

Future of Aviation Noise Management – Case for Change

Noise metrics and measurement

Summary

The impact of civil aviation noise on communities in the UK is currently described and managed using a variety of noise metrics. Noise metrics are devolved to the four nations of the UK and are covered by a range of legislative and policy instruments based on international, EU and national laws and regulations. The issues with noise metrics identified by communities affected by aviation noise are that: they are difficult to find and to understand; they are not representative of their lived experiences of noise and that they do not adequately represent the impact of aircraft noise on levels of local community annoyance or health effects.

Producing and publishing noise metrics requires resource and expertise which vary substantially across airports according to the metrics and presentation formats used and the frequency of publication. Detailed data may be commercially sensitive though there are now consumer-based flight tracking apps and decibel recording apps on tablets and smartphones.

Setting UK-wide guidance on the metrics used, together with the frequency and format of presentation, applied in a tiered way by airport capacity, could improve utility and trust.

ICCAN's Report on noise metrics reviews current practice and sets out these issues in greater detail to make a case for change ([ICCAN, 2020](#)).

Key issues

Clarity and appropriateness of metrics used

Concerns

Metrics required in UK legislation and policy (such as L_{Aeq}) are complex and describe annual average noise levels. They may not reflect the impact of peak noise events or the difference-to-background noise which communities report. A further complexity is the subjective experience of objectively measured noise ([ICCAN, 2020](#)).

Improvement opportunities

Tiered guidance to support greater clarity on the interpretation of the complex average acoustic metrics currently used and consistency in metrics used over time could improve practice nationally. Additional event-based metrics could be added to best practice which would be possible with existing technology and which may better capture the noise issues that reflect communities' concerns. Approaches including improved land use planning controls and community engagement may help address the disconnect between commonly used noise metrics by the aviation industry and individuals' experience of noise ([Sustainable Aviation, n.d.](#)).

Quality of presentation

Concerns

Where a postcode checker is not available, the quality of output from noise maps can render identifying where an address falls in relation to noise contours difficult, due to an inappropriate scale. This has implications for identifying whether an address is eligible for support grants from airports for noise insulation.

Improvement opportunities

Publishing standards guidance and better practices would make it easier to track noise issues in each location.

Frequency and location of publication

Concerns

The current infrequency of the publication of noise metrics (for example qualifying airports producing Noise Action Plans (NAPs), every five years) leads to concerns about the utility of the data and statistics, for example in planning permission. Locations of published data have changed over time making it hard to find the most recent information. This results in difficulties when regulators, local authorities and communities wish to measure long term trends of noise metrics, over time ([ICCAN, 2020](#)).

Improvement opportunities

Best practice guidance on a minimum frequency of publication of relevant noise information could be applied in a tiered way across airports. Such publications could be sourced from a national centre. This approach would improve trust and usefulness.

Gaps in coverage

Concerns

Airports below the current threshold of 50,000 movements per year are currently not required to provide noise information, despite having an impact on surrounding communities ([Europa, 2021](#)). There are currently no outputs recorded for ground noise as noise metrics have been developed for airborne noise. There is also no requirement for airports to offer temporary noise monitoring or standardisation as to how it should be carried out and reported where it does occur. Overlapping areas between airports are not accurately covered and the impact on differing facades (such as high-rise flats) are not adequately described ([London Assembly, 2019](#)).

Improvement opportunities

Best practice guidance could propose that all airports at the threshold and above, are required to produce a NAP. Recommendations to enable temporary noise monitoring sites, following community requests, could also feature as best practice, as could identifying appropriate steps for smaller airports to monitor and mitigate noise. Guidance on, for example, the type and location of the microphone to record noise and to identify appropriate metrics and outputs, as well as the materials and methods for collecting and reporting this noise information would bring clarity.

Transparency and quality of data

Concerns

There is currently little standardisation in the collection, processing and quality assurance of the noise data that is collected by airports and it is not required to be shared with regulators, planning authorities or researchers ([ICCAN, 2020](#)).

Improvement opportunities

Guidance with respect to information powers would aim to allow noise data to be used appropriately by bodies who would benefit from having regular access to a minimum quality level dataset, subject to commercial concerns.

Accountability and consistency

Concerns

The practice of collating and publishing noise data is scattered between multiple, sometimes out-dated publications. NAPs produced by airports include objectives to mitigate noise and projections for future noise impacts but there is currently little on whether targets are achieved, or on comparing forecasts to actual noise impacts.

