NOISE

CHAPTER 19

Noise, in its simplest definition, is unwanted sound. While high noise levels may cause hearing loss, the levels associated with environmental noise assessments are often below this hazardous range. However, noise levels that are not considered hazardous should not be overlooked since they can cause stress-related illnesses, disrupt sleep, and interrupt activities requiring concentration. In New York City, with its high concentration of population and commercial activities, such problems may be common.

This chapter discusses the topic of noise as it relates to regulations and guidelines that govern activities in New York City. It defines technical terms, discusses the appropriateness of a noise analysis, and provides information related to study area definitions, technical subareas, models, and detailed noise analysis techniques. Also discussed are methods used by agencies for projects within and outside New York City as well as accepted industry practices for environmental noise assessments applicable to New York City projects. With respect to noise, the goal of CEQR is to determine both (1) a proposed project's potential effects on existing noise sensitive uses and/or locations (known as a "receptors"), including the effects on the level of noise inside residential, commercial, and institutional facilities (if applicable), and at open spaces, and (2) the effects of ambient noise levels on new receptors introduced by the proposed project. If significant adverse impacts are identified, CEQR requires such impacts to be mitigated or avoided to the greatest extent practicable.

As mentioned throughout the Manual, it is important for an applicant to work closely with the lead agency during the entire environmental review process. In addition, the New York City Department of Environmental Protection (DEP) often works with the lead agency during the CEQR process to provide technical review, recommendations, and approvals relating to noise. When the review identifies the need for long-term measures to be incorporated after CEQR (prior to or during development), the lead agency, in coordination with DEP, determines whether an institutional control, such as an (E) Designation, may be placed on the affected site. The Mayor's Office of Environmental Remediation (OER) has the authority and responsibility to administer post-CEQR (E) Designations and existing Restrictive Declarations, pursuant to Section 11-15 (Environmental Requirements) of the Zoning Resolution of the City of New York and Chapter 24 of Title 15 of the Rules of the City of New York.

100. DEFINITIONS

In addition to defining technical terms used in a noise assessment, this section provides background information to better understand such an assessment.

110. SOURCES OF NOISE

For CEQR purposes, the three principal types of noise sources that affect the New York City environment are mobile, stationary, and construction sources.

111. MOBILE SOURCE NOISE

Mobile sources are those noise sources that move in relation to a receptor—principally automobiles, buses, trucks, aircraft, and trains. Each has its own distinctive noise character, and, consequently, an associated set of noise assessment descriptors. The details of these descriptors are discussed in following sections.

112. STATIONARY SOURCE NOISE

Stationary sources of noise do not move in relation to a receptor. Typical stationary noise sources of concern for CEQR include machinery or mechanical equipment associated with industrial and manufacturing operations; or building heating, ventilating, and air-conditioning systems. In addition, noise produced by crowds of people within a defined location, such as children in playgrounds or spectators attending concerts or sporting events, and noise produced by concerts or by announcements using amplification systems, are considered stationary sources.

113. CONSTRUCTION NOISE

Construction noise sources comprise both mobile (*e.g.*, trucks, bulldozers) and stationary (*e.g.*, compressors, pile drivers, power tools) sources. Construction noise is examined separately in Chapter 22, "Construction," because it is temporary, even though the duration of construction activities may last years. The duration of each phase of construction is a factor that should be considered when assessing noise from construction activities. See Chapter 22, "Construction," for more guidance.

114. RECEPTORS

Receptors are generally the subject of most noise impact analyses. A receptor is usually defined as an area where human activity may be adversely affected when noise levels exceed predefined thresholds of acceptability or when noise levels increase by an amount exceeding predefined thresholds of change. Receptors either currently exist or would be introduced by the project. These locations may be indoors or outdoors. Indoor receptors include, but are not limited to, residences, hotels, motels, health care facilities, nursing homes, schools, houses of worship, court houses, public meeting facilities, museums, libraries, and theaters. Outdoor receptors include, but are not limited to, parks, outdoor theaters, golf courses, zoos, campgrounds, and beaches.

Land use and zoning maps are usually helpful in initially targeting receptors that should be analyzed; however, field inspection of the area in question is the most appropriate way to identify all receptors that may be affected by the proposed project. In some cases, additional receptor sites may need to be identified after the initial analysis has been performed to ensure that the extent of the area where significant impacts may occur has been defined.

120. BACKGROUND DISCUSSION

This section provides the reader with a background of the terminology used in noise assessment discussions, the basic physical characteristics of noise, the types and appropriate use of noise descriptors, and the types of locations that may be considered receptors in the conduct of noise analyses. For additional background information, please refer to the Noise Appendix ("the Appendix").

121. CHARACTERISTICS OF NOISE

The first step in understanding the impact of sound, its perception, and control measures is gaining an understanding of the source, path, and receptor. The source is the equipment or process directly responsible for the sound generation. The path is the medium of sound propagation, such as air, water, or solid materials. The receptor is the final destination of concern for the sound in question. For CEQR purposes, the receptor is usually persons being affected; the ear of an affected person is the final destination of the noise source of concern. Each link of this chain plays a role in producing a resultant sound pressure level at the receptor.

122. SOUND LEVELS PRINCIPLES

Sound pressure is the parameter that is normally measured in noise assessments. People's ears respond to "acoustic" pressures that represent the range from the threshold of hearing to the threshold of pain. This vast range is represented as a logarithmic scale.

A basic measure of sound is the sound pressure level (SPL), which is expressed in decibels (denoted dB). When the SPL = 0 dB, the acoustic pressure is the same as the threshold of hearing, or the SPL at which people with healthy hearing can just begin to hear a sound.

Sound is emitted as a wave of varying wavelength and frequency. A higher frequency sound is perceived as a higher pitch—for example, the sound of the flute. A lower frequency is heard as a lower pitch—for example, the sound of the bass drum. The frequency is expressed in cycles per second or Hertz (Hz): one Hz is one cycle per second. Just as the ear cannot hear sound pressure levels below a certain range, it cannot hear some frequencies above a certain range. The normal range of hearing is 20 Hz to 20,000 Hz or 20 kilohertz (kHz).

The velocity of sound, which is constant in air, is governed by the relationship 'velocity equals wavelength times frequency.' Therefore, since sound travels at a constant velocity in air, the longer the wavelength, the shorter the frequency, and vice versa. The wavelength determines how the sound interacts with the physical environment. Since sound is a wave phenomenon, it is also subject to "diffraction," such as "bending" around corners.

In general, hearing is such that a change of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as a doubling or halving of sound level. In a large open area with no obstructive or reflective surfaces, SPL drops from a point source of noise at a rate of 6 dB with each doubling of distance from the source. For "line" sources (such as vehicles on a street), the SPL drops off at a rate of 3 dB(A) with each doubling of the distance from the source. Over distances greater than 1,000 feet, this may not hold true, as atmospheric conditions cause changes in sound path and absorption. The drop-off rate also varies with both terrain conditions and the presence of obstructions. In the urban canyon environment present in New York City, drop-off rates along city streets generally range from 2 to 4 dB per doubling of distance from the source because of sound reflections from buildings. The drop-off rate should be verified by field measurements whenever ideal open situations do not exist and a drop-off rate is required in the analysis.

123. SOUND WEIGHTING

Sound is often measured and described in terms of its overall energy, taking all frequencies into account. However, the hearing process is not the same at all frequencies. Over the normal hearing range, humans are most sensitive to sounds with frequencies between 200 Hz and 10 kHz. Therefore, noise measurements are often adjusted or weighted as a function of frequency to account for human perception and sensitivities. The most common weighting networks used are the A- and C-weighting networks.

These weight scales were developed to allow sound level meters to simulate the frequency sensitivity of the ear. They use filter networks that approximate hearing. The A-weighted network is the most commonly used and sound levels measured using this weighting are noted as dB(A). The letter "A" indicates that the sound has been filtered to reduce the strength of very low and very high frequency sounds, much as the human ear does. A listing of common noise sources with their associated typical dB(A) values is shown in Table 19-1. Note that the table presents a representative range of noise levels, where 0 dB(A) corresponds to the threshold of hearing and 120 dB(A) corresponds to an air raid siren at 50 feet.

The C-weighted network provides essentially the unweighted microphone sensitivity over the frequency range of maximum human sensitivity. C-weighted measurements, denoted as dB(C), are used in some ordinances and standards, usually when dealing with stationary mechanical noise sources; however, dB(A) are normally used for environmental assessments. Since C-weighting does not attenuate frequency levels below 1,000 Hz the way A-weighting does, comparison of dB(A) and dB(C) readings may give a quick estimate of the low frequency contribution of the sound source in question.

Table 19-1
Noise Levels of Common Sources

Sound Source	SPL (dB(A))
Air Raid Siren at 50 feet	120
Maximum Levels at Rock Concerts (Rear Seats)	110
On Platform by Passing Subway Train	100
On Sidewalk by Passing Heavy Truck or Bus	90
On Sidewalk by Typical Highway	80
On Sidewalk by Passing Automobiles with Mufflers	70
Typical Urban Area	60-70
Typical Suburban Area	50-60
Quiet Suburban Area at Night	40-50
Typical Rural Area at Night	30-40
Isolated Broadcast Studio	20
Audiometric (Hearing Testing) Booth	10
Threshold of Hearing	0

Notes: A change in 3 dB(A) is a just noticeable change in SPL. A change in 10 dB(A) is perceived as a doubling or halving in SPL.

