lookout Rd, Uralla.

We consider that this proposal is an economic and efficient use of spectrum that is likely to promote the objects in section 3 of the BSA, particularly the availability of a diverse range of radio services (paragraph 3(1)(a) of the BSA). In developing this proposal, we have taken into account the planning criteria in section 23 of the BSA and especially the technical restraints relating to the delivery or reception of broadcasting services in the area (paragraph 23(e)).

**Background**

The Armidale RA1 licence area comprises the towns of Armidale, Guyra, Uralla and Walcha, as well as surrounding areas. The population of the Armidale RA1 licence area is 36,058.[[1]](#footnote-2)

The urban centre of Armidale, also referred to as Armidale Town, is situated in the Northern Tablelands in New South Wales and has a population of 21,312.[[2]](#footnote-3) It is the largest of the urban centres in the Armidale RA1 licence area, with Guyra, Uralla and Walcha having populations of 2,077, 2,385 and 1,369 people respectively.[[3]](#footnote-4) Higher education is the leading industry for employment in the area.

The Armidale RA1 licence area overlaps the commercial radio licence areas of Inverell RA1 and the Remote Commercial Radio Service North East Zone RA1, while the Tamworth RA1 licence area lies on the southwestern edge of Armidale RA1. Commercial radio services within these areas include 2GEM, 2NZ, 4BRZ, 4RBL,   
2TM and 2TTT.

A variation of the Armidale radio LAP in January 2020 was approved to allow for the conversion of the 2AD[[4]](#footnote-5) commercial radio broadcasting service from an AM to FM transmission, with the main transmitter to broadcast from the Telstra site at Little Duval, Armidale (Little Duval site).

Engineering analysis predicted that the planned FM service from the Little Duval site would provide comparative coverage to the AM transmission. This included the localities of Guyra and Uralla.

Following the variation in January 2020, the licensee advised the ACMA that they   
were unable to access the Little Duval site and subsequently, requested that the 2AD   
and 2NEB[[5]](#footnote-6) main transmitters be allowed to operate at a new site on Thunderbolts Cave Rd   
(see [Appendix A](#_Appendix_A:_Map)).

## Coverage and overspill assessment

The proposed new Thunderbolts Cave Rd site for the main FM transmitters of the 2AD and 2NEB radio broadcasting services is approximately 8 km northeast of the LAP planned Telstra site at Little Duval site.

The ACMA is not proposing to change the nominal LAP planned location of the main site as it remains the optimal location from the planning perspective. Following the conclusion of the LAP variation process upon application, we would license transmitters at the Thunderbolts Cave Rd site consistently with Part 3 of the [Broadcasting Services (Technical Planning) Guidelines 2017](https://www.legislation.gov.au/Details/F2021C01288) (TPGs), otherwise known as the change of site criteria. Part 3 permits, under certain conditions, for a transmitter to be located at a different site to the one planned in the LAP. These conditions are met by the proposed technical specifications in the case of transmitters at the Thunderbolts Cave Rd site.

It is proposed that both the 2AD and 2NEB services will retain the previously planned technical specifications. The main transmitter for the 2AD service is still proposed to operate on 94.3 MHz with a maximum ERP of 10 kW, a vertical antennal polarisation and directional radiation. The main transmitter for the 2NEB service is still proposed to operate on 100.3 MHz with a maximum ERP of 10 kW, vertical antennal polarisation and directional radiation.

We have identified that it is possible for the 2AD and 2NEB services’ main transmitters to be operated from the Thunderbolts Cave Rd site, as no overspill into neighbouring licence areas is expected to occur. However, it was found that the signal strength from the Thunderbolts Cave Rd site may not reach a suburban grade level of 66 dBµV/m in Armidale Town, Guyra and Uralla. We are proposing additional infill transmitters in each of these townships to provide appropriate coverage across the Armidale RA1 licence area.

