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Realizing a 21st Century Noise Policy

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ABSTRACT

Aviation noise impacts affect the health and quality of life of communities nationwide. The FAA's noise policy, last updated in the 1970s, uses a single decision-making metric (DNL), to determine the significance of noise impacts caused by aircraft operations. The Neighborhood Environmental Survey (NES), released in 2021, shows that many more people are impacted by aircraft noise and at levels far below 65 dB DNL than previously thought. The current noise policy does not reflect the 21st century airspace environment, including the consequences of NextGen and the tremendous growth in air traffic. An important improvement to realize an up-to-date noise policy is to reflect the lived experience of impacted communities more accurately. This paper will cover how communities experience aircraft noise in two separate noise exposure environments both near and away from airports, which practices are issues and most concerning to communities, what metrics more accurately evaluate impacts, and how a community-centric approach provides a better representation of the aviation noise experienced by people, which is fundamental to operating a National Airspace System that works for all.

1. INTRODUCTION

The FAA asserts "Community concerns regarding noise have and continue to be a primary factor underlying the FAA's noise-related policies" [1]. Yet, the FAA persists in using DNL 65 as the metric and threshold to interpret Significant Impact, despite the surge in noise complaints by orders of magnitude and the number of lawsuits that occurred in the last 10 years because of NextGen rollouts.

Two major changes occurred in the last 15 years that should be reflected in the new noise policy**:** NextGen and the Neighborhood Environmental Survey (NES). The current FAA noise policy does not reflect these changes and the Communities' lived experience of new aviation noise impacts. Section 2 of this paper describes NextGen changes and NES findings, Section 3 details the communities

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experience of noise, Section 4 covers noise policy requirements, and Section 5 concludes with suggestions to realize a 21st Century noise policy.

2. NEXTGEN CHANGES AND NES FINDINGS

2.1. Nextgen Creates New Noise Impacts

Years ago, the FAA embarked on restructuring the National Airspace System through the NextGen program. NextGen moved established flight tracks and noise to communities unaccustomed to overflights and aircraft noise, concentrated air traffic into very narrow flight paths (“NextGen corridors”), lowered altitudes, and changed speeds and altitudes via new or modified waypoints.

Through the concentration of aircraft, NextGen created new noise problems away from airports, problems that did not exist before. This situation is best reflected in the comment made to Congress by Paul Rinaldi, President of the National Air Traffic Controllers Association to the House Transportation and Infrastructure Subcommittee Roundtable in 2021 “We hit the same position at the same altitude every time. And the [sic] winners and losers. There's a lot of winners in the noise game. They don't say anything because they don't hear any airplane noise. But the losers hear a lot of airplane noise. The FAA, they field a lot of complaints” [2].

2.1.1. NextGen Results in Significant Changes to Communities’ Lived Experience

Figures 1 and 2 compare flight tracks at Boston Logan International Airport (BOS) pre-NextGen and post-NextGen. Similar concentration of NextGen changes occurred nationwide at single site airports and metroplex locations. Despite the significant changes caused by NextGen, the FAA concluded a “Finding of No Significant Impact (FONSI)” in every environmental assessment for every NextGen rollout.

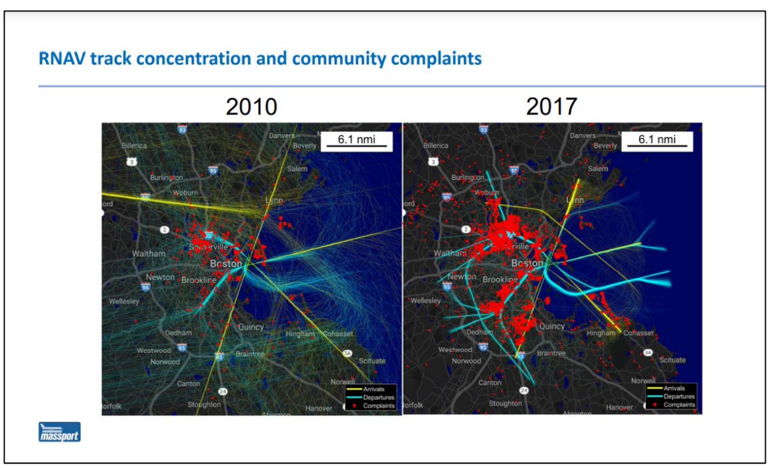

Figure 5.4-3 *Community complaints, before and after RNAV*

Figure 1: Community Complaints, Before and After RNAV [3]

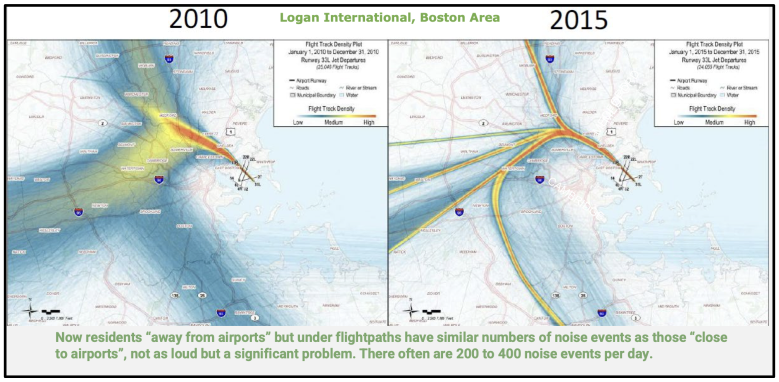

Figure 2: Changes in Flight Tracks Concentration in the Boston Area [4]

Figure 3, from the FAA/Massport RNAV study, shows the dramatic changes in the distribution of overflights that would be caused by the relocation of the turning waypoint of BOS 33L departures by 1 nmi. "Winning communities" in the blue-green shades would get noise relief at the expense of "losing communities" in the yellow-orange shades [5].

