Memorandum

To: GMP Taftsville Substation Project File

Date: 8/6/2026
Project #: R176601.000

From: Colby Michaud, Staff Air Quality and Noise Analyst
Chris Bajdek, Director of Noise and Vibration

Re: GMP Taftsville Substation Sound Assessment

Introduction

Green Mountain Power ("GMP") is proposing to relocate, upgrade, and replace its existing Taftsville Substation with a new substation at the intersection of US Route 4 and VT Route 12 in Hartland, Vermont. VHB conducted a sound assessment of future operational noise from the proposed substation. The assessment determined that predicted operational sound levels would be below the recommended nighttime noise limit and that the Project is not expected to create undue noise conditions in the surrounding area.

Project Description

On August 13, 2025, the existing Taftsville Substation transformer suffered a catastrophic fault, and on August 19, 2025, GMP petitioned the Commission for the emergency installation of a temporary substation to serve the Taftsville load while permanent plans could be developed. The temporary substation was constructed at the location proposed for the new substation and has been carrying the Taftsville customer load since September 30, 2025.

The Project consists of removing the existing Taftsville Substation from its current location at 2693 East Woodstock Road in Woodstock and rebuilding it at a new location, approximately 0.6 miles to the east, at the intersection of US Route 4 and VT Route 12 in Hartland, Vermont, where a temporary substation currently exists. As described below, the substation relocation requires transmission line modifications, including limited line work in Hartford, Vermont.

The Project includes installing new substation equipment together with the installation of a new fence, oil containment system, security, lights, animal fence, surface material, and ground grid. New equipment includes, but is not limited to, the installation of four new 46 kV transmission line breakers, a new 10/14 MVA 46 kV/12.47 kV transformer, two 12.47 kV distribution breakers, six new circuit regulators, a remote terminal unit, switches, a battery bank for protection and control, new control building, and other standard equipment necessary for modern substation construction. The existing substation, including steel structures and foundations, will be retired from service and removed from the existing Taftsville Substation site. The hydro generation facility interconnection at the existing Taftsville Substation site will be transferred from the 46 kV bus to the TA-G12 12.47 kV distribution feeder, and several spans of transmission conductor will be removed, thus modifying these facilities from a double circuit configuration to a single circuit configuration.

The retirement of the existing Taftsville Substation removes from service equipment at the end of its useful life to improve substation safety and reliability for Woodstock, Hartland, Quechee, and surrounding communities. The new 10/14 MVA transformer will replace the existing 1968 vintage power transformer.

Regulatory Context

Neither the Town of Hartland nor the State of Vermont has adopted a quantitative noise standard that establishes property-line or receptor-based limits for sound emissions from the Project. Therefore, VHB evaluated the Project's predicted operational sound levels by comparison with relevant national and international noise guidance commonly used to assess potential community noise impacts.

World Health Organization Guidelines

The World Health Organization (WHO) has "Night Noise Limits for Europe" guidelines which do not constitute a regulation or requirement. This guideline is generally considered to be the most stringent restriction of nighttime sound. Based on research of nighttime noise effects, WHO recommends a target outdoor night noise guideline (NNG) level of 40 dBA to protect the public, including the most vulnerable groups such as children, the chronically ill, and the elderly. An outdoor nighttime noise level of 55 dBA is recommended as an interim target for countries where the NNG cannot be achieved in the short term for various reasons, and where policymakers choose to adopt a stepwise approach. This noise limit is applied outside residential buildings where nighttime noise may adversely affect people.

American National Standards Institute Noise Standard

The American National Standards Institute (ANSI) Standard S12.9 Parts 4 and 5 (2017), "American National Standard Quantities of Procedure for Description and Measurement of Environmental Sound – Part 4: Noise Assessment and Prediction of Long-term Community Response" and "Part 5: Sound Level Descriptors for Determination of Compatible Land Use" specify methods to assess environmental sounds and predict potential annoyance response of a residential community to long-term outdoor noise. This is a general noise guideline that is often used to evaluate noise from energy facilities; however, there is no regulatory requirement for the Project to meet this noise standard. The ANSI sound standard accounts for the characteristics of the sound, such as tonality, onset rate, impulsivity, time of day, and day of week. A 5 dBA penalty is applied to sounds that are tonal, as they tend to produce higher levels of annoyance than broadband sounds at the same level. Since the Project has the potential to cause tonal conditions and would operate at night, an exterior nighttime noise limit of 40 dBA (Leq) for residential buildings has been used to evaluate the potential noise impact due to the transformer.

