Chapter 12: Noise

A. INTRODUCTION

Under 2014 *City Environmental Quality Review (CEQR) Technical Manual* guidelines, a noise analysis determines whether a proposed project would result in increases in noise levels that could have a significant adverse impact on nearby sensitive receptors and also considers the effect of existing noise levels at the project site on proposed uses.

As described in Chapter 1, "Project Description," the American Museum of Natural History (AMNH or the Museum) is proposing the construction of a new building, the Richard Gilder Center for Science, Education, and Innovation (the Gilder Center). The Museum is located in Theodore Roosevelt Park, which is City-owned parkland under the jurisdiction of the New York City Department of Parks and Recreation (NYC Parks).

The proposed project would not generate sufficient traffic to have the potential to cause a significant noise impact (i.e., it would not result in a doubling of noise passenger car equivalents [Noise PCEs] which would be necessary to cause a 3 dBA increase in noise levels). This includes traffic associated with conferences, public programs, and events that would be held in the Gilder Center. During the evening and late-night hours when guests could be traveling to and from the Gilder Center for conferences, public programs, and events, the existing level of traffic on Columbus Avenue and other roadways leading to the Museum is such that event traffic would not result in a doubling of traffic.

Furthermore, conferences, public programs, and events that would occur at the Gilder Center and the potential noise generated by the events (e.g., noise from attendees or event programming) would be comparable in size and character to events that already occur at the Museum and consequently would generate no greater level of noise than the events in the existing condition. While conferences, public programs, and events might occur more frequently with the proposed Gilder Center space, since the level of noise would not increase with the proposed project compared to the existing condition, event noise would not have the potential to result in a significant adverse noise impact.

However, the effect of ambient noise (i.e., noise from vehicular traffic) is addressed in the following attachment and an analysis is presented that determines the level of building attenuation necessary to ensure that interior noise levels at newly introduced spaces in the proposed Gilder Center satisfy applicable CEQR criteria. Chapter 16, "Construction Impacts," assesses the potential for any temporary noise impacts during the construction of the proposed project.

PRINCIPAL CONCLUSIONS

The analysis finds that the proposed project would not result in any significant adverse noise impacts. The proposed project would not generate sufficient traffic to have the potential to cause a significant noise impact. Columbus Avenue is already a busy and heavily trafficked roadway,

with relatively high levels of noise from vehicular traffic. The building's mechanical systems would be designed to meet all applicable noise regulations and to avoid producing levels that would result in any significant increase in ambient noise levels. Therefore, the proposed project would not result in any significant adverse noise impacts related to building mechanical equipment. Noise generated by the relocated service and loading area would not have the potential to adversely affect nearby receptors, as the new location would be shielded from nearby receptors due to its location in the below-grade space of the proposed expansion and would be farther away from any noise receptors than the existing loading dock. The proposed project, when completed and occupied, would not have the potential to affect noise levels within the surrounding Theodore Roosevelt Park, or nearby residences; rather, loading dock noise is expected to be reduced compared to existing conditions because the proposed project would move the loading dock to a place where it is shielded from the surrounding Park and residences.

With regard to the interior noise environment of the Gilder Center, the proposed project would provide acoustically-rated windows and air conditioning as an alternate means of ventilation. The building façade, including these elements, would provide a composite Outdoor-Indoor Transmission Class (OITC) such that interior noise levels would be less than CEQR guidelines of 45 dBA for museum, theater, classrooms, and education spaces, and less than 50 dBA for office rooms, meeting rooms, and retail uses.

B. ACOUSTICAL FUNDAMENTALS

Sound is a fluctuation in air pressure. Sound pressure levels are measured in units called "decibels" ("dB"). The particular character of the sound that we hear (a whistle compared with a French horn, for example) is determined by the speed, or "frequency," at which the air pressure fluctuates, or "oscillates." Frequency defines the oscillation of sound pressure in terms of cycles per second. One cycle per second is known as 1 Hertz ("Hz"). People can hear over a relatively limited range of sound frequencies, generally between 20 Hz and 20,000 Hz, and the human ear does not perceive all frequencies equally well. High frequencies (e.g., a whistle) are more easily discernable and therefore more intrusive than many of the lower frequencies (e.g., the lower notes on the French horn).

