Arrangements for highly localised WBB in the 3400-3475 MHz and 3950-4000 MHz bands

Technical liaison group paper

November 2023

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# Version control

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| **Version** | **Comments** |
| Version 1.0 | Initial release: 17 November 2023 |
| Version 2.0 | Release: 22 March 2024  Includes:   * updates based on submissions received from TLG members to Version 1 |
| Version 2.1 | Release: 8 April 2024  Updates to Amateur service coordination arrangements to clearly define criteria for HL WBB Tx 🡪 Amateur Rx and Amateur Tx 🡪 HL WBB Rx cases. |
| Version 3.0 | Release: 22 July 2024  Includes:   * updates based on submissions received from TLG members to version 2.1; and * updates to licence taxes quoted to align with increase to CPI; * inclusion of spurious emission limits for HL WBB BS and UEs; * radio altimeter study and proposed coexistence measures. |
| Version 4.0 | Release: 14 October 2024  Final Version  Includes updates based on submissions received from TLG members to version 3.0 regarding:   * in-band and unwanted emission limits; * methods to manage co-channel interference with spectrum licences; * coexistence with radio altimeters. |

# Introduction

On 19 July 2022, as part of the outcomes of the [proposed spectrum re-allocation declaration for the 3.4 GHz and 3.7 GHz bands](https://www.acma.gov.au/consultations/2022-03/proposed-spectrum-re-allocation-declaration-34-ghz-and-37-ghz-bands-ifc-102022) consultation process, the ACMA decided to reserve spectrum in the 3400-3475 MHz frequency range in urban areas, and 3950-4000 MHz band in metro and regional Australia (refer to Appendix A for a definition of areas), for highly localised wireless broadband (HL WBB) use.

Arrangements for HL WBB are intended to support the deployment of localised private and enterprise networks, including services at warehouses, factories, airports, ports, transport hubs, hospitals, schools and smart buildings. It is expected to enable the use of new technologies to support the internet of things, intelligent transport systems, smart cities, smart utility applications and other Industry 4.0[[1]](#footnote-2) opportunities.

The ACMA has convened the 3.4 GHz technical liaison group ([TLG](https://www.acma.gov.au/spectrum-licence-technical-liaison-groups)) to provide advice on the development of arrangements to support the introduction of HL WBB in the 3400-3475 MHz and 3950-4000 MHz frequency ranges.

The purpose of this paper is to:

present draft arrangements and possible options to support HL WBB use; and

summarise feedback on the draft arrangements from the TLG.

The ACMA will review and update the draft arrangements in this paper based on feedback received.

It is noted that:

A TLG is a short-term advisory body convened by the ACMA. Its purpose is to provide advice on the development of, or possible changes to, a spectrum or apparatus licence technical framework. While the ACMA strives to achieve consensus with members, the final decision on the content of, or changes to, a spectrum or apparatus licence technical framework rests with the ACMA. This is particularly relevant in cases where consensus cannot be achieved on an issue or advice from the TLG is not provided within a reasonable time frame.

This TLG is just one step in the process developing arrangements for HL WBB use of the 3400-3475 MHz and 3950-4000 MHz frequency ranges. The ACMA will use the outcomes of the TLG to publicly consult on changes to the relevant instruments that form the 3.4 GHz band technical framework. This means TLG members are able to provide comments on the technical framework both as part of the informal TLG and subsequent formal public consultation processes.

This version of the TLG paper is a draft and informal in nature. It makes no definitive proposals and has not been considered by the ACMA Authority (hence any references to the ACMA should be taken as ‘ACMA staff’). As an informal document, its development has been shared with members of the 3.4 GHz TLG only and not released publicly. Outcomes from the TLG will be considered by the ACMA when developing formal proposals for any relevant subsequent public consultation.

## Scope of TLG

The scope of this TLG paper is to consider frequency assignment arrangements to support the introduction of HL WBB services in the 3400-3475 MHz and 3950‑4000 MHz frequency ranges in the areas defined at Appendix A.

This TLG will not consider licence allocation issues, or changes to technical arrangements for area-wide licences or spectrum licences in other parts of the 3400-4000 MHz frequency range.

## Next steps

The ACMA will publish a final version of this paper on its website. The ACMA plans to publicly consult on arrangements for HL WBB in October 2024.

# Background

We have undertaken multiple streams of work to replan and optimise arrangements across the 3.4–4.0 GHz frequency range. Key areas of this work that are most related to the development of arrangements for HL WBB include:

[optimisation of arrangements in the 3400-3575 MHz frequency range](https://www.acma.gov.au/consultations/2019-08/optimising-3400-3575-mhz-band-consultation-122019)

[the 3.4 GHz band TLG](https://www.acma.gov.au/sites/default/files/2021-08/2021%203.4%20GHz%20TLG%20package.zip) (July 2021 outcomes, referred to as the 2021 TLG);

[planning for wireless broadband use of urban areas in the 3400–3475 MHz band](https://www.acma.gov.au/consultations/2021-08/planning-wireless-broadband-use-urban-areas-3400-3475-mhz-band-consultation-312021);

[proposed spectrum re-allocation declaration for the 3.4 GHz and 3.7 GHz bands](https://www.acma.gov.au/consultations/2022-03/proposed-spectrum-re-allocation-declaration-34-ghz-and-37-ghz-bands-ifc-102022).

An outcome of these processes was the identification of spectrum space for HL WBB use. These arrangements and those for the broader 3.4-4.0 GHz frequency range are depicted in Figure 1. The arrangements for HL WBB are in orange. Definitions for the applicable areas are at Appendix A.

1. Planning arrangements for the 3.4-4.0 GHz frequency range (not to scale)

AM = Amateur, AWL = area wide licence, FSS = Fixed satellite service,

PMP = point-to-multipoint, PTP = point-to-point, SL = spectrum licence,

WBB = wireless broadband



From October 2020 to July 2021, the 3.4 GHz TLG considered technical arrangements for HL WBB use of the 3400-3475 MHz frequency range in defined urban areas. The outcomes of that TLG are available on the [ACMA’s website](https://www.acma.gov.au/sites/default/files/2021-08/2021%203.4%20GHz%20TLG%20package.zip).

In August 2021, the ACMA [consulted on planning options](https://www.acma.gov.au/consultations/2021-08/planning-wireless-broadband-use-urban-areas-3400-3475-mhz-band-consultation-312021) for the 3400-3475 MHz band in defined urban areas.

The arrangements identified by the 2021 TLG and the August 2021 consultation included options for either low powered or macro cell WBB use. A subsequent consultation by the ACMA in March 2022 (as part of the [proposed spectrum re-allocation declaration for the 3.4 GHz and 3.7 GHz bands](https://www.acma.gov.au/consultations/2022-03/proposed-spectrum-re-allocation-declaration-34-ghz-and-37-ghz-bands-ifc-102022)) determined that the 3400-3475 MHz and 3950-4000 MHz frequency ranges in defined urban areas and metro/regional areas respectively, should be made available for low power HL WBB use.

For this reason, only the low power WBB arrangements developed in the 2021 TLG process, that support multiple operators in an area, will be considered in this TLG. This relates to Options 3 at Appendix E to the [*Planning for wireless broadband use in urban areas in the 3400–3475 MHz band – Options paper*](https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.acma.gov.au%2Fsites%2Fdefault%2Ffiles%2F2021-08%2FPlanning%2520for%2520wireless%2520broadband%2520use%2520of%2520urban%2520areas%2520in%2520the%25203400-3475%2520MHz%2520band%2520-%2520options%2520paper.docx&wdOrigin=BROWSELINK). This option is reproduced in the Table 1 for convenience.

### Previously developed interference management criteria

The interference management criteria detailed in Table 1 are derived from the outcomes of the 2021 TLG and from the [*Planning for wireless broadband use in urban areas in the 3400–3475 MHz band – Options paper*](https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.acma.gov.au%2Fsites%2Fdefault%2Ffiles%2F2021-08%2FPlanning%2520for%2520wireless%2520broadband%2520use%2520of%2520urban%2520areas%2520in%2520the%25203400-3475%2520MHz%2520band%2520-%2520options%2520paper.docx&wdOrigin=BROWSELINK). They provide support for multiple HL WBB operators in the 3400-3475 MHz frequency range in defined urban areas. As a general rule, it was intended that licensees would be free to negotiate alternative arrangements to manage interference with affected parties on a case-by-case basis.

Previously, some TLG members raised concerns about the practical limitations of synchronisation of a large number of HL WBB services, especially if services are operated by multiple different operators.

Summary of possible interference management framework for HL WBB use

|  |  |
| --- | --- |
| **Item** | **Interference management criteria** |
| Licence category | Apparatus (e.g., AWL) or class licence |
| Definitions | ‘Controlled premises’means premises that are owned by or under the control of a person who is providing a radiocommunications service under a class licence*.*  Note: If an AWL approach is adopted, the term ‘controlled premises’ would be defined as the geographical boundary of the licence. |
| General rules for all transmitters | 1. Operation of transmitters is limited to urban excise areas and within the 3400–3470 MHz range (i.e., 5 MHz restricted use band). Operation within the 3470–3475 MHz range is possible via agreement with the adjacent band spectrum licensee. 2. The maximum EIRP must not exceed 30 dBm. 3. The power spectral density must not exceed 17 dBm EIRP per MHz. 4. Base station transmitters must comply with the unwanted emission limits described in 3GPP TS 38.104. 5. User equipment transmitters must comply with the unwanted emission limits described in 3GPP TS 38.101-2. 6. Operation is on a no interference and no protection basis to services operating under other licences. 7. The operation of transmitters must be synchronised with the operation of services operating under adjacent area 3.4 GHz spectrum licences that are directly adjacent to urban excise areas. In this case synchronisation means operating in accordance with [clause 11 of Licence Schedule 4 of a 3.4 GHz spectrum licences](https://web.acma.gov.au/rrl/licence_image.extract_pdf?pLICENCE_NO=10917464). 8. The aggregate power flux-density from transmitters on controlled premises must not exceed –64.9 dBm/MHz/m2 at the external boundary of the controlled premises at a height of 5 metres above ground level. 9. The aggregate power flux-density from transmitters on controlled premises must not exceed –99.9 dBm/MHz/m2 at the boundary of urban areas at heights between 5 and 100 metres above ground level. |

# Summary of submissions

This section contains a summary of submissions made on versions 1.0, 2.1 and 3.0 of the TLG paper and the ACMA staff response to these.

## Submissions to TLG paper Version 1.0

Ten submissions were received to V1.0 of the TLG paper. Submissions were received from:

* Airservices Australia
* The Australian Mobile Telecommunications Association (AMTA)
* Aqura
* DB Telecommunications
* Hewlett Packard Enterprise (HPE)
* Joint satellite response (Inmarsat, Intelsat, SES and Speedcast)
* Nbn
* Optus
* Pivotel
* Telstra.

The main issues raised in submissions are summarised below. Please refer to individual submissions for more detail. This paper has been updated based on the ACMA staff responses below.

### Licence type for HL WBB

* Submissions were supportive of the proposed point-to-multipoint (PMP) licence arrangements for HL WBB, this included adopting the low and micro power discounts to reduce fees.
* AMTA, Optus and Telstra, recommended that arrangements for HL WBB in the 3400-3475 MHz band should support future defragmentation/optimisation activities in the broader 3400-3800 MHz band. As an example, Telstra stated that while current use of the 3400-3475 MHz band is limited by adjacent area nbn services, macro cells may become a viable option in the future. Optus argued macro cell deployments are currently possible in some urban excise areas. They also indicated that the boundary of urban excise areas could change over time as nbn’s fixed wireless access (FWA) footprint is replaced with fixed line solutions (to support population growth). In both these cases, re-allocating the spectrum for spectrum licensing was considered the optimal outcome. AMTA, Optus and Telstra argued flexibility to consider this in the future could be achieved by aligning the expiry dates of PMP licence with spectrum licences in the 3400-3700 MHz band. Specifically, all PMP licences in the 3400-3475 MHz band should expire on or before 13 December 2030.
* DB Telecommunications suggested that spectrum limits could be considered to help manage interference from multiple users in an area.
* Pivotel expressed concern with the co-sited policy as written. It proposed that the owner of the private enterprise should retain control of base station deployment. In the event a body corporate manages a building, then that entity should have authority to decide who can deploy base stations.

#### ACMA staff response

* Based on submissions, we will state that use of PMP licensing is the recommendation of the TLG. Matters concerning pricing arrangements will be considered further in the planned Q3 consultation paper.
* We note comments made regarding the duration of licences issued in the 3400-3475 MHz band. However, this is not within scope of the TLG and will not be considered further in this forum. This issue will be considered further in the planned Q3 consultation paper. For now, the TLG will continue to focus on possible technical arrangements to support HL WBB access to the 3400-3475 MHz band. In the meantime, separate from the TLG process, TLG members are free to provide their views to help inform our considerations.
* We note comments made regarding possible spectrum or allocation limits. However, this is not within scope of the TLG and will not be considered further in this forum. This issue will be considered further in the planned Q3 consultation paper. In the meantime, separate from the TLG process, TLG members are free to provide their views to help inform our considerations.
* We have considered various measures to manage interference from two or more services deployed at single (or nearby) premises. Our current proposal is to implement the co-sited policy as detailed in the *PMP* section of thispaper. This in effect, provides a large degree of control to the owner of a private enterprise or body corporate regarding the deployment of infrastructure. However, it also provides flexibility on how to interference is managed.

### Restrictions on HL WBB operation

* Submissions supported the operation of remote and supplementary stations being on a ‘no interference and no protection’ basis.
* Submissions supported adopting unwanted emission limits for base stations and user terminals that align with the 3GPP 38 series of technical specifications. The joint satellite submission proposed adopting the Local Area BS limits.
* Submissions generally supported the proposed power spectral density (PSD) limit for HL WBB. Pivotel suggested reviewing this limit once demand is better understood. HPE suggested both conducted and EIRP limits be defined to manage the risk of interference and improve spectral efficiency. nbn were open to a higher PSD limit provided suitable power flux density (PFD) limits were put in place at the boundary of urban areas.
* Telstra indicated that it should be made clear in a condition on the licence, that where HL WBB operates on a ‘no interference and no protection’ (NINP) basis to another service, this means there is no first-in-time protection. This is proposed to apply between neighbouring HL WBB operators. Telstra also considered the NINP criteria should apply to possible future outdoor macro-stations in the 3400-3475 MHz band.
* There were different views on whether HL WBB should be limited to indoor only use. Telstra supported indoor only operation in the 3400-3475 MHz band and recommended it also be considered for the 3950-4000 MHz band. Telstra argued that for a number of the use case scenarios identified by the ACMA, outdoor use would be better accommodated by Wi-Fi. Aqura, DB Telecommunications, Optus and Pivotel supported both indoor and outdoor use cases. Aqura suggested that HL WBB operation around airports in the 3950-4000 MHz band could be limited to indoor only use until 31 March 2026 (when interim arrangements for area-wide licences (AWLs) and spectrum licences (SLs) to protect radio altimeters end).
* Submissions supported the use of synchronisation to help manage interference. HPE indicated that there are numerous frame structures available, and requirements may change over time. They recommended the ACMA consider a synchronisation change mechanism and including a review every 3-5 years. Pivotel recommended that the fallback synchronisation requirement be compulsory for all outdoor base stations in the 3400-3475 MHz band, but should not be compulsory for indoor systems. AMTA, Telstra, Optus considered that the synchronisation requirement for HL WBB in the 3400-3475 MHz band should be to align with geographically adjacent spectrum licensees, rather than pointing to clause 11 of licence schedule 4 of existing spectrum licences. This would provide greater flexibility for SLs to adopt more efficient frame structures in the future. Optus also argued that the obligation for HL WBB to synchronise should apply to both adjacent area and adjacent band SLs. AMTA, Optus and Telstra stated it should be made clear that HL WBB operate on a ‘no interference and no protection’ (NINP) basis to spectrum licences. Furthermore, it should be made clear that spectrum licensees (either adjacent area or adjacent band) are not required to adjust their frame structure to synchronise with HL WBB users.
* There was support for the application of PFD limits. DB Telecommunications noted possible issues with modelling PFD levels at the boundary of a premises due to uncertainties with building penetration losses. Consequently, measurements may be the only viable solution. AMTA questioned whether such a precise PFD limit is required at the urban excise boundary and what was meant by ‘aggregate’ PFD. They suggested that either a simple site-to-site coordination method or device boundary style calculation could be used instead. To protect nbn services in the 3400-3475 MHz band, HPE and Pivotel supported the Option 3 (unsynchronised) PFD approach, while nbn were concerned with this option due to the proximity of some of their services to urban excise boundaries.
* Submissions supported the concept of a restricted use band (RB). However, there were different views on how big it should be. Pivotel recommended the RB be 5 MHz due to the limited spectrum available and the proposed PSD limit. AMTA, Aqura, Optus and Telstra supported a 15 MHz RB. They argued smaller bandwidths would not be sufficient to manage interference from high powered services operating above 3475 MHz.
* Aqura agreed with the ACMA proposal that any use of an RB comes with the risk that the licensee may need to modify or cease operation at any time to manage interference. AMTA, Optus and Telstra recommended that access to the RB only be permitted with agreement of the adjacent band spectrum licensee.