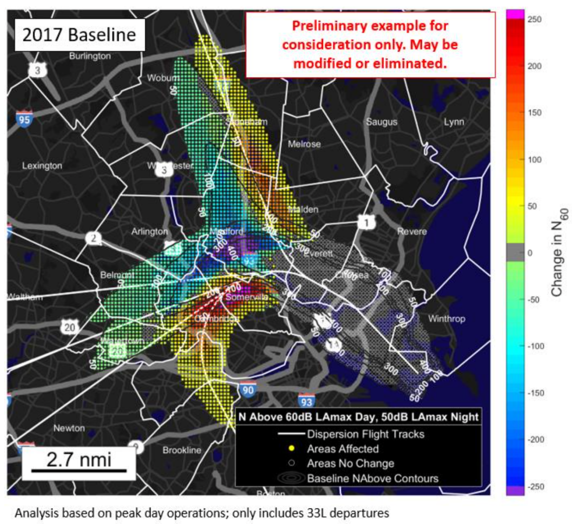

Figure 58. BOS 33L Departures RNAV Turning Waypoint Relocation -1nmi Change in N_{60} Overflights on a Peak Day

Figure 3: BOS 33L Departures RNAV Turning Waypoint Relocation -1nmi Change in N_{60} Overflights on a Peak Day [5]

2.2. Neighborhood Environmental Survey Findings

The NES results [6] show that a much greater proportion of people are highly annoyed by aircraft noise across all levels of DNL than was previously thought. Significant noise annoyance occurs at DNL levels significantly below 65 dB as shown in the National curve in Figure 4. The Schultz curve corresponds to 12.3% annoyance for DNL 65 dB. Extrapolating the same 12.3% of annoyance on the National curve corresponds to DNL 46 dB.

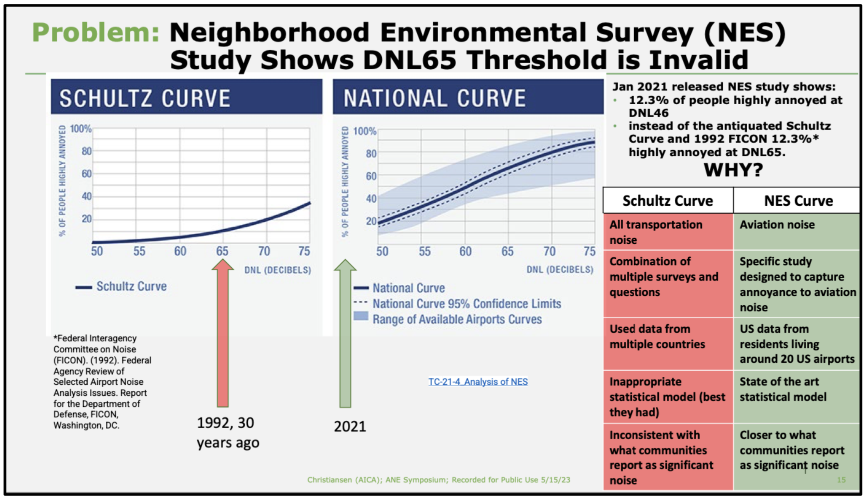

Figure 4: Neighborhood Environmental Survey (NES) Study Shows DNL65 Threshold is Invalid [4]

FAA follow-on analyses of the NES data concluded that N-Above (NA) is a good predictor of annoyance as shown in Figure 5. However, the current graph may confuse some people because the top horizontal axis of N-Above is listed above the lower horizontal axis of DNL. One cannot infer a number of noise events from a DNL value without knowing the noise level of the events. More importantly, since the FAA used 12.3% high annoyance levels to determine the 65 dB threshold, the FAA should publish the National NES (DNL) curve all the way down to 12.3% of annoyance (below DNL 50 dB) instead of stopping at 20% of annoyance even if this requires extrapolation. The FAA should consider providing access to the rich NES data to the research community as additional investigations could result in more findings.

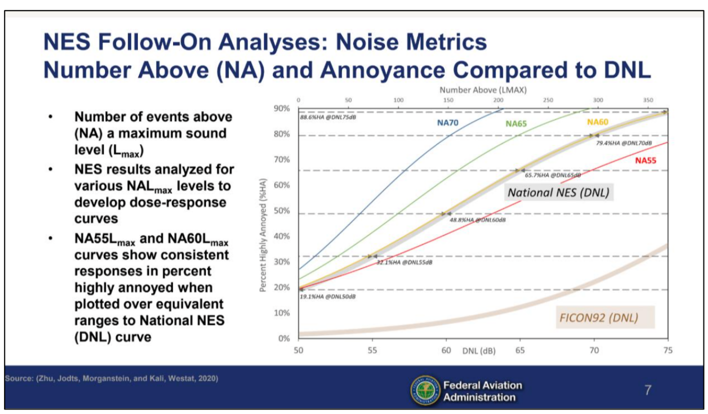

Figure 7.5-1 Number above is shown to be a good predictor of annoyance

Figure 5: Number Above is Shown to be a Good Predictor of Annoyance [7]

3. COMMUNITIES EXPERIENCE OF NOISE

3.1. Two Airspace Noise Environments

The FAA noise policy includes metrics, thresholds, and tools that were originally designed for assessing impacts for communities in the vicinity of airports, not for overflight communities away from airports. This approach was possibly reasonable prior to NextGen as flight paths away from airports were dispersed. However, today's one-size fits-all DNL 65 for Significant Impact is no longer valid for the two distinct noise exposure environments shown in Figure 6.