"A"-WEIGHTED SOUND LEVEL (DBA)

In order to establish a uniform noise measurement that simulates people's perception of loudness and annoyance, the decibel measurement is weighted to account for those frequencies most audible to the human ear. This is known as the A-weighted sound level, or "dBA," and it is the descriptor of noise levels most often used for community noise. As shown in **Table 12-1**, the threshold of human hearing is defined as 0 dBA; very quiet conditions (as in a library, for example) are approximately 40 dBA; levels between 50 dBA and 70 dBA define the range of noise levels generated by normal daily activity; levels above 70 dBA would be considered noisy, and then loud, intrusive, and deafening as the scale approaches 130 dBA.

Table 12-1
Common Noise Levels

Sound Source	(dBA)
Military jet, air raid siren	130
Amplified rock music	110
Jet takeoff at 500 meters	100
Freight train at 30 meters	95
Train horn at 30 meters	90
Heavy truck at 15 meters	80–90
Busy city street, loud shout	80
Busy traffic intersection	70–80
Highway traffic at 15 meters, train	70
Predominantly industrial area	60
Light car traffic at 15 meters, city or commercial areas, or residential areas close to industry	50–60
Background noise in an office	50
Suburban areas with medium-density transportation	40–50
Public library	40
Soft whisper at 5 meters	30
Threshold of hearing	0

Note: A 10 dBA increase in level appears to double the loudness, and a 10 dBA decrease halves the apparent loudness.

Sources: Cowan, James P. *Handbook of Environmental Acoustics,* Van Nostrand Reinhold, New York, 1994. Egan, M. David, Architectural Acoustics. McGraw-Hill Book Company, 1988.

In considering these values, it is important to note that the dBA scale is logarithmic, meaning that each increase of 10 dBA describes a doubling of perceived loudness. Thus, background noise at 50 dBA is perceived as twice as loud as at 40 dBA. For most people to perceive an increase in noise, it must be at least 3 dBA. At 5 dBA, the change will be readily noticeable.

COMMUNITY RESPONSE TO CHANGES IN NOISE LEVELS

The average ability of an individual to perceive changes in noise levels is well-documented (see **Table 12-2**). Generally, changes in noise levels of less than 3 dBA are barely perceptible to most listeners, whereas changes in noise levels of 10 dBA are normally perceived as doubling (or halving) of noise loudness. These guidelines permit direct estimation of an individual's probable perception of changes in noise levels.

Table 12-2
Average Ability to Perceive Changes in Noise Levels

Change (dBA)	Human Perception of Sound
2–3	Barely perceptible
5	Readily noticeable
10	A doubling or halving of the loudness of sound
20	A "dramatic change"
40	Difference between a faintly audible sound and a very loud sound

Source: Bolt Beranek and Neuman, Inc., *Fundamentals and Abatement of Highway Traffic Noise*, Report No. PB-222-703. Prepared for Federal Highway Administration, June 1973.

SOUND LEVEL DESCRIPTORS

Because the sound pressure level unit of dBA describes a noise level at just one moment and very few noises are constant, other ways of describing noise that fluctuates over extended periods have been developed. One way is to describe the fluctuating sound heard over a specific time period as if it had been a steady, unchanging sound. For this condition, a descriptor called the "equivalent sound level," L_{eq}, can be computed. L_{eq} is the constant sound level that, in a given situation and time period (e.g., 1 hour, denoted by $L_{eq(1)}$, or 24 hours, denoted by $L_{eq(24)}$), conveys the same sound energy as the actual time-varying sound. Statistical sound level descriptors such as L_1, L_{10}, L_{50}, L_{90}, and L_x, are used to indicate noise levels that are exceeded 1, 10, 50, 90, and x percent of the time, respectively.

