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May 6, 2014

Jason Blais, Project Manager  
Opechee Construction Corporation  
11 Corporate Drive  
Belmont, NH 03220

Project: Marriot Courtyard Hotel, Portland, ME  
Subject: Calculations and Evaluation of Environmental Sound Levels  
Associated with Hotel Rooftop HVAC Systems

Dear Mr. Blais,

This letter and technical data in Appendix A summarize our calculations and evaluation of environmental sound levels projected to be produced by hotel rooftop HVAC systems, and transmitted to receptor properties in the vicinity of the hotel.

### Acoustical Submittal Requirements

This report is submitted to fulfill the requirements of Condition 10 of the City of Portland Conditions of Site Plan Approval for the Marriot Courtyard Hotel, specified as follows:

10. All HVAC systems and external mechanical equipment shall meet the maximum allowable noise requirements of the zone; each unit shall submit documentation of dBA output to confirm compliance of both the unit and the building in respect of rated noise levels and cumulative noise levels, to the satisfaction of the Zoning Administrator prior to the issuance of a Building Permit for that unit. This requirement shall be included in the Condominium documents.

Included in Appendix A is a portion of the City of Portland Code of Ordinances that is pertinent to this acoustical evaluation (Code of Ordinances, Chapter 14, Section 14-230.5 *Performance Standards*, Subsection b, *Noise*).

The *Performance Standards* pertaining to *Noise* specify a 60 dBA (decibels, A-weighted) daytime sound level limit, and specify a 50 dBA (ibid.) nighttime sound level limit. Although not clearly stated in the *Performance Standards*, we have inferred that these limits are applicable at any/all receptor properties surrounding the hotel, at distances near or far, and including receptor locations at grade/sidewalk level and at the windows of any/all floor levels above grade.

- With the understanding that any/all of the hotel HVAC equipment could operate at any time of day or night, we conclude that the City of Portland 50 dBA nighttime sound level limit is the most stringent limit applicable for this acoustical evaluation.

- Our evaluation summarized herein is for the “worst-case operating scenario” with all of the hotel HVAC equipment operating simultaneously at night.

### **Acoustical Database**

The calculations conducted for this evaluation are based on the sound power levels of each type/model of HVAC equipment, which are derived in accordance with national/international standards and published by the equipment manufacturers.

Sound power is analogous to the electrical power (wattage) rating of a light bulb. The higher the electrical power (wattage) rating of a light bulb, the brighter the bulb. The higher the sound power rating of a sound source, the higher the sound level produced by the source.

- Table 1 within Appendix A lists each type/model/quantity of rooftop HVAC equipment proposed to be installed and operated at the hotel, and lists the sound power level of each equipment unit.
- Figure 1 within Appendix A is a Roof Plan of the hotel, showing the locations of the rooftop HVAC equipment (including locations on upper and lower roofs).

### **Calculations Methodology**

Calculations of hotel HVAC equipment environmental sound levels transmitted to receptor locations for this project evaluation were conducted using an acoustical computer model (Cadna/A, Datakustik GmbH, revision 4.4.145, 32-bit).

Cadna/A is a computer program that implements the acoustical input data and modeling techniques of International Standards Organization (ISO) Standards 9613-1 and 9613-2 to calculate sound levels transmitted to community receptor locations. The Cadna/A computer program is the current leading acoustical calculation program available on the commercial market and is used worldwide.

In calculating sound levels transmitted to receptor locations, the Cadna/A model takes into account reductions in sound levels that occur due to distances between sound sources and receptors, absorption of sound by the atmosphere, acoustical shielding provided by intervening structures and topography (if applicable), and the sound absorption/reflection characteristics of ground, water, vegetation, building surfaces, etc. (if applicable).

- Figure 2 within Appendix A is an aerial view (Google Earth satellite photo) of the hotel and vicinity, which we have annotated to show the outlines of the hotel building and closest nearby buildings, the locations of the HVAC equipment on the hotel rooftops (upper and lower level roofs), and the HVAC systems sound levels calculated by the computer model to be transmitted to the most critical receptor building locations/elevations surrounding the hotel (for “worst-case” condition with all equipment operating simultaneously).

