

**A. INTRODUCTION AND METHODOLOGY**

This chapter and its accompanying appendix (Appendix I) present a project-level analysis of the potential local and regional air quality impacts that could result from construction of the Second Avenue Subway, as well as the regional benefits that could result from its operation. Construction could cause temporary air quality impacts by increasing traffic congestion near station excavations and other areas where construction activities would occur, by diverting motor vehicles to alternative routes, and by increasing particulate matter (PM) in the form of fugitive dust and PM from engine exhaust of construction equipment and vehicles. As described later in this chapter, MTA New York City Transit (NYCT) would take aggressive measures during construction to limit negative effects to air quality during the construction of the Second Avenue Subway, including, for example, the use of ultra low-sulfur diesel fuels and extensive dust control measures.

As described in Chapter 1, “Purpose and Need,” the lack of capacity and resulting congestion on the city’s transportation system contribute to the deterioration of a range of environmental and socioeconomic conditions, including air quality. New York City was recently designated by the U.S. Environmental Protection Agency (EPA) as an area in attainment (i.e., National Ambient Air Quality Standards are being met) for carbon monoxide. However, New York City is not yet in attainment for ozone, which is associated with ozone forming pollutants emitted from internal combustion sources, such as vehicular traffic. Manhattan is also designated as a non-attainment area for particulate matter (PM<sub>10</sub>). In addition, EPA recently promulgated new standards for fine particulate matter (PM<sub>2.5</sub>) but no determination of attainment has yet been made. Without good public transit access, people tend to use taxis, automobiles, and other travel modes. These trends, if allowed to continue, would result in increased emissions of air pollutants.

The proposed project would help prevent further deterioration of New York City’s air quality. Once the Second Avenue Subway becomes operational, traffic is projected to decrease, resulting in corresponding benefits to air quality (compared with the No Build Alternative), as drivers and passengers shift from automobiles to mass transit. New transit connections to and from other parts of the city and region would also extend the project’s air quality benefits outside of Manhattan.

**ANALYZED POLLUTANTS**

Six primary air pollutants are of concern in New York City: carbon monoxide (CO), respirable particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>—which are particulate matter smaller than 10 micrometers and 2.5 micrometers in diameter, respectively), nitrogen oxides (NO<sub>x</sub>), ground-level ozone (including volatile organic compounds [VOCs] and NO<sub>x</sub>), lead, and sulfur dioxide. See Appendix I for more information on these pollutants. Ambient concentrations of CO, PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>x</sub>, and VOCs are particularly relevant to the air quality analyses conducted for the Second Avenue Subway because construction activities could result in temporary elevated levels

## **Second Avenue Subway FEIS**

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of these pollutants, while operation of the subway could reduce long-term regional emissions of these same pollutants because of its improvement to regional traffic conditions. As a result, CO levels at critical intersections along or near the alignment were assessed to evaluate the effects of traffic diversion and truck trips that would result from construction. Pursuant to the EPA's transportation conformity regulations (40 CFR 93), hot-spot analyses of CO and PM<sub>10</sub> are required for individual sites that would be affected by construction activities.

For the Second Avenue Subway, analyses were conducted of the project's effects on CO, PM, NO<sub>x</sub>, and VOCs. For CO, the localized effects of construction-related traffic diversions and congestion were assessed. For PM, the airborne emissions of PM resulting from on-site construction operations, equipment, and spoils removal and materials delivery trucks were assessed locally. PM, NO<sub>x</sub>, and VOC emissions generated by trucks and barges during construction were assessed regionally. Finally, the changes in CO, NO<sub>x</sub>, and VOC emissions resulting from changes in vehicular travel patterns throughout the New York metropolitan area during the subway's operation were also analyzed regionally.

Because no significant sources of lead or sulfur dioxide (SO<sub>2</sub>) are associated with the Second Avenue Subway's construction or operation, no analysis is necessary for these pollutants.

### **AIR QUALITY STANDARDS**

The Second Avenue Subway must be evaluated within the context of a federal, regional, state, and local regulatory framework of standards that aim to minimize the effects of project-related air quality impacts. Those regulatory standards that are applicable to the Second Avenue Subway are discussed below and in more detail in Appendix I.

#### *NATIONAL AMBIENT AIR QUALITY STANDARDS*

As required by the Clean Air Act, primary and secondary National Ambient Air Quality Standards (NAAQS) have been established for the major air pollutants identified in the previous section. These standards have also been adopted as the ambient air quality standards for New York State. The primary standards protect the public health, and represent levels at which there are no known significant effects on human health. The secondary standards are intended to protect the nation's welfare, and account for air pollutant effects on soil, water, visibility, vegetation, and other aspects of the environment.

#### *STATE IMPLEMENTATION PLAN (SIP)*

The Clean Air Act requires each state to submit a SIP to the EPA demonstrating attainment of NAAQS. Amendments to the Act in 1977 and 1990 require comprehensive plan revisions for areas where one or more of the standards have yet to be attained. In the New York City metropolitan area, the standard for ozone continues to be exceeded. Consequently, as part of the SIP, New York City is implementing measures to reduce levels of hydrocarbons and nitrogen oxides as part of its effort to attain the NAAQS ozone standard. In addition, Manhattan is designated as a moderate non-attainment area for PM<sub>10</sub>.

New York State and the EPA have not yet determined whether New York City is within attainment of the PM<sub>2.5</sub> NAAQS. Existing monitoring data indicate that the region is well within the 24-hour PM<sub>2.5</sub> standard, but the monitoring data for compliance with the annual standard do not indicate that New York City is within the annual PM<sub>2.5</sub> standard. In the event that New York

County were to be determined to be in non-attainment, a revised SIP would be required, which would incorporate the strategies needed to achieve the standards.

