A. INTRODUCTION

This chapter discusses sources of air pollutant emissions and their potential effect that could result from development of the Cornell NYC Tech project on Roosevelt Island (the "proposed project"). Air quality impacts can be either direct or indirect. Direct impacts result from emissions generated by stationary sources at a development site, such as emissions from on-site fuel combustion for heat and hot water systems. Indirect impacts are impacts from emissions associated with the transportation of people and goods or solid waste to and from a proposed project.

Cornell has proposed a substantial use of renewable sources of energy, including potential applications of geothermal, photovoltaic panels, and fuel cells. However, for the purpose of this air quality analysis, it is conservatively assumed that natural gas-fired combustion equipment would be used to provide building heat and hot water, and to provide a portion of campus electrical energy needs. Potential effects on the proposed project from nearby existing emission sources were not examined since stationary sources of concern were not identified around the project site.

The proposed project would increase traffic in the vicinity of the proposed project site. Therefore, an analysis was performed on the potential impacts on air quality from motor vehicles.

The results of the air quality analysis determined that the maximum predicted pollutant concentrations and concentration increments from mobile sources and stationary sources in Phase 1 and the Full Build of the proposed project would be below the applicable air quality impact criteria. Specific design measures would be required to ensure that stationary source impacts do not exceed applicable standards.

B. POLLUTANTS FOR ANALYSIS

Ambient air quality is affected by air pollutants produced both by motor vehicles and stationary sources. Emissions from motor vehicles are referred to as mobile source emissions, while emissions from fixed facilities are referred to as stationary source emissions. Ambient concentrations of carbon monoxide (CO) are predominantly influenced by mobile source emissions. Particulate matter (PM), volatile organic compounds (VOCs), and nitrogen oxides (nitric oxide, NO, and nitrogen dioxide, NO_2, collectively referred to as NO_x) are emitted from both mobile and stationary sources. Fine PM is also formed when emissions of NO_x, sulfur oxides (SO_x), ammonia, organic compounds, and other gases react or condense in the atmosphere. Emissions of sulfur dioxide (SO_2) are associated mainly with stationary sources, and sources utilizing non-road diesel such as diesel trains, marine engines, and non-road vehicles (e.g., construction engines). On-road diesel vehicles currently contribute very little to SO_2 emissions since the sulfur content of on-road diesel fuel, which is federally regulated, is extremely low. Ozone is formed in the atmosphere by complex photochemical processes that include NO_x and VOCs.

CARBON MONOXIDE

CO, a colorless and odorless gas, is produced in the urban environment primarily by the incomplete combustion of gasoline and other fossil fuels. In urban areas, approximately 80 to 90 percent of CO emissions are from motor vehicles. Since CO is a reactive gas which does not persist in the atmosphere, CO concentrations can vary greatly over relatively short distances; elevated concentrations are usually limited to locations near crowded intersections, heavily traveled and congested roadways, parking lots, and garages. Consequently, CO concentrations must be predicted on a local, or microscale, basis.

The proposed project would result in changes in traffic patterns and an increase in traffic volumes in the study area. Therefore, a mobile source analysis was conducted at critical intersections in the study area to evaluate future CO concentrations with and without the proposed project.

A parking garage analysis was also conducted to evaluate future CO concentrations with the operation of the parking garages associated with the proposed project.

NITROGEN OXIDES, VOCS, AND OZONE

NO_x are of principal concern because of their role, together with VOCs, as precursors in the formation of ozone. Ozone is formed through a series of reactions that take place in the atmosphere in the presence of sunlight. Because the reactions are slow, and occur as the pollutants are advected downwind, elevated ozone levels are often found many miles from the sources of the precursor pollutants. The effects of NO_x and VOC emissions from all sources are therefore generally examined on a regional basis. The contribution of any action or project to regional emissions of these pollutants would include any added stationary or mobile source emissions; the change in regional mobile source emissions of these pollutants would be related to the total vehicle miles traveled added or subtracted on various roadway types throughout the New York metropolitan area, which is designated as a moderate non-attainment area for ozone by the U.S. Environmental Protection Agency (EPA).

The proposed project would not have a significant effect on the overall volume of vehicular travel in the metropolitan area; therefore, no measurable impact on regional NO_x emissions or on ozone levels is predicted. An analysis of project-related emissions of these pollutants from transportation sources was therefore not warranted.

In addition to being a precursor to the formation of ozone, NO_2 (one component of NO_x) is also a regulated pollutant. Since NO_2 is mostly formed from the transformation of NO in the atmosphere, it has mostly been of concern farther downwind from large stationary point sources, and not a local concern from mobile sources. (NO_x emissions from fuel combustion consist of approximately 90 percent NO and 10 percent NO_2 at the source.) However, with the promulgation of the 2010 1-hour average standard for NO_2, local sources such as vehicular emissions may become of greater concern for this pollutant. Potential impacts on local NO_2 concentrations from fuel combustion for power, heat and hot water systems for the full development of the proposed project are addressed.

LEAD

Airborne lead emissions are currently associated principally with industrial sources. Effective January 1, 1996, the Clean Air Act (CAA) banned the sale of the small amount of leaded fuel that was still available in some parts of the country for use in on-road vehicles, concluding a 25-year effort to phase out lead in gasoline. Even at locations in the New York City area where traffic volumes are very high, atmospheric lead concentrations are far below the 3-month average national standard of 0.15 micrograms per cubic meter ($\mu g/m^3$).

No significant sources of lead are associated with the proposed project and, therefore, analysis was not warranted.

RESPIRABLE PARTICULATE MATTER—PM_{10} AND $PM_{2.5}$

PM is a broad class of air pollutants that includes discrete particles of a wide range of sizes and chemical compositions, as either liquid droplets (aerosols) or solids suspended in the atmosphere. The constituents of PM are numerous and varied, and they are emitted from a wide variety of sources (both natural and anthropogenic). Natural sources include the condensed and reacted forms of naturally occurring VOC; salt particles resulting from the evaporation of sea spray; wind-borne pollen, fungi, molds, algae, yeasts, rusts, bacteria, and material from live and decaying plant and animal life; particles eroded from beaches, soil, and rock; and particles emitted from volcanic and geothermal eruptions and from forest fires. Naturally occurring PM is generally greater than 2.5 micrometers in diameter. Major anthropogenic sources include the combustion of fossil fuels (e.g., vehicular exhaust, power generation, boilers, engines, and home heating), chemical and manufacturing processes, all types of construction, agricultural activities, as well as wood-burning stoves and fireplaces. PM also acts as a substrate for the adsorption (accumulation of gases, liquids, or solutes on the surface of a solid or liquid) of other pollutants, often toxic, and some likely carcinogenic compounds.

As described below, PM is regulated in two size categories: particles with an aerodynamic diameter of less than or equal to 2.5 micrometers ($PM_{2.5}$), and particles with an aerodynamic diameter of less than or equal to 10 micrometers (PM_{10}, which includes $PM_{2.5}$). $PM_{2.5}$ has the ability to reach the lower regions of the respiratory tract, delivering with it other compounds that adsorb to the surfaces of the particles; it is also extremely persistent in the atmosphere. $PM_{2.5}$ is mainly derived from combustion material that has volatilized and then condensed to form primary PM (often soon after the release from a source exhaust) or from precursor gases reacting in the atmosphere to form secondary PM.

Diesel-powered vehicles, such as heavy-duty trucks, buses, and marine vessels are a potentially significant source of respirable PM, most of which is $PM_{2.5}$; PM concentrations may, consequently, be locally elevated near roadways with high volumes of heavy, diesel-powered vehicles.

An analysis was conducted to assess the worst case PM impacts due to the increased traffic associated with the proposed project.

Stationary combustion by the proposed project’s HVAC system would result in emissions of PM; therefore, the HVAC system was evaluated for potential impacts. Potential 24-hour and annual incremental impacts of $PM_{2.5}$ from the HVAC system were evaluated using an incremental microscale analysis.

SULFUR DIOXIDE

SO_2 emissions are primarily associated with the combustion of sulfur-containing fuels (oil and coal). Monitored SO_2 concentrations in New York City are lower than the current national standards. Due to the federal restrictions on the sulfur content in diesel fuel for on-road and non-road vehicles, no significant quantities are emitted from vehicular sources. Vehicular sources of SO_2 are not significant and therefore, analysis of SO_2 on-road vehicles is not warranted.

As part of the proposed project, natural gas would be burned in the proposed heat and hot water systems. The sulfur content of natural gas is negligible; therefore, no analysis was performed to estimate the future levels of SO_2 with the proposed project.

C. AIR QUALITY REGULATIONS, STANDARDS, AND BENCHMARKS

NATIONAL AND STATE AIR QUALITY STANDARDS

As required by the CAA, primary and secondary National Ambient Air Quality Standards (NAAQS) have been established for six major air pollutants: CO, NO_2, ozone, respirable PM (both $PM_{2.5}$ and PM_{10}), SO_2, and lead. The primary standards represent levels that are requisite to protect the public health, allowing an adequate margin of safety. The secondary standards are intended to protect the nation's welfare, and account for air pollutant effects on soil, water, visibility, materials, vegetation, and other aspects of the environment. The primary and secondary standards are the same for NO_2 (annual), ozone, lead, and PM, and there is no secondary standard for CO and the 1-hour NO_2 standard. The NAAQS are presented in **Table 15-1**. The NAAQS for CO, annual NO_2, and 3-hr SO_2 have also been adopted as the ambient air quality standards for New York State, but are defined on a running 12-month basis rather than for calendar years only. New York State also has standards for total suspended particulate matter (TSP), settleable particles, non-methane hydrocarbons (NMHC), 24-hour and annual SO_2, and ozone that correspond to federal standards that have since been revoked or replaced, and for the noncriteria pollutants beryllium, fluoride, and hydrogen sulfide (H_2S).

EPA has revised the NAAQS for PM, effective December 18, 2006. The revision included lowering the level of the 24-hour $PM_{2.5}$ standard from 65 $\mu g/m^3$ to 35 $\mu g/m^3$ and retaining the level of the annual standard at 15 $\mu g/m^3$. The PM_{10} 24-hour average standard was retained and the annual average PM_{10} standard was revoked. EPA also proposed lowering the primary annual-average standard to within the range 12-13 $\mu g/m^3$. A final decision on this standard is expected by December 14, 2012.

EPA has also revised the 8-hour ozone standard, lowering it from 0.08 to 0.075 parts per million (ppm), effective as of May 2008. On January 6, 2010, EPA proposed a change in the 2008 ozone NAAQS, lowering the primary NAAQS from the current 0.075 ppm level to within the range of 0.060 to 0.070 ppm. EPA is also proposing a secondary ozone standard, measured as a cumulative concentration within the range of 7 to 15 ppm-hours aimed mainly at protecting sensitive vegetation. A final decision on this standard has been postponed but is expected to occur in 2013.

