

An aerial photograph showing a mix of residential houses and large industrial buildings. A large pond is visible on the right side. The area is surrounded by dense green trees. The sky is clear and blue.

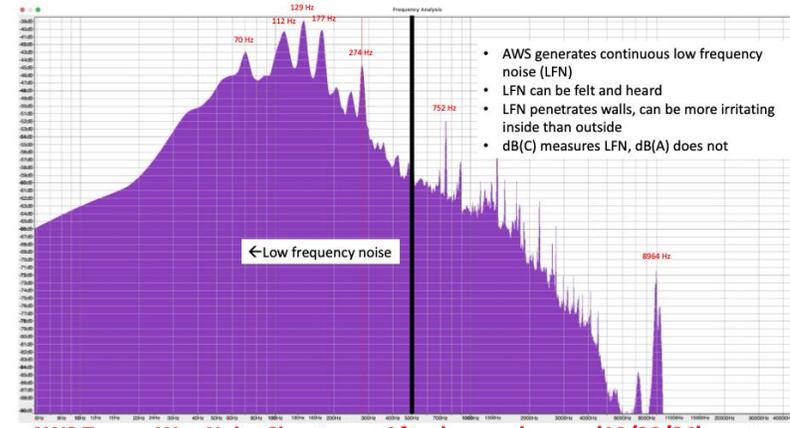
# Great Oak Status - DCOAG Proposed Ordinance Levels 9 April 2025

Great Oak Subdivision  
Dale Browne (Great Oak)

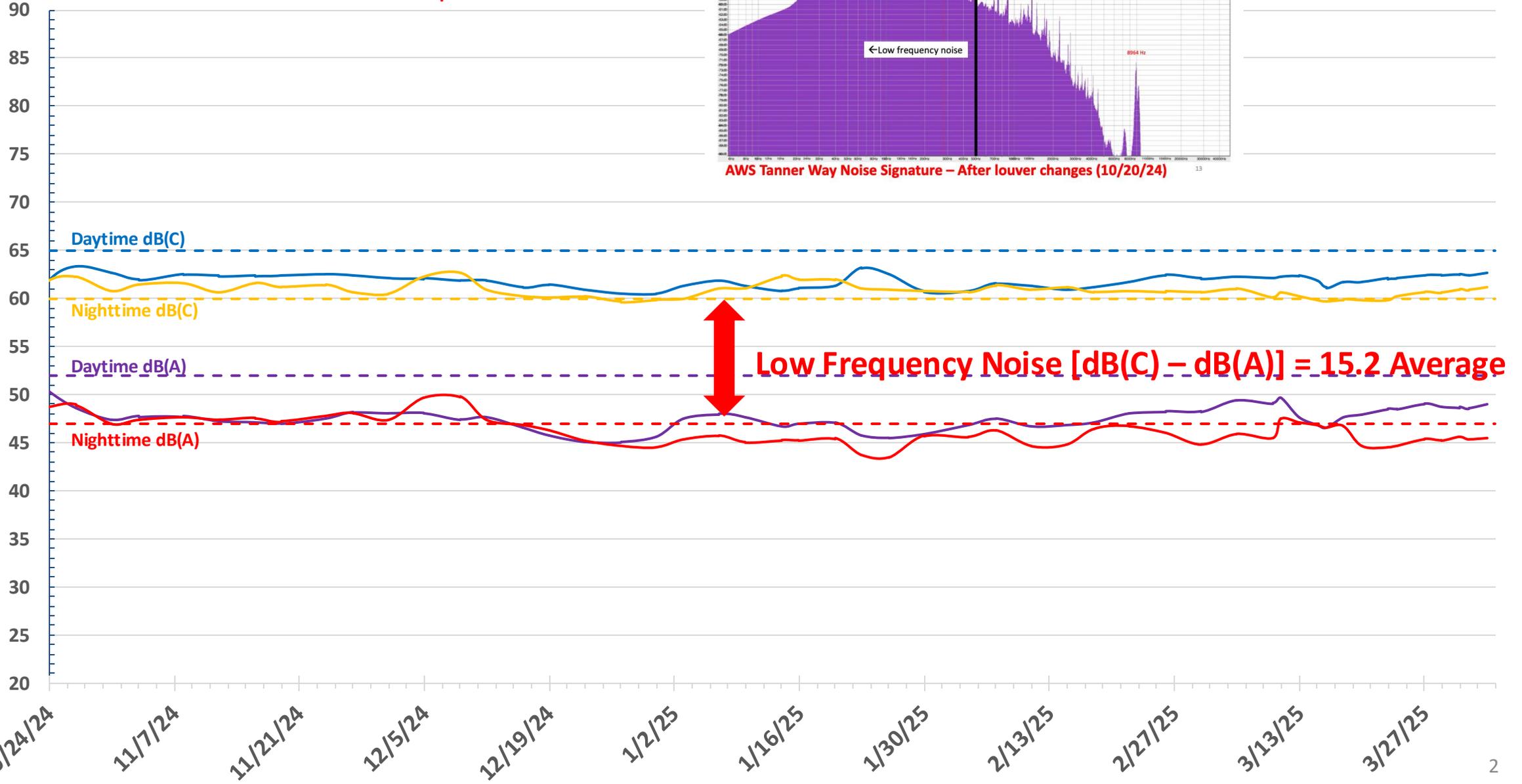
# Great Oak Noise - Proposed Ordinance Levels

## Great Oak Measurements

18 Oct 2024 - 4 Apr 2025



AWS Tanner Way Noise Signature – After louver changes (10/20/24)



# Noise Limit Proposal History – Continuous Sound

## 1 – Continuous Sound, L50s, + 5 dB

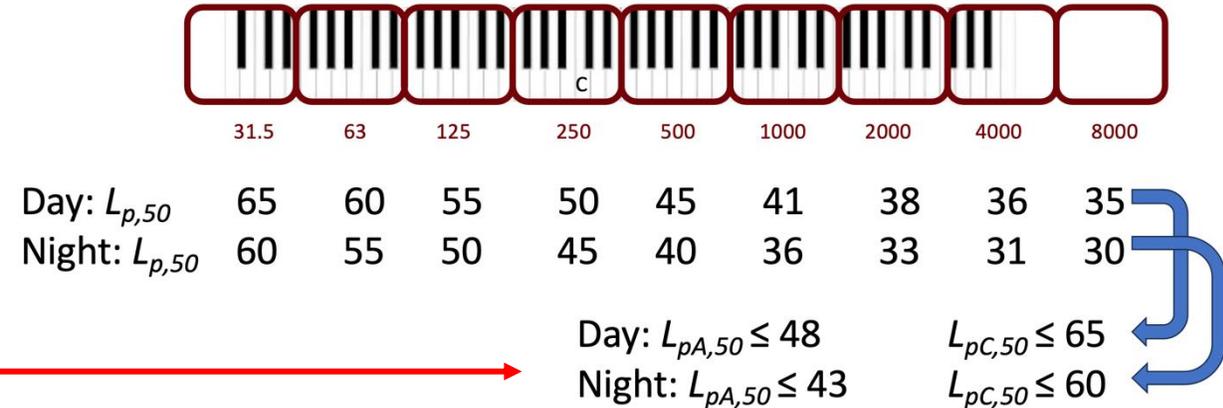
- Median + 5
- Windspeed ≤ 6 mph
- Option to overlook if critters active

