TECH environmental

FOCUSED KNOWLEDGE. REAL SOLUTIONS.

April 29, 2021

Mr. Michael C. Carelli
Isomedix Operations, Inc.
425 Whitney Street
Northborough, MA 01532

Ref. 4527

Re: 425 Whitney Street Redevelopment, Northborough, MA – Conceptual Design Sound Study

Dear Mr. Carelli:

Tech Environmental, Inc. (Tech) is pleased to provide this letter report summarizing the results of a conceptual design sound study (Study) for the proposed 425 Whitney Street Redevelopment in Northborough, MA. The proposed project will consist of three buildings: Existing Building (45,753 sf); Existing Building Expansion (20,100 sf) and New Warehouse (3,375 sf) (herein referred to as the Project). The goals of this Study is to demonstrate that the Project will comply with both the Town of Northborough Zoning Noise Bylaw (Noise Bylaw) and the Massachusetts Department of Environmental Protection (MassDEP) Noise Policy (Policy).

The Study was conducted to determine if the conceptual design of the Project will comply with the Noise Bylaw and the Policy. Since the Project will operate 24 hours day and seven (7) days a week, the focus of the Study was to assess compliance during late and early morning hours when ambient sound levels are at their lowest. If the Project complies with the Noise Bylaw and Policy during the quietest hours, the results of the Study also infers the Project complies at any time. Measured existing ambient L_{90} sound levels ranged from 38 dBA to 44 dBA in the area of the Project. Thus, the Noise Bylaw allowable limit is 43 dBA (i.e. the lowest ambient sound level + 5 dBA), and the Policy allowable limit is 48 dBA (i.e. the lowest ambient sound level + 10 dBA) for the Project. Tech used the Cadna/A acoustic model to predict future sound levels at the Project property lines and at the upper story windows of each abutting residential dwelling on Coolidge Drive and Whitney Street. The primary sources of continuous operational sounds are two (2) of three (3) 350-ton Daikin air-cooled screw chillers or equal operating, two (2) Peerless bunker exhaust fans or equal, and three (3) Greenheck low-noise or equal building exhaust fans. The acoustic model also included intermittent operations of up to four (4) trucks idling in the loading dock areas. The Study is conservative because it assumes all of these sound sources operating at maximum load simultaneously.

Tech is recommending the following sound mitigation measures be incorporated into the Project:

- Substitute the existing building proposed Greenheck GB-300 roof downblast exhaust fans with units that are 5-dBA quieter.

- The bunker exhaust fans need to be 20 dBA quieter than the unmitigated Peerless blower industrial fans. This can be achieved by substituting the proposed exhaust fans with larger and quieter units and installing silencers.

- Enclosing the chillers in a Kinetics Noise Control partial enclosure or equal. The enclosure would be a 40 by 44 foot three-sided enclosure attached to the proposed building expansion. The enclosure would include four (4)-inch thick 16 gage metal outer skin and 22 gage metal inner skin sound absorbing panels, acoustic treated access doors, acoustic louvers and the roof would be open, but covered with pergola style louvers.

The acoustic modeling results reveal that the Project predicted sound levels late at night and in the early morning ranging from 28 dBA to 38 dBA at the nearest residences and 42 dBA at the property line. With the existing lowest average ambient L_{90} sound level of 38 dBA, would result in future sound levels ranging from 38 dBA to 41 dBA at the nearest residences and 43 dBA at the property line. The predicted change in sound levels would be approximately 0 dBA to 3 dBA at the nearest residences and 5 dBA at the Project property line. In addition the Project will not generate any pure tone sound levels at the Project property line or at the nearest residences. Therefore, the Project will comply with both Noise Bylaw allowable limit of 43 dBA and Policy allowable limit of 48 dBA and no pure tone requirement.

While the Study demonstrates that conceptual design with additional sound mitigation complies with the applicable noise regulations, the final design of the Project may require incorporating additional sound mitigation measures beyond the recommendations in this report. It is our understanding that Steris will continue to work with their design team and Tech to ensure that the final design meets the sound limits presented in this report.

