Australian Government | acma Australian Communications and Media Authority

Additional assurance measures for the coexistence of wireless broadband services and radio altimeters

Outcomes paper

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Executive summary

Background

In June 2023, to support the release of new spectrum arrangements for wireless broadband (WBB) services operating above 3700 MHz, we developed ongoing and interim mitigations for the coexistence of radio altimeters (RAs) and WBB.

In December 2025, we consulted on a new set of voluntary measures, developed with input from the Civil Aviation Safety Authority (CASA) to provide assurances that WBB services operating above 3700 MHz can coexist with Federal Aviation Authority (FAA) Airworthiness Directive-compliant RAs after the interim mitigations expire in March 2026.

Consultation

In response to the consultation, we received submissions from stakeholders in the aviation sector and one from the WBB sector representing the major network operators (MNOs) and WBB equipment vendors. Submissions indicated that the aviation sector is concerned about the potential risk of interference to RAs, with key feedback related to the voluntary nature of the assurance measures and consideration of additional airports, landing approach scenarios and RA usage scenarios.

The WBB sector were of the view that coexistence measures are not required after the expiry of the interim mitigations. However, sector members have agreed to the assurance measures proposed in our consultation. The WBB sector made 2 further proposals:

- to grandfather existing base stations that currently operate in the defined areas
- to increase the granularity of these defined areas by dividing them into inner and outer zones with different spurious emission requirements.

Outcomes

We have considered the feedback to this consultation and have decided to implement the assurance measures as consulted, with the following adjustments:

- The defined areas for the restriction zones at each identified runway will be divided into inner and outer zones, with applicable spurious emission limits defined for each zone.
- The spurious emission limit for non-AAS transmitters in the restricted zone has been clarified to apply per (antenna) port.
- On advice from CASA, one runway has been removed from the list of identified runways as it does not support the specified instrument approach scenarios that require protection.
- Additional text has been included in Radiocommunications Assignment and Licensing Instruction (RALI) MS 47 to provide additional clarity on developments to support the eventual lifting of the assurance measures and to explicitly reference the planned review of the assurance measures in Q1 2026.

Background

In June 2023, interim mitigations were made in order to support the coexistence between radio altimeters in the 4200–4400 MHz band and wireless broadband services in the 3700–4000 MHz band.[1] The interim mitigations are time limited with an end date of 31 March 2026.

A new global standard (DO-155A) is currently under development by the RTCA, Inc.[2] (RTCA) and European Organisation for Civil Aviation Equipment (EUROCAE) joint committee with an estimated timeframe of March 2027 at the earliest. This means that RAs that comply with the new global standard will not be available when the interim mitigations are lifted.

We consulted on Additional assurance measures for the coexistence of wireless broadband services and radio altimeters (the consultation) between December 2025 and February 2026. The consultation included a discussion on the coexistence environment after the interim mitigations are lifted and proposed voluntary assurance measures that will apply after, and feedback was invited to assist us in making the final planning decisions on assurance measures.

Since that consultation, CASA have completed their own consultation and have mandated FAA Airworthiness Directive (AD) compliant RAs for the use of low visibility approaches.[3] For the specified instrument approach procedures identified by CASA, aircraft RAs must meet the FAA AD tolerance levels.

This outcomes paper provides a summary of the feedback received from the consultation, our responses to key issues raised in submissions. and decisions taken in light of that feedback.

[1] Wireless broadband and radio altimeters coexistence: Outcomes paper.
[2] RTCA, Inc. is the entity name, not an acronym.
[3] Radio altimeter requirements due to 5G transmissions - (CD 2513AS) - Civil Aviation Safety Authority - Citizen Space.

Response to submissions

We received 5 public submissions and one confidential submission in response to our consultation process (the public submissions are available on our consultation page). Four submissions were provided from the aviation industry, and one was from the WBB sector. Our response to the key issues raised in submissions is provided in this section.

Comments on the risk of interference to radio altimeters

Submissions differed on the potential risk of interference to RAs. One submission referenced analysis conducted by the FAA identifying events where all other potential sources of interference have been eliminated. However, another noted that there have been no interference cases in Australia where a WBB transmitter was identified as the cause.

One submitter noted that the assessment of interference risk should consider the aggregate interference from multiple WBB transmitters, and not just an individual transmitter.

