HENDERSON-VANCE FYI - CITIZEN RESEARCH SERIES

Data Center Noise

What every citizen should know before the vote

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Executive Summary

Data centers produce continuous noise from cooling systems, fans, and backup generators that operate 24 hours a day, 365 days a year. The difference between a facility that is a good neighbor and one that degrades quality of life is not the technology - it is whether the county requires noise mitigation before construction begins.

Well-designed facilities with proper sound barriers, mechanical enclosures, and adequate setbacks measure 45-55 dB at the property line. Poorly buffered facilities reach 65-85 dB - equivalent to a vacuum cleaner to a food blender running without pause.

Vance County currently has no data center-specific noise ordinance. No dBA limits at property lines. No low-frequency monitoring requirements. No mandatory setbacks beyond standard zoning. No pre-construction acoustic modeling requirement. This report explains why these protections matter and what other communities have done.

1. How Decibels Work

Decibels (dB) measure sound intensity on a logarithmic scale. This means every 10 dB increase represents a doubling of perceived loudness, not a small increment [1, 2]. The CDC identifies hearing loss as the third most common chronic physical condition among U.S. adults, with health effects extending beyond hearing to include cardiovascular disease, cognitive decline, and depression [3]:

Level	Example	Perceived Loudness
30 dB	Quiet rural night	Baseline
40 dB	Library, quiet home	2x baseline
50 dB	Moderate rainfall	4x baseline
60 dB	Normal conversation	8x baseline
70 dB	Vacuum cleaner	16x baseline
80 dB	Food blender, busy traffic	32x baseline
85 dB	Sustained hearing damage threshold	~45x baseline

Sources: [1] [2] [4] [7]

2. Data Center Noise Levels

Data center noise comes primarily from three sources: cooling systems (CRAC/CRAH units, chillers, cooling towers), mechanical ventilation fans, and backup diesel generators. These systems run continuously.

Well-Designed Facilities (45-55 dB at property line)

Facilities with proper sound-rated mechanical enclosures, solid concrete or masonry barrier walls, adequate setbacks (500+ feet), low-noise fan selections, and variable-speed drives achieve 45-55 dB at the property line. This is comparable to moderate rainfall and is generally considered acceptable for residential adjacency.

Poorly Buffered Facilities (65-85 dB at property line)

Facilities without these investments - relying on chain-link fencing, landscaping, or minimal setbacks - routinely produce 65-85 dB at the property line. At 70 dB, the noise is louder than a vacuum cleaner. At 85 dB, it reaches the threshold for hearing damage with sustained exposure. This runs 24/7/365.

Sources: [31] [32] [38] [40]

3. Distance Decay

Sound intensity decreases by approximately 6 dB per doubling of distance from a point source in open terrain (inverse square law). This means:

Distance	Well-Buffered (50 dB start)	Poorly Buffered (75 dB start)
Property line	50 dB	75 dB
500 feet	~44 dB	~69 dB
1,000 feet	~38 dB	~57 dB
Half mile	~30 dB	~49 dB
One mile	~24 dB	~45 dB

The WHO recommends nighttime noise below 40 dB outside bedrooms to prevent sleep disruption. A poorly buffered facility is still above this threshold at one mile. Rural ambient noise at night is typically 30-35 dB, meaning the data center would be the dominant sound source for every home within that radius.

Sources: [6] [8]; inverse square law (standard acoustics)

4. Generator Testing Spikes

Data centers maintain banks of diesel backup generators for power redundancy. Industry standards require regular testing, typically monthly for 30 minutes to several hours, with full-load transfer tests quarterly. A typical 2 MW diesel generator produces 95-105 dB at 23 feet (per Caterpillar and Cummins specification sheets).

During testing, noise at the property line increases by 20-30 dB above baseline operational noise. A facility running at 55 dB baseline spikes to 75-85 dB during generator tests. Without scheduling requirements or notification provisions, these tests can occur at any time.

Sources: [33] [34] [35]

5. Community Experience: Northern Virginia

Northern Virginia hosts the largest concentration of data centers in the world. Residents near facilities in Loudoun County and Prince William County report:

- Constant low-frequency drone audible inside homes with windows closed
- Sleep disruption requiring white noise machines or earplugs
- Property value concerns in adjacent neighborhoods
- Noise complaints that took years to result in zoning changes

Virginia has no statewide noise ordinance for data centers. Loudoun County eventually updated its zoning to require 50 dBA at residential boundaries, sound barrier walls, and quarterly noise monitoring reports - but only after years of complaints from residents who were already living next to the facilities.