#### ACMA staff response

* Based on submissions, no further changes are proposed to the arrangements for remote and supplementary stations.
* Except when required for coexistence reasons, we propose adopting the unwanted emission limits for base stations and user terminals defined in the 3GPP 38 series of technical specifications. Further thought is needed on whether to align with either Local Area or Medium Range base station (BS) requirements. Currently it is proposed to adopt the Medium Range BS limits as this provides greater flexibility in equipment choice. We note that the level of unwanted emissions in the 4200-4400 MHz band requires further consideration due to possible coexistence issues with radio altimeters.
* No further changes are proposed to the PSD limit. This limit can be reviewed in the future as demand is better understood or as use cases for HL WBB evolve. We do not intend to define both conducted and EIRP limits as it is not clear how doing so would reduce the risk of interference and improve spectral efficiency. We consider a PSD limit alone is sufficient to address these issues.
* Numerous submissions expressed interest in supporting both indoor and outdoor HL WBB operations. We consider this can be supported in the 3950-4000 MHz band, noting further discussion is required on whether any restrictions on operation (such as limiting to indoor only use) are required around airports. We are open to further discussion on whether HL WBB use in the 3400-3475 MHz band should support both indoor and outdoor operations. Our current view is to limit operation to indoor only, however, this could be reviewed in the future. This would allow time for demand and use cases for HL WBB to be better understood as well as providing a better understanding of the ability for HL WBB to coexist with nbn services (based on real world deployments).
* The arrangements proposed for HL WBB in V1.0 of the TLG paper intended that HL WBB would operate on a NINP basis to other HL WBB licences and SLs. We confirm this means that HL WBB is not provided first-in-time protection for those cases. This can be made clear in the soon to be developed HL WBB RALI as well as the relevant licence condition determination. At this stage we do not consider it appropriate to extend such measures to possible future macro stations in the 3400-3475 MHz band. As mentioned previously that issue is not within scope of this TLG.
* We see benefit in considering different synchronisation requirements in the 3400-3475 MHz and 3950-4000 MHz bands. For any arrangements developed, we recognise that technology and use cases will evolve over time and a periodic review would be beneficial. The mechanism to do this would be via a public consultation, possibly preceded by a TLG or other fora, to propose amendments to either conditions on licences or the relevant licence condition determination instrument. Advisory notes could be incorporated on licences (and/or the licence condition determination) so licensees are aware that the synchronisation requirement could be reviewed and may change in the future. We do not currently propose a definitive timeframe for any review but will continue to monitor developments and consider feedback from stakeholders (including to the FYSO) when deciding on future work plans.
  + 3400-3475 MHz: To provide flexibility to SLs to implement different frame structures (when nbn migrates to 5G or as technology and use cases evolve over time) we propose adopting the measures proposed by AMTA, Optus and Telstra. That is, rather than applying the synchronisation requirement detailed on spectrum licences, HL WBB would operate a NINP basis to all SLs. This condition would be specified either on the licence or in the relevant licence condition determination. It means the obligation would be on HL WBB users to implement measures to manage interference, including synchronising with adjacent area/frequency SLs.

Further consideration is required on how to make this approach work in practice. Specifically, what process should be used to manage a change in frame structure. Our current proposal is that the adjacent area SL (nbn) notify the ACMA of its intention to change frame structure ‘X’ months (TBD) before it occurs. The ACMA can then notify APs and relevant licensees. The intention being to provide them with reasonable warning to implement changes and minimise impact on services.

* + Feedback from the TLG is sought on this approach or any alternative proposals (e.g. whether such a process is even needed). We are also interested in views on how many months before the change the adjacent area SL should notify the ACMA.
  + 3950-4000 MHz: There was no opposition to adopting the same synchronisation fallback requirements as defined for AWLs. No changes are proposed. We note that any future review of this arrangement would also need to include a broader consideration of the synchronisation requirement for AWLs.
* After considering submissions we propose the following amendments to the proposed PFD limits:
  + PFD limit at the boundary of a controlled premises: The term ‘aggregate’ PFD was intended to apply to all devices deployed at a single premise. It formed part of the proposal presented to the 2021 TLG. However, we had not intended to include it as part of the measures proposed in this paper. Its inclusion in the summary of proposed arrangements was due to a simple copy-and-paste error. We have corrected this mistake for both PFD limits.

To address issues with modelling PFD limits for indoor systems, we propose using a standard value of 14 dB for building penetration loss (BPL). Of course, alternative values can be used where better information is available (for example in cases where penetration losses are greater than 14 dB). Applicants would also be free to use measurements for their assessment. The value of 14 dB is based on the value [proposed by Ofcom](https://www.ofcom.org.uk/__data/assets/pdf_file/0017/272051/Consultation-Shared-Access-Licence.pdf) for interference calculations involving HL WBB use in the 3800-4200 MHz. It is noted that the protection level Ofcom proposed is ‑88 dBm/20 MHz, which is similar to the level of -101.5 MHz dBm/MHz proposed in this paper and is also based on synchronised operation.

We recognise that assuming a 14 dB BPL may underestimate interference in some cases. However, the PFD limit is only intended to improve coexistence between HL WBB systems. It is not expected to manage interference in all cases. Under this arrangement, in the event of interference, licensees will need to agree on suitable measures to manage it. If agreement is not forthcoming, then the synchronisation requirement applies.

* + PFD limit at the boundary of urban areas (3400-3475 MHz band only): To address comments on simplifying this requirement, we have included options for direct HL WBB base station (BS) to nbn BS coordination and a device boundary criterion (DBC). Any arrangements will assume services are synchronised with SLs.
* After reviewing submissions, we consider that a 15 MHz RB would be appropriate for now. We can review this in the future, as HL WBB demand and use cases are better understood. This approach would also allow us to better understand the interference environment based on real world deployments. While we could authorise use of the RB on a case-by-case basis, we propose adopting a general policy of allowing access when there is agreement with the adjacent band spectrum licensee. Such use would need to be on a NINP basis. This means licensees would need to take on the risk that they may have to modify or cease operation at any time to manage interference with other HL WBB licensees or adjacent area/frequency SLs.

### Managing interference with other licensed services

* Submissions supported interference management arrangements proposed with point-to-point (PTP) links, earth station protection zones (ESPZs), radiolocation services and AWL Tx.
* While not an issue for this TLG AMTA, Optus and Telstra, flagged that a separate request has been made to the ACMA to vary spectrum licence unwanted emission limits such that the frequency boundary between non-spurious and spurious emission limits (currently 3840 MHz) be increased to 4040 MHz. Such a change will provide support for a greater range of equipment and align with the limits defined for AWL Tx.
* AMTA requested clarification on how the protection ratios in RALI FX3 can be applied to Amateur Repeaters and Beacons.
* The joint satellite submission indicated it was unclear if FSS earth station (FSS ES) are operating under an AWL Rx or earth receive licence in the 3950-4000 MHz band. They supported the use of earth receive licences as they consider the protection arrangements for AWL Rx (including the PFD limit at licence boundary) are not sufficient to protect FSS ES. They were also concerned with the proposed RF filter performance defined for FSS ES.
* The joint satellite submission proposed the following measures be used to manage interference with HL WBB:
  + Co-channel: Define a cull distance within which case-by-case coordination is required.
  + Adjacent channel: No HL WBB use within a defined distance of an FSS ES. No coordination required for HL WBB deployed outside this distance, provided unwanted emissions comply with those defined for Local Area BSs in 3GPP TS 38.104.
* AMTA, HPE, nbn, Optus, Pivotel and Telstra’s views on managing interference between HL WBB and spectrum licences are provided in the PFD limit and synchronisation requirement summaries in the *Restrictions on HL WBB operation* section.
* Airservices stated that measures to protect radio altimeters should be based on studies using conservative parameters to account for the high safety standards of the aviation industry. Aqura suggested that HL WBB deployments around airports should be limited to indoor only, but this could be relaxed once temporary coexistence measures for AWLs and spectrum licences end in March 2026. Several submissions indicated that both indoor and outdoor use cases are likely in the 3950-4000 MHz band. Most submissions did not comment on the possible use of spurious emission limits across the entire 4200-4400 MHz band, though separate comments were made about aligning with limits defined in 3GPP TS 38.104. AMTA indicated it was not clear what the ACMA was planning to review given the executive summary to the [*Wireless broadband and radio altimeter coexistence—Outcomes paper*](https://www.acma.gov.au/sites/default/files/2023-06/Wireless%20broadband%20and%20radio%20altimeters%20coexistence_Outcomes%20paper.pdf) outlines coexistence management *outside of* HL WBB arrangements in 3950-4000 MHz. AMTA also stated its view that they don’t believe 3GPP compliant equipment will cause harmful interference to radio altimeters fitted with adequately performing equipment.

#### ACMA staff response

* Based on submissions, no further changes are proposed to the interference management arrangements defined for PTP links, ESPZs and AWL Tx.
* We note comments made regarding 3.4 GHz spectrum licence spurious emission limits and invite stakeholders to raise this issue in response to the upcoming draft FYSO 2024-29 consultation process.
* We recognise the use of protection ratios in RALI FX3 may be impractical for assessing interference with Amateur Repeaters and Beacons. To rectify this, we propose adopting the same measures defined for AWLs in RALI MS47.
* We note that decisions regarding the applicable licence type for FSS ES in metropolitan and regional areas across the broader 3400-4200 MHz band were made as part of the [*Allocation of area-wide apparatus licences in the 3.8 GHz band*](https://www.acma.gov.au/consultations/2023-06/allocation-area-wide-apparatus-licences-38-ghz-band) consultation processes. The outcomes of that process state that AWL receive only (AWL Rx) and earth receive apparatus licensing apply in the 3750/3800-4000 MHz and 4000-4200 MHz bands respectively. Reviewing this decision, including filtering arrangements that apply to FSS ES, is not within scope of this TLG.
* Updates have been made to the coordination criteria for FSS ES. This includes distinguishing criteria between AWL Rx and earth receive licence types (which could be in 3400-4200 MHz in remote areas, and 4000-4200 MHz in metro/regional areas). Due to the low power nature of HL WBB, the relevant cull distances for coordination have been revised. We have also proposed a minimum separation distance for adjacent channel services.
* After considering submissions related to coexistence with Radio Altimeters, we will consider measures for both indoor and outdoor HL WBB use in the 3950-4000 MHz band. As HL WBB will be restricted to much lower EIRPs than WBB systems considered in previous studies, the ACMA is re-assessing the coexistence requirements for that case. We plan to provide our study to the TLG soon for review and comment.

We note that the European Commission Committee (ECC) is also investigating this issue via the group ECC Project Team 1. In January 2024 they released the latest [preliminary results of studies](https://cept.org/ecc/groups/ecc/ecc-pt1/client/meeting-documents). These preliminary results indicate that low to medium power WBB stations operating in the 3800-4100 MHz do not present an interference risk to radio altimeters. It is noted that these results are subject to change.

## Submissions to TLG paper Version 2.1

Five submissions were received in response to V2.1 of the TLG paper. Submissions were received from:

* The Australian Mobile Telecommunications Association (AMTA)
* Aqura
* DB Telecommunications
* Joint satellite response (Intelsat, SES, Speedcast and Viasat)
* Telstra.

An additional submission was provided by NBN Co, which included:

* support for a mandatory synchronisation requirement between HL WBB operations and adjacent area SLs operations;
* a proposal that the adjacent area SL operators notify the ACMA 6 months prior to any change in TDD frame structure.

The main issues raised in submissions are summarised below. Please refer to individual submissions for more detail. This paper has been updated based to incorporate outcomes from the consultation on Version 2.1, as reflected in the ACMA staff responses below.

### Unwanted emission limits

* The joint satellite submission supported adopting the 3GPP unwanted emission limits defined for Local Area BS in Table 6.6.4.2.4-1 of 3GPP TS 38.104. It was argued that this limit may provide greater compatibility with other adjacent band services including FSS ES.
* Telstra proposed adopting limits defined for Medium Range BSs in Table 6.6.4.2.3-2 of 3GPP TS 38.104 (Medium Range BS with transmit powers below 31 dBm). This was on the basis that the maximum EIRP limit for HL WBB is set at 30 dBm per occupied bandwidth.

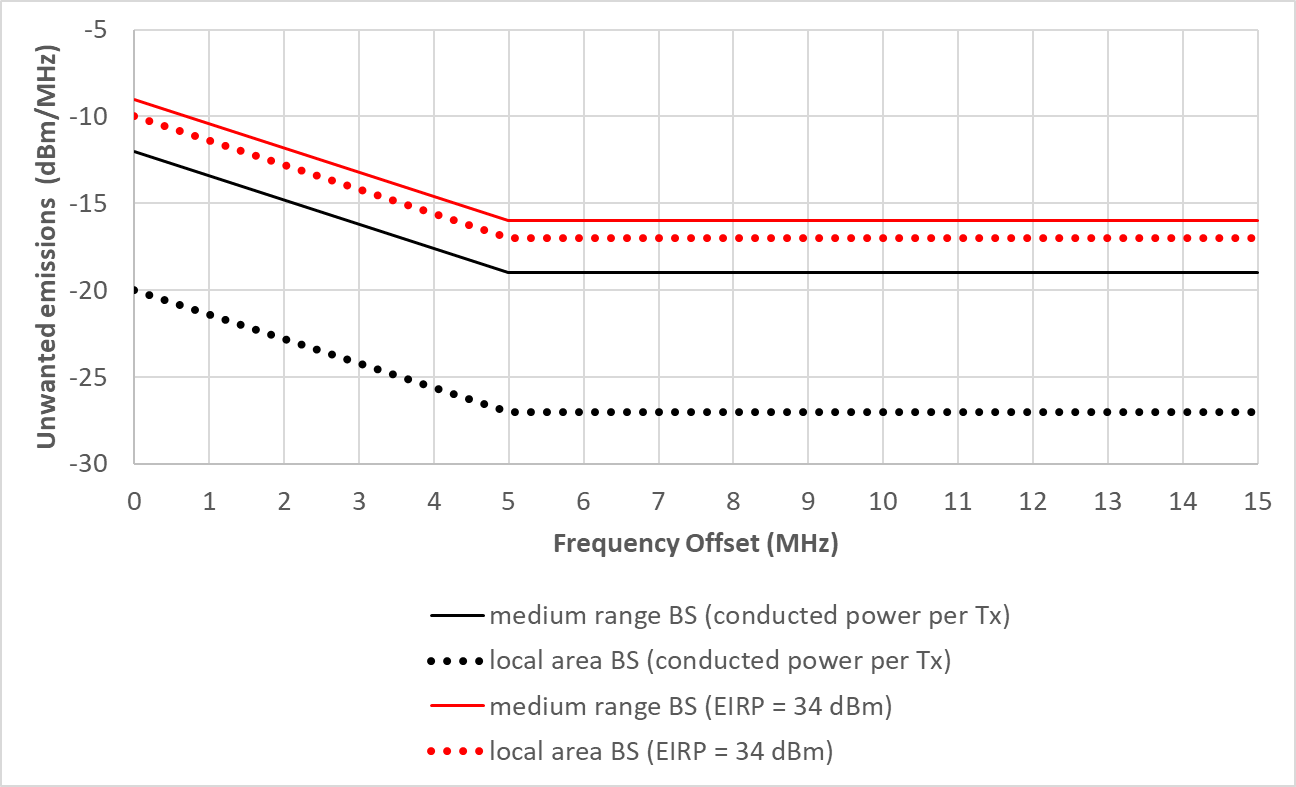
#### ACMA staff response

* We note that a maximum 30 dBm EIRP limit in combination with the 17 dBm/MHz PSD limit was previously proposed for HL WBB operations (see the *Background* section of this paper). However, V1.0 of the TLG paper proposed dropping the EIRP restriction. This was on the basis that the quanta of spectrum available for licensing effectively restricts the maximum EIRP. For example, in the 3400-3475 MHz band a maximum allocation of 60 MHz is typically available. The combination of maximum available spectrum and the prescribed PSD limit means that a maximum EIRP of 34.8 dBm/60 MHz is possible.
* The PSD limit also means that we expect that most deployments will make use of equipment compliant with the unwanted emission limits for Local Area BS. However, for services operating closer to the maximum allowed levels, deployment of equipment complying with Medium Range BS unwanted emission limits may become an option. In this case, we consider that if a Local Area BS and Medium Range BS were operating at the same in-band EIRP, then the peak level of (non-spurious) radiated unwanted emission limits would be comparable. For example, for the scenario in Figure 1-A, when antenna gain is included, the peak level of radiated unwanted emissions differ only by 1 dB. This is based on a 50 MHz channel (maximum EIRP is 34 dBm) where Local Area BS antenna gain is 10 dBi (EIRP – Tx power = 34 dBm - 24 dBm) and Medium Range BS antenna gain is 3 dBi (EIRP – Tx power = 34 dBm - 31 dBm).

For this reason, from an interference potential perspective, there is unlikely to be a significant difference between adopting the Local Area or Medium Range BS limits. Consequently, we propose specifying the unwanted emission limits for Medium Range BS defined in Table 6.6.4.2.3-2 (for non-AAS) and section 9.7.4.2 (for AAS) of 3GPP TS 38.104 as the upper limit for HL WBB BS. This will provide operators with a greater range of equipment options. Further comment on this issue is requested from the TLG.

* We note that the previous version of the TLG paper did not specify the spurious emission limits that should apply to HL WBB transmitters. We are now proposing the adoption of Category B limits defined by 3GPP Table 6.6.4.2.3-2 (for non-AAS) and section 9.7.5.2.2 (for AAS) of 3GPP TS 38.104.

***Figure 1-A: Comparison of Local Area BS and Medium Range BS unwanted emissions (non-AAS case)***



### PFD limits

* Both AMTA and DB Telecommunications re-iterated concerns with the complexity involved with calculating a PFD limit at the boundary of controlled premises. It was considered that operation on a NINP basis was suitable in this case. AMTA argued that the PFD limit proposed assumes high density deployments and was designed to support noise limited network deployments in adjacent areas. They argued an interference limited approach would result in a less complicated and more efficient outcome. AMTA considered that while this might not necessarily guarantee protection for all systems, it should provide for satisfactory C/I levels in most cases, thereby reducing the risk of interference overall.
* Rather than implementing a PFD limit at urban excise boundaries, AMTA proposed adopting a direct coordination (BS-BS) approach to managing co-channel interference with adjacent area SLs. It was argued that APs would already have been required to implement a similar methodology for Part 8 of the RAG Tx. AMTA also argued that a 14 dB BPL could easily be incorporated into this calculation. AMTA further recommended that application of higher BPLs (if an AP or operator has access to more accurate information) should be applied for via an out-of-policy exemption request to the ACMA. Under the direct coordination approach, AMTA recommended it be made clear that in the event the adjacent area SL deploys new base stations that HL WBB licensees are aware that the onus is on them to modify or cease operation in the event it is required to manage interference.
* DB Telecommunications proposed that a PFD limit of -99.9 dBm/MHz/m2 at the boundary of urban areas at a height of 10 metres above ground level, should be adopted.

