Bickerdike Allen Partners
Architecture
Acoustics
Technology

BRISTOL AIRPORT

12MPPA PLANNING APPEAL

PROOF OF EVIDENCE

NOISE

Report to

Bristol Airport

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15 June 2021

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1.0 INTRODUCTION

1.1 Qualifications and Experience

1.1.1 I am Nicholas Anthony Williams, an Associate at Bickerdike Allen Partners LLP (BAP). I work as an acoustic consultant and have over 12 years' experience.

1.1.2 I graduated from the University of Southampton in 2008 with a degree (BSc Hons) in Mathematics, and from London South Bank University in 2014 with a degree (MSc Hons) in Environmental and Architectural Acoustics. I am a Member of the Institute of Acoustics.

1.1.3 I joined BAP in 2008 and have remained with the company continuously to the present day, becoming an Associate in 2019. While the company offers a range of acoustic consultancy services, one of the specialisms of the company is the measurement, prediction and assessment of environmental noise, and in particular aircraft noise. We work with a number of clients who are owners or have an interest in airports as well as clients who might be affected by noise from airports.

1.1.4 I have undertaken a variety of aircraft noise assessments both in the UK and abroad. These have included assessments of environmental (including aircraft) noise on individual properties, as well as larger projects such as the preparation of chapters for Environmental Statements. I was heavily involved with BAP's work assisting the UK Airports Commission on noise matters relating to a national assessment of aircraft noise in the UK, which was published in 2015.

1.1.5 My relevant experience includes the measurement of aircraft noise in real-world situations, modelling of aircraft noise using industry-standard software, and the presentation and assessment of impacts.

1.1.6 My employers, Bickerdike Allen Partners LLP, were instructed to prepare the noise chapter of the Environmental Statement (ES) for both the original application and the Environmental Statement Addendum (ESA). I was heavily involved in the preparation of the noise chapter for both the ES and the ESA, while aided by my colleagues, most notably Peter Henson (former Partner) and David Charles (Partner).

1.1.7 I confirm that the evidence which I have prepared and present for this appeal has been prepared in accordance with the guidance of my professional institution and I confirm that the opinions expressed are my true and professional opinions.

1.2 Scope of Evidence

1.2.1 This Proof of Evidence (POE) records the key noise matters arising out of the proposed development and addresses the Reasons for Refusal given by North Somerset Council (NSC) as well as issues raised by NSC and the Parish Councils Airport Association (PCAA) in their Statements of Case and elsewhere, in relation to the noise effects of the proposed development.

1.2.2 In Section 2.0 I deal with the Reasons for Refusal given by NSC which are related to noise. In Section 3.0 I summarise the key legislation, planning policy and technical guidance relevant to this POE. In Section 4.0 I present a summary of the noise assessments carried out in the Environmental Statement (ES) and Environmental Statement Addendum (ESA). In Section 5.0 I respond to specific issues raised by North Somerset Council (NSC) and third parties.

1.3 Summary of Case

1.3.1 My Proof of Evidence includes a summary of the key findings of the Environmental Statement (ES) and Environmental Statement Addendum (ESA), and addresses the Reasons for Refusal given by North Somerset Council (NSC) as well as issues raised by NSC and the Parish Councils Airport Association (PCAA) in their Statements of Case and elsewhere, in relation to the noise effects of the proposed development.

1.3.2 There are two primary noise issues raised in NSC's Reasons for Refusal 1 and 2 which I consider.

1.3.3 Firstly, there is the issue of whether significant adverse noise effects arise due to the development. I conclude that they do not.

1.3.4 Secondly there is the issue of whether (not significant) adverse noise effects are adequately dealt with. I conclude that they are.

1.3.5 These conclusions are consistent with the conclusions of the ES and ESA, and the opinion of NSC Environmental Officers presented in their Officer's Report after they had reviewed the ES and received advice from their independent noise consultants.

1.3.6 A separate issue is consideration of the uncertainty in the future forecasts and how this affects the confidence in the assessment. This has been brought into focus by the announcement that Jet2 will be commencing operations from Bristol Airport in 2021.

1.3.7 In response it is noted that while there is always some uncertainty associated with future forecasts, this can be mitigated by the setting of suitable planning conditions which result in the noise effects being controlled to acceptable levels.

1.3.8 The uncertainty would also be expected to have a similar effect on both the 10 mppa and 12 mppa scenarios and therefore would be unlikely to materially affect the change

due to the development. Even making an assumption that only the 12 mppa scenario was affected, the faster growth analysis shows that the proposed development would still not give rise to any significant noise effects.

1.3.9 The other issues raised relate to NSC and PCAA challenging the assessment methodology on a number of points.

1.3.10 I demonstrate in this Proof that the assessment methodology is robust, being in line with the industry standard approach which is supported by current policy and guidance.

1.3.11 NSC Officers previously accepted the assessment methodology for the ES, and the same methodology has been used for the ESA.

2.0 REASONS FOR REFUSAL

2.1.1 Two of the five Reasons for Refusal given by NSC (Reasons 1 and 2) cited in the Decision Notice dated 19th March 2020 include a reference to noise matters. These Reasons for Refusal are reproduced below:

2.1.2 Reason 1:

"The airport has planning permission to expand to a throughput of 10 million passengers per annum (mppa) which allows for further expansion in passenger growth of approximately 1 mppa above the current passenger level. The further expansion beyond 10mppa now proposed would generate additional noise, traffic and off airport car parking resulting in adverse environmental impacts on communities surrounding Bristol Airport and which would have an adverse impact on an inadequate surface access infrastructure. The claimed economic benefits arising from the proposal would not outweigh the environmental harm caused by the development contrary to policy CS23 of the North Somerset Core Strategy 2017."

2.1.3 Reason 2:

2.1.4 *"The noise and impact on air quality generated by the increase in aircraft movements and in particular the proposed lifting of seasonal restrictions on night flights would have a significant adverse impact on the health and well-being of residents in local communities and the proposed development would not contribute to improving the health and well-being of the local population contrary to policies CS3, CS23 and CS26 of the North Somerset Core Strategy 2017."*

2.1.5 Policies CS3, CS23 and CS26 of the North Somerset Core Strategy 2017 are cited as the basis for Reasons for Refusal 1 and 2. These policies are discussed in a planning context in the POE of Mr Melling. They are discussed in a noise context in this section.

Policy CS3

2.1.6 Policy CS3 states that:

"Development that, on its own or cumulatively, would result in air, water or other environmental pollution or harm to amenity, health or safety will only be permitted if the potential adverse effects would be mitigated to an acceptable level by other control regimes, or by measures included in the proposals, by the imposition of planning conditions or through a planning obligation."

2.1.7 Policy CS3 also references the National Planning Policy Framework (NPPF) [CD5.8]and the Noise Policy Statement for England [CD10.4] (NPSE). These documents were discussed in Appendix 7B of the ES and are discussed in Sections 3.2 and 3.3 of this POE.

2.1.8 The key noise-related policy from these documents is to avoid significant adverse noise impacts from development and to mitigate and minimise adverse noise impacts.

2.1.9 I will demonstrate in this POE by reference to information presented in the ES and ESA and other related relevant information that no significant noise impacts arise as a result of the proposed development and that any adverse impacts will be adequately mitigated.

Policy CS23

2.1.10 Policy CS23 states that:

"Proposals for the development of Bristol Airport will be required to demonstrate the satisfactory resolution of environmental issues, including the impact of growth on surrounding communities and surface access infrastructure."

2.1.11 If policy CS3 is satisfied, in particular the requirement to mitigate adverse effects to an acceptable level, then policy CS23 would also be satisfied.

Policy CS26

2.1.12 Policy CS26 states that:

"The planning process will support programmes and strategies which increase and improve health services throughout the district, promote healthier lifestyles and aim to reduce health inequalities."

2.1.13 This policy is only indirectly related to noise in that it requires a Health Impact Assessment (HIA) to be undertaken for all large scale developments, and noise is one of the factors considered as part of such an assessment. The HIA that was carried out in relation to this application is discussed in the POE of Mr Pyper. It did not find any significant health or wellbeing impacts related to noise.

2.1.14 NSC in their Reason for Refusal 2 state that:

"noise … generated by the increase in aircraft movements and in particular the proposed lifting of seasonal restrictions on night flights would have a significant adverse impact on the health and well-being of residents in local communities…"

2.1.15 They do not offer any explanation or evidence to support this statement, which is contrary to the conclusions of the ES, ESA and the Officers' Report.

3.0 LEGISLATIVE AND POLICY CONTEXT

3.1.1 Relevant legislation, planning policy and technical guidance was discussed in the ES (Appendix 7B) and ESA (Section 6.2). The key documents are discussed in this section. Also included are references to other airport assessments.

3.2 National Planning Policy Framework (NPPF)

3.2.1 The *National Planning Policy Framework* (NPPF) [CD5.8] originally published in March 2012 and updated in July 2018, sets out the UK Government's planning policies for England and how these are expected to be applied. It is designed to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth.

3.2.2 The UK Government's current planning policy concerning noise is embodied in the NPPF (and more specifically the *Noise Policy Statement for England* [CD10.4] or NPSE). The aim of planning policies and decisions with respect to noise is addressed in paragraph 180 of the NPPF:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- *Mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise from giving rise to significant adverse impacts on health and quality of life; and*

- *Identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason;"*

3.2.3 The above policy refers to "significant adverse impacts" and "other adverse impacts" which are not defined numerically in this document, although the NPSE makes reference to further research being undertaken in this regard.

3.3 Noise Policy Statement for England (NPSE)

3.3.1 The *Noise Policy Statement for England* (NPSE) [CD10.4] provides the framework for noise management decisions to be made that ensure noise levels do not place an unacceptable burden on society.

3.3.2 The stated aims of the NPSE are to:

- *"Avoid significant adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development;*

- *Mitigate and minimise adverse impacts on health and quality of life from environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development, and*

- *Where possible, contribute to the improvement of health and quality of life through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development."*

3.3.3 The NPSE introduces the concepts of NOEL (No Observed Effect Level), LOAEL (Lowest Observed Adverse Effect Level) and SOAEL (Significant Observed Adverse Effect Level). The definition of these is as follows:

- *"NOEL – No Observed Effect Level. This is the level below which no effect can be detected";*
- *"LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected",* and
- *"SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur."*

3.3.4 Further guidance on how planning authorities should take account of the acoustic environment and the mitigation strategies which should be applied in relation to the above terms is provided in the *National Planning Practice Guidance, Noise (PPGN)* [CDX.01].

3.3.5 The NPSE states that it is not possible to give a single objective noise-based measure that defines a SOAEL that is applicable to all sources of noise for all situations. It acknowledges that the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It also acknowledges that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, it states that not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available.

3.3.6 Where any adverse noise effects are predicted, these are identified and, if these cannot be avoided, mitigation measures are recommended to ensure no significant residual effects on health and quality of life arise. This approach is considered consistent with the principal aims of the NPSE. It is important to note that findings against the LOAEL and SOAEL are measures of the effect of noise on health and quality of life, and not environmental impact assessment findings.

3.4 Planning Practice Guidance, Noise (PPGN)

3.4.1 The *National Planning Practice Guidance, Noise (PPGN)* [CD10.40] was first published in 2014, and most recently updated in March 2019. The advice referred to here has not changed materially since 2014.

3.4.2 The advice is that noise above the SOAEL should be avoided using appropriate mitigation while taking into account the guiding principles of sustainable development.

3.4.3 Where noise is between LOAEL and SOAEL, the advice is to take all reasonable steps to mitigate and minimise adverse effects on health and quality of life while also taking into account the guiding principles of sustainable development. Noise in this category is described as an observed adverse effect which is present and intrusive.

3.4.4 As well as assisting with the interpretation of the NPSE, the PPGN provides a web-based resource in support of the NPPF. The PPGN states (paragraph 3) that local planning authorities should take account of the acoustic environment and in doing so consider:

"*whether or not a significant adverse effect is occurring or likely to occur,*

whether or not an adverse effect is occurring or likely to occur, and

whether or not a good standard of amenity can be achieved."

3.4.5 The guidance advises on how planning can manage potential noise impacts in new development and provides a series of guidelines that are in line with the NPPF and the NPSE. Paragraph 5 of the PPGN provides guidance on how to recognise when noise could be a concern. It advises that as noise increases above the LOAEL it can start to cause small changes in behaviour and attitude, for example, having to turn up the volume on the television or needing to speak more loudly to be heard. It states that where noise could have an adverse effect consideration needs to be given to mitigating

and minimising those effects (taking account of the economic and social benefits being derived from the activity causing the noise).

3.4.6 A summary of how to interpret these concepts is given in the PPGN, which is reproduced as Table 1 below.

Response	Examples of Outcomes	Increasing Effect Level	Action
No Observed Effect Level			
Not present	No Effect	No Observed Effect	No specific measures required
Present and not intrusive	Noise can be heard, but does not cause any change in behaviour, attitude or other physiological response. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour, attitude or other physiological response e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a small actual or perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			

Response	Examples of Outcomes	Increasing Effect Level	Action
Present and disruptive	The noise causes a material change in behaviour, attitude or other physiological response e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour, attitude or other physiological response and/or an inability to mitigate effect of noise leading to psychological stress, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory.	Unacceptable Adverse Effect	Prevent

Table 1: Noise exposure hierarchy based on the likely average response

3.4.7 The guidance advises that above the SOAEL boundary, the planning process should be used to avoid this effect occurring, by use of appropriate mitigation such as by altering the design and layout. Such decisions must be made taking account of the economic and social benefit of the activity causing the noise, but it is undesirable for such exposure to be caused.

3.4.8 At the highest extreme, noise exposure would cause extensive and sustained changes in behaviour without an ability to mitigate the effect of noise. The impacts on health and quality of life are such that regardless of the benefits of the activity causing the noise, this situation should be prevented from occurring.

3.4.9 In the ES and ESA assessments, this highest noise exposure level is referred to as the Unacceptable Adverse Effect Level (UAEL). This approach has become a commonly accepted method of identifying the noise exposure level representing this important threshold to safeguard health and quality of life.

3.5 UK Aviation Policy Framework (APF)

3.5.1 The *Aviation Policy Framework* [CD6.1] (APF) was published in March 2013 by the Department for Transport (DfT). The APF defines the Government's objectives and policies on the impacts of aviation in the UK.

3.5.2 On managing aviation's environmental impacts, and specifically noise, it states in paragraph 3.12 that the Government's overall objective on noise is to:

"*Limit and where possible reduce the number of people in the UK significantly affected by aircraft noise*".

3.5.3 It goes on in paragraph 3.13 to state that:

"This is consistent with the Government's Noise Policy, as set out in the Noise Policy Statement for England (NPSE) which aims to avoid significant adverse impact on health and quality of life."

3.5.4 Guidance is provided on the noise metric used to rate airborne noise in paragraph 3.13 where it states:

"To provide historic continuity, the Government will continue to ensure that noise exposure maps are produced for the noise-designated airports on an annual basis providing results down to a level of 57 dB $L_{Aeq,16hour}$*"*.

3.5.5 The noise index is described in a footnote as:

3.5.6 *"the A-weighted average sound level over the 16 hour period of 07:00-23:00. This is based on an average summer day when producing noise contour maps at the designated airports."*

3.5.7 In paragraph 3.17 the interpretation of the contour is given as:

"We will continue to treat the 57 dB $L_{Aeq,16h}$ contour as an average level of day time aircraft noise marking the approximate onset of significant community annoyance. However, this does not mean that all people within this contour will experience significant adverse effects from aircraft noise. Nor does it mean that no-one outside of this contour will consider themselves annoyed by aircraft noise."

3.5.8 Under the heading *"Noise insulation and compensation"* the APF states that:

"*The Government continues to expect airport operators to offer households exposed to levels of noise of 69 dB $L_{Aeq,16h}$ or more, assistance with the cost of moving.*

The Government also expects airport operators to offer acoustic insulation to noise sensitive buildings, such as schools and hospitals, exposed to levels of noise of 63 dB $L_{Aeq,16h}$ or more. Where acoustic insulation cannot provide an appropriate or cost-effective solution, alternative mitigation measures should be offered."

3.5.9 With regard to airport development it continues:

"*Where airport operators are considering developments which result in an increase in noise, they should review their compensation schemes to ensure that they offer appropriate compensation to those potentially affected. As a minimum, the Government would expect airport operators to offer financial assistance towards acoustic insulation to residential properties which experience an increase in noise of 3dB or more which leaves them exposed to levels of noise of 63 dB LAeq,16h or more."*

3.6 Survey of Noise Attitudes 2014 (SoNA)

3.6.1 The Civil Aviation Authority *Survey of Noise Attitudes 2014* (SoNA) includes the results of a survey to noise attitudes to civil aircraft. SoNA largely replaces *Attitudes to noise from aviation sources in England* (ANASE) [CD10.41], the last large scale survey on attitudes to aircraft noise published in 2007.

3.6.2 SoNA compared reported mean annoyance scores against average summer-day noise exposure defined using $L_{Aeq,16h}$, L_{den}, N70 and N65. Mean annoyance score correlated well with average summer day noise exposure, $L_{Aeq,16h}$. No evidence was found to suggest any of the other indicators correlated better with annoyance than $L_{Aeq,16h}$.

