

Managing Noise from Emerging Aviation Technology

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Executive Summary

This Civil Aviation Publication examines the implications of emerging aviation technologies, particularly drones and electric vertical take-off and landing aircraft, for noise policy in the UK. These technologies have the potential to deliver significant economic and societal benefits, including improved connectivity, new logistics models and support for future transport systems. They may also displace some noisier forms of transport, including traditional aviation, depending on the use case and the overall pattern of operations. Their introduction raises important questions about how noise impacts should be understood, assessed and managed.

A key finding is that their noise impacts may differ in important ways from those associated with conventional aviation. While some platforms may be quieter at source, lower-altitude flight, distributed operations, hover and vertical flight, operation close to homes and potentially higher movement frequencies may create new patterns of noise exposure. The acoustic characteristics of some aircraft may also result in greater annoyance than other environmental noise sources at comparable sound levels. Community response may depend on the timing, frequency, predictability and purpose of operations, as well as acoustic exposure.

The report identifies limitations in existing noise metrics and assessment approaches, which were developed primarily for conventional aircraft operating at higher altitudes and along more concentrated flight paths. These approaches may not fully capture the intermittency, spatial distribution and acoustic qualities of emerging operations. There are also no robust UK-specific exposure-response functions for annoyance or sleep disturbance from routine drone and eVTOL operations. Conventional metrics remain useful, but may need to be supplemented where this materially improves assessment.

The UK's legislative and policy framework for aviation noise provides a substantial foundation, including national noise policy, the ICAO Balanced Approach, and established regulatory processes. However, these frameworks were largely developed for conventional aviation and do not yet provide a complete or consistently applicable framework for drones and eVTOL aircraft. Whether and how noise is assessed may also depend on the regulatory route taken. Greater consistency is therefore needed across approval routes, while keeping requirements proportionate to the operation and its likely effects.

Product-level sound-power requirements for some class-marked uncrewed aircraft, together with Remote ID, geo-awareness and market-surveillance arrangements, provide useful building blocks for future policy. However, they do not constitute a complete framework for assessing operational exposure, cumulative impacts or community response. International technical specifications have informed published UK equivalents, which provide a starting point for project-specific UK certification while internationally agreed standards continue to develop.

The evidence base remains limited and is still evolving. Much of the available information is derived from modelling, laboratory research, trials and early deployments, with limited empirical evidence on large-scale or long-term operations. Trials and early deployments therefore provide an opportunity to collect common operational and noise data, undertake targeted measurement and modelling, report complaints consistently and conduct staged social research. Evidence should be independently verified or scrutinised where appropriate to maintain public and stakeholder confidence.

No single noise-management measure is likely to be sufficient. Noise reduction at source will be particularly important. Land-use planning can assist with the location and design of vertiports, fulfilment centres and other fixed infrastructure, but cannot on its own address distributed operations close to homes. Operational procedures can reduce exposure, although practical constraints may limit the available options. Operating restrictions, including limits on operating hours, movement numbers or activity in sensitive locations, may therefore be required in some circumstances.

Early, transparent and inclusive stakeholder engagement should complement these measures and continue as operations develop. Communities should be able to understand what is operating, where, when and why, who is responsible and how to raise concerns. Complaints should be considered alongside exposure, operational and wider engagement evidence.

Governance responsibilities are likely to remain distributed. Government should provide national policy direction; the CAA should regulate and enforce within its statutory remit; and local, regional and devolved bodies should exercise their respective planning, environmental health, public health, transport and coordination functions. Clear arrangements will be needed for coordinating decisions and handling impacts across administrative boundaries.

Digital systems may support more adaptive and targeted noise management. Operational telemetry, flight logging, Remote ID and future UTM services may assist modelling, attribution and compliance monitoring. However, these capabilities remain at an early stage and will require appropriate legal, technical and data governance arrangements.

Overall, emerging aviation technologies present both an opportunity and a challenge for noise policy. Existing frameworks provide a valuable starting point but will need to evolve. A first edition of national drone noise policy should provide a consistent transitional framework for trials, early deployments and initial routine services, without prematurely setting definitive drone-specific effect levels or comprehensive numerical limits. Its initial priorities should include proportionate assessment tiers, common data requirements, appropriate interim metrics, practicable mitigation, transparent engagement and complaints arrangements, and periodic review as the evidence and sector develop.

This evolutionary approach would help protect communities, provide industry with greater regulatory clarity and enable policy to develop as operational experience and the evidence base mature.

Chapter 1

Introduction

- 1.1 Commercial air travel emerged in the early 20th century, supported by aviation developments during the First and Second World Wars. The need to control noise from aircraft became more apparent with the introduction of scheduled transatlantic services by jet aircraft in the late 1950s. This led to the first noise attitude survey in the UK in 1961 and the first international noise standard adopted in 1971. These initiatives evolved into aircraft noise management frameworks to protect those people exposed to, and disturbed by, noise from the new aircraft technology of that era.
- 1.2 With the recent rapid developments in battery technology, two categories of new electrically powered aircraft technologies are emerging: drones performing a range of activities; and electric vertical take-off and landing (eVTOL) aircraft which carry people. Drones are already proliferating, and significant investment is being made into eVTOL technology.
- 1.3 Support for drones and eVTOL has been a consistent feature of UK aviation policy over time. The UK Government has set an objective to see routine beyond visual line of sight drone operations by 2027 and piloted eVTOL operations from 2028. Under previous governments, this was set out in the Flightpath to the Future strategy¹, and the drone-specific policy Advancing Airborne Autonomy, Commercial drones saving money and lives in the UK². In March 2024, the Department for Transport (DfT) also published the UK Future of Flight Action Plan³ which set out the actions to be taken to responsibly introduce these new technologies. The current policy position continues to support CAA work towards enabling safe commercial operations of both technologies.
- 1.4 If these industries are successful, we could see a fundamental change in the types of vehicles operating in our skies, introducing new noise sources at lower altitudes, in different locations and with different acoustic characteristics from conventional aviation. These differences may influence not only measured noise

¹ Department for Transport (2022), Flightpath to the Future, 26 May 2022.

<https://assets.publishing.service.gov.uk/media/628f7d26e90e07039f799ebc/flightpath-to-the-future.pdf>

² Department for Transport and Department for Business, Energy and Industrial Strategy (n.d.), *Advancing Airborne Autonomy: Commercial Drones Saving Money and Lives in the UK*.

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/1091358/drone-ambition-statement.pdf

³ Department for Transport (2024), *UK Future of Flight Action Plan*, March 2024.

<https://assets.publishing.service.gov.uk/media/661943b7679e9c8d921dfeeb/fof-action-plan.pdf>

exposure but also how communities perceive, anticipate and respond to the introduction of new services. The responsible introduction of these new technologies involves developing the systems to manage their likely noise impacts, particularly those affecting people and communities, before these impacts become significant.

- 1.5 The UK Department for Transport (DfT) requested the Environmental Research and Consultancy Department (ERCD) of the Civil Aviation Authority (CAA) to advise on the issues relating to, and the potential components of, a noise management system for the two main categories of electrically-powered emerging aviation technology:
- Drones, forming part of the broader category of uncrewed aircraft systems (UAS) including remotely piloted aircraft systems (RPAS); and
 - Electric Vertical Take-Off and Landing (eVTOL) aircraft, which are commonly associated with concepts such as Advanced Air Mobility (AAM), Urban Air Mobility (UAM) and Future Air Mobility (FAM).
- 1.6 Both categories typically include aircraft with electricity-powered propulsion systems and the ability to take-off and land vertically. The term eVTOL, however, is most commonly used to refer to passenger-carrying vehicles. For the remainder of this study, we will use 'drones' and 'eVTOL' to refer to the two respective categories.
- 1.7 This document responds to this request, drawing from the various technical and engagement activities undertaken by ERCD over the last two years.
- Chapter 2 summarises the existing system for regulating and/or managing civil aviation noise. It identifies where noise research and knowledge from drones and eVTOL aircraft is currently, or could be, covered within the existing system, and any gaps which may need to be filled by new provisions.
 - Chapter 3 sets out the noise certification measures, and noise exposure and noise impact assessment capabilities that would need to be established as a prerequisite for managing noise from drones and eVTOL aircraft.
 - Chapter 4 considers how the principles of the ICAO Balanced Approach to Noise Management could be applied to drones and eVTOL technology and operations, and sets out potential noise management options which aim to fill the residual gaps and may be considered by DfT for future policymaking.
 - Chapter 5 describes the governance needed to manage noise from drones and eVTOL aircraft. It outlines the roles of DfT, CAA and local authorities, principles for decision-making, requirements for data, monitoring and digital enforcement, and how accountability and governance should evolve as operations progress from trials to commercial deployment.

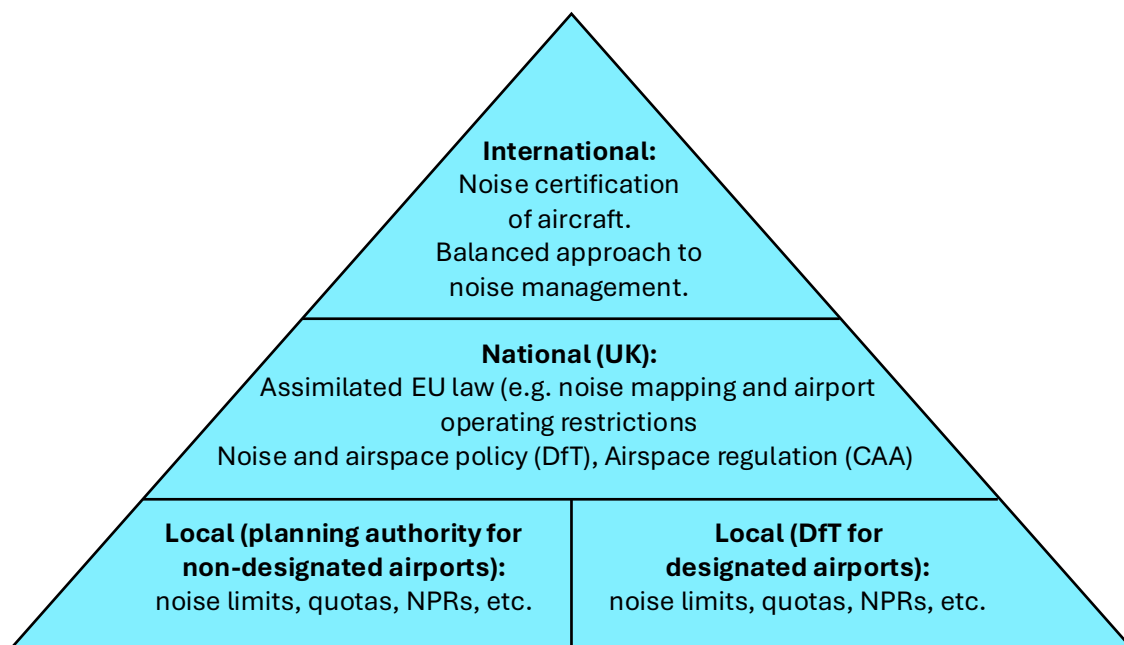
- Chapter 6 concludes the study by drawing together the main findings, identifying early priorities and proposing potential components of a first edition of national drone noise policy.
- Appendix A: Glossary of terms

Chapter 2

Existing Aviation Noise Regulation and Management

- 2.1 This chapter sets out the current UK policy, appraisal and regulatory framework relevant to the management of aviation noise. It distinguishes between: (i) strategic policy objectives, (ii) frameworks used to assess noise impacts, (iii) decision-making processes for airspace change, and (iv) operational rules which constrain how aircraft may be flown. It identifies where existing frameworks are well established, and where gaps remain in relation to emerging aviation technologies which may need to be filled by new provisions. These gaps are summarised at the end of this chapter.
- 2.2 Figure 1 summarises the aviation noise regulation and management system that exists within the United Kingdom (UK). It cascades down from the international framework owned by the International Civil Aviation Organisation (ICAO), through to the regional legislation which originated at the European Union (EU) level, to the UK's national measures and finally to local measures linked to airports.

Figure 1: Summary of aviation noise regulation and management system



NB. A Noise Preferential Route (NPR) is a designated flight path that departing aircraft must follow after take-off from certain airports to minimise noise disturbance over sensitive areas.

- 2.3 Following the UK's exit from the EU on 31 January 2020, the relevant EU-derived elements no longer directly apply to the UK. However, much of the framework was assimilated in UK law and amended to operate in a UK context,

including through the Aviation Noise (Amendment) (EU Exit) Regulations 2019 (see paragraph 2.85 onwards).

Strategic noise policy framework

International policy and standards

ICAO Annex 16 to the Chicago Convention, Volume I

- 2.4 This is an international agreement that sets out standards and recommended practices (SARPs) for the environmental protection of international civil aviation. Annex 16 was first adopted in 1971, and it has been amended several times since then to reflect the latest scientific and technological developments. It is divided into 4 volumes, each of which deals with a specific environmental issue; noise is handled in Volume I.
- 2.5 ICAO member States are expected to conform to the Standards in Annex 16 or notify ICAO of any differences. Recommended Practices are not binding in the same way, but States are encouraged to apply them.
- 2.6 The noise certification standards applicable to different classifications of aircraft are specified in individual chapters of Volume I. In each relevant chapter, the following provisions are set out:
 - Date(s) of applicability of the standard in that chapter.
 - Noise certification requirements for aircraft, where noise limits are based on the aircraft's size and weight, and are designed to ensure that aircraft do not exceed certain noise levels during take-off, landing, and en-route operations.
 - Noise measurement and evaluation methods, to support the robustness of the noise certification process.
- 2.7 The SARPs are designed to ensure that aircraft are designed in a way that minimises noise that is reflected in day-to-day operations.
- 2.8 In addition to the SARPs, Volume I also includes a number of appendices and attachments that provide additional information on topics such as noise measurement and evaluation methods and noise compatibility planning.
- 2.9 Three of the chapters in Volume I apply to aircraft that share some key characteristics with eVTOL aircraft, namely using rotors to provide lift. For example, Chapters 8 and 11 set out noise certification requirements for helicopters, whilst Chapter 13 sets out noise certification requirements for tilt-rotor aircraft.
- 2.10 However, the eVTOL and drone models currently under consideration also have characteristics that differ from those of helicopters and tilt-rotor aircraft, namely around the number of and types of engine that power them, and their weight.

They may also differ from tilt-rotor aircraft in that some eVTOL aircraft are intended to transition between vertical and cruise flight in a continuous manner. Consequently, they may not be capable of being tested in accordance with Annex 16 procedures without adapting the aircraft configuration or test procedures.

- 2.11 This therefore highlights a gap in the current framework. For many drone and eVTOL aircraft types, while broad environmental obligations exist, there are not yet internationally accepted noise standards, limits or recognised methods for measuring, evaluating and certifying noise emissions.

ICAO Balanced Approach

- 2.12 The ICAO Balanced Approach to Aircraft Noise Management is the international framework for managing aircraft noise. It is classed as best practice guidance, however, some of the rules and procedures it establishes for the fair and transparent introduction of noise-related operating restrictions at airports are mandated in certain ICAO States through specific legislation, see from paragraph 2.55.

- 2.13 The Balanced Approach is set out in ICAO Doc 9829 2nd Edition, and comprises four pillars:

1. Reduction of noise at source
2. Land-use planning and management
3. Noise abatement operational procedures
4. Operating Restrictions

- 2.14 The Balanced Approach has been adopted in the UK as the foundation for aviation noise management. The relevant elements of each pillar are explained in the following sections. The implementation of the Balanced Approach through specific legislative and regulatory frameworks is described later in this chapter (see from paragraph 2.54).

Pillar 1: Reduction of noise at source

- 2.15 This covers aircraft noise standards and product certification, including the role of ICAO Annex 16 Volume I in setting international noise standards for aircraft, the certification process to ensure compliance with these standards and the means to develop even stricter noise standards for future aircraft. Technological advances for noise reduction are also covered, including ongoing research and development in quieter engine technologies, such as bypass ratios, fan designs, and combustion processes. It acknowledges the limitations of current technologies and the need for continued innovation.

Pillar 2: Land-use planning and management

- 2.16 This is concerned with discouraging incompatible land uses around airports to minimise the number of people exposed to aircraft noise. It emphasises the need for proactive planning and collaboration between stakeholder groups to achieve sustainable and compatible development in the vicinity of airports.
- 2.17 It describes what are considered incompatible and compatible land uses, and the principles of zoning and development control. It advises how to integrate noise considerations into airport master plans to align future development with noise mitigation strategies, and advocates for open communication and collaboration with affected communities to build trust and acceptance of land-use planning decisions.
- 2.18 For drone delivery operations, one of the principal intended benefits is the ability to deliver goods faster to, or close to, the end user. This creates a particular challenge for the land-use planning and management pillar of the Balanced Approach, which has traditionally sought to reduce noise exposure by separating noise-sensitive land uses from aviation noise sources. Where operations are designed to serve residential areas, conventional land-use separation is unlikely to provide a mitigation solution across the majority of the delivery area served. However, it may still have an important role in influencing the location of launch sites, fulfilment centres and supporting infrastructure, and in identifying areas where operations may be less appropriate or require additional controls.
- 2.19 This consideration is not limited to densely populated residential areas. Drone operations may also affect rural, remote or protected areas, including locations valued for tranquillity, recreation, tourism, biodiversity or landscape character. In such areas, the number of permanent residents affected may be relatively low, but public expectations of low noise and limited visual intrusion may be higher. Land-use planning and related environmental policy may therefore need to consider not only residential exposure, but also sensitive receptors, quiet areas and visitor or amenity impacts.
- 2.20 For eVTOL operations, the role of land-use planning may be different. Where operations use vertiports, airports, heliports or other defined sites, there may be greater scope to consider noise exposure through site selection, design, operating procedures and planning controls. This suggests that the limitations of the land-use planning pillar are likely to be most acute for distributed drone delivery operations, rather than applying uniformly across all emerging aviation technologies.

Pillar 3: Noise abatement operational procedures

- 2.21 This pillar covers operational procedures designed to reduce noise exposure by changing how, where or when aircraft are operated. These include measures applied during take-off and landing, measures affecting the routes and flight

paths used by aircraft, and procedures applied at airports and other operating sites. There are several categories of actions:

- There are actions a pilot can take during take-off and landing to reduce noise exposure near airports. Actions include noise abatement departure procedures and continuous climb operations; reduced power, continuous descent and steeper approaches, and reduced use of reverse thrust on landing. It is expected that the principle would apply to remotely piloted aircraft, where the pilot is a human or control is automated.
- Some actions fall more within airspace use, such as noise preferential routes to avoid overflying built-up areas, flight track dispersion to avoid concentration of noise, especially as aircraft are switching to newer satellite-based navigation techniques which enable much more accurate track keeping.
- Other actions are linked more to airports, such as runway preference, runway alternation and displaced landing thresholds. There are also ground-based operational procedures to reduce noise caused by engine test runs, taxiing and aircraft on the stand.

Pillar 4: Operating restrictions

2.22 This pillar covers restrictions on aircraft operations intended to manage noise where measures under the other three pillars are insufficient. Operating restrictions are considered a last resort and may include limits on when, where, how often or which aircraft may operate. For instance:

- Movement Limits: Imposing limits on the maximum number of aircraft movements permitted over a specified period.
- Aircraft Type Restrictions: Banning or phasing out older, noisier aircraft types in favour of quieter, newer models. To determine an aircraft's noisiness, certification noise levels must be used.
- Noise Quotas: Imposing limits on the total amount of noise allowed at an airport, often categorised by time periods (such as day or night, and winter or summer seasons).
- Operating Hour Restrictions: Limiting take-off and landing times for noisier aircraft, particularly during nighttime hours.

2.23 Restrictions can impact the operational flexibility of airlines, increasing their costs which may lead to higher airfares. There also needs to be consideration of the effects of these measures on the origin/destination overseas, i.e. does it lead to noise disbenefit there, and/or any potential distortion to competition and market access.

2.24 In the UK, Regulation (EU) 598/2014 establishes rules and procedures for introducing noise-related operating restrictions at larger airports within its scope

(see paragraph 2.55 onwards). In England and Wales, the Airports (Noise-related Operating Restrictions) (England and Wales) Regulations 2018 establish the associated domestic competent-authority arrangements (see paragraph 2.66 onwards).

- 2.25 With advancements in quieter aircraft technology, restrictions need to be reviewed over time to avoid becoming obsolete. The introduction of drones and eVTOL aircraft raises further questions about how those restrictions might be applied to these new types of aircraft.

- 2.26 Noting that one of the main business models is residential delivery of goods, the application of operating restrictions to drone operations may differ from the conventional airport context. Some restrictions may be relatively straightforward in principle, such as limits on operating hours, restrictions on noisier vehicles where quieter alternatives are available, or controls on the number of movements from a particular launch site or fulfilment centre. However, restrictions on deliveries to particular addresses, neighbourhoods or types of customer may be more difficult to design and justify, and may be perceived as a form of demand management.

- 2.27 The appropriate approach may also depend on the use case. Public sector, emergency or socially beneficial services, such as medical logistics, emergency response or infrastructure resilience, may attract greater public support than purely commercial delivery services. However, these operations may still create localised noise impacts, particularly where they are concentrated around hospitals, blood banks, emergency service facilities or fixed “drones-in-a-box”⁴ sites. In such cases, operating restrictions may need to distinguish between essential and discretionary activity, while still considering the cumulative noise experienced by nearby communities and other sensitive receptors.

- 2.28 Public expectations may also extend beyond noise alone. For example, restrictions on overflight near schools, care settings or other sensitive locations may be sought partly because of privacy, safety or visual intrusion concerns, even where noise is the formal route through which concerns are raised. Restrictions imposed primarily for these non-noise reasons would fall outside the ICAO Balanced Approach and would require an appropriate separate legal or policy basis. Similarly, a noise-related operating restriction could not properly be justified under the Balanced Approach without first considering measures under the other three pillars and establishing that they were insufficient.

⁴ Drone-in-a-box (DiaB) systems are automated, self-contained units that house, charge, and launch drones without requiring a human pilot on site. They allow organisations to conduct remote, autonomous missions including security patrols, infrastructure inspections, and emergency response.

- 2.29 This suggests that operating restrictions for drone operations should not be dismissed as impractical, but their legal basis, proportionality and interaction with other approval mechanisms, such as operational authorisations and planning controls, would need to be clarified. Operational authorisations may provide one route for applying noise-related conditions to some operations, particularly where risks and mitigations are assessed on a case-by-case basis. However, further policy and legal consideration would be needed to determine how far this mechanism could be used to set broader or more systematic noise limits, such as restrictions on operating hours, locations, movement numbers or aircraft noise performance.

ICAO Doc 9911 – Recommended Method for Computing Noise Contours around Airports

- 2.30 This document serves as a guide for ICAO member States on the calculation of aircraft noise exposure around civil airports. It outlines methods for calculating single-event aircraft noise levels using an online database for international aircraft noise and performance (ANP) information. This provides a standardised approach for calculating noise exposure, facilitating comparisons and assessments on a global scale. This in turn supports informed decision-making within the ICAO Balanced Approach framework.
- 2.31 Currently, the ANP database does not include information to enable noise from drones and eVTOL aircraft to be calculated using the Doc 9911 methodology. Nor is there an equivalent international recommended method for computing noise from eVTOL and drone aircraft. Having no internationally recognised means for calculating noise exposure from eVTOL and drones is therefore a gap.

ECAC Doc 29, 5th Edition – Report on Standard Method of Computing Noise Contours around Civil Airports

- 2.32 Published by the European Civil Aviation Conference (ECAC), this document is developed and maintained by an ECAC technical working group. Although ECAC Doc 29 is intended to cater specifically to European airports and aviation practices, these are largely common to those internationally, and as such, it is to all intents and purposes aligned with ICAO Doc 9911. It also recommends using the same international aircraft noise and performance (ANP) database, and similarly does not make provisions for calculating noise from drones or eVTOL aircraft.

EASA guidance

- 2.33 EASA has published various guidance documents covering methods on managing noise from drones and eVTOL aircraft. Although these do not apply to the UK, we will draw from these in later sections of this report.

- Vertiports, Prototype Technical Specifications for the Design of visual flight rules (VFR) Vertiports for Operation with Manned VTOL-Capable Aircraft Certified in the Enhanced Category (PTS-VPT-DSN), March 2022.
- Guidelines on Noise Measurement of Unmanned⁵ Aircraft Systems Lighter than 600 kg Operating in the Specific category (Low and Medium Risk), as revised on 11 September 2023.
- Environmental Protection Technical Specifications applicable to VTOL-capable aircraft powered by non-tilting rotors, 12 December 2023. The first EPTS document applicable to VCA powered by non-tilting rotors.⁶
- Environmental Protection Technical Specifications applicable to VTOL-capable aircraft powered by tilting rotors, 15 July 2024. The second EPTS document applies to VCA powered by tilting rotors.⁷

UK strategic policy and legislative framework

Transport Act 2000

- 2.34 The Transport Act 2000 establishes the statutory framework for the CAA's air-navigation functions, including its role in deciding the design of airspace.
- 2.35 Section 70 of the Transport Act 2000 sets out the CAA's duties in relation to airspace change. These duties include:
- Our overriding primary duty, to maintain a high standard of safety in the provision of air traffic services (1).
 - To secure the most efficient use of airspace consistent with the safe operation of aircraft and the expeditious flow of air traffic (2)(a).
 - To take account of the interests of any person (other than an operator or owner of an aircraft) in relation to the use of any particular airspace or the use of airspace generally (2)(c).
 - To take account of any guidance on environmental objectives given to the CAA by the Secretary of State (2)(d).

⁵ CAA uses the gender-neutral term 'uncrewed' in preference to 'unmanned', except where referring to legislation, regulations, standards or policy documents that use the term 'unmanned'.

⁶ European Union Aviation Safety Agency (2023), *Environmental Protection Technical Specifications Applicable to VTOL-capable Aircraft Powered by Non-tilting Rotors*, 12 December 2023.
<https://www.easa.europa.eu/en/downloads/139022/en>

⁷ European Union Aviation Safety Agency (2024), *Environmental Protection Technical Specifications Applicable to VTOL-capable Aircraft Powered by Tilting Rotors*, 15 July 2024.
<https://www.easa.europa.eu/en/downloads/140184/en>

- 2.36 In exercising its air navigation functions, the CAA must consider all of these factors, amongst others, when deciding on the design of UK airspace. The Act also empowers the CAA to impose conditions when approving changes to airspace design proposed where necessary to help ensure that these duties are met. The process through which such decisions are made is set out in CAP 1616 (see paragraph 2.133 onwards).

Air Navigation Guidance 2026

- 2.37 Section 70(2) of the Transport Act 2000 requires the CAA to take account of guidance on environmental objectives given to the CAA by the Secretary of State when carrying out its airspace functions set out in the Air Navigation Directions 2026 (including decisions on airspace design), made under sections 66(1), 68 and 104(2) of the Transport Act 2000. The Air Navigation Guidance (ANG) 2026 is the relevant guidance that must be taken into account by the CAA when carrying out its air navigation functions balancing objectives during air navigation decisions, including environmental considerations. The ANG 2026 comes into effect from 1 October 2026, although its predecessor, the Air Navigation Guidance 2017 will continue to apply to some airspace design proposals already under development on that date.
- 2.38 The ANG 2026 establishes a set of Airspace Design Priorities that subject to the CAA primary duty to maintain a high standard of safety, guide how the CAA balances operational efficiency, environmental impacts and stakeholder interests when exercising its air navigation functions. Subject to safety and the delivery of aviation activity permitted by planning decisions (having regard to air transport demand), the priorities seek to minimise changes to the areas exposed to aircraft noise below 5,000 ft and then to minimise overall adverse noise impacts below 5,000 ft. Within the remaining design options, flight efficiency is prioritised for aircraft operating at and above 5,000 ft.
- 2.39 Although the ANG 2026 introduces policy provisions for emerging users and innovation, including uncrewed aircraft systems (UAS) and advanced air mobility (AAM), it does not yet provide a comprehensive framework for assessing the noise impacts of these technologies, nor offer guidance on how the CAA should balance the noise and intrusion of this aviation activity against the government's other priorities and the CAA's other statutory duties. The guidance recognises that the evidence base remains limited and that future policy development will be informed by operational experience and data gathered through trials and early deployments.
- 2.40 The ANG 2026 adopts an enabling, supportive of innovation and learning approach to certain airspace trials (a form of non-permanent change to airspace) involving emerging aviation technologies. In particular, it states that, when considering certain UAS airspace trials, the CAA is not required to take environmental impacts into account where the trial contributes to government

policy development and learning. The guidance envisages that evidence gathered through such trials, including operational experience, noise complaints and noise attitude surveys, will be used to inform the future development of policy for UAS operations. The guidance also notes that a definitive noise policy for UAS operations remains under development, and that future iterations of the ANG will be updated to reflect that policy as it evolves.

Noise Policy Statement for England (NPSE)

- 2.41 The NPSE sets out the overarching policy vision and aims for noise management in England, within the context of sustainable development. The statement aims to ensure that noise is considered as an important factor in the planning process and that it is managed effectively. It also provides guidance on how local authorities should assess and manage noise in their area.
- 2.42 It is based on a high-level vision to *promote good health and a good quality of life through the effective management of noise within the context of Government Policy on sustainable development*. This is supported by a set of aims which seek to:
- avoid significant adverse impacts on health and quality of life,
 - mitigate and minimise adverse impacts where they cannot be avoided, and,
 - where possible, contribute to improvements in health and quality of life.
- 2.43 Together, these aims establish a structured policy framework for noise management, moving from prevention through to mitigation and enhancement. They are significant in providing a consistent basis for decision-making across different noise sources, while allowing proportionate and context-specific application depending on the nature and scale of impacts.

Environment Act 2021

- 2.44 This establishes a framework for environmental governance and improvement, including environmental targets, environmental improvement plans, environmental monitoring, environmental principles and the functions of the Office for Environmental Protection. It covers a wide range of matters, including air quality, water pollution, waste management, and biodiversity, but does not directly establish requirements for the assessment or management of aircraft noise. Nevertheless, the wider environmental objectives supported by the Act may be relevant when considering the cumulative effects and potential trade-offs associated with emerging aviation technologies, including effects on air quality, biodiversity and the natural environment. The Act's provisions for measurable environmental targets illustrate a wider approach to environmental governance, but do not themselves provide a basis for setting targets or limits for aviation noise. The UK's statutory greenhouse-gas reduction target and carbon-budget framework are established separately under the Climate Change Act 2008.

- 2.45 The Act establishes an enforcement regime through the creation of the Office for Environmental Protection (OEP), which has oversight powers to hold public authorities accountable for breaches of environmental law. Although noise is not currently listed among the priority areas, the Act's focus on environmental improvement, biodiversity and environmental governance may become relevant where noise from low-altitude aircraft operations intersects with ecology or amenity concerns. UK public-attitudes research has identified potential effects on wildlife and agricultural animals as a significant concern. In a representative 2024 survey of 3,279 UK adults, 78% of respondents expressed concern about the effects of drones and eVTOL aircraft on animals, including birds and agricultural animals, while 74% expressed concern about habitat destruction.⁸ This suggests that future evidence-gathering may need to consider not only human annoyance, but also potential effects on sensitive species, livestock and habitats, and places valued for tranquillity or biodiversity. The survey provides evidence of public concern rather than evidence that these effects will occur, and the evidence base on actual impacts remains limited. These considerations may inform future policy or local environmental assessment, but the Act does not itself establish aviation noise zones, operating restrictions or specific requirements for assessing these effects.
- 2.46 In addition, local authorities and other bodies operating under the umbrella of Local Nature Recovery Strategies (also introduced by the Act) may, over time, consider low-noise zones or restrictions in areas of particular ecological or amenity value. Such frameworks could intersect with land-use or operational planning for low-altitude aircraft operations, particularly in rural, protected or ecologically sensitive areas. Given the current uncertainty in the evidence base, there may be circumstances where a precautionary approach is appropriate, especially where operations could affect designated sites, sensitive habitats, nesting or roosting locations, or areas valued for quiet recreation. This would need to be applied proportionately, but could help build public trust while evidence on ecological and amenity impacts is developed.
- 2.47 Although the Act does not establish new obligations specific to drone or eVTOL noise, its systems-level approach to environmental governance and target-driven planning could help shape the wider policy landscape in which noise management decisions are made.

Environmental Protection Act 1990

- 2.48 The Environmental Protection Act 1990 (EPA 1990) is a key piece of primary legislation that underpins the UK's statutory regime for controlling environmental pollution, including noise. It provides an important legal foundation for local

⁸ Cotton, C., Gosschalk, K., Konn, J. and Grandon-White, S. (2024), *Future Flight Survey 2024*, University of Birmingham/UKRI and YouGov, pp. 9–10.

authorities when responding to complaints about environmental harm, including those potentially arising from emerging technologies such as drones.

- 2.49 Under Part III of the Act, local authorities have a duty to inspect their areas and take reasonably practicable steps to investigate complaints about statutory nuisances, including noise emitted from premises or vehicles that is prejudicial to health or a nuisance. However, Section 79(6) provides that this statutory nuisance category does not apply to noise caused by aircraft other than model aircraft. Drones are treated as aircraft under aviation legislation, but the Act does not define “model aircraft”. Whether different types of drone are “model aircraft” has not been authoritatively determined. However, commercial delivery, inspection and other service drones are unlikely to be regarded as model aircraft, in which case noise caused by the drone itself would fall outside the statutory-nuisance regime. Noise from premises, machinery or ground equipment associated with drones may nevertheless remain within scope where the relevant statutory tests are met.
- 2.50 Additionally, where operations cross local authority boundaries, practical questions may arise about which authority should receive, investigate or act on complaints, particularly where the affected residents are not in the same area as the launch site or operating base.
- 2.51 While not designed specifically with uncrewed aircraft in mind, the EPA 1990 may become increasingly relevant in shaping expectations of acceptable noise exposure from drones at the community level, particularly in the absence of a dedicated statutory regime.

