Chapter 19: Air Quality

A. INTRODUCTION

This chapter examines the potential for air quality impacts from the Proposed Actions. Ambient air quality is affected by numerous sources and activities that introduce air pollutants into the atmosphere. A comprehensive assessment of potential air quality impacts from the Proposed Actions was performed. The analyses described in the sections that follow were performed utilizing the general procedures recommended in the *City Environmental Quality Review (CEQR) Technical Manual*; however, in some cases more detailed analyses were undertaken to characterize potential air quality impacts from the Proposed Actions, or because of changes in policies and procedures for conducting and evaluating air quality impacts from a proposed action.

Air quality impacts can be either direct or indirect. Direct impacts stem from emissions generated by stationary sources associated with the Proposed Actions, such as emissions from fuel burned on site for heating, ventilation, and air conditioning (HVAC) systems. Indirect effects include emissions from motor vehicles ("mobile sources") traveling to and from a project. This chapter presents the air quality impacts from the future operation of the Proposed Actions. Chapter 21, "Construction," presents a cumulative analysis of the air quality impacts from operational and construction activities. Chapter 24, "Alternatives," includes an analysis of air emissions from the operation of a cogeneration plant, which would provide heating, cooling, and power to some of the buildings in the Academic Mixed-Use Area.

Central energy plants and smaller package boiler systems would be constructed at various locations to provide heating and cooling to the new buildings in the Academic Mixed-Use Area. In addition, the projected development at Site 5 in Subdistrict A (the triangular-shaped block formed by the intersections of Broadway, West 125th Street, and West 129th Street), and projected developments in Subdistrict B[1] and the Other Areas would be equipped with fossil fuel-fired HVAC systems. This chapter assesses the impacts of these systems on the surrounding community and the environment. In addition, potential effects on the Proposed Actions from existing HVAC sources are examined.

This chapter also describes the expected use of potentially hazardous materials and the procedures and systems that would be employed in the Academic Mixed-Use Area to ensure the safety of staff, students, and the surrounding community in the event of a chemical spill in one of the proposed academic research laboratories. In addition, because portions of the Project Area are located adjacent to a zoned industrial area, air quality impacts from nearby industrial sources

[1] CPC is contemplating certain modifications to Subdistrict B. The proposed modifications would rezone Subdistrict B to a modified M1-2 light manufacturing district to support light manufacturing and retail uses. It is anticipated that this modification would not result in any projected development sites in Subdistrict B. The proposed modifications are more fully described in Chapter 29, "Modifications to the Proposed Actions."

of air pollution (e.g., from manufacturing or processing facilities) may be a concern. Potential air quality impacts from the Metropolitan Transportation Authority (MTA) Manhattanville Bus Depot on the Proposed Actions were evaluated, as well as the off-site impacts due to the possible reconstruction of the bus depot at its present below-grade location.

The Proposed Actions would increase traffic in the vicinity of the Project Area and along feeder streets to and from the project site, and would result in University housing sites in proximity to the elevated Riverside Drive. Therefore, an analysis was performed on the potential impacts on air quality from motor vehicles.

PRINCIPAL CONCLUSIONS

The analyses conclude that the Proposed Actions would not result in any significant adverse air quality impacts on sensitive uses in the surrounding community, and the Proposed Actions would not be adversely affected by new or existing sources of air emissions in the Project Area. A summary of the general findings is presented below.

Concentrations of carbon monoxide (CO) and fine particulate matter less than 10 microns in diameter (PM_{10}) due to project-generated traffic at intersections near the project site (the primary study area) and along main corridors outside the primary study area (the secondary study area) would not result in any violations of National Ambient Air Quality Standards (NAAQS). It was also determined that CO impacts 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. Concentrations of CO from traffic along the elevated Riverside Drive at proposed adjacent University housing sites would be below the NAAQS.

Impacts due to the Proposed Actions' parking facilities were found to result in no significant adverse air quality impacts. The Restrictive Declaration for the Academic Mixed-Use Area would include provisions restricting the locations of ventilation exhausts to ensure that the parking facilities do not result in any significant adverse air quality impacts.

The proposed central energy plants and package boilers in the Academic Mixed-Use Area would require permits from the New York State Department of Environmental Conservation (DEC), and the New York City Department of Environmental Protection (DEP). Analyses of the emissions and dispersion of nitrogen oxides (NO_x), CO, PM_{10}, and sulfur dioxide (SO_2) from the Academic Mixed-Use Area's stationary sources indicate that such emissions would not result in the violations of NAAQS. Emissions of $PM_{2.5}$ were analyzed in accordance with the City's current $PM_{2.5}$ interim guidance criteria, which determined that the maximum incremental increases in annual average $PM_{2.5}$ concentrations from stationary sources would be below the significant impact thresholds, as well as the 24-hour average interim guidance criterion of 5 micrograms per cubic meter ($\mu g/m^3$). Maximum 24-hour average $PM_{2.5}$ concentrations from the Proposed Actions' central energy plants and package boilers were predicted to exceed the City's interim guidance criterion of 2 $\mu g/m^3$; however, based on the magnitude, and the limited frequency and extent of these occurrences, no significant adverse air quality impact is predicted due to emissions of $PM_{2.5}$. To ensure the avoidance of impacts, limitations on annual fuel usage and minimum stack heights would be included in the Restrictive Declaration for the Academic Mixed-Use Area. For Site 15, the Restrictive Declaration would include a provision limiting the package boilers to natural gas.

Other projected development sites within the Project Area (at Site 5, Subdistrict B, and the Other Areas) were analyzed to determine whether fossil fuel-fired equipment would result in any potential significant adverse air quality impacts on nearby buildings. The results demonstrated that for Sites 20, 24 and 25, an air quality E-designation is necessary to ensure that concentrations from emissions of fossil fuel-fired equipment do not result in a violation of ambient air quality standards or exceedances of the City's $PM_{2.5}$ interim guidance criteria. The E-designations would require the use of certain types of fossil fuels and/or place restrictions on where exhaust stacks for fossil fuel-fired equipment could be located. The projected developments on other sites would not result in any violation of ambient air quality standards when firing natural gas or fuel oil.

Nearby existing combustion sources at large industrial, institutional, or residential developments were analyzed for their potential impact on the Proposed Actions. These nearby sources were also analyzed along with the proposed central energy plants and package boilers in the Academic Mixed-Use Area and other projected developments to determine cumulative impacts. These analyses determined that maximum future pollutant levels would be below NAAQS at all receptor locations.

The Proposed Actions were evaluated to assess potential impacts from plume fogging, rime icing, and elevated visible plumes from operation of the proposed cooling towers. The cooling tower fogging model predicted that there would be no hours of ground-level fogging or rime icing. While a water vapor plume would be visible at various times, the cooling towers would not result in a significant visual impact from elevated plumes.

The results of the laboratory chemical spill modeling analysis demonstrated that a potential spill in a fume hood would produce maximum concentrations at the nearest on-site or off-site location below the toxicity exposure thresholds established for the chemicals of primary concern. The Restrictive Declaration for the Academic Mixed-Use Area would include provisions to require a minimum laboratory fume hood exhaust height for each site having an academic research use. For laboratory facilities at Site 12, the initial modeling results predicted an exceedance of toxicity thresholds for the analyzed chemicals. Therefore, the Restrictive Declaration for the Academic Mixed-Use Area would include additional requirements relating to the fume hood mechanical equipment design for Site 12 to preclude the potential for significant adverse air quality impacts from the laboratory fume hood ventilation system on nearby receptors.

Nearby existing sources from manufacturing or processing facilities were analyzed for their potential impacts on the Proposed Actions. The results of the industrial source analysis demonstrated that there would be no significant adverse air quality impacts on the Proposed Actions.

An analysis was performed to assess pollutant levels from the existing MTA Manhattanville Bus Depot in the 2015 Build condition, and from the proposed below-grade bus depot in the 2030 Build condition. The results of the analysis determined that the maximum concentrations of CO and PM_{10} from the bus depot's operations, when added to ambient background levels, would be well below the NAAQS. However, to ensure that significant impacts of $PM_{2.5}$ at receptor locations in the community would not occur, the Restrictive Declaration for the Academic Mixed-Use Area would include provisions for the below-grade depot to utilize clean burning natural gas, and for the locations and height of combustion exhaust stacks. The Restrictive Declaration for the ventilation systems associated with the reconstructed below-grade MTA Manhattanville Bus Depot would ensure that the emissions from future bus depot operations do not result in any significant air quality impacts.

B. POLLUTANTS FOR ANALYSIS

Ambient air quality is affected by air pollutants produced by both 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. Typically, ambient concentrations of CO are predominantly influenced by mobile source emissions. Particulate matter (PM), volatile organic compounds (VOCs), and nitrogen oxides (NO and 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. The formation of such secondary PM takes hours or days to occur and thus has no measurable effect on air quality in the immediate vicinity of the source. Emissions of SO_2 are associated mainly with stationary sources and sources using nonroad diesel fuel, such as diesel trains, marine engines, and nonroad vehicles such as construction engines; diesel-powered vehicles, primarily heavy-duty trucks and buses, also contribute somewhat to these emissions. However, diesel fuel regulations that recently began to take effect will reduce SO_2 emissions from mobile sources to extremely low levels. Ozone is formed in the atmosphere by complex photochemical processes that include NO_x and VOCs, emitted mainly from industrial processes and mobile sources.

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 that 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 Actions would increase traffic volumes on feeder streets to and from the rezoning area, and within the rezoning area itself. Therefore, a mobile source analysis was conducted to evaluate future CO concentrations with and without the Proposed Actions. In addition, the potential effects of vehicle emissions from the elevated Riverside Drive on proposed adjacent University housing sites were evaluated.

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 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 Actions 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 would result. An analysis of project-related emissions of these pollutants from mobile sources is therefore not warranted.

There is a standard for average annual NO_2 concentrations, which is normally examined only for fossil fuel energy sources. An analysis of the potential NO_2 impacts from the Proposed Actions' stationary sources of emissions was performed.

LEAD

Airborne lead emissions are principally associated with industrial sources and motor vehicles that use gasoline containing lead additives. Most U.S. vehicles produced since 1975, and all produced after 1980, are designed to use unleaded fuel. As these newer vehicles have replaced the older ones, motor vehicle-related lead emissions have decreased. As a result, ambient concentrations of lead have declined significantly. Nationally, the average measured atmospheric lead level in 1985 was only about one-quarter the level in 1975.

In 1985, EPA announced new rules that drastically reduced the amount of lead permitted in leaded gasoline. The maximum allowable lead level in leaded gasoline was reduced from the previous limit of 1.1 to 0.5 grams per gallon effective July 1, 1985, and to 0.1 grams per gallon effective January 1, 1986. Monitoring results indicate that this action has been effective in significantly reducing atmospheric lead concentrations. 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 the 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 national standard of 1.5 $\mu g/m^3$ (three-month average).

No significant sources of lead are associated with the Proposed Actions, and, therefore, an analysis of this pollutant from stationary or mobile sources is 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 both 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 VOCs; 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, construction and agricultural activities, and 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 (µm), or $PM_{2.5}$, and particles with an aerodynamic diameter of less than or equal to 10 µm, or PM_{10}, which includes the smaller $PM_{2.5}$. $PM_{2.5}$ has the ability to reach the lower regions of the respiratory tract, delivering with it other compounds adsorbed to the surfaces of the particles, and is also extremely persistent in the atmosphere. $PM_{2.5}$ is directly emitted from combustion material that has volatilized and then condensed to form primary PM (often soon after the release from an exhaust) or from precursor gases reacting in the atmosphere to form secondary PM.

There is also a New York standard for total suspended particulate matter (TSP), which represents both coarse and fine particles. However, DEC no longer conducts monitoring for this pollutant.

An analysis was conducted to assess the worst-case PM impacts due to the increased automobile and truck traffic associated with the Proposed Actions, and from the Proposed Actions' HVAC systems.

SULFUR DIOXIDE

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

As part of the Proposed Actions, fuel oil would be burned in the proposed HVAC systems. Therefore, an analysis was performed to estimate the future levels of SO_2 with the Proposed Actions.

AIR TOXICS

In addition to the criteria pollutants discussed above, non-criteria toxic air pollutants, also called air toxics, are regulated. Air toxics are those pollutants that are known or suspected to cause serious health effects in small doses. Air toxics are emitted by a wide range of man-made and naturally occurring sources. Emissions of air toxics from industries are regulated by EPA. Federal ambient air quality standards do not exist for non-criteria compounds. However, DEC has issued standards for certain non-criteria compounds, including beryllium, gaseous fluorides, and hydrogen sulfide. DEC has also developed ambient guideline concentrations for numerous air toxic non-criteria compounds. The DEC guidance document DAR-1 (December 2003) contains a compilation of annual and short term (1-hour) guideline concentrations for these compounds. The DEC guidance thresholds represent ambient levels that are considered safe for public exposure.

The Project Area contains and is adjacent to existing industrial uses. Therefore, an analysis to examine the potential for impacts on the Proposed Actions from industrial emissions was performed.

C. AIR QUALITY REGULATIONS, STANDARDS, AND BENCHMARKS

NATIONAL AND STATE AIR QUALITY STANDARDS

As required by the CAA, primary and secondary 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 intended 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. For NO_2, ozone, lead, and PM, the primary and secondary standards are the same; there is no secondary standard for CO. EPA promulgated additional NAAQS that became effective September 16, 1997: a new 8-hour standard for ozone, which replaced the 1-hour standard, and new 24-hour and annual standards for $PM_{2.5}$. The standards for these pollutants are presented in Table 19-1. These standards have also been adopted as the ambient air quality standards for New York State. In addition, New York State has established ambient air quality standards for total suspended particulate, non-methane hydrocarbons, beryllium, gaseous fluorides, and hydrogen sulfide.

Table 19-1
Ambient Air Quality Standards

Pollutant	Primary		Secondary	
	ppm	µg/m³	ppm	µg/m³
Carbon Monoxide (CO)				
Maximum 8-Hour Concentration[1]	9	10,000	None	
Maximum 1-Hour Concentration[1]	35	40,000		
Lead				
Maximum Arithmetic Mean Averaged Over 3 Consecutive Months	NA	1.5	NA	1.5
Nitrogen Dioxide (NO_2)				
Annual Arithmetic Average	0.053	100	0.053	100
Ozone (O_3)				
8-Hour Average[2]	0.08	157	0.08	157
Respirable Particulate Matter (PM_{10})				
Average of Three Annual Arithmetic Means revoked, effective December 18, 2006	NA	50	NA	50
24-Hour Concentration[1]	NA	150	NA	150
Fine Respirable Particulate Matter ($PM_{2.5}$)				
Average of Three Annual Arithmetic Means	NA	15	NA	15
24-Hour Concentration[3,4]	NA	35	NA	35
Sulfur Dioxide (SO_2)				
Annual Arithmetic Mean	0.03	80	NA	NA
Maximum 24-Hour Concentration[1]	0.14	365	NA	NA
Maximum 3-Hour Concentration[1]	NA	NA	0.50	1,300

Notes: ppm – parts per million
µg/m³ – micrograms per cubic meter
NA – not applicable
Concentrations of all gaseous pollutants are defined in ppm — approximately equivalent concentrations in µg/m³ are presented.
[1] Not to be exceeded more than once a year.
[2] Three-year average of the annual fourth highest daily maximum 8-hr average concentration.
[3] Not to be exceeded by the 98th percentile averaged over 3 years.
[4] EPA has reduced these standards down from 65 µg/m³, effective December 18, 2006.
Sources: 40 Code of Federal Regulations (CFR) Part 50: National Primary and Secondary Ambient Air Quality Standards.

On September 21, 2006, EPA 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 µg/m^3 to 35 µg/m^3, and retaining the level of the annual fine standard at 15 µg/m^3. The PM_{10} 24-hour average standard was retained, and the annual average PM_{10} standard was revoked.

NAAQS ATTAINMENT STATUS AND STATE IMPLEMENTATION PLANS (SIP)

The CAA, as amended in 1990, defines non-attainment areas (NAAs) 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.

EPA has designated New York City as in attainment for NO_2, SO_2, and lead. EPA has re-designated New York City as in attainment for CO. The CAA 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 New York 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 boroughs of New York City as well as Nassau, Suffolk, Rockland, Westchester, and Orange counties as $PM_{2.5}$ non-attainment areas under the CAA. State and local governments are required to develop implementation plans by early 2008, which will be designed to meet the $PM_{2.5}$ standards by 2010. As described above, EPA has recently revised the 24-hour $PM_{2.5}$ standards. $PM_{2.5}$ attainment designations would be effective by April 2010, $PM_{2.5}$ SIPs would be due by April 2013, and would be designed to meet the $PM_{2.5}$ standards by April 2015, although this may be extended in some cases up to April 2020.

Nassau, Rockland, Suffolk, Westchester, and the five counties of New York City had been designated as severe non-attainment for the ozone 1-hour standard. In November 1998, New York State submitted its *Phase 2 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. New York State has recently submitted revisions to the SIP. These SIP revisions included additional emission reductions that EPA requested to demonstrate attainment of the standard, and an update of the SIP estimates using the latest versions of the mobile source emissions model, MOBILE6.2, and the nonroad emissions model, NONROAD—which have been updated to reflect current knowledge of engine emissions—and the latest mobile and nonroad engine emissions regulations. EPA revoked the 1-hour ozone standard on June 15, 2005; however, the specific control measures for the 1-hour standard included in the SIP will be required to stay in place until the 8-hour standard is attained. The discretionary emissions reductions in the SIP will also remain but could be revised or dropped based on modeling. New York State is currently formulating a new SIP for ozone, which is expected to be adopted in the near future. The SIP will have a target attainment deadline of June 15, 2010.

DETERMINING THE SIGNIFICANCE OF AIR QUALITY IMPACTS

The State Environmental Quality Review Act (SEQRA) regulations and the *CEQR Technical Manual* state that the significance of a likely consequence (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.

In terms of the magnitude of air quality impacts (bullet 6, above), 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 19-1) would be deemed to have a potential significant adverse impact. In addition, 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 incremental increase in CO concentrations that would result from proposed projects or actions, as set forth in the *CEQR Technical Manual*. These criteria set the minimum change in CO concentration that defines a significant 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 Build 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 Build) concentrations and the 8-hour standard, when No Build concentrations are below 8.0 ppm.

INTERIM GUIDANCE CRITERIA REGARDING $PM_{2.5}$ IMPACTS

DEC has published a policy to provide interim direction for evaluating $PM_{2.5}$ impacts. This policy would apply 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, DEP is currently recommending interim guidance criteria for evaluating the potential $PM_{2.5}$ impacts for projects subject to CEQR. The updated interim guidance criteria currently employed by DEP for determination of potential significant adverse $PM_{2.5}$ impacts under CEQR are as follows:

- 24-hour average $PM_{2.5}$ concentration increments which 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 which 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;
- Predicted annual average $PM_{2.5}$ concentration increments 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
- Predicted annual average $PM_{2.5}$ concentration increments greater than 0.3 $\mu g/m^3$ at a discrete or ground-level receptor location.

Actions under CEQR that would increase $PM_{2.5}$ concentrations by more than the DEP or DEC interim guidance criteria above will be considered to have potential significant adverse impacts. DEP 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 Actions' annual emissions of PM_{10} are estimated to be well below the 15-ton-per-year threshold under DEC's $PM_{2.5}$ policy guidance. The above DEP and DEC interim guidance criteria have been used for the purpose of evaluating the significance of predicted impacts of the Proposed Actions on $PM_{2.5}$ concentrations and determine the need to minimize PM emissions from the Proposed Actions.

D. METHODOLOGY FOR PREDICTING POLLUTANT CONCENTRATIONS

INTRODUCTION

This section presents the methodologies, data, and assumptions used to conduct the air quality analyses for the Proposed Actions. The analyses are presented below as follows:

- Mobile Source Analysis
  - Impacts at intersections due to the Proposed Actions; and
  - Impacts on University housing sites due to the elevated Riverside Drive.
- Stationary Source Analysis
  - HVAC impacts due to the fossil fuel-fired sources in the Academic Mixed-Use Area (Subdistrict A), Subdistrict B, and the Other Areas;
  - Impacts from proposed cooling towers;
  - Impacts from a potential chemical spill within a laboratory fume hood at an academic research building; and
  - Impacts on the Proposed Actions from industrial sources.
- MTA Manhattanville Bus Depot Analysis

REASONABLE WORST-CASE DEVELOPMENT SCENARIO

To fully assess air quality impacts of the Proposed Actions, several scenarios of development within the Project Area have been formulated. In Subdistrict A, an Illustrative Plan has been developed for the Academic Mixed-Use Development, which is generally the "reasonable worst-case development scenario" for the analysis of impacts. Table 1-6 of this Final EIS (FEIS) provides a summary of the permitted uses on each development site within the Academic Mixed-Use Development Area. Within this plan, the uses resulting in the reasonable worst-case development scenario were assumed for each of the air quality analyses conducted. For Subdistricts B, C, and the Other Areas, a reasonable worst-case development scenario has also been formulated as the framework for the impact analyses (see Chapter 1, "Project Description," for further information).

