

# Airports Commission Discussion Paper 05: Aviation Noise

## *The Mayor of London's response*

September 2013

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### 1. Purpose of paper

1.1. In July 2013 the Airports Commission issued a Discussion Paper on Aviation Noise inviting views and evidence. The Commission's paper set out a number of specific questions, which this response addresses under the following headings:

- Measuring exposure to aviation noise
- Valuing aviation noise exposure
- Heathrow's noise impacts mean that it must not be allowed to expand

### 2. Background

2.1. London is exposed to more aviation noise than any other city in Europe. Noise from Heathrow exposes 28 per cent of all the people impacted by airport noise in Europe<sup>1</sup>, more than Frankfurt, Madrid, Paris and Amsterdam airports combined. Amsterdam Schiphol accounts for only two per cent.

2.2. While 766,100 people are identified to live within the 55dB Lden contour for Heathrow airport<sup>2</sup>, it is noted that in the recent night noise respite trial at Heathrow<sup>3</sup> the zones from which flights were excluded and respite benefits gained were all outside this contour. This suggests that the noise impacts of Heathrow are felt over a much larger area than the airport's owners would have us believe.

2.3. The main effects of aircraft noise are:

- **Annoyance** - Aircraft noise can intrude on a person's daily life through interrupting desired activities such as having a conversation, breaking concentration or disturbing whilst relaxing. This results in a loss of amenity and reduced quality of life through increased stress and irritation<sup>4</sup>. A clear relationship between increasing

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<sup>1</sup> CAA, 2011, Insight Note 2: Aviation Policy for the Environment

<sup>2</sup> Night Flying Restrictions at Heathrow, Gatwick and Stansted Stage 1 Consultation Annexes, Jan 2013

<sup>3</sup> Helios, 2013, Heathrow airport – Early Morning Arrival Trial Analysis, Final Report

<sup>4</sup> Heaver, 2002, Attitudes to Aircraft Annoyance around Airports (5A) Focus Group Report EEC/ENV/2002/009

noise and annoyance is identified in both the ANIS (1985)<sup>5</sup> and ANASE (2007)<sup>6</sup> studies.

- **Adverse health effects and reduced productivity** – The stress associated with long term noise exposure can lead to long term health effects such as hypertension, acute myocardial infarctions, strokes and dementia<sup>7</sup>. The World Health Organisation has outlined a strong link between cardiovascular disorders and exposure to aircraft noise<sup>8</sup>. Aviation noise also reduces reading comprehension and recognition memory in schoolchildren. A five decibel increase in exposure to school-age children was seen to correspond to a two month delay in reading age among UK pupils<sup>9</sup>. Noise exposure at night results in sleep disturbance, which leads to reduced work output and quality<sup>10</sup>. Studies have found that aircraft noise can increase the time taken to fall asleep<sup>11</sup> and that during the hours of 04:00 and 07:00, sleepers keeping conventional hours are both more easily awakened by ambient noise, and have more difficulty going back to sleep. This is because the noise threshold for awakening is less in shallow sleep than in deep sleep<sup>12</sup>.

2.4. The Mayor made clear to the Commission in his three long term option submissions<sup>13</sup> that there are three excellent, credible, and deliverable options for a new hub airport serving London and the UK. A new hub airport will transform the health and well-being of the hundreds of thousands of Londoners who are exposed to the adverse impacts of aviation noise. It is possible for a new hub airport to accommodate two and a half times as many passengers while exposing less than five per cent of the number of people to aviation noise as Heathrow does currently. A new hub airport can minimise the impacts of aviation noise, and ensure that London remains a driving force in the global economy.

