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Sound Decisions: Moving forward with Acoustics

Competing considerations for aircraft noise monitor placements

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ABSTRACT

Airservices Australia has one of the most geographically spread aircraft noise monitoring networks in the world, with over 40 long-term noise monitors installed at eight major airports across the country. In Australia, aircraft noise monitoring is conducted to meet a number of objectives, including provision of information to the community, determining impacts from procedures and trials, or validating noise modelling results. Ministerial Direction M37/99 (Cth) requires Airservices to install, maintain and operate noise and flight path monitoring systems at major Australian airports. There is often community confusion around the objectives of Airservices aircraft noise monitoring system, with a perception that this system has a compliance and enforcement function in relation to aircraft noise. This affects the community's perception of the role of aircraft noise monitors and where they should be placed. When installing long-term noise monitors, Airservices has to consider a range of factors, including compliance with international standards, Airservices corporate objectives, the specific purpose of the individual noise monitor placement, and community perspectives. This paper discusses the dynamics and interplay of these factors in Airservices decision-making process for long-term noise monitor placements.

1 INTRODUCTION

Airservices has over 40 long-term noise monitors installed at eight major airports across Australia, making it one of the most geographically spread aircraft noise monitoring networks in the world (Airservices, 2014). In Australia, aircraft noise monitoring is conducted to meet a number of objectives including provision of information to the community, determining impacts from procedures and trials, or validating noise modelling results. Unlike other jurisdictions globally, Australia does not have maximum legal operational noise levels for aircraft, based on measured single noise events.

When installing long-term noise monitors, Airservices has to consider a range of factors, including compliance with *ISO 20906:2009 - Unattended monitoring of aircraft sound in the vicinity of airports* (ISO 20906:2009), Airservices corporate objectives and noise management strategy, the specific purpose of the individual noise monitor placement and community perspectives. Due to the time and costs associated with installing a long-term noise monitor, Airservices generally places noise monitors based on a minimum expected business requirement of 10 years. The Australian Government's Department of Defence has a separate noise monitoring network for military aircraft (Department of Defence, n.d.). As such, this paper only discusses Airservices current approach for noise monitoring of civil aircraft operations.

2 AIRSERVICES NOISE MONITORING OBJECTIVES

Due to the expense and resource commitment associated with long-term aircraft noise monitor deployments and installations, Airservices decisions to install a noise monitor are undertaken with extensive consideration. As a key principle, any long-term noise monitor placement should provide clear and unambiguous information on the aircraft noise experienced by the local community.

The considerations for a potential aircraft noise monitor placement include:

- current and previous noise monitor placements (short-term or long-term),
- objective of the placement and whether a noise monitor:
 - meets that objective,
 - is the most effective method (i.e. if the issue is related to the number of overflights, a flight track analysis would be more suitable),
- whether a noise monitor can effectively capture the aspect of concern, i.e. low-noise from aircraft won't generally be captured effectively by a noise monitor, and
- if the airport and/or flight procedures associated with the proposed placement are anticipated to change in a way which is likely to affect aircraft operations in that location.

In addition to the above considerations, the positioning of the noise monitor should consider whether a specific site would capture all, or a large proportion of the major aircraft types that operate at the airport. Airservices also intends to collect noise data that represents the extremes of aircraft noise for the local community. For this reason, noise monitors are positioned so that they measure, as much as possible, the highest aircraft noise levels experienced by the local community, which are generally directly under aircraft flight paths, rather than in a sideline position.

3 HISTORICAL IMPACTS

When considering Airservices aircraft noise monitoring network in Australia, it is important that the historical context of the network is considered. A large proportion of Airservices noise monitors have been in place since the mid-1990s. Airservices aims to install long-term noise monitors for a minimum of 10 years but ideally longer. It is also a priority to maintain consistency of the noise monitor positions over time, enabling opportunities for long-term analysis of data.

Once aircraft noise monitors are installed, Airservices has found that there is often a strong community response to any suggestions of relocating or removing the equipment. Many of Airservices existing noise monitors are also installed close to major airports in heavily built-up residential areas, where finding alternate noise monitoring sites can be challenging.

The combination of these factors influences both the current noise monitor network and future installations. Some of Airservices historic noise monitor placements may not fully meet the current requirements used for new installations. Conversely, with the long-term nature of noise monitor placements, each new noise monitor or noise monitor relocation is considered with both a current and forward looking consideration of the commitment.