Sources: [36] [38] [40] [41]

6. Infrasound

Infrasound is sound below 20 Hz, the lower limit of human hearing [9]. It is not heard but felt as vibration, pressure, or unease. Research has shown that outer hair cells of the cochlea respond to infrasound at levels well below the threshold of conscious hearing, providing a physiological mechanism for symptoms even when the sound is not "audible" [13]. Large rotating equipment, HVAC systems, cooling towers, and diesel generators all produce infrasound.

The Measurement Gap

Standard noise measurements use dBA (A-weighted) weighting, which filters out frequencies below 20 Hz by design [10]. A facility can comply with every dBA limit while producing significant low-frequency energy that residents feel in their homes. Measuring infrasound requires dBG or dBZ (unweighted) measurements and specialized equipment that most jurisdictions do not own or require. A systematic review found a pooled prevalence of 10.5% high annoyance from low-frequency noise across sources [11].

What the Research Shows

No peer-reviewed studies examine infrasound specifically from data centers. The closest analog is wind turbine research, which has produced roughly 60 studies. The scientific consensus from systematic reviews (Schmidt & Klokker 2014; Onakpoya et al. 2015) and the largest government study (Michaud et al. 2016, Health Canada):

- Infrasound at industrial levels does not cause direct physiological harm - no organ damage, no cancer, no cardiovascular disease from infrasound alone [18, 28, 29]
- Annoyance is consistently associated with proximity to noise sources and is real and measurable. The Onakpoya et al. meta-analysis found odds of high annoyance at OR 4.08 (95% CI: 2.37-7.04) [17]
- Sleep disruption is documented and clinically significant, with odds ratio OR 2.94 (95% CI: 1.98-4.37) [17]
- Chronic sleep disruption is independently linked to cardiovascular disease, metabolic disorders, and impaired immune function. The WHO estimates 903,000 DALYs lost annually in Western Europe to noise-induced sleep disturbance [23]
- Wind turbine noise produces higher annoyance at a given dB level than road traffic noise - at 40 dB(A), approximately 10% are highly annoyed by turbines vs ~3% for road traffic [21]

- Low-frequency noise exposure is associated with measurable impairment in attention, memory, and executive function [14]

The honest position: do not overstate the risks (infrasound is not causing organ damage), but do not dismiss the effects that are well documented. Annoyance and sleep disruption are health outcomes that deserve regulatory attention. The wind turbine literature is the closest peer-reviewed analog to data center noise because both sources share continuous 24/7 operation, dominant low-frequency energy, and proximity to residential areas [16, 17, 18, 36].

Sources: [7] [9] [11] [13] [16] [17] [18] [19] [20] [21] [22] [23] [28] [29]

7. What Good Regulation Looks Like

The technology to control data center noise exists. The question is whether the county requires it. Effective regulation includes:

1. **Hard dBA limits at the property line** (not at the source): 45-50 dBA daytime, 35-40 dBA nighttime
2. **Low-frequency limits** using dBC or dBG weighting in addition to dBA to capture infrasound
3. **Mandatory setbacks** of 500-1,500 feet from residential zones
4. **Pre-construction acoustic modeling** submitted with the site plan and verified by independent review
5. **Ongoing monitoring** with third-party verification, public reporting, and community complaint mechanisms
6. **Enforceable penalties** for exceedances, including operational restrictions and financial penalties
7. **Generator testing restrictions**: daytime-only, advance notification to adjacent property owners

Communities That Got It Right

Community	What They Require
Lea County, NM	Comprehensive ordinance adopted before any developer arrived. Closed-loop cooling, noise limits, PILOT payments to all taxing entities, decommissioning bonds.
Loudoun County, VA	After years of complaints: 50 dBA at residential boundaries, sound barrier walls, quarterly noise monitoring reports.
Cedar Rapids, IA	Performance-linked: 70% tax exemption only if noise, water, and job targets are met. $18M community fund over 18 years.

8. Vance County's Current Position

As of April 2026, Vance County has:

- No data center-specific noise ordinance
- No dBA limits at property lines for industrial facilities
- No low-frequency (infrasound) monitoring requirements
- No mandatory setbacks beyond standard zoning buffers
- No pre-construction acoustic modeling requirement
- No ongoing noise monitoring provisions
- No generator testing scheduling requirements

If the ZMA26-001 rezoning is approved without these protections in place, there is no regulatory mechanism to enforce noise limits after construction begins. The time to establish standards is before the vote, not after the facility is built.

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Wind Turbine Noise & Health (Closest Peer-Reviewed Analog to Data Center Noise)

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Data Center Noise Specifically

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This report is a citizen education project. Not funded by any data center company, activist organization, or political campaign. 41 sources cited. All publicly verifiable.

Vance County, North Carolina - April 2026