### Armidale Town

It is proposed that the 2AD and 2NEB services’ infill transmitters for Armidale Town will operate from the 2AD Studio site at 123 Rusden St, Armidale, with maximum ERP of 100 W, a mixed polarisation, an OD antenna pattern and an antenna height of 15 m (see [Appendices B1](#_B1:_2AD_commercial) and [B2](#_B2:_2NEB_commercial)). Approximately 12,500–19,500 persons[[6]](#footnote-7) from the Armidale Town urban centre population are predicted to receive coverage of both the 2AD and 2NEB infill transmitters. No overspill into adjacent licence areas has been predicted to occur as a result of the operation of the additional infill transmitters.

### Guyra

It is proposed that the 2AD and 2NEB services’ infill transmitters for Guyra would operate from the SE Reservoir, Prisk Hill, Georges Close, with maximum ERP of 100 W, a mixed polarisation, an OD antenna pattern and an antenna height of 25 m (see [Appendices B3](#_B3:_2AD_commercial) and [B4](#_B4:_2NEB_commercial)). The proposed site of the transmitters is located in the northern extreme of the Armidale RA1 licence area, which overlaps with both the Inverell RA1 and Remote Commercial Radio North East Zone RA1 licence areas.

As a result, people in the overlap areas between the Armidale RA1 licence area and the Inverell RA1 and Remote Commercial Radio North East Zone RA1 licence areas will be able to receive the 2AD and 2NEB services. However, the ACMA expects there will be very few people outside the Armidale RA1 licence area who will receive the services from these transmitters. There is minor overspill predicted within the Inverell RA1 licence area within a rural grade level of coverage (54 dBµV/m), affecting less than 50 people. No population in the Remote Commercial Radio Service North East Zone RA1 licence area (outside the overlap with the Armidale RA1 licence area) is predicted to be affected by any potential overspill.

### Uralla

It is proposed that the 2AD and 2NEB services’ infill transmitters for Uralla would operate from Council Tower, Mt Mutton, Lookout Rd, Uralla, with maximum ERP of 100 W, a mixed polarisation, an OD antennal pattern and an antenna height of 25 m (see [Appendices B5](#_B5:_2AD_commercial) and [B6](#_B6:_2NEB_FM)). The proposed site of the transmitters is located on the southwestern edge of the Armidale RA1 licence area.

The Tamworth RA1 licence area borders the southwestern edge of the Armidale RA1 licence area. However, no overspill is predicted to occur within the Tamworth RA1 licence area.

## Interference assessment

There is a potential risk of interference with other neighbouring radio services, although very low from the proposed infill transmitters.

### Armidale Town

The proposed 2AD and 2NEB services’ infill transmitters operating on 97.3 MHz and 98.1 MHz at Armidale Town have limited potential to cause mutual interference with neighbouring radio broadcasting services, including both national and commercial radio broadcasting services in nearby licence areas.

### Guyra

The proposed 2AD and 2NEB services’ infill transmitters at Guyra have been planned on an interference-limited basis. This means that any transmission in accordance with the proposed technical specification is planned to be protected to a minimum median field strength of 66 dBµV/m against interference from other broadcasting services. Signal levels below the minimum median field strength level are likely to suffer some interference.

While the interference risk has been predicted to be low, it is possible that the 2AD service’s infill transmitter operating on 105.7 MHz could receive interference from neighbouring radio broadcasting services, impacting less than 20 persons at the suburban signal level, and between approximately 160–310 persons in areas of rural signal level.[[7]](#footnote-8)

The 2NEB service’s infill transmitter operating on 107.3 MHz is also predicted to have limited potential to receive interference. However, if it were to occur, it would mainly be from the LAP planned Murrurundi community radio broadcasting service.[[8]](#footnote-9) However, no such service is currently provided, as no community radio broadcasting licence for the area has been allocated for it. If interference were to occur, it is predicted that less than 50 persons would be affected by interference in areas of suburban signal level, and between approximately 220–340 persons[[9]](#footnote-10) in areas of rural signal level.