EPA lowered the primary and secondary standards for lead to 0.15 $\mu g/m^3$, effective January 12, 2009. EPA revised the averaging time to a rolling 3-month average and the form of the standard to not-to-exceed across a 3-year span.

Table 15-1
National Ambient Air Quality Standards (NAAQS)

Pollutant	Primary		Secondary	
	ppm	µg/m³	ppm	µg/m³
Carbon Monoxide (CO)				
8-Hour Average [1]	9	10,000	None	
1-Hour Average [1]	35	40,000		
Lead				
Rolling 3-Month Average	NA	0.15	NA	0.15
Nitrogen Dioxide (NO_2)				
1-Hour Average [2]	0.100	188	None	
Annual Average	0.053	100	0.053	100
Ozone (O_3)				
8-Hour Average [3,4]	0.075	150	0.075	150
Respirable Particulate Matter (PM_{10})				
24-Hour Average [1]	NA	150	NA	150
Fine Respirable Particulate Matter ($PM_{2.5}$)				
Annual Mean	NA	15	NA	15
24-Hour Average [5]	NA	35	NA	35
Sulfur Dioxide (SO_2) [6]				
1-Hour Average[7]	0.075	196	NA	NA
Maximum 3-Hour Average [1]	NA	NA	0.50	1,300

Notes: ppm – parts per million
µg/m³ – micrograms per cubic meter
NA – not applicable
All annual periods refer to calendar year.
PM concentrations (including lead) are in µg/m³ since ppm is a measure for gas concentrations. Concentrations of all gaseous pollutants are defined in ppm and approximately equivalent concentrations in µg/m³ are presented.
(1) Not to be exceeded more than once a year.
(2) 3-year average of the annual 98th percentile daily maximum 1-hr average concentration. Effective April 12, 2010.
(3) 3-year average of the annual fourth-highest daily maximum 8-hr average concentration.
(4) EPA has proposed lowering this standard further to within the range 0.060-0.070 ppm, and adding a secondary standard measured as a cumulative concentration within the range of 7 to 15 ppm-hours aimed mainly at protecting sensitive vegetation.
(5) Not to be exceeded by the annual 98th percentile when averaged over 3 years.
(6) EPA revoked the 24-hour and annual primary standards, replacing them with a 1-hour average standard. Effective August 23, 2010.
(7) 3-year average of the annual 99th percentile daily maximum 1-hr average concentration.

Source: 40 CFR Part 50: National Primary and Secondary Ambient Air Quality Standards.

EPA established a 1-hour average NO_2 standard of 0.100 ppm, effective April 12, 2010, in addition to the annual standard. The statistical form is the 3-year average of the 98th percentile of daily maximum 1-hour average concentration in a year.

EPA also established a 1-hour average SO_2 standard of 0.075 ppm, replacing the 24-hour and annual primary standards, effective August 23, 2010. The statistical form is the 3-year average of the 99th percentile of the annual distribution of daily maximum 1-hour concentrations (the 4th highest daily maximum corresponds approximately to the 99th percentile for a year.)

NAAQS ATTAINMENT STATUS AND STATE IMPLEMENTATION PLANS

The CAA, as amended in 1990, defines non-attainment areas (NAA) as geographic regions that have been designated as not meeting one or more of the NAAQS. When an area is designated as non-attainment by EPA, the state is required to develop and implement a State Implementation Plan (SIP), which delineates how a state plans to achieve air quality that meets the NAAQS under the deadlines established by the CAA.

In 2002, EPA re-designated New York City as in attainment for CO. The Clean Air Act requires that a maintenance plan ensure continued compliance with the CO NAAQS for former non-attainment areas. New York City is also committed to implementing site-specific control measures throughout the city to reduce CO levels, should unanticipated localized growth result in elevated CO levels during the maintenance period.

Manhattan has been designated as a moderate NAA for PM_{10}. On December 17, 2004, EPA took final action designating the five New York City counties and Nassau, Suffolk, Rockland, Westchester, and Orange Counties as a $PM_{2.5}$ non-attainment area under the Clean Air Act due to exceedance of the annual average standard. Based on recent monitoring data (2006-2009), annual average concentrations of $PM_{2.5}$ in New York City no longer exceed the annual standard.

As described above, EPA has revised the 24-hour average $PM_{2.5}$ standard. In October 2009 EPA finalized the designation of the New York City Metropolitan Area as nonattainment with the 2006 24-hour $PM_{2.5}$ NAAQS, effective in November 2009. The nonattainment area includes the same 10-county area designated as nonattainment with the 1997 annual $PM_{2.5}$ NAAQS. Based on recent monitoring data (2007-2009), 24-hour average concentrations of $PM_{2.5}$ in this area no longer exceed the standard. New York has submitted a “Clean Data” request to EPA. Any requirement to submit a SIP is stayed until EPA acts on New York’s request.

Nassau, Rockland, Suffolk, Westchester, Lower Orange County Metropolitan Area (LOCMA), and the five New York City counties had been designated as a severe non-attainment area for ozone (1-hour average standard, 0.12 ppm). In November 1998, New York State submitted its *Phase II Alternative Attainment Demonstration for Ozone*, which was finalized and approved by EPA effective March 6, 2002, addressing attainment of the 1-hour ozone NAAQS by 2007. The 1-hour standard was revoked in 2004 when it was replaced by the 8-hour ozone standard, but certain further requirements remained (‘anti-backsliding’). On December 7, 2009, EPA determined that the Poughkeepsie nonattainment area (Dutchess, Orange, Ulster, and Putnam counties) has attained the 1-hour standard. On June 18, 2012, EPA determined that the New York Metropolitan Area (NYMA) has also attained the standard. Although not yet a redesignation to attainment status, this determination removes further requirements under the 1-hour standard.

Effective June 15, 2004, EPA designated these same counties as moderate non-attainment for the 1997 8-hour average ozone standard (LOCMA was moved to the Poughkeepsie moderate non-attainment area for 8-hour ozone). On February 8, 2008, the New York State Department of Environmental Conservation (NYSDEC) submitted final revisions to the SIP to EPA to address the 1997 8-hour ozone standard. On December 7, 2009, EPA determined that the Poughkeepsie nonattainment area has attained the 1997 8-hour standard. On June 18, 2012, EPA determined that the NYMA has attained the 1997 8-hour ozone NAAQS (0.08 ppm). Although not yet a redesignation to attainment status, this determination removes further requirements under the 1997 8-hour standard.

In March 2008 EPA strengthened the 8-hour ozone standards. EPA designated the counties of Suffolk, Nassau, Bronx, Kings, New York, Queens, Richmond, Rockland, and Westchester (NY portion of the New York-Northern New Jersey-Long, NY-NJ-CT NAA) as a marginal non-attainment area for the 2008 ozone NAAQS, effective July 20, 2012.

New York City is currently in attainment of the annual-average NO_2 standard. EPA has designated the entire state of New York as "unclassifiable/attainment" for the new 1-hour NO_2 standard effective February 29, 2012. Since additional monitoring is required for the 1-hour standard, areas will be reclassified once three years of monitoring data are available (2016 or 2017).

EPA has established a 1-hour SO_2 standard that replaces the former 24-hour and annual standards, effective August 23, 2010. Based on the available monitoring data, all New York State counties currently meet the 1-hour standard. Additional monitoring will be required. EPA plans to make final attainment designations in the near future, based on 2008 to 2010 monitoring data and refined modeling. SIPs for nonattainment areas will be due by June 2014.

DETERMINING THE SIGNIFICANCE OF AIR QUALITY IMPACTS

The State Environmental Quality Review Act (SEQRA) regulations states that the significance of a predicted consequence of a project (i.e., whether it is material, substantial, large, or important) should be assessed in connection with its setting (e.g., urban or rural), its probability of occurrence, its duration, its irreversibility, its geographic scope, its magnitude, and the number of people affected.[1] In terms of the magnitude of air quality impacts, any action predicted to increase the concentration of a criteria air pollutant to a level that would exceed the concentrations defined by the NAAQS (see Table 15-1) would be deemed to have a potential significant adverse impact. In addition, in order to maintain concentrations lower than the NAAQS in attainment areas, or to ensure that concentrations will not be significantly increased in non-attainment areas, threshold levels have been defined for certain pollutants; any action predicted to increase the concentrations of these pollutants above the thresholds would be deemed to have a potential significant adverse impact, even in cases where violations of the NAAQS are not predicted.

DE MINIMIS CRITERIA REGARDING CO IMPACTS

New York City has developed *de minimis* criteria to assess the significance of the increase in CO concentrations that would result from the impact of proposed projects or actions on mobile sources, as set forth in the June 2012 *City Environmental Quality Review (CEQR) Technical Manual*. These criteria set the minimum change in CO concentration that defines a significant

[1] *CEQR Technical Manual*, Chapter 17, section 400, June 2012; and State Environmental Quality Review Regulations, 6 NYCRR § 617.7

environmental impact. Significant increases of CO concentrations in New York City are defined as: (1) an increase of 0.5 ppm or more in the maximum 8-hour average CO concentration at a location where the predicted No-Action 8-hour concentration is equal to or between 8 and 9 ppm; or (2) an increase of more than half the difference between baseline (i.e., No-Action) concentrations and the 8-hour standard, when No-Action concentrations are below 8.0 ppm.

$PM_{2.5}$ INTERIM GUIDANCE CRITERIA

NYSDEC has published a policy to provide interim direction for evaluating $PM_{2.5}$ impacts[2]. This policy applies only to facilities applying for permits or major permit modifications under SEQRA that emit 15 tons of PM_{10} or more annually. The policy states that such a project will be deemed to have a potentially significant adverse impact if the project's maximum impacts are predicted to increase $PM_{2.5}$ concentrations by more than 0.3 $\mu g/m^3$ averaged annually or more than 5 $\mu g/m^3$ on a 24-hour basis. Projects that exceed either the annual or 24-hour threshold will be required to prepare an Environmental Impact Statement (EIS) to assess the severity of the impacts, to evaluate alternatives, and to employ reasonable and necessary mitigation measures to minimize the $PM_{2.5}$ impacts of the source to the maximum extent practicable.