National Planning Policy Framework (NPPF)

- 2.52 The NPPF sets out the UK Government’s planning policies for England and how these are expected to be applied. Separate planning policy frameworks apply in Scotland, Wales and Northern Ireland. The NPPF provides guidance on how local planning authorities should manage noise from airports within their remit of control. It states that planning policies and decisions should aim to avoid noise from giving rise to significant adverse impacts on health and quality of life as a result of new development, or the use of land and buildings, or changes in their use.
- 2.53 Additionally, it requires local planning authorities in England to consider the noise impacts of new development proposals near existing airports, including the cumulative impact of noise from multiple sources.

Airport noise management framework

- 2.54 The following section describes how the ICAO Balanced Approach to Aircraft Noise Management is implemented in practice through international and domestic legislation. While the Balanced Approach itself is non-binding

guidance, elements of its framework (particularly in relation to the introduction of operating restrictions) are given legal effect through specific regulatory instruments. These instruments establish the procedures and requirements that must be followed when applying the principles of the Balanced Approach in decision-making.

Regulation (EU) 598/2014 on the establishment of rules and procedures with regard to the introduction of noise-related operating restrictions at Union airports within a Balanced Approach

- 2.55 Regulation (EU) 598/2014 establishes the rules and procedures for introducing noise-related operating restrictions at qualifying airports within Pillar 4 of the ICAO Balanced Approach. It forms part of assimilated law in the UK and has been amended for the UK context, including by the Aviation Noise (Amendment) (EU Exit) Regulations 2019. The Regulation requires operating restrictions to be considered only after the potential contribution of measures under the other pillars have been assessed, including reduction at source, land-use planning and management, and noise-abatement operational procedures. It repealed former Directive 2002/30/EC.

- 2.56 The Regulation links its assessment framework to Directive 2002/49/EC. Often referred to as the Environmental Noise Directive, it relates to the assessment and management of environmental noise and provides a wider framework for strategic noise mapping and action planning, including common noise indicators and requirements for assessing the number of people affected. In the UK, the Regulation operates alongside the relevant domestic environmental-noise legislation, including the Environmental Noise (England) Regulations 2006, which are considered separately from paragraph 2.110 onwards, and the Environmental Noise (Wales) Regulations 2006.

- 2.57 Regulation (EU) 598/2014 sets out a structured process for decision-making, requiring a robust assessment of noise impacts, consideration of alternative measures, and consultation with affected stakeholders. This is intended to ensure that any operating restrictions are proportionate, evidence-based and justified in terms of their environmental benefits.

- 2.58 The Regulation also sets out a number of operation types that would be exempt from being counted towards any noise-related operating restrictions. These include emergency, military and medical evacuation flights. In applying similar principles to emerging aviation technologies, care would be needed to define any equivalent exemptions clearly. For example, a distinction may be needed between flights responding to urgent incidents, military or state activity, medical evacuation, and more routine public service operations such as scheduled medical logistics. Without such clarity, there is a risk that routine or discretionary operations could be treated as exempt from noise controls simply because they provide a public or socially beneficial service.

- 2.59 The most common noise-related operating restrictions in the UK are partial restrictions that apply at night, such as night movement limits and night noise quota restrictions. However, it would also apply to a limit on the maximum number of annual movements set for an airport, where that limit constrained airport capacity to less than the airport infrastructure could accommodate.
- 2.60 In practice, this framework requires decision-makers to demonstrate that operating restrictions are the most appropriate measure to address a specific noise problem, taking into account both costs and benefits. It therefore places a strong emphasis on transparency, consistency and proportionality in the management of aviation noise.
- 2.61 While the principles of the Balanced Approach remain relevant, the application of this framework to emerging aviation technologies may be less straightforward. In particular, the dispersed, lower-altitude and potentially higher-frequency nature of these operations may challenge how noise problems are defined, assessed and addressed within a process that has been designed for more traditional forms of aviation. In this context, noise complaints may also reflect wider concerns about the operation, such as visual intrusion, privacy, perceived safety, ecological impacts or local amenity, particularly where noise is the most accessible route for raising concerns. This does not mean that such complaints should be treated as unrelated to noise, but it reinforces the need for evidence, engagement and complaints processes that can distinguish between acoustic impacts and wider public concerns.
- 2.62 The Balanced Approach refers generally to aircraft noise and does not limit its application by reference to particular aircraft types, such as fixed-wing aeroplanes or helicopters, for instance. It is therefore reasonable to interpret its principles as potentially applicable to noise from drones and eVTOL aircraft. However, the extent to which those principles can be applied in practice may depend on the characteristics of the operations concerned. Dispersed, lower-altitude and potentially higher-frequency operations associated with drones and eVTOL aircraft may require adaptation of approaches developed principally around identifiable noise problems at individual airports. This broad potential application of the Balanced Approach should be distinguished from its implementation through Regulation (EU) 598/2014, which applies only where both the aircraft and airport concerned meet the thresholds specified in the Regulation.
- 2.63 For the purposes of Regulation (EU) 598/2014, 'aircraft' means fixed-wing aircraft with a maximum certificated take-off mass of 34,000 kg or more, or with a certificated maximum internal accommodation of 19 passenger seats or more, excluding crew seats. The Regulation also applies only at airports with more than 50,000 civil aircraft movements per year. Drones or eVTOL operations would therefore fall within the Regulation only if the aircraft and airport thresholds were

both met. Operating at, or in connection with, a qualifying airport would not by itself bring an operation within scope. Some eVTOL services may operate at qualifying airports, including airport access services, while drones may be used for activities such as airport perimeter monitoring. However, irrespective of their connection with a qualifying airport, most drones and near-term eVTOL aircraft are unlikely to satisfy the Regulation's definition of 'aircraft', particularly because it is limited to fixed-wing aircraft and incorporates minimum weight or seating thresholds.

- 2.64 This suggests a limitation in the existing operating restrictions framework, rather than an absence of potential control mechanisms. The practical effect is that Regulation 598/2014 is unlikely to provide a general route for applying noise-related operating restrictions to dispersed drone operations, vertiports, smaller operating sites, or most near-term eVTOL services. Noise-related controls may instead need to be considered through other mechanisms, such as operational authorisations, airspace change processes, planning controls, airport or site-specific procedures, or future policy instruments. The extent to which these mechanisms can provide consistent, proportionate and enforceable noise controls remains an area requiring further clarification.
- 2.65 It is also helpful to understand that helicopters also fall outside the scope of this specific regime. However, helicopters are already subject to established noise certification standards and may be managed through other mechanisms, including designated airport powers, local planning controls and site-specific operating procedures. For drones and eVTOL aircraft, the issue is therefore not simply exclusion from Regulation 598/2014, but the absence of a complete and coherent framework for applying equivalent noise management controls across dispersed and lower-altitude operations.

Airports (Noise-related Operating Restrictions) (England and Wales) Regulations 2018 (SI 2018/785)

- 2.66 In England and Wales, the Airports (Noise-related Operating Restrictions) (England and Wales) Regulations 2018 (SI 2018/785) establish the domestic competent-authority and supporting procedural arrangements associated with the application of Regulation (EU) No. 598/2014. Regulation 598/2014 sets out the rules and procedures to be followed when noise-related operating restrictions are being considered at major airports within the ICAO Balanced Approach.
- 2.67 Regulation 598/2014 applies to airports with more than 50,000 civil aircraft movements per year and requires noise-related operating restrictions to be considered within the framework of the Balanced Approach. The 2018 Regulations establish the relevant competent-authority arrangements for England and Wales.

- 2.68 The Regulations define the competent authority for introducing airport noise-related operating restrictions in England and Wales under Regulation 598/2014. The Competent Authority may be the local planning authority or the Secretary of State. They also set out detailed procedural requirements, including consultation with relevant stakeholders, assessment of the likely costs and benefits of proposed measures, and consideration of the proportionality and effectiveness of any restrictions. They also require the use of appropriate noise metrics and analysis to support decision-making.
- 2.69 In practice, the Regulations provide a structured and legally defined process for managing aircraft noise at larger airports, ensuring that any operating restrictions are introduced in a transparent, evidence-based and proportionate manner, consistent with international policy. This includes procedural safeguards such as consultation, cost-benefit assessment and consideration of alternative measures. However, the framework is airport-centred and does not directly address how equivalent transparency, engagement and accountability would be secured for dispersed low-altitude operations away from major airports.

Aircraft noise certification and control of noise source

- 2.70 One of the primary mechanisms for managing aviation noise is through control at source, by setting limits on the noise emissions of aircraft through certification standards. This approach forms a core element of the ICAO Balanced Approach and focuses on reducing noise impacts by ensuring that aircraft entering service meet progressively more stringent noise performance requirements. The following section outlines the international and UK regulatory framework governing aircraft noise certification, how these standards contribute to the overall management of aviation noise, and how equivalent measures are being developed for emerging aviation technologies.

UK Regulation (EU) 2018/1139 (The UK Basic Regulation)

- 2.71 The CAA is required, by law, to comply with the UK Basic Regulation. This was originally a European Union regulation that sets out common rules for civil aviation, including essential requirements for the design, manufacture, operation, and maintenance of civil aircraft. These requirements include environmental protection, and specifically noise.
- 2.72 The Basic Regulation was adopted in 2018. Following EU Exit, its provisions were assimilated in UK law and amended for the UK context, principally through the Aviation Safety (Amendment etc.) (EU Exit) Regulations 2019 (SI 2019/645), as subsequently amended, including by the Aviation Safety (Amendment) (EU Exit) Regulations 2020 (SI 2020/1116). This means that aircraft in the UK remain subject to the applicable requirements of the UK Basic Regulation, including those relating to environmental protection and noise.

- 2.73 For aircraft other than uncrewed aircraft, the UK Basic Regulation incorporates environmental protection requirements by reference to ICAO Annex 16 and, where Annex 16 does not contain applicable environmental protection requirements, to the essential requirements for environmental compatibility set out in Annex III of the UK Basic Regulation.
- 2.74 Some of the key provisions related to environmental noise are as follows:
- for aircraft other than uncrewed aircraft, the Regulation requires compliance with applicable ICAO Annex 16 environmental protection requirements, including noise certification requirements where they apply;
 - where Annex 16 does not contain applicable environmental protection requirements, Annex III provides essential requirements for environmental compatibility;
 - for uncrewed aircraft, the Regulation establishes a separate route through Article 55 and Annex IX, which also requires compliance with the environmental performance requirements set out in Annex III;
 - the Regulation provides powers for detailed implementing rules and amendments to the uncrewed aircraft requirements, including where necessary to reflect technical, operational or scientific developments.
- 2.75 Article 1 sets out the objectives of the Regulation, including:
- (a) contribute to the wider United Kingdom aviation policy and to the improvement of the overall performance of the civil aviation sector;
 - (b) provide a level playing field for all actors in the United Kingdom aviation market, and improve the competitiveness of the United Kingdom's aviation industry;
 - (c) contribute to a high level of environmental protection;
 - (i) promote research and innovation, inter alia, in regulatory, certification and oversight processes
- 2.76 These, and other, aims are to be achieved, amongst other things, by:
- (d) the development, with the involvement of standardisation and other industry bodies, of detailed technical standards to be used as a means of compliance with this Regulation, and with the regulations made under it, where appropriate;
 - (g) the gathering, analysis and exchange of information to support evidence-based decision making.
- 2.77 Article 4 also establishes a number of underlying regulatory principles, including the use of best available evidence, consideration of scientific and technical

progress, and the adoption of proportionate measures that reflect the nature and risk of the activity concerned.

- 2.78 Because of the shared source history with the EU Basic Regulation, international and overseas developments remain relevant to the UK. EASA has developed Environmental Protection Technical Specifications (EPTS) for certain eVTOL aircraft, and the Federal Aviation Administration (FAA) has developed noise certification approaches for some individual UAS models, as discussed further in Chapter 3.
- 2.79 The UK Basic Regulation distinguishes between aircraft ‘other than unmanned’ aircraft, and ‘unmanned’ aircraft. Article 9 applies to aircraft ‘other than unmanned’ aircraft. In relation to noise and emissions, it requires those aircraft, and their engines, propellers, parts and non-installed equipment, to comply with the applicable environmental protection requirements in ICAO Annex 16. Where Annex 16 does not contain applicable environmental protection requirements, the essential requirements for environmental compatibility in Annex III apply (see paragraphs 2.73 and 2.74 above).
- 2.80 Uncrewed aircraft are addressed separately in Article 55, which requires the design, production, maintenance and operation of uncrewed aircraft, together with associated components, non-installed equipment, remote pilots and relevant organisations, to comply with the essential requirements in Annex IX. Annex IX in turn requires uncrewed aircraft to comply with the environmental performance requirements set out in Annex III. The practical effect is that drones are regulated through a different legal route from other aircraft, but remain subject to environmental performance requirements through the uncrewed aircraft provisions.
- 2.81 Annex III requires products to be designed so as to minimise noise, emissions and emissions arising from the evaporation or discharge of fluids, taking account of the trade-offs between these objectives. It also requires organisations involved in the design, production and maintenance of aviation products to have the means necessary to ensure compliance with the essential requirements.
- 2.82 Articles 57 and 58 provide powers to make detailed rules relating to uncrewed aircraft. These include rules on compliance with the essential requirements in Article 55, certification and product declarations, and the privileges and responsibilities of certificate holders and persons making declarations. Article 58 also provides the Secretary of State a power to amend Annex IX and, where applicable, Annex III, where necessary for reasons of technical, operational or scientific developments or safety evidence related to air operations and to achieve the objective in Article 1.
- 2.83 This provides a legal route through which the essential requirements for uncrewed aircraft, including environmental performance requirements, could be

amended or supported by more detailed rules in response to technical, operational or scientific developments. However, the practical challenge remains that, for many drones and some emerging aircraft types, there are not yet internationally or nationally accepted means of certifying noise emissions, nor a complete set of standards and methods for assessing operational noise exposure and community impact.

- 2.84 The gap identified in paragraph 2.11 is therefore not the absence of any environmental obligation. Rather, the current framework contains broad requirements to minimise noise, but the standards, metrics and assessment mechanisms needed to apply those requirements consistently are still developing. In the absence of accepted international or national standards, national regulators may need to develop interim approaches. This could create practical issues, including duplication between jurisdictions, reduced transparency for stakeholders, less clear lines of regulatory accountability, and additional regulatory burden on industry. The absence of suitable and accepted noise standards for drones and some emerging aircraft types is therefore an area requiring further development.

Aviation Noise (Amendment) (EU Exit) Regulations 2019 (SI 2019/643)

- 2.85 These Regulations were made by the UK government in order to address deficiencies in the legal framework relating to aviation noise arising from the UK's withdrawal from the European Union.
- 2.86 The changes to the legislation relating to aviation noise were the removal of provisions concerning the recognition of noise certificates and exemptions issued by the authorities of EU Member States, and EEA States.
- 2.87 The Regulations came into force at the end of the EU exit implementation period on 31 December 2020.

Aeroplane Noise Regulations 1999 (SI 1999/1452)

- 2.88 These set out the UK's noise certification requirements. The Regulations were made in order to implement the provisions of Directive 89/629/EEC on the limitation of noise emissions from civil subsonic jet aeroplanes, which was subsequently replaced by Directive 2002/30/EC and more recently by the Balanced Approach Regulation (EU) 598/2014.
- 2.89 The Regulations require that all new aeroplanes that are to be registered in the UK must be certified as meeting the noise standards set out in ICAO Annex 16 Volume I, banning the operation of jet aeroplanes that could not meet the Chapter 2 standard, and on or after 1 April 2002, banning the operation of jet and propeller aeroplanes over 34 tonnes or with more than 19 seats that could not meet the Chapter 3 standard or better. The Regulations also set out the noise

certification requirements for existing aeroplanes that are already registered in the UK.

- 2.90 Noise certificates are granted by the CAA and are subject to limits on the maximum total weights at which the aircraft may land or take off, and other conditions relating to noise standards as the CAA thinks fit. This discretion has subsequently been removed by the UK Basic Regulation, which formally requires the CAA to apply noise standards as set in ICAO Annex 16 Volume I, though as set out earlier, where ICAO standards do not apply, the environmental essential requirements in Annexes III and IX continue to apply. The CAA may establish an appropriate project-specific certification basis and means of compliance within its certification functions, while generally applicable requirements would require an appropriate rule-making basis. A noise certificate does not time-expire, but would cease to apply if an aircraft or any part of it is modified so that it no longer complies with the required noise standard, at least until an inspection or test shows that the aircraft does comply with the required noise standard.
- 2.91 An aircraft must carry its noise certificate, which provides at least the following information:
- the State of registry and registration mark of the aircraft;
 - the manufacturer's serial number;
 - the manufacturer's type and model designation;
 - a statement of any additional modifications incorporated for the purpose of compliance with the applicable noise certification standards;
 - the maximum mass at which compliance with the applicable noise certification standards has been demonstrated; and
 - for new aircraft: the noise level or levels and their 90% confidence limits at the reference point or points for which compliance with the applicable noise certification standards has been demonstrated.
- 2.92 The CAA may issue exemptions from certain parts of the requirements if an aircraft does not meet the relevant noise standards. It is otherwise able to prevent an aircraft from taking off and/or detain an aircraft where there is reason to believe that the aircraft is in breach of the regulations.
- 2.93 Considering drones, the UK UAS framework classifies operations into three categories: Open, Specific and Certified. The Open category covers lower-risk operations that may be conducted without prior operational authorisation, provided the operator complies with the applicable operating limits and product requirements. The Specific category covers operations that present a higher or more complex risk and normally require an operational authorisation from the CAA. The Certified category covers the highest-risk operations and requires

certification of the UAS, certification of the operator and, where applicable, licensing of the remote pilot.

- 2.94 This distinction is important for noise policy. A conventional aircraft certification approach is most directly relevant to UAS in the Certified category. However, most current and near-term drone operations are more likely to take place in the Open or Specific categories. For these operations, noise is more likely to be addressed through product-level class-marking requirements, operator responsibilities, operational authorisation conditions, or future policy requirements, rather than through full aircraft noise certification. The regulatory issue is therefore not simply whether drones are subject to environmental protection requirements, but how those requirements can be applied consistently across the different UAS categories. The following regulations consider product standards and operational requirements respectively.

Commission Delegated Regulation (EU) 2019/945 of 12 March 2019 on unmanned aircraft systems and on third-country operators of unmanned aircraft systems (Unmanned Aircraft Product Requirements)

- 2.95 Product requirements are set out in UK Regulation (EU) 2019/945, which establishes technical standards and classification systems for uncrewed aircraft. Following amendments made by the Unmanned Aircraft (Amendment) Regulations 2025, this framework includes UK class markings and product-level noise requirements for some class-marked uncrewed aircraft. These include requirements to determine and indicate the guaranteed A-weighted sound power level, and for certain classes to comply with maximum sound power levels. These provisions provide a useful product-level control, but they do not establish a complete framework for assessing or managing operational noise exposure, cumulative impacts or community response.

Unmanned Aircraft Operational Requirements (Regulation (EU) 2019/947)

- 2.96 This Regulation, as assimilated in UK law following EU Exit, establishes the operational framework for UAS, setting out how and under what conditions uncrewed aircraft may be operated. It was assimilated and amended for UK operation through The Unmanned Aircraft (Amendment) (EU Exit) Regulations 2020⁹ and complements the product requirements in UK Regulation (EU) 2019/945, see above.
- 2.97 Within this framework, UAS.SPEC.050 sets out the responsibilities of the UAS operator in the Specific category. These include a requirement for operators to use an uncrewed aircraft that is designed to minimise noise and other emissions,

⁹ *The Unmanned Aircraft (Amendment) (EU Exit) Regulations 2020* (SI 2020/1593).

<https://www.legislation.gov.uk/uksi/2020/1593/contents/made>

taking into account the nature of the intended operations and the geographical areas in which they are conducted.

- 2.98 This is an important operator obligation, but its practical application differs from the conventional aviation model. For certified aircraft, noise control is normally supported by aircraft certification standards, placing clear obligations on the aircraft design and manufacturer. In the UAS Specific category, the framework is more operation-led, i.e. the operator must consider whether the aircraft and operation are appropriate for the intended environment. In the Certified category, there would likely be a greater expectation that manufacturers or aircraft types meet defined standards, although those standards are not yet fully established for many UAS.
- 2.99 In practice, noise could be considered through operational authorisation where it is relevant to the nature, location or scale of the proposed operation. Existing authorisation processes already provide a route for considering the characteristics of the aircraft, the proposed operating environment and the mitigations needed for safe operation. However, these processes are not currently designed to provide a quantitative or standardised framework for assessing noise. Further policy and legal consideration would therefore be needed to determine how far operational authorisations could be used to apply noise-related requirements, evidence expectations or operating conditions in a consistent way.
- 2.100 While it may be possible in principle to compare aircraft based on relative noise performance, this would require consistent and robust measurement methodologies and comparable data. These are only partly established at present. The product framework under UK Regulation (EU) 2019/945 now includes product-level sound power requirements for some class-marked uncrewed aircraft, but these do not provide a complete basis for assessing operational noise exposure, cumulative impact or community response.
- 2.101 This is particularly important because UAS noise may have different acoustic characteristics from conventional aviation noise, and may be experienced in different operational contexts, including urban, suburban, rural and quieter background sound environments. The response to UAS noise may also vary between individuals and communities in different circumstances, including people who are more sensitive to particular sound characteristics or operational contexts. These issues are considered further in Chapter 3.
- 2.102 Similar to the Basic Regulation Annex IX, this provision therefore highlights an area where the regulatory framework is incomplete rather than wholly absent. An obligation to minimise noise exists, and existing operational authorisation mechanisms may provide partial routes for considering it. However, the standards, metrics, evidence base and approval criteria needed to support consistent and enforceable implementation are not yet fully in place.

- 2.103 Taken together, these provisions show that there are areas of the noise framework for drones and eVTOL aircraft that remain incomplete. For some smaller class-marked UAS, product-level sound power requirements now apply or are being introduced through the UK class-marking framework. However, these requirements do not amount to a comprehensive noise certification regime, nor do they provide a basis for assessing operational noise exposure or community impact. For Certified category UAS, and for larger or more complex emerging aircraft types, further standards and means of compliance may still be needed to provide a clear and consistent route for demonstrating environmental protection requirements.

Airport-specific legislative context

- 2.104 The legislative framework for managing aviation noise in the UK differs depending on whether an airport is formally designated by the Secretary of State. Designation provides for specific, centrally exercised powers in relation to noise control, whereas non-designated airports are primarily subject to local planning and regulatory regimes. This distinction is important in understanding how noise controls are applied in practice across different types of airports.

Designated airports

- 2.105 At designated airports, specific powers are available to the Secretary of State under the Civil Aviation Act 1982 to impose noise-related controls, including limits on aircraft movements and restrictions on night operations. These powers enable direct intervention in response to noise impacts and have historically been applied at the UK's largest and busiest airports.
- 2.106 Section 80 of the Act gives the Secretary of State the power to designate aerodromes for the purpose of controlling aircraft noise. Gatwick, Heathrow and Stansted airports are currently designated for noise control.
- 2.107 Section 78 and Section 79 define the powers for the Secretary of State. Noise control measures may include prohibiting night flights, restricting the total number of flights and imposing noise limits. Penalty schemes can be established and maintained, whereby any aircraft operator that does not comply with certain noise criteria can be fined by the airport, or ultimately an aircraft can be prohibited from taking off or landing. Additionally, the Secretary of State can require the airport to make grants towards the cost of noise insulation to provide protection from aircraft noise in the most exposed areas.

Designated and non-designated airports

- 2.108 In addition, noise management may also be delivered at all airports (whether designated or not) through the planning system and local governance arrangements, with airport operators responsible for implementing noise mitigation measures within the framework set by local planning authorities (or the

Secretary of State in the case of Nationally Significant Infrastructure Project applications, known as Development Consent Orders (DCOs)). National policy places relatively limited direct constraints on airport operations or expansion, and it is therefore through the planning process that the impacts of airport development and operations are assessed, consulted upon with stakeholders, and controlled. Such controls are typically secured through Section 106 agreements, planning conditions, or planning requirements in the case DCO applications:

- Section 106 agreements (planning obligations under Section 106 of the Town and Country Planning Act 1990) are legal agreements between a local planning authority and a developer, used to secure measures necessary to make a development acceptable in planning terms, including noise-related mitigation.¹⁰
- Planning conditions are used to regulate the development or use of land. They are attached to planning permissions and can require the developer to comply with specific requirements or undertake defined actions.

Aviation noise assessment and decision-making

- 2.109 This section brings together the frameworks used to assess aviation noise impacts and the processes through which airspace and operational decisions are made. In practice, these are closely interrelated, with appraisal methodologies informing decision-making.

Assessment and analysis

Environmental Noise (England) Regulations 2006 (SI 2006/2238)

- 2.110 These Regulations implement Directive 2002/49/EC of the European Parliament and of the Council relating to the assessment and management of environmental noise¹¹. The regulations were amended in 2018 to implement Commission Directive (EU) 2015/996 establishing common noise assessment methods according to Directive 2002/49/EC. Separate legislation exists for Northern Ireland, Scotland and Wales.
- 2.111 The Regulations require the Secretary of State to identify agglomerations (urban areas) and major noise sources in England that are exposed to noise from major roads, railways, industrial facilities and major airports. They also require strategic noise maps to be produced for these areas, which show the levels of

¹⁰ Planning Portal (n.d.), *What are Section 106 agreements?*.

<https://www.planningportal.co.uk/services/help/faq/planning/what-are-section-106-s106-agreements/>

¹¹ European Commission (n.d.), *Environmental Noise Directive*.

https://environment.ec.europa.eu/topics/noise/environmental-noise-directive_en

environmental noise to which people are exposed and provide information on the number of people and dwellings affected.

- 2.112 The Regulations also require noise action plans to be prepared, including for major airports and certain other airports giving rise to relevant noise exposure within agglomerations. These plans are informed by the strategic noise maps and are intended to manage noise issues and effects, including reducing environmental noise where necessary, addressing identified priorities and preserving environmental noise quality where it is good. Airport operators are responsible for preparing the relevant airport action plans and submitting them to the Secretary of State for adoption. The process also includes requirements for public participation in the preparation and review of action plans.
- 2.113 The Regulations require the noise indicators L_{den} and L_{night} to be used in strategic noise maps and prescribe the applicable assessment methods. For aircraft noise, the methodology is based on ECAC Doc 29 and is considered further in paragraph 2.32.
- 2.114 The Environmental Noise (England) Regulations 2006 are an important tool for assessing and managing exposure to environmental noise. They help to ensure that people are aware of the noise levels in their area and that steps are taken to reduce noise levels where they are too high.
- 2.115 The regulations apply to noise associated with aircraft taking off from and landing at major airports and to noise from certain other airports affecting nearby agglomerations. Strategic noise maps and action plans must be reviewed at least every five years and, where necessary, revised.
- 2.116 Dispersed drone and eVTOL operations away from major airports are unlikely to be captured comprehensively by the existing strategic noise-mapping and action-planning framework. Operations associated with qualifying airports may be captured to the extent required by the applicable mapping methodology.

Noise impact assessment

- 2.117 A fundamental part of aircraft noise management involves quantifying noise exposure around an airport, i.e. working out the numbers of residents (and/or households) which experience different levels of aircraft noise. This is done using computer modelling. However, this only tells half the story, as the NPSE (see paragraph 2.41 onwards) guides decisionmakers to focus on the numbers of people who are adversely affected by aircraft noise.
- 2.118 People's reactions to aircraft noise are not linearly proportional to the level of noise, and they differ from person to person. The term annoyance is used to describe negative reactions to noise such as disturbance, irritation, dissatisfaction and nuisance. Annoyance can also be accompanied by stress-related symptoms, which may lead to changes in heart rate and blood pressure.

ISO/TS 15666 (2021) Acoustics - Assessment of noise annoyance by means of social and socio-acoustic surveys¹², provides a standardised way of measuring human responses to noise exposure.

- 2.119 Acoustic factors, such as the noise source and sound level, only account for a part of a person's annoyance responses; non-acoustic factors are estimated to account for up to one-third of the variance observed in annoyance reactions.¹³ These include fear associated with the noise source, interference with activities, ability to cope or to control, noise sensitivity, expectations, anger, attitudes to the source, and beliefs about whether noise could be reduced by those responsible.
- 2.120 As with safety, public annoyance or concern about noise may be affected by anecdote, visibility, and media amplification. For example, a single highly visible or disruptive drone noise event may disproportionately shape public opinion, especially in the absence of contextual data.
- 2.121 Aircraft noise occurring principally at night, or at other times when people are sleeping, can also affect sleep. Disturbance can be in terms of immediate effects (e.g. arousal responses, sleep stage changes, awakenings, body movements, total wake time, autonomic responses), after-effects (e.g. sleepiness, daytime performance, cognitive function deterioration) and long-term effects (e.g. self-reported chronic sleep disturbance).
- 2.122 For the purposes of managing aviation noise, it is essential to understand how people are bothered, disturbed or annoyed by different amounts of noise. The noise to which people are subject is referred to as the 'exposure', while the resulting annoyance, sleep disturbance or other effect is the 'response'. By assessing these together, research studies can estimate exposure-response functions. These are statistical relationships representing the proportion of a community likely to be highly annoyed or highly sleep-disturbed at a given level of noise exposure.
- 2.123 Exposure-response functions can be used to assess impacts, evaluate policy interventions and help prioritise mitigation measures. For instance, when combined with noise modelling results, they can be used to estimate the number of people likely to be highly annoyed or highly sleep-disturbed by noise around an airport.
- 2.124 The studies used to determine exposure-response functions are (or should be) based on statistically robust samples of data. Because of the prevalence of civil aviation, it is relatively easy to obtain sufficiently large samples of people to

¹² International Organization for Standardization (2021), *ISO/TS 15666:2021 Acoustics: Assessment of Noise Annoyance by Means of Social and Socio-acoustic Surveys*, Edition 2, May 2021.

¹³ Civil Aviation Authority (2021), *Aircraft Noise and Health Effects: A Six-monthly Update*, CAP 2257, September 2021. <https://www.caa.co.uk/cap2257>

survey who are exposed to aircraft noise over long periods of time. Currently, public exposure to noise from drones and eVTOL aircraft is, however, relatively limited. This constrains the locations and populations available for study, but suitable extended trials and early deployments may provide sufficiently stable and well-characterised exposure to begin developing exposure-response functions. Further studies are likely to be needed as operations become more widespread and representative.

- 2.125 Some exposure-response functions have been published, such as by EASA in their 2021 report¹⁴. This documented a laboratory-based study which aimed to develop a human exposure-response function with respect to single flyover events of both drones and eVTOL aircraft. This is discussed in more detail from paragraph 3.95.
- 2.126 This presents a gap: there is limited exposure-response function information for noise from these types of aircraft, and therefore no accepted means for calculating noise impact from drones and eVTOL aircraft. Some work has been done which indicates there is a difference in attitudes between eVTOL and conventional aircraft, that the effect must be taken into account, and this is covered further in the section on Noise Impact, from paragraph 3.89.

Transport Analysis Guidance (TAG)

- 2.127 The Transport Analysis Guidance (TAG) framework is a suite of software tools and guidance documents developed by the UK DfT. It provides standardised methods for evaluating various impacts, including noise. It therefore enables the costs and benefits of different transport interventions, including airspace changes, to be assessed and used in cost-benefit analysis when making planning decisions or selecting mitigation actions.
- 2.128 One such application is assessing aircraft noise within the context of airspace changes under the CAP 1616 Airspace Change Process. The magnitude and distribution of possible noise changes due to the airspace change proposal are predicted and used as inputs to TAG. Analysts may use the outputs of TAG to monetise the impact of noise changes, enabling anticipated benefits (e.g. improved airspace efficiency) to be compared against estimated costs (e.g. increased noise exposure for communities).
- 2.129 TAG offers a consistent and data-driven approach to decision-making. This relies on there being a consistent and robust method of estimating noise exposure, and also for assessing noise impact on the basis of this exposure. These methods exist for conventional aircraft but, as described in the previous section, they do

¹⁴ European Union Aviation Safety Agency (2021), *Determination of a Human Dose-response with Respect to Single Events of Urban Air Mobility-type Vehicles*, EASA.FC06.SC02.D1, 1 December 2021. <https://www.easa.europa.eu/en/downloads/137148/en>.

not yet exist for drones or eVTOL aircraft due to the lack of robust exposure-response functions.

- 2.130 As discussed in the previous section and further in Chapter 3, there is emerging, but not yet sufficiently robust, evidence that some drones and eVTOL aircraft may be perceived to be more disturbing or annoying than conventional aircraft at comparable levels of noise exposure. We know that drones and eVTOL aircraft, in particular those with multiple rotors, produce noise with characteristics that differ from those of traditional fixed-wing and rotary-wing aircraft, and this may help explain the higher annoyance responses reported in some studies. However, there is currently insufficient reliable evidence to incorporate drone- or eVTOL-specific exposure-response functions into DfT's TAG.
- 2.131 The UK Air Navigation Guidance 2026 adopts an enabling approach, supportive of innovation and learning, to certain airspace trials involving new and emerging airspace users. This reflects the fact that evidence on the operational, environmental and community impacts of emerging technologies is still developing. Where trials provide sufficiently stable and well-characterised noise exposure and an adequate study population, the operational, noise and community-response data gathered could begin to inform the development of exposure-response functions for drones and eVTOL aircraft and, in time, their potential incorporation into DfT's TAG.
- 2.132 The previous environmental assessment guidance in CAP 1616i¹⁵ required a +10 dB(A) correction to be applied to calculated noise-exposure levels for multirotor drones, reflecting evidence that their tonal characteristics could result in greater annoyance than conventional aircraft at the same sound level. That document has now been superseded, and the correction is not reproduced as a general requirement in CAP 1616 version 6, CAP 1616j or CAP 1616k. A wider methodological gap nevertheless remains: TAG cannot currently be applied to drone and eVTOL proposals in a way that is fully robust and comparable with the appraisal of conventional aircraft operations. Further development of appraisal methods and supporting exposure-response evidence will be required to address this.