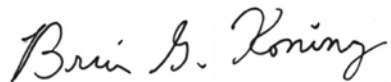
As shown on Figure 2, all of the hotel HVAC systems sound levels projected to receptor locations surrounding the hotel are within the City of Portland 50 dBA nighttime sound level limit.

## Conclusions

- To the best of our knowledge, this report submittal fulfills the requirements of Condition 10 of the City of Portland Conditions of Site Plan Approval for the Marriot Courtyard Hotel.
- The acoustical calculations and evaluations conducted for this report submittal indicate that environmental sound that would be produced by rooftop HVAC equipment at the Marriot Courtyard Hotel and transmitted to any/all receptor properties surrounding the hotel (at any/all elevations at and above grade) is expected to comply with the most stringent City of Portland Performance Standards pertaining to environmental noise (50 dBA limit, at night).

We trust this report fulfills your request. If we can provide any further information, please do not hesitate to contact us.

Sincerely,  
*CAVANAUGH TOCCI ASSOCIATES, INC.*



Brion G. Koning, *Senior Acoustical Consultant*  
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# APPENDIX A

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Acoustical Criteria

Roof Plan / HVAC Equipment Layout

Computer Model Visual Graphic

(Ord. No. 168-93, § 3, 1-4-93; Substitute Ord. No. 164-97, § 4, 5-19-97; Ord. No. 215-04/05, 5-2-05; Ord. No.112-11/12, 2-22-12; Ord. No. 119-13/14, §230.4, 1-15-14)

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**\*Editor's Note:** The text changes adopted in Order 215-04/05 Section 14-230.4 I3 and (g) shall remain in effect for six (6) months from the effective date (6-2-05) of the changes. By Council Order No. 94-05/06 passed on 11/7/05 the effective date of the amendments were extended through and including March 2, 2006. By Council Order No. 170-05/06 passed as an emergency on 2/22/06 the effective date of the amendments were extended through and including September 30, 2006 and thereafter shall cease to exist unless the Portland City Council takes action to extend the applicability of such changes.  
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### **Sec. 14-230.5. Performance standards.**

All uses shall comply with the following standards:

- (a) *Storage:* Any storage of new materials, finished products, or related equipment must be suitably screened from the public way and from abutting properties by a solid fence at least five (5) feet in height, or by a solid evergreen planting strip. All waste shall be stored in covered containers that do not leak or otherwise permit liquids or solids to escape from the container. All food processing waste shall be stored within a completely enclosed structure and if not refrigerated shall be removed from the site in an enclosed container within forty-eight (48) hours of its generation. All enclosed and exterior areas shall be cleaned and sanitized on a regular basis. Outdoor storage of refuse or debris shall be in an appropriate container or located within a designated, screened area.

(b) **Noise:**

1. *Definitions:*

- a. Tonal sounds are defined as sound waves usually perceived as a hum or whine because their instantaneous sound pressure varies essentially as a simple sinusoidal function of time.
- b. Impulse sounds are defined as sound events characterized by brief excursions of sound pressure, each with a duration of less than

one (1) second.

2. *Measurement:* Sound levels shall be measured with a sound level meter with a frequency weighting network manufactured according to standards prescribed by the American National Standards Institute (ANSI) or its successor body. Measurements shall be made at all major lot lines of the site, at a height of at least four (4) feet above the ground surface. In measuring sound levels under this section, sounds with a continuous duration of less than sixty (60) seconds shall be measured by the maximum reading on a sound level meter set to the A weighted scale and the fast meter response (L maxfast). Sounds with a continuous duration of sixty (60) seconds or more shall be measured on the basis of the energy average sound level over a period of sixty (60) seconds (LEQ<sub>1</sub>).
3. *Maximum permissible sound levels:* The maximum permissible sound level of any continuous, regular or frequent source of sound produced by an activity shall be as follows:
  - a. Sixty (60) dBA between the hours of 7:00 a.m. and 10:00 p.m.
  - b. Fifty (50) dBA between the hours of 10:00 p.m. and 7:00 a.m., as measured at or within the boundaries of any residential zone.

