Australian Government

Australian Communications and Media Authority

Wireless broadband and radio altimeter coexistence

Outcomes paper

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1. Executive summary

1.1 This outcomes paper continues the planning process that commenced in 2019 regarding the introduction of wireless broadband (WBB) services into the 3400–4000 MHz band. This band is near in frequency to the 4200–4400 MHz band used by radio altimeters (RAs).

1.2 This paper outlines the planning decisions and proposed technical framework to manage coexistence between WBB and RAs outside of the 'highly localised areas' (previously referred to as 'restricted cell areas' in consultations), which are proposed in 3950–4000 MHz in regional and metro areas.

Discussion

1.3 The object of the *Radiocommunications Act 1992* is to promote the long-term public interest derived from the use of the spectrum, by providing for the management of the spectrum in a manner that, among other things, facilitates its efficient planning, allocation and use, and facilitates the use of the spectrum for both commercial and other purposes.[1]

1.4 In this context, the ACMA acknowledges that radio altimeters are critical sensors that provide high integrity, accurate measurements of aircraft (whether commercial, civil or military) height above terrain and obstacles and these are used by many aircraft (both fixed and rotary wing) to enable and enhance flight safety and operations. Ensuring coexistence between radio altimeters with uses of the spectrum such as WBB is then a key requirement for the ACMA.

1.5 Similarly, the ACMA must consider opportunities to facilitate new uses of the spectrum, such as WBB. Spectrum in the 3400–4200 MHz range is of particular interest for WBB globally as an early band for 5G WBB (in addition to 4G and earlier broadband services in parts of the range), with extensive deployments worldwide in different parts of the band. The ACMA considers that the efficient use of this spectrum that supports both WBB and radio altimeters in 4200–4400 MHz will contribute to the long-term public interest.

1.6 The theoretical studies, controlled trials and empirical evidence from real-world deployments regarding the coexistence of radio altimeters and WBB do not provide a conclusive view of the actual likelihood of interference to radio altimeters. Some lack of certainty and consensus on spectrum coexistence matters is not unusual, given the differing perspectives of stakeholders. However, the critical nature of radio altimeters in some use-cases makes this lack of definitive evidence more challenging than usual.

1.7 Given these circumstances, the ACMA considers it appropriate to adopt a precautionary approach to the implementation of new WBB uses into this environment. This is based on the concept that the absence of definitive data to accurately determine risk likelihood and consequence (in this case, risk of interference to radio altimeters) should not preclude action to mitigate the possible risk through the adoption of prudent controls (that is, regulatory measures). The consequences of excessive or unnecessary regulatory restrictions on WBB systems may, however, reduce the long-term benefits that these services can provide to the Australian community.

1.8 An important consideration in determining this proposed approach is that the spectrum management coexistence performance of some[2] current radio altimeters appears to be generally poor, and not conducive to good spectrum management outcomes. This is characterised by industry testing[3] that indicates apparent susceptibility of some radio altimeters, in some

[1] This description is paraphrased from paragraph 3 of the Act.

[2] Given the lack of availability of detailed RA device data and being able to associate them to specific aircraft, it is not possible to be more definitive on the scale of the extent of poorer performing RAs applicable in Australia.

[3] See the RTCA, AVSI, Japanese and Canadian 'blackbox' testing in appendices B and C of the RA report.

circumstances, to operation of WBB devices far from the radio altimeters operating band (some multiples of 100 MHz). This occurs via a mechanism whereby fundamental (or 'wanted') WBB emissions interact with radio altimeter operation due to poor radio altimeter filter performance.

1.9 The coexistence issues outlined above can be resolved through improved radio altimeter performance by retrofitting filters (and other improvements) to susceptible existing deployed radio altimeters and, ultimately, through the adoption of new radio altimeter standards. The United States (US), for example, has adopted the approach of requiring retrofitting radio altimeters in a defined period during which additional constraints are imposed on WBB deployments to support coexistence. Canada is considering a similar approach.

1.10 The ACMA's approach is, in principle, like that adopted in the US (and proposed in Canada) and is based on dual obligations on the aviation and telecommunications sectors. That is, the approach involves the use of interim constraints on WBB for a clearly defined period to enable the necessary radio altimeters to be retrofitted. At the end of this period, interim mitigations would be removed, leaving ongoing mitigations only.

1.11 The technical approach developed by the ACMA to RA and WBB coexistence is based on the original French/Canadian approach to runway/approach exclusion and protected zones, modified to reflect Australian arrangements. This was based on aviation industry feedback to earlier ACMA consultation processes.

Consultation

1.12 This paper considers all current evidence made available to the ACMA, including responses to the March 2023 Draft allocation and technical instruments for the 3.4/3.7 GHz bands auction consultation (referred to as 'the consultation'). The consultation included a comprehensive report on WBB and RA coexistence that collated and considered evidence, as well as detailing our proposed approach at that time.

1.13 The consultation elicited submissions from stakeholders largely aligned with their responses to previous processes. These submissions indicated that the aviation sector remains concerned with both the risk of interference to RAs and the potential for operational disruption, and the WBB sector (principally the mobile network operators) remains of the view that there is no real-world evidence of interference.

1.14 Little new robust evidence was provided to the ACMA in response to submissions. However, evidence was sufficient, together with further study and engagement with the Civil Aviation and Safety Authority (CASA), to cause us to revise some of the previously proposed approaches. The ACMA appreciates the close engagement of CASA on this issue, which has resulted in the following agreed outcome.

1.15 The deployment of 5G and other innovative wireless broadband (WBB) services in the 3.4-4.0 GHz band (mid-band) is an important government priority that will bring benefits to Australian consumers and industry. Similarly, the government is committed to ensuring the safety of commercial air operations within Australia is not compromised, noting the importance of the reliable operation of radio altimeters to aviation safety.

1.16 To ensure that an appropriate balance is struck between these 2 important public interests, the ACMA and CASA have, worked closely together to identify an acceptable precautionary approach to the deployment of 5G WBB services in the mid-band.

1.17 The ACMA will put in place interim mitigations on new WBB deployments above 3.7 GHz until 31 March 2026, to protect against the risk of 5G interference with aircraft radio altimeters, which will allow the timely roll out of 5G services while providing time for the aviation sector to improve radio altimeter performance.

1.18 Both the aviation and communications sectors have a significant role to play in the safe and efficient use of spectrum.

1.19 The interim mitigations will impose restrictions on WBB deployments surrounding runways and approaches identified by CASA. After the end of the interim mitigation period, WBB will be able to be rolled-out, consistent with ongoing arrangements that do not include these restrictions.

1.20 It is anticipated that the interim measures will minimise disruption to aviation operations while giving air operators sufficient time to install any necessary equipment upgrades.

1.21 After the end of interim mitigations, ongoing mitigations will include a 200 MHz guard band between WBB and radio altimeter operations, and ongoing power and emission limits.

1.22 CASA will work with the aviation sector to ensure aviation operational impacts are minimised both during and after the end of the interim mitigation period.

Outcomes

1.23 The changes to RA/WBB coexistence measures since the March 2023 consultation are outlined below. These consist of changes determined independently by the ACMA, based on consideration of consultation feedback, and those developed jointly between the ACMA and CASA. The overall package of measures has been shared and agreed with CASA.

1.24 **Changes to coexistence measures**

i) The removal of the equivalent isotropically radiated power (EIRP) based interim unwanted emissions limits above 3800 MHz, with limits instead being defined by ongoing total radiated power (TRP) or conducted power limits, combined with the introduction of an ongoing EIRP limit for transmitters operating above 3700 MHz.

ii) A change of the definition of the spurious domain for ongoing unwanted emissions limits from within the RA band to below the RA band.

iii) A reduction in width for the sizes of the restriction zones for the interim mitigations.

iv) A rewording on the interim mitigation concerning beam pointing to restrict physical or electrical tilt, but not beam-forming, to below the horizon.

v) A change of the interim mitigations’ frequency boundary from 3800 MHz to 3700 MHz (developed jointly with CASA).

vi) A change of the interim mitigations end date from 31 March 2025 to 31 March 2026 (developed jointly with CASA).