¹⁵ Civil Aviation Authority (2023), Environmental Assessment Requirements and Guidance for Airspace Change Proposals, CAP 1616i, paras 11.8 and 11.14. Superseded; retained for reference.

Aviation decision-making

Airspace change process, airspace design review, operational authorisation and environmental assessment

- 2.133 CAP 1616 version 6¹⁶ sets out the CAA's overarching process for proposed changes to the notified design of UK airspace. It is supported by CAP 1616j¹⁷, which contains the requirements and guidance for permanent airspace change proposals, and CAP 1616k¹⁸, which addresses non-permanent proposals comprising temporary changes to airspace design and airspace trials.
- 2.134 The process is aligned with the Air Navigation Directions 2026, gives effect to the CAA's duties in section 70 Transport Act 2000, including taking account of the Air Navigation Guidance 2026, and is intended to support proportionate, fair, transparent, consistent and evidence-based decision-making. Safety remains the CAA's primary duty. Subject to that duty, the ANG 2026 establishes a set of Airspace Design Priorities that guides how the CAA balances operational efficiency, environmental impacts, the requirements of aircraft operators and owners, and the interests of other people affected by airspace use. The CAA must also take account of the Airspace Modernisation Strategy when making airspace change decisions.
- 2.135 Airspace design comprises the structures, routes and flight procedures that provide the framework within which aviation activity takes place. It is distinct from airspace management, air traffic management and individual operational approvals, which concern how that framework is used. An airspace change proposal is required where a proposal would change the notified airspace design and could, in the CAA's view, affect existing flight behaviours. A new operational requirement or technology does not necessarily require an airspace change if it can be accommodated within the existing notified design.
- 2.136 This distinction is particularly important for emerging aviation technologies. A UAS or eVTOL operation may require an airspace change, an operational authorisation, other regulatory approvals, or a combination of these. The applicable route depends on the nature of the proposed operation and whether implementation requires the notified airspace design to be changed. The airspace change process does not itself approve the aircraft or operation, and an

¹⁶ Civil Aviation Authority (2026), *Airspace Change Process*, CAP 1616, Version 6.

<https://www.caa.co.uk/cap1616>

¹⁷ Civil Aviation Authority (2026), *Requirements and Guidance on the Airspace Change Process for Permanent Airspace Change Proposals*, CAP 1616j.

¹⁸ Civil Aviation Authority (2026), *Requirements and Guidance on the Airspace Change Process for Non-permanent Airspace Change Proposals*, CAP 1616k.

airspace change approval cannot substitute for any operational authorisation, planning permission or other approval that may also be required.

- 2.137 The airspace change process has separate pathways for permanent and non-permanent proposals. Permanent proposals follow five stages: propose and develop; consult; update and submit; decision; and implement. Non-permanent proposals follow five equivalent steps: initiate; design, assess and engage; update and submit; CAA decision; and implement. The requirements are scalable according to the characteristics and potential effects of the proposal. Permanent proposals are assigned one of three levels, while the scope and detail required for a non-permanent proposal are specified by the CAA in a proposal-specific Step 2 assessment scope plan.
- 2.138 Permanent changes affecting aircraft flight behaviours below 5,000 feet above mean sea level over land will normally be Level 1 proposals. These require detailed consideration of changes in aircraft noise exposure and assessment using the Department for Transport's Transport Analysis Guidance. Level 2 generally applies to changes at or above 5,000 feet over land, or changes over the sea, while Level 3 provides a streamlined route for proposals expected to have low impacts. The process allows environmental assessment requirements to be scaled where a qualitative assessment, supported by appropriate evidence, demonstrates that the proposal will have no relevant effect.
- 2.139 For Level 1 permanent proposals, sponsors are generally required to assess daytime and, where relevant, night-time noise exposure against future baseline scenarios. This includes noise contours at and above the applicable Lowest Observed Adverse Effect Level, population and household exposure, noise-sensitive buildings, and assessment of health and quality-of-life impacts using the aviation noise workbook within the Transport Analysis Guidance. Direct effects and indirect effects caused by consequential changes in the behaviour of other airspace users must be considered. The final decision is not reduced to a numerical exercise, but quantification supports consistency and informs the CAA's application of its statutory duties and the Air Navigation Guidance.
- 2.140 The permanent process now expressly incorporates the Government's sequential airspace design priorities. After safety and viability, designs must enable aviation activity permitted by relevant planning decisions (having regard to air transport demand). For aircraft below 5,000 feet, sponsors must then seek first to minimise changes to areas already experiencing aircraft noise and subsequently to minimise total adverse noise effects as far as practicable and realistic. Flight efficiency is prioritised for aircraft at and above 5,000 feet. This approach links airspace design more explicitly to planning decisions while maintaining a distinct role for the environmental assessment of the airspace change itself.

- 2.141 The non-permanent process applies both to temporary changes to airspace design and to airspace trials. A temporary change is introduced for a limited operational requirement and would normally last no more than 180 consecutive days. An airspace trial may test or evaluate innovative airspace designs, technologies or operational procedures, assess their effects, or support the development and integration of new airspace users. A trial would normally last no more than three years. Approval of a non-permanent change creates no presumption that the arrangement will subsequently be approved on a permanent basis.
- 2.142 At the beginning of the non-permanent process, the sponsor submits a statement of need and briefs the CAA. The CAA then prepares and publishes a Step 2 assessment scope plan. This determines, on a case-by-case basis, the assessments, evidence and engagement required, having regard to the proposal's nature, scale, complexity, duration and anticipated effects. Depending on the proposal, this may include safety and policy, operational, planning, noise, protected-areas and European-sites assessments.
- 2.143 For most non-permanent proposals affecting the distribution of air traffic below 5,000 feet, the noise assessment will include operational diagrams, flight frequencies, timings and typical altitudes. Where a proposal lasts for less than one year, the prescribed assessment generally considers exceedances of 65 dB $L_{A_{Smax}}$ during the day and 60 dB $L_{A_{Smax}}$ at night at key locations. For proposals lasting for more than one year but less than three years, corresponding noise footprints are required for the loudest and most frequent participating aircraft, together with equivalent information showing where participating and consequentially affected aircraft would otherwise have flown.
- 2.144 A specific, time-limited policy applies to certain UAS proposals. In accordance with the Air Navigation Guidance 2026, the CAA is not required to take account of environmental impacts when considering an airspace trial proposed to enable UAS flights for policy development and learning, or a temporary airspace change proposed to facilitate government policy for enabling new airspace users and promoting economic growth. This is an exemption from the ordinary noise-assessment requirement for the specified proposals, rather than a conclusion that the operations will have no environmental effects. It does not remove the requirements to assess effects on protected areas or European sites.
- 2.145 For UAS proposals falling within that exemption, sponsors must monitor and report noise complaints. The Air Navigation Guidance also states that noise attitude surveys should be undertaken as a condition of sufficient trials to build the evidence base needed for future government policy. The CAA will identify through the Step 2 assessment scope plan whether a particular proposal must include a noise attitude survey. The specific UAS arrangements are expressly

transitional and are intended to apply while a definitive policy for UAS noise is developed.

- 2.146 Airspace trials must be supported by a trial plan setting out the purpose of the trial, the questions to be answered, the evidence to be collected, monitoring arrangements, success criteria and how outcomes will be assessed. A trial may proceed in phases where evidence from an earlier phase is needed before a later phase can begin. The CAA may require further impact assessment or engagement before allowing progression between phases, and the sponsor must produce a post-trial report covering outcomes, evidence gathered, complaints or feedback and any responsive action. These provisions provide a potential framework for generating real-world evidence on UAS noise where appropriately designed research is included from the outset.
- 2.147 The non-permanent process also expressly recognises that UAS operational authorisation may proceed as a parallel activity, including applications based on the UK Specific Operations Risk Assessment. Information, evidence or assurance produced through an operational authorisation, planning process or another regulatory activity may be used to satisfy parts of the airspace change process where the CAA considers this appropriate. This is intended to avoid unnecessary duplication, although each applicable approval remains distinct and the sponsor must manage dependencies between them.
- 2.148 Some UAS operations may be authorised without requiring any amendment to the notified airspace design. This may include some operations in an Atypical Air Environment under CAP 3040¹⁹. An Atypical Air Environment describes a volume in which crewed aircraft are unlikely to be encountered because of the characteristics of the operating environment. It is not a separate airspace classification and adopts the classification of the surrounding airspace. Consequently, its use does not itself engage CAP 1616, although an appropriate operational authorisation and any other applicable approvals remain necessary.
- 2.149 The environmental implications of such operations will therefore not necessarily be considered through the airspace change process. CAP 3040 addresses the air-risk case for the operation and is not an environmental approval framework. An operational authorisation may consider noise where relevant to the proposal or where policy requires it, but it does not currently provide an assessment process equivalent to the environmental requirements that apply to an airspace change. This remains a potential source of inconsistency where operations with similar noise effects follow different regulatory routes.

¹⁹ Civil Aviation Authority (2025), *Unmanned Aircraft Operations in an Atypical Air Environment: Policy Concept*, CAP 3040, Third Edition. <https://www.caa.co.uk/cap3040>

- 2.150 Where CAP 1616 applies, the form of public involvement differs between permanent and non-permanent proposals. Permanent proposals require proportionate consultation with stakeholders likely to be positively or negatively affected. For Level 1 proposals this includes affected communities, elected representatives and relevant representative bodies. The sponsor must provide accessible information about the proposal and its effects, conscientiously consider responses, and explain how feedback has or has not influenced the final design. For particularly significant permanent proposals, the CAA may also convene a public evidence session.
- 2.151 Non-permanent proposals use a more targeted engagement model. Engagement during Step 2 primarily concerns aviation stakeholders and whether the proposed arrangement is safe and operationally viable. However, where a noise assessment identifies people likely to be affected, the sponsor must inform them before implementation, provide the noise assessment and explain the reasons for and duration of the change. The sponsor must provide a complaints mechanism, monitor and report noise complaints, and consider responsive action where relevant issues arise. This is not equivalent to the full public consultation required for a permanent proposal, but it introduces specific transparency and accountability requirements during implementation.
- 2.152 The Air Navigation Directions 2026 also require the CAA to keep UK airspace design under review, determine whether it reflects the Airspace Modernisation Strategy and decide whether it should be amended. The CAA will do so taking account of the Air Navigation Guidance 2026. This review process provides a further means of identifying and enabling changes to airspace designs that could support emerging aviation technologies.
- 2.153 Changes to air traffic control operational procedures that do not alter the notified airspace design are outside CAP 1616, although a planned and permanent redistribution of air traffic may fall within CAP 1617²⁰. CAP 1618²¹ separately provides guidance on transparency where airspace use or aircraft movements change outside the formal airspace change process. Neither document is, by itself, a general alternative approval mechanism for integrated UAS or eVTOL operations. Their relevance will depend on whether the proposed activity satisfies the scope and legal conditions of the applicable process.
- 2.154 Overall, the revised framework provides a clear and proportionate route for permanent changes, temporary changes and trials involving emerging airspace users. It also creates a specific mechanism through which sufficient UAS trials

²⁰ Civil Aviation Authority (2023), *Planned and Permanent Redistribution of Air Traffic*, CAP 1617. <https://www.caa.co.uk/cap1617>

²¹ Civil Aviation Authority (2023), *Airspace Information: Transparency about Airspace Use and Aircraft Movements*, CAP 1618. <https://www.caa.co.uk/cap1618>

can contribute noise complaints, attitude-survey findings and other evidence to the development of future policy. Nevertheless, environmental noise may still be treated differently depending on whether an operation requires an airspace change or proceeds through operational authorisation within the existing airspace design. The principal remaining issue is therefore how to achieve an appropriately consistent and proportionate approach to noise assessment, engagement, monitoring and mitigation across these different approval routes.

Environmental Information Duties, Civil Aviation Act 2012

- 2.155 The Civil Aviation Act of 2012 introduced specific environmental information duties for the CAA. These duties require the CAA to publish information about the environmental effects of aviation, including noise, with the aim of improving transparency and enabling both consumers and wider stakeholders to make informed decisions and better understand the impacts of aviation. The Act outlines these duties in sections 83, 84 and 85.
- Section 83 requires the CAA to publish (or arrange for the publication of) information and advice for the benefit of users of air transport services (passengers and cargo owners). This includes publishing information to assist users in comparing available services and facilities at airports. The CAA may also carry out, commission, or provide financial or other support for research to support this publication.
 - Section 84 focuses on environmental information for the general public. The CAA is tasked with publishing information and advice about the environmental effects of civil aviation in the UK, encompassing emissions, noise, and the measures taken to minimise these adverse effects. As with section 83, the CAA may undertake or support research to fulfil this function.
 - Section 85 gives the CAA the power to require persons to provide information or documents reasonably required for the purposes of carrying out its functions under sections 83 and 84.
- 2.156 These powers allow the CAA to gather and commission information to support its environmental information duties. However, they do not extend to requiring others to create new data that does not already exist. Much of the environmental information that the CAA currently publishes is produced in response to other statutory obligations, directions or guidance. For instance, Article 87 of the Basic Regulation imposes a statutory duty on the CAA to report on the harmful effects of aviation.
- 2.157 These provisions may support the CAA's publication of information about the environmental effects of drone and eVTOL activity within the scope of its statutory functions. However, they do not by themselves establish the operational reporting, data-creation or monitoring requirements needed for a complete noise regime.

- 2.158 Collectively, these frameworks define how noise impacts are assessed and how airspace and operational decisions are made in practice. They have been developed primarily for conventional aviation and rely on mature evidence bases, established metrics and standardised appraisal approaches. As discussed, their direct applicability to emerging aviation technologies is limited, and both DfT and the CAA are actively consulting on how some of these frameworks should evolve to support new forms of aviation while maintaining appropriate environmental protections, alongside the changes needed for traditional aviation.

Operational and regulatory constraints

- 2.159 This section describes the operational and regulatory constraints that determine how aircraft may be flown in practice. These frameworks are not designed primarily as noise policy instruments, but they can have a significant influence on noise impacts by constraining flight profiles, altitudes and operating environments.
- 2.160 These constraints are primarily set out in the Standardised European Rules of the Air (SERA) for manned aviation, which establish baseline operational requirements such as minimum heights and separation distances. The CAA's Official Record Series 4 (ORS4) provides general permissions and authorisations which enable exemptions from certain SERA provisions, allowing operations to be conducted in accordance with established UK procedures and practices.

Official Record Series 4, No. 1496. UK Regulation (EU) No.923/2012 General Permissions and Authorisations

- 2.161 The Official Record Series 4 (ORS4) sets out these general permissions and authorisations in detail, enabling exemptions from certain provisions of SERA, including minimum height requirements. These permissions allow aircraft to operate in accordance with established UK procedures and practices, making use of the flexibility provisions within SERA where appropriate.
- 2.162 Under SERA.5005(f)(2), aircraft operating under visual flight rules (VFR) are generally required to maintain a minimum height of 500 ft above the ground or water, or a minimum distance of 150 m above the highest obstacle. The aircraft must be flown a minimum distance of 500 ft from any person, vessel, vehicle or structure. ORS4 sets out the circumstances in which the CAA permits operations below these minima. These provisions apply primarily to crewed aviation and do not generally govern uncrewed aircraft operations, which are regulated under a separate UAS framework.
- 2.163 In particular, ORS4 includes general permissions for day VFR flights which allow aircraft to operate below the standard minimum height and distance requirements, subject to conditions. These include that such operations must not

take place over congested areas of cities, towns or settlements, or over open-air assemblies of people, unless otherwise specifically authorised by the CAA.

- 2.164 This framework has been developed primarily for conventional aviation operations and may not be directly applicable to emerging aviation technologies such as drones and eVTOL aircraft. It therefore may require adaptation if these new technologies and their operational modes are to be fully accommodated within the regulatory framework.

Unmanned Aircraft (Amendment) Regulations 2025 (SI 2025/1106)

- 2.165 The Unmanned Aircraft (Amendment) Regulations 2025 introduce a range of technical and operational updates to the UK's regulatory framework for drones, focusing primarily on safety, classification, remote identification and operator accountability. The Regulations also introduce product-level noise requirements for some class-marked uncrewed aircraft. These requirements do not amount to a comprehensive framework for managing operational noise impacts, but they provide an important building block for future policy and regulatory control.
- 2.166 In particular, the UK class marking framework introduces requirements relating to the guaranteed A-weighted sound power level (L_{WA}) of certain uncrewed aircraft. For UK1 and UK2 non-fixed-wing uncrewed aircraft, manufacturers must determine the guaranteed L_{WA} in accordance with the noise test code in Part 13 of the Annex, ensure that it does not exceed the maximum levels set out in Part 15, and affix the guaranteed sound power level to the aircraft and/or its packaging in accordance with Part 14. The Part 15 limits are set by class and mass, with transition periods reducing the applicable limits over time. For UK1 and UK2 aircraft below 900 g, the maximum L_{WA} is 85 dB from entry into force, reducing to 83 dB after two years and 81 dB after four years. For UK2 aircraft from 900 g to below 4 kg, the limit is determined by a mass-based formula. UK3, UK5 and UK6 aircraft are also subject to requirements to indicate the guaranteed sound power level, although the Part 15 maximum sound power limits apply only to UK1 and UK2 aircraft.
- 2.167 These provisions are significant because they require some smaller class-marked uncrewed aircraft to meet, declare and display a product-level noise emission value. However, the provisions should not be interpreted as a complete noise certification or impact assessment regime. Sound power level is a property of the aircraft under defined test conditions and is not the same as the sound pressure level experienced by people on the ground. The requirements also do not address cumulative exposure, number of operations, operating height, flight procedures, time of day, background sound environment or community response. They are therefore useful for product-level control and transparency, but do not replace the need for methods to assess operational noise exposure and impact.

- 2.168 The Regulations also mandate Direct Remote Identification (DRI) functionality for a range of class-marked UAS. This requires the broadcast of real-time information such as the drone's operator registration number, aircraft serial number, timestamp, geographical position and height, route course, ground speed and the position of the remote pilot or take-off point. This is coupled with a requirement for each drone to have a visible or digitally accessible unique identifier. These measures improve traceability and accountability and create a viable basis for linking complaints or noise monitoring to specific operators or flights. Some DRI provisions are introduced progressively. In particular, from 1 January 2028 certain class-marked uncrewed aircraft will be required to prevent take-off if the DRI system is not functioning as required, strengthening compliance and enforcement mechanisms.
- 2.169 The legislation also reinforces geo-awareness functionality, requiring all qualifying drones to alert pilots when entering airspace that is subject to regulatory restrictions. Geo-awareness functionality provides an opportunity for drones to receive and use information relating to airspace restrictions or conditions that apply to their location. If an appropriate legal and policy framework were established, similar geospatial capabilities might in future help communicate or implement location-based environmental operating conditions, for example by supporting geographically defined restrictions designed to protect particularly sensitive locations from adverse environmental impacts.
- 2.170 These provisions build on and begin to diverge from the EU-derived product framework established under Regulation (EU) 2019/945, reflecting the UK's move towards a distinct regulatory approach. The Regulations formalise the UK's move away from the EU drone class structure (C0–C6) towards a UK classification system (UK0–UK6). While the immediate effect is on product labelling, conformity assessment and operational eligibility, the framework creates the potential for future policy differentiation between classes with different noise performance characteristics.
- 2.171 The CAA is designated under the Regulations as the UK's market surveillance authority for uncrewed aircraft. This strengthens the regulator's powers to ensure that products on the UK market comply with applicable technical standards. As noise performance requirements are now included for some classes, the market surveillance role may include ensuring that relevant sound power level requirements, declarations and markings are properly applied.
- 2.172 Although the Regulations are primarily concerned with product standards, safety, security and accountability, their noise, remote ID and geo-awareness requirements create regulatory infrastructure that may support future noise and broader environmental policies. However, the Regulations do not themselves establish a comprehensive noise management framework. As such, they

represent a valuable enabling step toward a more comprehensive approach to managing the environmental impact of drone operations in the UK.

- 2.173 While these operational frameworks are not designed primarily as noise policy instruments, they play an important role in shaping the noise impacts experienced by communities by influencing how and where aircraft can operate.

Chapter 2 summary

- 2.174 This chapter has reviewed the existing UK framework for regulating and managing aviation noise, drawing together the strategic policy framework, airport noise management measures, aircraft noise certification requirements, assessment and decision-making processes, and the wider operational rules that shape how aircraft may be flown in practice. Taken together, these provide a substantial and mature framework for conventional aviation noise management.
- 2.175 They have, however, largely been developed for traditional fixed-wing and rotary-wing aviation, and do not yet provide a complete or fully coherent basis for managing noise from drones and eVTOL aircraft. The remainder of this section therefore summarises the areas in the existing framework that would need to be addressed to support effective noise policy for these technologies.

Gaps in existing aviation noise regulation and management

- 2.176 The most fundamental gaps are at the front end of the system. For many drones and eVTOL aircraft, while broad environmental obligations exist, there are not yet internationally accepted noise standards or limits, recognised methods for measuring, evaluating and certifying noise emissions, internationally recognised methods for calculating operational noise exposure, or accepted approaches for quantifying noise impact in terms of human response. In practical terms, this means that several of the core technical building blocks on which conventional aviation noise policy depends are not yet in place for emerging aviation technologies. Corresponding gaps have been identified in noise certification requirements and standards, noise measurement and exposure modelling standards, and exposure-response functions.
- 2.177 A second set of gaps arises in the application of the existing policy framework. The ICAO Balanced Approach remains a relevant overarching structure and, in principle, applies to aircraft generally, including drones and eVTOL aircraft. However, some of its practical implementation mechanisms do not translate well. In particular, the existing operating restrictions regime under Regulation (EU) 598/2014 and its associated domestic arrangements is focused on larger conventional fixed-wing aircraft and larger airports, meaning drones and most near-term eVTOL designs fall outside that regime in practice. The land-use planning pillar also has limitations for distributed delivery operations that intentionally bring aircraft close to residential areas, although it may remain

important for the location and design of fulfilment centres, vertiports and other fixed infrastructure. This suggests a potential gap in the current noise-management framework for drone and near-term eVTOL operations between the conceptual applicability of the Balanced Approach and the legal tools currently available to implement it consistently across dispersed and lower-altitude operations. Other mechanisms, including operational authorisations, airspace change processes, planning controls and site-specific procedures, may provide partial routes for applying controls, but their ability to deliver a coherent and proportionate noise-management framework requires further clarification and a clear policy objective(s) to implement.

- 2.178 A third set of gaps concerns policy, appraisal and decision-making. Existing frameworks such as the Air Navigation Guidance, the Environmental Noise Regulations, TAG and CAP 1616 all continue to provide important structure, but they were developed primarily around conventional aviation operations and mature evidence bases. As a result, they do not yet provide a fully robust basis for assessing drone and eVTOL noise proportionately and consistently, nor policy on how it should be balanced against competing government policy objectives. The chapter identifies, in particular, that dispersed drone and near-term eVTOL operations away from major airports are unlikely to be captured comprehensively by the Environmental Noise Regulations; TAG cannot currently be applied in a way that is fully robust, consistent and comparable with the appraisal of conventional aviation operations; and the environmental assessment undertaken may differ depending on whether an operation requires an airspace change or proceeds through operational authorisation or another route. The Air Navigation Guidance 2026 and CAP 1616 Airspace Change Process Version 6 now provide separate, proportionate processes for permanent and non-permanent airspace changes. They also establish specific transitional arrangements for certain UAS trials and temporary airspace changes, including complaint monitoring and the possible use of noise attitude surveys to inform future policy. However, operations that do not require a change to the notified airspace design may still proceed without an equivalent standardised noise-assessment framework. A definitive noise policy for UAS operations and the supporting evidence base therefore remain under development.
- 2.179 The chapter also highlights an important distinction between explicit noise policy instruments and broader operational or product regulations. Although rules such as SERA, ORS4, the Unmanned Aircraft Operational Requirements and the 2025 Unmanned Aircraft Regulations are not comprehensive noise policy instruments in themselves, they will materially shape how, where and by whom noise is generated. The UAS framework also contains express obligations to minimise noise, while the UK class-marking framework now includes product-level sound power requirements for some uncrewed aircraft. Some of these frameworks create useful enabling infrastructure, for example through remote

identification, geo-awareness, product classification and market surveillance. These do not fill the core policy gaps identified above, or provide a complete basis for assessing operational exposure, cumulative impacts or community response, but they could support future noise controls, enforcement and differentiation between aircraft types if government chooses to develop them further.

- 2.180 Overall, the gaps identified in this chapter can be understood under five connected themes:
1. Noise certification
 2. Noise exposure and impact assessment
 3. Application of the Balanced Approach
 4. Coverage within policy, guidance and legislation
 5. Decision-making, oversight and regulation
- 2.181 The first three themes are the technical building blocks needed to apply the existing aviation noise management framework effectively to drones and eVTOL aircraft. The latter two concern how those technical capabilities are then embedded into policy, regulatory and governance arrangements. The gaps are therefore best understood as areas in which the existing framework is incomplete or not consistently applicable, rather than as an absence of environmental obligations or regulatory controls. The central challenge is to translate broad obligations and available regulatory powers into clear, proportionate and consistently applied standards, assessment requirements and controls across the different routes through which operations may be approved.
- 2.182 The following chapters therefore address these themes in turn: Chapter 3 considers how the technical gaps around certification, exposure and impact might be addressed, Chapter 4 explores policy options using the Balanced Approach structure, and Chapter 5 considers the governance framework needed to support implementation.

Chapter 3

Noise certification, exposure and impact

- 3.1 As highlighted in the previous chapter, while broad environmental obligations exist for drones and eVTOL aircraft, there are not yet internationally accepted noise standards or limits, or recognised methods for measuring, evaluating and certificating the noise emissions of many drone and eVTOL aircraft types. In particular ICAO Annex 16 Volume I does not currently contain environmental protection standards specifically developed for these aircraft categories.
- 3.2 There are also not yet internationally recognised methods for calculating operational noise exposure from drones and eVTOL aircraft, nor are there established approaches for assessing their noise impacts on people that are comparable to those used for conventional aircraft.
- 3.3 This chapter sets out some possible approaches to address these gaps in noise certification, and in the assessment of noise exposure and impact.

Noise certification

- 3.4 In the absence of internationally accepted noise certification standards for many drone and eVTOL aircraft types, Chapter 2 noted that the UK Basic Regulation nevertheless requires uncrewed aircraft to comply with environmental performance requirements through Annex IX and Annex III. Applying these requirements in practice requires robust and widely accepted methods for measuring and assessing noise from these types of aircraft. While several approaches are emerging internationally, these do not yet provide a complete and consistently applicable UK framework for all drones and eVTOL aircraft.

Progress so far

- 3.5 In 2020, CAA developed draft guidelines for measuring noise from drones and assessing noise as part of the environmental assessment of applications to operate, where a CAA decision was sought. At that time there was little demand for these, however they were used as a basis for the early proof-of-concept measurements undertaken by ERCD and first published in 2023.²²
- 3.6 Since then, entities such as EASA and the British Standards Institute (BSI) have published guidance and environmental technical specifications. In the US, the

²² Civil Aviation Authority (2025), Noise Measurements from eVTOL Aircraft: A Review of Available Data, CAP 2506, June 2025, first published 2023, Appendix C. <https://www.caa.co.uk/cap2506>

FAA has also set standards with maximum noise levels through imposing conditions on individual applicants.

EASA noise measurement guidelines

- 3.7 On 12 June 2023, EASA released its Guidelines on Noise Measurement of Unmanned Aircraft Systems Lighter than 600 kg Operating in the Specific category (Low and Medium Risk), as revised on 11 September 2023. As stated in the title, these Guidelines are for the measurement of the noise of drones with a maximum take-off mass (MTOM) of 600 kg or less, and are offered as a means for measuring the noise of drones operated in the Specific category. There is currently no obligation for manufacturers or operators to measure noise according to these Guidelines, but they may do so voluntarily. The intent is that the resulting measured noise levels could then be reported to EASA and contribute to an online data repository. There are no maximum noise levels defined in these Guidelines.
- 3.8 These Guidelines preceded the EPTS documents described below, however, there are some similarities in the content, since both are based on the existing ICAO noise certification standards. For example, the Guidelines specify a level-flight procedure and also a hover procedure for any uncrewed aircraft capable of stationary flight. However, whereas the EPTS documents require the measurement of Effective Perceived Noise Levels (EPNL, see paragraph 3.17) during take-off, overflight and approach, the Guidelines specify that noise during level-flight is measured using the conventional A-weighted Sound Exposure Level metric (SEL).
- 3.9 Because of differences in the specified measurement and test procedures and the associated noise metrics, there is no straightforward way to relate noise levels from the Guidelines with the following EPTS.
- 3.10 If noise limits or comparative criteria are subsequently developed using this methodology and eventually added to these Guidelines, it will be challenging to ensure these smaller vehicles (<600 kg) are quieter than larger vehicles that will qualify for the EPTS.

EASA Environmental Protection Technical Specifications (EPTS)

- 3.11 In Europe, in response to applications for the certification of aircraft with vertical take-off and landing (VTOL) capability, i.e. VTOL Capable Aircraft (VCA), EASA has developed technical specifications which serve as an interim measure pending their development of detailed environmental protection requirements under the delegated powers of Article 19(1)(a) for 'manned' aircraft, and under Article 58(1)(a) for 'unmanned' aircraft. These provisions remain relevant to the UK because the UK Basic Regulation derives from the same EU regulatory instrument, although subsequent UK and EU requirements may diverge.

- 3.12 EASA has published two Environmental Protection Technical Specification (EPTS) documents titled:
- Environmental Protection Technical Specifications applicable to VTOL-capable aircraft powered by non-tilting rotors²³.
 - Environmental Protection Technical Specifications applicable to VTOL-capable aircraft powered by tilting rotors²⁴.
- 3.13 These specifications were initially developed as separate documents reflecting different propulsion configurations. More recently, EASA has proposed consolidating these into a single framework through Notice of Proposed Amendment (NPA) 2025-03, with a view to establishing a more unified and formalised set of environmental protection requirements at the European level.
- 3.14 EASA intentionally called these documents ‘specifications’ rather than ‘standards’. As such, EPTS are not regulatory standards in their own right, but technical specifications, based on ICAO Annex 16 Volume I noise certification standards, that may be used by competent authorities as part of a certification basis:
- For aircraft with non-tilting rotors, they are based on Chapter 8 Helicopter Noise Standards but adapted for VTOL aircraft.
 - For aircraft with tilting rotors, they are based on Chapter 13 tilt-rotor standards (which themselves originated from Chapter 8 helicopter standards), to which they have applied the most stringent noise limits from Chapter 8; more details are given from paragraph 3.19.
- 3.15 The EPTS documents also include noise evaluation metrics, reference conditions, test procedures, and reporting requirements.
- 3.16 These specifications apply to VTOL-capable aircraft (VCA) and certification cases within their stated scope. A VCA is defined as a power-driven, heavier-than-air aircraft, other than aeroplane or rotorcraft, capable of performing vertical take-off and landing by means of lift and thrust units used to provide lift during take-off and landing. One EPTS applies to VCA powered by non-tilting rotors, while the other applies to VCA powered partially or exclusively by tilting rotors. Separately, EASA’s voluntary Guidelines described in the preceding section address noise measurements for UAS with a maximum take-off mass of 600 kg

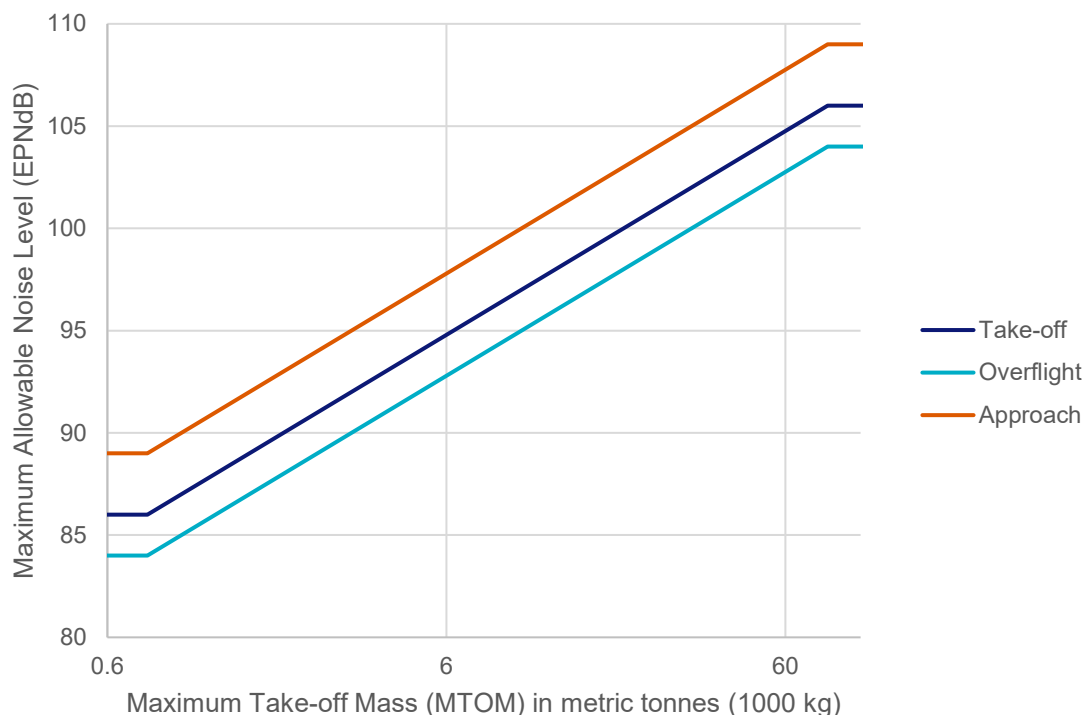
²³ European Union Aviation Safety Agency (2023), *Environmental Protection Technical Specifications Applicable to VTOL-capable Aircraft Powered by Non-tilting Rotors*, 12 December 2023.
<https://www.easa.europa.eu/en/downloads/139022/en>

²⁴ European Union Aviation Safety Agency (2024), *Environmental Protection Technical Specifications Applicable to VTOL-capable Aircraft Powered by Tilting Rotors*, 15 July 2024.
<https://www.easa.europa.eu/en/downloads/140184/en>

or less operating in the Specific category. The 600 kg scope of those Guidelines should not be interpreted as establishing a universal boundary between the Guidelines and the EPTS for every aircraft or certification case.