4 INTERNATIONAL STANDARDS

ISO 20906:2009 is the international standard considered for the placement of unattended noise monitors for the capture of aircraft noise. *ISO 20906* was introduced in 2009 to replace *ISO 3891:1978 - Acoustics — Procedure for describing aircraft noise heard on the ground*, and is used to guide installations of noise monitors to achieve the highest standard of data quality possible.

ISO 20906:2009 includes considerations of noise monitor placements in relation to:

- the vicinity of reflective surfaces,
- the angle of incidence between the noise monitor and target aircraft operations, in order to minimise potential uncertainty, and
- background noise levels in monitoring areas, compared to predicted aircraft L_{Amax} levels.

These and other factors, including contributions of residual noise and any uncertainty of measuring instrumentation, can contribute to the overall uncertainty of the captured noise events.

Airservices Noise and Flight Path Monitoring System (NFPMS) provides a level of sophistication and rigour to aircraft noise event identification which is additional to the requirements set out in *ISO 20906:2009*. The NFPMS utilises radar data to correlate potential noise events with aircraft within a pre-determined zone from the noise

monitor. The additional information provided by Airservices NFPMS improves the quality of aircraft noise event identification, by reducing the likelihood of community events being classified as aircraft noise events. The principles of *ISO 20906:2009* guide both Airservices initial deployment decisions and regular reviews of noise monitor placement suitability.

As recognised in *ISO 20906:2009*, noise monitor installations may be influenced by non-acoustic considerations, meaning that installation in acoustically preferable locations may not be possible. One of Airservices key objectives for all long-term noise monitor deployments is to minimise any potential uncertainty in captured data, as much as possible.

The International Civil Aviation Organization (ICAO) sets international standards for aircraft noise levels, through *ICAO, Annex 16 – Environmental Protection, Volume 1 – Aircraft Noise* (ICAO, Annex 16, Vol 1). This document (ICAO, 2017) outlines both the technical standards and recommended practices for noise testing and noise certification of aircraft. Aircraft models and configurations can be tested against the applicable ICAO standard, which includes consideration of the aircraft size, weight, age and whether it is a helicopter, propeller or jet aircraft. If an aircraft is found to be eligible for certification under the relevant ICAO standard, the nominated authority of the country (the ICAO member state) where testing was conducted can issue a noise certificate. Aircraft noise certificates issued under *ICAO, Annex 16, Vol 1* are generally recognised by other member states of ICAO. *ICAO, Annex 16, Vol 1* is therefore an essential method of standardising and managing aircraft noise on a global scale. However, within Australia, long-term aircraft noise monitors are not suited for aircraft noise certification testing, due to the specific testing conditions required by applicable ICAO standard.

Guidance on noise monitoring on, or in the vicinity of aerodromes can also be found in Appendix 5 of *ICAO, Annex 16, Vol 1*. This guidance includes the equipment requirements, avoidance of shielding between the noise source and microphone, and necessity of calibration both prior to and after installation (ICAO, 2017). As *ISO 20906:2009* is a more comprehensive standard on unattended aircraft noise monitoring, this standard is used by Airservices.

5 THE INFLUENCE OF AUSTRALIAN LEGISLATION AND REGULATION

Ministerial Direction *M37/99* (Cth) requires Airservices to install, maintain and operate noise and flight path monitoring systems at major Australian airports. On occasion, additional and more specific noise monitoring requirements may form conditions of planning approval for airport developments, or the introduction of a new flight procedure. Recent examples of this include Commonwealth ministerial approval of the Gold Coast Airport Instrument Landing System (ILS), which required a post-implementation review, supported by temporary noise monitoring (Truss, 2016).

On occasions such as that identified above, aircraft noise monitoring may be a condition of a legislative planning approval, however aircraft noise monitoring does not fulfil a compliance function in Australia (in terms of measuring aircraft noise against a specific, regulated level and then assessing compliance or otherwise). This fact is often a point of confusion for the community.

In Australia, civil aircraft noise is regulated through:

- the *Air Navigation (Aircraft Noise) Regulations 2018* (Cth),
- land-use zoning, through the development of Australian Noise Exposure Forecast (ANEF) and Australian Noise Exposure Index (ANEI) charts, as part of airport Master Plans (particularly for Commonwealth owned airports), and
- other legislated and voluntary noise mitigation strategies such as operational curfews, noise abatement procedures and fly neighbourly agreements.

Australian states and territories also have regulatory authority at specific locations where they have approval of an action, such as airports that are not owned by the Australian Commonwealth government and helipads.

