A. INTRODUCTION

Noise pollution in an urban area comes from many sources. Some are activities essential to the health, safety, and welfare of the city's inhabitants, such as noise from emergency vehicle sirens, garbage collection operations, and construction and maintenance equipment. Other sources, such as traffic, stem from the movement of people and goods, activities that are essential to the viability of the city as a place to live and do business. Although these and other noise-producing activities are necessary to a city, the noise they produce is undesirable. Urban noise detracts from the quality of the living environment and there is increasing evidence that excessive noise represents a threat to public health.

The proposed project will not result in any additional traffic increases in the study area. Therefore, the proposed project will not result in an exceedance of the CEQR thresholds, and no further analysis of noise impacts from mobile sources are warranted.

With the proposed project, a noise analysis for the operation of new mechanical equipment has been conducted to verify whether the project will result in increases in ambient noise levels near the North River Wastewater Treatment Plant (the Plant). This analysis examines the impacts of these stationary noise sources and the change in noise levels at sensitive receptor locations where maximum increases in noise levels would be expected to occur as a result of mechanical equipment operation.

B. METHODOLOGY

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.

NOISE MEASUREMENT

A number of factors affect sound, as it is perceived by the human ear. These include the actual level of the sound (or noise), the frequencies involved, the period of exposure to the noise, and changes or fluctuations in the noise levels during exposure. Levels of noise are measured in units called decibels (dB). Since the human ear cannot perceive all pitches or frequencies equally

well, these measures are adjusted or weighted to correspond to human hearing. A measurement system that simulates the response of the human ear, the "A-weighted sound level" or "dBA," is used in view of its widespread recognition and its close correlation with human judgment of loudness and annoyance. In the current study, all measured levels are reported in dBA or A-weighted decibels. Sound levels for typical daily activities are shown in **Table E-1**.

Table E-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.

Although sound levels from a sound level meter are generally given in dBA, measurements are sometimes made in octave band format. An octave band is one of a series of bands that cover the normal range of frequencies included in sound measurements. Such octave bands serve to define the sound in term of its pitch components. Octave band levels are "unweighted" levels corresponding to the overall acoustical energy in the corresponding octave band.

RESPONSE TO CHANGES IN NOISE LEVELS

The average ability of an individual to perceive changes in noise levels is well documented (see **Table E-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 E-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 E-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 E-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

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

STATISTICAL NOISE LEVELS

Since dBA describes a noise level at just one moment and very few noises are constant, other ways of describing noise over extended periods are needed. 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, $L_{eq(1)}$, or 24 hours, $L_{eq(24)}$, 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_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 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 the current studies to characterize the noise sources and to determine the nature and extent of their impact at all receptor locations.

NOISE DESCRIPTORS USED IN IMPACT ASSESSMENT

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. Hourly statistical noise levels were used to characterize the relevant noise sources and their relative importance at each receptor location.

NOISE STANDARDS AND CRITERIA

NEW YORK CEQR NOISE CRITERIA

The New York City Department of Environmental Protection (DEP) has set external noise exposure standards. These standards are shown in **Table E-4**. 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.

In addition, the *2012 CEQR Technical Manual* compares the proposed project's With-Action condition $L_{eq(1)}$ noise levels to those calculated for the No-Action condition, for receptors potentially affected by the project using the following criteria to determine whether a proposed project would result in a significant adverse noise impact:

- An increase of 5 dBA, or more, in With-Action $L_{eq(1)}$ noise levels at sensitive receptors (including residences, play areas, parks, schools, libraries, and houses of worship) over those calculated for the No-Action condition, if the No-Action levels are less than or equal to 60 dBA $L_{eq(1)}$ and the analysis period is not a nighttime period.
- An increase in With-Action $L_{eq(1)}$ noise levels at sensitive receptors of such that the total Build $L_{eq(1)}$ noise levels would be 65 dBA or greater, if the No-Action levels are between 60 and 62 dBA $L_{eq(1)}$ and the analysis period is not a nighttime period.
- An increase of 3 dBA, or more, in With-Action $L_{eq(1)}$ noise levels at sensitive receptors over those calculated for the No-Action condition, if the No-Action levels are greater than or equal to 62 dBA $L_{eq(1)}$ and the analysis period is not a nighttime period.
- An increase of 3 dBA, or more, in With-Action $L_{eq(1)}$ noise levels at sensitive receptors over those calculated for the No-Action condition, if the analysis period is a nighttime period (defined by the *CEQR Technical Manual* criteria as being between 10 PM and 7 AM).

