Realizing a 21st Century Noise Policy

Darlene Yaplee | ANE Symposium 2025

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AICA | AVIATION-IMPACTED COMMUNITIES ALLIANCE

Agenda

- Problem Statement and Critical Requirements
- Communities' Experience of Noise
- New Thinking to Realize a 21st Century Noise Policy

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

Presentation is primarily based on NOISE-CON paper, aviationimpactedcommunities.org

FAA Noise Policy Review: The Turning Point for Change

Aviation Noise in the United States: The Current State of Federal Aviation Administration Research on Community Response

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While today's civilian aircraft fleet i
the Federal Aviation Administration
affecting communities across the Un
Environmental Survey (NES) has sh
States has changed and the dose-response relationship between noise and annoyance such as the one represented by the Shultz Curve is no longer representative of communities' lived experiences.

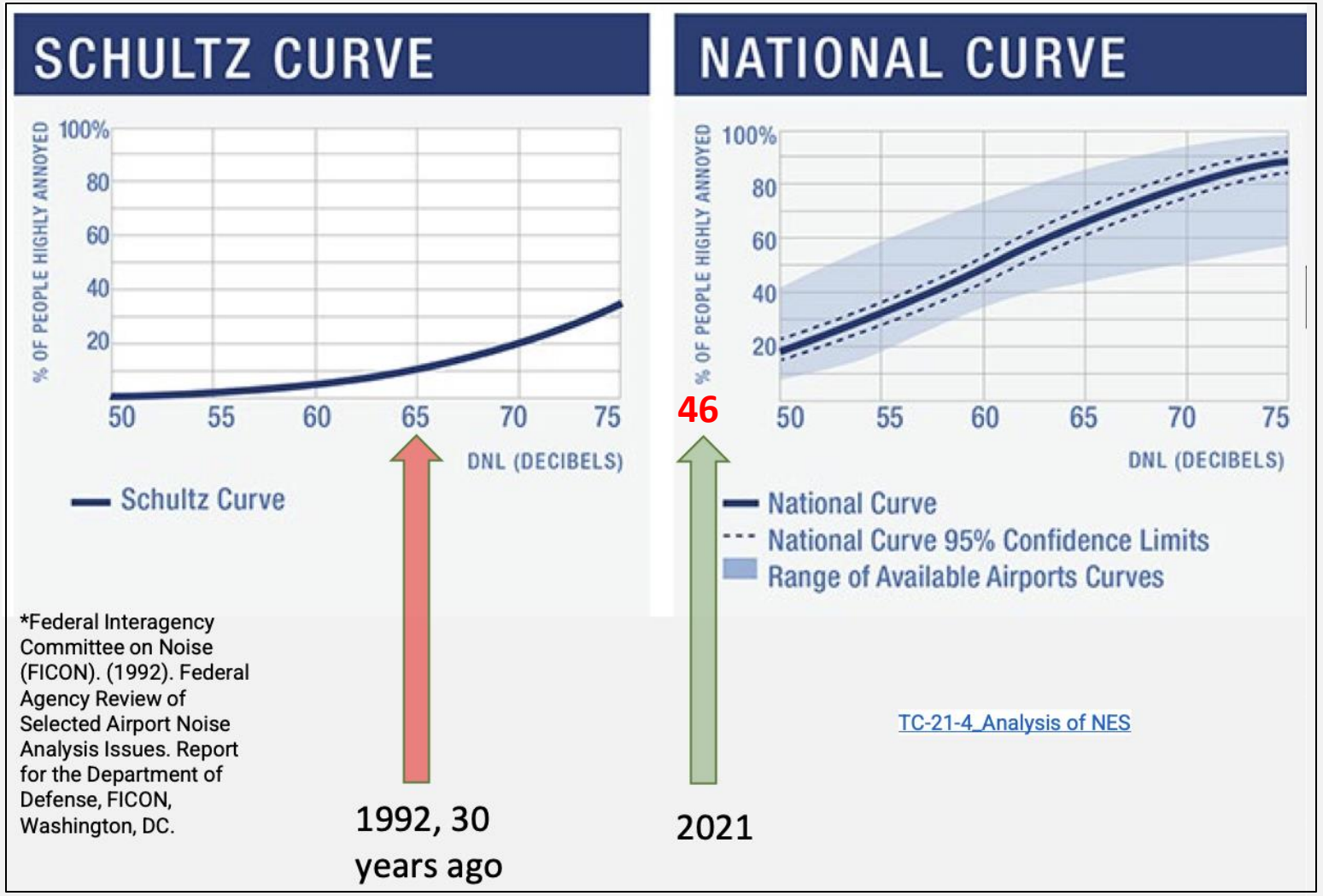
"The Schultz Curve is no longer representative of communities' lived experience."

"Communities concerns regarding noise have and continue to be a primary factor underlying the FAA's noise-related policies."

Is DNL the Right Metric?

12.3% of People Highly Annoyed at:

- DNL 46 based on the 2021 released NES study
- DNL65 for the antiquated Schultz curve and 1992 FICON



Excerpted from: Christiansen, C.L., *Is It Time to Retire a 30-Year-Old Aviation Single Noise Metric?,* ANE 2023

Problem Statement

3 TECHNICAL DISCUSSION

Metrics in common use for predicting noise impacts are largely expedient in nature. They are not supported by theory-based understanding of the causes of community reaction to noise, but rather on historical studies of perception of loudness, convenience of measurement, and on custom that has been codified in regulation. This section examines the rationales for use of

– Institute of Noise Control Engineering (INCE)
Supplemental Metrics Report, 2015

Lived Experience Matters: Critical Policy Requirements

- **Studies must be well-designed** with a scope and factors that accurately reflect communities' lived experiences, ensuring that generalizations are not made from an overly narrow scope or unrepresentative samples.
- **Noise policy must address two distinct noise environments**—near airports and farther away – while recognizing that ASNA (1979) allows a system of metrics, not just a single metric like DNL.
- **Metrics must fully capture the count and cadence of disruptive events**, as these are the primary sources of annoyance to communities.
- **Decision-making must be based on communities' lived experience** rather than historical studies on loudness perception, measurement convenience, or existing regulatory customs that underrepresent community impacts.

Comments Based on Published FAA Papers

inter·noise 2023
CHIBA,GREATER TOKYO 20-23 AUGUST

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NOISE-CON 2024
TRUMPETING NOISE CONTROL
New Orleans, LA - June 10-12, 2024

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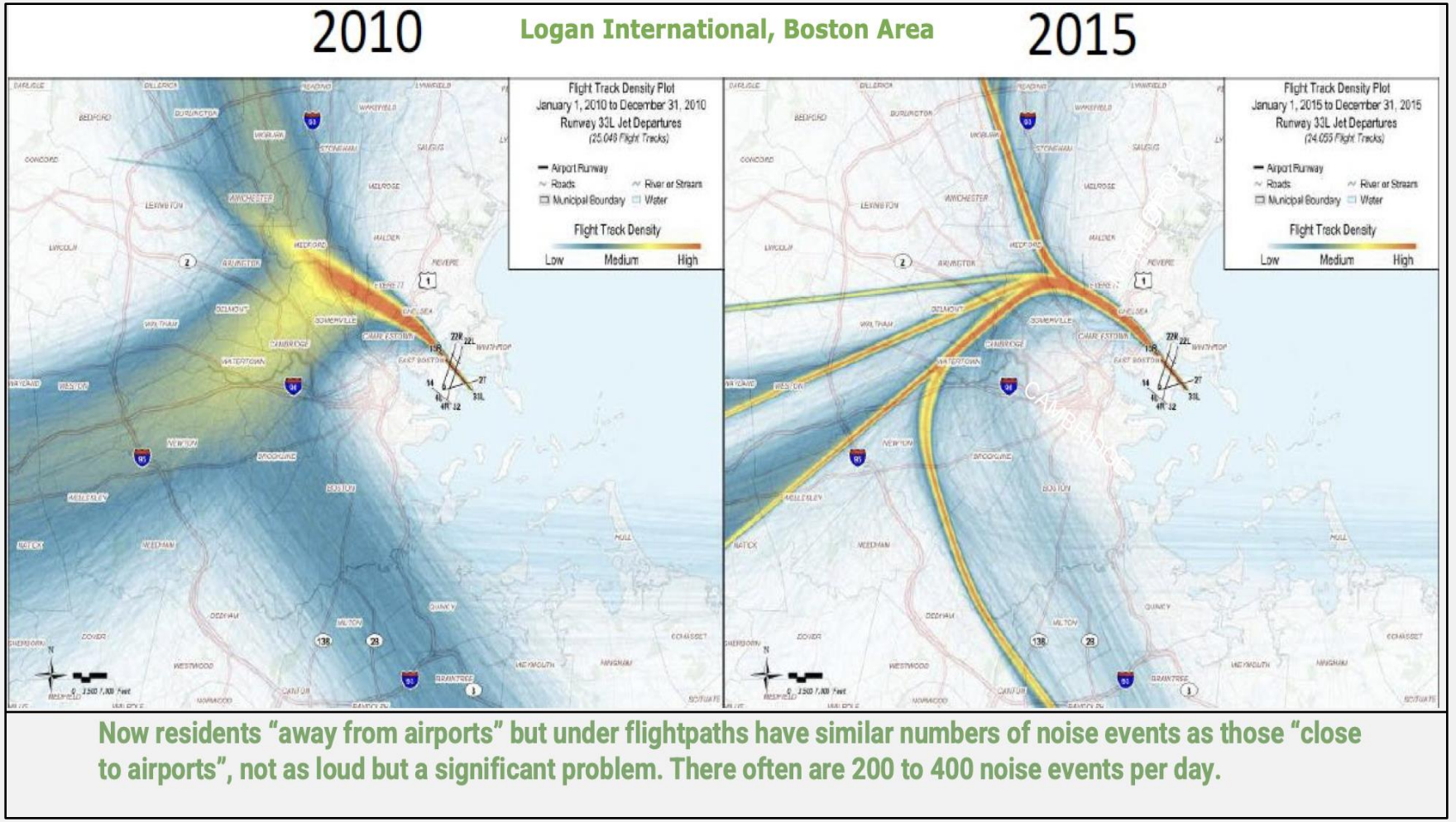
"The full details of the follow-on analyses conducted to date on the NES data are available in a companion technical report [4]."