In addition to the sound level standards established above, all uses located within this zone shall employ best practicable sound abatement techniques to prevent tonal sounds and impulse sounds or, if such tonal and impulse sounds cannot be prevented, to minimize the impact of such sounds in residential zones.

4. *Exemptions:*
  - a. Noises created by construction and maintenance activities between 7:00 a.m. and 10:00 p.m. are exempt from the maximum permissible sound

levels set forth in subsection (a)3 of this section. Construction activities on a site abutting any residential use between the hours of 10:00 p.m. of one (1) day and 7:00 a.m. of the following day shall not exceed fifty (50) dBA.

- b. The following uses and activities shall also be exempt from the requirements of subsection (a)3 of this section:
  - i. The noises of safety signals, warning devices, emergency pressure relief valves, and any other emergency devices.
  - ii. Traffic noise on public roads or noise created by airplanes and railroads.
  - iii. Noise created by refuse and solid waste collection, provided that the activity is conducted between 6:00 a.m. and 7:00 p.m.
  - iv. Emergency construction or repair work by public utilities, at any hour.
  - v. Noise created by any recreational activities which are permitted by law and for which a license or permit has been granted by the city, including but not limited to parades, sporting events, and fireworks displays.
- (c) *Vibration*: Vibration inherently and recurrently generated shall be imperceptible without instruments at lot boundaries.
- (d) *Federal and state environmental regulations*: All uses shall comply with federal and state environmental statutes and regulations regarding emissions into the air, except where provisions of this Code are more stringent.
- (e) *Storage of vehicles*: Storage of any unregistered automotive vehicle on the premises for more than sixty (60) days, and outdoor storage of any used automotive