ACMA response

To date, we are not aware of any confirmed cases of interference to radio altimeters that have been attributed to WBB transmitters in Australia. No new evidence has been provided through submissions of definitive interference events to RAs from WBB deployments. Similar to the development of the interim mitigations, theoretical studies and empirical evidence from real-world deployments do not provide a conclusive view of the actual likelihood of interference to RAs.

As discussed in the consultation paper, the assurance measures have been developed to manage coexistence after the interim mitigations expire.

While our calculations to determine the defined areas were based on interference from single WBB transmitter, the interference threshold in the FAA AD that was used includes an aggregate factor to account for simultaneous spurious emissions from multiple WBB transmitters.[4]

Expiry of mitigations

Multiple submissions suggested that the interim mitigations, due to expire on 31 March, and any new controls, such as the voluntary assurance measures, should be extended and not expire until international new RA standards are implemented and compliant equipment is deployed.

Another submission proposed some text for inclusion in RALI MS47 to provide clarity on what events would be considered relevant inputs to a decision to lift the assurance measures.

ACMA response

The interim mitigations were developed to protect UC1 RAs.[5] Since their implementation, CASA has mandated a requirement to retrofit RAs on aircraft to the FAA AD performance. We now believe that under the FAA AD requirements, the risk of interference can be

[4] Demonstration of Radio Altimeter Tolerant Aircraft PS-AIR-600-39-01.

[5] The fundamental emissions case is where the wanted emissions in the operating bandwidth of the WBB service falls outside the RA operating bandwidth.

managed without the interim mitigations in place. As discussed in the consultation paper, the defined areas and emission limits in the assurance measures are based on the performance metrics of the now-mandated FAA AD, which are different to the parameters used to develop the interim mitigations. For aircraft that have not yet retrofitted, CASA have landing restrictions in place to manage this risk.[6]

We remain of the view that the assurance measures should be time-limited to balance the impact on WBB operation with time for the global standard to be developed and RA equipment to become available. As discussed in the consultation paper, due to the uncertainty around the global standard we will conduct a review in Q1 2028 to determine whether the end date needs to be adjusted. The implementation of the global standard and associated equipment availability will be key factors in this review.

While noting the current uncertainty about when the global RA standard will be finalised and when the next generation of RAs will be available, we have included some additional text in RALI MS47 to provide clarity.

Voluntary nature of the assurance measures

Some submissions expressed concerns about the voluntary nature of the assurance measures and proposed that controls should be mandatory and enforceable.

ACMA response

The ACMA's assessment is that a voluntary approach is appropriate in these circumstances because:

- We are not aware of any confirmed cases in Australia of altimeter interference being attributed to WBB.
- WBB transmitters highly likely to already comply with the reduced spurious emissions limits specified in the voluntary approach.
- Our approach has been developed in consultation with, and agreed to by, CASA, which also has an established process for the aviation industry to report cases of suspected interference from WBB transmitters.
- It is our strong expectation, based on extensive industry consultation, that Australia's major mobile network operators will comply with the voluntary arrangements.

In the unlikely event of evidence of interference caused by WBB base stations, we would look at other possible approaches, including the consideration of mandatory conditions.

The voluntary approach is also consistent with the current approach implemented in the US, where MNOs have agreed to adhere to stricter spurious emission limits (that is, these emission limits have not been mandated in the US). Domestically, one submission provided confirmation that the MNOs can agree to the measures with respect to the operation of devices under their spectrum licences.

Additional scenarios to consider

Some submissions included feedback on the scenarios where the assurance measures should be considered, including approach and missed approach corridors, sub-optimal approaches, low-altitude departure routes, other aircraft categories, other airports and

[6] 5G and aviation safety | Civil Aviation Safety Authority.

operation types. A number of submissions highlighted that RAs are used for more than just height-above-ground readings for landing approaches and that the assurance measures do not consider operations outside the defined areas and identified runways, which put introduce an interference risk for aircraft in these scenarios (for example, for emergency and medical operations).

One submitter noted that new flight approach procedures are being designed and can be introduced at airports. Submitters also suggested that mitigations should be able to apply to small cell and private network deployments near airports and apply to WBB transmitters operating below 3700 MHz.

ACMA response

We have developed the assurance measures to address the upcoming expiration of the interim mitigations. The interim mitigations that applied around identified runways were a precautionary approach to address specified instrument approach procedures where the safe operation of a RA is critical. The assurance measures are intended to provide continuity of that level of assurance for these scenarios. This means that the assurance measures will apply to the same services and scenarios as the interim mitigations, noting that similar to the interim mitigations, registration-exempt transmitters are not included given their lower interference risk. For services that are not exempt from registration, the assurance measures will apply whether they are spectrum licensed, small cell, or part of a private network.