The relationship between L_{eq} and levels of exceedance is worth noting. Because L_{eq} is defined in energy rather than straight numerical terms, it is not simply related to the levels of exceedance. If the noise fluctuates very little, L_{eq} will approximate L_{50} or the median level. If the noise fluctuates broadly, the L_{eq} will be approximately equal to the L_{10} value. If extreme fluctuations are present, the L_{eq} will exceed L_{90} or the background level by 10 or more decibels. Thus, the relationship between L_{eq} and the levels of exceedance will depend on the character of the noise. In community noise measurements, it has been observed that the L_{eq} is generally between L_{10} and L_{50}.

For the purposes of this project, the maximum 1-hour equivalent sound level ($L_{eq(1)}$) has been selected as the noise descriptor to be used in the noise impact evaluation. $L_{eq(1)}$ is the noise descriptor used in the City Environmental Quality Review (CEQR) standards for vehicular traffic noise impact evaluation, and is used to provide an indication of highest expected sound levels. $L_{10(1)}$ is the noise descriptor used in the CEQR noise exposure standards for vehicular traffic noise. Hourly statistical noise levels (particularly L_{10} and L_{eq} levels) were used to characterize the relevant noise sources and their relative importance at each receptor location.

C. NOISE STANDARDS AND CRITERIA

NEW YORK CEQR NOISE CRITERIA

The *CEQR Technical Manual* also defines attenuation requirements for buildings based on exterior noise level (see **Table 12-3**). Recommended noise attenuation values for buildings are designed to maintain interior noise levels of 45 dBA or lower for noise sensitive uses and 50 dBA or lower for retail uses and are determined based on exterior $L_{10(1)}$ noise levels.

Table 12-3
Required Attenuation Values to Achieve Acceptable Interior Noise Levels

	Marginally Unacceptable				Clearly Unacceptable
Noise Level With the proposed project	$70 < L_{10} \leq 73$	$73 < L_{10} \leq 76$	$76 < L_{10} \leq 78$	$78 < L_{10} \leq 80$	$80 < L_{10}$
Attenuation[A]	(I) 28 dB(A)	(II) 31 dB(A)	(III) 33 dB(A)	(IV) 35 dB(A)	$36 + (L_{10} - 80)$[B] dB(A)

Notes:
[A] The above composite window-wall attenuation values are for residential dwellings and community facility development. Commercial office spaces, retail, and meeting rooms would be 5 dB(A) less in each category. All the above categories require a closed window situation and hence an alternate means of ventilation.
[B] Required attenuation values increase by 1 dB(A) increments for L_{10} values greater than 80 dBA.
Source: New York City Department of Environmental Protection.

D. EXISTING NOISE LEVELS

SITE DESCRIPTION

The project site is located on the superblock bounded by West 81st Street, West 77th Street, Central Park West, and Columbus Avenue, in the Upper West Side neighborhood of Manhattan. The study area contains residential, commercial, community facility, transportation/utility, open space, and parking uses.

SELECTION OF NOISE MONITORING LOCATIONS

One (1) receptor site was selected to represent the newly introduced spaces at the proposed Gilder Center. Site A was located adjacent to the existing Museum's West Façade, southwest of Weston Pavilion entrance. **Figure 12-1** shows the location of the noise monitoring site.