In addition, New York City uses interim guidance criteria for evaluating the potential $PM_{2.5}$ impacts for projects subject to CEQR. The interim guidance criteria currently employed for determination of potential significant adverse $PM_{2.5}$ impacts under CEQR are as follows:

- 24-hour average $PM_{2.5}$ concentration increments that are predicted to be greater than 5 $\mu g/m^3$ at a discrete receptor location would be considered a significant adverse impact on air quality under operational conditions (i.e., a permanent condition predicted to exist for many years regardless of the frequency of occurrence);
- 24-hour average $PM_{2.5}$ concentration increments that are predicted to be greater than 2 $\mu g/m^3$ but no greater than 5 $\mu g/m^3$ would be considered a significant adverse impact on air quality based on the magnitude, frequency, duration, location, and size of the area of the predicted concentrations;
- Annual average $PM_{2.5}$ concentration increments that are predicted to be greater than 0.1 $\mu g/m^3$ at ground level on a neighborhood scale (i.e., the annual increase in concentration representing the average over an area of approximately 1 square kilometer, centered on the location where the maximum ground-level impact is predicted for stationary sources; or at a distance from a roadway corridor similar to the minimum distance defined for locating neighborhood scale monitoring stations); or
- Annual average $PM_{2.5}$ concentration increments that are predicted to be greater than 0.3 $\mu g/m^3$ at a discrete receptor location (elevated or ground level).

Actions under CEQR predicted to increase $PM_{2.5}$ concentrations by more than the above interim guidance criteria will be considered to have a potential significant adverse impact. The *CEQR Technical Manual* recommends that actions subject to CEQR that fail the interim guidance criteria prepare an EIS and examine potential measures to reduce or eliminate such potential significant adverse impacts.

The proposed project's annual emissions of PM_{10} are estimated to be well below the 15-ton-per-year threshold under NYSDEC's $PM_{2.5}$ policy guidance. The above city and NYSDEC interim

[2] CP33/Assessing and Mitigating Impacts of Fine Particulate Emissions, NYSDEC 12/29/2003.

guidance criteria have been used to evaluate the significance of predicted impacts of the proposed project on $PM_{2.5}$ concentrations and determine the need to minimize particulate matter emissions from the proposed project.

D. METHODOLOGY

MOBILE SOURCES

The prediction of vehicle-generated emissions and their dispersion in an urban environment incorporates meteorological phenomena, traffic conditions, and physical configuration. Air pollutant dispersion models mathematically simulate how traffic, meteorology, and physical configuration combine to affect pollutant concentrations. The mathematical expressions and formulations contained in the various models attempt to describe an extremely complex physical phenomenon as closely as possible. However, because all models contain simplifications and approximations of actual conditions and interactions, and since it is necessary to predict the reasonable worst-case condition, most dispersion analyses predict conservatively high concentrations of pollutants, particularly under adverse meteorological conditions.

The mobile source analyses for the proposed project employ a model approved by EPA that has been widely used for evaluating air quality impacts of projects in New York City, other parts of New York State, and throughout the country. The modeling approach includes a series of conservative assumptions relating to meteorology, traffic, and background concentration levels resulting in a conservatively high estimate of expected pollutant concentrations that could ensue from the proposed project. The assumptions used in the PM analysis were based on the latest $PM_{2.5}$ interim guidance developed by NYCDEP.

VEHICLE EMISSIONS

Engine Emissions

Vehicular CO and PM engine emission factors are computed using the EPA mobile source emissions model, MOBILE6.2[3]. This emissions model is capable of calculating engine emissions factors for various vehicle types, based on the fuel type (gasoline, diesel, or natural gas), meteorological conditions, vehicle speeds, vehicle age, roadway types, number of starts per day, engine soak time, and various other factors that influence emissions, such as inspection maintenance programs. The inputs and use of MOBILE6.2 incorporate the most current guidance available from NYSDEC and NYCDEP.

Vehicle classification data were based on field studies. Appropriate credits were used to accurately reflect the inspection and maintenance program. The inspection and maintenance programs require inspections of automobiles and light trucks to determine if pollutant emissions from each vehicle exhaust system are lower than emission standards. Vehicles failing the emissions test must undergo maintenance and pass a repeat test to be registered in New York State.

[3] EPA, User's Guide to MOBILE6.1 and MOBILE6.2: Mobile Source Emission Factor Model, EPA420-R-03-010, August 2003.

All taxis were assumed to be in hot stabilized mode (i.e., excluding any start emissions). The general categories of vehicle types for specific roadways were further categorized into subcategories based on their relative breakdown within the fleet.

An ambient temperature of 43 degrees Fahrenheit is used. The use of this temperature is recommended in the *CEQR Technical Manual* for the Borough of Queens and is consistent with current NYCDEP guidance.

Road Dust

The contribution of re-entrained road dust to PM_{10} concentrations, as presented in the PM_{10} SIP, is considered to be significant; therefore, the PM_{10} estimates include both exhaust and road dust. In accordance with the $PM_{2.5}$ interim guidance criteria methodology, $PM_{2.5}$ emission rates are determined with fugitive road dust to account for their impacts in local microscale analyses. However, fugitive road dust is not included in the neighborhood scale $PM_{2.5}$ microscale analyses since NYCDEP considers it to have an insignificant contribution on that scale. Road dust emissions factors are calculated according to the latest procedure delineated by EPA[4] and the *CEQR Technical Manual*.

Traffic Data

Traffic data for the mobile source analysis were derived from existing traffic counts, projected future growth in traffic, and other information developed as part of the traffic analysis for the proposed project (see Chapter 14, “Transportation”). Traffic data for the future without and with the proposed project were employed in the respective air quality modeling scenarios. The weekday morning (7:30 AM to 8:30 AM), midday (11:30 AM to 12:30 PM), and evening (4:15 PM to 5:15 PM) peak hour traffic volumes were analyzed.

For particulate matter, off-peak traffic volumes in the future with and without the proposed project were determined by adjusting the peak period volumes by the 24-hour distributions of actual vehicle counts collected at appropriate locations.

Dispersion Model for Microscale Analyses

Maximum CO concentrations adjacent to the analysis sites resulting from vehicular emissions were predicted using the CAL3QHC model Version 2.0.[5] The CAL3QHC model employs a Gaussian (normal distribution) dispersion assumption and includes an algorithm for estimating vehicular queue lengths at signalized intersections. CAL3QHC predicts emissions and dispersion of CO from idling and moving vehicles. The queuing algorithm includes site-specific traffic parameters, such as signal timing and delay calculations (from the 2000 *Highway Capacity Manual* traffic forecasting model), saturation flow rate, vehicle arrival type, and signal actuation (i.e., pre-timed or actuated signal) characteristics to accurately predict the number of idling vehicles.

To determine motor vehicle generated PM_{10} and $PM_{2.5}$ concentrations on sidewalks near the project site, the CAL3QHCR model was applied. This is a refined version of the CAL3QHC

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[4] EPA, Compilations of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, Ch. 13.2.1, NC, http://www.epa.gov/ttn/chief/ap42, January 2011.

[5] EPA, User’s Guide to CAL3QHC, A Modeling Methodology for Predicted Pollutant Concentrations Near Roadway Intersections, Office of Air Quality, Planning Standards, Research Triangle Park, North Carolina, EPA-454/R-92-006.

model Version 2.0.[6] The CAL3QHCR model employs a Gaussian dispersion assumption and includes an algorithm for estimating vehicular queue lengths at signalized intersections. CAL3QHCR predicts emissions and dispersion of $PM_{2.5}$ from idling and moving vehicles. The queuing algorithm includes site-specific traffic parameters, such as signal timing and delay calculations (from the 2000 *Highway Capacity Manual* traffic forecasting model), saturation flow rate, vehicle arrival type, and signal actuation (i.e., pre-timed or actuated signal) characteristics to predict the number of idling vehicles. The CAL3QHCR model can utilize hourly traffic and meteorological data, and is therefore appropriate for calculating 24-hour and annual average concentrations.

Meteorology

In general, the transport and concentration of pollutants from vehicular sources are influenced by three principal meteorological factors: wind direction, wind speed, and atmospheric stability. Wind direction influences the direction in which pollutants are dispersed, and atmospheric stability accounts for the effects of vertical mixing in the atmosphere. These factors, therefore, influence the concentration at a particular prediction location (receptor). In applying the CAL3QHC model, the wind angle was varied to determine the wind direction resulting in the maximum concentrations at each receptor. Following the EPA guidelines,[7] CAL3QHC computations were performed using a wind speed of 1 meter per second, and the neutral stability class D. The 8-hour average CO concentrations were estimated by multiplying the predicted 1-hour average CO concentrations by a factor of 0.70 to account for persistence of meteorological conditions and fluctuations in traffic volumes. A surface roughness of 3.21 meters was chosen, consistent with the *CEQR Technical Manual*. At each receptor location, concentrations were calculated for all wind directions, and the highest predicted concentration was reported, regardless of frequency of occurrence. These assumptions ensured that worst-case meteorology was used to estimate impacts.

Using the CAL3QHCR model, hourly concentrations were predicted based on hourly traffic data and five years (2006-2010) of monitored hourly meteorological data. The data consist of surface data collected at LaGuardia Airport and upper air data collected at Brookhaven, New York, which are the nearest National Weather Surface data collection sites. All hours were modeled, and the highest resulting concentration for each averaging period is presented.

Analysis Year

The microscale analyses were performed for analysis years 2018, the first full year of operation for Phase 1, and 2038, the year by which the full build out of the proposed project would be complete. The analyses were performed both without the proposed project (the No-Action condition) and with the proposed project (the With Action condition).

Background Concentrations

Background concentrations are those pollutant concentrations originating from distant sources that are not directly included in the modeling analysis, which directly accounts for vehicular

[6] EPA, User's Guide to CAL3QHC, A Modeling Methodology for Predicted Pollutant Concentrations Near Roadway Intersections, Office of Air Quality, Planning Standards, Research Triangle Park, North Carolina, EPA-454/R-92-006.

[7] *Guidelines for Modeling Carbon Monoxide from Roadway Intersections*, EPA Office of Air Quality Planning and Standards, Publication EPA-454/R-92-005.

emissions on the streets within 1,000 feet and in the line of sight of the analysis site. Background concentrations are added to modeling results to obtain total pollutant concentrations at an analysis site. The 1-hour and 8-hour CO background concentrations used in this analysis, which were based on the second-highest concentrations recorded at the NYSDEC Queens College 2 monitoring station from 2007 to 2011, were 3.4 ppm and 2.0 ppm, respectively. The monitoring station at Queens College is the closest monitoring station to the project site that has available recorded data over a recent 5-year period.

The PM_{10} 24-hour background concentration of 44 $\mu g/m^3$ was based on the second-highest concentration, measured over the most recent three-year period for which complete data are available (2009–2011). The nearest NYSDEC monitoring site, at P.S. 19, was used. $PM_{2.5}$ impacts are assessed on an incremental basis and compared with the $PM_{2.5}$ interim guidance criteria. Therefore, a background concentration for $PM_{2.5}$ is not included.