We have worked with CASA to consider which flight approaches rely on the RA and should be on the list of identified runways. The number of identified runways subject to assurance measures has decreased when compared to the number of those subject to the interim mitigations, due to CASA amending the list of operations that require the protection of an FAA AD compliant RA. Consideration of including any new approach procedures would be dependent on advice from CASA.

Ongoing reporting system

Some submitters suggest that a reporting system should be established, involving coordination between government, airports and MNOs. The system would involve monitoring, verification and incident response.

ACMA response

We are of the view that the use of the current reporting method, whereby cases of potential interference to RAs are reported to CASA,[7] remains fit-for-purpose.

Alternative Method of Compliance (AMOC) runways

One submission mentioned that in the US, aircraft that have retrofitted to the FAA AD standard might still operate under an Alternative Method of Compliance (AMOC) that determines which runways are cleared for safe operation.

ACMA response

We are aware that the FAA has since determined that retrofitted aircraft can conduct previously restricted landings at all airports in the US. The potential issuing of AMOCs in Australia is a matter for CASA.

[7] Reporting issues, 5G and aviation safety | Civil Aviation Safety Authority.

In-band EIRP limit

We received differing views from stakeholders on the in-band equivalent isotropic radiated power (EIRP) limit on the 3.7 GHz spectrum licences. One submission requested that the EIRP limit be removed to make the licence conditions for all 3.4 GHz spectrum licences consistent with each other. Another submission emphasised that the EIRP limit should not be removed until the global standard has been finalised and RAs have been retrofitted.

ACMA response

These comments are outside the scope of this consultation process, as the in-band EIRP limit is an ongoing condition and not part of the interim mitigations that will expire 31 March 2026. The ACMA's five-year spectrum outlook[8] (FYSO) is the appropriate mechanism for proposing work on new or varied planning arrangements that are not within the scope of an existing consultation process.

Additional granularity in the defined areas

One submission contained a proposal for the defined areas to be split up into an inner and outer zone, with separate spurious emission limits applied to each. This would provide for easier compliance in the outer zone, while maintaining a similar level of protection for RAs.

ACMA response

We are of the view that splitting the defined areas into inner/outer zones, with associated spurious emission limits, would not significantly alter the interference risk to RAs, while easing the compliance burden for WBB operators. The spurious emission limits proposed in the consultation paper would still apply to transmitters located within the inner zone. The granular arrangements are illustrated in Tables 1, 2 and in Figure 1.

Appendix A contains the calculations used to determine the new outer zone, which was an application of the existing methodology described in the consultation paper to derive the restricted zone half-width. That is, the outer zone dimensions are based on the same methodology and FAA AD-informed interference threshold level as used in the consultation paper, with the exception of the assumed spurious emission limit that is set at -30 dBm/MHz without the additional 9 dB allowance for AAS transmitters.[9]

[8] Five-year spectrum outlook | ACMA.
[9] We also note that our calculations differ from those in the submission in that we round upwards to the nearest 10 m.