Residential		
Band	Day $L_{p50}$	Night $L_{p50}$
31.5	65	60
63	60	55
125	55	50
250	50	45
500	45	40
1000	41	36
2000	38	33
4000	36	31
8000	35	30

Extra protection for continuous noise  
The equivalent steady state levels, if all bands maxed out:

Weighting	Day	Night
$L_{pA,50}$	48	43
$L_{pC,50}$	65	60

## Octave-band sound levels, continuous



History of proposed changes to Residential Noise Levels					
	dB(A) Day	dB(A) Night	dB(C) Day	dB(C) Night	Remarks
Current Ordinance	60	55	N/A	N/A	
Criterion Development	50	44	N/A	N/A	20 Nov 2024 - David Nelson to DCOAG. Manassas "Quiet Urban and Normal Suburban Residential"
Criterion Development	45	39	N/A	N/A	20 Nov 2024 - David Nelson to DCOAG. Many PWC Residential Areas "Quiet suburban Residential"
Criterion Development	50	45	65	60	Proposed with +5dB, Page 11
Criterion Development	52	47	65	60	Data Centers @ Criteria, Page 12, included in draft Ordinance Feb 2025
Continuous Ord. Limits	48	43	65	60	Time-Varying and Continuous Ordinance Limits, 8 Jan 2025. Derived from Octave band limit addition
Site Visits	52	47	65	60	DCOAG Site Visit Data and Observations 20250206, 6 Feb 2025

Sec. 14-4. Industrial, Construction and Commercial Noise

14-4.1 - Maximum permissible sound levels generally.

A. Location, Type of Noise and Measurement

Except as otherwise provided, any noise which emanates from any operation, activity or source and which exceeds the maximum permissible sound pressure levels established in Tables 14.4.1 and 14.4.2 below is hereby prohibited. The location of the measurement shall determine the applicable zoning district classification noise limit. At property boundaries between dissimilar zoning district classifications, the limits of the more restrictive classification shall apply.

Table 14-4.1 MAXIMUM PERMISSIBLE EQUIVALENT CONTINUOUS SOUND PRESSURE LEVELS (Leq)

Zoning District Classification	Maximum dBA Daytime	Maximum dBA Nighttime	Maximum dBC Daytime	Maximum dBC Nighttime
Residential	52	47	65	60
Mixed Use	62	57	70	65
Commercial	65	60	75	75
Industrial	79	72	80	80

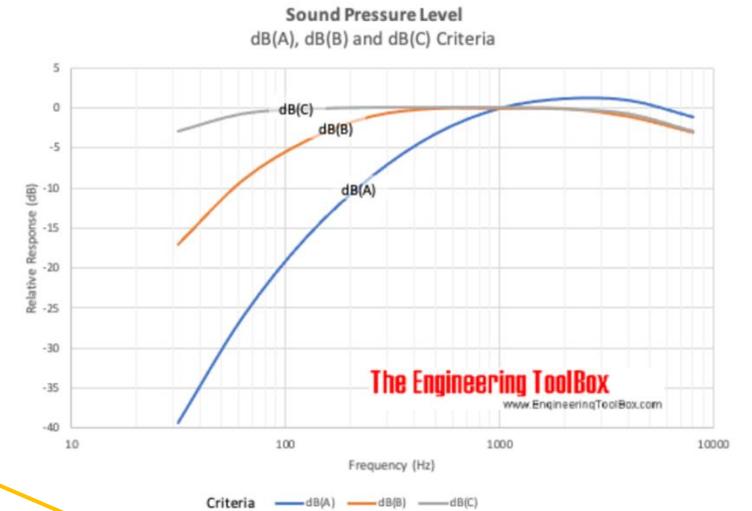
These numbers include a +5 dB increase to help mitigate the impact on other noise emitting entities. The DCOAG has not agreed to this. The resident team has proposed that continuous emitters be separately addressed at lower levels (w/o +5 dB at a minimum).

Table 14-4.2 MAXIMUM PERMISSIBLE MEDIAN SOUND PRESSURE LEVELS (L<sub>50</sub>) FOR RESIDENTIAL ZONING DISTRICTS

OCTAVE BAND (Hz)	DAYTIME	NIGHTTIME
31.5	65	60
63	60	55
125	55	50
250	50	45
500	45	40
1,000	41	36
2,000	38	33
4,000	36	31
8,000	35	30

Nighttime

Daytime

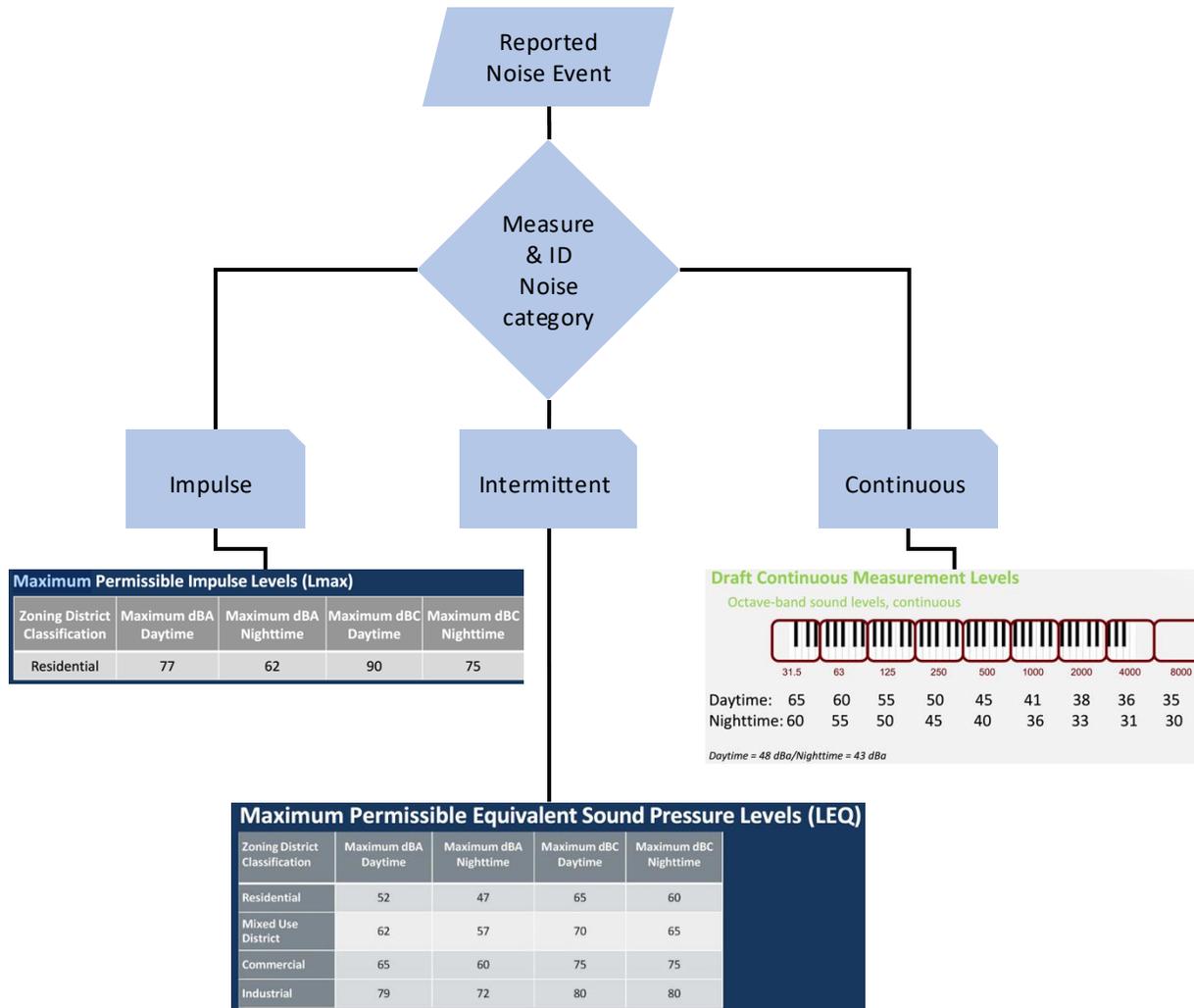


Higher than Leq Table for dBC?