Analysis Sites

Two intersections were selected for microscale analysis (see **Table 15-2**). These sites were selected because they are the locations in the study area with the highest level of project-generated traffic and, therefore, where the greatest air quality impacts and maximum changes in concentrations would be expected. The potential impact from vehicle emissions of CO, PM_{10} and $PM_{2.5}$ was analyzed for each of these intersections.

Table 15-2
Mobile Source Analysis Sites

Analysis Site	Location	Peak Periods Analyzed
1	36th Avenue at Vernon Boulevard	AM, Midday, and PM
2	Astoria Boulevard at 21st Street	AM, Midday, and PM

Receptor Placement

Multiple receptors (i.e., precise locations at which concentrations are predicted) were modeled at each of the selected sites; receptors were placed along the approach and departure links at spaced intervals. Receptors were placed at sidewalk or roadside locations near intersections with continuous public access and at elevated residential locations. Receptors in the analysis model for predicting annual average neighborhood-scale $PM_{2.5}$ concentrations were placed at a distance of 15 meters from the nearest moving lane at each analysis location, based on the *CEQR Technical Manual* procedure for neighborhood-scale corridor $PM_{2.5}$ modeling.

PARKING GARAGE

The proposed project is anticipated to include up to approximately 500 parking spaces, with 250 spaces in Phase 1 and another 250 spaces provided in Full Build, and they are assumed to be below grade in mechanically ventilated garages. Emissions from vehicles using the proposed garages could potentially affect ambient levels of CO in the immediate vicinity of the ventilation outlets. Projected parking facility capacity and the peak hour arrivals and departures were used to identify the parking garage most likely to result in impacts on local air quality. Currently, there are no mechanical designs for these proposed parking garages. Therefore, it was conservatively assumed that each of the proposed garages analyzed (one for each phase) would be vented through a single outlet at a height of approximately 10 feet. Representative receptor locations on the proposed buildings were also modeled. The vent face was modeled to directly discharge above the sidewalk, and receptors were placed along the sidewalks on both sides of the street (both near the vent and across the street) at a pedestrian height of six feet and at distances of seven feet and 44 feet from the vent to account for receptors near the vent and for receptors on the opposite side of a street. The vent was also analyzed assuming a sensitive receptor located at a height of six feet above the vent.

The analysis of emissions from the outlet vents and their dispersion was performed using the methodology set forth in the *CEQR Technical Manual*. The CO concentrations were determined for the time periods when overall garage usage would be the greatest, considering the hours when the greatest number of vehicles would exit the facility. Departing vehicles were assumed to be operating in a "cold-start" mode, emitting higher levels of CO than arriving vehicles. Traffic data for the parking garage analysis were based on analyses described in Chapter 14, "Transportation."

Emissions from vehicles entering, parking, and exiting the garages were estimated using the EPA MOBILE6.2 mobile source emission model and an ambient temperature of 43°F, as referenced in the *CEQR Technical Manual*. For all arriving and departing vehicles, an average speed of 5 miles per hour was conservatively assumed for travel within the parking garages. In addition, all departing vehicles were assumed to idle for 1 minute before proceeding to the exit. The concentration of CO within the garages was calculated assuming a minimum ventilation rate, based on New York City Building Code requirements of 1 cubic foot per minute of fresh air per gross square foot of garage area. To determine compliance with the NAAQS, CO concentrations were predicted for the maximum 8-hour and 1-hour averaging periods.

To determine pollutant concentrations, the outlet vents were analyzed as "virtual point sources" using the methodology in EPA's *Workbook of Atmospheric Dispersion Estimates, AP-26*. This methodology estimates CO concentrations at various distances from an outlet vent by assuming that the concentration in the garage is equal to the concentration leaving the vent, and determining the appropriate initial horizontal and vertical dispersion coefficients at the vent faces.

A persistence factor of 0.70 was used to convert the calculated 1-hour average maximum concentrations to 8-hour averages, accounting for meteorological variability over the average 8-hour period. Background CO concentrations and concentrations from on-street traffic were added to the parking garage modeling results to obtain the total ambient CO levels.

STATIONARY SOURCES

INTRODUCTION

An analysis was performed to evaluate potential impacts associated with the proposed project's stationary emission sources. Since building specific design information is not yet available, for the purpose of this air quality analysis, it is conservatively assumed that natural gas-fired combustion equipment would be used to provide building heat and hot water and to provide a portion of campus electrical energy needs. The reasonable worst-case development scenario assumes that one or more central utility plants, including a combined heat and power (CHP) plant, would be constructed, as well as boiler plants at each of the buildings shown in Figure 1-7 of Chapter 1, "Project Description".

Central Utility Plant—Combined Heat and Power (CHP) Plant

The proposed project is expected to include two central utility plants that would provide a portion of campus electrical energy needs. The plant(s) would have a maximum potential capacity of approximately 535 Kilowatts (KW) for Phase 1 (2018 analysis year) and 1,005 KW for Phase 2 (2038 analysis year) with a combined total of 1,540 KW for the Full Build. These are reasonably conservative maximum worst case estimates which do not account for renewable sources of energy, including potential applications of geothermal and photovoltaic panels. It was assumed that the plant(s) could be powered by natural gas-fired combustion turbines or microturbines, gas-fired reciprocating engines, or fuel cells. For the purpose of this analysis, it is conservatively assumed that the central utility plant would include a CHP plant that would use either natural gas-fired combustion turbines or natural gas-fired reciprocating engines with a maximum heat input rating of 5.9 million British Thermal Units per hour (mmBtu/hr) for Phase 1 and 11.1 mmBtu/hr for Phase 2.

Boiler Systems

The proposed project would include natural gas-fired boiler systems to provide heat and hot water for campus buildings. The analysis assumed that each of the buildings in Phase 1 and Phase 2 would have individual boiler installations to provide heat and hot water except for the academic building to be constructed in Phase 1, which would have a domestic hot water boiler only. The space heating demand for this academic building would be met by electric heat pumps.

Emergency Generators

Emergency diesel-fueled generators would be installed in individual buildings to serve in the event of the loss of utility electrical power. The emergency generators would be tested periodically for a short period to ensure its availability and reliability in the event of a sudden loss in utility electrical power. These would not be utilized in a peak load shaving program,[8] minimizing the use of these generators during non-emergency periods. Emergency generators are exempt from NYSDEC air permitting requirements, but would require a permit or registration issued by NYCDEP, depending on the generator heat input capacity. The emergency generators would be required to meet EPA's interim Tier 4 regulations, which include stringent limits on emissions of regulated pollutants. The emergency generators would be installed and operated in accordance with NYCDEP requirements, as well as other applicable codes and standards. Potential air quality impacts from the emergency generators would be insignificant, since these would be used only for testing purposes on a periodic basis for limited durations outside of an actual emergency use.

Reasonable Worst Case Development Scenario

Phase 1 (Analysis Year 2018)

Phase 1 would include construction of an academic building, a corporate co-location building, a residential building, an Executive Education Center with hotel and conference facilities, and a central utility plant. The analysis assumed that the CHP plant stack would be directed to the top of the adjacent residential building to avoid potential significant impacts on nearby campus buildings. The Phase 1 buildings would have individual boiler installations that would exhaust through a stack located on the top of the roof of each of these buildings.

Full Build (Analysis Year 2038)

Phase 2 would include construction of six additional buildings: two academic buildings, two corporate co-location buildings, and two residential buildings. To support this development, the proposed project would include an additional central utility plant to meet the increased electric

[8] The term "peak load shaving" refers to the use of customer-operated (non-utility) generators to produce electricity at the request of the local electrical utility in order to reduce the electrical demand during peak demand periods, particularly during the summer period.

needs of the full build out campus. A reasonable worst case scenario was modeled for the CHP plants in the Full Build which assumed that the first CHP plant would remain same as modeled in Phase 1 and the additional CHP plant would be located on the south end of the project site to support the energy needs of buildings constructed in Phase 2. Since residential buildings are anticipated to be taller than other buildings on the project site, the second CHP plant exhaust would be directed to the top of the Phase 2 residential building located at the south end of the project site. For the boiler systems, the analysis assumed that the Phase 2 buildings would have individual boiler installations for the heat and hot water demands which would exhaust through individual stacks located on the top of the roof of each of these buildings.

Emission Estimates and Stack Parameters

For the CHP plants, PM emission rates were developed using EPA's *Compilations of Air Pollutant Emission Factors* (AP-42)[9], based on the higher emission factors referenced for combustion turbines and reciprocating engines. Emission rates for NO_x were based on EPA New Source Performance Standards (NSPS) requirements. The analysis assumed that the CHP plant would use either natural gas-fired combustion turbines or natural gas-fired reciprocating engines and the higher of the estimated emission rates from these two technologies was modeled to determine potential worst-case impacts. Stack parameters and emission rates for the CHP plant are summarized in **Table 15-3**.

Table 15-3
Stack Parameters and Emission Rates for Potential CHP Plants

Stack Parameters	Combustion Turbine		Reciprocating Engine	
	Phase 1	Phase 2	Phase 1	Phase 2
Stack height (ft)	323[(2)]	283[(2)]	323[(2)]	283[(2)]
Stack Inside Diameter (ft)	1.2	1.8	1.2	1.8
Stack Exit Velocity (ft/s)	60	60	60	60
Stack Exhaust Temperature (F)	872	853	872	853
Emission Rate (g/s) [(1)]				
NO_x	0.1546	0.2913	0.1987	0.3744
PM_{10}	0.0049	0.0092	0.0074	0.0139
$PM_{2.5}$	0.0049	0.0092	0.0074	0.0139

Notes:
(1) The analysis assumed that the CHP plant would either use combustion turbines or reciprocating engines to model the worst case scenario.
(2) The analysis assumed a 3 foot tall stack on the roof of the proposed building.

For the boiler plants, NO_x and PM emission rates were estimated based on emission factors from AP-42 Tables 1.4-1 and 1.4-2. For the natural gas-fired boiler systems that would serve Phase 1 buildings, NO_x and PM emission rates were estimated using peak monthly and annual heat input determined from energy modeling performed for the anticipated Phase I development. Short-term and annual heat inputs for Phase 2 buildings were estimated based on building size and building type in comparison to the Phase 1 energy modeling data. Stack parameters and emission rates for the Phase 1 and Phase 2 buildings are presented in **Tables 15-4 and 15-5**, respectively.