Table E-4
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]		$L_{10} \leq 55$ dBA	---- Ldn ≤ 60 dBA ----		---- 60 < Ldn ≤ 65 dBA ----		(1) 65 < Ldn ≤ 70 dBA, (II) 70 ≤ Ldn		---------- Ldn ≤ 75 dBA ----------
2. Hospital, Nursing Home		$L_{10} \leq 55$ dBA		55 < $L_{10} \leq 65$ dBA		65 < $L_{10} \leq 80$ dBA		$L_{10} > 80$ dBA	
3. Residence, residential hotel or motel	7 AM to 10 PM	$L_{10} \leq 65$ dBA		65 < $L_{10} \leq 70$ dBA		70 < $L_{10} \leq 80$ dBA		$L_{10} > 80$ dBA	
	10 PM to 7 AM	$L_{10} \leq 55$ dBA		55 < $L_{10} \leq 70$ dBA		70 < $L_{10} \leq 80$ 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).

NEW YORK CITY NOISE CODE

The revised New York City Noise Control Code became effective July 1, 2007. It contains sound-level standards for motor vehicles, circulation equipment, air compressors, and paving breakers (e.g., jackhammers), requires that all exhausts be muffled, and prohibits all unnecessary noise adjacent to schools, hospitals, or courts. The revised Noise Control Code requires noise mitigation plans for construction work (consistent with the guidance set by DEP), and additional noise mitigation measures will be required when work does not occur on weekdays between 7 AM and 6 PM.

This Code contains ambient noise quality zones that are based on land use zoning designations. **Table E-5** 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. Construction activities and noise sources outside the boundaries of a project are not included within the provisions of this law.

Table E-5
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) dBA.
Source: Section §24-243 of the administrative Code of the City of New York.

IMPACT DEFINITION

For purposes of impact assessment, the proposed project will have a significant noise impact if the *CEQR Technical Manual* relative noise criteria are exceeded or if noise levels due to plant operation (i.e., the total noise generated by mechanical equipment) exceed noise levels specified in the City of New York Noise Control Code.

PREDICTION OF STATIONARY NOISE SOURCES

The plant will replace all ten (10) of the existing tri-fuel pump and blower engines with five (5) new engine generators. Four of the five generators would operate simultaneously. Noise from the generators and the associated stacks will increase ambient noise levels in the study area. No specific manufacturer of the new engines has been selected; however, engines from GE or similar engines are being considered. Based upon the design octave band sound pressure levels provided by GE (refer to **Noise Appendix E-1)**, the maximum noise levels would be 105 dBA (single generator) and 112 dBA for 4 generators operating simultaneously at a distance of 3 feet from the generators. With specific exhaust silencers, the maximum sound pressure levels would be 88 dBA (single stack) and 94 dBA for 4 stacks operating simultaneously at a distance of 3 feet from the stacks. The discharge of the stacks is approximately 107 feet above the park ground level. Predicted noise levels due to the new equipment operation at noise-sensitive receptor sites were calculated using the following formula:

$L_p = L_{p(1)} - A_{div} - A_{screen} - A_{TL}$

where:

$L_{p(1)}$ is the equipment source sound pressure level at 3 feet;

A_{div} is the attenuation due to geometrical divergence;

A_{screen} is the attenuation due to screening; and

A_{TL} is the attenuation due to sound transmission loss due to building partition (for generators located inside the Plant).

Noise levels were calculated at receptors due to effects on distance, shielding, and sound transmission loss, ignoring absorptions due to ground, air, foliage, etc. It is noted that this method results in a conservative estimation of the noise environment in open-space areas.

C. EXISTING CONDITIONS

SITE DESCRIPTION

The Plant site is located on the upper west side of Manhattan adjacent to the Hudson River. The site is zoned M1-1, and is within an N3 Ambient Noise Quality Zone (ANQZ). $L_{eq(1)}$ noise levels 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. Traffic is the dominant noise source.

SELECTION OF NOISE RECEPTOR LOCATIONS

Six (6) sensitive receptor sites were selected as representative existing ambient conditions adjacent to the Plant for the noise impact analysis. Site 1 is located on Riverside Drive between W. 144th and W. 145th Streets, Site 2 is located on Riverside Drive between W. 141st and W. 142nd Streets, Sites 3, 4, and 5 are located on Riverbank State Park (the roof-top of the Plant), and Site 6 is located on open space adjacent to the Plant. In addition, one receptor site (Site A) located on the property line close to the stacks was selected to determine compliance with the City of New York Noise Control Code. All these sites are the worst-case receptor locations with regard to noise from the generators and stacks (see **Figure E-1**).

