ICCAN
Independent Commission on Civil Aviation Noise

Review of the Survey of Noise Attitudes 2014

December 2019

Contents

Foreword

I am proud to introduce ICCAN's first report – a review of the Survey of Noise Attitudes (SoNA) 2014.

This review provides a summary of our investigation into SoNA. It details who we met, what we heard, and what we discovered. More importantly, this review ends with a look to the future and a plan to rebuild trust in the decision-making process.

Our review of SoNA is ICCAN's first major contribution to the debate around aviation noise. We prioritised this review after the feedback we received to our draft Corporate Strategy revealed the strength of feeling towards SoNA. It is fair to say that SoNA has been a divisive document. It doesn't just divide community groups from the aviation industry, it divides opinion between academics, acousticians and health experts.

In August I chaired a panel discussion at Heathrow Airport, where these divisions were explored. It was a valuable event, which brought together parties who don't always see eye-to-eye on SoNA to present their positions and challenge others. By the end of the event, I knew that ICCAN was the right body to address the stalemate surrounding SoNA and, what's more, I left feeling that my team had their work cut out for them!

As with all our work, my team responsible for conducting the review of SoNA was guided by our two-year aim: 'to improve public confidence and trust in the management of aviation noise by building our expertise, credibility and profile across the UK'. They have been methodical in their approach, have listened carefully to stakeholders and have thought carefully about how to ensure robust evidence can inform future decision-making processes. And because of that, we have been able to make some concrete recommendations that we can build on in the new year.

It has been almost five months since we published our Corporate Strategy in late July. To be publishing our first significant piece of work in December is testament to the hard work of my team. And yet, it feels like a long time coming because, in truth, we've been playing catch-up due to the delays in setting us up. As I wrote in the foreword to our Corporate Strategy, change in this industry takes longer than many people would like. But if our ambition is to be a world leader in the management on aviation noise, change has to begin. This review is an important step in this process and the next step, led by ICCAN, will be taken early in the new year with the development study described in this report. Again, we will bring together parties with opposing views to help develop a product that will command the confidence of everyone engaged with the issue of aviation noise.

Rob Light

Head Commissioner

ICCAN

Introduction

Sustainable, long-term policy decisions about aviation noise in the UK cannot be made without a robust evidence base. It is essential that this evidence is up to date for policy makers and airports to use it and for community groups to trust the outcome of decisions based on that evidence.

The Survey of Noise Attitudes (SoNA), conducted in 2014, is an important piece of evidence. It provided information about attitudes towards aviation noise and how they relate to aircraft noise exposure indices. This evidence was used to determine thresholds for community annoyance, which informed UK policy and guidance. It also provided data on factors that influence attitudes to aviation noise and the effects of aviation noise on health and wellbeing.

However, there has been considerable debate around the robustness of SoNA's methodology and results, with some community groups voicing a lack of confidence in SoNA and decisions based on SoNA's results[1].

The Independent Commission on Civil Aviation Noise (ICCAN) was created as an independent body to bring a fresh perspective to the issues and discussions that have animated the debate around aviation noise. Since our establishment at the start of 2019, we have met with a range of stakeholders in order to gain an understanding of the issue of aviation noise from all perspectives, including those of academics and experts, regulators and policy makers, airports and airlines and impacted community groups. Even in the short time since ICCAN was established, we have attended a number of events at which SoNA's results have been called into question. These events revealed the extent to which SoNA has been a divisive issue among our stakeholders and has deepened distrust between parties.

The aim of our review was to consider the lessons from SoNA 2014 and make recommendations on the scope of future research in this area. ICCAN spoke to a range of stakeholders and experts and reviewed relevant publicly-available documents. This report details the results of ICCAN's review.

We have deliberately not set out to conduct a full and critical review of the methodology used, the analysis of, or the conclusions drawn from SoNA. We view our role as forward-looking and, in that spirit, we have used the evidence and knowledge drawn from this review to make achievable recommendations for the future. We view this as being of more value than simply adding to the debate and commentary on the rights and wrongs of the previous survey.

[1] ICCAN (2019) *ICCAN Corporate Strategy 2019-2021 Published Survey Responses*, page 14. https://iccan.gov.uk/wp-content/uploads/2019_07_25_ICCAN_Corporate_Strategy_Published_Responses.pdf

Key recommendations

Our detailed recommendations can be found on pages 18 - 21. In summary, we recommend that:

- A new, regular attitudinal survey is begun before the end of 2021, and repeated frequently.
- The new surveys should be commissioned, run and analysed independent of Government, regulators and industry. We consider it appropriate for ICCAN to take on this role, working closely with relevant stakeholders.
- ICCAN will find a sustainable and equitable solution to funding the surveys, which involves government and industry, but does not impinge of the independence of our ownership and management of the surveys.
- Improvements should be made for the new surveys using lessons learned from SoNA.
- ICCAN will run a development study to identify the best way to implement improvements for the new surveys.

Review of SoNA 2014

SoNA 2014 background

The Survey of Noise Attitudes (SoNA) 2014 is the most recent attitudinal survey on aviation noise conducted in England. Prior to SoNA, there were two other major attitudinal studies on UK aviation noise: the Aircraft Noise Index Study (ANIS)[2] published in 1985; and the Attitudes to Noise from Aviation Sources in England (ANASE)[3] survey, published in 2007. Given the recommendation not to use ANASE's results in the formation of government policy[4], the findings from ANIS remained the evidence base for key aviation policy decisions. The decision to conduct SoNA in 2014 was driven by a recognition that attitudes towards aviation noise may have changed since 1982 – the reference period for ANIS.

In 2013, the Department for Environment, Food and Rural Affairs (Defra) carried out the first SoNA. The aim was to produce a questionnaire which could be implemented more frequently and included a topic focussed module to address different policy requirements without impacting on compatibility with previous years. For example, SoNA 2013 considered attitudes to entertainment noise, whereas SoNA 2014 included an aviation module, which is discussed here. The SoNA[5] conducted in 2014 was commissioned by the Department for Transport (DfT) and Defra. Ipsos MORI were awarded the contract and this was overseen by a project board consisting of DfT, Defra, the Civil Aviation Authority (CAA) and Public Health England (PHE). Ipsos MORI conducted 1,999 interviews with residents aged 18 and over located near nine airports in England. Fieldwork took place between 5 October 2014 and 8 February 2015.