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9 EPA, Compilations of Air Pollutant Emission Factors AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources, http://www.epa.gov/ttn/chief/ap42. Table 3.1-2a for combustion turbines and Table 3.2-2 for reciprocating engines

Table 15-4
Stack Parameters and Emission Rates for Potential Boiler Systems in Phase 1

Stack Parameters	Phase 1			
	Residential	Academic	Corporate Co-location	Executive Education Center
Building size (gsf)	335,000	150,000	150,000	170,000
Stack height (ft)(2)	323	65	81.5	203
Stack Inside Diameter (ft)(1)	2.0	1.0	1.0	1.0
Stack Exit Velocity (ft/s) (1)	19.5	25.6	25.6	25.6
Stack Exhaust Temperature (F) (1)	300	300	300	300
Maximum Emission Rate (g/s) (3)				
NO_x (1-hour) (3)	0.1379	0.0037	0.0346	0.0445
NO_x (Annual)	0.0206	0.0014	0.0025	0.0110
PM_{10} (24-hour) (3)	0.0105	0.0003	0.0026	0.0034
$PM_{2.5}$ (24-hour) (3)	0.0105	0.0003	0.0026	0.0034
$PM_{2.5}$ (Annual)	0.0016	0.0001	0.0002	0.0008

Note:
(1)The stack diameter, exhaust velocity, and exhaust temperature are based on a survey of New York City building boilers of similar size.
(2) The analysis assumed a 3 foot tall stack on the roof of the proposed building.
(3) Estimated emissions during the peak month; emissions for other months were determined based on the estimated energy usage from energy modeling.

Table 15-5
Stack Parameters and Emission Rates for Potential Boiler Systems in Phase 2

Stack Parameters	Phase 2					
	Residential		Academic		Corporate Co-location	
Building size (gsf)	326,000	264,000	245,000	175,000	140,000	170,000
Stack height (ft)	290(3)	290(3)	149(2)	123(2)	95(2)	123(2)
Stack Inside Diameter (ft)(1)	2	1.5	1	1	1	1
Stack Exit Velocity (ft/s) (1)	19.5	23.7	25.6	25.6	25.6	25.6
Exhaust Temperature (F) (1)	300	300	300	300	300	300
Maximum Emission Rate (g/s)						
NO_x (1-hour) (4)	0.1342	0.1087	0.0565	0.0404	0.0323	0.0392
NO_x (Annual)	0.0180	0.0145	0.0041	0.0029	0.0023	0.0029
PM_{10} (24-hour) (4)	0.0102	0.0083	0.0043	0.0031	0.0025	0.0030
$PM_{2.5}$ (24-hour) (4)	0.0102	0.0083	0.0043	0.0031	0.0025	0.0030
$PM_{2.5}$ (Annual)	0.0014	0.0011	0.0003	0.0002	0.0002	0.0002

Notes:
(1)The stack diameter, exhaust velocity, and exhaust temperature are based on a survey of New York City building boilers of similar size.
(2) The analysis assumed a 3 foot tall stack on the roof of the proposed building.
(3) The analysis assumed a 10 foot tall stack on the roof of the proposed building.
(4) Estimated emissions during the peak month; emissions for other months were determined based on the estimated energy usage from energy modeling.

This analysis also accounts for the fact that heating equipment is not employed on a continuous basis year-round. The analysis used refined assumptions for energy consumption to better reflect a reasonable worst-case operating scenario. The methodology for this analysis was developed to address specific parameters of the proposed project, acting in consultation with DEP. The details of the analysis are described below.

During the peak heating period in the winter, heating equipment is operated at the highest levels, at lower levels during the spring and fall, with little or no usage in the summer (cooling would be provided by electric powered HVAC equipment). The second tier analysis was performed based on examination of the monthly energy consumption developed using energy modeling[10] and data specific to the Cornell NYC Tech Phase 1 buildings. The monthly energy consumption is highest for January. Therefore, for January, the emission rates estimated based on the peak monthly energy modeling data were used since they are representative of peak heating and hot water system utilization. Then, using January as a baseline, the daily heating emission rates for the other months were estimated, based on the ratio of monthly energy demand of each month to the January monthly demand.

For the Phase 2 buildings, the energy modeling data was used based on the energy load for three modeled buildings types: residential, Executive Education Center, and corporate co-location (Phase 2 academic buildings were modeled using the Phase 1 corporate co-location energy consumption estimates). Energy consumption was determined based on the type of development, gross square footage and modeled energy consumption per square foot of development.

The emission rates for each month were then input into the AERMOD model to determine maximum predicted pollutant incremental concentrations for Phase 1 and the Full Build.

Dispersion Modeling

The air quality modeling analysis was performed using the EPA-approved AERMOD dispersion model. AERMOD is a state-of-the-art dispersion model, applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including point, area, and volume sources). AERMOD is a steady-state plume model that incorporates current concepts about flow and dispersion in complex terrain, including updated treatments of the boundary layer theory, understanding of turbulence and dispersion, and includes handling of terrain interactions.

The AERMOD model calculates 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. The analyses of potential impacts from exhaust stacks were made assuming stack tip downwash, urban dispersion and surface roughness length, with and without building downwash, and elimination of calms.

The AERMOD model also incorporates the algorithms from the PRIME model, which is designed to predict impacts in the "cavity region" (i.e., the area around a structure which under certain conditions may affect an exhaust plume, causing a portion of the plume to become entrained in a recirculation region). The Building Profile Input Program (BPIP) program for the PRIME model (BPIPRM) was used to determine the projected building dimensions modeling with the building downwash algorithm enabled. The modeling of downwash from sources accounts for all obstructions within a radius equal to five obstruction heights of the stack.

The analysis was performed both with and without downwash in order to assess the worst-case impacts at elevated receptors close to the height of the sources, which would occur without downwash, as well as the worst-case impacts at lower elevations and ground level, which would occur with downwash.

Methodology for Estimating 1-Hour NO_2 Concentrations

1-Hour average NO_2 concentration increments from the proposed project were estimated using AERMOD model's Plume Volume Molar Ratio Method (PVMRM) module to analyze chemical

[10] Anticipated Electric and Gas Loads for CornellNYC Tech Campus memo, dated June 4, 2012 (based on energy modeling performed by AKRF).

transformation within the model. The PVMRM module incorporates hourly background ozone concentrations to estimate NO_x transformation within the source plume. Ozone concentrations were taken from the NYSDEC Queens College monitoring station, which is the nearest ozone monitoring station and had complete five years (2007-2011) of hourly data available. An initial NO_2 to NO_x ratio of 10 percent[11] at the source exhaust stack was used for the boilers and 20 percent for the CHP which is considered representative for these source types.

Total 1-hour NO_2 concentrations were determined following methodologies that are accepted by the EPA as appropriate and conservative. The methodology used to determine the compliance of total 1-hour NO_2 concentrations from the proposed sources with the 1-hour NO_2 NAAQS[12] was based on adding the monitored background to modeled concentrations, as follows: hourly modeled concentrations from the sources were first added to the seasonal hourly background monitored concentrations; then the highest combined daily 1-hour NO_2 concentration was determined at each receptor location and the 98th percentile daily 1-hour maximum concentration for each modeled year was calculated within the AERMOD model; finally the 98th percentile concentrations were averaged over the last five years. This refined approach is recognized as being conservative by EPA and the city.

Meteorological Data

The meteorological data set consisted of five consecutive years of meteorological data: surface data collected at LaGuardia Airport (2007–2011) and concurrent upper air data collected at Brookhaven, New York. The meteorological data provide hour-by-hour wind speeds and directions, stability states, and temperature inversion elevation over the 5-year period. These data were processed using the EPA AERMET program to develop data in a format that can be readily processed by the AERMOD model. The land uses around the site where meteorological surface data were available were classified using categories defined in digital United States Geological Survey (USGS) maps to determine surface parameters used by the AERMET program.

Sensitive Receptors and Receptor Placement

Based on a review of land use maps and other information, a collection of sensitive receptors were identified within a half mile of the project site. Receptors within this area could potentially be affected by the proposed buildings' stationary sources. The receptors identified include residential developments, schools, and open spaces. The receptors located in the surrounding area of the proposed project are presented in **Table 15-6**.

A comprehensive receptor network (i.e., locations with continuous public access) was developed for the modeling analysis. Discrete receptors were analyzed, including locations on the proposed project sites and other nearby buildings, at operable windows, air intakes, and at publicly accessible ground-level locations. The model also included ground-level receptor grid in order to address more distant locations and to identify the highest ground-level impact.

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[11] MACTEC for Alaska Department of Environmental Conservation, Evaluation of Bias in AERMOD-PVMRM, June 2005 http://www.epa.gov/scram001/7thconf/aermod/pvmrm_bias_eval.pdf;

San Joaquin Valley, Recommended In-stack NO_2/NOx Ratios,

http://www.valleyair.org/busind/pto/Tox_Resources/AirQualityMonitoring.htm#modeling_guidance

[12] http://www.epa.gov/ttn/scram/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf

Table 15-6
Sensitive Receptor Sites

Receptor Site	Location
1	405-425 Main St Apartment Buildings
2	Firefighters' Field
3	Southpoint Park
4	455-475 Main St Apartment Buildings
5	Rivercross 531 Main St
6	Eastwood 510-580 Main St
7	Good Shepherd Community Center
8	Roosevelt Island Senior Center
9	Peter Detmold Park
10	Chabad Preschool Beekman Pl
11	Montessori School of NY Inc
12	Cathedral High School
13	Art and Design High School (M630)
14	419 East 58th Street
15	Renanim Manhattan Preschool
16	Manhattan Early Learning Center
17	PS 183
18	Queensbridge Park
19	Queensbridge Houses
20	Western Queens Nursery School

Background Concentrations

To estimate the maximum expected pollutant concentration at a given receptor, the predicted impact must be added to a background value that accounts for existing pollutant concentrations from other sources that are not directly accounted for in the model. Annual average NO_2 background concentration of 43.3 $\mu g/m^3$ was used from the nearest NYSDEC monitoring site, QCII, based on the second-highest concentration measured over the most recent five-year period (2007–2011). The 1-hour NO_2 background concentration is not presented here since the AERMOD model determines the total 98th percentile 1-hour NO_2 concentration at each receptor. For the PM_{10} 24-hour averaging period, background concentration of 44 $\mu g/m^3$ was used from the nearest NYSDEC monitoring site, P.S. 19, based on the second-highest concentration measured over the most recent three-year period for which complete data are available (2009–2011). $PM_{2.5}$ impacts are assessed on an incremental basis and compared with the $PM_{2.5}$ interim guidance criteria. Therefore, a background concentration for $PM_{2.5}$ is not used.

E. EXISTING CONDITIONS

Representative criteria pollutant concentrations measured in recent years at NYSDEC air quality monitoring stations nearest to the proposed project site are presented in **Table 15-7**. The values presented are consistent with the NAAQS format. For example, the 8-hour ozone concentration shown is the 3-year average of the fourth highest daily maximum 8-hour average concentrations. The concentrations were obtained from the 2011 New York State Ambient Air Quality Report, the most recent report available. As shown in **Table 15-7**, the recently monitored levels did not exceed the NAAQS.