Sound Modeling Methodology

This sound study evaluated the sound levels from the Project's proposed noise generating equipment. The Project's noise sources consist of one 10/14 MVA 46 kV/12.47 kV transformer and its cooling fans.

The sound power level assumptions for the transformer are provided in **Table 1**. Reference sound levels for the transformer are based on the data provided by GMP and the NEMA standard[1] for oil-immersed power transformers. The NEMA sound level rating for a 10/14 MVA transformer is 68 dB during ONAN conditions (only transformer active) and 71 dB during ONAF conditions (transformer and fans active). The NEMA ratings were converted to octave-band sound power levels for use in the CadnaA model. The sound spectrum was developed for the transformer based on the spectrum for a typical large power transformer from the *Handbook of Acoustical Measurements and Noise Control*[2] both with and without cooling fans running.

Table 1 Equipment Sound Power Level Emissions

Equipment ID	Overall dBA	Sound Power Level (dBA) by Octave Band Center Frequency (Hz) 31.5	63	125	250	500	1000	2000	4000	8000
Transformer (ONAN)[1]	82.2	21.1	31.5	64.3	75.6	80.7	69.3	61.3	49.1	41.4
Transformer (ONAF)[2]	88.8	43.4	49.4	73.6	81.9	86.7	79.8	72.1	64.9	58.1

1 NEMA TP 80050-2013 (R2024) Rating for 68 dBA rated 10 MVA self-cooled transformers.
2 NEMA TP 80050-2013 (R2024) Rating for 71 dBA rated 14 MVA fan-cooled transformers.

VHB has calculated the Project's operational sound pressure levels at each receptor location using the acoustic modeling software CadnaA[3] (Computer Aided Noise Abatement) by Datakustik. CadnaA is an internationally accepted sound prediction program that implements the ISO 9613-2:2024[4] sound propagation standard. The noise prediction model accounts for the sound emissions of equipment, the ground cover, terrain, and the geometry of the project area, under meteorological conditions that are favorable to propagation from sources of known sound emissions. Sound propagation was assumed to occur over mostly acoustically "soft" ground (G=1.0). The ground at the substation would be crushed stone, assumed to be acoustically "mixed" ground (G=0.6),[5] while the concrete equipment pad and local roadways were modeled as acoustically "hard" ground (G=0.0). Receptors were modeled at a height of 1.5 m (5 ft) above the ground at the nearest property line locations and at a height of 4 m (13 ft) at the nearest building façade for residential receivers (representative of a 2nd floor window).

Equipment and Receptor locations are presented in **Figure 1**.

[1] National Electrical Manufacturers Association (NEMA) TP 80050-2013 (R2024) formerly TR 1-2013 (R2019).
[2] Harris, C.M. (ed.), *Handbook of Acoustical Measurements and Noise Control*, Third Edition, McGraw-Hill Inc., Figure 35-1, p. 35.2, 1991.
[3] DataKustik GmbH, 2025. Computer Aided Noise Abatement Model.
[4] International Standards Organization (ISO) 9613-2 (2024). Acoustics - Attenuation of sound during propagation outdoors. Part 2: Engineering method for the prediction of sound pressure levels outdoors
[5] Kaliski,et al, "An overview of sound from commercial photovoltaic facilities," Proceedings of Noise-Con, 2020.

