

**Appendix I:**  
**Noise Fundamentals**

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*General Effects*

Quantitative information on the effects of airborne noise on humans is well documented. If sufficiently loud, noise may adversely affect humans in several ways. For example, noise may interfere with human activities, such as sleep, speech communication, and tasks requiring concentration or coordination. It may also cause annoyance, hearing damage, and other physiological problems. Although it is possible to study these effects on humans on an average or statistical basis, it must be remembered that all the stated effects of noise vary greatly with the individual. Several noise scales and rating methods are used to quantify the effects of noise on humans. These scales and methods consider such factors as loudness, duration, time of occurrence, and changes in noise level with time.

*“A”-weighted sound level dB(A)*

Noise is typically measured in units called decibels (dB), which are 10 times the logarithm of the ratio of the sound pressure squared to a standard reference pressure squared. Because loudness is important in the assessment of the effects of noise on humans, the dependence of loudness on frequency must be taken into account in the noise scale used in environmental assessments. Frequency is the rate at which sound pressures fluctuate in a cycle over a given quantity of time, and is measured in Hertz (Hz), where 1 Hz equals 1 cycle per second. Frequency defines sound in terms of pitch components. In the measurement system, one of the simplified scales that accounts for the dependence of perceived loudness on frequency is the use of a weighting network—known as A-weighting—that simulates response of the human ear. For most noise assessments, the A-weighted sound pressure level in dBA units is used in view of its widespread recognition and its close correlation with perception. In this analysis, all measured noise levels are reported in dBA or A-weighted decibels. Common noise levels in dBA are shown in **Table I-1**.

**Table I-1  
Common Noise Levels**

Sound Source	(dBA)
Military jet, air raid siren	130
Amplified rock music	110
Jet takeoff at 500 meters	100
Freight train at 30 meters	95
Train horn at 30 meters	90
Heavy truck at 15 meters	80
Busy city street, loud shout	80
Busy traffic intersection	70
Highway traffic at 15 meters, train	70
Predominantly industrial area	60
Light car traffic at 15 meters, city or commercial areas or residential areas close to industry	60
Background noise in an office	50
Suburban areas with medium density transportation	50
Public library	40
Soft whisper at 5 meters	30
Threshold of hearing	0
<b>Note:</b>	A 10 dBA increase in level appears to double the loudness, and a 10 dBA decrease halves the apparent loudness.
<b>Source:</b>	Cowan, James P. Handbook of Environmental Acoustics. Van Nostrand Reinhold. New York. 1994. Egan, M. David. Architectural Acoustics. McGraw-Hill Book Company, 1988.

*Community Response To Changes In Noise Levels*

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

**Table I-2**  
**Average Ability to Perceive Changes in Noise Levels**

Change (dBA)	Human Perception of Sound
2-3	Barely perceptible
5	Readily noticeable
10	A doubling or halving of the loudness of sound
20	A "dramatic change"
40	Difference between a faintly audible sound and a very loud sound
<b>Sources:</b> Bolt Beranek and Neuman, Inc., <i>Fundamentals and Abatement of Highway traffic Noise</i> , Report No. PB-222-703. Prepared for Federal Highway Administration, June 1973.	

*Noise Descriptors Used In Impact Assessment*

Because the sound pressure level unit of dBA describes a noise level at just one moment and very few noises are constant, other ways of describing noise over extended periods have been developed. One way of describing fluctuating sound is to describe the fluctuating noise heard over a specific time period as if it had been a steady, unchanging sound. For this condition, a descriptor called the "equivalent sound level,"  $L_{eq}$ , can be computed.  $L_{eq}$  is the constant sound level that, in a given situation and time period (e.g., 1 hour, denoted by  $L_{eq(1)}$ , or 24 hours, denoted as  $L_{eq(24)}$ ), conveys the same sound energy as the actual time-varying sound. Statistical sound level descriptors such as  $L_1$ ,  $L_{10}$ ,  $L_{50}$ ,  $L_{90}$ , and  $L_x$ , are used to indicate noise levels that are exceeded 1, 10, 50, 90 and x percent of the time, respectively. Discrete event peak levels are given as  $L_1$  levels.  $L_{eq}$  is used in the prediction of future noise levels, by adding the contributions from new sources of noise (i.e., increases in traffic volumes) to the existing levels and in relating annoyance to increases in noise levels. The relationship between  $L_{eq}$  and levels of exceedance is worth noting. Because  $L_{eq}$  is defined in energy rather than straight numerical terms, it is not simply related to the levels of exceedance. If the noise fluctuates very little,  $L_{eq}$  would approximate  $L_{50}$  or the median level. If the noise fluctuates broadly, the  $L_{eq}$  would be approximately equal to the  $L_{10}$  value. If extreme fluctuations are present, the  $L_{eq}$  would exceed  $L_{90}$  or the background level by 10 or more decibels. Thus the relationship between  $L_{eq}$  and the levels of exceedance would depend on the character of the noise. In community noise measurements, it has been observed that the  $L_{eq}$  is generally between  $L_{10}$  and  $L_{50}$ . The relationship between  $L_{eq}$  and exceedance levels has been used in this analysis to characterize the noise sources and to determine the nature and extent of their impact at all receptor locations.

For the purposes of this analysis, the maximum one-hour equivalent sound level ( $L_{eq(1)}$ ) has been selected as the noise descriptor to be used in the noise impact evaluation. The  $L_{eq(1)}$  is the noise descriptor recommended by the New York State Department of Environmental Conservation (NYSDEC) for noise impact evaluation, and is used to provide an indication of highest expected sound levels.

### *Noise Standards and Impact Criteria*

The following section describes New York State noise impact criteria. These criteria provide the basis upon which commonly-used threshold values for SEQRA analyses are established.

#### *New York State Department of Environmental Conservation*

NYSDEC has published a policy and guidance document, *Assessing and Mitigating Noise Impacts* (DEP-00-1, February 2, 2001), which presents noise impact assessment methods, identifies thresholds for significant impacts, and discusses potential avoidance and mitigated measures to reduce or eliminate noise impacts.<sup>1</sup>

NYSDEC's guidance document sets forth thresholds that can be used in determining whether a noise increase due to a project may constitute a significant adverse impact, noting that these thresholds should be viewed as guidelines subject to adjustment as appropriate for the specific circumstances. According to DEP-00-1:

- Increases in noise ranging from 0 to 3 dBA should have no appreciable effect on receptors;
- Increases of 3 to 6 dBA may have the potential for adverse impacts only in cases where the most sensitive of receptors (e.g., hospital or school) are present;
- Increases of more than 6 dBA may require a closer analysis of impact potential depending on existing noise levels and the character of surrounding land use and receptors; and
- Increases of 10 dBA or greater deserve consideration of avoidance and mitigation measures in most cases.

The guidance document also sets forth noise thresholds that can be used in identifying whether a noise level due to a project should be considered a significant adverse impact. According to the guidance, the addition of any noise source in a non-industrial setting should not raise the ambient noise level above a maximum of 65 dBA, and ambient noise levels in industrial or commercial areas may exceed 65 dBA with a high end of approximately 79 dBA. As set forth in the guidance, projects that exceed these levels should explore the feasibility of implementing mitigation.

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<sup>1</sup> [http://www.dec.ny.gov/docs/permits\\_ej\\_operations\\_pdf/noise2000.pdf](http://www.dec.ny.gov/docs/permits_ej_operations_pdf/noise2000.pdf).