### Uralla

As with the proposed infill transmitters at Guyra, the 2AD and 2NEB services’ infill transmitters at Uralla have been planned on an interference-limited basis. This means that any transmission in accordance with the proposed technical specification is planned to be protected to a minimum median field strength of 66 dBµV/m against interference from other broadcasting services. Field strengths below the minimum median field strength level are likely to suffer some interference.

For the 2NEB service’s infill transmitter operating on 105.3 MHz, the   
2ABCFM Newcastle national radio broadcasting service has been assessed to   
have the strongest potential for interference to the 2NEB service. Approximately   
60–130 persons[[10]](#footnote-11) may suffer interference within the areas of suburban signal level.

### Advisory note

We are proposing to attach advisory notes to the technical specifications of the 2AD and 2NEB infill transmitters at Armidale Town (see [Appendices B1](#_B1:_2AD_commercial) and [B2](#_B2:_2NEB_commercial)), indicating that the transmissions are protected to a minimum median field strength   
of 66 dBµV/m.

We are also proposing to attach advisory notes to the technical specifications of the 2AD and 2NEB infill transmitters at Guyra and Uralla (see [Appendices B3](#_B3:_2AD_commercial), [B4](#_B4:_2NEB_commercial), [B5](#_B5:_2AD_commercial)   
and [B6](#_B6:_2NEB_FM)), indicating that the transmissions have been planned on an interference-limited basis and are protected to a minimum median field strength of 66 dBµV/m.

## Preliminary view

We consider the proposal to make frequencies available for a total of 6 infill transmitters in Armidale Town, Guyra and Uralla an economic and efficient use of spectrum. The proposal promotes the objects of the BSA, particularly in section 3(1)(a), as it would assist in the continued delivery of a diverse range of broadcasting services to a significant proportion of the existing audience.

The proposed technical specifications for the 2AD and 2NEB service’s infill transmitters in Armidale Town, Guyra and Uralla are found in [Appendix B](#_Appendix_B:_Technical). The draft Variation to Licence Area Plan – Armidale Radio 2023 (No. 1) is available alongside this paper on the [ACMA website](https://www.acma.gov.au/have-your-say).

# Proposal 2: Minor amendments

In addition to the changes outlined above, we also propose to make minor amendments to the text, schedules and attachments of the Armidale LAP to:

Update clause 2 to omit ‘Six national’ and substitute with ‘Seven national’, to reflect the number of national radio broadcasting services listed in schedule one.

Remove from every attachment the reference to the Broadcasting Services (Technical Planning) Guidelines 2017 and put the reference in a substantive clause at the start of the LAP. These changes are not intended to affect the operation of the LAP.

Make formatting and grammatical changes to the Armidale LAP and its various attachments.

# Invitation to comment

## Making a submission

We invite comments on the issues set out in this consultation paper.

[Online submissions](https://www.acma.gov.au/have-your-say) can be made by uploading a document. Submissions in PDF, Microsoft Word or Rich Text Format are preferred.

Submissions by post can be sent to:

The Manager

Broadcasting Carriage Policy Section

Australian Communications and Media Authority

PO Box 78

Belconnen ACT 2616

The closing date for submissions is **COB,** **Friday 17 November 2023**.

Consultation enquiries can be emailed to [BCP@acma.gov.au](mailto:BCP@acma.gov.au).