Figure 1: Site Layout and Noise Sensitive Receptors

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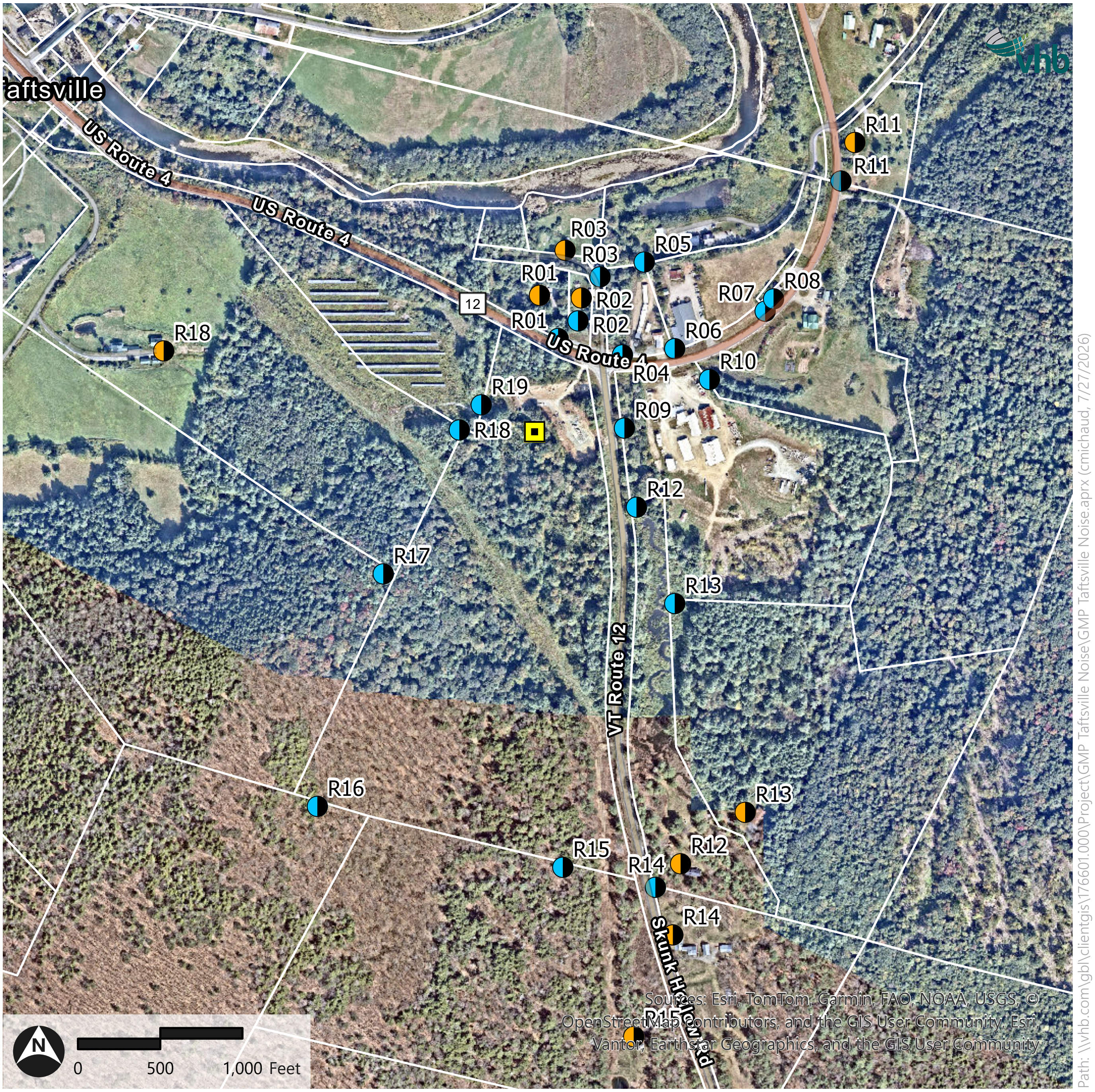


Nearby Receptors

- Property Line (1.5m / 5ft)
- 2nd Floor Residential Facade (4m / 13ft)

Proposed Transformer

Source: VHB, 2026.

Sound Modeling Predictions

Sound levels were predicted for the proposed equipment to evaluate the potential for undue sound conditions from the Project. **Figure 2** and **Figure 3** present the predicted sound level contours (i.e. lines of constant sound level) from the transformer during the ONAN (transformer operation) and ONAF (transformer and fan operation) conditions.

The maximum predicted sound level from the Project was 36 dBA, occurring during ONAF conditions at the property line between the proposed substation and an existing solar array. The maximum predicted sound level at the location of a residence was 33 dBA, occurring at the 2nd floor façade of 5 Morrill Rd (Receptor R01). During ONAN operation, the maximum predicted sound level at the property line of a nearby land use would be 29 dBA at 40 Woodstock Rd (Receptor R19) and 26 dBA at the 2nd floor façades of 5 and 7 Morrill Rd (Receptors R01 and R02, respectively). Receptor-specific prediction results are provided in **Table 2**.