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

124. NOISE DESCRIPTORS

Many descriptors are commonly used in environmental noise assessments. The choice of specific descriptors is related to the nature of the noise "signature" (SPL, frequency, and duration) of the source and the potential effect it may have on the surrounding environment.

The most common descriptors used in environmental noise assessments, described briefly below, include (i) time-equivalent level (L_{eq}); (ii) day-night level (L_{dn} and DNL); (iii) percentile level (L_x); (iv) maximum instantaneous level (SPL); and (v) sound power level (L_w). For purposes of noise assessments performed under CEQR review, the descriptors are typically expressed in the A-weighted decibel scale.

- L_{eq} is the continuous equivalent sound level, defined as the single SPL that, if constant over a stated measurement period, would contain the same sound energy as the actual monitored sound that is fluctuating in level over the measurement period. L_{eq} is widely recognized as the descriptor of choice for most environmental noise assessments. In addition to its simplicity, it is easy to combine with other readings or predictions to derive a total cumulative noise level. L_{eq} is an energy-average quantity that must be contrasted with an average or median sound level. L_{eq} must be qualified in terms of a time period to have meaning. The normal representation for the time period is placing it in parentheses in terms of hours (*e.g.*, $L_{eq(1)}$ refers to a 1-hour measurement and $L_{eq(24)}$ refers to a 24-hour measurement).
- L_{dn} is the day-night equivalent sound level, defined as a 24-hour continuous L_{eq} with a 10 dB adjustment added to all hourly noise levels recorded between the hours of 10 PM and 7 AM. This 10 dB addition accounts for the extra sensitivity people have to noise during typical sleeping hours.
- DNL is the annual average day-night average sound level. Aircraft noise around airports is usually mapped out in terms of DNL, which are normally depicted as noise contours on a map. The DNL contours are lines of constant DNL mapped similarly to elevations on topographical maps.
- L_x is the percentile level, where x is any number from 0 to 100. Here x is percentage of the measurement time that the stated sound level has been exceeded. For example, L_{10} = 80 dB(A) means

that SPL measurements exceeded 80 dB(A) 10 percent of the time during the measurement period. As with L_{eq}, the measurement time period must be specified and is denoted in parentheses (*e.g.*, $L_{10(1)}$ corresponds to the SPL exceeded 10 percent of the time during a one-hour period).

The most commonly used L_x values are L_1, L_{10}, L_{50}, and L_{90}. L_1, the SPL exceeded 1 percent of the time, is usually regarded as the average maximum noise level when readings are an hour or less in duration. L_{10} is usually regarded as an indication of traffic noise exposure with a steady flow of evenly-spaced vehicles. L_{50} provides an indication of the median sound level. L_{90} is usually regarded as the residual level, or the background noise level without the source in question or discrete events.

- The maximum instantaneous SPL is the highest single reading over the measurement period. It is useful to note this level because if it is very high, it elevates the L_{eq}, perhaps making it appear spurious. In instances where uses may be particularly sensitive to single-noise events, the lead agency should also consider analyzing potential noise impacts on a single event basis, particularly if the single event would be entirely new to the receptor, or where the receptor would experience a significant increase in the number of these single events.
- Sound power is a property of the source and describes the total power (i.e. rate of energy flow) emitted by a source in all directions. Sound power is expressed in watts. The sound power level (L_w) is expressed in decibels, which may or may not be A-weighted. Unlike the sound pressure level, the sound power level is not distance-dependent and therefore remains constant at any distance. The sound power level descriptor is often used to rate product noise. For environmental assessments, sound power levels are most commonly used to define source noise levels associated with mechanical equipment (e.g. HVAC) to be used in predicting sound pressure levels at receptors.

124.1. Descriptors for Mobile Sources

Each type of mobile source noise generator produces a distinct noise. The use of different descriptors for each is appropriate, as described below. In some cases, when assessing the cumulative effects of several noise sources (combination of vehicular traffic, aircraft, train and/or industrial process noise) are necessary, $L_{eq(1)}$ is the recommended descriptor.

VEHICULAR TRAFFIC

Because vehicular traffic on local streets is not steady—vehicles often move in groups or platoons—its noise signature is characterized by fluctuating levels. If the traffic stream is characterized by sporadic heavy vehicles such as trucks, the noise levels could contain “spikes” associated with these events. Generally, $L_{eq(1)}$ and/or $L_{10(1)}$ are the appropriate descriptors in a vehicular traffic noise assessment. The $L_{eq(1)}$ and $L_{10(1)}$ are noise level descriptors used by the Federal Highway Administration (FHWA). The $L_{eq(1)}$ descriptor should be used to assess the peak hour levels of the proposed action or when there are multiple noise sources, and $L_{10(1)}$ descriptor should be used when determining the appropriate noise attenuation from vehicular noise on the proposed action.

AIRCRAFT

Aircraft noise consists of a series of single events over time. Depending on the location of, and ambient noise levels at the receptor, these single events may be easily distinguishable from background noise levels. This is particularly true, for example, where the receptor is close to an airport or heliport and in the flight path. The Federal Aviation Administration (FAA) currently averages daily L_{dn} levels to use the yearly L_{dn}, or DNL as its preferred noise descriptor. In some cases, assessing aircraft noise using $L_{eq(1)}$ may be necessary, particularly when assessing peak hour levels or when determining cumulative effects of several noise sources, i.e. in combination with vehicle, train and/or industrial process noise.

TRAINS

Train noise is inclusive of transit or freight train activity. Similar to aircraft noise, train noise is comprised of a series of single events over time. Depending on the location of the receptor and ambient noise levels, these single events may be easily distinguishable from background noise levels. This is particularly true, for example, at noise receptors close to elevated train lines. The Federal Transit Administration (FTA) uses $L_{eq(1)}$ and/or L_{dn} as its principal noise descriptors for mass transit noise, depending on the adjacent land use. Noise assessments (see Section 420 below) require the use of the daily L_{dn} for impact assessment. Because of these standards, it is recommended that the L_{dn} be used in the analysis of train noise. In some cases, assessing train noise using $L_{eq(1)}$ may be necessary, particularly when assessing peak hour levels or when determining cumulative effects of several noise sources, i.e. in combination with vehicle, aircraft, and/or industrial process noise.

124.2. Descriptors for Stationary Sources

Stationary source noise is usually associated with mechanical equipment used for manufacturing purposes or building mechanical systems. Other stationary sources worth noting are crowd noise, as related to playgrounds or spectator events, and noise from amplification systems. In many cases, the nature of this noise is fairly uniform. The recommended descriptor for this type of noise source is the $L_{eq(1)}$. In order to develop noise attenuation measures for mechanical equipment, the noise analysis should generally be performed using the octave band components of the sound. The analysis should include the 31.5, 63, 125, 250, 500, 1000, 2000, 4000, and 8000 Hz octave band center frequencies.

The New York City Noise Control Code specifies maximum allowable sound pressure levels for designated octave bands emanating from a commercial or business enterprise as measured within a receiving property (see Section 711, below). Detailed analyses in these areas, if required, should include these descriptors for those assessments.

200. DETERMINING WHETHER A NOISE ANALYSIS IS APPROPRIATE

In many instances, it is possible to determine that a project would not have the potential for a significant noise impact simply from its proposed physical characteristics and, therefore, no further analysis is necessary. Recommended guidelines for the screening assessment and the rationale behind these guidelines are presented below for mobile and stationary sources.

The initial impact screening considers whether the project would: (1) generate any mobile or stationary sources of noise; and/or (2) introduce a new receptor to an area with existing high ambient noise levels. If the proposed project is located in areas with high ambient noise levels, which typically include those near highly trafficked thoroughfares, airports, heliports, train facilities, or other loud activities, further noise analysis may be warranted to determine the attenuation measures that are appropriate for the proposed project.

210. MOBILE SOURCES

211. VEHICULAR TRAFFIC NOISE

An initial noise screening assessment, described in Subsection 311.1, may be appropriate if a proposed project would:

- Generate or reroute vehicular traffic; or
- Introduce a new receptor near a heavily trafficked thoroughfare.

212. AIRCRAFT NOISE

An initial noise impact screening analysis, described in Subsection 311.2, is appropriate if the proposed project would:

- Generate or reroute aircraft, such as airplanes and helicopters; or
- Introduce a new receptor that is within a 65 dB(A) DNL contour.

213. TRAIN NOISE

Based on previous studies, unless existing ambient noise levels are very low and there are no structures that provide shielding, it is unusual for train activity to have a significant impact at distances beyond 1,500 feet in New York City. Therefore, a detailed analysis, as described in Subsection 332.3, may be appropriate if the proposed project would:

- Introduce a new receptor within 1,500 feet of existing train activity and have a direct line of sight to that train facility; or
- Add train activity to existing or new train lines within 1,500 feet of, and have a direct line of site to, a receptor.

