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May 17, 2016

Mr. Andrew E Graves LEED AP
Principal Architect
BL Companies
355 Research Parkway
Meriden, CT 06450

Ref 4121

Re: Self-Storage Facility Sound Study Opinion Letter, Newton, MA

Dear Mr. Graves:

Tech Environmental, Inc. (TE) performed a sound evaluation for a proposed self-storage facility on 255-257 Newtonville Avenue, Newton, MA. The sound evaluation includes a review of existing land use and sound conditions, proposed building and site plans, and rooftop units (RTUs) specifications.

COMMON MEASURES OF COMMUNITY NOISE

Noise is defined as "unwanted sound", which implies sound pressure levels that are annoying or disrupt activities 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 (Lp) is the decibel (dB), a logarithmic scale formed by taking 20 times the $\log_{10}$ of a ratio of two pressures: the measured sound pressure divided by a reference sound pressure. The decibel level scale conveniently compresses the range of audible sound pressures, which span 12 orders of magnitude, into an easy-to-use scale spanning 0 to 120 dB. Airborne sound is referenced to 20 micro-Pascals (20 µPa), which corresponds to 0 dB and the threshold of hearing. 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 70 dB is added to another sound of 70 dB, the total is only a 3-decibel increase (or 73 dB), not a doubling to 140 dB. For broadband sounds, a 3 dB change is the minimum change perceptible to the human ear.

Non-steady noise exposure in a community is commonly expressed in terms of the A-weighted sound level (dBA); A-weighting approximates the frequency response of the human ear. Levels of many sounds change from moment to moment. Some are sharp impulses lasting one-second or less, while others rise and fall over much longer periods of time. 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 over a given 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. These measures are generally reported to the nearest whole decibel as broadband sound pressure level, i.e., broadband sound levels include sounds at all frequencies. Sound level data also typically include an analysis of the sound spectrum into its various frequency components to determine tonal characteristics. The unit of frequency is Hertz (Hz), measuring the cycles per second of the sound pressure waves, and typically the frequency analysis examines eleven octave bands from 16 to 16,000 Hz. MassDEP Noise Policy states that a source creates a pure tone if acoustic energy is concentrated in a narrow frequency range and one octave band has a sound level 3 dB greater than both adjacent octave bands.

Table 1 presents the perceived change in loudness of different changes in sound pressure levels.

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

APPLICABLE NOISE REGULATIONS

MassDEP Noise Policy

The Massachusetts Department of Environmental Protection (MassDEP) regulates noise through 310 CMR 7.10, "Air Pollution Control". In these regulations "air contaminant" is defined to include sound and a condition of "air pollution" includes the presence of an air contaminant in such concentration and duration as to "cause a nuisance" or "unreasonably interfere with the comfortable enjoyment of life and property".

Regulation 7.10 prohibits "unnecessary emissions" of noise. The MassDEP Noise Policy (Policy Statement 90-001, February 1, 1990) interprets a violation of this noise regulation to have occurred if the source causes either:

(1) An increase in the broadband sound pressure level of more than 10 dBA above the ambient, or
(2) A "pure tone" condition

The "ambient level" is defined as the L_{90} level measured during equipment operating hours. 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.

The MassDEP does not regulate sound from construction activity and does not regulate sound from motor vehicles accessing the site or from truck safety backup alarms.

City of Newton

The Noise Control Ordinance of the City of Newton (Section 20-3 Noise Control) defines noise as a condition caused by a source that increases noise levels 10 dB(A) or more above background noise level, except if the noise source produces a tonal sound, in which case an increase of 5 dB(A) or more above background noise level is sufficient to cause noise pollution.

The ordinance defines a tonal sound as any sound that is judged by a listener to have the characteristics of a pure tone, whine, hum or buzz.