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<sup>5</sup> Brooker et al, 1985 DR Report 8402L United Kingdom Aircraft Noise Index Study: main report

<sup>6</sup> MVA Consultancy, 2007, Attitudes to Noise from Aviation sources in England (ANASE) study

<sup>7</sup> Rhodes, Weston and Jones, 2013, ERCD Report 1209

<sup>8</sup> WHO, 2011, Burden of disease from environmental noise quantification of healthy life years lost in Europe

<sup>9</sup> Clark and Stansfeld, 2011, The effect of nocturnal aircraft noise on health: A review of recent evidence

<sup>10</sup> Rhodes, Weston and Jones, 2013, ERCD Report 1209

<sup>11</sup> Öhrström E, 1993, Long-term effects in terms of psychosocial wellbeing, annoyance and sleep disturbance in areas exposed to high levels of road traffic noise, Health Council of the Netherlands, The Hague, A93/02E

<sup>12</sup> WHO Europe, 2009, Night Noise Guidelines for Europe

<sup>13</sup> Mayor of London, The Mayor of London's submissions to the Airports Commission, July 2013

### **3 Summary of key issues for the Airports Commission**

#### **3.1 The key issues for the Airports Commission are:**

*The Commission need to adopt a new approach to measuring aviation noise*

- The relative performance of different short, medium and long-term options should be assessed using a 55dB Lden average noise level threshold, alongside evidence which is able to represent the impacts of individual noise events. In the longer term, the development of a new noise metric is strongly supported
- Options should be assessed with reference to the number of people exposed to absolute noise values

*The Commission need to adopt a new approach to valuing aviation noise exposure*

- Current methods of monetising exposure to aviation noise are primarily derived from road and rail modes and underestimate the true impacts which are felt, regarding both 'willingness to pay' to avoid exposure to aviation noise, and the wider social impacts and costs
  - TfL has conducted a study using these current values to assess the noise impacts of Heathrow and the Mayor's three new hub options, all more than twice the size of Heathrow today. Heathrow is hugely inferior; closing it would provide benefits of +£6.2bn, compared to zero cost for the Outer Estuary option, -£250m for the Stansted option, and -£330m for the Isle of Grain option. Although a significant figure we believe £6bn does not do justice to the true value people would assign to the elimination of Heathrow's aviation noise, and new research should be commissioned.

*Heathrow's noise impacts mean that it must not be allowed to expand*

- Heathrow exposes far more people to noise than any other European airport, and significant impacts are felt far beyond the boundaries of its 55dB Lden contour. In the recent night noise respite trial, the zones from which flights were excluded and noise respite benefits' gained' were all outside of the 55dB Lden contour. The rate of technological progress has slowed to such an extent that more runways will mean more people exposed to noise
- Minimising the number of people exposed to aircraft noise and ensuring that the UK has a future hub airport which can accommodate demand from key world regions is best achieved by relocating the UK's hub to a less densely populated area

## 4 Measuring exposure to aviation noise

4.1 There are a number of metrics for measuring exposure to aviation noise:

- LAeq (equivalent continuous sound level) indices average noise exposure over an extended period of time – typically 16 hours (07:00-23:00). It is supported by an evidence base which links increasing noise to annoyance<sup>14, 15</sup>
- Lden (overall noise level during the day, evening and night) indices also average noise exposure over each 24 hour period and take into account the additional impact of noise events in the evening (19:00-23:00) and during the night (23:00-07:00)
- Other metrics are more strongly linked to the frequency or ‘peakiness’ of individual noise events. While they can more accurately reflect the intensity of noise generated by aircraft, they have a less well established link to attitudes to aircraft noise. The Commission must nonetheless consider the use of such metrics to inform and assist decision-making

4.2. The UK currently puts most weight on those exposed in excess of a 57dB LAeq threshold. As set out in his response to the Government’s Draft Aviation Policy Framework<sup>16</sup> the Mayor believes that 55dB Lden should be the benchmark against which the impacts of different potential options are compared for the following reasons:

- The European standard Lden is better than LAeq because it is a composite average of exposure during the day, evening and night, with weightings added to Levening and Lnight. It also enables the impacts at different locations across Europe to be compared and benchmarked against one another
- 55dB Lden is a more appropriate noise level to measure than 57dB LAeq, because it better reflects the intensity at which the adverse effects of noise exposure are felt