This letter report summarizes the monitoring and modeling analyses performed for the 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 sound modeling analysis approach and results, and recommended sound mitigation measures. In Section 5.0, the Study concludes that the Project will generate sound levels that fully comply with the Noise Bylaw and the Policy.

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.

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 rural industrial/residential area, such as that surrounding 425 Whitney Street in Northborough, primarily results from motor vehicle traffic on Route 290 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

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 1 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 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. This is a broadband sound pressure

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

measure, i.e., it includes sounds at all frequencies. 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.

2.0 EXISTING SOUND LEVELS

Tech performed both long-term and short-term baseline sound measurements to establish existing ambient sound conditions at the Project site and the abutting Coolidge Circle residential area. All short-term (30-minute) sound level measurements were collected using a Bruel and Kjaer 2250 ANSI Type 1 and Larson Davis 831 (high precision) real-time sound level analyzers. These analyzers are 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. These analyzers meet or exceed 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 analyzers were calibrated (no level adjustment was required, therefore they were monitoring accurately) with an ANSI Type 1 calibrator, which has an accuracy traceable to NIST. For each measurement session, the microphones were fitted with a 7-inch windscreen to negate the effect of air movement across microphone diaphragm. The sound analyzers were programmed to collect both broadband A-weighted maximum (L_{max}), average (L_{eq}) and background (L_{90}) sound levels and unweighted octave band sound levels at each location to provide a complete picture of ambient sound conditions in the residential areas surrounding the site.

All data were downloaded to a computer following the measurement session for the purposes of storage and further analysis.

A long-term sound analyzer was placed on the Project site at 425 Whitney Street to measure sound levels over an eight-day period, including a weekend, to characterize ambient sound conditions at the Project property boundary and abutting residences. The long-term sound analyzer measured hourly sound levels from Monday, March 8, 2021 through Tuesday, March 16, 2021. These ambient baseline measurements are representative of the homes in the neighborhoods surrounding the Project site. The results of the ambient baseline measurements are presented in Table 3. The average measured ambient sound levels (L_{90}) ranged from 38 dBA late at night and in the early morning, to 44 dBA during the afternoon and early evening hours. Figure 1 illustrates the location of the long-term sound analyzer. These are typical sound levels for a suburban area near a major highway.

Tech also performed short-term baseline ambient sound measurements during the late night/early morning hours (11:55 p.m. to 1:31 a.m.) of Wednesday, March 10, 2021 to Thursday, March 11, 2021 at three (3) additional monitoring locations. The purpose of these short-term measurements were to confirm that the long-term sound measurements at the property line are representative with those ambient sound conditions in the abutting Coolidge Circle neighborhood. Those three (3) additional locations were at the intersections of Stone Drive and Coolidge Circle, at the intersection of Patrick Drive and Coolidge Circle, and at the intersection of Cherlyn Drive and Coolidge Circle. One (1) set of 30-minute sound level measurements, was collected at each of these three (3) locations during the late night/early morning hours. The ambient (L_{90}) short-term monitoring was 36 dBA at each location. Since the ambient data collected at the Project property line was performed over an extended period of time to capture all ambient sound conditions, the lowest one-hour L_{90} levels of 38 dBA was determined to be appropriate for representing the lowest existing ambient sound levels at all locations.

TABLE 3

AVERAGE AMBIENT SOUND LEVEL MEASUREMENTS

Monday, March 8, 2021 to Tuesday, March 16, 2021

Hour Starting	Average Ambient (L_{90}) Sound Levels
12:00 AM	38 dBA
1:00 AM	38 dBA
2:00 AM	38 dBA
3:00 AM	39 dBA
4:00 AM	39 dBA
5:00 AM	41 dBA
6:00 AM	42 dBA
7:00 AM	43 dBA
8:00 AM	42 dBA
9:00 AM	42 dBA
10:00 AM	42 dBA
11:00 AM	42 dBA
12:00 PM	42 dBA
1:00 PM	42 dBA
2:00 PM	43 dBA
3:00 PM	44 dBA
4:00 PM	42 dBA
5:00 PM	42 dBA
6:00 PM	41 dBA
7:00 PM	41 dBA
8:00 PM	40 dBA
9:00 PM	40 dBA
10:00 PM	40 dBA
11:00 PM	40 dBA