EPA has recently redesignated New York City as an area in attainment for CO. The Clean Air Act Amendments (CAAA) require that a maintenance plan be established to ensure continued compliance of the CO NAAQS for former non-attainment areas.

#### *SIGNIFICANT ADVERSE IMPACT CRITERIA*

A significant impact generally results if the NAAQS for any of the major pollutants is exceeded. In addition to the NAAQS for CO, New York City has developed criteria (see Appendix I) to assess the significance of impacts on air quality that would result from proposed projects or actions, as set forth in the *City Environmental Quality Review (CEQR) Technical Manual*. These criteria (known as *de minimis* criteria) set the minimum change in CO concentration that defines a significant environmental impact.

Although the PM<sub>2.5</sub> monitoring data collected by the New York State Department of Environmental Conservation (NYSDEC) are still under review by NYSDEC, average annual PM<sub>2.5</sub> concentrations in some areas of New York City are expected to be slightly higher than the annual average NAAQS. Although the 3-year annual mean and the official 24-hour 98th percentile background levels are yet to be determined, NYSDEC has published a policy to provide interim direction for evaluating PM<sub>2.5</sub> impacts, until such time as NYSDEC adopts a SIP covering PM<sub>2.5</sub>.<sup>1</sup> This policy applies to facilities applying for permits or major permit modifications from NYSDEC under the State Environmental Quality Review Act that emit 15 tons of PM<sub>10</sub> or more annually. The interim policy states that such a project will be deemed to have a potentially significant adverse impact if the project's maximum predicted impacts are predicted to increase PM<sub>2.5</sub> concentrations by more than 5 µg/m<sup>3</sup> on a 24-hour basis or more than 0.3 µg/m<sup>3</sup> averaged annually. Projects that exceed either the annual or 24-hour threshold will be required to prepare an EIS to assess the severity of the impacts, to evaluate alternatives, and to employ reasonable and necessary mitigation measures to minimize the PM<sub>2.5</sub> impacts of the source to the maximum extent practicable.

Additionally, the New York City Department of Environmental Protection (NYCDEP) is currently recommending interim guidance criteria for evaluating the potential PM<sub>2.5</sub> impacts from NYCDEP projects subject to City Environmental Quality Review. The interim guidance criteria NYCDEP is currently employing for determination of significant adverse impacts from PM<sub>2.5</sub> are: 1) predicted 24-hour (daily) average increase in PM<sub>2.5</sub> concentrations greater than 5 µg/m<sup>3</sup> at a discrete location of public access, either at ground or elevated levels (microscale analysis); and 2) a predicted annual average increase in ground-level PM<sub>2.5</sub> greater than 0.1 µg/m<sup>3</sup> on a neighborhood scale. Appendix I provides more information on this issue.

#### *REGULATORY SETTING*

The conformity requirements of the Clean Air Act and regulations promulgated thereunder (conformity requirements) limit the ability of federal agencies to assist, fund, permit, and approve transportation projects that do not conform to the applicable SIP. Accordingly, an area's metropolitan planning organization (MPO), which is the entity responsible for transportation

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<sup>1</sup> NYSDEC Policy CP-33, "Assessing and Mitigating Impacts of Fine Particulate Matter Emissions," December 29, 2003. This policy was issued after publication of the Second Avenue Subway SDEIS.

planning, together with the State, are responsible for demonstrating conformity with respect to the SIP on metropolitan long-range transportation plans (LRTPs) and transportation improvement programs (TIPs). The EPA must then concur with such conformity determinations. The U.S. Department of Transportation has final approval of conforming plans and TIPs. Conformity determinations for FTA projects must be made according to the requirements of 40 CFR Part 93. A project must come from a conforming plan and TIP; there must be a currently conforming plan and TIP in place at the time of NEPA process completion; and, the project-level conformity requirements must also be satisfied.

The New York Metropolitan Transportation Council (NYMTC) is the MPO for this region. NYMTC approved the conformity determination for the LRTP, known as the Regional Transportation Plan entitled *Mobility for the Millennium*, on September 23, 1999. FHWA and FTA then approved the LRTP conformity determination on September 30, 1999, and EPA concurred with the findings. The 2002-2004 TIP was approved by NYMTC on September 20, 2001. FTA and FHWA provided a joint State TIP approval and positive conformity determination on November 1, 2001. Due to the evolution of the Second Avenue Subway project, only a northern subway segment (one of the alternatives assessed in the MIS/DEIS) was envisioned at that time and included in the LRTP. Thus the approved conforming TIP did not include the construction of the full-length Second Avenue Subway. More recently, NYMTC amended the LRTP to include the full-length subway in the fiscally constrained portion of the Plan. NYMTC adopted a 2004-2006 TIP on September 25, 2003. That TIP includes funding for the EIS, Preliminary Engineering, and Final Design related to the full-length subway and construction funding for the new subway.

At this time, as a result of the World Trade Center disaster on September 11, 2001, and the loss of NYMTC's files containing regional transportation and air quality data, combined with the damage incurred to the downtown mass transit system, the conformity requirements for the New York Metropolitan area have been temporarily waived until September 30, 2005, pursuant to Public Law 107-230; Stat. 1469, enacted October 1, 2002. (This means that the MPO has until September 30, 2005, to produce a conforming TIP and Plan.) Interim interagency consultation procedures were developed, to be in effect during the waiver. These procedures were developed to assist New York State in the interim reporting to congressional committees, the EPA, and the U.S. Department of Transportation.

The air quality analysis in this FEIS focuses on the legislative waiver of conformity requirements for the plan and TIP. MTA/NYCT is complying with the enhanced Interagency Consultation procedures during the conformity waiver. When the conformity waiver expires, the air quality effects of the Second Avenue Subway project will be included in the regional emissions analysis for the New York metropolitan area.