4.3. In the longer term, the development of a new noise metric is strongly supported. It must fully represent sensitivity to and the impacts of aviation noise and how individual aircraft events are experienced during different times of day and night. It is noted that the standard eight hour night period applied for different types of transport noise (including road and rail traffic) is 23:00-07:00; this is in line with World Health Organisation guidelines and the EU Environmental Noise Directive and, as such, is used for most official purposes in the UK. The exception is for aviation,

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<sup>14</sup> Brooker et al, 1985, DR Report 8402L United Kingdom Aircraft Noise Index Study: Main Report

<sup>15</sup> Miedema, 2007, Exposure-response relationships for environmental noise

<sup>16</sup> Mayor of London, October 2012, The Mayor of London’s Response to the Government’s Draft Aviation Policy Framework, <http://www.tfl.gov.uk/assets/downloads/corporate/daf-consultation-response-2012.pdf>

where, in response to strong lobbying by the aviation industry some decades ago, a compromise night quota count period of 23:30-06:00 was established by Government.

- 4.4. It is also important that the Government supplement the adoption of a new metric with the introduction of a stricter and more intelligent noise monitoring and enforcement regime<sup>17</sup>.
- 4.5. The Commission's Aviation Noise Discussion Paper and the Government's Aviation Policy Framework identify the concept of noise envelopes. It is recognised that there are several means of employing noise envelopes. Any such arrangements must have extensive and transparent data collection, analysis and reporting arrangements. While they could potentially be used to support longer-term commitments and incentives which minimise aviation's noise impacts, they must not be used to imply that current arrangements and impacts – particularly at Heathrow – are acceptable, nor should they be used by the Commission to assess different options. The Commission must make decisions on different options with reference to their overall impacts.
- 4.6. The Commission should assess potential options with reference to the number of people exposed to absolute noise levels, rather than the relative change in noise exposure. This is because:
  - Individual aircraft noise events are, in general, significantly noisier than ambient noise levels
  - The adverse health effects of noise are linked to exposure to absolute, specific noise intensity levels<sup>18</sup>
  - Over time people habituate to noise exposure, although its harmful impacts (which are related to absolute levels) continue to be felt
- 4.7. The Commission should identify the number of people exposed to specific, absolute noise levels. This will allow them to compare the change in the noise environment generated by the credible short, medium and long-term options. This will act as a useful baseline for comparing the number of people who will be annoyed and suffer from health and productivity impacts.
- 4.8. While consideration needs to be given to initial reactions to the introduction of a new noise source, a new hub airport would overall, dramatically reduce the number of people exposed to excessive noise levels.
- 4.9. Attitudes to noise exposure vary, but it is clear that there can be a very large gap between:

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<sup>17</sup> As called for by the Mayor in: Mayor of London, October 2012, The Mayor of London's Response to the Government's Draft Aviation Policy Framework

<sup>18</sup> WHO, 2011, Burden of disease from environmental noise. Quantification of healthy life years lost in Europe

- The level of average noise exposure at which significant impacts start to be experienced. Some studies identify levels as low as 50dB Lden<sup>19</sup>, and the current UK approach places most weight on 57dB LAeq, and,
- The level at which financial compensation is paid to homeowners, schools and businesses to mitigate impacts. At Heathrow currently, this starts at 69dB LAeq. London City Airport is far more generous, with compensation starting at 57dBLAeq. At Nice in France, compensation starts at 55dBLden.