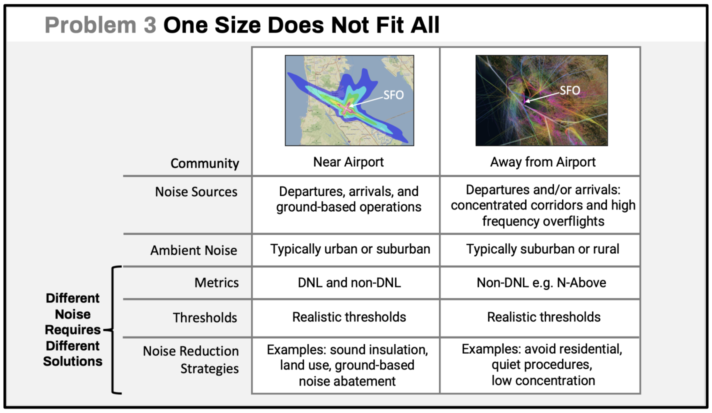

Figure 6: One Size Does Not Fit All for Two Distinct Noise Environments [8]

Noise mitigation and noise abatement actions will differ based on circumstances: reducing noise requires different solutions depending on the environment. Noise reduction for communities right by an airport includes actions such as sound proofing, land use compatibility (including buy back of the land) and reducing ground-based noise. In contrast, noise reduction for overflown communities includes actions such as procedure redesign (quieter procedures –clean configuration until final approach, optimizing thrust level for minimum noise) and traffic deconcentration and dispersion, including procedure rotation and runway use rotation.

3.2. Precision of Modeled Values Away from Airports

3.2.1. AEDT

FAA uses AEDT software for many purposes such as noise mitigation, noise abatement, and environmental reviews. AEDT was also used to estimate DNL impacts of the new NES curve. Research has shown that AEDT has problems accurately predicting noise levels for overflight communities beyond a few miles from an airport. For example, AEDT uses descent profiles that underestimate the use of flaps or slats over overflight communities, especially 10 or more miles away from the airport. However, no error bar or 95% confidence interval is provided on modeled noise results. Accordingly, as proposed by Nicholas Miller in his Federal Register Notice comment (FAA-2023-0855-0150) "...checks of the accuracy of the noise model database" [9] should be made.

Giladi and Menachi [10] tested AEDT estimates by comparing measured and estimated noise levels for landings and takeoffs at three locations: London Heathrow Airport (LHR), San Francisco International Airport (SFO), and Tel Aviv Ben Gurion Airport (TLV). The authors conclude that "...the AEDT model underestimates noise levels, sometimes considerably, by 4 to 7 dB(A), even when using an accurate flight path for its input" [10]. The study analyzed 13 Airbus 320 aircraft arriving at SFO on December 1st, 2018, using STARSERFR direct for the ILS approach to runway 28R or 28L. There were significant differences in actual flight paths and measured noise levels compared to the AEDT expected paths and noise levels. The measured SEL varied between 69 and 79 dB(A), with a standard deviation of 3.3 dB(A), and their maximum noise level (Lmax) varied between 58 dB(A) and 70 dB(A) with a standard deviation of 3.6 dB(A).

The authors concluded "...that aircraft noise model validation should be separated into four cases; takeoffs and landings, and for each operation, a different approach should be used for close and far NMTs [Noise Monitor Terminals]. Validation should involve correction of at least the NPD (Noise-Power-Distance) tables, as well as takeoff profiles, and a recursive process must continue until there is a match in terms of accuracy in its wider sense-trueness, and precision" [10].

Similarly, a Stanford Metroplex Overflight Noise Analysis (MONA) study [11] used a large data set of over 200,000 arrivals to SFO between July 2021 and June 2022 to compare AEDT predictions to

Sound Level Monitor (SLM) measurements on route segments close to two SLM locations ~6 and ~12 miles from the airport.

As reported in the study, “On average, AEDT underestimated LAmax by -3.09dB and SEL by -2.04dB, combining the results from both AEDT noise-modeling modes. Discrepancies appear to result from limitations in the physical modeling of flight trajectories and noise generation, combined with input data uncertainties (aircraft weight, airspeed, thrust, and lift configuration) and atmospheric conditions” [11]. Additionally, the MONA study found “The resulting statistical data indicate that this type of modeling is overly simplistic and gives far from accurate comparison with ground SLM measurements. It is highly troubling that for flights passing the SIDBY receptor, the estimated altitudes for 9 out of 13 significant aircraft types are significantly below the ADS-B measured altitudes by 2.6 to 4.2 times the standard deviation of the ADS-B altitude distribution. It is noteworthy that, despite these deficiencies, AEDT-R is the only FAA-approved regulatory mode for AEDT use” [11] and concluded “...that AEDT-R has substantial prediction errors on approach trajectories and cannot be considered a reliable methodology for predicting valid aircraft noise impact” [11].

3.2.2. Large Estimation Error

Per Christiansen [4], a measurement system is valid if it measures what it claims to measure (e.g., “significant noise”), and the results closely correspond to real-world values (e.g., “survey reactions of people to noise”). In statistics a measurement system [12] is valid if it is both accurate and precise, i.e., unbiased with a small estimation error.

Modeled DNL values are imprecise. As noted in Christiansen’s 2021 ANE Symposium presentation [4], according to Vincent Mestre, AEDT with good data produces DNL estimates with a margin of errors of about ±1.5 dB @ 65 DNL, ±3 dB @ 60 DNL, ±5 dB @ 55 DNL, and ±10 dB at or below 50 DNL. Therefore, AEDT estimates should not be used to determine significant or reportable increases in noise away from airports as required by FAA’s order 1050.1F because the margin of error is too great. With 95% confidence, an estimate of 55 DNL could be as great as 60 dBA which is a reportable increase.