dB Calculator

31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB	dB(A)
60	55	50	45	40	36	33	31	30	61.7	43.3
65	60	55	50	45	41	38	36	35	66.7	48.3

# How does the new ordinance determine violations?



14-4.2(4) Ongoing operations or activities shall be measured over a minimum **10-minute duration**.

a. This requirement shall not prohibit county staff or law enforcement from collecting shorter-duration observations subject to nuisance complaints regarding short-term activities or operations. Such observations shall consist of a **minimum of three instantaneous readings, or a minimum 60-second duration reading**. The **geometric mean of these readings will be used as the average sound level** and compared to the levels set forth in section 14-4 above.

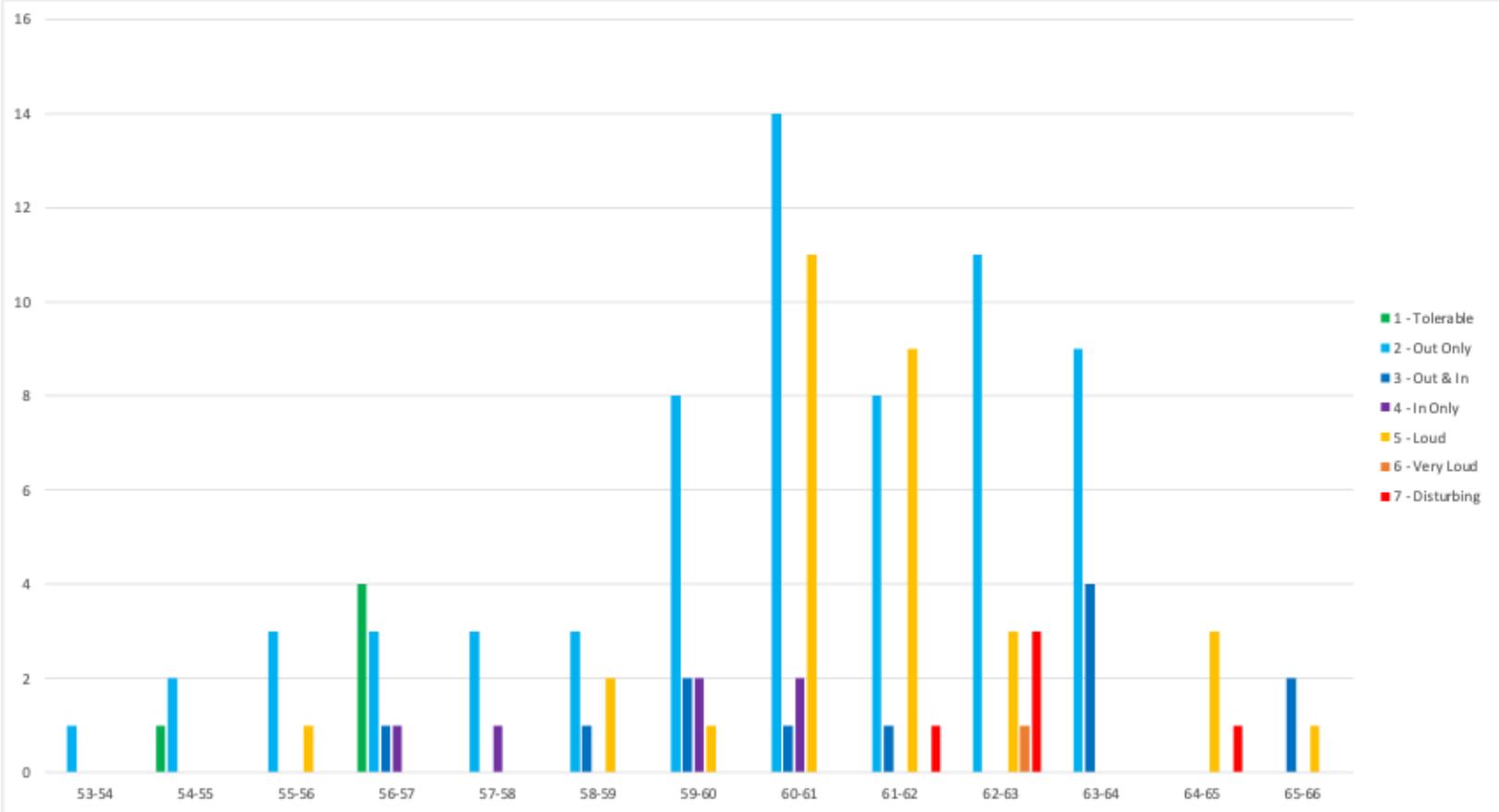
b. If the background noise is equal to the levels set forth in section 14-4 above, **three dB shall be subtracted out of the average sound level**.

c. Impulse sound sources observed to have Lmax exceeding Leq by 25 dB during daytime hours, or by 15 dB during nighttime hours, shall **have 5 dB added to the measured Leq for purposes of comparison** to Table 14-4.1.

## Questions

1. [b. above] What is background noise in Great Oak (already has noise) so how can one determine that 3 dB should be subtracted?
2. [c. above] Impulse is determined by Lmax not Leq, so what does +5 to Leq do for enforcement?
3. Is a 10-minute duration adequate for "Continuous" classification? Proposal for using this to initiate a 30-day perimeter monitoring to cover legal challenges needs to be considered

# DCOAG Resident Annoyance Perception



Great Oak informal perception comments taken along with measurements  
16 Feb to 4 Apr 2025, dB(C)

# DISCUSSION ONLY – NOT FINAL

## Noise Level Ceilings based on Great Oak Data

- Represents a CEILING for aggregated noise affecting a residential area
- Recognizes that the data center noise issue is primarily with low frequency noise
- Considers noise perception with very few measurements below 60 dB(C)
  - More low readings might change that
- Eliminates +5db for false positives
- Reduces Low Frequency octaves more than others to drive meaningful reductions in noise intensity and annoyance
- Does NOT account for multiple collocated data center campuses
  - Will require noise budgets or other means to force lower levels to stay below the aggregated levels in the affected residential area – proposals thus far have been silent on this
- Any level over 45 dB(C) means that PWC residents would be making a concession to huge companies that are impacting one of most precious assets