## 5. Valuing aviation noise exposure

- 5.1. No amount of money can cancel out the impacts of exposure to aviation noise. However, to try and understand the scale of the impacts, the principle of assigning a monetary value to the adverse effects of aviation noise is strongly supported. Attempting to monetise the impacts of aviation noise may begin to address the lack of a widely recognisable noise threshold level, and the discrepancy between the extent of impact that an airport can have, and the financial price (including compensation) it is required to pay.
- 5.2. Noise effects can be considered in three groups; annoyance/amenity effects, health effects and productivity/sleep disturbance effects. For annoyance/amenity effects, in the absence of a separate method valuing aviation noise, the Department for Transport (DfT) recommend using road and rail derived values as set out in the DfT's Transport Analysis Guidance (WebTAG)<sup>20</sup>.
- 5.3. TfL has assessed the noise benefits of closing Heathrow (+£6.2bn), and the noise costs of opening a new hub airport (more than twice the size of Heathrow today) at each of the Mayor's recommended locations: Isle of Grain (-£330m), Outer Estuary (£0) and Stansted (-£250m). TfL has used the methodology developed by the Civil Aviation Authority's Environmental Research and Consultancy Department which assigns a value not only to annoyance (as per WebTAG), but also health and productivity effects (Appendix 2).
- 5.4. It must be noted however, that aircraft noise propagates differently to road and rail noise. It can cause greater annoyance because it is heard on all sides of a building unlike road/rail noise<sup>21</sup>. Therefore its impacts could be greater and are potentially

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<sup>19</sup> WHO, 1999, Guidelines for community noise

<sup>20</sup> Department for Transport, August 2012, Transport Analysis Guidance The Noise Sub-objective TAG Unit 3.3.2

<sup>21</sup> The Interdepartmental Group on Costs and Benefits Noise Subject Group (IGCB(N)), 2010, Noise & Health – Valuing the Human Health Impacts of Environmental Noise Exposure

undervalued in this assessment.

- 5.5. Nevertheless, we wish to draw the Commission's attention to the significant value associated with Heathrow's adverse noise impacts, and the potential benefits of a new hub airport. In the long term, we would ask the Government to explore a brand new approach to valuing aviation noise impacts which not only reflects annoyance but also health and productivity effects. This would include using aviation derived values for annoyance. This could be done by carrying out longitudinal noise attitude research studies to better reflect current and future dose response relationships.

## **6. Heathrow's noise impacts mean that it must not be allowed to expand**

- **Heathrow's noise impacts significantly affect people outside the 55dB Lden contour.** London is exposed to more aviation noise than any other city in Europe. Already more than 760,000 people are exposed to noise in excess of 55dB Lden. But there is much evidence to suggest that the impacts are felt outside of this area too; in the recent night noise respite trial, the zones from which flights were excluded and respite benefits 'gained' were all outside of the 55dB Lden contour. This suggests that Heathrow's noise impacts are felt over a much larger area than the airport's owners would have us believe.
- **More runways would mean many more people exposed to noise – contrary to Heathrow's recent pronouncement.** It is misleading for Heathrow to suggest that a three runway airport would be quieter than the airport is today – a claim made in Heathrow's long-term options submission to the Airports Commission. This claim relies on the third runway being less than half utilised in 2030 and very optimistic assumptions on the rate of technological improvements. By 2040, 170,000 more air traffic movements and 30mppa more passengers are identified to be accommodated, but no noise assessment has been conducted. On this basis, and in light of the rate of technological improvement slowing<sup>22</sup> (see last bullet point), it is inevitable that any new runways at Heathrow would increase the number of people exposed to noise significantly in the long-term.
- **Heathrow's impacts are impossible to mitigate.** 'Mitigation' currently only benefits those worst affected (those exposed to 69dB LAeq or more qualify for compensation). This constitutes a token effort, for while triple glazing and sound-muffling learning domes can reduce noise exposure, they certainly don't do away

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<sup>22</sup> Worldwide-Aviation.net, 2012,

[www.worldwide-aviation.net/index.php?option=com\\_content&view=article&id=103:aircraft-noise-reducement-possible&catid=37:columns&Itemid=66](http://www.worldwide-aviation.net/index.php?option=com_content&view=article&id=103:aircraft-noise-reducement-possible&catid=37:columns&Itemid=66)

with the problem. People will still wish to use their gardens, and schools will still want to open their windows on a warm day.