Until AEDT better predicts the noise impacts of overflight communities, error bars on all modeled noise values should be reflected immediately in noise modeling estimation and in any Significant Impact determinations in environmental reviews.

3.3. Aircraft Noise Metrics - DNL vs N-Above

Adequately quantifying the Communities’ lived experience of noise impacts is crucial. This requires selecting the proper metric(s), applying appropriate penalties, and using a realistic time period to calculate noise impacts instead of an artificial one.

3.3.1. Counts of Events

People are disturbed by the count of noise events (how many), the level of noise above ambient that is associated with each event (how loud), the times the events occurred (when), and the cadence of events (how frequent).

The DNL metric does not “account” for the number of noise events even though its calculation “uses” the number of events. One very loud event or many less loud events can lead to the same DNL number. Figure 7 shows 10, 100, or 1000 aircraft over the same period of time can have the exact same DNL value even though 10, 100, or 1000 aircraft create very different noise experiences. According to the GAO report, “FAA officials stated that, while predicted DNL levels did not change much as a result of PBN (Precision Based Navigation) implementation, an increase in the number of flights across the national airspace may have contributed to community concerns about noise” [13] and “...the effects of PBN mean that any increase in air traffic will be concentrated along narrower flight paths, effectively increasing the noise impact on some communities while decreasing the impact on others" [13].

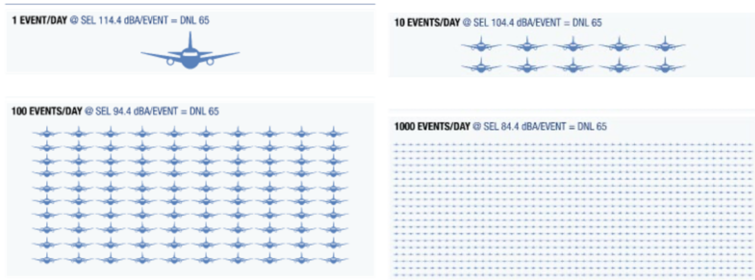

Figure 3: Equivalent Operations for DNL 65 dB

Figure 7: Equivalent Operations for DNL 65 dB [1]

The DNL calculation is based on Sound Equivalent Level (SEL), which is an artificial compression of the noise energy as if the noise event had occurred over one second. However, as illustrated in Figure 8, nobody experiences DNL or SEL. Instead, people experience and hear the noise of each individual event when the noise exceeds the ambient noise level. Furthermore, most people do not understand DNL as logarithmic scales cannot be averaged like arithmetic values.

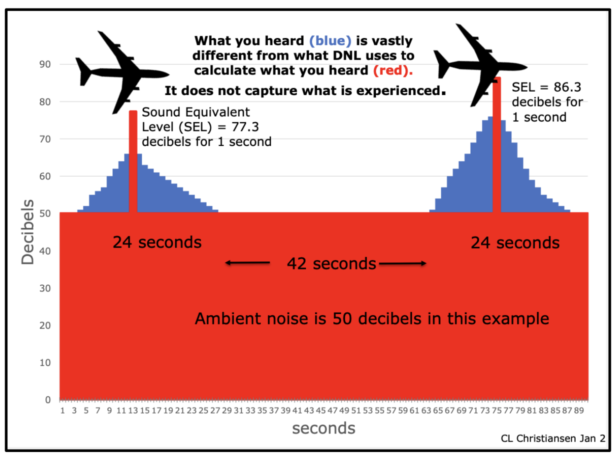

Figure 8: What You Heard is Vastly Different from What DNL Uses
to Calculate What You Heard [4]

Additionally, Brenner states "As a result of the logarithmic addition of SEL that forms the basis for DNL, the contribution to DNL of an additional overflight decreases with the total number of overflights" [14] as depicted in Figure 9. Each additional operation increases DNL by a smaller and smaller amount thus diluting the higher counts of events and therefore the representation of the Communities' lived experience. For example, going from 150 events per day to 300 events per day increases DNL by only 3 dBs.

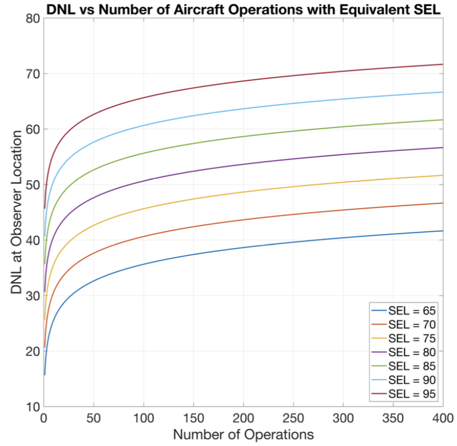

Figure 7: DNL vs. Number of Operations for Different SEL Values

Figure 9: DNL vs Number of Aircraft Operation with Equivalent SEL [14]

Schultz is often cited as the justification of using DNL as a regulatory metric. However, as pointed out by Brenner, "Schultz actually states in his paper that audibility of a noise event is probably more closely related to peak sound than time-averaged sound like DNL and that occurrences of individual noisy events are also likely important in understanding annoyance due to noise" [14].

