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October 15, 2021

Lowell Road Property Owner, LLC
c/o GFI Partners, LLC
Attn: Hayley Marsh
133 Pearl Street, Suite 300
Braintree, MA 02110

***Re: Sound Study of 161 Lowell Road, Hudson, NH*** Ref 4686

Dear Hayley:

Tech Environmental, Inc. (Tech) is pleased to provide this letter report summarizing the results of an acoustic modeling study of the proposed 161 Lowell Road warehouse facility in Hudson, New Hampshire. The goal of this work was to demonstrate that the proposed warehouse development will comply with sound limits in Chapter 249 of the Town of Hudson General Code (herein referred to as Noise Ordinance).

This letter report summarizes the modeling analysis performed for this study. Section 1.0 provides an introduction to the common measures of environmental sound. Section 2.0 presents ambient sound monitoring results, Section 3.0 presents the applicable noise regulations, and Section 4.0 presents the acoustic modeling approach and results. The study concludes that the proposed warehouse development will generate sound level impacts that fully comply with the Town of Hudson Noise Ordinance.

## 1.0 Common Measures of Environmental Sound

Noise is defined as "unwanted sound", which implies sound pressure levels that are annoying or disrupt activities that people are engaged in. The human sense of hearing is subjective and highly variable between individuals. Noise regulations and guidelines set quantitative limits to the sound pressure level (measured with sound analyzers and predicted with computer models) in order to protect people from sound exposures that most would judge to be annoying or disruptive.

The loudness of a sound is dependent on the radiated energy of the sound source and the propagation and attenuation characteristics of the air. The standard unit of sound pressure level ($L_p$) is the decibel (dB). A property of the decibel scale is that the sound pressure levels of two separate sounds are not directly additive. For example, if a sound of 40 dB is added to another sound of 40 dB, the total is only a 3 dB increase, not a doubling to 80 dB. For broadband sounds, a 3 dB change is the minimum change perceptible to the human ear. Table 1 presents the perceived change in loudness of different changes in sound pressure levels.

There are various measures of sound pressure designed for different purposes. To establish the background ambient sound level in an area, the $L_{90}$ metric, which is the sound level exceeded 90 percent of the time, is typically used. The $L_{90}$ can also be thought of as the level representing the quietest 10 percent of any time period. The $L_{eq}$, or equivalent sound level, is the steady-state sound level over a period of time that

has the same acoustic energy as the fluctuating sounds that actually occurred during that same period. It is commonly referred to as the average sound level. The $L_{max}$, or maximum sound level, represents the one second peak level experienced during a given time period.

**TABLE 1**

**SUBJECTIVE EFFECT OF CHANGES IN SOUND PRESSURE LEVELS**

| Change in Sound Pressure Level | Perceived Change in Loudness |
|---|---|
| 3 dB | Just perceptible |
| 5 dB | Noticeable |
| 10 dB | Twice (or half) as loud |

The acoustic environment in a suburban commercial/residential area, such as that surrounding 161 Lowell Road in Hudson, primarily results from motor vehicle traffic on Route 3 and local roadways. Typical sound levels associated with various activities and environments are presented in Table 2.[1]

**TABLE 2**

**COMMON SOUND LEVELS**

| Sound Level (dBA) | Common Indoor Sounds | Common Outdoor Sounds |
|---|---|---|
| 110 | Rock Band | Jet Takeoff at 1000’ |
| 100 | Inside NYC Subway Train | Chain Saw at 3’ |
| 90 | Food Blender at 3’ | Impact Hammer (Hoe Ram) at 50’ |
| 80 | Garbage Disposal at 3’ | Diesel Truck at 100’ |
| 70 | Vacuum Cleaner at 10’ | Lawn Mower at 100’ |
| 60 | Normal Speech at 3’ | Auto (40 mph) at 100’ |
| 50 | Dishwasher in Next Room | Busy Suburban Area at night |
| 40 | Empty Conference Room | Quiet Suburban Area at night |
| 25 | Empty Concert Hall | Rural Area at night |

[1] U.S. DOT, FHWA, Noise Fundamentals Training Document, Highway Noise Fundamentals, September, 1980.

