Before the Wellington City Proposed District Plan Hearings Panel

Under	The Resource Management Act 1991 (**Act**)
In the Matter of	The Wellington City Council Proposed District Plan Wrap-up Hearing
Between	**Wellington City Council** Local Authority
And	**Airways Corporation of New Zealand Limited** Submitter

Statement of Evidence of Michael Connolly on behalf of Airways Corporation of New Zealand Limited (Airways)

Dated 31 October 2024

1 Introduction

1.1 My full name is Michael Paul Connolly**.**

1.2 I am the Central and Lower North Island Maintenance Manager at Airways, the sole Air Traffic Service provider in New Zealand.

1.3 I am providing evidence for Airways in relation to its submission[1] on the Wellington City Council Proposed District Plan (Proposed Plan).

1.4 This evidence responds to paragraph 12 of Minute 57 of the Hearing Panel which directs that that the Airways submission seeking a new overlay is scheduled for reconsideration in the wrap up hearing (hearing 12).

2 Qualifications and experience

2.1 I hold a Bachelor of Engineering (hons) in electrical and electronic engineering from the University of Canterbury. I also hold a Bachelor of Business Studies (BBS) in finance and management and have several professional registrations.

2.2 I have been employed by Airways since 2002. In my current role, I lead a team of air navigation service provider staff who are responsible for air traffic management systems. In my previous role as a Systems Engineer within the Airways Communication and Surveillance Engineering team I was a design authority for various Airways Air Traffic Control systems.

2.3 While I am not giving expert evidence, my roles with Airways over the past 22 years means I am very familiar with the operation of radar and navigation equipment, its importance to air safety, and the need to maintain these assets whilst being cost efficient and effective.

2.4 I have authority to give this evidence on behalf of Airways. I was involved in the preparation of the Airways submission on the District Plan.

3 Scope of Evidence

3.1 My evidence:

a Outlines the objectives and functions of Airways;

b Outlines the importance of radar and navigation equipment in delivering safe, resilient and efficient air traffic services to New Zealand air space users and the general aviation community; and

c Addresses Airways' submission on the Proposed Plan seeking an overlay around its radar designations.

[1] Submission 100, 12 September 2022.

4 Objectives and functions of Airways

State Owned Enterprise

4.1 Airways is a State-Owned Enterprise established under the State Owned Enterprise Act 1986 (**SOE Act**) and is a public company registered under the Companies Act 1993.

4.2 Under section 4 of the SOE Act, one of the objectives of Airways is to be an organisation that exhibits a sense of social responsibility by having regard to the interests of the community in which it operates and by endeavouring to accommodate or encourage these when able to do so.

Civil Aviation Act

4.3 The New Zealand aviation industry is governed by the Civil Aviation Act 1990 and the Civil Aviation Rules made by the Minister of Transport under the Civil Aviation Act. Airways holds a certificate issued by the Director-General of Civil Aviation under the Civil Aviation Act, which enables it to provide air traffic control services.

4.4 Section 99 of the Civil Aviation Act 1990 provides that Airways shall be the sole provider of the following aviation services in New Zealand.

a Area control services;

b Approach control services; and

c Flight information services.

International Civil Aviation Organization

4.5 International Civil Aviation Organization (**ICAO**) is a specialised agency of the United Nations, formed to promote the safe and orderly development of international civil aviation throughout the world. It sets standards and regulations necessary for aviation safety, security, efficiency and regularity, as well as for aviation environmental protection. The Organization serves as the forum for cooperation in all fields of civil aviation among its 193 member states.

4.6 The ICAO standards are embedded into the Civil Aviation Act 1990 and Airways is required to follow the ICAO standards. New Zealand was among the 52 States that signed the Chicago Convention on 7 December 1944, which established the Provisional International Civil Aviation Organization (PICAO). The Civil Aviation Act 1948 formalised New Zealand’s acceptance of the Convention on International Civil Aviation.

Core functions

4.7 The core function of Airways is to deliver safe, resilient and efficient air traffic services to New Zealand air space users and the general aviation community, the

Air Force and airports.[2] Airways provides air navigation services across 30 million square kilometers of airspace.

4.8 It is in the interest of not only the aviation community but also of the general public, that Airways can provide these services and operations using equipment that is not at risk of being comprised by nearby development and/or infrastructure.

5 Importance of radar and navigation equipment

5.1 Airways has six designations in the Proposed Plan for its radar and navigation infrastructure. It is critical from a safety perspective that Airways' radar and navigation infrastructure is not interfered with by surrounding development.

5.2 Airways' surveillance systems utilise several different types of technology including radar, multilateration and ADS-B equipment to provide a three-dimensional picture of air traffic. These systems pinpoint aircraft and allow for the appropriate separation between aircraft and the ground, as well as separating aircraft from each other. Surveillance and navigation systems allow Airways to provide the most efficient flight path for aircraft.

5.3 The key concern for Airways is tall buildings and structures. If tall buildings/structures are built in close proximity to the radar and navigation designations, they have the potential to cause radio wave disturbances, impacting the radar and navigation technology.

5.4 The consequences of flight disruptions are very serious. As a worst-case scenario, tall structures can cause radio signal disturbances and generate 'false target reports', corrupting the surveillance system. This can result in planes being displaced in the sky (i.e. showing a plane in a different place to where it actually is) and in a worst-case scenario, flying into the ground or another aircraft.