### **METHODOLOGY FOR PREDICTING POLLUTANT CONCENTRATIONS DURING CONSTRUCTION AND OPERATIONS**

Generally, the air quality analyses were conducted using a combination of EPA emission and dispersion models to estimate increases in pollutant concentrations above the existing background level. Three different air quality analyses were conducted to assess potential effects of the Second Avenue Subway project's construction on air quality. A fourth air quality analysis was used to demonstrate the effects of the subway once operational. The three air quality assessments for the construction period included:

- *Carbon monoxide analysis*—to estimate increases in CO levels resulting from construction-related traffic diversions and congestion;
- *Particulate matter concentrations analysis*—to determine potential increases in PM<sub>10</sub> and PM<sub>2.5</sub> near the construction sites and on local streets resulting from construction activities and the use of diesel-powered equipment; and
- *Regional construction impact analysis*—to estimate potential regional increases in NO<sub>x</sub>, VOCs, and PM<sub>2.5</sub> from construction.

The air quality analysis for the operations period—a regional operational impact analysis—demonstrated the improvements in regional air quality (i.e., decreases in CO, VOCs, NO<sub>x</sub>, and PM<sub>10</sub>) that would result once the Second Avenue Subway is operational.

For detailed information on the analysis methodologies (including modeling assumptions, worst-case meteorological conditions, and emission rates), see Appendix I. As noted in Appendix I, revisions to the air quality analyses were made after completion of the SDEIS to update modeling assumptions to reflect the latest appropriate guidance and to revise the analysis year for the completed project from 2020 to 2025. (As described in Chapter 2, “Project Alternatives, the analysis year for the FEIS has been changed to 2025, rather than the 2020 analysis year used in the SDEIS, to be consistent with the Section 5309 FTA New Starts Annual Update for 2005.)

#### ANALYSIS OF CONSTRUCTION IMPACTS OF THE SECOND AVENUE SUBWAY

##### *Carbon Monoxide Analysis*

Maximum 8-hour average CO concentrations were first determined using EPA’s CAL3QHC model. At locations where maximum predicted CO concentrations exceeded the applicable ambient air quality standard, a more refined model, the CAL3QHCR<sup>1</sup>, was used to determine maximum concentrations. Vehicular CO emissions were computed using the EPA-developed Mobile Source Emissions Model (MOBILE5B). Background CO values were obtained from the New York City Department of Environmental Protection (NYCDEP).

To determine the most significant CO impacts that might result from construction, five representative receptor sites in the three most congested neighborhood zones—East Harlem, the Upper East Side, and East Midtown—were selected for quantified microscale analysis (see Table 11-1). The five receptor sites were selected based on the results of the vehicular transportation analysis, and represent either locations with the worst existing traffic conditions in the East Side study area or locations that would experience the greatest increases in traffic due to diversions and increased traffic from construction activities along the Second Avenue Subway alignment. More information on how these locations were determined to be the worst case intersections is provided in Appendix I.

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<sup>1</sup> CAL3QHCR User’s Guide, Office of Air Quality, Planning Standards, U.S. Environmental Protection Agency, Research Triangle Park, September 1995. CAL3QHCR is an enhanced but separate version of CAL3QHC that allows for the incorporation of actual local meteorological data into the modeling, instead of worst-case assumptions regarding meteorological parameters. The CAL3QHCR model also allows for varying traffic volumes of peak hour conditions (i.e., Tier II simulation scenario), which generally results in maximum predicted CO levels less than those calculated under Tier I (because traffic volumes during off-peak conditions are much less than during corresponding peak hour conditions).

**Table 11-1**  
**Mobile Source (CO) Receptor Locations**

Receptor Site	Study Area	Location	Time Period Analyzed
1	East Harlem	124th Street and Park Avenue	AM
2	East Harlem/ Upper East Side	96th Street and Lexington Avenue	AM
3	East Harlem/ Upper East Side	96th Street and Second Avenue	AM/PM
4	East Midtown	34th Street and Lexington Avenue	AM
5	East Midtown	34th Street and Second Avenue	AM/PM

The air quality analyses used the same assumptions related to baseline vehicle traffic, project-generated trucks, and project-related diversions of traffic as presented in Chapter 5D of this FEIS. As described there and in Chapter 3, since publication of the SDEIS, the total number of trucks to be generated by the project has increased. However, the daily and peak hour truck estimates used in the SDEIS were conservatively high and remain adequate for representing worst-case traffic conditions in this FEIS.

As described above, EPA’s transportation conformity regulations require analyses of CO for individual sites that would be affected by construction activities for more than 5 years. Based on the project’s current phasing plan, construction activities would last longer than 5 years at four locations: near the 125th Street Station (including construction of the station and mined tunnels), in the 96th Street vicinity, in the 34th Street vicinity, and at the Hanover Square Station area in conjunction with Pier 6. The project’s effects on CO at each of those locations are discussed later in this chapter.

*Particulate Matter Analysis*

To assess construction-related particulate matter emissions, site-specific modeling of selected construction sites was conducted for PM<sub>10</sub>. The results of that analysis were then used to estimate effects related to PM<sub>2.5</sub>. The methodology used for these localized analyses, which is described below and in greater detail in Appendix I, included consideration of both vehicles on the streets near the construction sites and construction activities and equipment at the construction sites themselves. An extensive discussion of issues specific to PM<sub>2.5</sub> appears in section D of this chapter, in the subsection entitled, “PM<sub>2.5</sub> Analysis,” below. In addition, particulate matter was considered on a regional basis as part of the project’s overall regional analysis.

On-street emissions modeling considered both construction vehicles and the diversions to existing traffic conditions along the alignment that would occur during the subway’s construction. The effect of construction on the emission levels of PM<sub>10</sub> from on-street sources was estimated using the EPA’s mobile source particulate matter model—PART5 (EPA, 1995a). PART5 computes PM<sub>10</sub> emission factors for a variety of gasoline- and diesel-powered vehicles for current and future years.