Table 19-2 presents a summary of the uses assumed for the developments within the Academic Mixed-Use Area for each of the air quality analyses conducted. In general, when analyzing potential impacts due to the Proposed Actions, development that maximizes emissions was assumed (for the mobile source analysis, air quality impacts were determined based on the future development that maximizes vehicle trip generation). When determining impacts on the Proposed Actions from new or existing sources, however, the development that maximizes sensitive uses within the Academic Mixed-Use Area (i.e., University housing) was assumed. In addition, the stationary source air quality analyses assumed the maximum allowable building heights under the proposed rezoning. This is conservative when determining impacts on the Proposed Actions, since maximum impacts from nearby elevated sources tend to occur on the upper floors of a receptor site (e.g., at window locations). In addition, maximizing building heights results in the greatest potential for building downwash conditions, which may result in higher concentrations at ground-level receptors and low-rise buildings.

Table 19-2
Reasonable Worst-Case Development Scenario

Site	Mobile Source Analysis	Stationary Source Analysis		
		HVAC [1]	Chemical Spill	Industrial Sources
1	Academic	Academic	Academic	Academic
2	Academic research	Academic research	Academic research	Academic research
3	Academic	Academic	Academic	Academic
4	Academic	University housing	Academic	University housing
5	Retail	Retail	Retail	Retail
6	Academic research	Academic research	Academic research	Academic research
6b	Academic research	Academic research	Academic research	Academic research
7	Academic [2]	University housing	University housing	University housing
8	Academic research	Academic research	Academic research	Academic research
9	Academic research	Recreation	Academic research	Recreation
10	Academic	Academic	Academic	Academic
11	Academic	Academic research	Academic research	Academic research
12	Academic	Academic research	Academic research	Academic
13	Academic	Academic	Academic	University housing
14	University housing	University housing	University housing	University housing
15	Academic research	Academic research	Academic research	Academic research
16	Academic	Academic	Academic	Academic
17	Academic research	Academic research	Academic research	University housing

Notes:
[1] Sites 13 and 17 were also analyzed as University housing developments to determine potential air quality impacts from the Proposed Actions' HVAC sources.
[2] Site was also analyzed to determine potential air quality impacts from elevated Riverside Drive.

MOBILE SOURCES

The prediction of vehicle-generated CO and PM emissions and their dispersion in an urban environment incorporates meteorological phenomena, traffic conditions, and physical configurations. Air pollutant dispersion models mathematically simulate how traffic, meteorology, and geometry 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 it is necessary to predict the reasonable worst-case condition, most of these dispersion models predict conservatively high concentrations of pollutants.

The mobile source analyses for the Proposed Actions employ models approved by EPA that have 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 result from the Proposed Actions. The assumptions used in the PM analysis were based on the latest $PM_{2.5}$ interim guidance developed by DEP.

DISPERSION MODELS FOR MICROSCALE ANALYSES

Maximum CO concentrations adjacent to streets near the Project Area, resulting from vehicle emissions, were predicted using the CAL3QHC model Version 2.0.[1] 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 pollutants 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. The CAL3QHC model has been updated with an extended module, CAL3QHCR, which allows for the incorporation of hourly meteorological data into the modeling, instead of worst-case assumptions regarding meteorological parameters. This refined version of the model is employed if maximum predicted future CO concentrations are greater than the applicable ambient air quality standards or when *de minimis* thresholds are exceeded using the first-level CAL3QHC modeling. It is also used to calculate PM mobile source impacts, since it is more appropriate for calculating 24-hour and annual average PM 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 accumulation of pollutants at a particular prediction location (receptor), and atmospheric stability accounts for the effects of vertical mixing in the atmosphere.

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

Tier I Analyses—CAL3QHC

CO calculations were performed using the CAL3QHC model. 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[1], CO 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. 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.

Tier II Analyses—CAL3QHCR

A Tier II analysis using the CAL3QHCR model, which includes the modeling of hour-by-hour concentrations based on hourly traffic data and five years of monitored hourly meteorological data, was performed to predict maximum 24-hour and annual average PM levels. The data consists of surface data collected at LaGuardia Airport and upper air data collected at Brookhaven, New York, for the period 2002-2006. All hours were modeled, and the highest resulting concentration for each averaging period was presented.

ANALYSIS YEAR

The microscale analyses were performed for existing conditions, an interim Build year of 2015 (Phase 1), and 2030, the year in which the full build-out of the Proposed Actions is expected to be completed (Phase 2). The future analyses were performed both without the Proposed Actions (the No Build condition) and with the Proposed Actions (the Build condition).

VEHICLE EMISSIONS DATA

Engine Emissions

Vehicular CO and PM emission factors were computed using the EPA mobile source emissions model, MOBILE6.2[2]. This emissions model is capable of calculating engine emission 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 changes in fuel and tailpipe emission standards, and inspection maintenance programs. The inputs and use of MOBILE6.2 incorporates the most current guidance available from DEC and DEP.

Appropriate credits were used to accurately reflect the New York State inspection and maintenance program, which requires inspections of automobiles and light trucks to determine if pollutant emissions from the vehicles' exhaust systems are below emission standards. Vehicles

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

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

failing the emissions test must undergo maintenance and pass a repeat test to be registered in New York State.

Vehicle classification data were based on field studies conducted for the project. The general categories of vehicle types for specific roadways were further categorized into subcategories based on their relative fleet-wide breakdown.[1]

An ambient temperature of 50°F was used. The use of this temperature is recommended in the *CEQR Technical Manual* for the Borough of Manhattan and is consistent with current DEP 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} emission estimates include both exhaust and re-entrained road dust. Fugitive road dust was not included in the $PM_{2.5}$ microscale analyses based on the current EPA protocol for determining fugitive dust emissions from paved roads.[2]

TRAFFIC DATA

Traffic data for the air quality 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 Actions (see Chapter 17, "Traffic and Parking"). Traffic data for the future without and with the Proposed Actions were employed in the respective air quality modeling scenarios. The weekday morning (8:00 to 9:00 AM) and afternoon (4:00 to 5:00 PM) peak periods were analyzed. These time periods were selected for the mobile source analysis because they produce the maximum anticipated project-generated and future Build traffic and, therefore, have the greatest potential for significant air quality impacts.

Intersections analyzed along Twelfth Avenue included background traffic volumes from the nearby Henry Hudson Parkway and from the elevated Riverside Drive.

Since the PM analysis requires hourly traffic data over an entire 24-hour period, it was necessary to estimate this information for the non-peak traffic periods. The projected weekday and weekend peak No Build traffic volumes were used as a baseline. No Build traffic volumes for other hours were determined by adjusting the peak period volumes by the 24-hour distributions of actual vehicle counts collected for the project. Project-generated traffic and background traffic diversion volumes were determined over the 24-hour period by using the 24-hour parking accumulation data used in the traffic analysis. 24-hour PM impacts were determined by using the 24-hour distribution associated with the highest total daily vehicle count. For annual impacts, average weekday and weekend 24-hour distributions were used to more accurately simulate traffic patterns over longer periods.

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[1] The MOBILE6.2 emissions model utilizes 28 vehicle categories by size and fuel. Traffic counts and predictions are based on broader size categories and then broken down according to the fleet-wide distribution of subcategories and fuel types (diesel, gasoline, or alternative).

[2] 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, November 2006.

BACKGROUND CONCENTRATIONS

Background concentrations are those pollutant levels not directly accounted for through the modeling analysis (which directly accounts for vehicle-generated emissions on the streets within 1,000 feet and line-of-sight of the receptor location). Background concentrations must be added to modeling results to obtain total pollutant concentrations at a study site.

The 8-hour average CO background concentration used in this analysis was 2.0 ppm for both the 2015 and 2030 predictions, which is based on the second-highest 8-hour measurements over the most recent three-year period for which complete monitoring data is available (2004–2006), utilizing measurements obtained at the DEC PS 59 monitoring station located in Manhattan. The 1-hour CO background employed in the analysis was 2.6 ppm.

The PM_{10} 24-hour background concentration was based on the second-highest concentration, measured over the most recent three-year period for which complete data are available (2003–2004 and 2006). The nearest DEC monitoring sites, at IS 52 in the Bronx for 2003 and 2004, and PS 59 for 2006, were used.

MOBILE SOURCE ANALYSIS SITES

Eight intersection locations were selected for microscale analysis (see Table 19-3 and Figure 19-1). These intersections were selected because they are the locations in the primary and secondary study areas where the largest levels of project-generated traffic are expected and, therefore, where the maximum changes in the concentrations would be expected and the highest potential for air quality impacts would occur.

Table 19-3
Mobile Source Analysis Intersection Locations

Analysis Site	Location
1	Twelfth Avenue and West 133rd Street
2	Broadway and West 133rd Street
3	Broadway and West 125th Street
4	Amsterdam Avenue and West 125th Street
5	Second Avenue and East 125th Street
6	Broadway and West 131st Street
7	Madison Avenue and East 125th Street
8	Twelfth Avenue and West 125th/130th Streets

Each of these intersections was analyzed for CO. For the PM_{10} and $PM_{2.5}$ analyses, two of the intersections were analyzed. Based on review of estimated project-generated traffic, the intersection of Broadway and West 125th Street was selected, since it has the highest Build traffic volumes and would therefore result in the highest predicted PM_{10} emissions. The intersection of Broadway and West 133rd Street was chosen because it has the highest overall build increment in both the 2015 and 2030 analysis years and, therefore, the greatest potential for maximum changes in $PM_{2.5}$ concentrations. Each of these intersections was analyzed for PM_{10} and $PM_{2.5}$.

Under the Illustrative Plan, Sites 7 and 14 would be developed as University housing. Since these sites would be adjacent to the elevated Riverside Drive, they were analyzed, as recommended in the *CEQR Technical Manual*, to determine the effect of pollutant concentrations from future traffic at elevated locations. Receptors were placed at various locations and elevations on each of these development sites to assess potential impacts from projected future background levels of traffic. The

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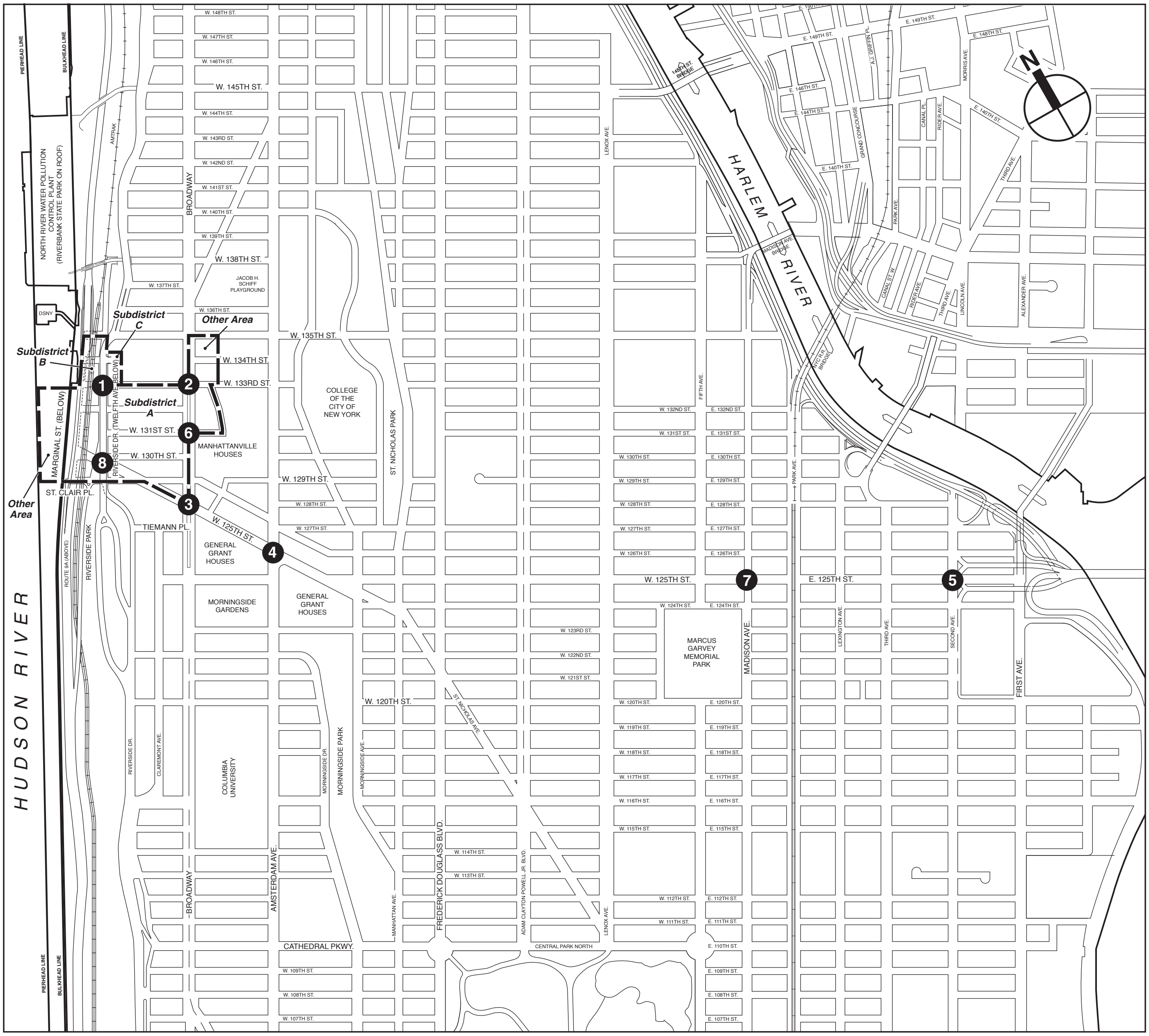

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SCALE

▬ ▬ ▬ *Project and Rezoning Area Boundary*

KEY TO AIR QUALITY MOBILE SOURCE ANALYSIS SITES

1 *Twelfth Avenue/133rd Street*
2 *Broadway/133rd Street*
3 *Broadway/125th Street*
4 *Amsterdam Avenue/125th Street*
5 *Second Avenue/125th Street*
6 *Broadway/131st Street*
7 *Madison Avenue/125th Street*
8 *Twelfth Avenue/125th Street/130th Street*

Figure 19-1
Air Quality Mobile Source Analysis Sites

analysis was performed to determine maximum CO concentrations; impacts due to emissions of PM from mobile sources were determined to be insignificant, since Riverside Drive is not a primary truck route or high volume roadway.

RECEPTOR LOCATIONS

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. Local model receptors were placed at sidewalk or roadside locations near intersections with continuous public access and at residential locations. Receptors in the annual $PM_{2.5}$ neighborhood scale models were placed at a distance of 15 meters from the nearest moving lane, based on the DEP procedure for neighborhood scale corridor $PM_{2.5}$ modeling. Receptors were also placed at the building façades of proposed University housing sites that would be adjacent to and facing the elevated Riverside Drive.

PARKING FACILITIES

As discussed in this DEIS, the Academic Mixed-Use Area would include below-grade parking facilities. The air exhausted from the garages' ventilation systems would contain elevated levels of pollutants due to emissions from vehicles using the garages. Ventilation air from the Proposed Actions' parking facilities would be directed to various exhausts located on the sides or roofs of buildings above the garages. The parking garage exhausts would be more than 30 feet above grade, and would be directed away from existing sensitive receptor sites (such as residences or schools) located within 20 feet. A minimum of four vents would be used to exhaust air from the main underground parking facilities, which would be located between Broadway and Twelfth Avenue, and between West 125th Street and West 133rd Street. These facilities would contain a combined total of approximately 2,000 parking spaces.

An analysis of the emissions from the outlet vents and their dispersion in the environment was performed, calculating pollutant levels in the surrounding area, using the methodology set forth in the *CEQR Technical Manual*. 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 50°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 determined for the maximum 8-hour average period.

To determine pollutant concentrations, the outlet vents were analyzed as a "virtual point source" 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.

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 derived from the trip generation analysis described in Chapter 17, "Traffic and Parking."

As discussed earlier, the air from the proposed parking garages would be vented through four outlets at a minimum height of 30 feet. The vent face was modeled to directly discharge to Broadway, and "near" and "far" receptors were placed along the sidewalks at a pedestrian height of 6 feet at a distance of 20 feet and 120 feet, respectively, from the vent. A persistence factor of 0.70, supplied by NYCDEP, 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 and on-street CO concentrations were added to the modeling results to obtain the total ambient levels. The on-street CO concentration was determined using the methodology in Air Quality Appendix 1 of the *CEQR Technical Manual*, utilizing traffic volumes utilized in the mobile source analysis.

STATIONARY SOURCES

HVAC SYSTEMS

A stationary source analysis was conducted to evaluate potential impacts from the Proposed Actions' central energy plants and package boilers associated with the Academic Mixed-Use Area, and HVAC systems associated with proposed development sites at Site 5 in Subdistrict A, as well as Subdistrict B and the Other Areas.

Academic Mixed-Use Area

Steam and hot water would be generated to service the Academic Mixed-Use Area's heating demand and to drive mechanical air conditioning equipment. By 2015, the first of the two central energy plants would be constructed in the below-grade space area beneath Site 3 on the block between West 129th and West 130th Streets to serve the development anticipated to be operational within this area in Phase 1. By 2030, the first central energy plant would be expanded to serve the additional development that would occur up to West 132nd Street in Phase 2. A second central energy plant would be constructed to serve the portion of the Project Area above West 132nd Street west of Broadway. Other development sites in the Academic Mixed-Use Area would be served by separate boiler installations in each building.

Emergency diesel-fueled generators would be installed to serve the Academic Mixed-Use Area in the event of the loss of utility electrical power. Two 2-megawatt (MW) standby emergency generators are anticipated to be installed at the proposed central energy plant to be constructed beneath Site 3 (one emergency generator would be installed initially in Phase 1, and the second emergency generator would be installed after 2015). A 2 MW standby emergency generator would also be installed at the central energy plant that is planned as part of Phase 2 at Site 14. In addition, each of the sites in the Academic Mixed-Use Area would have an emergency generator to provide life safety functions in the event of a power interruption. A summary of the approximate size of each emergency generator is provided in Table 19-4.

Table 19-4
Anticipated Emergency Generator Capacities

Site	Capacity (MW)
1	0.3
2	0.4
3	0.3
Central Energy Plant Beneath Site 3	4 (2-2MW Units)
4	0.45
5	0.03
6	0.45
6b	0.3
7	0.4
8	0.45
9	0.35
10	0.4
11	0.45
12	0.4
13	0.4
14	0.45
Central Energy Plant at Site 14	2
15	0.45
16	0.35
17	0.5

The emergency generators would be tested periodically for a short period to ensure their availability and reliability in the event of a sudden loss in utility electrical power. They would not be utilized in a peak load shaving program[1], minimizing the use of this equipment during non-emergency periods. Emergency generators are exempt from DEC air permitting requirements, but would likely require a registration issued by DEP. The emergency generators would be installed and operated in accordance with DEP requirements, as well as other applicable codes and standards. Potential air quality impacts from the emergency generators would be insignificant, since they would be used only for testing purposes outside of an actual emergency use (once per week for approximately 15 to 20 minutes), and individual generators would be tested at different times.

A description of the equipment and the areas they would serve is presented for both the 2015 and 2030 Build years.

2015

A centralized steam and chilled water plant (central energy plant) would be constructed beneath Site 3 to serve the Academic Mixed-Use Area buildings north of West 125th Street and south of West 132nd Street between Broadway and Twelfth Avenue. Electric power would be provided by Con Edison. By 2015, the central energy plant would serve a portion of this area, specifically Sites 2, 3, 4, and 7. The central energy plant may also serve Site 1, across West 129th Street.

Conventional high-efficiency boilers would be used to generate steam. For the purpose of this analysis, the Phase 1 central energy plant would be equipped with two 40,000-pound/hour (lb/hr) boilers and one 80,000-lb/hr boiler. The maximum steam demand in the 2015 analysis year is

[1] 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.

anticipated to be no greater than 80,000-lb/hr; therefore, demand would be met by operating either the two 40,000-lb/hr boilers or the 80,000-lb/hr boiler, with the other boiler(s) providing redundancy.