3.6.3 The survey resulted in the 54 dB $L_{Aeq,16h}$ becoming the threshold of community annoyance rather than 57 dB $L_{Aeq,16h}$ which was based on the *UK Aircraft Noise Index Study* (or ANIS) from 1985 [CD10.42].

3.7 UK Airspace Policy

3.7.1 Although the APF [CD6.1] remains the current national aviation policy document, in 2017 the Department for Transport reported on the outcome of consultations regarding changes to UK airspace [CD10.43] which included a review of criteria and metrics for assessing aircraft noise. This states in paragraph 9:

"*The Government's current aviation policy is set out in the Aviation Policy Framework (APF). The policies set out within this document provide an update to some of the policies on aviation noise contained within the APF, and should be viewed as the current government policy. The government also intends to develop aviation noise policy further through the Aviation Strategy consultation process. As part of the Aviation Strategy consultation on sustainable growth planned for 2018 the Government intends to consider the roles, structures and powers that currently exist and what, if any, new ones*

will be necessary to bring about the network wide, co-ordinated and complex changes needed for airspace modernisation". (emphasis added)

3.7.2 Based on this report, the Government will implement a range of proposals of which the key points are:

- The creation of an Independent Commission on Civil Aviation Noise (ICCAN) as an advisory non-departmental public body;
- The removal of the 3 dB minimum change requirement for financial assistance towards acoustic insulation to residential properties in the 63 dB $L_{Aeq,16h}$ level or above;
- A level of 54 dB $L_{Aeq,16h}$ is now acknowledged to correspond to the onset of significant community annoyance and replaces the 57 dB $L_{Aeq,16h}$ level in the APF,
- Some adverse effects of annoyance can now be seen to occur down to 51 dB $L_{Aeq,16h}$. LOAEL of 51 dB $L_{Aeq,16h}$ and 45 dB L_{night}, for daytime and night-time noise respectively, are to be used in assessing and comparing noise impacts of airspace changes (N.B. Following consultation with the CAA, the Government consider it appropriate to use 45 dB $L_{Aeq,8h}$ as the LOAEL for air space change assessment, for consistency with daytime noise).

3.7.3 As part of this consultation the Department for Transport published their draft *Air navigation guidance on airspace and noise management and environmental objective*s [CD10.12]. This proposes that rather than limiting the number of people exposed to any level of aircraft noise, the number of people experiencing significant adverse effects should be limited. For the purposes of assessing and comparing the noise impacts of

airspace changes, a LOAEL of 51dB L_{Aeq} for daytime noise and 45dB L_{night} for night time noise is proposed.

3.8 Aviation 2050

3.8.1 In December 2018, the Government published *Aviation 2050: The Future of UK Aviation* [CD9.29] (Aviation 2050) which outlines proposals for a new aviation strategy and addresses a wide range of associated issues. The Green Paper (among other things) sets out a robust policy framework and package of measures to reduce the harmful effects of aviation on the environment including in respect of noise. In the Green Paper, the Government recognises that there has been uncertainty on how current policy (to limit and, where possible, reduce the number of people in the UK significantly affected by aircraft noise) should be interpreted, measured and enforced. The Strategy sets out that the Government intends to put in place a stronger and clearer framework in order to ensure the sector is sufficiently incentivised to reduce noise, or to put mitigation measures in place where reductions are not possible. New measures are proposed including (among others):

- *"Setting a new objective to limit, and where possible, reduce total adverse effects on health and quality of life from aviation noise";*
- *"Developing a new national indicator to track the long term performance of the sector in reducing noise";*
- *"Routinely setting noise caps as part of planning approvals (for increases in passengers or flights)"*; and
- *"Requiring all major airports to set out a plan which commits to future noise reduction, and to review this periodically".*

3.8.2 Aviation 2050 also sets out that the Government proposes the following noise insulation measures:

- *"To extend the noise insulation policy threshold beyond the current 63dB $L_{Aeq,16h}$ contour to 60 dB $L_{Aeq,16h}$"* (N.B. BAL already operate a scheme that goes beyond this recommendation, with a threshold of 57 dB $L_{Aeq,16h}$);
- *"To require all airports to review the effectiveness of existing schemes. This should include how effective the insulation is and whether other factors (such as ventilation) need to be considered, and also whether levels of contributions are affecting take-up";*
- *"The Government or the Independent Commission on Civil Aviation Noise (ICCAN) to issue new guidance to airports on best practice for noise insulation schemes, to improve consistency"* (N.B. this has not yet been published);
- *"For airspace changes which lead to significantly increased overflight, to set a new minimum threshold of an increase of 3dB L_{Aeq}, which leaves a household in the 54 dB $L_{Aeq,16h}$ contour or above as a new eligibility criterion for assistance with noise insulation"* (N.B. even though this relates specifically to airspace change, which typically has a higher impact due to changes being instantaneous, no properties meet this criteria as part of the proposed development).

3.8.3 While Aviation 2050 describes the current intentions of the UK Government regarding the above measures, the final Aviation Strategy is still awaited and no fixed date for its publication is yet available.

3.9 Aviation Strategy: Noise Forecast and Analyses, CAP 1731

3.9.1 As part of the Aviation 2050 process, the Government commissioned the Civil Aviation Authority (CAA) to prepare *CAP 1731: Aviation Strategy: Noise Forecast and Analyses* [CD10.13] which was published in December 2018 and subsequently updated in February 2019. The objective of the report was to undertake an assessment of the feasibility of implementing noise limits nationally and locally in the UK. One aspect included a review of noise metrics and limits to help devise targets or limits in order to control aircraft noise emissions, noise exposure and their associated health impacts. This led to a proposed limit scheme which in summary consists of:

1) *"A nationally set absolute Quota Count (QC) limit or noise contour area limit at a particular noise level both day and night, aggregated across all major airports;*

2) *A locally set absolute QC or noise contour area limit at a particular noise level for both day and night for each airport;*

3) *Local monitoring of the number of highly annoyed and highly sleep-disturbed people; and*

4) *Reporting requirements."*

3.9.2 Noise emissions are currently controlled at Bristol Airport in full compliance with 2) above, operating a noise contour area limit to control daytime noise and a QC limit (alongside additional aircraft movement restrictions) to control night noise. An additional control of a night noise contour area limit has been proposed.

3.9.3 Any regular reporting requirements that were to arise under items 3) and 4) would be included in Bristol Airport's Annual Monitoring Report.

3.10 WHO Guidelines for Community Noise (1999)

3.10.1 WHO *Guidelines for Community Noise* [CD10.1] provides a range of aspirational noise targets aimed at protecting the health and well-being of the community. They therefore set out noise targets which represent goals for minimising the adverse effects of noise on health as opposed to setting absolute noise limits for planning purposes.

3.10.2 For dwellings, the 1999 WHO Guidelines state that to protect against moderate annoyance, a daytime indoor value of 35 dB L_{Aeq} should not be exceeded. The equivalent value to protect against sleep disturbance at night is 30 dB L_{Aeq}. It is also stated that:

"For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB LAmax more than 10–15 times per night".

3.10.3 These indoor noise level guidelines remain the current WHO guidance, as more recent guidance deals only with outdoor noise levels. The latest (2018) WHO Guidelines [CD10.10] stated the following on this topic:

"The current environmental noise guidelines for the European Region supersede the CNG from 1999. Nevertheless, the GDG recommends that all CNG indoor guideline values and any values not covered by the current guidelines (such as industrial noise and shopping areas) should remain valid."

3.11 WHO Night Noise Guidelines (2009)

3.11.1 Guidance on absolute noise levels at night were given in the WHO *Night Noise Guidelines* (NNG) [CD10.44]. These 2009 WHO Guidelines report findings concerning night noise from transportation sources and its effects on health and sleep. The 2009 WHO Guidelines acknowledge that the effect of noise on people at night depends not

just on the magnitude of noise of a single event but also the number of events. It considers that in the long term, over a year, these effects can be described using the $L_{night,outside}$ index. This is essentially equivalent to the $L_{Aeq,8h}$ index commonly used in the UK, but instead of being based on aircraft activities during the average summer night, is based on the average annual night and will therefore typically be lower than the $L_{Aeq,8h}$.

3.11.2 The 2009 WHO Guidelines were prepared by a working group set up to provide scientific advice to the Member States for the development of future legislation and policy action in the area of assessment and control of night noise exposure. The working group reviewed available scientific evidence on the health effects of night noise, and derived health-based guideline values. Although this provides guidance to the European Community in general and has no policy status, it provides a description of recent research into the health effects of noise and provides guidance on noise targets.

3.11.3 The following night noise guideline values were recommended by the working group for the protection of public health from night noise:

- Night noise guideline (NNG): $L_{night,outside}$ equal to 40 dB
- Interim target (IT): $L_{night,outside}$ equal to 55 dB

3.11.4 The NNG is a health based limit to aspire towards whereas the IT represents a feasibility based intermediate target. This is borne out to some extent by the Strategic Noise Mapping work undertaken across European Member States in compliance with the Environmental Noise Directive [CD10.45]. For night noise, Member States are required to produce noise maps in terms of the $L_{night,outside}$ index no lower than 50 dB for strategic planning purposes.

3.11.5 The relationship between night noise exposure and health effects as defined by WHO can be summarised as shown in Table 2.

$L_{night,outside}$	Relationship between night noise exposure and health effects
<30	No effects on sleep are observed except for a slight increase in the frequency of body movements during sleep due to night noise
30 – 40	There is no sufficient evidence that the biological effects observed at the level below 40 dB $L_{night,outside}$ are harmful to health
40 – 55[1]	Adverse health effects are observed at the level above 40 dB $L_{night,outside}$, such as self-reported sleep disturbance, environmental insomnia, and increased use of somnifacient drugs and sedatives
>55	Cardiovascular effects become the major public health concern, which are likely to be less dependent on the nature of the noise

[1] This corrects a typographic error in Table 7B.2 of the ES which stated 50 rather than 55

Table 2: WHO guidance on the relationship between night noise exposure and health effects

3.11.6 The 2009 WHO Guidelines have not been superseded by the latest (2018) WHO Guidelines [CD10.10] which state:

"Furthermore, the current guidelines complement the NNG from 2009."

3.12 WHO Environmental Noise Guidelines (2018)

3.12.1 When the ES was submitted, the World Health Organisation (WHO) had recently (October 2018) published their latest guidance document relating to aircraft noise, the Environmental Noise Guidelines for the European Region [CD10.10].

3.12.2 The WHO Guidelines contain the following recommendations:

"For average noise exposure, the GDG (Guideline Development Group) strongly recommends reducing noise levels produced by aircraft below 45 dB L_{den}, as aircraft noise above this level is associated with adverse health effects.

For night noise exposure, the GDG strongly recommends reducing noise levels produced by aircraft during night-time below 40 dB L_{night}, as night-time aircraft noise above this level is associated with adverse effects on sleep."

3.12.3 These WHO guidelines could not be adopted as thresholds without imposing very significant restrictions on the current permitted operations of most major airports. As an example, even a single Airbus A320 or Boeing 737-800 aircraft operating once per night would expose hundreds of people to noise levels in excess of the guideline 40 dB L_{night} value at Bristol Airport, despite its relatively rural location. 10 aircraft events during the daytime (07:00-19:00) period (or smaller numbers in the evening and night periods) would expose a similar number of people to noise levels in excess of the 45 dB L_{den} parameter.

3.12.4 These guidelines have not yet been adopted as UK policy, and there is no current indication that they will be. In December 2018, the UK Government published the consultation document Aviation 2050, which included the following (para 3.106) regarding the WHO Guidelines:

"There is also evidence that the public is becoming more sensitive to aircraft noise, to a greater extent than noise from other transport sources, and that there are health costs associated from exposure to this noise. The government is considering the recent new environmental noise guidelines for the European region published by the World Health Organization (WHO). It agrees with the ambition to reduce noise and to minimise adverse health effects, but it wants policy to be underpinned by the most robust evidence on these effects, including the total cost of an action and recent UK specific evidence which the WHO report did not assess."

3.12.5 At the recent Stansted Inquiry it was concluded that these guidelines should be given limited weight, with the Appeal Decision stating (para 37):

"The World Health Organisation's (WHO) Environmental Noise Guidelines 2018 (ENG) recommend lower noise levels than those used in response to SoNA. The Government has stated in Aviation 2050 that it agrees with the ambition to reduce noise and to minimise adverse health effects, but it wants policy to be underpinned by the most robust evidence on these effects, including the total cost of action and recent UK specific evidence which the WHO did not assess. <u>These factors limit the weight that can be given to the lower noise levels recommended in the ENG.</u>" (emphasis added)

3.13 BS8233:2014

3.13.1 The British Standard *BS8233:2014 Sound insulation and noise reduction for buildings – Code of practice* [CD10.46] provides guidance on the control of external noise. The standard presents a number of design ranges for indoor noise levels for different types of space.

3.13.2 Internal ambient noise guideline levels for dwellings are given in Table 4 of BS 8233, which is reproduced as Table 3 below.

Activity	Location	07:00 to 23:00	23:00 to 07:00
Resting	Living room	35 dB $L_{Aeq,16h}$	-
Dining	Dining room/area	40 dB $L_{Aeq,16h}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16h}$	30 dB $L_{Aeq,8h}$

Table 3: BS 8233:2014 Indoor ambient noise guideline levels for dwellings

3.13.3 Note 4 attached to this table in BS 8233 states:

"Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or L_{AFmax}, depending on the character and number of events per night. Sporadic noise events could require separate values."

3.13.4 These guideline noise levels can also be used for rooms for residential purposes including hotels, hostels, halls of residence, school boarding houses, hospices and residential care homes.

3.14 ICCAN Review of Aviation Noise Metrics and Measurement

3.14.1 The Independent Commission on Civil Aviation Noise (ICCAN) published a detailed review of noise metrics [CD10.47] in July 2020 which is a useful reference on the subject. This includes a description of a wide range of metrics which can be used to describe aircraft noise, including all those commonly used in the UK. The review concluded that:

"continued use of the L_{Aeq}-based metrics that are currently required in UK legislation and policy are appropriate."

3.14.2 It also recommends the use of Nx as a complementary metric to aid understanding of the noise impacts.

3.14.3 Regarding N70/N65 metrics, it stated that they have:

"some limited evidence linking to annoyance"

3.14.4 Regarding a level of 60 dB L_{ASmax}, it stated that:

"Assuming 15 dB(A) sound reduction through a partially open window, it can be related to advice in the WHO Community Noise Guidelines (1999/2000)"

3.15 Other Airport Assessments

3.15.1 Table 4 contains a list of references to other airport assessments which are referred to in this POE:

Airport	Application Reference	Application Year
Heathrow (Cranford Agreement)	41573/APP/2013/1288	2013
London City	13/01228/FUL	2013
Stansted	UTT/18/0460/FUL	2018
Manston	n/a (DCO)	2018
Southampton	F/19/86707	2019
Leeds Bradford	20/02559/FU	2020
Luton	21/00031/VARCON	2020

Table 4: Selected Recent UK Airport Planning Applications

3.15.2 The Heathrow Cranford Agreement application is of particular relevance regarding the change in noise level criteria, where a change of 3 dB as a threshold for significance was contested by the planning authorities but upheld by the Inspector at the Public Inquiry. In the Inspector's Report it is stated (para1063) that:

"Against the background above I consider that 57, 63 and 69 dB LAeq 16hr should, in this case, be regarded respectively as LOAEL, SOAEL and UAEL. In terms of the significance of any change in noise levels, and notwithstanding the various arguments put forward by the Authorities as to the increasing sensitivity of residents at higher noise levels, I find no good reason to depart from the 3dB criterion identified in the ES - which I consider also gains considerable support from current Government policy in the APF."

3.15.3 Further commentary from the Inspector's Report relating to change in noise level is provided in Appendix 1.

3.15.4 The other applications are used to demonstrate common industry practice when assessing aircraft noise in the UK.

4.0 ASSESSMENT SUMMARY

4.1 Introduction

4.1.1 The ES noise assessment was based on forecasts which at the time were believed to be representative. The findings of this assessment were accepted by NSC Officers who concluded that the impacts were acceptable. The NSC Committee nevertheless refused permission for the reasons given in Section 2.0.

4.1.2 As a result of the impacts of the COVID-19 pandemic on the aviation sector, BAL has produced an Addendum to the ES based on updated forecasts (the ESA). It is these forecasts which are now considered most relevant and the results presented in this POE primarily relate to the assessment and conclusions in the ESA. Data from the ES assessment is also presented where relevant.

4.1.3 Chapter 7 of the ES and Chapter 6 of the ESA presented a detailed assessment of the predicted noise impacts due to the proposed development. These chapters separately considered three sources of noise relating to the operation of Bristol Airport, being:

- Air noise, defined as noise produced by aircraft arriving and departing Bristol Airport, including start of roll and reverse thrust but not including other noise produced while on the ground.

- Ground noise, defined as noise produced by aircraft operating at Bristol Airport when on the ground, other than start of roll and reverse thrust. In particular this includes noise produced while aircraft are on the stands (e.g. when using APUs) and while aircraft are taxiing.

- Road traffic noise, defined as noise produced by road traffic using the roads in the vicinity of Bristol Airport.