3.0 NOISE REGULATIONS

Both Massachusetts and the Town of Northborough have sound limits that are applicable to the Project. The Noise Bylaw has a more restrictive broadband sound limit, but no tonal sound restriction. Although the Policy has a less restrictive broadband sound limit, it does have a "pure tone" restriction. A summary of the both noise regulations are presented below.

3.1 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 further 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.

Therefore, if the lowest ambient L_{90} sound level is 38 dBA, as presented in Section 2.0, then the MassDEP allowable limit for total sound (i.e. ambient sounds plus the Project) is 48 dBA. Thus, the Project sound should be limited to 47 dBA, to ensure compliance with a total sound level limit of 48 dBA. 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 Noise Policy states that this criteria should be measured both at the property line and at the nearest inhabited residence. However, MassDEP Noise Policy interpretation states that sound levels that exceed the criteria at the property line do not necessarily result in a violation of the policy[2].

3.2 Northborough

Under the Zoning Bylaw, *Chapter 7-05-040 Environmental Performance Standards, Part C. Noise*, establishes a sound limit for industrial uses having an impact on residential uses. The sound due to the operations of the facility, measured at the property line of the facility, shall not be increased over the ambient sound level by more than five (5) decibels weighted for the "A" scale [dB(A)].

Ambient is defined as the sound from all sources other than the subject facility. The ambient sound measurement (A-weighted sound level) is taken where the offending sound cannot be heard, or with the sound source shut-off. The ambient sound level is the level that is exceeded ninety percent (90%) of the time (i.e., L_{90} level) that the noise measurements are taken.

The following activities are exempt from the above stated sound limit:

1. Any noise produced by a registered motor vehicle; provided, that such vehicle is equipped with all noise-suppression devices required for legal operation under such registration by the laws of the Commonwealth;
2. Parades, public gatherings, or sporting events, for which permits have been issued where required by any federal, state, or local law or regulation;
3. Construction and maintenance activities between 7:00 a.m. and 7:00 p.m.;
4. Emergency police, fire, and ambulance vehicles; or
5. Police, fire, and civil and national defense activities.

Therefore, if the lowest ambient L_{90} sound level is 38 dBA, as presented in Section 2.0, then the Northborough allowable limit for total sound (i.e. ambient sounds plus the Project) is 43 dBA. Thus, the Project sound should be limited to 42 dBA, to ensure compliance with a total sound level limit of 43 dBA. There are no tonal sound limits in this bylaw.

.[2] https://www.mass.gov/files/documents/2018/01/31/noise-interpretation.pdf

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 Project site property line closest to the Coolidge Circle residences and the homes of the abutting residences.

4.1 Modeling Assumptions

Future sound levels of the Project were calculated with the Cadna/A acoustic model assuming both continuous and non-continuous sources associated with the Project. The assumptions in our acoustic modeling analysis are as follows:

1. The location of the Project and associated site layout, grading and building elevation plans was based on plans by VHB, Inc.[3] The plans show the existing building the building expansion to the west, and the warehouse expansion to the north.

2. The Project will operate 24 hours per day, seven days per week.

3. Since the Project will operate 24 hours day and seven (7) days a week, the focus of the Study is to assess compliance during late and early morning hours when ambient sound levels are at their lowest. If the Project complies with the Noise Bylaw and Policy during the quietest hours, the results of the Study also infers the Project complies at any time.

4. The height of the modeling receptors at the nearest homes are equal to the highest floor of the residence. The height of the modeling receptors at the nearest Project property lines are equal to five (5) feet above grade, to represent the height of the human ear.