## 2.0 Existing Sound Levels

### *2.1 Long-term Monitoring*

To identify the lowest $L_{90}$ background level of the nearest residential areas surrounding the proposed warehouse development, a long-term sound analyzer was used to measure hourly sound levels over a seven-day period, including a weekend, to provide a complete picture of 24-hour sound conditions at the site. The location of the long-term sound level measurements are presented in Figure 1. The long-term sound analyzer measured hourly sound levels and octave band levels from Tuesday, October 5, 2021 through Wednesday, October 13, 2021.

The long-term measurements were collected with a Larson Davis 831 sound level analyzer. This analyzer is equipped with a 1/2" precision condenser microphone and has an operating range of 5 dB to 140 dB, and an overall frequency range of 3.5 to 20,000 Hz. This analyzer meets or exceeds all requirements set forth in the American National Standards Institute (ANSI) Type 1 Standards for quality and accuracy. Prior to and immediately following the measurement session, the sound analyzer was calibrated (no level adjustment was required, therefore it was monitoring accurately) with an ANSI Type 1 calibrator, which has an accuracy traceable to the National Institute of Standards and Technology (NIST). For the measurement sessions, the microphone was fitted with a 7-inch windscreen to negate the effect of air movement across microphone diaphragm. All data were downloaded to a computer following the measurement session for the purposes of storage and further analysis. Sound measurements that included high-frequency natural sounds, such as from insects and birds, were removed and broadband $L_{90}$ sound levels were recalculated.[2]

A summary of the long-term sound measurement results are provided in Table 3. One-hour background levels ($L_{90}$) ranged from 39 to 52 dBA. The overall sound levels measured are typical of a suburban area located near busy roads. For the long-term measurements the lowest one-hour $L_{90}$ levels of 39 dBA were selected as the existing background sound level at the site. This sound level was measured on Sunday October 10, 2021 between 1:00 a.m. and 6:00 a.m.

[2] Acoustical Society of America, American National Standard ANSI/ASA S3/SC1.100-2014 and ANSI/ASA S12.100 "Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas", 2014.

**TABLE 3**

**SUMMARY OF LONG-TERM BASELINE SOUND LEVELS ($L_{90}$, dBA)**
**Tuesday, October 5, 2021 to Wednesday, October 13, 2021**

| Hour Starting | Measured $L_{90}$ Broadband Hourly Sound Levels (dBA) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Tues 10/5/21 | Wed 10/6/21 | Thurs 10/7/21 | Fri 10/8/21 | Sat 10/9/21 | Sun 10/10/21 | Mon 10/11/21 | Tues 10/12/21 | Wed 10/13/21 |
| Midnight | -- | 40 | 42 | 44 | 41 | 40 | 41 | 40 | 42 |
| 1 a.m. | -- | 41 | 42 | 44 | 40 | 39 | 41 | 40 | 42 |
| 2 a.m. | -- | 40 | 42 | 44 | 40 | 39 | 41 | 40 | 41 |
| 3 a.m. | -- | 41 | 41 | 43 | 40 | 39 | 41 | 40 | 42 |
| 4 a.m. | -- | 40 | 41 | 43 | 40 | 39 | 41 | 41 | 43 |
| 5 a.m. | -- | 44 | 44 | 44 | 41 | 39 | 42 | 44 | 47 |
| 6 a.m. | -- | 46 | 45 | 46 | 41 | 41 | 43 | 45 | 49 |
| 7 a.m. | -- | 47 | 47 | 47 | 41 | 42 | 44 | 48 | 51 |
| 8 a.m. | -- | 46 | 43 | 46 | 42 | 42 | 42 | 45 | 49 |
| 9 a.m. | -- | 43 | 44 | 44 | 43 | 41 | 42 | 47 | 47 |
| 10 a.m. | -- | 42 | 43 | 45 | 43 | 42 | 42 | 45 | 45 |
| 11 a.m. | -- | 41 | 42 | 44 | 43 | 44 | 44 | 44 | -- |
| Noon | -- | 41 | 43 | 45 | 42 | 44 | 43 | 48 | -- |
| 1 p.m. | -- | 42 | 43 | 46 | 43 | 44 | 43 | 44 | -- |
| 2 p.m. | -- | 43 | 46 | 46 | 45 | 45 | 47 | 44 | -- |
| 3 p.m. | 44 | 44 | 52 | 46 | 45 | 45 | 43 | 44 | -- |
| 4 p.m. | 42 | 45 | 46 | 46 | 44 | 44 | 43 | 46 | -- |
| 5 p.m. | 42 | 45 | 46 | 46 | 43 | 43 | 43 | 46 | -- |
| 6 p.m. | 42 | 47 | 48 | 44 | 43 | 42 | 44 | 48 | -- |
| 7 p.m. | 43 | 47 | 47 | 43 | 42 | 42 | 44 | 47 | -- |
| 8 p.m. | 41 | 47 | 47 | 42 | 42 | 42 | 43 | 45 | -- |
| 9 p.m. | 41 | 45 | 47 | 41 | 41 | 42 | 43 | 45 | -- |
| 10 p.m. | 41 | 44 | 46 | 41 | 42 | 41 | 42 | 44 | -- |
| 11 p.m. | 41 | 43 | 46 | 41 | 41 | 41 | 41 | 43 | -- |