1.25 As previously proposed, we will not include a general guidance requirement for WBB deployments to coordinate with airports in the technical frameworks.

1.26 In summary, the RA/WBB mitigations the ACMA intends to implement in technical frameworks are outlined below.

1.27 **Ongoing mitigations**

1. A 200 MHz[4] guard band, 4000–4200 MHz, where WBB deployments will not be permitted (previously determined*). No change from the consultation proposal.*

2. A total radiated power (TRP) limit of 48 dBm/5 MHz. *No change from the consultation proposal.*

3. The introduction of a total EIRP limit of 72 dBm/5 MHz for WBB deployments above 3700 MHz (an equivalent of 65 dBm/MHz total or 62dBm/MHz per plane of linear polarisation). *A change from the consultation proposal.*

4. Unwanted emissions limits of -21 dBm/MHz TRP for active antenna systems (AAS) and -30 dBm/MHz per antenna port for non-AAS within the RA band. With a change in the frequency boundary for the spurious domain of unwanted emissions for area-wide licences (AWLs) to 4040 MHz, specific interim EIRP-based unwanted emission limits are not required. *A change from the consultation proposal.*

1.28 **Interim mitigations**

1. For deployments above 3700 MHz around identified runways, where an 'identified runway' is one identified by CASA as requiring the protection of radio altimeters due to safety and/or important operational requirements (*change in frequency from the consultation proposal)*:
   a. exclusion zones, where no WBB services are permitted (*no change from the consultation proposal)*
   b. restricted zones, except in the 3950–4000 MHz range in metro and regional highly localised areas, with a power flux density (PFD) limit in the restricted zones. The restricted zones are narrower than the previous proposal, due to new evidence around base station side-lobe performance (*a change from the consultation proposal).*

2. For deployments above 3700 MHz everywhere:
   a. the fixed mechanical or electrical tilt of any WBB base station antenna system is to be directed below the horizon (*a change from the consultation proposal)*
   b. grating lobes of WBB antenna systems should be minimised as much as is practicable (*no change from the consultation proposal).*

1.29 In consultation with CASA, we have decided to change the interim mitigations end date to 31 March 2026. This period is made available to enable the aviation sector to undertake retrofits or replacement of necessary radio altimeters so that they can operate in the spectrum management environment that will exist after the interim mitigation period.

1.30 These decisions are intended to give sufficient certainty to both the wireless broadband and aviation sectors, to introduce WBB into the band while putting in place spectrum management measures to manage the risk for aviation operations.

1.31 Ultimately it is a matter for CASA as the aviation safety regulator to determine what, if any, additional measures they deem necessary to manage the aviation safety environment, particularly if, at the end of the interim mitigation period, there are affected radio altimeters that have not undergone necessary remedial action.

[4] Current implementation expectations are that there will be a separation of 250 MHz to high-powered WBB deployments in metropolitan and regional areas, and 200 MHz in remote areas.

Next steps

1.32 Table 1 shows the next steps in WBB allocation processes that will use these RA mitigations.

Table 1: WBB allocation processes that will use RA mitigations

Action	Proposed date
Release of the remote AWL allocation applicant information package (AIP)	June 2023
Remote AWL allocation process	July 2023
Remote/metro AWL allocation AIP public consultation	June 2023
Release/making of 3.4/3.7 GHz spectrum licensing allocation and technical instruments	July 2023
Spectrum licensing allocation, with licences awarded soon after the auction process	Q3 2023
Release of the metro/regional AWL allocation AIP	Q1 2024
Remote/metro AWL allocation process	Q1 2024
End of interim mitigations	31 March 2026

Note: dates in this table are subject to change.

2. Background

2.1 The recent Draft allocation and technical instruments for the 3.4/3.7 GHz bands auction consultation (referred to as ‘the consultation’), which closed on 29 March 2023, contained a complete history of the ACMA consultation on the WBB and RA coexistence issue. The consultation, with its associated RA report, intended to solicit sufficient feedback and any new evidence on the WBB and RA coexistence issue. This will enable us to make final planning decisions on the issue, both for the upcoming administrative allocation of AWLs in remote areas, as well as the other planned allocations in the 3.4–4.0 GHz band.

2.2 The consultation also sought feedback on the technical framework proposed for spectrum licensing. Because there are relationships with that framework and the other proposed technical frameworks in the band, feedback on the other frameworks was also received.

2.3 Separately from the consultation, the ACMA identified other technical framework issues requiring consideration.

2.4 This outcomes paper records planning decisions on the technical framework (in Chapter 5) for the coexistence of WBB and RAs outside of the proposed highly localised area spectrum spaces. Consideration of feedback and decisions on other aspects of proposed spectrum licence technical frameworks is not documented here and will be considered separately.

3. Summary of radio altimeter coexistence-related submissions from consultation

3.1 This chapter summarises submissions in relation to RAs that were primarily supported by evidence, but some general views are also noted. Some initial ACMA comments are also provided, but the following chapter contains a more detailed consideration of any new evidence presented in submissions.

3.2 Where useful, the summary and comments are preceded by the relevant question number from the spectrum licensing technical framework consultation.

Boeing

3.3 While Boeing welcomed the interim mitigation measures, they expressed ‘profound concern’ that the interim mitigations measures were still not proposed in the 3400–3800 MHz frequency range and did not accept that the ACMA has properly or correctly determined that they are not required below 3800 MHz.

3.4 *Submission to Q1*: Boeing supported a high degree of coordination between WBB operators and airports, including the ACMA being involved actively in a program to monitor base station power and frequencies.

3.5 *Submission to* Q2: Boeing stated that Innovation, Science and Economic Development Canada (ISED) demonstrated that susceptibility was identified at all test frequencies covering 3500 MHz, 3800 MHz and 3900 MHz yet the ACMA was still not considering interim mitigations below 3800 MHz.

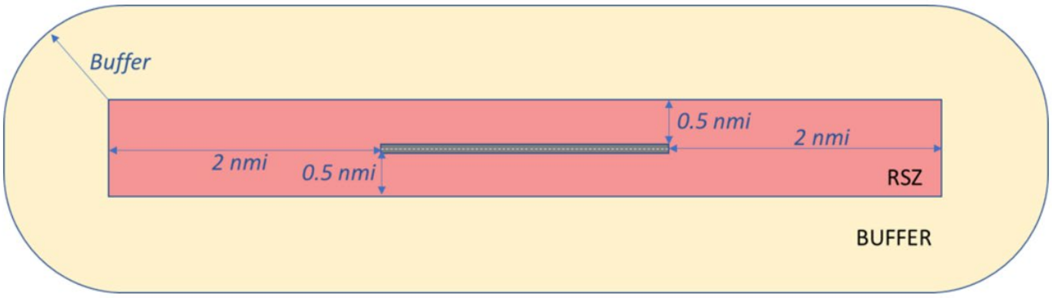
3.6 *ACMA comment:* As we noted in the RA report, those particular ISED tests were conducted with a base station pointed directly at an aircraft – ISED themselves did not use those results when developing their computational models for revising their proposed mitigations. Consequently, those results cannot be compared directly with practicable real-world scenarios.

3.7 *Submissions to Q5, Q9*: Boeing, in effect, proposed mitigations that ensure a power flux density (PFD) is kept below -49 dBW/m^2/MHz within a certain zone around airports.

3.8 *ACMA comment:* We understand that the intent of the mitigation method in Boeing’s submission was to protect RAs in Boeing’s fleet that do not meet Federal Aviation Authority (FAA) ‘Group 4’ performance, thus protecting ‘Group 2’ and ‘Group 3’ RAs. This proposal may be based on earlier FAA methodologies before the changes to a more nuanced ‘signal in space’ assessment approach occurred. We note that the power unit value in the -49 dBW/m^2/MHz figure is likely incorrect and should use dBm (not dBW).

