August 4, 2020

Mr. Lawrence Smith
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Subject: Peer Review of
Hub Project Noise Assessment

Dear Mr. Smith,

As requested, I have reviewed Burton Snowboards & Higher Ground Hub Project Noise Assessment dated April 20, 2020 prepared by RSG, White River Junction, Vermont. The Hub Project is to renovate the Burton Snowboard facility at 266 Queen City Park Road into an indoor entertainment venue with restaurants, retail space, and an indoor recreation area, as well including Burton offices, prototyping workshop, and manufacturing facility. The RSG report notes that the project will:

- Comply with Sec. 21-13(b)(1) of the Burlington Noise Control Ordinance.
- Not cause an "undue adverse impact on aesthetics" prohibited by the Vermont Act 250 process.
- Comply with WHO Community Noise Guidelines.

The RSG report only addresses the (b)(1) *General prohibition* of the Burlington Noise Ordinance. However, it is my understanding that the Hub Project must also comply with Sec. 21-13 (b)(2)(a) *Radios, television sets, musical instruments, phonographs and similar devices;* and Sec. 21-13 (b)(2)(c) *Parties and other social events*. These subsections are here quoted in full:

> Sec. 21-13 (b)(2)(a) *Radios, television sets, musical instruments, phonographs and similar devices.* The operation or permitting the use or operation of any musical instrument, radio, television, phonograph, or other device for the production or reproduction of sound in such a manner as to be plainly audible through walls between units within the same building, from another property or from the street between the hours of 10:00 p.m. and 7:00 a.m. or in such a manner as to unreasonably disturb the peace, quiet or comfort of the public.
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> Sec. 21-13 (b)(2)(c) *Parties and other social events.* Notwithstanding section (b)(1), it shall be unlawful for any person who is participating in a party or other social event to actively make unreasonably loud noise. A party or other social event is defined as a gathering upon the premises of one or more persons not residing at the premises. Unreasonably loud noise is noise that unreasonably interferes with the peace or health of members of the public or is plainly audible between the hours of 10:00 p.m. and 7:00 a.m. through the walls between units within the same building, from another property or from the street. It shall also be unlawful for any resident of a premises to allow a party or other social event occurring in or about the premises to produce unreasonably loud noise. There is a rebuttable presumption that all residents of the premises have allowed such party or other social event to occur in or about the premises. All

residents of the premises are responsible for such unreasonable noise made, each having joint and several liability.

This letter presents our conclusions regarding the analysis methods employed by RSG and makes recommendations on how the analysis should be revised to better protect the surrounding residential community.

Noise Standards

The Burlington Noise Control Ordinance is a nuisance type prohibiting "…*any person to make or cause to be made any loud or unreasonable noise*." As the Act 250 process requires consideration of impacts in areas outside the primary jurisdiction, the Hub Project is also subject to the City of South Burlington Section A.3(b)(ii) noise ordinance limiting Hub Project sound to 45 dBA at night (12:00 AM and 8:00 AM). The ordinance notes this to be a "one-hour average", presumably the A-weight one-hour equivalent sound level ($LA_{eq,1\text{-}hr}$). Music played at this level in neighborhoods, though compliant, may be clearly identifiable and "…*out of character with the area*…" as prohibited by Act 250.

It is my opinion that use of the equivalent sound level is most appropriate for broadband, indistinct sound such as that produced by ventilation equipment, for example, which contains no information. Music and speech are distinct, easily identifiable sounds that contain distracting information. We recommend that, in addition to adhering to applicable limits, a design goal for music transient sound be developed to minimize impact. Based on prior work of this firm[1], the community should be sufficiently protected if the 1st percentile A-weighted music and voice sound level ($LAF_{01,1\text{-}hr}$) does not exceed the existing residual sound level, expressed as the 90th percentile A-weighted sound level ($LAF_{90,1\text{-}hr}$), by more than 5 dBA. This correctly recognizes that the audibility of music in the environment is perceptible depending on the amount by which it exceeds the otherwise existing ambient sound level.

Music Sound Level

The RSG report assumes music sound will have an average ($LA_{eq,1\text{-}hr}$) sound level of 99 dBA. In the above footnoted paper, the A-weighted equivalent sound level for music of all genre ranged from 71 dBA (jazz and classical at the lowest levels) to 104 dBA (rock). The corresponding 1st percentile A-weighted sound level ranged between 79 and 107 dBA as measured mid-audience under the pavilion at Great Woods in Mansfield, MA. I would recommend that that performing acts be required to limit sound to an $LA_{eq,10\ min}$ of 105 dBA and that this be used by RSG in its analysis. The high level I have suggested, as a practical matter, is important to many rock acts wishing to maintain their entertainment value.