220. STATIONARY SOURCES

Based upon previous studies, unless existing ambient noise levels are very low and/or stationary source levels are very high, and there are no structures that provide shielding, it is unusual for stationary sources to have significant impacts at distances beyond 1,500 feet in New York City. Examples of substantial stationary source noise generators include unenclosed cooling or ventilation equipment (other than single-room units), truck loading docks, loudspeaker systems, stationary diesel engines (typically more than 100 horsepower), car washes, or other similar types of uses. The distance between a receptor and a substantial stationary source may be measured from any reliable sources. Therefore, a detailed analysis, as described in Subsection 333, may be appropriate if the proposed project would:

- Cause a substantial stationary source (*e.g.,* unenclosed mechanical equipment, manufacturing activities purpose or playground) to be operating within 1,500 feet of, and have a direct line of sight to, a receptor; or
- Introduce a new receptor in an area with high ambient noise levels resulting from stationary sources, e.g., unenclosed mechanical equipment, manufacturing activities or playgrounds.

300. ASSESSMENT METHODS

If the proposed project does not screen out in the initial noise impact screening analysis below, a more detailed noise analysis, which begins with establishing the study area in Section 320, may be appropriate.

310. NOISE IMPACT SCREENING

For most sources of noise (except train noise), the initial impact screening noise analysis identifies whether the potential exists for the project to generate a significant noise impact at a receptor or be significantly affected by high ambient noise levels. If the basic analysis does not identify the potential for significant impacts, no further noise analysis is necessary and it may be stated that the proposed project would not result in a significant noise impact.

311. MOBILE SOURCES

311.1. Vehicular Traffic Noise

In coordination with the vehicular traffic studies (see Chapter 16, "Transportation"), traffic volumes should be estimated for the expected hour or hours with the greatest noise level change at receptors likely to be most affected by the proposed project. For some projects, the worst-case hour or hours may occur during non-typical time periods (*e.g.*, during the nighttime for projects which produce significant traffic volumes or truck traffic when baseline traffic levels and/or ambient noise levels are low.) The method for assigning noise passenger car equivalent (Noise PCE) values to vehicle type is discussed in Subsection 332.1, below. If existing Noise PCE values are increased by 100 percent or more due to a proposed project (which is equivalent to an increase of 3 dB(A) or more), a detailed analysis is generally performed. Conversely, if existing Noise PCE values are not increased by 100 percent or more, it is likely that the proposed project would not cause a significant adverse vehicular noise impact, and therefore, no further vehicular noise analysis is needed.

311.2. Aircraft Noise

DNL contours should be obtained or calculated for the build year(s) of the proposed project. Calculation of the DNL contours is seldom necessary, since these contours are updated periodically by the Port Authority of New York and New Jersey (PANYNJ) for the two major metropolitan airports (PANYNJ may be contacted to confirm the latest contours). See official noise exposure maps in Appendix M of the Final Noise Exposure Map (NEM) Report for John F. Kennedy Airport and LaGuardia Airport.

If calculations are necessary, they may be performed using the latest version of the FAA Aviation Environmental Design Tool (AEDT). If the proposed project would generate or reroute aircraft, or if the proposed project would introduce a receptor within a 65 dB(A) DNL contour, a detailed analysis may be appropriate. No further aircraft noise analysis is needed if the proposed project would not generate or reroute aircraft or not introduce a receptor within an existing 65 dB(A) DNL contour.

320. ESTABLISHING STUDY AREAS AND IDENTIFYING RECEPTORS

Guidelines for determining the appropriate study area size and receptor locations are described below. Selection of a study area depends on the noise source. Both the effect of noise generated on surrounding receptors as a result of the proposed project and the effect of noise from surrounding sources on the proposed project need to be considered. Receptor sites should generally include all locations where significant impacts may occur. Therefore, if significant impacts are identified during the analysis, additional receptor sites, sometimes farther from the noise source than the distance suggested in these guidelines, may have to be added to the analysis. For rezoning purposes, please consult with the Department of City Planning (DCP) prior to selection of receptors, which are identified based on land use in the study area as a result of the proposed project.

321. MOBILE SOURCES OF NOISE

321.1. Vehicular Traffic Sources

The study area for potential noise impacts from vehicular sources includes: (i) receptor locations along project-affected roadways and (ii) the proposed project if introducing a new receptor. Of particular importance are routes where traffic volumes without the proposed project would be light and made up of lighter vehicles, and where the proposed project would result in a significant number of new trips. Typically, the selection of receptors for analysis goes hand in hand with the traffic and transportation trip generation and assignment process. Once the vehicular trips have been assigned to the roadway network, the potential locations where significant noise impacts could occur may be identified. Typically, this is done by driving the routes to and from the site to identify noise receptors along those routes.

When selecting receptor locations, the vehicular volumes and classifications generated by the proposed project as well as those of the background traffic should be considered. Under noise analysis procedures, vehicles are converted to Noise PCEs, which in turn are used to compute the noise levels for future conditions (see Subsection 332.1). If a significant increase in the number of Noise PCEs is expected (*i.e.*, more than a doubling of Noise PCEs) along any given route that proposed project-related vehicles would use going to and coming from the site within a given hour, then representative receptors should be selected along that route for analysis.

If the proposed action would include noise-sensitive use, then the project site itself should also be considered a receptor. Usually at this stage, these judgments are made without firm data in hand. It is therefore prudent to be conservative in the judgment regarding the analysis locations (*i.e.*, analyze any receptor that may conceivably be affected as a noise analysis location). The actual selection of the potential receptor sites may be narrowed if more data are available because potential noise increases along these routes may be calculated.

321.2. Aircraft Sources

Two types of projects require study areas for aircraft-related noise sources: (i) a proposed project that would generate or reroute aircraft and (ii) a proposed project that would introduce a new receptor within an existing 65 dB(A) DNL contour. For airport/heliport expansions or any proposed projects that would increase the number of aircraft at the facility or reroute aircraft, the study area should include affected areas along the route, assuming the proposed expansion was fully operational. Representative receptor locations are then selected from within these areas for detailed noise impact analysis. Every receptor need not be selected for this purpose. For example, if there were a number of residential buildings within this area, then one or more representative receptor sites may be selected within the area of marginally acceptable, marginally unacceptable and clearly unacceptable exposure levels. The same exercise may be repeated for other types of receptors within the same noise exposure levels.

For proposed projects that introduce a new receptor within an existing 65 dB(A) contour, the study area is the site of the proposed project.

321.3. Train Sources

Two types of projects generally require study areas for train-related noise sources: (i) a proposed project that would include a new train facility or that would add trains to an existing facility or (ii) a proposed project that would introduce a receptor within 1,500 feet of an existing train facility and having a direct line of sight to the train facility. Similar to aircraft facilities, for projects that would provide new train facilities or would add trains to an existing train facility, representative locations should be selected from within the area(s) most likely to be impacted by the proposed project. Not every receptor need be selected for this purpose. However, sufficient data should be collected to define the entire area that may be significantly impacted by the noise level changes.

If a proposed project is within 1,500 feet of, and has a direct line of sight to, an existing train facility, and the proposed project would introduce a new receptor, the study area should encompass the proposed project site.

322. STATIONARY SOURCES

Study area for stationary sources is based on proximity of a receptor to the site of the proposed project, or the proximity of the proposed project to a major stationary noise source in the area. Generally, when the proposed project would result in any significant stationary noise sources, receptors within a 1,500-foot radius of the proposed project that would be within a direct line of sight of the proposed project should be considered for analysis. Receptors closest to a proposed project containing a significant stationary source noise generator are the first candidates for inclusion in the analysis. If there is more than one such receptor within this distance from the site, the analysis may be phased to analyze the closest receptor first—if no significant impact is found at the closest site, then it is reasonable to conclude that receptors farther from the site would likewise not be affected by the proposed project. Otherwise, it is necessary to extend the analysis to the farthest receptor where no significant impact is found. A similar relationship between the proposed project and existing and future No-Action stationary sources should be described, as appropriate. Although these sources may not have to be analyzed separately (because they are included in ambient noise levels) they should be generally identified. It is possible that one or more may be close enough to the site of the proposed project and loud enough to require consideration of noise mitigation at the project site.

330. MODELS AND ANALYSIS TECHNIQUES

The basic analysis techniques used for noise impact analysis follow the same basic procedures as for other impact analysis areas—existing conditions are first characterized, then No-Action conditions are projected and analyzed, and finally, the With-Action condition is projected and analyzed. Impact assessments are then made by comparing the No-Action and With-Action conditions. The following discussion outlines this procedure for mobile and stationary sources of noise.

Proprietary models may be used for analysis purposes only if they have been deemed appropriate by the reviewing agency or agencies, and full disclosure of the model, the model's operation, and all data are made available to the reviewing agency or agencies. Information on proprietary models may not be able to be treated as confidential. Consequently, the use of proprietary models should be discussed with the reviewing agency or agencies prior to their use.

331. NOISE MEASUREMENT PROCEDURES

The first procedure for each noise source is the characterization of existing conditions at selected receptor locations within the noise study areas. As a first step within this process, existing noise levels at receptors are established through a noise measurement program. This noise measurement program described below follows a method consistent for all receptors.