5.5 As outlined above, Airways follows the ICAO standards, which require buffers around the Airways radar designations that control the height of structures within the vicinity of the equipment.[3] The size of the buffer depends on the type of navigation equipment. The following buffers would be required around the Airways designations:

a 500m buffer for Primary Surveillance Radars (PSR), Secondary Surveillance Radars (SSR) and Automatic Dependent Surveillance-Broadcast (ADS-B) - applies to designation ACNZ3[4] and ACNZ4[5] at Hawkins Hill.

b 200m buffer for 'Non-Directional Beacons' (NDB) - applies to the NDB designation ACNZ1[6] at Newlands.

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[2] Airways Statement of Corporate Intent 2022/23-2024/25, page 13. https://www.airways.co.nz/assets/Uploads/Airways-statement-of-corporate-intent-2022-2023_2024-2025.pdf

[3] International Civil Aviation Organization -European Guidance Material on Managing Building Restricted Areas (third edition) 2015, Appendix 1 (navigational facilities), Appendix 2 (communication facilities) and Appendix 3 (surveillance facilities).

[4] Section 5 SO24952.

[5] Section 1&2 SO31242, Section 4 SO24952.

[6] Section 1 SO24411, Lot 231 DP22898. 8 D10.

c 300m buffer for Very High Frequency (VHF) communication - applies to the VHF designations ACNZ2[7] and ACNZ5[8] at Hawkins Hill.

d 600m buffer for Doppler Very High Frequency Omni Range (DVOR) and Distance Measuring Equipment (DME) – applies to designation ACNZ6 at Palmer Head.[9]

5.6 A copy of the ICAO standards is attached to my evidence as **Annexure A**.

5.7 The process, called "safeguarding", facilitates the safe integration of new constructions around air traffic control equipment. A systematic assessment of the possible impacts of new constructions on aviation is conducted and demonstrates that the safety of air operations is not compromised. This assessment, also known as an "aeronautical study[10]" is one of the core competences of air sight aimed at making aviation safer. A recent example of this was with a windfarm development near Palmerston North under the fast track legislation where an aeronautical study found that the windfarm will impact the Radar, ADS-B and VHF at Ballance, resulting in risk mitigation measures of a new Airways facility being commissioned to preserve Airspace safety.

6 Airways submission

6.1 Airways lodged a submission seeking that the Proposed Plan include a new 'Air Traffic Control Overlay' within a 500 metre radius around its radar designations. Airways proposed two options in its submission, either an 'information overlay' or an 'overlay' with associated changes to the provisions.

6.2 The s42A report writer did not recommend including the overlay sought by Airways in the Proposed Plan, stating that an information overlay is a sub-optimal approach, and that a statutory overlay is an inappropriate method for ensuring effective ongoing operation of equipment within the designation.[11]

7 Minute 57

7.1 Minute 57 issued by the Hearings Panel stated that the Airways overlay submission point deserves reconsideration in the wrap up hearing.[12] The Minute notes that the Reporting Officer considered Airway's submission was seeking an enlargement of the designation. Paragraph 13 of the Minute states that the Airways submission can be read as seeking an overlay around the designated area that is not itself designated, akin to the relief that WIAL has sought.

8 Proposed changes to Proposed Plan provisions

8.1 Attached to my evidence as **Annexure B** is a drawing showing an indicative 500m buffer around the two radar designations (ACNZ3 and 4).[13] I will provide

[7] Section 6 SO24952 & Section 1 SO28033.
[8] Section 1 & Section 2 on SO24952.
[9] Section 1 on SO35088.
[10] CAA Advisory Circular AC139-15; Revision 0 dated 23 February 2011 – Aeronautical Studies for Aerodrome Operators; and ICAO Doc 9774, Doc 9734 Part A.
[11] S42A report, paragraph 80.
[12] Paragraph 12 of Minute 57.
[13] The indicative 500m buffer lines were made using the 'measure' tool on the District Plan Appeals Version maps.

the final drawing to the Hearings Panel once this has been completed. Airways requests that the buffers around the two radar designations are shown on the planning maps as an 'Air Traffic Control Overlay'.

8.2 The Air Traffic Control Overlays would not preclude development occurring within those areas, but would require the impact of development over a specified height on the radar equipment to be taken into account as a matter of discretion.

8.3 The new Air Traffic Control Overlay applies to the radar designations on Hawkins Hill which affects two zones: the General Rural Zone and the Open Space Zone. It is noted that there are already height restrictions for permitted buildings and structures within those zones.

8.4 I propose the following changes to the existing Proposed Plan provisions within the General Rural Zone and the Natural Open Space Zone (in underline and ~~strikeout~~) below. This will have the effect of adding an additional 'assessment criteria' where the permitted standard is infringed, in each zone. I do not propose any changes to the existing permitted activity height limits.