* Lowest hourly sound level was measured on Sunday, October 10, 2021 between 1:00 a.m. and 6:00 a.m.

### *2.2 Short-term Monitoring*

Short-term baseline sound levels were measured during the late night hours (12:00 a.m. to 1:56 a.m.) on Wednesday, October 13, 2021 at four (4) additional monitoring locations. Skies were clear with no precipitation; the temperature was 57°F, and wind speeds were calm. The approximate locations of the short-term sound level measurements are presented in Figure 1. One (1) set of sound level measurements, of 20 minutes in duration, was conducted at each of these locations during the late night hours. Broadband A-weighted maximum ($L_{max}$), average ($L_{eq}$) and background ($L_{90}$) sound levels were measured at each location to provide a complete picture of sound conditions in the residential areas surrounding the site.

All short-term (20-minute) sound level measurements were collected by an acoustic engineer using a Brüel & Kjær Model 2250 ANSI Type 1 (high precision) real-time sound level analyzer, which was equipped with a precision condenser microphone, windscreen, and frequency analyzers. This analyzer is equipped with a 1/2" precision condenser microphone and have an operating range of 5 dB to 140 dB, and an overall frequency range of 3.5 to 20,000 Hz. This analyzer meets or exceeds all requirements set forth in the American National Standards Institute (ANSI) Type 1 Standards for quality and accuracy. Prior to, and immediately following, each measurement session, the sound analyzer was calibrated (no level adjustment was required, therefore it was monitoring accurately) with an ANSI Type 1 calibrator, which has an accuracy traceable to NIST. For each measurement session, the microphone was fitted with a 7-inch windscreen to negate the effect of air movement across microphone diaphragm. All data were downloaded to a computer following the measurement session for the purposes of storage and further analysis. Concurrent observations of audible activity from sound-producing sources was recorded by the acoustic engineers. Sound measurements that included high-frequency natural sounds witnessed by Tech, such as from insects and birds, were removed and broadband $L_{90}$ sound levels were recalculated.[3]

A summary of the short-term sound level measurement results is provided in Table 4. The background levels ($L_{90}$) ranged from 34 to 37 dBA in the late night hours. The dominant sources of sound were distant and local traffic and natural sounds such as birds and insects. The overall sound levels measured are typical of a suburban area located near busy roads.