### Continuous Industrial Noise (Octave Bands)

Band	Nelson/JMT		Based on Great Oak Data		Δ Day	Δ Night
	Day Lp50	Night Lp50	Day Lp50	Night Lp50		
31.5	65	60	59	54	(6.0)	(6.0)
63	60	55	53	48	(7.0)	(7.0)
125	55	50	48	43	(7.0)	(7.0)
250	50	45	43	38	(7.0)	(7.0)
500	45	40	40	35	(5.0)	(5.0)
1000	41	36	36	33	(5.0)	(3.0)
2000	38	33	35	31	(3.0)	(2.0)
4000	36	31	34	30	(2.0)	(1.0)
8000	35	30	34	30	(1.0)	0.0
<b>dB(A)</b>	<b>48</b>	<b>43</b>	<b>44</b>	<b>39</b>	<b>(4.7)</b>	<b>(3.9)</b>
<b>dB*</b>	<b>67</b>	<b>62</b>	<b>60</b>	<b>55</b>	<b>(6.3)</b>	<b>(6.3)</b>
<b>Δ dB - db(A)</b>	<b>18</b>	<b>18</b>	<b>17</b>	<b>16</b>	<b>(1.6)</b>	<b>(2.4)</b>

\*dB includes more of 31.5 Octave than dB(C)

### Intermittent Noise (Leq)

Zoning District Classification	TO		TO	
	Maximum dBA Daytime	Maximum dBA Nighttime	Maximum dBC Daytime	Maximum dBC Nighttime
Residential	48	43	60	55
Mixed Use District	60	55	70	65
Commercial	65	60	75	75
Industrial	79	72	80	80

-2 dB(A) - Why was mixed use was increased by 2 day/night?

# DISCUSSION ONLY – NOT FINAL

## Approach for Multiple Data Center Campuses

TO - Multiple Campuses				
Zoning District Classification	Maximum dBA Daytime	Maximum dBA Nighttime	Maximum dBC Daytime	Maximum dBC Nighttime
Residential	48	43	60	55
Residential - 2 NCINS*	45	40	57	52
Residential - 3 NCINS*	42	37	54	49
Residential - 4 NCINS*	39	34	51	46
Mixed Use District	60	55	70	65
Commercial	65	60	75	75
Industrial	79	72	80	80

\*NCINS = Nearby Continuous Industrial Noise Sources, Limit applied to each industrial noise emitter

- Avoid statutory concerns with noise budgeting
- Similar approach can be applied to octave band calculations if retained
- Classification needs to be defined and named
- PWC [Planning] Department should have responsibility to look at all zoned data center parcels to identify applicable table and date of applicability (operational..)
  - Consider using linear distance/direction to/from affected residential area, not all may be "adjoining" each other so avoid that in the definition
- May need more than 3 rows
- Need to address jurisdictional concerns as well (Project Gold)

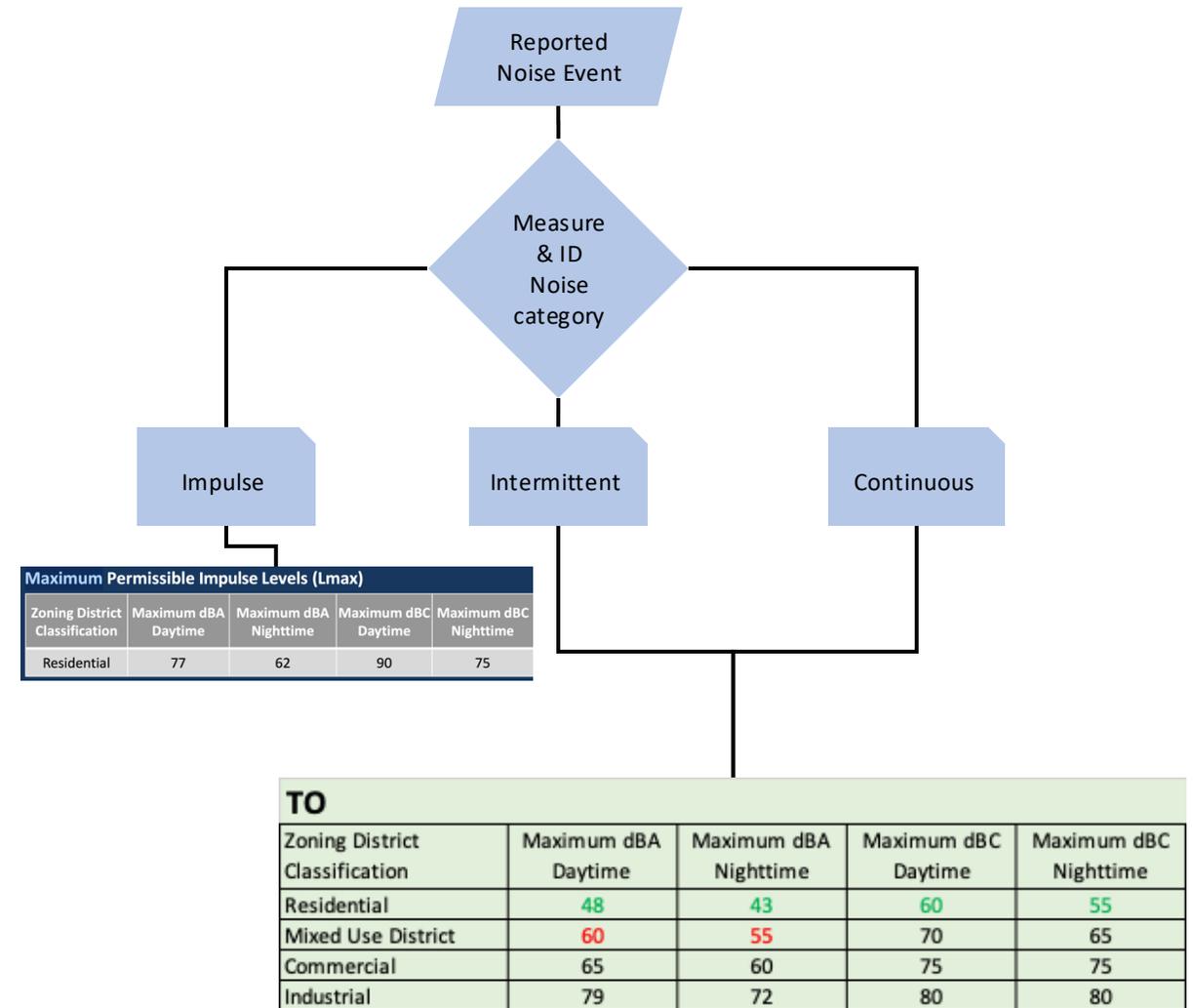
# Is there a simpler approach?