SoNA's aims for the 2014 survey were set out as follows:

- Obtain new and updated evidence on attitudes to aviation noise around airports in England, including the effects of aviation noise on annoyance, wellbeing and health.
- Obtain new and updated evidence on what influences attitudes to aviation noise, and how attitudes vary, particularly how attitudes vary with LAeq (see Glossary), but

[2] Civil Aviation Authority/ Department of Transport (1985) DR 8402 *United Kingdom Aircraft Noise Index Study: Main Report*. https://publicapps.caa.co.uk/docs/33/ERCD%208402.PDF

[3] MVA Consultancy/ Department for Transport (2007) *Attitudes to Noise from Aviation Sources in England*. https://www.aef.org.uk/uploads/2007/11/Attitudes-to-Noise-from-Aviation-Sources-in-England-Executive-summary-.pdf

[4] Civil Aviation Authority (2018) *CAP 1588: Aircraft Noise and Annoyance: Recent findings*, page 18. https://publicapps.caa.co.uk/docs/33/CAP1588_FEB18.pdf

[5] For more information about the *Survey of Noise Attitudes 2014* (SoNA) see

Civil Aviation Authority (2017) *CAP 1506: Survey of noise attitudes 2014: Aircraft*. https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7744

Ipsos MORI (2015) *CAP 1506a: The 2014 Survey of Noise Attitudes (SoNA) Technical Report*. http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7745

also other non-acoustic factors (see Glossary) that may influence attitudes, such as location and time of day, and socio-economic group of respondents.
- Examine whether the currently used measure of annoyance, LAeq, is the appropriate measure of annoyance for measuring the impact on people living around major airports.
- Consider the appropriateness of the policy threshold for significant community annoyance from aviation noise.
- Provide baseline results that can be used for a programme of regular surveys of attitudes to aviation noise.

SoNA 2014 found that significant community annoyance was observed at 54 dB LAeq, 16h (see Glossary) (prior to this it was observed at 57 dB LAeq, 16h) and that community annoyance was present at 51 dB LAeq, 16h in some areas[6]. This confirmed claims made by community groups that sensitivity to noise caused by aviation had increased. This new evidence was recognised by the government and new levels marking the onset of community annoyance were set[7].

A peer review of SoNA 2014 was conducted during 2016 and early 2017. The reviewers were 'satisfied that the survey methodology and analytical techniques employed in this study were robust'[8]. However, they made some recommendations that should be considered in any future study which included:
- Trying to achieve the desired sample size across all the airports;
- Undertaking the survey nearer to the time to which the noise exposure indicators relate;
- Being clearer about the type of statistical analyses used;
- If the possible effects of aircraft noise and health are of interest, consider including more questions on this issue, even if it means excluding some questions that were in SoNA 2014.

Since SoNA 2014 was published in February 2017, a number of issues regarding the methodology and results have been raised and debated between community groups, government and airports. Critics have pointed to aspects of SoNA that, they argue, decreases confidence in SoNA's findings. Our approach to understand these criticisms and a summary of our findings are described below.

[6] Department for Transport (2017) *Assessing aviation noise impacts during airspace changes* https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/653509/assessing-aviation-noise-impacts-during-airspace-changes.pdf

[7] Department for Transport (2017) *Airports Navigation Guidance 2017*, page 18. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/653978/air-navigation-guidance-2017.pdf

[8] Placewise Ltd & Stephen Turner Acoustics (2017) *SoNA 2014 Peer Review Final Report*, page 12. http://publicapps.caa.co.uk/docs/33/CAP1506c%20peer%20review.pdf

Our approach

Following feedback on our draft Corporate Strategy that we published in May 2019, SoNA 2014 emerged as a key priority. ICCAN's initial programme of engagement established a list of stakeholders with an interest in SoNA. Having identified the organisations and individuals involved in the development and execution of the survey, as well as those who have been active contributors to the discussions following SoNA's publication, we began a dedicated period of targeted engagement and knowledge gathering. In conversation with acousticians, health experts, survey teams, aviation bodies, government, regulators and community groups we developed our understanding of SoNA, its background, methodology and uses. You can see who we spoke to in the Acknowledgements section at end of this report.

Alongside our programme of engagement, we conducted extensive desk research. Not only did this support our understanding of attitudinal noise studies at a domestic level, it developed our knowledge of the issue from an international perspective and led to meetings with international experts who have examined similar surveys conducted in other countries.

Throughout our research, we were mindful that attitudes towards SoNA are varied. We were careful to ensure that we sought perspectives which challenged our understanding. ICCAN participated in a workshop, hosted by Heathrow Airport, which brought together opposing views on SoNA. Our Head Commissioner chaired a panel discussion that grappled with the reasons for disagreements around SoNA.

Following our initial engagement and research, we started to review the evidence we had gathered. We identified the key areas that we felt deserved some exploration in this report. However, our aim was to ensure the lessons of SoNA 2014 are learnt for the purposes of future studies, rather than to arbitrate between opposing sides. Therefore, this report seeks to characterise the nature of the debate in these key areas and then recommend how these could be addressed. The following section describes what we found for these key areas.

Issue 1: The use of clustered sampling

The objective of the survey was to obtain a representative sample of around 2,000 adults aged 18 and over living in private dwellings in proximity to nine of the largest airports in England by aircraft movements[9].

The original design was for a random, unclustered sample in the population exposed to 54 dB LAeq, 16hrs and over. However, after commissioning the study, the population of interest was extended to include noise from aircraft at 51 dB LAeq, 16h and above. Including the additional population living in the 51-54 dB LAeq, 16h noise contour band

[9] Ipsos Mori (2015) *CAP 1506a: The 2014 Survey of Noise Attitudes (SoNA) Technical Report*, page 10. http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7745

(see Glossary) increased the overall study population from 320,475 to 616,985[10]. Including this noise contour band also increased the distance interviewers would have had to travel to conduct face-to-face interviews between addresses and, in turn, the total survey cost. Therefore, to include the 51-54 dB LAeq, 16h noise contour without increasing the cost of the survey, it was decided to adopt a partially clustered (see Glossary) and partially unclustered sample design, to maximise precision[9]. An unclustered sample was retained for the over 54 dB LAeq,16h noise band, to maximise statistical precision, but a clustered sample was used for the 51-54 dB LAeq,16h noise band.