331.1. Noise Measurement Instrumentation

The most common instruments used for environmental noise assessments are sound level meters and spectrum analyzers. The American National Standards Institute (ANSI) has published standards on types of meters and methods of sound measurement. ANSI defines three types of meters—Type 0, having the most stringent tolerances, targeted for laboratory use; Type 1, called a precision meter; and Type 2, a general-purpose meter, having the least stringent tolerances acceptable for SPL monitoring. Sound level meters without at least Type 2 tolerances are not appropriate for SPL monitoring. Many sound level meters available for use today can measure and store in their memory the various statistical and average sound level parameters described earlier. These parameters may be read directly from the sound level meter or downloaded to a computer. Many of these devices may be programmed to carry out these measurements for a user-defined period at regular intervals, making long term monitoring even more convenient. Instrumentation used for the measurements must meet appropriate ANSI standards. To be sure that the meter is working properly, the sound level meter should be factory-calibrated periodically.

Most sound level meters have three time response characteristics — slow, fast, and impulsive. Slow, corresponding to a one second time constant, is usually recommended for environmental noise assessments, such as those performed for CEQR. Fast, corresponding to a one-eighth second time constant, is only recommended to monitor discrete events to obtain a better indication of peak levels. Impulsive, corresponding to 1/30 second, is used for assessing human loudness response to impulsive sounds. Generally, noise measurements performed for CEQR are documented in A-weighting and slow response.

331.2. Noise Measurement Procedures

ANSI also provides guidelines for SPL measurement practices to provide reliable data. Basic measurement procedures are defined by these standards and accepted industry practices.

These guidelines account for microphone placement, calibration of instruments, and precautions pertaining to meteorological conditions, principally wind speed. The following are general guidelines for reference.

CALIBRATION. In addition to periodic factory-calibration of the sound level meter, sound level calibrators or acoustic calibrators should be used to check the sound level meter before and after each series of noise readings. Typical sound level calibrators are small hand-held devices with adapters to fit the measuring microphone of the meter being used. With a properly operating meter and calibrator, the meter should not vary by more than 0.5 dB. Any variation beyond 0.5 dB that cannot be accounted for is an indication that the device should be returned to the manufacturer for adjustment and calibration. Manual adjustment of the sound level meter should not be done in the field unless a new microphone is being fitted. Calibrators should be factory-calibrated at least once a year.

MICROPHONE PLACEMENT. The measuring microphone should be placed with a direct line of sight to the noise source, generally 5 feet above the ground. In some cases, elevated placement may be necessary to obtain a direct line of sight to the noise source (*e.g.,* elevated train sources). To avoid distortion, the measuring microphone is placed a minimum of 3 to 4 feet away from any reflecting surfaces, including the ground, walls, and the body of the person performing the measurements. Failure to do so may introduce errors as high as 6 dB from reflected sound. Whenever feasible, the meter should be mounted on a tripod to permit the monitoring personnel to stand away from the instrument. Complete records of the measurement, including specifics of the measurement location(s), a map of the monitoring location(s), time of measurement(s), meteorological conditions during the measurement(s), identification of significant sound sources, model and serial numbers of all equipment used, and calibration results should be made. The electronic log files from the sound level meter should also be provided. This allows for accurate duplication of the measurements, if necessary, due to outstanding questions, changes in conditions, or inconsistencies.

ACCOUNTING FOR WIND. When measurements are performed outdoors or in areas where airflow may be sensed, the movement of air may skew the monitoring results because wind may introduce errors of as much as 20 dB over actual noise levels. Therefore, a windscreen designed to fit the specific instrument should be used. These windscreens are typically open cell foam spheres and are designed to block wind noise without attenuating the signal being measured. Even with a windscreen in place, wind speeds above 12 miles per hour may cause erroneous readings. Therefore, wind speed should be monitored and readings should not be taken when wind speeds exceed 12 miles per hour.

ACCOUNTING FOR TEMPERATURE. According to ANSI Standard S1.13-2005, the acceptable temperature range for measurements is 14 degrees Fahrenheit to 122 degrees Fahrenheit. In addition, the temperature should not be outside the ranges recommended for operation by the sound level meter manufacturer or individual instruments in the measurement system.

ACCOUNTING FOR RAIN. During periods of inclement weather (rain, snow, *etc.*), measurements should not be taken. Measurement should be performed when the ground is dry, and not when the ground is wet or snow covered.

NOISE MEASUREMENT PERIODS AND NOISE PEAK HOUR SELECTION. Noise measurements should be made in accordance with the expected times that the proposed activity at the site would be greatest, or when surrounding receptors may otherwise be most likely to experience significant impacts because of the proposed project. While this generally occurs for most projects during the peak typical weekday traffic hours (*i.e.*, the AM, midday, and/or PM peak periods), peak weekday traffic hours may not be appropriate for some projects. Rather, it may be necessary to gather data during weekend, late night hours, or for all 24 hours. For example, noise generated by traffic leaving a large multiplex movie theater may result in significant noise impacts during late night hours; maximum project impacts from truck traffic generated by solid waste transfer stations may occur either during late night or early morning hours; and noise from power generation facilities may be most likely to cause significant impacts during late night or early morning hours when background levels are low. Traffic data collection should be coordinated with the noise studies to ensure that, where necessary for analysis purposes, traffic data is available for late night, weekend, and/or all 24 hours. Traffic data collection should be conducted in accordance with the methods described in Chapter 16, "Transportation." Vehicular trip assignments and their hourly distribution should be defined before the hours for noise analysis are determined. Care must be exercised in selecting the noise measurement period and, as detailed information about a project is developed, it may be necessary to supplement initial noise measurements by including additional time periods. Noise levels may vary seasonally. For example, noise during the summer months from flights and from playgrounds are elevated due to increased activities compared to other seasons. Therefore, the noise measurements should be taken during the peak season.

OTHER ACTIVITIES DURING NOISE MEASUREMENT PERIODS. While each of the noise measurements is being taken, events that contribute to the monitored values should be noted. At locations where traffic on the adjacent street is a significant noise source, a traffic counting and classification program should be conducted that records the following: total vehicles; total number of buses (*i.e.*, vehicles having two or three axles and designed to carry more than nine passengers); total number of heavy trucks (*i.e.*, cargo vehicles with three or more axles); total number of medium trucks (*i.e.*, vehicles with two axles and six tires); and total number of passenger vehicles or light trucks (*i.e.*, vehicles having two axles and four tires).

At locations where train noise is a significant noise source, the noise levels should either be calculated or the duration of the measurement should be long enough to estimate the L_{dn}.

In general, noise from unusual events that occur during the measurement period should be excluded from the reported noise level. Typically, unusual events includes noise from sirens of emergency vehicles, construction activities, or other sources that may be atypical for the study area. However, it may include noise from other non-dominant sources (*e.g.*, train noise when vehicular traffic is the dominant noise source).

DURATION OF NOISE MEASUREMENTS. The duration of noise measurements should be sufficient to ensure that the measurements are representative of ambient conditions. For example, at locations where traffic is the dominant noise source, measurements made for shorter time periods are generally sufficient since noise is relatively insensitive to minor fluctuations in changes in Noise PCEs. For example, it takes a doubling of Noise PCEs to equal a 3 dB(A) change (*i.e.*, just perceptible) in sound levels. For that reason, it is generally not necessary to conduct noise measurements for more than a 20-minute period during any hour at any given location, provided that a traffic count and vehicle classification is conducted simultaneously with the noise measurement at the measurement site. When assessing noise from a train facility, measurement durations should be consistent with FTA methodologies provided within the FTA's September 2018 guidance document.

If the proposed project is expected to generate vehicular traffic or stationary source noise over a 24-hour period, it may be necessary to take 24-hour noise measurements at one or more receptor locations. When there is extreme variability in measured data from the noise sources, they should be calculated rather than measured.

MONITORING RESULTS. At a minimum, the summary of noise measurements downloaded from the noise meter should include the following descriptors: L_{max}, L_{min}, L_1, L_{10}, L_{50}, L_{90}, and L_{eq}. The raw data log should also be saved. If the measurement is called into question during the review, these descriptors and review of raw data files may assist in determining whether any anomalous conditions occurred during the measurement. If monitoring results are to be used in the placement of noise (E) Designations, 1/3 octave bands should also be recorded. Field data sheets should be attached to the environmental assessment. Field data sheets should detail notable events and atmospheric conditions during the measurement period, provide a description of the dominant noise source(s) and any anomalous events and also include a sketch of the measurement set-up. A noise measurement photo log should also be included. A copy of the current sound level meter calibration certificate should also be provided.

332. MOBILE SOURCES ANALYSES

332.1. Vehicular Traffic Noise

For most projects reviewed under CEQR, an analysis may be employed using a logarithmic equation (described below). However, the latest version of the approved Federal Highway Administration (FHWA) Traffic Noise Model (TNM) should be used when:

- Conditions result in new or significant changes in roadway or street geometry;
- Roadways currently carry no or very low traffic volumes are involved;
- Ambient noise is the result of multiple sources including traffic; or
- A detailed analysis of changes due to the traffic component of the total ambient noise levels is necessary.

The TNM model takes into account various factors that influence vehicular noise, including traffic volumes, vehicle classifications, source/receptor geometry, shielding (including barriers and terrain), ground attenuation, *etc.* According to the FHWA, the TNM model requires validation to verify the accuracy. The model is validated when differences between the measured versus modeled noise levels are within +/- 3 dB(A).