- 3.17 The noise metric used is the Effective Perceived Noise Level, EPNL. EPNL includes an allowance for tonal noise, but it may not fully capture the distinctive tonal and modulating characteristics of noise from aircraft with multiple rotors and motors. Although studies of drone noise suggest that EPNL may not perform significantly better than A-weighted sound exposure level (SEL) in predicting human response, its use in the EASA specifications provides consistency with existing ICAO noise standards for helicopters.
- 3.18 Take-off, overflight and approach procedures are defined, as are reference points and measurement points. Hover procedures are also defined, however the 30-second L_{Aeq} metric ($L_{Aeq,30s}$) is used instead of EPNL. Whereas take-off, overflight and approach EPNLs are measured using microphones mounted at the standard height of 1.2 m above ground, measurements of hover noise are to be made with an inverted microphone over a ground plate. The same ground microphone setup is specified in ICAO Annex 16 Volume I for the noise certification of light propeller-driven aeroplanes, since it minimises ground reflection effects that can occur when compared to using a microphone mounted at the standard height of 1.2 m.
- 3.19 Maximum allowable noise levels are identical for both specifications (i.e. for both VCAs with tilting or non-tilting rotors). They are specified for each of the reference procedures, which are a function of the maximum certificated take-off mass of the aircraft between 788 kg and 80 tonnes. The maximum allowable noise levels are illustrated in Figure 2.
- 3.20 Although the specifications define a hover procedure, no maximum noise level has been set for that condition. This is consistent with the approach for helicopters, where maximum hover noise levels have not been established. However, hover may be more significant for some drone operations, particularly commercial delivery services, where aircraft may hover at relatively low height, close to homes or other sensitive receptors, and potentially with repeated events over time. The absence of a maximum hover noise level should therefore not be interpreted as meaning that hover noise is unlikely to be relevant; rather, it indicates an area where operational evidence and community response may need to be monitored as services develop.

Figure 2: EASA Maximum allowable noise levels vs Maximum take-off mass (presented for 600 kg to 100 tonnes)



3.21 In August 2025, EASA issued a Notice of Proposed Amendment²⁵ which proposed:

- to create a delegated act to include detailed noise requirements applicable to vertical take-off and landing (VTOL)-capable aircraft (VCA) and a decision on the related acceptable means of compliance (AMC) and guidance material (GM); and
- to amend Annex I (Part 21) to Commission Regulation (EU) No 748/2012²⁶ for consistent implementation of the proposed new delegated act, and the related AMC and GM.

3.22 The proposed regulatory material is expected to ensure that new VCA are designed to minimise noise; to provide a level playing field for manufacturers; to provide certified noise levels for reference to the competent authorities responsible for land-use planning and for granting VCA operational

²⁵ European Union Aviation Safety Agency (2025), NPA 2025-03: Environmental Protection Requirements for Products Not Covered by ICAO Annex 16: Noise Requirements for VCA, 22 August 2025. [NPA 2025-03](#)

²⁶ Commission Regulation (EU) No 748/2012 laying down implementing rules for the airworthiness and environmental certification of aircraft and related products, parts and appliances, and for the certification of design and production organisations, OJ L 224, 21 August 2012, pp. 1–85. [Commission Regulation \(EU\) No 748/2012](#)

authorisations; and to maintain a high level of environmental protection in Europe.

- 3.23 In other words, EASA consulted on proposals to combine the EPTS for VCAs powered by tilting and non-tilting rotors into a single document, and they intend to make that an EU Requirement via a delegated act for adoption by the European Commission.
- 3.24 In the UK, the relevant EASA EPTS for tilting-rotor or non-tilting-rotor configurations have been used to define the noise certification basis for individual aircraft certification projects. Applicants have therefore been required to demonstrate compliance with the requirements set out in the applicable EPTS. On 1 April 2026, however, the CAA published corresponding UK EPTS for VTOL-capable aircraft powered by non-tilting rotors and tilting rotors, incorporating the respective EASA EPTS and identifying them as an acceptable basis for demonstrating compliance with UK noise type-certification requirements.^{27,28}
- 3.25 This approach enables the CAA to demonstrate compliance with the essential environmental protection requirements set out in Annex III of the UK Basic Regulation, in the absence of applicable ICAO Annex 16 noise standards.
- 3.26 Noise certificates issued by the CAA in advance of any update to ICAO Annex 16 are expected to reference compliance with the applicable UK EPTS, or other certification basis agreed for the aircraft, rather than an ICAO Annex 16 Chapter. This reflects the current absence of internationally agreed standards and provides a transparent means of demonstrating that the aircraft meets the intent of applicable environmental protection requirements.

British Standards Institute (BSI) noise measurement guidelines

- 3.27 BS ISO 5305:2024 Noise measurements for UAS (unmanned aircraft systems) was published in January 2024 and specifies methods for recording the time history of instantaneous sound pressure in several positions around rotor powered drones with an MTOM of less than 150 kg in accordance with ISO

²⁷ Civil Aviation Authority (2026), *UK.EPTS.VCA-NonTR Issue 1: Environmental Protection Technical Specifications Applicable to VTOL-capable Aircraft Powered by Non-tilting Rotors*, 1 April 2026. [UK.EPTS.VCA-NonTR Issue 1](#)

²⁸ Civil Aviation Authority (2026), *UK.EPTS.VCA-TR Issue 1: Environmental Protection Technical Specifications Applicable to VTOL-capable Aircraft Powered by Tilting Rotors*, 1 April 2026. [UK.EPTS.VCA-TR Issue 1](#)

21895^{29,30}. The drone can be either electrically powered or liquid fuel powered. It is not applicable to the tilt-rotor or tilt-wing drones.

3.28 This document can also be applied to measure the sound pressure from a drone with either multiple rotors or a single rotor.

3.29 This document specifies:

- recommendations and requirements for test facilities comprising anechoic chambers, anechoic wind tunnels and outdoor environments for the noise measurements of various categories of multirotor-powered drones.
- recommendations and requirements for the configuration of noise measurement for multirotor-powered drones in hover, vertical take-off and landing, and horizontal cruise; and
- recommendations for the test configuration and procedures to minimise the influence of meteorological effects.

3.30 It does not, however, cover drone noise certification or regulation. Requirements for the evaluation of sound pressure levels are also not specified, although several common noise metrics are recommended on an informative basis, including $L_{A\text{Smax}}$ and SEL. The BS ISO document therefore provides useful measurement guidance, but is less directly suited than the EASA Guidelines to establishing regulatory certification levels or assessing operational exposure.

FAA maximum permitted noise levels

3.31 In the absence of generally applicable noise certification standards for drones presented for certification, the FAA has established model-specific standards through Rules of Particular Applicability.³¹ Each has a common link back to ICAO Chapter 11 for Helicopters not exceeding 3,175 kg MTOM, i.e. 'light' helicopters. Chapter 11 uses SEL as the noise indicator, thus these standards are different to the EASA standards which are based on Chapters 8 and 13. Whilst there is no precise relationship between SEL and EPNL, the maximum permitted noise levels in Chapter 11 were intentionally established to be more stringent than the EPNL limits in Chapter 8. As described below in paragraph 3.33, the US FAA has adapted the Chapter 11 limits to make them more stringent for application to drones.

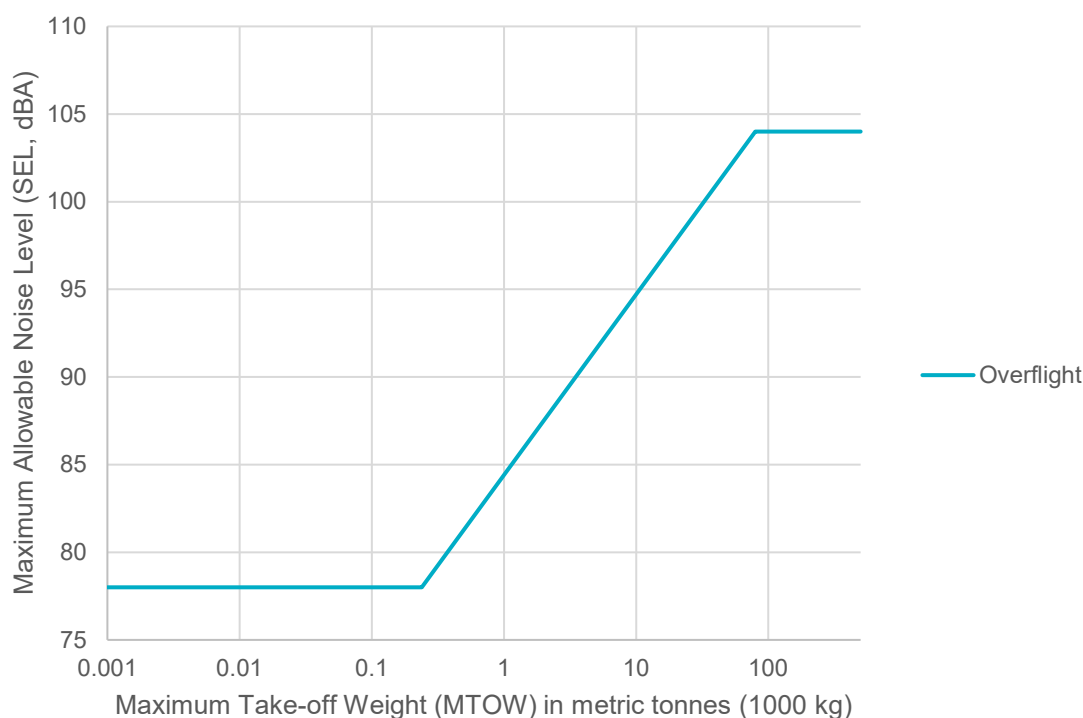
²⁹ British Standards Institution (2024), *BS ISO 5305:2024 Noise Measurements for UAS (Unmanned Aircraft Systems)*, 31 January 2024. <https://standardsdevelopment.bsigroup.com/projects/2020-02487>

³⁰ British Standards Institution (2020), *BS ISO 21895:2020 Categorization and Classification of Civil Unmanned Aircraft Systems*, 14 February 2020. <https://standardsdevelopment.bsigroup.com/projects/2016-03189>

³¹ Federal Aviation Administration (2023), *Noise Certification of UAS/AAM Using Rules of Particular Applicability*, updated 28 July 2023. https://www.faa.gov/about/office_org/headquarters_offices/apl/aee/noise/uas_noise_certification

- 3.32 FAA published the first final Rule of Particular Applicability (RPA) for the Matternet Model M2 aircraft in the Federal Register on 12 September 2022.
- 3.33 In demonstrating compliance with this rule, the aircraft overflight noise levels must be measured, evaluated, and calculated in accordance with procedures and requirements set out in the rule, and the calculated noise levels of the aircraft, at the measurement point as described, must be shown to not exceed 78.0 dB SEL at the reference altitude of 250 feet for an overflight operation only. This noise limit was derived by scaling the ICAO Annex 16 Volume I Chapter 11 flat portion down to a weight of 527 pounds (239 kg) and then correcting the Chapter 11 test altitude of 492 feet down to 250 feet. The mass scaling makes the limit more stringent than the equivalent Chapter 11 helicopter standards and more stringent than the maximum levels set by EASA, see Figure 3 below.

Figure 3: FAA Maximum allowable noise levels vs Maximum take-off weight (presented for 1 kg to 500 tonnes)



- 3.34 When a new drone model (not exceeding 527 pounds maximum take-off weight) is presented for certification by an applicant (operator) and the FAA finds that the appropriate noise certification basis is essentially the same as the standard adopted previously for another model that was adopted through notice and comment rulemaking, the FAA may adopt the same standard for another applicant only as a final RPA. Since each RPA affects a single manufacturer and a single vehicle model, no publication in the Federal Register is required. There have been further drone models for which the FAA has adopted a noise certification standard as a final rule, including models from Wing (Google) and Amazon.

- 3.35 For larger drones, FAA plans to use Appendix H of FAA Part 36 (the US Airworthiness Regulations³²) which invokes ICAO Annex 16 Volume I Chapter 8 into US law. This means using the EPNL metric rather than SEL, and at three test points (take-off, overflight and approach) rather than overflight only. The FAA's rationale for Appendix H is to control take-off and approach noise in addition to overflight, which is all that is required by Chapter 11.
- 3.36 There is reasonable alignment between FAA's standards for larger drones and those in EASA's EPTS. However, the US approach for smaller drones does not align with the EASA Guidelines for drones less than 600 kg.
- 3.37 In parallel with certification, the FAA has developed an environmental assessment framework for drone delivery operations under the National Environmental Policy Act. This includes a draft Programmatic Environmental Assessment (PEA) for Part 135 drone package delivery operations, intended to provide a generic assessment of environmental impacts, including noise, at a national level. The PEA is designed to streamline approvals by reducing the need for multiple site-specific environmental assessments, of which a number have already been undertaken for individual operations. This reflects a complementary regulatory approach in which aircraft certification and operational environmental approvals are progressed in parallel.

Commentary

- 3.38 There is a lack of consistency between EASA and FAA approaches for smaller UAS. EASA's voluntary Guidelines provide a method for measuring noise from UAS with a maximum take-off mass of 600 kg or less operating in the Specific category, but do not set maximum noise levels. By contrast, the FAA has established model-specific noise certification standards for certain UAS with maximum take-off weights not exceeding 527 pounds, approximately 239 kg. The approaches also differ in their test procedures and regulatory purpose. For larger aircraft requiring type certification, the FAA has indicated that it intends to use requirements based on ICAO Annex 16 Volume I Chapter 8, which would be more closely aligned with the technical basis of the EASA EPTS, although the applicable US requirements remain to be confirmed.
- 3.39 Both EASA and FAA are using their guidelines and standards to influence ICAO discussions. ICAO presented proposals for draft noise guidelines for smaller drones on the basis of the EASA Noise Guidelines in February 2025, which deviated from the current FAA position for small drones, but with FAA support. ICAO has since formally begun work on smaller and larger drones and eVTOL

³² Appendix H to Part 36 – Noise Requirements for Helicopters Under Subpart H. [eCFR :: Appendix H to Part 36, Title 14 -- Noise Requirements For Helicopters Under Subpart H \(Appendix H to Part 36, FAR\)](#)

noise standards. These are unlikely to be adopted by ICAO Council before 2028 at the earliest and not likely to be applicable until at least 2030-2032. The implications of this approach are that drones and eVTOL aircraft will be covered by at least two different noise standards, with not only different noise metrics, but also different microphone measurement positions.

- 3.40 The same parallel standards situation exists today for light and heavy propeller aeroplanes, where different standards apply to different aircraft categories within a mature certification framework. It does not appear to have resulted in significant unintended consequences. However, for drones and eVTOL aircraft, the relevant standards are still developing, and how the two approaches align at 600 kg will be an important matter.
- 3.41 In developing environmental standards, ICAO/CAEP considers whether the available options are technically feasible, environmentally beneficial and economically reasonable.³³ In this context, environmental benefit concerns whether a proposed change would deliver meaningful noise reductions, while economic reasonableness recognises that a standard should not be required to be achievable at any cost and that the costs and wider market implications must be considered. These considerations are particularly relevant when assessing whether an existing standard should be made more stringent.
- 3.42 Because of this, and because standards apply to single vehicle types, numbers of operations, production volumes or any form of social acceptability have no part to play in ICAO standard-setting. Acceptability is addressed by the ICAO Balanced Approach and national circumstances.
- 3.43 However, the pressure for acceptability and the 'size' of any noise problem, which may be reflected in the numbers of operations, will inherently create the pressure for more stringent noise standards. Although there is no direct link between the limits and the numbers of operations, it has already been raised as a reason not to apply the helicopter limits in the first instance (on the anticipation that the eVTOL market will be many times larger than the helicopter market).

Next steps for noise certification

- 3.44 EASA has developed voluntary noise measurement Guidelines, without maximum noise levels, for certain UAS operating in the Specific category, and separate Environmental Protection Technical Specifications for specified VCA configurations and certification cases. As explained in paragraph 3.16, these approaches are not divided by a universal 600 kg boundary and their scopes may overlap.

³³ International Civil Aviation Organization (n.d.), *Committee on Aviation Environmental Protection*.
<https://www.icao.int/ENVIRONMENTAL-PROTECTION/Pages/CAEP.aspx>

- 3.45 Taken together, these developments provide a useful technical basis for measuring and assessing noise from emerging aircraft, but they do not yet constitute a complete and consistently applicable certification framework for all UAS and VCA for the UK to align with. Further international and European work is under way, and its relevance to the UK will depend on the scope, timing and final form of the resulting requirements. Developing standalone UK requirements would involve substantial policy, technical, consultation and legislative work. In the near term, continued UK participation in ICAO work and the use of project-specific certification bases may therefore be more proportionate, while retaining the option of national action if international progress or operational need warrants it.
- 3.46 In the interim, the CAA is applying noise certification requirements on a project-specific basis using the applicable environmental essential requirements in Annex III and, where relevant, Annex IX of the UK Basic Regulation. In practice, this is being implemented through the Certification Review Item (CRI) process, which establishes the applicable noise certification basis and means of compliance for each certification project.
- 3.47 The current approach is to use the relevant UK EPTS as the starting point for defining these project-specific certification bases. Where the design characteristics of an individual aircraft prevent compliance with a particular requirement or reference procedure, an appropriate adaptation or deviation may be agreed with the CAA and documented through the CRI process. This provides a structured and internationally aligned means of demonstrating compliance with the applicable environmental essential requirements pending the development of formal ICAO standards.

Noise exposure

- 3.48 As mentioned in Chapter 2, for many decades it has been possible to use computer models, adhering to the guidelines set out in the recognised international standards in ECAC Doc 29 and ICAO Doc 9911, to calculate noise exposure from traditional fixed wing aircraft around airports. This has been an essential tool in setting noise management policies and measures, monitoring noise exposure over time at airports and tracking progress against policies and measures, and for estimating noise exposure that may result from changes at airports, e.g. new runway infrastructure, airspace changes and adding capacity, as well as introducing noise mitigating measures such as procedural improvements.
- 3.49 Neither of these international methods has traditionally covered helicopter noise. This has been justified on the basis that helicopter operations at airports with significant noise exposure tend to be very limited and consequently helicopters do not materially add to the total aircraft noise exposure.

- 3.50 The European Commission partly addressed this ‘helicopter’ gap by implementing a supplement to ECAC Doc 29 in Directive 2015/996, which also updated the method required to be used for END noise mapping to ECAC Doc 29 4th Edition. The method takes a simplified approach, modelling helicopters in a similar manner to fixed-wing aircraft. In parallel the Commission initiated a multi-year research contract with EASA to develop a dedicated rotorcraft noise-modelling methodology, subsequently known as NORAH, intended for future incorporation into the END assessment methodology.
- 3.51 The ability to estimate noise exposure from drones and eVTOL aircraft would be of benefit in quantifying the potential noise exposure of people living and working in the vicinity of operations. This would help in setting appropriate noise management policies, deciding whether to permit operations, setting appropriate limits or mitigation, and monitoring outcomes.

Noise model platforms and methodologies

- 3.52 In recent years, EASA has developed a helicopter noise modelling methodology called NORAH (Noise of Rotorcraft Assessed by a Hemisphere-approach). The methodology now forms the technical basis of ECAC Doc 32, the Report on Standard Method of Computing Rotorcraft Noise Contours, published by ECAC on 19 May 2026. There are some key differences between the approach in ECAC Doc 32 and that in ECAC Doc 29 which make the former better suited to modelling noise from drones and eVTOL aircraft:
- NORAH uses a hemispherical noise source model that is easier to model asymmetrical directivity which may be exhibited by multicopter aircraft. It is necessary to more accurately model directivity for multicopters than traditional aviation given the shorter propagation distances anticipated for drones and eVTOL operating at lower altitudes than traditional aircraft.
 - It is possible to model aircraft profiles in NORAH that include hover and vertical ascent and descent procedures, as can be performed by drones and eVTOL aircraft.
- 3.53 NORAH provides associated helicopter noise hemisphere data and a software prototype supporting application of the rotorcraft noise guidance.
- 3.54 ERCD has built a prototype drone noise model using the NORAH software, and created provisional source-noise hemispherical models to represent drones for which we have noise measurement data. This data is set out in CAA CAP 2506:

Noise measurements from eVTOL aircraft: A review of available data³⁴, and also in CAP 3076: Review of noise measurements from UAS and AAM aircraft³⁵.

- 3.55 Assuming growth of the drone and eVTOL industry, it is our expectation that NORAH would evolve to formally include hemispheres to represent these new technology aircraft. EASA has confirmed that they have also developed hemispheres for one drone for internal purposes.
- 3.56 Although the US has developed specialist rotorcraft noise models, its formal rotorcraft noise model for civil airports is integrated into its fixed-wing aircraft noise model, AEDT, using a similar approach to EU Directive 2015/996. Although there is planned ICAO work to develop a complementary rotorcraft noise calculation method to ICAO Doc 9911, the US has, so far, shown resistance to moving away from AEDT helicopter modelling, presumably because of the potential impact on noise insulation schemes.

Noise modelling scope

- 3.57 The geographical and temporal scope required of noise modelling depends on the situation. From the regulatory perspective, CAP 1616 version 6 distinguishes between permanent and non-permanent airspace change proposals. For non-permanent proposals, the CAA specifies the assessment and evidence required in a proposal-specific Step 2 assessment scope plan, taking account of the nature, scale, complexity, duration and anticipated effects of the proposal. The following noise modelling requirements will generally apply where a noise assessment is required:
- For non-permanent proposals lasting less than one year, estimates of L_{ASmax} at key locations will generally be required, identifying where noise is expected to exceed 65 dB L_{ASmax} during the day or 60 dB L_{ASmax} at night.
 - For non-permanent proposals lasting more than one year but less than three years, L_{ASmax} noise footprints will generally be required for the loudest and most frequently occurring participating aircraft, using the same daytime and night-time levels. Equivalent information may also be required for consequential changes to other aircraft activity.

³⁴ Civil Aviation Authority (2025), *Noise Measurements from eVTOL Aircraft: A Review of Available Data*, CAP 2506, June 2025. <https://www.caa.co.uk/cap2506>

³⁵ Civil Aviation Authority (2025), *Review of Noise Measurements from UAS and AAM Aircraft*, CAP 3076, March 2025. <https://www.caa.co.uk/cap3076>

- For permanent Level 1 proposals, long-term average $L_{Aeq,16h}$ noise contours will generally be required for daytime operations and $L_{Aeq,8h}$ contours where night-time operations are relevant. These support the assessment of population, household and noise-sensitive building exposure and the subsequent appraisal of health and quality-of-life effects using TAG.

- 3.58 Following approval for operations, there may, depending on their scale, duration, approval conditions and anticipated effects, be an expectation that monitoring and forecast noise contours or other appropriate noise information would be produced, much like the information currently produced for traditional aviation around airports. However, it must be acknowledged that many smaller airports do not regularly produce noise contours, if at all, and contour modelling may not be meaningful or proportionate for every drone or eVTOL operation. Any expectation for modelling, monitoring or reporting would need to be consistent with the recording and collection of information on operations, including numbers, flight paths and altitudes, etc. Without adequate data collection, the meaningful production of noise contours will be almost impossible.
- 3.59 Modelling noise from drones and eVTOL aircraft poses some new challenges. Beyond hovering and vertical operations, drones may operate from locations that are not airports, including fulfilment centres, delivery hubs, inspection sites or other distributed operating bases. Some delivery services may also be designed to serve homes directly. The focus of the modelling may therefore need to extend beyond the vicinity of airports and heliports to cover wider operational areas, including routes between distribution centres and delivery locations. This is likely to require consideration of full flight trajectories, including launch, climb, cruise, approach, hover and delivery phases.
- 3.60 Furthermore, we do not yet know at what noise levels these new technologies could have significant adverse effects, or whether impacts may differ between population groups, settings or types of operation. Modelling may therefore need to include phases of flight such as low-altitude cruise, that are not normally material for conventional aviation noise assessment but may be more relevant for drone operations. Evidence from other environmental noise sources, including sources with distinctive acoustic or temporal characteristics, may provide useful methodological insights. However, such evidence should be treated cautiously and not assumed to be directly transferable to drone or eVTOL noise without supporting evidence.

Noise model input data

- 3.61 The quality of noise modelling relies heavily on the quality of data used in the model. Here we consider the main categories of input data for aircraft noise modelling.

Source-noise levels

- 3.62 Although it might be expected that noise measurement guidance and a future certification regime would support the availability of robust source-noise data, this has not been the case for helicopters. The European Commission supported NORAH project has spent a large proportion of its near €1m budget on the hiring of helicopters to undertake the detailed measurements from which to derive hemispheres. It is anticipated that a similar situation will occur with eVTOL. Although it would be possible to simplify the measurement process used to build hemispheres, if the eVTOL market grows as anticipated to be many times the size of the helicopter market, it would seem contradictory to simplify the hemisphere generation process. However, if a simplification is not undertaken there will be a substantial funding and data gap to address.
- 3.63 It is, however, well known that due to differences in procedures and local conditions, noise from a given aircraft type can vary from one airport to another. Therefore, it is common practice for traditional aircraft noise modelling to validate the model for a given airport using locally gathered noise measurements and statistical analysis. These yield outputs which may be used to adjust the model inputs to better reflect noise at that airport, and for a given assessment period if needed. CAA has published requirements on this in CAP 2091³⁶ which sets minimum standards on aircraft noise modelling when the results are to be used as a basis for a CAA decision, for example for a change to airspace. The requirements may be considered good practice guidance for aircraft noise modelling more generally.
- 3.64 For modelling drones and eVTOL aircraft, consideration should also be given to validating source-noise levels against measured noise data. This could be done initially via attended measurement campaigns, and if appropriate, later using unattended long-term noise monitoring. Unattended long-term noise monitoring may be challenging in complex urban sound environments, particularly where there are multiple non-aviation noise sources and flight tracks are not well-defined. However, it may still be appropriate around major hubs, vertiports, fulfilment centres or other areas of concentrated activity, where repeated operations could make drone or eVTOL noise more identifiable and where cumulative community exposure is more likely to be a concern.
- 3.65 What might determine whether validation and/or unattended long-term noise monitoring is appropriate would most likely be the impact of the noise on people. CAP2091 standards are defined by the noise exposure of the airport in question. Although noise exposure is not strictly the same as impact (because it does not take account of the human effects), it is a good proxy given it provides an

³⁶ Civil Aviation Authority (2021), *CAA Policy on Minimum Standards for Noise Modelling*, CAP 2091, January 2021. <https://www.caa.co.uk/cap2091>

objective measure without requiring the extra levels of complexity involved in quantifying impact.

- 3.66 Therefore, noise exposure criteria similar to that set out in CAP 2091 could be established based on population exposure calculated from early drone or eVTOL modelling. The criteria and modelling accuracy would then naturally improve as modelling and monitoring techniques, and our understanding of human impacts, evolve, offering a proportionate and pragmatic approach to developing a robust and fit-for-purpose approach.
- 3.67 Other approaches to determine whether validation or long-term noise monitoring is appropriate could be considered. These may include the number of aircraft operations, the scale and location of the affected population, requirements in planning conditions, and the nature of the proposed operating environment. Movement numbers may become a particularly useful practical indicator as evidence develops, since they are closely related to time-averaged noise exposure and may have clear face validity for communities. Complaint rates may also provide useful supporting information, but should be treated with caution as a primary trigger, since the propensity to complain can vary between communities and may be influenced by socio-economic factors, awareness of complaint routes and confidence that complaints will be acted upon.

Operational data

- 3.68 The numbers and physical positions of aircraft are other factors which have a significant effect on modelled noise levels. Operators should be able to provide information based on their own plans and simulations to be used in modelling future scenarios when evaluating proposals for new operations. If the modelling is used in decision-making, the information should be well documented and capable of independent verification, particularly during early deployments where public confidence in the evidence base will be important.
- 3.69 Quantifying noise exposure from past operations, however, would be best undertaken using monitoring data. For traditional aviation, this data is gathered from airport noise monitoring and track keeping system (NTK), supported by air navigation service provider (ANSP) data, i.e. runway logs. Positional data comes from the airport's radar, which typically covers a circular area with a radius of the order of 50 km centred on the airport (radar position). The data also contains secondary data such as the aircraft's altitude. Speed is derived from the change in position of an aircraft between data points, which are separated by the time it takes the radar head to rotate.
- 3.70 The NTK is also connected to the airport's Flight Information Data Service (FIDS) which provides information such as the flight number, registration, aircraft type, origin or destination airport, runway, and scheduled departure and arrival dates and times. The NTK automatically correlates FIDS data with the radar data of

each operation using the aircraft's call sign. This therefore provides a comprehensive set of operational data which the modelling process needs. Where noise monitoring is undertaken at an airport, the noise measurement data is also correlated with the operational data, as necessary to carry out noise model validation as described from paragraph 3.63.

- 3.71 Airport noise and track keeping monitoring systems are expensive and complex, acquisition costs are often in excess of £1m and incur ongoing support and maintenance costs. Few small airports in the UK have NTK systems. Skyports has partnered with NTK provider Envirosuite and demonstrated an integrated vertiport with NTK system in Paris.³⁷
- 3.72 For modelling drone or eVTOL noise exposure for historic scenarios, such a monitoring service would need to be established to provide the necessary data. This will need to cover full flight trajectories and therefore potentially a larger geographical area than what is covered by an airport radar.
- 3.73 Drones and eVTOL aircraft make extensive use of precise Global Positioning System (GPS) data for navigation and other performance reasons. We are aware that this data can be gathered and logged by operators. Additionally, these new aircraft also measure performance data such as vehicle orientation, speed and acceleration (in three dimensions), individual motor rotational speeds and thrust, remaining battery and other parameters. Some of these parameters (namely three-dimensional position, speed, time of record, aircraft type and registration) would be useful in noise modelling.
- 3.74 How this data would be gathered may evolve over time. This should be considered in the development of System-Wide Information Management (SWIM), which is included in the CAA's Future of Flight BVLOS Roadmap³⁸ and Airspace Modernisation Strategy³⁹. SWIM provides a framework for sharing aviation information, while technologies such as ADS-B and other electronic conspicuity systems may provide some of the aircraft identification and positional data used within the wider system. As drone operations move from segregated towards integrated airspace, appropriate arrangements will be needed to share information about aircraft activity with other airspace users, as discussed in paragraph 3.76.
- 3.75 For safety reasons, it is expected that initially only one drone operator would be active in any given geographical region. It would therefore be feasible for the

³⁷ Skyports (n.d.), *Vertiports*. <https://skyports.net/vertiports/>

³⁸ Civil Aviation Authority (2025), *Future of Flight BVLOS Roadmap*, CAP 3182, October 2025. <https://www.caa.co.uk/cap3182>

³⁹ Civil Aviation Authority (2024), *Airspace Modernisation Strategy 2023–2040, Part 1: Strategic Objectives and Enablers*, CAP 1711, Version 2, February 2024. <https://www.caa.co.uk/cap1711>

operator to gather, log and provide the data needed to undertake noise modelling. This data could be considered commercially sensitive, so making sure it is provided for noise modelling purposes should be part of the approval process for allowing the operation to take place.

- 3.76 The vision for universal traffic management (UTM) is that as drone services become more sophisticated and autonomous, multiple operators will operate in the same airspace. By this point, a technology-agnostic monitoring service would ideally need to be established which gathers data from all makes and models of drone, and makes this available to those who need to use it. The level of access to this data would need to be agreed, as there may be privacy concerns where drones are undertaking residential deliveries. If drones are not ADS-B equipped, it may not be possible to use existing online services which make real-time aircraft flight information available to the public (such as FlightAware and Flightradar24). Even where drones are ADS-B equipped, accessing historic data may be considered to be on a commercial basis and incur an access cost (as is the case today for commercial aviation ADS-B data).
- 3.77 In addition to its technical value for noise modelling, operational data may also have an important transparency function where it can help explain the nature, frequency and purpose of drone operations to affected communities. The governance and privacy implications of this are considered further in Chapter 5.
- 3.78 As for traditional aviation, past data can be used to develop assumptions for modelling future scenarios if the simulation data mentioned in paragraph 3.68 is not available. Mean horizontal flight tracks and vertical profiles can be calculated to enable future scenarios to be modelled. Assumptions for durations in different phases of flight, such as hovering, climbing and descending could also be determined to a sufficient degree of accuracy from historic data.

Noise model output data

- 3.79 The usual outputs of airport noise modelling are a series of noise contours showing geographical areas of equal noise level, rather like the isobars on a weather map showing areas of equal atmospheric pressure. Contours can represent noise quantified using various noise metrics including single event metrics ($L_{A_{max}}$ and SEL), long-term aggregate energy (SEL)-based metrics ($L_{A_{eq}}$) and long-term aggregate maximum noise level ($L_{A_{max}}$)-based metrics (Number above).
- 3.80 In addition, numerical data on geographical areas exposed to noise at certain levels are usually produced, as well as on populations and numbers of houses exposed at these levels. There would be an expectation amongst aviation stakeholders that equivalent outputs would be made available for noise exposure modelling of drones and/or eVTOL aircraft.