4. Rimja, Mihir, Joseph J. Czech, Synthesis of NES Follow-up Analyses, Consolidated Report, HMMH Report 311950.001, Publication pending.

Available articles, Ingentaconnect.com

NextGen's Major Change: New Noise, New Impacts

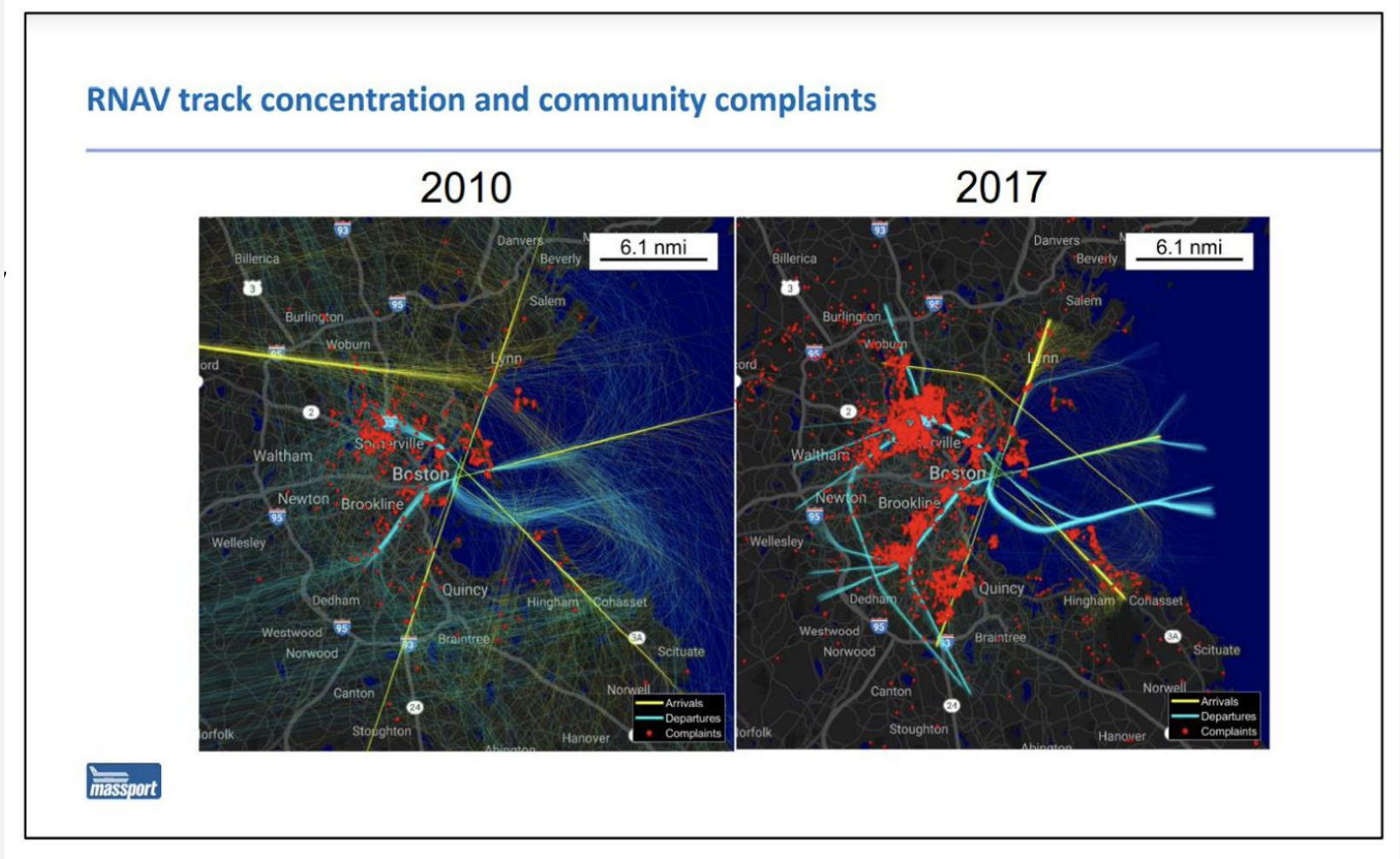
- Higher track concentration **creates new and intensified noise** impacts
- **NextGen shifts noise burden**—some winners, and some significant losers



Excerpted from: Christiansen, C.L., *Is It Time to Retire a 30-Year-Old Aviation Single Noise Metric?,* ANE 2023

NextGen's Major Change: New Noise, New Impacts (cont.)

- **Farther from the airport,** and including many **outside** traditional flight paths
- Noise impacts now **extend along flight paths, not just near airport**
- Most complaints **beyond DNL 65** contour



Source: Suprizio and Leo, *Noise Situation at Boston Logan Airport, Noise Around Airports: A Global Perspective*, INCE (2022)

NextGen's Major Change: New Noise, New Impacts (cont.)

- **Method 1, N-Above:**
  - **Criteria:** ≥50 Peak Day overflights
    - N-Above 60 LAmax (Day)
    - N-Above 50 LAmax (Night)
  - **Outcome:** Correlates to 80%+ complaint locations
- **Method 2, DNL:**
  - **Outcome:** DNL 45 Peak Day
- A mere 1-nautical-mile adjustment can shift 250 overflights daily, determining whether you come out as a 'winner' or a 'loser'

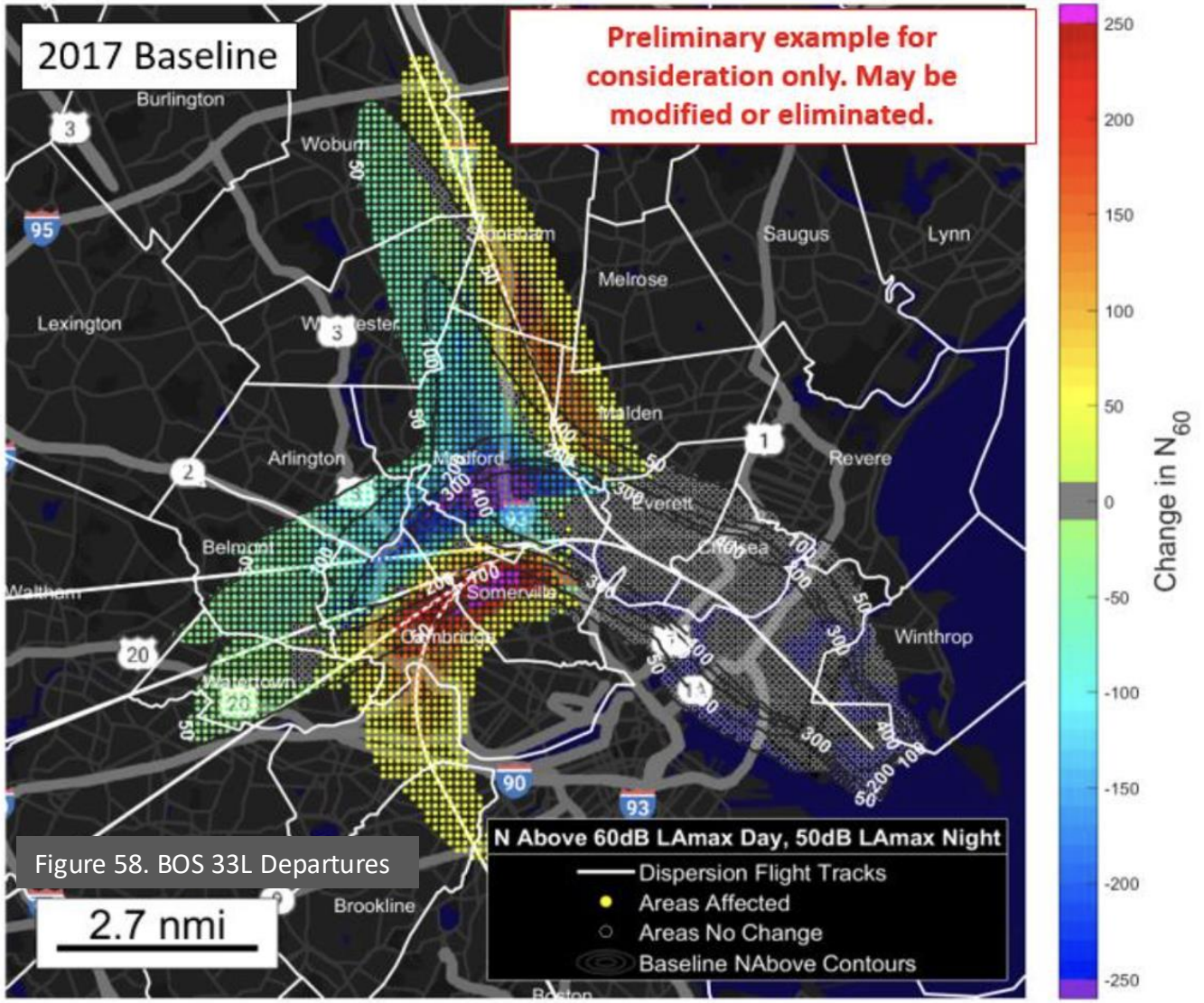
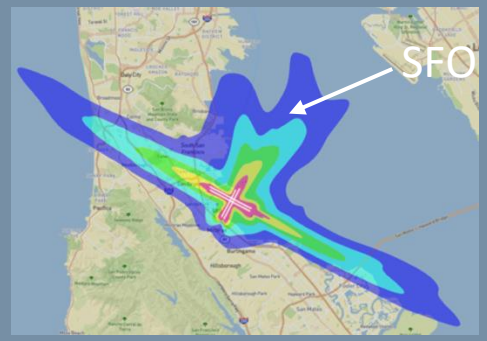