- Issues

- Impulse (defined) and intermittent (not defined) are close in nature, but have different limits and methods (Lmax/Leq)
  - may be challenged in court by "type of noise" since Impulse levels are more lenient.
- Continuous (defined as "essentially constant") uses octave bands requiring further measurement analysis/calculations
  - Requires 10 minutes of Leq to categorize as "Continuous"
- Added octave bands levels for CONTINUOUS noise results in higher dBC noise limits than the Intermittent table
  - Complicated measurement requiring special training and mathematical analysis
  - Legal challenges will be complicated and costly to PWC
- Complicated process for PWC PD, requires calculation of geometric mean.
- Does not account for co-located data center campus "Noise Budgets"
  - Addressing the +3 dB per additional data center is mandatory, even if this means setting lower levels to avoid statutory restrictions

- Change Proposed

- Define Continuous as "Continuous Industrial Noise"
- Define "Intermittent"
- Consider dropping octave bands
- Apply table 14-4.2 to consistently to both Intermittent and Continuous noise
- Reduce the Residential levels per this slide
  - Removes +5db buffer added by staff
  - Better supports "noise budgets" to address additive noise from N+x centers
  - Supported by 3 years of data recorded in Great Oak
  - Consider specific exemptions for non-industrial Intermittent noise to manage concerns for hospitals and other public entities



# Resident Testing Goals and Approach

- Will involve the collection and correlation of measurements (meter) and homeowner perceptions of the current data center noise
- Collect 72 hours of measured noise data, from 3 Great Oak locations
  - Include dB(A), dB(C), Octave bands and audio recordings
- Gather Great Oak Homeowner noise perceptions 5 to 10 times per day from at least 10 affected or potentially impacted homes
  - Will benefit from an online survey tool, hopefully 50 to 100 entries over 3 days
  - To be correlated by time of day and meter measurement levels
  - Location [address] possible but may not add much for analysis

# Resident Testing Design

## Metering Requirements

- Three locations
  - 10200 and 10224 Winged Elm - confirmed
  - Loblolly possible after 4/15 (front yard)
  - 3 days w/weekend, outside only
- Outside only
  - Technical and privacy issues inside
- Measurement guidance set/agreed under consultation with Mr. Nelson
- Raw data made available to the DCOAG to correlate perceptions with measurements

## Human Perception Requirements

- Perception survey will be taken prior to or without use of a meter
- Simple and quick to use
- Can be imported into spreadsheet
- Consider perceived noise annoyance during the measurement period
  - Survey options on next slide
- Goal is to get as many residents on the Tanner Way side of Great Oak as possible to complete an online survey, 5 to 10 times per day/night throughout the measurement period

# Perception Survey Options

**Loudness** - the attribute of auditory sensation in terms of which sounds can be ordered on a scale extending from quiet to loud” (Moore, 2004, p. 127). It is influenced by the spectral content and temporal variations of the sound as well as by intensity.

**Annoyance** - a person’s individual adverse reaction to noise. The term reaction to noise denotes an emotional response and may be related to dissatisfaction and bother due to the sound (Holm Pedersen, 2007), also ISO 15666 (SIS, 2002).

**Table 1.** Rating test labels.

<i>Loudness</i>		<i>Annoyance</i>	
Unpleasant	7	Unpleasant	
Very loud	6	Extremely annoying	
Loud	5	Very annoying	
Comfortable	4	Annoying	
Soft	3	Slightly annoying	
Very soft	2	Not annoying	
Inaudible	1	Inaudible	

Source: Nordic Audiological Society, Loudness and annoyance of disturbing sounds – perception by normal hearing subjects

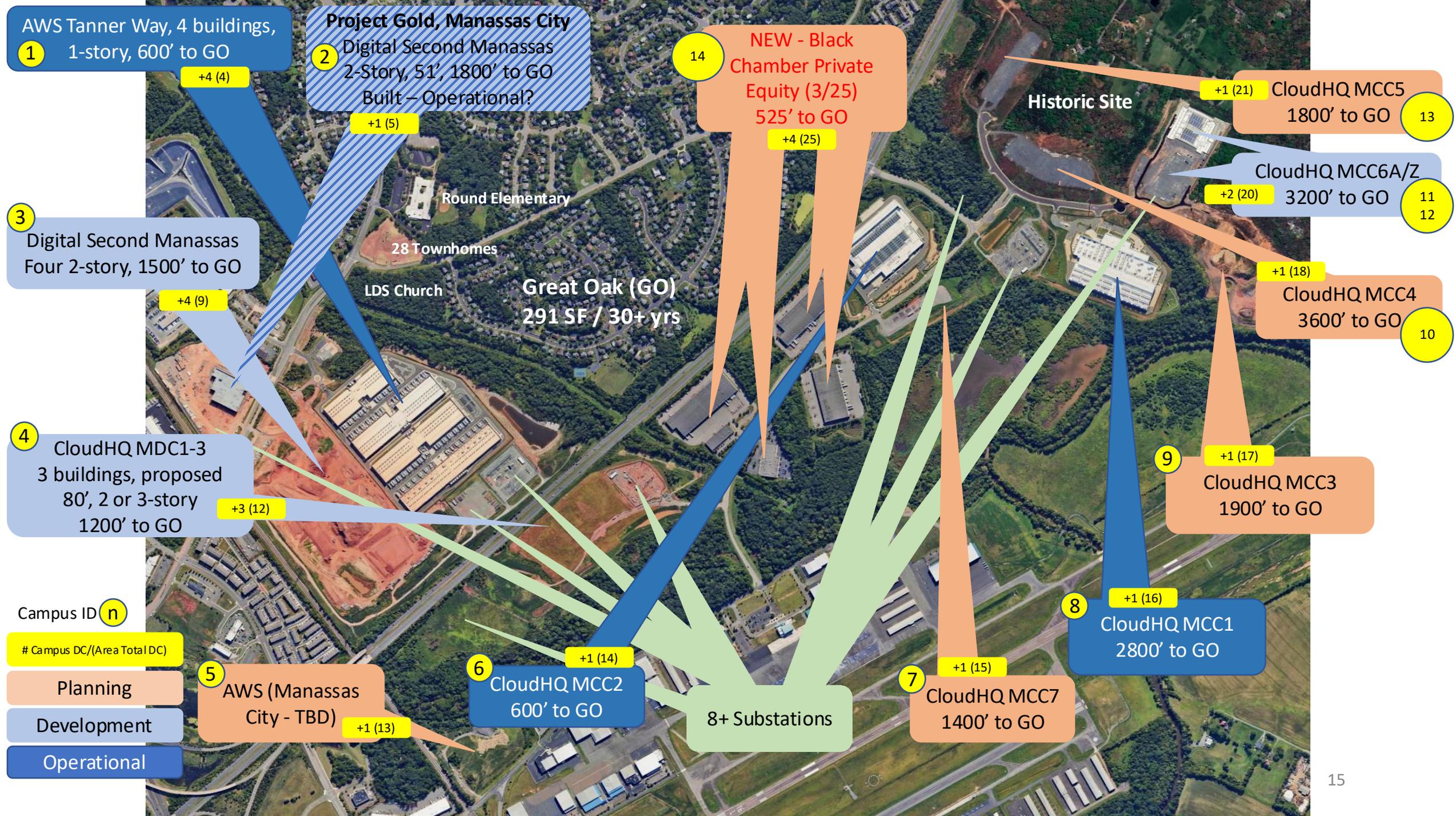
- Option 1: Thinking about the noise you are hearing, how much does noise from the nearby data center bother, disturb or annoy you?
  - [1] Not at all, [2] slightly, [3] moderately, [4] Very, [5] Extremely
- Option 2: Thinking about the noise you are hearing, what number from 0 to 10 best shows how much you are bothered, disturbed, or annoyed by the nearby data center noise
  - If you are not annoyed, choose 0;
  - if you are extremely annoyed choose 10;
  - if you are somewhere in between, choose a number between 0 and 10.

Source: ISO/TS 15666:2021(E) Acoustics – Assessment of noise annoyance by means of social and socio- acoustic surveys

# Backup Slides

# BOCS Meeting Notable Moments

- Discussion on octaves, focused on dBA levels, not dB(C) (see slide 5)
- Great Oak data discounted as "not having octave bands". True but misrepresents 3 years of dBA and 5 months of dB(C)
  - PWC (Wade and Nelson) tests were at best instantaneous and CANNOT accurately reflect the 24x7 lived experience
- Great Oak measurements were masked by traffic noise. This is the result of testing from 4:30 AM to 5:00
  - Commuters have always been early from PWC to DC
  - Trash trucks also stage at community entrances at 5 AM
  - Construction (dirt) trucks are also out early, note Sup. Gordy's Jake Break worry
- There is no solution for multiple data centers, aside from a discussion on needing a noise budget
  - A noise budget will require a significant reduction in levels. 60/65 db has to come down by up to 9 decibels for the area surrounding Great Oak.