5. The primary sources of continuous operational sounds are two (2) of three (3) 350-ton Daikin air-cooled screw chillers or equal operating, two (2) Peerless bunker exhaust fans or equal, and three (3) low-noise Greenheck building exhaust fans or equal. It is assumed that all of these sound sources are operating at maximum load simultaneously, and would have the following sound mitigation measures:

    - Substitute the existing building proposed Greenheck GB-300 roof downblast exhaust fans with units that are 5-dBA quieter.

    - The bunker exhaust fans need to be 20 dBA quieter than the unmitigated Peerless blower industrial fans. This can be achieved by substituting the proposed exhaust fans with larger and quieter units and installing silencers.

    - Enclosing the chillers in a Kinetics Noise Control partial enclosure or equal. The enclosure would be a 40 by 44 foot three-sided enclosure attached to the proposed building expansion. The enclosure would include four (4)-inch thick 16 gage metal outer skin and 22

[3] VHB, Inc. Facility Expansion Project Site Plans (October 17, 2019).

gage metal inner skin sound absorbing panels, acoustic treated access doors, acoustic louvers and the roof would be open, but covered with pergola style louvers (see Attachment A).

6. Other non-continuous sound sources are intermittent trucks idling in the loading dock areas.

4.2 Future Sound Levels

Cadna-A is a sophisticated 3-D model for sound propagation and attenuation based on International Standard ISO 9613.[4] Atmospheric absorption is the process by which sound energy is absorbed by the air and was calculated using ANSI S1.26-1995.[5] 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.[6]

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.

2. The model assumes that all continuous and intermittent sound sources operate at maximum load simultaneously (a worst-case condition not likely to occur).

Sound levels were predicted for the continuous operation of chillers, bunker exhaust fans and building exhaust fans, and the intermittent operation of trucks idling at the loading docks at twenty one (21) residential receptors and at the Project site property line abutting the Coolidge Circle neighborhood. The acoustic modeling results reveal that the Project predicted sound levels late at night and in the early morning ranging from 28 dBA to 38 dBA at the nearest residences and 42 dBA at the property line. With the existing lowest average ambient L_{90} sound level of 38 dBA, would result in future sound levels ranging from 38 dBA to 41 dBA at the nearest residences and 43 dBA at the property line. The predicted change in sound levels would be approximately 0 dBA to 3 dBA at the nearest residences and 5 dBA at the Project property line. In addition the Project will not generate any pure tone sound levels at the Project property line or at the nearest residences. Therefore, the Project will comply with both Noise Bylaw allowable limit of 43 dBA and thePolicy allowable limit of 48 dBA and no pure tone requirement.

Table 4 summarizes the modeling results and confirms that the Project will comply with both the Noise Bylaw and the Policy.

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[4] International Standard, ISO 9613-2, Acoustics – Attenuation of Sound During Propagation Outdoors, -- Part 2 General Method of Calculation.

[5] American National Standards Institute, ANSI S1.26-1995, American National Standard Method for the Calculation of the Absorption of Sound by the Atmosphere, 1995.

[6] https://docs.digital.mass.gov/dataset/massgis-data-digital-terrain-model-dtm-files

5.0 CONCLUSIONS

Tech performed a conceptual design sound study for the Project. The results of the Study reveal that the Project will fully comply with both the Noise Bylaw and Policy with recommended sound mitigation measures. While the Study demonstrates that the conceptual design with sound mitigation measures complies with the applicable noise regulations, the final design of the Project may require incorporating additional sound mitigation measures beyond the recommendations in this report. It is our understanding that Steris will continue to work with their design team and Tech to ensure that the final design meets the sound limits presented in this report.

If you have any questions, please call me at (781) 890-2220 x30.

Sincerely yours,

TECH ENVIRONMENTAL, INC.