One particularly useful application of the TNM model is for situations where traffic is one of the components of the total ambient noise. In such situations, the TNM model may be used to compute the traffic component of the noise and may then be subtracted from the measured ambient noise levels to determine the non-traffic components of the total ambient noise levels.

Computerized models, such as CadnaA and SoundPLAN, have developed algorithms that incorporate the TNM model for vehicular noise calculations; they may be utilized for CEQR analyses. Note that Federal or Federal-aid highway projects being undertaken pursuant to 23 CFR 772 must use TNM.

While the TNM model often yields accurate prediction results for first level screening purposes as well as for assessing project impacts, it is more convenient and easier to use the logarithmic equation described below.

EXISTING CONDITIONS. Analysis of existing noise conditions uses monitored noise levels and observations made during the monitoring period to assess noise levels and their sources. A validated TNM model can be used to identify existing noise conditions for additional sites other than the measurement locations. Results of the noise monitoring program at measurement locations are reported as existing conditions in the environmental assessment.

FUTURE NO-ACTION CONDITION. To arrive at the No-Action noise condition, the results of the No-Action traffic analysis (see Chapter 16, "Transportation") are used to compute total Noise PCEs passing each receptor site. From the existing and No-Action traffic data, existing and No-Action Noise PCEs are calculated in the following manner (see Subsection 331.2 under "Other Activities During the Conduct of the Noise Measurements" for definitions of vehicle types):

- Each Automobile or Light Truck: 1 Noise PCE
- Each Medium Truck: 13 Noise PCEs
- Each Bus: 18 Noise PCEs

- Each Heavy Truck: 47 Noise PCEs

Note: These values were obtained using the TNM model, assuming a speed of 25 mph and a distance of 30 feet from the roadway. For speeds below 25 mph, the TNM model should be run to develop project-specific screening values. For projects with traffic moving at higher speeds and/or receptors at more than 30 feet from the roadway, either the default values shown above or project-specific values obtained using the TNM model may be used for purposes of screening.

After the Noise PCEs are calculated and tabulated at each receptor site, the No-Action noise levels are calculated using Equation 19-1:

Equation 19-1

FNA NL =10 log (NA PCE/E PCE) + E NL

where:

FNA NL = Future No-Action Noise Level

NA PCE = No-Action Noise PCEs

E PCE = Existing Noise PCEs

E NL = Existing Noise Level

The calculation is conducted using the $L_{eq(1)}$ noise measurement results. $L_{10(1)}$ values are calculated by adding the difference between the $L_{10(1)}$ and $L_{eq(1)}$ descriptors found to exist in the measurement program to the calculated No-Action $L_{eq(1)}$ noise level. The results of the No-Action noise level calculation are then reported in the environmental assessment.

FUTURE WITH-ACTION CONDITION. The identical analysis procedure is used to determine the With-Action condition, with calculated total Noise PCEs derived from the With-Action traffic analysis. To determine potential significant impacts, the With-Action condition noise levels are compared with the No-Action noise levels, applicable standards and impact thresholds at each receptor (see Sections 410 and 710, below).

332.2. Aircraft Noise

EXISTING CONDITIONS. FAA DNL noise levels are the preferred descriptor. This descriptor tends to average out high hourly values. DNL values may be estimated using the latest FAA noise contour maps for the airports or calculated using the latest version of the FAA Aviation Environmental Design Tool (AEDT) computer model. When necessary to combine noise sources or determine peak hour, measured L_{eq} during peak aircraft activities can be utilized.

NO-ACTION CONDITION. Generally, under the No-Action Condition, aircraft noise levels should remain the same as under Existing Conditions; however, if increased aircraft activity would occur under the No-Action Condition, future noise levels may be calculated, following FAA methodologies.

WITH-ACTION CONDITION. The same analysis methods used to estimate existing aircraft noise levels are to be used in the With-Action scenario using the With-Action aircraft fleet mix. To determine potential significant impacts, the With-Action condition noise levels are compared with the No-Action noise levels, applicable standards, and impact thresholds at each of the receptors (see Sections 410 and 710, below).

332.3. Train Noise

EXISTING CONDITIONS. Noise from train operations is either measured or calculated. Noise measurements is the method preferred according to the Federal Transit Administration (FTA) guidance manual, Transit

Noise and Vibration Impact Assessment Manual (September 2018). This manual includes several measurement options for residential and non-residential land use to identify existing noise exposure in terms of the L_{eq} and L_{dn} descriptors. Per FTA guidance, noise measurements should be performed at representative receptor locations or at each individual receptor considered in the impact analysis, depending on the project.

The FTA's guidance manual also detailed noise analysis methodology to calculate train noise. Using FTA methodologies, $L_{eq(1)}$ and L_{dn} values may be calculated as a function of a number of factors, including the distance between the track and receptor; shielding at the receptor; number of trains; average number of cars per train; train speed; track conditions; whether the track is on grade or on structure; *etc.*

Computerized models, such as CadnaA and SoundPLAN, either have developed or are in the process of developing algorithms that incorporate the FTA and/or Federal Railroad Administration (FRA) algorithms for train noise calculations. Measurements during periods of peak train activity should be used to validate the models. Upon verification that these algorithms produce comparable results to the FTA algorithm, they may be utilized for CEQR analyses.

NO-ACTION CONDITION. Generally, under the No-Action Condition, train noise levels should remain the same as under Existing Conditions; however, if increased train activity would occur under the No-Action Condition, future noise levels may be calculated, following FTA methodologies.

WITH-ACTION CONDITION. The same analysis methods used to estimate No-Action train noise levels are used in the With-Action scenario using the With-Action train mix. To determine potential significant impacts, the With-Action condition noise levels are compared to the No-Action noise levels, applicable standards and impact thresholds at each of the receptors (see Sections 410 and 710, below).

333. STATIONARY SOURCES

EXISTING CONDITIONS. Noise levels of existing stationary sources should be measured at the receptors closest to the source. If the stationary source in question would be part of the proposed project and does not currently exist, noise measurements should be performed at the property line of the site closest to the proposed stationary source(s) and at the closest receptors to ensure that spatial coverage and receptor "type" coverage is adequate. For example, if there is a park nearby and residential units nearby, both need to be monitored for existing conditions.

NO ACTION CONDITION. In cases where new stationary sources are to be introduced into the study area in the future without the project, the noise contribution from these facilities is predicted at the receptors and/or the project site and logarithmically added to existing noise levels to obtain the No-Action condition. The calculations are based on operational information from the entity responsible for the new stationary noise sources.

WITH-ACTION CONDITION. If the project under consideration involves locating a potential receptor near an existing stationary noise source, then measurements made at the site location of the existing stationary source are generally used for the impact evaluation. Where the proposed project involves a new stationary source, the analysis should focus on determining the highest $L_{eq(1)}$ values at receptor locations (including the property line) with the stationary source operating. The first step in this calculation is acquiring project-specific noise emission data from the manufacturer, or, lacking that, estimating the emission levels from a literature review. Often the data is provided in terms of sound power level. This noise descriptor, expressed in decibels, is a measure of the total acoustic power of a source. Equation 19-2 can be used to predict the sound pressure level at a given distance using sound power level:

Equation 19-2

$L_p = L_w - 20*\log(d) - A_e$

where:

L_p is the sound pressure level

L_w is the sound power level

d is the distance from the source to the receiver in feet

A_e is excess attenuation caused by environmental and terrain features. Default value is zero (use of any other value requires reviewing agency's approval).

The noise emission data from the manufacturer for specific stationary equipment is always the best source. When this is not available, information may be available from industry groups such as the Electric Power Research Institute (EPRI) (3420 Hillview Avenue, Palo Alto, California 94304 USA), in publications such as Electric Power Plant Environmental Noise Guide published by the Edison Electric Institute, or in industry-sponsored computer models. Please note that the manufacturer data may not include the processing noise. If most of the processing noise is not attributable to the engine, then either supplemental information should be added to the manufacturer's data or alternative source of noise data should be used for modeling. Other alternatives include locating an operating facility with similar equipment and performing measurements at that facility, preferably at similar distances and under similar conditions to those anticipated for the proposed project.

Once data are acquired, the next step is predicting the sound levels at the receptors. Where a single or several discrete sources exist, and where the distances are moderate and have an unobstructed line of sight, this may be accomplished using basic noise fundamentals for calculation (*i.e.*, the addition of sound levels, frequency adjustments to get A-weighted values). For example, if sound power data is available, the equation given above may then be used. If sound pressure level data are available, Equation 19-3 can be used to estimate sound levels at a receptor:

Equation 19-3

$L_{p1} = L_{p2} – 20*\log(d_1/d_2)$

where:

L_{p1} is sound pressure level at the receptor

L_{p2} is sound pressure level at the reference location

d_1 is the distance from the source to the receptor

d_2 is the distance at which the source sound level data is known

Any attenuation by structures around the source or noise control measures (*e.g.,* silencers, acoustic barriers) that are to be used must be considered in calculating sound levels at the receptors.