General Rural Zone

GRUZ-S1 Maximum Height

Building or structure	Limit	Assessment criteria where the standard is infringed:
1.Residential buildings and structures outside the Mākara Beach and Mākara Village Precinct	5m or the height of the existing residential building, whichever is the greater, up to a maximum of 8m	1. Effects on rural character and amenity; 2. Dominance, privacy and shading effects on adjoining properties; 3. The ability to mitigate adverse effects through screening, planting and landscaping; 4.whether topographical or other site constraints make compliance with the standard impractical; 5.whether the form and scale of the building or structure is compatible with other buildings in the vicinity of the site; ~~and~~ 6.the extent to which the additional height is necessary to support a rural or residential activity~~.~~; and 7. Within the Air Traffic Control Overlay, the potential effects of the building or structure on the Airways navigation equipment.
2. Residential buildings and structures within the Mākara Beach and Mākara Village Precinct	8m or 3.5m for accessory buildings	
3. Buildings and structures associated with rural activities	8m	
This standard does not apply to fences or standalone walls		

Open Space Zone

NOSZ-S1 Maximum height of buildings and structures

<table>
<tr><td colspan="2">1.buildings and structures must not exceed the following maximum height limits above ground level:</td><td></td></tr>
<tr><td>Structure</td><td>Maximum heigh limit above ground level</td><td rowspan="6">Assessment criteria where the standard is infringed:
1. Design, appearance and siting of the building or structure in terms of the impact on the character and amenity of the open space;
2. Dominance, privacy and shading effects on adjoining sites;
3. Streetscape and visual amenity effects;
4. The extent to which adverse effects of additional height can be mitigated by the natural or physical features of the site, setbacks, landscaping or screening;
5. The extent to which the additional height is necessary to provide for functional needs or operational needs of the activities on the site; ~~and~~
6. Whether topographical or other site constraints make compliance with the standard impractical~~.~~; and
7. Within the Air Traffic Control Overlay, the potential effects of the building or structure on the Airways navigation equipment.</td></tr>
<tr><td>a.playground equipment and pou</td><td>8m</td></tr>
<tr><td>b.poles for lighting or surveillance</td><td>18m</td></tr>
<tr><td>c.fences and gates</td><td>2m</td></tr>
<tr><td>d.all other buildings and structures</td><td>4m</td></tr>
<tr><td colspan="2">This standard does not apply to:
a. Additions and alterations to existing buildings at Karori Wildlife Sanctuary (Zealandia)</td></tr>
</table>

8.5 As an aside, it would be beneficial for the Hearing Panel to clarify whether the height limit in GRUZ-S1(1) is 5m or 8m (the drafting is currently unclear).

8.6 I consider that an overlay, with associated provisions (which as above, requires only a small change to the existing provisions), is an effective and efficient way to

ensure that future development near the radar designations does not impact the operation of the radar and thus put aircraft (and people's lives) at risk.

9 Conclusion

9.1 It is critical from a safety perspective that Airways' radar and navigation infrastructure is not interfered with by surrounding development. If tall buildings/structures are built in close proximity to the radar and navigation designations, they have the potential to cause radio wave disturbances, impacting the radar and navigation technology.

9.2 The consequences of flight disruptions are very serious. In a worst-case scenario, it can result in planes being displaced in the sky (i.e. showing a plane in a different place to where it actually is) and in a worst-case scenario, flying into the ground or another aircraft.

9.3 Airways' submission requested a 500m buffer (overlay) around its radar designations at Hawkins Hill in order to prevent flight disruptions. My evidence attaches an indicative drawing showing where these buffers/overlays should be on the planning maps, and outlines the small changes to the existing provisions that would be required.

9.4 I consider that an overlay, with associated provisions is an effective and efficient way to ensure that future development near the radar designations does not impact the operation of the radar and thus put aircraft (and people's lives) at risk.

Mike Connolly

31 October 2024

Annexure A: ICAO Standards

INTERNATIONAL CIVIL AVIATION ORGANIZATION

EUROPEAN GUIDANCE MATERIAL ON MANAGING BUILDING RESTRICTED AREAS

- Third Edition -

2015

PREPARED BY THE EUROPEAN AND NORTH ATLANTIC OFFICE OF ICAO NOVEMBER 2015

THE DESIGNATIONS AND THE PRESENTATION OF MATERIAL IN THIS PUBLICATION DO NOT IMPLY THE EXPRESSION OF ANY OPINION WHATSOEVER ON THE PART OF ICAO CONCERNING THE LEGAL STATUS OF ANY COUNTRY, TERRITORY, CITY OR AREA OF ITS AUTHORITIES, OR CONCERNING THE DELIMITATION OF ITS FRONTIERS OR BOUNDARIES.

TABLE OF CONTENTS

SUMMARY

For the same CNS facilities widely differing protection zones are utilised by member states. This has led to the confusion of developers, planners, airport operators and others interested in the progressive development in, on and around sites where CNS facilities are necessarily located. This guidance material proposes harmonised protection zones and defines for the most common facilities a building restricted area (BRA). Buildings within this BRA have potential for causing unacceptable interference. All building activities in this area should be assessed. A process for the assessment of these buildings is identified herein.

1. Introduction

1.1 Under the European Air Navigation Planning Group (EANPG) the All-Weather Operation Group (AWOG) addressing the sustainability of All Weather Operations (AWO) was presented with a paper highlighting a problem with the determination of Building Restricted Areas (BRAs').

1.2 It has been identified by numerous member states that the control of buildings and the approval processes employed may lead to widely ranging allowances of what is permitted.