- 3.81 It is possible that stakeholders might expect to see noise exposure predicted for any new operation or service. Although modelling is not usually required for general aviation and similar operations, the new nature of the noise source might increase the need. It would likely depend on the scale and location of the operation and whether predictions are needed to support a regulatory decision, e.g. planning permission for a delivery hub or vertiport or airspace decision. There may also be an appetite to see these noise levels in the context of predicted noise exposure from other sources, such as road, rail and industrial noise (as mapped for various reasons, including every five years to meet the requirements of the Environmental Noise Directive).
- 3.82 Computer noise modelling will likely be appropriate in many circumstances where drone or eVTOL operations are introduced in urban areas, for instance, to provide a residential delivery service. However, detailed modelling may not be proportionate for all activities. For example, infrequent inspection flights around electricity pylons, power lines and telecommunications masts may not require detailed modelling where they are short-duration, localised and unlikely to affect noise-sensitive receptors. This should be considered case by case, taking account not only of population exposure, but also of the sensitivity of the surrounding environment, including quiet areas, protected landscapes, wildlife, livestock or recreational users.
- 3.83 Criteria may therefore be required to determine whether noise modelling is required at all for a given operation. Like for the criteria for whether noise measurement is necessary (see paragraph 3.65), any criteria for whether noise modelling is necessary should be based on likely impact on people. As described above, population exposure to noise is likely to be the best proxy for impact, at least in the short to medium-term while knowledge and capability evolve. Other approaches could of course be considered, again as described above.

Next steps for noise modelling

- 3.84 ECAC formally published the rotorcraft noise-modelling guidance based on NORAH version 1 as ECAC Doc 32 on 19 May 2026.⁴⁰ The updated NORAH version 2 (NORAH2) software prototype, which includes elements beyond the published guidance, was released in December 2024.⁴¹ NORAH2 extends the modelling of noise propagation to account for urban environments, varied terrain and vegetation, and weather effects. These capabilities could make it particularly

⁴⁰ European Civil Aviation Conference (2026), *ECAC Doc 32: Report on Standard Method of Computing Rotorcraft Noise Contours*, 19 May 2026. <https://www.ecac-ceac.org/documents/ecac-documents-and-international-agreements>

⁴¹ European Union Aviation Safety Agency (2024), *Environmental Research: Rotorcraft Noise, Research Project Report SC03: Upgrading the Software Tool to NORAH2 and Extending the Noise Hemisphere Database*. <https://www.easa.europa.eu/en/research-projects/environmental-research-rotorcraft-noise>

useful for modelling drone and eVTOL noise in complex environments, although the resources and computational demands involved may not always be proportionate to the scale of the assessment. The project also expanded the source-noise hemisphere database using data from dedicated helicopter flight tests and identified eVTOL aircraft for consideration in future testing.

- 3.85 ECAC would need to scrutinise the additional methods implemented in NORA2 before considering whether to incorporate them into a future edition of ECAC Doc 32. Further technical guidance would also be needed to enable practitioners to apply the methodology consistently to drones and eVTOL aircraft, supported by suitable and validated source-noise data for these aircraft types.
- 3.86 Existing modelling capability, although not formal, is likely to be sufficient to enable different policy options to be assessed, albeit without the ability to predict human impact, as discussed in the following section.
- 3.87 Formal noise modelling is likely to be needed in due course for decision-making and performance monitoring, and early discussion and agreement with industry on how to make the necessary input data available will be an important facilitating step. Engaging with and making the requirement known to those developing monitoring technology for air traffic management, collision avoidance, identification, etc is one such approach.
- 3.88 Research indicates, however, that the acoustic character of drone noise can influence annoyance independently of sound level. Experimental studies have found that tonal components, modulation and other psychoacoustic characteristics can cause drone sounds to be judged more disturbing than would be predicted by conventional level-based metrics alone. This suggests that the assessment of drone noise may need to consider additional sound quality indicators alongside traditional measures such as L_{Aeq} or SEL.⁴² This is explored in the following section.

Noise impact

- 3.89 Exposure tells us which geographical areas are likely to experience noise at certain levels. However, this doesn't tell us about how people will react to that noise.
- 3.90 Daytime noise can cause annoyance, nighttime noise can cause sleep disturbance, and noise experienced at any time, over the long-term, can contribute to stress-related physiological responses and has been associated with adverse health outcomes, including cardiovascular and metabolic effects.

⁴² Treichel, J. et al. (2024), 'Psychoacoustic Analysis of UAS Depending on Operating Modes', Quiet Drones 2024, Manchester, 8–11 September 2024.

The strength of evidence varies by outcome and noise source, and direct evidence specific to drones and eVTOL aircraft is not yet established.

- 3.91 Through social surveys and laboratory or field studies, it is possible to establish what are described as exposure-response functions. These are statistically derived relationships indicating the expected prevalence or magnitude of a response (e.g. annoyance or sleep disturbance) at a given noise exposure level. These can then be used in conjunction with noise exposure data, specifically population exposure at certain noise levels, to establish how many people may be, say, annoyed or sleep-disturbed due to the estimated noise exposure.
- 3.92 In addition, through the DfT's Transport Analysis Guidance (TAG), it is possible to establish a monetary value for the disbenefit calculated from the noise impact. This is often used by decision-makers in cost-benefit analyses of infrastructure schemes.
- 3.93 Obtaining exposure-response functions requires robust samples of data. We have several such relationships drawn from many social surveys and studies undertaken over the last few decades. For drones and eVTOL noise, however, routine public exposure is currently limited, which makes it difficult to obtain sufficiently large samples from populations exposed in real-world conditions. The evidence need also differs by outcome: annoyance and sleep disturbance may be studied over shorter exposure periods where the relevant noise exposure can be quantified, whereas longer-term health outcomes would require evidence from populations exposed over longer periods.
- 3.94 There is therefore a chicken-and-egg situation: evidence is needed to inform policy before operations scale, but the strongest evidence can only be obtained once operations are sufficiently established. This may require a staged approach, using trials and early deployments to gather evidence while minimising the risk of significant adverse effects. It will also be important to consider whether exposure-response functions vary by aircraft type, use case, operating context, background sound environment or affected population.

Human response research undertaken to date

- 3.95 A review of academic studies undertaken and published over the last few years is published in CAP 2505⁴³, CAP 2962⁴⁴, CAP 3086⁴⁵ and CAP3206⁴⁶. The studies indicate that traditional noise metrics may not fully capture the distinctive sound characteristics of drones and eVTOL aircraft, potentially underestimating annoyance. Multicopter drones, for example, can emit high-pitched and variable tones that differ from conventional aircraft noise, which may affect how they are perceived and how disruptive they are judged to be. Public engagement research has also identified concern about the possible effects of these noise characteristics on some people living with disabilities, health conditions or neurodivergence, including autism.⁴⁷ Further research is needed to determine whether responses differ between population groups.
- 3.96 There is a growing need to adapt current noise evaluation methods to address these differences. For instance, sound quality metrics (SQMs) are emerging that account for factors such as loudness, tonality, sharpness, roughness and fluctuation strength, which have been found to be amongst the main psychoacoustic parameters which drive human perception. Incorporating SQMs that account for these factors may improve assessments of drone noise impact. Any development of new sound quality metrics will need to feed back into calculation methods and models. For example, models like NORAH are currently designed to only output $L_{A\max}$, SEL and L_{Aeq} type metrics. It may be that establishing a new exposure-response function for an existing noise metric is a pragmatic and quicker route to large scale noise impact assessments.
- 3.97 Laboratory listening experiments indicate that drone noise can provoke stronger annoyance responses than some familiar environmental noise sources at similar sound levels. In one study comparing drone noise with road traffic noise, drone noise needed to be around 13 to 17 dB lower, depending on the noise measure used, to achieve comparable annoyance ratings. This suggests that conventional environmental noise benchmarks, like road traffic noise, may not translate directly to drone operations. Evidence also suggests that smaller drones may in

⁴³ Civil Aviation Authority (2023), *Emerging Technologies: The Effects of eVTOL Aircraft Noise on Humans*, CAP 2505, 17 March 2023. <https://www.caa.co.uk/cap2505>

⁴⁴ Civil Aviation Authority (2024), *The Effects of Emerging Technology Aviation Noise on Humans*, CAP 2962, 27 August 2024. <https://www.caa.co.uk/cap2962>

⁴⁵ Civil Aviation Authority (2025), *The Effects of Emerging Technology Aviation Noise*, CAP 3086, 21 May 2025. <https://www.caa.co.uk/cap3086>

⁴⁶ Civil Aviation Authority (2026), *The Effects of Emerging Technology Aviation Noise*, CAP 3206, 14 September 2026. <https://www.caa.co.uk/cap3206>

⁴⁷ Elsdon-Baker, F., Hughes, R., Mason-Wilkes, W. and Green, A. (2025), *Navigating Future Flight: Societal Principles for Drones and Advanced Air Mobility in the UK*, University of Birmingham. <https://futureflightsocial.ac.uk/research/>

some circumstances be perceived as disproportionately annoying relative to their sound level. Listening experiments have found that smaller drones with sharper and more tonal, sometimes described as ‘insect-like’, sound characteristics can produce a higher proportion of highly annoyed responses than larger drones with higher sound levels but less tonal noise. This highlights the importance of sound characteristics, as well as noise level, in determining people’s responses.⁴⁸

- 3.98 Most of this data has so far been gathered through laboratory experiments, see Examples 1 and 2 below. In these, subjects were asked to give their subjective response to stimuli comprising recordings of individual drone, eVTOL or traditional aircraft operations. The findings therefore relate to short-term doses of noise from individual events, not from long-term time-averaged doses which are more likely to be experienced if and when these operations become established. Generating this longer-term field data would lead to more robust and applicable exposure-response models.
- 3.99 Some experimental field measurement studies have been undertaken, the findings from which indicate that operational parameters such as flight altitude and manoeuvres can have a strong influence on perceived drone noise. For example, psychoacoustic analyses of drone overflights show that perceived loudness decreases significantly with increasing altitude, while manoeuvres involving rapid deceleration or acceleration can generate noticeably higher perceived loudness than steady flight. Additionally, low-altitude operations can increase the likelihood of disturbance due to rapid increases in perceived loudness during flyovers. At low altitudes, fast drone overflights can create sharper sound level changes that may contribute to startle responses or heightened disturbance for observers on the ground. These findings suggest that operational procedures may offer an effective means of reducing perceived noise impacts in urban environments.⁴⁹
- 3.100 As with other forms of environmental noise, non-acoustic factors may also influence public response to drone operations. Experimental research suggests that perceptions of proximity to the drone, familiarity with the technology, and associations with particular sound characteristics can all affect annoyance responses independently of measured sound levels.⁵⁰ Wider contextual factors are also likely to be important, including the perceived purpose and benefit of the operation, trust in the operator or regulator, perceived control, transparency, privacy, safety, visual intrusion, and whether those exposed to the noise also

⁴⁸ Green, N. and Torija, A.J. (2024), ‘Comparing the Human Response of Unmanned Aircraft System Noise and Other Transportation Noise’, *Quiet Drones 2024*, Manchester, 8–11 September 2024.

⁴⁹ Treichel, J. et al. (2024), ‘Psychoacoustic Analysis of UAS Depending on Different Operating Modes’, *Quiet Drones 2024*, Manchester, 8–11 September 2024.

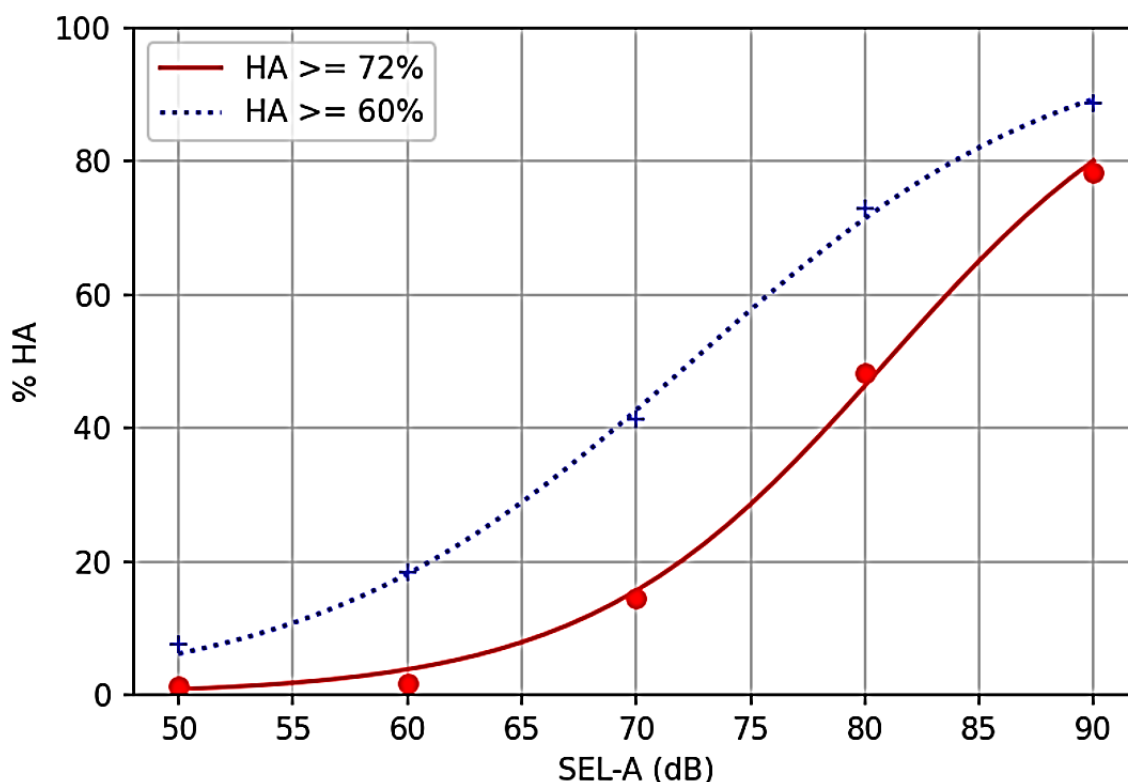
⁵⁰ Green, N. and Torija, A.J. (2024), ‘Comparing the Human Response of Unmanned Aircraft System Noise and Other Transportation Noise’, *Quiet Drones 2024*, Manchester, 8–11 September 2024.

benefit from the service. These factors may be particularly relevant for drone operations because they may take place close to homes, in areas not previously exposed to regular aviation activity, and in contexts where noise concerns are closely linked to wider perceptions of acceptability.

Example 1: EASA study on dose-response relationships for single events

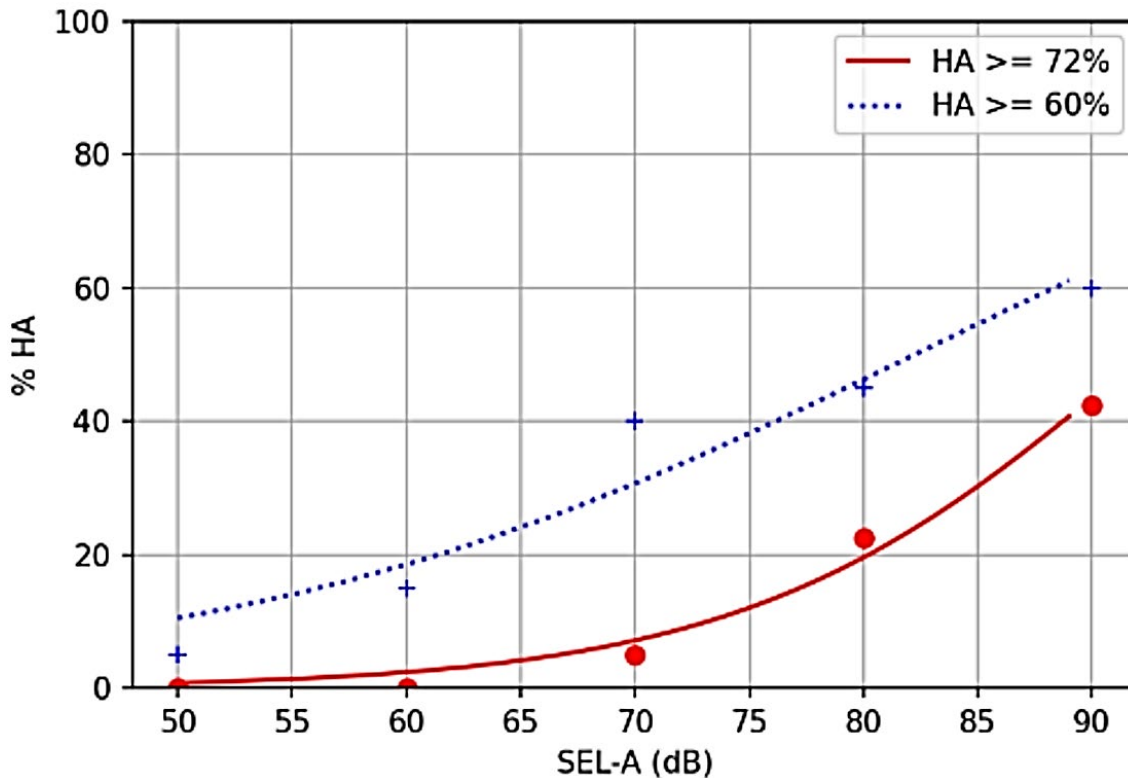
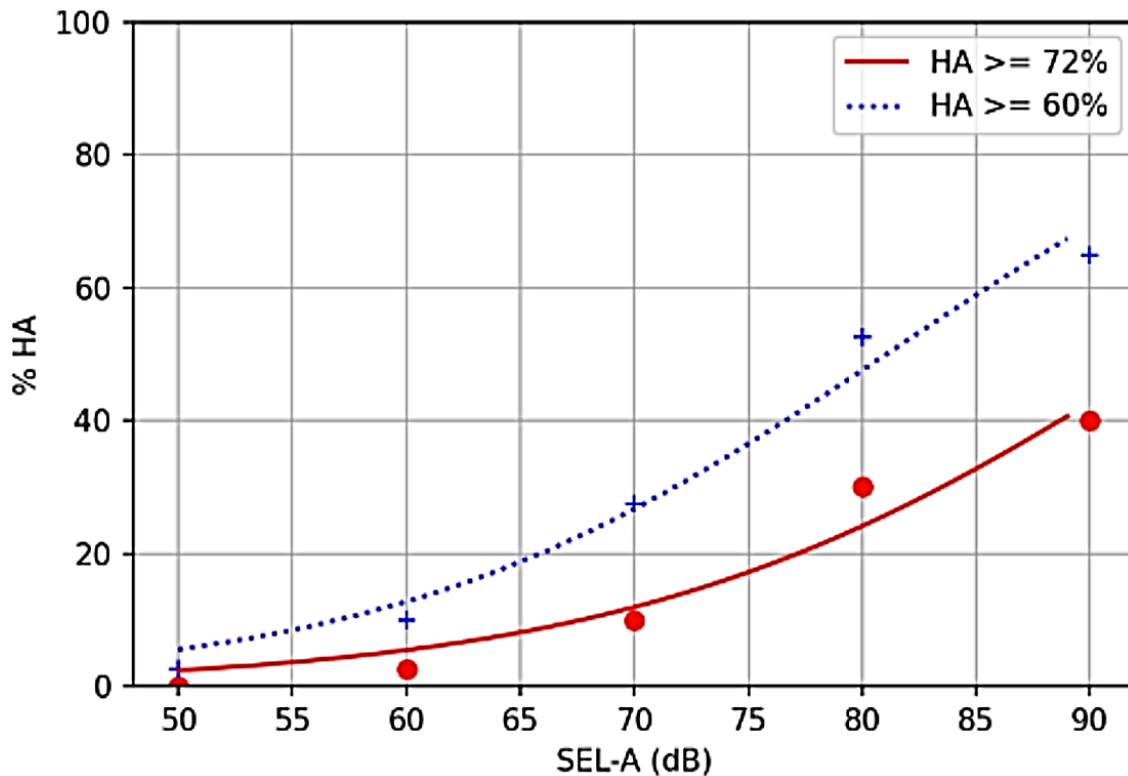
3.101 In 2021, EASA commissioned a study⁵¹ in Amsterdam to explore how noise from drones and eVTOL aircraft affects human annoyance. The study, involving 40 participants, focused on deriving the annoyance response to recorded flyovers of various aircraft, including helicopters, drones and eVTOL aircraft. Participants listened to the recordings in a laboratory environment and rated their annoyance on a sliding scale. The data was then used to calculate a combined 'dose-response relationship' (the term previously used for exposure-response function), mapping the percentage of highly annoyed responses against sound exposure levels (SEL) for individual flyover events. This is shown in Figure 4, and corresponds to noise from four different multicopter drones, one fixed-wing drone and one eVTOL. Figure 5 and Figure 6 show equivalent exposure-response functions for the two helicopters in the study.

Figure 4: Combined drone and eVTOL highly annoyed exposure-response curve



⁵¹ European Union Aviation Safety Agency (2021), *Determination of a Human Dose-response with Respect to Single Events of Urban Air Mobility-type Vehicles*, EASA.FC06.SC02.D1, December 2021.

<https://www.easa.europa.eu/en/downloads/137148/en>

Figure 5: Helicopter 1 highly annoyed exposure-response curve**Figure 6: Helicopter 2 highly annoyed exposure-response curve**

3.102 The study used a 72% threshold on the annoyance scale to classify participants as "highly annoyed," a criterion consistent with aircraft noise research. The 60% annoyance threshold was also examined. Participants also completed a post-test

questionnaire related to whether they recognised the sounds, their noise sensitivity, and their attitudes towards drones.

- 3.103 The results indicated that annoyance was higher for drone noise than for helicopter noise, especially above 70 dB(A) SEL. Annoyance levels for eVTOL aircraft were similar to those for drones, but more so than for helicopters at the higher noise levels.
- 3.104 The small size of the study limited the opportunities for further analysis, and the authors emphasised the need for more research on different eVTOL models and their noise impacts.
- 3.105 Some investigation would be required to determine whether these results can be extrapolated, perhaps with additional references and data, to long-term aggregate noise metrics, i.e. $L_{Aeq,16h}$.

Example 2: NASA study

- 3.106 In May 2024, NASA researchers presented results to ICAO's Committee on Aviation Environmental Protection (CAEP) from a psychoacoustic study examining how well different noise metrics correlated with annoyance responses to small drones. The data presented had been previously reported to a 2023 SAE Conference.⁵²
- 3.107 The stimuli consisted of recordings of 36 small drone sounds from four lightweight drones ranging in weight from 1.6 to 8.0 kg. The sounds were presented binaurally to enhance the sense of realism.
- 3.108 The results indicated that A-weighted SEL is marginally better correlated with annoyance than EPNL. This may be significant considering the EASA limits described above are set in terms of the EPNL metric, noting that EPNL is a significantly more costly indicator to measure and process than A-weighted SEL.

Next steps for noise impact

- 3.109 As mentioned in paragraph 2.132, we have an interim means for assessing noise impacts from drones and eVTOL aircraft for temporary and trial applications. However, this is not a substitute for a robust evidence base on how people respond to these new noise sources. To provide clarity to industry, support proportionate regulation, and give assurance to potentially affected members of the public, a staged programme of evidence gathering should be established.

⁵² Krishnamurthy, S., Rizzi, S., Biziorek, R., Czech, J., Berg, J., Tannler, D., Bean, D., Ayrapetyan, A., Nguyen, A. and Wivagg, J. (2023), 'Remotely Administered Psychoacoustic Test for sUAS Noise to Gauge Feasibility of Remote UAM Noise Study', *SAE Noise and Vibration Conference 2023*, Paper 1106, Grand Rapids, Michigan.

- 3.110 Initially, early operational data from trials should be used to test and improve noise modelling methods. This should include comparing predicted noise exposure with measured noise data where practicable, and using early deployments to refine what operational information is needed to support reliable noise exposure assessment. This stage would not, on its own, establish definitive exposure-response functions, but it would provide an important foundation for later stage studies.
- 3.111 In parallel, survey methods should be developed and tested. This should include building a toolkit of common core questions that can be used across trials and early deployments, enabling data to be compared and pooled to achieve greater statistical power. The questions should cover annoyance and disturbance, but may also include wider response factors likely to be relevant to drones and eVTOL aircraft, such as attitudes to the use case, trust in the operator, perceived control, visibility, privacy concerns and expectations about future scale of operations. They should also be capable of identifying whether responses differ between population groups, including people who may be more sensitive to particular acoustic characteristics or operational contexts. Where night-time operations are proposed, survey tools should also include validated questions on self-reported sleep disturbance, such as that used in the ANNE study⁵³, which was based on the ISO question format (see paragraph 3.114).
- 3.112 Shorter-term studies, including “sandbox” studies, should then be used to build understanding from trial activity while operations are still emerging. Such studies may be particularly useful for assessing response to change, testing survey instruments, identifying relevant non-acoustic factors, and understanding whether different operational contexts or use cases generate different responses. They should be designed so that the period covered by the survey question is aligned with the period over which noise exposure can be estimated with sufficient accuracy.
- 3.113 In the medium term, one or more dedicated UK noise attitude studies are likely to be needed, using extended trials or early deployments where these provide sufficiently stable and well-characterised operational exposure and an adequate study population. ISO/TS 15666:2021 Assessment of noise annoyance by means of social and socio-acoustic surveys⁵⁴ provides guidance on conducting social and socio-acoustic surveys, including the importance of asking about a period for which noise exposure can be estimated with confidence. In section A.11 it considers the appropriate period and recommends ideally a period of

⁵³ Department for Transport and Civil Aviation Authority (2026), *Aviation Night Noise Effects (ANNE) Subjective Study Report*, 10 June 2026. <https://www.gov.uk/government/publications/aviation-night-noise-effects-anne-study>

⁵⁴ International Organization for Standardization (2021), *ISO/TS 15666:2021 Acoustics: Assessment of Noise Annoyance by Means of Social and Socio-acoustic Surveys*, Edition 2.

approximately one year to encourage respondents to give their general reactions to a stable acoustical environment. This is consistent with the WHO's reference period for assessing the burden of disease for environmental noise.

Notwithstanding this, it also suggests that shorter survey periods may still provide useful evidence where the study is designed to reflect the specific circumstances of the operation and the noise exposure can be quantified robustly.

- 3.114 The purpose of a medium-term UK study would be to establish exposure-response functions for one or more relevant metrics such as L_{Aeq} , number-above metrics, and any additional indicators that may better reflect the acoustic characteristics of drones and eVTOL aircraft. The study should also consider whether responses differ by context, use case, time of day, background sound environment, or characteristics of the affected population. This should include consideration of whether particular groups, for example neurodivergent people or those living with chronic physical or mental health conditions, may experience different or more pronounced responses to drone and eVTOL noise. This is important because UK geography, population density, land-use patterns and public attitudes may mean that evidence from other countries cannot be directly transferred to the UK context.
- 3.115 A study of this nature would require careful design, sufficient sample sizes, robust noise modelling, and, where practicable, supporting noise measurements to validate exposure estimates. It may also need to cover different operational contexts, geographies, aircraft types and population groups. For initial planning purposes, a comprehensive study could reasonably be expected to require funding of the order of £1 million or more, although this is an indicative assumption rather than a detailed cost estimate. Actual costs would depend on the study's scope, sample size, duration, geographical coverage and the extent of associated measurement and modelling work. Consideration would therefore need to be given to funding, governance and the respective roles of government, regulators, industry and research partners.
- 3.116 Associated with the Future of Flight framework, the government has consulted on proposals that could allow certain trial operations to proceed with a more proportionate approach to the consideration of noise and visual intrusion, subject to appropriate data gathering. If taken forward, this could present a valuable opportunity to build the evidence base. Operational and complaints data should be gathered, and used alongside measured or modelled noise exposure data and structured social research, with independent validation where appropriate, to maintain public and stakeholder confidence.
- 3.117 A staged programme is therefore recommended:
- first, use early operational data to test modelling and data requirements;

- second, develop and trial common survey tools across early deployments, including a toolkit of common core questions;
- third, undertake targeted short-term studies to understand response to change and context; and
- fourth, use suitable extended trials and early deployments to conduct one or more dedicated UK noise attitude studies capable of supporting the development of robust exposure-response functions.

3.118 This approach would allow policy to develop proportionately and equitably as the quantity and quality of evidence increases, while reducing the risk that future decisions on operational authorisations or permanent services rely only on assumptions, complaints data, or evidence from dissimilar contexts.

Chapter 3 summary

- 3.119 This chapter has reviewed the current standards, methodologies and evidence base relevant to the certification, modelling and assessment of noise from drones and eVTOL aircraft. Overall, the evidence indicates that while these technologies have the potential to deliver lower noise levels at source compared to some conventional aircraft, their operational characteristics, particularly lower-altitude flight, distributed operations, hover and vertical flight phases, and the potential for higher movement frequencies, may result in different and, in some cases, more intrusive noise exposure for communities.
- 3.120 Existing international and overseas initiatives provide useful foundations, including EASA's voluntary UAS measurement Guidelines and Environmental Protection Technical Specifications, relevant BSI measurement guidance, and the FAA's model-specific certification requirements. In the UK, pending development of formal international standards, the CAA has published corresponding UK EPTS incorporating the relevant EASA technical specifications. These provide the starting point for project-specific noise certification bases, with any necessary design-specific adaptations or deviations addressed through the CRI process.
- 3.121 However, these approaches do not yet provide a complete and consistently applicable certification framework for all drone and eVTOL aircraft types. Developing standalone UK requirements would entail substantial policy, technical, consultation and legislative work. In the near term, continued participation in international standards development and the use of project-specific certification bases may therefore be more proportionate, while retaining the option of national action if international progress or operational need warrants it.
- 3.122 The analysis highlights that existing noise metrics and assessment approaches, which have been developed for conventional aviation, may not fully capture the

characteristics of these new sources. In particular, there are limitations in the application of averaged metrics (such as L_{Aeq}) to operations that are intermittent, spatially dispersed, or involve novel acoustic signatures. There is also evidence that community response to these noise sources may differ from that associated with conventional aircraft, including increased sensitivity to characteristics such as tonal content, modulation, sharpness, rapid variations in sound level and unpredictability.

- 3.123 Additional sound-quality indicators may therefore be useful alongside conventional metrics, although establishing exposure-response functions for existing metrics may provide a more pragmatic initial route to large-scale impact assessment. For noise exposure modelling, the NORAH-based ECAC Doc 32 methodology provides a useful technical foundation because it can represent rotorcraft directivity, hover and vertical flight. However, the source-noise data gathered to support the methodology focused on helicopter-type rotorcraft. Further development and validation would therefore be required to apply it across the range of drone and eVTOL configurations and operating conditions considered in this report. Further development is also required to provide appropriate modelling guidance and proportionate criteria for determining when detailed modelling, model validation or long-term monitoring is necessary.
- 3.124 The evidence base remains relatively limited and is still evolving, particularly in relation to large-scale or routine operations. Much of the available human-response evidence is derived from modelling, laboratory listening experiments, small-scale trials, or early-stage deployments, and there is currently limited empirical evidence on long-term community response. Existing studies indicate that drones and eVTOL aircraft may be judged more annoying than conventional aircraft or other environmental noise sources at comparable sound levels, but the available studies generally involve small samples or responses to individual noise events. There are not yet robust UK-specific exposure-response functions for annoyance or sleep disturbance arising from routine drone and eVTOL operations. Responses may vary according to aircraft type, use case, operating context, background sound environment, public attitudes and the characteristics of affected populations. The introduction of regular operations into communities not previously exposed to aviation activity may also influence response, and the distribution of benefits and impacts between users and affected non-users may be important. As a result, there is uncertainty in how best to assess and manage the impacts of these technologies within existing policy frameworks.
- 3.125 Reliable assessment will also depend on access to sufficiently detailed operational data, including flight paths, altitudes, timings, aircraft types and movement numbers, supported where appropriate by independently verifiable measurements and monitoring. Data from operational trials should be gathered systematically and used to develop and combine measured or modelled exposure, complaints and feedback, and methodologically robust social

research. Complaint data may provide an important indicator of experience but should not be interpreted in isolation, because complaint propensity varies and complaints do not provide a representative measure of the population affected.

- 3.126 Taken together, these findings point to a need for further research, development of appropriate noise metrics and assessment methodologies, and careful consideration of how existing policy and regulatory frameworks should adapt to ensure that the introduction of emerging aviation technologies is consistent with the Government's noise policy objectives.

Chapter 4

Noise Management Options

- 4.1 This chapter sets out potential approaches for managing the noise impacts of emerging aviation technologies, drawing on current evidence and technological developments. While a number of these approaches are technically feasible in principle, many remain at an early stage of development and would require further work to establish their practicality, proportionality and effectiveness within the UK regulatory framework.
- 4.2 The analysis draws on the principles of the ICAO Balanced Approach to Aircraft Noise Management, which has guided international aviation noise policy for several decades. While originally developed for conventional aviation, the Balanced Approach provides a useful framework for structuring noise management options for new aircraft types.
- 4.3 However, drone and eVTOL operations differ from conventional aviation in several important respects. Operations may be distributed rather than airport-based, may occur frequently at low altitude, and may involve a greater number of smaller aircraft operating across urban, suburban and rural environments rather than being concentrated around established airports and air routes. These characteristics mean that additional considerations may be required alongside the traditional pillars of noise management.
- 4.4 This chapter therefore considers how the Balanced Approach pillars could apply to emerging aviation technologies, and identifies additional measures that may be needed to manage noise impacts as the sector develops.