Since it is possible that Site 1 would not be connected to the central energy plant, for analysis purposes it was assumed that a boiler installation consisting of three dual-fuel 50-horsepower boilers (rated at approximately 1,725-lb/hr steam) would be used to service the heating needs of the building. Up to two units would operate at any given time, with the third unit serving as a spare.

The boilers would operate on either natural gas or distillate fuel oil (0.2 percent sulfur by weight or less). The central energy plant boilers would also be equipped with low-NO_x burners.

The exhaust stacks for the central energy plant boilers would be located on the roof of Site 2. Figure 19-2 shows the sites that would be served by the central energy plant's heating and cooling systems by the 2015 Build year, as well as stationary source exhaust stack locations.

Construction and operation of the central energy plant and package boiler systems would be subject to the terms of permits issued by DEC. The type of air permit(s) required would be primarily based on whether each site is permitted individually or sites are grouped together, and whether the projected emissions of air pollutants would exceed major source thresholds as defined in 40 CFR 52.21 and 6 NYCRR Parts 201 and 321. DEC issues state facility permits or registrations for minor sources of emissions and Title V permits for major sources of emissions and sources subject to certain regulations. Permits include protection against air quality impacts such as emission limits for specific pollutants, limitations of the types of fuels on which the emissions sources would operate, and monitoring, reporting, and recordkeeping requirements. The limitations are based upon EPA and DEC standards that are designed to protect public health and the environment. In addition, limitations on the annual fuel usage reflecting the analyzed equipment utilization and minimum stack heights would be included in the Restrictive Declaration for the Academic Mixed-Use Area.

2030

In Phase 2, one new 80,000-lb/hr boiler would be installed at the central energy plant beneath Site 3 to serve the needs of additional buildings that would be constructed north of West 125th Street and south of West 132nd Street between Broadway and Twelfth Avenue. The peak steam demand at this central energy plant in 2030 would be met by the Phase 1 boilers (either the two 40,000-lb/hr boilers or the 80,000-lb/hr boiler) and the additional 80,000-lb/hr boiler. By 2030, all of the central energy plant boilers would operate using natural gas exclusively. The exhaust stacks for the central energy plant equipment would be located on Site 2. A second central energy plant would be constructed on Site 14 to serve the entire block bounded by Broadway, West 132nd Street, Twelfth Avenue, and West 133rd Street. This second central energy plant would consist of two natural gas-fired 40,000-lb/hr boilers and one natural gas-fired 80,000-lb/hr boiler. The maximum steam demand would be met by operating either the two 40,000-lb/hr boilers or the one 80,000-lb/hr boiler, with the other boiler(s) providing redundancy.

Individual boiler systems would be installed at Sites 15, 16, and 17 to provide steam to the proposed buildings. Three 800-horsepower boilers (rated at approximately 27,600-lb/hr steam) would each be installed at Sites 15 and 17 (Site 15 would utilize natural gas-fired boilers, while Site 17 would be dual-fuel), while three dual-fuel 40-horsepower boilers (rated at approximately 1,380-lb/hr steam) would be installed at Site 16. At each development site, up to two boilers would be in use at any time, with the other boiler serving as a spare.

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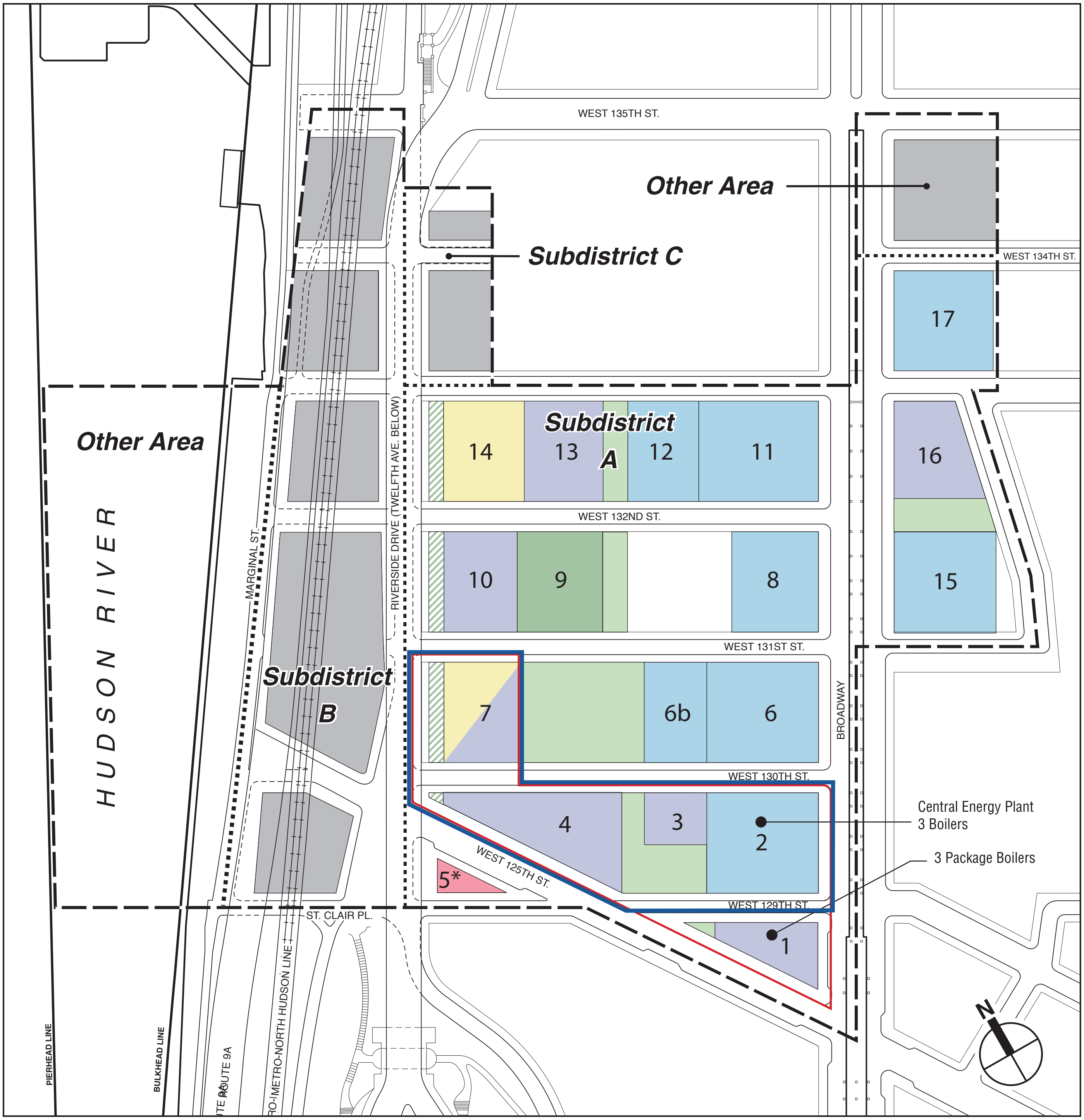

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SCALE

Project and Rezoning Area Boundary

Subdistrict Boundary

2015 Development

Academic Research

Academic

Housing for Graduate Students, Faculty, and Other Employees

Streetfront/Retail

Recreation Facility

Open Space

Twelfth Avenue 30-foot Widened Sidewalk with Open Market Area

Subdistricts B,C, and the Other Areas

1 Development Site

Area Served by Central Energy Plant

* NOTE: Public Open Space to be developed as partial open space mitigation (see Chapter 23)

Figure 19-2

Stationary Emission Sources—2015 Build Condition

The final Phase 2 configuration would therefore consist of four 40,000-lb/hr boilers, three 80,000-lb/hr boilers, six 27,600-lb/hr boilers, three 1,725-lb/hr boilers, and three 1,380-lb/hr boilers (including spares).

As with the 2015 analysis, low-NO_x burners would be used to reduce potential NO_x emissions from the central energy plant boilers. The boilers proposed for Sites 15 and 17 would also incorporate low-NO_x burner technology. Package boilers would use natural gas or fuel oil (0.2 percent sulfur by weight); however, to minimize emissions and potential off-site impacts, the package boilers at Site 15 and the central energy plants would utilize natural gas exclusively. Figure 19-3 shows the approximate stack locations and service area for the stationary sources that would be constructed by the 2030 Build year.

Construction and operation of the central energy plants and package boiler systems would be subject to the terms of permits issued by DEC. The type of air permit(s) required would be primarily based on whether each site is permitted individually or sites are grouped together, and whether the projected emissions of air pollutants would exceed major source thresholds as defined in 40 CFR 52.21 and 6 NYCRR Parts 201 and 321. DEC issues state facility permits or registrations for minor sources of emissions and Title V permits for major sources of emissions and sources subject to certain regulations. Permits include protection against air quality impacts such as emission limits for specific pollutants, limitations of the types of fuels on which the emissions sources would operate, and monitoring, reporting, and recordkeeping requirements. The limitations are based upon EPA and DEC standards that are designed to protect public health and the environment. In addition, limitations on the annual fuel usage reflecting the analyzed equipment utilization and minimum stack heights would be included in the Restrictive Declaration for the Academic Mixed-Use Area.

Central Energy Plant Emissions

Stack exhaust parameters and emission estimates for the proposed central energy plants and package boilers were conservatively estimated for the 2015 and 2030 Build years.

Short-Term Emissions. Short-term emissions rates were calculated based on emissions factors obtained from various sources, including vendor equipment specifications and the EPA *Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources*. The SO_2 emissions factors when burning fuel oil (for 2015 only) were calculated based on the maximum sulfur content of the fuels. PM_{10} and $PM_{2.5}$ emissions include both the filterable and condensable fractions.

Multiple scenarios were modeled to estimate emissions and predict short-term stationary source impacts from the central energy plants and package boilers. The boiler equipment would operate on either natural gas or distillate fuel oil. In addition, the equipment would be capable of operating at various loads depending on the steam and electrical demands of the buildings in the Academic Mixed-Use Area. The boilers would operate over a range of different loads; for modeling purposes, the loads considered ranged from 25 percent to 100 percent. The stack exhaust parameters and the estimated maximum short-term emission rates are provided in Table 19-5 for the 40,000-lb/hr and 80,000-lb/hr boilers, and Tables 19-6a and 19-6b for the individual Academic Mixed-Use Area buildings' boilers (Table 19-6a provides data on development sites that are projected to be completed by 2015, and Table 19-6b provides data on the additional development sites that would be completed by 2030). The 2015 Build year emissions estimates assume that the Phase 1 central energy plant would only supply steam for those development sites anticipated to be constructed by 2015.

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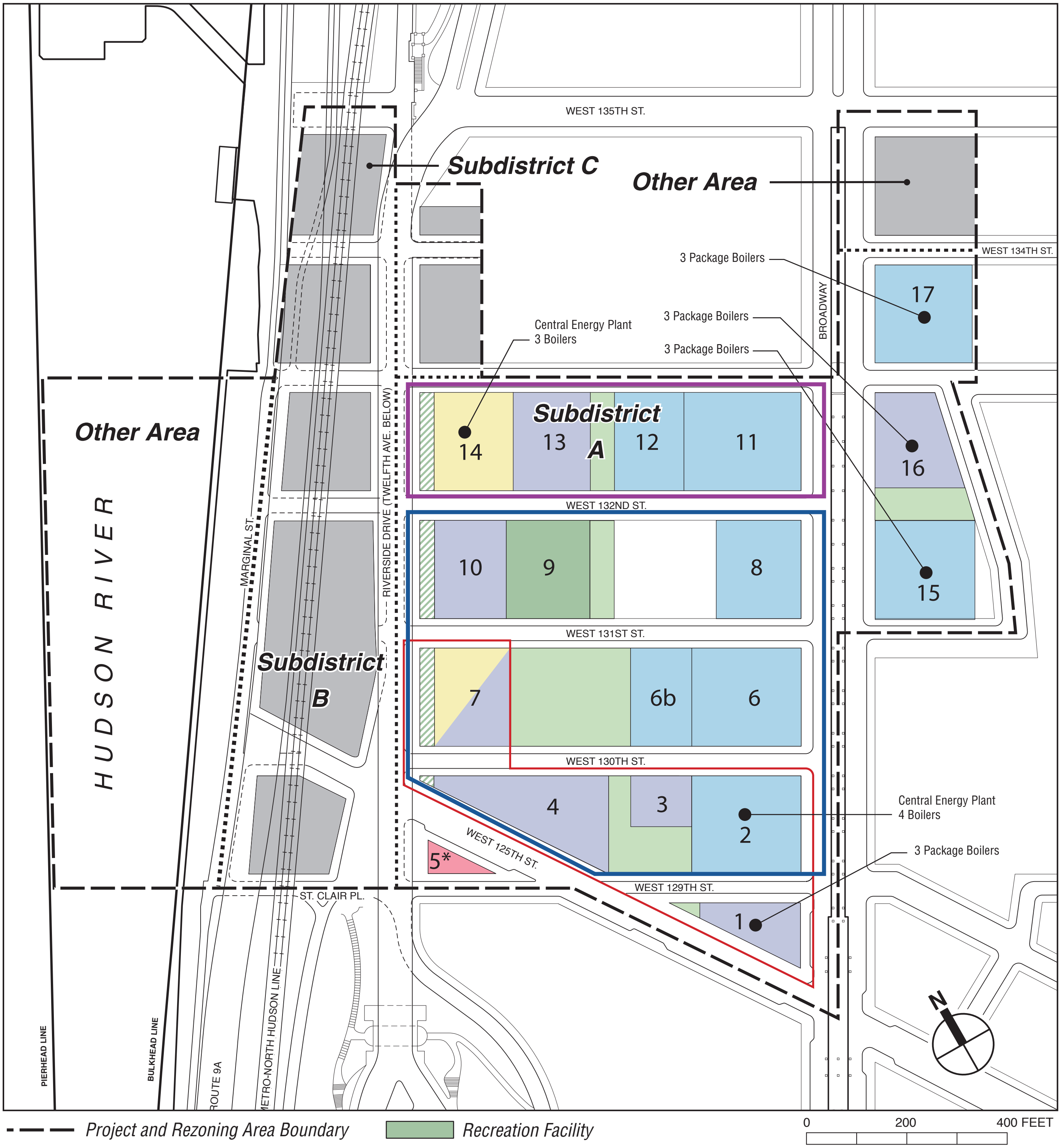

Project and Rezoning Area Boundary
Subdistrict Boundary
2015 Development
Research
Academic
Housing for Graduate Students, Faculty, and Other Employees
Streetfront/Retail
Recreation Facility
Open Space
Twelfth Avenue 30-foot Widened Sidewalk with Open Market Area
Subdistricts B,C, and the Other Areas
1 Development Site
Area Served by Central Energy Plant Constructed in Phase I
Area Served by Central Energy Plant Constructed in Phase II

* NOTE: Public Open Space to be developed as partial open space mitigation (see Chapter 23)

Figure 19-3
Stationary Emission Sources—2030 Build Condition

Table 19-5
Central Energy Plant Boilers Short-Term Emission Rates and Stack Parameters

Fuel		Natural Gas	Natural Gas	Natural Gas	Natural Gas	Oil	Oil	Oil	Oil
Liquid fuel sulfur content		--	--	--	--	0.2	0.2	0.2	0.2
Load		25%	50%	75%	100%	25%	50%	75%	100%
Heat input rate, (MMBtu/hr, HHV)		24.51	49.03	73.54	98.05	23.44	46.89	70.33	93.77
Stack Height – Site 2 (above datum, ft) (6)		335.7	335.7	335.7	335.7	335.7	335.7	335.7	335.7
Stack Height – Site 2 (above building roof, ft) (7)		135	135	135	135	135	135	135	135
Stack Height – Site 14 (above datum, ft) (6)		382.3	382.3	382.3	382.3	[redacted]			
Stack Height – Site 14 (above building roof, ft) (7)		130	130	130	130				
Stack exhaust temp. (°F)		300	300	300	300	300	300	300	300
Stack exhaust flow (lbs/hr)		23,293	46,585	69,878	93,171	22,423	44,846	67,269	89,692
Stack exhaust flow (ACFM)		7,559	15,118	22,677	30,236	7,277	14,554	21,830	29,107
Stack exhaust velocity (ft/s)		10.0	20.1	30.1	40.1	9.7	19.3	29.0	38.6
Lb/MMBtu, HHV	NO_x (2)	0.011	0.011	0.011	0.011	0.096	0.096	0.096	0.096
	CO (2)	0.0068	0.0068	0.0068	0.0068	0.028	0.028	0.028	0.028
	PM_{10} (3)	0.0076	0.0076	0.0076	0.0076	0.0164	0.0164	0.0164	0.0164
	$PM_{2.5}$ (3)	0.0076	0.0076	0.0076	0.0076	0.0111	0.0111	0.0111	0.0111
	SO_2 (4), (5)	0.0006	0.0006	0.0006	0.0006	0.203	0.203	0.203	0.203
Lb/hr (1)	NO_x	0.27	0.54	0.81	1.08	2.25	4.50	6.75	9.00
	CO	0.17	0.33	0.50	0.67	0.66	1.31	1.97	2.63
	PM_{10}	0.19	0.37	0.56	0.75	0.38	0.77	1.15	1.54
	$PM_{2.5}$	0.19	0.37	0.56	0.75	0.26	0.52	0.78	1.04
	SO_2	0.015	0.029	0.044	0.059	4.76	9.51	14.27	19.02

Notes:

(1) Represents emissions from 1-80,000 lb/hr boiler or 2-40,000 lb/hr boilers. Operation of 1-40,000 lb/hr boiler at 100% load would be approximately equivalent to operating 1-80,000 lb/hr boiler at 50% load.

(2) NO_x and CO emissions based on vendor data.

(3) PM_{10} and $PM_{2.5}$ emission factors based on Table 1.3-6 and 1.4-2 of AP-42 based on particle size distribution, with additional condensable fraction for fuel oil from Table 1.3-2.

(4) SO_2 natural gas-based emissions are based on an emission factor of 0.6 lb/million standard cubic feet of natural gas (AP-42 Table 1.4-2).

(5) SO_2 oil-based emissions are based on an emission factor of 142 * weight % sulfur lb/MMBtu (AP-42 Table 1.3-1). Assumed 0.2% sulfur content.

(6) Manhattan datum is defined as 2.75 feet above mean sea level.

(7) Stack heights referenced above roof are measured from the roof itself, i.e., do not include any building mechanical space above the roof.

Table 19-6a
Future (2015) Development
Projected Development Site 1
Short-Term Emission Rates and Stack Parameters

Parameter		50-Horsepower Boilers							
		Natural Gas	Natural Gas	Natural Gas	Natural Gas	Oil	Oil	Oil	Oil
Liquid fuel sulfur content		--	--	--	--	0.2	0.2	0.2	0.2
Load		25%	50%	75%	100%	25%	50%	75%	100%
Firing rate (cfh gas, gph oil)		620	1,048	1,571	2,095	4	8	11	15
Stack Height (above datum, ft) (2)		181.6	181.6	181.6	181.6	181.6	181.6	181.6	181.6
Stack Height – (above building roof, ft)(3)		20	20	20	20	20	20	20	20
Stack exhaust temperature (°F)		355	365	370	380	355	365	370	380
Stack exhaust flow (ACFM)		191	327	493	665	196	336	507	684
Stack exhaust velocity (ft/s)		9.1	15.6	23.6	31.8	9.4	16.1	24.2	32.7
Emissions Lb/MMBtu	NO_x	0.12	0.12	0.12	0.12	0.25	0.25	0.25	0.25
	CO	0.15	0.15	0.15	0.15	0.070	0.070	0.070	0.070
	PM_{10} (1)	0.01	0.01	0.01	0.01	0.0164	0.0164	0.0164	0.0164
	$PM_{2.5}$ (1)	0.01	0.01	0.01	0.01	0.0111	0.0111	0.0111	0.0111
	SO_2	0.001	0.001	0.001	0.001	0.203	0.203	0.203	0.203
Emissions Lb/hr	NO_x	0.054	0.091	0.136	0.182	0.155	0.263	0.394	0.525
	CO	0.067	0.113	0.170	0.227	0.043	0.074	0.110	0.147
	PM_{10}	0.004	0.008	0.011	0.015	0.010	0.017	0.026	0.034
	$PM_{2.5}$	0.004	0.008	0.011	0.015	0.007	0.012	0.018	0.023
	SO_2	0.0001	0.001	0.001	0.002	0.126	0.213	0.319	0.426

Notes:

(1) PM_{10} and $PM_{2.5}$ emission factors based on Table 1.3-6 and 1.4-2 of AP-42 based on particle size distribution, with additional condensable fraction for fuel oil from Table 1.3-2.