1.3 The AWOG set up a Project Team on Building Restricted Areas (PT/BRA) to elaborate respective European Operational Requirements (OR) and develop guidance material in order to ensure signal in space requirements are maintained within specification for the respective Communication, Navigation and Surveillance (CNS) facilities used in support of the AWO.

1.4 In the context of this guidance material the definition of the word "Building" will be as defined in section 3 of this document.

1.5 Guidance material by its very nature is for guiding the user and hence the process identified herein allows a two - step approach to the decision making process of whether a building causes unacceptable interference.

1.6 The principle behind this guidance material is to provide a readily accessible, practical standard procedure. This will enable member states to assess building applications to a known process.

1.7 It is provided for use by member states to aid the procedure of evaluating all planning applications for buildings.

1.8 It is recommended that the appropriate engineering authority be contacted for correct interpretation of the shapes included in the procedure. This is to ensure the shapes are used correctly for the appropriate facility.

2. SCOPE

2.1 This document establishes guidance material for determining whether the physical presence of a building may have an adverse effect on the availability or quality of CNS signals of the following ICAO recognised facilities:

- DME N
- VOR
- Direction Finder
- NDB
- GBAS (VDB & Receiver stations)
- ILS (Localiser, Glide-path, & Markers)
- SBAS (ground monitoring station)
- MLS (Azimuth & Elevation)
- VHF Communication
- Primary Radar
- SSR

2.2 Degradation of the signal in space caused by electromagnetic interference (EMI) is not covered in this guidance material.

2.3 The obstacle restrictions that are given in this guidance material do not take into account the effect of the proposed buildings upon VFR / IFR aeronautical operations. The criteria for evaluating buildings from an operational point of view are contained within Annex 14 (Aerodromes) and in ICAO Doc. 8168 (PANS OPS).

2.4 Satellite Up/Down links, VHF/UHF Ground/Ground communication facilities, Microwave links and HF facilities are not considered within this document.

2.5 Critical and Sensitive areas are based on the guidance found within Annex 10 and are not considered within this document.

2.6 Monitoring sites and radio links are not considered within this document.

2.7 PAR facilities are excluded from this document.

2.8 Military communication facilities are not considered within this document.

2.9 MLS and GNSS advanced operations are not considered within this document.

3. Definitions

3.1 Building

3.1.1 The development of the guidance material has been with the notion of building in mind. However the guidelines developed apply equally well for other objects whether moving or stationary, temporary or permanent causing interference to the radio signals of CNS facilities, such as machines, constructions used for the erection of buildings as well as excavation and spoil or even vegetation.

3.2 Building Restricted Area (BRA)

3.2.1 In the context of AWO, the BRA is defined as a volume where buildings have the potential to cause unacceptable interference to the signal-in-space in the service volume of CNS facilities for AWO. All CNS facilities have BRA defined which are not limited to actual site boundaries of the facility but extend to significant distances from the facility.

3.2.2 Buildings mentioned in 6.4 & 7.7 should be assessed even when outside the BRA limits.

4. General procedure

4.1 The general procedure is a two-step process (see **Figure 1**) for the approval of buildings that may adversely affect CNS facilities.

4.2 The analysis carried out under both processes should be formally recorded. The intention is that Step 1 should be an expedient evaluation and Step 2 should involve in-depth analysis.

4.3 For Step 1: Use the General Input Screening method for all applications. This screen is to be used by the appropriate authorities (for example: Airport, Planning, Local Official, Government Authorities who conduct the initial review of building applications) in order to ascertain whether approval can be given directly or it should be passed to the appropriate engineering authorities (Air Traffic Safety Electronic Personnel - ATSEP).

4.4 For Step 2: The ATSEP should carry out detailed analysis. This should cover all aspects of the CNS facility to be protected and the possible effects of the proposed building on the signal in space provided by these facilities.

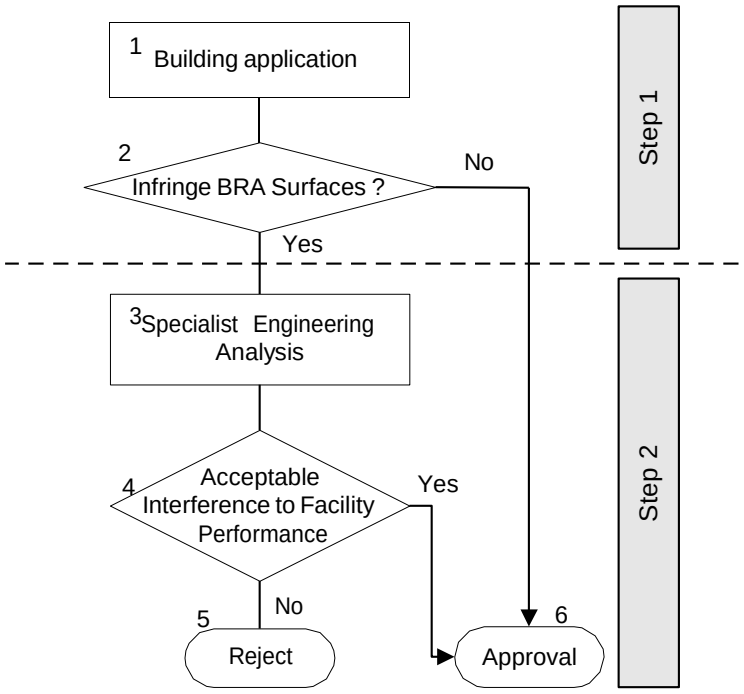


Figure 1: Guidance review process

Definitions and explanation applicable to Figure 1

Step 1

4.5 Building application

4.5.1 The application for a new building or modification to an existing or planned building.

4.6 Infringe surfaces

4.6.1 This is where the generic screening method is applied to the proposal to determine if the BRA surfaces are infringed. In case of non-infringement the process is terminated and the application is recorded as approved.