Reduction of noise at source

- 4.5 Noise certification is at the heart of reducing noise at source. We have already covered this in detail in Chapter 3 from paragraph 3.4. Notwithstanding what actions national aviation authorities take to certify drones and eVTOL aircraft for noise, there remains an expectation that ICAO/CAEP will continue to work on international noise certification standards. There is also a recognition that Member States generally benefit from common global noise standards, and that the nature of some operations envisaged by drones and eVTOL will be international as well as domestic and thus within the purview of ICAO.
- 4.6 Setting standards to control noise at source may have the greatest impact, since, if done properly, it will affect all aspects of operations. However, the first generation of vehicles have already been designed and developed without clearly defined maximum noise levels. Imposing levels that cannot be readily

achieved by these first-generation vehicles may lead to significant costs on industry and delay to the introduction of services.

- 4.7 It is anticipated that some emerging aircraft designs may seek certification for both vertical take-off and landing (VTOL) and conventional take-off and landing (CTOL) operations, for example to optimise energy performance over different mission profiles. This has implications for noise policy and certification, as the acoustic characteristics of these modes may differ significantly. In such cases, it is likely that noise assessment and certification will need to consider the full range of operating configurations, and that any applicable standards or limits would need to be defined in a manner that reflects both VTOL and CTOL operating conditions. This may introduce additional complexity in establishing consistent and comparable noise performance metrics, and reinforces the importance of developing flexible but robust certification frameworks.

International activity

- 4.8 Work is ongoing in ICAO to develop approaches to the measurement, assessment and management of noise from emerging aviation technologies. This includes activity within established aviation bodies to consider how existing frameworks may need to evolve to accommodate new types of aircraft and operations.
- 4.9 This work reflects a recognition that current standards and methodologies, which have been developed primarily for conventional fixed-wing aircraft, may not be directly applicable to emerging technologies such as drones and eVTOL aircraft. In particular, there is interest in how to characterise the acoustic properties of these systems and how they are perceived by communities.
- 4.10 A range of technical and policy questions are under consideration, including the suitability of existing noise metrics, the development of measurement and certification approaches, and how operational characteristics should be reflected in assessment methodologies. These discussions are at an early stage and are informed by a combination of modelling, experimental work and initial operational experience.
- 4.11 While this work is still developing, it is expected to inform the evolution of international standards and recommended practices over time. This, in turn, is likely to influence national approaches to noise management and regulation.
- 4.12 Given the global nature of aviation, alignment with international approaches will be an important consideration for the UK. However, there may also be a need for national policy and regulatory frameworks to respond more quickly as evidence emerges and operational experience develops.
- 4.13 The pace of technological development in this area means that policy and regulatory approaches will need to remain adaptable. Ongoing engagement with

international developments will be important to ensure that UK policy remains consistent with emerging best practice while continuing to reflect domestic priorities.

- 4.14 Overall, international activity provides an important context for UK policy development, but does not remove the need for a domestic evidence base and proportionate policy response tailored to the characteristics of emerging aviation technologies and operations in the UK.

Regulatory activity

- 4.15 As outlined in Chapter 3 (from paragraph 3.21), EASA has proposed formal noise certification requirements for VTOL-capable aircraft (VCA) through NPA 2025-03. These include test procedures for hover, take-off, overflight and approach using EPNL and L_{Aeq} as primary noise metrics. Maximum noise limits are proposed for take-off, overflight and approach, while hover is measured but does not have a corresponding maximum limit. Initial noise limits are aligned with those for helicopters under ICAO Annex 16 Volume I Chapter 8, with adjustments to reflect the specific design and operational characteristics of emerging eVTOL aircraft types.
- 4.16 While the initial limits proposed by EASA draw on those established for helicopters, these do not in themselves demonstrate that VTOL-capable aircraft are designed to minimise noise. Rather, in the absence of specific standards, they provide a pragmatic reference point against which compliance can be assessed. The overarching requirement under the UK Basic Regulation remains that products must be designed so as to minimise noise, taking account of relevant trade-offs, and current approaches rely on the use of technical specifications (such as EPTS) to support this demonstration.
- 4.17 In the absence of specific ICAO Annex 16 noise standards for eVTOL aircraft, the CAA uses the relevant UK EPTS as the starting point for defining the noise certification basis for each individual eVTOL certification project. The UK EPTS incorporate the corresponding EASA technical specifications and identify them as an acceptable basis for demonstrating compliance with the applicable environmental essential requirements. As set out in paragraph 3.24, this approach enables the CAA to apply the environmental protection requirements of the UK Basic Regulation on a case-by-case basis in advance of internationally agreed standards.
- 4.18 This approach reflects a pragmatic interim solution in the absence of established international standards, rather than a fully mature or optimised framework for assessing the noise impacts of emerging aircraft types. Over time, and when informed by experience from initial certification and validation programmes, this approach may evolve into more formalised UK requirements or updated published specifications.

- 4.19 In parallel, the CAA is developing UK Means of Compliance (MOC) associated with the Special Condition for Vertical Take-off and Landing aircraft (SC-VTOL) ⁵⁵, primarily in support of safety certification. These aircraft, typically propeller-driven, subsonic and with maximum take-off weights below 5,700 kg, span a range of configurations including multicopters, lift-and-cruise and vectored-thrust designs. While SC-VTOL provides a framework for airworthiness, it does not include noise performance requirements. Environmental protection, including noise, is addressed separately from SC-VTOL through the UK Basic Regulation and a project-specific environmental certification basis. As discussed in Chapter 3, ICAO Annex 16 Volume I does not currently contain applicable noise standards specifically developed for these VTOL-capable aircraft. The project-specific certification basis therefore draws on other relevant technical specifications and means of compliance, currently including the UK EPTS.
- 4.20 As such, the current approach to emerging aviation technology noise certification uses the relevant UK EPTS as the starting point for the project-specific environmental certification basis. The development of SC-VTOL MOC and ongoing international work, including EASA's rulemaking and ICAO/CAEP activity, are expected over time to support a more complete and standardised framework for noise certification. The underlying EASA EPTS are expected to be transitional, with current rulemaking proposing their consolidation into a delegated act at European level. Internationally agreed standards developed through ICAO may in time provide a more globally harmonised framework and supersede the need for some project-specific or regional requirements.
- 4.21 The relevance of type certification depends on the regulatory category of the UAS operation. For UAS in the Certified category, type certification and related approval processes provide the route most closely aligned with conventional aircraft noise certification. However, many current and near-term UAS operations are more likely to fall within the Open or Specific categories, where full aircraft certification is not generally the applicable mechanism. In those cases, noise management is more likely to depend on product-level requirements, operator responsibilities, flightworthiness approvals, operational authorisations, or evidence and monitoring requirements applied during trials and early deployment. These mechanisms may provide partial and proportionate routes for managing noise impacts as operational experience develops, but they do not yet amount to a complete or standardised UAS noise management framework.
- 4.22 For Open category operations, noise controls are more likely to be linked to product requirements and operating limits than to bespoke operational

⁵⁵ Civil Aviation Authority (2023), UK Means of Compliance for Vertical Take-off and Landing Aircraft under Special Condition VTOL, consultation document, 15 November 2023.

<https://consultations.caa.co.uk/airworthiness-policy-team/uk-vtol-moc-under-vtol-special-condition/>

approvals. The CAA Drone Code⁵⁶ and associated registration requirements provide an important route for communicating requirements to operators, but they are not currently a mechanism for imposing detailed noise conditions on individual operations. As the UK class-marking framework develops, product-level information such as guaranteed sound power levels may support consumer transparency, operator awareness, or future class-based noise policy

- 4.23 For Specific category operations, operational authorisation provides a more direct route through which the nature, location and scale of an operation can be considered. This could allow proportionate noise-related expectations to be applied during trials or early deployment, for example requirements relating to evidence gathering, monitoring, community engagement, operating hours or aircraft choice. However, operational authorisation is not currently designed as a standardised noise assessment process, so further policy and legal consideration would be needed before relying on it as a consistent route for applying noise limits or wider operating restrictions.
- 4.24 The UK market surveillance function is also relevant to product-level controls. Where noise-related product requirements apply, such as requirements to determine, indicate or comply with guaranteed sound power levels for certain class-marked UAS, market surveillance provides a route for checking that products placed on the UK market meet the applicable technical requirements. This is distinct from assessing the operational noise impact of a service, which depends on how, where and how often the aircraft is flown.

Industry activity

- 4.25 Industry has already begun optimising elements of drones and eVTOL aircraft to reduce noise. The following examples indicate that iterative progress is underway:
- GreenJets⁵⁷ have developed ducted rotors in a range of sizes for use on drones, with models for eVTOL aircraft in the pipeline.
 - The Joby S4 AAM eVTOL uses relatively larger and slower rotating propellers to reduce propeller tip speed in order to reduce noise.^{58,59}

⁵⁶ Civil Aviation Authority (2024), *The Drone and Model Aircraft Code*, updated March 2024. <https://register-drones.caa.co.uk/drone-code>

⁵⁷ Greenjets (n.d.), *Greenjets*. <https://greenjets.com/>

⁵⁸ Civil Aviation Authority (2025), *Review of Noise Measurements from UAS and AAM Aircraft*, CAP 3076. <https://www.caa.co.uk/cap3076>

⁵⁹ Pascioni, K.A. et al. (2022), 'Acoustic Flight Test of the Joby Aviation Advanced Air Mobility Prototype Vehicle', *28th AIAA/CEAS Aeroacoustics Conference*, Southampton, 14–17 June 2022.

- The London Health Bridge first operated using a light-weight hybrid drone, instead of a multicopter, which makes efficient use of wing-lift when in cruise.⁶⁰ It climbs vertically so noise is concentrated on the take-off and landing sites which are at height on hospital buildings in South London.
- Amazon Prime Air have updated their six-rotor multicopter which rotates in cruise to take advantage of some lift from the vehicle body. In addition, their recent Mk30 aircraft has a new propeller design that reduces noise compared with the previous Mk27-2 model. The Mk30 is 5-6 dB less noisy in cruise than their Mk27-2 version.⁶¹

Land-use planning and management

- 4.26 Land-use planning and management is a key pillar of the ICAO Balanced Approach to aircraft noise management. Its purpose is to ensure that noise-sensitive development is appropriately located relative to aviation activity and that aviation infrastructure is planned in a way that minimises adverse impacts on surrounding communities.
- 4.27 This is an important area, given both drones and eVTOL aircraft have the ability to and in some cases have been designed to, operate in locations close to where people live. These operations challenge traditional assumptions of aviation noise exposure being confined to areas around large airports. As such, land-use planning has a critical role to play in shaping how and where noise from such operations affects communities.
- 4.28 The influence of land-use planning on drone and eVTOL operations may be quite different for uncrewed drone delivery type operations and passenger carrying UAM or AAM operations. These differences will likely require differentiated planning policy responses.
- 4.29 In England, the planning system operates within the framework of the National Planning Policy Framework (NPPF), which sets out the Government's planning policies and must be taken into account when preparing local plans and determining planning applications. Infrastructure associated with drone or eVTOL operations, such as vertiports, launch sites, fulfilment centres, hospitals and other medical or logistics facilities may require planning permission and therefore fall within this framework. In such cases, local planning authorities may influence the location, design and operational characteristics of such infrastructure,

⁶⁰ Wing (n.d.), *Wing Drone Delivery: Everything You Need to Know*, video material. [Wing drone delivery | What are delivery drones made of?](#) and [Wing drone delivery | Everything you need to know](#)

⁶¹ Federal Aviation Administration (2024), *Noise Assessment: Amazon Prime Air MK27-2 Unmanned Aircraft Operations at College Station, Texas, Noise Technical Report, Attachment A*, prepared by Environmental Science Associates, May 2024. https://www.faa.gov/uas/advanced_operations/nepa_and_drones/FINAL-College-Station-Supplemental-EA-23Sept2024.pdf

including measures to mitigate potential environmental impacts such as noise. However, some works or changes may fall within permitted development rights, depending on their nature and scale. Where this is the case, there may be less opportunity for local planning authorities to consider drone-related noise impacts through a full planning application.

- 4.30 Drone delivery operations are also likely, at least initially, to make use of already established sites such as fulfilment centres, hospitals or other logistics facilities. These sites may have been selected and approved through the planning system before drone delivery operations were proposed or understood in detail. As a result, the original planning decision may not have considered the noise implications of aircraft launching from, landing at, or repeatedly operating to and from the site. A subsequent planning application may still be required for new infrastructure or a material change in use, but this may not provide the same opportunity to revisit the suitability of the original site location for drone delivery activity.
- 4.31 In the short- to medium-term, eVTOL services will also likely operate into existing aviation locations; mainly heliports and potentially also airports. The additional noise exposure, considering acoustic character as well as absolute noise levels, will depend on various factors and could range in significance. However, the need to physically separate the operation of these vehicles from aeroplane operations may require vertiport infrastructure to be positioned in new locations on the aerodrome, and require airborne vehicles to operate in airspace not previously routinely used by conventional aviation, potentially introducing noise into previously unaffected areas.
- 4.32 Secondly, deliveries will predominantly deliver to residential locations, bringing the noise emitted from delivery drones into close proximity with homes and leaving limited scope to use conventional land-use options to mitigate noise impacts. These effects may not fall only on the households using the services; neighbouring properties, residents in flats, or others close to delivery locations may also experience noise from approach, hover, delivery and departure phases. In such cases, planning policy may have limited ability to control the location of individual delivery points, and noise management would need to focus more on operational measures.
- 4.33 In the longer term, drone delivery operations and more extensive passenger carrying eVTOL services will likely operate from new locations, enabling their noise exposure to be taken into account when selecting appropriate sites. This creates a vital opportunity to apply preventative land-use planning. Site selection criteria should favour locations with compatible adjacent land uses (e.g. light industrial or commercial), and avoid residential and other noise-sensitive areas. Vertiport planning should also include development restrictions to prevent future incompatible land-use encroachment.

- 4.34 The planning system may also provide a mechanism for ensuring that potential environmental impacts are considered at an early stage in project development. Where new infrastructure associated with drone or eVTOL operations is proposed, local planning authorities may require environmental or transport assessments that consider potential impacts on surrounding communities, including noise. This can help ensure that potential noise exposure is assessed and mitigation options considered before operations commence.
- 4.35 The small size of drone and eVTOL vehicles, compared with conventional aeroplanes, may make it possible to use barriers or noise screens to reduce noise exposure at dominant take-off and landing sites. Any barriers or screens would need to comply with safety requirements. Installing barriers would unlikely be feasible at more than a small number of residential delivery locations, and may not be possible at mixed-use locations, such as heliports. Nonetheless, the potential for integrating acoustically considerate site design should be encouraged.
- 4.36 To support long-term compatibility, government and planning authorities should consider whether land-use planning controls are needed around planned or existing vertiports. The purpose would be to avoid, or carefully manage, new noise-sensitive development in areas where forecast operations are expected to generate higher noise exposure. This could be informed by forecast noise exposure contours, similar to the way airport noise contours are used to inform planning decisions around established airports. Planning controls may include restrictions on certain types of development, sound insulation requirements, or property disclosure conditions to ensure community awareness.
- 4.37 This approach would need to be adapted to the specific characteristics of drones and eVTOL aircraft. For vertiports and other fixed operating sites, the relevant issue may be repeated low-altitude arrivals, departures, hover or transition phases close to surrounding communities. For drone delivery operations, conventional zoning around a single site may be less effective because noise may also occur at or near delivery locations, including residential streets or individual properties. Land-use planning may therefore help manage noise around fixed infrastructure, but it is unlikely to provide a complete mitigation route for distributed delivery operations.

Noise abatement operational procedures

Measures for low altitude delivery operations

- 4.38 Drones may be at close range to potentially sensitive receptors at launch and landing sites and especially at residential delivery locations. Additionally, they may operate at low altitude, especially in the short term to separate them appropriately from commercial air traffic.

- 4.39 Considering these first, as discussed above, there are measures which can be taken to mitigate noise from launch and landing sites, however, spending as little time as possible ground-running, hovering, and climbing or descending would help to reduce noise exposure. Note that reducing the time taken in climbing or descending would affect acceleration and therefore the thrust required, therefore trading off reduced duration with potentially higher source-noise levels. Studies should be undertaken to identify optimal acceleration rates to achieve the lowest noise exposure, i.e. the best balance between instantaneous noise levels throughout the operation and the duration of the operation. This could be simply quantified using SEL at a given distance as this takes account of both noise level and duration.
- 4.40 Indeed, it may be necessary to consider noise metrics, like SEL, that take account of both level and event duration, as opposed to metrics like $L_{\max}$ that do not account for duration and thus may lead to the outcome that could favour increased separation without adequately capturing changes in event duration. There would potentially be further trade-offs in energy performance and maximum payload. Further consideration should also be given to the characteristics of the noise from drones under different acceleration rates, noting how this can affect human perception of and reactions to the noise.
- 4.41 Studies should also be undertaken to consider whether vertical climb or climb with forward motion offers the best performance. Again, this could influence energy performance and maximum payload, and could also create a larger geographical noise footprint of and in the vicinity of a launch/landing site even if noise exposure levels are lower due to the diluting of activity over the larger area. Optimising for these variables would be advisable, though may be subject to overarching safety considerations, e.g. in certain urban locations, it may be necessary to climb vertically to achieve the required obstacle clearance from surrounding buildings.
- 4.42 Considering residential delivery locations, minimising durations for the delivery phase would mean fast descent, minimal time hovering and delivering the package, and a fast ascent. This could affect safety and accuracy, so would need to strike a balance between safety/accuracy and duration (as a proxy for noise exposure and therefore disturbance). A mixture of vertical and diagonal ascent and/or descent could also be considered, and of course the rate of ascent and descent would affect the thrust required to control the drone's altitude; the same studies as mentioned above would be recommended to understand what offers the best balance between noise, performance and safety/security.
- 4.43 The need to minimise noise might also influence how a package is delivered. For instance, a free-fall drop from drone to the ground would take less time than lowering a package on a winch prior to release. However, depending on the respective release heights, a drone using a winch could potentially hover at a

greater height (and therefore offer a longer propagation distance between the drone and surrounding residential locations), albeit for longer than a drop release directly from the drone. Furthermore, hovering at higher altitude reduces the effect of local screening principally from buildings, so could expose a greater number of people to noise. Innovation in this area could usefully be encouraged.

Measures for low altitude non-delivery operations

- 4.44 Some drone operations are conducted at low altitude but away from immediate population centres, for example, the inspection of masts, power lines, pipelines, and railway corridors. These operations are anticipated to be lower in number in a given area than delivery operations. As such, this type of operation generally poses a lower risk of direct residential disturbance, but careful attention to the location, timing, and repetition rate of these operations could help manage indirect or cumulative noise impacts.
- 4.45 Even in remote areas, sound may propagate over long distances, particularly across flat or open terrain, or where topographical features such as embankments or cuttings can alter propagation, reflection or screening. Measures such as limiting hover time, avoiding repetitive overflights, and using drones optimised for quiet operation at survey altitudes can help reduce exposure.
- 4.46 In rural or edge-of-settlement locations, nearby properties may still be affected despite the apparent remoteness of the flight path. In such cases, operation and schedule planning should account for proximity to dwellings, particularly during early mornings, evenings, and weekends, when noise sensitivity tends to be higher. Thresholds based on appropriate noise metrics at residential receptors, and supported by evidence on community response, could offer a practical basis for future policy and/or operational guidance.
- 4.47 Seasonal considerations are also relevant. Inspection work in or near ecologically sensitive areas, such as woodlands, rivers, or wetlands, should account for bird nesting seasons or other wildlife constraints, as it would for conventional forms of inspection work. Scheduling and flight routing should aim to minimise disruption during such periods, especially where operations involve hovering or stationary monitoring.
- 4.48 In urban environments, similar seasonal considerations apply when inspecting rooftops, facades, or telecommunications infrastructure. While distances to sensitive receptors may be greater than during direct delivery, operations can still create disturbance through reflected sound, building amplification, or unexpected overflight. Coordinated scheduling with regard to the activities and sensitivity of nearby receptors, flight envelope constraints, and community notification procedures can all contribute to effective noise abatement.

- 4.49 Currently, helicopters may be used for such inspections subject to the applicable operating requirements and, provided they operate at least 500 feet from the nearest person, they do not usually need to meet noise conditions. It may seem obvious that replacing a helicopter with a relatively much quieter drone would provide an obvious noise benefit (though this may be offset where a drone is required to fly lower than a piloted helicopter for airspace segregation reasons in the short-term). However, the considerably higher cost involved in helicopter options means these operations only occur when the need outweighs the cost. Since drones offer a much lower cost option, there is a risk that the frequency of inspection operations could dramatically increase, which could have an adverse noise impact. In these circumstances, cumulative exposure may need to be assessed and, if justified, managed through proportionate limits or operating conditions.
- 4.50 Consistent application of low-noise practices, even in relatively isolated locations, could help set expectations and build confidence in wider drone operations.

Measures for en-route operations

- 4.51 Noise exposure does not only arise from launch, delivery, or landing phases. As the number of drone and eVTOL flights increases, noise from aircraft en route, particularly over communities close to launch and landing sites, may become a material concern. Even where individual overflights are brief or relatively quiet, their cumulative effect could be significant.

Cumulative exposure near operational hubs

- 4.52 Areas located close to fulfilment centres or vertiports are more likely to experience a higher density of overflights compared with locations further away. Even if each flight remains below significant noise thresholds, their repetition over time may result in material disturbance. Planning for these areas should include estimates of long-term noise exposure (i.e. L_{Aeq} levels), not just maximum levels of individual overflights. Where operations are forecast to scale up in number, thresholds such as number of overflights per hour/day or cumulative sound exposure (SEL summation) could be used alongside estimates of equivalent continuous levels to inform acceptable levels of noise exposure.

Altitude and propagation distance

- 4.53 Altitude plays a key role in moderating en-route noise. In general, greater separation between the aircraft and ground-based receptors allows for increased geometric and atmospheric attenuation of noise levels at ground level. For conventional aircraft, minimum altitude requirements are set out in SERA (see from paragraph 2.160), although these may be varied through permissions such as those provided under ORS4. For emerging aviation technologies, including eVTOL aircraft, altitude constraints are determined through a combination of

regulatory requirements and operational considerations, including obstacle clearance and visual line-of-sight (VLOS) requirements. In practice, this may result in operations at lower altitudes than conventional commercial aviation, which has implications for noise exposure.

- 4.54 Operators should aim to maintain higher altitudes over sensitive land uses where feasible, potentially using early climb profiles to gain height before routing over residential areas. This may require coordination between regulatory bodies and UTM systems to enable altitude-based route preferences in a safe and predictable manner.

Aircraft type and cruise optimisation

- 4.55 The acoustic signature of drone and AAM vehicles depends not only on their propulsion system but also on how they are optimised for different phases of flight. Aircraft designed primarily for cruise efficiency may emit more noise during climb and descent, precisely the phases when they are closest to receptors. Conversely, vehicles optimised for take-off and landing may trade off quiet take-off performance for increased cruise drag or lower endurance.
- 4.56 In areas with high population density or sensitive receptors, it may be beneficial to promote the use of aircraft with comparatively low noise across the relevant flight phases, even at the expense of marginal energy efficiency. However, to do so, would require a robust and reliable system to identify vehicle characteristics, i.e. a noise certification system, that covers all phases of flight. So as not to underestimate the scale of the challenge ahead, although we have had ICAO noise certification standards for helicopters since 1988, these do not cover hover flight for any helicopter size, and light helicopters are only tested with respect to cruise flight (there are no noise limits or testing of hover, climbing (take-off) or descending (approach) flight for light helicopters).

Track dispersion vs concentration

- 4.57 Dispersing flight tracks is sometimes proposed as a way of sharing noise burden across a wider population. This theoretically avoids repeatedly exposing the same geographical areas to noise. In practice, track dispersion has limitations:
- Battery constraints often favour fixed, efficient routes, or the shortest point-to-point distance.
 - Urban airspace is typically constrained, leaving limited room for variation.
 - Evidence from trials (e.g. Manna in Dublin and the London Health Bridge) suggests actual variation in tracks is modest, and the benefits of randomisation to create artificial dispersion may have been overstated.
- 4.58 Planned and repeatable routing, while being less equitable in distribution, in many cases may offer greater predictability, fewer safety risks, and easier

enforcement of noise limits. In particularly sensitive areas, rotational routing strategies could be explored to limit the duration of exposure for individual communities.

Preferred routing strategies

- 4.59 Where possible, routes may be planned to follow existing transport corridors such as major roads and rail lines, giving consideration to safety risks such as driver distraction and drone in-flight failure. Routes may also prioritise overflying non-residential land uses (e.g. industrial zones or open land), which tend to be less sensitive to noise. Flight corridors could also be vertically layered to manage overlapping operations at different altitudes.
- 4.60 Where routing options are limited, mitigation measures such as minimum flight altitudes, or temporal restrictions (e.g. avoiding early morning and late evening transits) could be applied to minimise impact.
- 4.61 In practice, as is predominantly the case for conventional commercial aviation, it is likely that operational performance, air traffic and/or economic factors will drive matters such as routing and aircraft speeds.

Single vs multiple operators in a region

- 4.62 Although it is more economically equitable to have multiple operators sharing the same geographical region, operational and noise management become more complex. In a single-operator scenario, route design and scheduling can be centrally coordinated to minimise peak exposure. With multiple operators, the risk of uncoordinated overflight clustering, cumulative exposure, and conflicting routing increases, especially if each optimises only for its own operations. It is envisaged that, even if single operators are permitted in the short term, competition rules will mean that airspace cannot be reserved exclusively for one operator.
- 4.63 This highlights the need for shared UTM systems with capabilities to manage and deconflict routes not only for safety but eventually also for noise exposure, including real-time adjustments to limit clustering or repeat overflights of a given area. In principle, this could enable regulators to explore regional noise budgets or operator coordination obligations when granting flight authorisation. Although such shared UTM systems are technically feasible, they are currently at an early stage of development. Implementing such controls and optimisation has been a real challenge for traditional aviation, so unless a step-change in technology materialises, what is practically achievable in this space will be limited.

Additional considerations

- 4.64 In time, predictive noise modelling integrated into UTM systems could theoretically support dynamic routing decisions that take account of real-time

atmospheric conditions, receptor sensitivity, and ambient noise levels. Again, what is practically achievable will depend heavily on technical progress.

- 4.65 Analysis undertaken to date suggests that some drone operating scenarios could produce noise exposure above 51 dB $L_{Aeq,16h}$ for neighbouring receptors as well as for people using or benefiting from the service. 51 dB $L_{Aeq,16h}$ is the current daytime Lowest Observed Adverse Effect Level (LOAEL) reference used in conventional UK aviation policy, and although it should not be treated as an established drone-specific effect threshold, it provides a potentially useful indicative screening reference pending the development of drone-specific exposure-response evidence.

Operating restrictions

- 4.66 The ICAO Balanced Approach identifies operating restrictions as a means of last resort, to be applied only when measures from the other three pillars are insufficient to prevent significant adverse effects. However, in the context of emerging technologies like drones and eVTOL aircraft, operating restrictions may play a more prominent precautionary role, particularly while vehicle noise signatures, flight behaviours, and public perceptions continue to evolve.

Types of operating restriction

- 4.67 For drones and eVTOL aircraft, restrictions could be tailored to manage noise exposure at both the network and local levels. These may include:
- Maximum noise limits for aircraft types operating a service, based on noise certification levels.
 - Limits on total movements per day or other period from a specific launch site or fulfilment centre (e.g. number of one-to-many package deliveries per day).
 - Limits on total daily operations along a given flight corridor per day or other period, depending on the level of noise impact imposed by operations along that flight corridor.
 - Movement quotas based on noise metrics. For example, a daily limit on operations where L_{Aeq} or 'number above' at a receptor exceeds a defined threshold. As noted, these would only be practical at or in the immediate vicinity of fulfilment facilities.
 - Time-of-day restrictions, particularly for operations near noise-sensitive uses such as residential areas, care homes, hospitals and schools.

- Operating hour constraints for launch or fulfilment facilities. These could draw on models used for managing noise from supermarket deliveries or construction sites. In these cases, activity is typically restricted in the early morning, evenings, at night and/or on Sundays to protect the amenity of residential neighbours. In the US Amazon Prime drone delivery fulfilment centres have been limited to operations during daylight hours and between 07:00 and 22:00.⁶²
- More speculatively, limits on the numbers of deliveries to individual addresses or localities, either in absolute terms or weighted by a relevant factor, such as time-of-day or ambient noise conditions. A practical implementation of this could comprise an automated slot booking system for a zone centred around a postcode. Such controls could be challenging to implement, as they could lead to issues where neighbours have used delivery services and a local noise quota is used up, preventing others from using services.

- 4.68 The introduction of different noise requirements for eVTOL operations, relative to existing aircraft such as helicopters, may have implications for the operation of mixed-use aerodromes and vertiports. In particular, where eVTOL-specific noise limits or operating conditions are applied at a given site, there is a potential for these to interact with, or indirectly constrain, the operation of other aircraft types. In practice, this is likely to be managed through site-specific operating procedures, planning conditions, or differentiated operating regimes, rather than through the imposition of new restrictions on existing aircraft. However, this interaction highlights the need for careful consideration of how noise policy is applied in shared operating environments, to ensure that new requirements do not create unintended consequences for established aviation activities.
- 4.69 Noise-related controls may be capable of being applied through a number of existing routes, depending on the nature of the operation. For Specific category operations, operational authorisation may provide a route for applying proportionate conditions relating to the location, scale, timing or conduct of the operation, particularly during trials and early deployment. Where an operation requires a change to the notified airspace design, the Airspace Change Process may also provide a route for considering environmental effects and associated mitigations. Land-use planning may provide a further route where new infrastructure, a material change of use, or conditions attached to an existing site are relevant.
- 4.70 However, these mechanisms were not designed as a comprehensive operating restrictions regime for drone noise. Their applicability will vary depending on the

⁶² Federal Aviation Administration (2022), *Draft Environmental Assessment: Amazon Prime Air Drone Package Delivery Operations in College Station, Texas*, September 2022.

https://www.faa.gov/sites/faa.gov/files/EA_Amazon_Prime_Air_College_Station_TX.pdf

operational category, whether an airspace change is required, and whether the activity is linked to infrastructure requiring planning consent. Further policy and legal consideration are therefore needed to clarify how operating restrictions could be applied consistently and proportionately across different types of drone operation.

Consideration of receptor sensitivity and context

- 4.71 Restrictions should reflect not just the number of movements, but also the contextual sensitivity of affected areas. This includes:
- Proximity to sensitive receptors (e.g. distance to third-party dwellings, presence of external amenity space).
 - Time-of-day weighting, recognising greater annoyance in the early morning, evening, and night.
 - Background noise conditions, although much research links noise-related health impacts to noise dose, some emerging research suggests drone noise is perceived as more intrusive in quiet environments than in areas with consistent ambient activity.
 - Community feedback, particularly in trial or early operational phases, should also inform how and when limits are applied. Feedback should be undertaken independently or independently verified where gathered through operators.

Trial operations vs commercial service

- 4.72 Trial operations present a particular use case, where uncertainties around noise impacts are often greatest, but data collection and operational learning are essential. In such cases:
- A temporary or time-limited planning consent could be issued, tied to clearly defined conditions on movements, timing, flight paths, and appropriate data collection (including public attitude studies where circumstances permit).
 - Public notification, engagement, and complaint logging mechanisms should accompany trial activity, preferably managed or independently overseen by a neutral body.
 - Studies of data gathered during trials should be used to inform restrictions for full-scale operations, including assessments of cumulative noise exposure, peak noise events, and subjective response.
- 4.73 In parallel, there is a clear case for undertaking noise attitude surveys during the trial phase to build the evidence base for future policy. The Department for Transport has recognised that policy for integrating new aviation users should be proportionate to the scale and nature of the activity while continuing to support environmental assessment and stakeholder engagement. The UK Air Navigation

Guidance 2026 and associated Air Navigation Directions 2026 introduce a more proportionate framework for airspace decisions involving new and emerging aviation users, including uncrewed aircraft systems, and support the use of trials and data-gathering activities to improve the evidence base for future policy and regulatory decisions. In this context, well-designed noise attitude studies undertaken alongside operational trials could play an important role in understanding community responses to emerging aviation technologies and informing future noise management approaches.

- 4.74 Noise attitude survey designs would need to meet certain criteria to be considered credible and robust. Reference should be made by survey designers to the recent ANAS, ANNE and 2014 SoNA surveys. Although these considered conventional aviation, their design met the criteria needed to enable them to withstand critical technical and political scrutiny. Significant adaptation to the conventional aviation survey designs would likely be needed in places, so allowance should be made for a phase of testing and validating new survey instruments.
- 4.75 This approach presents a valuable opportunity to generate robust, real-world evidence on community response to at-scale drone noise. Using operational data, such as flight volumes, trajectories and time of operations, to calculate noise exposure and combining this with one or more suitably designed noise attitude surveys would make it possible to quantify the relationship between exposure to drone noise and annoyance, identify sensitive time periods and contexts, and develop exposure-response functions specific to drones. The survey instruments may first need to be tested and validated, including through smaller-scale qualitative, quantitative or experimental studies.
- 4.76 Such data would contribute to the development of a proportionate and evidence-led national noise policy for commercial drone services, ensuring that regulatory decisions are grounded in objective, UK-specific community evidence rather than assumptions or extrapolations from other modes of transport.
- 4.77 These considerations highlight the importance of ensuring that trial design, data collection and regulatory frameworks are aligned to support the development of a robust evidence base.

Role of noise certification and standardisation

- 4.78 In the longer term, operating restrictions should draw on a standardised noise certification framework consistent with ICAO's Balanced Approach and Assembly Resolutions that require operating restrictions to be based on certified noise performance for conventional aircraft. If drone and eVTOL manufacturers are subject to harmonised certification standards covering the relevant operating configurations and supported by published certification levels, regulators could:

- Set differentiated restrictions based on certified noise performance.
- Incentivise operators to adopt quieter vehicles by offering enhanced access or higher movement limits to certified lower-noise models.
- Ensure planning and policy frameworks are aligned with international standards as they evolve.