Construction activities would take place at many locations along the proposed alignment. To determine which activities and locations should be used for analysis, the following factors were considered: intensity and duration of construction activities; proximity to sensitive uses; ability to represent activities that would occur in other places along the alignment; and amount of

existing traffic. Using data gathered for the traffic analyses detailed in Chapter 5D, “Transportation—Vehicular Traffic,” existing AM and PM peak hour traffic volumes along Second Avenue were categorized as low [fewer than 1,500 vehicles per hour (vph)], moderate (1,500 to 3,000 vph), and high (over 3,000 vph).

Based on these criteria, three construction sites were selected for quantified analysis of particulate matter: the area between 97th and 92nd Streets (“the 90s”), to be in construction in Phase 1, which was rated as having moderate existing traffic volumes; a corresponding area in the 30s concentrated near 36th Street (“the 30s”), to be in construction in Phase 3, which has high existing traffic volumes; and a barge facility, because the construction operations at the proposed Pier 6 barge site in Lower Manhattan in Phase 4 would differ from those along the subway alignment. As noted above, EPA’s transportation conformity regulations require analyses of PM<sub>10</sub> for individual sites that would be affected by construction activities for more than 5 years. The project’s effects on PM<sub>10</sub> concentrations at the four locations where construction would last longer than 5 years in the current phasing plan are discussed later in this chapter.

The methodology used for assessing potential particulate matter effects from barging activities involved identifying a “worst case” assumption for the barge operation. The SDEIS described two possible barge sites that might be used during construction: one in East Harlem at 129th Street and the Harlem River, and the other in Lower Manhattan at Pier 6 and the East River. The air quality analysis in the SDEIS was conducted for the barge site that was identified as worst-case in terms of potential air quality effects, the 129th Street barge site. Both barge sites would have had similar loading and unloading operations using the same type and number of construction equipment. At both sites, it was assumed that the same numbers of trucks would travel between the barging operations and the project’s construction sites. Both barge sites were located adjacent to a multi-lane, limited access highway (the Harlem River Drive at 129th Street and the FDR Drive at Pier 6). The 129th Street barge site is located directly across the street from a large public park, Harlem River Drive Park and Crack is Wack Playground. Because the sites were otherwise equivalent, the 129th Street barge site was selected as the worst-case barge site because it had a sensitive receptor (the park) in close proximity. Since completion of the SDEIS, the 129th Street barge site has been eliminated from further consideration, but the air quality analysis at this site can still be used to represent the reasonable worst-case air quality effects of barging operations for the project. See Appendix I for more details.

On-site sources for construction activities would include emissions from trucks, barges and equipment movements on unpaved and paved surfaces, transfer of spoils from cranes to trucks, transfer of spoils to temporary storage areas, and diesel emissions from construction equipment. Emissions of PM<sub>10</sub> from spoils removal and materials delivery trucks were computed using the previously discussed PM emissions model, PART5. Estimates of PM<sub>10</sub> emission rates from construction activities at the site were based on the anticipated operations and emission factors from EPA’s “AP-42, Compilation of Air Pollutant Emission Factors” while emissions from non-road construction equipment were computed using the EPA’s Draft NONROAD Model.

Increases in ambient particulate matter concentrations due to emissions from on-road and construction activity were evaluated using EPA’s Industrial Source Complex Short Term (ISCST3) dispersion model.

### *Regional Analysis of Construction Activity*

Because of the large scale and extended duration of the construction required for the Second Avenue Subway, the construction could potentially increase regional concentrations of ozone precursors—NO<sub>x</sub> and VOCs—as well as fine particulate matter (PM<sub>2.5</sub>), all of which are pollutants of concern on a regional basis. The regional effects of the project's construction were assessed in two ways: 1) the total amount of these pollutants throughout the region that would result from transportation of spoils was calculated; and 2) the concentrations of PM<sub>2.5</sub> that would result from the project's trucking and construction site activities were computed on a regional basis. The concentrations of ozone precursors (NO<sub>x</sub> and VOCs) that would result from construction were not predicted on a regional basis, since these pollutants are of concern because of their role in the formation of ozone, but that process is very complex and there is no reliable way to predict a project's effects on ozone.

### *ANALYSIS OF PERMANENT IMPACTS OF THE SECOND AVENUE SUBWAY*

Operation of the Second Avenue Subway would result in a decrease in air pollutant emissions due to a reduction in the number of vehicle miles traveled in the region. To determine the benefits that the Second Avenue Subway would have on air quality by changing vehicular traffic once it is operating, pollutant burdens were computed. Pollutant burdens represent total expected quantities of regional pollutant emissions for a defined time and provide an indication of the general change in air quality.

## **B. EXISTING CONDITIONS**

Based on the most recent NYSDEC monitoring data, there are no exceedances of the NAAQS for CO, NO<sub>x</sub>, PM<sub>10</sub>, or SO<sub>2</sub> at any location in East Harlem, the Upper East Side, East Midtown, Gramercy Park/Union Square, the East Village/Lower East Side/Chinatown, and Lower Manhattan. PM<sub>2.5</sub> has been monitored in New York since 2000. Although determination of compliance by EPA, based on three annual averages, is yet to be made, the data indicate that annual averages in New York City range from slightly lower to slightly higher than the 15 µg/m<sup>3</sup> NAAQS. In the past two decades, air quality in New York City has improved significantly. Ambient concentrations of most key (“criteria”) pollutants have decreased to their lowest levels in 25 years, and exceedances of the standard for a few pollutants are infrequent. The current trend is reflected by the monitored concentrations of criteria pollutants, including CO, NO<sub>x</sub>, PM, SO<sub>2</sub>, ozone, and lead, which are consistently lower throughout the city.