The clustered sample in the 51-54 dB LAeq, 16h noise contour accounted for 48.1% of the total study population. However, it was decided to disproportionately sample between the clustered and unclustered samples whereby the clustered sample in the 51-54 dB LAeq, 16h noise contour accounted for one-third of the final sample and the unclustered sample in the over 54 dB LAeq, 16h noise contour accounted for two-thirds. The rationale for this was to ensure that as more detailed analysis could be conducted in noisiest areas[10].

A list of full postcodes in each decibel band for each airport was obtained. For the postcodes in the 51-54 dB LAeq, 16h noise contour, bespoke clusters of around 1,200 addresses were created at each airport, taking into account features of the area such as roads as well as geographical barriers such as rivers and airport runways. The selection of clusters was conducted at random and was not stratified by other factors such as the location of Noise Preferential Routes (NPRs) (see Glossary) or the location of trials of different use of airspace over those being surveyed.

The clustered sampling in the 51-54 dB LAeq,16h noise contour band has been subject to criticism. Some critics have identified residential areas in the 51–54 dB LAeq noise band under Noise Preferential Routes whose perspectives were not collected as they were not selected as part of SoNA's clustered sample. This can be observed in the 'Achieved Interviews' maps around Heathrow Airport, Birmingham Airport, Manchester Airport and London City Airport[11]. Critics suggest that two addresses with the same LAeq, 16h noise level may experience noise differently according to a number of factors such as whether they are directly under a Noise Preferential Route or not and how much respite is experienced, and that this could affect their attitudes to aircraft noise. For example, no interviews were conducted in a residential area beneath Heathrow's easterly Detling Noise Preferential Route, which lies inside the 51-54 dB LAeq, 16h noise band. Critics argue that, given it is the most frequently used route when Heathrow is operating on easterlies, the experience of noise in this location is different to locations under other NPRs and to those not under any NPRs, even if they are categorised as having the same average noise level as determined by LAeq, 16h. Therefore, they argue that if the sample has not included an appropriate representation of all noise experiences then they question whether SoNA's results are accurate[12].

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[10] Ipsos Mori (2015) *CAP 1506a: The 2014 Survey of Noise Attitudes (SoNA) Technical Report*, page 13. http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7745

[11] Ipsos Mori (2015) *CAP 1506a: The 2014 Survey of Noise Attitudes (SoNA) Technical Report* Ipsos Mori appendix 1. http://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7745

[12] Teddington Action Group Presentation (2019) *Workshop Issues with UK Survey of Noise Attitudes (SoNA) 14th August 2019,* slide 16. Presented to Heathrow Community Noise Forum 14 August 2019.

Issue 2: Lowest Observable Adverse Effect Level (LOAEL)

Setting a Lowest Observable Adverse Effect Level (LOAEL) (see Glossary) establishes a perimeter around an airport or other noise source which serves as a binary line between areas at or above the LOAEL and areas below it. All areas at or above the LOAEL should be included in an impact assessment, in the event of future development plans.

In October 2017, the UK Government published the 'Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace'. This document cited the SoNA 2014 report as the evidence base for establishing 51 dB LAeq, 16hr as the LOAEL:

> 'The government acknowledges the evidence from recent research (SoNA) which shows that sensitivity to aircraft noise has increased, with the same percentage of people reporting to be highly annoyed at a level of 54 dB LAeq 16hr as occurred at 57 dB LAeq 16 hr in the past. The research also showed that some adverse effects of annoyance can be seen to occur down to 51 dB LAeq.'
>
> '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 (see Glossary) to be consistent with the daytime metric. These metrics will ensure that the total adverse effects on people can be assessed and airspace options compared.'[13]

Critics claim that SoNA is not suitable as the evidence base for the decision to set the LOAEL at 51 dB LAeq, 16hr. They argue that because SoNA's analysis is not based on samples from communities in areas exposed to less than 51 dB LAeq there is no evidence to suggest that the LOAEL is not less than 51 dB LAeq[14].

Furthermore, SoNA found that 7% of respondents in the 51-54 dB LAeq, 16h noise band were highly annoyed. Critics argue that this level is close to 9% - the threshold which has historically been used to define the onset of 'significant' community annoyance. For example, the 2003 Air Transport White Paper defined 57 dB LAeq,16h as marking the approximate onset of significant community annoyance, and this was reaffirmed in the Government's 2013 Aviation Policy Framework[15]. This was based on the ANIS study which found 9% of the population reporting high levels of annoyance at 57 dB LAeq[16]. Critics therefore argue that it is not credible to conclude that the LOAEL occurs at the bottom of a noise exposure band where 7% of the population were highly annoyed.

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[13] Department for Transport (2017) *Consultation Response on UK Airspace Policy: A framework for balanced decisions on the design and use of airspace*, page 18. https://www.gov.uk/government/publications/uk-airspace-policy-a-framework-for-the-design-and-use-of-airspace

[14] Teddington Action Group (2019) *Presentation Issues with Survey of Noise Attitudes Workshop on 14th August*, slide 2. Presented to Heathrow Community Noise Forum on 18 September 2019.

[15] Civil Aviation Authority (2018) *CAP 1588: Aircraft Noise and Annoyance: Recent findings*, page 7. https://publicapps.caa.co.uk/docs/33/CAP1588_FEB18.pdf

[16] Civil Aviation Authority (2017) *CAP 1506: Survey of Noise Attitudes 2014: Aircraft*, page 65. https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7744

Critics often pair this argument with their observation that some key residential communities did not feature in SoNA's sampling (as discussed in the section above). They argue that these communities may have reported a greater percentage of highly annoyed individuals and this could have altered SoNA's results. They claim this calls into question the confidence stakeholders can have in the credibility of SoNA's findings and the policy derived thereof.