It should be noted that results presented in **Table 2** may show higher predicted noise levels at the 2nd floor windows (receiver height of 13 ft) than at the property line receptors (5 ft). Although the property line receptors are closer to the noise source, the 2nd floor windows may have a more direct line of sight to the transformer, while the lower property line receptors can be partially shielded by topographical features. Furthermore, the sound propagation path from a source to an elevated receptor, such as a 2nd floor window, exhibits less attenuation (i.e., less noise reduction) over absorptive ground. These factors can outweigh the shorter slant distance to the property line, resulting in higher predicted levels at 2nd floor windows in certain cases.

Table 2 Calculated Operational Sound Levels by Receptor (dBA)

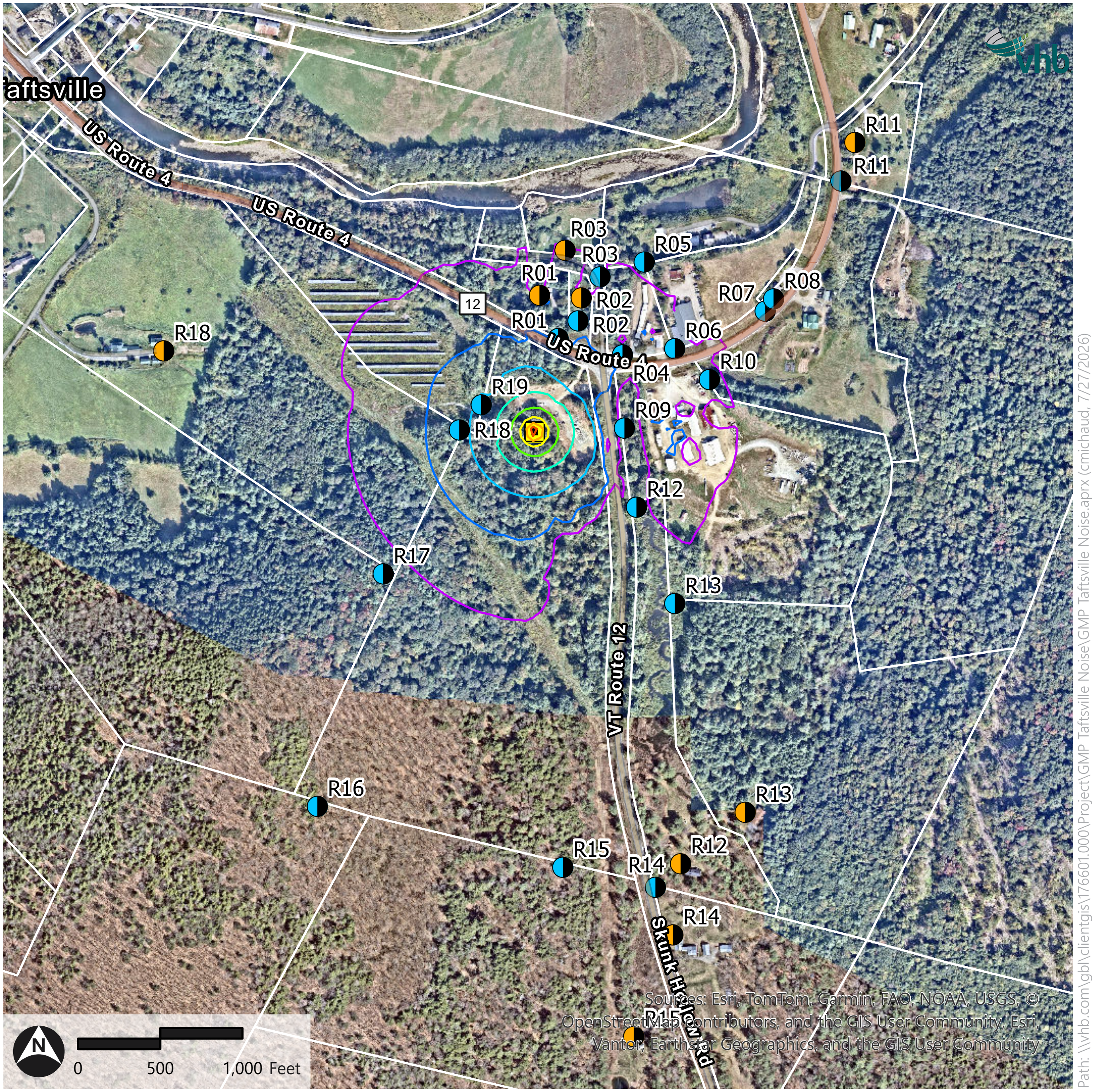
Receptor		ONAN (Transformer Only)		ONAF (Transformer and Fans)	
ID	Address	Property Line	2nd Floor Facade[1]	Property Line	2nd Floor Facade[1]
R01	5 Morrill Rd	22	26	28	33
R02	7 Morrill Rd	21	26	28	32
R03	14 Morrill Rd	14	21	21	27
R04	57 Woodstock Rd	24	-	31	-
R05	115 Town Line Rd	17	-	23	-
R06	59 Woodstock Rd	22	-	29	-
R07	67 Woodstock Rd	15	-	22	-
R08	69 Woodstock Rd	14	-	21	-
R09	56 Woodstock Rd	12	-	18	-
R10	68 Woodstock Rd	19	-	26	-
R11	9 Wood Rd	12	13	18	20
R12	728 Vermont Rte 12	13	6	20	12
R13	730 Vermont Rte 12	10	12	17	19
R14	720 Vermont Rte 12	3	5	10	12
R15	717 Vermont Rte 12	7	8	14	15
R16	46 Gray Rd	10	-	16	-
R17	45 Hartwood Way	17	-	23	-
R18	25 Hartwood Way	27	15	33	21
R19	40 Woodstock Rd	29	-	36	-