3.9 Figure 1 represents the proposed geometry around runways in the Boeing submission, with the Runway Safety Zone (RSZ) and a base station EIRP-dependent buffer zone. Transmissions are prohibited across the whole of these 2 areas.

Figure 1: Boeing protection geometry



3.10 Figure 2 indicates the Boeing proposed buffer zone sizes for different RA 'groups'.

3.11 *ACMA comment:* If it was desired to protect Group 2 RAs, for the as-consulted interim mitigation base station EIRP limits of 62 dBm/MHz/plane of polarisation, then the buffer size from the RSZ would need to be 1.8 nm.

Figure 2: Boeing buffer zone dimensions

Max 5G Power Level	**62 dBm/MHz** EIRP Fundamental **3.3-3.67 GHz** (-48 dBm/MHz Conducted Spurious 4.2-4.4 GHz)		**65 dBm/MHz** EIRP Fundamental **3.3-3.67 GHz** (-48 dBm/MHz Conducted Spurious 4.2-4.4 GHz)	
5G Height Limit / **5G Elevation Mask** / **5G Location** — **RA Installations**	Height < 130m With or Without Mask **In RSZ, No Buffer**	Height < 130m With or Without Mask **Outside RSZ + Buffer (nmi)**	Height < 130m With or Without Mask **In RSZ, No Buffer**	Height < 130m With or Without Mask **Outside RSZ + Buffer (nmi)**
Group 1 (No RA Data, Regional Jet, General Aviation)	All AD Ops Restrictions	All AD Ops Restrictions	All AD Ops Restrictions	All AD Ops Restrictions
Group 2 (e.g., ERT-530)	All AD Ops Restrictions	Limited or No Risk in RSZ with Buffer = 1.8 nmi	All AD Ops Restrictions	Limited or No Risk in RSZ with Buffer = 2.5 nmi
Group 3 (e.g., ERT-550, LRA-700, LRA-900, 860F-4)	All AD Ops Restrictions	Limited or No Risk in RSZ with Buffer = 0.8 nmi	All AD Ops Restrictions	Limited or No Risk in RSZ with Buffer = 1.2 nmi
Group 4+ (e.g., ALA-52B, ERT-550R, 860F-4+filter, LRA-900 upgrade, LRA-2100)	Compatible	Compatible	Compatible	Compatible

3.12 *Submission to Q5*: Boeing also proposed an unwanted emissions limit within 4200-4400 MHz of -48 dBm/MHz, stating: 'This tolerance would allow 5G transmitters to be treated as normal physical obstacles from a safety perspective without concern for interference, as long as there were no towers taller than approximately 450 feet (130 m) near airports'.

3.13 *ACMA comment*: We understand that this proposed limit is derived from a use-case that is likely not applicable in most situations. We also note that the Canadian ISED approach is not proposing as low a value.

3.14 *Submission to Q10*: Boeing's view on a timeframe where new radio altimeters could be fitted to meet the expected new standard (the proposed DO-155A and the following FAA Minimum Operational Performance Standards (MOPS)) was not explicit but could be as long as 10 years after the MOPS and subsequent product development. Boeing indicated that this may be able to be expedited to 12 to 18-months with more severe operational impacts.

3.15 *Submission to Q11*: Boeing imply that base station unwanted emissions will still be a concern if the draft RTCA DO-399 is adopted to form the basis of the new DO-155A/MOPS standard, but otherwise the new standard should support RA unwanted emissions resilience to the 'Group 4' RA category. Boeing indicated that they are assisting industry to develop even more advanced RA standards above Group 4 performance, but this will take several years.

3.16 *Submission to Q12*: Boeing supports ISED's proposal for Canada to define exclusion zones of 80 metres radius centred at a heliport final approach and take-off. In addition, protection of all approach surfaces out to 1,050 metres would be appropriate to cover the entire approach and all critical phases of approach.

3.17 *Submission to Q13*: For reasons given in their answer to Q10, Boeing considered the ACMA-proposed interim mitigation end date of 31 March 2025 as aspirational only. Based on experience in the US, for Australia, more time will be necessary.

3.18 *Submission to Q14*: Boeing indicated that the current registered fleet in Australia is 225, with 42 having Group 4 capable RAs. A small number of the others have been or are in the process of retrofitting.

3.19 There were 1,251 international Boeing aircraft operated in Australia over the last 12 months and approximately 493 had Group 4 RAs. Of the total, 220 were registered and operating in Australia, with 20 having Group 4, but 80 with no current plans to upgrade as 'they don't fly to the US'.

3.20 It was Boeing's view that the currently proposed domestic mitigation situation creates a serious contradiction in that using mitigations only where there are no current deployments, and not proposing mitigations where there currently are, creates an environment where there is no incentive to retrofit RAs, and engenders a high degree of complacency created by the ACMA's position.

3.21 *ACMA comment*: The potential use of time-limited mitigations is intended to provide sufficient incentive for aircraft operators to retrofit poorer performing RAs.

3.22 *Submission to Q15*: It was Boeing's view that the FAA estimated retrofit costs, summarised in the draft revised airworthiness directive, had serious limitations, effectively underestimating existing and future costs significantly.

Ericsson

3.23 Ericsson provided a commercial-in-confidence submission that included information and views about the practicalities of Ericsson base station performance and their involvement with the ISED work. ACMA staff have considered this in-confidence information as part of the relevant material in making the final RA technical planning decisions.

Optus

3.24 *Submission to Q1*: Optus does not support any general coordination guidance and the Radio Frequency National Site Archive (RFNSA) database can be used to alert airport operators about forthcoming WBB deployments with its registration feature.

3.25 *Submission to Q2*: Optus noted that ISED's conclusions were that limiting base station scanning to below the horizon has little impact when combined with digital and mechanical tilts below the horizon. Uptilting also had minimal impact in dense urban areas.

3.26 *ACMA comment*: The ISED comments were to support conclusions in relation to search-and-rescue operations in remote areas. These operations are intended to be mitigated by our beam pointing and scanning interim mitigations.

3.27 *Submission to Q3*: Optus considered that, while the performance of many existing 5G base stations could exceed 3GPP specifications, as evidenced by those measured in the NTIA/ITS report, the evolution of base station technologies means that mitigations requiring compliance to better than 3GPP will be challenging and will hinder future deployments, especially in multi-band base stations and if hand-tuned cavity filters are required to meet the performance requirements.

3.28 *Submission to Q4*: It was Optus's view that while most current Australian deployments operate below 62 dBm/MHz EIRP, higher EIRP will be necessary in future to improve performance, and that higher peak antenna gains result in less power towards aircraft. They strongly oppose any permanent in-band power limits other than 48 dBm/5 MHz TRP and the power limit should remain defined as TRP rather than EIRP.

3.29 *Submission to Q7*: While not providing explicit evidence from actual equipment, Optus provided reasoning to indicate that the antenna grating lobe level used in mitigation development was too high (18 dBi) and it practically should be reduced to at most 12 dBi.

3.30 *Submission to Q8*: Optus indicated that while it could be technically possible to restrict AAS scanning angles by restricting beamforming codebooks, this would result in a significant reduction in the AAS beamforming capabilities and performance. User handsets also have different capabilities in terms of supported codebooks. Hence, limiting the codebooks pushes the UEs to non-optimal beams and limits the 5G network performance. Based on the Canadian consultation findings, an alternative solution to keep the 5G emissions minimum towards the aircraft could be to set a limit on the combined electrical and mechanical tilts, rather than limiting the scanning pattern of the AAS.

Airservices Australia

3.31 *Submission to Q12*: Airservices Australia suggested that if interim mitigations were extended, then they should be consulted regarding any new approaches. Given the limited number of currently impacted approaches, the data for any of these runways is available in Section 18 of the DAH (Designated Airspace Handbook), as part of the Airservices Aeronautical Information Package.

AMTA

3.32 AMTA strongly supported the ACMA preliminary view that interim mitigations only apply above 3800 MHz and that there is no evidence that mitigations are needed below this.