Critics also argue that SoNA is not reliable as the evidence base to set a LOAEL because it is a 'snapshot' survey conducted at one point in time. They argue that regular surveys need to be conducted to be able to confidently establish where to set the LOAEL, and to confirm whether the increase in noise sensitivity identified by SoNA has continued or changed.

Issue 3: The change effect

Changes to the experience of aviation noise can be brought on by a number of developments, including airport expansion and alterations to established flight paths. These changes introduce a degree of volatility to the experience of noise and this volatility has been shown to increase sensitivity to noise[17]. The change effect describes an increase in the percentage of a population who report high levels of annoyance above the increase accounted for by the baseline exposure-response curve (see Glossary). Put more simply, a community who experiences an increase in aviation noise will report higher levels of high annoyance than a community who have lived at the higher exposure level for a long period of time. In fact, it has been found that even an announcement of a change can affect community sensitivity towards noise[18].

There is limited evidence on the extent of the increase caused by the change effect and its duration; however, current indications suggest that an increase in annoyance after a change can last for at least two years[19] [20]. Part of the uncertainty surrounding the change effect is caused by the difficulty in defining what constitutes a change and what is part of the normal variation in operations. The term 'high-rate change' is used to describe an airport undergoing a period of operational volatility. Equally, a 'low-rate change' airport describes an airport in a period of operational stability. However, these terms are not

[17] Guski, R et al. (2017) *WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Annoyance*, page 12. https://www.mdpi.com/1660-4601/14/12/1539/htm

[18] Airports Commission (2013) *Discussion Paper 05: Aviation Noise,* page 11/12. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/223764/airports-commission-noise.pdf

[19] Brink, M et al. (2008) *Annoyance responses to stable and changing aircraft noise exposure*. https://www.dora.lib4ri.ch/empa/islandora/object/empa%3A2254/datastream/PDF/Brink-2008-Annoyance_responses_to_stable_and-%28published_version%29.pdf

[20] Breugelmans, O et al. (2007) *Longitudinal effects of a sudden change in aircraft noise exposure on annoyance and sleep disturbance around Amsterdam airport*. http://www.sea-acustica.es/WEB_ICA_07/fchrs/papers/env-04-002.pdf

clearly defined, and experts disagree as to when changes to an airport's operations merits reclassification of that airport from a low-rate change to a high-rate change airport[21].

SoNA was not designed to consider the change in noise attitudes caused by an airport undergoing a period of volatility in its operations. It did not discriminate between high-rate change and low-rate change airports. However, changes did occur at airports during the period in which SoNA was conducted that may have affected levels of annoyance reported in SoNA. In the summer of 2014, seven of the featured airports 'undertook consultations and or operated airspace trials that altered the actual and/or potentially the perceived noise exposure in their vicinity'[22]. Some of these alterations (or potential alterations) to normal operations were minor; however, some were significant, such as the Standard Instrument Departure (SID) route (see Glossary) trials and Performance Based Navigation (PBN, see Glossary) trials at Heathrow and the opening of the extended runway and introduction of Airbus A380 aircraft at Birmingham Airport. Critics argue that the impact these changes may have had on SoNA's findings serve to undermine confidence in using SoNA as an evidence base upon which long-term decisions are made.

To measure the actual effect of change on people's attitudes to noise, surveys need to be conducted over time before and after the change occurs. SoNA was conducted at one point in time providing a 'snapshot' of attitudes in that period but it did not measure the change effect. Critics argue that its findings should not be used to guide policy decisions because it cannot reliably describe the response of communities who will experience change, nor how long that change in sensitivity may last[23]. Therefore, they argue that it should not be used to support a credible cost/benefit analysis which informs decision making when changes are being considered.

Issue 4: Noise metrics

SoNA drew its sample using noise contour maps to ensure it collected views from a range of different levels of noise exposure around airports. It used the LAeq, 16h metric, which generates a hypothetical average sound pressure over a given time – in SoNA's case, the 16 hours considered 'daytime': 07:00–23:00 for the summer months. Once the average sound pressure over an area is calculated, it can be used to stratify an area into noise contours.

LAeq is a commonly used measure of aircraft noise internationally[24]. Its use in SoNA enabled direct comparison with previous attitudinal noise studies in the UK.

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[21] Gjestland, T (2018) *A Systematic Review of the Basis for the WHO's New Recommendation for the Limiting Aircraft Noise Annoyance*, page 5-6. https://www.mdpi.com/1660-4601/15/12/2717/htm

[22] Civil Aviation Authority (2017) *CAP 1506: Survey of Noise Attitudes 2014: Aircraft,* page 113. https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7744

[23] ICCAN (2019) *ICCAN Corporate Strategy 2019-2021 Published Survey Responses*, page 14 https://iccan.gov.uk/wp-content/uploads/2019_07_25_ICCAN_Corporate_Strategy_Published_Responses.pdf

[24] Civil Aviation Authority (2009) *ERCD Report 0904: Metrics for Aircraft Noise*, page 7. http://publicapps.caa.co.uk/docs/33/ERCD0904.pdf

Critics suggest that LAeq, 16h is not the most appropriate metric to use when sampling for surveys like SoNA. They argue that LAeq, 16h cannot demonstrate how noise at different times of the day or night affects annoyance and that a hypothetical average sound pressure does not capture the episodic nature of aviation noise. Other measurements, such as the 'Lden' metric (see Glossary), have been suggested as more appropriate to use in order to reflect the impact of night flights[25]. Like LAeq, Lden creates a hypothetical average sound pressure; however, it does so over a 24-hour period and is weighted to amplify the impact of flights in the evening and the night. LAeq, 16h can present a more flattering profile of noise at airports that accommodate night movements but harsher profile when used at airports that operate with night time bans. Critics argue that night flights have an impact on levels of annoyance through sleep disturbance and that by sampling using LAeq, 16h SoNA did not take this into account.

Additionally, it is argued that a single noise metric is not adequate for capturing the nature of aviation noise (historically, the UK used the Noise and Number Index but this has not been used in policy-setting since 1990). A common argument is that either LAeq or Lden should be used alongside a metric that effectively illustrates the episodic nature of aviation noise[26]. The 'N>' measure is usually advocated. This measure takes a decibel threshold and counts the number of incidents where that threshold is met or breached. For example, if the threshold is set at 65 dB and an area on the ground experiences 100 noise events that breach 65 dB in the assessment period, the 'N>' measure would identify the area as 100>65 dB.