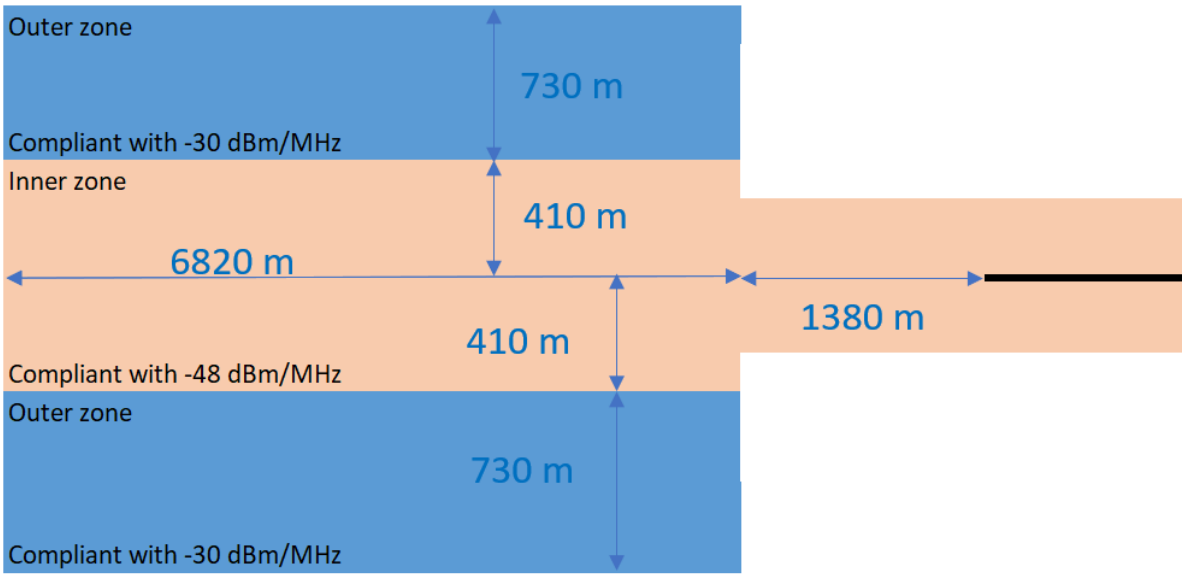
Table 1: Initially proposed arrangements

	Restricted zone (up to 1140 metres from runway centreline)
3GPP Base station (-21 dBm/MHz worst case based on licence condition)	Should not operate
Outdoor base station compliant with: • -48 dBm/MHz conducted (non-AAS transmitter) • -39 dBm/MHz TRP (AAS transmitter) In-building base station compliant with: • -30 dBm/MHz conducted (non-AAS transmitter) • -21 dBm/MHz TRP (AAS transmitter)	Can operate

Table 2: More granular arrangements

	Outer zone (from 410 m to 1140 m from runway centreline)	Inner Zone (up to 410 m from runway centreline)
3GPP Base station (-21 dBm/MHz worst case based on licence condition) Half-width calculation of 1140 m	Should not operate	Should not operate
Outdoor base station compliant with -30 dBm/MHz conducted (for non-AAS) / TRP (for AAS). In-building base station compliant with: • -30 dBm/MHz conducted (non-AAS transmitter) • -21 dBm/MHz TRP (AAS transmitter). Half-width calculation of 410 m	Can operate	Should not operate
Outdoor base station compliant with: • -48 dBm/MHz conducted (non-AAS transmitter) • -39 dBm/MHz TRP (AAS transmitter) In-building base station compliant with: • -30 dBm/MHz conducted (non-AAS transmitter) • -21 dBm/MHz TRP (AAS transmitter)	Can operate	Can operate

Figure 1: Inner and outer arrangements (illustrated on one end of a runway)



Grandfathering of existing base stations

One submission included a proposal to grandfather existing base stations that are located within the defined areas. This submission noted that ascertaining whether already-deployed transmitters comply with the reduced spurious emission limits may be costly and incur service disruption. This submission also highlighted that these existing transmitters have not to date caused any interference issues.

ACMA response

We are of the view that existing base stations should not be grandfathered. The assurance measures are a response to the mandate of a new RA requirement, which will have different performance to those fitted on existing aircraft.

Table 3 shows the number of existing base station transmitters that are within the defined areas (as of February 2026). While we understand that there will be some burden on licensees in confirming compliance for existing transmitters, this burden is expected to be lower for transmitters located in outer zones, given that those transmitters will be subject to a more relaxed spurious emission limit compared to transmitter in an inner zone. As shown in Table 3, of the 50 existing transmitters within a defined area, only 5 are located within the inner zones. The overall impact to WBB operators of not grandfathering existing transmitters will not be significant.

Table 3: Number of registrations (February 2026) within the restricted zones around identified runways

	Inner and outer zones	Inner zone only
Sydney	35	2
Perth	9	3
Western Sydney International	3	
Canberra	3	
Total	**50**	**5**

Comments on recent developments in the US

Some submissions noted that the FAA are currently considering updated RA performance requirements to support the consideration of WBB services potentially being introduced into the frequency range 3980–4200 MHz.

ACMA response

We note these observations. While potential consideration of WBB services being introduced above 4000 MHz in Australia are outside the scope of this consultation process, we are watching international developments.

Outcomes

Decisions on assurance measures

Having considered both stakeholder feedback to our consultation process and advice from CASA we have decided to implement the assurance measures as proposed, but with the following amendments:

Implementation of inner and outer zones

Inner and outer zones have been implemented in RALI MS 47, with the additional provisions highlighted in yellow below (non-highlighted text is unchanged from the draft version of RALI MS 47 proposed in the consultation process). We have also clarified that the conducted power limit is applied *per port*.