**1** AWS Tanner Way, 4 buildings,  
1-story, 600' to GO

+4 (4)

**2** Project Gold, Manassas City  
Digital Second Manassas  
2-Story, 51', 1800' to GO  
Built – Operational?

+1 (5)

**14** NEW - Black Chamber Private Equity (3/25)  
525' to GO

+4 (25)

+1 (21) CloudHQ MCC5  
1800' to GO

13

CloudHQ MCC6A/Z  
+2 (20) 3200' to GO

11  
12

**3** Digital Second Manassas  
Four 2-story, 1500' to GO

+4 (9)

Round Elementary  
28 Townhomes  
LDS Church

Great Oak (GO)  
291 SF / 30+ yrs

+1 (18) CloudHQ MCC4  
3600' to GO

10

**4** CloudHQ MDC1-3  
3 buildings, proposed  
80', 2 or 3-story  
1200' to GO

+3 (12)

**9** +1 (17) CloudHQ MCC3  
1900' to GO

Campus ID **n**  
# Campus DC/(Area Total DC)

Planning  
Development  
Operational

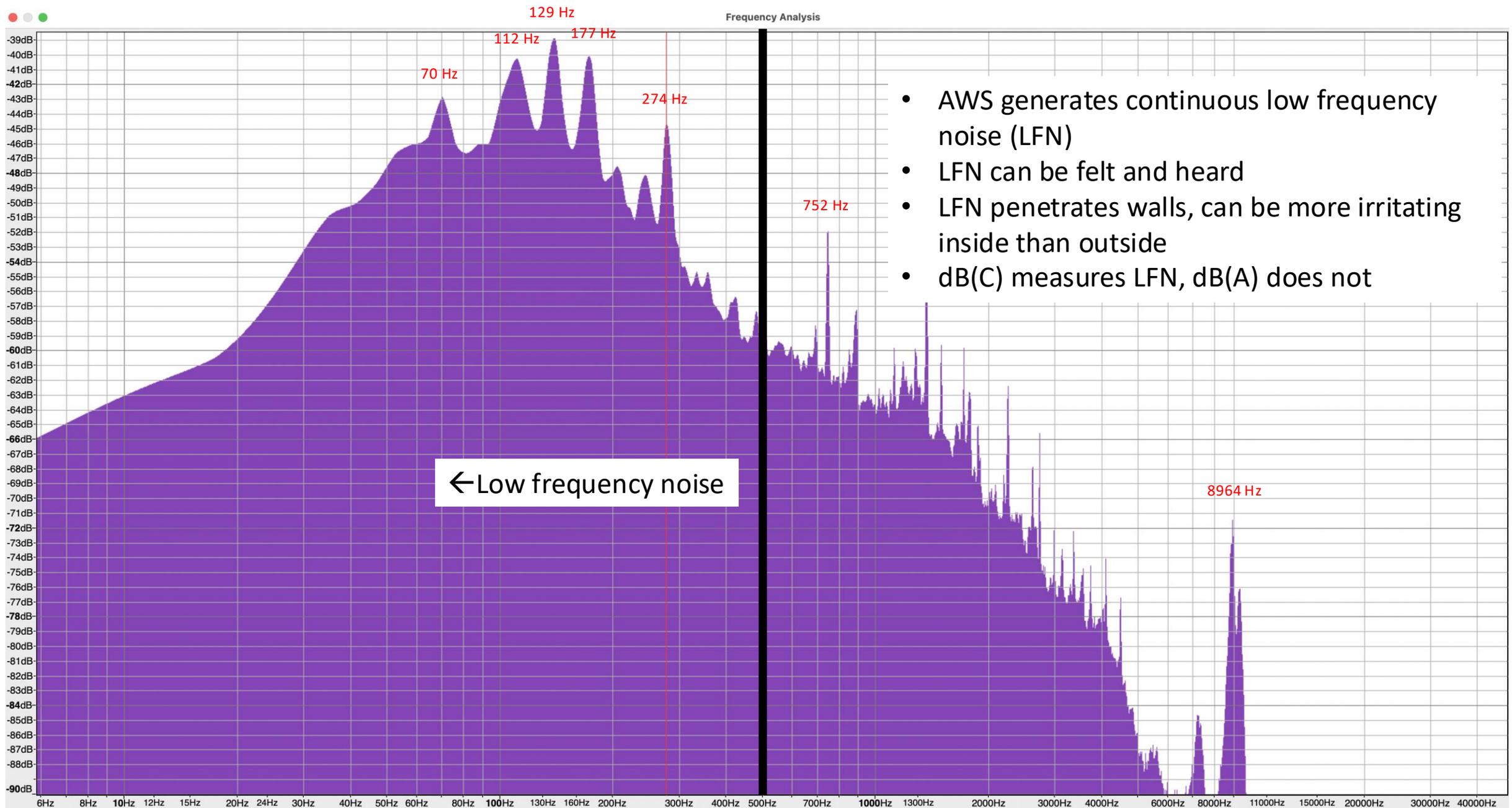
**5** AWS (Manassas City - TBD)  
+1 (13)

