A. INTRODUCTION

The principal impacts of the proposed school on ambient noise levels would result from the increased vehicular traffic generated by the proposed school. The following section examines the potential for impacts from this source.

NOISE FUNDAMENTALS

Quantitative information on the effects of airborne noise on people is well documented. If sufficiently loud, noise may adversely affect people 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 people on an average or statistical basis, it must be remembered that all the stated effects of noise on people vary greatly with the individual. Several noise scales and rating methods are used to quantify the effects of noise on people. These scales and methods consider such factors as loudness, duration, time of occurrence, and changes in noise level with time.

"A"-WEIGHTED SOUND LEVEL (dBA)

Noise is typically measured in units called decibels (dB), which are ten 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 people, 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. One of the simplified scales that accounts for the dependence of perceived loudness on frequency is the use of a weighting network—know as A-weighting—in the measurement system, to simulate response of the human ear. For most noise assessments the A-weighted sound pressure level in units of dBA 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 9-1.

COMMUNITY RESPONSE TO CHANGES IN NOISE LEVELS

The average ability of an individual to perceive changes in noise levels is well documented (see Table 9-2). 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 9-1
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	
Busy city street, loud shout	80
Busy traffic intersection	
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	
Background noise in an office	50
Suburban areas with medium density transportation	
Public library	40
Soft whisper at 5 meters	30
Threshold of hearing	0

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

Source: Cowan, James P. Handbook of Environmental Acoustics. Van Nostrand Reinhold, New York, 1994.

Egan, M. David, Architectural Acoustics. McGraw-Hill Book Company, 1988.

Table 9-2
Average Ability to Perceive Changes in Noise Levels

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

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

It is also possible to characterize the effects of noise on people by studying the aggregate response of people in communities. The rating method used for this purpose is based on a statistical analysis of the fluctuations in noise levels in a community, and integrates the fluctuating sound energy over a known period of time, most typically during 1 hour or 24 hours. Various government and research institutions have proposed criteria that attempt to relate changes in noise levels to community response. One commonly applied criterion for estimating this response is incorporated into the community response scale proposed by the International Standards Organization (ISO) of the United Nations (see Table 9-3). This scale relates changes in noise level to the degree of community response and permits direct estimation of the probable response of a community to a predicted change in noise level.

Table 9-3
Community Response to Increases in Noise Levels

Change (dBA)	Category	Description
0	None	No observed reaction
5	Little	Sporadic complaints
10	Medium	Widespread complaints
15	Strong	Threats of community action
20	Very strong	Vigorous community action

Source: International Standards Organization, Noise Assessment with Respect to Community Responses, ISO/TC 43 (New York: United Nations, November 1969).

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 sometimes 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_{01} 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} will approximate L_{50} or the median level. If the noise fluctuates broadly, the L_{eq} will be approximately equal to the L_{10} value. If extreme fluctuations are present, the L_{eq} will exceed L_{90} or the background level by 10 or more decibels. Thus the relationship between L_{eq} and the levels of exceedance will depend on the character of the noise. In community noise measurements, it has been observed that the L_{eq} is generally between L_{10} and L_{50}. 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 project, the maximum 1-hour equivalent sound level ($L_{eq(1)}$) has been selected as the noise descriptor to be used in the noise impact evaluation. $L_{eq(1)}$ is the noise descriptor used in the City Environmental Quality Review (CEQR) standards for vehicular traffic noise impact evaluation, and is used to provide an indication of highest expected sound levels. $L_{10(1)}$ is the noise descriptor used in the CEPO-CEQR noise exposure standards for vehicular traffic noise. Hourly statistical noise levels (particularly L_{10} and L_{eq} levels) were used to characterize the relevant noise sources and their relative importance at each receptor location.

B. NOISE STANDARDS AND CRITERIA

NEW YORK CITY NOISE CODE

The New York City Noise Control Code promulgates sound-level standards for motor vehicles, air compressors, and paving breakers, requires that all exhausts be muffled, and prohibits all unnecessary noise adjacent to schools, hospitals, or courts. The code further limits construction activities to weekdays between 7 AM and 6 PM.

This Code contains ambient noise quality criteria and standards based on existing land use zoning designations. Table 9-4 summarizes the ambient noise quality criteria contained in the Noise Code. Conformance with the noise level values contained in the Code is determined by considering noise emitted directly from stationary activities within the boundaries of a project. The noise levels generated in playgrounds from play and recess activities would be subject to the Ambient Noise Quality Criteria.

Table 9-4
City of New York
Ambient Noise Quality Zone Criteria (dBA)

Ambient Noise Quality Zone (ANQZ)	Daytime Standards* (7 AM-10PM)	Nighttime Standards* (10 PM-7AM)
Noise quality zone N-1 (Low density residential R_L; land-use zones R-1 to R-3)	60	50
Noise quality zone N-2 (High density residential R_H; land-use zones R-4 to R-10)	65	55
Noise quality zone N-3 (All commercial and manufacturing land-use zones)	70	70

Note:
* Leq(1 hour).
Source: City of New York Local Law No. 64.