4.1.4 Chapter 7 of the ES also dealt with two other sources of potential adverse effects. Firstly it assessed the noise impacts of the construction of the proposed development. Construction noise impacts were considered acceptable by the Officers' Report, on the provision that a Construction Environmental Management Plan (CEMP) is developed to ensure that the identified potential significant effects due to the A38 highway improvements are suitably mitigated. The Officers' Report stated the following in relation to this:

"In general, no significant effects from daytime construction noise are expected, apart from works to be carried out on the A38 highway improvements. BAL's results shows that there is one receptor where noise levels would exceed the SOAEL for the A38 highway improvements. It is likely that noise impacts can however be addressed through the development a more detailed noise assessment and mitigation schedule. This can be dealt with through a Construction Environmental Management Plan (CEMP)."

4.1.5 Secondly, Chapter 7 of the ES assessed the potential vibration impacts of both the construction and the operation of Bristol Airport. Neither assessment found the potential for significant effects, which was accepted by the Officers' Report, which stated:

"It is concluded that the vibration assessment is reasonable and that the proposed development is unlikely to increase the very low numbers of properties adversely affected by noise vibration."

4.1.6 As the construction noise impact and the construction and operation vibration impacts were considered acceptable by NSC Officers and were not cited by NSC as reasons for refusal of the application, I have not considered them further in my POE.

<u>Development Summary (relevant to noise impacts)</u>

4.1.7 The proposed development consists of infrastructure works as well as a number of changes to existing operational controls on Bristol Airport. The key changes from a noise assessment perspective are summarised below:

- Increase in permitted number of annual passengers from 10 million to 12 million.
- Change to permitted number of flights in the 23:30 to 06:00 period from 3,000 in the summer season and 1,000 in the winter season to 4,000 in two consecutive seasons. This does not change the number of total flights permitted in this period but allows greater flexibility for whether they operate in the summer or winter seasons.
- APUs will be used on Stands 38 and 39, which is not currently permitted. This will increase the ground noise level at the properties closest to those stands. The hours of operation assumed for the assessment work were 06:00 to 23:00. NSC have proposed a condition limiting this to 07:00 to 23:00 which BAL are currently considering.
- New infrastructure buildings which will benefit some properties on Downside Road due to increased screening from ground noise.
- Surface access improvements to the A38, northwards of the main airport access roundabout, and to the internal road system and surface car parking.

4.1.8 In addition to the above, a number of planning conditions are proposed which are summarised in Section 4.7.

4.2 Air Noise

Air Noise Methodology – Primary Noise metrics

4.2.1 The $L_{Aeq,T}$ metric is the average noise exposure level that occurs over a time period T. In the case of air noise therefore, it accounts for the sound energy produced both by the number of aircraft events and the noisiness of each aircraft event, over a defined time period. It is the primary metric for quantifying community effects of aircraft noise in the UK and internationally. In the UK specifically the $L_{Aeq,16h}$ metric covering the daytime period from 07:00 to 23:00 and the $L_{Aeq,8h}$ metric covering the night-time period from 23:00 to 07:00 are used. The convention in the UK is to assess aircraft movements over three summer months, specifically the 92 day period from 16 June to 15 September inclusive. This typically relates to the busiest period of the year, as is the case at Bristol Airport. For example in 2017 approximately 29% of the annual flights at Bristol Airport took place in this 92-day summer period, which constitutes approximately 25% of the days in the year.

4.2.2 The Government, as set out in the Aviation Policy Framework [CD6.1] (APF) and supported by SoNA, confirms that the current convention in the UK is to assess the effect of daytime aircraft noise in terms of daytime $L_{Aeq,16h}$ noise contours determined from an average summer day of aircraft movements. As a result, emphasis is placed on this recognised UK methodology using the $L_{Aeq,16h}$ noise metric. This metric has been used historically within the UK over the past 30 years to assess the effects of aircraft noise.

4.2.3 More recently, the SoNA study [CD10.9] specifically confirmed $L_{Aeq,16h}$ as the metric which correlates best with self-reported community annoyance. The SoNA study is referenced in the Government's Consultation Response on UK Airspace Policy dated October 2017, the Executive Summary of which states:

"*The Government's current aviation policy is set out in the Aviation Policy Framework (APF). The policies set out within this document provide an update to some of the policies*

on aviation noise contained within the APF, and should be viewed as the current Government policy..."

4.2.4 For night-time, the Government's response to the airspace change consultation confirms the use of $L_{Aeq,8h}$ noise exposure contours determined from an average summer night of aircraft movements for assessing aircraft noise effects at night. These contours are also now prepared and published annually for the designated airports such as Heathrow, Stansted and Gatwick, along with daytime $L_{Aeq,16h}$ contours.

4.2.5 There are a number of other noise metrics that can be used to describe air noise impacts. The Independent Commission on Civil Aviation Noise (ICCAN) published a detailed review [CD10.47] of noise metrics in July 2020 which is a useful reference on this subject. This includes a description of the metrics mentioned above as well as many others. The review concluded that:

"continued use of the L_{Aeq}-based metrics that are currently required in UK legislation and policy are appropriate."

4.2.6 Based on the above, the ES and ESA assessments utilised $L_{Aeq,16h}$ and $L_{Aeq,8h}$ as the primary metrics used to determine the significance of the proposed development, with a number of supplementary metrics provided in order to aid understanding of the noise impacts.

4.2.7 This approach is consistent with that used in the recent application at Stansted Airport, with the Appeal Decision stating (para 45):

"The use of L_{Aeq} levels in the assessment is in accordance with Government policy and reflects the conclusions of SoNA, but the ES and ESA also include assessments of the number of flights exceeding 60 and 65 dB(A) and maximum single event noise levels. The assessments of aircraft noise are comprehensive, and the methodology used is

justified and widely accepted as best practice, including by the Government and industry."

Air Noise Methodology – Supplementary Noise metrics

4.2.8 While average exposure noise contours of this type are well established and important at demonstrating trends in total noise around an airport, it is recognised in the APF that people do not experience noise in an averaged manner and that the L_{Aeq} indicator does not necessarily reflect all aspects of the perception of aircraft noise. Supplementary metrics were therefore considered as part of the ES and ESA air noise assessments which aid an understanding of how aircraft noise is experienced in different localities. The purpose of this was to ensure a more complete understanding of noise impacts and to inform the development of targeted noise mitigation measures. The metrics assessed are listed below. Not all of the metrics assessed in the ES were re-computed for the ESA. The reasoning for this is discussed in Section 5.10.

- Single aircraft events at night (ES and ESA)

4.2.9 It is important to assess the noise impact of aircraft at night by considering single aircraft events. This has historically been done in the UK by looking at L_{Amax} and/or Single Event Level (SEL) noise levels. L_{Amax} is simply the maximum noise level of an aircraft passby. The SEL is all of the noise energy produced by an aircraft passby averaged over a period of 1 second. It therefore accounts for the duration as well as the maximum noise level of the event.

- Number of people highly annoyed or highly sleep disturbed (ES and ESA)

4.2.10 Noise annoyance ratings are a useful way of explaining how a given noise environment is likely to affect the local community , by identifying those likely to be 'highly annoyed' by aircraft noise. The measure considers the average sensitivity of the general

population and it is accepted that some people would be more annoyed or less annoyed for a given noise exposure level. This method of assessment offers some advantages over simply banding a population into “low”, “moderate” and “high” annoyance categories since it recognises that even at relatively low levels of aircraft noise, some people can by highly annoyed. It can therefore be usefully used as a means of evaluating differences between scenarios. Similar ratings for sleep disturbance also exist for night-time activities.

4.2.11 The health effects of noise are linked to annoyance and sleep disturbance, and therefore these measures are a good indicator of the overall health effects of air noise.

- Number Above noise contours (ES only)

4.2.12 The Number Above (Nx) metric is an example of an alternative metric and is becoming more commonly used to describe aircraft noise. This metric describes the number of times a noise level of x is exceeded in a given time period.

4.2.13 It is common to assess N70 or N65 for the daytime period and N60 for the night period. For example, an N60 value of 10 for a given receptor means that the receptor will experience a maximum noise level of 60 dB or higher 10 times per night on average. As with L_{Aeq} contours, the convention in the UK is to average over the 92-day summer period.

4.2.14 The ICCAN review of noise metrics recommends the use of Nx as a complementary metric to aid understanding of the noise impacts.

4.2.15 While the Nx metrics are a useful tool in understanding how the noise impact might change at a specific location, they are complex to interpret at a population level due to a couple of features in particular.

4.2.16 Firstly, the Nx metrics only consider whether a noise event is above or below a threshold, but no consideration of how far above. For example, when considering N60, a receptor experiencing 10 overflights at 60 dB L_{Amax} would be counted as within the 10 event contour, and a second receptor experiencing 9 overflights at 70 dB L_{Amax} and one overflight at 59 dB L_{Amax} would not. However it is clear that in terms of actual impact the second receptor would be experience significantly greater impacts; for example the L_{Aeq} level would be around 10 dB higher.

4.2.17 Secondly, the contour size for a given number of events can change dramatically with only a very small change in the number of flights. For single-runway airports such as Bristol Airport, there are four distinct situations; arrivals and departures for each of the two operating directions. An example of the typical shape of these contours is illustrated by ESA Figure 6A.19, which shows these four situations for the 737 MAX 8. An extract of this figure is reproduced below as Figure 1.

Figure 1: 80 dB L_{Amax} Air Noise Contours – Boeing 737 MAX 8

4.2.18 The contours produced by arrivals are longer and narrower than those produced by departures which are shorter and wider.

4.2.19 Considering the N60, 10 event contour as an example, this will have large changes in area (and associated populations depending on where exactly that area is located) when a relevant number of flights changes from just below to just above 10. Relevant

numbers of flights include each of the four situations individually, as well as overlapping combinations of them, for example runway 27 departures and runway 10 arrivals.

4.2.20 These large changes in the N60 can occur despite there being no perceptible difference for receptors between an average of 9.9 or 10 flights per night.

4.2.21 N70 and N60 contours were produced as part of the ES assessment, in line with what had been presented in the Airports Commission final report [CD6.11] (2015). There is, however, only limited evidence relating to how these metrics correspond to community response and, as a consequence, these contours were presented as supplementary noise descriptors to aid an understanding of how the noise environment will change between one scenario and another.

- Single mode contours (ES only)

4.2.22 While the primary metrics of $L_{Aeq,16h}$ and $L_{Aeq,8h}$ consider the average over the 92-day assessment period, they only provide an average and while this is useful for planning purposes, it does not reflect what a receptor will experience on an individual day. The ES presented so called single mode contours, which separately assume that all flights operate in either a westerly or an easterly direction.

- Variation in noise level over the day (ES only)

4.2.23 It can also be useful to illustrate how the noise level will typically change over an individual 24-hour period. This has particular relevance to the assessment of schools, which does not use the standard 16-hour assessment period, but instead considers the worst-case half-hour.

4.2.24 Hourly noise levels at representative residential locations were presented in the ES for both average mode and single mode.

- Consideration of detailed night periods (ESA only)

4.2.25 In response to NSC in their Reasons for Refusal claiming that the proposed changes to the permitted number of flights in the period 23:30 to 06:00 would give rise to a significant adverse impact, the standard night-time assessment period (23:00-07:00) was sub-divided and individual consideration was given the 23:00-23:30, 23:30-06:00, and 06:00-07:00.

Air Noise Methodology – Noise Modelling

4.2.26 The air noise assessments rely heavily on predicted noise levels derived from noise modelling software.

4.2.27 Noise levels used in the ES and ESA assessments were predicted using the industry standard Aviation Environmental Design Tool (AEDT) software. The latest version at the time was used, which was 2d for the ES and 3c for the ESA. The two versions have the same underlying calculation methodology, and both comply with the latest European guidance on noise modelling, ECAC Doc 29 (4th Edition) [CD10.48]. The primary change between the two assessments being the addition of new aircraft information such as that for the Airbus A320neo in the ESA assessment.

4.2.28 Measurement results from Bristol Airport's Noise Monitoring Terminals (NMTs) were accounted for in the preparation of the noise contours. These were used to modify the default aircraft noise values in the AEDT software to ensure that the model more accurately reflected the actual noise levels produced by aircraft operating at Bristol Airport.

4.2.29 NSC agreed that the noise modelling methodology was appropriate for the ES, stating the following in the Officer's Report:

"Officers agree that the results are based on the correct noise assessment methodology and they are an accurate projection."

Air Noise Methodology – Determination of Significance

4.2.30 When assessing the significance of a development, it is important to have regard for both the absolute level of noise and the change in noise level due to the development.

4.2.31 Considering first the absolute levels, the key levels in the context of the ES and ESA are the values adopted for the LOAEL and SOAEL, as the planning guidance changes at these thresholds as described in PPGN [CD10.40].

4.2.32 The adopted LOAEL was 51 dB $L_{Aeq,16h}$ for daytime air noise and 45 $L_{Aeq,8h}$ for night-time air noise.

4.2.33 This was based primarily on the Government's Consultation Response on UK Airspace Policy (2017) which stated that:

"So that the potential adverse effects of an airspace change can be properly assessed, for the purpose of informing decisions on airspace design and use, we will set a LOAEL at 51 dB LAeq 16 hr for daytime, and based on feedback and further discussion with CAA we are making one minor change to the LOAEL night metric to be 45dB LAeq 8hr rather than Lnight to be consistent with the daytime metric."

4.2.34 While this strictly relates specifically to airspace change assessments, it is on the basis that adverse air noise effects are experienced down to these levels and is therefore considered appropriate to use for a LOAEL.

4.2.35 The adopted SOAEL was 63 dB $L_{Aeq,16h}$ for daytime air noise and 55 dB $L_{Aeq,8h}$ for night-time air noise.

4.2.36 63 dB $L_{Aeq,16h}$ is recommended by the Government as an eligibility criterion for sound insulation grant schemes. As a result, this value is commonly considered to represent the SOAEL.

4.2.37 There is a proposal in Aviation 2050 to reduce this threshold to 60 dB $L_{Aeq,16h}$. However, this has not yet been brought forward and Aviation 2050 states that:

"Until any framework is adopted as government policy, planning applications should continue to be considered against existing policy."

4.2.38 In any case, it is not clear that there is an evidence-based case for reducing the SOAEL. The SoNA study found that while there is evidence that people are becoming more sensitive to noise at lower noise levels, the same is not true at higher levels. The same percentage of people (23%) were found to be highly annoyed by aircraft noise at a value of 63 dB $L_{Aeq,16h}$ in the SoNA study as was the case in the previous (1982) ANIS study.

4.2.39 The 2009 WHO Night Noise Guidelines set out a guideline value of 40 dB L_{night} as an environmental goal to aspire towards, and a value of 55 dB L_{night} as an interim target.

4.2.40 The $L_{Aeq,8h}$ index differs slightly from the L_{night} index in that it relates to an average summer day of aircraft activity, as opposed to an average annual day. As summer activity is generally higher than at other times of the year, the adoption of the $L_{Aeq,8h}$ unit, in place of the L_{night} unit represents a conservative approach.

4.2.41 The value of 55 dB $L_{Aeq,8h}$ is used as an eligibility criterion for insulation schemes at a number of UK airports which operate insulation schemes with night noise criteria.

4.2.42 Table 5 lists a number of UK airports that have made recent planning applications, and the values that were adopted for the SOAEL. All of these are identical to those adopted for this assessment, with the exception of Stansted which was 1 dB lower for night-time.

No justification or explanation for this difference was given in the Stansted Environmental Statement.

Airport	Adopted SOAEL, Air Noise	
	Daytime	Night-time
Bristol (2018)	63 dB $L_{Aeq,16h}$	55 dB $L_{Aeq,8h}$
London City (2015)	63 dB $L_{Aeq,16h}$	n/a
Stansted (2018)	63 dB $L_{Aeq,16h}$	54 dB $L_{Aeq,8h}$
Manston (2018)	63 dB $L_{Aeq,16h}$	55 dB $L_{Aeq,8h}$
Southampton (2019)	63 dB $L_{Aeq,16h}$	n/a
Leeds Bradford (2020)	63 dB $L_{Aeq,16h}$	55 dB $L_{Aeq,8h}$
Luton (2021)	63 dB $L_{Aeq,16h}$	55 dB $L_{Aeq,8h}$

Table 5: Adopted SOAEL in Recent UK Airport Planning Applications

4.2.43 Once it has been determined where a receptor lies in relation to the LOAEL and SOAEL, significance in an ES context can then be determined by considering how the noise level changes between the baseline scenario (without development) and the with development scenario.

4.2.44 In the APF [CD6.1] (2013) it is stated that the Government:

"would expect airport operators to offer financial assistance towards acoustic insulation to residential properties which experience an increase in noise of 3dB or more which leaves them exposed to levels of noise of 63 dB LAeq,16h or more."

4.2.45 While current policy, as expressed in the Government's Airspace Change Consultation response of October 2017 [CD10.43], drops the need for a 3 dB change, this indicates that a change of this magnitude is a threshold of significance.

4.2.46 This is further supported in the Aviation 2050 [CD9.29 Strategy where it is proposed that should airspace changes lead to significantly increased overflight, a new minimum

threshold of an increase of 3dB L_{Aeq}, which leaves a household in the 54 dB $L_{Aeq\ 16hr}$ contour or above will be set as a new eligibility criterion for assistance with noise insulation.

4.2.47 In the IEMA Guidelines for Environmental Noise Impact Assessment (2014) [CD10.49], the effect of a change in sound level of less than 3 dB is described as *"None/Not significant"*.

