RIVER RING
Chapter 13: Air Quality

A. INTRODUCTION

The Applicant, River Street Partners LLC, is proposing a series of land use actions to facilitate the redevelopment of the Proposed Development Site with mixed-use buildings and waterfront public spaces designed to promote resiliency and programmed for in-water activities, passive recreation, and educational programs for the community. The Applicant's Proposed Development consists of two mixed-use towers and waterfront public spaces located on a zoning lot to be comprised of Block 2355, Lots 1 and 20; Block 2361, Lots 1, 20, and 21; Block 2376, Lot 50; and portions of Metropolitan Avenue and North 1st Street (collectively known as the "Proposed Development Site"). The Project Area also includes two non-Applicant owned blocks to the east of the Proposed Development Site (Blocks 2356 and 2362).

The Applicant's Proposed Development would include two high-rise buildings – the North Tower and South Tower. For CEQR purposes, it is also assumed that the Proposed Actions would result in the redevelopment of a Projected Development Site. The Projected Development Site is a non-~~a~~Applicant site located at 230 Kent Avenue (Block 2362 Lot 1).

The location of the Project Area, including an aerial view, is shown in **Figures 13-1** and **13-2**. Based on the current design, the South Tower of the Proposed Development will have a maximum building height of 710 feet. The North Tower of the Proposed Development will have a maximum building height of 560 feet.

Each building will have its own heating, ventilation, and air conditioning (HVAC) system that will fire natural gas. The HVAC systems of both the South and North towers will use co-generation units with supplemental boilers and duct burners; the non-applicant site will use a traditional gas-fired HVAC system.

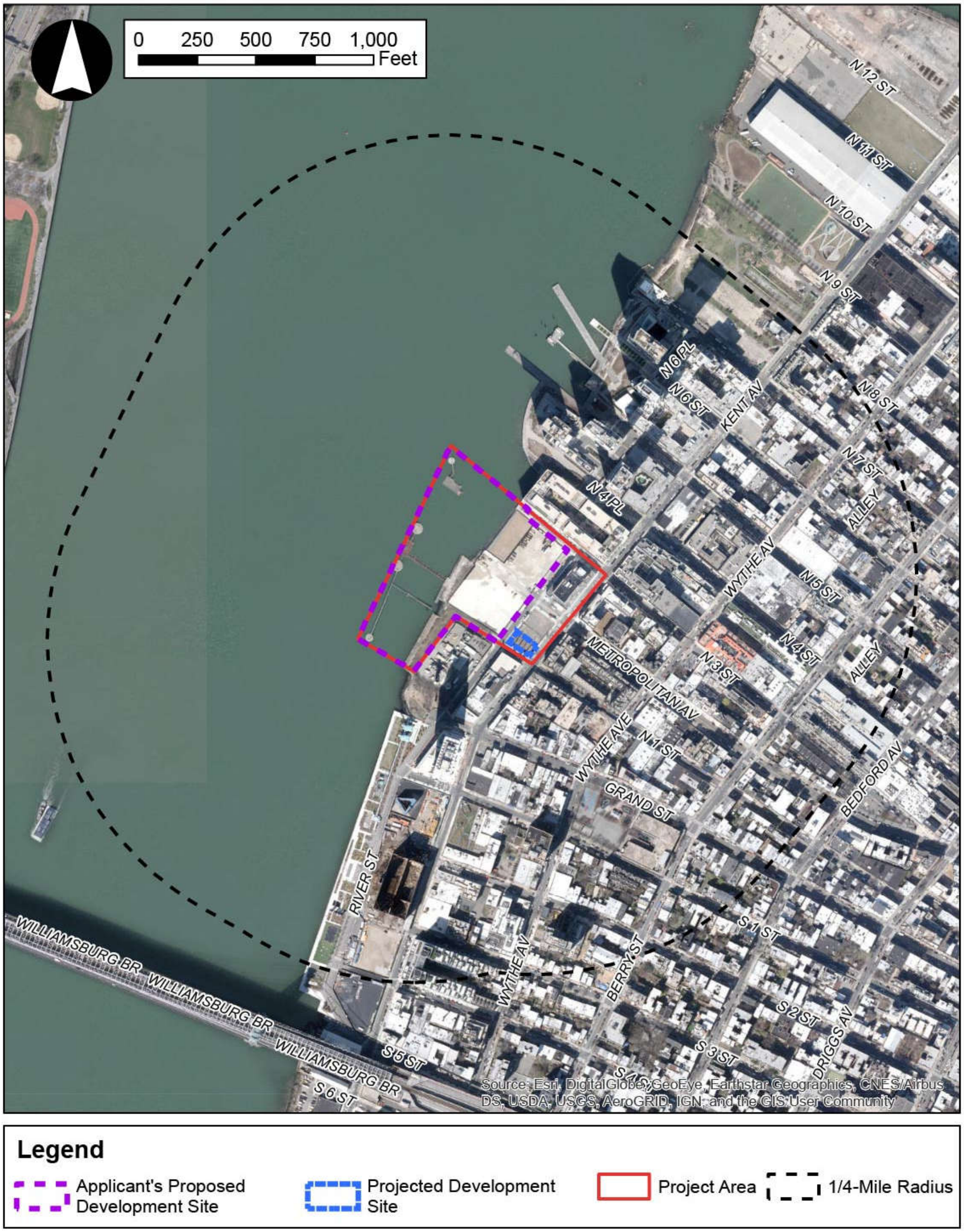
Air quality, which is a general term used to describe pollutant levels in the atmosphere, will be affected by the proposed development. Potential air quality impacts were estimated following the procedures and methodologies prescribed in the *New York City Environmental Quality Review (CEQR) Technical Manual*.

The following air quality issues are considered in this analysis:

- The Proposed Development is located near (i.e., within 1,000 feet of) the New York Power Authority's (NYPA) 1st Street Power Plant (see **Figure 13-2**). The combustion emissions of this plant could affect the proposed towers as well as the Projected Development Site.
- The potential of the HVAC emissions of one tower to significantly impact the other tower (project-on-project impacts). Emissions from the North Tower, as the shorter building, could potentially impact the taller South Tower.
- The potential of the HVAC emissions from development at the Projected Development Site to impact South and North Towers (project-on-project impacts) as well as nearby taller existing buildings (project-on-existing impacts).

Figure 13-1
Project Location

Figure 13-2
Project Location – Aerial View



- The potential impacts of the emission generated by the vehicles using the on-site parking garage of the Proposed Development.
- The potential of toxic air emissions generated by nearby (i.e., within 400 feet of the Project Area) existing industrial sources to significantly impact the proposed and projected developments.

As presented in Chapter 12, "Transportation," compared to the reasonable worst-case development scenario (RWCDS) for No-Action conditions, the Proposed Actions would result in a net increase of approximately 33 and three trips in the weekday AM and Saturday peak hours, respectively, and net decreases of 29 and eight vehicle trips in the weekday midday and PM peak hours, respectively. As such, the Proposed Actions would not exceed the *City Environmental Quality Review (CEQR) Technical Manual* carbon monoxide (CO) screening threshold of 170 peak-hour vehicle trips at any intersection in the study area, nor would it exceed the particulate matter (PM) emission screening threshold discussed in Chapter 17, Sections 210 and 311 of the *CEQR Technical Manual*. Therefore, a quantified assessment of the potential impacts of emissions from traffic generated by the RWCDS is not warranted.

B. PRINCIPAL CONCLUSIONS

Detailed analyses were conducted based on the methodology set forth in the *CEQR Technical Manual*, and determined that the Proposed Actions would not have a significant adverse impact on related to air quality.

NYPA Analysis

NYPA stack emissions would not cause exceedances against *National Ambient Air Quality Standards (NAAQS)*. Therefore, emissions from the NYPA power plant stack would not significantly impact the Proposed Development or development at the Projected Development Site.

Project-on-Project HVAC Analysis

Emissions from the HVAC system of the shorter North Tower on the Applicant's Proposed Development Site would not significantly impact the taller South Tower. Based on results of the project-on-project HVAC analysis, the exhaust stacks on the roof of the North Tower can be located anywhere on the North Tower roof. In addition, emissions from the Projected Development's HVAC system would not significantly impact either the Applicant's Proposed Development or nearby existing land uses. In order to avoid any potential significant adverse air quality impacts, an (E) designation (E-636) would be placed on the Applicant's Proposed Development Site that would require the use of natural gas for the HVAC system, restrict the heating plant's capacity, and limit NOx emissions from both the co-generation units and boilers for the North Tower. Similarly, in order to avoid any potential significant adverse air quality impacts, an (E) designation would also be placed on the Projected Development Site that would require the use of natural gas for the HVAC system.

Project-on-Existing HVAC Analysis

As the towers comprising the Proposed Development would be taller than any nearby buildings, the HVAC emissions of these towers would not significantly impact nearby existing land uses. In addition, HVAC emissions from the Projected Development would not significantly impact existing taller buildings located within 400 feet of the Projected Development Site.

Garage Analysis

Emissions from vehicles using the Proposed Development's garage – together with on-street mobile source emissions -- would not result in any significant adverse air quality impact. The maximum estimated CO impacts would be less than the *CEQR* de minimis criteria; the 24-hour $PM_{2.5}$ impacts would be less than the significant impact criteria; and the maximum estimated total 8-hour CO and 24-hour total $PM_{2.5}$ concentrations would be less than the applicable NAAQS.

Air Toxics Analysis

There are no existing nearby (i.e., within 400 of the Project Area) industrial sources that could significantly impact the development that would occur as a result of the Proposed Actions. As such, there would be no significant adverse air quality impacts on the Proposed Development or Projected Development Site from existing industrial uses.

C. POLLUTANTS AND APPLICABLE STANDARDS/GUIDELINES

As required by the Clean Air Act, National Ambient Air Quality Standards (NAAQS) have been established for criteria pollutants by the U.S. Environmental Protection Agency (EPA). NAAQS are concentrations set for each of the criteria pollutants to protect public health and the nation's welfare, and New York has adopted the NAAQS as of the State ambient air quality standards.

The criteria pollutants associated with natural gas combustion -- particulate matter smaller than 2.5 and 10 microns ($PM_{2.5}$ and PM_{10}), nitrogen dioxide (NO_2), SO_2, and CO -- were considered for the NYPA and project-on-project HVAC analyses, and CO and $PM_{2.5}$ were considered for the garage analysis.

In addition to the NAAQS, the *CEQR Technical Manual* requires that projects subject to *CEQR* apply $PM_{2.5}$ *de minimis* criteria (based on concentration increments) developed by the New York City Department of Environmental Protection (DEP) to determine whether potential adverse $PM_{2.5}$ impacts would be significant. If the estimated impacts of a proposed project are less than the *de minimis* criteria, the impacts are not considered to be significant. In addition to determining compliance with the NAAQS' 1-hour/annual NO_2 thresholds, this analysis addresses compliance with the 24-hour/annual $PM_{2.5}$ *CEQR de minimis* criteria.

The current standards that were applied to this analysis are provided in **Table 13-1**.

TABLE 13-1
Applicable National Ambient Air Quality Standards and CEQR Significant Impacts Criteria

Pollutant	Averaging Time	NAAQS	Form	CEQR Significant Impact Criteria
NO_2	1 Hour	0.10 ppm (188 μg/m^3)	98th percentile of 1-hour daily maximum concentrations averaged over 3 years	
	Annual	0.053 ppm (100 μg/m^3)	Annual Mean	
$PM_{2.5}$	24 Hour	35 μg/m^3	98th percentile averaged over 3 years	8.6 μg/m^3
	Annual	12 μg/m^3	annual mean averaged over 3 years	0.3 μg/m^3
PM_{10}	24 Hour	150 μg/m^3	Not to be exceeded more than once per year on average over 3 years	
SO_2	1-hour	196 ug/m^3	99th percentile of 1-hour daily maximum concentrations averaged over 3 years	
CO (ppm)	1-hour	35	Not to be exceeded more than once per year	
	8-hour	9		

Source: US Environmental Protection Agency, "National Primary and Secondary Ambient Air Quality Standards." (49 CFR 50) (www.epa.gov/air/criteria.html) and New York State Department of Environmental Conservation (http://www.dec.ny.gov/chemical/8542.html.

ppm = parts per million
μg/m^3 = micrograms per cubic meter

NO_2 NAAQS

Nitrogen oxide (NO_x) emissions from gas combustion consist predominantly of nitric oxide (NO) at the source. The NO_x in these emissions are then gradually converted to NO_2, which is the pollutant of concern, in the atmosphere (in the presence of ozone and sunlight as these emissions travel downwind of a source).

The 1-hour NO_2 NAAQS standard of 0.100 ppm (188 ug/m^3) is the 3-year average of the 98th percentile of daily maximum 1-hour average concentrations in a year. The EPA guidance and memorandums recommend a three-tiered modeling approach for 1-hour NO_2 modeling. Each approach accounts for increasingly complex considerations of NO_2/NO_x. Tier 1, the most conservative approach, assumes a full (100%) conversion of NO_x to NO_2; Tier 2 Ambient Ratio Method (ARM2) applies a conservative ambient NO_x/NO_2 ratio to the NO_x estimated concentrations; Tier 3 employs AERMOD's Plume Volume Molar Ratio Method (PVMRM) module to accounts for the chemical transformation of NO emitted from the stack to NO_2 within the source plume using hourly ozone background concentrations.

The 1-hour NO_2 procedure with PVMRM module consists of a 3-steps methodology:

1. At each receptor, the model selects the highest-concentration hour from each day;
2. From this pool of 365 one-hour values (one from each day), the eighth highest NO_2 value from each year is selected, leaving one value per year; and
3. These five values, one from each year of five years, are averaged together to produce the final number.

Tier 1, as the most conservative approach, is recommended initially to be applied as a preliminary screening tool to determine whether violations of the NAAQS are likely to occur. If exceedances of the 1-hour NO_2 NAAQS are estimated, the more accurate, less conservative, Tier 2 or Tier 3 methods should be applied.

The annual NO_2 standard is 0.053 ppm (100 ug/m^3). A NO_2/NOx ratio of 0.75 percent recommended by NYCDEP for an annual NO_2 analysis, will apply.