Improvement opportunities

In order to ensure that practices are still relevant and inclusive of new technologies and practices, such as noise mapping, the guidance should consolidate practices into a single guide, which is regularly reviewed, to ensure that data collection is both standardised and of sufficient quality. We would seek to ensure that there was appropriate follow up on these documents to increase the accountability of airports.

Supplementary information

Clarity and appropriateness of noise metrics used

Concerns

Noise metrics are complex, opaque and the average noise measures required by legislation such as annual or summer month period L_{Aeq} may not be as representative of experiences of aviation noise by those affected as N_x or event-based metrics such as the Sound Exposure Level (SEL) ([ICCAN, 2020](#)). Noise metrics are used in international long-term health effect guidance, but do not sufficiently describe the noise experience of a community, which can foster resentment between affected communities, industry or government bodies. A further complexity is the subjective experience of objectively measured noise which can be affected by weather conditions and individuals' noise sensitivity ([Basner & McGuire, 2018](#)). The difficulty in understanding these complex metrics adds to frustration and may lead to communities feeling disempowered to respond to airspace change proposals (ACPs) made by airports, or planning decisions made by local authorities being based on poorly understood and/or incomplete information.

Current approach and limitations

Currently there is little in the relevant legislation and government policies that considers the complex nature of noise metrics or the subjective experience of noise by individuals in local communities where airports capture noise data. Community noise monitoring does not have any guidelines.

Current legislation and UK policy (see Appendices for details) describe the minimum requirements for noise contour mapping and noise metrics used in them. There is also best practice guidance produced by the International Civil Aviation Organisation (ICAO), International Organization for Standardization (ISO) and The British Standards Institution (BSI) which provide a means of implementing UK legislation and policy.

Opportunities for improvement and challenges

ICCAN's noise metrics report suggested setting tiered guidance for industry in the sharing and presentation of information to help bring consistency and greater clarity for non-experts ([ICCAN, 2020](#)). New metrics are difficult to produce but could improve understanding and acceptance by including 1) sampling over longer time periods; 2) clear descriptions alongside the metrics, following best practice made by an independent body; 3) a greater range of metrics to reflect a wider variety of noise parameters such as numbers of peaks or difference-to-background (described in BS 4142 as nuisance noise).

Although it may be possible to develop new metrics, they are likely to require focused research to establish the association between health impacts and annoyance, reducing their immediate utility.

Example 1: Australia

Who, What and How?

Australian airports produce maps (i.e. FPMC – flight path movement charts) that are useful for summarising data, especially predictive data. FPMC display the distribution of average aircraft movements around an airport, based on aircraft movements over time (from daily to annual, depending on requirements). These charts are relatively easy to understand and based on real-time rather than modelled data. In Australia, FPMC supplements Australian Noise Exposure Forecast (ANEF) noise contours to aid in decision-making processes e.g. by land use planners ([Australian Government, 2003](#)).

How could the best practice be applied to the UK?

These could be produced by airports and updated more frequently, and at low cost relative to noise contour maps, to show the flights expected for each flight path.

Quality of presentation

Concerns

The quality of outputs of noise contour maps is extremely variable and the contours do not always reflect noise on the ground. Those published within NAPs are often of low resolution. It can be near-impossible to identify where a household or business address falls in relation to noise contours particularly for those with accessibility limitations. This has implications for identifying whether an address is eligible for support grants from airports for noise insulation or other compensation and mitigation allowances, for people looking for environmental information when moving into a new neighbourhood and for planning decisions. Noise monitoring, on which the contour maps are based, only occurs at a limited number of locations and is calculated from the average flight information. This does not take into account important variations in noise emitted from each flight, such as how heavily loaded the aircraft is, nor of local phenomena which could affect noise ([ICCAN, 2020](#)).

Current approach and limitations

Directive 2002/49/EC of the European Parliament and of the Council of June 2002 relating to the assessment and management of environmental noise (known as the END) requires that L_{den} and L_{night} are to be plotted on noise contour maps and sets out the minimum requirements for noise mapping. It defines a major airport as having more than 50,000 ATMs ([Europa, 2021](#)).

Under the Environmental Noise (England) Regulations (2006) noise maps must meet the general requirements by including using the indicators L_{den} and L_{night} , as well as the supplementary noise indicators $L_{Aeq,16\text{ hr}}$, L_{day} and $L_{evening}$ for major airports.

Opportunities for improvement and challenges

Publishing standards and better practices could make it easier to follow noise issues at a given location. Validation could be improved by installing a greater number of noise monitors with costs limited by having temporary noise monitors available. Although data sets are already large and difficult to process, guidance can set out best practice for assessing modelled versus actual noise levels and presentation of results.