The count of noise events is critical for a decision-making metric. The term "count" is important because in the 2020 FAA Metrics Report [15], the FAA showed that both DNL and NA satisfied the "Number of Events" characteristic as shown in Table 1. However, at the FAA and AICA webinar in July 2023 [16] the FAA clarified the distinction between "Number of Events" for DNL versus NA. "DNL reflects cumulative averaged noise energy derived from the total number of aircraft noise events over the course of a year divided by 365 days to get to an annual average day (AAD). N-Above similarly could use the concept of an AAD, but instead of representing averaged cumulative noise energy, N-Above represents the **count** [emphasis added] of the number of events that exceed a certain specified maximum sound level (like 60 dB). Since DNL is a measure of cumulative noise energy, and not the number of events, if people want a metric that counts the number of events, then N-Above would be a better suited metric" [16].

Table 1 from FAA Report to Congress, April 14, 2020, page 19
Additions in Red are for Emphasis

Table 1. Noise Metrics

	Noise Level	Time of Day	Number of Events
L_{eq}	✓		✓
DNL	✓	✓	✓ ?
LAeq(hr) (e.g. 16hr, 8hr)	✓	✓	✓
L_{den}	✓	✓	✓
CNEL	✓	✓	✓
SEL and CSEL	✓		
L_{max}	✓		
PSF[a]	✓		
NA[b]	✓	✓	✓
TA[c]	✓	Time of Day is easy to account for using different thresholds.	
Time Audible[d]	✓		

[a] PSF, or pounds per square foot, is functionally a measure of "noise level" instead of decibels. PSF is typically used as a measure of the peak overpressure of a sonic boom.
[b] NA is the number of noise events above a certain noise level threshold.

For remaining footnotes see FAA report

Table 1: Noise Metrics [15]

Because the Community experiences the count of noise events, the Community seeks a metric that reveals the count of events. The "Number of Events" category in Table 1 above is misleading and should be renamed "Reveals the Count of Events". Furthermore, NA can account for "Time of Day" occurrence. One can for example apply a night penalty to the maximum sound levels of the noise events (Lmax) as is done today for DNL.

Figure 10 is an example of the disconnect between DNL and the count of noise events. Palo Alto experiences about 250 SFO overflights per day (monitored October 30, 2018 – January 4, 2019) resulting in a 52 dB CNEL (CNEL is like DNL with an additional 5 dB evening penalty between 7pm and 10pm). To reach a 65 dB CNEL threshold, Palo Alto would need almost 5,000 airplane noise events per day. This would be an airplane every 17.7 seconds in a 24-hour period. The example also dispels the common myth that decreasing the 65 dB DNL threshold by 5 to 10 decibels would represent the significant impacts of most overflight communities. It won't.

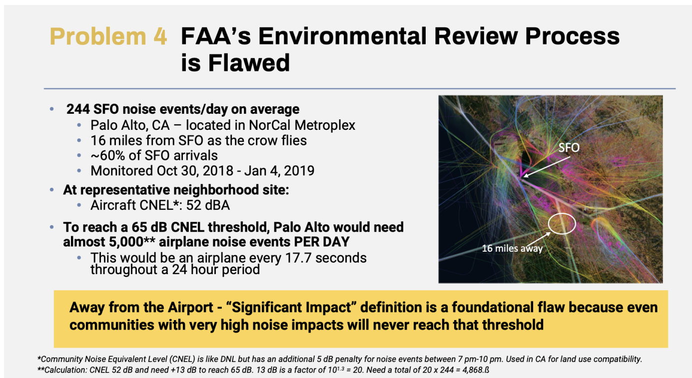

Figure 10: FAA's Environmental Review Process is Flawed [8]

3.3.2. Formulas

DNL is a 24-hour metric that calculates aviation noise over 86,400 seconds for each day of the year, using zeros for seconds when there is no aviation noise. DNL is complicated and difficult to understand because of the logarithmic calculation shown in Equation 1.

Equation 4: Formula for DNL. Source: HMMH [7]

$$DNL = 10 * log_{10}\left(\frac{1}{T}\left[\sum_{i=1}^{n_{day}} 10^{\frac{SEL_{i,day}}{10}} + \sum_{i=1}^{n_{night}} 10^{\frac{SEL_{i,night}+10}{10}}\right]\right)$$

Equation 1: Formula for DNL [14]

NA simply counts the number of noise events with noise above a selected value (Lmax, which is the maximum sound level). It is simple to compute and understand as shown in Equation 2.

Equation 3: Formula for N_{above}

$$N_{above} = \sum_{i=1}^{n_{day}} x_{i,day} + \sum_{i=1}^{n_{night}} x_{i,night}$$

Equation 2: Formula for N_{above} [14]

Both equations are sums of day and night calculations to enable penalizing nighttime events (and evening events in California). Another way would be to multiply the number of nighttime events by, say, 10.

3.4. Ambient Noise and N-Above-Ambient

3.4.1. Ambient Noise

Today the FAA assesses noise impacts independently of a community's ambient noise. Ambient noise, also called background noise, is the typical average noise in a community without the noise caused by air vehicles and is calculated as the noise level that is exceeded 90% of the time by all noise events (L90 in statistical terms). The FAA uses the same DNL 65 threshold for all locations, regardless of the community ambient noise level or distance from the airport. Communities in the vicinity of airports are typically urban or suburban, with high ambient noise levels, whereas overflight communities farther out are typically suburban or rural and have lower ambient noise levels.

The 1978 Schultz study [17] commented that background noise may lead to differences in people's response to noise events. Figure 11 shows that annoyance to a given level of aircraft noise is lower in communities with heavy road traffic/high ambient noise than with light road traffic/low ambient noise. This makes sense because people perceive noise events relative to the ambient noise at their location.