(2) Manhattan datum is defined as 2.75 feet above mean sea level.

(3) Stack heights referenced above roof are measured from the roof itself, i.e., do not include any building mechanical space above the roof.

Table 19-6b
Future (2030) Development
Projected Development Sites 15, 16 and 17
Short-Term Emission Rates and Stack Parameters

Parameter		Projected Development Site 16 (40-Horsepower Boilers)							
Parameter		Natural Gas	Natural Gas	Natural Gas	Natural Gas	Oil	Oil	Oil	Oil
Liquid fuel sulfur content		--	--	--	--	0.2	0.2	0.2	0.2
Load		25%	50%	75%	100%	25%	50%	75%	100%
Firing rate (cfh gas, gph oil)		496	838	1,256	1,675	4	6	9	12
Stack Height (above datum, ft) [(1)]		195.1	195.1	195.1	195.1	195.1	195.1	195.1	195.1
Stack Height – (above building roof, ft)[(2)]		23	23	23	23	23	23	23	23
Stack exhaust temperature (°F)		355	365	370	380	355	365	370	380
Stack exhaust flow (ACFM)		153	262	395	532	157	269	406	547
Stack exhaust velocity (ft/s)		7.3	12.5	18.8	25.4	7.5	12.8	19.4	26.1
Emissions Lb/MMBtu	NO_x	0.12	0.12	0.12	0.12	0.25	0.25	0.25	0.25
	CO	0.15	0.15	0.15	0.15	0.070	0.070	0.070	0.070
	PM_{10} [(3)]	0.01	0.01	0.01	0.01	0.0164	0.0164	0.0164	0.0164
	$PM_{2.5}$ [(3)]	0.01	0.01	0.01	0.01	0.0111	0.0111	0.0111	0.0111
	SO_2	0.001	0.001	0.001	0.001	0.203	0.203	0.203	0.203
Emissions Lb/hr	NO_x	0.059	0.101	0.151	0.201	0.124	0.210	0.315	0.420
	CO	0.074	0.126	0.188	0.251	0.035	0.059	0.088	0.118
	PM_{10}	0.005	0.008	0.013	0.017	0.008	0.014	0.021	0.028
	$PM_{2.5}$	0.005	0.008	0.013	0.017	0.006	0.009	0.014	0.019
	SO_2	0.0001	0.001	0.001	0.002	0.101	0.170	0.256	0.341
Parameter		Projected Development Sites 15 and 17 (800-Horsepower Boilers)							
Parameter		Natural Gas	Natural Gas	Natural Gas	Natural Gas	Oil	Oil	Oil	Oil
Liquid fuel sulfur content		--	--	--	--	0.2	0.2	0.2	0.2
Load		25%	50%	75%	100%	25%	50%	75%	100%
Firing rate (cfh gas, gph oil)		9,909	16,740	25,110	33,480	71	120	179	239.3
Stack Height – Building 15 (above datum, ft)[(1)]		344.9	344.9	344.9	344.9	344.9	344.9	344.9	344.9
Stack Height – Building 15 (above building roof, ft)[(2)]		90	90	90	90	90	90	90	90
Stack Height – Building 17 (above datum, ft)[(1)]		396.6	396.6	396.6	396.6	396.6	396.6	396.6	396.6
Stack Height – Building 17 (above building roof, ft)[(2)]		90	90	90	90	90	90	90	90
Stack exhaust temperature (°F)		355	365	370	380	355	365	370	380
Stack exhaust flow (ACFM)		3,023	5,170	7,802	10,528	3,139	5,379	8,115	10,947
Stack exhaust velocity (ft/s)		10.3	17.6	26.5	35.7	10.7	18.3	27.6	37.2
Emissions Lb/MMBtu	NO_x	0.0175	0.0175	0.0175	0.0175	0.187	0.187	0.187	0.187
	CO	0.109	0.037	0.037	0.037	0.070	0.070	0.070	0.070
	PM_{10} [(3)]	0.01	0.01	0.01	0.01	0.0164	0.0164	0.0164	0.0164
	$PM_{2.5}$ [(3)]	0.01	0.01	0.01	0.01	0.0111	0.0111	0.0111	0.0111
	SO_2	0.001	0.001	0.001	0.001	0.203	0.203	0.203	0.203
Emissions Lb/hr	NO_x	1.734	0.293	0.439	0.586	1.850	3.132	4.699	6.235
	CO	1.080	0.619	0.929	1.239	0.692	1.173	1.759	2.345
	PM_{10}	0.099	0.167	0.251	0.335	0.162	0.275	0.412	0.549
	$PM_{2.5}$	0.099	0.167	0.251	0.335	0.110	0.186	0.279	0.372
	SO_2	0.010	0.017	0.025	0.033	2.007	3.398	5.097	6.796

Notes:
(1) Stack heights areas referenced to Manhattan datum, which is defined as 2.75 feet above mean sea level.
(2) Stack heights referenced above roof are measured from the roof itself, i.e., do not include any building mechanical space above the roof.
(3) PM_{10} and $PM_{2.5}$ emission factors based on Table 1.3-6 and 1.4-2 of AP-42 based on particle size distribution, with additional condensable fraction for fuel oil from Table 1.3-2.
(4) The package boilers at Site 15 would be restricted to natural gas.

A three-cell cooling tower would be located on the roof of Sites 2, 6, and 14. Cooling towers with a much smaller capacity would be sited on the roofs of buildings not served by the central energy plants' chilled water systems (Sites 1, 15, 16, and 17). Table 19-7 presents emission estimates of PM_{10} and $PM_{2.5}$ for each of the central energy plants' cooling towers. The cooling towers' design would feature a high-efficiency drift eliminator to minimize the quantity of water droplets, and therefore PM, that are emitted. PM emissions were determined based on the cooling tower design parameters.

Table 19-7
Maximum PM_{10} and $PM_{2.5}$ Emissions from Cooling Towers

Parameter	Value
Number of cells	3
Water flow rate (gallons/minute)	36,370
Makeup water solids (milligrams/liter)	50
Air flow rate (acfm)	636,000
Drift rate (gallons/minute)	0.29
Exit temperature (°F)	93.6
Exit velocity (feet/sec)	26.7
Exit diameter (feet)	27.9
PM_{10}/$PM_{2.5}$ (lb/hr)	0.0073

Annual Emissions. Annual emissions for stationary sources were determined assuming conservative estimates of their annual use. Based on the maximum projection of steam demand, the boilers were assumed to operate at 45 percent load on an annual average basis. Pollutant concentrations were modeled using a scenario that assumes all the equipment uses natural gas exclusively, and a worst-case scenario that assumes all of the boilers operate exclusively on oil (with the exception of the central energy plants, which would be restricted to natural gas in the 2030 Build condition and the package boilers at Site 15, which would be restricted to natural gas to minimize annual pollutant impacts). The stack exhaust parameters and the estimated maximum annual emission rates are provided in Table 19-8 for the 40,000-lb/hr and 80,000-lb/hr boilers, and Tables 19-9a and 19-9b for the individual Academic Mixed-Use Area buildings' boilers (Table 19-9a provides data on development sites that are projected to be completed by 2015, and Table 19-9b provides data on the additional development sites that would be completed by 2030). Table 19-10 presents a summary of the total annual emissions in tons per year from the Academic Mixed-Use Area for the 2015 and 2030 Build years, assuming the equipment operates at its maximum anticipated annual average capacity.

Dispersion Modeling

Potential impacts from the central energy plants and individually heated buildings were evaluated using the EPA/AMS AERMOD dispersion model. The AERMOD model was designed as a replacement to the EPA Industrial Source Complex (ISC3) model and is approved for use by EPA. 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.

Table 19-8
Central Energy Plant Boilers
Annual Average Emissions and Stack Parameters

Parameter		Burning Natural Gas Exclusively	Burning Fuel Oil Exclusively
Liquid fuel sulfur content		--	0.2
Average operating load		45%	45%
Annual Avg. heat input rate, (MMBtu/hr, HHV)		98.05	93.77
Stack Height – Site 2 (above datum, ft) (3)		335.7	335.7
Stack Height – Site 2 (above building roof, ft)		135	135
Stack Height – Site 14 (above datum, ft) (3)		382.3	[redacted]
Stack Height – Site 14 (above building roof, ft)		130	[redacted]
Stack exhaust temp. (°F)		300	300
Stack exhaust flow (ACFM)		30,236	29,107
Stack exhaust velocity (ft/sec)		40.1	38.6
Lb/MMBtu, HHV	NO_x	0.011	0.096
	CO	0.0068	0.0280
	PM_{10}	0.0076	0.0164
	$PM_{2.5}$	0.0076	0.0111
	SO_2	0.0006	0.203
Lb/hr (1)	NO_x	0.49	4.05
	CO	0.30	1.18
	PM_{10}	0.34	0.69
	$PM_{2.5}$	0.34	0.47
	SO_2	0.03	8.56

Notes:
(1) Emissions represent operation of 1-80,000 lb/hr boiler or 2-40,000 lb/hr boilers vented to a common exhaust stack.
(2) Stack parameters are at 100% load; sources were also modeled at 50% and 75% load.
(3) Manhattan datum is defined as 2.75 feet above mean sea level.

Table 19-9a
Projected Development Site 1
Boiler Annual Average Emissions and Stack Parameters

Fuel		Projected Development Site 1 (50-Horsepower Boilers, 1725 lb/hr Steam)	
		Natural Gas	Fuel Oil
Liquid fuel sulfur content		--	0.2
Average operating load		45%	45%
Fuel utilization		100%	100%
Average firing rate (cfh gas, gph oil)		2,095	15.0
Stack Height (above datum, ft) (2)		181.6	181.6
Stack Height – (above building roof, ft)		20	20
Stack exhaust temp. (°F)		380	380
Stack exhaust flow (ACFM)		665	684
Stack exhaust velocity (ft/s)		31.8	32.7
Lb/MMBtu, HHV	NO_x	0.12	0.25
	CO	0.15	0.070
	PM_{10}	0.01	0.0164
	$PM_{2.5}$	0.01	0.0111
	SO_2	0.001	0.203
Lb/hr	NO_x	0.115	0.236
	CO	0.144	0.066
	PM_{10}	0.010	0.015
	$PM_{2.5}$	0.010	0.010
	SO_2	0.001	0.192

Notes:
(1) Stack parameters are at 100% load; sources were also modeled at 50% and 75% load.
(2) Manhattan datum is defined as 2.75 feet above mean sea level.

Table 19-9b
Projected Development Site 15, 16 and 17
Boiler Annual Average Emissions and Stack Parameters

Fuel		Projected Development Site 16 (40-Horsepower Boilers, 1380 lb/hr Steam Max)	
		Natural Gas	Fuel Oil
Liquid fuel sulfur content		--	0.2
Average operating load		45%	45%
Average firing rate (cfh gas, gph oil)		1,675	12.0
Stack Height (above datum, ft) (2),		195.1	195.1
Stack Height – (above building roof, ft) (3)		23	23
Stack exhaust temp. (°F)		380	380
Stack exhaust flow (ACFM)		532	547
Stack exhaust velocity (ft/s)		25.4	26.1
Lb/MMBtu, HHV	NO_x	0.12	0.25
Lb/MMBtu, HHV	CO	0.15	0.070
Lb/MMBtu, HHV	PM_{10}	0.0076	0.0164
Lb/MMBtu, HHV	$PM_{2.5}$	0.0076	0.0111
Lb/MMBtu, HHV	SO_2	0.001	0.203
Lb/hr	NO_x	0.092	0.189
Lb/hr	CO	0.115	0.053
Lb/hr	PM_{10}	0.0058	0.012
Lb/hr	$PM_{2.5}$	0.0058	0.0084
Lb/hr	SO_2	0.0008	0.153

Fuel		Projected Development Sites 15 and 17 (800-Horsepower Boilers, 27,600 lb/hr Steam Max)			
		Natural Gas		Fuel Oil (4)	
Liquid fuel sulfur content		--		0.2	
Average operating load		45%		45%	
Average firing rate (cfh gas, gph oil)		33,480		239.3	
Stack Height (above datum, ft) (2)		344.9	396.6	344.9	396.6
Stack Height – (above building roof, ft) (3)		90	90	90	90
Stack exhaust temp. (°F)		380		380	
Stack exhaust flow (ACFM)		10,528		10,947	
Stack exhaust velocity (ft/s)		35.7		37.2	
Lb/MMBtu, HHV	NO_x	0.0175		0.187	
Lb/MMBtu, HHV	CO	0.04		0.070	
Lb/MMBtu, HHV	PM_{10}	0.01		0.0164	
Lb/MMBtu, HHV	$PM_{2.5}$	0.01		0.0111	
Lb/MMBtu, HHV	SO_2	0.001		0.203	
Lb/hr	NO_x	0.27		2.819	
Lb/hr	CO	0.57		1.055	
Lb/hr	PM_{10}	0.154		0.247	
Lb/hr	$PM_{2.5}$	0.154		0.167	
Lb/hr	SO_2	0.015		3.058	

Notes:
(1) Stack parameters are at 100% load; sources were also modeled at 50% and 75% load.
(2) Manhattan datum is defined as 2.75 feet above mean sea level.
(3) The first value is for Site 15 and the second value is for Site 17.
(4) The package boilers at Site 15 would be restricted to natural gas.

Table 19-10
Annual Emissions (Tons per Year)

Pollutant	2015	2030[1]
NO_x	19.8	37.2
CO	5.8	19.2
PM_{10}	3.2	7.8
$PM_{2.5}$	2.1	7.1
SO_2	39.2	30.3

Note:
1. Annual emissions based on an annual average load of 45%.

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.

Meteorological Data

The meteorological data set consisted of five consecutive years of meteorological data: surface data collected at LaGuardia Airport (2000–2004) and concurrent upper air data collected at Brookhaven, New York. This meteorological data provides hour-by-hour wind speeds and directions, stability states, and temperature inversion elevation over the five-year period. These data were processed using the EPA AERMET program to develop data in a format which can be readily processed by the AERMOD model. The land use around the site where meteorological surface data were available was classified using categories defined in digital United States Geological Survey (USGS) maps to determine surface parameters used by the AERMET program.

Receptor Locations

A comprehensive receptor network (i.e., locations with continuous public access) was developed for the modeling analyses. The receptor network included regularly spaced ground level receptors and numerous discrete receptors on nearby sensitive uses and tall buildings. A polar grid was used, centered on Site 2 and extending out to 5 kilometers (km), at 10 degree radials in all directions. The receptors were placed initially at 50 meters, and at 100-meter intervals out to 2 km and 500-meter intervals from 2 km to 5 km. Source and receptor elevations were determined using surveys conducted for the project and 7-Minute Digital elevation model (DEM) files. A terrain pre-processor program was used to process the DEMs and determine the representative elevations for each receptor. Receptors were also placed at sensitive sites, such as at residences, schools, religious institutions, and recreational facilities. These included the New York City Housing Authority (NYCHA) Manhattanville Houses and the Riverside Park Community apartment complex, as well as at projected development sites in the Project Area. Additional receptors were placed along sidewalks at intersections analyzed for mobile sources of air emissions in order to determine potential cumulative impacts from stationary and mobile sources.

Background Concentrations

To estimate the maximum expected pollutant concentration at a given receptor, the calculated impacts from the emission sources must be added to a background value that accounts for existing pollutant concentrations from other sources (see Table 19-11). The background levels were based on concentrations monitored at the nearest DEC ambient air monitoring stations over the most recent three-year period for which data are available (2004–2006), with the exception of PM_{10}, which, due to the lack of monitoring data available for 2005, was based on 2003–2004 and 2006 background data. For all pollutants, the short-term averages (24-hour, 8-hour, 3-hour, and 1-hour) are the second-highest measured values over a specified period. The annual average background values are the highest measured average concentrations for these pollutants. The measured background concentration was added to the predicted contribution from the modeled source to determine the maximum predicted total pollutant concentration. It was conservatively assumed that the highest monitored concentrations would occur at the same time as the highest predicted increments from modeled sources.

Table 19-11
Maximum Background Pollutant Concentrations

Pollutant	Average Period	Location	Concentration ($\mu g/m^3$)	NAAQS ($\mu g/m^3$)
NO_2	Annual	P.S. 59 Manhattan	68	100
SO_2	3-hour	P.S. 59, Manhattan	183	1,300
	24-hour		99	365
	Annual		29	80
CO	1-hour	P.S. 59, Manhattan	2,971	40,000
	8-hour		2,286	10,000
PM_{10} (1)	24-hour	P.S. 59, Manhattan	60	150

Notes:
(1) Annual standard revoked effective December 18, 2006.
Sources: New York State Air Quality Report Ambient Air Monitoring System, DEC, 2003–2006.

Other Projected Development Sites

A screening analysis was performed to assess air quality impacts associated with emissions from the HVAC systems at Site 5 in Subdistrict A and at projected development sites in Subdistrict B[1] and the Other Areas. The methodology described in the *CEQR Technical Manual* was used for the analysis and considered impacts on sensitive uses (both existing developments and other residential developments planned or under construction, including University housing developments). The *CEQR Technical Manual* methodology determines the threshold of development size below which the action would not have a significant adverse impact. The screening procedures use information regarding the type of fuel to be burned, the maximum development size, the HVAC exhaust stack height, and the distance to the nearest building of a similar or greater height to evaluate whether a significant adverse impact is likely. The maximum development size is plotted on the appropriate screening figure in the *CEQR Technical Manual.* If the maximum development size is greater than

[1] As described earlier, CPC is contemplating certain modifications to Subdistrict B that would not result in any projected development sites in Subdistrict B. The proposed modifications are more fully described in Chapter 29, “Modifications to the Proposed Actions.”

the development size as plotted in the figure, there is the potential for significant air quality impacts, and a refined dispersion modeling analysis would be required. Otherwise, the source passes the screening analysis, and no further analysis is required.

Each of the proposed development sites was evaluated to assess impacts on existing buildings and other proposed development sites (i.e., project-on-project impacts). In addition, other proposed residential developments (i.e., No Build developments) were reviewed for analysis as potential receptor sites. Proposed development sites in close proximity to each other and of similar height were analyzed for potential cumulative impacts.

The maximum development floor area of each proposed development site was used as input for the screening analysis. It was assumed that either natural gas or No. 4 fuel oil would be used in the HVAC systems and that the stack would be located three feet above roof height (as per the *CEQR Technical Manual*).

An additional analysis was conducted for each of the analyzed sites to determine the potential for impacts due to $PM_{2.5}$. The AERMOD model was used to calculate 24-hour and annual average impacts of $PM_{2.5}$ on the nearest building of a similar or greater height as determined from the HVAC screening analysis. Maximum concentrations were compared with the updated interim guidance criteria for $PM_{2.5}$.

Cumulative Impacts

To assess the combined impacts of criteria air pollutants with the Proposed Actions with pollutants from other nearby existing or planned future sources that may contribute to ambient air quality concentrations, a cumulative impact analysis was performed. The methodology and determination of the sources to be included in the cumulative impact analysis were developed in consultation with DEP. The cumulative impact analysis analyzed sources of PM_{10}, NO_x, and SO_2. Cumulative impacts of CO are considered to be minor because the Proposed Actions stationary source emissions are relatively low. As per current DEP policy, $PM_{2.5}$ impacts from a proposed action are examined on an incremental basis; therefore, a cumulative analysis was not performed for this pollutant as well.

The cumulative emissions inventory was developed based on a survey of permitted facilities that are significant sources of air emissions. These sources include existing or proposed facilities subject to federal Title V operating permit provisions, DEC State facility operating permits, or other permitted facilities that have a combined heat input rating of 20 million BTU/hour[1] or greater. Sources of information reviewed included the DEP permit data, EPA's Envirofacts database, and the DEC State Facility and Title V permit Web sites. Within a ½-mile study area, a total of 20 facilities with significant sources of combustion emissions were identified for analysis: these included the North River Water Pollution Control Plant (WPCP), the Columbia University Morningside Heights campus central steam plant, the City College of New York central steam plant, the Riverside Park Community apartment complex, the Manhattanville Houses, the General Grant Houses, and the MTA Manhattanville Bus Depot.

[1] British Thermal Units, or BTUs, are a measure of energy used to compare consumption of energy from different sources, such as gasoline, electricity, etc., taking into consideration how efficiently those sources are converted to energy. One BTU is the quantity of heat required to raise the temperature of one pound of water by one Fahrenheit degree.

These emissions sources were modeled along with the emissions sources from the Proposed Actions to determine the combined impacts. The same design assumptions and restrictions identified above for the analysis of the Proposed Actions' sources (e.g., fuel type, stack height) were used in the cumulative analysis.