SoNA examined how different noise metrics correlated with annoyance. The SoNA report states that the LAeq metric correlated well with mean annoyance scores and found no evidence that Lden correlated better with annoyance than LAeq. However, it also acknowledges the merit in considering greater use of the N> metrics 'as supplemental indicators to help portray noise exposure'[27].

Issue 5: The World Health Organisation's Noise Guidelines

In October 2018, the World Health Organisation (WHO) published 'Environmental Noise Guidelines for the European Region (2018)'. The main purpose of these guidelines was 'to provide recommendations for protecting human health from exposure to environmental noise originating from various sources'[28]. Noise from transportation, including aviation noise, was a key focus of the report.

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[25] Aviation Environment Federation (2018) *Discussion Paper on Noise*, page 11. https://www.aef.org.uk/uploads/2018/07/AEF-discussion-paper-on-noise-with-feedback-COMBINED.pdf

[26] Teddington Action Group (2019) *Workshop Issues with UK Survey of Noise Attitudes (SoNA) 14th August 2019*, slide 43.

[27] Civil Aviation Authority (2017) *CAP 1506: Survey of Noise Attitudes 2014: Aircraft,* page 63. https://publicapps.caa.co.uk/modalapplication.aspx?appid=11&mode=detail&id=7744

[28] World Health Organisation (2018) *Environmental Noise Guidelines for the European Region,* page vii. http://www.euro.who.int/en/health-topics/environment-and-health/noise/publications/2018/environmental-noise-guidelines-for-the-european-region-2018

The WHO publication identified two key questions for the guidelines to address:

1. In the general population exposed to environmental noise, what is the exposure-response relationship between exposure to environmental noise and the proportion of people with a validated measure of health outcome, when adjusted for confounders?
2. In the general population exposed to environmental noise, are interventions effective in reducing exposure to and/or health outcomes from environmental noise?[29]

The WHO report issued strong recommendations that aircraft noise should be reduced to levels below 45 dB Lden, and 40 dB Lnight (see Glossary) for night noise exposure, as aircraft noise above this level is associated with adverse health effects. The publication also recommended that policy-makers implement suitable measures to reduce noise exposure from aircraft in populations exposed to levels above the guideline values.

Since its publication, the WHO report has been a subject of scrutiny among some academics. One prominent critic summarised the recommendations as 'based on the idealistic assumption that nobody should ever be exposed to noise levels which endanger complete individual well-being or quality of life, and, as such, it is useless for general regulatory purposes'[30]. This criticism of the recommendations is compounded by critics who point out that their application in practice was not subject to any cost-benefit evaluation[31].

In the UK, the aviation noise recommendations from the WHO drew significant attention because of the differences between its findings and the conclusions derived from SoNA. In particular, critics of SoNA argue that the decision to set a LOAEL at 51 dB LAeq, 16hrs is undermined by the WHO recommendations which suggest a lower level (45 dB Lden)[32]. Following the publication of the WHO's guidelines, a discussion emerged that sought to identify reasons for the difference in findings between the WHO recommendations and SoNA.

The WHO's recommendations on aircraft noise levels were based in part on a systematic review[33] on Environmental Noise and annoyance which identified 15 published surveys of aircraft noise and annoyance that met a set of defined criteria. The authors of these surveys shared relevant data and analyses, which were then aggregated to conduct a meta-analysis to examine the relationship between aircraft noise and annoyance. SoNA

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[29] World Health Organisation (2018) *Environmental Noise Guidelines for the European Region*, page XIII. http://www.euro.who.int/en/health-topics/environment-and-health/noise/publications/2018/environmental-noise-guidelines-for-the-european-region-2018

[30] Gjestland, T. (2018) *A Systematic Review of the Basis for the WHO's New Recommendation for Limiting Aircraft Noise Annoyance*, page 1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6313593/

[31] Clark, C (2019) *WHO Guidelines*, slide 30. Presented to Institute of Acoustic on 8 November 2019.

[32] ICCAN (2019) *ICCAN Corporate Strategy 2019 - 2021 Published Survey Responses*, page 9. https://iccan.gov.uk/wp-content/uploads/2019_07_25_ICCAN_Corporate_Strategy_Published_Responses.pdf

[33] Guski, R et al. (2017) *WHO Environmental Noise Guidelines for the European Region: A Systematic Review on Environmental Noise and Annoyance*. https://www.ncbi.nlm.nih.gov/pubmed/29292769

was published after 2014 (the cut off point for inclusion in the WHO systematic review) and therefore was not considered.

The surveys included in the WHO systematic review were conducted using different methodologies and, often, their methods were different to those used in SoNA. The methodology used by a survey has been found to affect the responses given by interviewees and the results of the survey[34]. In that light, it is important to explore the methodologies used by the surveys that were used in the WHO systematic review and how they are similar or different to SoNA's methodology, as this may point to why the findings differ. A comparison of the methodologies used in the contributing surveys, and an exploration of how those methodologies relate to or differ from SoNA's methodologies is summarised below.

Fieldwork

The surveys of aircraft noise and annoyance selected for the WHO systematic review featured findings from airports across Europe and Vietnam. Some used face-to-face interviews, while others used telephone interviews or postal questionnaires. In comparison, SoNA collected data from respondents around nine airports in England using face-to-face interviews.

Like SoNA, the majority of these contributing studies were cross-sectional, meaning they captured a 'snapshot' of the time in which they were completed. However, there were two exceptions: one study was repeated two years later[35]; another study was repeated twice at intervals of four or five months[36]. The purpose of the repeated studies was to assess the change effect, over time, by measuring noise annoyance before and after a planned change had been implemented.

Sampling

The contributing surveys of aircraft noise and annoyance all selected their samples using an averaged noise metric to map and select their sample. The majority of these studies used the Lden metric, although the LAeq, 16hr metric that was used by SoNA was also used for one other study in the Rhine-Main region in Germany around Frankfurt Airport[37].