Step 2

4.7 Specialist engineering analysis

4.7.1 When an infringement of the BRA is identified, the application is handed over to the responsible engineering authorities for the CNS facilities. This is in accordance with the relevant formal approval process. The engineering authority will conduct appropriate analysis based on theory, experience and existing conditions.

4.8 Interference to facility performance

4.8.1 The results of the ATSEP analysis determine if the interference effects are acceptable or not. Where conflicting analysis or studies arise it is recommended that first consideration be given to altering the proposal.

4.9 Application rejection

4.9.1 The building applicant is notified of the rejection of the application by the appropriate authority. This does not preclude any modification that may be made to the application. Following rejection of the building proposal it may be possible to modify and re-submit the application. A modified proposal is subjected to the applicable review processes as identified in Figure 1.

4.10 Application approval

4.10.1 Approval for the building application is given when interference effects to facility performance are accepted.

5. Details of the two-step process

5.1 **Step 1**

5.1.1 The signal in the service volume for all CNS facilities must be protected from unacceptable interference. In order to achieve this, each type of facility must have its own safeguarded surface as defined by a shape of a certain form. The dimensions of the shape are dependent upon individual facility types.

5.1.2 Omni-directional facilities are assessed using the shape formed from a cone and cylinder (sees **Figure 2.1 and 2.2**).

5.1.3 Directional facilities are assessed using an adapted shape (see **Figure 3**).

5.1.4 Local terrain and environmental constraints may modify the application of the shapes.

5.1.5 The shapes generated, when applied to different CNS facilities, represent the individual safeguarded surfaces of these individual facilities.

5.1.6 Where these shapes overlap, they are identified as being "clustered" (e.g. at an airport). This then forms a 3 dimensional picture, which is represented as one shape and will form the basis of the overall airport BRA map. The facility that requires the most restrictive BRA takes precedence in step 1 and triggers a step 2 review.

5.1.7 The appropriate authority applies the BRA map as a template, including elevation information for the screening process.

5.1.8 It has been noted that the Critical and Sensitive areas, for particular system installations and runway profiles, need to be tailored by the ATSEP. These tailored areas are based on the guidance found within Annex 10. They are not considered in this document.

5.2 Step 2

5.2.1 The appropriate engineering authority that has responsibility for the CNS facilities in question conducts the second step of the review process.

5.2.2 This engineering authority conducts an analysis of the building proposal. The analysis is based on, although not limited to the experience and expert knowledge of the engineers undertaking the task. The procedure may cover theoretical analysis, numerical simulation and modelling in order to identify significant effects of the proposed building in the current environment.

5.2.3 During the analysis work, the engineers involved will gain an understanding as to the extent of the impact on the CNS facilities affected. There are three possible results from the initial analysis of the building application:

a) The effects are unacceptable.

b) Some effects are identified. Where this is the case or any doubt exists then further detailed analysis will need to be conducted.

c) Negligible effects.

5.2.4 The output of these analyses results in an approval or rejection answer to the building application. It is recommended that where a definite answer is not forthcoming then the engineering authority should protect the facility by refusing the application.

5.2.5 If the result of the analysis is to reject the application there may be feedback available from the ATSEP. This is in order to allow some comment on the nature of the proposal and the aspects, which in their view are causing the unacceptable effects on the CNS facilities.

5.2.6 The rejection of the application does not preclude the applicant from re-submission. This may take the form of a new or modified building application, which is then re-assessed against the conditions extant at time of re-submission.

6. BRA for omni-directional facilities

6.1 The cylinder is referenced to the ground terrain; the cone is referenced to a horizontal plane. Where irregular terrain is present the BRA shape is adapted.

6.2 The BRA is considered to provide worst case protection.

6.3 Direction finder figures may require modification if the antenna is installed at a high level.

6.4 It is recommended that buildings such as skyscrapers, large excavating works, TV towers and other high towers should be assessed at all times even outside the BRA for omni-directional facilities. Particular attention should be paid to clusters of buildings and overhead power lines.