## **C. FUTURE CONDITIONS COMMON TO ALL ALTERNATIVES**

In the future, air quality in the region should continue to improve due to the effects of federally mandated emission control programs scheduled to be implemented over the next several years. Many of these programs were part of the 1990 CAAA or are included as part of each state's SIP to meet the ozone NAAQS. These programs cover a wide range of sources, both mobile and stationary, and will affect emissions of NO<sub>x</sub>, SO<sub>2</sub>, CO, PM, and VOCs. Furthermore, as directed in the 1990 CAAA, EPA has taken measures to reduce emissions from non-road (e.g., construction equipment, etc.) diesel engines in two past regulatory actions. Based on the current and projected air quality trends for New York City, the region should experience continued reductions of ambient concentrations and improving air quality.



## D. CONSTRUCTION IMPACTS OF THE PROJECT ALTERNATIVES

### NO BUILD ALTERNATIVE

With the No Build Alternative, the Second Avenue Subway would not be built. Thus, there would be no interim construction impacts.

### SECOND AVENUE SUBWAY

As described in Chapter 3 of this FEIS (“Description of Construction Methods and Activities”), since issuing the SDEIS, NYCT has identified a phasing plan for the project that would allow the new Second Avenue Subway to be built and operated incrementally, in four phases. The current phasing plan is as follows:

- Phase 1: 105th Street to 62nd Street, including a tunnel connection to the 63rd Street/Broadway Line;
- Phase 2: 125th Street to 105th Street;
- Phase 3: 62nd Street to Houston Street; including the 63rd Street tunnel connection to Queens for non-passenger service; and
- Phase 4: Houston Street to Hanover Square tail tracks.

The plan permits portions of the project to operate prior to completion of the entire line, with some service provided within each of the areas upon completion of that construction phase. This plan is subject to revision as engineering continues.

During all phases of the Second Avenue Subway construction, the heaviest trucking activity would likely occur when cut-and-cover excavation takes place at station locations, access shafts, and tunnel boring machine (TBM) insertion locations. During such periods, the subway’s construction would generate a significant volume of truck traffic throughout the East Side of Manhattan to permit spoils removal from, and materials delivery to, the various construction sites. The construction-related truck traffic and delays to and diversions of other vehicular traffic on the roads near the construction sites would have the potential to affect localized CO levels within the areas under construction for a given phase. These changes could affect both the location and the quantity of pollutants emitted from vehicles. The results of the CO analysis conducted for the construction sites and locations where traffic would be diverted are presented below.

Air quality in close proximity to construction sites would also be affected by fugitive dust and other particulate matter created at active construction sites and from diesel-powered equipment that would operate at the sites, as well as particulate matter from vehicular traffic on streets adjacent to the construction sites. The results of the analysis of particulate matter conducted for the construction sites are presented below.

Finally, in addition to localized effects near construction sites that are specific to a particular construction phase, construction activities also have the potential to affect regional air quality throughout the construction period. A regional analysis was therefore also conducted, and is presented following the description of the CO analysis and particulate matter analysis.

With the current phasing plan, construction of the subway is expected to start in 2004 and would continue until 2020. As construction year near the approximate midpoint of construction duration, 2010 was conservatively selected as the analysis year for construction-related air quality effects. Chapter 3 provides more information on construction activities.

CARBON MONOXIDE ANALYSIS

A microscale CO analysis was performed for the construction phase of the Second Avenue Subway for the year 2010 following the CO modeling procedures discussed above. Vehicular traffic estimates, which are outlined in Chapter 5D, were employed in the air quality mobile source modeling. The modeling effort accounted for increased congestion, lower running speeds, and increased idle emissions. Table 11-2 shows the results of the CO analysis<sup>1</sup> for the No Build Alternative and for the Second Avenue Subway’s construction phase.

**Table 11-2  
Future (2010) Maximum Predicted 8-Hour Average Carbon Monoxide  
Concentrations for Second Avenue Construction  
(parts per million)**

Receptor Site	Location	Time Period	CO Concentration [ppm]	
			No Build	Subway Construction
1	124th Street and Park Avenue	AM	3.5	3.6
2	96th Street and Lexington Avenue	AM	3.5	3.5
3	96th Street and Second Avenue	PM	4.4	4.7
4	34th Street and Lexington Avenue	AM	5.4	5.4
5	34th Street and Second Avenue	PM	5.1 <sup>1</sup>	5.0 <sup>1</sup>

**Notes:**  
The 8-hour NAAQS for CO is 9 ppm.  
<sup>1</sup> Detailed CAL3QHCR results.

In all neighborhood zones along the Second Avenue Subway’s alignment, the predicted CO concentrations during construction would be well below the NAAQS, and no significant adverse impacts on CO levels in the study area would occur as a result of construction, with or without traffic mitigation measures. (The air quality analysis conservatively assumed no traffic mitigation would be implemented.) Despite traffic impacts, lower vehicle speeds, and longer idling queues at intersections, CO levels during the Second Avenue Subway’s construction period are predicted to be the same or lower than No Build levels at three of the five receptor sites, because lower overall traffic volumes would pass through the affected intersections once their capacity is reduced for construction activities. Assuming the standard traffic mitigation measures described in Chapter 5D are implemented, the traffic impacts at receptor sites 1 and 3 would be fully mitigated, and predicted CO levels at those locations would be reduced during construction. At receptor site 5, which would be the most severely affected intersection from traffic (to be used during Phase 3), a variety of mitigation measures were considered. Because of construction constraints and concerns about these measures’ feasibility at this location, NYCT will continue to determine the most effective practicable traffic mitigation measures during the ongoing engineering (for more information, see Chapter 5D). Regardless, there would be no air quality impacts from CO at this location, nor would any be expected at any other intersections

<sup>1</sup> No 1-hour values are shown since predicted concentrations are far below the respective standard. In addition, 8-hour values are the most critical for impact assessment. The values shown for CAL3QHCR modeling are the highest predicted concentrations for each receptor location for the time periods analyzed.

where standard traffic engineering improvements would not fully mitigate traffic impacts and alternative measures are necessary.