#### ACMA staff response

* We have reconsidered the need for a PFD limit at the boundary of controlled premises and decided to not include it. Guidance in the new RALI developed will make clear that HL WBB licensees operate on a NINP basis and, as far as is practicable, should design their networks to minimise the risk of causing and receiving unacceptable levels of interference.
* We are open to the idea of a direct coordination method (DCM). However, our concern is that it will not provide sufficient protection for NBN CPEs. This is because the DCM only coordinates with NBN BS. Interference into NBN BS is already covered by the mandatory synchronisation method. Therefore, the purpose of the DCM would be to provide a pseudo level of protection for CPEs. As CPEs can be located several km from a base station, the DCM may not provide adequate protection in all cases. For this reason, our currently preferred approach is to adopt the PFD limit of -99.9 dBm/MHz/m2 at the boundary of urban areas at a height of 10 metres above ground level.
* As an alternative, a hybrid approach could also be considered. This would involve applying the DCM to all proposed deployments and limiting use of the PFD limit to services within 4 km of the urban boundary. The idea of the hybrid approach is that the DCM accounts for possible interference into CPEs that are pointing in the direction of the HL WBB service. The requirement to assess the PFD limit within 4km is to account for CPEs that are close to the urban excise boundary but not pointing at the HL WBB service. The distance of 4 km is based on the maximum separation distance required assuming free space loss, a 14 dB BPL, HL WBB EIRP of 17 dBm/MHz, CPE antenna gain of 0 dBi (assumes antenna pointing away from boundary) and a protection level of ‑112 dBm/MHz (refer to appendix C).
* We support the use of an assumed 14 dB BPL in propagation loss calculations. We also support an approach where higher BPLs can be applied via an out-of-policy exemption request.

### Synchronisation

* AMTA, Aqura and NBN Co supported a mandatory synchronisation for HL WBB licensees with adjacent area SLs. AMTA, Aqura and NBN Co proposed timeframes of 3 months, 2 months and 6 months respectively for the adjacent area SL to notify the ACMA of an intended change to their frame structure.
* DB Telecommunications considered that in both the 3400-3475 MHz and 3950-4000 MHz bands, synchronising services should only be required if required to manage interference.

#### ACMA staff response

* We note that the in the 3950-4000 MHz band, a fallback synchronisation requirement is proposed, the same as applies for AWLs. This means that operators only need to synchronise their services in the event of interference and there are no other measures to manage it.
* A different approach to synchronisation in the 3400-3475 MHz band was proposed in V2.1 of the TLG paper (i.e. mandatory synchronisation). The reason for the alternative approach was to help manage interference into NBN Co’s services and also provide NBN Co with the flexibility to migrate to 5G (and future generation technologies) frame structures in the future. As indicated at Appendix E, there are unique interference management challenges to consider in this case. We consider that, at least initially, a conservative approach of managing interference is prudent in this case. For this reason, we are proposing to mandate HL WBB synchronise with NBN Co in the 3400-3475 MHz band. This requirement can be reviewed in future when demand is better understood or as use cases for HL WBB evolve.
* We propose adopting a minimum 3-month timeframe for SLs to notify the ACMA of a change in frame structure. This provides the ACMA reasonable to time to notify HL WBB licensees. Of course, licensees are free to provide the ACMA with a greater notice period.

### FSS ES

* AMTA recommended that the frequency breakpoints for the application of the minimum separation distance be modified to be < 5 MHz and ≥ 5MHz (as opposed to ≤ 5 MHz and > 5 MHz).
* The joint satellite submission reiterated their preference for the use of earth receive licensing in the 3950-4000 MHz band. It was argued this would result in more efficient use of the spectrum. The joint satellite submission expressed concern that decisions on FSS use of the 3950-4000 MHz band were made outside of the HL WBB TLG process. They also argued that similar reasoning for the proposed adoption of PMP licensing should apply to FSS ES (i.e. licence tax and spectrum denial).

#### ACMA staff response

* The proposed changes to the minimum separation distance frequency breakpoints have been adopted.
* We appreciate concerns raised in the joint satellite submission. However, we note that the HL WBB TLG is not tasked with developing licensing arrangements for FSS ES in the 3950-4000 MHz (or any other) band. The TLG has been tasked with providing advice on the development of arrangements for HL WBB use of the 3400-3475 MHz and 3950-4000 MHz bands. The ACMA publicly consulted on licensing arrangements for AWL Rx in the 3750-4000 MHz band from 20 June to 1 August 2023. This was done as part of the consultation for [AWLs in the 3.8 GHz band in metropolitan and regional Australia](https://www.acma.gov.au/consultations/2023-06/allocation-area-wide-apparatus-licences-38-ghz-band) (3.8 GHz consultation). Outcomes for that process were announced on 15 February 2024.

## Submissions to TLG paper Version 3.0

Five submissions were received in response to V3.0 of the TLG paper. Submissions were received from:

* AMTA
* Boeing Australia
* Ericsson
* Joint satellite response (Intelsat, SES, Speedcast and Viasat)
* nbn.

An additional response was also provided by the Australian & International Pilots Association (AIPA), which included:

* support for the proposed coexistence arrangements with radio altimeters;
* a desire for assumptions about BPLs to be confirmed/proven for indoor installations.

The main issues raised in submissions are summarised below. Please refer to individual submissions for more detail. ACMA staff responses to each issue are also included below.

### In-band emission limits

* Ericsson supported implementing a PSD limit of 17 dBm/MHz only (i.e.no max EIRP limit).
* The joint satellite response supported applying both a PSD limit of 17 dBm/MHz and a maximum EIRP limit of 30 dBm. The submission argued that both limits are required as they take into account antenna gain and power to minimise interference to other services. Furthermore, if support for Medium Range BS is provided, then it was proposed to restrict HL WBB to indoor use only.

#### ACMA staff response

* We do not propose to apply a maximum EIRP limit. Due to the limited amount of spectrum available for HL WBB use, the proposed PSD limit already restricts HL WBB transmitter to an EIRP of no greater than 35.5 dBm/70 MHz in the 3400-3475 MHz band and 34 dBm/50 MHz in the 3950-4000 MHz band. We consider this is a reasonable limit for such use.
* We propose to restrict HL WBB base stations to indoor operation in the 3400‑3475 MHz band. However, we do not propose similar restrictions for operations in the 3950-4000 MHz band. We are aware of HL WBB use cases that would benefit from the ability to deploy services outdoors. To manage potential interference with other licensed services, suitable coordination criteria are also considered in this paper.
* We will raise the divergent views on this issue in the planned consultation paper and consider any further submissions on the issue before finalising outcomes.

### Unwanted emission limits

* AMTA and Ericsson supported adopting 3GPP TS 38.104 Medium Range BS unwanted emission limits. Ericsson stated this will allow for a choice of small cell base stations to be used in outdoor environments where Local Area BSs are not suitable for deployment.
* The joint satellite response supported adopting 3GPP TS Local Area BS unwanted emission limits. The submission stated that FSS ES receivers are sensitive to out-of-band (OOB) emissions. It also cited previous submissions that point to this being a major mechanism for interference as filters cannot be used to mitigate against it. The submissions stated that as the ACMA is not proposing to consider OOB emissions in determining coordination and minimum separation distances, HL WBB should operate on a NINP basis to FSS ES with respect to their OOB emissions.

#### ACMA staff response

* As detailed in version 3.0 of the TLG paper, when antenna gains are taken into account, the difference in actual radiated power between the Medium Range BS and Local Area BS are small when services are operating at or near the maximum PSD limit (see Figure 1-A). This means that, from an interference perspective, there is unlikely to be a large difference between adopting either of the limits. We also recognise that a benefit of adopting the Medium Range BS limits is it provides licensees with a greater range of equipment options, particularly for outdoor environments.
* We recognise the potential for interference from HL WBB OOB emissions into FSS ES receivers. For this reason, prospective new HL WBB licensees are required to protect earth receive licences on a first-in-time coordinated basis to the levels defined in subsection 4.3(3) of the *Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015*. This specifically requires an assessment of the impact of unwanted emissions. For AWL Rx, consistent with the arrangements developed for AWLs and 3.4 GHz spectrum licences, it is the responsibility of the AWL licensee to ensure the spectrum space covered by their licence is sufficient to manage the risk of such interference. This could include locating earth stations to take advantage of shielding from clutter such as buildings or walls or choosing sites that are isolated from areas of population to minimise the risk of interference.
* For the above-mentioned reasons, our currently preferred approach is to adopt the Medium Range BS unwanted emission limits. We will raise the divergent views on this issue in the planned consultation paper and consider any further submissions on the issue before finalising outcomes.

### Managing co-channel interference with spectrum licences

* AMTA indicated in the cover email to their submission that they were still considering their preference regarding this issue.
* nbn stated support for the hybrid PFD approach. nbn suggested that a direct contact register could be developed as a way to further mitigate risks.

#### ACMA staff response

* ACMA staff are open to adopting either the PFD or hybrid PFD approaches, though the currently preferred method is the PFD approach. To provide more time for some members to consider the issue will include both options in our public consultation process.
* We do not propose to implement a direct contact register. However, relevant details of HL WBB licensees will be available on the RRL.

### Coexistence with radio altimeters

* AIPA supported the proposed coexistence requirements with radio altimeters. AIPA expressed a desire for any BPL assumptions used to relax the requirements to be confirmed/proven.
* Boeing generally supported the proposed coexistence requirements with radio altimeters. However, they made the following comments:
  + Studies conducted did not take into account other aircraft that typically do not use commercial airport runways;
  + Studies did not take into account aggregate interference from UEs;
  + Restricted zone arrangements appear administratively cumbersome. An alternative option could be to restrict HL WBB operations close to airports to indoors only.
* Ericsson supported no additional mitigation measures being required when HL WBB BS meet Category B spurious emission limits across the entire 4200-4400 MHz band.
* AMTA indicated that they have not reviewed Appendix F *Coexistence between highly localised wireless broadband stations and radio altimeters* in detail, so have not formed a view on the specific restrictions proposed.

#### ACMA staff response

* When coordinating indoor HL WBB BS, licence applicants (or their accredited persons) may apply to the ACMA to have building penetration losses considered. Before the ACMA would approve such a request, the applicant would need to include suitable information detailing the level of building penetration loss and how this was determined.
* The studies contained in Appendix F are consistent with the scope of studies conducted to assess coexistence between AWLs/3.4 GHz spectrum licences and radio altimeters. In this case, a decision was made to consider the need to implement coexistence measures at defined airports only and to protect Usage Category 1 landings where ILS CAT II/II critical approaches are common.
* We note that the studies in Appendix F did not specifically consider aggregate interference from multiple UEs transmitting simultaneously. However, the results can be extrapolated to gauge the impact. For example, assuming a typical UE has a gain of 0 dBi and is operating at maximum power, study results in Appendix F provide a 10 dB margin for a single terminal located 60m from the runway terminal (i.e. just outside the obstacle free zone). This becomes 13 dB if the additional 3 dB RTCA margin is taken into account. For the latter case, it would require 20 user terminals operating simultaneously, at maximum power and within 10m of an aircraft before interference would occur. The number of UEs needed to cause interference increases when power control is taken into account (which lowers the average operating power) and a more realistic distribution of terminals (resulting in larger typical separation distances) is applied.

This suggests that the risk of interference from UEs is low. The main area of concern would be within the obstacle free area around runaways. In this case, it is expected that the risk of interference can be mitigated via the implementation of suitable site management arrangements by airports.

In addition to this, we note that the ECC recently consulted on Report 362 *Compatibility between mobile or fixed communications networks (MFCN) operating in 3400-3800 MHz and wireless broadband systems in low/medium power (WBB LMP) operating in the frequency band 3800-4200 MHz with Radio Altimeters (RA) operating in 4200-4400 MHz*. This report does not identify any compatibility issues with UEs.

* The restricted zones proposed are small in size. While we have considered restricting HL WBB to indoor use only in these areas, to provide flexibility for operators while protecting radio altimeters, alternative arrangements were developed. Under these arrangements operators can decide whether or not to deploy in a restricted zone. This includes investigating what mitigation measures may need to be employed to meet the required EIRP limitations.

# Frequency assignment arrangements

This section provides details on the proposed arrangements for coexistence and coordination of HL WBB with other incumbent spectrum uses and users. Where appropriate, the same criteria as defined for AWLs and 3.4 GHz spectrum licences (SLs) is applied to the HL WBB use case. It is proposed that any arrangements developed will be contained in a new RALI for the assignment of HL WBB licences.

When reading this section please note:

the definitions for urban areas as well as metro and regional Australia is provided at Appendix A.

the term user equipment (UE) applies to any device that communicates with a base station.

no changes are proposed to class licences that authorise the operation of devices within the 3400-4000 MHz frequency range. However, such devices operate on a ‘no interference and no protection’ basis.

## Licence type for HL WBB

It is intended that HL WBB use be supported under apparatus licensing (AL) arrangements. The use of AL will provide visibility of the location of services and the identity of the licensee to assist in the management of interference.

Two possible AL types are considered in this section:

Area-wide licences (AWL)

Point-to-multipoint (PMP) licences

In assessing which licence type to adopt, a range of possible HL WBB deployment scenarios have been considered as follows:

A single licensee provides services to a single business/customer within a defined geographical area;

A single licensee provides services to multiple businesses/customers within a defined geographical area (e.g. at an industrial park, shopping centre or high rise building);

A single licensee provides services to multiple businesses/customers across numerous different geographical areas;

Multiple licensees provide services to different businesses/customers within the same geographical area or premise (e.g. shopping centre or high rise building); and

Multiple licensees provide services to different businesses/customers across numerous different geographical areas.

### Area Wide Licences (AWLs)

AWLs have the benefit of being clearly definable in terms of the area and frequency within which a licensee may operate transmitters. The location of individual base stations, the identity of the licensee and other technical information can be included on the register of radiocommunications licences (RRL). AWL areas are defined using the [hierarchical cell identifier scheme](https://www.acma.gov.au/australian-spectrum-map-grid). A key issue with AWLs in the 3400-4000 MHz frequency range is that currently the smallest area that they can be defined over is HCIS level 0. This equates to roughly a 1.8x1.8 km area.

The annual tax applicable to AWLs is defined in the [Radiocommunications (Transmitter Licence Tax) Determination 2015](https://www.legislation.gov.au/Details/F2023C00725). For the 3400-4000 MHz frequency range the tax rate is $0.0041/MHz/population. In low population areas the resulting tax is low and, in many cases, will equate to the minimum tax rate ($41.37 in 2023). However, the rate is higher in populated areas, especially capital cities. For example, in the Sydney CBD a 50 MHz licence would be in the order of $3,000 per HCIS level 0 cell.

The key issues identified with the use of AWLs are:

For HL WBB use, a single HCIS level 0 cell is likely to be a much larger than is required for most deployment scenarios. Also, multiple cells may be required for one licensee to meet boundary power flux density (PFD) limits if, for example, they are located near the cell edge. If exclusive access is provided to the spectrum space of a licence (the combination of HCIS cell and frequency occupied) this would unnecessarily deny access to the band to other users.

It is expected that some entities will be prepared to take out licences during the initial release of HL WBB spectrum. However, it is likely that many will seek access to spectrum as demand emerges and business cases develop over time (refer to submissions received to the [*Allocation of area-wide apparatus licences in the 3.8 GHz band*](https://www.acma.gov.au/consultations/2023-06/allocation-area-wide-apparatus-licences-38-ghz-band) consultation). Ideally, implementing arrangements that enable this outcome or at least reduce the impact are preferred. This way entities are not penalised (or restricted from accessing spectrum) for not acting fast enough to obtain licences.

In the case of HL WBB, ACMA staff consider that issuing AWLs that provide exclusive access to a defined spectrum space would either not cover the issues identified above or could exacerbate them.

One proposal to manage aspects of these issues was made in a submission to the [*Allocation of area-wide apparatus licences in the 3.8 GHz band*](https://www.acma.gov.au/consultations/2023-06/allocation-area-wide-apparatus-licences-38-ghz-band) consultation. The submission proposed that ‘indoor only’ AWLs be issued that allow multiple operators to operate in the same HCIS cell and frequency range. It was proposed that emission limits outside buildings be defined to reduce spectrum denial to other operators (rather than PFD limits at the AWL area boundary). To further assist with interference management, it was suggested all base stations (BS) should be registered. This would help entities to plan service and/or resolve any interference issues that may arise.

The same submission also argued that the cost of AWLs in capital cities could discourage smaller business from taking up HL WBB solutions.

The concept of an ‘indoor only’ AWL could be considered for HL WBB in the 3400-3475 MHz and 3950-4000 MHz frequency ranges. Though, as it is likely that there would be both indoor and outdoor use cases, it may need to be modified to be ‘low power’ AWL. That said, the concept of an AWL is that it covers the spectrum space required to deploy a service while also providing an inherent level of protection to any services deployed. Allowing overlapping AWLs (for which both Tx and Rx operate under) does not provide for this. Also, the resulting area licensed will still typically be much larger than is required for many of the deployment scenarios detailed previously.

Support for HCIS level 00 (approximately 500x500 m) could be considered for 3400-4000 MHz AWLs. While this reduces the size and cost of an AWL this is still likely to be larger than is required in many deployment scenarios.

For the reasons previously stated, ACMA staff consider that use of AWLs to support HL WBB use is not preferred.

In the event the use of overlapping AWLs is considered further, then measures would still need to be defined on how to manage cases where multiple entities seek access to the spectrum at the same or very close locations (i.e. in the same controlled premises[[2]](#footnote-3)). In this case the same solution as proposed for PMP (as detailed in the next section) is proposed. The measures proposed help to address the third key issue with AWLs identified previously.

### PMP

Under a PMP licensing approach, it is intended that a single site be recorded on the RRL. This is to provide information on the location of the controlled premises services are deployed, the identity of the licensee, the frequency range used, and other relevant technical parameters of BS deployed for coordination purposes. The site recorded is intended to be notional only, to assist in the management of interference. Arrangements could be implemented such that multiple BS operating under a PMP licence at a controlled premises or within a defined distance of the location recorded on the licence. For example, a condition on the licence could allow such use within 100 m of the location specified on the licence.