Example 2: Northern Ireland, Department of Agriculture Environment and Rural Affairs (DAERA)

Who, What and How?

Noise is a devolved topic within the UK. In NI, noise is covered by DAERA where they publish the noise information for roads, railways and airports on their web site ([NI Government, 2021a](#)). Three noise maps are displayed simultaneously for Belfast International and George Best Belfast City Airport, for the three years where noise maps were produced, as required for the NAP. The maps are available to view in L_{den} , L_{night} , L_{day} , $L_{evening}$ and $L_{Aeq,16\text{ hr}}$. They can be magnified and have the presentation styles varied to help improve accessibility ([NI Government, 2021b](#)).

How could best practice be applied to the rest of the UK?

This could be undertaken by showing maps side-by-side and at the same scale to make it easier to compare differences and this could be further enhanced by publishing descriptor statistics and having a postcode lookup tool. A brief introduction to the metrics used may also be useful.

Frequency and location of publication

Concerns

NAPs from the three designated airports (Heathrow, Gatwick and Stansted) are published annually and those from non-designated airports are published every five years. Noise metrics are published infrequently, usually in the form of noise contour maps in NAPs, or sometimes annually on their website as descriptive statistics. Such infrequent publications raise concerns about how relevant the statistics are, for example, in justifying planning permissions or reflecting current conditions for affected communities.

The data can be published in multiple locations and in different formats, making it difficult to compare data sets from different years. This makes it difficult for regulators, local authorities and communities to keep track of the outputs over time. This is particularly important if a local authority or community group wish to challenge an airport or a local planning decision. It can appear that the airport is trying to hide information when there may be no such intent.

Current approach and limitations

The END requires that every 5 years, or whenever a major development occurs at an airport which affects its noise impacts, a summary report containing NAPs and noise maps is produced and the information shared in the public domain. It also stipulates that an appropriate authority must be set by each country to identify the agglomerations which need to be considered for the provision of NAPs and to collate the NAPs and maps.

The Aviation Policy Framework ([DfT, 2013](#)) encourages airports to “use alternative measures which better reflect how aircraft noise is experienced in different localities” to gain a better understanding of noise impacts, in order to develop mitigation measures. Therefore, alternative measures could include a more consistent and standardised approach to the publication of noise metrics.

Opportunities for improvement and challenges

A more consistent publication of relevant noise information would make information more relevant for communities and for planning. Best practice guidance could stipulate a centralised location where relevant noise information can be collated and published and the frequency of updates ([Budd & Ison, 2017](#)).

Example 3: Frankfurt Airport, Germany

Who, What and How?

Frankfurt Airport has an accessible noise data website of noise information. One of the key features is a postcode look up tool which not only informs users of the noise level in their area, but also links to eligible support schemes.

How could best practice be applied to the UK?

Having a much more structured website, with clear information and useful tools and links to supporting information, would provide greater transparency of communication between airport and community.

Gaps in coverage

Concerns

Smaller airports, those below the current threshold of 50,000 movements per year or not affecting a conurbation, are currently not required to provide noise information, despite having an impact on surrounding communities.

There are currently no outputs recorded for ground noise which affects communities that are closer to an airport. In part this is because noise metrics have been developed for airborne

noise. Thrust reversers and taxiing are deemed to be air noise, for example, but engine ground running and APUs are categorised as ground noise. It is difficult to distinguish between air noise, ground noise from aircraft and other surface noise sources including surface access, airfield transport and building plant noise possibly leading to underestimations of ground noise experienced within communities closest to airports.

There is currently no requirement for airports to offer temporary noise monitoring (although some airports do offer this service), and therefore no standardisation as to how it should be carried out where it does occur, or how the results should be reported.

It is currently not possible to examine the effects of noise from overlapping airports as this is something models currently cannot accommodate and there is no requirement that overlapping airports cooperate to examine their combined impact. These areas may fall outside of the outermost contours, but the cumulative noise could push the area into a higher contour leading to noise levels being under-estimated there. Noise mitigation techniques at one airport, such as respite, may be compromised by the other airport. This may be particularly true for overlaps with smaller airports which are not currently required to monitor and report noise and is also likely to be a greater issue for the south east of England where there is a higher concentration of airports and airspace is busier. For example, in locations between Luton and Stansted airports there is an airspace change proposal in progress to separate the arrival routes and holds. If the airspace change is approved, it may be possible to more accurately examine the effects of aircraft noise from these two airports ([CAA, 2021b](#)).