**TABLE 4**
**SUMMARY OF LATE NIGHT SHORT-TERM SOUND LEVELS (dBA)**
**SURROUNDING THE PROJECT SITE**
**Wednesday, October 13, 2021, 12:00 a.m. to 1:34 a.m.**

| Measured Broadband Sound Levels (dBA) | Location #1: 800 Fox Hollow Drive | Location #2: 500 Fox Hollow Drive | Location #3: Hickory Street & Locust Street | Location #4: Hickory Street & Juniper Street |
|---|---|---|---|---|
| | 12:00 a.m. – 12:20 a.m. | 12:24 a.m. – 12:44 a.m. | 12:44 a.m. – 1:14 a.m. | 1:26 a.m. – 1:56 a.m. |
| **Baseline Sound Level ($L_{90}$)** | 34 | 35 | 37 | 36 |

Ambient ($L_{90}$) sound levels concurrently collected at the long-term monitoring location were not consistent with the short-term monitoring results, presented above. That is, the sound level measured at the long-term monitoring location, during the same time period (42 dBA), was eight (8) dBA more than at Location #1 (800 Fox Hollow Drive, 34 dBA), was seven (7) dBA more than at Location #2 (500 Fox Hollow Drive, 35 dBA), was five (5) dBA more than at Location #3 (Hickory Street & Locus Street, 37 dBA) and was six (6) dBA more than at Location #4 (Hickory Street & Juniper Street, 36 dBA). This is not surprising given that the monitoring locations are varying distances from Route 3 and Route 3A, which are the principal sources of continuous sound in the area.

[3] Acoustical Society of America, American National Standard ANSI/ASA S3/SC1.100-2014 and ANSI/ASA S12.100 "Methods to Define and Measure the Residual Sound in Protected Natural and Quiet Residential Areas", 2014.

Furthermore, the lowest one-hour $L_{90}$ level measured by the long-term monitor of 39 dBA (see Section 2.1) was three (3) dBA less than the sound level measured by the meter during the short-term monitoring. Thus, sound levels measured at the short-term monitoring locations could have been three (3) dBA less if measured on the quietest night (i.e. 10/10/21 at 1:00 a.m.). Thus, this analysis assumes that the lowest ambient sound levels at each of the nearest sensitive locations are three (3) dBA less than was measured during the late night short-term sound monitoring (i.e. 31 dBA at Location #1, 32 dBA at Location #2, 34 dBA at Location #3 and 33 dBA at Location #4).

## 3.0 Noise Regulations

### *3.1 New Hampshire*

The State of New Hampshire has not established regulations that set community noise exposure criteria. It is up to each individual community to establish noise regulations through community by-laws. Many local communities have some form of community noise ordinance.

### *3.2 Hudson Noise Ordinance*

Noise is regulated under Chapter 249 Noise in the Town's general code. A summary of the applicable quantitative sound limits is presented below.

*Under § 249-4. Prohibited noise emissions and conditions, no person or persons owning, leasing or controlling the operations of any source or sources of noise shall willfully, negligently or through failure to provide necessary equipment or facilities or through failure to take necessary precautions make or permit the emission of noise levels or conditions exceeding the following noise limits for the applicable land use:*

*B. Noise Limit 2: Continuous sound-level limits. No person shall cause the continuous sound level to exceed the following limits, as measured at the applicable locations in accordance with the provisions of § 249-3D(5) of this chapter:*

**Continuous $L_{eq}$ (One-Hour[3]) Sound Limits (dBA)**

| Receptor Land Use Category | Daytime | Nighttime |
|---|---|---|
| Residential/Rural/Institutional[1] | 55 | 50 |
| Business/Recreational[2] | 65 | 55 |
| Industrial | 75 | 75 |

[1] Hospitals, schools, places of worship, libraries, public parklands, etc.

[2] Public playgrounds, swimming pools, athletic fields, golf courses, etc.

[3] Where the offending source of noise is nearly constant over a one-hour period, a measurement sampling period of less than one hour, but no less than five minutes, is permitted. This measurement shall be made with the sound-level meter set to slow A-weighting responses.

Note the ordinance defines ambient sound level as the hourly energy-equivalent noise level that is produced by transportation vehicles, natural phenomena and distant activity which is not related to an offending sound source.

*C. Noise Limit 3: Impulsive sound-level limits. No person shall cause an impulsive sound level that exceeds the following limits, as measured at the applicable locations in accordance with the provisions of § 249-3D(5) of this chapter:*

**Impulsive Sound Limits (dBC fast)**

| Receptor Land Use Category | Daytime | Nighttime |
|---|---|---|
| Residential/Rural/Institutional[1] | 67 | 62 |
| Business/Recreational[2] | 77 | 67 |
| Industrial | 87 | 87 |

[1] Hospitals, schools, places of worship, libraries, public parklands, etc.
[2] Public playgrounds, swimming pools, athletic fields, golf courses, etc.