$PM_{2.5}$ CEQR *De Minimis* Criteria

CEQR Technical Manual guidance includes the following criteria for evaluating significant adverse $PM_{2.5}$ incremental impacts:

> *Predicted 24-hour maximum $PM_{2.5}$ concentration increase of more than half the difference between the 24-hour $PM_{2.5}$ background concentration and the 24-hour standard.*

The 3-year (2017-2019) average of the 98th percentile 24-hour $PM_{2.5}$ background concentration for Brooklyn JHS 126 monitoring station from New York State Department of Environmental Conservation (NYSDEC) 2019 monitoring Report is 17.8 ug/m^3 (2017= 17.2 ug/m^3, 2018=17.9 ug/m^3, and 2019=18.4 ug/m^3)[1]. Half the difference between the 24-hour $PM_{2.5}$ NAAQS of 35 ug/m^3 and the background value of 17.8 ug/m^3 is 8.6 ug/m^3. As such, a significant impact threshold of 8.6 ug/m^3 was used for determining whether a potential 24-hour $PM_{2.5}$ impact is significant.

For an annual $PM_{2.5}$ *de minimis* criterion, according to *CEQR* guidance:

> *Predicted annual average $PM_{2.5}$ concentration increments greater than 0.3 ug/m^3 at any receptor location for stationary sources.*

The above 24-hour and annual significant impact criteria were used to evaluate the significance of predicted $PM_{2.5}$ impacts from the NYPA plant as well as from HVAC and garage emissions. The annual $PM_{2.5}$ background concentration averaged over 3-years (2017-2019) from JHS-126 is 7.6 ug/m^3.

D. NYPA POWER PLANT ANALYSIS

The nearby NYPA plant has a current Title V air pollution control permit (Permit ID 2-6101-01077/00003) issued by the NYSDEC. The facility consists of one simple-cycle natural gas-fired combustion turbine (GE LM6000), which is rated at 420 million Btus per hour (MMBtu/hour) and can generate a maximum of 47 megawatts of power. The unit is equipped with a selective catalytic reduction to control emissions of oxides of nitrogen (NO_x) and catalytic oxidation to control CO emissions. Other on-site combustion equipment includes one 7.5 MMBtu/hour Heatec boiler and one 746 brake horsepower (bhp) diesel backup generator. The boiler is used to heat gas turbine combustion inlet air when ambient temperature and humidity could cause icing at the turbine inlet. Boiler emissions were included in the analysis of combined potential impacts. The emergency generator emissions were not included because it will operate only temporarily in emergencies and for less than 500 hours a year.

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[1] NEW YORK STATE AMBIENT AIR QUALITY REPORT FOR 2019 (ny.gov)

The NYPA stack is located approximately 305 feet from the nearest edge of the South Tower and 620 feet from the nearest edge of the North Tower on the Applicant's Proposed Development Site, and 350 feet from the Projected Development Site. The stack was located using the physical stack location on Google Maps, which was correlated with the UTM coordinates provided in permit. The boiler stack was located using the UTM coordinates provided in the permit. The location of the NYPA stack in relation to the development sites is shown in **Figure 13-3**.

Figure 13-3
Location of NYPA Stack Relative to the Proposed and Projected Development Sites

Stack and Boiler Parameters

The turbine stack parameters are as follows: height = 106.49 feet (32.46 meters); diameter = 12 feet (3.657 meters); exhaust temperature = 718° F (654° K); and exit velocity = 77 feet/second (23.46 meters/second). These values are the same as those used in the 2012 Domino EAS.

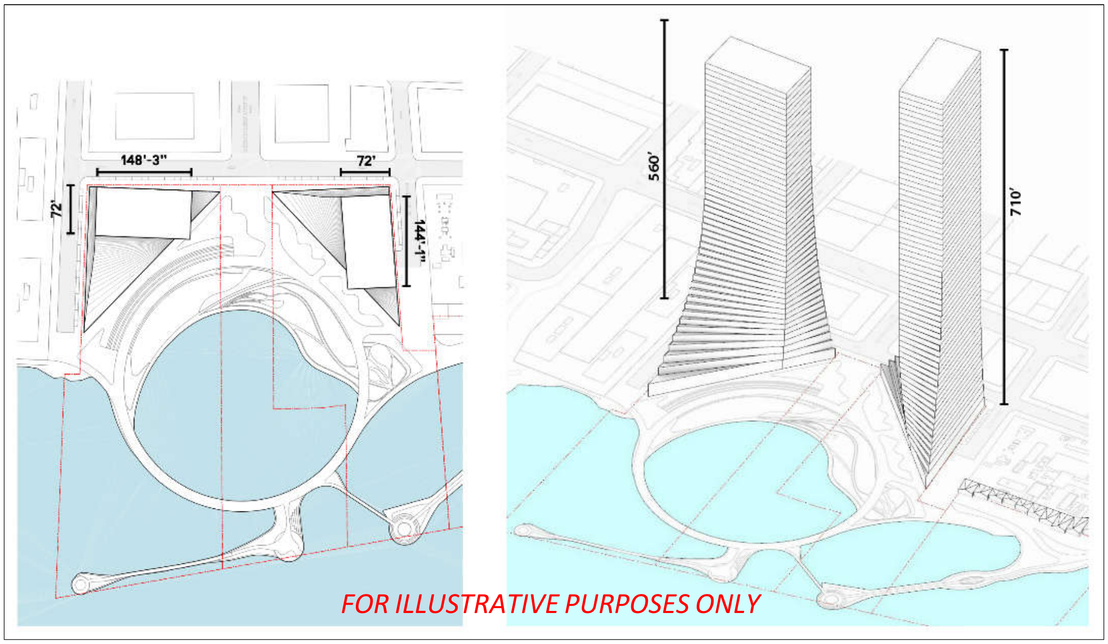
The boiler stack height is 15 feet -- with a diameter is 22 inches. The exit temperature, which is not listed in the permit, is assumed to be 300°F (423°K), which is appropriate for boilers. The exit velocity (7.2 m/sec) was obtained from DEP's "CA Permit" database, which contains data for the various boiler sizes.

Building Configurations for Proposed and Projected Development Sites

Applicant's Proposed Development – South and North Tower Configuration

Based on the latest design for the Applicant's Proposed Development, the South Tower is facing the NYPA stack along its wide side; the North Tower is facing the NYPA stack along its narrow side. The South Tower is closer to the NYPA stack (approximately 305 feet) than the North Tower and, as such, would experience greater impacts from NYPA plant emissions. The South Tower has a wide base (facing the NYPA stack) that narrows with elevation while the North Tower has a narrow base that narrows further with elevation. The massing diagram for the Proposed Development is shown in **Figure 13-4**.

Figure 13-4
Proposed Development – Massing Diagram



Projected Development Site

As described in Chapter 1, "Project Description," the Projected Development is assumed to be a 3-story rectangular building under With-Action conditions, located near the corner of North 1st Street and Kent Avenue, with a height of approximately 45 feet. The potential impacts on the 3-story Projected Development Site should be minimal.

Methodology Used for Estimating NYPA Plant Emissions

24-hour $PM_{2.5}$ Emissions

$PM_{2.5}$ is listed in the facility emissions summary report (Permit ID: prr2-6101-0107700003_1) as a contaminant under CAS NY075-00-0 but it is not monitored or controlled. However, due to stringent CEQR significant impact criteria established by CEQR for this pollutant, $PM_{2.5}$ should be considered as the critical pollutant.

The potential impact of emissions from NYPA emissions on River Street buildings was previously assessed in the 2012 Domino Sugar Redevelopment FEIS and subsequent analyses. It was contemplated that due to the complexity of NYPA facility operations as a peaking facility, that generally operates only when there is high peak demand for electricity, using uniform average 24-hour $PM_{2.5}$ emission rates based on maximum plant capacity of 420 MMBtu/hr may not represent a reasonable worst-case emission scenario because of plant type of peaking facility. A historical review of the NYPA facility operations for the last 10-years shows that this peaking facility operates differently from day to day and month to month, and there are many days (and hours) with emission rates that are much lower than those that occur during peak days, and there are many hours of the day with zero emissions. As such, to reflect facility operations and conservatively predict $PM_{2.5}$ impacts, the analysis should be based on conservative emission estimates that are over and above actual facility operational data. This scenario was developed for the Domino FEIS based on input from NYCDEP and used in this analysis. It accounted for emissions generated on the worst day of each month and assumed that these emissions would occur every day of that month. Turbine and boiler emissions were combined and modeled in the one modeling run to estimate combined NYPA impacts.

To estimate hourly emission rates for the worst day of a month, a computerized data transfer procedure was developed that used raw historical hourly heat load data for the NYPA facility over the 5-year analysis period. Data were obtained from the NYPA electronic report submitted to the DEC Air Compliance and Emissions Electronic-Reporting System available on EPA's Open Market Program Data website. Raw hourly heat loads were extracted via a data transfer system and transformed values into hourly emission rates using $PM_{2.5}$ emission factor (the same emission factor of 0.00355 lb/MMBtu as in 2012 Domino EAS). The system selected the worst operational day for each month and applied these worst-case emission rates to each day of that month. The procedure was repeated for each of five (5) analysis years (2015-2019). Estimated hourly emission rates for each year were combined into a 5-year hourly emission rate file format using the AERMOD hourly emission file editor. Hourly emission rates were modeled with concurrent meteorological data for the same period.

This procedure was also applied to the $PM_{2.5}$ 24-hour impact assessment from NYPA emissions on the Projected Development site.

Annual $PM_{2.5}$ Emissions

For estimating NYPA annual $PM_{2.5}$ impacts, actual historical daily operating loads were used (as opposed to worst day emissions) as input for the data transfer system. This is because the assumption that the emissions of the worst day of each month would occur every day of that month, while appropriate for conservatively estimating short-term (24-hour) impacts, is not appropriate for estimating annual impacts. The use of this approach would assume annual emission rates that are substantially above the facility's Title V permit limits. The use of actual loads to calculate annual emission rates (rather than worst day emission rates) reflect actual plant operating conditions that are commensurate with Title V permit limitations.

The actual hourly heat loads for the five-year analysis period were multiplied by the same $PM_{2.5}$ emission factor of 0.00355 lb/MMBtu and converted to a 5-year hourly emission data file using the AERMOD hourly emission file editor. Emissions were coupled with 5-years of concurrent meteorological data for 2015-2019.

NO_2 Emissions

According to EPA, compliance demonstrations for the 1-hour NO_2 NAAQS should address emission scenarios that can logically be assumed to be relatively continuous, or which occur frequently enough to contribute significantly to the annual distribution of daily maximum 1-hour concentrations. The intermittent nature of the actual emissions associated with emergency generators and startup/shutdown in many cases, when coupled with the probabilistic form of the standard, could result in modeled impacts being significantly higher than actual impacts would realistically be expected to be for these emission scenarios. However, guidance provides sufficient discretion for reviewing authorities to make decision of whether to include intermittent emissions from emergency generators or startup/shutdown operations from compliance demonstrations for the 1-hour NO_2 standard under appropriate circumstances. The NYSDEC DAR-10 guidance for 1-hour NO_2 analysis explicitly states that operating scenarios of relatively short duration such as "startup" and "shutdown" should be assessed implying that these conditions may result in maximum hourly ground-level concentrations.[2]

In accordance with NYCDEP-recommended DAR-10 guidance for the 1-hour NO_2 analysis, start-up turbine emissions were included in NO_2 analysis together with steady-state emissions. NO_2 emission rates were estimated based on the amount of mass NOx collected at the monitor every hour of the day. While the Title V NYPA permit limits the maximum NOx rate to 5 lb/hr (which correspond to 21.9 tons/year), the amount of NOx collected during start-up operations is much higher and reaches as much as 15 lb/hr). Start-up operations with higher NOx emissions usually occur once a day early in the morning. Five-year historical hourly NOx emission data, in units of lb/hr, which included start-up and steady-state operations, were converted to g/sec and used in the AERMOD modeling of the turbine NO_2 emissions.

Modeling Procedures

Given the complexity of the compliance demonstration, the most refined EPA Tier 3 approach was employed for 1-hour NO_2 analysis of the NYPA operations. Tier 3 consists of two methods: Plume Volume Molar Ratio Method (PVMRM) or Ozone Limiting Method (OLM). Tier 3 analyses require default or source-specific in-stack ratio of NO_2/NOx emissions (ISRs), and hourly ozone background data. PVMRM is preferred for tall stacks and OLM for short stacks. As per DAR-10, for a more refined pairing of background and modeled data with Tier 3 PVMRM module, background data can be either a uniform monitored background concentration or temporally varying monitored background averaged by season and hour of-day. Hour-by-hour pairing of monitored concentrations is not allowed because this approach per DAR-10 would assume that the hourly monitored background concentration is spatially uniform for the hour and representative of the background levels at each receptor. A default value of 40 ppb or annual average ozone concentrations is not recommended.

Ozone concentrations can be entered into the model as a single (highest hourly) value or hourly datasets.

The analysis included steps necessary to estimate 1-hour NO_2 design concentration for compliance determination with 1-hour NO_2 standard. It follows the DAR-10 procedure, as below:

1. The uniform monitored NO_2 background concentration from Queens College monitoring station is used. This value represents a 3-years average of the 98^{th}-percentile of the annual distribution of the daily maximum 1-hour concentrations, as prescribed (DAR-10, Table 3, Determination of Background Concentrations).
2. The background ozone concentration entered into the model as a single (highest hourly) value. This value was estimated as the highest ozone concentration from 5-years NYSDEC data sets (212 ug/m3) and was concurrent with the meteorological data.
3. The default ISR and ambient equilibrium ratios set up as 0.5 and 0.9, respectively. As per DAR-10, the default in-stack ratio of 0.5 is accepted without justifications.
4. AERMOD POLLUTID keyword set to NO_2 and the RECTABLE keyword to the 8^{th}-highest value.
5. The H8H value, which represents the modeled 1-hour NO_2 design concentration, is extracted from the AERMOD summary table which included the maximum 8^{th}-highest (98^{th} percentile) maximum daily 1-hour results averaged over 5-years modeled (DAR-10, Table 2).

[2] https://www.dec.ny.gov/docs/air_pdf/dar10.pdf)

6. This value is added to the uniform monitored background concentration and the sum compared to the 1-hour NO_2 NAAQS to determine compliance with 1-hour NO_2 NAAQS.

PM_{10}, SO_2, and CO NYPA Emissions

The Title V NYPA permit emission summary includes, in addition to NOx, the three criteria pollutants – PM_{10} (CAS NY75-00-5), SO_2 (CAS 7446-09-5), and CO (CAS 630-08-0) which were modeled with the AERMOD model. The difference for modeling PM_{10}, SO_2, and CO was that these emissions were calculated using maximum averaged emission rates for turbine and boiler corresponding to their maximum capacity of 420 MMBtu/hr and 7.5 MMBtu/hr, as opposed to worst day hourly $PM_{2.5}$ emission rates or actual NO_2 hourly emission rates. This approach conservatively assumes that maximum emission rates would occur every hour of the year over 5-year of plant operations. Turbine and boiler emissions were modeled in the same modeling run.