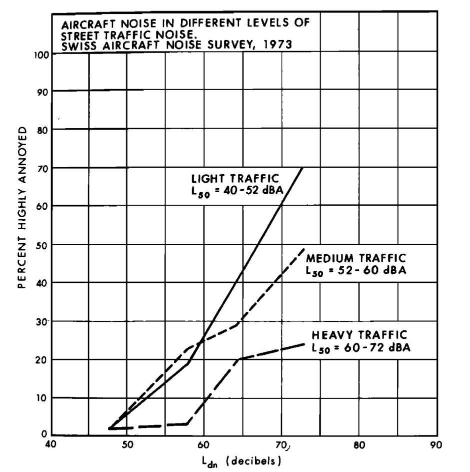

FIG. 9. Annoyance vs noise exposure due to aircraft noise, for different levels of local street traffic noise (Ref. 20 and 23).

Figure 11: Annoyance vs Noise Exposure Due to Aircraft Noise, for Different Levels of Local Street Traffic Noise [17]

Ambient noise needs to be a major consideration in assessing aircraft noise impacts.

The 1971 EPA study of Community Noise [18] found the standard deviation of the noise level data about the mean relationship between community reaction and noise level was cut nearly in half (i.e., the data scatter was reduced) when background noise was considered.

A Mitre study [19] used ambient noise and N-Above (NA) for a fictional US airport using the NES data. Mitre defined "detectable" events as events with L_{max} at least 3 dB above the ambient sound level. Mitre simplified the Environmental Protection Agency's (EPA) ambient sound levels into three categories: urban, suburban, and rural with designated L_{max} of 65 dB, 55, dB, and 45 dB, respectively. Larger changes in NA were found in quieter rural areas compared to urban areas, thus confirming that ambient noise is critical in evaluating noise impacts. Note however that the Mitre categorization of ambient noise levels is overly simplistic. Palo Alto, a quiet suburban community featured in section 3.3.1., had ambient noise of 35 dB, which is 10 dB below the rural ambient noise of 45 dB used by Mitre. Ambient noise estimates should be evidence-based, e.g., informed by noise monitoring data already collected by airports if available or through temporary monitoring by airports. In the absence of noise monitoring data, ambient noise could be estimated using evidence-based community characteristics (for example, ambient of 35 dB for rural or very low-density suburban, 40 dB for low-density suburban, 50 dB for medium-density suburban, 60 dB for urban, etc.).

3.4.2. N-Above-Ambient

NA captures the number of aircraft with a maximum sound level Lmax that exceeds a specific noise level over a given location. For the N-Above-Ambient (NAA) metric, the specific noise level is the ambient noise. NAA captures the Communities' lived experience of aircraft noise of overflight communities because it can capture how many, how loud, when, and how frequent the aircraft are. NAA captures the number of times people heard an aircraft and is understandable by everyone.

NAA can be calculated via noise recordings or modeled via AEDT for any location after specifying the ambient noise level (measured or assumed based on realistic characteristics). Figure 12 is an example of the NAA distribution of aircraft noise events from multiple airports recorded by one sound monitor over 24 hours in one location in Palo Alto on May 19, 2023. The calculated CNEL was 50 dB. The low level of ambient noise was 35 dB, therefore minimizing the risk of contamination by non-aircraft noise sources. The accuracy of the noise events identification was high because aircraft noise events were identified using ANEEM, not a threshold and duration method. Furthermore, aircraft noise events that occurred at the same time as some community noise were excluded from the reporting.

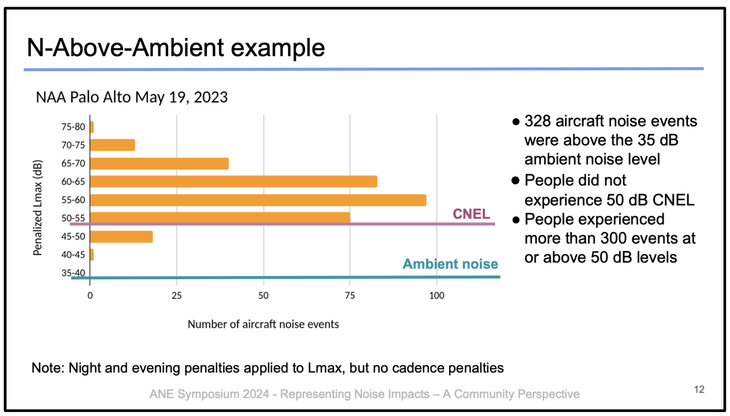

Figure 12: N-Above-Ambient Example [20]

3.5. Penalties

DNL applies a nighttime penalty of 10 dB for flights occurring between 10pm and 7am (California also adds a 5 dB evening penalty between 7pm and 10pm to calculate CNEL).

Similarly, time of occurrence penalties (night, evening) can be applied to the Lmax values of N-Above-Ambient in the same way that nighttime penalties are applied to calculate DNL. Night penalties ought to be revised because the impacts of flights in the core night hours (midnight to 5am) are much more deleterious than in the shoulder night hours (10pm to midnight, 5am to 7am).

In addition, and to better represent the Communities' lived experience, penalties need to be defined for the cadence of aviation events. The frequency of events is a critical factor in how individuals experience aircraft noise and is a universal problem caused by all aircraft vehicles (including helicopters), all aviation (commercial aviation, general aviation, military aviation) for scheduled or non-scheduled flights, including flight training and other activities such as helicopter hovering or skydiving.

3.6. Time Period for Calculation – Average Annual Day vs Peak Day

As Brenner states in her DNL analysis using an annual average day (AAD) for BOS data, “This annual average day, however, is **fictitious** [emphasis added] as it reflects a full year of operations condensed to a daily timescale for noise impact analysis rather than representing an actual day of operations” [14]. The GAO report conveyed “While the DNL metric is not defined based on an average annual day, FAA policy uses the DNL for the average annual day to determine whether potential noise impacts are significant when conducting environmental analyses” [13].