4.2.48 In the Design Manual for Roads and Bridges (DMRB) document LA 111 [CD10.50], changes of a long term nature are rated as negligible if they are less than 3 dB. The long term changes are appropriate in this context since Bristol Airport would not be changing from 10 mppa to 12 mppa overnight, rather the changes would occur over a number of years. While the DMRB relates specifically to the assessment of road traffic noise, this further supports the value of 3 dB as the threshold for significance regarding change in general terms.

4.2.49 Based on the above guidance the conclusion is that an increase of less than 3 dB is not considered to be significant. However, there is evidence that people are more sensitive to increases in noise level at higher absolute values. For example the SoNA study shows annoyance increasing at a faster rate at higher noise levels.

4.2.50 On this topic the Planning Practice Guidance states that:

"In cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small increase in the overall noise level may result in a significant adverse effect occurring even though little or no change in behaviour would be likely to occur."

4.2.51 At the Heathrow Cranford Inquiry, the assessment by the airport operator used a criteria of 3 dB change as a threshold for significant. It was put forward by the planning

authority that this was acceptable below the SOAEL, but above the SOAEL should reduce to 1 dB. The inspector concluded (para 1063) the following:

"In terms of the significance of any change in noise levels, and notwithstanding the various arguments put forward by the Authorities as to the increasing sensitivity of residents at higher noise levels, I find no good reason to depart from the 3dB criterion identified in the ES - which I consider also gains considerable support from current Government policy in the APF."

4.2.52 Taking the above into account, and using professional judgement, for receptors where the noise level in the louder of the two scenarios being compared is between the LOAEL and the SOAEL, a value of 3 dB was adopted as the threshold for a significant change. For receptors above the SOAEL, a lower value of 2 dB was adopted.

4.2.53 This approach was accepted for the ES by NSC's Officers who, after receiving advice from their noise consultants, stated multiple times in the OR that they considered a change of no more than 2 dB to be of negligible magnitude and not significant.

Air Noise Assessment Findings

4.2.54 The air noise assessments presented in the ES and ESA considered the first year in which 12 mppa was forecast to be reached, in the event that the application was successful (2026 in the ES, 2030 in the ESA).

4.2.55 This 12 mppa scenario was compared with two separate 10 mppa forecasts; one for the first year in which 10 mppa was forecast to be reached (2021 in the ES, 2024 in the ESA) and the other for same year as the 12 mppa forecast.

4.2.56 The relevance of the first year in which 10 mppa is reached is that it relates to the worst-case year for air noise impacts forecast to arise under the current permission. In later

years it is forecast that aircraft will on average get quieter and therefore the air noise impacts will reduce.

4.2.57 As stated in 4.1.2 above, the results presented in this section primarily relate to the assessment and conclusions in the ESA. Data from the ES assessment is also presented where relevant.

4.2.58 All areas presented in this section have been rounded to the nearest 0.1 km^2. All dwelling and population totals have been rounded to the nearest 50 if the total was above 100, to the nearest 10 if the total was below 100 but above 10, and not rounded if the total was below 10. This follows the approach in the ES and ESA.

Air Noise Assessment Findings - Daytime

4.2.59 The noise contour areas relating to the daytime LOAEL and SOAEL along with the associated number of dwellings exposed to noise levels above each are presented in Table 6 for the scenarios presented in the ES and the ESA.

Scenario	Contour Value			
	Daytime LOAEL 51 dB $L_{Aeq,16h}$		Daytime SOAEL 63 dB $L_{Aeq,16h}$	
	Area (km^2)	# Dwellings	Area (km^2)	# Dwellings
Scenarios Presented in the ES				
2017	37.7	3,250	3.1	20
10 mppa 2021	36.9	3,150	2.9	10
12 mppa 2026	37.0	3,100	2.8	10
10 mppa 2026	29.9	2,200	2.2	10
Scenarios Presented in the ESA				
10 mppa 2024	37.1	3,200	3.0	20
12 mppa 2030	35.2	3,100	2.9	10
10 mppa 2030	30.7	2,600	2.4	10

Table 6: Summary of Air Noise Contour Areas and Dwellings Above LOAEL and SOAEL – Day

4.2.60 The number of dwellings exposed to daytime air noise levels at or above the LOAEL does not materially change between the 2017, 10 mppa (2024) and 12 mppa (2030) scenarios, reducing slightly from around 3,250 in 2017 to around 3,100 in the 12 mppa (2030) scenario. The 10 mppa (2030) scenario shows a further reduction to around 2,600.

4.2.61 The number of dwellings exposed to daytime air noise levels at or above the SOAEL is low in all scenarios, at around 20 in the 2017 and 10 mppa (2024) scenarios and reducing to around 10 in both of the 2030 scenarios.

4.2.62 The changes in noise level between the 10 mppa and 12 mppa scenarios assessed in the ESA are presented in Table 7. To give further detail, those changes rated as “Negligible” have been separated into 0-1 dB and 1-2 dB bands. The thicker line marks the threshold for the onset of significant effects.

Change in Noise Level	51 dB $L_{Aeq,16h}$ (LOAEL) to 63 dB $L_{Aeq,16h}$ (SOAEL)		Above 63 dB $L_{Aeq,16h}$ (SOAEL)	
	Beneficial	Adverse	Beneficial	Adverse
ESA – 10 mppa (2024) to 12 mppa (2030)				
0 – 1 dB	2500	600	2	10
1 – 2 dB	0	0	0	0
2 – 3 dB	0	0	0	0
3 – 6 dB	0	0	0	0
6 – 9 dB	0	0	0	0
>9 dB	0	0	0	0
ESA – 10 mppa (2030) to 12 mppa (2030)				
0 – 1 dB	0	3050	0	10
1 – 2 dB	0	0	0	0
2 – 3 dB	0	0	0	0
3 – 6 dB	0	0	0	0
6 – 9 dB	0	0	0	0
>9 dB	0	0	0	0

Table 7: Summary of Change in Air Noise Levels – Day

4.2.63 When considering the change in noise level, the ESA assessment found that when comparing 10 mppa (2024) with 12 mppa (2030), daytime noise levels would remain comparable with or without development, as the increase in flights would be offset by a higher proportion of quieter aircraft. The majority of receptors would experience decreases in noise level while some would experience increases. The changes in noise level were forecast to be less than 1 dB for all assessed receptors, i.e. a negligible amount well below the significance threshold.

4.2.64 When comparing 10 mppa (2030) with 12 mppa (2030), the ESA assessment found that daytime noise levels for all assessed receptors would increase by less than 1 dB, i.e. a negligible amount well below the significance threshold.

4.2.65 The number of people forecast to be highly annoyed by aircraft noise under each scenario was also calculated. The health effects of daytime noise are linked to annoyance, and therefore this measure is a good indicator of the overall health effects of daytime air noise.

4.2.66 This calculation utilises the percentage of people likely to be highly annoyed by a given noise level in the SoNA study, and multiplied this percentage by the number of people within each noise contour band. The resulting totals are presented in Table 8.

Scenario	Population Highly Annoyed
Scenarios Presented in the ES	
2017	750
10 mppa 2021	750
12 mppa 2026	750
10 mppa 2026	550
Scenarios Presented in the ESA	
10 mppa 2024	750
12 mppa 2030	700
10 mppa 2030	600

Table 8: Number of people forecast to be highly annoyed

4.2.67 It can be seen from Table 8 that the assessed number of people highly annoyed is marginally lower in the 12 mppa 2030 scenario than in the 2017 and 10 mppa 2024 scenarios. It would however be lower still in the without development case of 10 mppa 2030.

Air Noise Assessment Findings – Night-time

4.2.68 The noise contour areas relating to the night-time LOAEL and SOAEL along with the associated number of dwellings exposed to noise levels above each are presented in Table 9 for the ES and the ESA.

Scenario	Contour Value			
	Night-time LOAEL 45 dB $L_{Aeq,8h}$		Night-time SOAEL 55 dB $L_{Aeq,8h}$	
	Area (km^2)	# Dwellings	Area (km^2)	# Dwellings
Scenarios Presented in the ES				
2017	46.7	3,750	6.0	150
10 mppa 2021	64.5	5,150	8.4	300
12 mppa 2026	65.6	5,050	8.5	350
10 mppa 2026	54.7	4,150	6.8	250
Scenarios Presented in the ESA				
10 mppa 2024	47.8	3,800	6.0	200
12 mppa 2030	50.0	4,000	6.8	250
10 mppa 2030	42.4	3,400	5.4	100

Table 9: Summary of Air Noise Contour Areas and Dwellings Above LOAEL and SOAEL – Night

4.2.69 The number of dwellings exposed to night-time air noise levels at or above the LOAEL does not materially change between the 2017, 10 mppa (2024) and 12 mppa (2030) scenarios, increasing slightly from around 3,750 in 2017 to around 4,000 in the 12 mppa (2030) scenario. The 10 mppa (2030) scenario shows a reduction to around 3,400.

4.2.70 The number of dwellings exposed to night-time air noise levels at or above the SOAEL increases from around 150 in the 2017 scenario to around 200 in the 10 mppa (2024) scenario and around 250 in the 12 mppa (2030) scenario. In the 10 mppa (2030) scenario it would reduce to around 100.

4.2.71 The changes in noise level between the 10 mppa and 12 mppa scenarios assessed in the ESA are presented in Table 10. To give further detail, those changes rated as "Negligible" have been separated into 0-1 dB and 1-2 dB bands. The thicker line marks the threshold for the onset of significant effects.

Change in Noise Level	45 dB $L_{Aeq,8h}$ (LOAEL) to 55 dB $L_{Aeq,8h}$ (SOAEL)		Above 55 dB $L_{Aeq,8h}$ (SOAEL)	
	Beneficial	Adverse	Beneficial	Adverse
ESA – 10 mppa (2024) to 12 mppa (2030)				
0 – 1 dB	3350	400	50	200
1 – 2 dB	0	0	0	0
2 – 3 dB	0	0	0	0
3 – 6 dB	0	0	0	0
6 – 9 dB	0	0	0	0
>9 dB	0	0	0	0
ESA – 10 mppa (2030) to 12 mppa (2030)				
0 – 1 dB	0	3800	0	250
1 – 2 dB	0	0	0	0
2 – 3 dB	0	0	0	0
3 – 6 dB	0	0	0	0
6 – 9 dB	0	0	0	0
>9 dB	0	0	0	0

Table 10: Summary of Change in Air Noise Levels – Night

4.2.72 When considering the change in noise level, the ESA assessment found that when comparing 10 mppa (2024) with 12 mppa (2030), night-time noise levels would remain comparable with or without development, as the increase in flights would be offset by a higher proportion of quieter aircraft. The majority of receptors experience increases in noise level while some would experience decreases. The changes in noise level would

be less than 1 dB for all assessed receptors i.e. a negligible amount well below the significance threshold.

4.2.73 When comparing 10 mppa (2030) with 12 mppa (2030), the ESA assessment found that night-time noise levels for all assessed receptors would increase by less than 1 dB, i.e. a negligible amount well below the significance threshold.

4.2.74 The number of dwellings exposed to levels above the SOAEL for single events at night is presented in Table 11.

Scenario	Number of dwellings above threshold at least once per night	
	90 dB SEL	80 dB L_{ASmax}
Scenarios Presented in the ES		
2017	250	250
10 mppa 2021	600	650
12 mppa 2026	100	100
10 mppa 2026	100	100
Scenarios Presented in the ESA		
10 mppa 2024	200	200
12 mppa 2030	350	500
10 mppa 2030	350	500

Table 11: Summary of Number of Dwellings Above SOAEL – Single Events at Night

4.2.75 For the noise levels of individual aircraft events, the number of dwellings exposed to significant absolute noise levels at least once per night was forecast to be the same with or without the proposed development in 2030, and therefore no significant effects were assessed.

4.2.76 These assessed effects are, however, greater than those assessed in the ES. This is because of an increase in the number of flights now forecast by the Airbus A321neo, which is louder than the A320neo and Boeing 737 MAX 8.

4.2.77 The number of people forecast to be highly sleep disturbed by aircraft noise under each scenario was also calculated. The health effects of night-time noise are linked to sleep disturbance, and therefore this measure is a good indicator of the overall health effects of night-time air noise.

4.2.78 This calculation utilises the same methodology as the UK Government's Webtag tool to calculate the percentage of people expected to be highly sleep disturbed by a given noise level. This percentage is then multiplied by the number of people within each contour band. The resulting totals are presented in Table 12.

Scenario	Population Highly Sleep Disturbed
Scenarios Presented in the ES	
2017	450
10 mppa 2021	850
12 mppa 2026	800
10 mppa 2026	650
Scenarios Presented in the ESA	
10 mppa 2024	450
12 mppa 2030	500
10 mppa 2030	400

Table 12: Number of people forecast to be highly sleep disturbed

4.2.79 It can be seen from Table 12 that the assessed number of people highly sleep disturbed is marginally higher in the 12 mppa 2030 scenario than in the 2017 and 10 mppa 2024 scenarios. It would however instead be marginally lower in the without development case of 10 mppa 2030.

Air Noise Assessment – Other Supplementary Metrics

4.2.80 N70 and N60 contours relating to the average summer day and night respectively were presented in the ES. These were presented using the same number of event thresholds as were presented in the Airports Commission final report [CD6.11] (2015). The results are summarised in Table 13 and Table 14.

Scenario	No. Dwellings Exposed to No. Events Above 70 dB L_{ASmax} per Day				
	10	20	50	100	200
2017	3100	1450	650	20	0
10 mppa 2021	3300	2350	600	250	0
12 mppa 2026	2800	1300	650	350	0
10 mppa 2026	2500	1050	550	250	0

Table 13: Summary of N70 Dwelling Exposure – Day

Scenario	No. Dwellings Exposed to No. Events Above 60 dB L_{ASmax} per Night				
	10	20	50	100	200
2017	3800	90	0	0	0
10 mppa 2021	5150	2050	0	0	0
12 mppa 2026	6350	3300	1	0	0
10 mppa 2026	4400	2000	0	0	0

Table 14: Summary of N60 Dwelling Exposure – Night

4.2.81 Looking at the above tables, at some values the differences between scenarios are broadly consistent with the L_{Aeq} results presented in the ES, although at other values there are clear differences.

4.2.82 These inconsistencies, which are discussed in more detail in paragraphs 4.2.12 to 4.2.21, means that while the Nx metrics are a useful tool in understanding how the noise impact might change at a specific location, they are complex to interpret at a population level as there are a number of potential situations where the metric value can change by a large amount between two near-identical scenarios.

4.2.83 Single mode contours were presented in the ES. These found that the contour areas were comparable to the average mode contours, however the number of dwellings exposed varied. In general the easterly mode contours exposed fewer dwellings to the LOAEL, but more people to the SOAEL, when compared to the westerly mode contours.

4.2.84 The hourly noise level on an average summer day was presented in the ES, for average mode and single mode scenarios, for the 14 representative residential receptors assessed. One of the findings from this assessment was that the loudest hour of the day was around 3 dB louder than the $L_{Aeq,16h}$ value. This was taken as a proxy for the loudest 30-minute period and used in the assessment of schools.

4.2.85 In the ESA, an assessment was undertaken of three specific periods of the night, being 23:00-23:30, 23:30-06:00, and 06:00-07:00. While there are no commonly accepted absolute criteria for these periods, the assessment was undertaken to investigate the change in noise level between different scenarios. Noise levels were presented at the set of 14 representative residential receptors. Difference contours were also produced to show the changes across the whole study area.

4.2.86 The finding when comparing the 10 mppa (2024) and the 12 mppa (2030) scenarios was that there was almost no change in the 23:00-23:30 and 23:30-06:00 periods, and a 1 dB increase in the 06:00-07:00 period for 8 of the 14 assessed representative residential receptors, with the others showing no change.

4.2.87 The finding when comparing the 10 mppa (2030) and the 12 mppa (2030) scenarios was that there was a 1 dB increase in all of the three periods for most of the assessed receptors, with the others showing no change.

4.2.88 These findings are consistent with the overall findings of changes of less than 1 dB when considering the standard 8-hour night period, and in particular show that the 23:30-06:00 period is not disproportionately affected.

Air Noise Assessment Findings – Faster and Slower Growth

4.2.89 The ESA also considered a qualitative assessment of faster and slower growth forecasts, reaching 12 mppa in 2027 and 2034 respectively. This assessment concluded that the effect of faster or slower growth on the 10 mppa and 12 mppa scenarios was likely to be comparable, and would result in differences in air noise levels of up to +0.5 dB for the faster growth scenario and -0.5 dB for the slower growth scenario. This equates to a difference in contour area of around 10%.

4.2.90 While this uncertainty in the forecast affects the absolute air noise levels experienced by the community in the first year in which 12 mppa is reached, it would apply similarly to the without development scenario and the conclusions of the ESA assessment would therefore not change, as the difference between the with and without development cases would remain similarly low and result in no significant adverse impacts.

Air Noise Assessment Findings – Overall

4.2.91 The findings of the ES in terms of the differences between the 10 mppa and 12 mppa scenarios were comparable to those of the ESA, although the absolute noise impacts at night are now forecast to be lower for all scenarios than they were in the ES. The absolute daytime impacts are comparable in the ES and ESA.

4.2.92 The primary metrics are used as the basis for determining significance. This is supported by UK policy.

4.2.93 The supplementary metrics sit alongside the primary metrics. Their main purpose is to provide context for the assessment and aid understanding of the changes that might arise due to the proposed development.