Cumulative exposure management and UTM integration

- 4.79 In the future, for regions with multiple operators, restrictions may need to be coordinated through UTM systems to manage cumulative impact. This could include:
- Shared noise budgets for defined airspace volumes or communities.
 - Flight slot allocation, akin to the slot framework at major airports, to avoid clustering.
 - Dynamic restrictions based on real-time activity or measured environmental noise conditions.

Enforcement and compliance

- 4.80 For operating restrictions to be effective, they must be measurable, monitorable, and enforceable. This may involve the use of automated flight logging via ADS-B or other technologies, and noise monitoring systems to verify compliance. Any collection, retention or use of data relating to identifiable operators or individuals would need to comply with the UK GDPR and the Data Protection Act 2018. Over time, there is an expectation that all air vehicles will need to be equipped with electronic conspicuity to provide an automatic layer in the measures to ensure deconfliction. The underlying technology may offer a dual function if it could be used in supporting flight logging, attribution of operations and investigation of potential breaches, subject to suitable data-access, retention and governance arrangements.
- 4.81 Flight-logging technology would offer a means of providing independently gathered data against which to measure performance against regulatory thresholds, such as those in the preceding sections. The independent nature of the data is essential in giving confidence to those responsible for measuring compliance and any necessary enforcement, that they have an accurate understanding of what operations occurred.

Digital enforcement and assurance mechanisms

- 4.82 As drone operations scale, digital services and regulatory registration systems will play an increasingly central role in managing and enforcing noise-related operating restrictions. Under the UK UAS framework, many operators must register and display an operator ID, while remote pilots may need to obtain a

Flyer ID or demonstrate other applicable competency requirements. These arrangements provide a foundational layer of operator accountability, enabling authorities to apply differentiated conditions or limits across various classes of users and aircraft.

- 4.83 Platforms such as DiSCO (Digitalising Specific Category Operations) are now in development to support the safe integration of drones into UK airspace. These systems provide a centralised point of interaction between operators and the regulator, offering potential opportunities for embedding and automating operating restrictions as part of flight authorisation workflows.
- 4.84 In the longer term, digital authorisation and traffic management systems could provide new opportunities to manage noise impacts through more targeted and automated operating constraints. For example, operating permissions could be linked to noise-sensitive zones, policy-based thresholds, community feedback, or real-time monitoring data, allowing restrictions to be applied dynamically according to local circumstances. Emerging UTM concepts and the European U-space framework⁶³ already envisage highly automated, data-driven management of low-altitude airspace, including functions such as digital flight authorisation, geofencing, airspace constraints and real-time operational coordination. Similar approaches could, in future, support the implementation of noise-management measures in a more responsive and proportionate manner than is possible through conventional regulatory processes alone.
- 4.85 These capabilities are still at an early stage of development, and their implementation would depend on further advances in technology, data integration, regulatory frameworks and stakeholder acceptance. As such, while these approaches offer significant potential, they should be considered as part of a longer-term evolution of the regulatory framework rather than near-term solutions.
- 4.86 Policy frameworks should support and anticipate these capabilities, ensuring that planning conditions and noise policies could be operationalised efficiently via digital platforms. The ability to track compliance, link permissions to performance data, and respond dynamically to community impacts could be a defining feature of effective noise management in the drone and eVTOL sector. Where these activities involve the processing of personal data, appropriate arrangements would be required to ensure compliance with the UK GDPR and the Data Protection Act 2018.

⁶³ U-space is the European framework for digital and automated services designed to support the safe, secure and efficient management of large numbers of drone operations in shared airspace. It comprises services and procedures that support functions such as flight authorisation, geofencing, traffic information and operational coordination. It is the European equivalent of the broader UAS Traffic Management concepts being developed internationally.

Stakeholder engagement

- 4.87 Although not formally one of ICAO's Balanced Approach pillars, robust stakeholder engagement is essential for establishing trust, and may help develop the durable public acceptance sometimes described as a social licence to operate. Public engagement research on Future Flight technologies⁶⁴ indicates that people expect transparent communication, independent accountability, and opportunities for public and specialist input before services are scaled. Engagement should therefore begin early, be transparent and inclusive, and, where practicable, be independently facilitated or overseen rather than solely operator-led.
- 4.88 Evidence presented by University of Birmingham suggests that public confidence is strengthened where engagement involves both affected communities and independent specialists, rather than relying solely on operator or regulatory assurances. This will be particularly important during trials and early deployments, where public confidence may be shaped by concerns about noise alongside wider issues such as privacy, safety, security, visual intrusion and ecology. Research further suggests that perceptions of acceptability are influenced not only by the impacts experienced, but also by the perceived public benefit and purpose of the operation.⁶⁵

Consultation

- 4.89 Early-stage operations or trials should be accompanied by structured consultation before activity begins, where practicable. This should explain the purpose of the operation, where and when flights are expected to take place, what noise and other impacts may occur, and how feedback will be used.
- 4.90 Consultation should be designed to obtain input from a representative range of affected people, using appropriate sampling, sufficient sample sizes and mixed methods where needed, such as surveys, workshops, interviews or drop-in sessions. Consideration should also be given to engaging stakeholders who may experience impacts differently or who may bring specialist knowledge, including organisations representing people who may face accessibility barriers or experience operational impacts differently. Community members should have accessible channels to provide feedback and report disturbance, privacy or other

⁶⁴ Elsdon-Baker, F., Hughes, R., Mason-Wilkes, W. and Green, A. (2025), *Navigating Future Flight: Societal Principles for Drones and Advanced Air Mobility in the UK*, University of Birmingham; *Framework for Future Flight in the UK: Principles from a Deliberative Public Dialogue* (2024); and University of Birmingham/UKRI, *Future Flight Survey 2024*. <https://futureflightsocial.ac.uk/research/>

⁶⁵ Elsdon-Baker, F., Hughes, R., Mason-Wilkes, W. and Green, A. (2025), *Navigating Future Flight: Societal Principles for Drones and Advanced Air Mobility in the UK*, University of Birmingham, p. 22. <https://futureflightsocial.ac.uk/research/>

concerns. Responses and mitigation actions should be documented and communicated promptly.

- 4.91 Consultation should also explain how decisions will be proportionate to the scale, duration and risk of the proposed operation. Over-regulating in response to isolated or anecdotal cases should be avoided, but lived experience should not be dismissed, particularly where concerns are repeated, affect sensitive receptors, or indicate issues not captured by modelling or operational assumptions.
- 4.92 For steady-state operations, local authorities and operators should consider establishing community advisory panels, akin to airport noise consultative groups. These forums can promote transparency, help bridge trust gaps, and enable community views to inform land-use, routing or procedural decisions. Such groups may also provide a mechanism for maintaining ongoing dialogue throughout the life of an operation, recognising that public attitudes, operational characteristics and evidence on impacts may evolve over time.
- 4.93 To support confidence in the process, such groups may be best chaired by an independent person rather than the operator, particularly where the operator is responsible for delivering the service being discussed. However, they should complement rather than replace wider engagement routes, including accessible complaints mechanisms and targeted engagement with affected communities who may be less likely to participate in formal advisory groups.

Reporting and transparency

- 4.94 Policy frameworks should support dynamic planning responses to emerging noise exposure. Governments could require operators to publish noise contour maps and flight activity data where the scale and nature of operations mean that noise modelling is appropriate and the resulting information would be meaningful to communities and planners. These should be accessible via online noise portals, enabling communities and planners to monitor trends and inform policy updates.
- 4.95 In parallel, transparency measures such as community-facing noise dashboards, notification systems, and real-time vehicle identification tools could help build trust and support adaptive responses to emerging noise patterns. These measures may be particularly important during trials and early deployments, when public understanding and confidence are still developing. They could help communities understand what operations are taking place, where and when flights are expected, who is responsible for them, and how concerns can be raised. They could also help explain why operations are taking place, what public or commercial need they are intended to serve, what oversight arrangements apply, and how operators are being held accountable for their impacts.

Complaints, identification and privacy

- 4.96 Residents exposed to drone noise should have clear and easy mechanisms to lodge complaints or give feedback. Especially in regions with multiple operators, identifying who is responsible for a flight is crucial. Operators should publish and advertise clear contact channels, such as a hotline or web form, for complaints and feedback.
- 4.97 Unlike fixed-wing aviation, where complainants can use tools like Flightradar24⁶⁶ or WebTrak⁶⁷ to trace aircraft origins, drone operations may not have this kind of tracking or other means of identification, making attribution harder.
- 4.98 The Information Commissioner's Office (ICO) has explored remote ID (identification) programmes⁶⁸ to enable information relating to drones and their operators to be made available through smartphone applications or other digital platforms in a privacy-compliant way. Similar to how car number plates work, a unique identifier would be wirelessly broadcast from the drone and could be received by members of the public as well as authorised organisations such as aviation safety bodies, law enforcement and national security agencies. However, the information made available to members of the public need not be the same as that available to authorised organisations, and privacy and security considerations may limit public access to information identifying an individual operator. Such programmes have already been implemented in countries such as Japan, Switzerland and the US.
- 4.99 Remote ID and other flight identification tools could support transparency by helping members of the public obtain information about a drone operating nearby, identify the organisation responsible where appropriate, and understand how to raise a concern. This could be particularly important in areas with multiple operators, where attribution of noise, privacy or safety concerns may otherwise be difficult. Research suggests that public access to clear information about who is operating, where operations are taking place and for what purpose may play an important role in building trust and legitimacy.⁶⁹ Any such approach would

⁶⁶ Flightradar24 is a commercial flight-tracking network using crowdsourced Automatic Dependent Surveillance-Broadcast (ADS-B) information. Other such services are available.

⁶⁷ WebTrak is Envirosuite's public-facing, web-based airport noise and track-keeping monitoring system. Other such services are available.

⁶⁸ Information Commissioner's Office (2024), *Commercial Use of Drones*, in *Tech Horizons Report 2024*.
<https://ico.org.uk/about-the-ico/research-reports-impact-and-evaluation/research-and-reports/technology-and-innovation/tech-horizons-and-ico-tech-futures/tech-horizons-report-2024/commercial-use-of-drones/>

⁶⁹ Elsdon-Baker, F., Hughes, R., Mason-Wilkes, W. and Green, A. (2025), *Navigating Future Flight: Societal Principles for Drones and Advanced Air Mobility in the UK*, University of Birmingham.
<https://futureflightsocial.ac.uk/research/>

need to balance public-facing transparency with privacy, security and commercial confidentiality requirements.

- 4.100 Importantly, privacy law applies where drone operations involve the processing of personal data, including through captured imagery or location data that identifies or could identify an individual. The ICO treats drone footage in a similar way to CCTV footage, where it contains personal data, and requires adherence to the UK GDPR and the Data Protection Act 2018.
- 4.101 As noted earlier, privacy law will also apply to personal data gathered by drone delivery services, as this may reveal information about participating addresses or individuals. This could affect how operational data can be collected, shared and published for the purposes of monitoring operations and calculating noise exposure, although suitably designed data-governance and anonymisation arrangements may help manage these issues.
- 4.102 Research undertaken by the University of Reading found that industry participants regarded public perception, engagement and acceptance as significant drivers of the commercial viability of drone operations, and considered further engagement with communities essential as the sector develops.⁷⁰ Evidence from wider Future Flight engagement programmes highlighted concerns relating to privacy, safety, cybersecurity and criminal use, which require transparent communication and responsive mechanisms for feedback, and suggested that these concerns are often considered together rather than in isolation, and may influence how noise is perceived and reported.⁷¹ The way in which complaints are acknowledged and addressed is therefore likely to play an important role in shaping public acceptance. Transparent and accessible complaint processes, supported by clear reporting of outcomes, should form a core component of noise governance.

Community liaison and mitigation

- 4.103 Operators should proactively notify communities ahead of high-rate activity (e.g. trial flights or, if commercial at-scale operations are permitted, upscaling services or periods of elevated activity). This could be done via local bulletins, websites, or social media, signalling transparency and allowing proactive engagement.

⁷⁰ Jackman, A. (2023), *UK Commercial Drone Industry: Professional, Responsible and Considerate Drone Use*, University of Reading, October 2023. https://research.reading.ac.uk/drone-geographies/wp-content/uploads/sites/271/2023/10/Industry_report.pdf

⁷¹ Elsdon-Baker, F., Hughes, R., Mason-Wilkes, W. and Green, A. (2025), *Navigating Future Flight: Societal Principles for Drones and Advanced Air Mobility in the UK*, University of Birmingham. <https://futureflightsocial.ac.uk/research/>

- 4.104 In more advanced models, authorities could issue pre-flight community alerts (e.g. via subscription to app or text alerts), especially in sensitive residential corridors or during quiet periods.
- 4.105 If noise impacts are left unacknowledged or under-communicated, negative narratives may fill the void, leading to opposition that may not reflect actual noise exposure levels. This risk may be heightened where noise becomes the most visible route for expressing wider concerns, such as privacy, visual intrusion, safety, security or ecological impacts, particularly if there is no clear route for reporting those concerns directly. Emerging evidence also suggests that communities often experience and assess noise alongside visual intrusion, rather than as entirely separate impacts, and engagement processes should be designed accordingly.⁷² Regulators and operators must therefore prepare to explain what is and is not known about drone noise, including its measurement, management, and limits, while also ensuring that wider concerns are directed to appropriate reporting and accountability routes.

Financial instruments for impact mitigation

- 4.106 In locations where sustained, material noise impacts cannot reasonably be avoided or mitigated, policymakers could consider whether proportionate financial mitigation mechanisms are justified. Any such mechanism, such as noise levies or compensation schemes, would require clear eligibility criteria, evidence thresholds, funding arrangements, a sound legal basis, and to be articulated clearly and accessibly to affected communities.

Case study: FAA community engagement approach

- 4.107 Experience in the United States suggests that effective public engagement should not be treated as a procedural add-on to regulatory decision-making, but as a core part of how new aviation activity is introduced and governed. The FAA's published community engagement framework⁷³ and community involvement guidance⁷⁴ place emphasis on early dialogue, transparency, plain-language information, and ensuring that community concerns are considered as aviation decisions are made. The lesson for the UK is that engagement on drone and eVTOL operations should be structured, credible and continuous, rather

⁷² Elsdon-Baker, F., Hughes, R., Mason-Wilkes, W. and Green, A. (2025), *Navigating Future Flight: Societal Principles for Drones and Advanced Air Mobility in the UK*, University of Birmingham.
<https://futureflightsocial.ac.uk/research/>

⁷³ Federal Aviation Administration (n.d.), *Community Engagement*.
https://www.faa.gov/air_traffic/community_engagement

⁷⁴ Federal Aviation Administration (n.d.), *Community Involvement Manual*.
https://www.faa.gov/sites/faa.gov/files/air_traffic/community_engagement/FAA_CIM.pdf

than limited to formal consultation once a preferred solution has already been developed.

- 4.108 A useful principle for UK policy would therefore be to encourage engagement at the problem-definition stage, before options are fixed. At this stage, the emphasis should be on explaining the operational need, the wider system context, and the constraints within which solutions must be developed, rather than prematurely presenting preferred routes or operating models. This would help reduce the risk of creating unrealistic expectations while still allowing communities, local authorities and other stakeholders to understand the purpose of the change and influence how the problem is framed. Engagement should also be designed to capture a representative range of views, using appropriate methods and sample sizes, rather than relying only on those who are most able or motivated to participate.
- 4.109 The FAA's community involvement guidance stresses the importance of giving the public an opportunity to be informed, become involved, and have their concerns considered. Its drone environmental review guidance also recognises that operator-led community engagement should run in parallel with formal regulatory and environmental processes. In some cases, proposals for new aviation activity have progressed through collaborative engagement between operators, independent experts and affected communities before formal regulatory approval, demonstrating that early dialogue can help shape proposals in ways that are both operationally viable and socially more acceptable. Future Flight research similarly indicates strong public support for engagement processes that combine public participation with independent expert input and scrutiny, rather than treating these as alternatives.⁷⁵ A similar approach in the UK would fit well with the objective of ensuring that engagement is meaningful without implying that all options are open at all stages.
- 4.110 The FAA model also highlights the value of regional leadership and cross-functional engagement teams. The FAA's national airspace system is divided into nine regions led by Regional Administrators, supported by regional teams and Community Engagement Officers, to determine how best to engage affected communities. For the UK, the precise institutional model would differ, but the underlying principle is relevant: responsibility for engagement should not sit only with technical specialists or individual operators. Governance arrangements should bring together policy, operational, environmental and communications functions so that communities hear a clear and comprehensible account of the issue, the relevant constraints, and the roles of the organisations involved. This

⁷⁵ Elsdon-Baker, F., Hughes, R., Mason-Wilkes, W. and Green, A. (2025), *Navigating Future Flight: Societal Principles for Drones and Advanced Air Mobility in the UK*, University of Birmingham.
<https://futureflightsocial.ac.uk/research/>

is particularly important for drone and eVTOL operations, where novelty, and technical and regulatory complexity could otherwise leave a vacuum that is quickly filled by misunderstanding or speculation.

- 4.111 A further lesson is the importance of plain-language, representative graphics and building public awareness. FAA community engagement materials recognise that building awareness can help affected communities understand the agency's role and the causes of noise exposure. The FAA has supported this through community engagement material, governance infographics, videos and public workshops. For UK policy, this suggests that engagement material should avoid excessive jargon and acronyms, explain issues through practical examples that members of the public can readily understand, and use graphics that accurately reflect the nature and scale of the proposed activity. This would be particularly important for drone operations, where poor or misleading visual material may create lasting public impressions that are difficult to correct later. Public workshops or online awareness sessions could also be used to explain basic operational concepts before seeking views on specific proposals.
- 4.112 The FAA experience also underlines the value of centralised and transparent complaint handling, while keeping responsibility for frontline response with the relevant operator or airport sponsor. The FAA's current aircraft noise complaint and inquiry arrangements describe local airport sponsors as the primary contact for noise complaints, with the FAA and local operators playing distinct but coordinated roles. For the UK, this supports an approach in which operators remain responsible for receiving and responding to complaints about their own activities, but within a more standardised national framework that enables consistent reporting, escalation and transparency. This could include a central or nationally standardised portal for complaints and enquiries, linked where possible to operational data and public-facing explanatory material. Funding permitted, such an approach would help communities understand where responsibility lies, while reducing fragmentation where multiple operators are active in the same area.
- 4.113 Finally, the FAA approach suggests that engagement is not only good administration but also a form of implementation risk management. Published FAA material states that community involvement is an important consideration in decisions affecting the public, and its more recent engagement practice has involved workshops, roundtables, regional engagement structures and virtual public information sessions to support understanding and dialogue.
- 4.114 For the UK, a practical implication is that proportionate but early and sustained engagement should be seen not simply as a communications exercise, but as part of building a defensible decision-making process. This is especially relevant for drone and eVTOL operations, where public concern may be shaped as much by perceived fairness, transparency, responsiveness and accountability as by

measured noise exposure itself. Similarly, acceptance may be influenced by the perceived benefits of a particular use case, with communities often making different judgements about operations that are seen to deliver wider public value than those primarily delivering private or commercial benefit. A policy framework that requires operators and regulators to engage early, explain clearly, respond consistently and publish outcomes would therefore be likely to support both better decisions and more durable public acceptance.

Chapter 4 summary

- 4.115 This chapter has presented a comprehensive set of potential noise management measures for drone and eVTOL operations, structured around the ICAO Balanced Approach and supplemented by additional mechanisms tailored to the specific characteristics of emerging aviation technologies.
- 4.116 In applying the ICAO Balanced Approach to emerging aviation technologies, this chapter has highlighted a number of important differences from conventional aviation which affect both the nature of noise impacts and the effectiveness of mitigation measures. Available evidence suggests that some drone and eVTOL operations may give rise to noise exposure above the 51 dB $L_{Aeq,16h}$ LOAEL reference used in conventional UK aviation policy, not only for service users but also for neighbouring receptors. Although this should not be treated as an established drone-specific effect threshold, it provides a useful indicative comparison pending drone-specific exposure-response evidence. This raises distributional considerations, whereby those who do not benefit from such services may nonetheless experience adverse noise effects.
- 4.117 The analysis also indicates that some of the traditional mitigation levers may be more constrained in this context. In particular, land-use planning is likely to be of limited effectiveness for delivery operations that intentionally bring aircraft into close proximity with residential receptors, while the scope for operational mitigation at the point of delivery and through routing may be restricted by practical factors such as vehicle performance, energy constraints and demand patterns. As a result, control of noise at source is likely to play a particularly important role, although the existence of first-generation vehicles designed in the absence of established standards may lead to costs to industry and delays to service entry. In practice, this suggests that operating restrictions, including limits on hours of operation or activity levels at specific sites, may be required alongside other measures, albeit with some limitations in addressing localised exposure hotspots.
- 4.118 With these considerations in mind, the proposed measures outlined and summarised below recognise that no single intervention will be sufficient. Instead, effective management will require a combination of technology improvements, operational practices, planning controls and, where necessary,

operating restrictions, supported by transparent engagement with affected communities. Although the chapter presents some more innovative and longer-term options, the initial focus should be on developing appropriate standards, assessment methods and proportionate controls.

Reduction of noise at source

1. Support ICAO/CAEP development of internationally agreed noise-certification standards and supporting technical methods for drones and eVTOL aircraft.
2. Consider continued use of EASA's measurement Guidelines and Environmental Protection Technical Specifications, alongside its proposed noise-certification regime for VTOL-capable aircraft.
3. Continue using relevant UK Environmental Protection Technical Specifications as the starting point for project-specific certification bases, while supporting greater international alignment and retaining the option of UK action where operational need warrants it.
4. Use market surveillance and registration frameworks to support noise-related compliance.
5. Encourage manufacturers to incorporate noise reduction into aircraft design from the outset, supported by appropriate measurement, certification and reporting methods.

Land-use planning and management

6. Adapt airport-centred planning approaches to address distributed operations close to homes or other sensitive receptors.
7. Consider noise exposure when selecting and designing fulfilment centres, vertiports and other fixed infrastructure.
8. Use buffer zones, planning controls and property disclosure where appropriate within the relevant planning framework.
9. Encourage acoustically considerate infrastructure design at locations with high levels of activity, including launch sites and fulfilment centres.

Noise abatement operational procedures

10. Optimise climb, descent, hover and other operational profiles to minimise noise exposure, using metrics appropriate to the operation and effect being assessed.
11. Compare alternative operating procedures, such as winch and free-drop delivery or vertical and diagonal climb and descent profiles, for acoustic impact and practicality.

12. Develop tailored noise-abatement procedures for inspection and other non-delivery drone operations.
13. Use route design, operating altitude, activity limits and aircraft selection to manage cumulative overflight noise, especially near hubs or corridors.

Operating restrictions

14. Consider movement limits, time-of-day restrictions, noise-based quotas or thresholds based on appropriate noise metrics at relevant receptors.
15. Tailor restrictions to contextual factors, including time of day, ambient sound, location, operational purpose and frequency of activity.
16. Explore dynamic management of restrictions through UTM and noise-aware flight authorisation tools, where appropriate legal, policy and technical arrangements exist.
17. Use digital authorisation workflows to screen flight plans, with additional mechanisms where necessary to prevent non-compliant operations. Flight logging and identification technologies could support monitoring and attribution, subject to appropriate data governance.

Stakeholder engagement (proposed fifth pillar)

18. Begin engagement early, explaining the operational purpose, need and constraints before presenting specific solutions.
19. Provide accessible consultation, complaint and reporting tools, including noise portals, real-time alerts and activity summaries where appropriate.
20. Maintain two-way engagement throughout design, implementation and operation, using clear language and representative graphics, to help communities understand the proposed operations, their constraints and likely impacts, and to explain how public input has influenced decisions.
21. Require operators to respond to complaints arising from their operations, supported by consistent complaint-handling and reporting approaches. Interpret complaint data alongside noise exposure, operational and wider engagement evidence.
22. Use Remote ID and other identification tools to provide appropriate public information about nearby operations, while protecting personal data, security and commercial confidentiality.
23. Consider levies or compensation schemes where significant impacts cannot be adequately avoided or mitigated, using transparent eligibility and assessment criteria.

- 4.119 The measures identified in this chapter provide a menu of potential policy responses rather than a single prescriptive framework. Their relevance and proportionality will depend on factors including the aircraft and operation, the scale and duration of the activity, the characteristics of the affected location, the availability of supporting evidence and the maturity of the sector. Chapter 5 considers the governance arrangements through which appropriate measures might be selected, implemented and reviewed.

Chapter 5

Governance

- 5.1 The development of noise management measures for drones and eVTOL aircraft is only one part of the policy challenge. Ensuring that these measures are implemented lawfully, proportionately and transparently, and that relevant parties are accountable for their respective roles and actions, requires a clear governance framework. This chapter therefore describes how the noise management approaches outlined in Chapter 4 could be overseen and implemented in practice.
- 5.2 Unlike conventional aviation, where noise governance is largely centred on major airports, emerging aviation technologies involve distributed low-altitude operations across urban, suburban and rural environments. These operations are expected to be digitally enabled, may involve multiple operators, service providers and commissioning bodies, and could scale rapidly. For example, public sector services such as health, emergency response or infrastructure monitoring may be delivered by private drone operators. Governance arrangements must therefore be capable of managing cumulative impacts, identifying who is responsible for different aspects of an operation, supporting innovation and maintaining public trust while ensuring appropriate environmental protection.
- 5.3 This Chapter therefore aims to:
- clarify institutional roles and responsibilities
 - set out principles for decision-making
 - outline data, monitoring and enforcement mechanisms
 - consider oversight, public accountability and wider policy integration
 - describe how governance may evolve as the sector matures, including a pathway toward an effective, evidence-led UK drone noise policy

Institutional architecture

- 5.4 Establishing an effective governance framework first requires clarity about the roles of the institutions involved in policymaking, regulation, planning and oversight.

Department for Transport

- 5.5 The Department for Transport (DfT) is responsible for setting national aviation policy, including the framework within which noise from emerging aviation

technologies will be assessed and managed. This includes determining how environmental impacts, including noise, should be balanced with commercial growth, innovation, and wider societal and connectivity benefits.

- 5.6 As noted in Chapter 2, the Air Navigation Guidance 2026 has been issued and replaces the 2017 guidance as of 1 October 2026. The guidance anticipates further development of policy for emerging aviation technologies as operational evidence becomes available. Linked to this, DfT also has a central role in commissioning and overseeing the evidence base necessary to inform such policy, including noise attitude studies undertaken through suitable trials and early deployments, and any subsequent studies needed as operations become more widespread and representative. Future revisions of the Air Navigation Guidance may therefore provide more explicit policy on the assessment and management of their noise impacts.
- 5.7 It is ultimately for DfT, working where appropriate with other government departments, such as the Department for Environment, Food and Rural Affairs (Defra), to establish the policy objectives, metrics, effect levels or assessment criteria against which noise should be judged; determine whether product or operational controls are required; and provide an appropriate framework for local planning decisions.

Civil Aviation Authority

- 5.8 The Civil Aviation Authority is responsible for aviation safety regulation and for implementing government policy within its statutory remit. In the context of emerging aviation technologies, the CAA's current functions include: certification, operational authorisation, UAS market surveillance, registration and safety oversight.
- 5.9 As noise standards and policies evolve, the CAA may acquire responsibilities to implement and enforce some or all of these. Measures could include embedding noise-related conditions into operational authorisations, linking permissions to certified performance (where such certification exists), and using digital platforms to support enforcement.
- 5.10 The CAA may also play a role in collecting and analysing operational telemetry data for use in monitoring performance against restrictions, and in calculating and assessing environmental effects such as noise exposure and its impacts.

Local Government

- 5.11 Local government may have responsibilities for land-use planning, environmental and public health, and community engagement at the local level, although the allocation and extent of these functions vary between authorities and across the four UK nations. Where planning permission is required, the relevant planning authority may determine applications for vertiports, fulfilment centres and

associated infrastructure, including imposing conditions relating to operating hours, site layout and mitigation measures. In some areas, combined authorities, regional transport bodies or devolved administrations may also have relevant strategic planning, transport or coordination roles.

- 5.12 For operations affecting residential or noise-sensitive areas, local authorities may use planning conditions, where these are necessary, relevant to planning and to the development being permitted, enforceable, precise and reasonable, to require proportionate measures connected with the development. Depending on the circumstances, these might include pre-flight public notices; a dedicated point of contact for complaints; reporting on community feedback; and providing evidence of operator responses to local concerns. Where operations cross local authority boundaries, noise may be experienced outside the area in which the launch site, fulfilment centre or vertiport was approved. Clear arrangements will therefore be needed for receiving, sharing and responding to complaints across authorities and, where relevant, between local, combined and regional bodies.
- 5.13 Under Part III of the Environmental Protection Act 1990, local authorities in England and Wales have duties to inspect their areas and take reasonably practicable steps to investigate complaints about potential statutory nuisances. However, section 79(6) excludes noise caused by aircraft, other than model aircraft, from the statutory-nuisance provision for noise emitted from premises. As explained in paragraph 2.49, drones are likely to be regarded as aircraft rather than model aircraft, meaning that noise caused by the aircraft itself is likely to fall outside this provision. Noise from ground-based activities or equipment associated with drone and eVTOL operations may still engage local authority responsibilities where the relevant statutory tests are met. The position may depend on the source and circumstances of the noise and requires careful legal interpretation. Separate statutory frameworks and institutional arrangements apply in Scotland and Northern Ireland. In practice, complaints may not always align neatly with the location of the launch site, fulfilment centre or vertiport, particularly where flights cross administrative boundaries.
- 5.14 Effective governance will therefore require coordination between national aviation regulation and the relevant local and regional planning, environmental health, public health and transport functions. This should include clarity on the respective roles of DfT, the CAA, local authorities, combined authorities and devolved administrations, especially as operations scale from trials to routine services, and arrangements for coordination where operations or their impacts extend across administrative and democratic boundaries.

Other relevant bodies

- 5.15 The governance of emerging aviation technology noise engages a number of public bodies beyond DfT, the CAA and local authorities. The Information Commissioner's Office (ICO) oversees compliance with data protection

legislation and has issued guidance on drone-related privacy and surveillance. As remote ID systems and flight telemetry become increasingly central to accountability and enforcement, the ICO's role in ensuring that personal data is processed lawfully, transparently and proportionately will be important. Governance arrangements must balance the need for traceability and public confidence with compliance under UK GDPR and the Data Protection Act 2018.

- 5.16 The Office for Environmental Protection (OEP), established under the Environment Act 2021, provides independent oversight of the implementation of environmental law by public authorities in England and Northern Ireland, as well as reserved matters across the UK. While noise is not currently a primary focus of its statutory remit, the OEP's scrutiny of environmental target-setting and policy coherence may influence the wider context in which drone noise is managed, particularly where operations interact with broader environmental objectives.
- 5.17 Digital infrastructure providers, including UAS Traffic Management (UTM) service providers, play a critical operational role. Their systems support aircraft routing and identification, and potentially noise-aware management functions. As operating restrictions and movement caps become digitally encoded, governance arrangements must account not only for aircraft operators but also for the resilience, interoperability and accountability of the digital systems that enable operations.
- 5.18 Industry bodies and professional associations may play a supporting role in shaping responsible practice. Collaboration between the CAA and relevant industry and professional bodies could help develop standardised noise management practices across the sector. These may include best practice protocols for commercial drone operations, guidance on typical noise profiles developed with acoustic expertise, and templates for operator self-auditing and structured community reporting. Such measures would complement formal regulation and help embed consistent expectations during early-stage deployment.
- 5.19 The Environment Agency, and its devolved equivalents in Scotland, Wales and Northern Ireland, are significant environmental regulators whose functions may intersect indirectly with drone operations. While they do not regulate aviation noise, they oversee environmental permitting, waste management and certain aspects of industrial development that may relate to fulfilment centres or associated infrastructure. Their broader environmental duties, including oversight of environmental impacts and compliance with statutory requirements, contribute to the regulatory landscape within which drone noise governance will operate.
- 5.20 Other public and land-management bodies may have more localised interests. For example, heritage organisations and conservation agencies may control or consent to take-off, landing or other activity on land that they own or manage,

although airspace regulation remains the responsibility of the CAA. Similarly, environmental bodies such as Natural England and NatureScot may have an interest where operations occur near designated ecological sites. These roles illustrate the distributed and cross-sectoral nature of governance, even where aviation regulation remains nationally led.

Allocation of decision-making responsibilities

- 5.21 Clarity over who is responsible for taking decisions is vital to ensure consistency, accountability and public confidence. Drone and eVTOL operations engage multiple layers of governance, and decision-making responsibilities should be aligned with statutory powers and operational competence.
- 5.22 In practice, strategic policy decisions, including the setting of national noise thresholds or exposure metrics, are most appropriately taken at national level by DfT. Operational authorisations and technical conditions should sit with the aviation regulator, the CAA. Site-specific infrastructure decisions may fall within local planning processes, while being guided by regional transport and spatial planning strategies. Clear delineation of roles, potentially supported by memoranda of understanding that clarify coordination, consultation and information-sharing arrangements, will reduce uncertainty for operators and communities alike. Such arrangements would not alter or transfer the statutory responsibilities of the bodies concerned.
- 5.23 Where decisions have material implications for community noise exposure, transparency should be embedded in the process. This may include publication of the relevant evidence base, clear reasoning for decisions taken, and accessible mechanisms for review or appeal where these are available under the applicable decision-making framework. A structured allocation of responsibilities, along with procedural transparency, will be central to maintaining legitimacy and public confidence as the sector scales.

Decision-making principles

- 5.24 While institutional roles determine who is responsible for different aspects of governance, clear principles are also needed to guide how decisions affecting noise exposure from drones and eVTOL aircraft should be taken.