Although a detailed analysis was only conducted for the five identified intersections in East Harlem, the Upper East Side, and East Midtown, these receptor sites represent the reasonable worst-case conditions that are likely to occur throughout the entire East Side study area during any construction phase. Since no CO air quality impacts would occur at the five worst-case intersections, no impacts are expected at any other intersections along the Second Avenue Subway alignment as well.

Based on the project's current phasing plan, construction activities would last longer than 5 years at four locations: near the 125th Street Station (including construction of the station and mined tunnels), in the 96th Street vicinity, in the 34th Street vicinity, and at the Hanover Square Station area in conjunction with Pier 6. To evaluate the project's effects on localized CO concentrations in the 90s vicinity and in the 30s vicinity, quantitative modeling was conducted, as described above. That modeling concluded that no significant adverse CO impacts would occur at those worst-case intersections. Therefore, it can be concluded that no CO impacts would occur at other intersections in those construction zones either. Similarly, the analysis of construction-related activity on CO concentrations conducted for the worst-case locations demonstrates that no significant adverse effects on CO would occur at the 125th Street construction zone. Finally, no significant CO impacts would be expected at the Pier 6 barge site in Lower Manhattan either. At that site, traffic volumes on local streets that could be affected by construction activities are much lower than at the intersections that were modeled and no significant traffic diversions are expected. Further, trucks traveling to the barge site would not be a significant source of CO emissions (since diesel trucks emit only a small amount of CO).

Based on the analysis conducted, it can also be concluded that no significant adverse CO impacts would occur to the intersections identified in the 1992 SIP attainment demonstration that are within ½ mile of the project's alignment: First Avenue and 57th Street, Third Avenue and 57th Street, Second Avenue and 36th Street, and Delancey and Allen Streets. At the two 57th Street locations and at Delancey Street, the project's construction is not anticipated to cause significant traffic impacts that cannot be mitigated (see Chapter 5D and Appendix D for more on traffic conditions during construction). At 36th Street, the analysis conducted at 34th Street and Second Avenue represents worst-case conditions for the project during the construction period, and impacts at 36th Street would be similar.

#### *PARTICULATE MATTER CONCENTRATIONS*

Two construction zones were selected for construction activity modeling of PM: the area between 97th and 92nd Streets ("the 90s") to be constructed in Phase 1 and a corresponding area in the 30s concentrated near 36th Street ("the 30s") to be constructed in Phase 3. As noted earlier, these sites were selected because they could experience the most intense and longest duration construction activities along the alignment, because both locations have heavy existing traffic volumes as well as sensitive receptors nearby, and because both areas can represent activities that would occur in other places along the alignment. At both locations, two construction activities were modeled separately: the open-cut station excavation process and the spoils removal process for the TBM. These activities were chosen for modeling because they would each require a large number of construction vehicles and machinery over a multi-year period and because they would also occur at all locations where stations would be constructed. Further, although a variety of construction techniques could be used to build a particular project

element, these two construction activities (open cut station excavation and TBM spoils removal) would result in the greatest potential effect to air quality.<sup>1</sup> Consequently, the activities analyzed represent the worst-case conditions at those construction sites, and the results of the analysis for these activities can be used to make conclusions about other portions of the subway alignment where less construction activity would take place.

In addition, an analysis was performed of the potential impacts of barge facilities on PM<sub>10</sub>. As described in Chapter 3, "Description of Construction Methods and Activities," current plans call for a potential barge facility to be used during the construction period at Pier 6 on the East River in Lower Manhattan in Phase 4. This site would function as a transfer point for outgoing spoils, collecting the spoils arriving by truck from the various construction sites and loading them on barges for further transport to the final destination. Incoming materials that would be distributed to the various construction sites would also depart from this site. As described above, the analysis of barging operations considered the worst-case location of the 129th Street barge site (which is no longer under consideration). The main activities modeled at the barge facility were the transfer of spoils from the trucks via cranes and hoppers to awaiting barges, and engine emissions from trucks, barges, cranes, and the various other pieces of construction equipment that would operate at the site.

The PM<sub>10</sub> concentrations expected at typical Second Avenue Subway construction sites are described below, based on the modeling conducted for the sites in the 90s and 30s. Following that discussion is a description of the PM<sub>10</sub> concentrations expected at the barge site. A separate discussion of fine particulate matter (PM<sub>2.5</sub>) at construction sites and barge sites is provided after the discussion of PM<sub>10</sub>. In addition, regional effects related to particulate matter are described, in the overall discussion of regional air quality that follows.

### *Construction Sites—PM<sub>10</sub>*

At the sites in the 90s and in the 30s, project-related particulate matter during construction would result from the combination of on-street sources (i.e., trucks and automobiles on the road), and construction activity and equipment at the construction site (creating dust and emitting diesel pollutants), as well as background sources. The analysis included both on-street mobile sources, including the spoils removal and materials delivery trucks traveling in the study areas during construction, and construction site PM<sub>10</sub> emissions from construction activities and equipment at shaft site/spoils removal locations. Both the construction site and on-street activity would contribute together to the total particulate matter levels in areas where construction activities would be most intense, such as directly at the open cut excavation areas. Farther from the construction site, the predominant source of airborne particulate matter would be the resuspension of road dust by passing vehicles.