3.33 *Submission to Q1*: AMTA indicate that there are already enforceable obligations under the Mobile Base Station Deployment Code to notify and consult with the community and interested parties when deploying base stations.

3.34 *Submission to Q2*: AMTA provided their views and observations on the proposed ISED measures and their associated studies. They consider proposing mitigations that are roughly consistent across the Canadian 3.5 GHz band (3450–3900 MHz) is unnecessarily cautious. They support the methodology that derived the revised (and smaller) zone sizes.

3.35 AMTA's view is that the ISED proposed unwanted emissions limit is, considering slightly different altitudes and polarisation discrimination, the same as the -30 dBm/MHz 3GPP conducted power values for non-active antenna systems (non-AAS).

3.36 *Submission to Q3*: AMTA note that the beamforming used in the NTIA tests only used the codebook approach, rather than full beam steering. With only one radio model per manufacturer tested, and likely future performance changes with multi-band radios, they object to the NTIA input study parameters being codified in ACMA licence conditions or in ACMA licensing policy/rules.

3.37 *Submission to Q4*: AMTA do not agree with a 62d Bm/MHz EIRP-based limit on WBB deployments on an ongoing basis, especially for AAS base stations and all base stations below 3800 MHz. They note that while higher EIRPs are enabled using higher antenna gains, they have narrower beams, resulting in a potential victim being illuminated for a lower percentage of time. An EIRP limit precludes the use of smarter, more directional beams that would be less likely to illuminate the RA receiver, particularly in the case of aircraft that will be above the base stations, which are, in turn, primarily communicating with UEs at lower elevations.

3.38 *Submission to Q5*: AMTA recognise that spurious emission limits of -30 dBm/MHz (non-AAS) and -21 dBm/MHz (AAS) should apply to n77 equipment above 4200 MHz, as opposed to above 4240 MHz (that is, 40 MHz above the operating band edge of 4200 MHz), and that global deployments are being restricted to some upper limit below the 4200 MHz band edge and equipment designs will reflect this. They remain opposed to limits stricter than 3GPP and a -30 dBm/MHz limit is supported by ISED results. They question the margins of the values measured in the NITA report compared with to the 3GPP limit values.

3.39 *Submission to Q6*: In line with the AMTA response to Q5, the 3GPP spurious emissions limit for AAS is below that calculated by the ACMA as being required. Noting the excessive 18 dBi grating lobe gain used in the EIRP calculations, their view is that there is no need to specify EIRP-based spurious domain limits, and the TRP-based limits should remain based on the 3GPP limits.

3.40 *Submission to Q7*: AMTA agreed with the mitigation that, as a general practice, grating lobes should be minimised. With above-the-horizon grating lobes being formed at steep downwards scanning angles, pointing to very close UEs where little power is needed, an overall 18 dBi grating lobe gain is excessive. They said that these grating lobes will not exceed 12 dBi and occur at lower angles than the zenith, which is what is assumed in the ACMA calculations. These figures are supported by analysis of the NTIA measurements.

3.41 *Submission to Q8*: AMTA indicate that, while base station antennas are designed to tilt mechanically or electrically to below the horizon, there are applications where an up-tilt is desirable, such as in urban areas with multi-level dwellings. As such, restrictions on pointing are not desirable, but can be achieve via mechanical and/or electrical pointing restrictions. However, limitations of vertical scanning of beamforming are not practicable.

3.42 While vertical scanning restriction is theoretically possible with a codebook approach, MNOs have experienced poor performance with user equipment (UE) located between beams or off-beams. The AMTA view is also, that, ‘If we establish that true beamforming, in which beams are directed towards the target UE, is the best approach, then limiting vertical scanning is not feasible’.

3.43 AMTA submitted that the interim mitigation iii.: ‘Requiring WBB base station antennas to point or scan below the horizon only should be amended to delete the words ‘or scan’ could benefit from clarification that ‘to point’ refers to the aggregate of the mechanical and fixed electrical tilt – noting that the fixed electrical tilt is different to the dynamic vertical scanning.

Other information

3.44 After the consultation closed, there were some further activities that occurred in the US.

3.45 In a letter of 1 April 2023, the 4 main WBB licensees allocated licences in 3700–3980 MHz offered voluntary commitments to the Federal Communications Commission (FCC) in relation to deployment of wireless broadband services.

3.46 On 12 April 2023, the FAA published a notice of proposed rulemaking for a proposed airworthiness directive for helicopters in relation to radio altimeter performance. The proposed airworthiness directive notes that as Helicopter Terrain Avoidance Warning Systems (HTAWS) do not rely on radio altimeter inputs, potential 5G interference will not result in an erroneous HTAWS alert. RA inputs are used for vertical situational awareness in low visibility conditions (for example, snow and dust blown up by rotor down-wash) and as an input into several procedures and automated system.

3.47 To limit the potential future 'nuisance' alerts leading to flight crew desensitisation to system warnings, in rotorcraft in an expanded 5G deployment environment, the proposed airworthiness directive specifies RA performance. For rotorcraft that meet the requirements, there are no longer operational restrictions. For those that don't, operational restrictions will still apply.

3.48 The FAA, in an update to stakeholders of 2 May 2023, reiterated their commitment to the RA retrofit timeline indicated in the draft revised airworthiness directive.

3.49 These activities indicate that the FAA is proceeding to restrict operations of non-retrofitted aircraft from 1 July 2023 and to require the retrofit of RAs to a 1 February 2024 timeline. As noted at paragraph 3.45, carriers have agreed to some mitigations that may extend to 1 January 2028, which are aimed to provide certainty in that period to a post-retrofit RA performance level.

3.50 The FAA subsequently made the airworthiness directive AD 2023-10-02 on May 26 2023. The principal changes from the draft airworthiness directive were:

i) change of title of figure 1, the tolerance to fundamental 3.7–3.98 GHz emissions, to clarify it is an effective isotropic power spectral density (PSD) (at the radio altimeter air interface) mask

ii) change of spurious emissions tolerance from a single number to figure 2, a tolerance to spurious emissions effective isotropic PSD mask. They state that this new mask is based on the spurious emissions limits documented in the voluntary commitments letter, which is -48dBm/MHz for outdoor base stations.

3.51 Change i) is a useful clarification. Change ii) is more substantive but, as we note later in paragraph 4.24, the draft single spurious number could not be used by itself without other information. Analysing the revised mask and original value it appears that:

i) the PSD mask value of -116.5dBm/MHz used at 400ft or below is the calculated PSD at 50ft separation from a -48dBm/MHz EIRP source (or conversely, an emission limit of -48dBm/MHz can be calculated to protect a PSD value of -116.5dBm/MHz at a minimum distance of 50ft).

3.52 Please see our later commentary on unwanted emissions limits for our views on possible unwanted emissions limit of -48dBm/MHz.

3.53 The GSMA released the paper *5G and Aviation Altimeters - Co-existence with IMT in 3.3-4.2 GHz and 4.8-4.99 GHz* in May 2023. While highlighting that there have been many (approximately 160) network deployments in the band, and no instances of interference between 5G and aviation, it does not present any new evidence on the issue that the ACMA has not already considered.

3.54 Note that the quote in the GSMA paper from the ACMA, 'The ACMA considers that compatibility with radio altimeters can be successfully managed with WBB (wireless broadband) services introduced up to 4000 MHz', was taken from the *Replanning the 3700-4200 MHz band – Outcomes paper*, in response to submissions from the previous options paper. In the outcomes paper, we also stated that 'While the ACMA considers a 200 MHz guard band should be sufficient, coexistence would be further considered in the development of detailed technical frameworks for WBB'. Subsequent work through the technical liaison groups, consultations and agreement with CASA, have resulted in our current technical planning decisions.

4. Views and conclusions on new evidence gained from consultation

4.1 This chapter outlines our views on evidence-based elements of consultation responses, and our general conclusions and revised approach. Chapter 5 details the decisions on mitigations and Chapter 6 describes how the ACMA intends these to be implemented in the technical frameworks.