Noise at the same location may be different at different facets of buildings. In a high-rise building, the height of a flat or side of the building facing the direction of a flight path may expose the occupants to a greater level of noise ([ICCAN, 2020](#)). At the top of a high-rise building the background noise levels are much lower, as they are away from street level, railway, tram, bus, coach and car noise. This difference between background noise could make aviation noise more noticeable for residents living in upper-storey flats.

Noise modelling is imperfect, and noise is perceived subjectively leading to some communities feeling that noise is incorrectly estimated in their area. Perception of noise can vary individually and is associated with a range of factors including noise-sensitivity, age and affluence. It is important to have data collection from areas where there are disputed noise impacts, so that communities can feel reassured that their noise exposure has been correctly measured.

There are other features of noise that may not have been accounted for, such as helicopter noise, which is difficult to model but should be captured. These factors can also have implications for planning applications.

Current approach and limitations

The Environmental Noise (England) Regulations (2006) stipulates that affected agglomerations are those who receive air traffic noise equal to, or greater than, L_{den} 55 dB or L_{night} 50 dB, based on a noise map using the previous year's noise data.

Other sectors (e.g. road and rail) can also have requirements to produce noise contour maps and use similar metrics to aviation e.g. L_{Aeq} based metrics ([Frost & Ison, 2007](#)). These maps are likely to face similar interpretation problems with non-experts.

Opportunities for improvement and challenges

Improvements and challenges could include:

- Identifying appropriate metrics and outputs for ground noise with best practice methods for predicting, monitoring and presenting this information.

- Ensuring that overlapping airports' noise is monitored, and where possible mitigated, through effective collaboration between airports.
- Ensuring the security of commercially sensitive information, required to improve modelling, for example, it has been suggested that the modelling outputs could be improved if the loaded weight of an aircraft could be known. However, the aviation industry regards the weight of an aircraft as being commercially sensitive and have argued against the information being passed onto the CAA.
- Smaller airports currently at the threshold required to produce a NAP should have the facilities to enable temporary noise monitoring following community requests.

Additional noise exposure affecting high-rise buildings is complex and poorly understood requiring more research into the effect of height above ground on the impact of aviation noise. Potentially greater noise insulation may be needed for some residents but trying to identify which buildings (or parts of buildings) would benefit from additional insulation support would be difficult. This is because of the large areas that are overflowed by aircraft. A further consideration is that this could significantly increase noise mitigation costs for some airports.

Accountability and consistency

Concerns

There is no standardised method across the aviation industry for processing and quality checking data to ensure consistency. Data quality is commonly validated by sample comparisons of predicted and actual movement records but, for example, the proportion of events that should be investigated, or how sampling should occur, is not set out.

Much noise data is collected by airports, but other than designated airports, there is currently little requirement that the data is shared with regulators, planning authorities or researchers. For the information that is shared, detailed data is not normally made available limiting scrutiny.

NAPs are produced by airports and include targets as to how they will mitigate noise and projections for future noise impacts. NAPs will usually review the success of the previous NAP and community groups and local authorities will often seek to hold airports accountable but there is currently little enforcement where NAP targets are not achieved.

There is also the issue of the 'ownership' of noise. Airports do not generate much of the noise, which comes from aircraft. These are owned or leased by the airlines and operated in accordance with standard operating procedures (SOPs) by flight crew adhering to air traffic control (ATC) instructions. However, residents complain to the airport operator who has limited power or incentives in a highly competitive marketplace to impose sanctions or financial penalties on aircraft operators.

Current approach and limitations

The three designated airports are required to produce annual NAP reports and other data to the regulators.

The Environmental Noise (England) Regulations (2006) state that the public must be given the opportunity to submit feedback on consultations relating to proposals contained within NAPs, as well as be informed of any final decisions made ([UK Statutory Instruments, 2021](#)).

Any NAP or noise map accepted by the Secretary of State must be published, along with a summary of key points.

Opportunities for improvement and challenges

Standardised for quality assurance would help to ensure consistency and increased transparency. It is hoped that upgraded noise recognition technologies may allow for improved validation but this will be aided by best practice guidance, regularly reviewed to keep up to date with developments ([Zaporozhets, n.d.](#)).

Airports should report to communities and stakeholders on the effectiveness of existing NAPs when updating them to increase accountability.