Table 15-7
Representative Monitored Ambient Air Quality Data

Pollutant	Location	Units	Averaging Period	Concentration	NAAQS
CO	Queens College 2, Queens	ppm	8-hour	1.4	9
			1-hour	1.9	35
SO_2	Queens College 2, Queens[1]	µg/m^3	3-hour	77.7	1,300
			1-hour	79.8	196
PM_{10}	P.S. 19, Manhattan	µg/m^3	24-hour	40	150
$PM_{2.5}$	P.S. 19, Manhattan	µg/m^3	Annual	11.9	15
			24-hour	27	35
NO_2	Queens College 2, Queens[2]	µg/m^3	Annual	40.7	100
			1-hour	126.9	188
Lead	J.H.S. 126, Brooklyn	µg/m^3	3-month	0.019	0.15
Ozone	CCNY, Manhattan	ppm	8-hour	0.072	0.075

Notes:
(1) The 1-hour value is based on a three-year average (2009-2011) of the 99th percentile of daily maximum 1-hour average concentrations. EPA replaced the 24-hr and the annual standards with the 1-hour standard.
(2) The 1-hour value is based on a three-year average (2009-2011) of the 98th percentile of daily maximum 1-hour average concentrations.
Source: NYSDEC, New York State Ambient Air Quality Report (2009-2011).

MODELED CO CONCENTRATIONS FOR EXISTING TRAFFIC CONDITIONS

As noted previously, receptors were placed at multiple sidewalk locations next to the intersections selected for the analysis. The receptor with the highest predicted CO concentrations was used to represent these intersection sites for the existing conditions. CO concentrations were calculated for each receptor location, at each intersection, for each peak period analyzed.

Table 15-8 shows the maximum modeled existing (2011) CO 8-hour average concentrations at the receptor sites for the peak period when those concentrations are greatest. (No 1-hour values are shown since predicted values are much lower than the 1-hour standard of 35 ppm.) At all receptor sites, the maximum predicted 8-hour average concentrations are well below the national standard of 9 ppm.

Table 15-8
Modeled Existing (2011) 8-Hour Average CO Concentrations (ppm)

Receptor Site	Location	Time Period	8-Hour Concentration
1	36th Avenue at Vernon Boulevard	PM	2.6
2	Astoria Boulevard at 21st Street	AM/Midday/PM	3.3

Note: 8-hour standard (NAAQS) is 9 ppm.

F. THE FUTURE WITHOUT THE PROPOSED PROJECT

2018 ANALYSIS YEAR

MOBILE SOURCES

Carbon Monoxide

CO concentrations without the proposed project were determined for the 2018 Phase 1 analysis year using the methodology previously described. **Table 15-9** shows future maximum predicted 8-hour average CO concentrations, including background concentrations, at the analyzed intersections in 2018 without the proposed project. The values shown are the highest predicted concentrations at any receptor location for each of the time periods analyzed.

As shown in **Table 15-9**, 2018 CO concentrations without the proposed project are predicted to be well below the 8-hour CO standard of 9 ppm.

Table 15-9
Future (2018) Maximum Predicted 8-Hour Average
CO Concentrations Without the Proposed Project (ppm)

Receptor Site	Location	Time Period	8-Hour Concentration
1	36th Avenue at Vernon Boulevard	PM	2.6
2	Astoria Boulevard at 21st Street	AM/Midday/PM	3.3
Note: 8-hour standard (NAAQS) is 9 ppm.			

Particulate Matter

PM_{10} concentrations without the proposed project were determined for the 2018 analysis year using the methodology previously described. **Table 15-10** presents the future maximum predicted PM_{10} 24-hour concentrations, including background concentrations, at the analyzed intersections in 2018 without the proposed project. The values shown are the highest predicted concentrations for the receptor locations.

Table 15-10
Future (2018) Maximum Predicted 24-Hour Average
PM_{10} Concentrations Without the Proposed Project (μg/m^3)

Receptor Site	Location	Concentration
1	36th Avenue at Vernon Boulevard	51.9
2	Astoria Boulevard at 21st Street	61.4
Note: NAAQS—24-hour average 150 μg/m^3.		

STATIONARY SOURCES

Without the proposed project, it is assumed there would be no new buildings constructed by 2018 on the project site, and the hospital campus on the project site is expected to be vacant. Therefore, there would be no stationary sources of emissions.

2038 ANALYSIS YEAR

MOBILE SOURCES

Carbon Monoxide

CO concentrations without the proposed project were determined for the 2038 analysis year, the year by which the full build out is expected to be completed, using the methodology previously described. **Table 15-11** shows future maximum predicted 8-hour average CO concentrations, including background concentrations, at the analyzed intersections in 2038 without the proposed project. The values shown are the highest predicted concentrations at any receptor location for each of the time periods analyzed.

Table 15-11
Future (2038) Maximum Predicted 8-Hour Average CO Concentrations Without the Proposed Project (ppm)

Receptor Site	Location	Time Period	8-Hour Concentration
1	36th Avenue at Vernon Boulevard	AM/PM	2.6
2	Astoria Boulevard at 21st Street	AM/PM	3.6
Note: 8-hour standard (NAAQS) is 9 ppm.			

As shown in **Table 15-11**, 2038 CO concentrations without the proposed project are predicted to be well below the 8-hour CO standard of 9 ppm.

Particulate Matter

PM_{10} concentrations without the proposed project were determined for the 2038 analysis year using the methodology previously described. **Table 15-12** presents the future maximum predicted PM_{10} 24-hour concentrations, including background concentrations, at the analyzed intersections in 2038 without the proposed project. The values shown are the highest predicted concentrations for the receptor locations.

Table 15-12
Future (2038) Maximum Predicted 24-Hour Average PM_{10} Concentrations Without the Proposed Project (μg/m^3)

Receptor Site	Location	Concentration
1	36th Avenue at Vernon Boulevard	53.2
2	Astoria Boulevard at 21st Street	65.4
Note: NAAQS—24-hour average 150 μg/m^3.		

STATIONARY SOURCES

The project site is not expected to change in the No-Action condition between 2018 and 2038. Without the proposed project, it is assumed there would be no new buildings constructed by 2018 on the project site, and the hospital campus on the project site is expected to be vacant. Therefore, there would be no stationary sources of emissions.

G. PROBABLE IMPACTS OF THE PROPOSED PROJECT

2018 ANALYSIS YEAR (PHASE 1)

MOBILE SOURCES

Carbon Monoxide

CO concentrations with the proposed project were determined for the 2018 analysis year using the methodology previously described. **Table 15-13** shows the future maximum predicted 8-hour average CO concentrations with and without the proposed project at the intersections analyzed. (No 1-hour values are shown, since no exceedances of the NAAQS would occur and the *de minimis* criteria are only applicable to 8-hour concentrations; therefore, the 8-hour values are the most critical for impact assessment.) The values shown represent the highest predicted concentrations for any of the receptors analyzed and include the 8-hour CO ambient background concentration.

Table 15-13
Future (2018) Maximum Predicted 8-Hour Average
CO Concentrations With and Without the Proposed Project (ppm)

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)			
			Without the Project	With the Project	Increment	*De Minimis*
1	36th Avenue at Vernon Boulevard	PM	2.6	2.6	0.0	3.2
2	Astoria Boulevard at 21st Street	AM/Midday/PM	3.3	3.3	0.0	2.8
Notes: 8-hour standard (NAAQS) is 9 ppm.						

The results indicate that the proposed project would not result in any violations of the 8-hour CO standard. In addition, the increments in 8-hour average CO concentrations are small and consequently would not exceed the *de minimis* CO criteria. (The *de minimis* criteria are described above in Section C, “Air Quality Regulations, Standards, and Benchmarks.”)

Particulate Matter

Using the methodology previously described, PM_{10} concentrations with and without the proposed project were determined for the 2018 analysis year. The values shown in **Table 15-14** are the highest predicted concentrations for all receptors analyzed and include the PM_{10} ambient background concentration. The results indicate that the vehicle trips generated by the proposed project would not result in PM_{10} concentrations that would exceed the NAAQS.

Table 15-14
Future (2018) Maximum Predicted 24-Hour Average
PM_{10} Concentrations With and Without the Proposed Project (μg/m^3)

Receptor Site	Location	Without the Project	With the Project
1	36th Avenue at Vernon Boulevard	51.9	52.7
2	Astoria Boulevard at 21st Street	61.4	61.7
Note: The National Ambient Air Quality Standard for PM_{10} is 150 μg/m^3, for a 24-hour average.			

Future maximum predicted 24-hour and annual average $PM_{2.5}$ concentration increments were calculated so that they could be compared to the interim guidance criteria that would determine the potential significance of any impacts from the proposed project. Based on this analysis, the maximum predicted localized 24-hour average and neighborhood-scale annual average incremental $PM_{2.5}$ concentrations are presented in **Table 15-15** and **Table 15-16**, respectively. $PM_{2.5}$ concentrations without the proposed project are not presented, since impacts are assessed on an incremental basis.

Table 15-15
Future (2018) Maximum Predicted 24-Hour Average $PM_{2.5}$ Increments (μg/m^3)

Receptor Site	Location	Increment
1	36th Avenue at Vernon Boulevard	0.3
2	Astoria Boulevard at 21st Street	0.1
Note: $PM_{2.5}$ interim guidance criteria—24-hour average, 2 μg/m^3 (5 μg/m^3 not-to-exceed value).		

Table 15-16
Future (2018) Maximum Predicted Annual Average $PM_{2.5}$ Increments (μg/m^3)

Receptor Site	Location	Increment
1	36th Avenue at Vernon Boulevard	0.003
2	Astoria Boulevard at 21st Street	0.001
Note: $PM_{2.5}$ interim guidance criteria—annual (neighborhood scale), 0.1 μg/m^3.		

The results show that the annual and daily (24-hour) $PM_{2.5}$ increments are predicted to be well below the interim guidance criteria. Therefore, there would be no potential for significant adverse impacts on air quality from vehicle trips generated by the proposed project for the 2018 analysis year.

PARKING GARAGE

The CO levels from the parking garage associated with Phase 1 of the proposed project, which is expected to include up to 250 parking spaces, were predicted using the methodology set forth in the *CEQR Technical Manual*. Based on the projected parking demand developed for the proposed project, the number of vehicles entering and exiting the garages would be greatest during the weekday PM (4:15 PM to 5:15 PM) peak hour. To account for emissions from local on-street traffic, the With Action weekday PM peak hour traffic along East Road was included in the analysis. The *CEQR Technical Manual* methodology was used to calculate concentrations.