Figure 2.1: Omni - Directional BRA Shape (three dimensional representation)

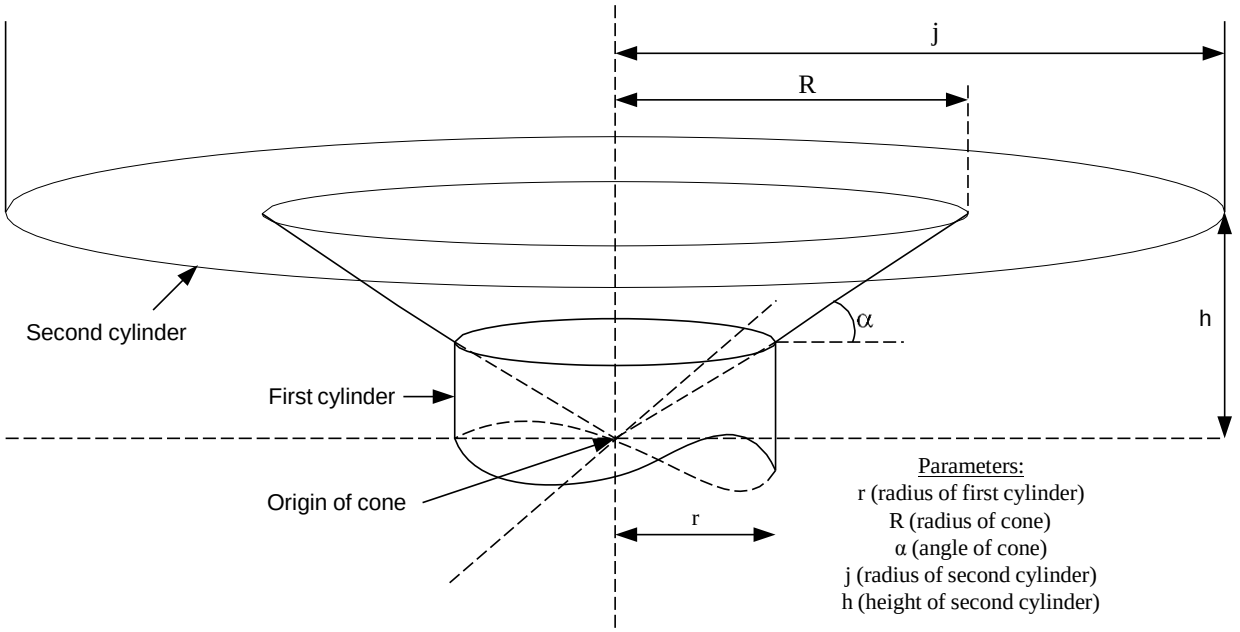
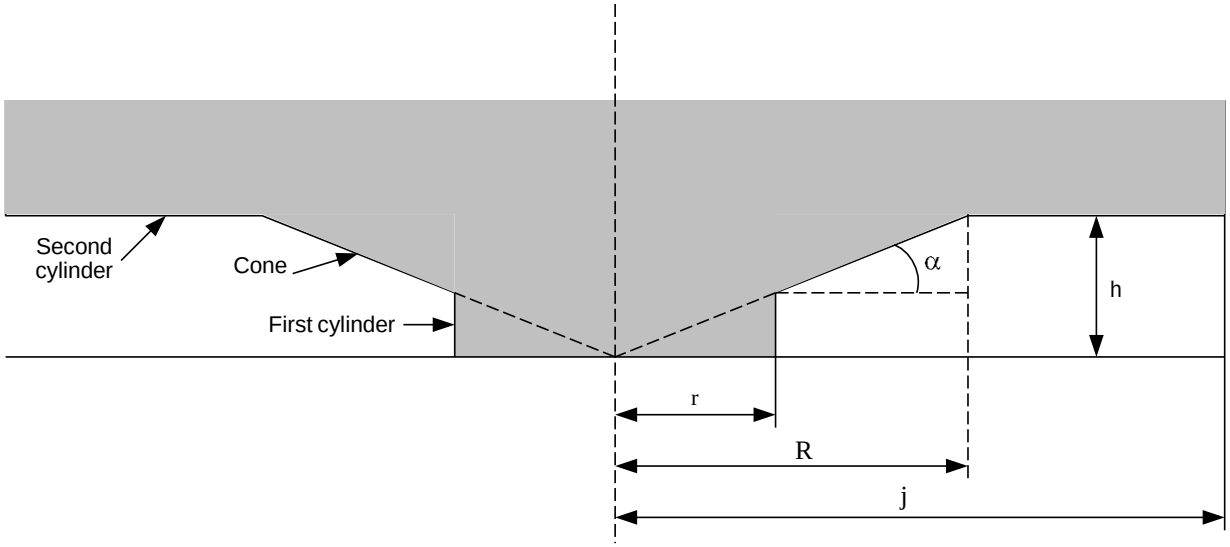


Figure 2.2: Omni - Directional BRA Shape (side elevation view)



7. BRA for directional facilities

7.1 The directional BRA dimensions for variants of localiser systems will differ significantly, this is due to the aperture and antenna designs.

7.2 Wide aperture arrays (typically 24 / 25 element) will have additional protection through the use of the medium aperture BRA figures. Hence the guidance figures presented in table 2 only represent the BRA figures for medium aperture antenna arrays for facility performance category III facilities.

7.3 The end fire array glide-path will require a narrower protection zone due to the directivity of the antenna system.

7.4 MLS operations are to be taken as straight in approaches only, with narrow beam antennas. Advanced operations are not yet covered in the guidance material and hence Out of Coverage Indication (OCI) and back azimuth protection are not given. If advanced operations are planned then appropriate protection should be established.

7.5 Directional DME is assumed to be associated with landing systems. BRA volumes in both directions should be established where DME is used for go around procedures.