*D. Noise Limit 4: Background referenced sound level. No person shall cause the background noise level, as defined in § 249-2 of this chapter, to increase by more than 10 dBA in any receptor area at any time of day.*

Note the ordinance defines background noise as the highest A-weighted sound-pressure level which is exceeded 90% of the time period during which measurement is taken.

*E. Noise Level 5: Pure-tone conditions. No person shall produce a pure-tone condition at the nearest receptor buildings or activity areas in rural/residential/institutional or business/recreational/industrial zoned property.*

Note the ordinance defines a "pure tone" condition occurs when any octave band sound pressure level exceeds both of the two adjacent octave band sound pressure levels by 3 dB or more.

*F. Noise Level 6: High noise-level areas. In areas where the ambient sound level is already as high as or higher than three dB below the sound-level limits of Noise Limit 2, no person shall cause the noise level in any area to increase by more than three dB. This limit is in lieu of Noise Limit 2, but shall not supersede any other noise limit as defined in this chapter.*

The Noise Ordinance limits for continuous sounds from the project are 55 dBA during daytime hours and 50 dBA during nighttime hours. Continuous sound level impacts from the proposed warehouse development may not exceed those levels. The Noise Ordinance also limits for background sounds are 49 dBA in the areas off of Lowell Road and Friars Drive, 41 dBA in the area of Location #1 (800 Fox Hollow Drive, 42 dBA in the area of Location #2 (500 Fox Hollow Drive), 44 dBA in the area of Location #3 (Hickory Street & Locust Street), and 43 dBA in the area of Location #4 (Hickory Street & Juniper Street). Background sound level impacts from the proposed warehouse development may not exceed those levels. A "pure tone" condition occurs when any octave band sound pressure level exceeds both of the two adjacent octave band sound pressure levels by 3 dB or more.

## 4.0 Modeling Assumptions and Results

This section describes the modeling approach and assumptions included in our acoustic modeling analysis, and predicted sound levels at the residences nearest to the proposed warehouse development.

### *4.1 Modeling Assumptions*

Future sound levels of the proposed warehouse development were calculated with the CadnaA acoustic model assuming both continuous and background sources associated with the facility. The assumptions in our noise modeling analysis are as follows:

1. The location of the proposed warehouse development and associated grading was based on site plans by The Dubay Group, Inc.[4] The plans show the proposed location of the warehouse building in the center of the lot, with loading docks to the north and south, and with car and trailer parking stalls in all directions surrounding the building.
2. The primary sources of continuous operational sounds are rooftop-mounted heating, ventilation, and air conditioning (HVAC) equipment, and rooftop units (RTUs) on top of the building. Other sound sources assumed to be continuous are heavy trucks traveling to and from the facility, and trucks idling in the loading dock areas prior to leaving the facility.
3. The primary sources of background operational sounds are rooftop-mounted heating, ventilation, and air conditioning (HVAC) equipment, and rooftop units (RTUs) on top of the building.
4. The proposed warehouse development will operate up to 24 hours per day, seven days per week

### *4.2 Future Sound Levels*

Cadna-A is a sophisticated 3-D model for sound propagation and attenuation based on International Standard ISO 9613.[5] Atmospheric absorption is the process by which sound energy is absorbed by the air and was calculated using ANSI S1.26-1995.[6] Absorption of sound assumed standard conditions and is significant at large distances and at high frequencies. ISO 9613 was used to calculate propagation and attenuation of sound energy by hemispherical divergence with distance, surface reflection, ground, and shielding effects by barriers, buildings, and ground topography. Offsite topography was determined using MassGIS digital terrain models.[7] The residential modeling locations are illustrated in Figure 2.

The predicted maximum sound levels are conservative because:

1. The model assumes a ground-based temperature inversion, such as may occur on a clear, calm night when sound propagation is at a maximum. This worst-case condition is infrequent.