The yearly tax applicable to PMP licences is defined in the [Apparatus licence fee schedule](https://www.acma.gov.au/fees-apparatus-licences). For the 3400-4000 MHz frequency range the tax rate differs based on whether a device is in a remote, low, medium or high-density area. It may also be possible to amend the apparatus licence fee schedule to apply the low and micro power adjustments to tax. Low and micro power devices are devices that operate with an EIRP less than 8.3 Watts (39.2 dBm) and 1.7 Watts (32.3 dBm) respectively. If a device meets the low power requirements the tax is reduced by 90%, while meeting the micro power requirements reduces tax by 95%. The relevant taxes payable for a 50 MHz system are summarised in the table below.

Tax rate for a 50 MHz PMP licence in the 3.4-4 GHz frequency range (updated for 5 April 2024)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **High density** | **Medium density** | **Low density** | **Remote density** |
|  |
| Annual tax ($ per kHz) | $0.2312 | $0.0938 | $0.0775 | $0.0387 |  |
| Standard tax rate | $11,560 | $4,690 | $3,875 | $1,935 |  |
| low power tax rate | $1,155 | $470 | $385 | $195 |  |
| micro power tax rate | $580 | $235 | $195 | $95 |  |

A benefit of the PMP licence approach is that the licence tax in populated areas is lower than AWLs. However, the tax in low population areas (in regional areas) is higher ($195 compared to $41.86).

The use of PMP licensing removes the issue of exclusive access to HCIS and the associated spectrum denial (as described previously for AWLs). In this case, interference between adjacent area HL WBB operators would be managed via the same mechanisms as proposed for ‘low power’ AWLs.

Under a PMP licence approach, there is still the issue of whether measures can be implemented to improve future access to spectrum by entities. In this case, the same measures are proposed to address this for both the AWL and PMP licensing approach.

Managing interference when multiple entities/service providers want to access the spectrum at the same controlled premises is a key concern with this approach. This is important given there will be a maximum 50 MHz of spectrum available in metro and regional Australia and 125 MHz in urban areas.

In most cases it is expected that there will only be one entity at each controlled premises seeking WBB services. This would be for example a university, hospital or individual business. Essentially, this means only one HL WBB network is expected to be deployed in a controlled premises in many cases.

It is therefore proposed that a policy of not providing protection to licences operating on the same frequency and located on the same controlled premises be adopted (referred to as the HL WBB co-sited policy). This way, for deployment scenarios where multiple licensees take out licences on the same frequency at a controlled premises (whether speculatively or with the intention of deploying services), they would be required to manage interference amongst themselves.

If only one licensee actually deploys a service, then there is no need to manage interference with the other licensees. If two or more licensees deploy or wish to deploy a service, then they will need to work amongst themselves on how to manage interference. This is irrespective of who deployed services first-in-time. Possible outcomes could be the deployment of a single network, implementing more stringent mitigation techniques, or division of access to the spectrum between independent networks.

### Proposed licence type

It is proposed that the PMP licence type be used for HL WBB services along with a licence condition that HL WBB operate on a NINP basis to each other.

## Other HL WBB licences (3400-3475 MHz & 3950-4000 MHz)

It is intended that multiple different HL WBB operators will be able to access the 3400-3475 MHz band in urban areas and the 3950-4000 MHz band in metro and regional Australia. This means arrangements to manage both co-channel and adjacent channel interference between HL WBB licences needs to developed.

The 2021 TLG considered measures to manage this interference scenario (refer to the *Background* section and Table 1 for further details). However, there was only a brief period to review the proposed arrangements for HL WBB use. These outcomes are used as the starting point for the development of interference management arrangements in this paper.

### Managing co-channel interference

#### In-band emission limits

Limiting in-band emissions for HL WBB use in the 3400-3475 MHz frequency range can help to reduce the risk of co-channel interference and improve frequency re-use by multiple operators. The 2021 TLG proposed an in-band power spectral density (PSD) limit of 17 dBm/MHz EIRP for HL WBB. This results in example maximum EIRPs of 35.5 dBm/70 MHz or 34 dBm/50 MHz.

The 2021 TLG also proposed a maximum EIRP of 30 dBm per occupied bandwidth. This would restrict HL WBB BS to the Local Area BS transmitter class as defined by 3GPP. While this may assist with managing adjacent channel interference to other services (refer to Figure 2), it is unlikely to have much impact on the co-channel case if HL WBB devices are also required to meet both the PSD and PFD limits irrespective of the EIRP used.

Some members of the TLG supported adopting the maximum EIRP limit of 30 dBm in addition to a PSD limit. These members also recommended that if support for Medium Range BS is provided HL WBB transmitters should be restricted to being indoors only.

Given the difference in maximum EIRP possible using only a PSD limit is not significant, to improve flexibility, ACMA staff’s preliminary preferred view is that a PSD limit by itself is sufficient.

It is proposed that HL WBB base stations are restricted to indoor operation in the 3400‑3475 MHz band. However, we do not propose similar restrictions for operations in the 3950-4000 MHz band. There are HL WBB use cases that would benefit from outdoor deployments. To manage potential interference with other licensed services, appropriate coordination criteria is considered in this paper.

#### PFD limits and synchronisation requirement

To manage interference between adjacent area co-channel HL WBB, the 2021 TLG proposed a PFD limit of –64.9 dBm/MHz/m2 at the external boundary of the controlled premises at a height of 5 metres above ground level. In this case, definition of the term ‘controlled premises’ is the same as that used for class licensed WBB services in the 24.25-25.51 GHz frequency range[[3]](#footnote-4). That is, it means premises that are owned by or under the control of a person who is providing a radiocommunications service under a HL WBB licence*.*

Appendix C details how this limit was derived. It is aimed at managing interference from a HL WBB base station into UEs. The PFD limit proposed assumes that HL WBB operations are synchronised, such that base station to base station interference will not occur.

If measures to support unsynchronised operation are preferred, then an alternative PFD limit could be considered. However, this could further restrict the deployment of HL WBB services. Instead, it is proposed that the following conditions be applied:

3400-3475 MHz frequency range: HL WBB BS deployments are limited to indoor only. It is proposed that HL WBB be required to synchronise with adjacent area spectrum licensees (i.e. nbn) – refer to the *3.4 GHz band spectrum licences (3400-3800 MHz)* section for further details.

3950-4000 MHz frequency range: The same fallback synchronisation requirement as specified for AWLs is proposed.

Under the above approach, it is intended that HL WBB only be provided the protection afforded by the PFD limit. Otherwise, HL WBB services operate on a NINP basis to each other. This means HL WBB services are not afforded ‘first-in-time’ protection to other HL WBB services. If interference occurs, licensees will be required to either negotiate measures to manage it or adopt the frame structures defined in the synchronisation requirement. This will be detailed in the soon to be developed HL WBB RALI as well as the relevant licence condition determination.

Advisory notes could be incorporated on licences (and/or the licence condition determination) so licensees are aware that the synchronisation requirement could be reviewed and may change in the future. For the 3400-3475 MHz band further information is required on how to make this work in practice. For example, if/when SLs plan to adopt a new frame structure, should HL WBB licensees be provided with reasonable warning so they can implement changes while minimising the impact on services. For the 3950-4000 MHz band, any review of the synchronisation arrangements would need to include a broader consideration of the synchronisation requirement for AWLs.

After further review, the TLG recommended that a PFD limit at the boundary of a controlled premises should not be implemented. Such calculations would be complicated to perform and require accredited persons to have access to relevant building/premises information as well as suitable propagation modelling. It was considered that the PSD limit and synchronisation requirements along with designing networks to operate in an interference limited environment would provide a reasonable level of protection (and frequency re-use) in many situations. However, it was also recognised that there will still be situations where nearby HL WBB operators will need to work with each other to manage interference.

### Managing adjacent channel interference

#### Synchronisation requirement

To manage adjacent channel interference between HL WBB licences, the same synchronisation requirements specified for the co-channel case are proposed.

#### Unwanted emission limits

It is proposed that HL WBB base station comply with the unwanted emission limits described in 3GPP TS 38.104. In this case two possible options apply:

Medium Range BS: Table 6.6.4.2.3-2 (non-AAS) and section 9.7.4.2 (for AAS) of 3GPP TS 38.104. The unwanted emission limits for Prated,x ≤ 31 dBm are considered. This is because the proposed PSD limit restricts the maximum EIRP to being less than or equal to 34.8 dBm/ 60 MHz, noting this could be capped to at a lower level depending on decision made on in-band emission limits.

Local Area BS: Table 6.6.4.2.4-1 (non-AAS) and section 9.7.4.2 (for AAS) of 3GPP TS 38.104.

Figure 2 displays the different BS unwanted emission limits. While it is unclear if BS with AAS will be used for HL WBB, the relevant emission masks for these are also proposed to be included.

Adoption of Medium Range BS unwanted emission limits is expected to provide greater flexibility in equipment choice for HL WBB operators, particularly for operation in outdoor environments. Furthermore, when antenna gains are taken into account, the difference in actual radiated power between the Medium Range BS and Local Area BS are minor when services are operating at or near the maximum PSD limit (refer to Figure 1-A). This means that, from an interference perspective, there is unlikely to be an appreciable difference between adopting either of the limits.

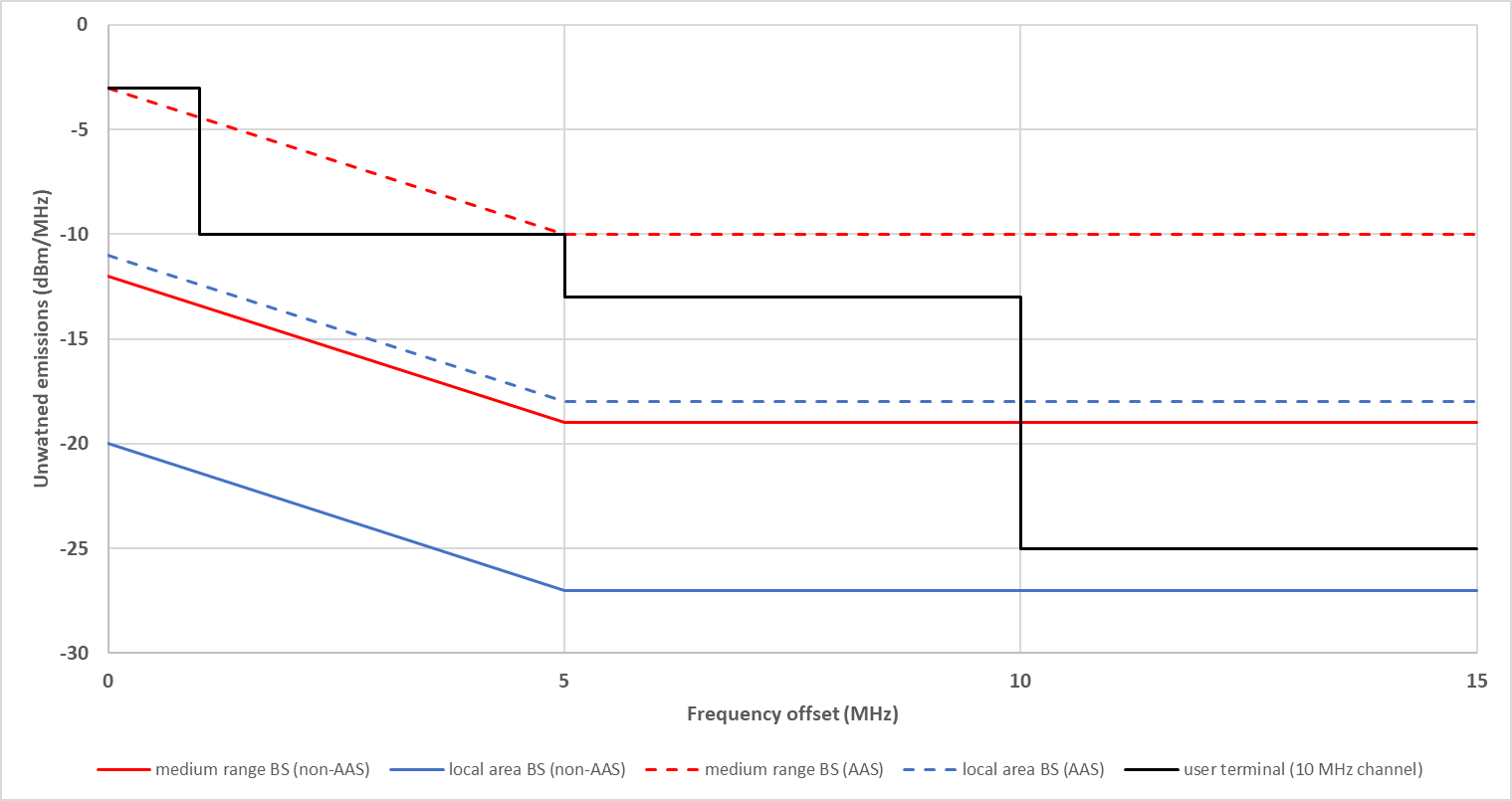
The potential for interference from HL WBB OOB emissions into earth station receivers requires consideration. Prospective new HL WBB licensees will be required to protect earth receive licences (on a first-in-time coordinated basis) to the levels defined in subsection 4.3(3) of the *Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015*. This specifically requires an assessment of unwanted emissions. For AWL Rx, in line with the arrangements developed for AWLs and 3.4 GHz spectrum licences, it is the responsibility of the AWL licensee to ensure that the spectrum space covered by their licence is sufficient to manage potential interference. This could include locating earth stations in a way that takes advantage of shielding from clutter such as buildings or walls or choosing sites that are isolated from areas of population to minimise the risk of interference.

After considering feedback from the TLG, the ACMA staff preliminary view is to adopt the Medium Range BS limits.

It is proposed that UEs comply with the unwanted emission limits described in Table 6.5.2.2-1 of 3GPP TS 38.101-1. Figure 2 provides an example of what this looks like for a 10 MHz channel bandwidth.

It is proposed that HL WBB BS be subject to the spurious emission limits defined in Table 6.6.5.2.1-2 (spurious emissions in FR1, category B, for non-AAS) and section 9.7.5.2.2 (for AAS) of 3GPP TS 38.104. Furthermore, it is proposed that UEs comply with spurious emission limits defined in Table 6.5.3.1-2 (spurious) of 3GPP TS 38.101-1.

1. Unwanted emissions for HL WBB BS and UEs (normalised to 1 MHz)



### Co-sited devices

As discussed in the *Licence type for HL WBB* section, it is proposed to adopt the PMP licence type along with a condition that HL WBB operate on a NINP basis to each other.

## Remote and supplementary base stations (3400‑3475 MHz & 3950-4000 MHz)

The [*Radiocommunications Licence Conditions (Fixed Licence) Determination 2015*](https://www.legislation.gov.au/Series/F2015L01430) (the Fixed LCD) authorises the operation of remote[[4]](#footnote-5) and supplementary stations under PMP licences. The Fixed LCD includes conditions that:

authorise the use of remote stations only when communicating with a base station or supplementary base station operating under a point-to-multipoint licence.

restricts the use of supplementary base stations to overcoming deficiencies within the coverage area of a base station. This means supplementary base stations cannot be used to extend the coverage of a base station.

The Fixed LCD provides that remote stations and supplemental base stations must not cause interference to another radiocommunications service. Since the location of remote stations is not recorded, it is also ACMA policy that these stations are not afforded protection from interference from another radiocommunications service. This includes customer premises equipment. However, these stations are afforded a degree of protection via the coordination requirements in place for the base station.

## Point-to-point links (3590-4200 MHz)

Proposed HL WBB services will need to coordinate with existing point-to-point (PTP) links. Due to the small cell nature of HL WBB services, direct coordination is only considered from base stations to PTP receivers. RALI FX3 *Microwave fixed services* defines the relevant protection criteria. In this case, the size of the first adjacent channel is defined as being the larger bandwidth of the two services being coordinated. A cull distance of 65 km is proposed, this is based on the calculation in Table 3 (value rounded up to nearest 5 km).

HL WBB BS into PTP cull distance calculation

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Reference |
| Receiver Gain | 40.9 dBi | Maximum 3.8 GHz PTP gain on RRL |
| EIRP | 17 dBm/MHz | Proposed maximum EIRP for HL WBB |
| Receiver height | 100 m | Maximum 3.8 GHz PTP height on RRL |
| Transmitter height | 10 m | Assumption for HL WBB |
| Protection criteria (I/N) | -10 dB | Recommendation ITU-R F.758  (worst case assumption) |
| Receiver noise floor | -107.5 dBm/MHz | Recommendation ITU-R F.758  (worst case assumption) |
| Required path loss | 165.4 dB | Calculation |
| Co-channel separation distance | ≈ 61.5 km | Assuming free space loos and smooth earth diffraction (with k = 4/3 and f = 3950 MHz) |

A minimum separation distance of 2 km between HL WBB BS and PTP receiver is also proposed. This accounts for:

the proposed flexibility to deploy BS within 100 m of the site recorded on the PMP licence

an assumed coverage radius for a HL WBB service of 100 m

potential interference from a UE within the coverage area of the HL WBB BS, particularly in the case where the HL WBB BS passes coordination within the back lobe of a PTP receiver. The table below shows the assumptions used in estimating the separation distance.

It is proposed new HL WBB and PTP links would need to adhere to the 2 km minimum separation distance. At present there are 19 PTP sites, only in in regional areas, that would need to be considered. Case-by-case exemption consideration for deployments within this distance could be considered.

HL WBB UE into PTP back lobe distance calculation

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Reference |
| Back lobe Rx gain | -23.9 dBi | Worst case on RRL |
| UE EIRP (/5 MHz) | 23 dBm/5 MHz | Maximum UE output for class 3 device |
| UE EIRP (/MHz) | 16 dBm/MHz | Calculation |
| Receiver height | 100 m | Maximum 3.8 GHz PTP height on RRL |
| Transmitter height | 1.5 m | Assumption |
| Protection criteria (I/N) | -10 dB | Recommendation ITU-R F.758  (worst case assumption) |
| Receiver noise floor | -107.5 dBm/MHz | Recommendation ITU-R F.758  (worst case assumption) |
| Required path loss | 109.6 dB | Calculation |
| Co-channel separation distance | ≈ 1.8 km | Assuming free space loss |

Proposed new PTP links (now restricted to 3800-4200 MHz) will need to coordinate with existing HL WBB licences to a protection level of -110 dBm/MHz (but logarithmically scaled to the BW of the system). A cull distance of 60 km is proposed, this is based on the calculation in Table 5 below.