The cumulative modeling impact assessment employed the EPA AERMOD dispersion model. Hourly meteorological data measured at the LaGuardia Airport station during the years 2000 through 2004 were utilized in this analysis.

To estimate the maximum expected total pollutant concentrations at a given receptor, the predicted concentrations were added to corresponding background concentrations of criteria air pollutants monitored at the nearest DEC ambient air monitoring station (see Table 19-11). The maximum predicted concentrations from the cumulative modeling were added to the background concentrations to estimate the ambient air quality at the locations near the project site.

CON EDISON COOLING STATION

The Con Edison cooling station located between West 131st and West 132nd Streets and Broadway and Twelfth Avenue would be relocated as part of the Proposed Actions (see Chapter 16, "Energy," for a description of this facility). This facility does not have any combustion equipment and does not emit any air pollutants, only thermal emissions. With the Proposed Actions, no new or additional sources of emissions would be required to provide cooling at the relocated station; therefore, no potential significant air quality impacts would occur, and no analysis of this facility is required.

COOLING TOWERS

The Proposed Actions would include three-cell wet evaporative cooling towers, located on the roofs of Sites 2, 6, and 14. Cooling towers with a much smaller capacity would be located on the roofs of Sites 1, 15, 16, and 17.

A cooling tower removes heat from water that is produced when cooling mechanical equipment. The cooling tower's emissions consist solely of water vapor and a very small amount of water mist (referred to as drift). Potential cooling tower impacts consist of plume fogging, rime icing, the formation of elevated visible plumes, and mineral (salt) deposition from dissolved chemicals that are present in the cooling tower water.

Potential effects from the largest cooling towers proposed for the Academic Mixed-Use Area sites were analyzed (the other cooling towers are typical of systems used on commercial buildings, would be much smaller, and therefore were not analyzed). The cooling tower impact assessment was initially conducted using the Seasonal and Annual Cooling Tower Impact (SACTI) cooling tower model, developed by the Electric Power Research Institute (EPRI). The SACTI model was developed especially for modeling utility cooling water towers. The analysis considered potential impacts on the existing buildings in the area around the Project Area and the elevated subway line along Broadway.

The model used five years of hourly surface meteorological data (1999 through 2003) recorded at LaGuardia Airport, in Queens. Mixing height data from the Brookhaven National Laboratory located in Brookhaven, New York, was used. These data are considered to be reasonably representative meteorological data to assess the potential cooling tower impacts for the Proposed Actions.

SACTI is a statistically based model that provides total hourly counts of ground fog and rime ice (among other parameters). The SACTI model calculates the probable frequency of occurrence of ground-level plume fogging, rime icing, shadowing (i.e., elevated visible plumes), and mineral deposition. In the case of plume fogging, icing, and shadowing, the SACTI model provides results tabulated as total hours for the five-year block of data. These values are divided by the number of years in the meteorological data set (in this case, five) to determine the annual average. However, in the case of mineral deposition, the values provided are maximum deposition rates (i.e., mass/area/time). Table 19-7 lists the specific model input parameters.

The SACTI model assumes that fogging and icing potentially occurs during 10 pre-defined meteorological scenarios. For the purpose of this analysis, ground fogging has conservatively been defined to occur for a given scenario when the plume is modeled to be in physical contact with the ground and/or the plume is below the height of the cooling tower. The area covered by the plume is then taken to be the area of fogging. Likewise, ground-level icing is conservatively assumed to occur when icing occurs during the five plume fogging scenarios for which the air temperature is less than freezing.

Mineral deposition is computed using the assumption that a portion of drift droplets falling from the plume will strike the ground, thereby depositing the dissolved minerals within the droplets. The mineral content in the circulating water is the dissolved minerals, plus other suspended solids. While the design has yet to be finalized, the makeup for the circulating water may undergo up to 10 cycles of concentration. This analysis assumed that the concentrations of minerals (as calcium carbonate) in the circulating water would be 50 ppm.

Additional analysis of potential vapor plume fogging was conducted using a model developed by TRC that utilizes the EPA AERMOD model. The model uses hourly meteorological data with cooling tower design parameters to calculate the hourly water evaporation rate from the tower and the plume temperature, as well as calculate the rise of the plume, its trajectory, and mixing with the surrounding ambient air. The hydrodynamic effects of the plume/air mixing (i.e., visible plume formation and subsequent evaporation) were evaluated with a post processor program.

CHEMICAL SPILL ANALYSIS

Introduction

An analysis was performed to determine potential impacts from an accidental chemical spill within a fume hood at academic research buildings in the Academic Mixed-Use Area. Impacts were evaluated using procedures described in the *CEQR Technical Manual*. Maximum concentrations were compared with the short-term exposure levels (STELs) or ceiling levels recommended by the U.S. Occupational Safety and Health Administration (OSHA) for the chemicals examined. While the exact types of academic research to be conducted are not yet known, representative types and quantities of materials that may be used in the proposed labs were obtained from Columbia University Environmental Health & Safety (EH&S) personnel at the Morningside Heights and Medical Center campuses.

The following section details the expected usage of potentially hazardous materials, as well as the systems that would be employed at the proposed academic research facilities to ensure the safety of the students, staff, and the surrounding community in the event of an accidental chemical spill in the academic research laboratories. A quantitative analysis employing mathematical modeling was performed to determine potential impacts on nearby places of public access and potential impacts due to recirculation into air intake systems.

Laboratory Fume Hood Exhausts

All laboratories in which hazardous chemicals are used would be equipped with energy-efficient fume hoods. Fume hoods are enclosures that are maintained under negative pressure and continuously vented to the outside via exhaust stacks mounted on the roof of the building. Their function is to protect faculty, researchers, and students from potentially harmful fumes. By providing a continuous exhaust from laboratory rooms, they also prevent any fumes released within the laboratory from escaping into other areas of the building, or through windows to the outside.

Based on the reasonable worst-case development scenario for the laboratory fume hood analysis, which maximizes the development of academic research space (see Table 19-2), a number of buildings are designated for research use, and, therefore, these buildings would potentially include laboratory facilities. These buildings are identified as Sites 2, 6, 8, 9, 11, 12, 15, and 17.

Preliminary design information from the laboratory ventilation system proposed for Site 2 was used as the basis for analyzing potential spills from each of the other academic research sites. That design specifies the following parameters for the exhaust system:

- Number of exhausts—eight;
- Exhaust flow rate—37,500 cubic feet per minute (cfm), per stack;
- Exhaust velocity—2,984 feet per minute (fpm); and
- Exhaust stack height—45 feet above building roof (approximate).

Planned Operations

Inventories of chemicals that may be present at academic research facilities were examined. Common buffers, salts, enzymes, nucleotides, peptides, and other bio-chemicals were not considered in the analysis, since they are not typically categorized as air pollutants. Chemicals were surveyed for further examination based on their toxicity and vapor pressure. Vapor pressure is a measure of the material’s volatility—its tendency to evaporate, or to form fumes or vapors, which is a critical parameter in determining potential impacts from potential chemical spills. The exposure standards (OSHA permissible exposure limit [PEL], National Institute of Occupational Safety and Health [NIOSH)], immediately dangerous to life or health [IDLH], and OSHA and/or NIOSH short-term exposure level [STEL] and ceiling values) are measures of the material’s toxicity—more toxic substances have lower exposure standards.

Based on relative exposure thresholds and the vapor pressures of the chemicals provided by EH&S personnel, a subset of the chemicals with the greatest potential hazard was selected for analysis (see Table 19-12). Besides the relative toxicities, other factors such as molecular weight and container size were also considered. Chemicals with high vapor pressures are most likely to have high evaporation rates. Since the chemicals selected for detailed analysis are most likely to have the highest emissions rates and the lowest exposure standards, if the analysis of these chemicals resulted in no significant impacts, it would indicate that the other chemicals would also not present any significant potential impacts.

Table 19-12
Chemicals Selected for Worst-Case Spill Analysis

Chemical	Vapor Pressure (mm Hg)	PEL PPM	STEL PPM	IDLH PPM	Ceiling PPM
Acrolein	210	0.1	0.3	2	0.1
Bromine	175	0.1	0.3	3	0.1
Osmium oxide	7	0.002	0.0006	0.096	0.0002
Methyl isocyanate	348	0.02	-	3	0.02

Notes:
PEL—permissible exposure limit; time weighted average (TWA) for up to a 10-hour workday during a 40-hour workweek.
STEL—short-term exposure limit is a 15-minute TWA exposure that should not be exceeded at any time during a workday.
IDLH—immediately dangerous to life or health.
Ceiling—Level set by OSHA not to be exceeded in any work place based on up to 15 minutes exposure.
PPM = parts per million.
Where a hyphen (-) appears there is no recommended corresponding guideline value.

Estimates of Worst-Case Emission Rates

The dispersion of hazardous chemicals from a potential spill within one of the proposed academic research laboratories was analyzed to assess the potential for exposure of the general public and of students and staff to hazardous fumes in the event of an accident. Evaporation rates for volatile hazardous chemicals to be potentially used in the proposed laboratories were estimated using the model developed by the Shell Development Company (Fleischer, M.T., "An Evaporation/Air Dispersion Model for Chemical Spills on Land," Shell Development Company, December 1980). The Shell model, which was developed specifically to assess air quality impacts from chemical spills, calculates evaporation rates based on physical properties of the material, temperature, and rate of air flow over the spill surface. Room temperature conditions (20°C) and an air flow velocity of 0.5 meters/second were assumed for calculating evaporation rates.

The analysis conservatively assumes that a full container of the chemical would be spilled in a fume hood. The emission rates were determined using the evaporation rates and assuming a maximum spill area of 12 square feet (approximately 1.1 square meters). For modeling purposes, the emission rates shown in Table 19-13 are calculated for a 15-minute period. The vapor from the spill would be drawn into the fume hood exhaust system and released into the atmosphere via the roof exhaust fans. The high volume of air drawn through this system would provide a high degree of dilution for hazardous fumes before they are released above the roof.

Table 19-13
Estimated Emissions from Fume Hood

Chemical	Quantity (Liters)	Evaporation Rate (gram/meter^2/sec)	Emission Rate* (gram/sec)
Acrolein	0.5	1.22	0.47
Bromine	0.5	2.35	1.88
Osmium oxide	0.002	0.31	0.012
Methyl isocyanate	0.018	7.39	0.028

Note: * Average emission rate

Modeling

Using the worst-case spill analysis emission rates shown in Table 19-13, two separate analyses were performed: an analysis that looked at potential effects of recirculation of fume hood emissions back into the building air intakes in the event of a spill, and an analysis that looked at potential effects due to dispersion of fume hood emissions on nearby buildings. Buildings were selected for analysis based on their proximity to proposed academic research sites and their heights. The buildings considered in this analysis were the Riverside Park Community apartment complex and Manhattanville Houses. In addition, projected development sites within the Academic Mixed-Use Area were included in the analysis.

The potential for recirculation of the fume hood emissions due to a spill back into building air intakes was assessed using a method described by D.J. Wilson in "A Design Procedure for Estimating Air Intake Contamination from Nearby Exhaust Vents," ASHRAE TRAS 89, Part 2A, pp. 136-152 (1983). This empirical procedure takes into account such factors as plume momentum, stack-tip downwash, and cavity recirculation effects. It determines the worst-case, absolute minimum dilution between exhaust vent and air intake. Three separate effects produce the available dilution: internal system dilution, obtained by combining exhaust streams (i.e., mixing in plenum chambers of multiple exhaust streams, introduction of fresh air supplied from roof intakes); wind dilution, dependent on the distance from vent to intake and the exit velocity; and dilution from the stack, caused by stack height and plume rise from vertical exhaust velocity. The critical wind speed for worst-case dilution is dependent on the exit velocity, the distance from vent to intake, and the cross-sectional area of the exhaust stack.

Potential effects due to dispersion of fume hood emissions on nearby buildings were examined using the EPA INPUFF model, version 2.0 (Peterson, W.B., "A Multiple Source Gaussian Puff Dispersion Algorithm—Users Guide," EPA, 600/8-86-024, August 1986). INPUFF assumes a Gaussian dispersion of a pollutant "puff" as it is transported downwind of a release point. A series of elevated receptors were placed on the buildings to be analyzed. Stable atmospheric conditions and a 1-meter/second wind speed were assumed for this dispersion analysis. Since the emissions resulting from potential chemical spills are short-term releases, a worst-case assumption of the wind blowing the exhaust directly to the receptors was made for modeling purposes.

EXISTING HVAC SOURCES

The *CEQR Technical Manual* requires an assessment of any proposed action that could result in the location of sensitive uses within 1,000 feet of a large emission source (e.g., a power plant, incinerator, or asphalt plant) or within 400 feet of commercial, institutional, or large-scale residential developments where the proposed structure would be of a height similar to or greater than the height of an existing emission stack. Therefore, a review of existing permitted facilities was conducted. Sources of information reviewed included the DEP permit data, EPA's Envirofacts database, and the DEC State Facility and Title V permit Web sites.

Two facilities with Title V permits were identified: the North River WPCP, which lies within the 1,000-foot study area, and the Riverside Park Community apartment complex, which lies within the 400-foot study area. Other large scale residential developments (e.g., the Manhattanville and General Grant Houses) were identified within the 400-foot study area. In addition, other sources with a combined heat input of 20 million BTUs/hr or greater (including the MTA Manhattanville Bus Depot) were included in the analysis (these sources were also analyzed in the cumulative impact analysis as described above). These sources were modeled to assess impacts on the Proposed Actions' buildings. The analysis employed the same EPA AERMOD dispersion model and utilized the same model assumptions as in the modeling of the criteria pollutants from the Proposed Actions. Hourly meteorological data measured at the LaGuardia Airport station during the years 2000 through 2004 were employed in this analysis.

For this analysis, a receptor array was created to simulate impacts on elevated receptors (e.g., windows, balconies, air intakes) on the proposed development sites. Receptors were placed on the façade of each building at various heights up to the maximum building height.

To estimate the maximum expected total pollutant concentrations at a given receptor, the predicted concentrations were added to corresponding background concentrations of criteria air pollutants monitored at the nearest DEC ambient air monitoring station (see Table 19-11). The maximum predicted concentrations from the modeling were added to the background concentrations to estimate the ambient air quality at proposed development sites.

INDUSTRIAL SOURCE ANALYSIS

Potential effects from existing industrial operations in the surrounding area on the Proposed Actions were analyzed. Industrial air pollutant emission sources within 400 feet of the Project Area boundaries were considered for inclusion in the air quality impact analysis, as recommended in the *CEQR Technical Manual*. This distance was used to identify the extent of the study area for determining air quality impacts associated with the Proposed Actions from industrial sources.

As the first step in this analysis, a request was made to the DEP's Bureau of Environmental Compliance (BEC) and DEC to obtain all the available certificates of operation for these locations and to determine whether manufacturing or industrial emissions occur. In addition, a search of federal and State-permitted facilities within the study area was conducted using the EPA's Envirofacts database[1] and the NYSDEC DAR-1 air toxics software program.

Land use and Sanborn maps were reviewed to identify potential sources of emissions from manufacturing/industrial operations. Next, a field survey was conducted to identify buildings within 400 feet of the project site that have the potential for emitting air pollutants. The survey was conducted on October 7–8, 2004. More recent permit searches were conducted to update the initial findings of the analysis. Approximately 60 businesses were identified in the field survey and permit search. A small number of these would remain by the 2015 Build year; most of these are auto-related, such as auto body shops and gas stations. Fewer sources would remain in the 2030 Build condition as a result of the development in the Academic Mixed-Use Area.

After compiling the information on facilities with manufacturing or process operations in the study area, an air quality dispersion model screening database, ISC3, was used to estimate maximum potential impacts from different sources at various distances from the site. Impact distances selected for each source were the minimum distances between the boundary of the project site and the source site. Predicted worst-case impacts on the proposed development sites were compared with the short-term guideline concentrations (SGCs) and annual guideline concentrations (AGCs) recommended in the DEC's *DAR-1 AGC/SGC Tables.*[2] These guideline concentrations present the airborne concentrations, which are applied as a screening threshold to determine whether future occupants in the Project Area could be significantly impacted from nearby sources of air pollution.

To assess the effects of multiple sources emitting the same pollutants, cumulative source impacts were determined. Concentrations of the same pollutant from industrial sources that were within

[1] http://oaspub.epa.gov/enviro/ef_home2.air

[2] DEC Division of Air Resources, Bureau of Stationary Sources, December, 2003.

400 feet of the Project Area were combined and compared with the guideline concentrations discussed above.

MTA MANHATTANVILLE BUS DEPOT

The existing bus depot is equipped with a central ventilation system that filters intake and exhaust air. The ventilation exhausts are located on the sides of the building, facing West 132nd and West 133rd Streets. Engine exhaust from buses that operate while undergoing maintenance and repair are connected to flexible ducts and directed to the roof of the depot building. Parking for NYCT employees is provided on the roof of the bus depot. For the 2030 Build condition, it has been assumed that the depot would be rebuilt below grade at its present location. The ventilation system for the rebuilt bus depot would be designed to be exhausted at the roof of the proposed buildings on the bus depot site, away from sidewalk receptors and elevated receptors, such as windows and air intakes. Compared with existing conditions, there would be no increase in emissions from bus and employee vehicle exhausts in the future with the Proposed Actions.

An analysis was performed to assess pollutant levels from the existing depot in the 2015 Build condition. The 2015 Build analysis focused on receptor sites associated with the Proposed Actions. The analysis of the reconstructed below-grade depot in the 2030 Build analysis assessed potential air quality impacts on the Proposed Actions as well as off-site receptors.

Information on the existing bus depot was obtained from NYCT. The sources of emissions included in the analysis included stationary combustion sources (boilers and a water heater) and mobile sources from buses and NYCT employee vehicles, both within and on the roof of the depot).

Potential impacts from the bus depot were evaluated using the EPA/AMS AERMOD dispersion model. For a description of the model and the assumptions used in the analysis, see “Stationary Sources” in this section. It should be noted that process activities from the bus depot were analyzed separately, as part of the industrial source analysis presented in this chapter.

E. EXISTING CONDITIONS

EXISTING MONITORED AIR QUALITY CONDITIONS

Monitored background concentrations of SO_2, NO_2, CO, ozone, lead, PM_{10}, and $PM_{2.5}$ for the study area are shown in Table 19-14. These values (2006) are the most recent monitored data that have been made available by DEC. In the case of the 8-hour ozone and 24-hour $PM_{2.5}$, concentrations reflect the most recent three years of data, consistent with the basis for these standards. There were no monitored violations of NAAQS at these monitoring sites, with the exception of the maximum 24-hour $PM_{2.5}$ concentration, which is above the recently revised NAAQS. For modeling purposes, the analysis utilized the maximum values over the most recent three-year period (Table 19-11).

Table 19-14
Representative Monitored Ambient Air Quality Data

Pollutants	Location	Units	Period	Concentration	Exceeds Federal Standard?	
					Primary	Secondary
CO	P.S. 59, Manhattan	ppm	8-hour	1.7	N	N
			1-hour	2.3	N	N
SO_2	P.S. 59, Manhattan	μg/m³	Annual	26	N	-
			24-hour	84	N	-
			3-hour	183	-	N
Respirable particulates (PM_{10})	P.S. 59, Manhattan	μg/m³	Annual	23	N	N
			24-hour	60	N	N
Respirable particulates ($PM_{2.5}$)	JHS 45, Manhattan	μg/m³	Annual	12.8	N	N
			24-hour	37.6	Y(2)	Y(2)
NO_2	P.S. 59, Manhattan	μg/m³	Annual	64	N	N
Lead	JHS 126, Brooklyn	μg/m³	3-month	0.02	N	-
Ozone (O_3)	I.S. 52, Bronx	ppm	1-hour	0.114 (1)	N	N
		ppm	8-hour	0.072	N	N

Notes:
1 The 1-hour ozone NAAQS has been replaced with the 8-hour standard; however, the maximum monitored concentration is provided for informational purposes.
2 The maximum concentration exceeds the recently revised NAAQS.
Source: DEC, 2006 New York State Ambient Air Quality Data.

$PM_{2.5}$ BACKGROUND CONCENTRATIONS

$PM_{2.5}$ monitoring data were reviewed to understand the historical and seasonal patterns in $PM_{2.5}$ background concentrations, and the frequency of measured exceedances of the NAAQS. Figure 19-4 presents a summary of individual 24-hour average $PM_{2.5}$ measurements at the nearest monitoring location using the federal reference method for monitoring of $PM_{2.5}$ (JHS 45 on First Avenue and East 120th Street). The figure shows that there is widely varying concentrations on a day-to-day basis, with higher concentrations occurring somewhat more frequently in the summer months. This is expected because $PM_{2.5}$ is created by a wide variety of sources both directly and indirectly. In addition, there was only one occurrence where the $PM_{2.5}$ concentration exceeded the previous short-term $PM_{2.5}$ NAAQS of 65 μg/m³. This occurred in July 2002 and was attributed to a forest fire in Canada, which caused a regional increase in ambient $PM_{2.5}$ concentrations.