**6** +1 (14) CloudHQ MCC2  
600' to GO

8+ Substations

**7** +1 (15) CloudHQ MCC7  
1400' to GO

**8** +1 (16) CloudHQ MCC1  
2800' to GO



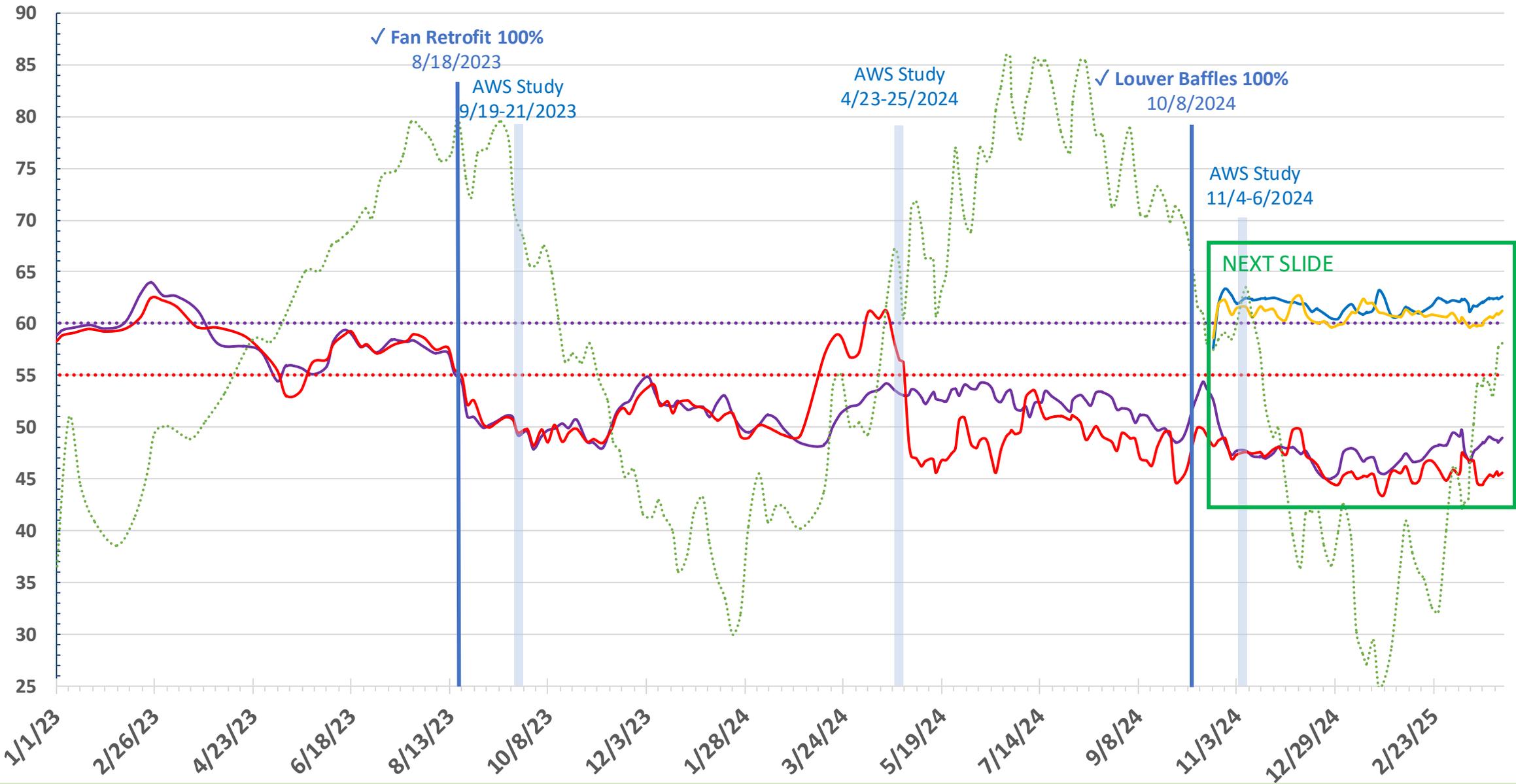
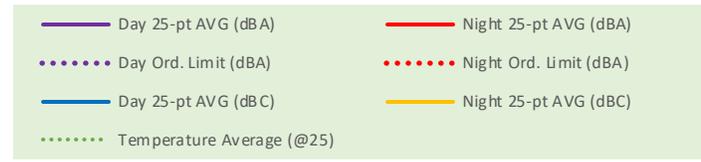
- AWS generates continuous low frequency noise (LFN)
- LFN can be felt and heard
- LFN penetrates walls, can be more irritating inside than outside
- dB(C) measures LFN, dB(A) does not

**AWS Tanner Way Noise Signature – After louver changes (10/20/24)**

# Great Oak Noise 25-Point Averages

## AWS Tanner Way

1 Jan 2023 - 4 Apr 2025



# Low Frequency Noise (LFN) Health Concerns

LFN is emitted within the range of 20 to 500\* Hz by a variety of sources such as **heating, cooling, and ventilation systems for buildings**

In exposure to LFN, significant problems such as **depression and mental dysfunction are seen in 3% to 5% more than prevalence** in general population. Other problems observed following exposure to low-frequency sound include an **increase in heart rate and potentially related problems**.

Feelings of **discomfort, agitation, and restlessness** when exposed to LFN have been observed in other patients, which causes people to have **difficulty in daily work and job performance**.

National Institutes of Health: National Library of Medicine, National Center for Biotechnology Information

- *Health effects from low-frequency noise and infrasound in the general population: Is it time to listen? A systematic review of observational studies*

Christos Baliatsas <sup>a</sup>, Irene van Kamp <sup>b</sup>, Ric van Poll <sup>b</sup>, Joris Yzermans <sup>aa</sup>Netherlands Institute for Health Services Research (NIVEL), Utrecht, The Netherlands<sup>b</sup>National Institute for Public Health and the Environment (RIVM), Bilthoven, The Netherlands, Epub 2016 Mar 17

# Expectations

SOURCE: Prince William Times, Peter Cary, Feb 27.2023, *Some cities suffering from data center noise turn to tough limits*

*"Data center noise is unique in that it is not so much its loudness that is an irritant as its constancy."*

Les Blomberg, director of the Noise Pollution Clearinghouse *"Blomberg noted that typical noise limits are focused on transient noise and "not on the 24/7 drone that invades your house." People say noise of 55 to 65 decibels (the range of Prince William's noise ordinance limit) is no louder than human conversation, he said, *"but it's like having a conversation with someone you don't want to have, all the time. That's the thing; there's no escaping it."**

*"One solution could be to write an ordinance that penalizes the duration of noise. Alameda, California, regulates noise based not only on decibel level, but also its time length. The longer the noise continues, the quieter it must be. But Blomberg said such an ordinance requires a police officer to stay in place as long as an hour to measure noise duration. *"It makes sense, but it's not enforceable"* he said "*

*The better solution, he [Blomberg] said – as in Chandler and Niagara Falls – is to require emitters of nonstop noise to be especially quiet. *"It's not unreasonable to choose a night level of 45 decibels,"* Blomberg said, *"and a daytime limit of 50"*.*

*"Writing ordinances to deal with data center noise is relatively new", said Blomberg. But he and Eric Zwerling, who runs the Rutgers University Noise Technical Assistance Center, said "it can be done".*

# Apparent Violations – Data Centers - Night

Date	Time	Class	Location	L50	A/EQ	C/EQ	Lp OBSPL										
							31.5	63	125	250	500	1000	2000	4000	8000	LpA50	LpC'50
10/23/24	03:23	Data Center	Tanner Way Powerline Easement	L50	47	61	58	57	54	49	45	40	37	41	19	46	60
1/30/25	05:35	DC/Traffic	Tanner Way Powerline Easement	L50	52	65	61	60	56	50	50	48	37	22	17	52	63
1/30/25	04:24	DC/Traffic	10200 Winged Elm	L50	48	61	57	58	51	47	45	43	32	23	20	47	60
1/30/25	04:44	DC/Traffic	10224 Winged Elm	L50	52	63	59	58	56	48	46	44	33	20	17	48	62
1/30/25	05:06	DC/Traffic	10087 Post Oak Terrace	L50	49	60	54	56	50	46	45	45	35	20	17	47	58
10/23/24	04:47	Data Center	Wellington Glen	L50	56	66	60	61	53	49	50	49	44	35	26	52	63
11/12/24	05:40	Data Center	Wellington Glen	L50	54	70	59	60	55	49	42	44	43	34	22	47	62
1/30/25	06:13	Data Center	Wellington Glen A	L50	60	72	72	71							26	58	72
1/30/25	06:21	Data Center	Wellington Glen B	L50	62	73	70								30	59	71
10/23/24	05:06	Data Center	Hornbaker 1	L50	55	70	66	64	63	56	54	51	48	44	40	55	68
10/23/24	05:09	Data Center	Hornbaker 2	L50	52	67	65	63	61	54	50	48	46	43	38	52	67
Night Criterion					47	60	60	55	50	45	40	36	33	31	30	43	60

LFN

Traffic?