Coordination out to the first adjacent channel also needs to be considered, where first adjacent channel is defined as being the larger bandwidth of the two services being coordinated. The proposed protection criteria for HL WBB accounting for the adjacent channel selectivity and in-band blocking levels of different bandwidth systems (as defined in the standard 3GPP TS 38.104 for Medium Range BS) is contained in Tables 6 and 7.

PTP into HL WBB BS cull distance calculation

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Reference |
| Receiver Gain | 5 dBi | Annex 4.4 of document WP5D/716[[5]](#footnote-6)  (Micro cell non-AAS) |
| EIRP | 48.4 dBm/MHz | Maximum 3.8 GHz PTP gain on RRL |
| Receiver height | 10 m | Assumption |
| Transmitter height | 100 m | Maximum 3.8 GHz PTP height on RRL |
| Rx Noise figure | 10 dB | Annex 4.4 of document WP5D/716  (Micro cell noise figure) |
| Protection criteria (I/N) | -6 dB | ITU-R Recommendation M.2101 |
| Receiver noise floor | -104 dBm/MHz | Calculation (kTBn, T = 290 K) |
| Required path loss | 163.4 | Calculation |
| Co-channel separation distance | ≈ 60 km | Assuming free space loss and smooth earth diffraction (with k = 4/3 and f = 3950 MHz) |

Protection criteria for PMP BS Rx with bandwidths of 20 MHz or less

|  |  |
| --- | --- |
| Frequency offset from licence edge | Base station protection criteria (at the input of the receiver) |
| Co-channel | –110 dBm/MHz |
| ≤ 5 MHz | –47 dBm/5 MHz |
| > 5 MHz | –38 dBm/5 MHz |

Protection criteria for PMP BS Rx with bandwidths greater than 20 MHz

|  |  |
| --- | --- |
| Frequency offset from licence edge | Base station protection criteria (at the input of the receiver) |
| Co-channel | –110 dBm/MHz |
| ≤ 20 MHz | –47 dBm/20 MHz |
| > 20 MHz | –38 dBm/20 MHz |

## Amateur services (3300-3600 MHz)

The [*Radiocommunications Licence Conditions (Amateur Licence) Determination 2015*](https://www.legislation.gov.au/Series/F2015L01113) allows Advanced Amateur licensees to operate in the 3300–3600 MHz frequency range in defined geographical areas. It is noted that amateur operation in metro and regional Australia is not authorised in the 3400-3600 MHz frequency range.

The [*Australian Radiofrequency Spectrum Plan*](https://www.acma.gov.au/australian-radiofrequency-spectrum-plan) sets a secondary status for all Amateur services in the 3300–3600 MHz frequency range. This status means that incumbent amateur services must not cause interference to a primary service and cannot claim protection from interference from a primary service. HL WBB is considered a primary service.

It is proposed that Amateur Beacon and Repeater licensees coordinate with HL WBB assuming the protection criteria defined in Tables 6 and 7.

Coordination of HL WBB transmitter with Amateur Beacon or Repeater licences operating in the 3300–3600 MHz frequency range can be conducted assuming the notional receiver performance levels and compatibility requirement set out in Schedules 1 and 2 to the [*Radiocommunications Advisory Guidelines (Managing Interference to Spectrum Licensed Receivers — 3.4 GHz Band) 2015*](https://www.legislation.gov.au/F2015L00729/latest/versions) (RAG Rx), as in force from time to time, or any instrument made under section 262 of the *Radiocommunications Act 1992* to replace it. Alternatively, if more reliable or accurate parameters for the amateur system are known these can be used instead. In the event coordination indicates that interference may occur, it is recommended that the prospective licensees notify[[6]](#footnote-7) and make reasonable efforts to work with the affected amateur licensees operating to enable coexistence and prevent harmful interference from occurring. However, in the event there is no practical solution, services operated under a HL WBB licence have priority (i.e. Amateur services cannot claim protection from or cause interference to a HL WBB service).

## Earth Station Protection Zones (3400-4200 MHz)

HL WBB will be restricted from deploying within the Earth station protection zones (ESPZ) specified in RALI MS44 [*Frequency coordination procedures for the earth station protection zones*](https://www.acma.gov.au/publications/2019-08/instruction/frequency-coordination-procedures-earth-station-protection-zones).

Proposed HL WBB services within 50 km of the coordination points defined in Appendix A of RALI MS44 will need to follow the assessment criteria defined in that RALI. The distance of 50 km is based on the calculation in the table below.

ESPZ cull distance calculator

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Reference |
| Receiver Gain | 2.6 dBi | Recommendation ITU-R S.465, and  RALI MS 44 - minimum 15° elevation angle |
| EIRP | 17 dBm/MHz | Proposed maximum EIRP for HL WBB |
| Receiver height | 100 m | Assumed worst case based on location of Uralla earth station facility |
| Transmitter height | 10 m | Assumption |
| Protection criteria | -128.6 dBm/MHz | RALI MS44 |
| Required path loss | 148.1 dB | Calculation |
| Separation distance | ≈ 50 km | Assuming free space loos and smooth earth diffraction (k = 4/3 and f = 3950 MHz) |

## Fixed satellite service (3400-4200 MHz)

Fixed satellite earth station receivers may operate under either an earth receive licence or (proposed to be) area-wide receive licence (AWL Rx). The issue of AWL Rx licences are proposed to be restricted to the 3750/3800 – 4000 MHz frequency range in regional and metro areas.

### 3400–3600 MHz frequency range

Protection of and coordination with Earth station receivers operating in the 3400–3600 MHz frequency range is detailed in Part 4.2 of the [*Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015*](https://www.legislation.gov.au/Details/F2018C00558).

It is noted that Earth station receivers operate on a secondary basis in the 3400–3600 MHz frequency range. Therefore, in the event coordination indicates that interference may occur, prospective HL WBB licensees must notify[[7]](#footnote-8) and make reasonable efforts to work with the affected Earth station licensees operating in the 3400–3600 MHz frequency range to enable coexistence. If there is no practical solution, services operated under a HL WBB licence has priority.

### 3600–4200 MHz frequency range

Protection of and coordination with Earth station receivers operating in the 3600–4200 MHz frequency range is detailed in Parts 4.3, 4.4 and 4.5 of the [*Radiocommunications Advisory Guidelines (Managing Interference from Spectrum Licensed Transmitters — 3.4 GHz Band) 2015*](https://www.legislation.gov.au/Details/F2018C00558) – with the modifications detailed below It is proposed that HL WBB cannot be licensed within the spectrum space of an AWL Rx unless agreed to by all affected licensees.

The separation distance that coordination with an earth receive licence is required has been modified to account for the low power nature of HL WBB:

* Co-channel: 60 km. This is based on the calculation provided in the ESPZ section and a 5° minimum elevation angle for FSS ES.
* Adjacent channel:
  + HL WBB in 3400-3475 MHz 🡪 2 km
  + HL WBB in 3950-4000 MHz 🡪 5 km

These distances are based on the calculation provided in the ESPZ section and a 5° minimum elevation angle for FSS ES. It also assumes a HL WBB ACLR of 50 dB for 3400‑3475 MHz and 43 dB for 3950-4000 MHz.

To further assist with the management of adjacent channel interference, a minimum separation distance between HL WBB and FSS ES is proposed. The minimum separation distance is defined as the distance HL WBB and FSS ES deployments are unlikely to coordinate with each other and the risk of interference is high. It is noted that, meeting this minimum separation distance does not remove the need to conduct the usual site-to-site coordination activities between HL WBB and FSS ES. This is expected to cover mange interference for scenarios where FSS ES elevations are lower or other possible scenarios.

The minimum separation distance is intended to apply on a first-in-time basis between HL WBB and FSS ES registered on the RRL (whether under an AWL Rx or earth receive licence). A license (or receiver registration for AWL Rx) would not normally be issued within this range without further consideration by the ACMA. For HL WBB this would involve an applicant providing a detailed assessment of interference. For FSS ES, it could involve a more detailed assessment of interference or agreement to include a condition of no protection on the service.

Derivation of the minimum separation distance considers the interference scenarios of Rx overload and unwanted emissions falling within the FSS ES pass band. Calculations assume, direct line-of-site (as shorter distances increase the likelihood of this occurring), the minimum gain for FSS ES antennas (based on Recommendation ITU-R S.465) and HL WBB unwanted emissions for a Medium Range BS from 3GPP TS 38.104. For the Rx overload case the RF filter response in Table 1 of section 4.3 of the RAG Rx is applied. For the unwanted emissions case, it is assumed that the combined filter performance of an FSS ES is such that the unwanted emissions from HL WBB dominate frequency dependant rejection calculations.

Table 9 and Table 10 summarise the calculation results. Based on these results, the following minimum separation distances are proposed for HL WBB in the 3400-3475 MHz and 3950-4000 MHz bands:

* channel edge frequency separations < 5 MHz: 350m
* channel edge frequency separations ≥ 5 MHz: 220m.

These separation distances above are based on the largest separations calculated in Tables 9 and 10 plus 100 m. The 100 m accounts for the ability for HL WBB operators to deploy transmitters within 100 m of the location specified on the licence.[[8]](#footnote-9)

The minimum separation distances should be measured from the location recorded on the PMP licence and an FSS ES receiver site recorded on the licence and operating in the 3400-4200 MHz band. Note for earth receive apparatus licences, earth station locations can also be recorded in special conditions on the licence.

Separation distance between HL WBB BS and FSS ES (Rx overload)

|  |  |  |  |
| --- | --- | --- | --- |
| **Channel edge frequency separation (MHz)** | **FDR[[9]](#footnote-10) (dB)** | **Required path loss (dB)** | **Separation distance (m)** |
| 0 | 10.8 | 78.2 | 50 |
| 10 | 16.9 | 72.1 | 25 |
| 20 | 22.9 | 66.1 | 13 |
| 30 | 29.1 | 59.9 | 6 |

Note: Calculations assume free space loss, EIRP = 34 dBm/50 MHz, Rx overload threshold = -65 dBm, Rx antenna gain = -10 dBi

Separation distance between HL WBB BS and FSS ES (unwanted emissions within FSS ES pass band)

|  |  |  |  |
| --- | --- | --- | --- |
| **Channel edge frequency separation (MHz)** | **FDR[[10]](#footnote-11) (dB)** | **Required path loss (dB)** | **Separation distance (m)** |
| < 5 | 43 | 92.6 | 250 |
| ≥ 5 | 50 | 85.6 | 120 |

Note: Calculations assume free space loss, EIRP = 17 dBm/MHz,

Interference threshold = -128.6 dBm/MHz dBm, Rx antenna gain = -10 dBi

## Radiolocation services (3100-3500 MHz)

The same rules that apply to AWLs and 3.4 GHz band SLs are proposed for HL WBB licences. These means that:

HL WBB Transmitters: Radiocommunications transmitters will not be taken to cause unacceptable interference to radiolocation services if they are operated in accordance with all conditions on their licence.

HL WBB Receivers: High power radiolocation services in the 3100-3500 MHz frequency range are operated by the Department of Defence on an itinerant basis. These radiolocation services have the potential to disrupt the throughput of receivers operating in-band or adjacent band to radiolocation services, particularly on the uplink channel (base station receiver).

The Department of Defence is expected to take all reasonable measures to minimise the impact of radiolocation services to other in-band and adjacent band services. However, there will be occasions when interference cannot be fully mitigated. In such instances the interference may be due to blocking, strong out-of-band radar emissions or other susceptibilities within a fixed or mobile wireless network configuration.

When planning service deployments, HL WBB apparatus licensees are urged to consider additional measures to reduce the likelihood of impact to services operating under their licence. If such measures are necessary, it is likely that they would only apply in specific areas that are subject to regular radar use. They may include additional RF filtering, network redundancy, or resilience of network configuration where vulnerabilities to radar signal interference are identified. The ACMA will work with the Department of Defence to make available, where feasible, any additional information that may assist existing or prospective HL WBB apparatus licensees on this matter.

## Area-wide licences (3750/3800-4000 MHz)

HL WBB in the 3950-4000 MHz frequency range will operate co-channel to AWLs issued in remote areas and adjacent channel to AWLs operated in metro and regional areas. Interference is proposed to be managed as follows:

Adjacent channel interference: To avoid the use of guard bands or restricted use bands, it is proposed that adjacent channel interference between HL WBB and AWLs be managed using the same mechanism described for adjacent channel AWLs. That is the use of the fallback synchronisation requirement specified in section 5 of Schedule 4 to the [*Radiocommunications Licence Conditions (Area-Wide Licence) Determination 2020*](https://www.legislation.gov.au/Series/F2020L00070) (the AWL LCD).

Under the fallback synchronisation requirement, licensees are free to implement or negotiate alternative measures to manage interference. However, in the event these do not work, or there is no agreement on how to manage the interference, the fallback synchronisation scheme will apply.

Co-channel interference: Co-channel interference between HL WBB and AWLs will only occur at the metro and regional area boundary. Due to the low power nature of HL WBB transmitters and remote location of this boundary, no coordination criteria is proposed.

HL WBB receivers will be afforded the protection provided by the AWL device boundary criteria. Adherence to the device boundary will also limit how close AWL devices can operate to the metro and regional area boundary. This (along with remote location and low power nature of HL WBB) should be sufficient to manage interference in most cases. However, in the event of interference, the fallback synchronisation requirement will apply. Furthermore, as detailed in the *remote and supplementary base stations* section, user terminals operate on a ‘no interference and no protection basis’. So if they are found to cause interference, the operator will need to modify or cease operation to rectify the situation.

It is noted that high powered PMP licences can be issued outside the ASMG (i.e. in Australian waters or offshore territories. Due to the low powered nature of HL WBB, the risk of interference is considered to be low. However, in the event it occurs the same rules as with AWLs is proposed to apply.

## 3.4 GHz band spectrum licences (3400-3800 MHz)

HL WBB operating in the 3950-4000 MHz frequency range are considered to have sufficient frequency separation that coordination with 3.4 GHz band SL is not required.

HL WBB in the 3400-3475 MHz frequency range will operate both co-channel and adjacent channel to 3.4 GHz band SLs. The 2021 TLG considered measures to manage this interference scenario (refer to the *Background* section and Table 1 for further details). However, there was only a brief period to review the proposed arrangements for HL WBB use. These outcomes are used as the starting point for the development of interference management arrangements in this paper.

As of 23 October 2023, nbn is the only co-channel 3.4 GHz band spectrum licensee and Optus is the only directly adjacent channel 3.4 GHz band spectrum licensee. For this reason, co-channel interference management arrangements focus on the protection of nbn services, while adjacent channel protection arrangements focus on the protection of services provided by mobile network operators.

The ACMA’s goals in developing protection criteria for this scenario, are to:

Provide adequate protection to incumbent nbn services in adjacent areas.

Ensure nbn is not unreasonably constrained in their ability to deploy new and more spectrally efficient technologies in the future (e.g., moving from 4G to 5G technologies).

Minimise the impact on existing 3.4 GHz SLs above 3475 MHz.

Advice was sought from the TLG on the measure proposed to manage this interference scenario.

### Managing co-channel interference

#### Managing emissions across the urban area boundary

To manage the level of emissions into adjacent area SLs, three possible options were identified:

* PFD limit;
* direct coordination with adjacent area SL BS;
* a hybrid PFD-direct coordination approach.

Each of these options are detailed further below. The ACMA staff preferred option is the PFD limit.

*PFD limit*

For this approach to managing emissions into adjacent area SLs, a PFD limit of -99.9 dBm/MHz/m2 is proposed at the boundary of urban areas. Appendix C details how this limit was derived. It is aimed at managing interference from a HL WBB base station into nbn consumer premise equipment (CPE). This assumes that HL WBB operation is synchronised with adjacent area nbn services, such that base station to base station interference will not occur.

Originally it was proposed the PFD limit apply at any height between 5-100 metres above ground level. However, it is recognised this may be difficult to assess adherence to in practice. Instead, it is proposed that adherence to the PFD limit be considered at a height of 10 metres above ground level at urban area boundaries. This is to account for the location of CPEs at different heights with respect to the HL WBB transmitter (due to changes in terrain) beyond the urban area boundary.

To simplify the calculation methodology, a process similar to that used for calculating the DBC un the 3.4 GHz band could be used (i.e. use of radials and 100 m increments). A key difference with the PFD approach, is that operators would be free to use detailed clutter information (if available) when calculating propagation loses.

*Direct coordination*

For this approach each HL WBB BS would be coordinated with each adjacent area BS – using a LOP of -115 dBm/MHz. For multi-sector sites, only the sector with the highest gain in the direction of the HL WBB BS would need to be considered.

This approach affectively assumes systems are not synchronised for the purposes of coordination. The idea is that coordinating with the adjacent area BS in this nature will provide an inherent level of protection to CPEs – as a BS antenna typically has the same or higher gain and is usually located higher above ground level.

The main drawback of this approach is it only considers existing BS deployments in adjacent SL areas. However, given the current density of deployments close to urban boundaries this may not be a significant issue.

*Hybrid approach*

The hybrid approach involves applying the direct coordination method (DCM) to all proposed deployments and limiting use of the PFD limit to services within 4 km of the urban boundary. The idea of the hybrid approach is that the DCM accounts for possible interference into CPEs that are pointing in the direction of the HL WBB service (the worst case scenario). The requirement to assess the PFD limit within 4km is to account for CPEs that are close to the urban excise boundary but not pointing at the HL WBB service. The distance of 4 km is based on the maximum separation distance required assuming free space loss, a 14 dB BPL, HL WBB EIRP of 17 dBm/MHz, CPE antenna gain of 0 dBi (assumes antenna pointing away from boundary) and a protection level of ‑112 dBm/MHz (refer to appendix C).

#### Synchronisation requirement

To ensure BS to BS interference is not an issue, HL WBB will be required to synchronise with adjacent area SLs. To provide flexibility for nbn to migrate to frame structures optimised for 5G or other next generation technologies, no frame structure will be defined. It will be incumbent on HL WBB licensees to adopt whatever frame structure the adjacent area SL (nbn co) is using.