Emission Rates Used in the Modeling Analyses

$PM_{2.5}$

As previously described, $PM_{2.5}$ emissions for turbine were calculated using an emission factor of 0.00355 MMBtu/hr and worst day hourly emission rates. The emission rate for the boiler was calculated using an emission factor of 7.6 lb/10^6 standard cubic feet (scf) for a total PM from the EPA AP-42 "Emission from "Emission Factors for Criteria Pollutants and Greenhouse Gases from Natural Gas Combustion" (Table 1.4-2), which include both condensable and filterable particles, and the boiler maximum capacity of 7.5 MMBtu/hr.

NO_2

NO_2 emission rates for the turbine were estimated based on historical hourly NOx emissions. In lbs/hr, collected by the monitor at the facility. Start-up NOx emissions were included.

Boiler emission rates were calculated using an emission factor of 100 lb/10^6 scf from the EPA AP-42 "Emission Factors for Criteria Pollutants and Greenhouse Gases from Natural Gas Combustion" (Table 1.4-1) and the boiler maximum capacity of 7.5 MMBtu/hr.

PM_{10}

PM_{10} emission rates for turbine were calculated using an emission factor of 6.6E-03 lb/MMBtu for a total PM from the EPA AP-42 "Emission Factors for Criteria Pollutants and Greenhouse Gases from Stationary Gas Turbines" (Table 3.1-2a) which includes both condensable and filterable particles and turbine maximum capacity of 420 MMBtu/hr.

Boiler emission rates were calculated using the emission factor of 7.6 lb/10^6 scf for a total PM from the EPA AP-42 "Emission from "Emission Factors for Criteria Pollutants and Greenhouse Gases from Natural Gas Combustion" (Table 1.4-2) which includes both condensable and filterable particles and the boiler maximum capacity of 7.5 MMBtu/hr.

SO_2

SO_2 emission rates for turbine were calculated using the emission factor of 0.94S (lb/MMBtu) - where S is sulfur content in fuel from the EPA AP-42 "Emission Factors for Criteria Pollutants and Greenhouse Gases from Stationary Gas Turbines" (Table 3.1-2a) and the turbine maximum capacity of 420 MMBtu/hr.

SO_2 emission rates for boiler were calculated using the emission factor of 0.6 lb/10^6 scf from the EPA AP-42 "Emission from "Emission Factors for Criteria Pollutants and Greenhouse Gases from Natural Gas Combustion" (Table 1.4-2) and the boiler maximum capacity of 7.5 MMBtu/hr.

CO

CO emission rates for turbine were calculated using the emission factor of 8.2E-02 lb/MMBtu from the EPA AP-42 "Emission Factors for Criteria Pollutants and Greenhouse Gases from Stationary Gas Turbines" (Table 3.1-1) and turbine maximum capacity of 420 MMBtu/hr.

CO emission rates for boiler were calculated using the emission factor of 84 lb/10^6 scf from EPA AP-42 "Emission from "Emission Factors for Criteria Pollutants and Greenhouse Gases from Natural Gas Combustion" (Table 1.4-1) and the boiler maximum capacity of 7.5 MMBtu/hr.

Emission rates for all modeled pollutants are provided in **Table 13-2**.

TABLE 13-2
NYPA Pollutant Emission Rates

Pollutant	Unit	Emission Factors	Heat Input	Emission Rate Short-Term		Emission Rate Annual	
		lb/MMBtu	MMBtu/hr	lb/hr	g/sec	lb/year	g/sec
$PM_{2.5}$(1)	**Boiler Emissions (2)**	7.60E-03	7.5	0.06	7.18E-03	499	7.18E-03
NO_2(3)	**Boiler Emissions (4)**	1.00E-01	7.5	0.75	9.45E-02	6,570	9.45E-02
PM_{10}	**Combustion Gas-Turbine(5)**	6.60E-03	420	2.77	3.49E-01	24,283	3.49E-01
	Boiler Emissions (6)	7.60E-03	7.5	0.06	7.18E-03	499	7.18E-03
SO_2	**Combustion Gas-Turbine(7)**	1.41E-03	420	0.59	7.46E-02	5,188	7.46E-02
	Boiler Emissions (8)	6.00E-04	7.5	0.005	5.67E-04	39	5.67E-04
CO	**Combustion Gas-Turbine(9)**	8.20E-02	420	34.44	4.34E+00	301,694	4.34E+00
	Boiler Emissions (10)	8.40E-02	7.5	0.06	7.94E-02	5,519	7.94E-02

Notes:

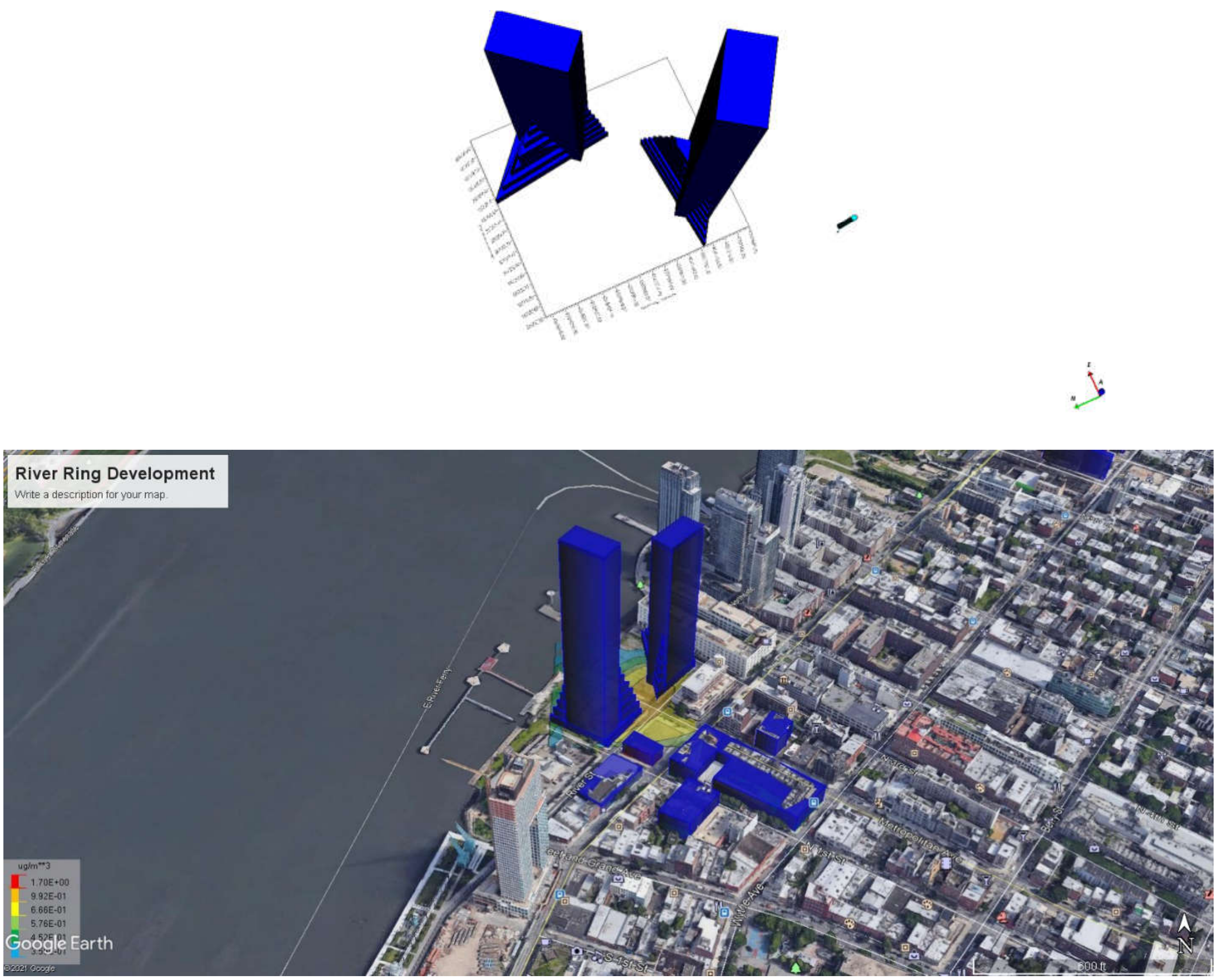
1. $PM_{2.5}$ turbine emissions were modeled using worst-case hourly emissions.
2. $PM_{2.5}$ emission factor for the boiler is 7.6 lb/MMBtu (AP-42, Table 1.4-2).
3. NO_2 turbine emissions were modeled using actual hourly emission rates.
4. NO_2 emission factor for the boiler is 100 lb/MMBtu (AP-42, Table 1.4-1).
5. PM_{10} Emission factor for the turbine is 6.6E-03 lb/MMBtu (AP-42, Table 3.1-2a).
6. PM_{10} Emission factor for the boiler is 7.6E-03 lb/MMBtu (AP-42, Table 1.4-2).
7. SO_2 Emission factor for the turbine is 0.94S lb/MMBtu (AP-42, Table 3.1-2a) where S is assumed to be 15 ppm (0.0015%).
8. SO_2 Emission factor for the boiler is 6.0 E-04 lb/MMBtu (AP-42, Table 1.4-2).
9. CO Emission factor for the turbine is 8.2E-02 lb/MMBtu (AP-42, Table 3.1-1).
10. CO Emission factor for the boiler is 8.4E-02 (AP-42, Table 1.4-2).

Dispersion Analysis

The dispersion modeling analysis used the latest version of EPA's AERMOD dispersion model (Version 19191). AERMOD is a steady-state plume model that is applicable in rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including point, area, and volume sources). AERMOD can be used to calculate pollutant concentrations from one or more points (e.g., exhaust stacks) based on hourly meteorological data, and has the capability of calculating pollutant concentrations at locations when the plume from the exhaust stack is affected by the aerodynamic wakes and eddies (downwash) produced by nearby structures. Following *CEQR* guidance, the analysis was conducted assuming stack tip downwash, urban dispersion surface roughness length, elimination of calms, with and without downwash effects. The Building Profile Input Parameters program BPIPPRM regulatory version 04272 was employed to estimate building profile input parameters for all combinations of stack and wind directions. BPIP data associated with 36 wind directions were used to compute the plume downwash by the PRIME Plume Rise and Building Downwash Model.

To reproduce the configuration of the South and North towers of the Proposed Development for the dispersion modeling analysis given the complex shapes of these structures, stepped or tiered structures near the base of each tower were simulated. The configurations produced by the AERMOD 3-D Analyst in Google Maps are shown in **Figure 13-5**.

Figure 13-5
Proposed Development – South and North Towers Configurations



Meteorological Data

All analyses were conducted using the latest five consecutive years of meteorological data (from 2015 through 2019) provided by the NYSDEC. Surface data were obtained from La Guardia International Airport – KLGA New York, NY (Queens County) and upper air data were obtained from Brookhaven station (okx), New York. These meteorological data provide hour-by-hour wind speeds and directions, stability states, and temperature inversion elevations over the 5 years. A graphical depiction of the frequency of wind speed and wind direction is provided in **Figure 13-6**. Five-year meteorological data were converted into a 5-year concatenated file of meteorological conditions which was used for all AERMOD modeling runs.

The results of the analysis are influenced by the location of the NYPA stack relative to the proposed structure of nearby South Tower, wind direction, and tower configuration. The prevalent wind direction is from north to south while plume direction from NYPA stack to the towers would be opposite (from south to north) however, with sufficient frequency.

Building influences on wind flow plays role in the dispersion characteristics and pollutant dispersion around the proposed buildings. In relation to the proposed development, the effects of downwash from the NYPA stack could be diminished by the configuration of South Tower (nearest to NYPA stack), which has a relatively narrow width at a base, which is usually a critical dimension for downwash effects.

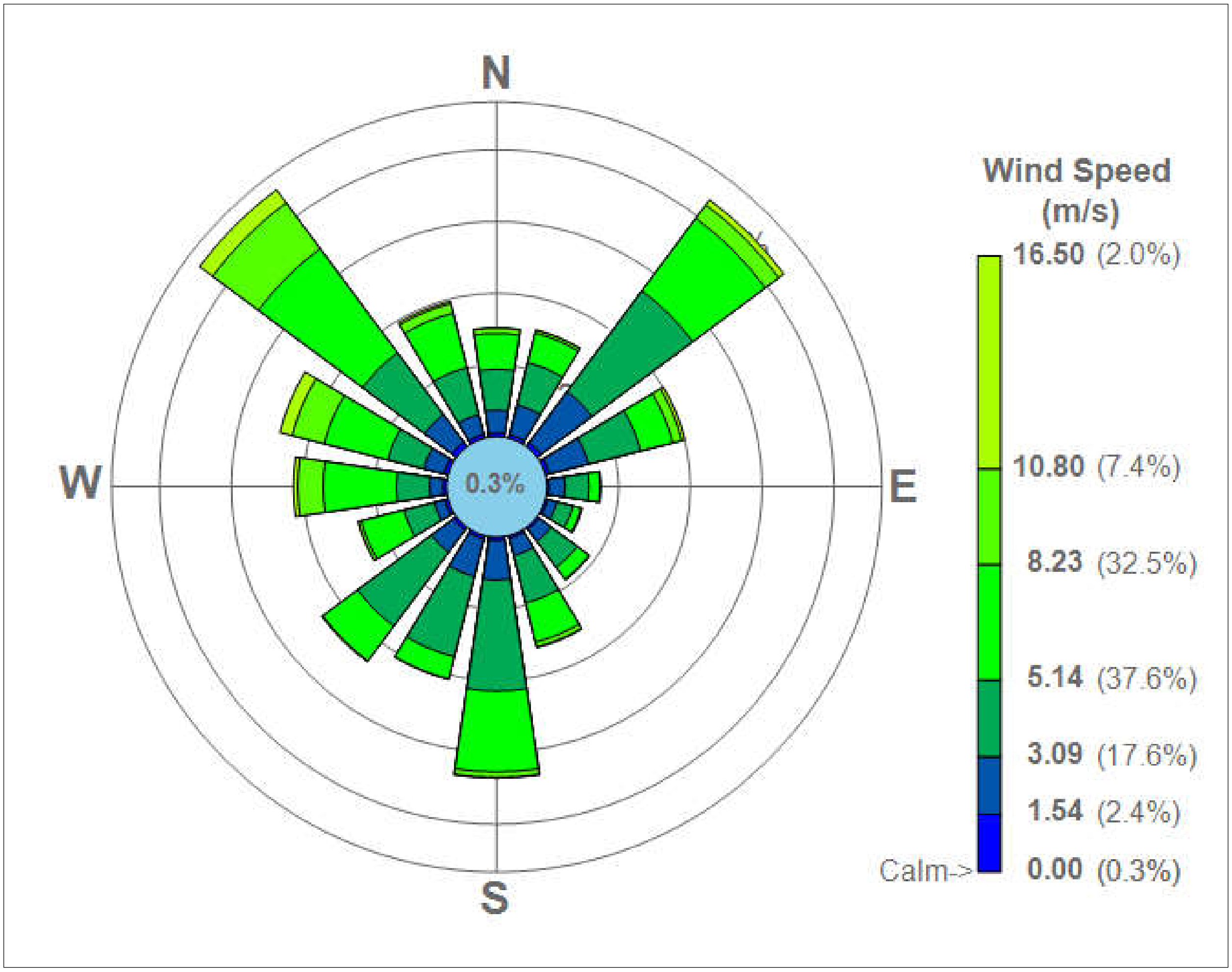
Wind flow around a structure generally produces an area of wake effect influence that extends out to a distance of approximately five times the height of the structure downwind. As the wind direction rotates full circle, each direction-specific area of influence changes. A plume that is within this distance is affected by wake effects for some wind directions or range of wind directions. The aerodynamic influences and the extent of the wake are highly dependent on the particular shape and design of the structure. It appears that the downwash zone of influence is relatively narrow for South Tower (in relation to NYPA impact) because South Tower (as well as North Tower) are narrow at ~~a~~the base and become even narrower going up the structures. However, for North tower on South tower project-on-project impact, the downwash effect is likely to be (and was) more significant. The whole South Tower structure would be in zone of downwash influence and the wide base of the South Tower would be facing the North tower traveled plume. The BPIP analysis shows that South Tower is the dominant structure for building downwash effect.