4.2.94 The supplementary indicators in the original ES which have not been re-assessed still provide context as intended, although their precise values would likely change slightly due to the updated forecasts. In line with the metrics which have been re-assessed, it is likely that the absolute impacts would be lower than those presented in the ES, but the differences between future scenarios would be similar.

4.2.95 In both the ES and the ESA, the change in air noise exposure level ($L_{Aeq,T}$) at all of the assessed receptors was below the threshold for significance. Therefore the assessment findings for both the ES and the ESA were that no significant air noise effects were predicted to arise due to the proposed development.

4.2.96 In order to ensure that the noise effects are not greater than those forecast, suitable planning conditions should be set which ensure that the noise effects are controlled to acceptable levels. For example, BAL are proposing noise contour area limits for the day and night periods.

4.3 Ground Noise

Ground Noise Methodology – Noise Metrics

4.3.1 There is no current UK policy or standard which sets out an assessment method which must be followed for ground noise. Various methods have been adopted in the past, and these typically follow a similar approach to air noise assessments, i.e. using the L_{Aeq} metric for daytime and night-time noise, although the LOAEL and SOAEL thresholds are not necessarily the same.

4.3.2 For example, all of the other airport assessments referenced in Table 5 considered ground noise in terms of $L_{Aeq,16h}$ and $L_{Aeq,8h}$, with the exception of Luton which scoped out ground noise. The ES and ESA assessments have also used these metrics when considering ground noise.

4.3.3 This approach was accepted by NSC who stated in the Officers' Report:

"Officers consider this is an acceptable way to assess ground noise."

Ground Noise Methodology – Noise Modelling

4.3.4 The ground noise assessments rely heavily on predicted noise levels derived from noise modelling software.

4.3.5 Noise levels used in the ES and ESA assessments were predicted using the CadnaA software package, following the industry standard methodology set out in ISO 9613-2:1996.

4.3.6 Ground activities included were engine start-up, taxiing, manoeuvring, holding before departure and the use of Auxiliary Power Units (APUs). Engine running for test and maintenance purposes was not included as it occurs very rarely (less than once per week at high power) at Bristol Airport and this is not expected to change in the future.

4.3.7 Typical noise levels for each ground activity for use in the model were derived from measurements taken by BAP at Bristol and other airports.

4.3.8 A conservative assumption was made to assume no benefit of modern aircraft for ground noise. In practice it is expected that there will be some benefit, although of much smaller magnitude than for air noise, and it is difficult to quantify precisely at this stage.

Ground Noise Methodology – Determination of Significance

4.3.9 A similar approach for rating significance was adopted as for air noise, the only difference being the choice of LOAEL and SOAEL values. An assessment of ground noise following this general approach has been used in recent airport assessments at Leeds Bradford, Manston, and London City Airports.

4.3.10 For ground noise, the LOAEL and SOAEL levels have been derived from the guideline internal noise levels given in BS 8233 [CD10.46], namely 35 dB $L_{Aeq,16h}$ in the daytime and 30 dB $L_{Aeq,8h}$ at night.

4.3.11 Even with windows open most of the time, these internal levels would correspond to an external level around 15 dB higher, i.e. 50 dB $L_{Aeq,16h}$ and 45 dB $L_{Aeq,8h}$. These levels have therefore been used as the LOAEL.

4.3.12 If windows are closed, an additional protection of around 10 dB can be expected. Above this level, some form of additional mitigation would be required to achieve the guideline internal levels given in BS 8233. This threshold corresponds to external levels of 60 dB $L_{Aeq,16h}$ and 55 dB $L_{Aeq,8h}$, which have been adopted as the SOAEL.

4.3.13 Once it has been determined where a receptor lies in relation to the LOAEL and SOAEL, significance in an ES context can then be determined by considering how the noise level changes between the baseline scenario (without development) and the with development scenario.

4.3.14 As for the air noise assessment, for receptors where the noise level in the louder of the two scenarios being compared is between the LOAEL and the SOAEL, a value of 3 dB was adopted as the threshold for a significant change. For receptors above the SOAEL, a lower value of 2 dB was adopted.

4.3.15 This approach was accepted for the ES by NSC's Officers who, after receiving advice from their noise consultants, stated multiple times in the OR that they considered a change of no more than 2 dB to be of negligible magnitude and not significant.

Ground Noise Assessment Findings

4.3.16 The ground noise assessments presented in the ES and ESA considered the first year in which 12 mppa was forecast to be reached, in the event that the application was successful (2026 in the ES, 2030 in the ESA).

4.3.17 This 12 mppa scenario was compared with a 10 mppa scenario for the same year. As no benefit was being assumed for modern aircraft, an earlier 10 mppa scenario as considered in the air noise assessment was not relevant.

4.3.18 All dwelling and population totals presented in this section have been rounded to the nearest 50 if the total was above 100, to the nearest 10 if the total was below 100 but above 10, and not rounded if the total was below 10. This follows the approach in the ES and ESA.

4.3.19 The number of dwellings exposed to noise levels above the LOAEL and SOAEL are presented in Table 15 for the ES and the ESA, for both daytime and night-time.

Scenario	# Dwellings			
	Daytime		Night-time	
	LOAEL 50 dB $L_{Aeq,16h}$	SOAEL 60 dB $L_{Aeq,16h}$	LOAEL 45 dB $L_{Aeq,8h}$	SOAEL 55 dB $L_{Aeq,8h}$
Scenarios Presented in the ES				
2017	70	1	70	1
10 mppa 2026	80	1	100	2
12 mppa 2026	70	1	100	3
Scenarios Presented in the ESA				
10 mppa 2030	90	1	100	1
12 mppa 2030	100	1	90	2

Table 15: Summary of Dwellings Above Ground Noise LOAEL and SOAEL

4.3.20 The number of dwellings exposed to ground noise levels at or above the LOAEL does not materially change between the 10 mppa (2030) and 12 mppa (2030) scenarios, increasing from around 90 to around 100 in the daytime while doing the reverse at night.

4.3.21 The number of dwellings exposed to ground noise levels at or above the SOAEL is low in all scenarios, with only one property so exposed in the 10 mppa (2030) scenario for both day and night, increasing to 2 at night in the 12 mppa (2030) scenario.

4.3.22 The changes in noise level between the 10 mppa (2030) and 12 mppa (2030) scenarios assessed in the ESA are presented in Table 16 and Table 17. To give further detail, those changes rated as “Negligible” have been separated into 0-1 dB and 1-2 dB bands. The thicker line marks the threshold for the onset of significant effects.

Change in Noise Level	50 dB $L_{Aeq,16h}$ (LOAEL) to 60 dB $L_{Aeq,16h}$ (SOAEL)		Above 60 dB $L_{Aeq,16h}$ (SOAEL)	
	Beneficial	Adverse	Beneficial	Adverse
ESA – 10 mppa (2030) to 12 mppa (2030)				
0 – 1 dB	20	20	0	0
1 – 2 dB	9	1	0	1
2 – 3 dB	7	0	0	0
3 – 6 dB	30	0	0	0
6 – 9 dB	3	0	0	0
>9 dB	0	0	0	0

Table 16: Summary of Change in Ground Noise Levels – Day

Change in Noise Level	45 dB $L_{Aeq,8h}$ (LOAEL) to 55 dB $L_{Aeq,8h}$ (SOAEL)		Above 55 dB $L_{Aeq,8h}$ (SOAEL)	
	Beneficial	Adverse	Beneficial	Adverse
ESA – 10 mppa (2030) to 12 mppa (2030)				
0 – 1 dB	20	30	0	0
1 – 2 dB	4	1	0	2
2 – 3 dB	4	0	0	0
3 – 6 dB	30	0	0	0
6 – 9 dB	3	0	0	0
>9 dB	0	0	0	0

Table 17: Summary of Change in Ground Noise Levels – Night

4.3.23 When considering the change in noise level, the ESA assessment found that when comparing the 10 mppa and 12 mppa scenarios, the effects during the day and night periods were comparable.

4.3.24 For the majority of dwellings above the LOAEL, in particular those to the north of Bristol Airport such as those on Downside road, the proposed development is forecast to

provide a benefit in terms of ground noise due to additional screening provided by the proposed infrastructure works. This benefit was of a significant magnitude in some cases.

4.3.25 For dwellings which do not benefit from screening, the proposed development gives rise to an increase in noise level no greater than 1 dB for almost all receptors. For the 3 receptors closest to Stands 38 and 39, the proposed newly permitted use of APUs on these stands gave rise to increases no greater than 2 dB. This caused 1 additional dwelling to be exposed to noise levels above the SOAEL in the 12 mppa scenario, compared to the 10 mppa scenario. This was true in both the ES and the ESA.

4.3.26 In both the ES and the ESA, the change in ground noise level at all of the assessed receptors was below the threshold for significance. Therefore the assessment findings for both the ES and the ESA were that no significant ground noise effects were predicted to arise due to the proposed development.

4.3.27 The ESA also considered a qualitative assessment of faster and slower growth forecasts. This assessment concluded that the effect of faster or slower growth on the 10 mppa and 12 mppa scenarios was likely to be comparable, and would result in differences in ground noise levels of less than 0.1 dB, which would not materially change any of the assessment results or conclusions.

4.4 Road Traffic Noise

Road Traffic Noise Methodology – Noise Metrics

4.4.1 The assessment of road traffic noise in the UK is set out in the Design Manual for Roads and Bridges (DMRB) document LA 111 [CD10.50]. This requires the use of the $L_{A10,18h}$ metric, which is the A-weighted sound level exceeded for 10% of the time between 06:00 and midnight.

4.4.2 NSC agreed with this approach for the ES, stating the following in the OR:

"This is widely used to measure road traffic noise and it is acceptable."

Road Traffic Noise Methodology – Noise Modelling

4.4.3 Noise levels used in the ES and ESA assessments were predicted using the CadnaA software package, following the methodology set out in the Department of Transport document Calculation of Road Traffic Noise (CRTN). This calculation method is recommended by LA 111 [CD10.50].

4.4.4 Traffic flows were forecast for 4 roads in the vicinity of Bristol Airport, being Downside Road, the A38 (north and south of the airport), West Lane and North Side Road (airport access).

Road Traffic Noise Methodology – Determination of Significance

4.4.5 A similar approach for rating significance was adopted as for air noise and ground noise, in that absolute noise levels are combined with changes in noise level in order to determine any significant effects.

4.4.6 For road traffic noise the LOAEL, SOAEL and change thresholds are defined in LA 111 [CD10.50]. The change thresholds differ slightly to those used for air and ground noise, and separate thresholds apply for short term (e.g. when a new road is being built) or long term (e.g. a gradual increase in traffic over time) changes.

4.4.7 The only new roads being built as part of the proposed development are within Bristol Airport. The receptors closest to these roads lie on Downside Road and will receive the greatest amount of road traffic noise from vehicles using this existing road. Therefore, the long-term changes in noise level are the only changes relevant to this assessment.

Road Traffic Noise Assessment Findings

4.4.8 The road traffic noise assessments presented in the ES and ESA considered the first year in which 12 mppa was forecast to be reached, in the event that the application was successful (2026 in the ES, 2030 in the ESA).

4.4.9 This 12 mppa scenario was compared with a 10 mppa scenario for the same year.

4.4.10 All dwelling and population totals presented in this section have been rounded to the nearest 50 if the total was above 100, to the nearest 10 if the total was below 100 but above 10, and not rounded if the total was below 10. This follows the approach in the ES and ESA.

4.4.11 The number of dwellings exposed to noise levels above the LOAEL and SOAEL are presented in Table 15 for the ES and the ESA.

Scenario	**# Dwellings**	
	LOAEL 55 dB $L_{A10,18h}$	**SOAEL 68 dB $L_{A10,18h}$**
Scenarios Presented in the ES		
2017	100	20
10 mppa 2026	100	30
12 mppa 2026	100	30
Scenarios Presented in the ESA		
10 mppa 2030	150	40
12 mppa 2030	150	40

Table 18: Summary of Dwellings Above Road Traffic Noise LOAEL and SOAEL

4.4.12 The number of dwelling exposed to road traffic noise levels at or above the LOAEL does not change between the 10 mppa (2030) and 12 mppa (2030) scenarios, at around 150 in both.

4.4.13 The number of dwelling exposed to road traffic noise levels at or above the SOAEL does not change between the 10 mppa (2030) and 12 mppa (2030) scenarios, at around 40 in both.

4.4.14 The changes in noise level between the 10 mppa and 12 mppa scenarios assessed in the ESA are presented in Table 16 and Table 17. To give further detail, those changes rated as "Negligible" have been separated into 0-1 dB and 1-3 dB bands. The thicker line marks the threshold for the onset of significant effects.

Change in Noise Level	55 dB $L_{A10,18h}$ (LOAEL) to 68 dB $L_{A10,18h}$ (SOAEL)		Above 68 dB $L_{A10,18h}$ (SOAEL)	
	Beneficial	Adverse	Beneficial	Adverse
ESA – 10 mppa (2030) to 12 mppa (2030)				
0 – 1 dB	0	90	0	40
1 – 3 dB	0	0	0	0
3 – 5 dB	0	0	0	0
5 – 10 dB	0	0	0	0
>10 dB	0	0	0	0

Table 19: Summary of Change in Road Traffic Noise Levels

4.4.15 When considering the change in noise level, the ESA assessment found that when comparing the 10 mppa and 12 mppa scenarios, all assessed receptors experienced an increase of less than 1 dB, i.e. a negligible amount well below the significance threshold. This was also true for the ES assessment.

4.4.16 Therefore the assessment findings for both the ES and the ESA were that no significant road traffic noise effects were predicted to arise due to the proposed development.

4.5 Cumulative Noise Effects

4.5.1 In discussions following the ES, NSC requested that cumulative noise levels for air noise, ground noise and road traffic noise were presented for key receptors, despite this being a non-standard approach. This analysis was repeated in the ESA (Section 11.3) and in both cases concluded that there were no significant effects. NSC Officers agreed with this for the ES, stating in the Officers' Report:

"BAL say a change in noise level cannot be greater than the change in noise level for individual sources. Their cumulative noise assessment also shows that the change in noise level at all the assessed receptors is less than 2 dB(A), which would not be considered as significant by the ES if cumulative noise levels were considered. Officers agree with this."

4.6 Mitigation

4.6.1 The airport currently operates a Noise Insulation Scheme (NIS) which offers grants towards noise insulation works residential buildings exposed to a daytime air noise level of 57 dB $L_{Aeq,16h}$ or above. In summary, residential buildings exposed to 63 dB $L_{Aeq,16h}$ or above are eligible for a grant of up to £5,000, and others in the scheme are eligible for a grant of up to £2,500, with the condition that they must contribute the same amount themselves, i.e. BAL pay for half of the total cost of the works up to £2,500 (known as match funding).

4.6.2 As part of the application, in recognition that there will be some (not significant) adverse noise impacts, it is proposed to increase both grant amounts by 50%, and remove the match funding requirement. It is also proposed to introduce a new eligibility threshold of 55 dB $L_{Aeq,8h}$ (night-time) with a corresponding grant amount of £5,500.

4.6.3 The minimum standard of glazing and ventilators available under the scheme will also be increased.

4.7 Proposed Planning Conditions (Noise)

4.7.1 This section contains a summary of the proposed changes to noise-related planning conditions being put forward by BAL, other than those listed in Section 4.1. The conditions in this section do not affect the noise assessments carried out; rather they serve to control the noise effects to acceptable levels.

Daytime Noise Contour (change)

4.7.2 The area of the 57 dB $L_{Aeq,16h}$ daytime noise contour is currently limited by planning condition to 12.42 km^2. As part of the original application process, BAL and NSC agreed to reduce this to 11.5 km^2. BAL propose to retain this previously agreed condition.

4.7.3 The 11.5 km^2 limit previously agreed with NSC was on the basis that some allowance should be made for uncertainty while still reducing the permitted area. In the ESA, the opportunity was taken to understand the potential noise impacts of the faster growth scenario, based on the latest forecasts. This found that the faster growth scenario would give rise to contours around 10% larger than those in the core case, which based on the ESA forecasts would relate to a contour of 11.77 km^2. However BAL are prepared to accept the previously agreed limit.

Night-time Noise Contour (new)

4.7.4 BAL have proposed that the area of the 55 dB $L_{Aeq,8h}$ night-time noise contour area limit is limited to 6.8 km^2 from 2030.

Quota Count (QC) Scheme (change)

4.7.5 A QC scheme assigns a QC value to each aircraft operation in the assessment period (other than exemptions) based on its certificated noise levels. Separate QC values are used for arrivals and departures. A limit is applied to the total QC points permitted for the summer and winter seasons.

4.7.6 The QC categories are typically based on 3 dB wide bands, with each successive band having a QC value of double the one below it. This reflects the fact that an increase of 3 dB approximately relates to a doubling of noise energy.

4.7.7 The current QC scheme, as is the case at Heathrow, Gatwick and Stansted airports, is based on the period 23:30 to 06:00.

4.7.8 Currently at Bristol Airport there is a QC limit of 1,260 for the summer season (BST period) and 900 for the winter season. This is not proposed to change.

4.7.9 It is currently permitted to carry over any unused allowance to the next season, up to a maximum of 10%. NSC have proposed to phase out this allowance, reducing by 2% per year for 5 years. BAL have agreed to this change.