A "restriction zone" is an area comprised of 2 zones:

The area of the first zone is comprised of three segments:

1) A segment of length 1380 m from the landing end of an identified runway.

2) A segment of length 250 m at the opposite end of the landing end of an identified runway.

3) A segment the length of the runway.

The width of each segment is 250 m either side of the identified runway's centreline.

The area of the second zone extends 6820 m lengthwise from each end of the first zone.

- The width of the inner part of the second zone extends 410 m either side of the identified runway centreline; and
- The width of the outer part of the second zone extends 730 m from both edges of the inner part (either side of the identified runway centreline).

Together, the first zone and the inner part of the second zone comprise the "inner zone" of the restriction zone.

Figures 3 and 4 below are instructive as an example.

Figure 3: Example zone sizes definitions – where both approaches to a runway require protection (not to scale)

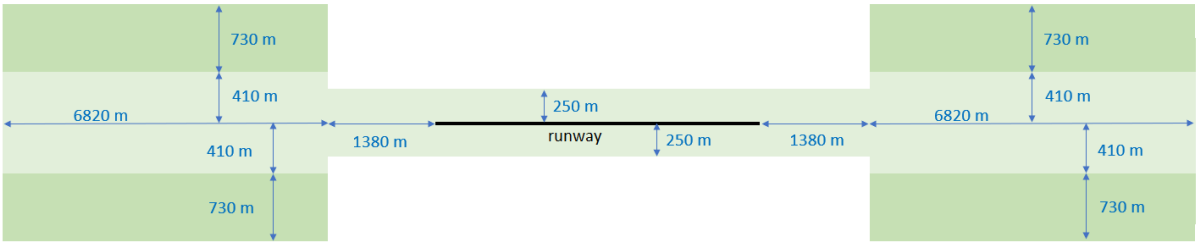
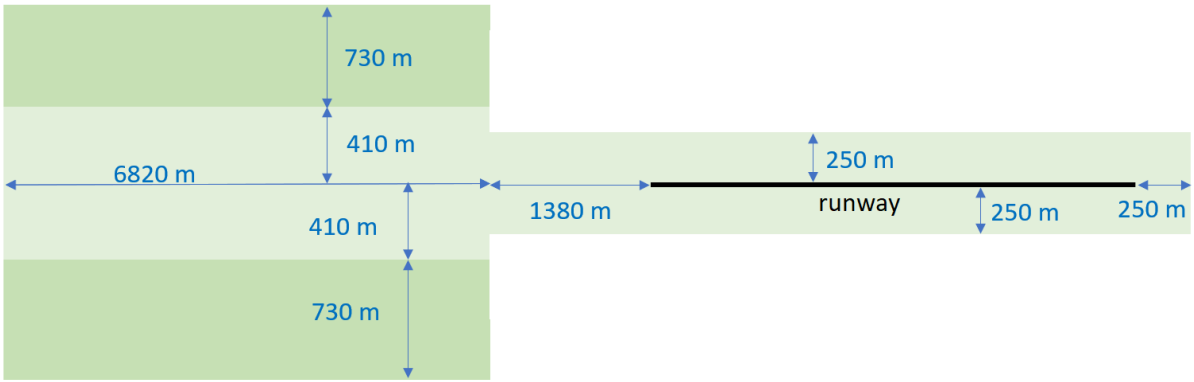


Figure 4: Example zone sizes definitions – where only one approach to a runway requires protection (not to scale)



4.9.2.3 Registration recommendations

A non-exempt AWL tx transmitter should not operate or have its details included in the RRL if the proposed transmitter would operate above 3700 MHz, the transmitter is located in a restriction zone and one or more of the following apply:

4.9.2.3.1 For non-AAS transmitters operating outdoors, unwanted emissions in the frequency range 4200–4400 MHz exceeds:

- Within the inner zone, -48 dBm/MHz conducted power per port.
- Outside of the inner zone: -30 dBm/MHz conducted power per port.

4.9.2.3.2 For AAS transmitters operating outdoors, unwanted emissions in the frequency range 4200–4400 MHz exceeds:

- Within the inner zone, -39 dBm/MHz total radiated power.
- Outside of the inner zone: -30 dBm/MHz total radiated power.