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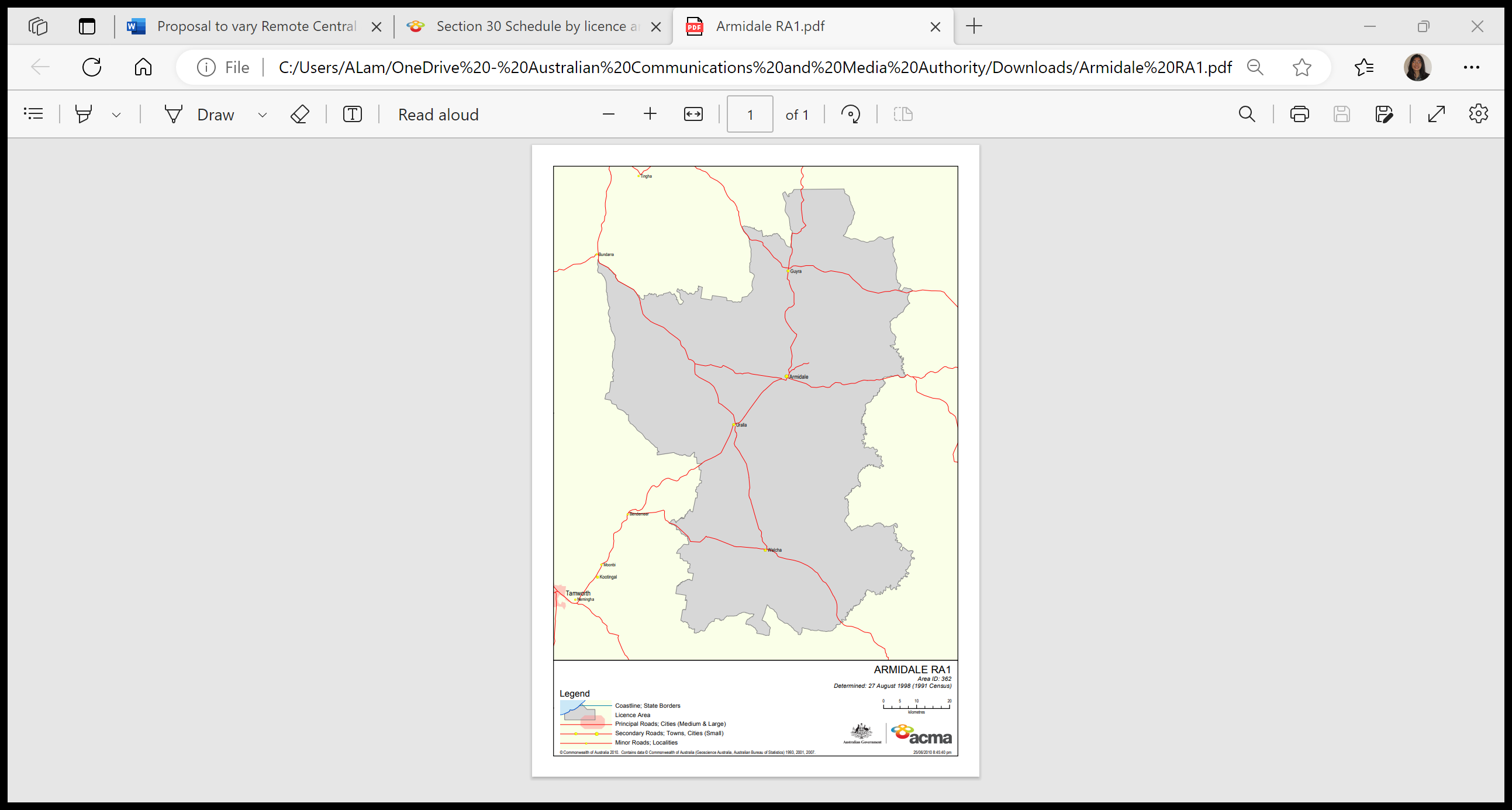
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# Appendix A: Map of the Armidale RA1 licence area



# Appendix B: Technical specifications

## B1: 2AD commercial radio broadcasting service – infill transmitter

**LICENCE AREA PLAN : Armidale Radio**

Category : Commercial

General Area Served : Armidale Town (NSW)

Service Licence Number : SL4105

**TECHNICAL SPECIFICATION - FM Radio**

Specification Number : TS12001211

Transmitter Site :-

Nominal location : Broadcast Studio Site 123 Rusden St

ARMIDALE

Nominal Co-ordinates Latitude Longitude  
(GDA94) :  -30.515052 151.667427

Emission :-

Frequency Band & Mode : VHF-FM

Carrier Frequency : 97.3 MHz

Polarisation : Mixed

Maximum antenna height : 15 m

Output Radiation Pattern :-

|  |  |
| --- | --- |
| Bearing or Sector (Clockwise direction) | Maximum ERP |
| At all angles of azimuth | 100 W |

***Advisory note:-***

Any transmission in accordance with this technical specification is planned on the basis that it will be protected to a minimum median field strength level of 66 dBμV/m against interference from other broadcasting services.