4.7.10 As part of the original application process, alterations were agreed to the QC scheme to bring it in to line with the latest scheme in operation at Heathrow, Gatwick and Stansted airports. In summary this categorises aircraft based on their certificated noise level in 3 dB wide bands and assigns a QC score for each, from 0.125 upwards (quieter aircraft get a score of 0).

4.7.11 NSC have now instead proposed a bespoke scheme which utilises 1 dB wide bands and assigns QC scores from 0.025 upwards, but otherwise follows a similar approach, i.e. for every 3 dB increase the QC value doubles. BAL have accepted this proposal.

Noisiest Permitted Aircraft (change)

4.7.12 As part of the original application process, BAL proposed to reduce the noisiest aircraft operations permitted to be scheduled to operate between 23:30 and 06:00 from a QC value of 2 to a QC value of 1. BAL propose to retain this previously agreed condition.

Number of Flights Permitted in Shoulder Periods

4.7.13 As part of the original application process, BAL proposed to reduce the permitted number of annual flights in the shoulder periods (23:00 to 23:30 and 06:00 to 07:00) from 10,500 to 9,500.

5.0 RESPONSE TO ISSUES RAISED BY NSC AND THIRD PARTIES

5.1.1 A number of issues have been raised, in particular by NSC and PCAA, as well as by third parties. For ease of reading this section addresses the issues in turn. Table 20 lists the issues and who they have been raised by.

5.1.2 A number of the issues listed were also raised by private individuals in responses to either the original ES or the ES Addendum.

5.1.3 In this section I discuss issues in relation to air noise and ground noise only. No specific issues have been raised regarding other noise and vibration effects, i.e. road traffic noise, aircraft vibration, or construction noise and vibration.

Section	Issue Summary	Raised By
5.2	Whether the forecast increase in noise is contrary to government policy	NSC
5.3	Whether the noise impacts of the proposed lifting of seasonal restrictions on night flights would be significant	NSC
5.4	Whether aircraft traffic forecasting uncertainty (including Jet2) has the potential to change the assessment conclusions	NSC, PCAA
5.5	Whether any increase in properties above the SOAEL at night should be avoided	NSC
5.6	Whether the adoption of 55 dB $L_{Aeq,8h}$ as the SOAEL at night is appropriate	NSC
5.7	Whether the adoption of 45 dB $L_{Aeq,8h}$ as the LOAEL at night is appropriate	NSC
5.8	Whether recent evidence supporting the case that people are more sensitive to noise affects the assessment methodology	NSC
5.9	Whether recent evidence supporting the case that people are more sensitive to noise	NSC
5.10	Whether the supplementary metrics provided for the ES should all have been re-assessed for the ESA	NSC
5.11	Whether the increase in flights should be regarded as significant despite small changes in LAeq	NSC
5.12	Whether it is relevant to the assessment that quieter aircraft may not give a noticeable benefit or that aircraft noise certification levels	NSC, PCAA
5.13	Whether an awakenings assessment would be best practice	NSC
5.14	Whether LAmax levels should have used a fast time-weighting rather than slow	NSC
5.15	Whether the ground noise assessment should account for tonal characteristics or a BS 4142 assessment should be carried out	NSC
5.16	Whether ground noise should average LAeq over the whole day/night or only over the period it is occurring	NSC

Table 20: Summary of issues raised

5.2 Whether the forecast increase in noise is contrary to government policy

5.2.1 NSC's Statement of Case (SoC) interprets paragraph 3.3 of the APF [CD6.1] as meaning that any increase in aviation noise impacts is contrary to government policy, stating (para 38):

"The Council will contend that the Government expectation is that growth in airport capacity is not to be delivered via increased aviation noise impacts; rather growth is to be managed so that noise impacts are mitigated and reduced. Growth which is delivered via increased noise impacts is not then growth that accords with the APF."

5.2.2 The interpretation of the APF is considered to be a planning matter rather than a noise matter and is dealt with in the POE of Mr Melling.

5.2.3 My understanding is that both Government and NSC noise policy is achieved if significant adverse noise impacts are avoided and any adverse noise impacts are considered to be acceptable, either because they have been mitigated or in the context of the development benefits.

Significance of Impacts

5.2.4 NSC in their Reason for Refusal 2 state that:

"noise … generated by the increase in aircraft movements and in particular the proposed lifting of seasonal restrictions on night flights would have a significant adverse impact on the health and well-being of residents in local communities…"

5.2.5 They did not offer any explanation or evidence to support this statement, which is contrary to the conclusions of the ES, ESA and the Officers' Report.

5.2.6 It is presumed that this issue relates to air noise.

5.2.7 The methodology for determining the significance of air noise impacts is set out in the assessment summary presented in Section 4.2. This takes into account both the absolute value and the change in noise level due to the development. This is a standard approach followed by recent UK airport assessments.

5.2.8 The ES and ESA methodology was that the change in noise level due to the development is considered to be significant if it is greater than 3 dB for noise levels between the LOAEL and SOAEL, or if it is greater than 2 dB for noise levels above the SOAEL.

5.2.9 The increases in the air noise level were no greater than 1 dB for all receptors exposed to noise levels above the LOAEL, i.e. well below the threshold for significance. This was true when considering both daytime and night-time noise.

5.2.10 These changes are therefore considered to be not significant when following a standard approach.

5.2.11 Concern regarding the proposed lifting of seasonal restrictions on night flights, which relates to the period 23:30-06:00, is considered separately in Section 5.3.

Acceptability of (not significant) Adverse Impacts

5.2.12 The ES and ESA assessments found that there would be some adverse noise impacts, albeit not of a significant magnitude.

5.2.13 To address these impacts, as part of the application BAL have proposed enhancements to their noise mitigation scheme as described in Section 4.5, which offers grants for sound insulation works for dwellings within the 57 dB $L_{Aeq,16h}$ contour.

5.2.14 As mentioned above, the proposed changes are to increase the grant amount available, add in a new eligibility threshold for those exposed to noise levels of at least 55 dB $L_{Aeq,8h}$, remove the requirement for homeowners benefitting from the scheme to

match fund (i.e. pay 50% of the cost) and improve the minimum specification of windows and ventilators to be used as part of the scheme.

5.2.15 This compares favourably with current Government policy which is that mitigation should be offered to properties within the 63 dB $L_{Aeq,16h}$ contour. The Government have indicated that this may change to 60 dB in the future. The BAL sound insulation scheme therefore more than satisfies both current and emerging Government policy in this regard.

5.2.16 Operational restrictions were also agreed to ensure that the impacts presented in the ES would be adequately controlled. The impacts forecast in the ESA would not breach any of the agreed restrictions, and additional restrictions are also proposed.

5.2.17 It is therefore considered that the adverse impacts are acceptable when taking into account the mitigation.

5.2.18 These measures were accepted as being appropriate in the Officer's Report, which stated:

"Officers consider that the combination of the revised operational restrictions, enhanced acoustic mitigation grant scheme and air noise control scheme would provide an acceptable form of mitigation for air noise having regard to current policy."

5.3 Whether the noise impacts of the proposed lifting of seasonal restrictions on night flights would be significant

5.3.1 NSC in their Reason for Refusal 2 state that:

"noise … generated by the increase in aircraft movements and in particular the proposed lifting of seasonal restrictions on night flights would have a significant adverse impact on the health and well-being of residents in local communities…"

5.3.2 They did not offer any explanation or evidence to support this statement, which is contrary to the conclusions of the ES, ESA and the Officers' Report.

5.3.3 It is presumed that this issue relates to air noise and, as reference is made to the seasonal restrictions of night flights, it is the period of the night where these restrictions apply that is of specific interest, namely from 23:30 to 06:00. It is also assumed that it is the summer period that is of interest as potentially more flights might occur in this period in the future with the development in place. Noise is currently controlled during this period by the airport's night noise quota count scheme.

5.3.4 In response to this specific issue, the ESA considered how noise levels are forecast to change during the standard 8 hour night period from 23:00 to 07:00, as well as during the three separate periods of the night, namely:

- 23:00 to 23:30 (shoulder period of the night)
- 23:30 to 06:00 (night noise quota count period or "QC period" which refers to the seasonal restrictions on night flights period).
- 06:00 to 07:00 (shoulder period of the night)

5.3.5 As demonstrated in Section 5.2, following the standard approach of considering the 8 hour night period (using the $L_{Aeq,8h}$ metric) does not find any significant noise effects at night.

5.3.6 Although there are no commonly accepted objective criteria to rate the absolute noise levels of specific periods of the 8 hour night, considering specifically the QC period (as this was referenced by NSC in their Reason for Refusal 2), the noise levels are lower in the QC period than for the standard 8 hour night assessment period (23:00-07:00). This

is because fewer flights (per hour) occur in the QC period. The assessment therefore considered the change in noise level in the QC period.

5.3.7 Noise levels were presented at the set of 14 representative residential receptors. Difference contours were also produced to show the changes across the whole study area.

5.3.8 The assessment found that the changes in noise level in the QC period between the 10 mppa (2030) and 12 mppa (2030) scenarios were between 0 and 1 dB for all of the assessed receptors, and indeed for the entirety of the study area. This is a negligible change in noise level and would not be considered significant.

5.3.9 This finding is not particularly surprising since there was no proposal to increase the permitted maximum QC total for the summer season (currently 1,260), so air noise in this period is already restricted independently of the restriction on the number of flights.

5.4 Whether aircraft traffic forecasting uncertainty (including Jet2) has the potential to change the assessment conclusions

5.4.1 Subsequent to the assessment work being carried out for the ESA, it was announced that Jet2.com would be commencing operations from Bristol Airport.

5.4.2 It has been raised by NSC, PCAA and others that this creates significant uncertainty regarding the assessment results. For example in NSC's SoC they state (para 47):

"The Council considers that the air traffic forecasts, on which the noise contour results in the ES Addendum are based, are subject to significant uncertainty."

5.4.3 In PCAA's SoC they state (para 42):

"there is additional uncertainty because many airlines have delayed or cancelled future orders for new, potentially less noisy, aircraft because of the pandemic"

5.4.4 Specific forecasting issues will be addressed in the POE of Mr Brass, however I will discuss the implications on the noise assessment here.

5.4.5 This issue was commented on by the Inspectors in the recent Stansted Inquiry, with the Appeal Decision stating (para 30):

"It remained unclear throughout the Inquiry, despite extensive evidence, why the speed of growth should matter in considering the appeal. If it ultimately takes the airport longer than expected to reach anticipated levels of growth, then the corresponding environmental effects would also take longer to materialise or may reduce due to advances in technology that might occur in the meantime. The likely worst-case scenario assessed in the ES and ESA, and upon which the appeal is being considered, remains just that."

5.4.6 It is accepted that future forecasts are unlikely to be 100% accurate. The forecasts are however the best estimate at that point in time. The associated assessments, such as noise, then use these forecasts as a basis for the determination of the likely impacts.

5.4.7 Ultimately the effect of forecast uncertainty on the noise assessment is to introduce uncertainty regarding the noise impacts, however the effects are likely to be similar for both with development and without development scenarios.

5.4.8 This uncertainty is commonly dealt with in the UK by the setting of suitable planning conditions to ensure that the noise effects are controlled to acceptable levels.

5.4.9 An example of such a condition is a noise contour area limit, for example the 10 mppa permission had a condition which limited the area of the daytime 57 dB $L_{Aeq,16h}$ noise contour to 12.42 km^2.

5.4.10 There are two key aspects of forecast uncertainty that are relevant to the noise assessment; firstly the rate of growth and secondly the future fleet mix. I will discuss both separately in detail below although it will be seen that both are interlinked in practice.

Uncertainty regarding the rate of growth

5.4.11 There is always some uncertainty regarding the rate of growth of airport traffic, and this is only increased by the COVID-19 pandemic which has had a significant impact on the aviation sector. It is currently expected that demand for air travel will recover, but there is uncertainty around when airports will return to pre-pandemic levels of activity and then grow beyond that.

5.4.12 Separately, the commencement of operations at Bristol Airport by Jet2 means that growth could potentially be faster than the core case forecast in the ESA.

5.4.13 In general, faster growth means that the worst-case year for air noise impacts will be earlier, and that those impacts would be slightly greater than for the core case. If 12 mppa was reached before 2030 then it is likely that (if there were no planning controls) the noise impacts in this earlier year would be slightly greater than those assessed for 2030 in the ESA, although the impacts for 12 mppa in 2030 would likely remain similar to those assessed in the ESA. However, the same would be true for 10 mppa and so the difference due to the development would be unlikely to change as much.

5.4.14 This is because over time airlines are upgrading their fleets to use quieter aircraft, in particular the Airbus A320neo and A321neo and the Boeing 737 MAX, which will replace the Airbus A320, A321 and Boeing 737-800 which make up the majority of the current fleet. These new aircraft also have slightly more seats than their older equivalents and therefore it is expected that there would be a slightly lower number of flights for the same number of passengers.

5.4.15 As part of the ESA forecasting work, faster and slower growth scenarios were produced. These are discussed in paragraphs 4.2.89 and 4.2.90 of this POE. This concluded that the effect on the 10 mppa and 12 mppa scenarios was likely to be comparable, and would result in differences in air noise levels in the order of +0.5 dB for the faster growth scenario and -0.5 dB for the slower growth scenario. This equates to a difference in contour area of around 10%.

5.4.16 While this uncertainty in the forecast affects the absolute air noise levels experienced by the community in the first year in which 12 mppa is reached, it would apply similarly to the without development scenario and the conclusions of the ESA assessment would therefore not change, as the difference between the with and without development cases would remain similarly low and result is no significant adverse impacts.

5.4.17 If growth is slower than forecast, then the air noise impacts when 10 mppa or 12 mppa are first reached are likely to be lower than those assessed in the ESA.

5.4.18 If growth is higher than forecast, then with no planning controls the noise impacts when 10 mppa or 12 mppa are first reached are likely to be higher than those assessed in the ESA as the fleet would contain fewer of the new aircraft. While this is currently permissible up to 10 mppa under the current planning permission (with a daytime contour area limit of 12.42 km^2), appropriate contour area limits for growth up to 12 mppa would ensure that the noise effects were controlled to acceptable levels.

5.4.19 Fluctuations in the forecast will have a smaller effect on ground noise and road traffic noise levels because these are not materially influenced by fleet modernisation. Even so, these noise levels would rise fractionally in absolute terms if more movements occur at the airport and reduce fractionally if movements reduce in line with the sensitivity assessment undertaken in the ESA. In summary, the effects on noise levels would be minimal and would not change the ESA conclusions.

Uncertainty regarding the future fleet mix

5.4.20 While every effort has been made to be as accurate as possible regarding the future fleet mix, it is not possible to say with certainty what aircraft each airline will fly a number of years in the future; indeed, as Mr Brass explains, that is not the purpose of the forecasts. This issue has, however, been brought into focus by the announcement that Jet2 will be commencing operations from Bristol Airport in 2021.

5.4.21 In the event that planning permission were to be granted, this would be on the basis of the assessed impacts rather than the specific airlines and aircraft which make up the forecast. Again, suitable planning conditions would ensure that the noise effects were controlled to acceptable levels.

5.5 Whether any increase in properties above the SOAEL at night should be avoided

5.5.1 NSC state in their SoC (para 55):

"The ES and Addendum ES both confirm that there will be a substantial increase in properties, and therefore people, exposed to night time noise above SOAEL. Thus, the Proposed Development will give rise to noise impacts which should be avoided and which the NPPG indicates should result in refusal of planning permission."

5.5.2 One aspect of NSC's argument here is that any increase in the number of people above the SOAEL goes against policy and should result in refusal of planning permission. My understanding is that this is not true if suitable mitigation measures are applied. This is however a point on interpretation of policy, which is covered in the POE of Mr Melling.

5.5.3 The number of properties above the SOAEL at night does increase. As presented in Table 9 in the ESA the number assessed as being at or above the SOAEL at night increases from around 100 in the 10 mppa (2030) scenario to around 250 in the 12 mppa (2030) scenario. For context the equivalent number in 2017 was 150 and in the 10 mppa (2024) scenario was 200.

5.5.4 When considering the worst-case comparison of 10 mppa (2030) to 12 mppa (2030), the increase in noise level at all of these properties above the SOAEL is less than 1 dB, rated as negligible and well below the threshold for a significant impact due to the development.

5.5.5 The policy advice given in PPGN for properties above the SOAEL is to avoid these noise levels from occurring, by use of appropriate mitigation such as altering the design or layout. The SOAEL is set based on an external noise level, however the relevant noise level is that which is experienced inside the property. This is particularly true at night when most people would be expected to be indoors. Therefore, improving the sound insulation of the dwelling is a suitable mitigation to avoid the noise effects of being above the SOAEL.

5.5.6 All properties above the SOAEL at night (55 dB $L_{Aeq,8h}$) will be eligible to benefit from the enhanced noise insulation scheme proposed as part of the application (as described in Section 4.5). If they take up the offer of improved sound insulation, these properties will have lower internal noise levels in the 12 mppa 2030 scenario than they would in the 10 mppa 2030 scenario without improved sound insulation.

5.5.7 Additionally, the enhanced noise insulation scheme includes an improvement in the minimum noise performance of the windows and ventilators which can be paid for by the scheme. This will enable residents to keep windows closed more often in warmer weather while still benefitting from the improved noise performance.