Where there are many individual sources associated with the project, and when there is varying landscape (*e.g.*, parks, buildings, trees) between the source and receptors, calculations become even more complicated. In addition, data provided by manufacturers and/or the literature are often presented in octave bands. While it is useful to perform the calculations in octave bands, particularly when designing noise control features, the calculated octave band values should be converted to equivalent A-weighted values for impact evaluation purposes. Both ANSI and International Organization for Standardization (ISO) have documents that describe techniques and considerations for carrying out these calculations. Following these procedures often involves programming a computer spreadsheet to automate the details (*i.e.*, sound power level to sound pressure level conversion as a function of frequency and distance; application of attenuation of buildings, barriers, terrain, noise control as a function of frequency; summation of contributions of the various sources; and conversion to A-weighted sound levels).

Computer models are also available that are based upon the various standards and allow the calculations to be carried out. These models also often include databases of source sound levels for use in the model. Programs such as CadnaA developed by DataKustik, SPM9613 developed by Power Acoustics Inc, SoundPLAN developed by Braunstein + Berndt GmbH, and Predictor 7810 developed by Brüel & Kjær are examples of such programs. These programs are not specifically endorsed, and other programs may be available to perform similar functions.

In all cases, rather than using theoretical modeling techniques, it is preferable to use actual facility data. Therefore, if a facility comparable to the proposed project can be measured, and its levels can be adjusted to account for differences in conditions between its site and the proposed project site, that is generally a preferred modeling approach.

As previously mentioned, noise generated by children in playgrounds or people using parks is considered stationary source noise. For locations adjacent to playgrounds or parks, utilize noise source levels provided in the 1992 study performed for the School Construction Authority (SCA) at eight New York City public schools. The study categorized playgrounds into early childhood, elementary, intermediate, and high school. Recommendations for playground noise source levels are provided within the study in the Appendix. In most cases, it would be necessary to cumulatively add playground noise levels to other source noise levels representative of future conditions.

To determine potential significant impacts, the With-Action condition noise levels are compared with the No-Action noise levels, applicable standards, and impact thresholds at each of the receptor locations or within contours developed to indicate noise levels within varying distances from a source (see Sections 410 and 710, below).

334. Combined Effects of Mobile and Stationary Noise Sources

Each mobile and stationary source analysis yields a maximum $L_{eq(1)}$ noise level. These values are logarithmically added to yield a total maximum-possible $L_{eq(1)}$ level. To determine the potential for significant impacts caused by the proposed project, the totals in the With-Action condition are compared to the No-Action total noise levels at the respective receptor locations, the applicable standards, and the impact thresholds.

400. DETERMINING IMPACT SIGNIFICANCE

The following section provides guidelines and recommendations for the determination of impact significance. Depending on the project, applying either one, or both, of the following approaches to determine impact significance may be appropriate. The first approach describes the use of an incremental change from No-Action conditions (impact thresholds). The second approach describes the use of absolute noise level limits (for proposed project that introduce receptors). For either approach, two questions must be considered:

- Are the existing and future receptors experiencing noise levels above absolute limits? Absolute limits, in this case, relate to published standards (see Section 710, below)?
- Would the proposed project introduce a new receptor in the area?

The manner in which these typical significant impact thresholds are applied to mobile and stationary sources is discussed in Sections 430 and 440.

410. IMPACT THRESHOLDS

The selection of incremental values and absolute noise levels should be responsive to the nuisance levels of noise and critical time periods when nuisance levels are most acute. During daytime hours (between 7 AM and 10 PM), nuisance levels for noise are generally considered to be more than 45 dB(A) indoors and 70 to 75 dB(A) outdoors. Indoor activities are subject to task interference above this level, and 70 to 75 dB(A) is the level at which speech interference occurs outdoors. Typical building materials used in the past (including typical single-glazed windows) provide a minimum of approximately 20 dB(A) of noise attenuation from outdoor to indoor areas.

In view of these factors and for the purposes of determining a significant impact during daytime hours, it is reasonable to consider 65 dB(A) $L_{eq(1)}$ as an absolute noise level that should not be significantly exceeded. For example, if the No-Action noise level is 60 dB(A) $L_{eq(1)}$ or less, a 5 dB(A) $L_{eq(1)}$ or greater increase would be considered significant. If the No-Action noise level is 61 dB(A) $L_{eq(1)}$, the maximum incremental increase would be 4 dB(A), since an increase higher than this would result in a noise level higher than the 65 dB(A) $L_{eq(1)}$ threshold and is considered significant. Similarly, if the No-Action noise level is 62 dB(A) $L_{eq(1)}$ or more, a 3 dB(A) $L_{eq(1)}$ or greater change is considered significant.

Nighttime (between 10 PM and 7 AM) is a particularly critical time period relative to potential nuisance values for noise level increases. Therefore, irrespective of the total nighttime noise levels, an increase of 3 dB(A) L_{eq} is typically considered a significant impact during nighttime hours.

420. IMPACT THRESHOLDS FOR PROPOSED PROJECTS THAT INTRODUCE RECEPTORS

Impact thresholds for proposed projects that introduce receptors are more straightforward. Typically, potential significant impacts on the newly created receptor relate to absolute noise limits. The Noise Exposure Guidelines shown in Table 19-2 are followed by lead agencies for this purpose. If a proposed project is within an area where the project noise levels exceed the marginally acceptable limit shown in the Noise Exposure Guidelines (as measured at the proposed building line, or if that is not known, at the property line), a significant impact would occur. Then, the project would be subject to mitigation measures necessary to bring its interior noise levels down to a level of 25 dB(A) or more below the maximum marginally acceptable levels (by receptor type) for external exposure shown in Table 19-2. If the proposed project includes a publicly accessible outdoor area requiring serenity and quiet (such as a park for passive recreation), the feasibility and applicability of implementing mitigation measures to bring exterior noise levels to below 55 dB(A) $L_{10(1)}$ should be explored on a case by case basis in consultation with the lead agency and the New York City Department of Parks and Recreation (or controlling entity if it would not be a city park).

Table 19-2
Noise Exposure Guidelines For Use in City Environmental Impact Review[1]

Receptor Type	Time Period	Acceptable General External Exposure	Airport[3] Exposure	Marginally Acceptable General External Exposure	Airport[3] Exposure	Marginally Unacceptable General External Exposure	Airport[3] Exposure	Clearly Unacceptable General External Exposure	Airport[3] Exposure
1. Outdoor area requiring serenity and quiet[2]		$L_{10} \le 55$ dBA	---------DNL ≤ 60 dBA---------		---------60 < DNL ≤ 65 dBA---------		(I) 65 < DNL ≤ 75 dBA		--------- 75 dBA < DNL ---------
2. Hospital, nursing home		$L_{10} \le 55$ dBA		$55 < L_{10} \le 65$ dBA		$65 < L_{10} \le 80$ dBA		$L_{10} > 80$ dBA	
3. Residence, residential hotel, or motel	(7 AM to 10 PM)	$L_{10} \le 65$ dBA		$65 < L_{10} \le 70$ dBA		$70 < L_{10} \le 80$ dBA		$L_{10} > 80$ dBA	
	(10 PM to 7 AM)	$L_{10} \le 55$ dBA		$55 < L_{10} \le 70$ dBA		$70 < L_{10} \le 80$ dBA		$L_{10} > 80$ dBA	
4. School, museum, library, court, house of worship, transient hotel or motel, public meeting room, auditorium, out-patient public health facility		Same as Residential Day (7 AM-10 PM)		Same as Residential Day (7 AM-10 PM)		Same as Residential Day (7 AM-10 PM)		Same as Residential Day (7 AM-10 PM)	
5. Commercial or office		Same as Residential Day (7 AM-10 PM)		Same as Residential Day (7 AM-10 PM)		Same as Residential Day (7 AM-10 PM)		Same as Residential Day (7 AM-10 PM)	
6. Industrial, public areas only[4]	Note 4	Note 4		Note 4		Note 4		Note 4	

Notes:

(i) In addition, any new activity shall comply with Impact Thresholds detailed in Section 410.

[1] Measurements and projections of noise exposures are to be made at appropriate heights above site boundaries as given by American National Standards Institute (ANSI) Standards; all values are for the worst hour in the time period.

[2] Tracts of land where serenity and quiet are extraordinarily important and serve as important public need, and where the preservation of these qualities is essential for the area to serve its intended purpose. Such areas could include amphitheaters, particular parks or portions of parks, or open spaces dedicated or recognized by appropriate local officials for activities requiring special qualities of serenity and quiet. Examples are grounds for ambulatory hospital patients and patients and residents of sanitariums and nursing homes.

[3] One may use the FAA-approved DNL contours supplied by the Port Authority of New York and New Jersey (PANYNJ), or the noise contours may be computed from the federally approved Aviation Environmental Design Tool (AEDT) Computer Model using flight data supplied by the PANYNJ.

[4] External Noise Exposure standards for industrial areas of sounds produced by industrial operations other than operating motor vehicles or other transportation facilities are spelled out in the New York City Zoning Resolution, Sections 42-20 and 42-21. The referenced standards apply to M1, M2, and M3 manufacturing districts and to adjoining residence districts (performance standards are listed by octave bands).

Sources: New York City Department of Environmental Protection (adopted policy 1983).