Pollutant Background Concentrations

Three-year average background concentrations for all pollutants were obtained from Queens College monitoring station for the 2017-2019 period, as follows:

- The 3-year average of the 98thpercentile of the annual distribution of the daily maximum 1-hour NO_2 concentration was 55.1 ppb (104 ug/m^3);
- The highest annual NO_2 concentration over the 3 years was 14.62 ppb (27.6 ug/m^3);
- The 3-year average of the 99th percentile of the annual distribution of the daily maximum 1-hour SO_2 concentration was 5.17 ppb (13.4 ug/m^3);
- The average of the highest 24-hour PM_{10} concentrations over the 3-years was 28 ug/m^3, and
- The highest-2nd highest 1-hr and 8-hr CO background concentrations over 3-years were 1.51 ppm and 1.1 ppm, respectively.

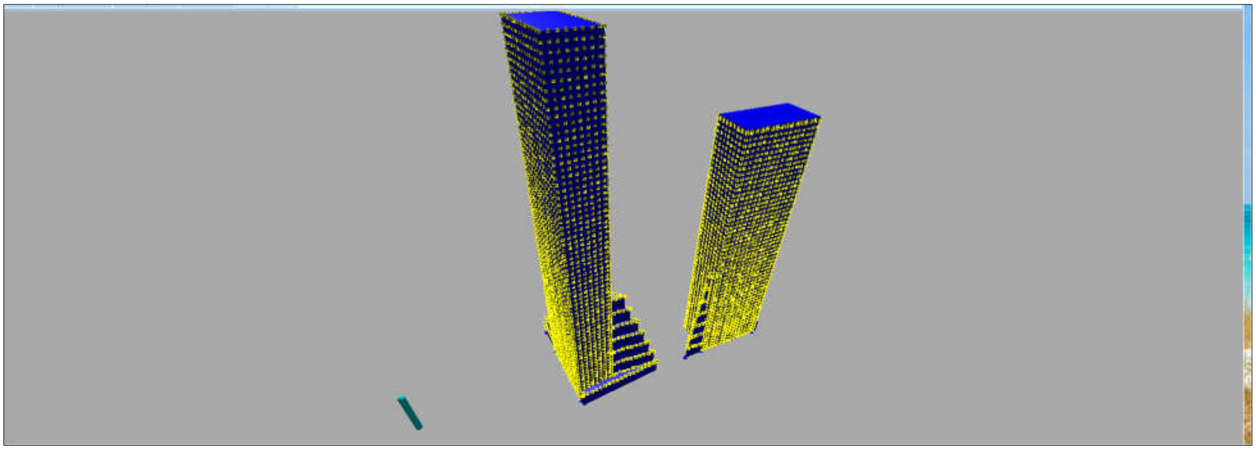
Figure 13-6
Wind Rose Diagram from LaGuardia Airport for 2015-2019



Receptor Locations

Receptors were placed around the perimeter of each Tower in 10-foot increments horizontally and vertically -- on all floor levels from ground level to the roof of each building (see **Figure 13-7**). The upper windows receptors were placed 5 feet below roof level. A large number of receptors (about 7,000) were placed on the South and North Tower to assure that maximum impacts are estimated. Receptors were also placed along all sides of the Projected Development – from ground level to 5 feet below roof level.

Figure 13-7
Receptors on the South and North Towers



A summary of the modeling parameters is provided in **Table 13-3**.

TABLE 13-3
AERMOD Modeling Parameters

Model	AERMOD (EPA Version 19191)
Source Type	Point
Emission Sources and Receptor Coordinates	UTM NAD 83 Datum and UTM Zone 18
Downwash Program	Building Profile Input Program (BPIP, regulatory version 04272)
Surface Characteristics	Urban Area Option
Urban Surface Roughness Length	1
The population of the area (Brooklyn)	Approximately 2.6 million (2019) with a population density of more than
Meteorological Data	Provided by NYSDEC for 2015-2019 in form of concatenated single multiyear file
Surface Meteorological Data	LaGuardia 2015-2019
Profile Meteorological Data	Brookhaven Station 2015-2019
$PM_{2.5}$ Analysis	Special procedure incorporated into AERMOD where model calculates concentration at each receptor for each year modeled, averages those concentrations across the number of years of data, and then selects the highest across all receptors of the N-year averaged highest values
$PM_{2.5}$ and other Pollutants Background Concentrations	Brooklyn JHS-126 and Queens College 2 monitoring stations data for 2017-2019

Analysis Results of NYPA Impacts on the Proposed Development's Towers

24-hour $PM_{2.5}$ Impacts With Downwash

The result of the 24-hour $PM_{2.5}$ dispersion analysis is that the maximum NYPA plant impact is estimated to be 7.2 ug/m^3, which is less than the *CEQR* significant impact criteria of 8.6 ug/m^3. The maximum 5-year average total concentration (including background value) is estimated to be 24 ug/m^3 which is less than the 24-hr $PM_{2.5}$ NAAQS of 35 ug/m3.

24-hour $PM_{2.5}$ Impacts Without Downwash

The result of the 24-hour $PM_{2.5}$ dispersion analysis is that the maximum NYPA plant impact is estimated to be 8.55 ug/m^3, which is in less than the *CEQR* significant impact criteria of 8.6 ug/m^3. The maximum 5-year average total concentration (including background value) is estimated to be 24.6 ug/m^3, which is less than the 24-hr $PM_{2.5}$ NAAQS of 35 ug/m3.

Annual $PM_{2.5}$ Impacts With Downwash

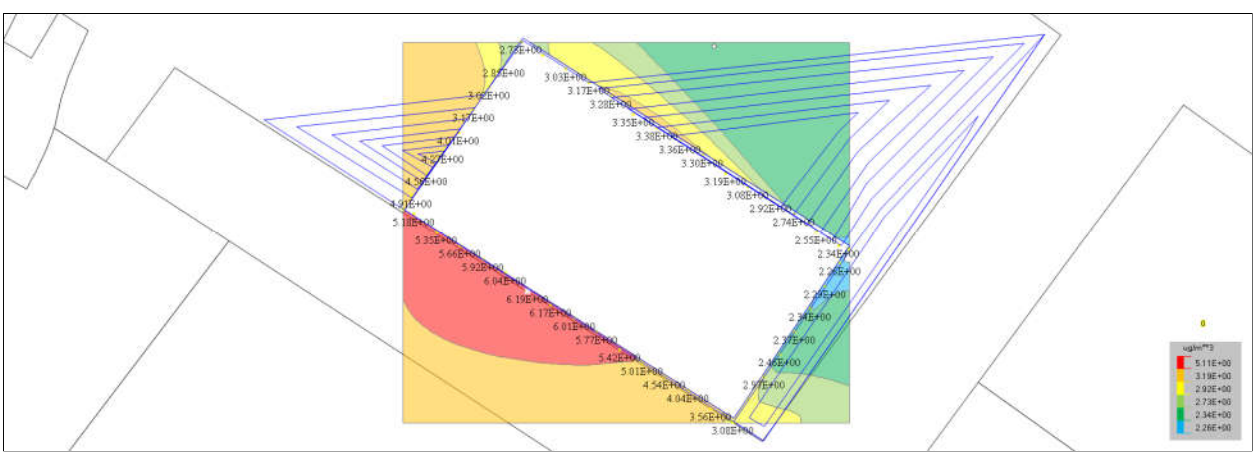
The result of the annual analysis is that the maximum annual $PM_{2.5}$ impact is 0.1 ug/m^3, which is less than the *CEQR* annual significant impact criteria of 0.3 ug/m^3. The maximum 5-year average total concentration (including background value) is estimated to be 7.7 ug/m^3 which is less than the annual $PM_{2.5}$ NAAQS of 12 ug/m^3.

Annual $PM_{2.5}$ Impacts Without Downwash

The result of the annual analysis is that the maximum annual $PM_{2.5}$ impact is 0.2 ug/m^3, which is less than the *CEQR* annual significant impact criteria of 0.3 ug/m^3. The maximum 5-year average total concentration (including background value) is estimated to be 7.8 ug/m^3, which is less than the annual $PM_{2.5}$ NAAQS of 12 ug/m3.

Based on these results, the potential impacts of NYPA $PM_{2.5}$ emissions are not considered to be significant. The 24-hr $PM_{2.5}$ contour map is provided in **Figure 13-8**.

Figure 13-8
24-hr $PM_{2.5}$ Contour Map



NO_2 Impacts with Downwash

The 1-hour NO_2 analysis with Tier 3 PVMRM module followed the previously described procedure. Hourly NO_2 emission rates were based on actual NYPA plant daily operation rates and included turbine start-up operations. The results of this analysis are that the maximum estimated 8th highest daily 1-hour NO_2 concentration with the added uniform background concentration is 160.7 ug/m^3 (with a maximum impact of 56.7 ug/m^3 and a background concentration of 104 ug/m^3), which is below the 1-hour NO_2 NAAQS of 188 ug/m^3. The estimated annual average total NO_2 concentration is 28.5 ug/m^3 (with a maximum impact of 0.9 ug/m^3 and a background concentration of 27.6 ug/m^3) is less than the annual NO_2 NAAQS of 100 ug/m^3.

NO_2 Impacts without Downwash

The result of this analysis is that the maximum estimated 8th highest daily 1-hour NO_2 concentration with the added uniform background concentration is 151.8 ug/m^3 (with a maximum impact of 47.8 ug/m^3 and a background concentration of 104 ug/m^3), which is below the 1-hour NO_2 NAAQS of 188 ug/m^3. The maximum estimated total annual average NO_2 concentration is less than the annual NO_2 NAAQS of 100 ug/m^3.

PM_{10} Impacts with and Without Downwash

The maximum total estimated concentrations (impact plus background concentration) with or without downwash are less than the 24-hour PM_{10} NAAQS of 150 ug/m^3.

SO_2 Impacts

The maximum total 4th highest daily 1-hour SO_2 concentration with or without downwash is less than the 1-hour SO_2 NAAQS of 196 ug/m^3.

CO Impacts

The maximum total second-highest estimated 1-hour and 8-hour CO concentrations with or without downwash are less than the 8-hour CO NAAQS of 9 ppm.

NYPA Analysis Results Summary for the Proposed Development's Towers

A summary of the results for all pollutants, with and without downwash effect, are provided in **Tables 13-4** and **13-5**. As shown, 24-hour/annual $PM_{2.5}$ impacts are less than the *CEQR* significant impact criteria and all estimated pollutant concentrations are less than applicable standards.

TABLE 13-4
Results of NYPA Emissions Analysis with Downwash

Pollutant	Modeled Concentration	Background Conc.	Total Conc. (3)	Evaluation Criteria	
				***CEQR* Criteria**	**NAAQS**
	ug/m³	**ug/m³**	**ug/m³**	**ug/m³**	**ug/m³**
24-hr $PM_{2.5}$	7.2 (1)			8.6	
	6.2 (2)	17.8	24.0		35
Annual $PM_{2.5}$	0.1			0.3	
		7.6	7.7		12
1-hr NO_2	56.7	104.0	160.7		188
Annual NO_2	0.9	27.6	28.5		100
24-hr PM_{10}	26.1	28	54.1		150
1-hr SO_2	9.0	13.4	22.4		196
CO 1-hr	0.5	1.5	2.0		35 ppm
CO 8-hr	0.4	1.1	1.5		9 ppm

1. Maximum impact.
2. 5-year averaged impact.
3. All concentrations are in ug/m³, except for CO, which is in ppm.

TABLE 13-5
Results of NYPA Emissions Analysis without Downwash

Pollutant	Modeled Concentration	Background Conc.	Total Conc. (3)	Evaluation Criteria	
				CEQR	**NAAQS**
	ug/m³	**ug/m³**	**ug/m³**	**ug/m³**	**ug/m³**
24-hr $PM_{2.5}$	8.55 (1)			8.6	
	6.8 (2)	17.8	24.6		35
Annual $PM_{2.5}$	0.2			0.3	
		7.6		7.8	12
1-hr NO_2	47.8	104.0	151.8		188
Annual NO_2	1.71	27.6	29.3		100
24-hr PM_{10}	24.9	28	52.9		150
1-hr SO_2	8.7	13.4	22.1		196
CO 1-hr	0.5	1.5	2.0		35 ppm
CO 8-hr	0.4	1.1	1.5		9 ppm

1. Maximum impact.
2. 5-year averaged impact.
3. All concentrations are in ug/m³, except for CO, which is in ppm.

Analysis Results of NYPA Impacts on the Projected Development

The result of this analysis is that the highest potential impact on Projected Development Site receptors, which occurs at a height of 40 feet (i.e., where the upper windows will be located), is minimal. The highest estimated 24-hour $PM_{2.5}$ impact is 1.78 μg/m³ (versus the *CEQR* threshold of 8.6 μg/m³) and the highest estimated 1-hour NO_2 concentration, with the background values of 104 μg/m³, is 148.3 μg/m³ (versus the NAAQS of 188 μg/m³). Therefore, NYPA stack emissions would not significantly impact the Projected Development.