NOISE MONITORING

Existing noise levels were measured for 20-minutes at the six (6) receptor sites at the late night period from approximately 10:00 PM to 2:00 AM on June 13, 14 and 26, 2012. The plant was operating normally during the noise measurements. Two to three pump engines and two to three blower engines were in operation. At all receptor sites, noise from the plant and vehicular traffic on adjacent and nearby roadways contributed to the total ambient noise levels. The selected time periods represented the worst case to have a maximum potential for increasing ambient noise levels near the plant due to the new mechanical equipment operation.

Measurements were performed using a Brüel & Kjær Sound Level Meter (SLM) Type 2250 and Brüel & Kjær SLMs Type 2260, Brüel & Kjær ½ inch microphones Type 4189, and a Brüel & Kjær Sound Level Calibrator Type 4231. The Brüel & Kjær SLM is a Type 1 instrument according to ANSI Standard S1.4-1983 (R2006). The SLMs were calibrated within one year of use. The microphone was mounted at a height of approximately five feet above the ground surface on a tripod and mounted at least approximately five feet away from any large reflecting surfaces. The SLMs were 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 meters and displayed at the end of the measurement period in units of dBA. Measured quantities included L_{eq}, L_1, L_{10}, L_{50}, L_{90}, and 1/3 octave band levels. A windscreen was used during all sound measurements except for calibration. All measurement procedures were based on the guidelines outlined in ANSI Standard S1.13-2005.

RESULTS OF MEASUREMENTS

The measured noise levels are shown in **Table E-6**. The noise levels at each site are considered to be representative of quieter ambient noise levels near the Plant. The quieter noise levels were selected to provide a conservative assessment and identify the largest incremental change. In terms of New York City CEQR guideline levels, the noise levels at residential Sites 1 and 2 are