Source: VHB, 2026.

1 2nd floor façade was only considered for residential properties. Noise levels at the 2nd floor façade is considered to assess possible noise related impacts to sleep.

Figure 2: Modeled Sound Level Contours (ONAN)

GMP Taftsville Substation Sound Study | Hartland, VT



dBA

- 55
- 50
- 45
- 40
- 35
- 30
- 25
- 20

Nearby Receptors

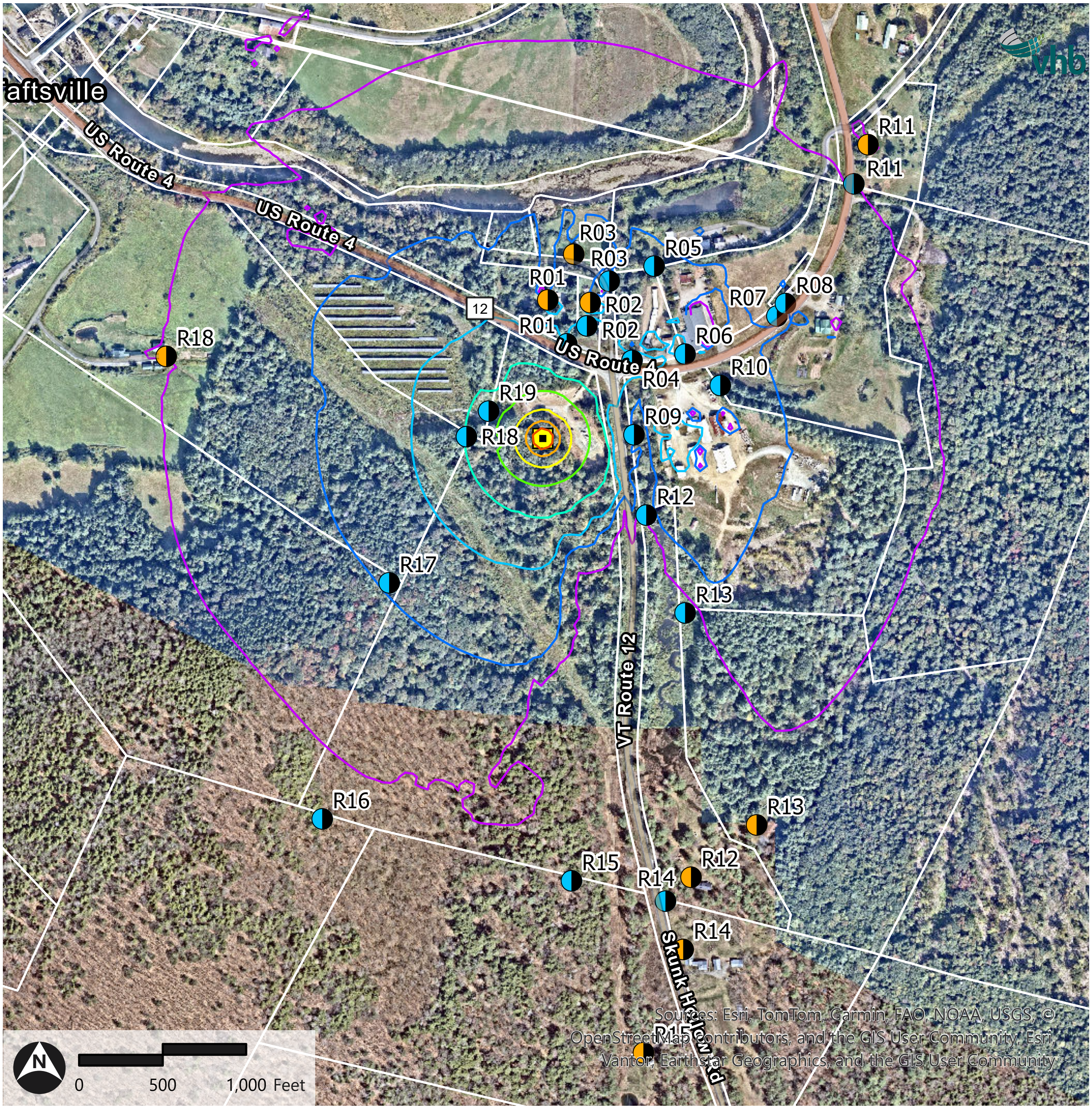
- Property Line (1.5m / 5ft)
- 2nd Floor Residential Facade (4m / 13ft)