NOISE MONITORING

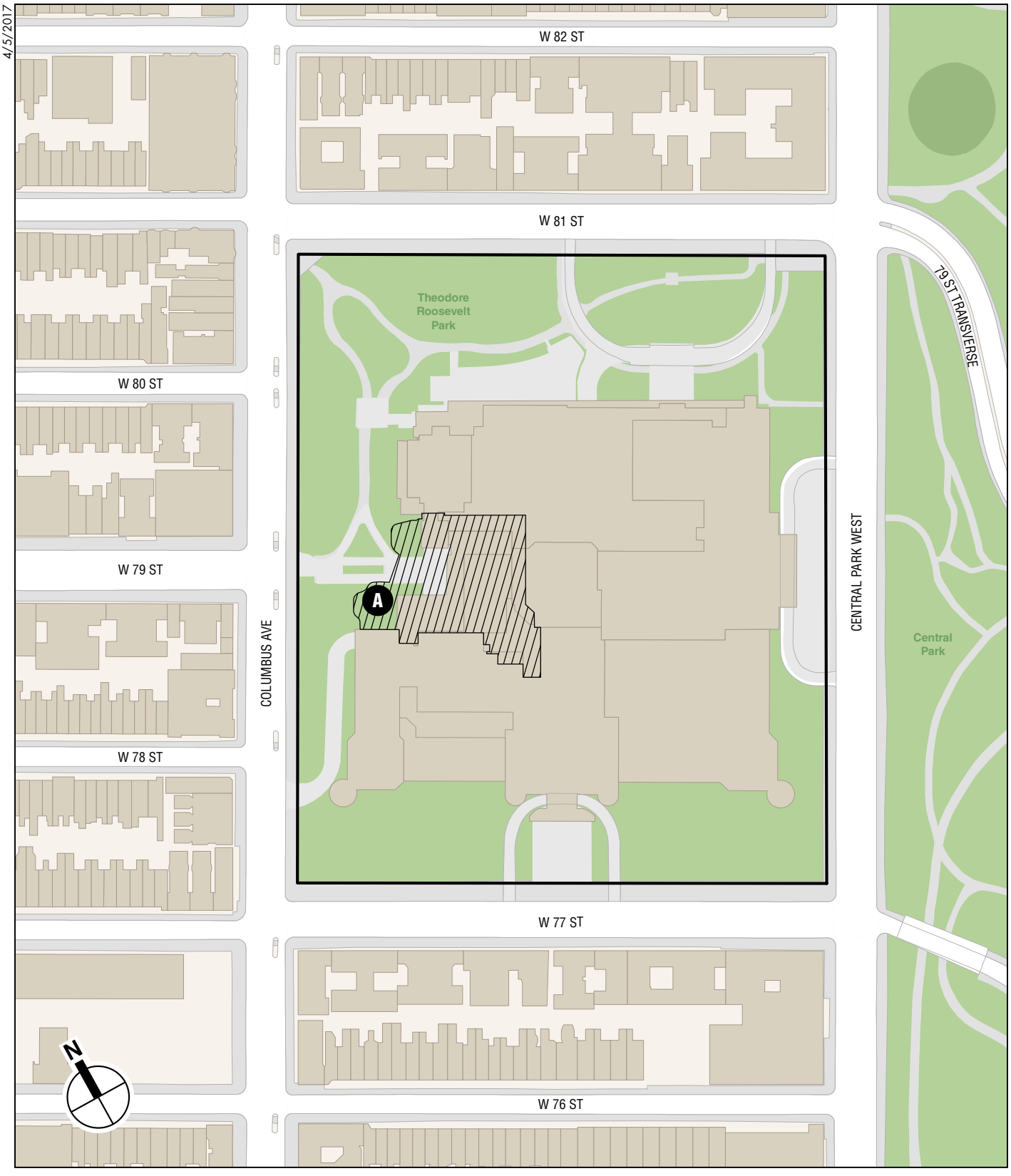
At the receptor site, existing noise levels were measured for 20-minute periods for weekday AM (7:00 AM to 9:00 AM), weekday midday (12:00 PM to 2:00 PM), and weekday PM (4:30 PM to 6:30 PM). Measurements were taken on April 5, 2016, April 6, 2016, and May 14, 2016.

Measurements were performed using a Brüel & Kjær Sound Level Meter (SLM) Type 2250, a Brüel & Kjær ½-inch microphone Type 4189 and a Brüel & Kjær Sound Level Calibrator Type 4231. The SLM had a laboratory calibration date within one year of the time of use, as is standard practice. The Brüel & Kjær SLM is a Type 1 instrument according to ANSI Standard S1.4-1983 (R2006). The instrument/microphone was mounted on a tripod at a height of approximately 5 feet above the ground. Microphones were mounted at least approximately 5 feet away from any large reflecting surfaces. The SLM was calibrated before and after readings with a Brüel & Kjær Type 4231 Sound Level Calibrator using the appropriate adaptor. Measurements at each location were made on the A-scale (dBA). The data were digitally recorded by the sound level meter and displayed at the end of the measurement period in units of dBA. Measured quantities included L_{eq}, L_1, L_{10}, L_{50}, L_{90}, and 1/3 octave band levels. A windscreen was used during all sound measurements except for calibration. All measurement procedures were based on the guidelines outlined in ANSI Standard S1.13-2005.