4.9.2.3.3 For non-AAS transmitters operating in-building, unwanted emissions in the frequency range 4200–4400 MHz exceeds -30 dBm/MHz conducted power per port (applies both within and outside the inner zone).

4.9.2.3.4 For AAS transmitters operating in-building, unwanted emissions in the frequency range 4200–4400 MHz exceeds -21 dBm/MHz total radiated power (applies both within and outside the inner zone).

Changes to the list of identified runways from 1 April 2026

During the consultation period, we discussed with CASA any planned new runways with approaches that will rely on radio altimeters that might be operational before the end date of the assurance measures, and none were identified. While we have made all efforts to provide certainty with respect to the list of identified runways, as always it should be noted

that the identified runways may need to change as airport runways are re-developed or upgraded to improved landing systems.

The Canberra runway 17 was on the list of identified runways proposed in the consultation paper. However, we understand that that runway does not support the specified instrument approaches that require protection. We have removed this runway from the list of runways subject to the assurance measures (provided at Appendix B).

Updates to text in MS47

We received some comments that the text in draft RALI MS47 is not clear on the end date for the assurance measures. The text has been made clearer in describing the review of the assurance measures in Q1 2028. We have also made it clearer upfront that the measures only apply to non-registration-exempt devices and added a statement that licensees are strongly encouraged to follow the measures. The relevant excerpt from RALI MS47 is below. Please note that the term 'MOPS' in the excerpt is a reference to is the Minimum Operational Performance Standards for low-range radio altimeters, being the future altimeter standard currently under development.

> 4.9.2 Measures from 1 April 2026
>
> The measures in this subsection only apply for the registration and operation of non-registration-exempt devices under an AWL tx from 1 April 2026 until 30 June 2029.
>
> The following arrangements have been developed based on the Federal Aviation Association Airworthiness Directive radio altimeter performance requirements. They provide additional assurances for coexistence with these radio altimeters after the mitigations in 4.9.1 are lifted on 1 April 2026. Noting that the development of MOPS for next-generation RAs is ongoing, these arrangements will be reviewed in Q1 2028 to assess international progress on the new MOPS and the potential availability of next-generation RAs.
>
> We strongly encourage licensees to follow these measures from 1 April 2026, as any evidence of interference from WBB based stations into radio altimeters may necessitate consideration of more robust measures.

Summary of decisions

In summary, we have decided the following:

- The interim mitigations will end on the 31 March 2026 as planned.
- From 1 April 2026, WBB base stations operating above 3700 MHz, within defined areas around identified runways, should not exceed the following spurious emission limits in the 4200–4400 MHz frequency range:
  - For outdoor operations:
    - for non-AAS transmitters: a maximum conducted spurious emission limit per port of -48 dBm/MHz in the inner zone, and -30 dBm/MHz in the outer zone.
    - for AAS transmitters: a maximum total radiated power of –39 dBm/MHz in the inner zone and -30 dBm/MHz in the outer zone.
  - For in-building operations in both inner and outer zones,

    - for non-AAS transmitters: a maximum conducted spurious emission limit per port of -30 dBm/MHz
    - for AAS transmitters, a maximum total radiated power of -21 dBm/MHz.
- An identified runway is one identified by CASA as requiring the protection of radio altimeters due to safety and/or important operational requirements. Based on advice provided by CASA, the runways for the purposes of the assurance measures are listed in Appendix B.
- From 1 April 2026, licensees should notify the ACMA of the intent to register a WBB base station, within defined notification zones, 4 weeks prior to registration. This notification is intended to provide advanced awareness to the aviation sector that WBB operation in the vicinity will soon be occurring, so flight scheduling can take into account the need for FAA AD-compliant altimeters to be used at the specified airports when necessary. This notification will only be required for the first instance of a planned registration in each notification zone and the requirement will be reviewed at a later date pending progress of retrofitting to FAA AD-compliant altimeters.
- We strongly encourage WBB providers to follow these voluntary arrangements from 1 April 2026, as any evidence of interference from WBB based stations into radio altimeters may necessitate consideration of more robust measures.
- The above arrangements will be reviewed in Q1 2028.
- Subject to the review, the above arrangements will end on 30 June 2029.

Implementation

As discussed in the consultation paper, the assurance measures will be common to spectrum licence, area-wide licence and highly localised WBB system technical frameworks. The measures and time frames are documented in RALI MS 47.