NEW YORK CEQR NOISE STANDARDS

The New York City Department of Environmental Protection (NYCDEP) has set external noise exposure standards. These standards are shown in Table 9-5 and 9-6. Noise Exposure is classified into four categories: acceptable, marginally acceptable, marginally unacceptable, and clearly unacceptable. The standards shown are based on maintaining an interior noise level for the worst-case hour L_{10} less than or equal to 45 dBA. Mitigation requirements are shown in Table 9-6.

Table 9-5
CEQR Noise Exposure Guidelines
For Use in City Environmental Impact Review

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	---------- $L_{dn} \le 60$ dBA ----------						
2. Hospital, Nursing Home		$L_{10} \le 55$ dBA		$55 < L_{10} \le 65$ dBA	---------- $60 < L_{dn} \le 65$ dBA ----------	$65 < L_{10} \le 80$ dBA	(1) $65 < L_{dn} \le 70$ dBA, (II) $70 \le L_{dn}$	$L_{10} > 80$ dBA	---------- $L_{dn} \le 75$ 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 not increase the ambient noise level by 3 dBA or more.

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 an 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 old-age homes.

3 One may use the FAA-approved L_{dn} contours supplied by the Port Authority, or the noise contours may be computed from the federally approved INM Computer Model using flight data supplied by the Port Authority of New York and New Jersey.

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 octave band standards).

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

Table 9-6
Required Attenuation Values to Achieve Acceptable Interior Noise Levels

	Marginally Acceptable	Marginally Unacceptable		Clearly Unacceptable		
Noise Level With Proposed Action	$65 < L_{10} \le 70$	$70 < L_{10} \le 75$	$75 < L_{10} \le 80$	$80 < L_{10} \le 85$	$85 < L_{10} \le 90$	$90 < L_{10} \le 95$
Attenuation*	25 dB(A)	(I) 30 dB(A)	(II) 35 dB(A)	(I) 40 dB(A)	(II) 45 dB(A)	(III) 50 dB(A)

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

Source: New York City Department of Environmental Protection

In addition, the *CEQR Technical Manual* uses the following criteria to determine whether a proposed project would result in a significant adverse noise impact. The impact assessments compare the proposed project's Build condition $L_{eq(1)}$ noise levels to those calculated for the No Action condition, for receptors potentially affected by the project.

If the No Action levels are less than 60 dBA $L_{eq(1)}$ and the analysis period is not a nighttime period, the threshold for a significant impact would be an increase of at least 5 dBA $L_{eq(1)}$. For the 5 dBA threshold to be valid, the resultant Build condition noise level would have to be equal to or less than 65 dBA. If the No Action noise level is equal to or greater than 62 dBA $L_{eq(1)}$, or if the analysis period is a nighttime period (defined in the CEQR standards as being between 10 PM and 7 AM), the incremental significant impact threshold would be 3 dBA $L_{eq(1)}$. (If the No Action noise level is 61 dBA $L_{eq(1)}$, the maximum incremental increase would be 4 dBA, since an increase higher than this would result in a noise level higher than the 65 dBA $L_{eq(1)}$ threshold.)

IMPACT DEFINITION

For purposes of impact assessment, this report will utilize a relative noise impact criterion which considers project-related increases in $L_{eq(1)}$ noise levels over future conditions without the project of greater than 5.0 dBA as significant impacts. The 5.0 dBA relative criteria is consistent with increases in noise levels that the public considers noticeable and likely to result in complaints. The $L_{eq(1)}$ descriptor is used in this document to quantify and describe both playground and traffic noise. In this way, the different noise sources can be combined to produce a total predicted noise level. This criterion will be used in this document for the purposes of identifying noise impacts.

C. EXISTING CONDITIONS

SITE DESCRIPTION

The proposed project is located on the southeast corner at the intersection of Adams and Johnson Streets. Adams Street is a major feeder roadway to and from the Brooklyn Bridge. The project site is located in Downtown Brooklyn.

The project site is located within a C5-4 zone or an N3 Ambient Noise Quality Zone (ANQZ). $L_{eq(1)}$ noise level limits for this type of zone are 70 dBA for daytime (7 AM to 10 PM) and 70 dBA for nighttime (10 PM to 7 AM) hours.

SELECTION OF NOISE RECEPTOR LOCATION.S

Two (2) noise receptor locations on the streets adjacent to the school site were chosen for 20-minute monitoring. Site 1 was located on Adams Street between Joralemon and Johnson Streets, and Site 2 was located on Johnson Street between Adams and Jay Streets (see Figure 9-1).