The surveys used a range of methods to define the population of interest for the study. The majority of these studies established a boundary a set distance from an airport (such as 40km[37]). Another approach used around airports in Vietnam was to sample according to the position of flight paths in order to give a range of aircraft noise exposures by including locations at various distances and directions relative to the airports. To do this, a

[34] Kelley, K et al. (2003) Good Practise in the Conduct and Reporting of Survey Research. https://academic.oup.com/intqhc/article/15/3/261/1856193

[35] Brink, M et al. (2008) *Annoyance responses to stable and changing aircraft noise exposure*. https://www.ncbi.nlm.nih.gov/pubmed/19045781

[36] Yano, T et al. (2009) *Activity disturbances by a step change in aircraft noise exposure around Hanoi Noi Bai International Airport*. http://pub.dega-akustik.de/ICA2019/data/articles/000951.pdf

[37] Schreckenberg, D et al. (2010) *Effects of Aircraft Noise on Noise Annoyance and Quality of Life around Frankfurt Airport*. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2954552/

range of sites were selected from underneath flight paths at each airport relative to the number of air movements each airport handled per day[38]. None of the other surveys sampled using only noise contour bands in the way SoNA did.

Almost all of the surveys included interviews at noise levels below 51 dB, which was the cut off point for SoNA, with one survey gathering information from areas exposed to noise levels as low as 30 dB Lden[35]. However, for some of these surveys, gathering information below 51 dB was a consequence of the decision to sample within a certain distance around the airport, rather than a specific decision to sample below that level of noise exposure.

SoNA used a combination of clustered and unclustered sampling, with clustered sampling for the 51–54 dB LAeq noise contour band. The majority of aircraft noise surveys included in the WHO systematic review of annoyance only used unclustered sampling in each noise band, citing reasons of increased representativeness[35] and practicality[39].

Issue 6: SoNA's wider uses

The publication of SoNA in February 2017 presented policy makers with an updated evidence base. As has already been discussed, SoNA was a key piece of evidence behind the decision to revise the Lowest Observable Adverse Effect Level (LOAEL) down to 51 dB LAeq, 16hr. However, as concerns over SoNA's methodology were raised, the importance of understanding how it informed decision making more broadly increased. In particular, we encountered conflicting reports over how SoNA had been used to inform WebTAG[40] (see Glossary).

WebTAG is DfT's suite of guidance on how to assess the expected impacts of transport policy proposals and projects[41]. Using a baseline scenario, WebTAG calculates a monetary cost and/or benefit when that baseline scenario experiences a change – known as an 'intervention'. WebTAG's Noise Workbook assigns a monetary value for every decibel of change in the following areas:

- Amenity (annoyance)
- Acute myocardial infarction (heart attacks)
- Dementia
- Stroke
- Sleep disturbance.

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[38] Nguyen, T et al. (2011) *Community response to aircraft noise around three airports in Vietnam*. https://www.researchgate.net/publication/224035689_Community_response_to_aircraft_noise_around_three_airports_in_Vietnam

[39] Gelderblom (2014) *The impact of civil versus military aircraft noise on noise annoyance*. https://www.acoustics.asn.au/conference_proceedings/INTERNOISE2014/papers/p106.pdf

[40] ICCAN (2019) *ICCAN Corporate Strategy 2019-2021 Published Survey Responses*, page 14. https://iccan.gov.uk/wp-content/uploads/2019_07_25_ICCAN_Corporate_Strategy_Published_Responses.pdf

[41] Department of Transport (2018) *WebTAG – Noise*. Presented to Heathrow Community Noise Forum on 14 March 2018.

The evidence that underpins WebTAG has been developed over many years and as new evidence emerges the values that inform WebTAG's calculations can be reviewed.

One of the aspects that is assessed for aviation noise is annoyance. The relationship between noise exposure and annoyance is described by an exposure–response curve (see Glossary). It shows how annoyance increases as noise exposure increases. The exposure–response curve that guides WebTAG's aircraft noise and annoyance calculations is the EU's Miedema curve[42] (see Glossary).

The shape of the exposure-response curve calculated using SoNA data takes a similar shape to the Miedema curve, although it consistently finds a lower percentage 'highly annoyed' between 51 dB LAeq and 66 dB LAeq. In May 2018 WebTAG was updated, however SoNA's findings were not included in the WebTAG review because they were not available at the time the review took place[43].

Building on WebTAG, WebTAG+ has been developed to offer enhanced insight in assessing the expected impacts of transport policy proposals and projects. Currently, WebTAG+ has not been integrated into policy in the same way as WebTAG; however, it can be used as a supplementary sensitivity test. WebTAG+ can use different exposure-response curves to assess the relationship between aircraft noise and annoyance. Therefore, the SoNA curve can and has been used in WebTAG+, which may account for why there continues to be some uncertainty about SoNA's wider use.

As yet, WebTAG and WebTAG+ are not able to account for the change effect (see Issue 3 above). For example, if a community experiences a change that increases its exposure to aviation noise, WebTAG and WebTAG+ can anticipate the associated health costs and/or benefits by applying the health impacts of communities already under that level of exposure. However, it does not calculate the additional impacts that are associated with the change represented by an increase in exposure.

[42] Department for Environment Food & Rural Affairs (2014) *Environmental Noise: Valuing impacts on: sleep disturbance, annoyance, hypertension, productivity and quiet*, page 47. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/380852/environmental-noise-valuing-imapcts-PB14227.pdf.

Heathrow Airport Limited (2019) table 8.1 *Preliminary Environmental Information Report: Appendix 17.1: Noise and vibration*, page 163, table 8.1. https://aec.heathrowconsultation.com/wp-content/uploads/sites/5/2019/06/23-Volume-3-PEIR-Chapter-17-Noise-and-vibration-Appendices.pdf

[43] Department for Transport (2017) *Understanding and Valuing Impacts of Transport Investment*, page 5. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/668438/wider-economic-impacts-consultation-response.pdf

Recommendations

ICCAN's review of SoNA provided a detailed insight into the survey itself and the issues that have been raised regarding its methodology and results. Overall, we have found that SoNA sought to follow best practice in the methodology that was used within its budgetary constraints. However, it is abundantly clear that there remain disputes over the use of the evidence base from SoNA in relation to issues such as the change effect, the 'snapshot' nature of the study, the sampling methodology, the lower limit of 51 dB LAeq, and its use in government policy-setting (such as the Lowest Observable Adverse Effect Level) and we have therefore identified some areas where it would be beneficial to explore how improvements to the methodology could be made for future studies. Based on this review, ICCAN has formed a set of recommendations that are set out below.