In the No Build condition, predicted background PM<sub>10</sub> concentrations in 2010, including local traffic contributions, in the vicinity of the 90s were a maximum of 88.0 µg/m<sup>3</sup> averaged daily and 34.4 µg/m<sup>3</sup> averaged annually. In the 30s area, the predicted maximum No Build concentrations of PM<sub>10</sub> were 98.9 µg/m<sup>3</sup> averaged daily and 37.9 µg/m<sup>3</sup> averaged annually.

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<sup>1</sup> As described in Chapter 3, in the 90s construction zone, slurry wall construction and TBM operations could occur simultaneously for approximately one year during Phase 1. For air quality, the cut-and-cover operations at this location would be the worst-case condition (with greater effects to air quality than the year of simultaneous TBM and slurry wall operations), and therefore can be used to determine the worst-case conditions here.

The truck traffic from Second Avenue Subway construction would not in itself add any discernable contribution to PM<sub>10</sub> concentrations near the access roadways. Traffic diversions due to the partial closure of Second Avenue, in comparison to No Build background levels, would result in an increase of PM<sub>10</sub> concentrations of 3.9 μg/m<sup>3</sup> averaged daily and 1.0 μg/m<sup>3</sup> averaged annually in the 30s area. For the 30s area, in areas not adjacent to the construction activity, the total maximum concentration of PM<sub>10</sub>, including background concentration, would therefore amount to 102.6 μg/m<sup>3</sup> averaged daily and 38.9 μg/m<sup>3</sup> averaged annually. PM<sub>10</sub> concentrations in the 90s area would be unaffected by the traffic diversions.

These maximum concentrations would occur at only a few points near the intersections, and concentrations at most other locations would be considerably lower. Depending on the location, increases in PM<sub>10</sub> concentrations from project-related traffic diversions would range from no change at all to maximum of 1.0 μg/m<sup>3</sup> for the annual average and 3.9 μg/m<sup>3</sup> for the daily average throughout the study area. Overall, project-related on-street vehicular sources during construction would not have a significant effect on ambient air quality.

The modeling of the Second Avenue Subway's construction activities examined both potential fugitive dust emissions from the construction sites and PM emissions from the various pieces of construction equipment.

Fugitive dust emissions from construction operations can occur from excavation, hauling, dumping, spreading, grading, compaction, wind erosion, and traffic over unpaved and paved surfaces. Actual quantities of emissions depend on the extent and nature of the operations, the type of equipment employed, the physical characteristics of the underlying soil, the speed at which construction vehicles are operated, and the type of fugitive dust control methods employed. Much of the fugitive dust generated by construction activities consists of relatively large-size particles that are expected to settle within a short distance from the construction site and that would not significantly affect the buildings or people in the surrounding area.

Excavation and construction would be conducted with the care mandated by the alignment's proximity to sensitive land uses. The project's construction activities would be required to follow a dust-suppression program. This construction dust-suppression program would be set forth in a Construction Environmental Protection Program (CEPP). As described previously in this FEIS, the CEPP will be the document in which all project commitments and requirements related to construction will be incorporated. NYCT will incorporate relevant portions of the CEPP in all construction contracts, and contractors will be obligated to follow these provisions. NYCT will ensure that the CEPP and all related individual plans established by their contractors are implemented and coordinated. The program would include using dust covers for trucks, (water) spray misting exposed areas, using safe chemical dust suppressants to treat and control spoils at construction areas that could otherwise be a source of substantial fugitive dust emissions (e.g., heavy vehicular movements and continuous material handling operations), and a fence of an appropriate height would surround the construction sites to reduce the suspension of dust by wind erosion.

Accordingly, the modeling analysis takes into account an 80 percent reduction of PM emissions that would result with the project's planned dust-suppression program, which would be developed and monitored by NYCT. (This is a conservative assumption, since EPA's *AP-42* indicates an effectiveness of up to 90 percent through the establishment of thorough watering programs.) In addition, as described later in this chapter, if certain construction activities were to take place below ground or within enclosures, less fugitive dust would be emitted.

NYCT’s directives also ensure that PM emissions from use of diesel-powered construction equipment are minimized. To that end, the NYCT has implemented an agency policy directing that all future contracts for capital construction projects, including the Second Avenue Subway, implement diesel emission controls for off-road and non-road equipment. These controls require that all heavy equipment use ultra-low sulfur diesel (ULSD) fuel and employ diesel particle filters, and/or other reduction technologies. In addition, idling time for non-road and on-road equipment must be limited to 3 consecutive minutes, except in certain limited circumstances. This policy is recommended by the NYSDEC and non-governmental organizations attempting to minimize pollutant emissions. ULSD fuel has a sulfur content range of between 15 and 30 parts per million; not only does it in itself reduce emissions of SO<sub>2</sub> and related particulate matter, but it also permits use of advanced pollution control technologies. Implementation of these measures would reduce the emissions of particles from the combustion process by approximately 85 percent.<sup>1</sup> These NYCT requirements will be included in the project’s CEPP.

As described earlier, open-cut station excavation and TBM spoils removal activities were selected for modeling to determine the worst-case effect of construction-related emissions on PM levels throughout the study area. Impacts from below-grade construction activities and equipment, including ventilation exhaust, would be comparable to or less than those for the at-grade activities analyzed. Similarly, if any enclosures are employed to mitigate noise during construction, these would reduce fugitive dust emissions, but would have to be carefully designed, sited, and vented to avoid creating any adverse impacts themselves.