5.1 Air Navigation (Aircraft Noise) Regulations 2018

The aircraft noise standards prescribed in *ICAO, Annex 16, Vol 1* are implemented in Australia through the Commonwealth *Air Navigation (Aircraft Noise) Regulations 2018* (the Regulations). The Regulations ensure that

ICAO's international noise certification standards by all aircraft operating within Australia. Those aircraft which do not have existing international noise certification can either be tested for an Australian noise certificate, may be exempt due to the method of usage (such as firefighting or agricultural purposes), or may be issued a permit to operate without a noise certificate, under a range of potential circumstances and conditions. Aircraft must have demonstrated compliance with the Regulations, in order to operate within Australia.

Aircraft may have noise testing conducted in order to determine eligibility or compliance with the Regulations, however this must be under test conditions. Within Australia, most civilian aircraft operate under existing international noise certification, undertaken under ICAO test conditions applicable to the aircraft type, weight and age.

5.2 Australian Noise Exposure Forecasts (ANEFs)

The Commonwealth *Airports Act 1996* requires that all federally leased airports (i.e. those owned by the Commonwealth but leased by third parties) produce a Master Plan including an ANEF on a cyclical basis (5 or 8 years, depending on the airport). Other non-federally leased airports are also able to develop Master Plans and ANEFs, however there is no time restriction.

An ANEF assists in identifying areas where noise sensitive development should be controlled, through land-use zoning, and to help to ensure the long term development and sustainability of airport operations. Measured noise data can be utilised to calibrate an ANEF model.

5.3 Contrasting Australian Regulations With International Approaches

Aviation is traditionally managed within Australia at the federal (Commonwealth) level, noting that there are some state and territory regulated activities such as regional airports and helipad developments. This has resulted in a national approach to aircraft noise management. As a result, Australian aircraft noise policy development and regulation falls under Commonwealth jurisdiction. This contrasts with some countries air navigation services and aircraft noise management strategies, which may be managed at an airport or regional level.

Airservices is therefore not only responsible for providing Australia's air navigation services but also for installing, maintaining and operating an NFPMS at major Australian airports, and maintaining and operating a national aircraft Noise Complaint and Information Service (NCIS).

Different jurisdictions manage aircraft noise in different ways. In the city of Denver, in the United States of America, Denver International Airport has implemented Noise Exposure Performance Standards (NEPS) for specific communities around the airport and if these levels are exceeded based on an annual average, penalties apply (HMMH, n.d.; Board of County Commissioners of Adams County, City of Aurora, City of Brighton, City of Commerce City, and City of Thornton, Plaintiffs-Appellees and Cross-Appellants, v. City and County of Denver, Defendant-Appellant and Cross-Appellee (2001)). Many European airports have noise surcharges, such as Aberdeen Airport in the United Kingdom (Aberdeen International Airport, 2017), where aircraft are charged based on ICAO certificated noise levels, with noisier aircraft paying a surcharge. In contrast, Heathrow International Airport monitors track compliance as part of their noise abatement strategy and utilises noise monitors to identify and fine aircraft which exceed specified noise thresholds (Heathrow Airport Limited, 2019; NATS, 2019).

It is important to note that all countries and even different airport operators utilise a range of strategies to manage the impacts of aircraft noise on the community and Heathrow Airport is one of the few locations where noise monitors are utilised to fulfil a compliance-function based on individual noise events. These different approaches to aircraft noise management globally can result in inaccurate perceptions by members of the community about the specific purpose of aircraft noise monitoring in Australia.