People do not experience aircraft noise impacts from average annual days. However, they experience Peak days and Peak hours as shown in the MIT study correlating noise complaints and DNL levels for AAD, Peak day, and Peak hour as shown in Figure 13. DNL based on an AAD does not cover a large portion of noise complainants. In contrast, Peak day and Peak hours cover much larger fractions of noise complainants.

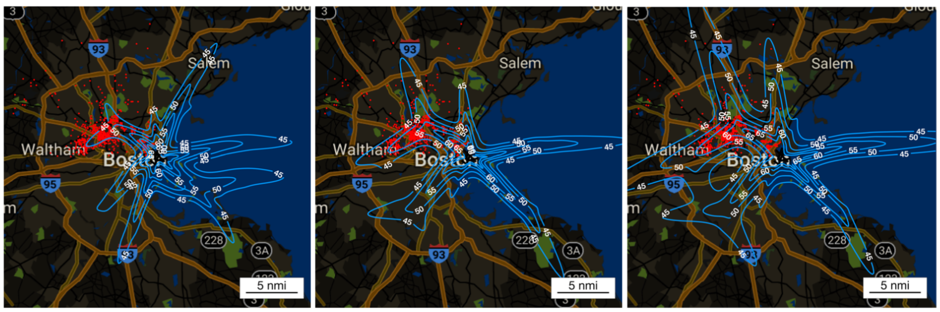

Figure 25: Annual Average Day DNL Contours **Figure 26: 33L Peak Day DNL Contours** **Figure 27: 33L Peak Hour DNL Contours**

Table 19: 33L Departures Complainant Coverage for All Scenarios by DNL Contour Level

Contour Level	Annual Average Day	33L Peak Day	33L Peak Hour
45dB DNL	54.21%	87.26%	93.39%
50dB DNL	14.66%	66.11%	88.94%
55dB DNL	8.05%	21.27%	74.04%
60dB DNL	3.49%	8.53%	30.05%
65dB DNL	0.12%	5.17%	9.38%

Table 20: Contour Area and Population Exposure for All Scenarios by DNL Contour Level

Contour Level	Annual Average Day		33L Peak Day		33L Peak Hour	
	Contour Area (nmi^2)	Pop Exposure	Contour Area (nmi^2)	Pop Exposure	Contour Area (nmi^2)	Pop Exposure
45dB DNL	107.43	554,679	114.80	879,087	236.90	1,345,823
50dB DNL	47.88	198,862	51.54	443,925	98.30	795,659
55dB DNL	20.28	61,017	21.86	153,988	43.44	384,738
60dB DNL	7.99	19,852	9.18	49,200	18.24	131,671
65dB DNL	3.38	1,568	3.76	17,640	7.94	50,955

Figure 13: 33L Departures Complainant Coverage for All Scenarios by DNL Contour Level [14]

Yu also noted through discussions with community members that complaints were frequently correlated with the lived experience of high intensity operation periods such as a flight every 90 seconds starting at 6am, which are not adequately captured through an AAD [5]. Yu’s analysis compared the number of operations between AAD and the Peak day for each of the runway procedures at BOS, MSP, LHR, and CLT airports as shown in Table 2. “Since runway configuration varies from day to day based on several factors including wind, there are days where a runway procedure has hundreds of operations and days where a runway procedure has no operations. Communities have expressed that the complaints are a result of the days on which there are hundreds of overflights over their homes, hence why the Peak day was used as the representative time frame in the following analysis” [5]. AAD calculations vastly underestimate the count of operations compared to Peak day.

	Procedure	Annual Average Day Operations	Peak Day Operations	Peak Day
BOS	33L dep	116	487	May 18th, 2017
	27 dep	71	345	September 18th, 2017
	4L/R arr	129	567	October 12th, 2017
MSP	17 dep	174	421	August 25th, 2017
	30L dep	151	394	July 13th, 2017
	12L/R arr	239	677	July 25th, 2017
	30R dep	128	302	June 15th, 2017
LHR	9R dep	125	690	July 17th, 2017
	27L/R arr	526	696	June 30th, 2017
CLT	18L/C/R arr	258	806	May 4th, 2017
	18C dep	156	439	April 4th, 2017
	18L dep	185	503	April 26th, 2017
	36R arr	146	343	October 12th, 2017

Table 2. Annual Average Day Operations vs Peak Day Operations*

*Note: Operations for parallel runways are the sum of all operations on the parallel runways.

Table 2: Annual Average Day Operations vs Peak Day Operations [5]

When calculated for an Average Annual Day, DNL underestimates the Communities' lived experience. The AAD is an artificial day that does not reflect that noise impacts vary on a day-to-day basis because of changes in the volume of operations, runway configurations, flight schedules, fleet mix, usage of procedures, flight paths, thrust levels, aircraft configuration, and weather conditions. People do not experience noise impacts on an AAD because such a day does not exist. DNL can be calculated for any period, including Peak day. However, DNL will always be an average noise level over a certain number of hours that will neither count the number of noise events nor capture how people experience noise on the ground.

4. NOISE POLICY REQUIREMENTS

4.1. A Single System, Not Single Metric

21st century metrics must represent the Communities' lived experience and meet ASNA requirements of a single system, not a single metric. The introduction section of the report Analysis of the Neighborhood Environmental Survey, January 2021 states and misinterprets ASNA: "Through the Aviation Safety and Noise Abatement Act (ASNA) of 1979, Congress directed the Federal Aviation Administration (FAA) to establish **a single metric** [emphasis added] for assessing land use compatibility with respect to noise from aircraft operations, and to establish standards and methods for assessing the noise environment associated with ongoing aircraft operations near airports" [21].