Further consideration is required on how to make this approach work in practice. Specifically, what process should be used to manage a change in frame structure. Our current proposal is that the adjacent area SL (nbn co) notify the ACMA of its intention to change frame structure at least 3 months before it occurs. The ACMA can then notify APs and relevant licensees. The intention being to provide them with reasonable warning to implement changes and minimise impact on services.

#### In-band emission limit

Limiting in-band emissions for HL WBB use in the 3400-3475 MHz frequency range can help to reduce the risk of interference. As mentioned previously a PSD limit of -17 dBm/MHz is proposed for all HL WBB use. This results in a maximum EIRP of 35.5 dBm/70 MHz.

Arrangements proposed in the 2021 TLG restricted the maximum EIRP to 30 dBm/occupied bandwidth. This would largely restrict HL WBB BS to the Local Area BS transmitter class as defined by 3GPP. While this may assist with managing adjacent channel interference it is unlikely to have much impact on the co-channel case. This is because HL WBB device will be required to meet the PFD limit irrespective of the EIRP used.

Given the difference in maximum EIRP is not significant, to improve flexibility, it is proposed a maximum EIRP limit is not required for this scenario. Discussion on whether to implement a maximum EIRP limit is considered in the *other HL WBB licences* section.

#### Other conditions on operation

The measures specified previously assist in the management of interference from HL WBB into adjacent area services. While this may provide some degree of protection for HL WBB licences, there is still a reasonable risk of interference. This is because macro cell BS and customer premise equipment (CPEs) are and can be deployed in the adjacent area SLs. How this is managed needs to be considered.

There is a unique challenge in this case, as adjacent band nbn services are deployed right up to the urban area boundary (refer to Appendix E for background on this issue). This further increases the risk of interference into HL WBB devices. It also presents a challenge in the development of arrangements that ensure nbn is not unreasonably constrained in their ability to deploy new and more spectrally efficient technologies in the future.

Several possible measures have been identified to manage interference from nbn services into HL WBB licences:

Existing and new nbn CPEs: It is proposed that HL WBB not be afforded protection from CPEs. This is to ensure CPEs are not required to modify or cease operation – which would affect the delivery of nbn services.

Existing and new nbn BS: It is proposed that HL WBB not be protected from interference caused by nbn BS existing before they are licensed. This ensures there is no impact on existing nbn services. HL WBB will need to design their service to account for the existing interference environment. HL WBB are required to synchronise with nbn services.

### Managing adjacent channel interference

#### Unwanted emission limits

It is proposed that the unwanted emission limits for HL WBB defined in the *Other HL WBB licences* section apply to HL WBB operating in the 3400-3475 MHz frequency range. Please refer to that section for further details.

#### Restricted use band (RB)

It is recognised that unwanted emission limits alone will not be sufficient to manage adjacent channel interference between HL WBB and 3.4 GHz band SLs. For this reason, the following additional measures are proposed:

Operation of HL WBB services within the 3400–3475 MHz frequency range be limited to indoor operation (at least initially) and urban excise areas.

An RB be applied below 3475 MHz. HL WBB operation within the RB will generally not be permitted unless there is agreement with the adjacent frequency SL. The ACMA may also choose to consider use on a case-by-case basis if alternative spectrum options are not available or sufficient. The licensee of any licence issued in an RB will take on the risk they may have to modify or cease operation at any time to manage interference with other HL WBB licensees or adjacent area/frequency SLs.

An RB is proposed to assist in the management of interference between HL WBB and 3.4 GHz band SLs. It is proposed for the same reasons an RB was applied between AWLs and 3.4 GHz band SLs. That is, it helps to isolate HL WBB licences from adjacent band SLs. This may allow different frame structures to be implemented. It recognises that HL WBB licensees and 3.4 GHz band spectrum licensees may have different uplink and downlink requirements and are also likely to have different commercial incentives and timings to adopt new or alternative frame structures in the future (for example those based on 6G or other next generation technologies).

While an operator may reach agreement to deploy services in the RB, it is important to understand they also need to accept the risk that they may need to modify or cease operation at any time to manage interference with 3.4 GHz band SLs as well as other HL WBB operators. Refer to the *Frequency assignment arrangements - Other HL WBB operators* section for details on how interference is proposed to be managed between HL WBB licensees. This could be codified in an advisory note attached to any licence issued.

The size of an RB is a balance between potential interference from adjacent frequency services and spectrum utility. Advice provided in the 2021 TLG is that a guard band of 15 MHz is generally sufficient to manage interference between unsynchronised 4G and 5G adjacent band macro cell deployments. Consequently, a 15 MHz RB has been adopted between AWLs and 3.4 GHz SLs.

A typical macro cell deployment has a power spectral density (PSD) in the order of 55-60 dBm/MHz EIRP (based on RRL data for the 3400-3700 MHz frequency range). However, it is proposed that HL WBB be limited to a PSD of 17 dBm/MHz EIRP – resulting in a maximum EIRP of 35.5 dBm/70 MHz for a device operating in the 3400-3475 MHz frequency range. This is a much lower EIRP than permitted under an AWL or 3.4 GHz band SL, suggesting a smaller RB may be possible.

Given 4G and 5G operation is most efficient in bandwidths that are an integer multiple of 5 or 10 MHz, an RB that is some multiple of 5 MHz is considered appropriate. This provides three options for the RB below 3475 MHz: 5, 10 or 15 MHz.

After considering submissions to V1.0 of the TLG, it is proposed that an RB of 15 MHz be adopted initially. This provides 60 MHz of spectrum for general HL WBB use. The size of the RB could be reviewed in the future as HL WBB demand and use cases are better understood.

#### Other conditions on operation

It is expected that a combination of the PSD limits, RB and unwanted emission limits will be sufficient to manage interference in most circumstances. However, in the event interference occurs, it is proposed that HL WBB in the 3400-3475 MHz frequency range operate on a ‘no interference and no protection’ basis to services operating under 3.4 GHz band SLs. This means HL WBB do not have first-in-time status in managing any interference issues.

## Radio altimeters (4200-4400 MHz)

A radio altimeter is an aircraft station used for radionavigation in the 4200-4400 MHz frequency range under the [*Radiocommunications (Aircraft and Aeronautical Mobile Stations) Class Licence 2016*](https://www.legislation.gov.au/Details/F2021C00648). The ACMA previously studied the potential for interference from WBB services operating in the 3400-4000 MHz frequency range into radio altimeters. The outcomes of this work and measures implemented are detailed on the [ACMA website](https://www.acma.gov.au/5g-and-aviation-services-australia).

While HL WBB will be restricted to much lower EIRPs than WBB systems considered in previous studies, the ACMA has conducted studies to assess the coexistence requirements for this case (the RA study). The study is at Appendix F and is available as a separate document.

We note that the European Commission Committee (ECC) has also investigated this issue. Their final study is currently being consulted on and is available [here](https://cept.org/files/9522/Draft-CEPT-Report-088.docx). Results from these studies state that no mitigation measures are required for low to medium power devices operating in the 3800-4100 MHz band.

**Proposed mitigation measures**

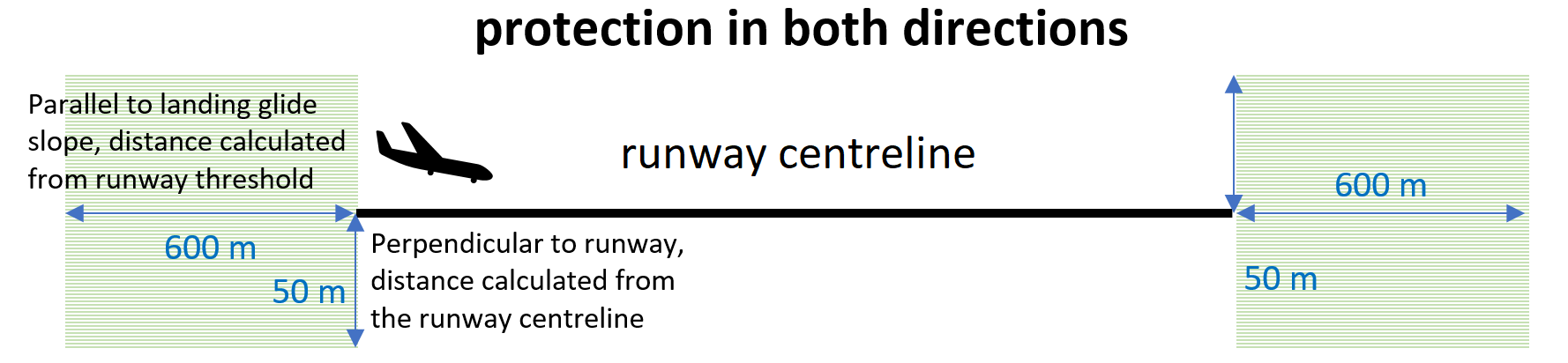
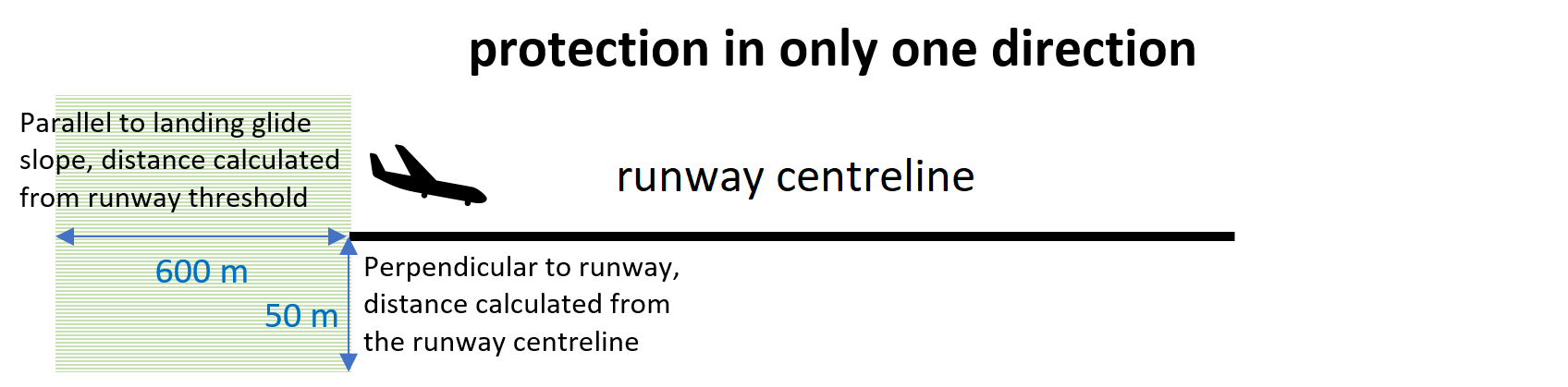
Based on the outcomes of the RA study at Appendix F, in addition to the in-band 17 dBm/MHz EIRP limit and unwanted emissions limits defined previously, the following measures are proposed to mitigate potential interference from HL WBB transmitters to RAs:

* No additional mitigation measures are required for UEs. Interference can be managed via site management arrangements at airports. This could include, for example, restricting the use of user terminals that can connect to HL WBB networks in these areas.
* No additional mitigation measures are required for BS that meet category B spurious emissions limits for non-AAS devices (as defined by 3GPP) across the entire 4200-4400 MHz band;
* For BS that meet Local Area and Medium Range BS unwanted emissions within the 4200-4240 MHz band, a small restricted zone is proposed in the area parallel to the landing glide slope at airports[[11]](#footnote-12). This is detailed in Figure 3. No restricted zone is required perpendicular to the runway.

Within the restricted zone, it is proposed to implement limits on the EIRP of unwanted emissions from HL WBB BS at different elevation angles (with respect to the horizon) as defined by the equation for EIRPlim below.

* When coordinating indoor HL WBB BS, licence applicants (or their accredited persons) may apply to the ACMA to have building penetration losses considered. Such a request would need to include suitable information detailing the level of building penetration loss and how this was determined. If the building penetration losses are greater than or equal to 5.6 dB then no additional mitigation measures are required.

Diagram of the proposed Restricted zone (not to scale)



*Unwanted emissions EIRP limit – for BS located parallel to the landing glide slope*

(dBm/MHz)

(dBm/MHz) – unwanted emissions EIRP limit within the 4200-4400 MHz frequency band at angle (degrees) with respect to the horizon

(metres) –distance from the runway threshold (parallel to the runway centreline)

# Summary of proposed arrangements

A high-level summary of the arrangements proposed for HL WBB are provided in Table 11.

Summary of proposed arrangements for HL WBB

|  |  |
| --- | --- |
| **Item** | **Description** |
| Licence type | 1. PMP licence. 2. Record notional location of controlled premises on licence, BS deployments permitted. BS deployment must be both:    1. within 100 m of the location recorded on the licence; and    2. within the bounds of a controlled premises. |
| Definitions | ***Controlled premises*** means premises that are owned by or under the control of a person who is providing a radiocommunications service (or being provided the service)*.*  ***Indoor*** means a space that is:   1. enclosed by permanent walls on all sides, a permanent roof and a permanent floor; and 2. permanently fixed to a location. |
| HL WBB | General conditions  1. Power spectral density must not exceed 17 dBm/MHz EIRP. 2. Base station transmitters must comply with the unwanted emission limits described in:     1. Tables 6.6.4.2.3-2 (unwanted emissions within the profile band, limits for Medium Range BS, for non-AAS) and section 9.7.4.2 (for AAS) of 3GPP TS 38.104    2. 6.6.5.2.1-2 (spurious emissions in FR1, category B, for non-AAS) and section 9.7.5.2.2 (for AAS) of 3GPP TS 38.104. 3. User equipment transmitters must comply with the unwanted emission limits described in Tables 6.5.2.2-1 (out-of-band) and 6.5.3.1-2 (spurious) of 3GPP TS 38.101-1. 4. UEs operate on a no interference and no protection basis. 5. HL WBB operate on a NINP basis to other HL WBB services.  Conditions for 3400-3475 MHz frequency range  1. Operation of transmitters is limited to urban areas and within the 3400–3460 MHz frequency range. 2. A general policy of only supporting HL WBB operation within the 3460–3475 MHz frequency range if there is agreement with adjacent frequency SL. Licensee takes on risk of having to cease or modify operation at any time to manage interference. 3. Only indoor BS deployments are allowed. 4. HL WBB operation is on a no interference and no protection basis to services operating under a 3.4 GHz band SL. 5. The operation of transmitters *must be synchronised* with the operation of services operating under adjacent area 3.4 GHz SLs that are directly adjacent to urban excise areas. 6. The power flux-density from transmitters on controlled premises must not exceed –99.9 dBm/MHz/m2 at the boundary of urban areas at a height of 10 metres above ground level. [alternative options also under consideration]  Conditions for 3950-4000 MHz frequency range  1. Operation of transmitters is limited to metro and regional Australia and within the 3950-4000 MHz frequency range. 2. UE operation is on a no interference and no protection basis to other licensed services. 3. The same fallback synchronisation requirement that applies to AWLs in the 3400-4000 MHz band applies. Refer to *Radiocommunications Licence Conditions (Area-Wide Licence) Determination 2020* for details. |
| Coordination with PTP | 1. Only applies to HL WBB in 3950-4000 MHz frequency range. 2. PTP Rx and HL WBB BS cannot be deployed within 2 km of each other.  Conditions HL WBB BS into PTP Rx  1. Cull distance: 65 km 2. Cull frequency: 2nd adjacent channel (largest system BW). 3. Coordinate using notional site location on PMP 4. PTP Rx protection criteria defined in RALI FX3.  Conditions PTP Tx into HL WBB BS  1. Cull distance: 60 km 2. Cull frequency: 1st adjacent channel (largest system BW). 3. Coordinate using notional site location on PMP. 4. Protection criteria defined in Tables 6 and 7. |
| Coordination with Amateurs | 1. Only applies to HL WBB in 3400-3475 MHz frequency range. 2. Amateur services operate on a no interference and no protection basis.   **Coordination into Amateur Rx**   1. Performed using the same notional receiver performance levels and compatibility requirement set out in Schedules 1 and 2 to the RAG Rx. 2. If coordination suggest interference may occur, notify licensee. 3. Reasonable efforts to enable coexistence. HL WBB has priority if not possible.   **Coordination into HL WBB Rx**   1. Performed using the criteria defined in Tables 6 and 7. |
| ESPZs | 1. Only applies to HL WBB in 3950-4000 MHz frequency range. 2. No HL WBB deployments within EPSZs. 3. Cull distance: 50 km from coordination point in RALI MS44. 4. Coordinate using criteria in RALI MS44. |
| Coordination with FSS | 1. Same measures that apply to AWLs, except as follows:    1. Cull distance for earth receive licence coordination:       1. co-channel: 60 km       2. adjacent channel: 2 km for HL WBB in 3400-3475 MHz, 5 km for HL WBB in 3950-4000 MHz.    2. Minimum separation distance HL WBB (in both bands) with earth receive licences and AWL Rx registrations:       1. Channel edge separation ≥ 5 MHz: 220 m       2. Channel edge separation < 5 MHz: 350 m |
| Radiolocation services | 1. Same measures that apply to AWLs. |
| Coordination with 3400-4000 MHz frequency range AWLs | 1. Only applies to HL WBB in the 3950-4000 MHz frequency range. 2. The same fallback synchronisation requirement that applies to AWLs in the 3400-4000 MHz frequency range applies. Refer to *Radiocommunications Licence Conditions (Area-Wide Licence) Determination 2020* for details. 3. HL WBB afforded co-channel protection provided by AWL device boundary criteria. This assumes systems are synchronised. |
| Coordination with high powered PMP operating outside the ASMG | Same measures that apply to AWLs |
| Coordination with 3.4 GHz band SLs | General conditionsOnly applies to HL WBB in the 3400-3475 MHz frequency range.HL WBB limited to indoor BS only.Conditions HL WBB into adjacent area SLsPFD limit as defined for HL WBB tx. [alternative options also under consideration]The operation of transmitters *must be synchronised* with the operation of services operating under adjacent area 3.4 GHz SL. The obligation is on HL WBB licensees to align with adjacent area SL.HL WBB Rx operate on no protection basis to all existing and new CPEs operating under adjacent area 3.4 GHz band SLs.HL WBB Rx operate on no protection basis to all existing and new BS under adjacent area 3.4 GHz band SLs.Conditions HL WBB into adjacent frequency SLsRestricted use band at 3470-3475 MHz. Operation within restricted use band is possible via agreement with the adjacent band 3.4 GHz band SL.Unwanted emission limits defined for HL WBB tx.HL WBB operate on a no interference and protection basis to adjacent band SLs. |
| Coexistence with radio altimeters | Only applies to HL WBB in the 3950-4000 MHz frequency range.In-band PSD limit of 17 dBm/MHz EIRP applies to all transmitters, unwanted emission limits as defined previously apply to all transmitters.No additional restrictions on UEsNo additional restrictions on BS that meet category B spurious emissions limits (as defined by 3GPP) across the entire 4200-4400 MHz band.BS that meet Local Area and Medium Range BS unwanted emissions within the 4200-4240 MHz band (as defined by 3GPP) must meet defined EIRP limits above the horizon within restricted zones at defined airports. Refer to the *Radio altimeters (4200-4400 MHz)* section for further details. |

# Appendix A: Spectrum space identified for HL WBB use

The geographical areas identified for HL WBB use in the 3400-3475 MHz and 3950-4000 MHz frequency range are detailed in Table 12 and illustrated in Figures 4 and 5.