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[4] Friars Drive, Tax Map 209, Lot 001-000, 161 Lowell Road, Hudson, NH, Project #475. August 3, 2021.
[5] International Standard, ISO 9613-2, Acoustics – Attenuation of Sound During Propagation Outdoors, -- Part 2 General Method of Calculation.
[6] American National Standards Institute, ANSI S1.26-1995, American National Standard Method for the Calculation of the Absorption of Sound by the Atmosphere, 1995.
[7] https://docs.digital.mass.gov/dataset/massgis-data-digital-terrain-model-dtm-files

2. The model assumes that all rooftop equipment operate at maximum load simultaneously (a worst-case condition not likely to occur).
3. The model assumes that truck traffic occurs at all hours of the day and night, although the Town of Hudson currently limits commercial truck traffic from any Town road after 7:00 pm and until 6:00 am, except by special permit.[8] This is a conservative approach.

Sound levels were predicted for the continuous operation of HVAC equipment and RTUs on top of the building, as well as heavy trucks traveling to and from the facility, and trucks idling at the loading docks.

Continuous Sound Levels

Table 5 summarizes the modeling results for the continuous sound level impacts from the warehouse development. The primary sources of continuous sounds are HVAC equipment, RTUs, and heavy trucks. Those impacts range from 25 dBA to 45 dBA at the nearest residential property lines. The sound level impacts of the warehouse development at locations further away would be even less. Furthermore, the modeled sound level impact at the nearest residences does not demonstrate the presence of a pure tone condition. Table 5 confirms that the proposed warehouse development will comply with the Hudson Noise Ordinance limits for continuous sounds (i.e. 55 dBA daytime/50 dBA nighttime).

**TABLE 5**

**CONTINUOUS SOUND LEVELS FROM THE WAREHOUSE DEVELOPMENT**

| Sensitive Receptor Location | Sound Level Impact of Project | Hudson Limit (Day/Night) | Complies? |
|---|---|---|---|
| 7 Juniper Street | 25 dBA | 55/50 dBA | **Yes** |
| 26 Hickory Street | 28 dBA | 55/50 dBA | **Yes** |
| 24 Hickory Street | 29 dBA | 55/50 dBA | **Yes** |
| 22 Hickory Street | 30 dBA | 55/50 dBA | **Yes** |
| 20 Hickory Street | 31 dBA | 55/50 dBA | **Yes** |
| 18 Hickory Street | 33 dBA | 55/50 dBA | **Yes** |
| 16 Hickory Street | 34 dBA | 55/50 dBA | **Yes** |
| 14 Hickory Street | 34 dBA | 55/50 dBA | **Yes** |
| 12 Hickory Street | 34 dBA | 55/50 dBA | **Yes** |
| 10 Hickory Street | 33 dBA | 55/50 dBA | **Yes** |
| 8 Hickory Street | 32 dBA | 55/50 dBA | **Yes** |
| Fox Hollow Apartments | 31 to 44 dBA | 55/50 dBA | **Yes** |
| 145 Lowell Road | 32 dBA | 55/50 dBA | **Yes** |
| 149 Lowell Road | 36 dBA | 55/50 dBA | **Yes** |
| 153 Lowell Road | 41 dBA | 55/50 dBA | **Yes** |
| 155 Lowell Road | 41 dBA | 55/50 dBA | **Yes** |
| Friars Court Apartments | 43 to 45 dBA | 55/50 dBA | **Yes** |
| 171 Lowell Road | 42 dBA | 55/50 dBA | **Yes** |
| 173 Lowell Road | 39 dBA | 55/50 dBA | **Yes** |

[8] Chapter 317 Trucks, commercial vehicles and heavy vehicles in the Town's general code (§ 317-13(B)).