$PM_{2.5}$ is also monitored using a continuous measurement technique known as TEOM at the Manhattanville Post Office. Similar trends in monitoring data are noted at this location.

Figure 19-5 presents a histogram of the $PM_{2.5}$ data measured at JHS 45. The figure shows that 24-hour average $PM_{2.5}$ concentrations are typically between 5 μg/m³ and 35 μg/m³. The 98th percentile values, which are used as the basis for determining compliance with the 24-hour average $PM_{2.5}$ NAAQS, are typically 36 to 46 μg/m³, which are above the recently revised $PM_{2.5}$ NAAQS, which were lowered from 65 μg/m³ to 35 μg/m³.

PREDICTED CO CONCENTRATIONS IN THE STUDY AREA

As noted previously, receptors were placed at multiple sidewalk locations next to the intersections under 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 specified above.

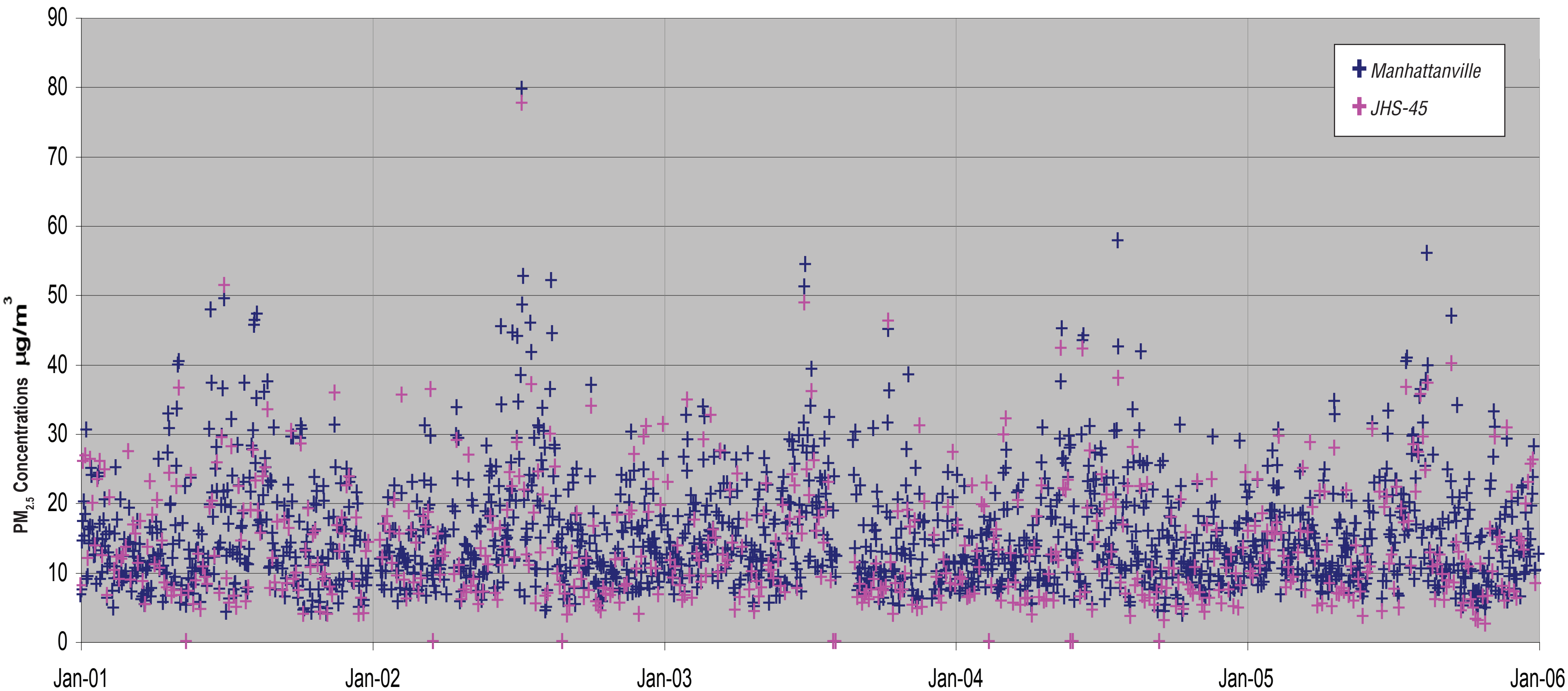

Figure 19-4

24-hour Average $PM_{2.5}$ Concentrations Measured at JHS 45 and Manhattanville P.O.

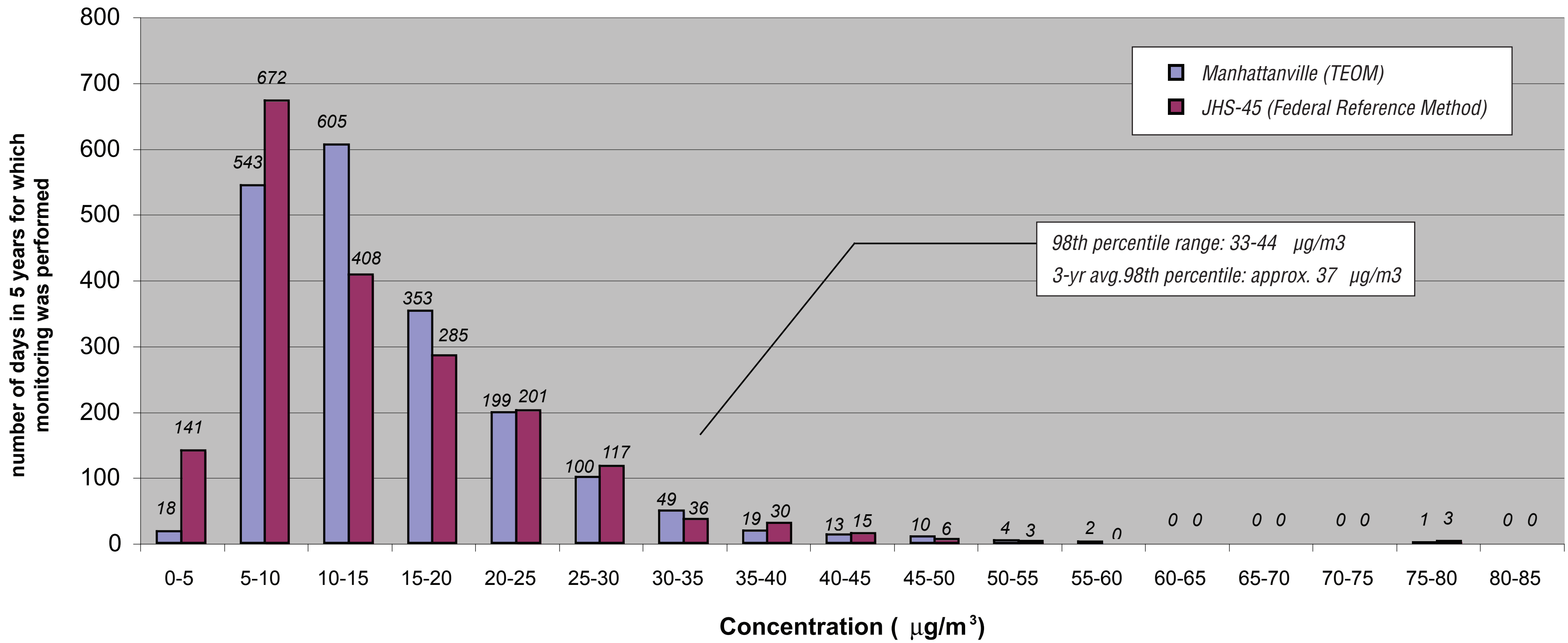

Figure 19-5

24-hour Average $PM_{2.5}$ Concentration Frequency 2000-2005
JHS 45 and Manhattanville Station

Table 19-15 shows the maximum predicted existing (2006) CO 8-hour average concentrations at the receptor sites. (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 19-15
Maximum Predicted Existing 8-Hour Average CO Concentrations for 2006

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)
1	Twelfth Avenue and West 133rd Street	PM	4.5
2	Broadway and West 133rd Street	AM	3.6
3	Broadway and West 125th Street	PM	4.7
4	Amsterdam Avenue and West 125th Street	AM/PM	3.8
5	Second Avenue and East 125th Street	PM	5.6
6	Broadway and West 131st Street	PM	3.0
7	Madison Avenue and East 125th Street	PM	3.9
8	Twelfth Avenue and West 125th/130th Street	PM	4.6
Note: 8-hour standard is 9 ppm.			

F. 2015 FUTURE WITHOUT THE PROPOSED ACTIONS

MOBILE SOURCES ANALYSIS

TRAFFIC INTERSECTIONS

CO

CO concentrations without the Proposed Actions were determined for the 2015 Build year using the methodology previously described. Table 19-16 shows future maximum predicted 8-hour average CO concentrations at the analysis intersections without the Proposed Actions (i.e., 2015 No Build values). The values shown are the highest predicted concentrations for the receptor locations for any of the time periods analyzed.

As shown in Table 19-16, 2015 No Build values are predicted to be well below the 8-hour CO standard of 9 ppm, and lower than predicted existing average concentrations (shown in Table 19-15). The predicted decrease in CO concentrations would result from the increasing proportion of newer vehicles with more effective pollution controls as well as the continuing benefits of the New York State I&M Program.

Table 19-16
Future (2015) Maximum Predicted 8-Hour Average Carbon Monoxide No Build Concentrations

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)
1	Twelfth Avenue and West 133rd Street	PM	3.8
2	Broadway and West 133rd Street	AM	3.1
3	Broadway and West 125th Street	AM/PM	3.8
4	Amsterdam Avenue and West 125th Street	PM	3.5
5	Second Avenue and East 125th Street	AM/PM	4.5
6	Broadway and West 131st Street	AM	2.7
7	Madison Avenue and East 125th Street	PM	3.5
8	Twelfth Avenue and West 125th/130th Streets	PM	3.8
Note: 8-hour standard is 9 ppm.			

PM

PM concentrations without the Proposed Actions were determined for the 2015 Build year using the methodology previously described. Table 19-17 presents the future maximum predicted 24-hour and annual average PM_{10} concentrations at the analysis intersections without the Proposed Actions (i.e., 2015 No Build values). The values shown are the highest predicted concentrations for the receptor locations for any of the time periods analyzed. Note that $PM_{2.5}$ concentrations without the Proposed Actions are not presented, since impacts are assessed on an incremental basis.

Table 19-17
Future (2015) Maximum Predicted No Build
24-Hour PM_{10} Concentrations

Receptor Site	Location	Concentration (μg/m^3)
2	Broadway and West 133rd Street	67.19
3	Broadway and West 125th Street	71.99
Note: NAAQS—24-hour, 150 μg/m^3; annual average, 50 μg/m^3 (annual standard revoked, effective December 18, 2006).		

STATIONARY SOURCE ANALYSIS

Minimal growth and development within the Project Area would occur in the future without the Proposed Actions by 2015. HVAC and industrial source emissions in the No Build condition would likely be similar to existing conditions.

G. 2015 FUTURE WITH THE PROPOSED ACTIONS

The Proposed Actions in 2015 would result in increased mobile source emissions in the immediate vicinity of the Project Area and could also affect the surrounding community with emissions from HVAC equipment and academic research laboratories. The following sections describe the results of the studies performed to analyze the potential impacts on the surrounding community from these sources for the 2015 Build year. In addition, existing industrial facilities, including the MTA Manhattanville Bus Depot, were assessed for potential adverse impacts on the Proposed Actions' buildings.

MOBILE SOURCES ANALYSIS

TRAFFIC INTERSECTIONS

CO

CO concentrations with the Proposed Actions were determined for the 2015 Build year at traffic intersections using the methodology previously described. Table 19-18 shows the future maximum predicted 8-hour average CO concentration with the Proposed Actions at the eight intersections studied. (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 are the highest predicted concentration for any of the time periods analyzed. The results indicate that the Proposed Actions would not result in any violations of the 8-hour CO standard. In addition, the incremental increases in 8-hour average CO concentrations are very small, and consequently would not result in a violation of the CEQR *de minimis* CO criteria. (The *de minimis* criteria were previously described in Section C of this chapter.) Consequently, the Proposed Actions would not result in any significantly CO air quality impacts in the 2015 Build condition.

Table 19-18
Future (2015) Maximum Predicted 8-Hour Average
No Build and Build Carbon Monoxide Concentrations

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)	
			No Build	Build
1	Twelfth Avenue and West 133rd Street	PM	3.8	3.8
2	Broadway and West 133rd Street	PM	2.9	3.3
3	Broadway and West 125th Street	PM	3.8	3.9
4	Amsterdam Avenue and West 125th Street	PM	3.5	3.7
5	Second Avenue and East 125th Street	PM	4.5	4.8
6	Broadway and West 131st Street	PM	2.6	2.8
7	Madison Avenue and East 125th Street	PM	3.5	3.6
8	Twelfth Avenue and West 125th/130th Streets	PM	3.8	3.7

Notes:
8-hour standard is 9 ppm.
Concentrations in Build condition are in some cases lower than No Build. This is due to factors such as changes in street geometry, street directions, traffic controls, etc.

PM

PM concentrations with the Proposed Actions were determined for the 2015 Build year using the methodology previously described. Table 19-19 shows the future maximum predicted 24-hour average PM_{10} concentrations with the Proposed Actions.

Table 19-19
Future (2015) Maximum Predicted
24-Hour Average PM_{10} Concentrations

Receptor Site	Location	24-Hour Concentration (μg/m^3)[1]	
		No Build	Build
2	Broadway and West 133rd Street	67.19	67.77
3	Broadway and West 125th Street	71.99	71.31

Note:
1 NAAQS—24-hour, 150 μg/m^3.
2 Concentrations in Build condition are in some cases lower than No Build. This is due to factors such as changes in street geometry, street directions, traffic controls, etc.

The values shown are the highest predicted concentrations for any of time periods analyzed. The results indicate that the Proposed Actions would not result in any violations of the PM_{10} standard at any of the receptor locations analyzed.

Future maximum predicted 24-hour and annual average $PM_{2.5}$ concentration increments with the Proposed Actions were determined so that they could be compared with the interim guidance criteria that would determine the potential significance of the Proposed Actions' impacts. Based on this analysis, the maximum predicted localized 24-hour average and neighborhood-scale annual average incremental $PM_{2.5}$ concentrations are presented in Tables 19-20 and 19-21, respectively. The results show that the annual and daily (24-hour) $PM_{2.5}$ increments are predicted to be well below the updated DEP interim guidance criteria and, therefore, the Proposed Actions would not result in significant $PM_{2.5}$ impacts at the analyzed receptor locations.

Table 19-20
Future (2015) Maximum Predicted
24-Hour Average $PM_{2.5}$ Concentrations

Receptor Site	Location	Increment
2	Broadway and West 133rd Street	0.10
3	Broadway and West 125th Street	0.01

Notes:
EPA has lowered the NAAQS to 35 μg/m^3, effective December 18, 2006.
$PM_{2.5}$ interim guidance criteria—24-hour average, ≥ 2 μg/m^3 (5 μg/m^3 not-to-exceed value), based on the magnitude, frequency duration, location, and size of the area of the predicted concentrations..
The differences between No Build and Build are due to rounding.

Table 19-21
Future (2015) Maximum Predicted
Annual Average $PM_{2.5}$ Concentrations

Receptor Site	Location	Increment
2	Broadway and West 133rd Street	0.00
3	Broadway and West 125th Street	0.00

Notes:
NAAQS—annual, 15 μg/m^3.
$PM_{2.5}$ interim guidance criteria—annual (neighborhood scale), 0.1 μg/m^3.

ADDITIONAL RECEPTOR SITES

As described in Section D, “Methodology for Predicting Pollutant Concentrations,” an analysis was also undertaken to determine maximum CO concentrations on proposed University housing adjacent to the elevated Riverside Drive (Site 7). The maximum predicted 1-hour and 8-hour average CO concentrations are presented in Table 19-22. The results show that future CO concentrations at development sites situated near elevated roadways are well below the 1-hour and 8-hour CO standards for the 2015 Build condition.

Table 19-22
Future (2015) Maximum Predicted 1-Hour and 8-Hour Carbon Monoxide Concentrations on University Housing Development Sites (parts per million)

Location	Time Period	1-Hour	8-Hour
Site 7	AM	3.8	2.8
	PM	4.2	3.1

Notes:
NAAQS: 1-hour: 35 ppm. 8-hour: 9 ppm.

PARKING FACILITIES

In 2015, the proposed underground parking facilities would not be operational. For specific details of the modeling results for the parking facility, see Section I, “2030 Future with the Proposed Actions,” below.

STATIONARY SOURCES

HVAC SYSTEMS

Academic Mixed-Use Area

Table 19-23 shows maximum predicted concentrations for NO_2, SO_2, CO, and PM_{10} from the proposed central energy plant and package boiler systems proposed for the Academic Mixed-Use Area. As shown in the table, the maximum concentrations from stack emissions, when added to ambient background levels, would be well below the NAAQS.

Table 19-23
Future (2015) Maximum Modeled Pollutant Concentrations from Central Energy Plant and Package Boilers (in µg /m³)

Pollutant	Averaging Period	Concentration Due to Stack Emission	Maximum Background Concentration	Total Concentration	Standard
NO_2	Annual	0.80 (1)	68	68.8	100
SO_2	3-hour	90.76	183	273.8	1,300
	24-hour	41.39	99	140.4	365
	Annual	1.59	29	30.6	80
CO	1-Hour	41.12	2,971	3,012.1	40,000
	8-Hour	9.83	2,286	2,295.8	10,000
PM_{10} (2)	24-hour	3.37	60	63.4	150

Notes:
[1] NO_2 impacts were estimated using a NO_2/NO_x ratio of 0.57.This ratio has been revised since the DEIS to reflect updated ambient air monitoring data.
[2] EPA revoked the annual NAAQS for PM_{10}, effective December 18, 2006.

The air quality modeling analysis also determined the highest predicted increase in 24-hour and annual average $PM_{2.5}$ concentrations from the central energy plant and package boilers (see Table 19-24). As shown in the table, the maximum 24-hour incremental impact at any discrete receptor location would be less than the applicable interim guidance criterion of 5 µg/m³. On an annual basis, the projected $PM_{2.5}$ impacts would be less than the applicable interim guidance criterion of 0.3 µg/m³, and the DEP interim guidance criteria of 0.1 µg/m³ for neighborhood scale impacts.

Table 19-24
Future (2015) Maximum Predicted $PM_{2.5}$ Concentrations

Pollutant	Averaging Period	Maximum Concentration	Threshold Concentration (µg/m³)
$PM_{2.5}$	24-hour	2.28	5/2
	Annual (discrete)	0.09	0.3
	Annual (neighborhood scale)	0.01	0.1

$PM_{2.5}$ concentrations from the Proposed Actions were also compared with the 2 µg/m³ interim guidance value. The receptor location with the maximum continual 24-hour exposure would be at the Riverside Park Community apartment complex on the southeast portion of the easternmost building of the complex, at an elevation of approximately 307 feet above Manhattan datum. At this location, 24-hour $PM_{2.5}$ impacts would be 2.28 µg/m³. Two other receptor locations at the same apartment building were found to have concentrations above 2.0 µg/m³. At each of these receptors, the concentration was above 2.0 µg/m³ only once over the five-year modeling period.

At all other locations in the community, maximum 24-hour concentrations of $PM_{2.5}$ would be below 2.0 $\mu g/m^3$, the updated $PM_{2.5}$ interim guidance criterion. The magnitude, extent, and frequency of concentrations above 2.0 $\mu g/m^3$ is low. Consequently, no potential significant air quality impacts related to $PM_{2.5}$ are expected to occur with the Proposed Actions.