Summary of the NYPA Plant Analysis

The results of the NYPA combined turbine and boiler emissions analysis (including start-up emissions) are that no exceedances of the *CEQR* 24 hour/annual $PM_{2.5}$ *de minimis* criteria or the applicable NAAQS (i.e., 24-hour/annual $PM_{2.5}$, 1-hour/annual NO_2, 24-hour PM_{10}, 1-hour SO_2, and 1-hour and 8-hr CO) are predicted. Therefore, emissions from the NYPA power plant would not significantly impact the South and North Towers on the Applicant's Development Site or the building on the Projected Development Site.

E. PROJECT-ON-PROJECT (NORTH TOWER ON SOUTH TOWER) ANALYSIS

HVAC emissions from the Proposed Development's shorter North Tower could impact the taller South Tower. A tower-on-tower analysis was therefore conducted to estimate whether these impacts have the potential to be significant.

Based on preliminary information provided by the Applicant, the HVAC system of the North Tower would be a combination of a co-generation plant, supplemental boilers, and water pumps to provide electricity, heat, hot water, and air conditioning to the building's residents. Duct burners would also be utilized to increase the heat energy of the gas turbine's exhaust.

The HVAC system of the Projected Development, which could impact the tall towers on the Proposed Development and nearby existing taller buildings, is assumed to be supplied by a conventional natural gas-fired boiler.

Co-Gen Plant and Supplemental Boilers

The design of the HVAC system for both towers on the Applicant's Development Site is still in a preliminary stage. Based on information provided by the Applicant, the North Tower will be equipped with an efficient heating system that consists of a gas-fired co-generation heating plant that will include a combination of heat and power units that will simultaneously generate electricity, heat, and hot water and supplemental boilers. Three (3) CHP units for the North Tower are currently proposed. The units would likely utilize a Capstone system with microturbines (C65 model), where multiple units could be combined in one single generating source.

The C65 Capstone model is expandable and can be paralleled to provide 30 MW of power. Waste heat from the units will be recovered and used to produce domestic hot water as well as provide relief to boilers in the generation of heat for domestic hot water.

In addition to the co-gen units, three supplemental gas-fired condensing boilers, with maximum of 6 MMBtu/hour heat input each, are proposed to operate on North Tower together to provide the remaining energy requirements for domestic hot water and heat for all building common areas, lobbies, retail areas and corridors.

While each co-gen unit would generally operate at full (100 percent) capacity on an hourly basis over the course of a year to provide electricity and hot water, the boilers would operate on an as needed basis (depending on heat and hot water demand) at less than full load during much of the year.

However, for purpose of conservatively estimating short-term emission rates from both the co-gen units and boilers, it is assumed that both units would operate at the maximum (100 percent) capacity every day of the year all year to provide heating and hot water demand (as well as electricity).

Capstone Microturbines

The Capstone units will provide thermal output with ultra-low emission rates. The selected C65 model microturbines are rated at 65 kW with an electrical efficiency of 29%, combined heat and power efficiency of up to 90%, and a net heat rate of 12.4 MJ/kWh (11,800 BTU/kWh).

In summary, based on this preliminary design, the HVAC system on North Tower will consist of:

- Three Capstone C65 natural gas-microturbines, each with a net heat rate of 11,800 Btu/kWh (or 0.0118 MMBtu/kWh) each;
- Three condensing boilers with high efficiency for NOx emissions of 6 MMBtu/hour each, for a total of 18 MMBtu/hr; and
- Two supplemental duct burners with approximately 0.5 MMBtu/hour each, for a total of 1 MMBtu/hr.

The total estimated thermal heat input from the co-gen units at 100% capacity will be 2.301 MMBtu/hour [(0.0118 MMBtu/kWh x 65 kWh x 3) and a total boiler thermal input 18 MMBtu/hr (3x6 MMBtu/hr). Total duct burners heat input will be 1 MMBtu/hr (2 x 0.5 MMBtu/hr).

Pollutant emission factors for microturbines were obtained from AP-42, Stationary Gas Turbines, Chapter 3, Section 3.1, (Tables 3.1-1 and 3.1-2a). Emission factors are 6.6E-03 lb/MMBtu for $PM_{2.5}$, 8.2E-02 lb/MMBtu for CO, and 1.4E-03 lb/MMBtu for SO_2.

For NO_2, based on microturbine C65 exhaust characteristics, each unit limits the concentration of NO_x to, at least, 9 ppmv in a dry combustion exhaust gas corrected to 15 volume percent O_2 in the dry gas. This concentration corresponds to an emission factor of 0.033 lb/MMBtu (C65 HPNG 331035A lowres.pdf).

Boilers

Pollutant emission factors for the boilers were obtained from AP-42 Chapter 1.4, External Combustion Sources, Natural Gas Combustion, for boilers with less than 100 MMBtu/hour, (Tables 1.4-1 and 1.4-2). These emission factors are 7.6E-03 lb/MMBtu for $PM_{2.5}$, 8.4E-02 lb/MMBtu for CO, and 6.0E-04 lb/MMBtu for SO_2. While short-term emission rates for $PM_{2.5}$ were estimated based on maximum boiler capacity, the annual emission rates (due to uncertainty with boiler operation on an annual basis) were calculated based on the total size (gsf) of the North Tower.

For NO_2, assuming that low NO_x burners will provide at least 30 ppmvd in a dry combustion exhaust gas corrected to 3 volume percent O_2 in the dry gas, this concentration corresponds to a NOx emission factor of 0.036 lb/MMBtu.

Duct Burners

The type of duct burner that will work in combination with Capstone microturbines is not known at this time. However, two parameters were preliminary estimated -- heat input and diameter. It is assumed that two duct burners would operate on the North Tower, the exhaust stacks would be 12 inches in diameter, and have a combined heat input of 1 MMBtu/hr. Based on specifications for similarly rated units, the exit temperature was assumed to be 1900-deg F for natural gas burning. Emission factors and rates for pollutants associated with duct burning were assumed to be the same as for turbines.

Stack Locations

A total of three chimneys (exhaust stacks) are assumed on the roof of the North Tower -- one for turbines, one for the boilers, and one for two duct burners. Because the locations of these stacks have not been identified, it was assumed, for the conservative purpose of this analysis, that all three stacks were located on the building roof at a minimum distance from the edge of North Tower -- approximately 245 feet from the South Tower.

Stack Exhaust Parameters

Stack heights were assumed to be 3 feet above the roof height (e.g., 560 feet or 171.6 m), as per *CEQR* guidance. Stack diameters were assumed (based on input from the architect) to be, as follows: 14 inches for the turbines; 20 inches for the boilers; and 12 inches for the duct burners. Exit temperatures were assumed to be 588-deg F for the turbines (as in the unit's specifications) and 300°F (423° K) for the boilers (as is typical for these units). The mass flow rate for the turbines is 0.49 kg/s (1.08 lbm/s), as per specifications, which translates to 0.4 m^3/sec per unit or 1.2 m^3/sec for all three units.

Based on *CEQR* guidance, it is generally recommended that in addition to analyses at 100 percent load, additional analyses be conducted at 50 percent and 75 percent of peak load to assure that maximum impacts are estimated. This requirement is based on assumption that emission factors could be greater than under 100 percent load while exit velocities and exhaust temperatures could be lower when the boilers are operating at less than peak load. However, emission factors and exit temperatures for the proposed boilers are not likely to change with heating loads, and lower exit velocities would not measurably affect the results. Emission rates, on the other hand, would decrease proportionally with heating loads, and impacts at lower loads would be proportionally lower than the values estimated under 100 percent load. As such, analyses were conducted based on 100 percent load conditions.

Estimated emission rates for turbines, boilers, and duct burners, together with emission factors, are provided in **Table 13-6**.

TABLE 13-6
Estimated Pollutant Emission Rates for Turbines, Boilers, and Duct Burners

Pollutants	Short-term Emission Rates				Annual Emission Rates				Short-term Emission Rates		Annual Emission Rates	
	CHP		Boilers		CHP		Boilers*		Duct Burners			
	lb/hr	g/sec	lb/hr	g/sec	lb/year	g/sec	lb/year	g/sec	lb/hr	g/sec	lb/year	g/sec
Max Time					8760	hours/yr	8760	hours/yr			8760	hours/yr
NOx	7.60E-02	9.58E-03	6.54E-01	8.23E-02	666.1	9.58E-03	5,725	8.23E-02	3.30E-02	4.16E-03	289.5	4.16E-03
$PM_{2.5}$	1.52E-02	1.91E-03	1.37E-01	1.72E-02	133	1.91E-03	268*	3.86E-03	6.60E-03	8.32E-04	57.8	8.32E-04
PM_{10}	1.52E-02	1.91E-03	1.37E-01	1.72E-02	133	1.91E-03	1,198	1.72E-02	6.60E-03	8.32E-04	57.8	8.32E-04
CO	1.89E-01	2.38E-02	1.51E+00	1.91E-01	1,653	2.38E-02	13,245	1.91E-01	8.24E-02	1.04E-02	721	1.04E-02
SO_2	3.24E-03	4.09E-04	1.08E-02	1.36E-03	28.4	4.09E-04	95	1.36E-03	1.41E-03	1.78E-04	12.4	1.78E-04

*Annual emission rates for $PM_{2.5}$ from boilers were calculated based on the size of the North Tower of 603,676 gsf

Pollutants	Emission Factors			Reference Sources
	CHP	Boilers	Units	
NOx	3.30E-02	3.63E-02	lb/MMBtu	Estimated based on 9 ppm for the turbines and 30 ppm for the boilers
$PM_{2.5}$	6.60E-03	7.6E-03	lb/MMBtu	AP-42 Tables 3.1-2a, 1.4-1, and 1.4-2
PM_{10}	6.60E-03	7.6E-03	lb/MMBtu	AP-42 Tables 3.1-2a, 1.4-1, and 1.4-2
CO	8.2E-02	8.4E-02	lb/MMBtu	AP-42 Tables 3.1-1, 3.1-2a, 1.4-1, and 1.4-2
SO_2	1.4E-03	6.0E-04	lb/MMBtu	AP-42 Tables 3.1-1, 3.1-2a, 1.4-1, and 1.4-2
Maximum Heat Input	2.301	18.0	MMBtu/hr	

Results of Tower-on-Tower Analysis for the Proposed Development

In the project-on-project analysis, where the stack was located directly on the North Tower, the tower itself was determined to be a dominant structure and its effect on plume dispersion was rather significant. Therefore, results with downwash for project-on-project are significantly different compared to the NYPA stack analysis. However, in both cases, downwash is a positive factor, reducing potential plume impacts.

The results of the project-on-project dispersion analysis -- for comparison with the 24-hour/annual $PM_{2.5}$ *CEQR de minimis* criteria and NAAQS, and the 1-hour/annual NO_2 NAAQS -- are provided below.

$PM_{2.5}$ Results with Downwash

The result of the analysis of the North Tower $PM_{2.5}$ emission impacts on the South Tower is that no exceedances of the 24-hour/annual *CEQR de minimis* criteria or 24-hour/annual NAAQS for $PM_{2.5}$ are predicted. The maximum estimated 24-hour $PM_{2.5}$ impact is 0.6 ug/m^3 and the 5-year averaged impact is 0.5 ug/m^3. These values are less than the *CEQR de minimis* criteria of 8.6 ug/m^3. The maximum estimated total 24-hour $PM_{2.5}$ concentration (with added background value of 17.8 ug/m^3) is less than the 24-hour $PM_{2.5}$ NAAQS. The maximum estimated annual $PM_{2.5}$ impact is less than the *CEQR de minimis* criteria of 0.3 ug/m^3. As such, the $PM_{2.5}$ emissions from the North Tower would not significantly impact the South Tower.

$PM_{2.5}$ Results without Downwash

The maximum estimated 24-hour $PM_{2.5}$ impact is much higher than with downwash (8.35 ug/m^3) but still less than the *CEQR de minimis* criteria of 8.6 ug/m^3. The maximum estimated total 24-hour $PM_{2.5}$ concentration (with added background value of 17.8 ug/m^3) is less than the 24-hour $PM_{2.5}$ NAAQS of 35 ug/m^3. The maximum estimated annual $PM_{2.5}$ impact is 0.2 ug/m^3, which is less than the *CEQR de minimis* criteria of 0.3 ug/m^3. As such, the $PM_{2.5}$ emissions from the North Tower would not significantly impact the South Tower.

NO_2 Analysis with Downwash

With a Tier 3 analysis, the maximum estimated impact is 13.6 ug/m^3 and the total 8th-highest maximum daily 1-hour NO_2 concentration (with added background concentration of 104 ug/m^3) is 117.6 ug/m^3, which is less than the 1-hour NAAQS of 188 ug/m^3. The maximum estimated total annual concentration is 27.9 ug/m^3, which is less than the annual NAAQS of 100 ug/m^3. As such, NO_2 emissions from the North Tower would not significantly impact the South Tower.

NO_2 Analysis without Downwash

With a Tier 3 analysis, the maximum estimated impact is 77.7 ug/m^3 and the total 8th-highest maximum daily 1-hour NO_2 concentration (with added background concentration of 104 ug/m^3) is 181.7 ug/m^3, which is less than the 1-hour NAAQS of 188 ug/m^3. The maximum estimated annual concentration is 30.3 ug/m^3, which is less than the annual NAAQS of 100 ug/m^3. As such, NO_2 emissions from the North Tower would not significantly impact the South Tower.

PM_{10} Analysis with and Without Downwash

The result of PM_{10} analysis is that no exceedances of the 24-hour NAAQS are predicted with or without downwash. The maximum estimated total 24-hour $PM_{2.5}$ concentration is less than the 24-hour PM_{10}

NAAQS of 150 ug/m3. As such, the PM_{10} emissions from the North Tower would not significantly impact the South Tower.