Background Sound Levels

Table 6 summarizes the modeling results for the background sound level impacts from the warehouse development. The primary sources of background sounds are HVAC equipment, and RTUs. Those impacts range from 24 dBA to 37 dBA at the nearest residential property lines. The sound level impacts of the warehouse development at locations further away would be even less. These projected sound levels are greater than the existing lowest ambient sound levels of 31 dBA to 39 dBA (see Section 2.0). The predicted total sound level during the quietest late night and early morning periods would therefore range from 32 dBA to 41 dBA. And, the resulting change in sound level would range from approximately + 0 dBA to + 3 dBA, which are less than the Hudson Noise Ordinance limit of + 10 dBA. Furthermore, the modeled sound level impact at the nearest residences does not demonstrate the presence of a pure tone condition. Table 6 confirms that the proposed warehouse development will comply with the Hudson Noise Ordinance limits for background sounds (i.e. less than a 10 dBA increase).

**TABLE 6**

**BACKGROUND SOUND LEVELS FROM THE WAREHOUSE DEVELOPMENT**

| Sensitive Receptor Location | Lowest Ambient Sound Level | Sound Level Impact of Project | Total Future Sound Level | Sound Level Increase |
|---|---|---|---|---|
| 7 Juniper Street | 33 dBA | 24 dBA | 33 dBA | **+ 0 dBA** |
| 26 Hickory Street | 33 dBA | 26 dBA | 34 dBA | **+ 1 dBA** |
| 24 Hickory Street | 33 dBA | 26 dBA | 34 dBA | **+ 1 dBA** |
| 22 Hickory Street | 33 dBA | 28 dBA | 34 dBA | **+ 1 dBA** |
| 20 Hickory Street | 33 dBA | 29 dBA | 34 dBA | **+ 1 dBA** |
| 18 Hickory Street | 33 dBA | 31 dBA | 35 dBA | **+ 2 dBA** |
| 16 Hickory Street | 34 dBA | 32 dBA | 36 dBA | **+ 2 dBA** |
| 14 Hickory Street | 34 dBA | 33 dBA | 36 dBA | **+ 2 dBA** |
| 12 Hickory Street | 34 dBA | 32 dBA | 36 dBA | **+ 2 dBA** |
| 10 Hickory Street | 34 dBA | 30 dBA | 35 dBA | **+ 1 dBA** |
| 8 Hickory Street | 34 dBA | 27 dBA | 35 dBA | **+ 1 dBA** |
| Fox Hollow Apartments | 31 to 32 dBA | 24 to 31 dBA | 32 to 34 dBA | **+ 1 to +3 dBA** |
| 145 Lowell Road | 39 dBA | 27 dBA | 39 dBA | **+ 0 dBA** |
| 149 Lowell Road | 39 dBA | 31 dBA | 40 dBA | **+ 1 dBA** |
| 153 Lowell Road | 39 dBA | 33 dBA | 40 dBA | **+ 1 dBA** |
| 155 Lowell Road | 39 dBA | 33 dBA | 40 dBA | **+ 1 dBA** |
| Friars Court Apartments | 39 dBA | 36 to 37 dBA | 41 dBA | **+ 2 dBA** |
| 171 Lowell Road | 39 dBA | 30 dBA | 40 dBA | **+ 1 dBA** |
| 173 Lowell Road | 39 dBA | 29 dBA | 39 dBA | **+ 0 dBA** |

Impulsive Sound Levels

The Hudson Noise Ordinance defines impulsive noise as, *"A repeatedly applied sound of short duration (usually less than one second) characterized by an abrupt onset and rapid decay and occurring at the rate of less than one per second."* Typical impulsive sounds are gunfire, a balloon bursting, and loud clicks or popping sounds. These types of instantaneous impulsive sounds are not expected from the proposed warehouse development, thus the impulsive sound limits within the Hudson Noise Ordinance are not

applicable. Furthermore, the impulsive sound limits within the Hudson Noise Ordinance are higher than the continuous and background sound level limits applicable to this project.

### *4.3 Conclusions*

An acoustic modeling study was performed revealing that the proposed 161 Lowell Road warehouse development in Hudson, New Hampshire will not create a noise nuisance condition and will fully comply with the Hudson Noise Ordinance.

If you have any questions, please call me at 781-890-2220.

Sincerely,

TECH ENVIRONMENTAL, INC.