General coordination requirement

4.2 Submissions indicated that there is a regulatory requirement for telecommunications operators to comply with local and state government requirements, but we note that this is generally only where the facilities are not defined as 'low impact' under the Telecommunications (Low impact Facilities) Determination 2018. Also, the radio frequency national site archive is publicly available and gives indications of future network deployments. Consequently, as proposed in the consultation, we will not proceed with including general coordination requirements clauses in any technical framework.

4.3 We note that the proposed highly localised area deployments in 3950–4000 MHz in regional and metro areas may be classed as low impact facilities in some cases. We will consider this further when consulting and developing that technical framework.

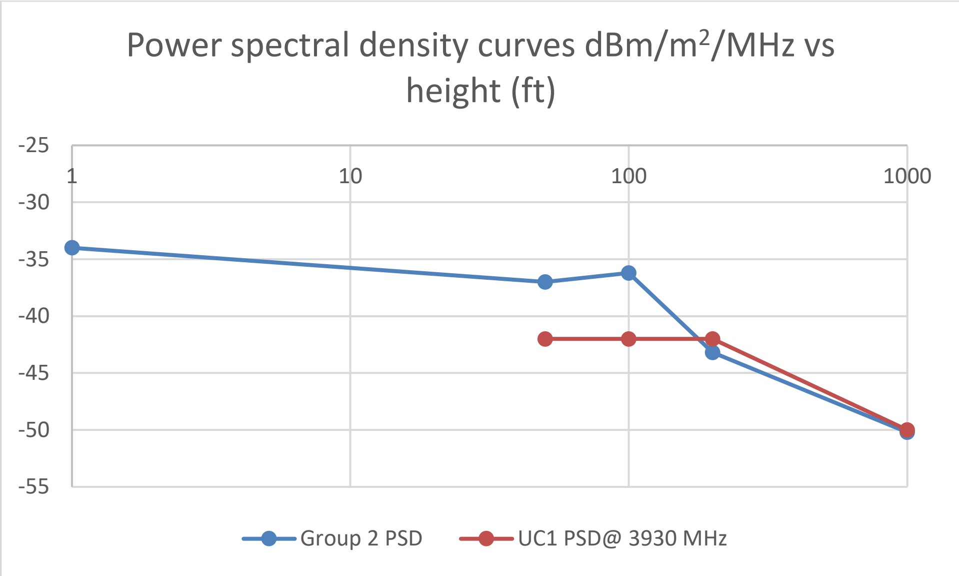
Boeing-proposed mitigation zones

4.4 We have compared the as-consulted interim mitigations we proposed with the Boeing proposal to determine if the interim mitigations also meet the implied requirements in the Boeing proposal. This is apart from the Boeing-proposed -48 dBm/MHz unwanted emissions limit.

4.5 While there was not sufficient supporting evidence provided to clearly confirm the derivation of the Boeing mitigation values, we can compare them with the RTCA report and figures 3A and 3B in the US carrier voluntary commitments letter. It appears that the Boeing target protected PFD of -49 dBm/m^2/MHz (we view the quoted unit of dBW/m^2/MHz as an error), within the runway safety zone (RSZ), does equate to a desired protection of Group 2 RAs at a height of 1,000 ft or below, without taking into account the change in required PFD at lower altitudes.

4.6 Figure 3 below compares the Group 2 and Usage Category 1 protection. Usage Category 1 offers the same or better protection than Group 2, especially as an additional 6 dB factor is also used in our method when determining the size of exclusion zones.

Figure 3: Comparison of Group 2 and Usage Category 1 protection below 1,000 ft



4.7 Consequently, the differences compared with the ACMA proposal derivations are:

i) desired protection of a larger RSZ areas compared with the runway/s alone

ii) use of a 1,000 ft (more stringent) Group 2 protection value for determination of an exclusion zone (that is, RSZ plus buffer zone) size, vs an RTCA usage category 1 value at 200 ft used for the ACMA exclusion zone

iii) use of the maximum EIRP in the buffer zone compared with use of a grating lobe antenna gain for the ACMA restricted-zone calculations. The French/Canadian/ACMA restricted-zone size calculations also did not use the aviation safety factor.

4.8 The ACMA concludes that the intended class of RA protection is the same or better. Differences then are other assumptions around the desired areas to protect and the degree of simplification around base station operation and flight operation use-cases.

4.9 The mitigations approach proposed by Boeing may be aligned with an earlier approach used by the FAA. We understand that the FAA moved on from that approach to a more nuanced ‘signal in space’ assessment.

4.10 Our view is that using an ITM value at 1,000 ft for all heights below 1,000 ft is unnecessarily conservative. Our combined exclusion-zone/restricted-zone approach provides a better balance of accuracy vs simplicity.

Alignment with revised ISED Canadian proposed approach

4.11 There was not sufficient evidence provided to suggest we should re-align our proposed interim mitigation geometry and calculations with the revised ISED proposal, although AMTA were supportive of it. Boeing were supportive of generally aligning mitigations for heliports with the ISED proposed approach but did not advocate for the other ISED zones around airports.

4.12 As some of the determined ISED mitigations were based on in-confidence information about advanced antenna systems (AAS) obtained from manufacturers, we do not have sufficient information to be able to confidently extrapolate the ISED approach to Australian use-cases. We are of the view that it is important for the ACMA to be able to independently understand and calculate mitigation approaches.

AAS maximum side-lobe gain

4.13 The ACMA considered submissions about side-lobe gain and consider there is scope to review our calculations and interim mitigations to use a side-lobe gain of 12 dBi rather than 18 dBi. Using a revised maximum side-lobe gain has the effect under the ACMA mitigations proposal of reducing the width of a protection zone and increasing margin for unwanted emissions.

AAS scanning angles

4.14 The ACMA considered submissions about the ability of AAS to restrict scanning above the horizon. The ACMA view is that it is unreasonable to restrict scanning completely to below the horizon and we propose revised wording to restrict electrical and mechanical tilt only to below the horizon.

Total power limits vs per plane of polarisation limits

4.15 As noted in a couple of submissions, the ISED and ACMA proposed ongoing regulatory limits, either TRP or EIRP based, that are always the total power, that is, for all polarisations together. However, the calculations of potential interference to RAs, which use a single linear polarity, are based on a single plane of polarisation. Consequently, any limits determined by calculation can have a factor of 3 dB added to them to represent total power limits. For example, the previous proposed interim EIRP limit of 62 dBm/MHz (per plane) is really a limit of 65 dBm/MHz total EIRP.

Frequency boundary for interim mitigations

4.16 Boeing's submission indicated that it was the strong view of parts of the aviation sector that the ACMA was not sufficiently conservative in proposing 3800 MHz rather than 3700 MHz, and that the evidence from overseas deployments above 3700 MHz was not sufficiently robust.

4.17 No new evidence, however, was provided to demonstrate that there have been definitive events to RAs from WBB deployments below 3800 MHz. The ACMA had proposed in the consultation that the interim mitigations only apply above 3800 MHz. This was supported strongly by the WBB sector.

4.18 The ACMA engaged further with CASA about the safety of commercial air operations within Australia and considers that an acceptable precautionary approach to the deployment of 5G WBB services in the mid-band is to establish interim mitigations on new WBB deployments above 3.7 GHz until 31 March 2026.

Maximum EIRP limits

4.19 The ACMA considered submissions about maximum EIRP limits, for either interim or ongoing use, rather than TRP-based limits. We acknowledge potential future operational impacts if an EIRP-based in-band limit was used, such as reduced flexibility for future EIRP increases or possible spectrum holdings defragmentation across the wider 3.4–3.8 GHz range. At this time, the ACMA considers these impacts minimal given that, as per the RA report[5] and the NTIA report, these EIRPs are unlikely to be possible in the short- to medium-term. However, an EIRP-based limit provides more certainty about the potential for interference. Consequently, we have decided to apply an EIRP-based limit more broadly, which includes any new spectrum licences in 3700–3800 MHz, on an ongoing basis.