Figure 58. BOS 33L Departures

Excerpted from: Yu and Hansman (2019), MIT

Two Noise Environments: One Size Does Not Fit All

Community	 Near Airport	 Farther from Airport Near Flight Path(s)
Noise Sources	Dep., Arr., and ground-based operations	Dep. and/or Arr.: Concentrated corridors and high cadence overflights
Ambient Noise	Typically, urban or suburban	Typically, suburban or rural
Metrics	DNL and non-DNL	Non-DNL e.g., N-Above-Ambient
Noise Reduction Strategies	Examples: Sound insulation, land use, and ground-based noise abatement	Examples: Community sensitive routing, residential avoidance, quieter procedures, and dispersion

Lived Experience: The "Count" of Events

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 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.

Adapted from: Christiansen, C.L., *Is It Time to Retire a 30-Year-Old Aviation Single Noise Metric?,* ANE 2023

1, 10, 100, 1,000 Flights: Same DNL, More Noise

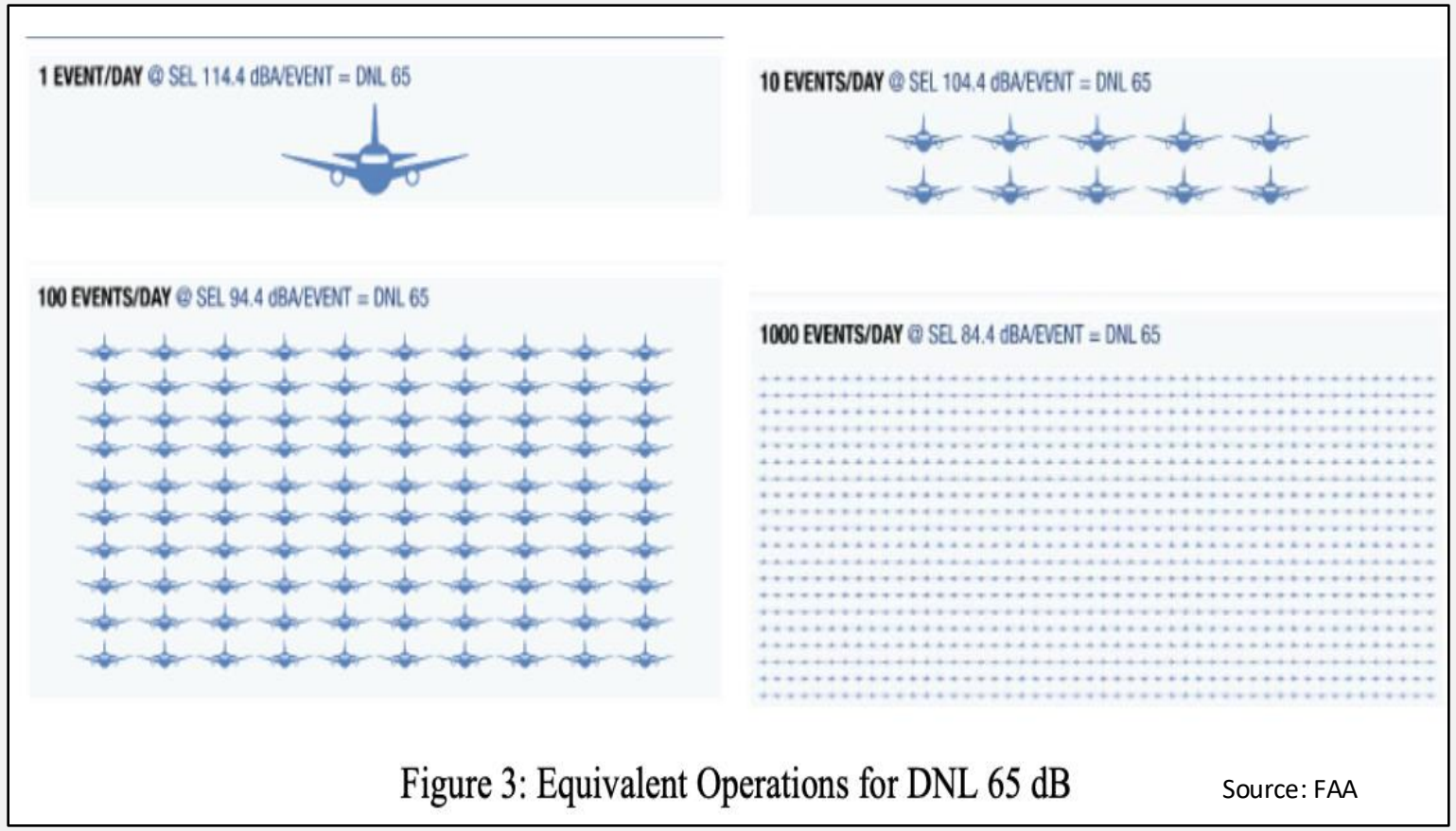


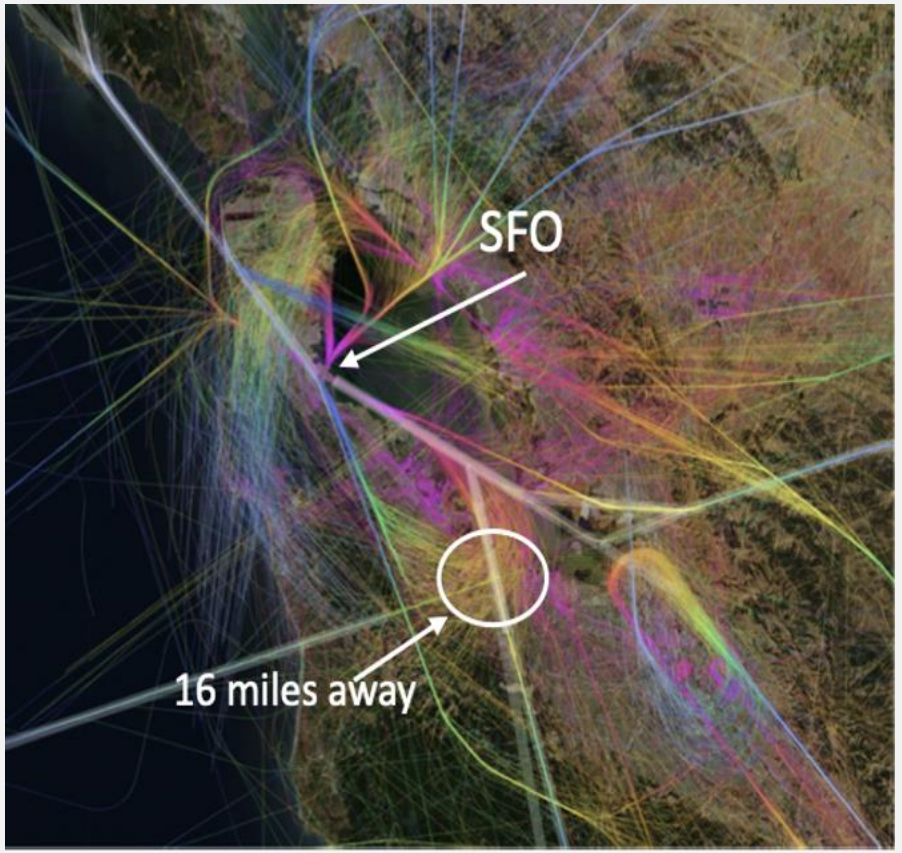
Figure 3: Equivalent Operations for DNL 65 dB

Source: FAA

- 1, 10, 100, or 1,000 flights = **same DNL** 65 dB
- Each additional flight adds **less and less** to DNL, even as overflights increase