7.6 The directional shape is orientated by the appropriate ATSEP.

7.7 It is recommended that buildings such as , skyscrapers, large excavating works, TV towers and other high towers should be assessed at all times even outside the BRA for directional facilities. Particular attention should be paid to clusters of buildings and overhead power lines.

Figure 3 Directional facilities shape

Figure 3.1 ***Figure 3.2***

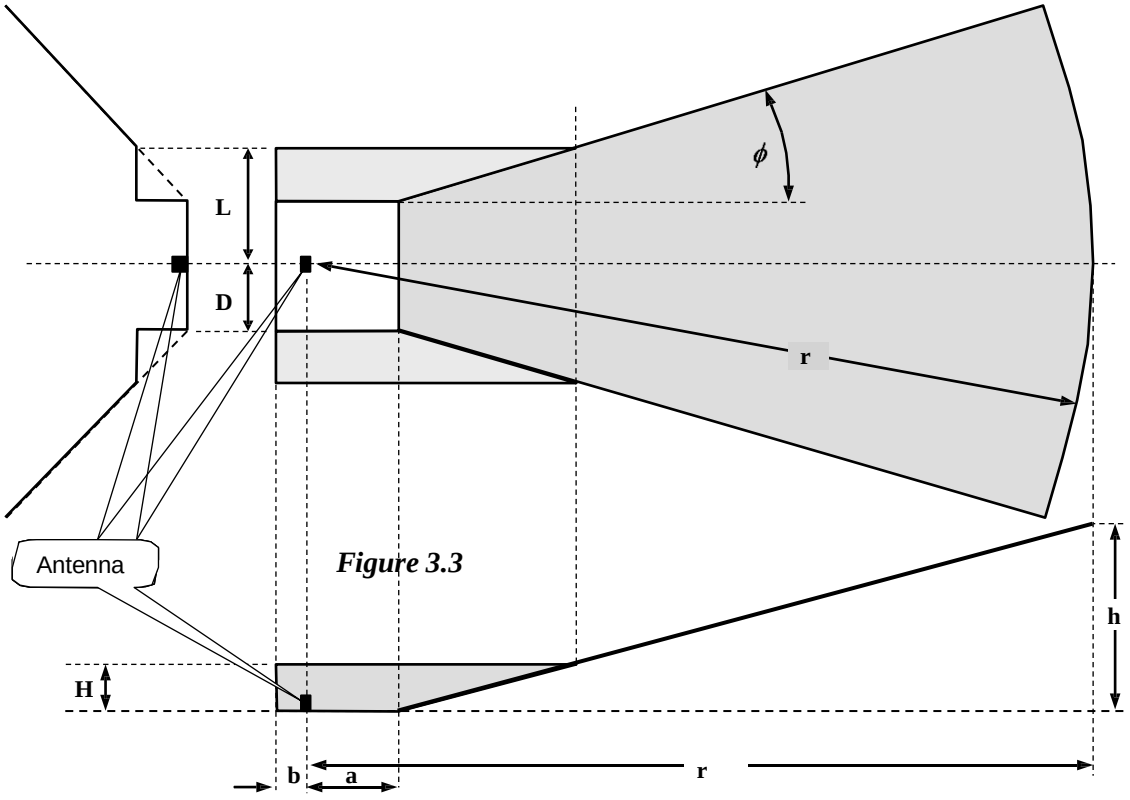
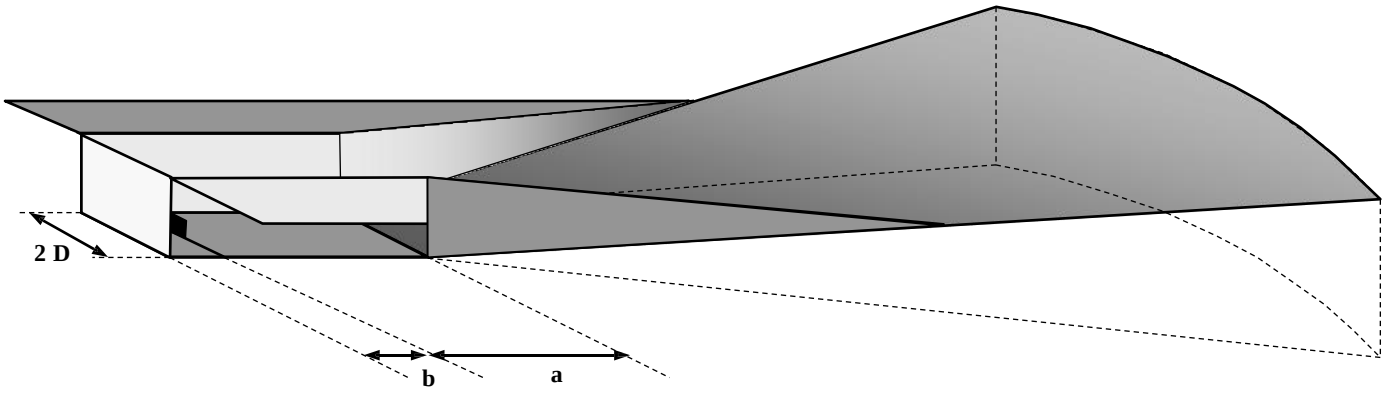


Figure 3.3

Shape to be applied for the directional facilities
Figure 3.1 End elevation
Figure 3.2 Plan elevation
Figure 3.3 Side elevation

Figure 3.4 - Directional facilities perspective



8. General notes for omni-directional and directional facilities

8.1 Where facilities are co-located the most stringent BRA volume applicable should apply.

8.2 Non-standard installations (for example: height above 7m, mountain-top site, offset localiser) require careful assessment because changes in the radiation pattern will occur and hence more specific shapes may be required.