4.20 The EIRP-based limit will be a density of 65 dBm/MHz but specified in a 5 MHz bandwidth, like the TRP limit. This limit recognises that EIRP values used in coexistence calculations are for each plane of polarisation, where the regulatory limit is normally specified as a total EIRP (or TRP) limit. This means that the use of a 65 dBm/MHz EIRP limit produces the same outcomes as a 62 dBm/MHz limit when used in coexistence calculations with RAs because of the 3 dB loss due to

[5] 99.9% of existing base station registrations had an EIRP of <65dBm/MHz. Those above have been confirmed as administrative errors. 99.3% are less than 62.5dBm/MHz.

polarisation mismatch/discrimination. Consequently, the limit is 72 dBm/5 MHz (65 dBm/MHz + 7dB to scale from 1 MHz to 5 MHz) for base stations operating above 3700 MHz.

Unwanted emission limits

4.21 Boeing indicated that an unwanted emissions limit of -48dBm/MHz TRP was necessary. It is the ACMA's view that an unwanted emissions limit of -48 dBm/MHz is not necessary and does not represent a reasonable use-case, as discussed below.

4.22 The ACMA considers that the -48 dBm/MHz proposed limit may be based on the near-collision (with base station) scenario modelled as part of the draft RTCA DO-399. This involved the assessment of spurious interference when the aircraft was at different near lateral and vertical distances from a base station for several spurious level cases. It proposed protection of the RA receiver noise floor in a high RA self-received (wanted) signal level environment. The US FAA draft and final airworthiness directive also appear to use a bse -48dBm/MHz emissions limit, derived from protecting a very low value of -116.5dBm/MHz PSD at an RA at a distance of 50 ft.

4.23 It is not necessary to protect the RA receiver noise floor when its own transmitted signal level received is high. The ACMA (and ISED) have based proposed unwanted emission limits on the use of measured ITMs that do not involve protection to the noise floor. Both the ACMA and ISED consider that an unwanted emissions limit of -48 dBm/MHz is unwarranted. While we noted that the draft proposed FAA revised airworthiness directive also uses the -48 dBm/MHz figure as a compliance figure for a 'radio altimeter tolerant airplane', it specifies no other conditions to be able to use the figure. It is not appropriate to reference this figure alone as a 'tolerance to an aggregate base station conducted spurious emission level' without then determining the required performance of the actual RA or the conditions under which the tolerance is assessed, as the required performance of the RA is distance dependent from the source of the unwanted emissions.

4.24 We note in AMTA's submission that they agreed the spurious domain for N77 equipment should start at 4200 MHz or below, rather than at 4240 MHz in the 3GPP specification and current ACMA–proposed technical frameworks. Given that we are aware there will be a large ecosystem of 'N77 sub-band (3400–3980 MHz) equipment in the US, the ACMA considers that a practicable 'end of the band' is 4000 MHz, resulting in an out-of-band/spurious boundary at 4040 MHz for the AWL technical frameworks (the boundary for the spectrum licensing technical framework is 3840 MHz as it assumes N78 band equipment).

4.25 Regardless of the exact spurious domain boundary, if it is set at 4200 MHz or less for the ongoing AWL technical framework, it ensures that the ongoing unwanted emission limits for base stations in the RA band would be -30 dBm/MHz mean power per port for non-AAS systems and -21 dBm/MHz TRP for AAS systems.

4.26 We have examined the impact upon potential interim unwanted emission limit requirements using a reduced antenna side-lobe gain of 12 dBi. This gain value is still conservative, as it is likely that the WBB antenna is fully decorrelated at the RA frequencies and exhibits a gain equal to its single element gain, which would be a still lower 5–7 dBi. The revised calculations, using the same method as in the RA Report Appendix D, result in unwanted emissions TRP limits of at worst approximately -14 dBm/MHz per plane of polarization, or around-11 dBm/MHz total. This value is for areas outside of the proposed highly localised area spectrum spaces, so applicable during the interim mitigations period. Due to the peculiar nature of the determined zone sizes that are appropriate for highly localised areas, we will consider their possible mitigations at a future time.

4.27 Given the ongoing unwanted emission limits for spectrum licences and AWLs are now proposed as -21 dBm/MHz TRP total for AAS base station emissions in the 4200–4400 MHz range and -30 dBm/MHz mean power per antenna port for non-AAS, these are significantly lower (that is, more stringent) than the approximately -11 dBm/MHz total value discussed at para 4.27. With the spurious domain boundary to be at 4200 MHz or below, an interim EIRP-based limit for unwanted emissions is unnecessary; that is, the ongoing unwanted emissions requirements will satisfy the interim mitigations requirement.

4.28 Consequently, we have decided to remove this interim mitigation outside of highly localised areas and will consider those areas further. The ACMA intends to set the spurious domain boundary to 4040 MHz, which allows WBB operation up to the planned 4000 MHz use (the out-of-band domain will be 4000–4040 MHz and the spurious domain then above 4040 MHz).

4.29 Considering unwanted emissions requirements after interim mitigations end, we note that the revised ISED spurious domain limit proposal is -30 dBm/MHz[6] TRP for AAS or total mean power of all antenna ports for non-AAS. This is based on aircraft to base station separation distances of 50 ft for aircraft and 35 ft for helicopters. The 50 ft distance was selected by ISED to represent the minimum clearance of an aircraft flying above a base station located on the obstacle clearance surface around airport runways.

4.30 The interference tolerance mask (ITM) used for the ISED calculations is based on the worst of all RAs they tested across all Radio Technical Commission for Aeronautics (RTCA) usage categories, a value of -91 dBm/MHz[7] for up to 200 ft. If restricted to radio altimeters that ISED tested that met RTCA usage category 1, the worst measurement would be -70.5 dBm/MHz[8]. The ACMA previously used the RTCA report itself usage category 1 limit for spurious of -80 dBm/MHz up to 200 ft. Using the latter value as a target, the 11 dB difference (-80 to -91) means that the clearance surface method will be met by the ACMA ongoing unwanted emissions limits for RTCA usage category 1 aircraft. The -21 dBm/MHz TRP limit for AAS will have a 2 dB margin and the -30 dBm/MHz per port for non-AAS systems will also have a 2 dB margin (considering a total of 8 antenna ports). In practice, we expect that real-world base stations will exhibit a larger margin, given that the specification will apply above 4040 MHz and the typical base station intermodulation and filter response will exhibit some roll off as the RA band is approached.

4.31 The ISED methodology is not applicable during the interim mitigations period, due to the use of the exclusion zones. There may, however, be some applicability after the interim mitigations end date. However, all radio altimeters after the interim mitigation end date will be expected to have a spurious performance of at least RTCA usage category 1 (and better than usage category 1 for overload and blocking mechanisms). The revised RA standard and Minimum Operational Performance Standards (MOPS) are also expected to be based on, in part, equipment standards and regulatory requirements globally, which will be the 3GPP-based limits we use. Consequently, the decided unwanted emissions are sufficient on an ongoing basis, as well as during the interim mitigations period.

4.32 Table 2 below summarises the revised ongoing unwanted emissions regulatory limits to apply in the RA (4200–4400 MHz) range and the determined maximum values during and after the interim mitigations period that satisfy the RTCA report usage category 1 requirements.

[6] For fixed-wing aircraft. For helicopters, this figure was -33 dBm/MHz. ISED calculations did not take into account the 3dB polarisation factor, meaning that their limits are -27 dBm/MHz for fixed wing and -30dBm/MHz for helicopters, TRP or total mean conducted power.

[7] Altimeter under test model 6, 50 ft value. This is a usage category 2&3 altimeter.

[8] Altimeter under test model 2, 200 ft value.