Appendices

Appendix I: Legislation

The Air Navigation Order (2016) (UK Statutory Instruments, 2016) ([CAA, 2021a](#))

- Article 218 of this Order states, “The Secretary of State may prescribe the conditions under which noise and vibration may be caused by aircraft”, on a number of aerodromes.

Directive 2002/49/EC of the European Parliament and of the Council of June 2002 relating to the assessment and management of environmental noise (Official Journal of the European Communities, 2002) (Known as the END). Below are the requirements of the END:

- The END defines a major airport as having more than 50,000 ATMs.
- L_{den} and L_{night} are required to be plotted on noise contour maps. The calculation of the metrics are defined in the annexes of the Directive.
- Every 5 years, a summary report containing Noise Action Plans (NAPs) and noise maps shall be produced and the information is to be shared with the public.
- An appropriate authority must be set by each country to identify the agglomerations which need to be considered for the provision of NAPs and the collect the NAPs and maps.
- The minimum requirements for noise mapping are set out in the END.

The Environmental Noise (England) Regulations (2006) (UK Statutory Instruments, 2006) ([UK Statutory Instruments, 2021](#))

- These regulations apply to England, as noise is a devolved issue.
- The Secretary of State must identify agglomerations and major airports.
- Noise maps must meet the general requirements set out, including using the indicators L_{den} and L_{night} , as well as the supplementary noise indicators $L_{Aeq, 16 hr}$, L_{day} and $L_{evening}$.
- Strategic noise maps must be produced every 5 years. The map will show the data for the preceding year. The map, along with the data used to create it, will be submitted to the Secretary of State.
- The airports that are required to produce these noise maps are the non-designated major airports (i.e. Airports other than Heathrow, Gatwick and Stansted, with more than 50,000 air transport movements per year) and non-designated other airports whose noise affects a defined agglomeration.
- Affected agglomerations are those who received air traffic noise equal to, or greater than, L_{den} 55 dB or L_{night} 50 dB.
- The general requirements for NAPs are laid out.

- NAPs must be produced every 5 years or whenever a major development occurs at an airport which affects its noise impacts.
- The public must be given the opportunity to submit feedback on consultations relating to proposals contained within NAPs, as well as be informed of any final decisions made.
- Any NAP or noise map accepted by the Secretary of State must be published, along with a summary of key points.

REGULATION (EU) No 598/2014 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 April 2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach and repealing Directive 2002/30/EC ([Publications Office of the EU, 2014](#))

- The data used to model noise contours should be accessible and validated via the agreed internationally accepted processes and following best practice.

Appendix II: Policy

International Civil Aviation Organisation (ICAO): Guidance on the Balanced Approach to Aircraft Noise Management ([ICAO, 2008](#))

The Department for Transport: The Aviation Policy Framework ([DfT, 2013](#))

- The three designated airports should produce annual noise contour maps to a level of 57 dB $L_{Aeq, 16\text{ hr}}$ to assess the impacts of day noise.
- Contours should also be produced using $L_{Aeq, 8\text{ hr}}$ to assess night noise.
- 57 dB $L_{Aeq, 16\text{ hr}}$ is considered to mark the onset of significant community annoyance for daytime aviation noise.
- Airports are urged to “use alternative measures which better reflect how aircraft noise is experienced in different localities” to gain a better understanding of noise impacts, in order to develop mitigation measures.

The Department for Environment, Food and Rural Affairs: Guidance for Airport Operators to produce NAPs under the terms of the Environmental Noise (England) Regulations 2006 (as amended) (July 2013) ([Defra, 2013](#))

- Sets out the requirements for NAPs and noise maps, as originally laid out in the END (Directive 2002/49/EC), which should be produced by airports in England
- Provides overview of related government policies, such as the Noise Policy Statement for England (NPSE) and the Aviation Policy Framework

Appendix III: Other

The majority of noise monitoring guidance comes from best practice guides and standards produced by other bodies, such as the Institute of Acoustics (IOA), ICAO: Guidance on the Balanced Approach to Aircraft Noise Management ([ICAO, 2008](#)), ICAO: Annex 16 of the 1944 Chicago Convention, International Organization for Standardization (ISO) and The British Standard Institute (BSI) e.g. BS ISO 20906:2009+A1:2013 Acoustics – Unattended monitoring of aircraft sound in the vicinity of airports ([BSI, 2021a](#)). BS 7445 – Description and measurement of environmental noise ([BSI, 2021b](#)). Although these standards and guidance are not part of UK legislation, they are likely to be considered the appropriate means of implementing UK legislation and policy.

Appendix IV: References

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