I have pulled out from the NES report, several concepts that I think might provide FAA with some food for thought as they consider how to use the results of the 20 airport annoyance survey. The following comments on the NES lead to ideas for how the FAA might modify its analysis of the noise effects of changes in airspace use.

1. **Explore variations in individual airport dose-response curves, Figure 8.1**

   These variations may have policy implications. FAA should try to understand what factors, if any, may contribute to the different dose-response relationships, including testing of the following hypothesis.

   **Hypothesis – Altered airspace use in airport vicinity is a primary cause of the higher dose-response curve airport surveys.**

   i. O'Hare (ORD) is one of the more sensitive (higher) dose-response curves. ORD analysis was conducted with flight tracks from 1 Nov 2013 to 31 Oct 2014, while all other airport flight tracks were from June 1, 2012 to May 31, 2013. Originally, ORD tracks were also from June 1, 2012 to May 31, 2013. But ORD’s airport Modernization started in October 2013 which resulted in significant changes in runway use and flight tracks. The changes resulted in major community reaction. For example, the number of people complaining (complainants, not complaints) about aircraft noise during the month of June 2013 was 609 spread across surrounding jurisdictions. While the number in June 2014 was 2,323. Hence, it is not surprising to have such a high (sensitive) dose-response curve.
   
   https://www.oharenoise.org/noise-management/noise-reports/anms/noise-complaint-reports

   ii. That the Tucson (TUS) response curve is similarly high might be attributed to “Operation Snowbird” an apparent visit to Davis Monthan of military aircraft from other bases throughout the US and from foreign forces. See PLAN TUCSON, Public Comment: Aircraft Noise, https://www.tucsonaz.gov/files/pbsd/planning/Handout_Received_from_Hearing_Attendee.pdf

   iii. Airport communities that experience “high rate of change” (HRC) of aircraft noise exposure exhibit more annoyance than those without a high rate of change. HRC airports are defined as those that have experienced large changes in their operational patterns within three years prior to interviewing, or announcement of controversial plans for major changes, and/or extensive public discussions and media focus on operational issues.
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In the above figure, the red squares are for HRC airports. Contrary to the appearance, these values of CTL reflect higher (more sensitive) annoyance relationships. https://ince.publisher.ingentaconnect.com/content/ince/incep/2015/00000250/00000007/art00001#

iv. My limited review of comments on the NES report demonstrates frequent reference to NEXGEN, Metroplex and RNAV recognizing, it seems to me, that FAA restructuring of airspace is a major cause for community dissatisfaction.

Suggested Action – Review history of airspace changes and community reactions for the airport dose-response curves of Figure 8.1 to determine if any appear to be high rate of change airports and tend to validate the hypothesis.

A Sidebar Discussion: If one or more airports of the sample can be considered HRC airports, (I assume that TUS and ORD are) a reasonable question would be: how much affected is the national curve by the HRC airports? And consequentially, is the national curve primarily an HRC curve (what happens when an airspace change occurs) or a steady state curve (the dose-response that applies to airports where no recent airspace changes have been occurred or proposed)? One concept that some studies suggest is that at airports where noise exposures have held constant for many years, the surrounding communities would exhibit a dose-response curve indicative of no change. When a high rate of change or abrupt change in noise exposure occurs, the dose-response curve for the communities would shift to a more sensitive (higher) curve. Though this may be an elegant concept, and considerable work has been done studying the attitudinal responses to changes in noise exposure in residential communities, unambiguous determination of a change in response to aircraft noise has been elusive. Further, the duration of an effect, if any, does not seem to have been answered with any certainty. For reviews of many of these studies, see: https://ntrs.nasa.gov/api/citations/19980217679/downloads/19980217679.pdf

https://www.researchgate.net/publication/289297525_Response_to_change_in_noise_exposure_An_update

If the most recent information on the “change effect” is to be reviewed, try http://www.laermstudie.de/en/norah-study/overview/

It could be argued that the national dose-response curve, NES report Figure 8.2, includes some HRC airports so that using it for aircraft noise impact assessment is a reasonable, and certainly the least complicated approach. In other words, a change in response could reasonably be determined by movement along the curve. The following discussion addresses the implications of using this concept.

2. Noise impact assessment implications of the above hypothesis and the national dose-response curve, Figure 8.2.

FAA could consider expanding on the approach to impact assessment that is now in use. Presently, FAA’s significance threshold for noise from an action is defined as: The action would increase noise by DNL 1.5 dB or more for a noise sensitive area that is exposed to noise at or above the DNL 65 dB noise exposure level, or that will be exposed at or above the DNL 65 dB level due to a DNL 1.5 dB or greater increase, when compared to the no action alternative for the same timeframe. But for certain types of projects that encompass large areas, any changes in noise exposure of DNL ±3dB between 60 dB and 65 dB DNL and DNL ±5dB between 45 dB and 60 dB DNL are “reportable.”
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These guidelines were derived from the Schultz curve, updated by the FICON curve, shown for comparison with the NES curve in Figure 8.4. This relationship suggests that below exposures of DNL 65 dB, fewer than 12% to 15% of the population would be highly annoyed, while the NES curve shows exposure needs to be below DNL 50 dB to insure less than 20% are highly annoyed. Considering this new relationship and the above discussions, I suggest considering exposures to DNL 45 dB (admittedly an extrapolation of the data) in the following manner.

i. Compute existing (or no-build) DNL contours to 45 dB;
ii. Estimate build DNL contours to 45 dB;
iii. Compute difference contours within the build DNL 45 dB (build minus no-build);

This approach will yield difference contours that clearly show where and what amount of change in exposure will occur.