Table 2: Unwanted emissions limits summary

Base station type	Regulatory limit	Determined maximum limit *during* interim period	Determined maximum limit *after* interim period
Non-AAS	-30 dBm/MHz per port mean conducted power (-21 dBm/MHz total mean conducted power for 8 antenna ports)	-11 dBm/MHz total mean conducted power	-19 dBm/MHz total mean conducted power
AAS	-21 dBm/MHz TRP	-11 dBm/MHz TRP	-19 dBm/MHz TRP

Interim mitigations end date

4.33 While not providing definitive timelines, Boeing indicated that a 31 March 2025 interim mitigation end date was likely to be impracticable.

4.34 Formal records of conversation regarding the FAA proposed revision of the RA-related airworthiness directive (AD) since its publication for comment are publicly available.

4.35 Some submissions to the draft AD made general comments about difficulty meeting the AD date of 1 February of 2024; for example, Airbus Defence and Space (DS) stated, 'Feb 2024 doesn't seem a feasible date to implement the requested upgrade in the whole fleet' and Embraer proposed a modified date of July 1 2025.

4.36 As confirmed in the published revised AD, the US retrofit end date is understood to be 1 February 2024.

4.37 We recognise that there have not been decisions on mitigations for Australia to give a clear signal to the aviation sector to start a retrofit, whereas the US has been actively managing a retrofit program. Consequently, the ACMA has decided with CASA to change the interim mitigation end date to 31 March 2026. The management of the end of interim mitigations is detailed in Chapter 8.

Retrofit cost estimates

4.38 Boeing provided some references that indicates the FAA-estimated costs were too low. Separately, Bombardier, in their response to the FAA-revised AD consultation, indicated that their costs would be significantly more than the FAA estimates (US$10,000–25,000 for newer aircraft models and on average US$45,000 for legacy models, in addition to approximately US$183,600 total for administrative compliance costs).

4.39 The ACMA received no substantive evidence of the costs of operational impacts to WBB operators having to implement or sustain possible mitigations, in response to the consultation.

5. Decisions on RA mitigations

5.1 This section summarises the ACMA's planning decisions on radio altimeter (RA) mitigations. Chapter 6 describes how we will implement them in the technical frameworks.

Summary of mitigations

5.2 **Ongoing mitigations:**

1. A 200 MHz[9] guard band, 4000–4200 MHz, where WBB deployments will not be permitted.
2. A total radiated power (TRP) limit of 48 dBm/5 MHz.
3. A total EIRP limit of 72 dBm/5 MHz for WBB deployments above 3700 MHz. For dual polarisation systems, this can be met by restricting each plane of polarisation to 69 dBm/5 MHz.
4. A range of unwanted emissions limits (articulated as TRP or conducted power per antenna port), which result in limits within the RA band of -30 dBm/MHz per port mean conducted power for non-AAS and -21 dBm/MHz TRP for AAS base stations.

The detail of the limits will be found in the draft example spectrum licence for spectrum-licensed services and the AWL licence condition determination. Limit values are the same, but their applicable frequency ranges and boundaries are different, reflecting proposed allocation ranges between spectrum-licensed services and AWLs. The frequency boundary for the spurious domain of unwanted emissions for AWLs will now be 4040 MHz, whereas the spurious domain boundary for unwanted emissions for base stations under spectrum licenses will remain at 3840 MHz.

5.3 **Interim mitigations:**

i) For deployments above 3700 MHz around identified runways:
   (1) exclusion zones, where no WBB services are permitted
   (2) restricted zones, except in the 3950–4000 MHz range in metro and regional highly localised areas, with a PFD limit in the restricted zones.

ii) For deployments above 3700 MHz everywhere:
   (1) the fixed mechanical or electrical tilt of any WBB antenna system is to be directed below the horizon only
   (2) grating lobes of WBB antenna systems should be minimised as much as is practicable.

An 'identified runway' is one identified by CASA as requiring the protection of radio altimeters due to safety and/or important operational requirements. An initial list is provided with the RA report.

An 'exclusion zone' is a zone made of 3 contiguous areas using the following 4 dimensions:

(1) An area extending lengthwise from the landing end of an identified runway for the 'extension length' indicated in Table 3, Column B for highest operating frequency.
(2) An area extending along the length of the runway to the far end.
(3) The exclusion zone extends beyond the far end of the runway for a length equal to the 'half-width' in Table 3, Column C.
(4) The width of the exclusion zone each side of the runway centreline, for the 3 parts in 1, 2, 3 is the 'half-width' using the applicable *maximum* operating frequency row in Table 3, Column C.

[9] Current implementation expectations are that there will be a separation of 250 MHz to high-powered WBB deployments in metropolitan and regional areas, and 200 MHz in remote areas.

A ‘restricted zone’ is an area extending lengthwise from a landing end only of an exclusion zone, and horizontally from an identified runway centreline. The dimensions apply using the *maximum* operating frequency row in Table 3, Column D.

Figures 3 and 4 below are instructive for an example case at 3750[10] MHz.

Figure 4: Zone sizes example (not to scale) for a runway that requires protection in both directions

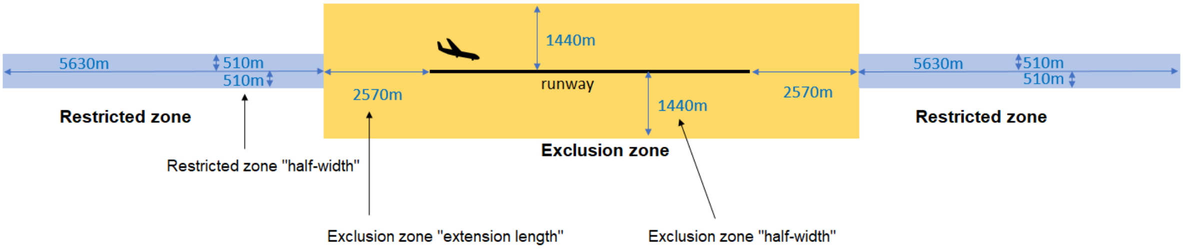
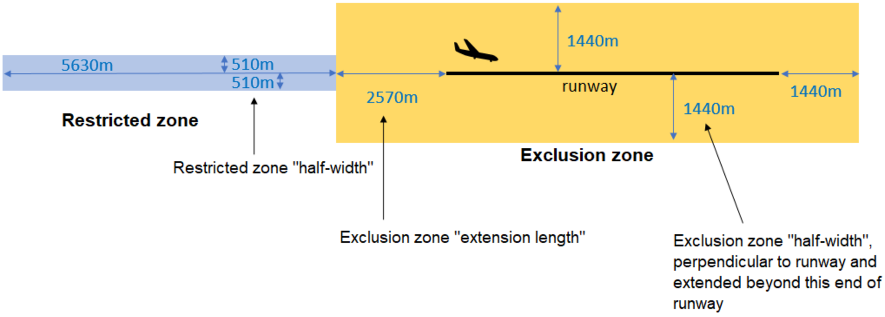


Figure 5: Zone sizes example (not to scale) for a runway that requires protection in only one direction



The ‘PFD limit’ value is defined in Table 3 column F for the *maximum* operating frequency row. The PFD cannot exceed that value at a height above the ground of the corresponding column G of Table 3, for any percentage of the time for all combinations of elevation and azimuth angles above the horizon, for deployments within the restricted zone.

[10] 3750 MHz was used as a comparison against French and Canadian examples only and does not represent the frequency range where we propose mitigations.

Table 3: Example table of interim mitigations in a frequency range

A	B	C	D	F	G
Base station operating frequency (MHz)	**Exclusion zone extension length (m)**	**Exclusion zone half-width (m)**	**Restricted zone size (m) (Length x half-width)**	**Power flux density limit (dBW/m²/MHz)**	**Power flux density limit restriction height (m)**
>3700 to 3750	2,570	1,440	5,630 x 260	-39.0	120
>3750 to 3800	2,720	1,590	5,480 x 270	-39.9	130
>3800 to 3850	2,890	1,760	5,310 x 280	-41.0	140
>3850 to 3900	3,000	1,870	5,200 x 350	-42.4	145
>3900 to 3950	3,110	1,980	5,090 x 420	-43.7	150
>3950 to 4000 (remote areas)	3,230	2,100	4,970 x 520	-45.2	155

5.4 The ACMA is of the view that these interim mitigations be time limited, with an end date of 31 March 2026.

5.5 The identified runways can be found in Appendix A. Any list published as part of the technical framework to support allocations in the band may supersede this list. The intent is that this list remains static until the end of the interim mitigations period.