The maximum predicted CO concentration from a single garage, with ambient background, and on-street traffic levels would be 5.0 ppm for the 1-hour period, and 2.7 ppm for the 8-hour period at the building receptor. The maximum 1- and 8-hour contributions from the parking garage alone would be 1.6 ppm and 0.7 ppm, respectively. The maximum 1- and 8-hour contributions from on-street traffic would be 0.05 ppm for the 1-hour period, and 0.04 ppm for the 8-hour period. The values are the highest predicted concentrations for any time period analyzed.

These maximum predicted CO levels are below the applicable CO standards and CEQR CO *de minimis* criteria. Therefore, no significant adverse impacts from the proposed project's parking garages are expected.

STATIONARY SOURCES

An AERMOD modeling analysis was performed to determine potential NO_2, $PM_{.10}$ and $PM_{2.5}$ impacts from the exhaust stack for the CHP plant and boiler systems associated with the proposed project's Phase 1 development. Maximum predicted concentrations were added to the design ambient background concentration and compared to the NAAQS.

CHP Plant

The analysis assumed that the CHP plant would exhaust through the top of the adjacent residential building to avoid potential significant adverse impacts on the nearby campus buildings (no potential off-site significant adverse impacts were identified). Maximum modeled concentrations of NO_2 and PM_{10} are presented in **Table 15-17**, along with the relevant background concentrations, the total potential concentrations and the applicable NAAQS. The modeled concentrations presented below are the maximum of the combustion turbine and the reciprocating engines.

Table 15-17
Maximum Modeled Pollutant Concentrations from the Proposed Project's Potential Phase 1 CHP Plant (in µg/m³)

Pollutant	Averaging Period	Modeled Concentration	Background Concentration	Total Concentration	NAAQS
NO_2	1-hour(1)	--	--	134.82	188
	Annual(2)	2.37	43.3	45.67	100
PM_{10}	24-hour	0.66	44	44.66	150

Notes: (1) The 1-Hour NO_2 concentration presented here is the maximum of the total 98th percentile 1-Hour NO_2 concentration predicted at any receptor using seasonal-hourly background concentrations.
(2) NO_2 annual impacts were estimated using NO_2/NO_x ratio of 0.75 as per EPA guidance.

The maximum concentrations were predicted at elevated receptors on other campus buildings. As shown in **Table 15-17**, the maximum potential increase in concentrations associated with the proposed project's CHP plant, when added to background concentrations for PM_{10} and NO_2, would be less than the NAAQS.

$PM_{2.5}$ incremental concentrations were also evaluated. As shown in **Table 15-18**, the maximum 24-hour incremental impact at any location would be less than the applicable interim guidance criteria of 2 $\mu g/m^3$ and 5 $\mu g/m^3$. On an annual basis, the projected $PM_{2.5}$ impacts would be less than the applicable interim guidance criterion of 0.3 $\mu g/m^3$. Therefore, the proposed project's CHP plant would not have a significant adverse impact on air quality, either at on campus buildings or at off-site receptor locations.

Table 15-18
Maximum Modeled $PM_{2.5}$ Concentrations from the Proposed Project's Potential Phase 1 CHP Plant (in µg/m³)

Pollutant	Averaging Period	Maximum Increment	Incremental Threshold
$PM_{2.5}$	24-hour	0.66	2 / 5
	Annual	0.12	0.3

Notes: $PM_{2.5}$ interim guidance criteria—24-hour average, 2 µg/m3 (5 µg/m3 not-to-exceed value) and annual average, 0.3 µg/m3 not-to-exceed value.

To ensure that there are no significant adverse impacts on nearby campus buildings, the Phase 1 CHP Plant would have to meet certain measures, as follows:

- Fossil fuel-fired exhaust stack(s) must be directed to the roof of the adjacent residential building and have a minimum exhaust height of at least 323 feet above grade.

Boiler Systems

Maximum predicted concentrations of NO_2 and PM_{10} from the Phase I boiler installations are presented in **Table 15-19.**

Table 15-19
Maximum Modeled Pollutant Concentrations from the Proposed Project's Potential Phase 1 Boiler Systems (in μg/m³)

Pollutant	Averaging Period	Modeled Concentration	Background Concentration	Total Concentration	NAAQS
NO_2	1-hour	--	--	166.09	188
	Annual	2.70	43.3	46.00	100
PM_{10}	24-hour	3.11	44	47.11	150

Notes:
(1) The 1-Hour NO_2 concentration presented represents the maximum of the total 98th percentile 1-Hour NO_2 concentration predicted at any receptor using seasonal-hourly background concentrations.
(2) NO_2 annual impacts were estimated using NO_2/NO_x ratio of 0.75 as per EPA guidance.

The maximum concentrations were predicted at elevated receptors on the residential campus building (no potential off-site significant adverse impacts were identified). As shown in **Table 15-19**, the maximum potential increase in concentrations associated with the proposed project's boiler systems in Phase 1, when added to background concentrations for PM_{10} and NO_2, would be less than the NAAQS.

$PM_{2.5}$ incremental concentrations were also evaluated. As shown in **Table 15-20**, the $PM_{2.5}$ 24-hour average and annual average incremental concentrations would not exceed the applicable interim guidance criterion of 5 μg/m³ and 0.3 μg/m³, at any location, respectively.

Table 15-20
Maximum Modeled $PM_{2.5}$ Concentrations from the Proposed Project's Potential Phase 1 Boiler Systems (in μg/m³)

Pollutant	Averaging Period	Maximum Increment	Incremental Threshold
$PM_{2.5}$	24-hour(1)	3.11	2 / 5
	Annual	0.15	0.3

Notes:
(1) 24-hour $PM_{2.5}$ interim guidance criterion, > 2 μg/m³ (5 μg/m³ not-to-exceed value), depending on the magnitude, frequency, duration, location, and size of the area of the predicted concentrations.

The air quality analysis also evaluated impacts with the 24-hour average interim guidance criterion of 2 μg/m³ for discrete receptor locations on the proposed campus buildings. The assessment examined the magnitude, duration, frequency, and extent of the increments at locations where exposure above the 2 μg/m³ threshold averaged over a 24-hour period could occur. The receptor location with the maximum continual 24-hour exposure was predicted on the proposed residential building at a height of approximately 206 feet above grade. At this location, the maximum 24-hour $PM_{2.5}$ incremental concentration from the proposed project was predicted to be 3.11 μg/m³, at a maximum annual frequency of two times per year, and at an average frequency of less than once per year, over five years. On the same floor, there were locations with incremental concentrations exceeding 2 µg/m^3 on the north and west facades of the building. At these receptors, 24-hour incremental concentrations from the proposed project were predicted to exceed 2 µg/m^3 at a maximum frequency ranging from 1 to 4 times per year, with an average frequency of less than 2 per year. One other floor on this building was found to have a location with incremental concentration exceeding 2 µg/m^3, on the north west corner, at a height of 216 feet above grade. At this receptor, 24-hour incremental concentrations from the proposed project was predicted to exceed 2 µg/m^3 at a maximum frequency of 1 time per year.

Overall, the magnitude, extent, and frequency of concentrations above 2.0 µg/m^3 are very low.

To ensure that there are no significant adverse impacts on nearby campus buildings or off-site receptor locations, the project would have to meet certain measures, as follows:

- Corporate Co-location Building

  Fossil fuel-fired exhaust stack(s) must be located at least 210 feet away from any operable windows or air intakes on buildings of a greater height.

- Executive Education Center

  Fossil fuel-fired exhaust stack(s) must be located at least 166 feet from any operable windows or air intakes on buildings of a greater height.

The pollutant concentrations predicted from the residential building and the academic building are well below the NAAQS and $PM_{2.5}$ applicable criteria and therefore, do not require any specific measures regarding the placement of the exhaust stack on the roof of these buildings.

2038 ANALYSIS YEAR (FULL BUILD)

MOBILE SOURCES

Carbon Monoxide

CO concentrations with the proposed project were determined for the 2038 analysis year using the methodology previously described. **Table 15-21** shows the future maximum predicted 8-hour average CO concentrations with and without the proposed project at the intersections analyzed. (No 1-hour values are shown, since no exceedances of the NAAQS would occur and the *de minimis* criteria are only applicable to 8-hour concentrations; therefore, the 8-hour values are the most critical for impact assessment.) The values shown represent the highest predicted concentrations for any of the receptors analyzed and include the 8-hour CO ambient background concentration.

Table 15-21
Future (2038) Maximum Predicted 8-Hour Average CO Concentrations With and Without the Proposed Project (ppm)

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)			
			Without the Project	With the Project	Increment	*De Minimis*
1	36th Avenue at Vernon Boulevard	PM	2.6	2.8	0.2	3.2
2	Astoria Boulevard at 21st Street	AM/PM	3.6	3.7	0.1	2.7
Notes: 8-hour standard (NAAQS) is 9 ppm.						

The results indicate that the proposed project would not result in any violations of the 8-hour CO standard. In addition, the increments in 8-hour average CO concentrations are small and consequently would not exceed the *de minimis* CO criteria. (The *de minimis* criteria are described above in Section C, "Air Quality Regulations, Standards, and Benchmarks.")

Particulate Matter

Using the methodology previously described, PM_{10} concentrations with and without the proposed project were determined for the 2038 analysis year. The values shown in **Table 15-22** are the highest predicted concentrations for all receptors analyzed and include the PM_{10} ambient background concentration. The results indicate that the vehicle trips generated by the proposed project would not result in PM_{10} concentrations that would exceed the NAAQS.

Table 15-22
Future (2038) Maximum Predicted 24-Hour Average PM_{10} Concentrations With and Without the Proposed Project (μg/m^3)

Receptor Site	Location	Without the Project	With the Project
1	36th Avenue at Vernon Boulevard	53.2	54.4
2	Astoria Boulevard at 21st Street	65.4	66.0
Note: The National Ambient Air Quality Standard for PM_{10} is 150 μg/m^3, for a 24-hour average.			

Future maximum predicted 24-hour and annual average $PM_{2.5}$ concentration increments were calculated so that they could be compared to the interim guidance criteria that would determine the potential significance of any impacts from the proposed project. Based on this analysis, the maximum predicted localized 24-hour average and neighborhood-scale annual average incremental $PM_{2.5}$ concentrations are presented in **Table 15-23** and **Table 15-24** respectively. $PM_{2.5}$ concentrations without the proposed project are not presented, since impacts are assessed on an incremental basis.

Table 15-23
Future (2038) Maximum Predicted 24-Hour Average $PM_{2.5}$ Increments (μg/m^3)

Receptor Site	Location	Increment
1	36th Avenue at Vernon Boulevard	0.4
2	Astoria Boulevard at 21st Street	0.2
Note: $PM_{2.5}$ interim guidance criteria—24-hour average, 2 μg/m^3 (5 μg/m^3 not-to-exceed value).		