NOISE MONITORING

Noise monitoring at the two receptor locations was performed on Tuesday, September 27th, 2005. At each of the sites 20-minute measurements were made during two time periods that reflect the school's AM (8 to 9 AM) and PM (3 to 4 PM) peaks.

EQUIPMENT USED DURING NOISE MONITORING

The instrumentation used for the 20-minute noise measurements was a Brüel & Kjær Type 4176 ½-inch microphone connected to a Brüel & Kjær Model 2260 Type 1 (according to ANSI Standard S1.4-1983) sound level meter. This assembly was mounted at a height of 5 feet above the ground surface on a tripod and at least 6 feet away from any large sound-reflecting surface to avoid major interference with sound propagation. The meter was calibrated before and after readings with a Brüel & Kjær Type 4231 sound-level calibrator using the appropriate adaptor. Measurements at each location were made on the A-scale (dBA). The data were digitally recorded by the sound level meter and displayed at the end of the measurement period in units of dBA. Measured quantities included L_{eq}, L_1, L_{10}, L_{50}, and L_{90}. A windscreen was used during all sound measurements except for calibration. Only noise from typical noise sources was measured; noise from intermittent and atypical sources (e.g. emergency sirens, aircraft flyovers, etc.) was excluded from the measured noise levels. Weather conditions were noted to ensure a true reading as followed: wind speed under 12 mph; relative humidity under 90 percent; and temperature above 14°F and below 122°F. All measurement procedures conformed with the requirements of ANSI Standard S1.13-1971 (R1976).

RESULTS OF BASELINE MEASUREMENTS

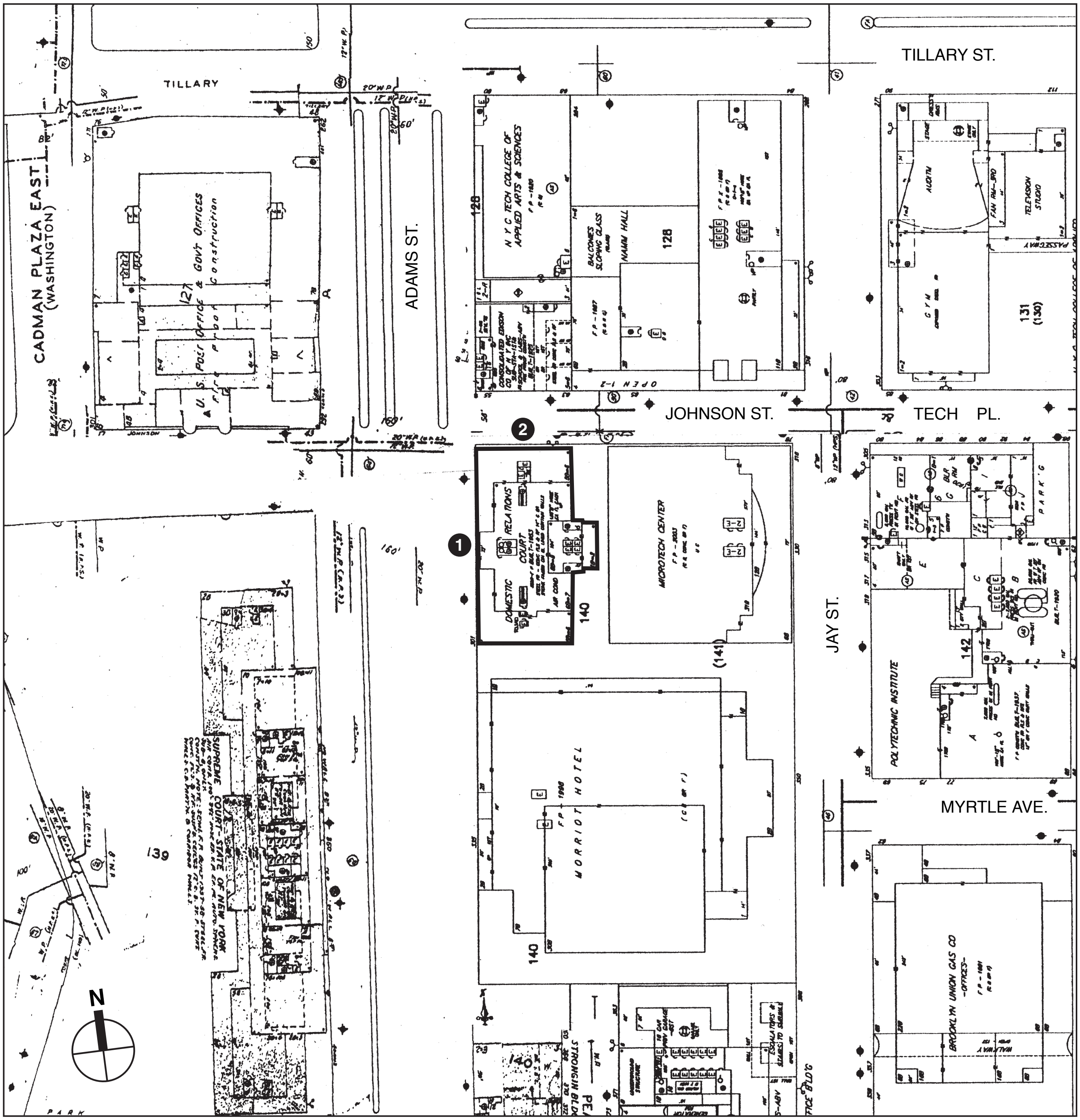
Noise monitoring results for the two measurement locations are summarized in Table 9-7. At all of the locations, traffic noise was the dominant noise source.