- **Amending Heathrow's operations to offer some greater respite from noise, adversely impacts hundreds of thousands of others.** While the recent Heathrow night noise respite trial enabled 1,211,600 people within and outside of the trial zones to receive 'a degree of respite', 597,900 people were overflowed more during the trial. Heathrow is surrounded by such a large number of people that the application of track keeping technology to concentrate or disperse noise will still either expose a lot of people to an awful lot of noise (concentration), or an awful lot of people to a lot of noise (dispersal). Both are unacceptable.
- **A UK hub airport needs to accommodate a significant number of flights between 23:00 and 07:00 – when most people are asleep.** Night flights at Heathrow result in adverse health effects and reduced productivity for thousands of Londoners. Heathrow struggles to meet demand for longhaul flights arriving from key world regions between 04:00 and 07:00, so much so, that the practice of using both runways (de-alternated operations) for arrivals after 06:00 is commonplace. Early morning arrivals in London are particularly important for several longhaul routes in both important established and emerging markets, including the Far East and North America. To further restrict them in the future risks undermining the routes profitability and potentially their viability. This is particularly so if European hub rivals can receive flights at the most optimal times. At Heathrow, each and every one of these flights during this time has profound impact on the people under the flight paths who are particularly sensitive to awakenings during this shallow sleep stage. Only an airport located away from populated areas can offer the requisite degree of operational flexibility that would enable the connectivity benefits of night flights to be maximised, without disrupting the sleep of hundreds of thousands of residents. Heathrow simply cannot offer these benefits because of its proximity to residential areas.
- **While aircraft continue to become quieter, the rate of progress has slowed.** No step-change beyond high-bypass turbofans is on the horizon, and further development of current technologies is yielding increasingly marginal gains. Furthermore, in taking forward new technologies and operating approaches there is an increasing tension between noise and emissions objectives. Open-rotor technology for instance, achieves lower fuel burn and reduced carbon dioxide emissions, but is noisier than turbofans<sup>23</sup>.

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<sup>23</sup> Rolls-Royce, 2013, [http://www.rolls-royce.com/sustainability/casestudies/noise\\_technology.jsp](http://www.rolls-royce.com/sustainability/casestudies/noise_technology.jsp)



**APPENDIX 1: Airports Commission questions presented in Discussion Paper 05 and the section of this document in which they are addressed**

Question	Section
<p>1. What is the most appropriate methodology to assess and compare different airport noise footprints? For example:</p> <p>(a) What metrics or assessment methods would an appropriate 'scorecard' be based on?</p> <p>(b) To what extent is it appropriate to use multiple metrics, and would there be any issues of contradiction if this were to occur?</p> <p>(c) Are there additional relevant metrics to those discussed in Chapter 3 which the Commission should be aware of?</p> <p>(d) What baseline should any noise assessment be based on? Should an assessment be based on absolute noise levels, or on changes relative to the existing noise environment?</p> <p>(e) How should we characterise a noise environment currently unaffected by aircraft noise?</p>	4
<p>2. How could the assessment methods described in Chapter 4 be improved to better reflect noise impacts and effects?</p>	4
<p>3. Is monetising noise impacts and effects a sensible approach? If so, which monetisation methods described here hold the most credibility, or are most pertinent to noise and its various effects?</p>	5
<p>4. Are there any specific thresholds that significantly alter the nature of any noise assessment, e.g. a level or intermittency of noise beyond which the impact or effect significantly changes in nature?</p>	5
<p>5. To what extent does introducing noise at a previously unaffected area represent more or less of an impact than increasing noise in already affected areas?</p>	5
<p>6. To what extent is the use of a noise envelope approach appropriate, and which metrics could be used effectively in this regard?</p>	5
<p>7. To what extent should noise concentration and noise dispersal be used in the UK? Where and how could these techniques be deployed most effectively?</p>	6
<p>8. What constitutes best practice for noise compensation schemes abroad and how do these compare to current UK practice? What noise assessments could be effectively utilised when constructing compensation arrangements?</p>	6