Marc C. Wallace

Marc C. Wallace, QEP, INCE
Vice President
4527/Sound Study Letter Report 4.29.2021

TABLE 4

PREDICTED SOUND LEVELS FROM THE PROJECT AT 425 WHITNEY STREET, NORTHBOROUGH (dBA)

Receptor #	Receptor Location	Lowest Ambient Sound Level	Sound Level Impact of Project	Total Future Sound Level	Sound Level Increase
R1	42 Coolidge Circle	38	35	40	+2
R2	26 Coolidge Circle	38	32	39	+1
R3	34 Coolidge Circle	38	33	39	+1
R4	407 Whitney Street	38	33	39	+1
R5	14 Coolidge Circle	38	31	39	+1
R6	405 Whitney Street	38	31	39	+1
R7	399 Whitney Street	38	28	38	0
R8	46 Coolidge Circle	38	38	41	+3
R9	30 Coolidge Circle	38	30	39	+1
R10	22 Coolidge Circle	38	29	39	+1
R11	38 Coolidge Circle	38	33	39	+1
R12	50 Coolidge Circle	38	32	39	+1
R13	18 Coolidge Circle	38	28	38	0
R14	10 Coolidge Circle	38	28	38	0
R15	6 Coolidge Circle	38	28	38	0
R16	2 Coolidge Circle	38	28	38	0
R17	54 Coolidge Circle	38	32	39	+1
R18	58 Coolidge Circle	38	33	39	+1
R19	62 Coolidge Circle	38	33	39	+1
R20	66 Coolidge Circle	38	32	39	+1
R21	34 Rear Coolidge Circle	38	38	41	+3
R22	Property Line	38	42	43	+5