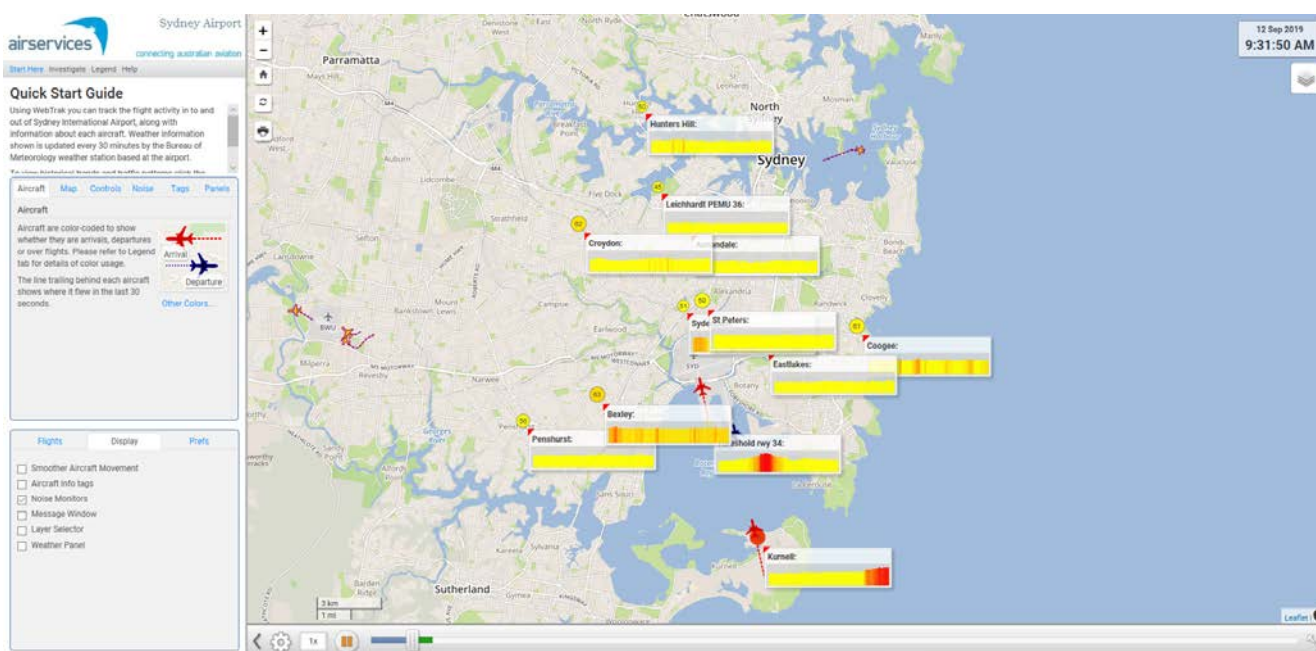
6 COMMUNITY EXPECTATIONS

In Australia, there is often community confusion regarding the objective of aircraft noise monitoring. There is generally a misconception that noise monitors have a compliance and enforcement function, and this affects the community's perception of noise monitors and where they should be placed.

Community expectations about aircraft noise monitoring in Australia seem to generally fall into one of a number of broad categories:

- existing noise monitors protect an area from getting aircraft overflights and noise increases,
- installation of a new noise monitor will prove that the noise exposure or maximum noise levels from aircraft operations are unacceptable in that area, and that this will result in a change to operations,
- noise monitors aren't installed in certain areas in order to hide the extent of aircraft noise or because Airservices does not believe that the noise exists, or
- noisy aircraft captured by a noise monitor will be fined or otherwise reprimanded.

Airservices has information including factsheets on aircraft noise available through Airservices website, and data from the network of long-term noise monitors accessible online through WebTrak and online reports. However, the opportunities to educate the community on aircraft noise and the purpose of noise monitors in the Australian context is limited. Airservices Noise Complaints and Information Service (NCIS), as well as Airservices participation in Community Aviation Consultative Groups (CACGs) are the main methods for Airservices to connect and share local aircraft noise information with the public but the resulting information dissemination is restricted by the number of participants and need for the community to initiate the interaction.



Source (EMS Brüel & Kjær, n.d.)

Figure 1: Airservices WebTrak for Sydney Airport showing one-second noise data for installed noise monitors

Due to these perceptions, Airservices has found that communities with existing noise monitors in their area will tend to be defensive of the installation. Noise monitors where there has been a change to operations can be difficult to de-commission, due to community concerns and responses. With upcoming runway developments planned at multiple major airports around Australia, the potential impacts of community perceptions of the role of existing and potential new aircraft noise monitors is an ongoing consideration for Airservices.

7 CONCLUSIONS

While Airservices is required to install long-term noise monitors at major airports around Australia, Airservices uses its technical experience to determine the optimum location of long-term noise monitors. Considering the long-term nature of these noise monitor installations and community expectations that they will remain, thorough consideration of all factors is critical.

Aircraft noise monitoring in Australia, while not fulfilling a regulatory compliance function, is an essential source of information for the community. As such, Airservices is responsible for ensuring the effective function of the noise monitor and the needs of the community when making any noise monitor installation decisions. Airservices uses *ISO 20906:2009* to provide technical guidance for the optimum placement of aircraft noise monitors, however, final installation decisions require a thorough consideration of all factors to ensure that acceptable balance between technical and social factors is achieved.

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