## B2: 2NEB commercial radio broadcasting service – infill transmitter

**LICENCE AREA PLAN : Armidale Radio**

Category : Commercial

General Area Served : Armidale Town (NSW)

Service Licence Number : SL10316

TECHNICAL SPECIFICATION - FM Radio

Specification Number : TS12001212

Transmitter Site :-

Nominal location : Broadcast Studio Site 123 Rusden St

ARMIDALE

Nominal Co-ordinates Latitude Longitude  
(GDA94) :  -30.515052 151.667427

Emission :-

Frequency Band & Mode : VHF-FM

Carrier Frequency : 98.1 MHz

Polarisation : Mixed

Maximum antenna height : 15 m

Output Radiation Pattern :-

|  |  |
| --- | --- |
| Bearing or Sector (Clockwise direction) | Maximum ERP |
| At all angles of azimuth | 100 W |

Advisory note:-

Any transmission in accordance with this technical specification is planned on the basis that it will be protected to a minimum median field strength level of 66 dBμV/m against interference from other broadcasting services.

## B3: 2AD commercial radio broadcasting service – infill transmitter

**LICENCE AREA PLAN : Armidale Radio**

Category : Commercial

General Area Served : Guyra (NSW)

Service Licence Number : SL4105

**TECHNICAL SPECIFICATION - FM Radio**

Specification Number : TS12000900

Transmitter Site :-

Nominal location : SE Reservoir, Prisk Hill

Georges Close

GUYRA

Nominal Co-ordinates Latitude Longitude  
(GDA94) :  -30.217098 151.683086

Emission :-

Frequency Band & Mode : VHF-FM

Carrier Frequency : 105.7 MHz

Polarisation : Mixed

Maximum antenna height : 25 m

Output Radiation Pattern :-

|  |  |
| --- | --- |
| Bearing or Sector (Clockwise direction) | Maximum ERP |
| At all angles of azimuth | 100 W |

Advisory notes:-

Any transmission in accordance with this technical specification is planned on the basis that it will be protected to a minimum median field strength level of 66 dBμV/m against interference from other broadcasting services.

This specification is planned on an interference limited basis. Field strengths below the planned minimum median field strength are likely to suffer interference from other broadcasting services.

## B4: 2NEB commercial radio broadcasting service – infill transmitter

LICENCE AREA PLAN : Armidale Radio

Category : Commercial

General Area Served : Guyra (NSW)

Service Licence Number : SL10316

**TECHNICAL SPECIFICATION - FM Radio**

Specification Number : TS12000899

Transmitter Site :-

Nominal location : SE Reservoir, Prisk Hill

Georges Close

GUYRA

Nominal Co-ordinates Latitude Longitude  
(GDA94) :  -30.217098 151.683086

Site Tolerance : Refer to *Broadcasting Services   
 (Technical Planning) Guidelines 2017*

Emission :-

Frequency Band & Mode : VHF-FM

Carrier Frequency : 107.3 MHz

Polarisation : Mixed

Maximum antenna height : 25 m

Output Radiation Pattern :-

|  |  |
| --- | --- |
| Bearing or Sector (Clockwise direction) | Maximum ERP |
| At all angles of azimuth | 100 W |

Advisory notes:-

Any transmission in accordance with this technical specification is planned on the basis that it will be protected to a minimum median field strength level of 66 dBμV/m against interference from other broadcasting services.

This specification is planned on an interference limited basis. Field strengths below the planned minimum median field strength are likely to suffer interference from other broadcasting services.