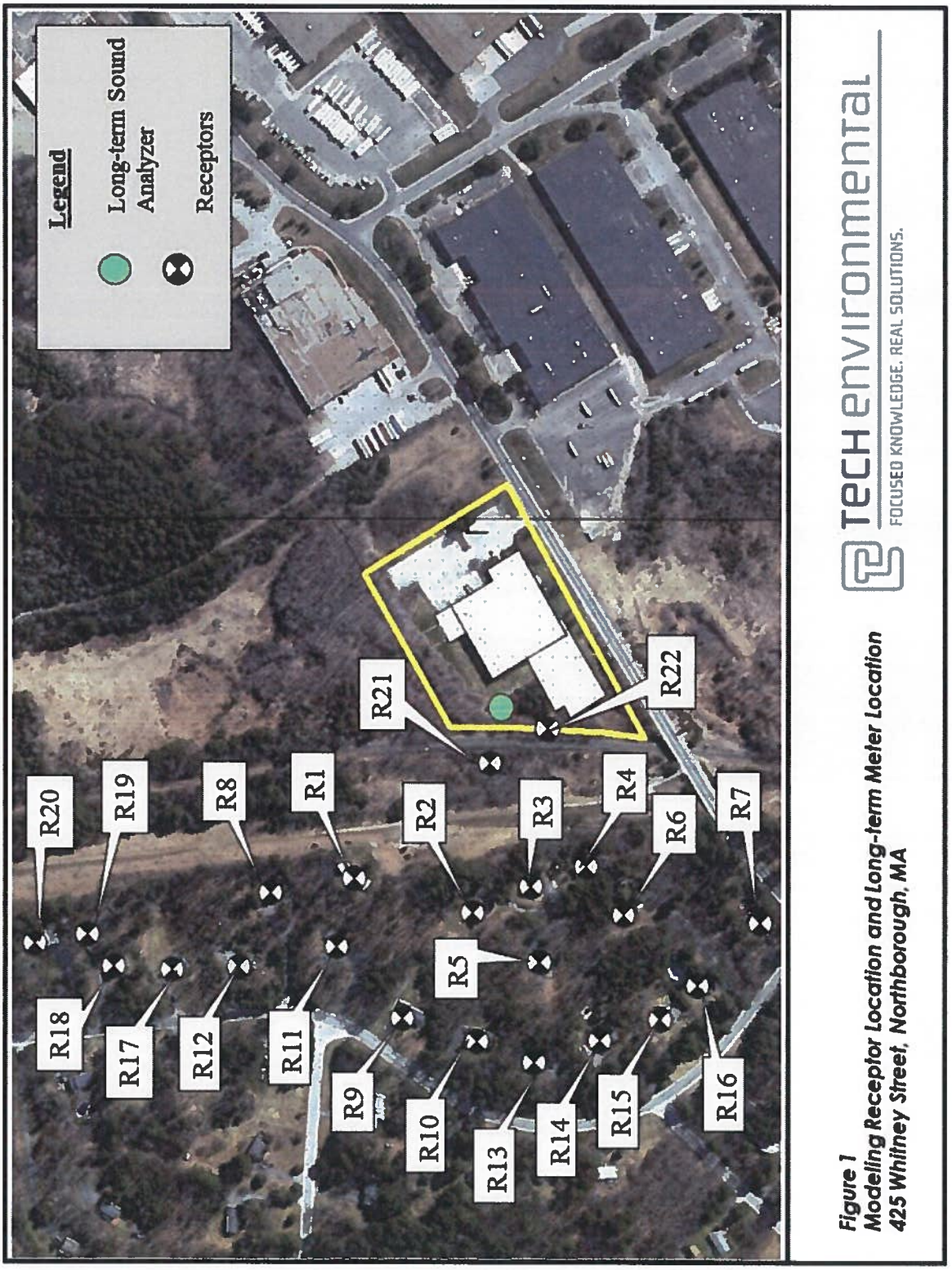


Figure 1
Modeling Receptor Location and Long-term Meter Location
425 Whitney Street, Northborough, MA

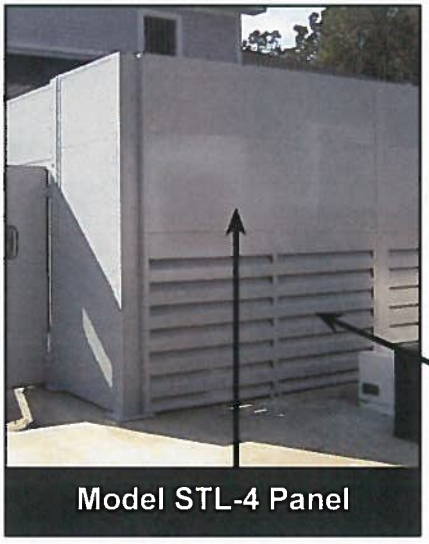
ATTACHMENT A

KINETICS NOISE CONTROL ENCLOSURE

System: CATM

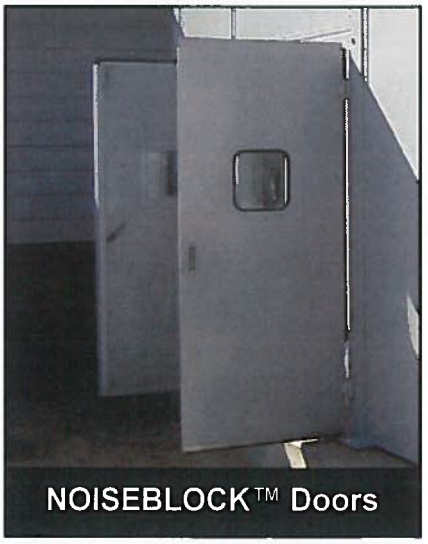
KINETICS® Solutions

Outdoor Air-Cooled Chiller Acoustical Barrier Wall System



Model STL-4 Panel

Model VAL & VAR Louvers



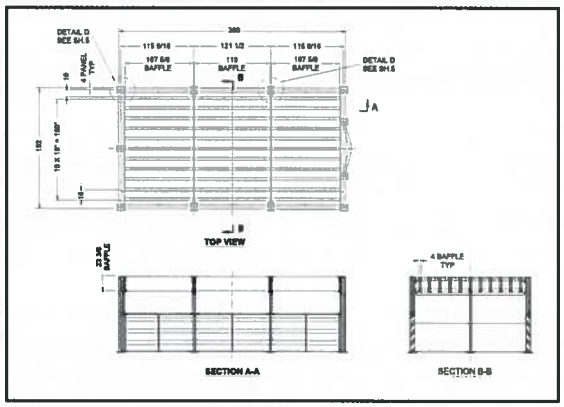
NOISEBLOCK™ Doors

The Situation

The noise source is an outdoor Air-Cooled Chiller. Noise is propagating into critical areas: screw compressors (on the bottom of the unit) generate mid/hi frequency noise; Up-blast fans (on the top) generate low frequency noise.