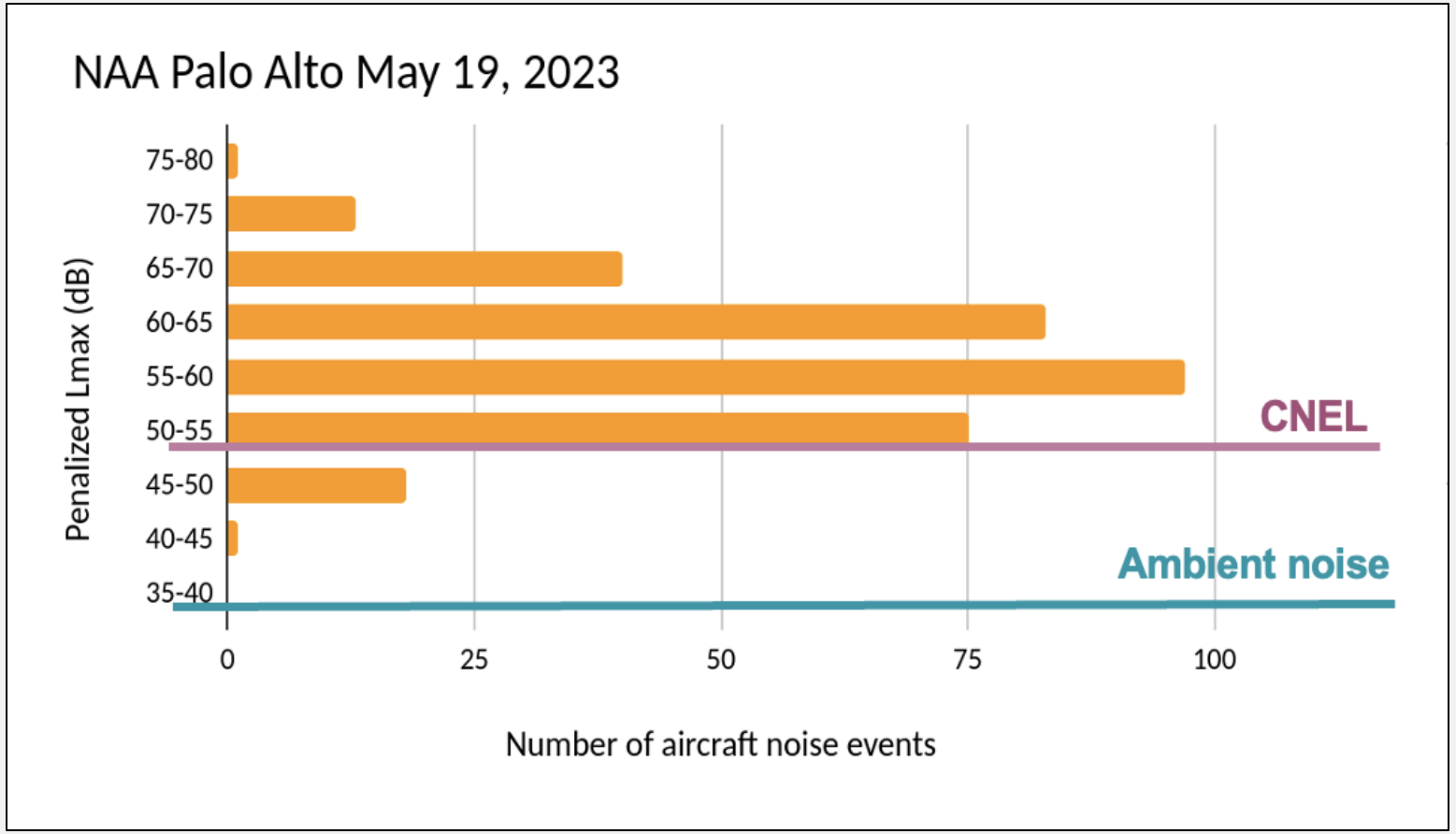
Highly Annoying Impacts May Never Reach DNL 65

- **244 SFO Events/day on average**
  - Palo Alto, CA: ~16 miles from SFO
  - ~60% SFO arrivals
  - Monitored Oct 30, 2018 – Jan 4, 2019
  - Aircraft CNEL: 52 dBA
- **To reach a 65 dB CNEL, Palo Alto would need almost 5,000 events PER DAY**
  - This would be an airplane every 17.7 seconds throughout a 24-hour period



Lived Experience: N-Above-Ambient Accurately Captures Impact to Communities'

- **How Many? How Loud?**
  - 328 events above 35 dB ambient
  - 300+ events ≥ 50 dB
  - 137 events ≥ 60 dB
- **When? Penalties**
  - 10pm-7am: 10dB (36 ct.)
  - 7pm-10pm: 5 dB (15 ct.)
- People do not hear 50 dB CNEL



Excerpted from: Fremont, M., *Representing Aircraft Noise Impacts – A Community Perspective*, ANE 2024
Source: SFO Noise Office (ANEEM data)

Ambient Noise Today: Is Our Data Keeping Up?

TABLE B-3

ESTIMATED PERCENTAGE OF URBAN POPULATION (134 MILLION) RESIDING IN AREAS WITH VARIOUS DAY/NIGHT NOISE LEVELS TOGETHER WITH CUSTOMARY QUALITATIVE DESCRIPTION OF THE AREA (B-3 & B-4)

Description	Typical Range L_{dn} in dB	Average L_{dn} in dB	Estimated Percentage of Urban Population	Average Census Tract Population Density, Number of People Per Square Mile
Quiet Suburban Residential	48-52	50		
Normal Suburban Residential	53-57	55		
Urban Residential	58-62	60		
Noisy Urban Residential	63-67	65		
Very Noisy Urban Residential	68-72	70	7	63,000

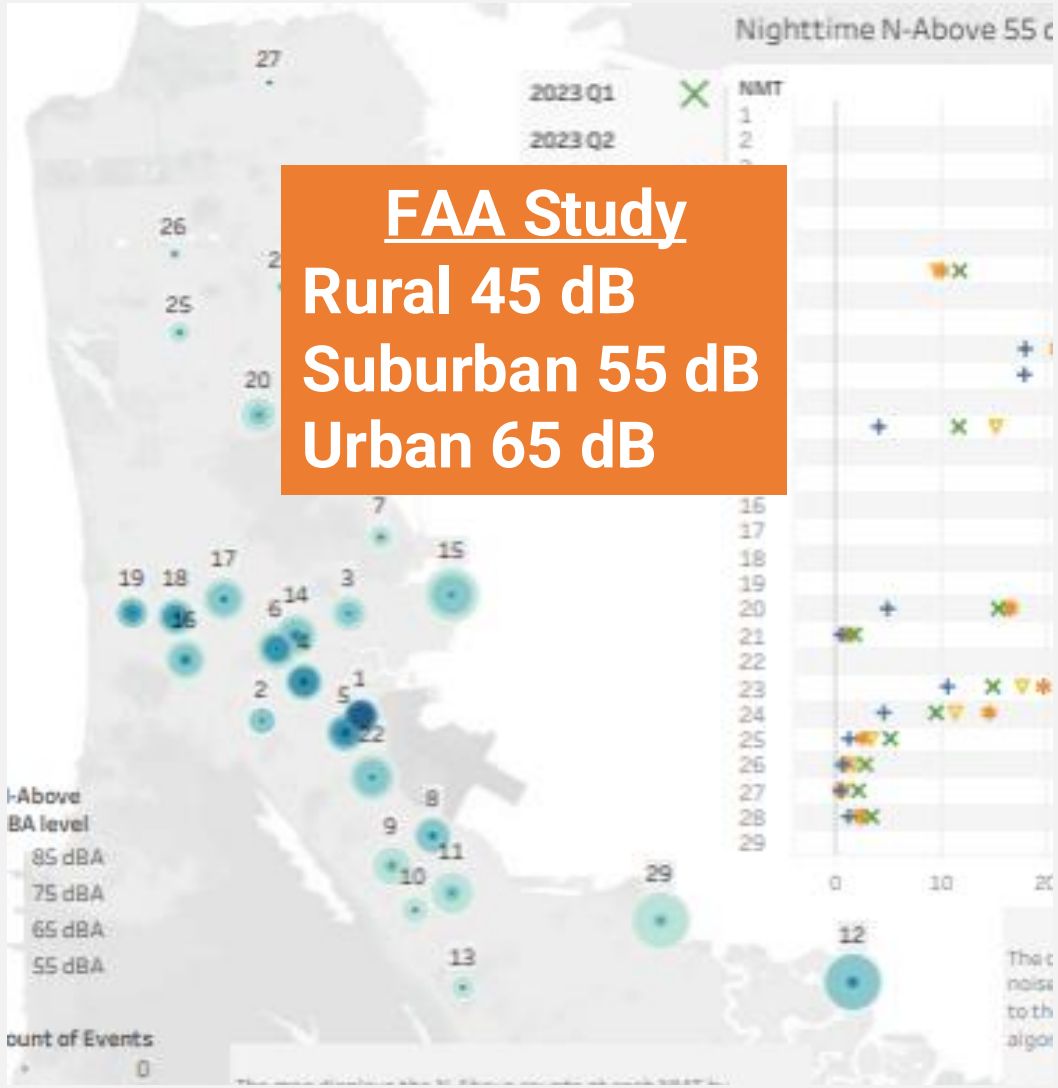
No "Rural" reference in EPA document

FAA Study
Rural 45 dB
Suburban 55 dB
Urban 65 dB

Adapted from: U.S. EPA, Office of Noise Abatement and Control (1974), Noise Levels & Public Health
Source: FAA NOISE-CON Paper (2024)

Measured Ambient Noise: Lower Than FAA Assumptions

Permanent Monitor	City	Ave. Ambient Noise In dBA
#7	Brisbane	45
#12	Foster City	42
#15	South San Francisco	45
#18	Daly City	45
#22	San Bruno	46
#23	San Francisco	47
#29	San Mateo	43
Temp Monitor	Palo Alto	34
Temp Monitor	Portola Valley	31



Monthly permanent monitoring, Aug 2023–Dec 2024
Temporary Monitor: Palo Alto, Sept 2023–Oct 2024; Portola Valley, Aug 2023 –Aug 2024
Source: SFO, https://noise.flysfo.com/data-reports/published-reports/ and https://sforoundtable.org/wp-content/uploads/2024/02/20240207PACKET-w-footer-1.pdf

People **Do Not Hear** An Annual Average "Fictitious" Day – They Hear Every Flight