In addition, maximum 24-hour and annual average $PM_{2.5}$ impacts from the mobile source analysis (see Tables 19-20 and 19-21), when added to the maximum ground-level stationary source $PM_{2.5}$ concentrations, would be below the 24-hour average significant impact criterion of 5 $\mu g/m^3$, as well as the annual impact criteria. This is a conservative method of calculating cumulative impacts, as the locations of maximum concentration differ for the stationary and mobile sources. Although maximum concentrations from stationary sources were predicted to exceed the 24-hour average significant impact criterion of 2 $\mu g/m^3$ at a total of three locations, additional contributions from mobile sources at these locations would be negligible, since they are at elevated receptors on buildings, far away from the analyzed intersections. Furthermore, at the locations analyzed in the mobile source analysis (see Tables 19-20 and 19-21), concentrations from stationary sources from the Proposed Actions are well below 2 $\mu g/m^3$, so cumulative impacts are not considered significant. Therefore, no significant adverse air quality impacts are predicted from emissions of $PM_{2.5}$ from the Proposed Actions.

An analysis of potential impacts on projected development sites other than University housing was also undertaken. The results of the analysis demonstrated that the Proposed Actions would not result in any exceedance of the NAAQS at these locations for the 2015 Build condition.

Other Projected Development Sites

Projected development sites at Site 5 in Subdistrict A, and within Subdistrict B and the Other Areas, were analyzed. The HVAC screening analysis indicates that no significant air quality impacts are expected in the year 2015. For specific details of the modeling results, see Section I, "2030 Future with the Proposed Actions," below.

Cumulative Impacts

A cumulative impact analysis was performed to determine the maximum air pollutant concentrations from HVAC systems proposed for the Academic Mixed-Use Area and existing HVAC sources near the Project Area. The cumulative impact analysis indicates that no significant air quality impacts are expected in the year 2015. For specific details of the modeling results, see Section I, "2030 Future with the Proposed Actions," below.

COOLING TOWERS

The Proposed Actions have the potential for impacts due to plume fogging, rime icing, and elevated visible plumes from operation of the proposed cooling towers. The analysis indicates that no significant air quality impacts are expected in the year 2015. For specific details of the modeling results, see Section I, "2030 Future with the Proposed Actions," below.

CHEMICAL SPILL ANALYSIS

An analysis was performed to determine potential impacts from an accidental chemical spill within a fume hood at academic research buildings in the Academic Mixed-Use Area. The analysis indicates that no significant air quality impacts are expected in the year 2015. For specific details of the modeling results, see Section I, "2030 Future with the Proposed Actions," below.

EXISTING HVAC SOURCES

Potential stationary source impacts on the Proposed Actions' buildings from nearby combustion sources were determined using the methodology previously described. The analysis indicates that no significant air quality impacts are expected in the year 2015. For specific details of the modeling results, see Section I, "2030 Future with the Proposed Actions," below.

INDUSTRIAL SOURCE ANALYSIS

As discussed above, a study was conducted to identify manufacturing and industrial uses within 400 feet of the Project Area. DEP-BEC and EPA permit databases were used to identify existing sources of industrial emissions. Four permitted facilities were identified within 400 feet of the Project Area in the 2015 Build condition, including the bus depot.

The screening procedure used to estimate the emissions from these businesses is based on information contained in the certificates to operate obtained from DEP-BEC and DEC, and supplemental information on the bus depot obtained from MTA. The information describes potential contaminants emitted by the permitted processes, hours per day and days per year in which there may be emissions (which is related to the hours of business operation), and the characteristics of the emission exhaust systems (temperature, exhaust velocity, height, and dimensions of exhaust).

Table 19-25 presents the maximum impacts at the projected and potential development sites. The table also lists the SGC and AGC for each toxic air pollutant.

Table 19-25
Maximum Predicted Impacts from Industrial Sources (μg/m^3)

Pollutant	CAS No.	1-Hour	Annual	SGC	AGC
Acetone	00067-64-1	737.51	0.684	180,000	28,000
N-Butyl Alcohol	00071-36-3	96.56	0.071	---	1,500
Isobutyl Alcohol	00078-83-1	2.51	0.002	---	360
Methyl Ethyl Ketone	00078-93-3	7.29	0.003	59,000	5,000
1,2,4-Trimethyl Benzene	00095-63-6	193.44	0.158	---	290
Ethylbenzene	00100-41-4	34.17	0.025	54,000	1,000
Propylene Glycol Monomethyl Ether Acetate	00108-65-6	558.43	0.458	55,000	2,000
1,3,5 Trimethyl Benzene	00108-67-8	18.94	0.018	---	290
Methyl Amyl Ketone	00110-43-0	1,008.58	0.854	---	550
Ethylene Glycol Monobutyl Ether Acetate	00112-07-2	160.00	0.124	14,000	0.31
Butyl Acetate	00123-86-4	805.76	0.679	95,000	17,000
Butyl Carbitol Acetate	00124-17-4	125.27	0.122	370	200
Tetrachloroethylene	00127-18-4	306.44	0.856	1,000	1
Ethyl Acetate	00141-78-6	585.77	0.469	---	3,400
Heptane	00142-82-5	7.29	0.003	210,000	3,900
Carbon Monoxide	00630-08-0	57.14	0.151	14,000	---
Ethyl 3-Ethoxypropionate	00763-69-9	125.27	0.122	140	64
Zinc oxide	01314-13-2	4.64	0.003	380	50
Anti Float Agent (Calcium carbonate)	01317-65-3	0.05	4.9E-05	---	24
Xylene	01330-20-7	123.03	0.089	4,300	100
Carbon Black	01333-86-4	0.05	2.2E-05	---	8.3
Titanium Dioxide	13463-67-7	22.39	0.020	---	24
Distillates (petroleum)	64742-47-8	6,774.87	12.884	---	50
Aromatic Hydrocarbon	64742-95-6	286.64	0.221	---	3,800

The results of the industrial source analysis demonstrate that there would be no predicted significant adverse impacts on the Proposed Actions from existing industries in the area.

MTA MANHATTANVILLE BUS DEPOT

Table 19-26 presents the maximum predicted concentrations for CO and PM_{10} from the existing bus depot. As shown in the table, the maximum concentrations from bus depot operations, when added to ambient background levels, would be well below the NAAQS. Therefore, no significant air quality impacts from the existing bus depot on the Proposed Actions is predicted for the 2015 Build condition.

Table 19-26
Future (2015) Maximum Predicted Pollutant Concentrations from Existing Manhattanville Bus Depot

Pollutant	Averaging Period	Background Concentration (ug/m^3)	Maximum Predicted Concentration From Existing Depot (ug/m^3)	Total Predicted Concentration (ug/m^3)	Ambient Standard (ug/m^3)
CO	1-hour	2,971	72.2	3,043.2	40,000
	8-hour	2,286	71.9	2,357.9	10,000
PM_{10}	24-hour	60	3.47	63.5	150
Notes: [1] EPA revoked the annual NAAQS for PM_{10}, effective December 18, 2006.					

H. 2030 FUTURE WITHOUT THE PROPOSED ACTIONS

MOBILE SOURCES ANALYSIS

TRAFFIC INTERSECTIONS

CO

CO concentrations without the Proposed Actions were determined for the 2030 Build year using the methodology previously described. Table 19-27 shows future maximum predicted 8-hour average CO concentrations at the analysis intersections without the Proposed Actions (i.e., 2030 No Build values). The values shown are the highest predicted concentrations for the receptor locations for any of the time periods analyzed.

As shown in Table 19-27, 2030 No Build values are predicted to be well below the 8-hour CO standard of 9 ppm, and lower than predicted existing average concentrations (shown in Table 19-15). The predicted decrease in CO concentrations would result from the increasing proportion of newer vehicles with more effective pollution controls, as well as the continuing benefits of the New York State I&M Program.

PM

PM concentrations without the Proposed Actions were determined for the 2030 Build year using the methodology previously described. Table 19-28 presents the future maximum predicted 24-hour and annual average PM_{10} concentrations at the analysis intersections without the Proposed Actions (i.e., 2030 No Build values). The values shown are the highest predicted concentrations for the receptor locations for any of the time periods analyzed. Note that $PM_{2.5}$ concentrations without the Proposed Actions are not presented, since impacts are assessed on an incremental basis.

Table 19-27
Future (2030) Maximum Predicted 8-Hour Average Carbon Monoxide No Build Concentrations

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)
1	Twelfth Avenue and West 133rd Street	PM	3.8
2	Broadway and West 133rd Street	AM/PM	2.9
3	Broadway and West 125th Street	AM/PM	4.0
4	Amsterdam Avenue and West 125th Street	AM/PM	3.4
5	Second Avenue and East 125th Street	PM	4.5
6	Broadway and West 131st Street	AM/PM	2.6
7	Madison Avenue and East 125th Street	PM	3.3
8	Twelfth Avenue and West 125th/130th Streets	AM/PM	3.5
Note: 8-hour standard is 9 ppm.			

Table 19-28
Future (2030) Maximum Predicted No Build 24-Hour PM_{10} Concentrations

Receptor Site	Location	Concentration (μg/m^3)
2	Broadway and West 133rd Street	67.53
3	Broadway and West 125th Street	72.78
Note: NAAQS—24-hour, 150 μg/m^3; annual average, 50 μg/m^3 (annual standard revoked, effective December 18, 2006).		

STATIONARY SOURCE ANALYSIS

Minimal growth and development within the Project Area would occur in the future without the Proposed Actions by 2030. HVAC and industrial source emissions in the No Build condition would likely be similar to existing conditions.

I. 2030 FUTURE WITH THE PROPOSED ACTIONS

The Proposed Actions in 2030 would result in increased mobile source emissions in the immediate vicinity of the Project Area and could also affect the surrounding community with emissions from HVAC equipment, academic research labs, and the reconstructed below-grade MTA Manhattanville Bus Depot. The following sections describe the results of the studies performed to analyze the potential impacts on the surrounding community from these sources for the 2030 Build year. In addition, existing industrial facilities were assessed for potential adverse impacts on the Proposed Actions' buildings.

MOBILE SOURCES ANALYSIS

TRAFFIC INTERSECTIONS

CO

CO concentrations with the Proposed Actions were determined for the 2030 Build year at traffic intersections using the methodology previously described. Table 19-29 shows the future maximum predicted 8-hour average CO concentration with the Proposed Actions at the eight

Table 19-29
Future (2030) Maximum Predicted 8-Hour Average
No Build and Build Carbon Monoxide Concentrations

Receptor Site	Location	Time Period	8-Hour Concentration (ppm)	
			No Build	Build
1	Twelfth Avenue and West 133rd Street	PM	3.8	3.8
2	Broadway and West 133rd Street	PM	2.9	3.3
3	Broadway and West 125th Street	PM	4.0	4.0
4	Amsterdam Avenue and West 125th Street	PM	3.4	3.6
5	Second Avenue and East 125th Street	PM	4.5	5.1
6	Broadway and West 131st Street	PM	2.6	2.9
7	Madison Avenue and East 125th Street	PM	3.3	3.4
8	Twelfth Avenue and West 125th/130th Street	PM	3.5	3.6

Notes:
8-hour standard is 9 ppm.
Concentrations in the Build condition are in some cases lower than No Build. This is due to factors such as changes in street geometry, street directions, traffic controls, etc.

intersections studied. (No 1-hour values are shown, since no exceedances of the standard 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 are the highest predicted concentration for any of the time periods analyzed. The results indicate that the Proposed Actions would not result in any violations of the 8-hour CO standard. In addition, the incremental increase in 8-hour average CO concentrations would not result in a violation of the CEQR *de minimis* CO criteria. Consequently, the Proposed Actions would not result in any significant CO air quality impacts in the 2030 Build condition.

PM

PM concentrations with the Proposed Actions were determined for the 2030 Build year using the methodology previously described. Table 19-30 presents the future maximum predicted 24-hour PM_{10} concentrations with the Proposed Actions.

Table 19-30
Future (2030) Maximum Predicted
24-Hour Average PM_{10} Concentrations

Receptor Site	Location	24-Hour Concentration (μg/m³)[1]	
		No Build	Build
2	Broadway and West 133rd Street	67.53	68.62
3	Broadway and West 125th Street	72.78	72.18

Notes:
[1] NAAQS—24-hour, 150 μg/m³.
[2] Concentrations in the Build condition are in some cases lower than No Build. This is due to factors such as changes in street geometry, street directions, traffic controls, etc.

The values shown are the highest predicted concentrations for any of the time periods analyzed. The results indicate that the Proposed Actions would not result in any violations of the PM_{10} standard at any of the receptor locations analyzed.

Future maximum predicted 24-hour and annual average $PM_{2.5}$ concentration increments with the Proposed Actions were determined so that they could be compared with the interim guidance criteria that would determine the potential significance of the Proposed Actions' impacts. Based on this analysis, the maximum predicted localized 24-hour average and neighborhood-scale annual average incremental $PM_{2.5}$ concentrations are presented in Tables 19-31 and 19-32, respectively. The results show that the annual and daily (24-hour) $PM_{2.5}$ increments are predicted to be well below the updated DEP interim guidance criteria, and, therefore, the Proposed Actions would not result in significant $PM_{2.5}$ impacts at the analyzed receptor locations.

Table 19-31
Future (2030) Maximum Predicted
24-Hour Average $PM_{2.5}$ Concentrations

Receptor Site	Location	Increment
2	Broadway and West 133rd Street	0.11
3	Broadway and West 125th Street	0.03

Notes:
EPA has lowered the NAAQS to 35 μg/m³, effective December 18, 2006.
$PM_{2.5}$ interim guidance criteria—24-hour average, ≥ 2 μg/m³ (5 μg/m³ not-to-exceed value), based on the magnitude, frequency, duration, location, and size of the area of the predicted concentrations.
The values for the 24-hour concentration increment reflect rounding.

Table 19-32
Future (2030) Maximum Predicted
Annual Average $PM_{2.5}$ Concentrations

Receptor Site	Location	Increment
2	Broadway and West 133rd Street	0.00
3	Broadway and West 125th Street	0.00

Notes:
0.00 is due to rounding.
NAAQS—annual, 15 μg/m³.
$PM_{2.5}$ interim guidance criteria—annual (neighborhood scale), 0.1 μg/m³.

ADDITIONAL RECEPTOR SITES

As described in Section D, "Methodology for Predicting Pollutant Concentrations," an analysis was also undertaken to determine maximum CO concentrations on proposed University housing sites adjacent to the elevated Riverside Drive (Sites 7 and 14). The maximum predicted 1-hour and 8-hour average CO concentrations are presented in Table 19-33. The results show that future CO concentrations at development sites situated near elevated roadways are well below the 1-hour and 8-hour CO standards for the 2030 Build condition.

Table 19-33
Future (2030) Maximum Predicted 1-Hour and 8-Hour Carbon Monoxide Concentrations on University Housing Development Sites (parts per million)

Location	Time Period	1-Hour	8-Hour
Sites 7 and 14	AM	4.1	3.1
	PM	4.0	3.0

Note: NAAQS: 1-hour: 35 ppm. 8-hour: 9 ppm.

PARKING FACILITIES

A screening analysis was performed to assess potential impacts from the Proposed Actions' parking facilities. Based on the methodology previously discussed, the maximum overall predicted future CO concentrations, including ambient background levels and potential contributions from nearby on-street traffic, at sidewalk receptor locations, would be 4.7 ppm and 3.0 ppm for the 1- and 8-hour periods, respectively. At elevated locations, the maximum CO concentrations, including ambient background levels, would be 7.6 ppm and 3.5 ppm, respectively. The maximum 1- and 8-hour contributions from the parking garages alone would be 5.0 ppm and 1.5 ppm, respectively. 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. Since the analysis was based on certain design limitations, the Restrictive Declaration for the Academic Mixed-Use Area would include provisions regarding the ventilation exhausts for the parking facilities as used in the air quality analysis. These provisions would require a minimum of four ventilation exhausts, a minimum exhaust height of 30 feet, and a minimum distance of 20 feet from the vent face to the nearest operable window or air intake. Based on the use of these design provisions, no significant adverse impacts from the Proposed Actions' parking garages are expected.

STATIONARY SOURCES

HVAC SYSTEMS

Academic Mixed-Use Area

Table 19-34 shows maximum predicted concentrations for NO_2, SO_2, CO, and PM_{10} from the proposed central energy plants and package boiler systems proposed for the Academic Mixed-Use Area. As shown in the table, the maximum concentrations from stack emissions, when added to ambient background levels, would be well below the NAAQS.

Table 19-34
Future (2030) Maximum Modeled Pollutant Concentrations(1)
from Central Energy Plants and Package Boilers (in µg /m³)

Pollutant	Averaging Period	Concentration Due to Stack Emission	Maximum Background Concentration	Total Concentration	Standard
NO_2	Annual	1.35 (1)	68	69.4	100
SO_2	3-hour	97.5	183	280.5	1,300
	24-hour	28.23	99	127.2	365
	Annual	2.20	29	31.2	80
CO	1-Hour	43.74	2,971	3,014.7	40,000
	8-Hour	21.07	2,286	2,307.1	10,000
PM_{10} (2)	24-hour	2.60	60	63.2	150

Notes:
1 NO_2 impacts were estimated using a NO_2/NO_x ratio of 0.57. This ratio has been revised since the DEIS to reflect updated ambient air monitoring data.
2 EPA revoked the annual NAAQS for PM_{10}, effective December 18, 2006.

The air quality modeling analysis also determined the highest predicted increase in 24-hour and annual average $PM_{2.5}$ concentrations from the central energy plants and package boilers (see Table 19-35). As shown in the table, the maximum 24-hour incremental impacts at any discrete receptor location would be less than the applicable interim guidance criterion of 5 µg/m³. On an annual basis, the projected $PM_{2.5}$ impacts would be less than the applicable interim guidance criterion of 0.3 µg/m³, and the DEP interim guidance criterion of 0.1 µg/m³ for neighborhood scale impacts.

Table 19-35
Future (2030) Maximum Predicted $PM_{2.5}$ Concentrations

Pollutant	Averaging Period	Maximum Concentration	Threshold Concentration (µg/m³)
$PM_{2.5}$	24-hour	2.15	5/2
	Annual (discrete)	0.25	0.3
	Annual (neighborhood scale)	0.05	0.1

$PM_{2.5}$ concentrations from the Proposed Actions were also compared with the 2 µg/m³ interim guidance value. The receptor location with the maximum continual 24-hour exposure would be the Columbia University faculty and graduate student housing complex at 560 Riverside Drive, at an elevation of approximately 231 feet. At this location, 24-hour $PM_{2.5}$ impacts would be 2.15 µg/m³. $PM_{2.5}$ concentrations at one other receptor, at the Riverside Park Community apartment complex, also was predicted to be greater than 2.0 µg/m³. At each of these receptors, the concentrations above 2.0 µg/m³ were predicted to occur at a maximum frequency of only once per year. At all other locations in the community, maximum 24-hour concentrations of $PM_{2.5}$ would be less than 2.0 µg/m³, the updated $PM_{2.5}$ interim guidance criterion. The magnitude, extent and frequency of concentrations above 2.0 µg/m³ is low. Consequently, no potential significant air quality impacts related to $PM_{2.5}$ are expected to occur with the Proposed Actions.

In addition, maximum 24-hour and annual average $PM_{2.5}$ impacts from the mobile source analysis (see Tables 19-31 and 19-32), when added to the maximum ground-level stationary source $PM_{2.5}$ concentrations, would be below the 24-hour average significant impact criterion of 5 µg/m³, as well as the annual impact criteria. This is a conservative method of calculating cumulative impacts, as the locations of maximum concentration differ for the stationary and mobile sources. Although maximum concentrations from stationary sources were predicted to exceed the 24-hour average significant impact criterion of 2 µg/m³ at a total of two locations, additional contributions from mobile sources at these locations would be negligible, since they are at elevated receptors on buildings, far away from the analyzed intersections. Furthermore, at the locations analyzed in the mobile source analysis (see Tables 19-31 and 19-32), concentrations from stationary sources from the Proposed Actions are well below 2 µg/m³, so cumulative impacts are not considered significant. Therefore, no significant adverse air quality impacts are predicted from emissions of $PM_{2.5}$ from the Proposed Actions.

An analysis of potential impacts on projected development sites other than University housing was also undertaken. The results of the analysis demonstrated that the full build-out of the Proposed Actions would not result in any exceedance of the NAAQS at these locations.

Other Projected Development Sites

HVAC Screening Analysis

The HVAC screening analysis was performed to determine whether impacts from Site 5 in Subdistrict A and proposed development sites in Subdistrict B and the Other Areas could potentially impact other proposed development sites or existing buildings. The analysis was performed assuming both natural gas and No. 4 fuel oil as the HVAC systems' fuel types. For the screening analysis, the primary pollutant of concern when burning natural gas is NO_2, and when burning oil, SO_2.