The FAA will need to decide at what noise exposure increases in noise sensitive areas are likely to produce increased annoyance (and possibly community reactions), and how to characterize these reactions. Are these changes to be considered areas of noise impact? Do they require mitigation? Should they necessitate additional modifications to the proposed airspace design? The following figure shows for each DNL value, what increases in percent highly annoyed are likely to result from DNL increases of 1 dB, 1½ dB, 2 dB, 3 dB and 5 dB. The values in the figure were derived directly from the slope of the NES dose-response curve.

For example, a 3 dB increase in an area that was DNL 60, could increase the percent highly annoyed by 10 percentage points; i.e., this assumes the annoyance reactions will be similar those who lived at DNL 63 dB. Determining change in reactions this way, suggests that one would prefer actions that
limit increases everywhere to between 2 dB and 3 dB DNL. Determining how these results should be incorporated into aircraft noise assessments is a decision for the FAA.

3. **Additional metrics that might be included as affecting the computation of %HA**

   i. The analysis of the NES report found that NUMBERABOVE50 might be worth investigating further. I assume that will be done.

   ii. Use of complaints as indicators of locations of HA. For airports that have experienced a high rate of change, because it is prohibitively expensive to conduct a thorough survey, (and it isn’t possible to conduct a survey before the change) complaint locations can indicate, if no-build contours are available, the relationship of complaints to increases in exposure.

   The ORD results (and possibly others) could be used for this purpose. (We found as a data exploration for ACRP Project 02-35, that almost all of the complaints communicated to the airport, were by individuals who had also reported high annoyance.) As mentioned above, Section 1.i., two different years of flight data were collected, but only the later (1 Nov 2013 to 31 Oct 2014) were used because the airspace use changed significantly in October 2013. ORD keeps detailed complaint data by jurisdiction, and since 2015, by location, by month. Hence, it is possible to produce contours for ORD prior to the airport Modernization (June 1, 2012 to May 31, 2013). The already computed 1 Nov 2013 to 31 Oct 2014 contours and the prior contours can be used to determine where changes in exposure occurred and by how much. Plotting the changes in exposure with the primary complaint locations will suggest how much change in exposure gave rise to complaints.

   Also, the telephone interviews could be used to gain some sense of what changes in noise exposures produce complaints (questions 26 and 26a). Note that similar questions were asked as part of the ACRP Project 02-35 (Questions 30 and 30a). In general, though the data samples are small compared with the mail NES survey, a review of the questions in the telephone surveys may add to the understanding of factors that could affect the annoyance responses.

4. **Comparison of the NES dose-response curve with the CTL dose-response curve**

   The CTL analysis assumes human reaction to aircraft noise parallels individual reactions to the loudness measure of noises. My personal experience, though limited, was with individual community member logged responses to helicopter noise, HMMH Report No. 305220.007, where we found very close correlation between annoyance and loudness (2010 DIN 45631/A1).
Hence, I think the CTL method may have some value. In comparison with NES curve, CTL overestimates annoyance slightly at low exposures, and underestimates at high levels. If we assume that on an individual-by-individual noise event, loudness correlates well with annoyance, then these two miss-estimates may be related to a number / duration effect. At low event levels, the duration of each event will be relatively lower (affected possibly by background noise) and at the higher levels, the effective levels (the levels that intrude) may seem longer and result in higher annoyance. Maybe there is a way to test these wild guesses.
5. Additional Thoughts

i. How many people are exposed to changes in noise exposure must be important. So, the question becomes, is it better policy to design airspace so that relatively small numbers of people are exposed to the greatest increases in level and the smaller increase in levels affect the larger number of people?

ii. What to conclude about increases in noise and adverse effects if some area of the population experiences virtually no aircraft noise in the existing or no-build situation; e.g., going from well below 45 dB DNL from aircraft to above 45 dB DNL?

iii. Are single event levels important in determining annoyance? A common complaint is that the “average” of DNL isn’t what you hear, and doesn’t represent the true loudness of the aircraft events. Controlling for number above 70 dB or 80 dB L_{max} might include the effects of speech interference or, simply stated, an aircraft event that cannot be easily ignored.

iv. Is there some way to combine telephone survey response from question 21 through 27 to segregate respondents into “very knowledgeable” about the aircraft noise situation and those who have very little knowledge about aircraft noise? Similarly, can responses to questions 28 and 30 through 34 segregate respondents into those who are well informed and knowledgeable about the airport and have a high level of trust and those who are neither well-informed nor trust the airport? Perhaps trust should be a single factor for analysis by itself?

v. The elephant in the room is: does the new national curve imply that there should be a new threshold of acceptability for residential use? I would suggest a consideration of potential costs of mitigation. For example, there may be little cost benefit of providing sound insulation for homes exposed to less than 60 dB DNL, assuming maximum noise reduction achievable it about 25 dB. What to do for homes in the 50 dB to 60 dB DNL regions?

vi. I could probably come up with a few more, if I didn’t have some other time demands (exercise, going for a walk, other retirement pass-times).