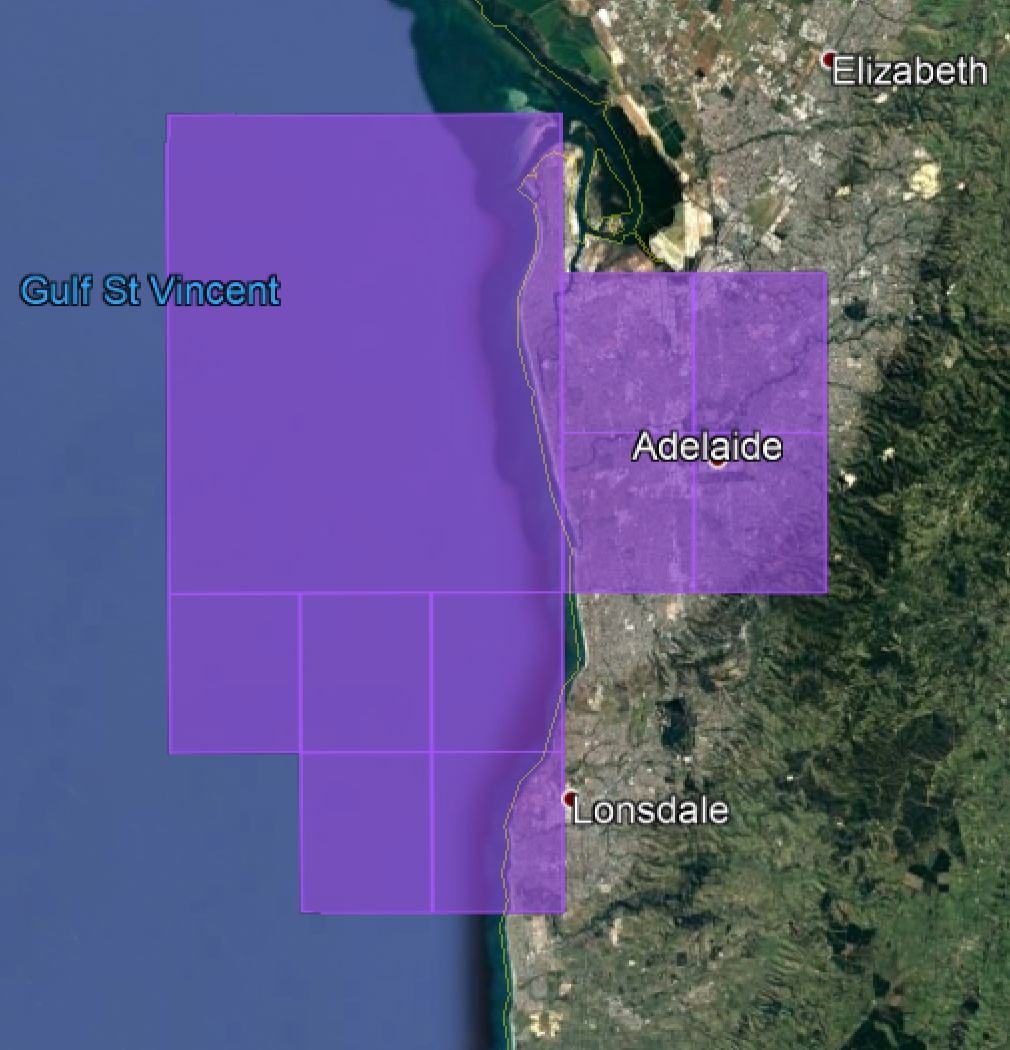
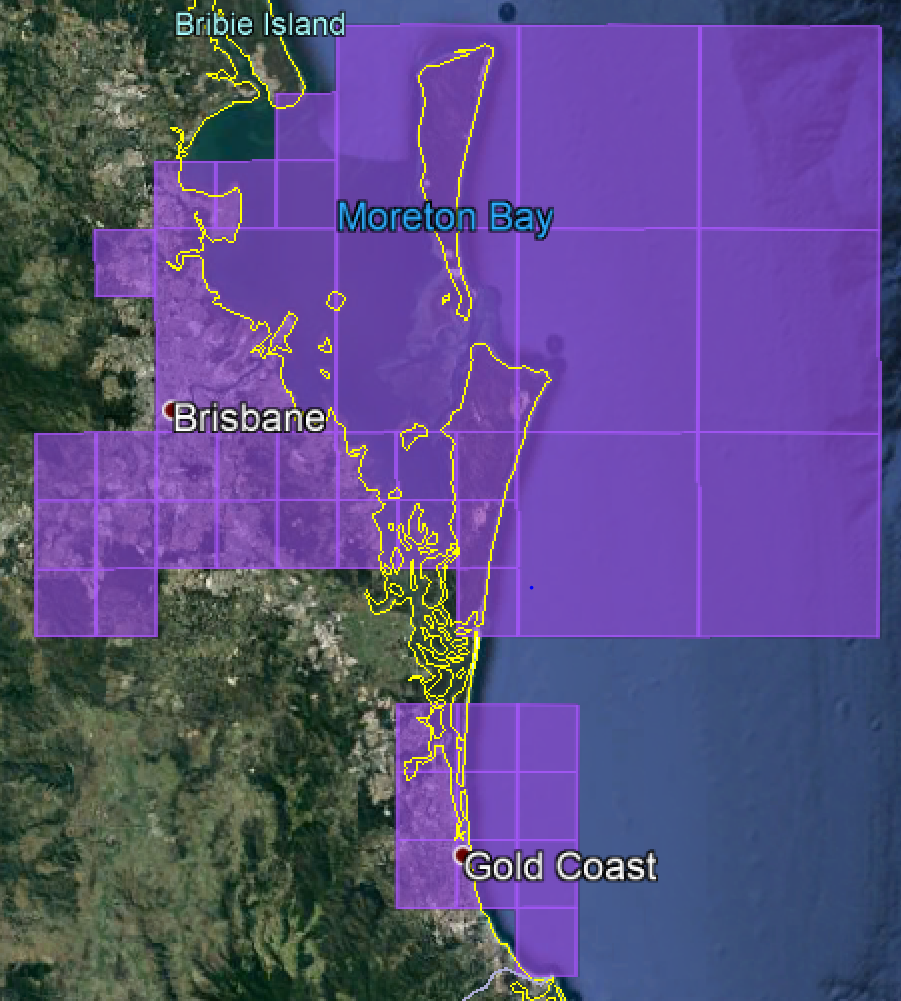
The Australian Spectrum Map Grid (ASMG) is used to define the geographical areas. The Hierarchical Cell Identification Scheme (HCIS) is a naming convention developed by the ACMA that applies unique ‘names’ to each of the cells that make up the ASMG. The ASMG and HCIS are described in detail in the document [*The Australian spectrum map grid 2012*](https://www.acma.gov.au/australian-spectrum-map-grid). The HCIS coordinates can be converted into a Placemark file (viewable in Google Earth) through a facility on the [*Convert HCIS area description to Placemark*](https://www.acma.gov.au/convert-hcis-area-description-placemark-0) facility on the ACMA website.

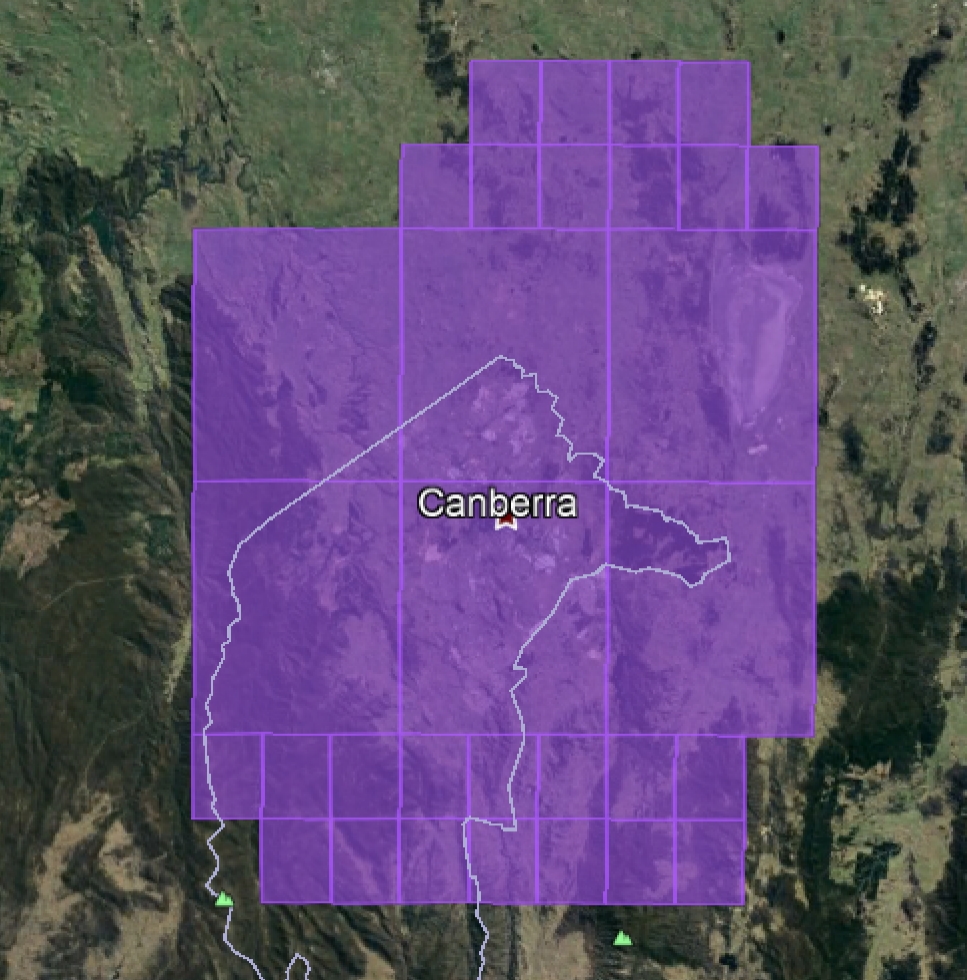
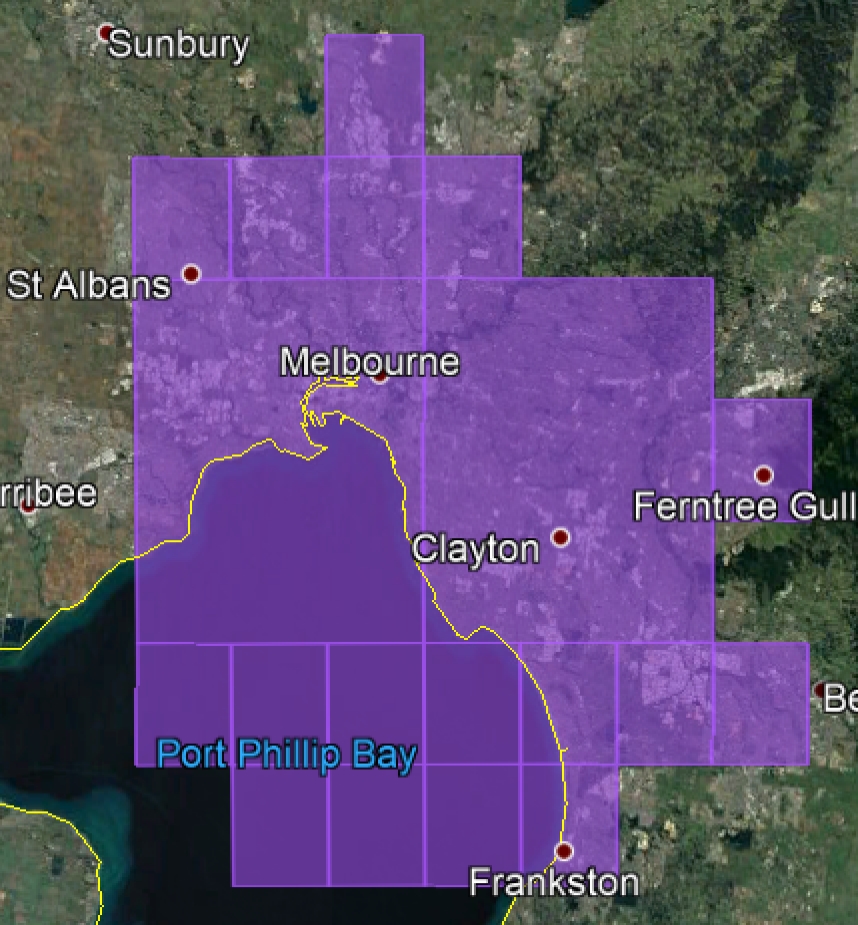
Spectrum space identified for HL WBB use