Precaution and proportionality

- 5.25 During early-stage deployment, uncertainties around operational scale, noise exposure and community response may justify a precautionary approach. However, governance should remain proportionate to the level of risk. Measures should be evidence-led and adaptable as data becomes available.
- 5.26 Over-regulation in response to isolated complaints risks undermining innovation and economic benefit. Conversely, failure to anticipate and respond to significant

disturbance risks eroding public trust. Complaint data should therefore be treated as an important indicator of lived experience, but interpreted alongside noise exposure, operational and engagement evidence, recognising that people's propensity and ability to complain vary. Governance must therefore strike a careful balance, informed by robust data and transparent assessment.

Evidence-based policy

5.27 Noise policy should be grounded in evidence from multiple sources, subject to appropriate independent verification, validation or scrutiny, including:

- certified acoustic performance data
- environmental noise measurements of drones in operation
- operational data gathered from telemetry
- complaint and feedback data from members of the public, interpreted alongside methodologically robust qualitative and quantitative engagement evidence
- modelled noise exposure
- noise attitude survey results

5.28 UK-specific exposure–response evidence is likely to be central to developing proportionate and defensible policy thresholds. A staged research programme may be needed before a sufficiently large and stable operational population exists for a definitive national study. This could include initial qualitative, quantitative and experimental studies, the testing and validation of survey instruments, and the pooling of comparable evidence from trials and early deployments, followed by larger-scale noise attitude surveys as operations mature.

Data, monitoring and enforcement tools

Data governance and transparency

5.29 Given the autonomous or highly automated manner in which emerging aircraft are expected to operate, effective governance of drone and eVTOL noise will depend heavily on the collection, management and appropriate use of operational and environmental data. Emerging aviation technologies are digitally enabled by design, and this presents both a responsibility and an opportunity given that governance mechanisms could be embedded into digital systems from the outset.

5.30 Operational telemetry, including flight paths, altitudes, timings and volumes, can be used to model noise exposure and to assess compliance with operating restrictions. Where remote identification requirements are implemented, flights

can be attributed to specific operators, enabling accountability in the event of complaints or breaches of authorisation conditions. As noted in Chapter 2, the Unmanned Aircraft (Amendment) Regulations 2025 strengthen traceability and identification requirements, which may underpin future noise enforcement mechanisms.

- 5.31 Noise monitoring may be undertaken through a combination of physical measurement and modelling. While it is unlikely to be proportionate to deploy large-scale fixed monitoring networks for early-stage operations, targeted unattended monitoring during trials or in areas of concern may be appropriate. Governance frameworks should specify minimum standards for measurement and for modelling, including assumptions regarding source levels, flight profiles and propagation conditions.
- 5.32 Given that accountability and transparency will be critical in maintaining public trust, consideration should be given to publishing periodic summaries of flight activity and modelled noise exposure, potentially through accessible and easily updated online portals. This should include clear information about the organisations operating the services, the purpose of the operation, the areas affected, and how concerns can be raised. Public-facing information should not disclose personal operator data unless there is a lawful and proportionate basis for doing so. Complaints data should also be summarised and reported by operators in a consistent format. Transparency should extend to explaining how noise is measured, how thresholds are derived, what actions are taken when limits are exceeded, and how operators are held accountable.
- 5.33 Data governance must also respect privacy and commercial confidentiality. Personal data associated with remote identification systems should be handled in accordance with the UK GDPR, the Data Protection Act 2018 and relevant ICO guidance. Where operational data is commercially sensitive, publication may require aggregation or anonymisation. Clear protocols should be established to balance transparency with legitimate confidentiality interests.

Digital enforcement and UTM governance

- 5.34 Unlike conventional aviation noise management, which still relies largely on physical infrastructure and airspace procedures, the governance of drone noise will increasingly depend on digital systems. UAS Traffic Management (UTM) platforms could offer opportunities to incorporate noise-related conditions directly into operational approvals.
- 5.35 For example, authorisations could include:
- geographic restrictions linked to noise-sensitive zones
 - time-of-day operating limits

- movement caps within defined airspace volumes
- vehicle-class-based permissions reflecting certified noise performance

- 5.36 These conditions could be incorporated into digital authorisation workflows so that non-compliant flight plans are not accepted. Preventing an aircraft from executing a non-compliant flight would require additional onboard, network-based or enforcement mechanisms, together with an appropriate legal basis. Over time, integration between UTM systems and noise modelling tools could support more advanced 'noise-aware' routing, including altitude preferences and real-time dynamic adjustments to manage the spatial and temporal distribution of trajectories in accordance with an agreed policy objective, balancing noise impacts and operational efficiency.
- 5.37 The governance framework should recognise that reliance on digital infrastructure introduces new forms of systemic risk. The resilience, interoperability and redundancy of UTM systems are relevant to environmental governance as well as to safety. Policymakers may wish to consider minimum standards for system continuity and contingency arrangements in the event of failure or disruption.
- 5.38 Digital enforcement does not remove the need for regulatory oversight. Responsibility for auditing compliance, reviewing conditions and taking enforcement action should rest with the body holding the relevant statutory powers. This is likely to include the CAA where conditions form part of an operational authorisation, but other authorities may be responsible where requirements arise through planning, environmental or other regulatory regimes. However, well-designed digital systems can reduce administrative burden and increase the predictability and fairness of noise management measures.
- 5.39 The UK Specific Operations Risk Assessment (UK SORA) and its associated digital application service provide a potential foundation for this approach. UK SORA supports a structured, risk-based assessment of applications for operational authorisation in the Specific category, while the digital service guides operators through the submission process and supports validation and CAA review of the evidence. The current framework is focused on operational safety and does not provide a standardised means of assessing noise or digitally enforcing noise-related limits. However, if appropriate noise policy, assessment requirements and legal powers were established, its structured assessment and digital workflow could provide a route for submitting proportionate noise evidence and incorporating any resulting operating conditions into the operational authorisation process.

Oversight, accountability and policy integration

Adaptive governance and review mechanisms

- 5.40 Emerging aviation technologies are evolving rapidly. Vehicle design, propulsion systems, routing concepts and business models are likely to change significantly over the coming decade. Governance arrangements must therefore be adaptive to respond effectively and efficiently to these changes.
- 5.41 Drone noise policy should therefore be subject to periodic review, informed by operational data and community response. Review cycles might occur at defined intervals, for example, every three years, or be triggered by specific indicators or events, such as:
- material changes in complaints or feedback, considered alongside operational and noise-exposure evidence
 - evidence of cumulative exposure exceeding policy thresholds
 - significant changes in fleet composition or technology
 - new research on health or annoyance impacts.
- 5.42 Rather than implying regulatory instability, adaptive governance recognises that early assumptions may need refinement as experience and evidence accumulates. Clear review mechanisms can provide certainty to industry while reassuring communities that policy will respond to emerging impacts. Public engagement is also more likely to build trust where participants can see that evidence and community experience may, where appropriate, lead to changes in policy, operating practices or mitigation.

Public accountability and social licence

- 5.43 Noise governance is not solely a technical or legal matter. Public perception, fairness and trust are critical determinants of long-term acceptance.
- 5.44 International experience provides an early indication of how noise considerations may be incorporated into the approval and oversight of drone operations. In Australia, where residential drone delivery services have been trialled, noise management has formed part of the broader process of assessing and approving operations in populated areas. This illustrates the value of considering community noise during the development of operational arrangements rather than only after services have been introduced.⁷⁶

⁷⁶ Burgess, M. (2024), 'Approaches to Noise Management for Commercial Drone Deliveries with Reference to Australian Experience', University of New South Wales, *Quiet Drones 2024*, Manchester, 8–11 September 2024.

- 5.45 Governance arrangements should therefore ensure:
- accessible and well-publicised complaint mechanisms
 - clear attribution of flights to operators
 - operators taking primary responsibility for responding to community concerns arising from their operations
 - prompt investigation and response to concerns
 - transparent publication of outcomes
 - periodic independent assurance of complaint-handling processes, where proportionate
- 5.46 Community advisory panels, similar to airport consultative committees, may provide a forum for structured engagement in areas experiencing sustained operations. Importantly, governance should demonstrate not only that limits exist, but that they are meaningful, monitored and enforceable.
- 5.47 The way in which complaints are handled may influence public acceptance alongside measured noise levels. Governance must therefore prioritise responsiveness, clarity and transparency.

Interaction with wider environmental and sustainability policy

- 5.48 Drone noise policy should not be developed in isolation from wider environmental objectives, including the UK's statutory climate targets and carbon budgets, air quality policy, biodiversity protections and local planning strategies.
- 5.49 Where environmental objectives interact, for example where measures to reduce greenhouse-gas emissions affect acoustic performance, governance frameworks should make trade-offs explicit. Decision-making should consider cumulative environmental effects rather than assessing noise in isolation.
- 5.50 Furthermore, noise should be considered more generally across transport modes, addressing situations in which drone operations replace noisier alternatives, such as some helicopter missions, or alternatives that may produce lower overall impacts, such as electric bicycles and some electric road vehicles. Comparisons should consider changes in the overall pattern of activity and exposure, rather than source-noise alone.
- 5.51 In this way, drone noise governance can form part of an integrated approach to sustainable aviation and the wider transport system.

Evolution of the governance model

Governance of trials and transition to commercial operations

- 5.52 The governance framework should distinguish clearly between trial operations and full-scale commercial services.
- 5.53 Trial operations provide a controlled environment in which to gather data, test mitigation measures and assess community response. Authorisations for trials may be time-limited and subject to defined conditions, including mandatory data collection and transparent reporting of findings. Governance during this phase should prioritise learning and evidence generation, with clear objectives set for the trial and reflected in the authorisation decision.
- 5.54 As operations transition to commercial scale, governance should evolve accordingly. It is envisaged that measures such as noise thresholds, movement caps, routing constraints and digital enforcement mechanisms may be developed and formalised. Ongoing monitoring and periodic review mechanisms should be established to ensure that scaling does not result in unintended cumulative impacts.

Path to UK Drone Noise Policy

- 5.55 The development of a proportionate and defensible national drone noise policy requires a structured pathway from evidence generation through to regulatory implementation. Unlike conventional aviation, where policy has developed over decades of operational experience, drone operations are only now beginning to scale. Governance must therefore support the systematic and iterative development of the evidence base needed to underpin policy decisions.

Phase 1 – Evidence generation

- 5.56 The initial phase should prioritise the collection of robust UK-specific data through controlled operational deployment. This includes:
- structured trial operations in urban, suburban and rural environments
 - standardised collection of operational telemetry to support noise modelling
 - targeted environmental noise measurements where appropriate
 - initial qualitative, quantitative and experimental studies, followed by short-term and medium-term statistically robust noise attitude studies as the scale and stability of operations allow
 - ongoing public engagement activity
- 5.57 The proposed staged programme of noise attitude and sleep disturbance surveys is central to this pathway. By linking modelled noise exposure levels to reported annoyance, sleep disturbance, quality of life, wellbeing, perception and

contextual factors across a representative population sample, policymakers can develop exposure–response functions specific to drone operations. Initial smaller-scale studies can also inform the development and validation of survey instruments before sufficiently large and stable operational populations exist for more definitive studies. This approach avoids reliance on proxy data from conventional aviation or other transport modes and ensures that UK policy reflects the particular acoustic characteristics and operational patterns of drones.

- 5.58 The Air Navigation Guidance 2026 provides a valuable opportunity to gather such evidence by facilitating certain time-limited UAS airspace trials that contribute to government policy development and learning. Where operational exposure is sufficiently stable and an adequate study population can be obtained, trial authorisations, combined with structured data-collection requirements could support noise attitude research alongside real-world operations. Where those conditions are not met, trial data may instead contribute to smaller-scale studies and the progressive development of the evidence base needed to inform long-term policy.

Phase 2 – Policy formation

- 5.59 Using the evidence generated in Phase 1, which will be ongoing, government could define the core elements of a national drone noise policy, including:
- appropriate noise metrics for policy purposes
 - effect levels, appraisal thresholds and other policy criteria for interpreting community impact
 - time-of-day weighting approaches
 - guidance for local planning authorities
 - criteria for imposing operating restrictions where necessary
- 5.60 These elements could be incorporated into future iterations of the Air Navigation Guidance and/or supporting CAA policy documents.

Phase 3 – Regulatory embedding

- 5.61 In the longer term, noise policy may be embedded through a combination of:
- harmonised certification standards
 - class-based access conditions linked to vehicle noise performance
 - digitally enforced operating limits implemented through UTM systems
 - integration with land-use planning frameworks.

- 5.62 At this stage, noise governance would move from precautionary, trial-based controls to a stable, evidence-led regulatory regime capable of supporting large-scale operations while maintaining appropriate protection for communities.

Phasing of measures and governance elements

- 5.63 The appropriate governance framework for drone and eVTOL noise should evolve alongside the scale, maturity and societal impact of the sector. Measures that are proportionate during initial trials may become inadequate as operations increase in frequency, geographic extent and public exposure. Equally, governance arrangements that may be justified for mature, high-density operations could impose disproportionate burdens if introduced prematurely. Policy should therefore allow for the phased introduction of monitoring, engagement, reporting and mitigation requirements as operational activity develops.
- 5.64 In practice, this is likely to involve a progression from evidence-generation measures during the current trial and early deployment period, through more formal governance arrangements if and as routine commercial services become established, and potentially more interventionist controls only if operations later achieve widespread scale and significant cumulative exposure.
- 5.65 During the early trial and demonstration phase, governance should focus on evidence generation, transparency and learning. Priority should be given to collecting operational and noise data, undertaking noise attitude studies, testing engagement approaches, establishing accessible complaints processes, and improving understanding of how communities respond to different operating environments and use cases. The objective at this stage should be to build the evidence base needed to support future policy decisions while maintaining public confidence in the development process.
- 5.66 As operations move towards routine commercial deployment, potentially during the latter part of the 2020s and around 2030, governance arrangements should become progressively more structured. This may include more standardised reporting requirements, community engagement processes, operational transparency measures, complaints handling procedures and mechanisms for ongoing stakeholder oversight. At this stage, regulators and policymakers should be able to draw on evidence gathered during trials to determine which measures are justified and where they should be targeted.
- 5.67 Beyond 2030, if drone and eVTOL operations reach significant scale, particularly in densely populated areas or where cumulative exposure becomes substantial, additional governance interventions may be required. These could include more formalised noise monitoring networks, nationally standardised reporting frameworks, stronger requirements for public transparency, enhanced community representation arrangements, and, where justified by the level of

impact, consideration of more formal mitigation or compensation mechanisms. Such measures should be guided by objective evidence of exposure and impact rather than assumptions made during the early stages of sector development.

- 5.68 This phased approach recognises that noise governance should not be static. The framework should be capable of adapting as operational experience grows, technologies mature, public expectations evolve and new evidence becomes available. In this way, governance can remain proportionate, supporting innovation and economic benefit while ensuring that community concerns continue to be identified, understood and addressed as the sector develops.

Potential long-term institutional models

- 5.69 As drone and eVTOL operations scale from trials to routine commercial services, and as more formal governance measures become necessary, the governance arrangements described above may need to evolve beyond transitional measures into a more permanent institutional model. While the preceding sections consider how noise governance may develop over time, an additional question is which institutions should ultimately be responsible for implementing, overseeing and coordinating these functions. It would be premature to prescribe a definitive structure; however, several options are worth consideration.
- 5.70 One option is to retain the existing distributed model, under which DfT sets policy, the CAA regulates safety and operational authorisations, and local and regional governing bodies exercise their respective land-use planning, strategic planning and environmental health functions. Under this model, enhanced coordination mechanisms, such as formal guidance, shared data standards and structured engagement protocols, would strengthen coherence without creating new institutions.
- 5.71 A second option would be to establish a dedicated national oversight function for environmental and societal impacts of emerging aviation technologies. This could take the form of a standing advisory panel or oversight board focused on noise, privacy and community impact. Such a body could provide independent review of data, advise on effect levels, appraisal thresholds or other relevant policy criteria, and publish periodic assessments of cumulative impacts. This may be particularly relevant in the early years of large-scale deployment, when exposure–response functions and appropriate policy criteria are still being defined. A UK-wide public dialogue commissioned by Sciencewise, the UKRI Future Flight Challenge and the University of Birmingham identified independent oversight as core principle in building public trust in the governance of emerging aviation technologies. A subsequent UK-wide survey found that 76% of respondents considered it important to establish independent bodies to monitor and hold industry accountable in areas including safety, wildlife, accessibility, environmental impacts and drone surveillance. While this does not establish a specific preference for a new national oversight board, it provides evidence of

public support for independent oversight in principle.⁷⁷ Such a function could therefore play a key role in building public trust and durable societal acceptance.

- 5.72 A third option could involve a more formalised ‘regional noise management’ model. As operations become denser in particular urban areas, there may be value in managing cumulative exposure at a regional level rather than on an operator-by-operator basis. This could include the concept of regional noise budgets or coordinated movement caps, administered through UTM systems and overseen by the CAA, local government or another body with the necessary statutory responsibility. Any such arrangement would require an appropriate legal basis, an agreed noise metric, sufficiently complete operational data across relevant operators, and transparent rules for allocating capacity, reviewing decisions and resolving disputes. Such an approach would recognise that cumulative noise exposure arises from aggregated activity and that governance must reflect this reality.
- 5.73 In the longer term, institutional arrangements may also need to account for the increasing role of digital infrastructure providers. As UTM systems become integral to managing routing, slot allocation and potentially noise-aware operations, governance frameworks should clarify expectations around resilience, data integrity and public accountability. This may include minimum standards for interoperability and continuity of service, given the dependency of environmental governance on digital control systems.
- 5.74 At present, the evolutionary approach seems more appropriate than structural reform, given the limited data available to make high-quality regulatory decisions. Existing institutions are capable of governing early-stage deployment, provided coordination is strengthened and evidence is systematically gathered. For the foreseeable future, improvements in guidance, transparency, monitoring and stakeholder engagement may be more important than creating new organisations. However, policy-makers should remain open to institutional adaptation if operational density, cumulative exposure or public concern reaches levels that warrant more formalised oversight.

Chapter 5 summary

- 5.75 The governance of noise from emerging aviation technologies requires more than the identification of mitigation measures. It demands clarity of institutional roles, robust data systems, transparent decision-making and mechanisms for

⁷⁷ Elsdon-Baker, F., Hughes, R., Mason-Wilkes, W. and Green, A. (2025), *Navigating Future Flight: Societal Principles for Drones and Advanced Air Mobility in the UK*, University of Birmingham, p. 20. The nationally representative survey asked respondents about the importance of ‘establishing independent bodies to monitor and hold industry accountable in key areas’, with 76% rating this important.

<https://futureflightsocial.ac.uk/research/>

adaptation as evidence evolves. Governance arrangements should be proportionate to the scale, maturity and impacts of operations, becoming more structured if and as routine commercial services develop.

5.76 This Chapter has set out a framework in which:

- national policy direction is provided by government
- the CAA regulates and enforces within its statutory remit
- local, regional and devolved bodies exercise their respective planning, environmental health, public health, transport and coordination functions
- responsibility for monitoring and enforcement follows the relevant statutory or regulatory regime
- digital systems support measurable and enforceable controls, while recognising that authorisation workflows, flight execution and enforcement may require different technical and legal mechanisms
- evidence, particularly UK-specific exposure-response data, underpins future policy development
- affected communities and relevant specialists are engaged through transparent and accessible processes
- policy is reviewed and adapted as operational experience and evidence develop.

5.77 Central to this approach is the generation of a robust evidence base, including operational telemetry, environmental monitoring and a staged programme of social research, including noise attitude studies during suitable extended trials and early deployments and, where needed, further studies as operations become more widespread and representative. Together, these forms of evidence could support the development of a proportionate, defensible and transparent national noise policy for drone and eVTOL operations. Complaint and feedback data should contribute to this evidence base but be interpreted alongside operational, exposure and wider engagement evidence.

5.78 Governance must ultimately secure not only regulatory compliance, but public confidence and durable acceptance. By embedding transparency, accountability and adaptability from the outset, the UK can support innovation in emerging aviation technologies while maintaining public confidence and environmental protection. At present, an evolutionary approach is likely to be more proportionate than immediate structural reform: existing institutions can govern early deployment if coordination is strengthened and evidence is gathered systematically, while retaining scope for more formalised oversight if operational density, cumulative exposure or public concern later warrants it.

Chapter 6

Conclusions

- 6.1 This report has examined the emerging evidence base, policy context and regulatory frameworks relevant to managing noise from emerging aviation technologies, including drones and eVTOL aircraft. These technologies offer potential benefits through improved connectivity, more efficient services, innovation and economic growth. However, their introduction raises new considerations for noise policy in the UK.
- 6.2 A central finding is that noise from emerging aviation technologies may differ in important respects from conventional aviation noise. Although some drone and eVTOL aircraft may be quieter at source than some conventional aircraft, lower-altitude operations, distributed flight paths, hover and vertical flight, potentially higher movement frequencies and operation close to homes may create new patterns of noise exposure. The acoustic characteristics of some drone and eVTOL aircraft may also result in greater annoyance than other environmental noise sources at comparable sound levels.
- 6.3 Noise impacts are unlikely to be determined by sound exposure alone. Community response may also be influenced by the time, frequency and predictability of operations, the existing sound environment, visual presence, privacy and safety concerns, the purpose and perceived public benefit of the service, and confidence in the organisations responsible for it. The benefits and impacts may also fall on different groups, with people who do not use a service potentially experiencing its noise. Effective policy will therefore need to account for context and distributional effects alongside acoustic exposure.
- 6.4 The existing legislative and policy framework provides a substantial foundation. This includes national noise policy, the ICAO Balanced Approach, aircraft certification, airspace regulation, planning, operational authorisation and the Airspace Change Process. However, these frameworks were largely developed for conventional aviation and do not yet provide a complete or consistently applicable framework for drones and eVTOL aircraft.
- 6.5 Important technical gaps remain. There are not yet internationally agreed noise-certification standards covering the full range of aircraft, established source-noise datasets for all relevant configurations, internationally recognised methods for modelling operational exposure, or robust UK-specific exposure-response functions for annoyance and sleep disturbance. Conventional metrics remain useful, but may need to be supplemented by event-based or sound-quality information where this materially improves the assessment of distinctive, intermittent or repetitive operations.

- 6.6 Existing international work provides a practical basis on which to build. In the near term, the CAA's published UK EPTS can continue to provide the starting point for project-specific environmental certification bases for VTOL-capable aircraft within their scope, while the UK supports the development of internationally agreed standards through ICAO/CAEP and remains engaged with European and other international developments. Further work will be needed to improve source-noise data, modelling guidance and proportionate criteria for determining when detailed assessment, validation or monitoring is required.
- 6.7 The regulatory route taken by an operation may affect whether and how noise is assessed. CAP1616 version 6 and its supporting documents establish proportionate processes for permanent and non-permanent airspace changes, including transitional arrangements for certain UAS trials and temporary changes. However, some operations may proceed through operational authorisation within the existing airspace design and will not necessarily be subject to an equivalent standardised environmental assessment. Achieving greater consistency across these routes is an important policy objective, while recognising that requirements should remain proportionate to the scale, duration, location and likely effects of the operation.
- 6.8 No single noise-management measure will be sufficient. The ICAO Balanced Approach provides a useful structure, but its application will need to reflect the characteristics of emerging operations. Noise reduction at source is likely to be particularly important. Planning can help manage the location and design of fixed infrastructure but cannot, on its own, address distributed operations close to homes. Operational procedures can reduce exposure, although vehicle capability, energy use, safety and service requirements may constrain the available options. Operating restrictions may therefore be required in some circumstances, including limits on operating hours, movement numbers or activity in sensitive locations.
- 6.9 Stakeholder engagement should complement these measures. Engagement should begin early, be transparent and inclusive, involve affected communities and relevant specialists, and continue as operations develop. Communities should be able to understand what is operating, where, when and why, who is responsible and how concerns can be raised. Operators should respond to complaints arising from their activities, but complaint data should be interpreted alongside exposure, operational and wider engagement evidence.
- 6.10 Governance responsibilities are likely to remain distributed. Government should provide national policy direction; the CAA should regulate and enforce within its statutory remit; and local, regional and devolved bodies should exercise their respective planning, environmental health, public health, transport and coordination functions. Clearer arrangements will be required for coordinating decisions, sharing information and handling impacts that cross administrative

boundaries. Responsibility for monitoring and enforcement should follow the relevant statutory or regulatory regime.

- 6.11 Digital systems offer opportunities to make noise controls more measurable, responsive and enforceable. Operational telemetry, flight logging, Remote ID, electronic conspicuity and future UTM services may support modelling, attribution and compliance monitoring. Digital authorisation workflows may also help screen non-compliant flight plans. These capabilities should not be overstated, however. Preventing the execution of a non-compliant operation would require additional technical and legal mechanisms, and the use of operational data must comply with applicable data-protection, security and commercial-confidentiality requirements.

Early priorities

- 6.12 The current period of trials and early deployment provides an opportunity to establish good practice before operating patterns become entrenched. A number of practical measures could be progressed over the next 6 to 12 months without waiting for definitive exposure-response functions or a mature national regulatory regime:
- a) **establish a common minimum dataset for relevant trials and early deployments**, covering aircraft type, flight path, altitude, time, duration, operating mode and movement numbers
 - b) **develop proportionate interim guidance on noise information and assessment**, identifying when basic source data, event-level calculations, noise footprints, cumulative exposure modelling or physical measurements may be appropriate
 - c) **agree common principles for the collection and reporting of complaints and community feedback**, while making clear that complaint numbers are not a direct measure of the population affected
 - d) **develop and test a core set of survey questions and supporting research methods** that can be used consistently across trials and early operations
 - e) **identify suitable trials and early deployments for noise measurement and social research**, including noise attitude studies where the operational exposure and available study population are suitable
 - f) **establish minimum expectations for operator transparency and engagement**, including advance information about operations, accessible contact arrangements and reporting of findings
 - g) **clarify how noise should be considered across airspace change, operational authorisation and planning routes**, including how

information gathered through one process may support another without duplicating effort

- h) **maintain active UK engagement in international certification, measurement and modelling work**, while identifying where national guidance may be needed before international standards mature.

- 6.13 These early actions would provide immediate benefits. They would improve the consistency and comparability of evidence, give operators greater clarity, support proportionate regulatory decisions and reduce the risk that early deployments proceed without generating information needed for future policy. They would also demonstrate to affected communities that trials are being used to learn and that evidence and feedback can lead to changes in operations or mitigation.

A first edition of national drone noise policy

- 6.14 A first edition of a UK drone noise policy should be transitional and capable of development as evidence improves. It should not attempt prematurely to establish definitive drone-specific effect levels or comprehensive numerical limits. Instead, it should provide a consistent framework for the assessment and management of trials, early deployments and initial routine services.

- 6.15 As a minimum, a first edition policy should:

- a) **define its scope and relationship with existing processes**, including airspace change, operational authorisation, planning and environmental health
- b) **establish proportionate assessment tiers**, linked to factors such as duration, movement frequency, operating height, time of day, proximity to sensitive receptors and the scale of the potentially affected population
- c) **specify minimum operational and noise data requirements**, together with expectations for data quality, retention and access
- d) **identify appropriate interim metrics and assessment methods**, while explaining the limitations of conventional aviation reference levels when applied to drones
- e) **require consideration of the full operation**, including launch, climb, cruise, hover, approach, delivery or inspection activity and return flight
- f) **establish principles for mitigation**, covering quieter aircraft, site selection, route and altitude design, operating profiles, movement management and time-of-day restrictions
- g) **set expectations for early and continuing stakeholder engagement**, transparency, complaints handling and reporting

- h) **require monitoring and review that are proportionate to the operation**, with clear provision for conditions or mitigation to be adjusted where evidence demonstrates material impacts
- i) **support coordinated evidence gathering**, using common data and research methods wherever practicable
- j) **provide for periodic policy review**, allowing requirements to evolve as technology, operational scale and the evidence base develop.

6.16 The first edition should distinguish between requirements that can be applied immediately and matters that remain dependent on further evidence. Immediate requirements can include data collection, transparency, engagement, proportionate assessment and the consideration of practicable mitigation. Research to develop drone-specific exposure-response functions should begin during suitable trials and early deployments. However, their use to establish definitive national effect levels or appraisal thresholds, together with the introduction of noise budgets or more automated enforcement arrangements, should depend on the maturity and representativeness of the supporting evidence and, where relevant, the availability of appropriate legal powers and technical infrastructure.

Longer-term development

- 6.17 Over time, evidence gathered from trials and early deployments should support more formal policy. A staged research programme should combine operational telemetry, noise measurement and modelling, qualitative and quantitative engagement, experimental studies and noise attitude studies designed around sufficiently stable and well-characterised operational exposure. Studies undertaken during extended trials can provide valuable early evidence on community response and help develop exposure-response functions, provided that the operating conditions, study populations and exposure data are suitable. Further studies may be required as operations become more widespread and representative, including to assess annoyance, sleep disturbance and responses across different aircraft, use cases and operating contexts.
- 6.18 Governance should evolve alongside the sector. More structured reporting, monitoring, engagement and oversight may be justified if and as routine services become established. More interventionist measures, such as regional noise-management arrangements, coordinated movement caps, noise budgets or compensation mechanisms, should be considered only where operational density and evidence of cumulative impact justify them and where an appropriate legal, technical and institutional framework exists.
- 6.19 At present, an evolutionary approach is more proportionate than immediate structural reform. Existing institutions should be capable of governing early

deployment if responsibilities are clarified, coordination is strengthened and evidence is gathered systematically. Policymakers should nevertheless remain open to more formalised independent or regional oversight if operational density, cumulative exposure or public concern later warrants it.

- 6.20 Emerging aviation technologies present both an opportunity and a challenge for noise policy. Their benefits can be realised sustainably only if noise is considered from the outset rather than addressed after operations become established. A proportionate first edition of drone noise policy, supported by consistent early evidence gathering and transparent engagement, would provide a practical foundation for protecting communities, giving industry regulatory clarity and enabling policy to become more sophisticated as the sector and evidence base mature.

APPENDIX A

Glossary of terms

Term	Definition
AAM (Advanced Air Mobility)	A new class of aviation operations including electric aircraft designed for short distance passenger or cargo transport often in urban environments
ACP (Airspace Change Process)	The formal process set out by the CAA for proposing assessing and approving changes to UK airspace
A-weighting dB(A)	A method of adjusting sound measurements to reflect human hearing sensitivity to different frequencies
Ambient noise	The background level of sound in an environment from all sources excluding the specific source being assessed
CAA (Civil Aviation Authority)	The UK aviation regulator responsible for safety airspace and environmental oversight
CAP (Civil Aviation Publication)	Official documents published by the CAA providing policy guidance or regulatory information
Community response	The way individuals or communities perceive and react to noise including annoyance disturbance or complaint
Decibel dB	A logarithmic unit used to measure sound levels
Drone	An uncrewed aircraft with no people on board, operated remotely or autonomously
eVTOL (Electric Vertical Take-off and Landing aircraft)	An aircraft capable of vertical take-off and landing typically powered by electric propulsion
Frequency	Acoustic frequency is the number of sound wave cycles per second measured in Hertz, Hz which influences the perceived pitch of a sound. Frequency is also used in the sense of how often flights occur.
Geo-awareness	A system providing drone operators with information about airspace restrictions or hazards
Geofencing	A technology that restricts drone operations within defined geographic boundaries using digital controls
Geometric spreading	The reduction in sound energy as it spreads out from a source over distance
ICAO (International Civil Aviation Organization)	A United Nations agency that sets global aviation standards including noise management
L_{Aeq} (Equivalent continuous sound level)	A metric representing average noise exposure over a specified time period
L_{Amax} (Maximum sound level)	The highest instantaneous sound level during a single noise event
L_{den} (Day Evening Night Level)	A noise metric that averages noise over a 24-hour period with penalties for evening and night noise
LOAEL (Lowest Observed Adverse Effect Level)	The noise level above which adverse effects on health and quality of life begin to occur

Term	Definition
Noise contour	A line on a map connecting points of equal noise exposure used to show the spatial distribution of noise
Noise exposure	The level of noise experienced by individuals or communities over time
Noise metric	A method or indicator used to quantify noise exposure or effects
ORS4 (Official Record Series 4)	CAA permissions allowing exemptions from standard aviation rules including minimum flying heights
Propagation	The way sound travels from a source to a receiver through the environment
Remote ID	A system allowing drones to transmit identification and positional information during flight. Also known as Direct Remote Identification (DRI)
Receptor	A location or individual exposed to noise such as a residential property or community
Reflection	The bouncing of sound waves off surfaces such as buildings or the ground
SERA (Standardised European Rules of the Air)	Rules governing how aircraft operate including minimum altitudes and separation distances
SEL (Sound Exposure Level)	A measure of the total energy of a single noise event standardised to one second
Shielding	The reduction of noise by obstacles such as buildings or terrain blocking the sound path
SOAEL (Significant Observed Adverse Effect Level)	The level above which significant adverse effects on health and quality of life occur
Tonality	The presence of distinct tones or pitches in a sound which can increase annoyance
Transport Analysis Guidance, TAG	DfT guidance on assessing transport project impacts including environmental effects
UAS (Uncrewed Aircraft System)	See 'Drone'. The CAA generally uses the gender-neutral term 'uncrewed' in preference to 'unmanned'. The term 'unmanned' is retained where it forms part of the title or wording of legislation, regulations, standards, official policy documents, or established terms such as Unmanned Aircraft System (UAS).
UTM (UAS Traffic Management)	Systems for managing drone traffic including routing separation and data exchange
VTOL (Vertical Take-Off and Landing)	Aircraft capable of taking off, hovering, and landing vertically without the need for a runway. VTOL aircraft typically use rotors or vectored-thrust and are a common design configuration for eVTOL and other emerging aviation technologies