The measured noise levels are summarized in **Table 12-4**. At the receptor site, vehicular traffic noise on adjacent roadways was the dominant noise source. Measured levels were moderate and reflect the level of vehicular activity on the adjacent roadways. In terms of the CEQR criteria, the existing noise levels are in the "marginally acceptable" at site A.

Table 12-4
Existing Noise Levels (in dBA)

Site	Measurement Location	Date	Time	L_{eq}	L_1	L_{10}	L_{50}	L_{90}
A	Existing Museum West Façade Southwest of Weston Pavilion	Weekday	AM	65.5	79.8	65.7	61.2	57.3
			MD	63.8	72.4	66.4	61.1	57.6
			PM	63.3	74.6	65.6	60.1	55.5
		Saturday	MD	62.6	38.5	64.3	61.4	58.1
Note:	Field measurements were performed by AKRF, Inc. on April 5, 2016, April 6, 2016, and May 14, 2016.							



AMNH Gilder Center for Science, Education, and Innovation

Noise Receptor Locations
Figure 12-1

E. NOISE ATTENUATION MEASURES

As shown in **Table 12-4**, the *CEQR Technical Manual* has set noise attenuation quantities for buildings, based on exterior $L_{10(1)}$ noise levels, and in order to maintain interior noise levels of 45 dBA $L_{10(1)}$ or lower for museum, theater, classrooms, and education spaces and 50 dBA or lower for office rooms, meeting rooms, and retail uses. The proposed renovation of existing Museum space and construction of the proposed expansion would be conducted using standard construction methods, and would provide acoustically-rated windows and air conditioning as an alternate means of ventilation. The building façade, including these elements, would be expected to provide a composite Outdoor-Indoor Transmission Class[1] ("OITC") such that interior noise levels would be less than 45 dBA for museum, theater, classrooms, and education spaces, and less than 50 dBA for office rooms, meeting rooms, and retail uses. Furthermore, because the exterior $L_{10(1h)}$ noise levels at the project site, represented by receptor Site A, would be less than 70 dBA, the *CEQR Technical Manual* does not provide a specific requirement for the level of window/wall attenuation.

F. LOADING DOCK NOISE

Noise measurements were also conducted at a second location adjacent to the Museum loading dock. The measurement location was located east of Columbus Avenue between West 77th Street and West 78th Street. While the loading dock does not currently have a direct line-of-sight to neighboring buildings, noise from loading and unloading vehicles reaches the residences on the west side of Columbus Avenue due to reflections from a large solid wall located above the loading dock area. As part of the proposed project, the loading dock would be relocated to the below-grade level of the proposed expansion. The proposed location for the relocated loading dock would be shielded from nearby receptors due to its below-grade location and is farther away from any noise receptors, including residential buildings along Columbus Avenue. Consequently, due to building shielding and increased distance from receptors, noise generated by the relocated loading dock would not have the potential adversely affect nearby receptors; rather, loading dock noise is expected to be reduced compared to existing conditions due to the reconfiguration associated with the proposed project.

G. MECHANICAL SYSTEM

The building mechanical system (i.e., heating, ventilation, and air conditioning systems) would be designed to meet all applicable noise regulations (i.e., Subchapter 5, §24-227 of the New York City Noise Control Code and the New York City Department of Buildings Code) and to avoid producing levels that would result in any significant increase in ambient noise levels. ✷

[1] The attenuation of a composite structure is a function of the attenuation provided by each of its component parts, and how much of the area is made up of each part. A building façade generally consists of wall, glazing, and any vents or louvers associated with building mechanical systems. The OITC classification is defined by the American Society of Testing and Materials ("ASTM") E1332-10 and is used in the acoustical design of building façades.