Proposed Transformer

Source: VHB, 2026.

Figure 3: Modeled Sound Level Contours (ONAF)

GMP Taftsville Substation Sound Study | Hartland, VT



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dBA

- 55
- 50
- 45
- 40
- 35
- 30
- 25
- 20

Nearby Receptors

- Property Line (1.5m / 5ft)
- 2nd Floor Residential Facade (4m / 13ft)

Proposed Transformer

Source: VHB, 2026.

Conclusions

VHB conducted a noise analysis to evaluate the proposed relocation and upgrade of the GMP Taftsville Substation at the intersection of US Route 4 and VT Route 12 in Hartland, Vermont. The Project includes installing new substation equipment including a new 10/14 MVA 46 kV/12.47 kV transformer. The sound levels expected to be produced by this transformer were compared to WHO and ANSI guidelines, which suggest nighttime noise be limited to 40 dBA outside residential buildings.

The existing ambient noise environment around the Project area is likely dominated by traffic on Woodstock Road (Route 4) and Vermont Route 12, as well as operational noise from Britton's Lumber and Hardware. Currently, a temporary substation is active on the Project parcel, which would also contribute to the existing noise environment. However, this temporary substation will be retired when the proposed substation becomes operational. Biogenic sound sources, such as insects and birds, also would contribute to the ambient sound environment during warmer months.

Noise modeling shows the maximum sound level produced by the transformer and its cooling fans (ONAF) at the 2nd floor façade of a residential building would be 33 dBA. However, continuous nighttime operation of the transformer cooling fans is unlikely because ambient temperatures are typically lower at night. The highest predicted noise level due to transformer operation without fans (ONAN) would be 26 dBA at a residential building. These values are 7 dBA and 14 dBA below the suggested 40 dBA nighttime noise standard. VHB has concluded the operation of the proposed substation as described in this report would not cause undue sound conditions and no mitigation efforts are necessary.

Attachments:

1. Sound Level Concepts

Attachment 1: Sound Level Concepts

Sound is the rapid fluctuations of air pressure above and below ambient pressure levels. Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities such as sleep, work, communication or recreation. How people perceive sound depends on several measurable physical characteristics including:

Sound Level - Sound level is based on the amplitude change in pressure and is related to the loudness or intensity. Human hearing covers a wide range of changes in sound pressure amplitude. Therefore, sound levels are most often measured on a logarithmic scale of decibels (dB) relative to 20 micro-pascals. The decibel scale compresses the audible range of acoustic pressure levels, which can vary from the threshold of hearing (0 dB) to the threshold of pain (120 dB). Because sound levels are measured in dB, the addition of two sound levels is not linear. For example, adding two equal sound levels results in a 3 dB increase in the overall level. Research indicates the general relationships between sound level and human perception are as follows:

- A 3-dB increase is a doubling of acoustic energy and is approximately the smallest difference in sound level that can be perceived in most environments.
- A 10-dB increase is a tenfold increase in acoustic energy and is generally perceived as a doubling in loudness to the average person.