Obligations on spectrum licensees and area-wide licensees to follow the existing interim mitigation measures in RALI MS 47 are contained in the Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licenced Transmitters – 3.4 GHz band) 2025 and the Radiocommunications Licence Conditions (Area-Wide Licence) Determination 2020. These obligations have been updated to specify the end date of 31 March 2026 for the interim mitigations and to add an additional note that encourages licensees to follow the assurance measures in RALI MS 47.

For highly localised WBB services, the Radiocommunications Licence Conditions (Fixed Licence) Determination 2025 has been amended to include a note that that encourages licensees to follow the assurance measures in RALI MS 47. RALI MS 50 has been amended to apply the assurance measures to high localised WBB services operating in 3950–4000 MHz and to lift the temporary restrictions on issuing PMPS licences near airports.

Appendix A: Calculation of the inner and outer zone half-widths

The calculation of the restricted zones (including for 200 ft altimeter height) can be found in more detail in Appendix A of the consultation paper. The method for calculating the restriction zone up to 1000 ft altimeter height is summarised below.

Calculation of the restriction zone sizes up to 1000 ft altimeter height

To determine the size of the restriction zones, areas of potential interference were calculated using the same method as in the ACMA report: *Coexistence between Radio Altimeters operating in 4200-4400 MHz and Wireless Broadband systems in 3400-4000 MHz*.[10] The area of potential risk for an aircraft up to 200 ft height is based on the exclusion zone calculation methodology and for an aircraft up to 1000 ft height is based on the restricted zone calculation methodology.

Key points of this methodology are:

- The distance required in free space to achieve the path loss in the following link budget is determined as the half-width of the exclusion zone:

$$Path\ Loss = P_{Tx} + G_{Tx} + G_{Rx} + Margin - ITM_{thres}$$

- The half-width of the restricted zone is calculated using the ITM value at 1000 ft height with no safety margin applied. The path loss distance is assumed to be at 45 degrees to the ground because the altitude of the aircraft is higher than the base station.
- The height of the aircraft is calculated from an approach angle of 3 degrees with a margin of 0.375 degrees, which makes the worst-case angle 2.625 degrees.
- The restricted zone extension length is the horizontal distance from the end of the exclusion zone to when the aircraft is at an altitude of 1000 ft with an additional 80 m margin to account for uneven terrain and base station height.

$$Restricted\ Zone\ Length\ (m) = 8200\ \mathrm{m} - Exclusion\ Zone\ Length$$

Adjustments have been made to account for differences in how the FAA AD and RTCA Interference Tolerance Mask (ITM) performance masks are derived. The FAA AD includes an FAA policy statement that provides guidance on demonstrating that a RA meets the AD.[11]

[10] Appendix D of the report which is Appendix G of the 3.4-3.7 spectrum licencing TLG package.
[11] Demonstration of Radio Altimeter Tolerant Aircraft PS-AIR-600-39-01.

Table 4: Calculation summary for restriction zone (for 1000 feet)

Parameter	FAA AD spurious emissions	Notes
Maximum Tx unwanted emissions P_{Tx} (total radiated power) per polarisation	-24 dBm/MHz	Spurious emissions 3GPP limit of -30 dBm/MHz + 9 dB for AAS and -3 dB for TRP per polarisation.
Margin, $Margin$	-6 (Margin removed)	None used by ANFR for restricted zone. The FAA AD mask includes 6 dB margin in its calculation. For the restricted zone case the 6 dB margin is not applied.
FAA AD Spurious emissions PSD, ITM_{thres}	-139 dBm/MHz	FAA PSD for aircraft at 1000 ft height.
Required path loss	109 dB	Calculated.
Separation distance to achieve path loss	1609.72 m	Calculated using FSL with frequency 4200 MHz.
Separation distance (d cos 45)	1138.24 m	Path loss distance 45 degrees angle from the horizontal.
Restricted zone half-width, area of potential interference	1140 m	Rounded up to nearest 10 m.

In our calculations, the worst-case spurious emissions power level was determined by using the -30 dBm/MHz 3GPP limit, adding 9 dB to get the active antenna system (AAS) power level. Assuming a dual plane antenna, 3 dB is subtracted to consider a single plane of polarisation into the radio altimeter receiver.