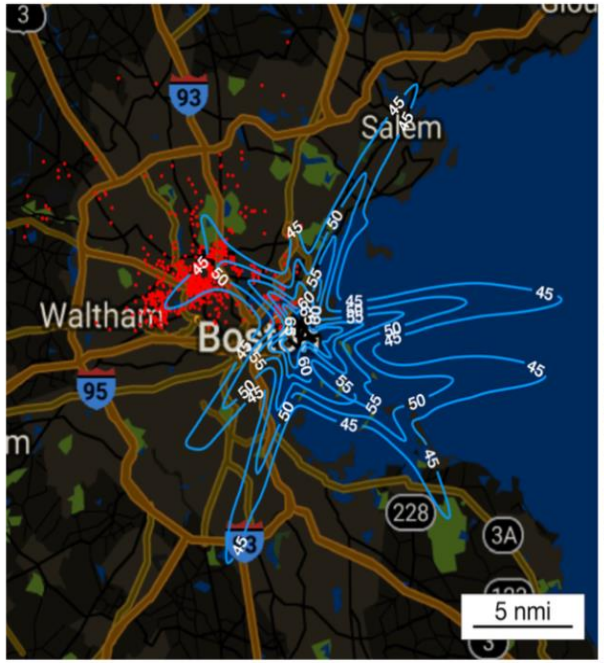


Figure 25: Annual Average Day DNL Contours

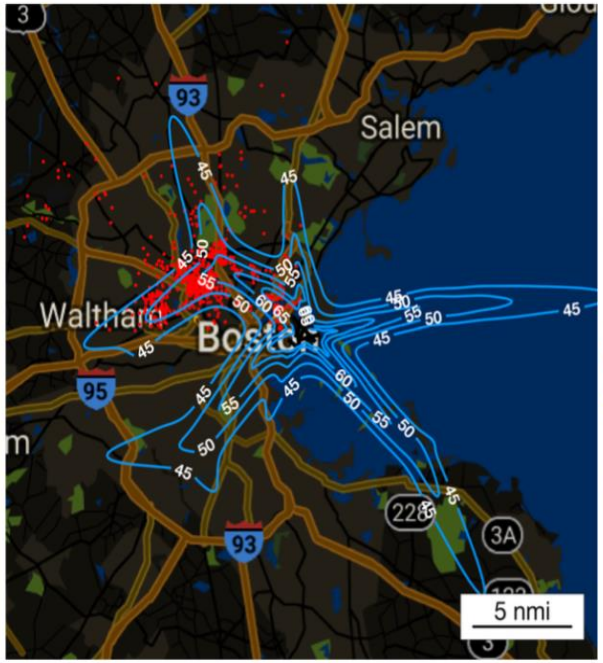


Figure 26: 33L Peak Day DNL Contours

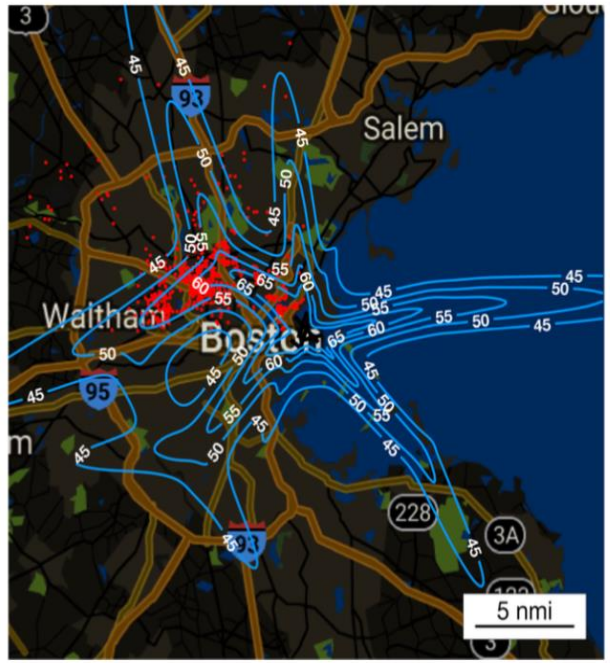


Figure 27: 33L Peak Hour DNL Contours

DNL 45 Correlates w/80%+ Complainants

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

Source: Brenner and Hansman (2017), MIT

Annual Average Day – Underestimates Impacts

Peak Day Better
Captures
Communities'
Lived Experience

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

	Procedure	Annual Average Day Operations		Peak Day Operations	Peak Day
BOS	33L dep	116	4.20x	487	May 18th, 2017
	27 dep	71	4.86x	345	September 18th, 2017
	4L/R arr	129	4.39x	567	October 12th, 2017
MSP	17 dep	174	2.42x	421	August 25th, 2017
	30L dep	151	2.61x	394	July 13th, 2017
	12L/R arr	239	2.83x	677	July 25th, 2017
	30R dep	128	2.36x	302	June 15th, 2017
LHR	9R dep	125	5.52x	690	July 17th, 2017
	27L/R arr	526	1.32x	696	June 30th, 2017
CLT	18L/C/R arr	258	3.12x	806	May 4th, 2017
	18C dep	156	2.81x	439	April 4th, 2017
	18L dep	185	2.72x	503	April 26th, 2017
	36R arr	146	2.35x	343	October 12th, 2017

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

Adapted from: Yu and Hansman (2019), MIT

FAA Study Confirms: Significant Peak Day Variation

FAA's follow-on studies used NES computations to analyze **daily DNL variability** (50–65 dB contours) across 20 airports

Key findings:

- **Daily operations varied by up to 45%** compared to the Annual Average Day (AAD)
- **Population and housing units exposed to 65 dB DNL** were, on average, **2.5 times higher** on peak days at 18 airports

Source: FAA NOISE-CON Paper (2024)

How Well Do NES Airports Reflect NextGen Impacts?

	PERFORMANCE BASED NAVIGATION (PBN) DASHBOARD (5/1/23-4/30/24)				
	Airport (NES Study)	RNAV SID	RNAV STAR	RNP AR Authorization Req	Total IFR Operations
Similar BDL Sized Airports	Bradley Intl, CT (BDL)	0	0	2	70,549 ✗
	Albuquerque Intl, NM (ABQ)	9	5	6	84,608 ?
	Syracuse Hancock Intl, NY (SYR)	0	0	2	50,548 ✗
	Boeing Field/King County, WA (BFI)	2	0	1	60,737 ✗
	Albany, NY (ALB)	0	0	2	43,843 ✗
	Billings Logan Intl, MT (BIL)	0	4	1	47,924 ✗
	Tucson Intl, AZ (TUS)	4	2	2	61,831 ✗
Large Airports Examples	Chicago O'Hare, IL (ORD)	0	10	0	721,049 ✓
	Los Angeles Intl, CA (LAX)	14	16	6	577,558 ✓

Source: FAA Performance Based Navigation (PBN) Implementation and Usage Dashboard – https://www.faa.gov/air_traffic/community_engagement/dashboard/, data retrieved 3/1/25

FAA Study: NA Metrics Add Value—Even DNL Alone Falls Short

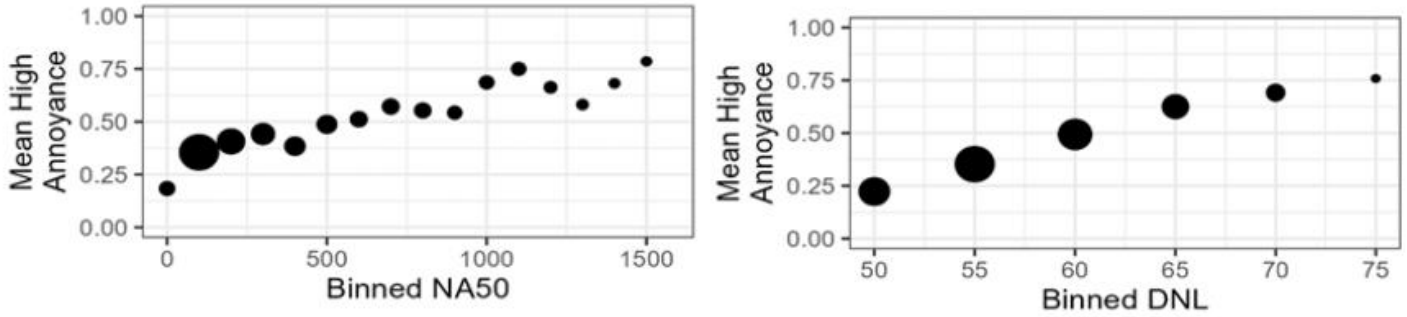


Figure 5: Relationship between Select Binned NA Values and DNL and High Annoyance, with the Number of Observations in each Bin Proportional to the Size of the Points [4]

Source: FAA NOISE-CON Paper (2024)

- **DNL models outperformed N-Above in 75% of cases**
- **Replacing DNL with N-Above is "unwarranted"**
  - Based on any of the seven studies NA L_{max} measures
- However, FAA also found that **N-Above and hourly metrics add insight** beyond DNL alone
- **Next Steps (recommended):**
  - Review data behind the 25% where N-Above outperformed DNL
  - Recognize NextGen not well represented in NES airports
  - Use measured data from high-NextGen airports, such as SFO and BOS, beyond just the NES airports, for validation

FAA Study: Evaluating NA vs. Traditional DNL and Leq Contours

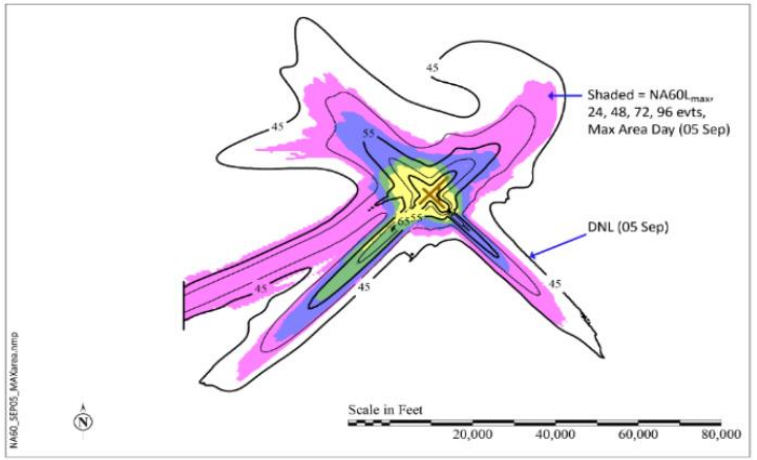


Figure 4a: Overlay of Select DNL and NA60L_{max} Contours for Day of Maximum Area of the NA60L_{max} Contours [4]