8.3 More capable antenna arrangements or advanced technology (e.g. wide aperture, out of phase clearance, Doppler techniques) will allow the reduction of the protection zone applied by the ATSEP.

8.4 Annex 14 surfaces are applicable and should also be taken into account.

8.5 The shapes are applicable from ground terrain upwards.

8.6 Local terrain and environmental constraints, or existing performance limitations may modify the applicable BRA dimensions.

APPENDIX 1 – Navigational facilities

Table 1: Harmonised guidance figures for the omni-directional navigational facilities in accordance with Figures 2.1 and 2.2

*Type of **navigation** facilities*	*Radius (r – Cylinder) (m)*	*Alpha (a – cone) (°)*	*Radius (R- Cone) (m)*	*Radius (j – Cylinder) (m) Wind turbine(s) only*	*Height of cylinder j (h -height) (m) Wind turbine(s) only*	*Origin of cone and axis of cylinders*
DME N	300	1.0	3000	N/A	N/A	Base of antenna at ground level
CVOR	600	1.0	3000	15000	52	Centre of antenna system at ground level
DVOR	600	1.0	3000	10000	52	Centre of antenna system at ground level
Direction Finder (DF)	500	1.0	3000	10000	52	Base of antenna at ground level
Markers	50	20.0	200	N/A	N/A	Base of antenna at ground level
NDB	200	5.0	1000	N/A	N/A	Base of antenna at ground level
GBAS ground Reference receiver	400	3.0	3000	N/A	N/A	Base of antenna at ground level
GBAS VDB station	300	0.9	3000	N/A	N/A	Base of antenna at ground level
VDB station monitoring station	400	3.0	3000	N/A	N/A	Base of antenna at ground level

- The heights and surfaces specified for wind turbine(s) apply to the tip of the turbine blade when vertical.

Table 2: Harmonised guidance figures for the directional navigational facilities in accordance with Figure 3

*Type of **navigation** facilities*	***A*** *(m)*	***b*** *(m)*	***h****(m)*	***r*** *(m)*	***D*** *(m)*	***H*** *(m)*	***L*** *(m)*	***ϕ*** *(°)*
ILS LLZ (medium aperture single frequency)	Distance to threshold	500	70	a+6000	500	10	2300	30
ILS LLZ (medium aperture dual frequency)	Distance to threshold	500	70	a+6000	500	20	1500	20
ILS GP M–Type (dual frequency)	800	50	70	6000	250	5	325	10
MLS AZ	Distance to threshold	20	70	a+6000	600	20	1500	40
MLS EL	300	20	70	6000	200	20	1500	40
DME (directional antennas)	Distance to threshold	20	70	a+6000	600	20	1500	40

Notes:

- The parameters (a) and (b) originate from the base of the antenna and follow the terrain.
- (r) originates from the base of the antenna and is referenced to the horizontal plane.
- ϕ is measured in a horizontal plane.
- Other specific notes pertaining to omni- or directional shapes are included in the respective section of the procedure.
- In case of advanced operations supported by either MLS or GNSS, specific adaptation to the respective BRA will have to be made.

APPENDIX 2 – Communication facilities

Table 3: Harmonised guidance figures for the omni-directional Communication facilities in accordance with Figures 2.1 and 2.2

Type of ***communication*** *facilities*	*Alpha (a – cone)* (°)	*Radius (R- cone) (m)*	*Radius (r – cylinder) (m)*	*Origin of cone*
VHF Communication Tx	1.0	2000	300	Base of antenna at ground level
VHF Communication Rx	1.0	2000	300	Base of antenna at ground level

Notes:

- ATIS – is a service which is considered to have sufficient protection within VOR or VHF facilities.
- ADS – ADSB & VDL mode 4 –VDL ground stations – This is considered to be protected within the VHF Communication protection volumes (includes all VDL modes / VDL data links in Communication due to the frequency of operation).
- Directional communication facilities may exist in support of AWO however it is recommended that protection should be established based on the omni-directional shape.

APPENDIX 3 – Surveillance facilities

Table 4: Harmonised guidance figures for the omni-directional Surveillance facilities in accordance with Figures 2.1 and 2.2

*Type of **surveillance** facilities*	*Alpha (a – cone) ( )*	*Radius (R- cone) (m)*	*Radius (r – cylinder) (m)*	*Origin of cone*
PSR	0.25	15000	500	Base of antenna at ground level
SSR	0.25	15000	500	Base of antenna at ground level

Notes:

- SMR protection should be implemented in accordance with Line of Sight requirements.
- ASMGCS has to fulfil ICAO operational requirements. ASMGCS systems may be composedout of several different sub systems some ICAO recognised some not. The ICAO recognized facilities BRA are given in this document. BRA for the non-ICAO recognised facilities have to be developed to conform to their specific requirements.

– END –

Annexure B: Drawings showing 500m overlays (indicative only)