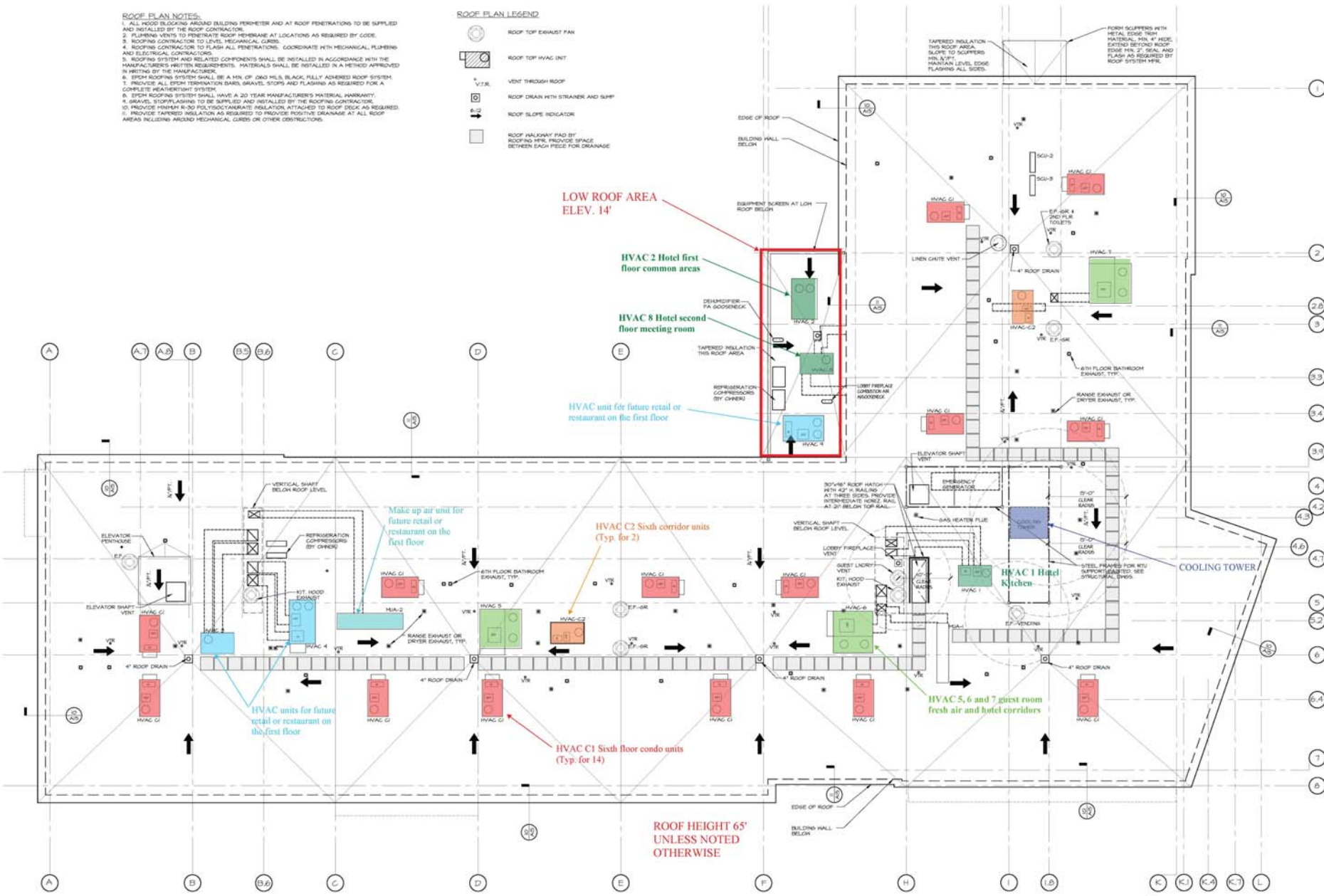


**ROOF PLAN NOTES:**

1. ALL ROOF BLOCKING AROUND BUILDING PERIMETER AND AT ROOF PENETRATIONS TO BE SUPPLIED AND INSTALLED BY THE ROOF CONTRACTOR.
2. PLUMBING VENTS TO PENETRATE ROOF MEMBRANE AT LOCATIONS AS REQUIRED BY CODE.
3. ROOFING CONTRACTOR TO FLASH ALL PENETRATIONS. COORDINATE WITH MECHANICAL, PLUMBING AND ELECTRICAL CONTRACTORS.
4. ROOFING SYSTEM AND RELATED COMPONENTS SHALL BE INSTALLED IN ACCORDANCE WITH THE MANUFACTURER'S WRITTEN REQUIREMENTS. MATERIALS SHALL BE INSTALLED IN A METHOD APPROVED IN WRITING BY THE MANUFACTURER.
5. EPDM ROOFING SYSTEM SHALL BE A MIN. OF 280 MIL BLACK FULLY ADHERED ROOF SYSTEM. PROVIDE ALL EPDM TERMINATION BARS, GRAVEL STOPS AND FLASHING AS REQUIRED FOR A COMPLETE WEATHERTIGHT SYSTEM.
6. EPDM ROOFING SYSTEM SHALL HAVE A 20 YEAR MANUFACTURER'S MATERIAL WARRANTY.
7. GRAVEL STOP FLASHING TO BE SUPPLIED AND INSTALLED BY THE ROOFING CONTRACTOR.
8. PROVIDE TAPERED INSULATION AS REQUIRED TO PROVIDE POSITIVE DRAINAGE AT ALL ROOF AREAS INCLUDING AROUND MECHANICAL GRIDS OR OTHER OBSTRUCTIONS.

**ROOF PLAN LEGEND**

- ROOF TOP EXHAUST FAN
- ROOF TOP HVAC UNIT
- VENT THROUGH ROOF
- ROOF DRAIN WITH STRAINER AND SUMP
- ROOF SLOPE INDICATOR
- ROOF WALKWAY PAD BY ROOFING MFR. PROVIDE SPACE BETWEEN EACH PIECE FOR DRAINAGE



REVISION SCHEDULE	
DATE	REVISION DESCRIPTION
02-09-13	REVISED RTU LAYOUT.
02-09-13	REVISED LAYOUT FOR RTU HVAC 1 AND HVAC C1 UNITS AT COL. LINE 3A.
11-04-13	REVISED COOLING TOWER & RTU LAYOUT.