The half-width is the distance beyond the runway centreline where a base station with a spurious emission of -21 dBm/MHz AAS can operate. Under the single-zone concept proposed in the consultation paper, within that distance an outdoor base station should have a spurious emission level below -48 dBm/MHz conducted power per port for non-AAS base stations and -39 dBm/MHz TRP for AAS transmitters.

Proposed limits for inner and outer zones

The inner/outer zone concept adds an intermediate step to the half-width. Under this concept, the dimensions of the boundary between the inner and outer zones would be based on a spurious emission limit that is lower that the values used to calculate the restricted zone in Table 4 (i.e. less than -24 dBm/MHz. For these calculations, we have applied the worst-case power level of -33 dBm/MHz, that has been derived from the 3GPP value of -30 dBm/MHz plus a polarisation loss of -3 dB.

Table 5: Maximum Tx unwanted emissions P_{Tx}

	Non-AAS	AAS	Per polarisation
3GPP determined level	-30 dBm/MHz	-21 dBm/MHz	-24 dBm/MHz
Proposed intermediate level	-30 dBm/MHz	-30 dBm/MHz	-33 dBm/MHz

Table 6: Calculation summary for the boundary between the inner and outer zones (for 1000 ft)

Parameter	FAA AD Spurious Emissions	Notes
Maximum Tx unwanted emissions P_{Tx} (total radiated power) per polarisation	-33 dBm/MHz	Spurious emissions 3GPP limit of -30 dBm/MHz AAS and -3 dB for TRP per polarisation.
Margin, $Margin$	-6 (Margin removed)	None used by ANFR for restricted zone. The FAA AD mask includes 6 dB margin in its calculation. For the restricted zone case the 6 dB margin is not applied.
FAA AD spurious emissions PSD, ITM_{thres}	-139 dBm/MHz	FAA PSD 1000 ft.
Required path loss	100 dB	Calculated.
Separation distance to achieve path loss	571.15 m	Calculated using FSL with frequency 4200 MHz.
Separation distance (d cos 45)	403.86 m	Path loss distance 45 degrees angle from the horizontal.
Restricted zone half-width, area of potential interference	410 m	Rounded up to nearest 10 m.

The calculation results in a half-width of 410 m. Therefore, if a base station has a spurious emission level of -30 dBm/MHz it can operate at a minimum distance of 410 m from the runway centreline. At closer distances (that is, within the inner zone), the base station should comply with the stricter spurious emission limits.

Appendix B: List of identified runways

Table 7 contains the identified runways that will be subject to the assurance measures, based on advice from CASA. An explanation of runway numbering can be found at the Airservices Australia website. The runways in Table 7 are a subset of the existing runways in RALI MS 47 with the inclusion of Western Sydney Airport (YSWS) runways 05 and 23.

The coordinates for each 'runway' are the runway centreline landing end threshold and the far end for the specific approach. Consequently, the same physical runway may have slightly different coordinates, and slightly different zone locations, when the same physical runway has a landing approach from either end.

Table 7: Identified runways subject to additional assurance measures

Identifier	Location	Runway	Landing end coordinate (WGS84)	Far end coordinate (WGS84)
YSCB	Canberra	35	35°18'53.31"S, 149°11'40.0"E	35°17'26.26"S, 149°11'39.99"E
YMML	Melbourne	16	37°39'11.45"S, 144°50'5.69"E	37°41'8.80"S, 144°50'27.60"E
YPPH	Perth	03	31°57'31.46"S, 115°57'34.86"E	31°55'42.94"S, 115°58'6.47"E
YPPH	Perth	21	31°55'42.94"S, 115°58'6.47"E	31°57'31.46"S, 115°57'34.86"E
YSSY	Sydney	16L	33°57'5.89"S, 151°11'19.85"E	33°58'14.72"S, 151°11'37.72"E
YSSY	Sydney	16R	33°55'48.35"S, 151°10'18.43"E	33°57'51.35"S, 151°10'50.33"E
YSSY	Sydney	34L	33°57'51.35"S, 151°10'50.33"E	33°55'48.35"S, 151°10'18.43"E
YSSY	Sydney	34R	33°58'14.72"S, 151°11'37.72"E	33°57'5.89"S, 151°11'19.85"E
YSWS	Western Sydney Intl	05	33°53'30.66" S, 150°41'44.63" E	33°52'30.12" S, 150°43'48.95" E
YSWS	Western Sydney Intl	23	33°52'30.12" S, 150°43'48.95" E	33°53'30.66" S, 150°41'44.63" E