5.5.8 In summary, the residents of dwellings who will be newly above the SOAEL will have gone from just below to just above the SOAEL and will not experience a material change in noise impact. The benefit of the insulation scheme is greater than the increase in noise they experience.

5.6 Whether the adoption of 55 dB $L_{Aeq,8h}$ as the SOAEL at night is appropriate

5.6.1 NSC have agreed in the Statement of Common Ground (SoCG) that for the daytime $L_{Aeq,16h}$ metric a SOAEL of 63 dB $L_{Aeq,16h}$ is appropriate. However for the night-time $L_{Aeq,8h}$ metric they disagree with the adoption of 55 dB $L_{Aeq,8hr}$ as the SOAEL, stating in their SOC (para 57):

"Further, the Council will question the use of a 55 dB LAeq,8 hrs as SOAEL at night. This level is drawn from the WHO Night Noise Guidelines ("NNGs"), which in section 1.3.6 states: "most levels mentioned in this report do not take background levels into account". Further, the WHO Guidelines for Community Noise comments in the executive summary in regard to sleep disturbance that "Special attention should also be given to: noise sources in an environment with low background sound levels..." The Council will contend that the WHO NNG levels do not allow for increased sleep disturbance where intermittent noise events occur in rural locations similar to those around Bristol airport with low noise conditions."

5.6.2 Background noise levels are not relevant to the assessment of aircraft noise, apart from potentially at very low levels of noise, and it is standard practice to ignore them. I will present further information in this section to support this approach.

5.6.3 Table 5 lists a number of recent airport planning applications along with the adopted SOAELs. Of the 5 which have assessed night noise, 4 have adopted a SOAEL of 55 dB $L_{Aeq,8h}$, with the other (Stansted) adopting 54 dB $L_{Aeq,8h}$. None of the assessments took background noise level into account when setting the SOAEL, despite there being rural locations in the vicinity of some of the airports.

5.6.4 It is also the case that strategic noise maps covering transportation sources, such as aircraft, rail and road traffic, prepared by Defra every 5 years to assist in the preparation of Noise Action Plans, rely solely on the L_{Aeq} based units such as L_{den} and L_{night}, without any consideration of background noise levels.

5.6.5 When assessing noise of an industrial or commercial nature (as described in BS 4142 [CD10.51], for example) it is important to consider it in the context of other existing sources, i.e. background noise. If the background noise level is close to the specific source noise level then it can mask the noise from the specific source and lessen its impact.

5.6.6 NSC reference section 1.3.6 of the 2009 WHO Guidelines. While this states that the noise levels given in the guidelines do not take background levels into account, the section also gives justification for this approach. The following extracts from the same section are relevant to this issue:

"Masking, however, is a complex process. The human auditory system is uncannily good at separating signals from "background"."

"The rule of thumb that a noise can be considered masked if the signal is 10 dB below the background is only valid if the noises have the same frequency composition and if they actually occur at the same time. This is particularly important to stress where L_{Aeq} levels are compared: even a relatively continuous motorway of 50 dB cannot mask aircraft noise of 30 dB, because this may be composed of five aircraft arriving at an L_{Amax} of 57 dB. Neither can birdsong, because the frequency domains do not overlap."

5.6.7 It is clear that background levels would need to be very high in order to mask a level of 55 dB $L_{Aeq,8h}$ – even at an airport with a large number of flights the background would still need to be in well excess of 65 dB in order to mask the aircraft noise, and this is already a very high background level which would be unlikely to occur even in urban areas.

5.6.8 The 2009 WHO Guidelines also state:

"Most levels mentioned in this report do not take background levels into account – explicitly. Where long-term L_{Aeq} levels are related to effects like hypertension and self-reported sleep disturbance, background levels are ignored, but they could obscure the effect at the lower end of the scale. This then influences the lowest level where an effect starts to occur."

5.6.9 Bearing in mind that the 2009 WHO Guidelines considered noise levels down to 30 dB L_{night}, it is clear that 55 dB is not at *"the lower end of the scale"* and background levels would be unlikely to obscure the noise effects.

5.6.10 For the reasons above, it is standard practice when assessing aircraft noise to only take into account the noise level of the aircraft, and not the potential masking effect of background noise.

5.7 Whether the adoption of 45 dB $L_{Aeq,8h}$ as the LOAEL at night is appropriate

5.7.1 NSC have agreed in the SoCG that for the daytime $L_{Aeq,16h}$ metric a LOAEL of 51 dB $L_{Aeq,16h}$ is appropriate. However for the night-time $L_{Aeq,8h}$ metric they disagree with the adoption of 45 dB $L_{Aeq,8hr}$ as the LOAEL, stating in the SoCG:

"The LOAEL value at night is not agreed. The LPA considers that the rural nature of the surroundings warrants a lower LOAEL at night of 40dB in accordance with the WHO NNG"

5.7.2 The adoption of 45 dB $L_{Aeq,8hr}$ as the LOAEL is discussed in paragraph 4.2.33 of this POE. This value is clearly defined as the LOAEL by the UK Government.

5.8 Whether a qualitative assessment of sensitivity forecasts is sufficient

5.8.1 NSC have contended that a qualitative assessment of the sensitivity of the forecasts provided in the ESA is not sufficient to assess the effects, stating in their SOC (para 48):

"Paragraphs 6.7.16 to 6.7.21 of the ES Addendum discuss sensitivity tests and conclude that noise levels could be 0.5dBA higher and contours 10% larger than reported in the ES Addendum. However, the ES Addendum presents only a qualitative assessment of the sensitivity tests which conclude there will be no significant adverse effects. This is considered inadequate as no quantitative assessment of the effect to increasing the size of the noise contours is provided i.e. number of noise sensitive receptors and people affected."

5.8.2 The quantitative assessment of the forecasts presented in the ES and the ESA give full details of the likely noise effects of the proposed development. This is based on the most likely outcome at the time the forecasts were produced, i.e. the core case.

5.8.3 The faster and slower growth cases differ from the core case only slightly, as the number of total passengers would be the same.

5.8.4 Considering first the faster growth case, this relates to 12 mppa being reached in 2027 rather than 2030. Compared to the core case, this would result in a lower proportion of newer aircraft such as the Airbus A320neo and Boeing 737 MAX. It is expected that there might be around 10% fewer of these aircraft in the fleet mix for 12 mppa in 2027 compared with 2030.

5.8.5 Additionally these newer aircraft are slightly larger, so a lower proportion of them would mean slightly more (1-2%) total flights would be needed to carry the same number of passengers.

5.8.6 Both of these effects would be expected to apply similarly to the 10 mppa and 12 mppa scenarios; i.e. the noise effects of 10 mppa would be greater in 2027 than 2030 for the same reasons.

5.8.7 Taking these two effects together, using a high level assumption that the newer aircraft are 3 dB quieter in flight on average and the changes occur equally across the fleet, in the faster growth case the 12 mppa noise exposure levels at each receptor would be expected to be greater than those assessed for the 12 mppa (2030) scenario assessed in the ESA by up to 0.5 dB.

5.8.8 The slower growth case, not reaching 12 mppa until 2034, would be expected to give rise to slightly lower noise effects of a similar magnitude, as it would likely have a higher proportion of newer aircraft than the core case.

5.8.9 I do not think it is reasonable to do so, but even if one assumed that the faster growth effects applied only to the 12 mppa forecast and the 10 mppa forecast remained unchanged from the core case, the increase in noise exposure levels due to the

development would be 1.5 dB or less, which is still below the adopted threshold for significant effects. Therefore the conclusions of the ESA would be unchanged, i.e. that there would be no significant adverse effects due to the development.

5.8.10 The night noise effects, even in the faster growth case, would still be below what was presented in the ES, which also concluded that there would be no significant adverse effects due to the development.

5.8.11 On this basis it was considered that a quantitative assessment of these sensitivity forecasts was not necessary.

5.9 Whether recent evidence supporting the case that people are more sensitive to noise affects the assessment methodology

5.9.1 NSC contend in their SoC (para 49) that that:

"as a result of recent evidence supporting a changing sensitivity to noise, there is no single authoritative dose response that can be relied on solely to robustly evaluate aviation noise effects and alternative dose responses should be used as sensitivity tests to any 'primary' dose response used."

5.9.2 Recent research, in particular the SoNA study, point to an increased sensitivity to noise at low levels, and have resulted in the UK Government now considering 54 dB $L_{Aeq,16h}$ to be the onset of significant community annoyance, which was previously considered to be 57 dB $L_{Aeq,16h}$.

5.9.3 Correspondingly UK policy has changed to now consider the LOAEL to be 51 dB $L_{Aeq,16h}$ for daytime noise and 45 dB $L_{Aeq,8h}$ for night-time noise, as discussed in Section 4.2 of this POE. Historic UK airport assessments did not consider noise levels as low as this.

The ES and ESA assessments however do account for this change and follow the latest UK Government policy in this regard.

5.9.4 The SoNA study did not find an increased sensitivity to higher noise levels, for example the same percentage of people reported being highly annoyed at 63 dB $L_{Aeq,16h}$ in both the SoNA and ANIS studies, and at noise levels above this the SoNA study found a lower percentage of people reported as highly annoyed.

5.9.5 However, this research only considered a single point in time, and therefore did not consider community response to changes in noise level over time. There is no indication that people have become more sensitive to smaller changes in noise level than they were in the past.

5.9.6 None of the above offers any reason why the significance criteria adopted for the ES and ESA are not appropriate.

5.10 Whether the supplementary metrics provided for the ES should all have been re-assessed for the ESA

5.10.1 NSC stated in their response to the draft SoCG:

"Supplementary indicators that were used to provide context in the ES have not been updated in the ESA which is considered to be a serious omission. The assessment using these indicators is thus not up to date."

5.10.2 In a separate response they also stated in relation to supplementary indicators:

"The LPA consider that these are necessary to correctly evaluate the significance of the effect of the noise impacts of the prosed scheme. "

5.10.3 The main reason for producing the ESA was that in light of the COVID-19 pandemic, the years in which 10 mppa and 12 mppa had been forecast to be reached were likely to be delayed. It was therefore important to carry out a quantitative assessment for the later assessment years to understand whether the conclusions reached in the ES were still valid.

5.10.4 The conclusions of the ES were based on the assessment of the average noise metrics $L_{Aeq,16h}$, $L_{Aeq,8h}$ and single events at night (SEL and L_{ASmax}). The $L_{Aeq,16h}$ and $L_{Aeq,8h}$ metrics are the primary metrics recommended by the Government for the evaluation of air noise impacts.

5.10.5 These metrics were re-produced in full. The conclusions for the ESA were comparable to those in the ES, albeit with lower absolute noise impacts at night. If the reassessment of the Core Case in the ESA had revealed materially different results from the ES then that may have been a trigger for undertaking a quantitative reassessment of the other metrics, but it found very little difference in results when considering the change due to the development.

5.10.6 There is, therefore, no reason to believe that reassessing the supplementary metrics for a later 12mppa Core Case year (2030 v 2026) would reveal materially different results from those in the ES and, indeed, insofar as there is any difference there is very high confidence that the night noise effects of the 12 mppa (2030) scenario presented in the ESA will be less than those for the 12 mppa (2026) scenario presented in the ES.

5.10.7 The ESA did however reassess some of the supplementary metrics presented in the ES. These were the following:

- Number of people likely to be highly annoyed or highly sleep disturbed, as this is relevant to the health assessment.

- Noise levels at representative locations for the different scenarios, to show how the noise levels are now expected to change in the future.

5.10.8 These metrics both showed lower absolute impacts in the ESA compared to the ES, with comparable differences between the 10 mppa and 12 mppa scenarios.

5.10.9 Additional supplementary metrics were also provided in the ESA to describe noise during the night period, and specifically the period 23:30 to 06:00, in more detail and in response to issues that had been raised after submission of the ES. These did not find any significant effects and are discussed in more detail in Section 5.3.

5.11 Whether the increase in flights should be regarded as significant despite small changes in LAeq

5.11.1 NSC state the following in their SoC (para 52) regarding the adopted criteria for assessing change in noise level as significant:

"The Council will contend that this approach is flawed and fails to appreciate the impact upon quality of life that even small changes in LAeq,16hr can have. This is because such changes represent substantial increases in the number of noisy events occurring; and fails to appreciate that the magnitude of noticeable and valuable change in cumulative LAeq,T noise levels is smaller than the noise level of individual aircraft movements."

5.11.2 This comment is somewhat ambiguous as it depends heavily on the definition of a *"substantial"* number of events, and also on what is considered *"noisy"*. NSC's position however, appears to be that the number of flights is relevant in determining significance, regardless of their noise level.

5.11.3 This is a position which I do not endorse, as clearly the noise level must be taken into account to determine the noise impact, and research has consistently shown that L_{Aeq}

corresponds well with community response. However, even accepting this position, I do not think the proposed development would reasonably be described as a substantial increase in the number of noisy events.

5.11.4 In theory, there can be relatively large variations in the number of flights while the L_{Aeq} value remains similar, in particular when comparing the noise contours from different airports which might have very different fleet mixes (e.g. a predominantly long haul airport using larger and much noisier aircraft such as Boeing 747s and a predominantly short haul airport using smaller and much quieter aircraft such as Airbus A320s), but this is not the case here where we are considering a relatively small increase in movements from the same short haul airport.

5.11.5 When considering the proposed development, this is for an increase in the passenger capacity of 20%. The size of aircraft using Bristol Airport is not expected to change a great deal; possibly increasing slightly as the modern quieter aircraft typically have slightly more seats than those they are replacing. The forecasts presented in the application show that the 20% increase in passenger numbers from 10 mppa to 12 mppa would only result in an increase of around 10-15% in the number of flights. In my view, an increase in flights of this magnitude would not reasonably be described as "substantial".

5.11.6 Additionally, the aircraft fleet is getting quieter over time, and the forecast is that under 12 mppa the proportion of modern, quieter aircraft will increase relative to 10 mppa. This would further reduce the impact of the increase in aircraft movements alone.

5.12 Whether it is relevant to the assessment that quieter aircraft may not give a noticeable benefit or that aircraft noise certification levels may not exactly reflect real world noise levels

5.12.1 NSC state in their SoC (paras 53 and 54):

"The Council also intends to explore whether any future change in the fleet mix operating from the airport towards a greater proportion of quieter aircraft will, in fact deliver noticeable benefit to the community in terms of quality of life.

Reference will be made to research which shows that for different individual aircraft noise levels:

(a) A 2 to 3 dB difference between successive sounds is not particularly noticeable, although over half of the participants thought that it could lead to a more positive view of the airport, compared to providing no difference at all.

(b) Differences of 5 to 6 dB between successive sounds may be needed for people to even tell there is a difference.

(c) A difference of at least 7 or 8 dB may be needed between the average sound level of two sequences of aircraft sounds to provide a valuable break from aircraft noise.

In addition, the Council considers that it is relevant to examine the uncertainties associated with the noise emitted from aircraft operating in the real world as opposed to the noise emitted during the certification process. The Council will present evidence to suggest that aircraft are in fact noisier than the certification process suggests."

5.12.2 The PCAA state in their SoC (para 42):

"Future noise predictions make the unproven assumption that future fleet changes will lead to a reduction in noise due to technology advancement. This is not based on any fact, knowledge or assurance…"

"A conservative approach of no improvement / reduction in aircraft noise should be used in this work to mitigate against the future not delivering on the assumptions currently made. It should be noted that the analysis of ground noise from aircraft "conservatively assumes that the modernised aircraft are no quieter than existing aircraft" (section 6.7.17 of the ES Addendum). This approach has not been used for airborne noise, which is a glaring inconsistency."

5.12.3 There are a number of related issues here that I feel it is logical to address together.

5.12.4 Regarding the issue of whether new aircraft will be noticeably quieter, my opinion is that whether NSC's statement is true or not has little bearing on the conclusions of the ESA, as the assessment of significance relies on the absolute level and change of the average noise level, i.e. the L_{Aeq} metric, as this is current Government policy and has been shown to correlate well with community response to aircraft noise.

5.12.5 Regarding whether aircraft perform at their certificated noise levels in the real world, this also has little bearing on the conclusions of the ESA due to the model validation that is undertaken.

5.12.6 The noise modelling software used for the assessment, AEDT, has a library of aircraft types and associated noise information, that is derived from certification tests. However, there can be large numbers of variants within an aircraft type, for example there are hundreds of different variants of an Airbus A320, which will not all have identical noise performance.

5.12.7 To avoid this uncertainty, as part of the noise modelling which underpins the air noise assessment in the ES, a validation process was carried out which compared the actual measured noise levels of aircraft with those predicted by the model for the most common aircraft types. Specifically this included the Airbus A319, A320 and A321, and the Boeing 737-800 and 757. The modelled noise levels were then adjusted to match the measurements as closely as possible. For other aircraft types the default values were used.

5.12.8 The adjustments required were less than 1 dB(A) in most cases; the exceptions were the Boeing 737-800 arrivals which were adjusted down 1.2 dB(A) and the Airbus A321 departures which were adjusted up 1.3 dB(A). This suggests that the model provides a reasonable estimate of the noise levels even without any adjustment.