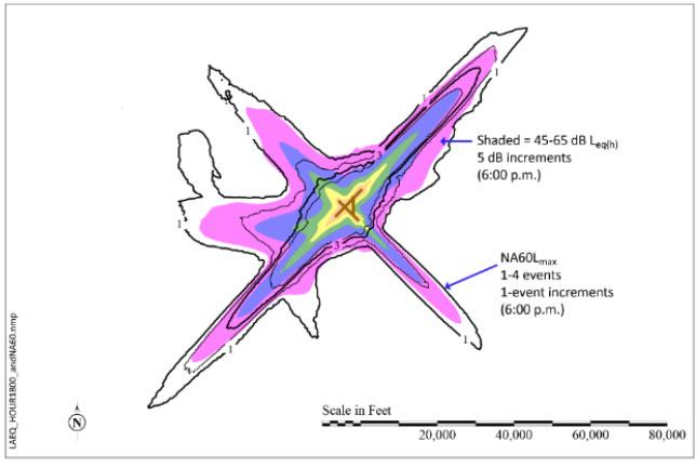


Figure 4b: Overlay of Select $L_{eq(h)}$ and NA60L_{max} Contours for the Hour of Maximum Flight Operations (6 p.m.) [4]

Source: FAA NOISE-CON Paper (2024)

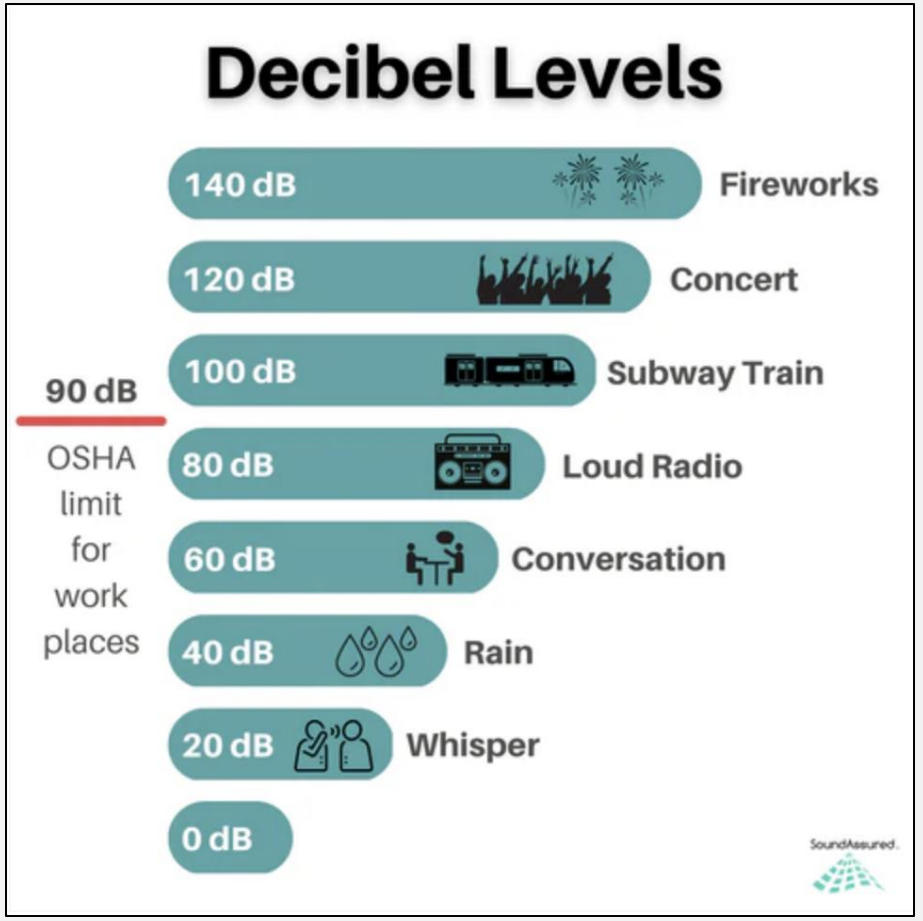
- **BDL Study Airport**: DNL contours, medium-sized airport
- "An L_{max} of **60 dB** was chosen because a steady sound of 60 dB is approximately the threshold of speech interference for normal conversation"

Noise Impact Depends on Your Activity and Ambient Noise

- **Aircraft noise <60 dB** considered non-disruptive based on conversation levels
- However, people are **not in conversation all day**—impact depends on **activity and ambient noise**
- **Quieter areas experience greater disturbance** "Larger changes in NA L_{max} were observed in quieter rural areas compared to urban areas."
- **Noise affects more than conversations**—it disrupts:

  ✔ Sleep ✔ Reading ✔ Relaxation ✔ Concentration

- DNL penalties recognize quieter nights, but not ambient noise



Source: FAA NOISE-CON Paper (2024)

“Normal Voice” Level?

FAA NA to DNL Contour Study

“…a steady sound level of 60 dB is approximately the threshold of speech interference for normal conversation [10].”

Source: FAA NOISE-CON Paper (2024)
Citing U.S. EPA, *Public Health and Welfare Criteria for Noise* (1973) [10]

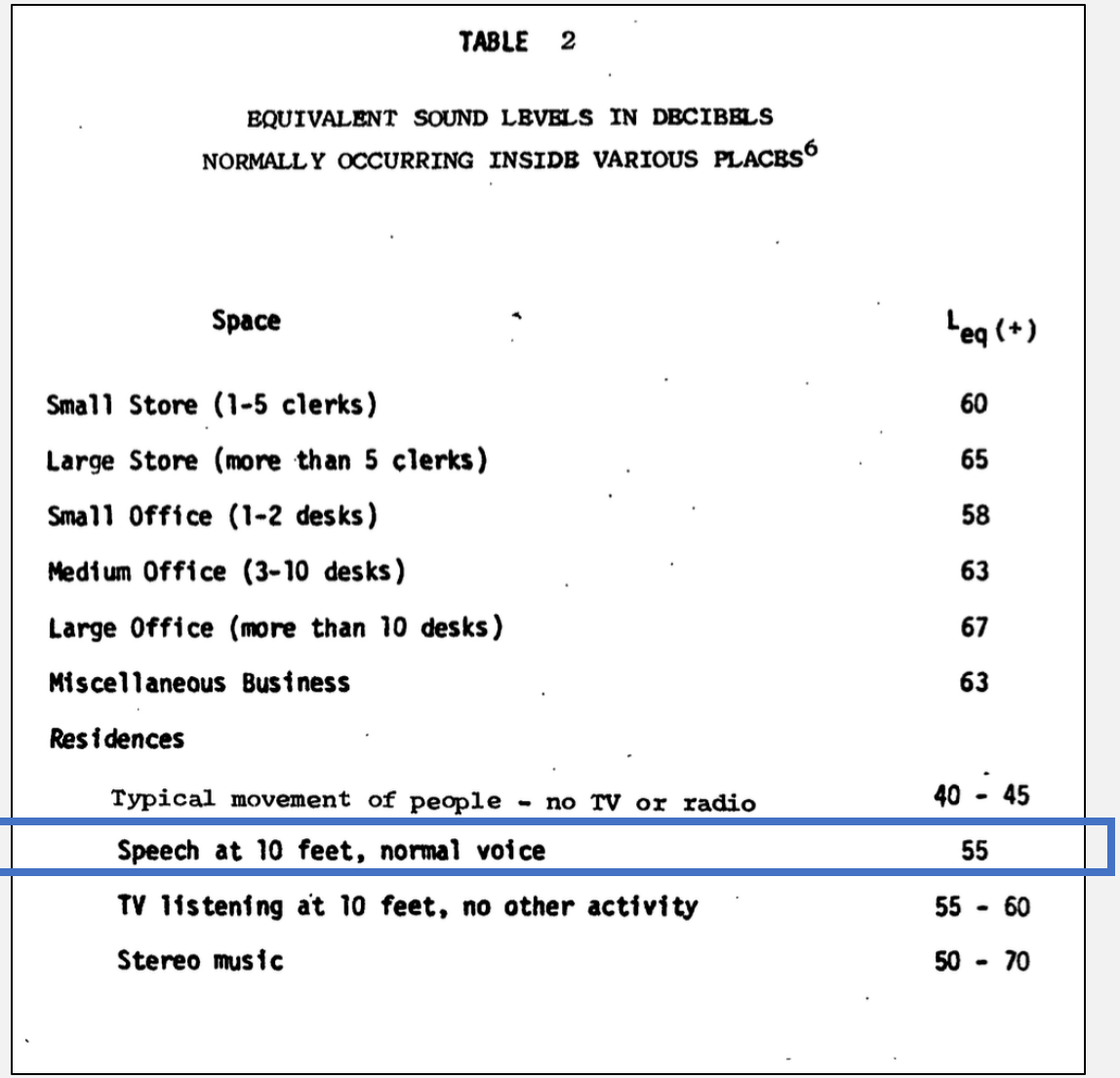


TABLE 2

EQUIVALENT SOUND LEVELS IN DECIBELS
NORMALLY OCCURRING INSIDE VARIOUS PLACES[6]