SO_2 Analysis with and Without Downwash

The result of SO_2 analysis is that no exceedances of the 1-hour SO_2 NAAQS are predicted with or without downwash. The maximum estimated 4th highest 1-hour SO_2 concentration is less than 1-hour SO_2 NAAQS of 196 ug/m^3. As such, the SO_2 emissions from the North Tower would not significantly impact the South Tower.

CO Analysis with and Without Downwash

The result of CO analysis is that no exceedances of either the 1-hour or 8-hour CO NAAQS are predicted with or without downwash. The maximum estimated 1-hour and 8-hour second-highest concentrations are much less than 1-hour/8-hour CO NAAQS of 35 and 9 ppm, respectively. As such, the CO emissions from the North Tower would not significantly impact the South Tower.

Results of the project-on-project analyses are provided in **Tables 13-7** and **13-8**.

TABLE 13-7
Results of Building-on-Building Impact with Downwash

Pollutant	Modeled Concentration	Background Conc.	Total Conc. (3)	Evaluation Criteria	
				CEQR Criteria	NAAQS
	ug/m^3	ug/m^3	ug/m^3	ug/m^3	ug/m^3
24-hr $PM_{2.5}$	0.6 (1)			8.6	
	0.5 (2)	17.8	18.3		35
Annual $PM_{2.5}$	<0.1			0.3	
		7.6	7.6		12
1-hr NO_2	13.6	104	117.6		188
Annual NO_2	0.28	27.6	27.9		100
24-hr PM_{10}	0.6	28	28.6		150
1-hr SO_2	0.4	13.4	13.8		196
CO 1-hr	0.05	1.5	1.6		35 ppm
CO 8-hr	0.01	1.1	1.1		9 ppm

TABLE 13-8
Results of Building-on-Building Impact without Downwash

Pollutant	Modeled Concentration	Background Conc.	Total Conc. (3)	Evaluation Criteria	
				CEQR	NAAQS
	ug/m³	ug/m³	ug/m³	ug/m³	ug/m³
24-hr $PM_{2.5}$	8.35 (1)			8.6	
	6.8 (2)	17.8	24.6		35
Annual $PM_{2.5}$	0.2			0.3	
		7.6	7.8		12
1-hr NO_2	77.7	104	181.7		188
Annual NO_2	2.7	27.6	30.3		100
24-hr PM_{10}	8.4	28	36.4		150
1-hr SO_2	1.6	13.4	15.0		196
CO 1-hr	0.2	1.5	1.7		35 ppm
CO 8-hr	0.14	1.1	1.2		9 ppm

1. Maximum impact.
2. 5-year averaged impact.
3. All concentrations are in ug/m3, except for CO, which is in ppm.

Based on the results of the project-on-project analysis, no (E)- designations for stack locations for the proposed North Tower are required. The exhaust stacks from all combustion units can be located anywhere on the North Tower roof.

The following (E)- designation (E-636) will be required for the North Tower on the Applicant's Proposed Development Site to restrict CHP capacity and limit NOx emissions from both the CHP and boilers:

Block 2355, Lots 1 and 20 – Proposed Development Site North Tower

To avoid potential significant adverse air quality impacts, any new residential and/or commercial development on the above mentioned property must utilize exclusively natural gas for fossil fuel fired heating and hot water boilers and ducted burners, and ensure that such heating and hot water equipment be fitted with low NOx burners (30 ppm); in addition, any combined heat and power (CHP) system total capacity should not exceed 195 kw/hr while the CHP's microturbines' exhaust NOx concentration should not be higher than 9 ppmv adjusted for 15% O_2 of dry base.

Summary of HVAC Tower-on-Tower Analysis

In summary, HVAC emissions from the proposed North Tower would not have any significant adverse air quality impacts on the South Tower, as well as on local air quality levels.

F. PROJECTED DEVELOPMENT SITE HVAC ANALYSIS

The Projected Development Site, which would be re-developed as a result of the Proposed Actions, is located at 230 Kent Ave (Block 2362, Lot 1). Under No-Action conditions, it is assumed the Projected Development Site would be occupied by a 2-story building. Under With-Action conditions it is assumed that this building would be expanded to a 3-story, 45-foot-tall rectangular building 20,233 gsf in size.

The HVAC emissions from the Projected Development Site could potentially impact both the Proposed Development as well as existing buildings within 400-feet of the Project Area that are taller than the development at the Projected Development Site. In addition, NYPA plant emissions may have the potential to impact the Projected Development Site.

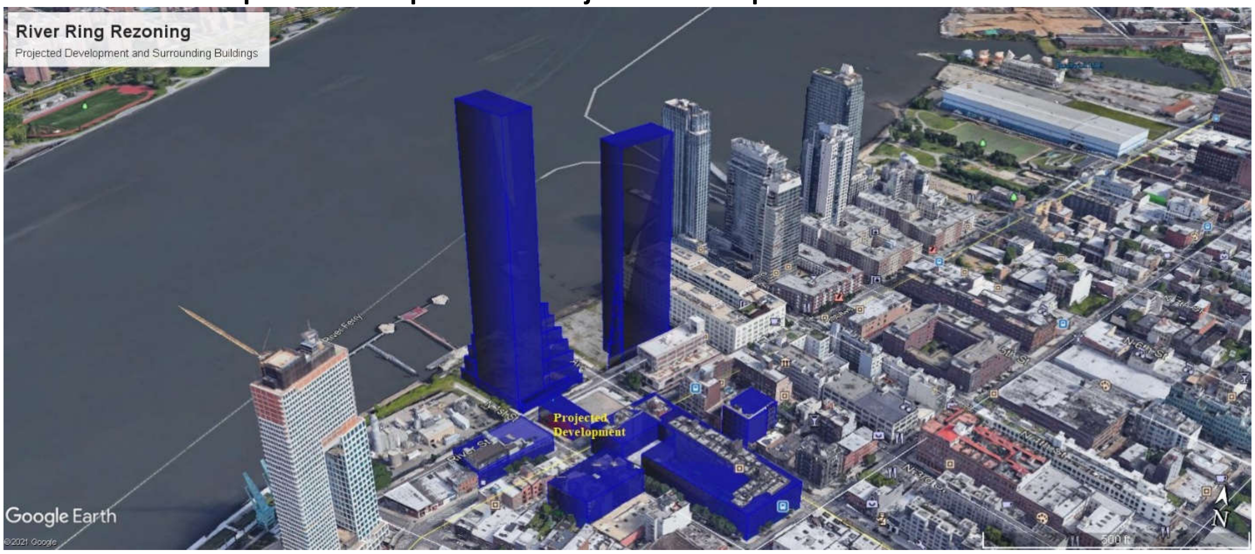
The air quality analysis was conducted to assure that the HVAC emissions from this Projected Development Site would not cause any potential significant impact on the Proposed Development and other nearby existing buildings. The HVAC system of Projected Development Site will use a traditional natural gas-fired boiler.

Review of the land use in the expanded rezoning area near the non-Applicant Projected Development Site identified seven buildings, including the proposed South and North Towers and four existing buildings within a 400-feet radius that may be affected by the HVAC emissions from the proposed Projected Development building. These are:

1. The 710-foot tall South Tower at 87 River Street (Block 2361, Lot 1) located approximately 50 feet from the Projected Development;
2. The 560-foot tall North Tower at 87 River Street (Block 2361, Lot 1) located approximately 200 feet from the Projected Development;
3. A 7-story existing building at 58 Metropolitan Ave (Block 2363, Lot 7502) located approximately 60 feet from the Projected Development;
4. A 4-story existing building at 234 Kent Ave (Block 2377, Lot 12) located approximately 50 feet from the Projected Development;
5. A 7-story existing building at 52 North 1st Street (Block 2378, Lot 11) located approximately 150 feet from the Projected Development;
6. A 6-story existing building at 80 Metropolitan Ave (Block 2363, Lot 7501) located approximately 160 feet from the Projected Development, and
7. A 5-story existing building at 67 Metropolitan Ave (Block 2357, Lot 25) located approximately 280 feet from the Projected Development.

The Projected Development Site and surrounding existing buildings are shown in **Figure 13-9**.

Figure 13-9
With-Action Development on Proposed and Projected Development Sites



Screening Analysis

In accordance with *CEQR Technical Manual* guidance, a preliminary screening analysis was conducted as a first step to predict whether the potential impacts of the HVAC emissions of the Projected Development would have the potential to significantly impact the other existing buildings and therefore require a detailed analysis.

The total square footage of Projected Development Site (20,233 gsf) was used with the conservative generic nomograph on Figure 17-3 of the *CEQR Technical Manual* "Stationary Source Screen," for a corresponding stack height, was applied. This nomograph depicts the size of development versus the distance below which a potential impact could occur and provides a threshold distance. As required by the *CEQR TM* screening procedure, the 30-foot curve in Figure 17-3 was applied as the 30-foot curve height is closest to but not higher than the stack height of Projected Development (45 feet). The estimated threshold distance is 70 feet.

If the actual distance between a building with an HVAC stack and an affected building is greater than the threshold distance for building size, then that building passes the screening analysis, and no significant impact is predicted. However, if the actual distance is less than the threshold distance for a building, then there is a potential for a significant impact, and a detailed analysis would be required.

The results of the screening project-on-existing analysis presented in **Table 13-9** show that the actual distances between three buildings (the North Tower, the 7-story building on Block 2378 Lot 11, and the 6-story building on Block 2363 Lot 7501), and the Projected Development Site are greater than the threshold distance determined by curve, indicating that all these buildings passed the screening analysis, and detailed analyses are not required. However, three other buildings – the South Tower, the 7-story building on Block 2363 Lot 7502, and the building on Block 2377 Lot 12 failed the screen, and therefore, require detailed AERMOD analyses.

TABLE 13-9
Results of the Screening Project-on-Existing Analysis

Building No.	Floor Area	Stack Height (1)	Potentially Impacted Buildings	Distance to Building	Threshold Distance by Nomograph	CEQR Nomograph Results
	gsf	feet		feet	feet	(Pass/Fail)
Projected Development Site	20,233	48	South Tower (Proposed Development	50	70	Fail
			Block 2363 Lot 7502	57		Fail
			Block 2377 Lot 12	50		Fail
			Block 237 Lot 11	154		Pass
			Block 2363 Lot 7501	198		Pass
			Block 237 Lot 25	280		Pass
			North Tower (Proposed Development)	201		Pass

Dispersion Analysis

The dispersion modeling analysis employed the same version of the AERMOD model with dispersion options and the same meteorological data set for 2015-2019, as those used for Proposed Development's South and North towers analysis. As the building at the Projected Development Site would be heated by natural gas, the two criteria pollutants (NO_2 and $PM_{2.5}$) associated with natural gas emissions were considered. The fuel factor was 45.2 cubic feet/sq ft/year was obtained from CEQR AQ Appendix - Table C25, Natural Gas Consumption and Conditional Energy Intensity by Census Region for Non-Mall Buildings, 2003, which is applicable for all northeast buildings. Heights of existing buildings were obtained from the NY City Open Data Shapefile database.

Emission rates for $PM_{2.5}$ and NO_2 were estimated using the floor area size of the Projected Development and the EPA AP-42 emission factors for firing natural gas in small boilers. Short-term NO_2 and $PM_{2.5}$ emission rates were estimated by accounting for seasonal variation in heat and hot water demand. Based on DCP guidance, seasonal emission factors for the winter season were set as 1.0 and at 0.5 for each of the three other seasons of the year.

The stack diameter and exit velocity were obtained as in the previous analysis from DEP's "CA Permit" database. The maximum boiler size was estimated based on the assumption that all fuel (natural gas) would be consumed during the 100-days (or 2,400-hour) heating season. The stack exit temperature was assumed to be 300°F (423°K), which is appropriate for building boilers. Estimated $PM_{2.5}$ and NO_2 emission rates are provided in **Table 13-10**.

TABLE 13-10
Estimated Short-term and Annual Pollutant Emission Rates

Building ID	Block/Lot	Stack Height (1)	Total Floor Area	$PM_{2.5}$ Emission Rate (2)		NO_2 Emission Rate	
		feet	ft^2	g/sec	g/sec	g/sec	g/sec
				24-hr	Annual	1-hr	Annual
Projected Development	2362/1	48	20,223	4.01E-04	1.10E-04	5.27E-03	1.44E-03

1. Stack height is 3 feet above the roof.
2. $PM_{2.5}$ emission factor for natural gas combustion of 7.6 lb/10^6 cubic feet included filterable and condensable particulate matter (Filterable $PM_{2.5}$ =1.9 lb/10^6 ft^3 and condensable $PM_{2.5}$ = 5.7 lb/10^6 ft^3 (AP-42, Table 1.4-2).

Stack and Receptor Locations

The stack was placed at the minimum distance (10 feet) from the property lot line facing nearby South Tower. Receptors of the South tower were those used in the NYPA analysis.

Because the stack on the Projected Development Site would be 48-feet high, some receptors on taller impacted buildings would be located at or above stack height and, as such, would be near the plume centerline -- where the highest impacts would likely occur. However, the potentially significant impact should be minimal because of the small amounts of emissions generated by this relatively small building.

Results of the Projected Development Site Analysis

Predicted potential $PM_{2.5}$ and NO_2 impacts with and without downwash are minimal (due to small building size and corresponding emission rates). The downwash effect plays role in dispersion due to the tall nearby South Tower. Results of this analysis with and without downwash for both $PM_{2.5}$ and NO_2 are provided in **Tables 13-11** through **13-14**.

$PM_{2.5}$

With the HVAC exhaust stack located at the minimum 10 feet distance from the edge of the Projected Development Site, the maximum estimated 24-hour $PM_{2.5}$ impacts are 0.07 ug/m^3 and 0.68 ug/m3, respectively, with or without downwash, which are less than the 24-hour *CEQR* significant impact value of 8.6 ug/m^3, and the total $PM_{2.5}$ concentrations (with the added background concentration) are less than 24-hour $PM_{2.5}$ NAAQS of 35 ug/m^3. The maximum annual average $PM_{2.5}$ impacts and the maximum total annual concentrations (with a background value of 7.6 ug/m^3) are less than either the *CEQR* annual *de minimis* criterion of 0.3 ug/m^3 or the annual $PM_{2.5}$ NAAQS of 12 ug/m^3.

Therefore, $PM_{2.5}$ emissions from the Projected Development Site HVAC system would not significantly impact the existing land uses.

The following (E) designation (E-636) will be required for the Projected Development Site:

<u>**Block 2362, Lot 1**</u> - **Projected Development Site**

Any new commercial, manufacturing and/or community development on the above-mentioned property must exclusively use natural gas as the type of fuel for HVAC systems to avoid any potential significant air quality impacts.