430. MOBILE SOURCES

If the proposed project would introduce a new receptor, With-Action noise levels of the new receptor in dB(A) would be compared to the values contained in the Noise Exposure Guidelines. Furthermore, the descriptor used to assess the mobile noise sources depending on the type of noise sources. If these noise levels would exceed the marginally acceptable levels, a significant impact would occur unless the building design as proposed provides a composite building attenuation that would be sufficient to reduce these levels to an acceptable interior noise level. These values are shown in Table 19-3. The applicant should demonstrate that sufficient attenuation is provided in the form of composite building attenuation calculations based upon the Outdoor Indoor Transmission Class (OITC) values of individual major window/wall/ventilation components, unless a federal funding source, as defined in Subsection 723 of this chapter, requires usage of a different single number rating, such as the Sound Transmission Class (STC) rating, to calculate the noise levels and attenuation values.

Table 19-3
Required Attenuation Values To Achieve Acceptable Interior Noise Levels

	Marginally Unacceptable				Clearly Unacceptable
Vehicular Traffic	$70<L_{10}\leq73$	$73<L_{10}\leq76$	$76<L_{10}\leq78$	$78<L_{10}\leq80$	$80<L_{10}$
Aircraft[A]	65<DNL≤68	68<DNL ≤71	71< DNL ≤73	73< DNL ≤75	75< DNL
Train	$65<L_{dn}\leq68$	$68<L_{dn}\leq71$	$71<L_{dn}\leq73$	$73<L_{dn}\leq75$	$75<L_{dn}$
Attenuation[B]	(I) 28 dB(A)	(II) 31 dB(A)	(III) 33 dB(A)	(IV) 35 dB(A)	See note [C]

Note:

[A] DNL descriptor based on average values of L_{dn} over a year period.

[B] The above composite window-wall attenuation values are for residential dwellings and community facility development. Commercial office spaces and meeting rooms would be 5 dB(A) less in each category. All of the above categories require a closed window situation and hence an alternate means of ventilation.

[C] The required attenuation value is the difference between L_{build} and $L_{interior,}$, using the appropriate noise descriptor

Where:

L_{build} is the projected noise level under the build condition rounded up to the whole number

$L_{interior}$ is the designed interior noise level (45 dB(A) for vehicular noise, 40 dB(A) for aircraft and train noise)

Source: New York City Department of Environmental Protection

430.1. Vehicular Noise

The impact assessments for vehicular noise compare the proposed project $L_{eq(1)}$ noise levels at receptors potentially affected by the project to those calculated for the No-Action condition, as discussed in Section 410. If the No-Action levels are less than 60 dB(A) $L_{eq(1)}$ and the analysis period is not at nighttime, an increase of 5 dB(A) $L_{eq(1)}$ or more in the future with the project would be considered a significant impact. In order for the 5 dB(A) threshold to be valid, the resultant With-Action condition noise level would have to be equal to or less than 65 dB(A). If the No-Action noise level is equal to or greater than 62 dB(A) $L_{eq(1)}$, or if the analysis period is a nighttime analysis period, the incremental significant impact threshold would be 3 dB(A) $L_{eq(1)}$. If the No-Action noise level is 61 dB(A) $L_{eq(1)}$, the maximum incremental increase would be 4 dB(A), since an increase higher than this would result in a noise level higher than the 65 dB(A) $L_{eq(1)}$ threshold and be considered significant.

430.2. Aircraft Noise

If the proposed project would generate or reroute aircraft, impact criteria discussed in Section 410 apply to the peak hour noise levels. Furthermore, if the proposed project involves other noise sources, in addition to the aircraft, impact criteria discussed in Section 410 apply to the cumulative impacts as well. Impact criteria discussed in Section 420 applies to a proposed project that would introduce a new receptor within an existing 65 dB(A) DNL contour of an airport. The applicant should demonstrate that sufficient attenuation is provided in the form of composite building attenuation calculations based upon the OITC values of individual major window/wall/ventilation components, unless a federal funding source, as defined in Subsection 723 of this chapter, requires usage of a different single number rating, such as the STC rating, to calculate the noise levels and attenuation values.

430.3. Train Noise

If the proposed project would create a train facility or cause a change in frequency of trains along the train facility, the impact criteria discussed in Sections 410 apply to the peak hour levels. Furthermore, if the proposed project involves other noise sources, in addition to the train, impact criteria discussed in Section 410 apply as well. Impact criteria discussed in Section 420 apply to a proposed project that would introduce a new receptor to train noise. If the train noise at the receptor exceeds 65 dB(A) L_{dn}, design measures should be implemented that achieve the levels of composite building attenuation provided in Table 19-3. The applicant should demonstrate that sufficient attenuation is provided in the form of composite building attenuation calculations based upon the OITC values of individual major window/wall/ventilation components, unless a federal funding source, as defined in Subsection 723 of this chapter, requires usage of a different single number rating, such as the STC rating, to calculate the noise levels and attenuation values.

440. STATIONARY SOURCES

If a proposed project would be subject to stationary source noise levels greater than the impact criteria discussed in Section 410, a significant impact would occur, unless the building design as proposed provides a composite building attenuation that would be sufficient to reduce these levels to an acceptable interior noise level. In the case of significantly impacted buildings, design measures should be implemented that achieve the levels of composite building attenuation provided in Table 19-3. The applicant should demonstrate that sufficient attenuation is provided in the form of composite building attenuation calculations based upon the OITC values of individual major window/wall/ventilation components, unless a federal funding source, as defined in Subsection 723 of this chapter, requires usage of a different single number rating, such as the STC rating, to calculate the noise levels and attenuation values. Some noise sources (mechanical ventilation, air compressor, *etc.*) are also controlled by New York City Noise Control Code (Local Law No. 113 of 2005).

500. DEVELOPING MITIGATION

The following section provides guidelines and recommendations for developing mitigation of a significant noise impact. General types of possible mitigation measures that may be used to alleviate significant noise impacts for the different source types are discussed.

510. MOBILE SOURCES

511. VEHICULAR TRAFFIC NOISE

The first mitigation option to be considered is the rerouting of the traffic that would cause the significant impact. This is generally possible only for facilities that generate traffic under the control of the applicant (for example, a city vehicle storage facility would fit this requirement, but a commercial office building would not). Where this mitigation appears appropriate, it is necessary to be sure that the rerouted traffic would not simply relocate the significant noise impact or introduce a significant traffic or air quality impact in another location.

If rerouting is not feasible, the most common mitigation measure used for vehicular noise impacts is the provision of adequate window/wall attenuation at the affected receptor that conforms with the Noise Exposure

Guidelines acceptable interior noise levels of 45 dB(A) $L_{10(1)}$. When maximum hourly exterior levels are greater than 70 dB(A), alternate means of ventilation should be incorporated into buildings so that windows do not need to be opened at any time of the year. If windows were open, the effect of the window-wall attenuation would be reduced. An alternate means of ventilation would allow for a closed window condition, ensuring that acceptable interior noise levels are achieved. For existing receptors where the maximum exterior noise level is less than 75 dB(A), standard double-glazed and/or laminated windows are available that would provide adequate noise attenuation. However, as the maximum exterior noise level increases, the project may be required to incorporate special designs into the windows and possibly the exterior walls of buildings to conform to Noise Exposure Guidelines.

At locations adjacent to highways and limited access roadways, barrier walls (and sometimes berms) may be used for vehicular traffic noise impact mitigation; however, to be effective in providing attenuation, the barrier wall must interrupt the line of sight between the noise source (the flow of traffic) and the receptor. Buildings taller than the barriers receive no acoustical benefit from their presence. Barriers could also detract from the aesthetics of neighborhoods and, therefore, may be impractical for most uses in the New York City area. There are a number of methodologies for calculating the noise attenuation attributable to noise barriers, including the use of the TNM model algorithms.

512. AIRCRAFT NOISE

The first mitigation option investigated should be potential changes to flight paths. If this mitigation is appropriate, it is necessary to ensure that the mitigation does not merely relocate the significant impact to another area. In addition, facility use restrictions (*e.g.*, capacity limitations, lower takeoff angles, curfews, using only certain types of aircraft) should be investigated. These measures would require commitment from the appropriate agency.

If flight operations adjustment is not feasible, the only possible mitigation measure for significant aircraft noise impacts is treatment of all exterior walls and roofs of buildings to ensure that interior noise levels would be less than 45 dB(A) $L_{10(1)}$. If exterior noise levels are less than 75 dB(A), double-glazed or laminated windows (with alternate means of ventilation for levels above 70 dB(A)) should be provided to achieve adequate attenuation and ensure interior noise levels of 45 dB(A). However, if noise levels are equal to or greater than 75 dB(A), special designs may have to be incorporated into windows, walls, roofs, and doors.

513. TRAIN NOISE

Mitigation measures available for significant train noise impacts are the exterior building attenuation measures discussed above (Subsection 511) for significant vehicular noise impacts, barrier wall (or berm) construction, treating the vehicles, wheel truing and rail grinding, rail lubrication on sharp curves, and operational restrictions. Barrier wall attenuation has a practical limit of 10 to 15 dB(A), so it would provide complete impact mitigation only when exterior noise levels (for existing uses) at receptors are less than 75 dB(A). It must also be kept in mind that barriers are only effective when the line of sight is broken between the source and receiver. Therefore, buildings with windows higher than the barrier may not receive much benefit from the barriers and exterior wall attenuation; window attenuation and an alternate means of ventilation would have to be designed into the facades of buildings facing the train activity.