In addition, given that "'Significance' must be determined as policy decision" as stated by the FAA [22], selecting metrics should not be conflated with selecting thresholds for defining Significant Impact. Select the most appropriate metric(s) first to accurately represent the Communities' experience, and then through policy decisions, identify appropriate thresholds.

4.2. Critical Factors in Annoyance Levels

Recognize that annoyance is a direct function of the count of events, loudness relative to ambient noise, time of occurrence, and frequency of events.

Historically, some of these factors were acknowledged. As asserted in the 1978 Schultz study [17], percentages of high annoyances of various surveys are scattered as shown in Figure 14. Some reasons for the scattering include differences between measured noise and the actual noise exposure, background noise, the time of year in which the survey was conducted (when people are outdoors they are less protected from outside noise), and noise attenuation for example "…the typical noise attenuation (A-weighted) for railroad noise in Japanese houses is only 10 dB, compared to 28 dB in northern North America or Europe" [17].

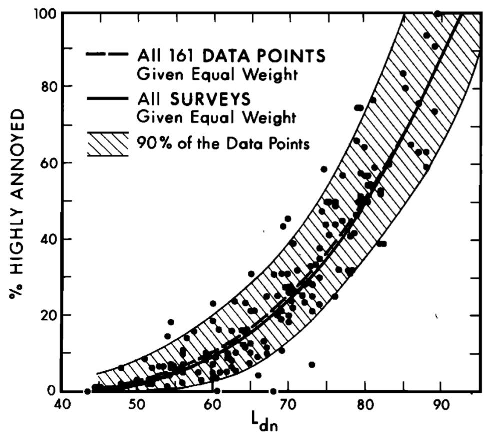

FIG. 6. Summary of all survey data points.

Figure 14: Summary of All Survey Data Points [17]

Similarly, the FAA paper on FAA Aircraft Noise Impacts Research Roadmap 2010 [23], emphasized the need to address the large scatter, data variability of community survey data on annoyance such as number and types of aircraft operating, when aircraft operate, step changes in noise versus gradual or little change, background noise, and frequency of events. Also acknowledged was the need for identifying annoyance issues from two perspectives: annoyance reported through surveys and noise complaints filed. "Whereas personal annoyance can be determined by social surveys of sample populations, public or community action manifests as complaints to an airport, organized expression of dissatisfaction or, occasionally, legal action. Part of the approach to improving the predictive ability of the annoyance model is to study complaint and other public action data for insight into other sources of data variability" [23]. Alonso's 2022 ANE Symposium presentation on Implications for Noise Metrics Investigations reviewed complaints per day during the high changing COVID-19 period of January 2020 to April 2022 and found a high correlation between the number of complaints per day and the operation counts per day [24].

4.3. Different Thresholds for Different Environments

The current noise policy relies on the DNL 65 metric and threshold for every decision including environmental reviews, airport noise compatibility planning, soundproofing eligibility, permanent noise monitoring eligibility, and noise abatement. As covered in section 3.1, the two distinct noise exposure environments of overflown communities and vicinity of airport communities require different noise reduction solutions. An incorrect assumption is that all communities want and would benefit from soundproofing. Do not equate thresholds with noise insulation.

Simplicity in a noise policy as emphasized by the FAA cannot be at the expense of Communities; different noise metrics and thresholds and different noise reduction solutions are needed to address the different circumstances of communities near an airport versus communities away from an airport. The two environments are different and face very different constraints from an aircraft noise solutions perspective.

5. NEW THINKING TO REALIZE A 21st CENTURY NOISE POLICY

All the above is important but irrelevant unless there is a willingness to embrace new thinking for a 21st century noise policy to represent and have high predictability regarding the Communities' lived experience. It will take new thinking and a change in previously held core assumptions on annoyance to realize a new noise policy.

At the 2010 FAA Noise Impacts Research Roadmap Workshop regarding the "Key Issues– Annoyance - Public, Can community / public actions be predicted?" [22] the FAA asked the question "Should we have known what would happen?" [22]. Almost 15 years later with the consequences of NextGen, the NES study [6], and the Request for comment on the Noise Policy Review [25], the answer is still a resounding "yes", we should know what will happen when aviation changes are considered. This is the litmus test for the new noise policy. The FAA must appropriately reflect what people experience on the ground or will experience if a change is made. There should not be surprises as there were with NextGen roll outs. Only if valid metrics and tools are accurate can precise noise modeling be used to evaluate potential impacts.

DNL would not need to be replaced entirely because ASNA requires a system of metrics: more than one metric and threshold can be used to represent the true impacts of the distinct environments of near airports and overflight communities. The FAA needs to address the two noise environments differently through metrics, thresholds, and noise mitigation and abatement solutions.

The lived experience of aircraft noise impacts (how many, how loud, when, and how often) can be represented effectively by the count of events with a maximum sound level above ambient noise for the Peak day of operations after appropriate penalties such as time of occurrence and cadence have been applied, namely NAA for Peak day. The metric is simple and understandable.

Most importantly, the FAA needs to evaluate and select metric(s) that best represent the communities' lived experience separately from setting thresholds to define significant impact for NEPA and land use compatibility.

Any metric that is neither understandable, nor a valid representation of noise impacts should not be used for decision-making. Valid noise metrics will disclose truths about the impacts of aviation noise on Communities and will enable the development of solutions to reduce impacts.

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