← 90 Hz Tone

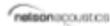
← 90 Hz Tone

← 90 Hz Tone

← LF Tone 40 Hz

← LF Tone 40 Hz

<https://nelsonacoustical.com>



1618 PWC 2025 FEB 06

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## dB Calculator

	31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB	dB(A)
10200 Winged Elm	57	58	51	47	45	43	32	23	20	61.3	46.9
10224 Winged Elm	59	58	56	48	46	44	33	20	17	62.9	48.3
10087 Post Oak	54	56	50	46	45	45	35	20	17	59.3	47.8

# Apparent Violations – Data Centers - Day

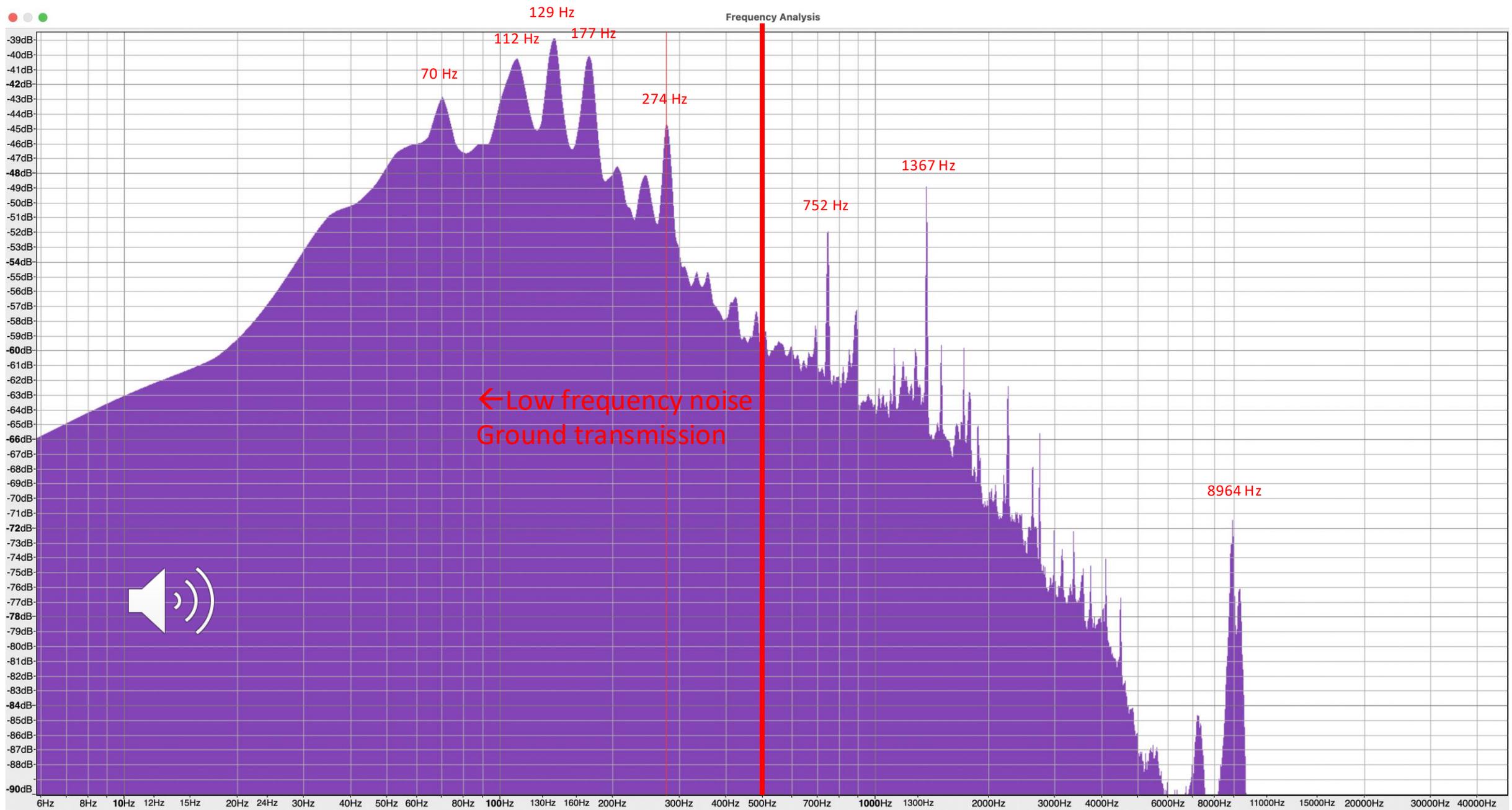
Date	Time	Class	Location	LpA	LpC	Lp OBSPL							2000	4000	8000	LpA'50	LpC'50
						31.5	63	125	250	500	1000						
10/9/24	Day	Data Center	Tanner Way	L50	54	66	64	61	56	51	51	51	42	31	24	53	65
10/9/24	Day	Data Center	Wellington Glen	L50	59	73	64	65	59	53	51	53	49	41	30	55	67
10/9/24	Day	Data Center	Hornbaker 1	L50	60	71	69	64	63	59	59	57	51	44	29	60	70
10/9/24	Day	Data Center	Hornbaker 2	L50	62	75	66	64	64	56	56	54	50	43	29	57	69
1/30/25	Day	DC/Traffic	Hornbaker 1	L50	56	68	65	62	59	52	52	51	48	37	22	54	66
				L90			62	60	57	51	51	50	48	36	20	53	64
1/30/25	Day	Traffic/DC	Cloud HQ	L50	52	64	60	59	56	51	46	43	33	25	20	48	62
				L90			57	56	53	47	43	40	31	21	17	45	59
Day Criterion					52	65	65	60	55	50	45	41	38	36	35	48	65

LFN

## dB Calculator

Tanner Way

31.5Hz	63Hz	125Hz	250Hz	500Hz	1kHz	2kHz	4kHz	8kHz	dB	dB(A)
64	61	56	51	51	51	42	31	24	66.6	53.8



**AWS Tanner Way Noise Signature – After louver changes (10/20/24)**

# Diesel Testing – not for DCOAG Wed.

Ray Cuervo



Rob Pixley

They seemed to start ramping about 7:30am.

3mins  
dbA 59.2  
dbC 76.6  
dbc 63.0 - inside windows closed, far side of the house

did a 2nd outside dbC 3 min just now and got 76.9.

seems to be pretty consistent 73-76 dbC.

can't say I smell much so far.

Not sure why but my subsequent emails haven't been showing up on the list

8:30am - almost exactly consistent with 7:30am both dbA and dbC  
9:30am - 1-2 db louder on both A and C, some 10+ periods sustained over 80 dbC

11:10 - still about the same as 7:30 and 8:30

12:15 - still just as loud.

Rob

Wade Hugh

## Tests 1 & 2 – Sesame Court (He took 2 – 10 minute measurements from the cul-de-sac)

- Test #1 8:19am – 8:29am
  - Very windy conditions
  - Minimal road traffic
  - One airplane flew overhead
- Test #2 8:30am – 8:40am
  - Very windy conditions
  - Minimal road traffic
  - Car door shut

## Tests 3 & 4 – 10200 Winged Elm (He took 2 – 10 minute measurements from the property line)

- Test #3 8:48am – 8:59am
  - Winds somewhat calmer at this location
  - Heavy construction taking place across the street (residential project)
    - Backup alarms
    - Heavy equipment – roller
  - Hastings Drive traffic noise
- Test #4 9:00am – 9:10am
  - Winds
  - Traffic noise
  - Construction noise