Frequency - Sounds are comprised of acoustic energy distributed over a range of frequencies. Acoustic frequencies, commonly referred to as tone or pitch, are typically measured in Hertz. Human hearing generally ranges from 20 to 20,000 Hz; however, the human ear does not perceive sound levels from each frequency as equally loud. To compensate for this phenomenon in perception, a frequency filter known as A-weighting is commonly used to evaluate environmental noise levels and sound levels are denoted as "dBA".

- Sound levels reported in octave or one-third-octave frequency bands are often used to describe the frequency content of different sounds. Some sources of sound can generate "pure tones" which is when there is a concentration of sound within a narrow frequency range such as a whistle. Humans can hear pure tones very well and such conditions can be a cause of increased annoyance.

A variety of sound level descriptors can be used for environmental noise analyses. These descriptors relate to the way sound varies in level over time. The following is a list of common sound level descriptors:

- **Statistical Sound Levels** – Sound level metrics, such as L_{10}, L_{50} or L_{90}, represent the levels that are exceeded for a particular percentage of time over a given period. For example, L_{10} is the level that is exceeded for 10 percent of the time. Therefore, it represents the higher end of the range of sound levels. The L_{90}, on the other hand, is the level that is exceeded 90 percent of the time, and therefore, is representative of the background sound level and of constant sources of sound that are present.
- **Equivalent Continuous Sound Level (Leq)** - Leq is a single value, which represents the same acoustic energy as the fluctuating levels that exists over a given period of time. The Leq takes into account how loud noise events are during the period, how long they last, and how many times they occur. Leq is commonly used to describe environmental noise and relates well to human annoyance.
- **Day-night Average Sound Level (Ldn)** - Ldn is similar to the Leq in that it is a single value, which represents the same acoustic energy as the fluctuating levels, that exists over a 24-hour period. The Ldn takes into account how loud sound events are, how long they last, how many times they occur over a 24-hour period, and whether they occur during the day (7:00 AM to 10:00 PM) or night (10:00 PM to 7:00 AM). Sound that occurs during the night is given a 10-dB penalty to account for the increased human sensitivity to noise at night. If sound levels are constant over a 24-hour period, the Ldn level is 6.4 dB greater than the Leq level due to the 10-dB nighttime penalty.
- **Maximum Sound Level (Lmax)** – Many sources of sound, including mobile sources and stationary sources, change over time. It is common to describe sound in terms of the maximum (Lmax) sound level emissions. The following figure presents a list of the maximum sound levels of common outdoor and indoor sources.

Memorandum

Common Outdoor and Indoor A-weighted Sound Levels

Outdoor Sound Levels	Sound Pressure (μPa)*		Sound Level dB(A)**	Indoor Sound Levels
	6,324,555	-	110	Rock Band at 5 m
Jet Over Flight at 300 m		-	105	
	2,000,000	-	100	Inside New York Subway Train
Gas Lawn Mower at 1 m		-	95	
	632,456	-	90	Food Blender at 1 m
Diesel Truck at 15 m		-	85	
Noisy Urban Area—Daytime	200,000	-	80	Garbage Disposal at 1 m
		-	75	Shouting at 1 m
Gas Lawn Mower at 30 m	63,246	-	70	Vacuum Cleaner at 3 m
Suburban Commercial Area		-	65	Normal Speech at 1 m
	20,000	-	60	
Quiet Urban Area—Daytime		-	55	Quiet Conversation at 1 m
	6,325	-	50	Dishwasher Next Room
Quiet Urban Area—Nighttime		-	45	
	2,000	-	40	Empty Theater or Library
Quiet Suburb—Nighttime		-	35	
	632	-	30	Quiet Bedroom at Night
Quiet Rural Area—Nighttime		-	25	Empty Concert Hall
Rustling Leaves	200	-	20	
		-	15	Broadcast and Recording Studios
	63	-	10	
		-	5	
Reference Pressure Level	20	-	0	Threshold of Hearing

Source: Highway Noise Fundamentals. Federal Highway Administration, September 1980.

* μPA – MicroPascals, which describe pressure. The pressure level is what sound level monitors measure.

** dB(A) – A-weighted decibels, which describe sound pressure logarithmically with respect to 20 μPa (the reference pressure level).