The initial *CEQR Technical Manual* screening method, which is very conservative, was undertaken for all sites for No. 4 fuel oil and for natural gas as the type of fuel to be used in the

HVAC systems. In all cases, the HVAC stack was assumed to be placed at the edge of the roof closest to the nearest building. This analysis determined that at each development site analyzed, except Sites 20, 24, and 25, utilizing either fuel would not result in any significant adverse air quality impacts (see Table 19-36).

Table 19-36
HVAC Source Screening Analysis Results

Zoning District	Source	Nearest Receptor	Distance (ft)	No. 4 Fuel Oil	Natural Gas
Subdistrict A	5	Existing building	74	Pass	Pass
Subdistrict B	18	Site 7	185	Pass	Pass
	19	Site 7	243	Pass	Pass
	20	Site 7	80	Pass [1]	Pass
	21	Site 14	100	Pass	Pass
	22	Site 14	240	Pass	Pass
	23	Site 14	330	Pass	Pass
Other Area	24	Site 25	0	Fail	Fail
	25	Site 24	0	Fail	Fail

Note:
[1] The development site did not pass the screening analysis; however, a refined analysis was performed which determined that no significant adverse air quality impacts are predicted when using No. 4 oil.

For Site 20, the screening analysis determined that based on No. 4 oil as the fuel type and the maximum proposed development size, the distance from the nearest receptor of a similar or greater height was less than the allowable distance in Figure 3Q-6 of the *CEQR Technical Manual*. Therefore, a refined air quality analysis was undertaken utilizing the EPA AERMOD dispersion model. The results of the analysis determined that maximum SO_2 concentrations, when added to monitored background concentrations, would be less than the NAAQS utilizing No. 4 oil.

PM2.5 Analysis

In addition to the HVAC screening analysis, potential impacts of $PM_{2.5}$ emissions from Site 5 in Subdistrict A and proposed development sites in Subdistrict B and the Other Areas were considered. Each of the sites was analyzed using the AERMOD model since the screening approach described in the *CEQR Technical Manual* was designed for comparison to the NO_2 and SO_2 ambient air quality standards. Maximum impacts were examined and compared to the updated interim guidance criteria for $PM_{2.5}$.The results of the analysis determined that at Site 20, the fuel type for HVAC systems would need to be restricted to No. 2 oil or natural gas, while for Sites 24 and 25, the fuel type for HVAC systems would need to be restricted to natural gas only, to avoid potential significant impacts on Site 17 as well as on each other.

Proposed E-Designations

Based on the results of the HVAC screening analysis and $PM_{2.5}$ analysis of Site 5 in Subdistrict A and proposed development sites is Subdistrict B and the Other Areas, an E-designation would be provided on certain development sites as part of the zoning proposed to ensure these developments would not result in any significant air quality impacts from HVAC emissions.

The text of the E-designations would be as follows:

Block 2204, Lots 46, 50, 65, 68, 71, 72, 171 (Projected Development, Site 20)

> Any new development on the above-referenced property must ensure that the heating, ventilating and air conditioning stack(s) utilize either No. 2 fuel oil or natural gas, to avoid any potential significant air quality impacts.
>
> Block 1988, Lot 60 (Projected Development, Site 24)
> Any new development on the above-referenced property must ensure that the HVAC stack(s) is located at least 52 feet from the lot line facing Block 1988, Lot 53, when firing natural gas, to avoid any potential significant air quality impacts.
>
> Block 1988, Lot 53 (Projected Development, Site 25)
> Any new development on the above-referenced property must ensure that the HVAC stack(s) is located at least 42 feet from the lot line facing Block 1988, Lot 60, when firing natural gas, to avoid any potential significant air quality impacts.

With these restrictions in place, no significant adverse air quality impacts are predicted from any of the analyzed developments.

Cumulative Impacts

A cumulative impact analysis was performed to determine the maximum air pollutant concentrations from HVAC systems proposed for the Proposed Actions and existing HVAC sources near the Project Area. This is a very conservative analysis, which included the following assumptions:

- The background concentrations include some portion of the cumulative sources modeled, resulting in “double counting”;
- The highest annual or second-highest short-term background concentrations were added to cumulative impact results even though the impacts probably do not occur coincidently; and
- The analysis assumes all of the cumulative sources operate simultaneously, and in many cases, assumes continuous operation throughout the year, which is very conservative.

The results of the analysis determined that maximum future pollutant levels with the Proposed Actions would be below NAAQS at all off-site receptor locations (see Table 19-37). Therefore, no significant adverse impacts are anticipated from the Proposed Action’s stationary sources.

COOLING TOWERS

The Proposed Actions were evaluated to assess potential impacts from plume fogging, rime icing, and elevated visible plumes from operation of the proposed cooling towers. The cooling tower fogging model predicted that there would be no hours of ground-level fogging or rime icing. The maximum mineral salt deposition from the proposed cooling tower is below the established threshold for salt density on electrical insulators, and would not result in any significant impact with respect to air quality.

Table 19-37
Future (2030) Maximum Predicted Pollutant Concentrations[1]
Cumulative Impact Analysis

Pollutant	Averaging Period	Background Concentration (ug/m^3)	Maximum Predicted Concentration From Cumulative Sources (ug/m^3)	Total Predicted Concentration (ug/m^3)	Ambient Standard (ug/m^3)
NO_2	Annual	68	14.0 [2]	82.0	100
SO_2	3-hour	183	857.1	1,040.1	1,300
	24-hour	99	202.2	301.2	365
	Annual	29	12.8	41.8	80
PM_{10} [3]	24-hour	60	40.2	100.2	150

Notes:
1 The values shown in this table were calculated assuming use of No. 2 fuel oil in the package boilers at Site 15. However, the package boilers at Site 15 will be restricted to natural gas only. Therefore, with this restriction, the resulting concentrations would be the same as or less than the values shown in the table.
2 NO_2 impacts were estimated using a NO_2/NO_x ratio of 0.57. This ratio has been revised since the DEIS to reflect updated ambient air monitoring data.
3 EPA revoked the annual NAAQS for PM_{10}, effective December 18, 2006.

The proposed cooling towers would produce a visible elevated water vapor plume. During periods on days with high humidity, the elevated plumes would be more frequent and persistent. However, most of the cooling towers that would be installed are small systems typical of commercial and institutional buildings. The larger cooling towers that would be installed for the central energy plants would be typical of similarly sized systems, such as at Columbia's Morningside Heights campus steam plant, which do not have any adverse effects on existing buildings or other sensitive receptors. The proposed cooling tower systems would be designed to minimize impacts from visible water vapor plumes to avoid potential significant impacts due to plume shadows or fogging. The cooling tower fogging analysis determined that the potential for a visible vapor plume extending to an existing residential building is almost nonexistent. The analysis predicted that a visible vapor plume may extend to upper levels of nearby taller buildings at a maximum frequency of once per year. Therefore, no significant adverse impacts to the environment or property are predicted from the proposed cooling towers.

CHEMICAL SPILL ANALYSIS

An analysis was performed to determine potential impacts from an accidental chemical spill within a fume hood at academic research buildings in the Academic Mixed-Use Area.

Recirculation Analysis

The recirculation analysis used the laboratory exhaust equipment and exhaust intake system design for Site 2. There are a few options for locating ventilation air intakes on Site 2: at the third floor, upper floor (penthouse), and rooftop level. Since locating the intakes on the rooftop minimizes the distance between the laboratory fan exhaust and the intake (which is the worst case), only this option was analyzed.

The recirculation analysis indicates that the minimum potential dilution factor between the fan exhausts and the nearest air intake on the rooftop is over 1,256 (i.e., pollutant concentrations at the nearest intake to the exhaust fan would be 1/1,256th the concentration at the fan). Thus, for example, a potential bromine spill in a fume hood as described above would produce a maximum concentration at the nearest intake location of about 0.013 ppm.

The results of the recirculation analysis are presented in Table 19-38. For the four chemicals analyzed, a potential spill in a fume hood as described above would produce a maximum concentration at the nearest intake location below the corresponding STELs or ceiling values set by OSHA and/or NIOSH for all of the chemicals analyzed. Consequently, it can be concluded that no significant adverse effects would be expected due to recirculation of fume hood emissions back into the building air intakes in the event of a chemical spill.

Table 19-38
Fume Hood Recirculation Analysis
Maximum Predicted Concentrations (ppm)

Chemical	STEL/OSHA Ceiling	15-Minute Average
2-Propenal (acrolein)	0.3	0.009
Bromine	0.3	0.013
Osmium oxide	0.0006	0.00005
Methyl isocyanate	0.02	0.0005

Potential Impacts on Other Buildings

Three separate dispersion analyses were performed that assessed the potential effects due to dispersion of fume hood emissions on: (1) projected developments, (2) residential buildings east of the Project Area, and (3) residential buildings north of the Project Area. Receptors were placed on various locations on the buildings, including potential locations for operable windows and air intakes. Modeling was performed for the proposed academic research buildings (Sites 2, 6, 8, 9, 11, 12, 15, and 17) to determine whether the nominal exhaust system design for Site 2 would provide sufficient dilution and plume rise to avoid any concentrations exceeding the analyzed chemicals' exposure thresholds (STELs or ceiling values set by OSHA and/or NIOSH).

Projected Developments

An analysis was performed that examined effects due to dispersion of fume hood emissions from a potential laboratory chemical spill on projected developments associated with the Proposed Actions. For purposes of this analysis as a worst-case condition, the ventilation system exhaust stack heights were assumed to be 45 feet above the building roof, and the maximum height was assumed for proposed adjacent and nearby buildings. A Restrictive Declaration would be placed on each of the sites that could be developed as academic research to ensure that the minimum laboratory ventilation exhaust velocity of 2,984 fpm and the minimum stack height of 45 feet above the building roof is utilized. Using the laboratory exhaust design developed for Site 2, the dispersion modeling analysis yielded maximum pollutant concentrations at all of the receptor locations that were below the exposure threshold for each of the four chemical compounds examined. Consequently, it can be concluded that no significant adverse effects would be expected on proposed buildings from the dispersion of fume hood emissions from a potential laboratory chemical spill.

Manhattanville Houses

An analysis was performed that looked at potential effects due to dispersion of fume hood emissions from a potential laboratory chemical spill on residential buildings east of the Project Area—the Manhattanville Houses, a housing complex consisting of six Y-shaped, 20-story buildings located east of Broadway between West 129th and West 131st Streets. The proposed academic research buildings nearest to the Manhattanville Houses (Sites 2, 6, and 15) were analyzed. For purposes of this analysis as a worst-case condition, the ventilation system exhaust heights were assumed to be 45 feet above the building roof. Using the laboratory exhaust design developed for Site 2, the dispersion modeling analysis yielded maximum pollutant concentrations at all of the receptor locations that were below the exposure threshold for each of the four chemical compounds examined. Consequently, it can be concluded that no significant adverse effects on residential buildings east of the Project Area would be expected due to dispersion of fume hood emissions from a potential spill.

Riverside Park Community Apartment Complex

Analyses were performed that looked at potential effects due to dispersion of fume hood emissions from a potential laboratory chemical spill on residential buildings north of the Project Area—the Riverside Park Community apartment complex, a housing development consisting of buildings with heights ranging from 11 to 35 stories, west of Broadway between West 133rd and West 135th Streets. Receptors were placed at various locations on the building.

For Sites 2, 6, 12, 15, and 17, the maximum predicted concentrations of the four chemicals at the analyzed receptors were below the exposure thresholds. For Site 12, the initial modeling results predicted an exceedance for the analyzed chemicals. Therefore, to reduce potential impacts to acceptable levels, the exhaust velocity of the ventilation stacks was assumed to be 4,000 fpm, and the exhaust stacks were assumed to be 70 feet above the building roof.

Table 19-39 shows the maximum overall impacts for each analyzed chemical.

Table 19-39
Maximum Predicted Concentrations (ppm)

Chemical	STEL/OSHA Ceiling	15-Minute Average
Acrolein	0.3	0.076
Bromine	0.3	0.11
Osmium oxide	0.0006	0.0004
Methyl isocyanate	0.02	0.004

As shown in the table, the analysis demonstrates that a potential spill in a fume hood as described above would under these conditions produce a maximum concentration at the nearest intake location below the corresponding STELs set by OSHA and/or NIOSH for the analyzed chemicals. A Restrictive Declaration would be placed on Site 12 to preclude the potential for significant adverse air quality impacts from the laboratory fume hood ventilation system on nearby receptors.

EXISTING HVAC SOURCES

Potential stationary source impacts on the Proposed Actions from nearby combustion sources were determined for the 2030 Build year using the methodology previously described. The estimated concentrations from the modeling were added to the background concentrations to estimate total air quality concentrations at the proposed development sites. The results of this analysis are presented in Table 19-40.

As shown in the table, the predicted pollutant concentrations for all of the pollutant time averaging periods are well below their respective standards. Therefore, no significant air quality impacts would occur on the Proposed Actions' buildings.

Table 19-40
Future (2030) Maximum Predicted Pollutant Concentrations
Existing HVAC Source Analysis

Pollutant	Averaging Period	Background Concentration (ug/m^3)	Maximum Predicted Concentration From Existing Sources (ug/m^3)	Total Predicted Concentration (ug/m^3)	Ambient Standard (ug/m^3)
NO_2	Annual	68	3.29[1]	71.3	100
SO_2	3-hour	183	839.1	1,022.1	1,300
	24-hour	99	193.5	292.5	365
	Annual	29	7.08	36.1	80
PM_{10}	24-hour	60	23.9	83.9	150

Notes:
[1] NO_2 impacts were estimated using a NO_2/NO_x ratio of 0.57. This ratio has been revised since the DEIS to reflect updated ambient air monitoring data.
[2] EPA revoked the annual NAAQS for PM_{10}, effective December 18, 2006.

INDUSTRIAL SOURCE ANALYSIS

For the 2030 Build year analysis, three permitted industrial sources were identified. These sources were analyzed for the 2015 Build year and were determined to result in no significant adverse air quality impacts. In addition, although in the 2030 Build year the MTA Manhattanville Bus Depot could potentially remain at its present location, emissions from the depot and other industrial source activities would be designed to minimize impacts on sensitive receptor locations through the application of appropriate pollution controls and/or ventilation system design. A Restrictive Declaration would be recorded for the ventilation systems associated with the reconstructed bus depot at the time Columbia acquires the property to ensure that the emissions from future bus depot operations do not result in any significant air quality impacts.

Therefore, no significant impacts are anticipated, and no additional analysis was necessary. For specific details of the modeling results, see Section G, “2015 Future with the Proposed Actions,” above.

MANHATTANVILLE BUS DEPOT

An analysis of the potential impacts of the MTA Manhattanville Bus Depot with the Proposed Actions in 2030 was conducted. As described earlier under “Methodology,” the Proposed Actions assume that the existing bus depot on the block between West 132nd and West 133rd Streets would be relocated to the below-grade space generally beneath its current location.

Table 19-41 presents the maximum predicted concentrations for CO and PM_{10} from the below-grade bus depot. As shown in the table, the maximum concentrations from bus depot operations, when added to ambient background levels, would be well below the NAAQS. Therefore, no significant air quality impacts from the future bus depot are predicted for the 2030 Build condition.

The air quality modeling analysis also determined the highest predicted increase in 24-hour and annual average $PM_{2.5}$ concentrations from the below-grade bus depot on the Proposed Actions and the surrounding community. The analysis considers the potential cumulative effects of the emissions from the bus depot and the proposed central energy plants and package boiler systems for the Academic Mixed-Use Area. As shown in Table 19-42, the maximum 24-hour incremental impacts at any discrete receptor location would be less than the applicable interim guidance criterion of 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 $\mu g/m^3$, and the DEP interim guidance criterion of 0.1 $\mu g/m^3$ for neighborhood scale impacts.

Table 19-41
Future (2030) Maximum Predicted Pollutant Concentrations from Below-Grade Manhattanville Bus Depot

Pollutant	Averaging Period	Background Concentration (ug/m³)	Maximum Predicted Concentration From Depot Sources (ug/m³)	Total Predicted Concentration (ug/m³)	Ambient Standard (ug/m³)
CO	1-hour	2,971	93.9	3,064.9	40,000
	8-hour	2,286	21.1	2,307.2	10,000
PM_{10}	24-hour	60	2.6	62.6	150

Notes: [1] EPA revoked the annual NAAQS for PM_{10}, effective December 18, 2006.

$PM_{2.5}$ concentrations from the reconstructed below-grade bus depot with the Proposed Actions were also compared with the 2 µg/m³ interim guidance value. Maximum concentrations were found at elevated receptor locations. The receptor location with the maximum continual 24-hour exposure would be the Columbia University faculty and graduate student housing complex at 560 Riverside Drive, at an elevation of approximately 231 feet. At this location, 24-hour $PM_{2.5}$ impacts would be 2.15 µg/m³. This is identical to the maximum predicted $PM_{2.5}$ concentration if the existing bus depot were left in place (see Table 19-35). $PM_{2.5}$ concentrations at two other receptors, at the Riverside Park Community apartment complex, also were predicted to be greater than 2.0 µg/m³. At each of these receptors, the concentrations above 2.0 µg/m³ were predicted to occur at a maximum frequency of only once per year. At all other locations in the community, maximum 24-hour concentrations of $PM_{2.5}$ would be less than 2.0 µg/m³, the updated $PM_{2.5}$ interim guidance criterion. The magnitude, extent, and frequency of concentrations above 2.0 µg/m³ is low. As presented above in "HVAC Systems," no significant adverse air quality impacts are predicted from emissions of $PM_{2.5}$ from the central energy plants and package boilers. This analysis of the proposed below-grade MTA Manhattanville Bus Depot includes emissions from the central energy plants and package boiler systems, and results in maximum concentrations of $PM_{2.5}$ identical to those without the inclusion of the MTA Manhattanville Bus Depot emissions. Therefore, no significant adverse impacts of $PM_{2.5}$ are predicted from the Proposed Actions with the below-grade MTA Manhattanville Bus Depot.

Table 19-42
Future (2030) Maximum Predicted $PM_{2.5}$ Concentrations from Below-Grade Manhattanville Bus Depot-Proposed Actions Relocation Scenario

Pollutant	Averaging Period	Maximum Concentration	Threshold Concentration (µg/m³)
$PM_{2.5}$	24-hour	2.15	5/2
	Annual (discrete)	0.29	0.3
	Annual (neighborhood scale)	0.05	0.1

The analysis presented for the below-grade bus depot was based on certain design assumptions. To minimize potential effects of $PM_{2.5}$ emissions from the below-grade bus depot, the Restrictive Declaration for the Academic Mixed-Use Area would include provisions that combustion sources of emissions would utilize natural gas exclusively, and would be located above the roof of Site 14 at a minimum elevation of 382.3 feet (above Manhattan Datum). With these restrictions in place, no potential significant air quality impacts related to $PM_{2.5}$ are expected to occur with the below-grade bus depot. In the event that a different bus depot plan would ultimately be pursued, additional environmental review of the new scenario may be required at that time.

The air quality analysis for the below-grade depot is very conservative since it does not reflect possible increased future use of cleaner technology for buses, such as gas-electric hybrid, and more energy efficient and cleaner technologies for fossil fuel-fired HVAC systems. With the use of these technologies, emissions of $PM_{2.5}$ from the below-grade bus depot would be lower as compared to existing conditions, and therefore the below-grade bus depot may not require the additional restrictions outlined above.

CONSISTENCY WITH NEW YORK STATE AIR QUALITY IMPLEMENTATION PLAN

As addressed above, maximum predicted CO concentrations with the Proposed Actions would be less than the applicable ambient air standards. Therefore, the Proposed Actions would be consistent with the New York SIP for the control of ozone and CO.

J. PROBABLE IMPACTS OF THE PROPOSED ACTIONS WITHOUT PROPOSED IMPROVEMENTS

In Appendix M, analyses are presented which examine potential impacts of the Proposed Actions without the traffic improvements that are proposed as part of the Proposed Actions. These consist of an analysis of potential mobile source air quality impacts at receptor sites 1 and 3 for CO, and the two sites analyzed for PM_{10} and $PM_{2.5}$ for the Build with improvements (receptor sites 2 and 3). The CO receptor sites were selected for analysis because they were the locations in the primary traffic study area that had the highest No Build and Build concentrations based on the analyses of the Proposed Actions with proposed traffic improvements. At other locations, the No Build and Build concentrations were lower and/or the receptor sites were situated in the secondary study area, outside of where Build traffic improvements were proposed.

The results presented in Appendix M show that without the proposed traffic improvements, future concentrations of pollutants with the Proposed Actions would be below NAAQS and would not result in any significant adverse air quality impacts using the *de minimis* criteria for CO impacts or $PM_{2.5}$ interim guidance criteria. Therefore, no significant adverse air quality impacts are predicted without the proposed traffic improvements. ✷