ICCAN recommends that a new, regular attitudinal survey towards aviation noise is begun, with the first of the series conducted before the end of 2021.

The fieldwork for SoNA was conducted in late 2014 and early 2015 and therefore it has been five years since attitudes towards aviation noise were measured around airports in England. Since then it is likely there have been changes in people's attitudes towards aviation noise as there has been variation in operations at domestic airports. Community groups suggest that even announcements of changes can impact on attitudes towards aviation noise[44] so announcements surrounding airport expansion may have had an impact too. A new survey would test this theory and, in any case, ensure future policy and operational decisions are based on up-to-date evidence.

ICCAN's engagement found that some community groups voiced a lack of confidence in SoNA and decisions based on SoNA's results. A new survey, which community groups would be involved in setting the terms of reference, would we believe help them have more confidence in decisions made on aviation issues as well as helping improve relationships between the community, Government and regulators, and airports and airlines.

The new survey will need to consider at which point in the year it is best to conduct fieldwork for optimum recall by respondents. However, whatever fieldwork period is decided upon, our intention is that the survey should be completed before the end of 2021.

SoNA was intended to be a regular survey that would provide a time series to look at changes in attitudes over time but only SoNA 2014 included aviation noise. This information would provide valuable evidence on how attitudes change over time as noise levels change and could contribute to the evidence base on the change effect. Therefore, ICCAN recommends that the new survey should be set up to be repeated over time.

[44] Airports Commission (2013) *Discussion Paper 05: Aviation Noise*, page 11. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/223764/airports-commission-noise.pdf

ICCAN recommends that this new survey is run and analysed independent of Government, regulators and industry.

ICCAN's engagement with some stakeholders revealed a considerable lack of trust in the way SoNA was designed, conducted and analysed, which has resulted in low confidence in the results and therefore the decisions that this evidence has been used to inform. Furthermore, a number of community groups were dissatisfied with the way their concerns were addressed by the SoNA Project Board. A range of stakeholders said they welcomed ICCAN's review of SoNA as they felt the debate had got to a stage where it needed an independent body to assess the issues raised[45]. We will work to ensure that there is engagement, involvement and trust from all parties during the scoping and setting of the new survey's design and terms of reference.

We have found no evidence to suggest that the design, conduct or analysis of SoNA was in any way compromised by the governance arrangements around its conduct. However, in light of the lack of confidence voiced to us, and the fact that we have been established specifically to improve the trust between communities and government/industry, we recommend that the design, oversight and analysis of the new attitudinal survey should be independent of Government, regulators and industry, in order to ensure that trust in the survey as an evidence base for making policy decisions can be rebuilt. As ICCAN was set up as an independent body for aviation noise we consider it appropriate for us to take on this role, which fits with ICCAN's aims of increasing trust, transparency and clarity. While ICCAN would lead the management and coordination of this new attitudinal survey, we would work closely with all relevant stakeholders whose expertise would be vital to the success of the survey, including DfT, CAA, Defra and PHE. Given the importance of such surveys to community groups, we will also ensure that community groups are engaged during the development study in the design of the new attitudinal survey.

ICCAN will look into a sustainable solution to funding the surveys, involving government and industry.

It is in the interest of all within the aviation sector and those that live near airports that the decisions about the future of aviation, and its effects on people, are based on robust evidence. The scale and scope of this research, while we believe providing value for money, will be significant, and will require resources on a bigger scale than the previous survey. We believe that the cost of the ongoing surveys should be contributed to by the government and the aviation industry. We have already begun encouraging conversations within the industry along these lines and will continue to seek a formal commitment to contribute to the funding of these surveys.

However, the funding model should not and will not impinge on ICCAN's ownership and management of the survey. In order to ensure full confidence in the survey, we will ensure that ICCAN has absolute operational authority in order to avoid the perception of interference from government or industry bodies.

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[45] ICCAN (2019) *ICCAN Corporate Strategy 2019 - 2021 Published Survey Responses*, page 9. https://iccan.gov.uk/wp-content/uploads/2019_07_25_ICCAN_Corporate_Strategy_Published_Responses.pdf

ICCAN recommends that lessons learned from SoNA are used to make improvements for the new attitudinal survey.

While SoNA sought to follow best practice in the methodology it used, ICCAN's review identified some areas where it would be beneficial to explore whether methodological improvements could be made for future attitudinal surveys of aviation noise. We have looked at some of the most significant issues in this report; however, there remain a number of critical strategic and methodological questions that we would want to answer before designing the new survey. These include:

Scope of population

- How can the survey include noise contours at a level below that used in SoNA to balance robustness of results, value for money and accuracy of lower noise estimates? What noise level is appropriate and possible to go down to satisfactorily examine the LOAEL and the WHO's 'Environmental Noise Guidelines for the European Region (2018)'?
- Should the survey get a national view of a large number of airports or focus on fewer airports but with increased sample coverage around them?
- How could the survey be designed to allow us to look at relevant flight operational changes and their influence on annoyance? For example, those who are/will be newly overflown vs. those who have been overflown for some time, those who get respite vs. those who don't, those who experience one mode of airport operation vs. those who experience another (e.g. westerly vs. easterly operations).
- Should we interview one adult in each household, or should we also include children resident in the household?

Survey mode

- Are other modes of interview feasible other than face-to-face interviewing, including mixed modes of contact and interview?