520. STATIONARY SOURCES

The most common mitigation measures available for stationary sources include exterior building attenuation (as discussed for mobile sources in Subsection 510 above), noise barrier (or earthen berm) construction (as discussed above), and noise control design on the source in question. Caution should be exercised when constructing barriers in New York City given the limitations mentioned above. In many cases, treating the noise source (*e.g.*, providing baffles, silencers, mufflers, sound insulation, placing it within an enclosed structure) may be the least expensive option. Moving the source in question so that receptors would not be significantly affected is also a potential mitigation measure.

530. (E) DESIGNATIONS

The (E) Designation is an institutional control that is implemented through CEQR review of a zoning map, text amendment, or action pursuant to the Zoning Resolution. It provides a mechanism to ensure that measures aimed at avoiding a significant adverse impact are part of future development, thereby eliminating the potential for a noise impact.

If necessary, the lead agency may consult with DEP during the CEQR process to identify sites requiring an (E) Designation. The Mayor's Office of Environmental Remediation (OER) is responsible for administering post-CEQR determinations for projects with assigned (E) Designations and existing Restrictive Declarations, pursuant to Section 11-15, "Environmental Requirements," of the Zoning Resolution of the City of New York and Chapter 24 of Title 15 of the Rules of the City of New York (Rules). In order to facilitate OER's review of the proposed work to address the requirements of the (E) Designation, it may be necessary for property owners to provide historical technical documentation related to the CEQR Noise analysis (*e.g.*, EAS/EIS, Technical Memoranda, CEQR determination, modeling results, lead agency and DEP correspondence, Restrictive Declarations, Notices) to OER. The Rules and Section 11-15 of the Zoning Resolution set out the procedures for placing, satisfying and removing (E) Designations. OER reviews and approves all documents needed to satisfy the requirement of a noise (E) Designation.

(E) Designations are listed in Table 1 of Appendix C of the Zoning Resolution of the City of New York and appear in the Department of Buildings' (DOB) online Buildings Information System (BIS) and DOB NOW.

With respect to (E) designated lots, DOB will not issue building permits or certificates of occupancy in connection with the following actions until it receives an appropriate "Notice" from OER that the (E) requirements have been met:

- Developments;
- Enlargements, extensions, or changes of use; or
- Alterations that involve window or exterior wall relocation or replacement.

As appropriate, OER issues the applicable notices to DOB including a Notice of No Objection, Notice to Proceed, or Notice of Satisfaction.

600. DEVELOPING ALTERNATIVES

In developing project alternatives to reduce or avoid significant noise impacts, the simplest and most common way of analyzing the situation is to calculate the conditions that would just avoid an impact and tailor the project alternative to that new scenario. For instance, if a significant vehicular traffic noise impact were identified at a receptor, the project-generated $L_{eq(1)}$ worst-hour increase would be at least 3 dB(A), depending on the No Action noise level. If one calculated the project-generated traffic volume that would, in the worst-hour, cause a less than 3 dB(A) increase in $L_{eq(1)}$ values, that traffic volume would define the alternative project volume . A change in plan that dispersed traffic differently or reduced the project size and thus the trip generation from the project may address this traffic noise issue. Similar analysis techniques may be used for analyzing alternatives from any relative impact criterion.

When dealing with absolute impact criteria, alternative project arrangements may be set by moving, scaling down, or shielding the original project to the point where significant impacts are avoided. For instance, if a manufacturing facility generated a significant impact at a residence, the noise-generating part of the facility may be moved to the distance at which the noise levels at the property line would be low enough not to cause a significant impact. Another possible alternative would be to scale down operations until noise levels reached would not cause a significant impact. Yet another alternative to the project may include a building or barrier between the noise-generating facility and the property line to shield the noise to the point where a significant impact would be avoided. These options may each have to be evaluated in terms of their feasibility and potential impacts on other environmental assessment categories.

700. REGULATIONS AND COORDINATION

710. REGULATIONS AND STANDARDS

Regulations applicable to New York City environmental noise assessments are found in the Noise Exposure Guidelines. These regulations, which apply to all private or city-sponsored projects subject to CEQR in New York City, are described below. When a project to be undertaken in New York City also includes some level of State or federal involvement, additional State or federal regulations may also apply.

In 1983 DEP adopted City Environmental Protection Order-City Environmental Quality Review (CEPO-CEQR) noise guidelines for environmental impact review. Four categories of acceptability have been established, based on noise level limits and land use, for vehicular traffic, train, and aircraft noise sources. These acceptability categories include: "generally acceptable," "marginally acceptable," "marginally unacceptable," and "clearly unacceptable." These categories and associated noise limits apply to exterior noise levels only. The levels are shown in Table 19-3. The exterior limitations are based on an acceptable interior noise level of 45 dB(A).

711. NEW YORK CITY NOISE CONTROL CODE

In addition to the Noise Exposure Guidelines, the New York City Noise Control Code (Local Law No. 113 of 2005) governs noise emissions in New York City, and the New York City Zoning Resolution includes noise performance standards for any manufacturing activity in manufacturing districts. These have not traditionally been used for purposes of CEQR environmental assessments. However, it is appropriate to discuss the proposed project's method for compliance with the Noise Control Code. Below is a description of the Noise Code.

The New York City Noise Control Code defines "unreasonable and prohibited noise standards and decibel levels" for the City of New York. The amended Noise Control Code specifically addresses noise from circulation devices and commercial and business enterprises (see Subsection 711.1, below).

711.1. Circulation Devices §24-227

The New York City Noise Control Code stipulates the following noise limits that apply to "circulation devices," which include HVAC equipment, when measured inside a receiving property dwelling unit:

- A circulation device shall not create a sound level in excess of 42 dB(A);
- The cumulative sound from all circulation devices on a building shall not create a sound level in excess of 45 dB(A).

As per §24-227(a), the measurement shall be taken in a receiving property dwelling unit with the window or terrace door open at a point three feet from the open portion of the window or terrace door.

Note: If the cumulative sound from all circulation devices on a building exceed 50 dB(A), when measured inside a receiving property dwelling unit, the commissioner may order the owner or person in control of such devices to achieve a 5 dB(A) reduction in such cumulative sound level within not more than 12 months after the issuance of such order (see §24-227(c)).

711.2. Allowable Decibel Levels-Octave Band Measurement §24-232

The New York City Noise Control Code specifies maximum allowable sound pressure levels for designated octave bands emanating from a commercial or business enterprise as measured within a receiving property. These values are shown in Table 19-4.

Table 19-4
New York City Noise Control Code §24-232

Octave Band Frequency (Hz)	Maximum Sound Pressure Levels (dB) as Measured Within a Receiving Property as Specified Below	
	Residential receiving property for mixed-use building and residential buildings (as measured within any room of the residential portion of the building with windows open, if possible)	*Commercial receiving property (as measured within any room containing offices within the building with windows open, if possible)*
31.5	70	74
63	61	64
125	53	56
250	46	50
500	40	45
1000	36	41
2000	34	39
4000	33	38
8000	32	37

Source: Section §24-232 of the Administrative Code of the City of New York, as amended December 2005.

720. APPLICABLE COORDINATION

Lead agencies may need to coordinate with other agencies when developing an environmental noise assessment for a proposed project in New York City. The need for coordination depends on either the mitigation required to reduce or eliminate the significant impact or the funding sources for the project. This is discussed below in terms of city, state, and federal agencies.

721. CITY COORDINATION

The lead agency may need to coordinate with other agencies when developing mitigation measures for significantly impacted facilities under the control of those agencies. Examples of this coordination may include coordination with the Department of Education or the New York City Housing Authority for the installation of double-glazed windows and alternate means of ventilation at a school or residential building experiencing significant noise impacts from a proposed project. For technical assistance in conducting noise analyses, the lead agency may wish to coordinate with DEP.

722. STATE COORDINATION

If any part of the proposed project would involve a State-funded highway, coordination concerning analysis methodologies and significant impact thresholds with the New York State Department of Transportation (NYSDOT) is necessary. In general, NYSDOT follows the guidelines of the FHWA. Otherwise, no coordination with State agencies on noise issues is necessary.

723. FEDERAL COORDINATION

If any part of the proposed project would be financially assisted by the U.S. Department of Housing and Urban Development (HUD), analysis methodologies, significant impact thresholds, and reporting of noise information should be in accordance with HUD noise regulations or in a form acceptable to HUD officials. If any part of the proposed project would involve a federally-funded highway, coordination with FHWA (usually through the State) for the same items is necessary. Any part of the proposed project dealing with new aircraft or flight patterns should be coordinated with FAA. New train projects funded by the Federal Transit Administration (FTA) should be coordinated with that agency for analysis methodologies and significant impact thresholds.

730. LOCATION OF INFORMATION

If some level of environmental noise assessment is required for a proposed project, it is useful to obtain any recent data or information concerning existing noise levels in the area of the proposed project, or information concerning other development proposed in the area that could affect future noise levels. Environmental Impact Statements (EISs) for such other proposals may be available through the NYC Mayor's Office of Environmental Coordination (MOEC). Information regarding the removal of (E) Designations may be obtained from OER.