Marc C. Wallace, QEP, INCE
Vice President

4686/161 Lowell Road Sound Study

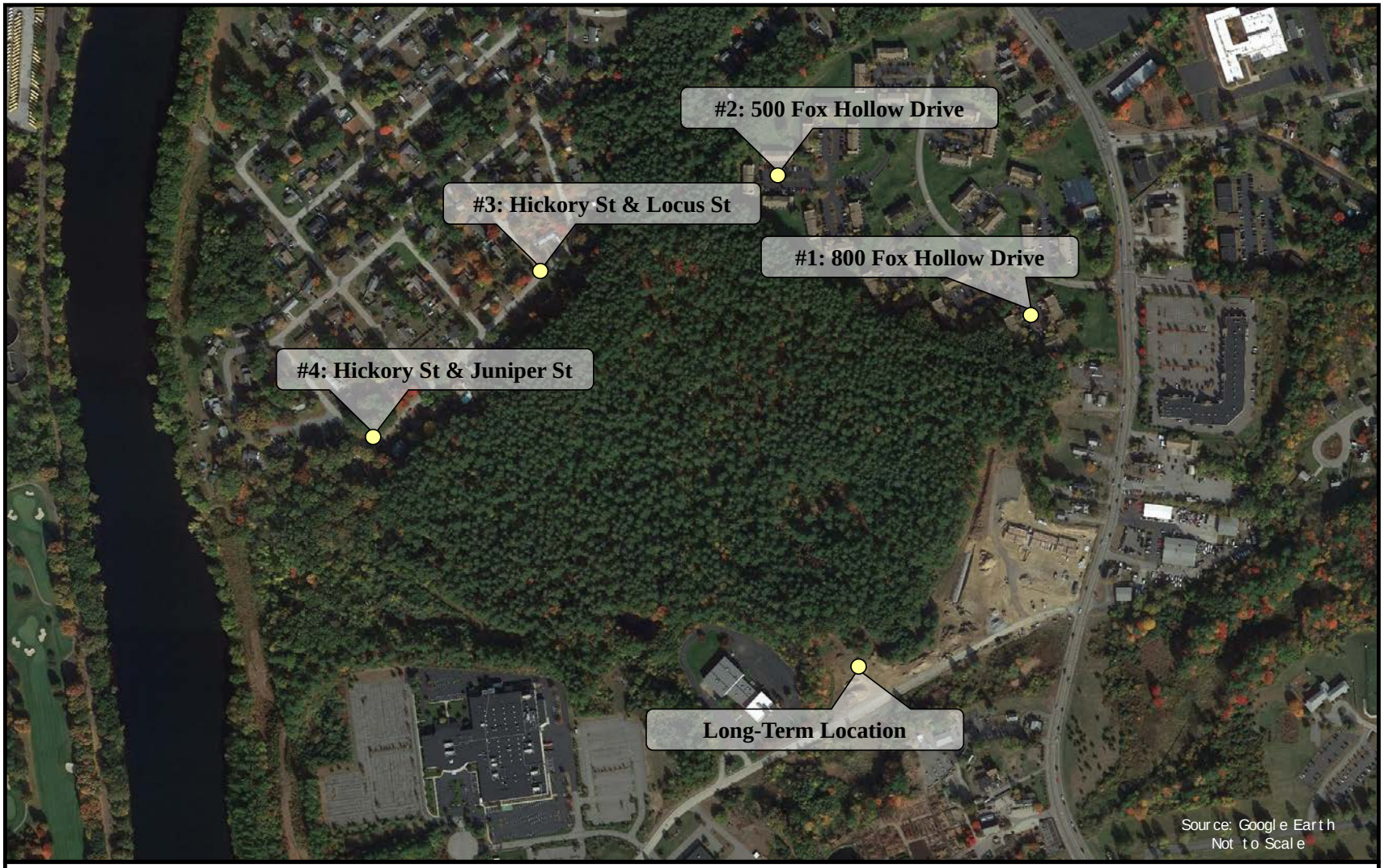


**Figure 1**
**Sound Monitoring Locations**
**161 Lowell Road Warehouse Development, Hudson, NH**


**Figure 2**
**Residential Modeling Locations**
**161 Lowell Road Warehouse Development, Hudson, NH**