Table 15-24
Future (2038) Maximum Predicted Annual Average $PM_{2.5}$ Increments (μg/m^3)

Receptor Site	Location	Increment
1	36th Avenue at Vernon Boulevard	0.006
2	Astoria Boulevard at 21st Street	0.002
Note: $PM_{2.5}$ interim guidance criteria—annual (neighborhood scale), 0.1 μg/m^3.		

The results show that the annual and daily (24-hour) $PM_{2.5}$ increments are predicted to be well below the interim guidance criteria. Therefore, there would be no potential for significant adverse impacts on air quality from vehicle trips generated by the proposed project for the 2038 analysis year.

PARKING GARAGE

The CO levels from the parking garage associated with the full build out of the proposed project were predicted for 2038 using the methodology set forth in the *CEQR Technical Manual*. Based on the projected parking demand developed for the proposed project, which is expected to include up to 500 parking spaces, the number of vehicles entering and exiting the garages would be greatest during the weekday PM (4:15 PM to 5:15 PM) peak hour. To account for emissions from local on-street traffic, the With Action weekday PM peak hour traffic along East Road was included in the analysis. The *CEQR Technical Manual* methodology was used to calculate concentrations.

The maximum predicted CO concentration from a single garage, with ambient background, and on-street traffic levels would be 7.1 ppm for the 1-hour period, and 3.1 ppm for the 8-hour period at the building receptor. The maximum 1- and 8-hour contributions from the parking garage alone would be 3.7 ppm and 1.1 ppm, respectively. The maximum 1- and 8-hour contributions from on-street traffic would be 0.06 ppm for the 1-hour period, and 0.04 ppm for the 8-hour period. The values are the highest predicted concentrations for any time period analyzed.

These maximum predicted CO levels are below the applicable CO standards and CEQR CO *de minimis* criteria. Therefore, no significant adverse impacts from the proposed project's parking garages are expected.

STATIONARY SOURCES

An AERMOD modeling analysis was performed to determine potential NO_2, $PM_{.10}$ and $PM_{2.5}$ impacts from the exhaust stack for the CHP plant and boiler systems associated with the proposed project's Full Build development.

CHP Plant

The analysis assumed that the full build would have two CHP plants, one located at the north end of the project site as analyzed in Phase 1(see **Tables 15-17 and 15-18**) and a second one located at the south end that would be constructed in Phase 2. The second CHP at the south end of the site would exhaust through the top of the adjacent residential building to avoid potential significant impacts on the nearby campus buildings (no potential off-site significant adverse impacts were identified). Maximum modeled concentrations of NO_2 and PM_{10} are presented in **Table 15-25**, along with the relevant background concentrations, the total potential concentrations, and the applicable NAAQS. The modeled concentrations presented below are the maximum of the combustion turbine and the reciprocating engines.

Table 15-25
Maximum Modeled Pollutant Concentrations from the Proposed Project's Potential CHP Plants in the Full Build (in $\mu g/m^3$)

Pollutant	Averaging Period	Modeled Concentration	Background Concentration	Total Concentration	NAAQS
NO_2	1-hour(1)	--	--	141.04	188
	Annual(2)	2.93	43.3	46.23	100
PM_{10}	24-hour	0.66	44	44.66	150

Notes:
(1) The 1-Hour NO_2 concentration presented represents the maximum of the total 98th percentile 1-Hour NO_2 concentration predicted at any receptor using seasonal-hourly background concentrations.
(2) NO_2 annual impacts were estimated using NO_2/NO_x ratio of 0.75 as per EPA guidance.

The maximum concentrations were predicted at elevated receptors on the neighboring residential campus building. As shown in **Table 15-25,** the maximum potential increase in concentrations associated with the proposed project's CHP plant, when added to background concentrations for PM_{10} and NO_2, would be less than the NAAQS.

$PM_{2.5}$ incremental concentrations were also evaluated. As shown in **Table 15-26**, the maximum 24-hour incremental impact at any location would be less than the applicable interim guidance criteria of 2 µg/m^3 and 5 µg/m^3. On an annual basis, the projected $PM_{2.5}$ impacts would be less than the applicable interim guidance criterion of 0.3 µg/m^3. Therefore, the proposed project's CHP plant would not have a significant adverse impact on air quality, either on campus buildings or off-site receptor locations.

Table 15-26
Maximum Modeled $PM_{2.5}$ Concentrations from the Proposed Project's Potential CHP Plants in the Full Build (in µg/m^3)

Pollutant	Averaging Period	Maximum Increment	Incremental Threshold
$PM_{2.5}$	24-hour	0.66	2 / 5
	Annual	0.15	0.3

Notes:
(1) $PM_{2.5}$ interim guidance criteria—24-hour average, 2 µg/m3 (5 µg/m3 not-to-exceed value) and annual average, 0.3 µg/m3 not-to-exceed value.

To ensure that there are no significant adverse impacts on nearby campus buildings, the CHP plant to be constructed during Phase 2 would have to meet certain measures as follows:

- Fossil fuel-fired exhaust stack(s) must be directed to the roof of the adjacent residential building and have a minimum exhaust height of at least 283 feet above grade

Boiler Systems

Maximum predicted pollutant concentrations of NO_2 and PM_{10} from the boiler installations are presented in **Table 15-27.**

Table 15-27
Maximum Modeled Pollutant Concentrations from the Project's Boiler Systems in the Full Build (in µg/m^3)

Pollutant	Averaging Period	Modeled Concentration	Background Concentration	Total Concentration	NAAQS
NO_2	1-hour(1)	--	--	169.84	188
	Annual(2)	3.47	43.3	46.77	100
PM_{10}	24-hour	3.11	44	47.11	150

Notes:
(1) The 1-Hour NO_2 concentration presented represents the maximum of the total 98th percentile 1-Hour NO_2 concentration predicted at any receptor using seasonal-hourly background concentrations.
(2) NO_2 annual impacts were estimated using NO_2/NO_x ratio of 0.75 as per EPA guidance.

The maximum concentrations were predicted at elevated receptors on the residential campus building (no potential off-site significant adverse impacts were identified). As shown in **Table 15-27** the maximum potential increase in concentrations associated with the proposed project's boiler systems in the Full Build, when added to background concentrations for PM_{10} and NO_2, would be less than the NAAQS.

$PM_{2.5}$ incremental concentrations were also evaluated. As shown in **Table 15-28**, the $PM_{2.5}$ 24-hour average and annual average incremental concentrations would not exceed the applicable interim guidance criterion of 5 µg/m^3 and 0.3 µg/m^3, at any location, respectively.

Table 15-28
Maximum Modeled $PM_{2.5}$ Concentrations from the Project's Boiler Systems (in µg/m^3)

Pollutant	Averaging Period	Maximum Increment	Incremental Threshold
$PM_{2.5}$	24-hour[(1)]	3.11	2 / 5
	Annual	0.19	0.3

Notes:
[(1)] 24-hour $PM_{2.5}$ interim guidance criterion, > 2 µg/m^3 (5 µg/m^3 not-to-exceed value), depending on the magnitude, frequency, duration, location, and size of the area of the predicted concentrations.

The air quality analysis also evaluated impacts with the 24-hour average interim guidance criterion of 2 µg/m^3 for discrete receptor locations on the proposed campus buildings. The assessment examined the magnitude, duration, frequency, and extent of the increments at locations where exposure above the 2 µg/m^3 threshold averaged over a 24-hour period could occur. The receptor location with the maximum continual 24-hour exposure was predicted on the proposed Phase 1 residential building (335,000 gsf) (known was Residential building 3) as presented earlier under Phase 1 results. The maximum concentration and frequency of occurrence remains the same in the full build as in phase 1 which is 3.11 µg/m^3, at a maximum annual frequency of two times per year, and at an average frequency of less than once per year, over five years. Three locations on the proposed Phase 2 Academic building (245,000 gsf) (known as Academic building 9) also had incremental concentrations exceeding 2 µg/m^3 on the west façade at heights 106 feet and 130 feet, as well as at one location on the northeast corner of the Phase 2 Corporate Co-location building (170,000 gsf) (known as Corporate Co-location building 7), at height of 96 feet. At these receptors, 24-hour incremental concentrations from the proposed project were predicted to exceed 2 µg/m^3 at a maximum frequency of 1 to 3 times per year, with an average frequency of less than once per year.

Overall, the magnitude, extent, and frequency of concentrations above 2.0 µg/m^3 are very low.

To ensure that there are no significant adverse impacts on nearby campus buildings, the project would have to meet certain measures as follows:

- Residential Building 8 (326,000 gsf)

  Fossil fuel-fired exhaust stack(s) must be located 10 feet above the roof and at least 80 feet away from any operable windows or air intakes on buildings of a greater height.
- Residential Building 12 (264,000 gsf)

  Fossil fuel-fired exhaust stack(s) must be located 10 feet above the roof and at least 99 feet away from any operable windows or air intakes on buildings of a greater height.
- Corporate Co-location Building 10 (140,000 gsf)

  Fossil fuel-fired exhaust stack(s) must be located at least 146 feet away from any operable windows or air intakes on buildings of a greater height.
- Corporate Co-location Building 7 (170,000 gsf)

The building must not have any air intakes between heights 90 feet to 100 feet on the north facade in order to avoid impacts from the adjacent Phase 1 Corporate Co-location building.

- Academic Building 9 (245,000 gsf)

  Fossil fuel-fired exhaust stack(s) must be located at least 195 feet away from any operable windows or air intakes on buildings of a greater height.

- Academic Building 6 (175,000 gsf)

  Fossil fuel-fired exhaust stack(s) must be located at least 160 feet away from any operable windows or air intakes on buildings of a greater height.

H. CONCLUSIONS

MOBILE SOURCES

The maximum predicted pollutant concentrations and concentration increments from mobile sources in Phase 1 and the Full Build of the proposed project would be below the applicable air quality impact criteria. Concentrations of carbon monoxide (CO) and fine particulate matter less than 10 microns in diameter (PM_{10}) due to project-generated traffic at intersections in the study area would not result in any violations of NAAQS. It was also determined that CO impacts from mobile sources associated with the proposed project would not exceed CEQR *de minimis* criteria, while incremental increases in fine particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) would not exceed the city's current interim guidance criteria. Emissions due to the proposed project's parking garage were found to result in no significant adverse air quality impacts.

STATIONARY SOURCES

Based on detailed stationary source analyses, no potential for significant adverse air quality impacts are anticipated from the potential CHP Plants associated with the Phase 1 and Full Build development. To ensure that there are no significant adverse impacts on nearby campus buildings, the project would have to meet certain measures on the placement of fossil fuel-fired exhaust stacks. For potential fossil fuel fired boiler systems, specific measures are proposed to ensure that boiler systems would not have significant adverse impacts. With these restrictions in place, no significant adverse air quality impacts are predicted from the proposed project's stationary sources. ✷