TABLE 13-11
$PM_{2.5}$ Analysis Results (with Downwash)

Building ID	Receptors Building	Maximum 24-hour Impact (1)	Maximum Annual Impact	*CEQR de minimis Criteria*	
				24-hour	**Annual**
Projected Development Site	**Existing Buildings and Proposed South Tower**	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
		0.5	<0.1	8.6	0.3
		24-hour Average Conc. (2)	**Annual Average Conc. (3)**	**NAAQS**	
				24-hour	**Annual**
		$\mu g/m^3$	**$\mu g/m^3$**	**$\mu g/m^3$**	**$\mu g/m^3$**
		18.2	7.6	35	12

Note:
1. Includes 24-hr $PM_{2.5}$ maximum impact of 0.5 ug/m^3.
2. Includes 24-hr $PM_{2.5}$ 5-year averaged impact of 0.4 ug/m^3 and background value of 17.8 ug/m^3.
3. Includes annual $PM_{2.5}$ background concentrations of 7.6 ug/m^3.

TABLE 13-12
$PM_{2.5}$ Analysis Results (Without Downwash)

Building ID	Receptor Buildings	Maximum 24-hour Impact (1)	Maximum Annual Impact	*CEQR de minimis* Criteria	
				24-hour	**Annual**
Projected Development Site	**Existing Buildings and Proposed South Tower**	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
		2.0	<0.1	8.6	0.3
		24-hour Average Conc. (2)	**Annual Average Conc. (3)**	**NAAQS**	
				24-hour	**Annual**
		$\mu g/m^3$	**$\mu g/m^3$**	**$\mu g/m^3$**	**$\mu g/m^3$**
		19.6	7.6	35	12

Note:
1. Includes a 24-hr $PM_{2.5}$ maximum impact of 2.0 ug/m^3.
2. Includes 24-hr $PM_{2.5}$ 5-year averaged impact of 1.8 ug/m^3 and a background value of 17.8 ug/m^3.

NO_2

Because Tier 1 was sufficient to demonstrate compliance with the 1-hour NO_2 with NAAQS, a Tier2/Tier 3 analysis was not employed. The maximum estimated 1-hour NO_2 concentrations with and without downwash, are less than the 1-hour NO_2 NAAQS of 188 ug/m^3 and the maximum annual NO_2 concentrations are less than the annual NO_2 NAAQS of 100 ug/m^3. Therefore, NO_2 emissions from the Projected Development Site's HVAC system would not significantly impact existing land uses or the proposed South Tower.

TABLE 13-13
NO_2 Analysis Results (with Downwash)

Building ID	Receptor Building	1-hour Conc. (1)	Annual Conc. (2)	NAAQS 1-hr/Annual
		μg/m^3	μg/m^3	μg/m^3
Projected Development Site	**Existing Buildings and Proposed South Tower**	117.3	27.8	188/100

1. Includes 1-hour/annual NO_2 impacts of 13.3 ug/m^3 and 0.18 ug/m3, respectively.
2. Includes 1-hour/annual NO_2 background concentrations of 104 and 27.6 ug/m^3, respectively.

TABLE 13-14
NO_2 Analysis Results (without Downwash)

Building ID	Receptor Building	1-hour Conc. (1)	Annual Conc. (2)	NAAQS 1-hr/Annual
		μg/m^3	μg/m^3	μg/m^3
Projected Development Site	**Existing Buildings and the Proposed South Tower**	143.4	28.1	188/100

Note:
1. Includes 1-hour/annual NO_2 impacts of 39.4 ug/m^3 and 0.49 ug/m^3, respectively.
2. Includes 1-hour/annual NO_2 background concentrations of 104 and 27.6 ug/m^{3,} respectively.

Summary of the Projected Development Analysis

No significant air quality impacts are associated with the Projected Development Site.

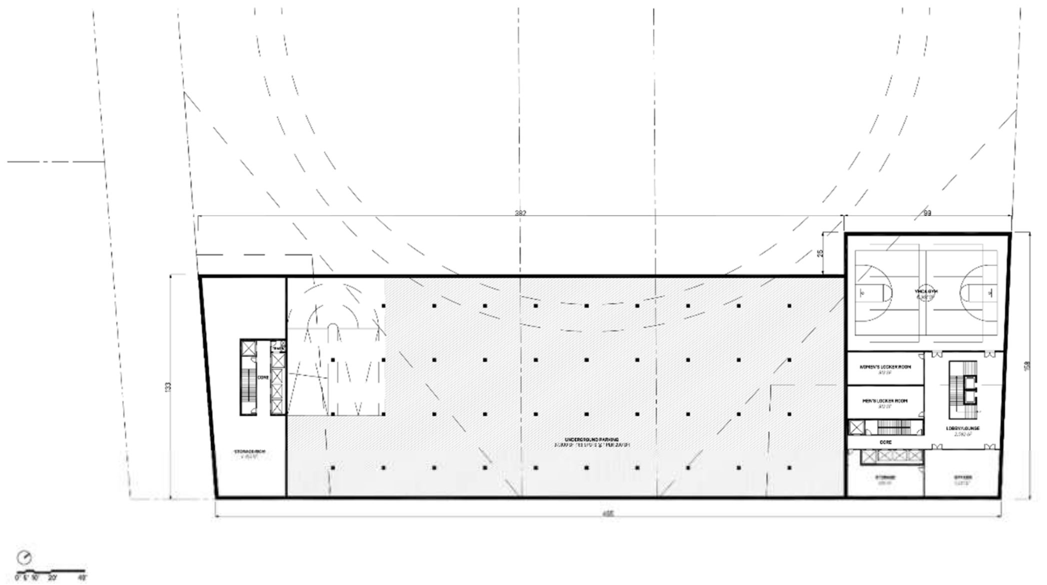
G. PARKING GARAGE ANALYSIS

The Proposed Development would include a 250-space below-grade parking garage. Emissions from the vehicles using the proposed garage could potentially affect pollutant levels at nearby sensitive land uses. An analysis, therefore, was conducted to determine whether the potential air quality impacts of these emissions, together with background traffic impacts, would be significant.

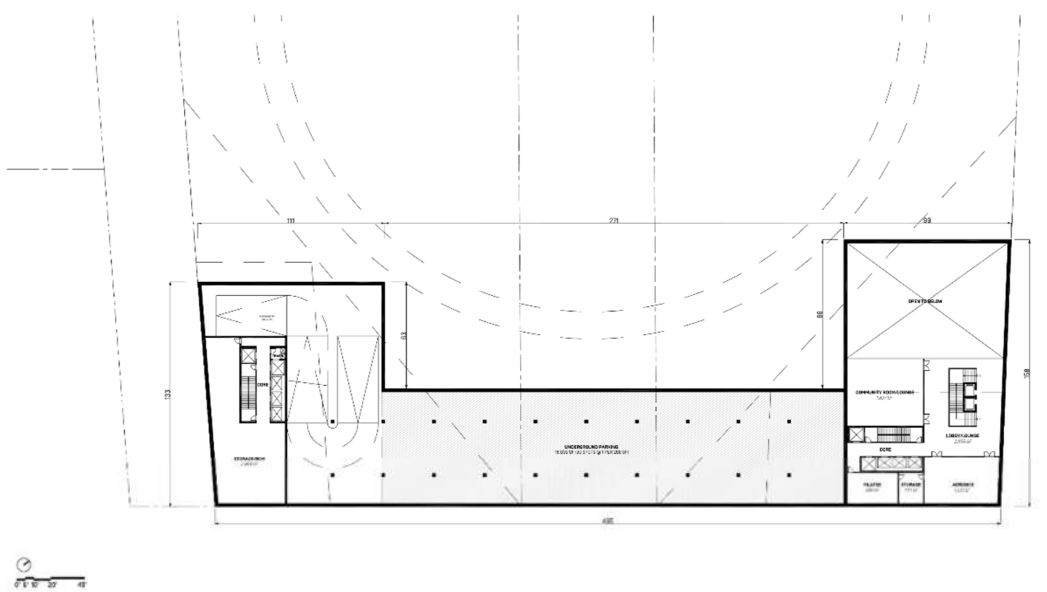
The garage, which will include ramps that will take vehicles down to two underground parking levels, will have an entrance and exit located on North 1st Street. The total underground garage area is 83,000 gsf and total ramp length on the two parking levels was estimated to be 274 feet. The total travel distance within the garage was estimated to be 757 feet. The preliminary garage plans are provided in **Figure 13-10**.

The highest ~~impact is~~ emissions are likely to occur at the garage exit. However, the location(s) of the exhaust vent(s) from the garage are yet determined. The build year for the garage is 2027.

Figure 13-10
Parking Garage Plan



LEVEL P2 PLAN



LEVEL P1 PLAN

Traffic Data

Traffic data on weekday parking accumulation, which include vehicular trips in and out of the garage, are provided in **Table 13-15**, which shows the hourly and the average number of incoming and outgoing vehicles for 1-hour, 8-hour, and 24-hour periods. The average 24-hour number of 28 vehicles in and 28 vehicles out was used for the $PM_{2.5}$ analysis and the highest average 8-hour number of 55 vehicles in and 48 vehicles out was used for CO analysis.

TABLE 13-15
Proposed Development's Weekday Parking Accumulation

Time	Vehicles			Accumulation
	In	Out	Total	
12-1AM	4	0	4	246
1-2 AM	4	0	4	250
2-3 AM	0	0	0	250
3-4 AM	0	0	0	250
4-5 AM	0	0	0	250
5-6 AM	4	7	11	247
6-7 AM	6	22	28	231
7-8 AM	14	37	51	208
8-9 AM	38	67	105	179
9-10AM	40	34	74	185
10-11 AM	37	33	70	189
11-12 AM	39	36	75	192
12-1 PM	39	38	77	193
1-2 PM	70	70	140	193
2-3 PM	46	37	83	202
3-4 PM	52	35	87	219
4-5 PM	64	54	118	229
5-6 PM	79	68	147	240
6-7 PM	51	44	95	247
7-8 PM	33	31	64	249
8-9 PM	26	25	51	250
9-10 PM	15	18	33	247
10-11 PM	12	14	26	245
11-12 PM	7	10	17	242
24-hr Average	28	28	56	
8-hr Average	55	48		
Peak 1-hour	70	70		

Peak Hour Traffic Volumes

Traffic volumes on the study area roadway network were developed for 2027 Existing, No-Build, and Build conditions for typical weekday AM, midday (MD), and PM peak hours. This includes all surrounding garage streets (N. 1st Street, N. 3rd Street and River Street, and others). **Figure 13-11** provides the 2027 With Action traffic volumes for the PM peak hour, which experiences the highest traffic volumes.

The primary area of concern for the garage analysis is North 1st Street and River Street because the garage exit/entrance, where the highest ~~impacts~~ emissions are likely to occur, is on North 1st and River Street, which is the closest street to the garage entrance. Metropolitan Avenue appears to be a dead-end street while North 3rd Street is more than 400 feet from the garage entrance. The highest hourly traffic volumes on North 1st Street are estimated to be 140 vehicles per hour while on River Street is 184 vehicles per hour. These background volumes were added to the garage-generated vehicular trips, and total volumes were modeled to estimate contributions from on-street vehicular traffic.

The highest ~~impact is~~emissions are likely to occur near the garage exit. As such, traffic volumes for the PM period were used to determine the background traffic component for analysis of the parking garage cumulative impact.

While the location(s) of the exhaust vent(s) from garage were yet determined, it was assumed, for the conservative purpose of this analysis, that the garage would have one exhaust vent and it would be located on the side of the building facing North 1st Street.

Methodology

The analysis was conducted following guidelines provided in the 2020 *CEQR TM* and AQ Appendix for parking facilities. The pollutants of concern for parking facilities are CO and $PM_{2.5}$.

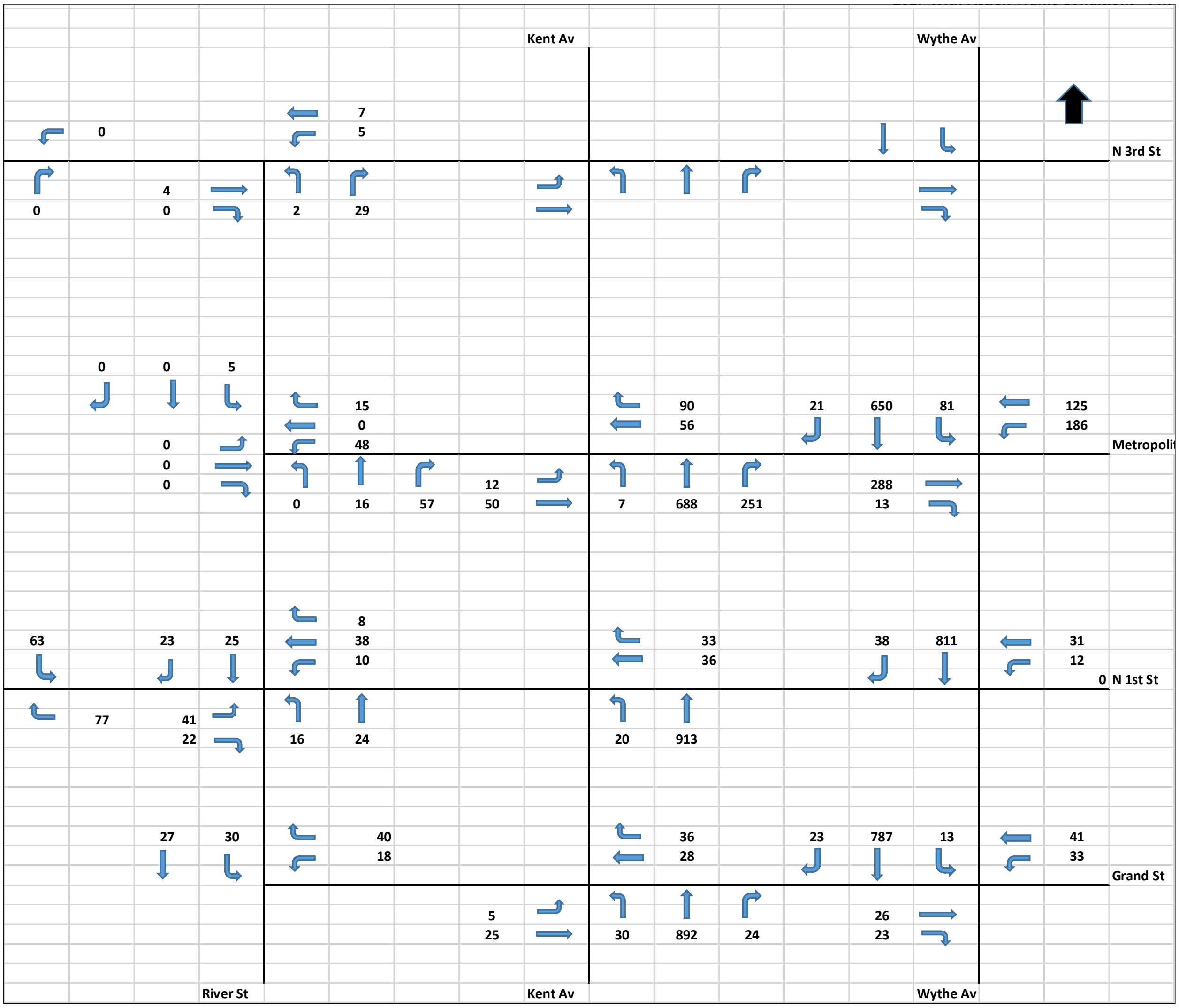
The proposed garage would be an enclosed facility with mechanical ventilation. To estimate pollutant concentrations, the garage's exhaust vent(s) was analyzed as a "virtual point source" using the computational procedure provided in EPA's Workbook of Atmospheric Dispersion Estimates (AP-26), as referenced in the *CEQR Technical Manual* on page 17-30. This methodology estimates concentrations at various distances from the vent (using appropriate initial horizontal and vertical dispersion coefficients) assuming that the concentrations within the garage are equal to the concentrations in the vent exhaust.