The Noise Control Ordinance establishes maximum noise levels for HVAC systems. The ordinance states that "*No person shall operate any air conditioning, refrigeration or heating equipment for any residence or other structure or operate any pumping, filtering or heating equipment for any pool or reservoir in such manner as to create any noise which would cause the noise level on the premises of any other occupied property or if a condominium, apartment house, duplex, or attached business, within any adjoining unit, to exceed the background noise level by more than 5 dB(A).*"

EXISTING SOUND CONDITIONS

The proposed site is bound by Interstate 90 (I-90) to the north, the NEFCO property to the west, Lewis Terrace residences to the east and Newtonville Avenue residences to the south. The dominant noise sources are traffic along I-90 and local traffic along Newtonville Avenue. Highway traffic noise tends to be the loudest just before and after the peak morning and afternoon rush hours. However, the major source of sound from the proposed self-storage building will be roof top units (RTUs), which can operate 24 hours a day and seven days a week; thus, the quietest nighttime hours are used to determine compliance with the MassDEP Noise Policy and City Noise Control Ordinance.

The residences on Lewis Terrace are closest to I-90, and therefore, the background sound levels will be the loudest compared to residences on Newtonville Avenue, which are also impacted by local traffic noise. TE has not taken sound level measurements to define existing background conditions. However, the average (L_{eq}) sound levels near a highway during the quietest nighttime hours similar to the conditions near the proposed site are 50 to 60 dBA and the background ambient (L_{90}) sound levels are approximately 10 dBA quieter or 40 to 50 dBA based on similar sound level measurements taken near an interstate highway in Massachusetts.[1]

[1] Tech Environmental sound level measurements of I-495 in Bellingham, MA.

PROPOSED FACILITY SOUND LEVELS

The primary sources of continuous operational sound are four package rooftop units (RTUs) situated closest to the I-90. The acoustic profile from all four RTUs operating concurrently under full load conditions is assumed as a worst-case scenario. The roof plan shows that four (25-ton) Carrier RTUs will be installed on the west side of the building furthest away from residences on Lewis Terrace and Newtonville Avenue. According to Carrier's manufacturer specification, the reference sound power level is 86 dBA.[2] A review of the octave band sound levels reveals that the proposed unit does not produce a tonal sound.

Sound propagating outdoors through the atmosphere generally decreases in level with increasing distance between the source and the receiver. This attenuation is the result of several mechanisms, principally, geometrical divergence from the sound source, absorption of acoustic energy by the air through which the sound waves propagate, and the effect of the propagation close to different ground surfaces. The distance between the RTUs and the nearest residences on Lewis Terrace and Newtonville Avenue ranges from approximately 240 to 340 feet away. Accounting for sound attenuation due to geometric divergence (distance) only, the calculated sound levels from the RTUs at the nearest residences on Lewis Terrace and Newtonville Avenue would be 45 and 46 dBA, respectively. The adding of the RTUs sound levels to the assumed background L_{90} sound level of 40 dBA would increase the background levels to 46 to 47 dBA, or approximately 6 to 7 dBA. These changes in sound levels would comply with the MassDEP Noise Policy allowable sound level increase of 10 dBA, but would exceed the City's Noise Control Ordinance allowable sound level increase of 5 dBA for HVAC equipment.

You have advised me that additional acoustical treatment including perimeter condenser fan panels such as the BRD Noise and Vibration, Inc. HUSH GUARD (HGU model) or equal will be installed on each RTU. This would reduce the predicted sound level increases to less than 3 dBA above the background L_{90} level. A less than 3 dBA increase in background sound level is readily achievable with those fan panels and will be imperceptible by people at the Lewis Terrace and Newtonville Avenue residences.

[2] A sound power level of 87 dBA produces a relatively low sound pressure level of 43 dBA at a distance of 100 feet.

CONCLUSION

It is my professional opinion that the operations of the RTUs on the self-storage facility will comply with the MassDEP Noise Policy and City's Noise Control Ordinance with the installation of acoustic condenser fan panels on all four RTUs. This would reduce the predicted sound level increases to less than 3 dBA above the background L_{90} level. A less than 3 dBA increase in background sound level is readily achievable with those fan panels and will be imperceptible by people at the Lewis Terrace and Newtonville Avenue residences.

Sincerely yours,

TECH ENVIRONMENTAL, INC.

Marc C. Wallace, QEP
Principal