Table 9-7
Existing Noise Levels at Sites 1 and 2
(in dBA)

Site	Measurement Location	Time	L_{eq}	L_1	L_{10}	L_{50}	L_{90}
1	Adams Street between Joralemon and Johnson Streets	AM	70.9	79.4	74.0	68.0	63.4
		PM	70.0	78.8	73.0	67.0	63.6
2	Johnson Street between Adams and Jay Streets	AM	68.1	77.0	69.4	66.6	64.2
		PM	68.8	77.8	70.6	66.4	63.6

Note: Field measurements were performed by AKRF, Inc. on September 27, 2005.

12.13.05



Project Site Boundary

Noise Receptor Location

0 100 200 FEET

SCALE

Noise Receptor Locations

Figure 9-1

At all monitoring sites, traffic noise was the dominant noise source. Measured noise levels are moderate to relatively high and reflect the relatively high level of vehicular activity on the adjacent streets. In terms of the CEQR criteria, the existing noise levels at both Site 1 and at Site 2 are in the “marginally unacceptable” category.

D. IMPACT ANALYSIS

An assessment was made to determine whether project-generated traffic would have the potential for causing a significant increase in noise levels. Proportional modeling techniques were used for this assessment. Using this methodology the prediction of future noise levels is based on a calculation using measured existing noise levels and predicted changed in traffic volumes. The proportional model is consistent with the methodology described in the New York City *CEQR Technical Manual* for mobile source analysis. Using this technique, the prediction of future noise levels is based on a calculation using measured existing noise levels and predicted changes in traffic volumes to determine both future No Build and Build levels.

Future Build traffic volumes were obtained by adding project-generated traffic values to No Build conditions. Using this methodology, vehicular traffic volumes were converted into Passenger Car Equivalent (PCE) values, for which one medium-duty truck (having a gross weight between 9,900 and 26,400 pounds) is assumed to generate the noise equivalent of 13 cars, one bus is assumed to generate the noise equivalent of 18 cars, and one heavy-duty truck (having a gross weight of more than 26,400 pounds) is assumed to generate the noise equivalent of 47 cars. Future noise levels are calculated using the following equation:

$$F\ NL - E\ NL = 10 * \log_{10} (F\ PCE / E\ PCE)$$

where:

F NL = Future Noise Level

E NL = Existing Noise Level

F PCE = Future PCEs

E PCE = Existing PCEs

Sound levels are measured in decibels and therefore increase logarithmically with sound source strength (in this case, the sound source is traffic volumes measured in PCEs). For example, if the existing traffic volume on a street is 100 PCEs and if the future traffic volume were increased by 50 PCEs to a total of 150 PCEs, the noise level would increase by 1.8 dBA. If the future traffic were increased by 100 PCEs, or doubled to a total of 200 PCEs, the noise level would increase by 3.0 dBA.

Based upon this methodology, in order to have a significant increase in noise level (i.e., an increase in noise level of greater than 5 dBA) the project would have to generate sufficient traffic to cause more than a tripling in traffic volumes compared to future No Build values. As shown in Chapter 6, “Traffic and Parking,” traffic on the streets in the project area is relatively high and the proposed school would result in only a modest increase in traffic. This modest increase in traffic is well below the levels that would be needed to result in any significant increases in noise level. The resultant increase in noise level would be less than 1.8 dBA. Changes of this magnitude would not be perceptible. Therefore, the proposed project would not result in any significant adverse noise increases.

SCHOOL INTERIOR NOISE LEVELS

The maximum exterior $L_{eq(1)}$ noise levels adjacent to the school site are in the low 70 dBA range. To achieve desirable interior noise levels of 45 dBA or below, the building design would include double-glazed windows achieving at least 35 dBA window/wall attenuation. An alternate means of ventilation, such as centralized air-conditioning, will be incorporated in the school design as part of its construction. With these noise attenuation measures, noises levels within the school buildings would be expected to be sufficiently low so that exterior vehicular activity should not result in noise levels that are disturbing to classroom activity. ✷