5.12.9 Considering the new aircraft specifically, there are three future aircraft which operate in large numbers in the forecasts; these are the Airbus A320neo and A321neo, and the Boeing 737 MAX 8. The two Airbus aircraft have already begun operating at Bristol Airport, and in-service measurements were used to calibrate the noise model. The Boeing 737 MAX 8 has not yet entered service at Bristol, so the default AEDT aircraft was used. Measurements taken in certification tests confirm that it is demonstrably quieter than the 737-800.

5.13 Whether an awakenings assessment would be best practice

5.13.1 NSC state in their SoC (para 56):

5.13.2 "The Council will also contend that the omission of an assessment of additional awakenings due to aircraft noise at night within the ES is not in line with good practice and undermines the validity of the conclusions drawn in the ES regarding effects of noise at night on health. The use of "awakenings" to describe effects allows sleep disturbance

to be considered in terms of increased risk. For example, the ES does not use the Basner method of predicting awakenings due to aircraft noise to assess sleep disturbance.

However, the Basner method was used to inform the assessment of awakenings at night for Phases 1, 2A and 2B of the HS2 project and is proposed as part of the assessment of the sleep effects of noise from the Third Runway at Heathrow."

5.13.3 Awakenings are a measure of the impact of individual aircraft noise events. Individual events were assessed in the ES and ESA by looking at the number of events which exceeded 80 dB L_{Amax} or 90 dB SEL. The adopted SOAEL was a level of 1 event per night above these thresholds.

5.13.4 Research carried out by Basner [CD10.52] (2018) for the WHO has resulted in a method for estimating the percentage of people who will be awoken by aircraft events at night. However, this was not adopted by the WHO, with their 2018 Guidelines instead relying on L_{Aeq}-based metrics and stating (Section 2.2.2):

"In many situations, average noise levels like the L_{den} or L_{night} indicators may not be the best to explain a particular noise effect. Single-event noise indicators – such as the maximum sound pressure level ($L_{A,max}$) and its frequency distribution – are warranted in specific situations, such as in the context of night-time railway or aircraft noise events that can clearly elicit awakenings and other physiological reactions that are mostly determined by $L_{A,max}$. Nevertheless, the assessment of the relationship between different types of single-event noise indicators and long-term health outcomes at the population level remains tentative. The guidelines therefore make no recommendations for single-event noise indicators." (emphasis added)

5.13.5 Additionally, the assessment of awakenings is not required by current UK policy. Therefore consideration of awakenings should not be required for an assessment to be considered good practice.

5.13.6 Despite this, assessments of awakenings have been used in some recent assessments such as that carried out for the recent development consent order application at Manston Airport, as well as those cited by NSC. It was however omitted from a number of other assessments such as Stansted, Luton and Leeds Bradford.

5.13.7 Where awakenings assessments have been carried out, a threshold for significance of one additional awakening per night on average over a year has been adopted. This is based on a recommendation in a 2006 Basner paper [CD10.53] on a similar topic. At Manston for example this was translated into a threshold of 18 aircraft events per night above 80 dB L_{ASmax} (outdoor).

5.13.8 The ES and ESA adopted a SOAEL of one event per night above this noise level, which is therefore a much more stringent criteria. Although there were dwellings above this threshold, the number of dwellings so affected did not change with or without the development.

5.13.9 Had an awakening assessment been carried out for Bristol Airport, it is likely that very few, if any, people would have been assessed as having at least one additional awakening per night.

5.13.10 In summary, I do not agree that an awakening assessment is best practice, as the WHO Guidelines which commissioned the research do not themselves consider that there is a robust link between this metric and long-term health outcomes at a population level. Even if such an assessment had been carried out at Bristol Airport, it is considered unlikely to have found any significant effects due to the development.

5.14 Whether LAmax levels should have used a fast time-weighting rather than slow

5.14.1 NSC have expressed concern that L_{Amax} assessments have used the slow time weighting, whereas the fast time weighting is typically used in environmental noise guidance documents such as WHO Guidelines for Community Noise, stating in their SoC (para 58):

"The Council intends to explore the fact that the LAmax slow index has been used in the night noise impact assessment. That index is considered against sleep disturbance thresholds drawn from the WHO Community Noise Guidelines which utilise the LAmax fast index. The Council considers that this comparison is inappropriate and underestimate the extent and nature of impacts at night."

5.14.2 Fast time-weighting samples more frequently and therefore normally results in higher readings (typically around 3 dB for aircraft events). Fast time-weighting is widely used for environmental noise measurement and assessment, but not for aircraft noise.

5.14.3 The measurement of aircraft noise is required to use the slow time weighting to comply with recognised standards and guidelines, such as *BS ISO 20906:2009 Acoustics – Unattended monitoring of aircraft sound in the vicinity of airports* [CD10.54].

5.14.4 Aircraft noise has historically been assessed using the slow time-weighting and this is the only option available in most aircraft noise modelling software. Therefore any criteria must use the slow time weighting in order to be readily assessed.

5.14.5 Aircraft-specific research, such as the awakenings research carried out by Basner for the WHO [CD10.52], also uses the slow time-weighting.

5.14.6 The key L_{Amax} criteria presented in the ES and ESA is the SOAEL for individual aircraft events. This was based on a level of 90 dB(A) SEL which is an energy based index independent of time weighting. It is broadly equivalent to 80 dB L_{ASmax} for aircraft

events. It could also be interpreted as being broadly equivalent to around 83 dB L_{AFmax}, i.e. using a fast time weighting. Therefore any discrepancy between slow and fast time weighting would not have affected the assessment of significance, as the SOAEL of 90 dB(A) SEL would remain the same but the equivalent value of L_{AFmax} would simply be higher than L_{ASmax}.

5.14.7 It is appropriate and recognised as industry standard that the L_{Amax} metric for the assessment of aircraft noise should use the slow time-weighting, and even if the fast time-weighting had been used, this would not have materially changed the assessment results, and would have affected the 10 mppa and 12 mppa scenarios equally.

5.15 Whether the ground noise assessment should account for tonal characteristics or a BS 4142 assessment should be carried out

5.15.1 NSC in the SoC (para 59) present the following as reasons why they consider the ground noise assessment to be inadequate:

"The assessment criteria used do not take account of features of the noise that enhance its impact such as tones and/or substantial low frequency content.", and

" No BS4142 based assessment of the noise is provided."

5.15.2 BS 4142 [CD10.51] provides a method for rating noise of an industrial and/or commercial nature. The general principle is to use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a residential building upon which sound is incident.

5.15.3 The principle of the method is to:

- Determine the specific (industrial/commercial) noise level at the assessment location, independently of any influences contributing to the ambient sound. The reference time interval is 1 hour during the day and 15 minutes during the night.

- Apply any relevant rating penalties if the specific sound is particularly tonal, impulsive, intermittent, or has some other characteristic which makes it readily distinctive against the residual acoustic environment. This results in the rating level.

- Compare the rating level with the background noise level. The greater the difference, the greater the magnitude of the impact.

5.15.4 BS 4142 gives guidance for interpreting the impacts. In summary, a difference of around 10 dB or more is likely to be an indication of a significant adverse impact, depending on context, and a difference of 5 dB or more relates to a likely adverse impact.

5.15.5 The issue of a BS 4142 assessment was discussed with NSC as part of the post-application discussions. BAP's response was as follows:

"This standard is not considered relevant to the assessment of aircraft operating to and from an airport. It was originally designed to address noise from factories, industrial premises, or fixed installations and then extended to include mobile plant and vehicles associated with industrial or commercial premises, including loading and unloading activities in service yards, etc.

The use of this standard to assess aircraft ground noise is rare in BAP's experience, although a variation on this BS standard method is occasionally used as a supplementary device to try to account for prevailing background noise conditions. BAP consider that there is no evidence base for using BS 4142 in this manner and, if adopted

at all, it should be used as the standard intended, i.e. in accordance with the prescribed methodology. Were it to be used this way, most airports would not be able to operate aircraft on the ground as it would predict noise complaints around most if not all airports."

5.15.6 Corrections for tonality or intermittency are part of the BS 4142 methodology. This is also reflected in a reference in BS 8233 (7.7.1) which states:

"Noise has a specific character if it contains features such as a distinguishable, discrete and continuous tone, is irregular enough to attract attention, or has strong low-frequency content, in which case lower noise limits might be appropriate."

5.15.7 The LOAEL, SOAEL and UAEL values for ground noise were derived from BS 8233 limits with no correction.

5.15.8 While ground noise can have a specific character, when the airport is busy (i.e. when the ground noise is loudest), it forms part of the general noise in and around the airport, blending with that of other noise sources such as road traffic. Additionally, the character of the noise is not changed by the proposed development, rather, the proposed development represents a slight intensification of an existing noise source.

5.15.9 Reviewing other recent airport applications where ground noise is considered, the approach taken is summarised in Table 21:

Airport	Allowance for tonality, low frequency content, or intermittence?	Allowance for background noise?
Bristol (2018)	No	No
London City (2015)	No	No
Stansted (2018)	No	Yes
Manston (2018)	No	No
Southampton (2019)	No	Yes
Leeds Bradford (2020)	No	No

Table 21: Adopted SOAEL in Recent UK Airport Planning Applications

5.15.10 None of the airport applications took any account of tonality, low frequency content or intermittency in the assessment of ground noise. Only two of the six airport applications took any consideration of background noise and these are discussed below.

5.15.11 The Stansted assessment included background in the determination of significance, using similar trigger levels to BS 4142 (i.e. 5 or 10 dB above background). However in essence background noise was only taken into account in that if the background noise was higher than the ground noise level; in this case it was not deemed to have a significant effect regardless of any increase in ground noise.

5.15.12 The Southampton assessment followed a BS4142 approach but considered the background to be the noise environment without development (including aircraft), effectively using the BS 4142 scale but assessing the change in noise level rather than a comparison to background.

5.15.13 In summary, BAP's methodology, which was previously accepted by NSC, is the same or similar to that adopted by other recent UK airport assessments. Those that have taken elements of the BS 4142 methodology into account have not done so in a way that affects their assessment of significance.

5.16 Whether ground noise should average LAeq over the whole day/night or only over the period it is occurring

5.16.1 NSC state the following in their SoC (para 59) as a reason why they consider the ground noise assessment to be inadequate:

"The use of long term LAeq 16 hr and 8hs for assessment of day and night effect respectively will "average down" the intermittent periods of ground noise of shorter duration during these times. Consideration needs to be given to the actual level of noise during each episode of ground noise, the number of such episodes in each 16 hr and 8 hr period, and the peak noise level of each event."

5.16.2 It is standard practice to average L_{Aeq} over a 16 hour (day) or 8 hour (night) period for rating ground noise (as for air noise). Assessments of this nature have been accepted for a number of airport assessments, for example all of the airports listed in Table 5 which carried out a ground noise assessment used the $L_{Aeq,16h}$ and $L_{Aeq,8h}$ metric to assess its impact.

5.16.3 This approach in the ES was accepted by NSC officers, with the Officers' Report stating:

"BAL have assessed ground noise in a similar way to air noise in that the $L_{Aeq,16h}$, and $L_{Aeq,8h}$, average noise metrics for day and night time noise impacts. Officers consider this is an acceptable way to assess ground noise."

5.16.4 NSC state specifically in their SoC that the level of noise and number of events need to be accounted for as well as the peak noise level of each individual event. Other than consideration of the peak noise level, this is precisely what the L_{Aeq} metric does, regardless of time period, which is why it is widely used as a method to average the noise effects of multiple events in a period.

5.16.5 Peak noise levels are not usually relevant for ground noise as they are substantially lower than for air noise, which occurs at similar times (as ground noise is largely associated with an aircraft arrival or departure). In any case, the development does not permit any different aircraft to operate at Bristol Airport than would otherwise operate in a 10 mppa scenario, so the peak level of individual ground noise events will be the same with or without the development (it may occur slightly more often with development).

5.16.6 Notwithstanding the preference for using $L_{Aeq,16h}$ and $L_{Aeq,8h}$ for the assessment, even if a shorter assessment period such as 1 hour were used, this would not materially affect the difference in noise level between scenarios. This is because the distribution of aircraft traffic over the day is not forecast to materially change as a result of the application.

5.16.7 Additionally, criteria based on 16-hour or 8-hour average noise levels cannot be appropriately applied to different time periods so it is not clear what criteria could be applied (other than change in noise level, which is already assessed) to the non-standard time periods.

APPENDIX 1

EXTRACT FROM HEATHROW CRANFORD AGREEMENT PUBLIC INQUIRY INSPECTOR'S REPORT

The Heathrow Cranford Agreement Public Inquiry Inspector's Report paragraphs 1054-1062 are reproduced below:

"With regard to the significance of a change in noise level, the Authorities suggest that the ES reliance on a +3dB change in judging significance is out of kilter with current views and that there is no justification in the APF, or any other policy, for imposing a +3dB change criterion irrespective of noise level [313–315]. The Authorities instead suggest that a 3dB change should be adopted up to a guideline level of 63dB (SOAEL) and 1dB above that. For its part, HAL argues that use of a 3dB change is common practice, aligns with the APF and is robust in statistical terms such that a change in the noise environment is in fact referable back to the development. [549–551]

In support of their case that a 1dB change should be used to denote significance above a guideline level of 63dB the Authorities have referred to the Institute of Environmental Management and Assessment (IEMA) Guidelines for Environmental Noise Impact Assessment (2014) as well as the PPG [320-324]. The Authorities have also referred to the "…up to date dose response of the EEA report…."[956] as showing that the change in percentage annoyed for any particular increase in noise becomes greater as the overall noise levels increase.

The IEMA guidelines themselves were not put before the Inquiry. Although the Authorities suggest by reference to a figure extracted from the IEMA Guidelines[957] that noise changes at or above a 'guideline' have more impact than the same changes below that guideline I am not convinced by either the figure or the oral evidence at the Inquiry that it is necessarily so.

I accept that there is some evidence that the dose/response relationship is dependent on the absolute noise level - as illustrated by the changing gradient of the figure and borne out by the change in percentages of those highly annoyed between various noise

levels as shown in the table from the EEA report. However, both the IEMA figure and the table from the EEA report seem to suggest that there is little difference in the dose/response relationship at the extremes. Whilst I accept that the IEMA figure does indicate a change in response around the guideline value, the figures given in the table suggest that the most significant disparity is when comparing figures around the guideline value to low levels of noise. Indeed, whilst the Authorities suggest that with reference to the EEA report that the ES "…fails to recognise that the change in percentage annoyed for any particular increase in noise becomes greater as the overall noise levels increase…" the table actually shows that the increase in percentage terms of those highly annoyed for a 3dBA increase in Lden is 8% between 57 Lden and 69Lden – falling to 6% at 72Lden.

Although the Authorities also refer to the guidance in the PPG that, "in cases where existing noise sensitive locations already experience high noise levels, a development that is expected to cause even a small impact in the overall noise level may result in a significant adverse effect occurring even though little to no change in behaviour would be likely to occur", nothing was drawn to my attention that would help to quantify what might be meant by 'high noise levels' or a 'small impact'. Consequently it seems to me that whilst the PPG alerts the decision maker to the possibility that significant adverse effects may occur at high noise levels with little or no change in behaviour I do not see this as offering any significant support to the Authorities' position that the appropriate significance criterion above 63dB should be a change of 1dB.

However, whilst I am not convinced by the Authorities' arguments that a 1dB change should be the criterion for assessing significance above 63dB LAeq 16hr, nor am I convinced by HAL's reliance on the statistical significance of a 3dB change. Given that 3dB represents a doubling of noise (which may be translated here as a doubling of the number of over-flights) it seems to me highly likely that increases of somewhat less than

3dB would be noticed, even over time. Although HAL argues [551] that if two different noise environments differ by 1dB on the LAeq16hr index there is a 20% probability that a social survey would show no change in annoyance between those environments that suggests to me that there is actually a high probability that such a survey would show some change in annoyance. As far as HAL's argument that 3dB as a criterion of significance is, in effect, in 'common usage' little in the way of support for that argument was put before the Inquiry.

In summary I find that none of the arguments above should be accorded any significant weight; in contrast, as current Government policy, the approach in the APF should be accorded substantial weight. Although the Authorities maintain that there is no justification in the APF for a 3dB change irrespective of the noise level the fact is that the only change criterion specified in the APF in respect of noise insulation and compensation is 3dB – and then only when leaving a residential property exposed to levels of noise of 63dB or more.

In that respect it is of note that the APF only seeks to apply the change criterion to residential properties; the Government expects operators to offer acoustic insulation to noise sensitive buildings such as schools and hospitals solely on the basis that they are exposed to levels of 63db LAeq 16hr or more. That is a clear distinction in the APF and confirms that the Government's expectation for residential properties is that acoustic insulation should be linked to both an appreciable change in the noise environment as well as an absolute noise level.

Although nothing before the Inquiry fully explains the reasoning behind the differing approach to insulation in schools and residential properties, I note that the findings of the 'Road Traffic and Aircraft Noise Exposure and Children's Cognition and Health' study (RANCH) reveal that high levels of chronic aircraft noise exposure impair children's reading and their ability to perform complex cognitive tasks. That seems to me indicative of a strong correlation between absolute levels of noise and learning - as opposed to the annoyance suffered by residents which appears

to also depend on the ability to perceive a change. However, it is in any event the case that whilst HAL originally considered mitigation for schools by reference to a 3dB change, it no longer adopts that approach in its proffered mitigation - relying instead solely on the 63dB LAeq 16hr contour."

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