Space	L_{eq} (+)
Small Store (1-5 clerks)	60
Large Store (more than 5 clerks)	65
Small Office (1-2 desks)	58
Medium Office (3-10 desks)	63
Large Office (more than 10 desks)	67
Miscellaneous Business	63
Residences	
Typical movement of people - no TV or radio	40 - 45
Speech at 10 feet, normal voice	55
TV listening at 10 feet, no other activity	55 - 60
Stereo music	50 - 70

U.S. EPA, Office of Noise Abatement and Control (1974), Noise Levels & Public Health
FAA NOISE-CON Paper (2024)[11]

Penalty Applied to Only One Metric

- "**DNL adds 10 dB** to aircraft noise occurring at night (between 10 PM and 7 AM) whereas the **Leq(h)** metrics **add nothing** to nighttime noise."
- Study acknowledges–differences between the metrics accounts for some of the variation between AAD DNL and Leq(24h) contours
- Comparisons between DNL and NA were flawed, as **penalties** were **applied to only one metric**
- BDL Study Airport

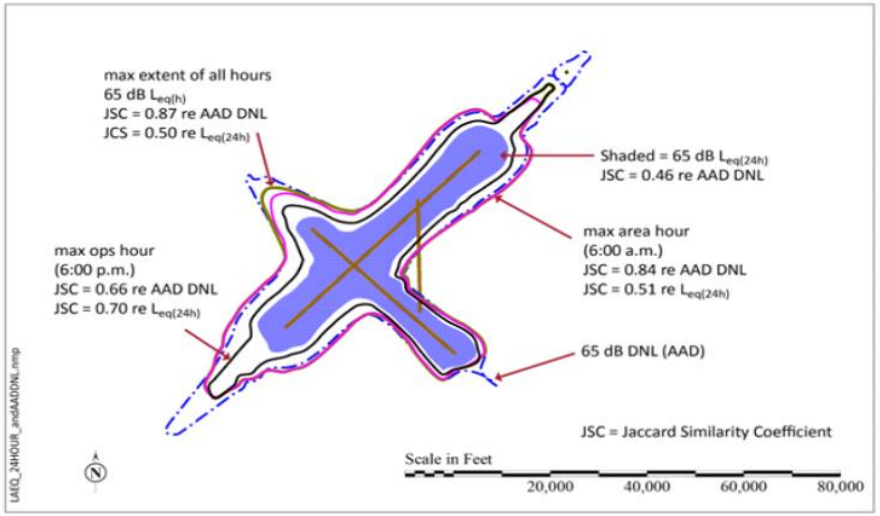


Figure 7b: Comparison of the AAD $L_{eq(24h)}$ Contour with the AAD DNL 65 dB Contour and Three Other Operational Concepts [4]

Source: FAA NOISE-CON Paper (2024)

FAA Study: Significance Thresholds

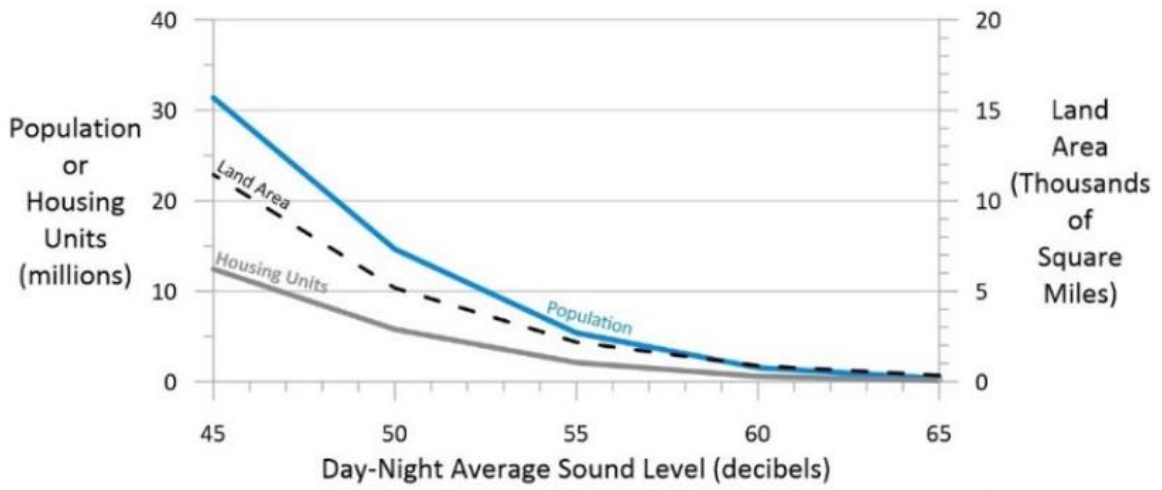


Figure 6: People, Housing Units and Land Area Exposed to DNL Between 45 dB and 65 dB at 92 of Top 100 US Airports in 2015. Source: Data from BAH/VHB report in [4]

Study Findings

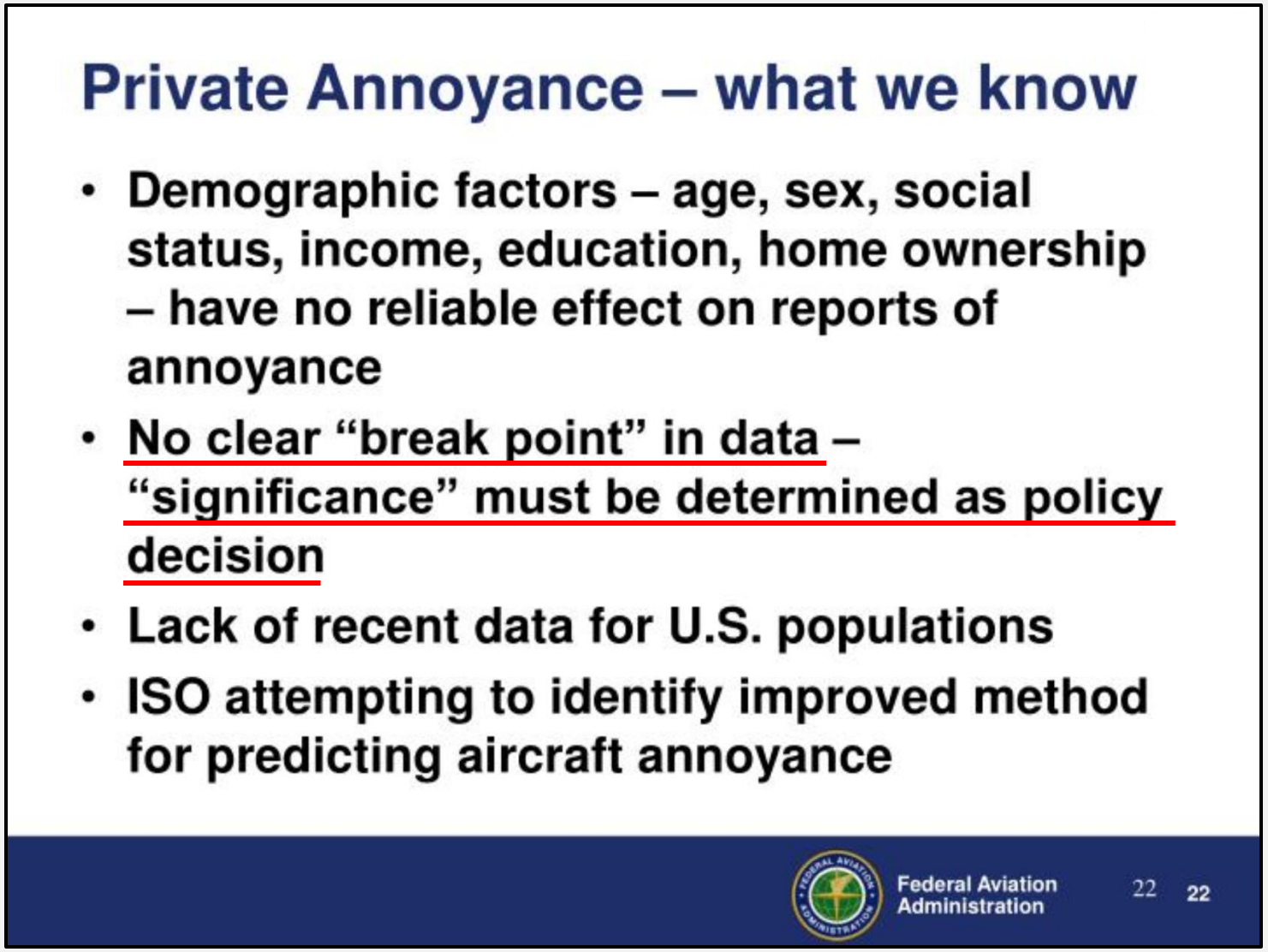
- Lowering the significance threshold from **65 dB to 60 dB** would increase the affected population nearly **4x**, while reducing it to **45 dB** would increase the population by **90x**
- Such increases could trigger a higher level of NEPA review, expanded cumulative impact analysis, and broader community engagement

Not Addressed

- **Different** thresholds and metrics for two **different** noise environments
- Mitigation strategies **not all based** on population (e.g., Soundproofing–Yes, Dispersion–No)

Source: FAA NOISE-CON Paper (2024)

Metrics Reflect Experience, Thresholds Reflect Policy



New Thinking to Realize a 21st Century Noise Policy

Rosenblith-Stevens Model

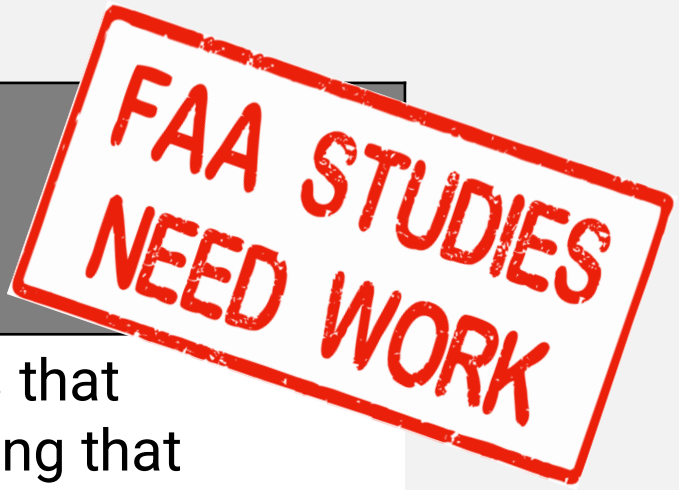
Rosenblith and Stevens[15] developed, in the early 1950's, a model for relating the probable community reaction to intrusive aircraft noise. This model included seven factors that were corrected for.