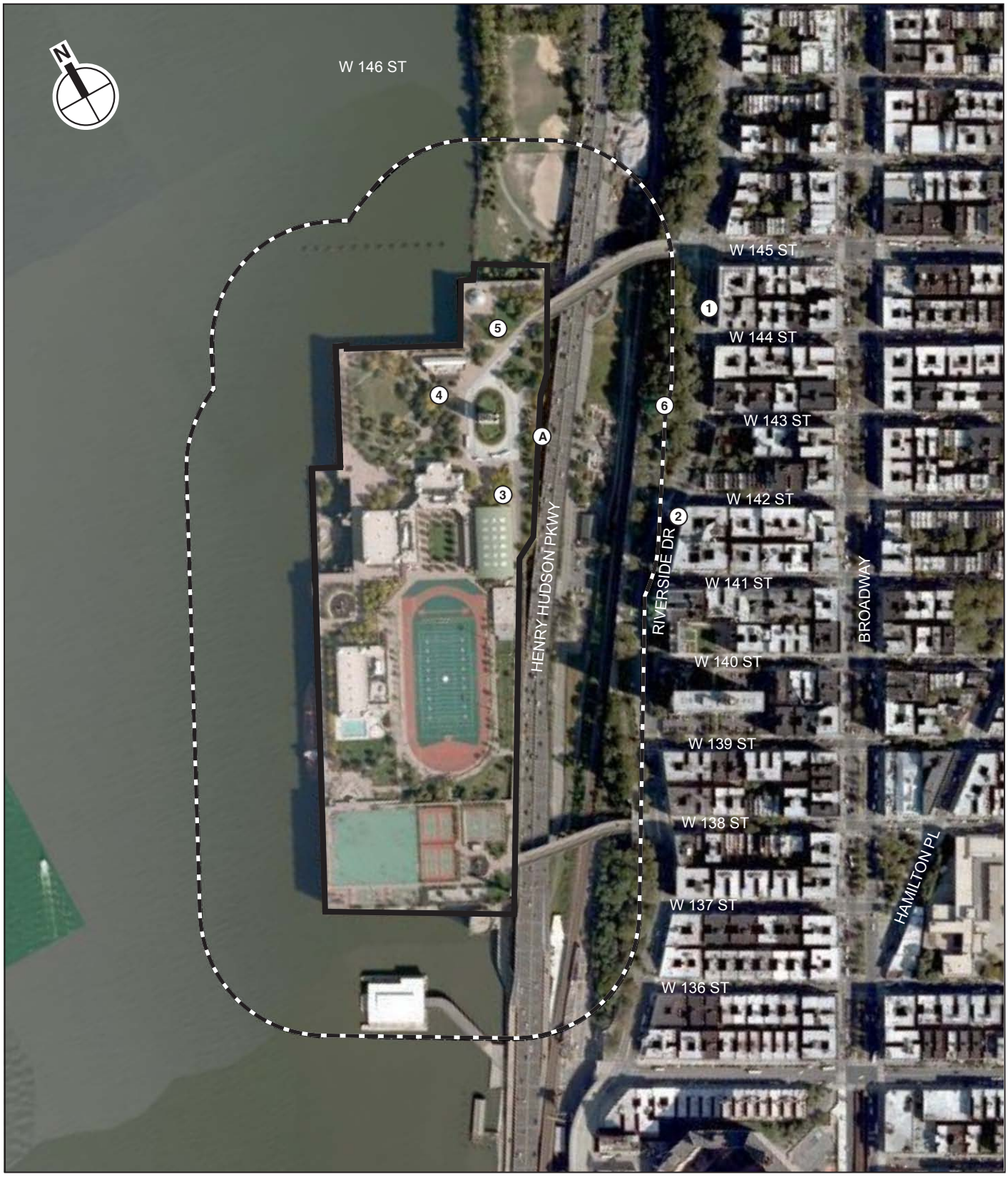

Figure E-1

NORTH RIVER Wastewater Treatment Plant

Noise Receptor Locations

considered to be in the "marginally acceptable" range, and the noise levels at open-space sites from 3 to 6 exceed the CEQR threshold for outdoor area requiring serenity and quiet uses.

Table E-6
Existing Noise Levels (in dBA)

Site	Location	Land Use	Time	L_{eq}	L_{10}
1	Riverside Drive between W. 144th and W. 145th Streets	Residential	Late Night	62.3	64.8
2	Riverside Drive between W. 141st and W. 142nd Streets	Residential	Late Night	61.5	63.0
3	Riverbank State Park	Open Space	Late Night	60.0	61.3
4	Riverbank State Park	Open Space	Late Night	54.8	55.6
5	Riverbank State Park	Open Space	Late Night	57.4	58.5
6	Riverside Drive between W. 143rd and W. 144th Streets	Open Space	Late Night	61.5	62.2
Note: Field measurements were performed by AKRF, Inc. on June 13 and 14, 2012.					

D. THE FUTURE WITHOUT THE PROPOSED PROJECT

In the future without the proposed project, the plant's existing engines and vehicular traffic on adjacent and nearby roadways are the dominant noise sources. Noise in the region is anticipated to be similar to that described for existing conditions.

E. PROBABLE IMPACTS OF THE PROPOSED PROJECT

An assessment of potential noise impacts from stationary sources for the proposed project was performed using the methodology described previously. **Table E-7** shows noise levels in the Future with the proposed project at the six (6) receptor sites. The proposed project would increase the noise level by a maximum of 2.5 dBA compared to the Future without the proposed project noise levels. Changes of this magnitude would be considered imperceptible, and they would not exceed the noise impact evaluation criteria set forth in the *CEQR Technical Manual*. In terms of New York City CEQR guideline levels, the noise levels at residential sites 1 and 2 would remain in the "marginally acceptable" range, and the noise levels at open-space sites from 3 to 6 would remain above the 55 dBA $L_{10(1)}$ noise level guideline for outdoor areas requiring serenity and quiet uses. These values are based on the predicted $L_{10(1)}$.

Table E-7
The Future With-Action Noise Levels (in dBA)

Site	Land Use	Existing & No Action $L_{eq(1)}$	Project-Generated $L_{eq(1)}$	With-Action $L_{eq(1)}$	With-Action $L_{10(1)}$	Change
1	Residential	62.3	45.7	62.4	64.9	0.1
2	Residential	61.5	46.6	61.6	63.1	0.1
3	Open Space	60.0	54.7	61.1	62.4	1.1
4	Open Space	54.8	53.7	57.3	58.1	2.5
5	Open Space	57.4	51.4	58.4	59.5	1.0
6	Open Space	61.5	48.2	61.7	62.4	0.2

At the project property line location (Site A), the maximum project-generated noise level is 57.5 dBA. This level is well below the impact threshold level (i.e., 70 dBA) of N3 Ambient Noise Quality Zone. Therefore, the proposed project would not result in significant adverse noise impacts in terms of the City of New York Noise Control Code. More information on the noise calculations is provided in the **Noise Appendix E-1**.

CONCLUSION

Based on the analyses presented above, the proposed project will not result in any predicted exceedances of the suggested incremental thresholds in the city's *CEQR Technical Manual* at nearby sensitive receptors, and will not create exceedances of the noise limits contained in the New York City Noise Code. Therefore, no predicted significant adverse noise impacts from the proposed project are predicted. ✷