Building Sound Isolation

Wall and roof section sketches, and a description of how their sound isolation performance has been determined, should be provided. Of most importance is the ability of the building to limit the transmission of low frequency sound to the community. This aspect of building design is important as

[1] Cavanaugh, W.J.; Tocci, G.C.; "Criteria for community acceptance of outdoor concert sound...a progress report on continuing research", The 2002 International Congress and Exposition on Noise Control Engineering, Dearborn, MI, USA, August 19-21, 2002.

low frequency rhythm sound (bass beat) is generally the dominant source of complaints by residents living near entertainment venues.

Building Mechanical Systems

The report indicates that the building will be served by three existing Carrier rooftop air handling units producing sound power levels of 78-87 dBA (assumed to be based on field measurements) and two new units producing sound power levels of 86 and 87 dBA. I would recommend that manufacturer technical information for the new units be submitted when available.

Lounge Crowd Sound

Sound produced by patrons in the outdoor lounge with space for 150 to 300 patrons was modeled as 15 "loud" male voices. ANSI S3.5 Methods for Calculation of the Speech Intelligibility Index provides one-third octave band power spectral densities for normal, raised, loud, and shouting vocal effort. From this information, the sound power level of 1 loud male vocal effort is 85 dBA. For 15 voices, the total A-weighted sound power emitted, instead of 88 dBA, would be 97 dBA.

In a similar outdoor rooftop patio of a private downtown club, the average sound level measured in the seating area of a typical outdoor restaurant was 75 dBA. This level was applied to the design of an outdoor rooftop patio of a proposed private club. The corresponding sound power level for the maximum occupancy of 65 patrons was 98 dBA. Increasing the patron count from 65 to 300 would increase the emitted sound power level emitted from 98 dBA to 105 dBA.

For an outdoor hotel roof deck with 18 of 50 patrons speaking with normal vocal effort (instead of loud vocal effort), the total power emitted was 88 dBA. Scaling this up to 300 patrons would increase the sound power level to 92 dBA.

The RSG corrected assumption of an emitted sound power level of 97 dBA is probably on the low side compared with the scaled-up club roof deck emission of 105 dBA and the scaled-up hotel outdoor roof patio emission of 92 dBA. An assumed sound power emission of 100 dBA may be more appropriate.

The report does not provide details on shielding by buildings, the lounge elevation, nor possible screening by barriers to reduce crowd sound transmitted to the community. The analysis of the lounge would benefit from consideration of these and other details. In addition, some consideration should be given to sound transmission through double doors accessing the event space during concerts.

Parking Lot Sound

Without the Cadna model input file, it is not possible to evaluate parking lot sound power levels used in modeling. The Cadna parking lot computational standards do not include sound associated with crowds arriving at or departing from music events. This would require sound measurements near a similar event parking area during patron arrival and departure, at least to confirm the appropriateness of the Cadna standard algorithms for parking lot sound. We also wish to emphasize the Hub Project management decision to prohibit tailgating in facility parking areas. Barriers screening parking lot sound levels may provide some benefit as well.

Computer Modeling

I am familiar with Cadna and its methods for evaluating sound. It is among the correct tools to use for evaluating Hub Project sound. However, its inputs should be modified to reflect the above-mentioned descriptors, and to evaluate the potential for low frequency rhythm sound (bass sound) most often the source of community complaints in connection with entertainment facilities. Cadna can be used to evaluate other controls, among them sound barriers to screen sound from sensitive areas.

Conclusions

The organization of the technical study of potential impact of the proposed Hub Project is generally correct. However, though the regulations cited are important, they do not adequately protect the residential community from exposure to unwanted entertainment sound. Protecting residential areas requires developing design goals that incorporate existing background sound levels obtained through actual sound monitoring of existing conditions. Revising the study to develop design goals for sound as we have suggested, providing more detail on building envelope and outdoor lounge design, and investigating possible use of barriers to screen sound would provide better certainty that impacts have been minimized through project design.

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If I can provide further detail, please do not hesitate to contact me. Thank you.

Sincerely,

CAVANAUGH TOCCI

Gregory C. Tocci, *Sr. Principal Consultant*

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