## APPENDIX 2: Assigning a monetary value to closing Heathrow and developing a new hub airport

The impacts of aviation noise on annoyance, health and productivity in two scenarios, accruing over a twenty-year period were monetised using the methodology developed by the Civil Aviation Authority's Environmental Research and Consultancy Department (ERCD)<sup>24</sup>. The two scenarios are:

- A) opening a new hub airport at each of the Mayor's three recommended locations
- B) closing Heathrow

Key assumptions made are:

- A new hub airport which is open in 2030 at 90mppa, reaching a capacity of 180mppa and 1 million air traffic movements by 2050
- Heathrow airport closed by 2030
- A new hub airport in the Outer Estuary exposes no one to noise. A noise contour assessment by ERCD placed a new hub airport in the smallest assessment category of <50 people

### Annoyance values

WebTAG was used to estimate householders 'willingness to pay' to avoid transport related noise. The assessment is based on  $L_{Aeq,16h}$  daytime noise exposure and has taken into account population exposed to levels exceeding 45 dB.

Table 1: Annoyance values (2030-2050)

Scenario	Description	Value (£ million)
A	New hub airport - Isle of Grain	-£130
	New hub airport - Outer Estuary	£0
	New hub airport - Stansted	-£110
B	Heathrow closed	+£1,800

### Health and productivity values

**Health** - the risk of the following occurring within the population exposed to 55dB or more was estimated:

- Acute Myocardial Infarction (AMI, or heart attacks): the level of risk is defined using the Babisch dose response relationship<sup>25</sup>. The calculations are based on  $L_{Aeq}$

<sup>24</sup> Rhodes, Weston, Jones, 2013 ERCD Report 1209

<sup>25</sup> Babisch W, 2006, Transportation noise and cardiovascular risk. Review and synthesis of epidemiological studies, dose-effect curve and risk estimation

noise exposure, combining 16-hour daytime and 8-hour night time metrics to obtain an un-weighted 24-hour noise exposure metric.

- Hypertensive strokes and dementia: the level of risk is identified through the method proposed by Harding et al<sup>26</sup>. Calculations are based on  $L_{Aeq}$  noise exposure, combining 16-hour daytime and 8-hour night time metrics to obtain an unweighted 24-hour noise exposure metric.

The risk of occurrence is in turn used to estimate the number of years of life lost (YLL) and years of life with disability (YLD) for instances of AMI, hypertension, stroke and dementia. YLL and YLD values are then added up.

**Productivity** – the cost of sleep disturbance was based on the Miedema dose response relationship<sup>27</sup> (as recommended by the WHO<sup>28</sup>) to estimate the number of people said to be highly sleep disturbed (HSD). This has been translated into YLD values deriving from a per decibel increase per household. It is based on  $L_{Aeq, 8h}$  night noise exposure and takes into account population exposed to levels exceeding 45 dB.

**Table 2: Health and productivity values (2030-2050)**

Scenario	Airport	Value (£ million)
A	New hub airport - Isle of Grain	-£200
	New hub airport - Outer Estuary	£0
	New hub airport - Stansted	-£140
B	Heathrow closed	+£4,400

Tables 1-3 show that the noise impact of a two runway Heathrow is valued at £6.2 billion, far higher than the Mayor's three options for a much larger new hub airport. Although a significant figure, we believe this to be woefully lower than the true value people would actually assign to reduced aviation noise and new research should be commissioned.

**Table 3: Total noise exposure values (2030-2050)**

Scenario	Airport	Value (£ million)
A	New hub airport - Isle of Grain	-£330
	New hub airport - Outer Estuary	£0
	New hub airport - Stansted	-£250
B	Heathrow closed	+£6,200

<sup>26</sup> Harding et al, 2011, Quantifying the links between Environmental Noise related hypertension and health effects

<sup>27</sup> Miedema et al, 2003, Elements for a position paper on night-time transportation noise and sleep disturbance

<sup>28</sup> WHO Europe, 2011, Burden of disease from environmental noise. Quantification of healthy life years in Europe