**COPECHEE**  
 CONSTRUCTION CORPORATION  
 11 CORPORATE DRIVE, BELMONT, NH 03220  
 PHONE (603) 527-8888 FAX (603) 527-8181

**ROOF PLAN**

PROJECT: **COMMERCIAL & MAPLE STREET MIXED USE DEVELOPMENT**  
 PORTLAND, ME

DATE: 02-09-13  
 SCALE: SEE PLAN  
 DRAWN BY: K2R  
**A19**  
 SHEET

**Figure 1 Roof Plan Equipment Layout**



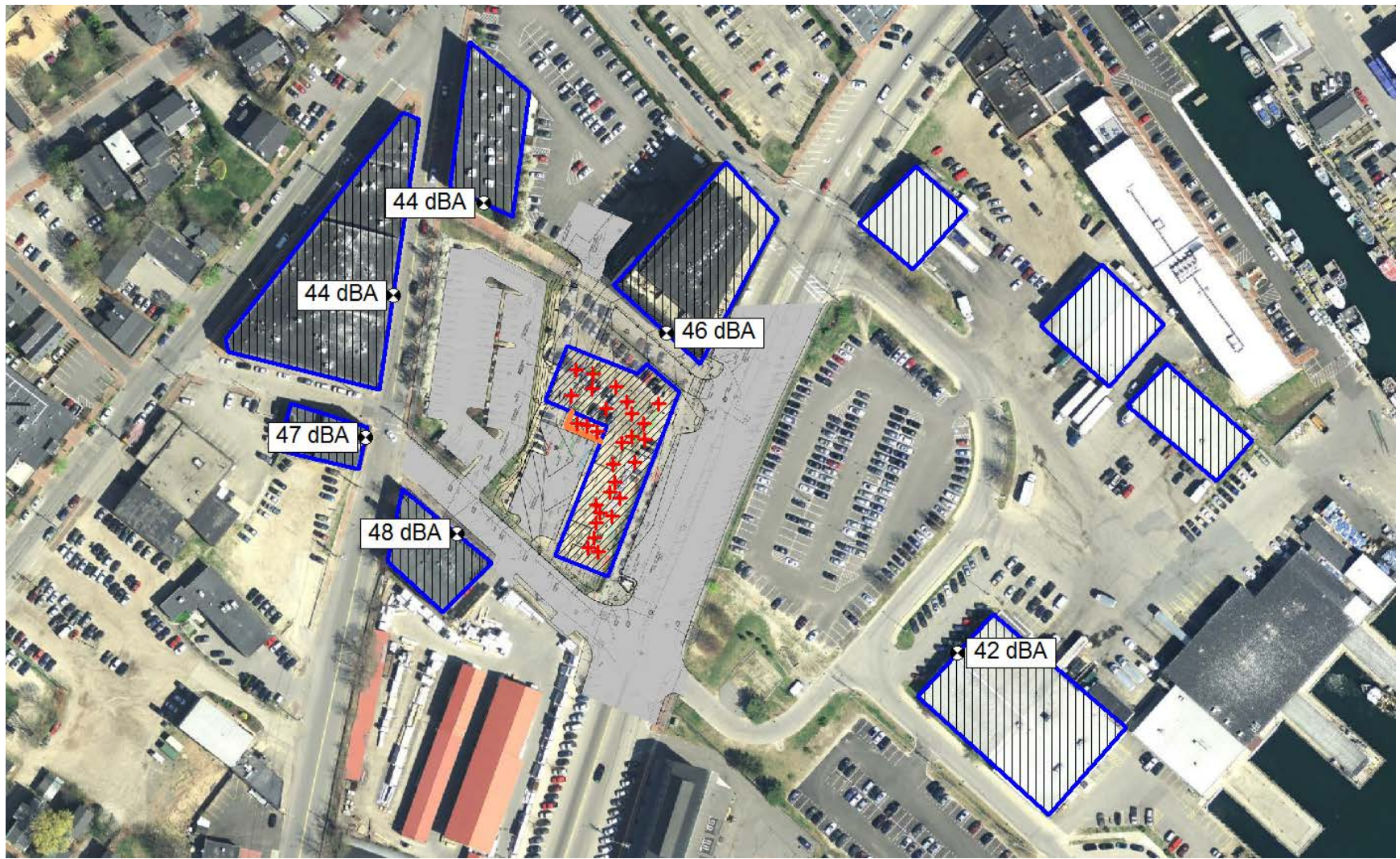


Figure 2. Results of computer modeling  
Marriott Courtyard (Portland, ME)