In accordance with *CEQR* guidance, pollutant concentrations were estimated at locations on near and far pedestrian sidewalks to ensure that the maximum cumulative effects from on-street traffic and garage emissions are estimated. Concentrations were also estimated at a window (receptor) assumed to be located directly above the vent.

Contributions from on-street CO and $PM_{2.5}$ vehicular emissions at these receptor locations were calculated through dispersion modeling analyses using EPA's AERMOD dispersion model, and these values were added to garage-generated impacts and appropriate background levels to estimate the total cumulative pollutant concentrations. Pollutant concentrations within the garage were calculated assuming a minimum ventilation rate, as per New York City Building Code requirements, of one cubic foot per minute of fresh air per gross square foot of garage area.

To determine compliance with the 8-hour CO *CEQR de minimis* criteria and NAAQS, and the 24-hour $PM_{2.5}$ CEQR *de minimis* criteria and NAAQS, maximum CO concentrations were predicted for 1 and 8-hour averaging periods and maximum $PM_{2.5}$ concentrations were predicted for a 24-hour and annual period.

Figure 13-11
Traffic Network Roadway Analysis Under 2027 With-Action PM Period



MOVES Emission Factors

MOVES2014b was used to estimate CO and $PM_{2.5}$ emission factors for entering, exiting, and idling vehicles within the garage, and vehicles travelling on nearby streets. Vehicles exiting the garage were assumed to idle for one minute before departing, and the speed within the garage was assumed to be 5 miles per hour (mph). Speeds on the nearby streets were assumed to be 25 mph.

Emission factors estimated by the MOVES model for moving and idling vehicles were used to estimate garage exhaust impacts and model CO and $PM_{2.5}$ emissions from on-street traffic with the AERMOD dispersion model.

Modeling inputs for inspection/maintenance, fuel supply and formulation, age distribution, meteorology, etc., were all based on a dataset provided by NYSDEC for the borough of Brooklyn. Running exhaust and crankcase running exhaust for $PM_{2.5}$, including brake and tire wear emissions, were all included in the emission factors estimates. Fugitive dust (i.e., from the re-entrainment of particles off the ground) emission factors for $PM_{2.5}$ were added to the emission factors calculated by MOVES.

Fugitive dust was estimated using equations from Section 13.2.1-3 of EPA's AP-42 for roadways with less than 5,000 vehicles a day applicable for roadways in the vicinity of the garage, The formulas are based on an average fleet weight, which varies according to the vehicular mix for a given roadway, and a silt loading factor. A silt loading factor of 0.16 g/m^{2}was used, as recommended by the *CEQR TM*.

The build year of 2027 was used to generate pollutant emission factors with MOVES model, which was run for the peak PM period.

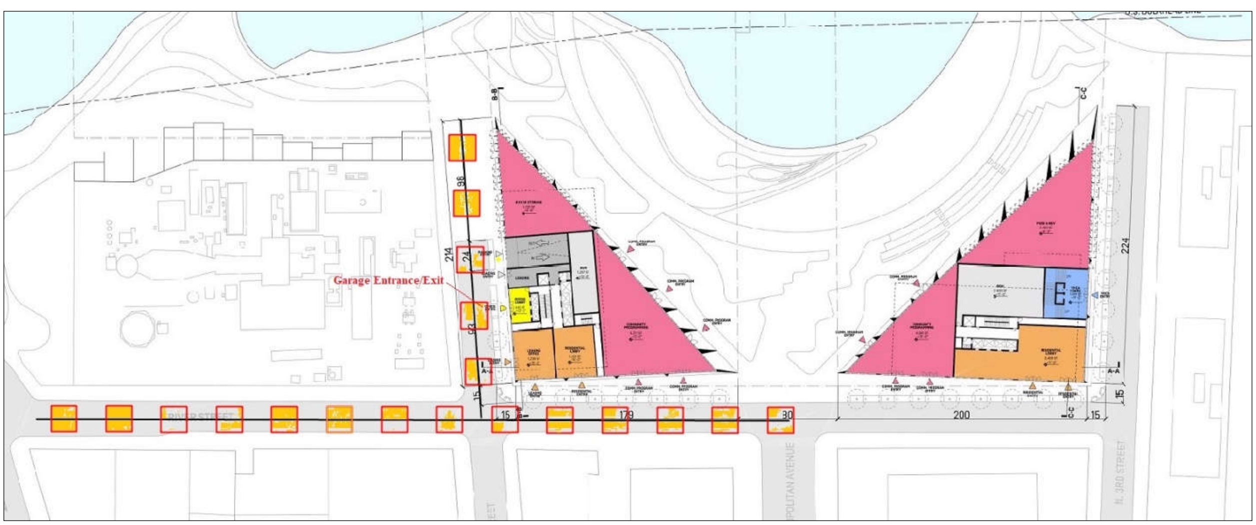
Post-processing was conducted using the MOVES MariaDB HeidiSQL tool data management software application to extract CO and $PM_{2.5}$ emission factors from MOVES output for each link included in the analysis. These emission factors, together with traffic hourly volumes on each link, were used to model nearby roadway link emissions with the AERMOD model.

Dispersion Analysis

The AERMOD dispersion model was used to estimate CO and $PM_{2.5}$ contributions from the vehicular traffic on the nearby roadway links as components of the total predicted pollutant concentrations. AERMOD is currently recommended by EPA as a preferred model to estimate concentration from vehicular traffic at intersections, highways, by simulating them as a line, volume, or area sources.

Roadway links (see **Figure 13-12**) were modeled using an array of adjacent volume sources to represent a line source. A release height of 0.152 meters for the exhaust tailpipe was used, as recommended by the DCP. Adjusted roadway width included width of the road plus 6 meters to account for dispersion in mixing zone, as required. Inputs to the model included emission rates in grams per second of each adjacent volume source and link coordinates. Dispersion parameters (initial lateral and vertical dimensions) were calculated by the model. Meteorological data from LaGuardia Airport for the 2015-2019 years were used for this analysis.

Figure 13-12
Traffic Roadway Links



Concentrations were estimated at the near garage vent along North 1st Street and the receptor located across the street at the middle of the far sidewalk. Concentrations at the window receptors (assumed to be located above the exhaust vent) was also estimated. The vent was assumed to be 12 feet above the ground and the window above the vent was assumed to be 5 feet higher than the vent (e.g., 17 feet). A pedestrian on the adjacent sidewalk was assumed to be 5 feet from the garage vent while a pedestrian standing in the middle of the far sidewalk across North 1st Street was approximately 46 feet from the vent.

The analysis for estimating pollutant concentrations was conducted based on the computational procedures provided in the *CEQR Technical Manual*, which uses spreadsheets that include garage dimensions and total parking area, vent height(s), receptor distances from the vent, number of vehicles entering and exiting garage, emission factors for moving and idling vehicles, and pre-tabulated dispersion parameters to estimate concentration at the near and far sidewalks and windows above the vent. CO and $PM_{2.5}$ concentrations from the on-street sources were added to garage impacts on far sidewalk receptors and the total cumulative CO and $PM_{2.5}$ concentrations were estimated by adding together the contributions from the garage exhaust vent, on-street sources, and background levels. The maximum estimated total 1-hour and 8-hour CO concentrations were compared to the 1-hour and 8-hour CO NAAQS of 35 and 9 ppm, respectively, and CEQR *de minimis* criteria, and the maximum estimated 24-hour $PM_{2.5}$ impact was compared to the *CEQR* $PM_{2.5}$ *de minimis* criteria and (with the added background concentration) to the 24-hour $PM_{2.5}$ NAAQS.

All modeling inputs and emission factors determined by the MOVES model and AERMOD inputs, spreadsheets with estimated CO and $PM_{2.5}$ concentrations within the garage, at windows above the vent, near and far sidewalks, and on-street traffic as well as the cumulative pollutant concentrations at these locations and comparison to the NAAQS and *de minimis* criteria for CO and the *CEQR de minimis* for $PM_{2.5}$ are provided in the back-up documentation for this project.

Results

The results of the garage analyses are summarized in **Tables 13-16** and **13-17**. As shown, the maximum estimated total 8-hour CO concentrations, including the background concentration, for near sidewalk, far sidewalk, and the window above the vent are all less than the *CEQR de minimis* criteria and the 8-hour CO NAAQS of 9 ppm. The maximum 24-hour $PM_{2.5}$ impact and total concentration are less than the *CEQR de minimis* criterion and respective NAAQS. As such, the proposed garage impact together with on-street mobile source emissions would not cause a significant adverse air quality impact.

Summary of Garage Analysis Results

The result of the analysis is that the garage emissions from the Proposed Action garage – together with on-street mobile source emissions -- would not result in any significant adverse air quality impact.

TABLE 13-16
Estimated Cumulative 1-hr/8-hr CO Concentrations from Garage and On-Street Traffic

	Near Sidewalk	Far Sidewalk	Window Above
Distance from Vent (feet)	5	46	5
Averaging Period		**1-hour**	
Garage CO (ppm)	1.3	1.06	1.05
Line Source (ppm)		0.17	
Cumulative Garage impact (ug/m^3)	1.3	1.23	1.05
Significant Garage Impact?	**No**	**No**	**No**
Background Value (ppm)		1.5	
Total CO Concentration (ppm)	2.8	2.7	2.6
NAAQS, CO (ppm)		35	
Significant Impact?	**No**	**No**	**No**
Averaging Period		**8-hour**	
Garage CO (ppm)	0.91	0.86	0.74
Line Source (ppm)		0.12	
Cumulative Garage impact (ug/m^3)	0.91	0.98	0.74
CEQR *De Minimis* (ug/m^3)		4.0	
Significant Garage Impact?	**No**	**No**	**No**
Background Value (ppm)		1.1	
Total CO Concentration (ppm)	2.0	2.1	1.8
NAAQS, CO (ppm)		9	
Significant Impact?	**No**	**No**	**No**

TABLE 13-17
Estimated Cumulative 24-hr/Annual $PM_{2.5}$ Concentrations from Garage and On-Street Traffic

	Near Sidewalk	Far Sidewalk	Window Above
Distance from Vent (feet)	5	46	5
Averaging Period	**24-hour**		
Garage $PM_{2.5}$ (ug/m^3)	1.6	1.3	1.6
Line Source (ug/m^3)	-	1.9	-
Cumulative Garage impact (ug/m^3)	1.6	3.2	1.6
CEQR *De Minimis* (ug/m^3)	8.6		
Significant Garage Impact?	**No**	**No**	**No**
Background Value (ug/m^3)	17.8		
Total 24-hr $PM_{2.5}$ Concentration (ug/m^3)	19.4	21.0	19.4
NAAQS, 24-hr $PM_{2.5}$ (ug/m^3)	35		
Exceeds NAAQS?	**No**	**No**	**No**
Averaging Period	**Annual***		
Conversion factor annual/24-hour	0.2		
Annual Garage impact (ug/m^3)	0.3	0.3	0.3
CEQR De Minimis (ug/m^3)	0.3		
Significant Garage Impact?	**No**	**No**	**No**
Background Value (ug/m^3)	7.6		
Total Annual $PM_{2.5}$ Concentration (ug/m^3)	7.9	7.9	7.9
NAAQS, Annual $PM_{2.5}$ (ug/m^3)	12		
Exceeds NAAQS?	**No**	**No**	**No**

- No annual line source modeled concentration

H. INDUSTRIAL SOURCE ANALYSIS

In accordance with Section 220 of *CEQR Technical Manual* Chapter 17 Air Quality, projects that would result in new uses located within 400 feet of manufacturing or processing facilities may be under potentially significant impact of air toxics emitted by these facilities. Data Sources

Information regarding possible emissions of toxic air pollutants from existing nearby industrial sources was collected using the following procedure:

- Based on a review of existing land uses with Open Accessible Space Information System (OASIS) mapping and data analysis application including land-use option, an aerial photograph via Google Earth of the area within 400 feet of the project, several industrial sources were identified.
- A formal request for the relevant permitted information for these facilities, with block and lot numbers, was submitted to the NYCDEP.

The permit or permit application data received from DEP contained the following information:

- Two permits (PA001592 and PR010718) are for combustion sources (not industrial sources with toxic air pollutants) and, therefore, were omitted from consideration;
- Two permits (PA054981 and PA046496) are for painting operations; and
- Two permits (PA017772 and PA054394) are for food processing facilities.

- Two permits PA055081 and PA052990 could not be retrieved.

All permits were listed as long expired (from 1996). In addition, a review of these permits as well as a field survey showed that none of these permitted facilities are still operating in this area and, therefore, they were eliminated from the further consideration. As such, no significant impacts from industrial sources with toxic pollutants are anticipated from industrial sources located within 400 feet of the Proposed and Projected Development Sites.

Summary of Industrial Analysis Results

The result of the analysis is that there are no existing nearby (i.e., within 400 of the project area) industrial facilities that could impact the Proposed Development or development at the Projected Development Site.