Issue

A common but inadequate attempt to control the noise is to wrap the compressors with mass-loaded vinyl jackets. This rarely solves the system noise problem.



Considerations

- Equipment warranty
- Electrical/Building codes
- Equipment ventilation
- Noise ordinance
- Location of equipment relative to critical areas
- Maintenance access
- Structural issues - seismic, drainage, wind loading, footings, tie-ins, etc.

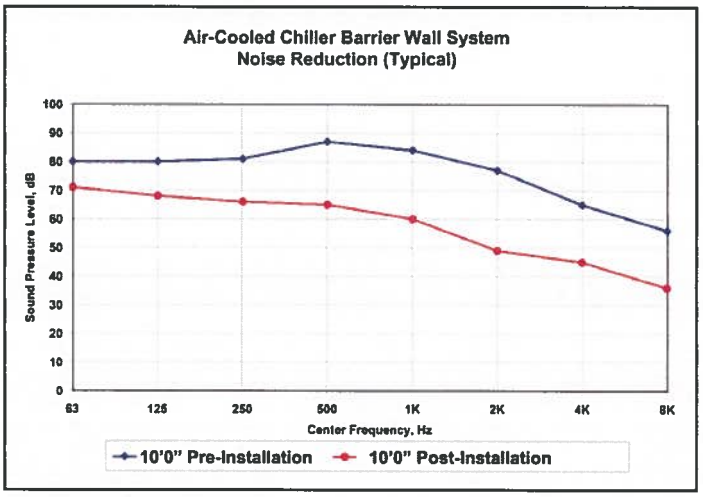
KINETICS OFFERS:

Proper Acoustical Design

Three and four-sided Model STL, acoustical barrier wall systems, allowing sufficient space between barrier/chiller as well as equipment and access doors as required. Add on VAL acoustical louvered skirt for ventilation. Add on VAR acoustical louvered roof system to redirect noise from critical areas, achieving maximum noise reduction at a very low pressure drop. Systems can be located on grade or rooftop.

Standard Products; Custom Engineered

Our knowledge and experience save you time and money. Modular units ship knocked-down for easy transport and quick field assembly. Product manufactured from galvanized steel or aluminum and can be factory powder-coated or field painted.



Walls (Reduction): 18-23 dBA
Baffled Top (Reduction): 8-10 dBA
Δ P(Sys.) = 0.10" Wg

NOISEBLOCK™ STL AND HTL Panel Performance, Various Skin Types
Sound Transmission Loss per ASTM E90

	Transmission Loss						
Model	**125**	**250**	**500**	**1000**	**2000**	**4000**	**STC**
NOISEBLOCK (STL)-2" (18s/22p)	17	23	34	47	55	57	37
NOISEBLOCK (STL)-2" (18s/22s)	19	25	35	48	56	60	39
NOISEBLOCK (STL)-4" (18s/22p)	21	28	39	48	56	58	40
NOISEBLOCK (STL)-4" (18s/22s)	24	32	41	51	60	66	44
NOISEBLOCK (HTL)-4" (16s/22p)	27	34	48	61	66	70	48
NOISEBLOCK (HTL)-4" (16s/22s)	27	39	59	68	67	72	52

NOTES
18s/22p - 18 gage solid outer skin and 22 gage perforated inner skin
18s/22s - 18 gage solid outer skin and 22 gage solid inner skin
16s/22p - 16 gage solid outer skin and 22 gage perforated inner skin
16s/22s -16 gage solid outer skin and 22 gage solid inner skin
STL - Standard Transmission Loss
HTL- High Transmission Loss

KINETICS Noise Control®
kineticsnoise.com
sales@kineticsnoise.com
1-800-959-1229