6. Proposed implementation of mitigations

6.1 This chapter describes how the decisions on mitigations will be implemented in technical frameworks. It does not include the technical framework documents themselves, as they will be considered separately in individual allocation processes.

Interim mitigations

6.2 The interim mitigations and their timeframe will be documented in radiocommunications assignment and licensing instructions (RALI) MS47. These mitigations are, however, common to both AWL and spectrum-licensed technical frameworks.

6.3 The obligations on spectrum licences will be specified by reference to RALI MS47 in an amended Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015 (RAG Tx), itself referenced by a licence condition in each spectrum licence.

6.4 The obligations on AWLs will be specified by reference to RALI MS47 in the Radiocommunications Licence Conditions (Area-Wide Licence) Determination (AWL LCD).

Ongoing mitigations

6.5 Ongoing mitigations for AWLs will be documented in the AWL LCD.

6.6 Ongoing mitigations for spectrum licences will be documented as licence conditions in each spectrum licence.

7. The end of the interim mitigations period

7.1 This chapter describes how the ACMA intends to manage the end of interim mitigations and potentially review ongoing mitigations.

The end of interim mitigations

7.2 The ACMA has agreed an end date of 31 March 2026 to allow sufficient time for the aviation sector to take any necessary action to retrofit, or otherwise improve the performance of at-risk radio altimeters. Consequently, we are planning to end all interim mitigations after this date.

7.3 After 31 March 2026, it will be a matter for CASA as the aviation safety regulator to determine what, if any, additional measures they deem necessary to manage the aviation safety environment.

Removing interim mitigations

7.4 As the interim mitigations are wholly contained within RALI MS47, which also includes a reference to the interim mitigations end date, ending the interim mitigations requires no action from the ACMA. The RALI MS47 may be revised after the interim mitigations end date for completeness.

7.5 After the revision of RALI MS47, MS47 would still be referenced by the RAG Tx and AWL LCD. Consequently, it would be proposed that the RAG Tx and AWL LCD be amended at an appropriate future time, considering any other changes to those instruments that may be required.

8. Potential review of ongoing mitigations

8.1 This chapter describes how the ACMA may review ongoing mitigations.

Mitigations review

8.2 The ACMA will review all new evidence on the issue as it is presented. If sufficient new evidence has been presented to warrant a review of what mitigations are now in the best public interest, the ACMA may conduct a public mitigations review consultation. The submissions to that consultation will assist in deciding if the interim or ongoing mitigations should change.

8.3 Any changes to ongoing obligations on spectrum licensees that are specified in the spectrum licences, would likely be achieved using a variation with agreement process under section 72 of the Radiocommunications Act. Given that, based on evidence known today, it is unlikely that we would propose more onerous ongoing mitigations.

8.4 Any changes to ongoing obligations on AWLs that are specified in the AWL LCD would be considered in the mitigations review consultation, so that another consultation step would not be required to then amend the AWL LCD.

Appendix A: List of identified runways

This section described the identified runways and coordinates. These have been provided by CASA. An explanation of runway numbering can be found at the Airservices Australia website.

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.

Identifier	Location	Runway	Landing end coordinate (WGS84)	Far end coordinate (WGS84)
YMAV	Avalon	36	38°3'15.98"S, 144°27'53.44"E	38°1'38.0"S, 144°28'9.95"E
YPAD	Adelaide	05	34°57'27.54"S, 138°31'6.50"E	34°56'26.23"S, 138°32'35.75"E
YBAS	Alice Springs	12	23°48'3.71"S, 133°53'36.10"E	23°48'43.63"S, 133°54'50.50"E
YBAS	Alice Springs	30	23°48'43.63"S, 133°54'50.50"E	23°48'3.71"S, 133°53'36.10"E
YBNA	Ballina	06	28°50'8.65"S, 153°33'6.51"E	28°49'51.11"S, 153°34'13.70"E
YBNA	Ballina	24	28°49'51.11"S, 153°34'13.70"E	28°50'8.65"S, 153°33'6.51"E
YBBN	Brisbane	01L	27°22'59.5"S, 153°6'24.49"E	27°21'23.56"S, 153°7'19.9"E
YBBN	Brisbane	01R	27°24'10.7"S, 153°7'5.59"E	27°22'28.79"S, 153°8'3.50"E
YBBN	Brisbane	19L	27°22'28.79"S, 153°8'3.50"E	27°24'10.7"S, 153°7'5.59"E
YBBN	Brisbane	19R	27°21'23.56"S, 153°7'19.9"E	27°22'59.5"S, 153°6'24.49"E
YBRM	Broome	10	17°56'45.53"S, 122°13'0.78"E	17°57'4.71"S, 122°14'12.94"E
YBRM	Broome	28	17°57'4.71"S, 122°14'12.94"E	17°56'45.53"S, 122°13'0.78"E
YBCS	Cairns	15	16°51'56.94"S, 145°44'36.85"E	16°53'31.9"S, 145°45'19.41"E
YBCS	Cairns	33	16°53'31.9"S, 145°45'19.41"E	16°51'56.94"S, 145°44'36.85"E
YSCB	Canberra	17	35°17'26.26"S, 149°11'39.99"E	35°18'53.31"S, 149°11'40.0"E
YSCB	Canberra	35	35°18'53.31"S, 149°11'40.0"E	35°17'26.26"S, 149°11'39.99"E
YPDN	Darwin	11	12°24'33.85"S, 130°51'54.94"E	12°25'9.22"S, 130°53'39.99"E

Identifier	Location	Runway	Landing end coordinate (WGS84)	Far end coordinate (WGS84)
YPDN	Darwin	29	12°25'9.22"S, 130°53'39.99"E	12°24'33.85"S, 130°51'54.94"E
YBCG	Gold Coast	14	28°9'23.44"S, 153°30'2.54"E	28°10'21.25"S, 153°30'39.31"E
YBCG	Gold Coast	32	28°10'21.25"S, 153°30'39.31"E	28°9'23.44"S, 153°30'2.54"E
YBHM	Hamilton Is	14	20°21'4.76"S, 148°56'48.18"E	20°21'49.1"S, 148°57'23.69"E
YBHM	Hamilton Is	32	20°21'49.1"S, 148°57'23.69"E	20°21'4.76"S, 148°56'48.18"E
YMML	Melbourne	16	37°39'11.45"S, 144°50'5.69"E	37°41'8.80"S, 144°50'27.60"E
YBMA	Mount Isa	16	20°39'18.15"S, 139°29'9.17"E	20°40'39.51"S, 139°29'27.97"E
YBMA	Mount Isa	34	20°40'39.51"S, 139°29'27.97"E	20°39'18.15"S, 139°29'9.17"E
YSNF	Norfolk Is	11	29°2'11.68"S, 167°55'47.99"E	29°2'44.46"S, 167°56'47.11"E
YSNF	Norfolk Is	29	29°2'44.46"S, 167°56'47.11"E	29°2'11.68"S, 167°55'47.99"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
YBSU	Sunshine Coast	13	26°34'59.57"S, 153°4'28.26"E	26°36'2.62"S, 153°5'22.37"E
YBSU	Sunshine Coast	31	26°36'2.62"S, 153°5'22.37"E	26°34'59.57"S, 153°4'28.26"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
YBTL	Townsville	01	19°15'29.90"S, 146°45'53.0"E	19°14'17.53"S, 146°46'27.18"E
YBTL	Townsville	19	19°14'17.53"S, 146°46'27.18"E	19°15'29.90"S, 146°45'53.0"E
YBWW	Wellcamp	12	27°32'55.51"S, 151°47'4.19"E	27°33'58.66"S, 151°48'21.19"E