## B5: 2AD commercial radio broadcasting service – infill transmitter

**LICENCE AREA PLAN : Armidale Radio**

Category : Commercial

General Area Served : Uralla (NSW)

Service Licence Number : SL4105

**TECHNICAL SPECIFICATION - FM Radio**

Specification Number : TS12000918

Transmitter Site :-

Nominal location : Council Tower, Mt Mutton

Lookout Rd

URALLA

Nominal Co-ordinates Latitude Longitude  
(GDA94) :  -30.634600 151.496188

Emission :-

Frequency Band & Mode : VHF-FM

Carrier Frequency : 105.3 MHz

Polarisation : Mixed

Maximum antenna height : 25 m

Output Radiation Pattern :-

|  |  |
| --- | --- |
| Bearing or Sector (Clockwise direction) | Maximum ERP |
| At all angles of azimuth | 100 W |

Advisory notes:-

Any transmission in accordance with this technical specification is planned on the basis that it will be protected to a minimum median field strength level of 66 dBμV/m against interference from other broadcasting services.

This specification is planned on an interference limited basis. Field strengths below the planned minimum median field strength are likely to suffer interference from other broadcasting services.

## B6: 2NEB FM radio broadcasting service – infill transmitter

**LICENCE AREA PLAN : Armidale Radio**

Category : Commercial

General Area Served : Uralla (NSW)

Service Licence Number : SL10316

**TECHNICAL SPECIFICATION - FM Radio**

Specification Number : TS12000917

Transmitter Site :-

Nominal location : Council Tower, Mt Mutton

Lookout Rd

URALLA

Nominal Co-ordinates Latitude Longitude  
(GDA94) :  -30.634600 151.496188

Emission :-

Frequency Band & Mode : VHF-FM

Carrier Frequency : 106.1 MHz

Polarisation : Mixed

Maximum antenna height : 25 m

Output Radiation Pattern :-

|  |  |
| --- | --- |
| Bearing or Sector (Clockwise direction) | Maximum ERP |
| At all angles of azimuth | 100 W |

Advisory notes:-

Any transmission in accordance with this technical specification is planned on the basis that it will be protected to a minimum median field strength level of 66 dBμV/m against interference from other broadcasting services.

This specification is planned on an interference limited basis. Field strengths below the planned minimum median field strength are likely to suffer interference from other broadcasting services.

1. [Section 30](https://www.acma.gov.au/section-30-schedule-licence-area) of the BSA provides for the ACMA, having regard to the most recently published census count prepared by the Australian Statistician, to determine the population of a licence area. The most recent section 30 determination for the Armidale RA1 licence area uses 2021 census population data. [↑](#footnote-ref-2)
2. Australian Bureau of Statistics, [2021 Census QuickStats](https://www.abs.gov.au/census/find-census-data/search-by-area), viewed 1 September 2023. All other data in this section, unless stated otherwise in a footnote, will also originate from this source. [↑](#footnote-ref-3)
3. For extra context, Guyra is around 40 km north of Armidale, Uralla is about 23 km southwest of Armidale and Walcha sits approximately 55 km to the south of Armidale. [↑](#footnote-ref-4)
4. 2AD is the callsign and its broadcasting service licence (BSL) is 4105. [↑](#footnote-ref-5)
5. 2NEB is the callsign, and its BSL is 10316. [↑](#footnote-ref-6)
6. Based on figures produced from the CRC Predict and ITU-R 1546-1 analysis models. [↑](#footnote-ref-7)
7. Based on figures produced from the CRC Predict and ITU-R 1546-1 analysis models. [↑](#footnote-ref-8)
8. This service serves the Muswellbrook RA2 licence area, planned in the Licence Area Plan – Muswellbrook (Radio) – October 1998. [↑](#footnote-ref-9)
9. Based on figures produced from the CRC Predict and ITU-R 1546-1 analysis models. [↑](#footnote-ref-10)
10. Based on figures produced from the CRC Predict and ITU-R 1546-1 analysis models. [↑](#footnote-ref-11)