Sampling

- What is the best way to sample to ensure the survey achieves a representative sample of noise exposures?
- Are noise metrics the best way to achieve a representative sample for the survey or would other strategies used in similar research (for example using distance from the airport or flight paths) be more appropriate?
- Which noise metrics would be appropriate to use to sample, including use of multiple noise metrics in combination?
- Which other factors that may influence responses, such as different modes of airport operation or areas that get respite, should also be considered in order to create a representative sample?
- Should night noise metrics be used in the sampling to ensure a representative sample is achieved for questions on sleep disturbance?
- Is clustered sampling the best approach to use? If so, how could it be done to ensure robust coverage of the population?
- Is disproportionate sampling needed and, if so, where?
- What sample sizes are needed to robustly conduct the analysis required?

Questionnaire

- Did the questions in the SoNA 2014 questionnaire work well or are there any improvements that could be made?
- Can new topics of questions be developed and tested, including expanding the sections on sleep disturbance, health, wellbeing and quality of life?
- What should the reference period for the aircraft annoyance questions be (e.g. the summer months or 12 months previously or another period) and when should the fieldwork be conducted (e.g. during the summer months or following them or another period)?
- Would the survey benefit from any objective measures? For example, actual noise measures, actual monitoring of sleep disturbance, sleep/annoyance diaries or apps, or health monitoring.

Time series

- How can this new survey be set up to ensure that it can be conducted regularly over time to build up a robust time series? How can the new survey contribute to the evidence base on the change effect?

Survey costs

- What are the cost options for this new survey, in order to make an informed decision on the survey design which balances robustness, practicality and value for money?

Compatibility

- Should the survey seek compatibility with other historic UK noise topic surveys, or international studies; and, if so, to what extent?

ICCAN will run a development study to explore the best way to implement improvements for the new attitudinal survey.

There are many areas to investigate potential improvements for the new attitudinal survey and many of these issues are complex and interlinked. All changes would need to be considered in relation to its impact on the robustness of the results, whether it is feasible in practice and whether it represents value for money. Therefore, ICCAN recommends that the best way to examine these issues is to commission a development study to be undertaken by external experts (such as a research agency or other relevant experts). We are committed to taking action on our recommendations immediately, and it is within our resource and authority to do so, therefore ICCAN will run this study, working with all relevant stakeholders, to examine the issues listed above and the output would be a design for the new attitudinal survey. This approach would ensure that a robust and practical design was achieved for the new survey which meets stakeholders' needs. This thorough and independent approach would help all in the sector to develop confidence in the design and results of this new attitudinal survey and, in turn, its use as an evidence base for policy decisions on aviation noise.

Glossary

Term	Definition
Cluster sampling	Cluster sampling refers to a type of sampling method where information is gathered from a population by sampling a series of clusters of densely packed subjects. A disadvantage of cluster sampling is that it does not provide the same coverage of a population as unclustered sampling, increasing the likelihood of missing some perspectives. However, by sampling in clusters, the distance travelled between subjects is lessened, increasing the rate of data gathering and lowering costs.
Exposure-response curve	The exposure-response relationship describes the relationship between the level of exposure and the extent of the response to it. The exposure-response curve describes the respective change in the response as the exposure is increased or decreased. For attitudinal surveys such as SoNA the response is based on questionnaire replies.
Health impacts	When discussing WebTAG, a health impact is assessed when an intervention creates a monetary saving or cost because of that intervention. A health dis-benefit occurs when an intervention incurs a monetary cost in health expenditure as a consequence of that intervention.
LAeq, time	The most common international measure of noise (sometimes shown as $L_{Aeq,T}$ or L_{eq}) creates an average sound pressure which it presents as a hypothetical steady-state sound level having the same sound energy a time varying signal, expressed as a dBA over a given time period. SoNA used LAeq, 16hr over the summer months in 2014. This presented the average noise exposure from 07:00 to 23:00 in the area around airports. The “A” indicates a frequency weighting curve based on typical human hearing response to average level sound.
Lden	Like LAeq, Lden presents an annual average, hypothetical, steady-state sound level. Lden looks at the 24hr annual day, split into three periods, which have different weightings, reflecting the various levels of intrusiveness that noise has at different times.
Lnight	Part of the Lden noise metric. Lnight presents the annual average noise level at night, 23:00 to 07:00 (a weighting of 10 dB is used

	for Lden i.e. one night flight becomes the equivalent of 10 day flights)
LOAEL	Lowest Observable Adverse Effect Level. This is a noise level introduced by the Noise Policy Statement for England (2010) based on toxicology health effects. In this instance, the LOAEL identifies the noise exposure level where adverse effects to health and quality of life can begin to be observed.
Miedema curve	The Miedema curve is an exposure-response curve. It was calculated in 2001 and is the exposure-response curve that informs WebTAG's cost-benefit evaluation.
Noise contour and Noise contour band	A line of equal noise exposure level usually drawn on a map. A noise contour band is the area between two contours (and/or the people exposed within that area).
NPRs	Noise Preferential Routes. Some airports require aircraft to follow NPR flightpaths on arrival and departure. They are designed to avoid the overflight of densely populated areas, when possible. A clearly defined flight path is created between the runway and UK air traffic routes.
Non-acoustic factors	All factors other than noise level that contribute to annoyance are non-acoustic factors. These include age, gender, socio-economic status, attitudes to aviation, to name but a few.
PBN	Performance Based Navigation uses satellite navigation to improve the accuracy of where aircraft fly. It is being adopted world-wide. Airspace and new flight routes are being designed with PBN in mind.
SIDs	Aircraft taking off follow pre-defined routes, known as Standard Instrument Departures routes. A SID is a coded departure procedure – a set of established manoeuvring instructions. The choice of SID used is decided by the airline and is predominately dictated by the destination of the aircraft.
Unclustered sampling	Unclustered sampling refers to a type of sampling method where information is gathered from a population by randomly selecting subjects across the entire population. Unclustered sampling provides more robust information about a population than cluster sampling.
WebTAG	WebTAG (Web-based Transport Analysis Guidance) is DfT's suite of guidance on how to assess the expected impacts of transport policy proposals and projects[46]. It has approval from Defra and Public Health England. Using a baseline scenario, WebTAG calculates a cost/benefit analysis when that baseline scenario experiences a change – known as an 'intervention'

[46] Department of Transport (2018) *WebTAG – Noise*. Presented to Heathrow Community Noise Forum on 14 March 2018.

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