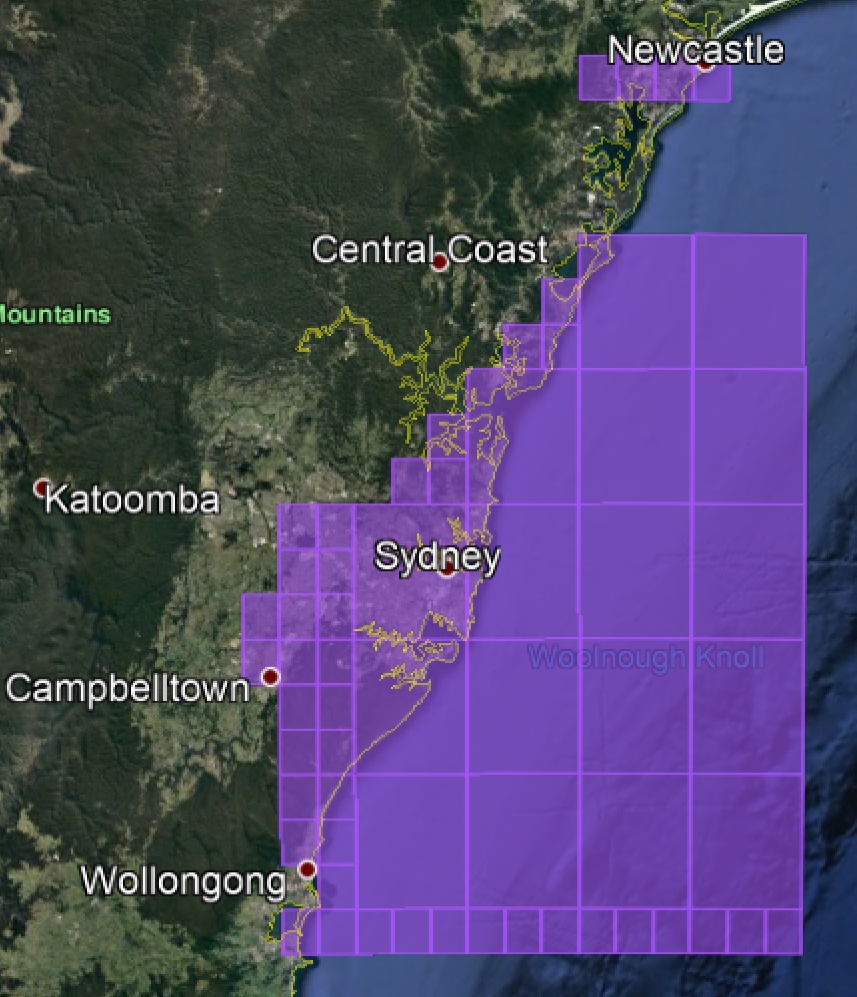
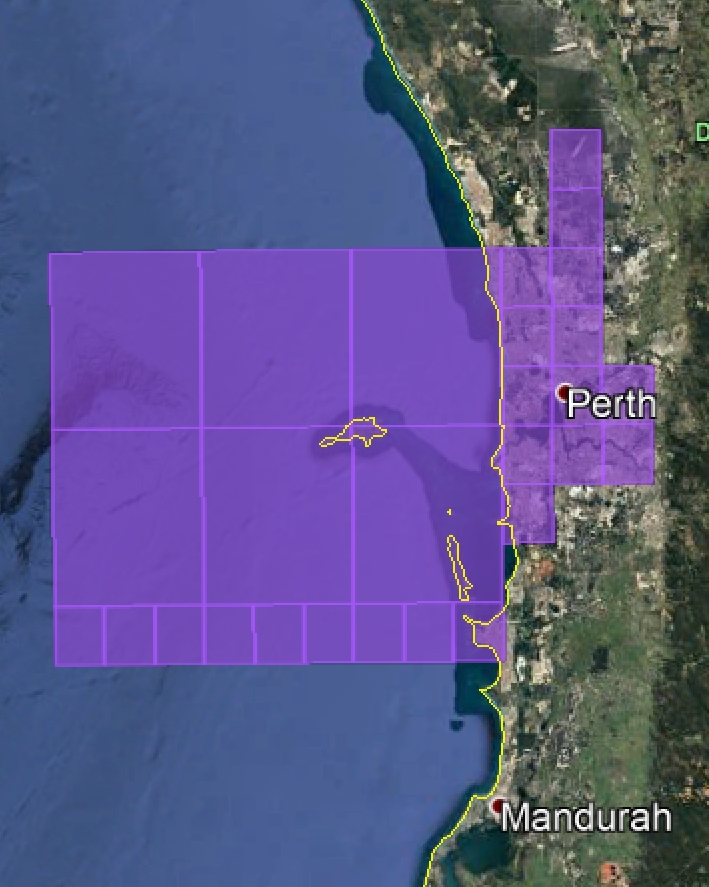
| Frequency range | Area name | HCIS |
| --- | --- | --- |
| 3400-3475 MHz | Adelaide | IW3N, IW3O4, IW3O5, IW3O7, IW3O8, IW6B1, IW6B2, IW6B3, IW6B5, IW6B6 |
| Brisbane | NT9B, NT9C, NT9D, NT9E, NT9F, NT9G, NT9H, NT9K, NT9L, NT8H3, NT8L2, NT8L3, NT8L5, NT8L6, NT8L8, NT8L9, NT9A6, NT9A7, NT9A8, NT9A9, NT9I1, NT9I2, NT9I3, NT9I4, NT9I5, NT9I6, NT9J1, NT9J2, NT9J3, NT9J4, NT9J5, NT9J6, NT9J9, NT9N5, NT9N6, NT9N8, NT9N9, NT9O4, NT9O7, NU3B2, NU3B3, NU3C1, NU3C4 |
| Canberra | MW4D, MW4H, MW5A, MW5B, MW5E, MW5F, MW2M5, MW2M6, MW2M7, MW2M8, MW2M9, MW2N4, MW2N5, MW2N7, MW2N8, MW2N9, MW4L1, MW4L2, MW4L3, MW4L5, MW4L6, MW5I1, MW5I2, MW5I3, MW5I4, MW5I5, MW5I6, MW5J1, MW5J2, MW5J4, MW5J5 |
| Melbourne | KX3P, KX3L6, KX3L7, KX3L8, KX3L9, KX6D1, KX6D2, KX6D3, KX6D5, KX6D6, LX1M, LX1I7, LX1N4, LX4A1, LX4A2, LX4A3, LX4A4, LX4A5, LX4B1 |
| Perth | BV1M, BV1N, BV1O, BV4A, BV4B, BV4C, BV1L5, BV1L8, BV1P1, BV1P2, BV1P4, BV1P5, BV1P7, BV1P8, BV4D1, BV4D2, BV4E1, BV4E2, BV4E3, BV4F1, BV4F2, BV4F3, BV4G1, BV4G2, BV1P9, BV4D3, BV4D4, BV4G3 |
| Sydney | NV7G, NV7H, NV7J, NV7K, NV7L, NV7M, NV7N, NV7O, NV7P, NW1A, NW1B, NW1C, NW1D, NW1E, NW1F, NW1G, NW1H, MV9P2, MV9P3, MV9P5, MV9P6, MV9P7, MV9P8, MV9P9, MW3D1, MW3D2, MW3D3, MW3D5, MW3D6, MW3D8, MW3D9, MW3H2, MW3H3, MW3H5, MW3H6, MW3H9, MW3L2, MW3L3, NV4O7, NV4O8, NV4O9, NV4P7, NV7F6, NV7F8, NV7F9, NV7I6, NV7I8, NV7I9, NW1I1, NW1I2, NW1I3, NW1J1, NW1J2, NW1J3, NW1K1, NW1K2, NW1K3, NW1L1, NW1L2, NW1L3 |
| 3950-4000 MHz | Metro and regional Australia | BV, CV, DV, IV, IW, JV, JW, KQ, KV, KW, LR, LV, LW, LX, LY, MS, MW, NT, AU9, AV9, AW3, BU7, BU8, BW1, BW2, BW3, BW5, BW6, CW1, CW2, CW3, CW4, DW1, DW2, DW3, EV1, EV2, EV3, EV4, EV5, EV6, EV7, FV1, FV2, FV3, FV4, FV5, GV1, GV2, GV3, GV6, HV1, HV2, HV3, HV4, HV5, HV6, HV8, HV9, HW3, HW6, JX1, JX2, JX3, JX5, JX6, KO1, KO4, KO5, KO7, KO8, KP1, KP2, KP4, KP5, KP6, KP7, KP8, KP9, KX1, KX2, KX3, KX4, KX5, KX6, KX8, KX9, KY2, KY3, KY6, LP4, LP7, LQ1, LQ2, LQ4, LQ5, LQ7, LQ8, LZ1, LZ2, LZ3, MR1, MR4, MR5, MR7, MR8, MR9, MT1, MT2, MT3, MT6, MT7, MT8, MT9, MU1, MU2, MU3, MU4, MU7, MU8, MU9, MV1, MV2, MV4, MV5, MV6, MV7, MV8, MV9, MX1, MX2, MX3, MX4, MX7, MY1, MY4, MY7, MZ1, NS4, NS7, NS8, NS9, NU1, NU2, NU3, NU4, NU5, NU6, NU8, NU9, NV1, NV2, NV3, NV4, NV5, NV7, NW1, AU6I, AU6J, AU6K, AU6L, AU6M, AU6N, AU6O, AU6P, BU4H, BU4I, BU4J, BU4K, BU4L, BU4M, BU4N, BU4O, BU4P, BU5E, BU5F, BU5G, BU5H, BU5I, BU5J, BU5K, BU5L, BU5M, BU5N, BU5O, BU5P, BU9A, BU9B, BU9E, BU9F, BU9I, BU9J, BU9M, BU9N, MT4A, MT4B, MT4C, MT4D, MT4E, MT4I, MT4M, MT4N, MT5A, MT5B, MT5C, MT5D, MT5F, MT5G, MT5H, MT5J, MT5K, MT5L, MT5N, MT5O, MT5P, MU5A, MU5B, MU5E, MU5F, MU5I, MU5J, MU5M, MU5N, MU5O, MU5P, MU6B, MU6C, MU6D, MU6F, MU6G, MU6H, MU6J, MU6K, MU6L, MU6M, MU6N, MU6O, MU6P, MV3A, MV3B, MV3E, MV3I, MV3M, MV3N, NU7A, NU7B, NU7C, NU7D, NU7E, NU7F, NU7G, NU7H, NU7I, NU7J, NU7L, NU7M, NU7N, NU7O, NU7P, MT4F1, MT4F2, MT4F3, MT4F4, MT4F5, MT4F6, MT4F7, MT4F8, MT4G1, MT4J1, MT4J2, MT4J4, MT4J5, MT4J7, MT4J8, MT4J9, MT4O4, MT4O5, MT4O7, MT4O8, MT4O9, MT4P6, MT4P7, MT4P8, MT4P9, MT5E1, MT5E2, MT5E3, MT5E5, MT5E6, MT5E8, MT5E9, MT5I3, MT5I6, MT5I8, MT5I9, MT5M2, MT5M3, MT5M4, MT5M5, MT5M6, MT5M7, MT5M8, MT5M9, MU5C1, MU5C2, MU5C3, MU5C4, MU5C5, MU5C6, MU5C7, MU5D1, MU5D2, MU5D3, MU5D4, MU5D5, MU5D6, MU5K7, MU6A1, MU6A2, MU6A3, MU6A4, MU6A5, MU6A6, MU6A8, MU6A9, MU6E3, MU6E6, MU6E9, MU6I3, MU6I6, MU6I8, MU6I9, MV3C1, MV3C2, MV3C3, MV3C4, MV3C5, MV3C6, MV3C7, MV3D1, MV3D2, MV3D3, MV3D4, MV3D5, MV3D6, MV3D8, MV3D9, MV3F1, MV3F2, MV3F4, MV3F7, MV3J1, MV3J4, MV3J7, MV3J8, MV3O4, MV3O5, MV3O6, MV3O7, MV3O8, MV3O9, MV3P2, MV3P3, MV3P4, MV3P5, MV3P6, MV3P7, MV3P8, MV3P9, NU7K1, NU7K2, NU7K3, NU7K5, NU7K6, NU7K7, NU7K8, NU7K9 |

Note: The HCIS coordinates can be converted into a Placemark file (viewable in Google Earth) through a facility on the [ACMA website](https://acma.gov.au/convert-hcis-area-description-placemark-0).

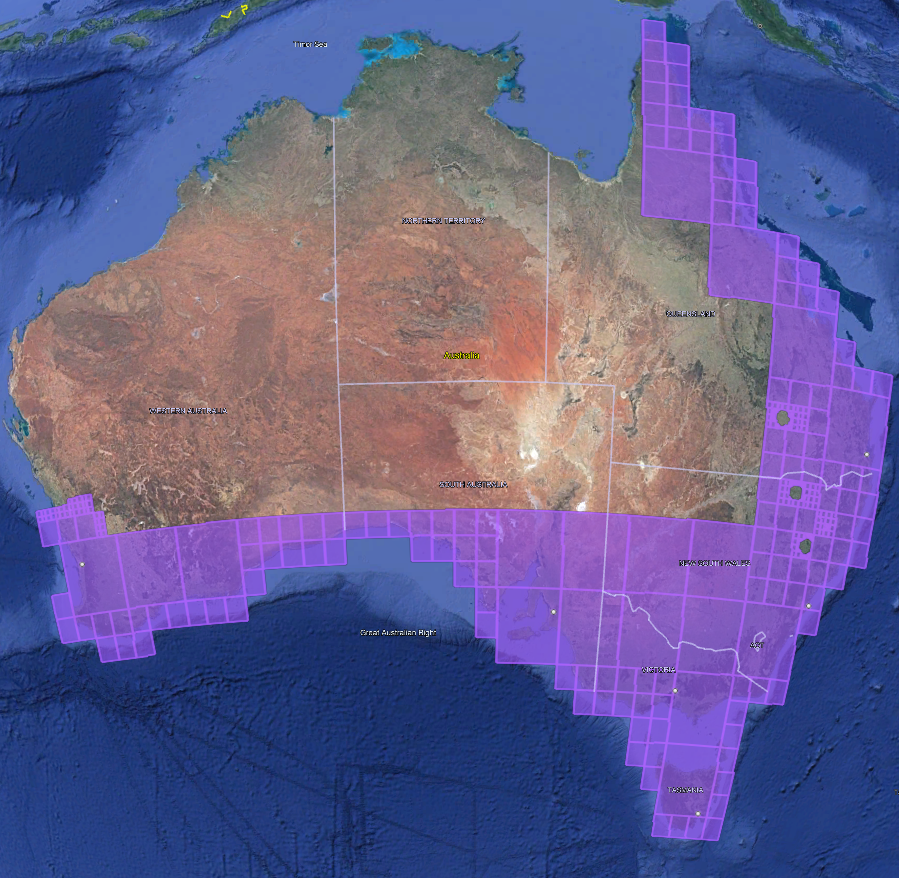
1. Illustration of spectrum space for HL WBB in 3400‑3475 MHz frequency range (purple areas)

1. Illustration of spectrum space for HL WBB in 3950‑4000 MHz frequency range (purple areas)



# Appendix B: Notification requirements

When notifying licensees, the following information (as a minimum) must be provided:

The reason the licensee is being notified, for example:

In accordance with section [section number] of RALI MS[HL WBB], [the licensee] is being notified of a proposed new area-wide licensed service that will be operated within [X] MHz of [one/a number] of your existing licensed point to multipoint services.

Information identifying the affected licensed service or services (e.g., licence number, site ID)

Details of the proposed area-wide licensed service required for the coordination of services (e.g., location, transmitter characteristics, receiver characteristics etc); and

Contact details of an appropriate person for further discussion of the issue

# Appendix C: Development of PFD limits

This section provides detail on how the ACMA developed the power flux density (PFD) limits for HL WBB operating in the 3400-3475 MHz frequency range.

Derivation of proposed PFD limit at urban area boundaries (BS🡪CPE)

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Parameter** | **Value** | **Reference** |
| **A** | Consumer premise Equipment (CPE) antenna gain | 20 dBi | Typical antenna gain for nbn b42 CPE |
| **B** | Effective antenna aperture | -12.1 dB(m2) | Equation 2, for frequency of 3400 MHz |
| **C** | CPE noise figure | 7 dB | Representative noise figure of nbn CPE |
| **D** | Thermal noise | -114 dBm/MHz | = kTB, assuming T = 293 K |
| **E** | I/N | -5 dB | Provided by nbn |
| **F** | Max. interference | -112 dBm/MHz | =C+D+E |
| **G** | PFD limit | -99.9 dBm/(m2.MHz) | Equation 1, assumes non-AAS |

Derivation of proposed PFD limit at urban area boundaries (BS🡪BS)

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Parameter** | **Value** | **Reference** |
| **A** | Base station antenna gain | 25 dBi | Maximum antenna gain on RRL for nbn base stations (assumes a Lens antenna) |
| **B** | Effective antenna aperture | -7.1 dB(m2) | Equation 2, for frequency of 3400 MHz |
| **C** | noise figure | 5 dB | Recommendation ITU-R M.2292 |
| **D** | Thermal noise | -114 dBm/MHz | = kTB, assuming T = 293 K |
| **E** | I/N | -6 dB | Recommendation ITU-R M.2292 |
| **F** | Max. interference | -115 dBm/MHz | =C+D+E |
| **G** | PFD limit | -108 dBm/(m2.MHz) | Equation 1, assumes non-AAS |

Derivation of proposed PFD limit at controlled premise boundary

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **Parameter** | **Value** | **Reference** |
| **A** | MS antenna gain | -4 dBi | Recommendation ITU-R M.2292 |
| **B** | Effective antenna aperture | -36.1 dB(m2) | Equation 2, for frequency of 3400 MHz |
| **C** | Body loss | 4 dB | Recommendation ITU-R M.2292 |
| **D** | MS noise figure | 9 dB | Recommendation ITU-R M.2292 |
| **E** | Thermal noise | -114 dBm/MHz | = kTB, assuming T = 293 K |
| **F** | I/N | 0 dB | Proposal. Actual level seen would be lower further away from boundary |
| **G** | Max. interference | -101 dBm/MHz | =C+D+E+F |
| **H** | PFD limit | -64.9 dBm/(m2.MHz) | Equation 1, assumes non-AAS |

The equation for power flux density is:

**equation 1**

Where:

: Power flux density (W/m2)

: Received power (W)

: Effective antenna aperture (m2)

The equation for effective antenna aperture is:

**equation 2**

Where:

: Gain of the receiving antenna

: wavelength (m)

# Appendix D: Synchronisation requirement

**No longer used**

# Appendix E: Development of urban areas in 3400-3475 MHz band

In 2015, as a result of the [*Australian Communications and Media Authority (3.5 GHz frequency band) Direction 2014*](https://www.legislation.gov.au/Details/F2014L01399), nbn were issued apparatus licences that covered urban excise and surrounding areas. Since that time, they have deployed terrestrial wireless broadband services at about 1000 locations (based on RRL data) under the licences issued.

In 2021, as part of the [process to convert nbn’s 3.5 GHz apparatus licences to spectrum licences](https://www.acma.gov.au/consultations/2019-08/optimising-3400-3575-mhz-band-consultation-122019), nbn agreed to surrender licences it held in urban areas of the 3400-3475 MHz frequency range. This related to the areas it deploys fixed line solutions, consequently it was not needed as part of their fixed wireless broadband solution. The ACMA then committed to work with stakeholders to make that spectrum available for other WBB use cases.

It is noted that a key part of nbn’s agreement to surrender licences was that suitable measures be put in place to provide protection of its existing and planned services.

To maximise their size, urban areas were defined to include those areas of capital cities that were not part of nbn’s terrestrial fixed wireless service area. This means a large number of nbn services are located near the urban area boundary with little or no geographical separation between them. This creates a challenging coexistence environment.

This situation is different to the typical scenario where an operator is issued a licence where the boundaries are pre-defined, and they are aware of possible future co-frequency use in adjacent areas. In such cases, an operator can design their network and deploy services that take this into account. Often this involves some form of geographical separation between services and shared area boundaries – something that many existing nbn services gain limited benefit from with urban areas.

To account for this while recognising the benefits of the services provided by nbn, measures need to be put in place to achieve coexistence through managing interference between existing and future nbn services and future uses/users of urban areas.

It is important to note that there will naturally be a trade-off between the level of protection provided to nbn services and the utility that can be derives from use of spectrum in urban areas. For example, a more conservative protection criteria for nbn services corresponds to a reduction in utility of spectrum available in urban areas. Consequently, a suitable balance needs to be identified.

# Appendix F: HL WBB and radio altimeter coexistence study

[Study provided as a separate document]

1. Industry 4.0 or the fourth industrial revolution refers to the transformation of how businesses operate by connecting the physical with the digital world. Artificial intelligence, advanced automation and robotics are examples of Industry 4.0 technologies. [↑](#footnote-ref-2)
2. Definition of the term ‘controlled premises’ is the same as that used for class licensed WBB services in the 24.25-25.51 GHz frequency range, refer to the interpretation section of the [*Radiocommunications (Low Interference Potential Devices) Class Licence 2015*](https://www.legislation.gov.au/Details/F2023C00524) [↑](#footnote-ref-3)
3. Refer to the interpretation section of the [*Radiocommunications (Low Interference Potential Devices) Class Licence 2015*](https://www.legislation.gov.au/Details/F2023C00524) [↑](#footnote-ref-4)
4. In the context of a PMP licence a remote station includes user terminals and other devices that communicate with a base station. [↑](#footnote-ref-5)
5. Characteristics of terrestrial component of IMT for sharing and compatibility studies in preparation for WRC-23 [↑](#footnote-ref-6)
6. Refer to Appendix B for details of the notification requirements. [↑](#footnote-ref-7)
7. Refer to Appendix B for details of the notification requirements. [↑](#footnote-ref-8)
8. It is noted that since any HL WBB transmitters also have to be within the bounds of a controlled premise, this means the actual distance may be less than 100 m. [↑](#footnote-ref-9)
9. Frequency Dependant Rejection [↑](#footnote-ref-10)
10. Frequency Dependant Rejection [↑](#footnote-ref-11)
11. The list of airports that the restricted zone applies is intended to be the same as those defined for 3.4 GHz spectrum licences and area-wide licences. [↑](#footnote-ref-12)