1. Magnitude of the noise.
2. Duration of the intruding noise.
3. Time of the year (winter/summer; windows opened or closed). ☒ Peak Day
4. Time of day (night/day). ☒ Evening and Night Penalties
5. Outdoor noise level when the intruding noise is not present. ☒ Validated, Accurate Ambient Noise
6. History of prior exposure of the community to the intrusive noise.
7. Frequency components in the noise or its impulsive nature.

Other methods have been proposed. Most of these represent some modification of the basic model of Stevens and Rosenblith.

Source: U.S. EPA, *Public Health and Welfare Criteria for Noise* (1973)

Lived Experience Matters: Critical Policy Requirements



- **Studies must be well-designed** with a scope and factors that accurately reflect communities' lived experiences, ensuring that generalizations are not made from an overly narrow scope or unrepresentative samples.
- **Noise policy must address two distinct noise environments**—near airports and farther away – while recognizing that ASNA (1979) allows a system of metrics, not just a single metric like DNL.
- **Metrics must fully capture the count and cadence of disruptive events**, as these are the primary sources of annoyance to communities.
- **Decision-making must be based on communities' lived experience** rather than historical studies on loudness perception, measurement convenience, or existing regulatory customs that underrepresent community impacts.

THEN

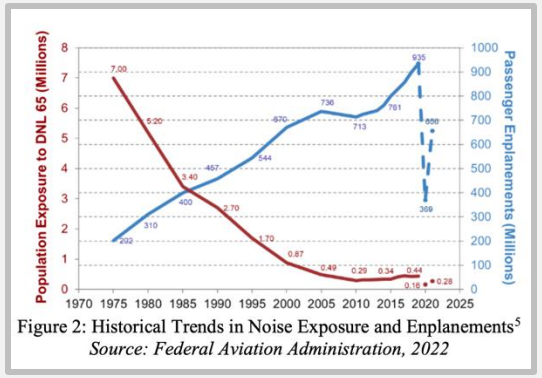
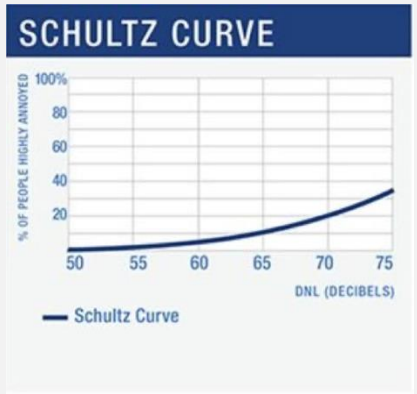
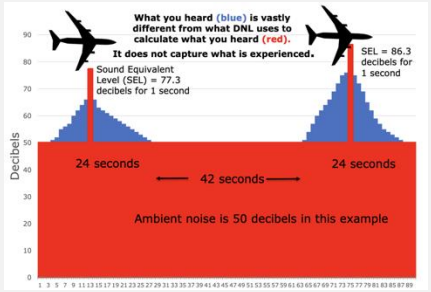


Figure 2: Historical Trends in Noise Exposure and Enplanements[5]
Source: Federal Aviation Administration, 2022



FAA Study

Rural 45 dB
Suburban 55 dB
Urban 65 dB



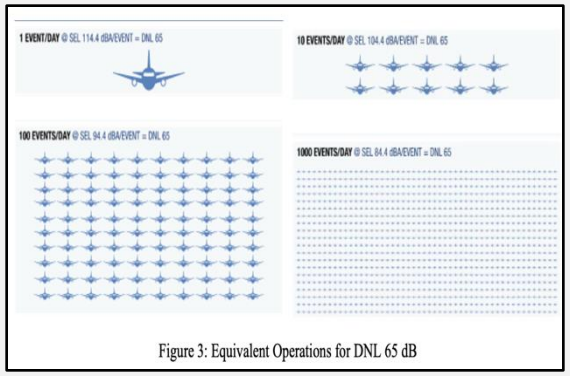
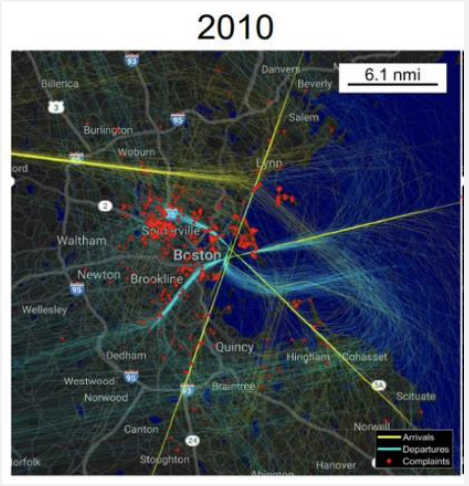


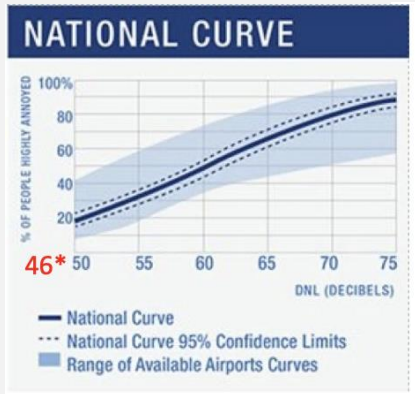
Figure 3: Equivalent Operations for DNL 65 dB



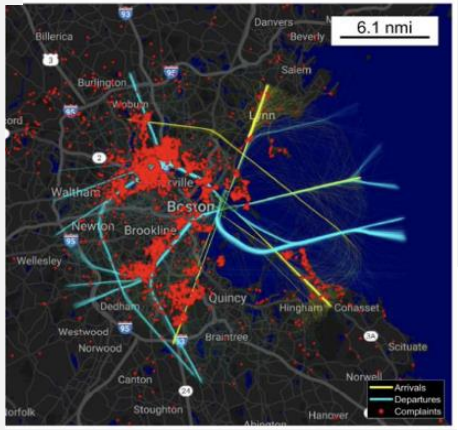
Equation 4: Formula for DNL. Source: HMMH [7]

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

NOW



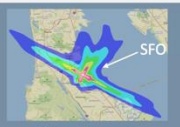
*DNL extrapolated for 12.3% annoyance

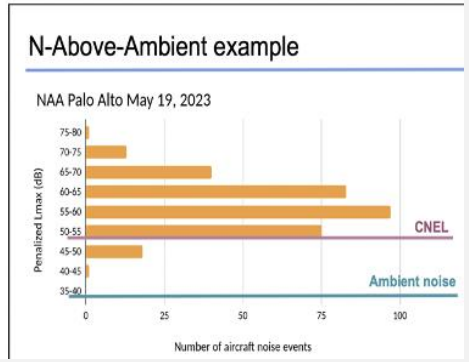


Equation 3: Formula for N_{above}

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

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%

Community	 Near Airport	 Farther from Airport Near Flight Path(s)
Noise Sources	Dep., Arr., and ground-based operations	Dep. and/or Arr.: Concentrated corridors and high cadence overflights
Ambient Noise	Typically, urban or suburban	Typically, suburban or rural
Metrics	DNL and non-DNL	Non-DNL e.g. N-Above-Ambient
Noise Reduction Strategies	Examples: Sound insulation, land use, ground-based noise abatement	Examples: community sensitive routing, residential avoidance, quieter procedures, and dispersion to reduce concentrated impacts



Adverse Health Impacts

APPENDIX

20 Airports in Focus: A Limited Picture of NextGen

Table 3-3 and Figure 3-1 show the 20 airports in the sample. As described in Chapter 7, noise modeling also included SEA due to the influence of its aircraft operations on BFI.

Table 3-3. The 20 Airports in the Sample

Identifier	Airport Name	Identifier	Airport Name
ABQ	Albuquerque International Sunport	LAX	Los Angeles International
ALB	Albany International	LGA	LaGuardia
ATL	Hartsfield-Jackson Atlanta International	LIT	Bill and Hillary Clinton National Airport / Adams Field
AUS	Austin-Bergstrom International	MEM	Memphis International
BDL	Bradley International	MIA	Miami International
BFI	Boeing Field / King County International	ORD	Chicago O'Hare International
BIL	Billings Logan International	SAV	Savannah / Hilton Head International
DSM	Des Moines International	SJC	Norman Y. Mineta San Jose International
DTW	Detroit Metropolitan Wayne County	SYR	Syracuse Hancock International
LAS	McCarran International	TUS	Tucson International

FAA Analysis of the NES Survey, 2021