The maximum predicted concentrations, including both the construction and on-road sources, were added to the background concentrations to estimate ambient air quality at both the 30s and the 90s sites. According to the results of this analysis (see Tables 11-3 and 11-4), NAAQS standards would not be exceeded as a result of the proposed construction activities. Overall, no significant adverse impacts on PM<sub>10</sub> levels in the study area were predicted as a result of either open-cut station excavation or spoils removal from tunneling. Maximum predicted PM<sub>10</sub> contributions from construction-related activity adjacent to the construction sites were 17.6 µg/m<sup>3</sup> and 4.2 µg/m<sup>3</sup> averaged daily and annually, respectively. These concentrations decrease as the distance from the construction site increases, and at a distance of 100 meters from the construction sites, the predicted maximum project-related contribution to the PM<sub>10</sub> concentrations ranges from negligible to 1.0 µg/m<sup>3</sup> on an annual average. Based on this analysis of worst-case locations, it can also be concluded that no significant PM<sub>10</sub> impacts would occur at the 125th Street construction zone.

**Table 11-3  
Maximum Predicted 2010 PM<sub>10</sub> Contributions from  
Construction Sites and Related Traffic Diversions (µg/m<sup>3</sup>)**

Location	24-hour Average Concentration		Annual Average Concentration	
	On-Street	Construction	On-Street	Construction
36th-35th Street	3.9	17.6	1.0	4.2
97th-95th Street	0.1	17.6	0.1	4.2
	24-hour NAAQS is 150 µg/m <sup>3</sup> .		Annual NAAQS is 50 µg/m <sup>3</sup> .	

<sup>1</sup> Sources: Northeast States for Coordinated Air Use Management (NESCAUM), Memorandum: Diesel Emissions Resulting from Ground Zero Activity, April 8, 2002; *The Impact Of Retrofit Exhaust Control Technologies On Emissions From Heavy-Duty Diesel Construction Equipment*, SAE 199-01-0110, Environment Canada, NESCAUM, Manufacturer of Emission Controls Association.

**Table 11-4**

**Maximum Predicted 2010 Total PM<sub>10</sub> Concentrations  
Near Construction Sites and Access Roads (µg/m<sup>3</sup>)**

Location	24-hour Average Concentration			Annual Average Concentration		
	No Build	Along Roads Not Adjacent to Construction	Adjacent to Construction Site	No Build	Along Roads Not Adjacent to Construction	Adjacent to Construction Site
36th-35th Street	98.9	102.6	107.2	37.9	38.9	40.5
97th-95th Street	88.0	88.1	96.0	34.4	34.5	36.4
	24-hour NAAQS is 150 µg/m <sup>3</sup> . Background Concentration is 61 µg/m <sup>3</sup> .			Annual NAAQS is 50 µg/m <sup>3</sup> . Background Concentration is 24 µg/m <sup>3</sup> .		

#### *Construction Activities at Potential Barge Sites*

As discussed in Chapter 3, due to the large number of trucks that would be required to remove spoils from the shaft sites and station excavation areas each day, removing spoils from Manhattan by barge is being considered as a way to minimize disruption. Spoils would likely be transported to the barge site via trucks. It is also possible that spoils could be transported to the barge site via a covered above-ground conveyor system between the Hanover Square Station excavation area on Water Street and the barge site. The air quality issues associated with the barging facility are discussed below. As described above, the 129th Street barge site formerly included in the project was analyzed as a worst-case condition, and barging activities at Pier 6 on the East River in Lower Manhattan would result in similar or lesser emissions and ensuing concentrations of pollutants in the surrounding area than described below for the 129th Street site.

The analysis conducted for the 129th Street facility assumed that the barge site would be located in an industrial area, approximately 600 feet from the nearest residences and approximately 150 to 200 feet away from a nearby park, the Crack Is Wack Playground. As at the Pier 6 site, the potential barge use would be separated from these sensitive uses by a heavily traveled roadway—in this case, the Harlem River Drive. (At Pier 6, the roadway separating the pier from the office buildings is the FDR Drive.) Barging facilities would primarily be used for spoils and material transfer and storage, and only minimal, if any, excavation would be required. The operations at the barging facility would include trucks, front-end loaders and cranes loading spoils and unloading materials, as well as truck and equipment movements on paved and unpaved surfaces, and diesel emissions from non-road equipment. The barge site would accommodate a large quantity of spoils and materials delivery trucks because it would support multiple project construction sites. It would also include tug boats, which have their own emissions; however, these would generally be located on the river itself at least 100 feet from the bulkhead edge, and would therefore be even farther removed from sensitive receptors.

Similar to the analysis done for the construction sites, the maximum predicted concentrations were added to the background concentrations to estimate ambient air quality. The maximum resulting project-related contribution to the PM<sub>10</sub> concentrations, as forecast by the simulation, would be 40.1 µg/m<sup>3</sup> and 2.5 µg/m<sup>3</sup> for the daily and annual averaging times respectively. The total maximum predicted concentrations in the vicinity of the barge site, including the contribution from the Harlem River Drive and the background concentration, were 117 µg/m<sup>3</sup> and 38 µg/m<sup>3</sup> for the daily and annual averaging times respectively. The predicted concentrations do not

## Second Avenue Subway FEIS

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exceed the NAAQS standards. Overall, for activities associated with barging operations, no significant adverse impacts on PM<sub>10</sub> levels in the study area would occur.

### *PM<sub>2.5</sub> Analysis*

In addition to PM<sub>10</sub> analysis described above, an analysis was conducted for PM<sub>2.5</sub>, or fine particulate matter. However, adequate data and analysis techniques are still being developed, as described below.

New York State and EPA have not yet determined whether New York City is within attainment of the PM<sub>2.5</sub> NAAQS. Existing monitoring data indicate that the region is well within the 24-hour PM<sub>2.5</sub> standard, but the 3-year annual average PM<sub>2.5</sub> concentrations in New York City range from just below to just above the standard of 15 µg/m<sup>3</sup>. Furthermore, a preliminary examination of both the annual average and daily average PM<sub>2.5</sub> data for New York City indicates that measured concentrations are significantly more uniform across geographical areas than concentrations of PM<sub>10</sub>. This reflects the contribution of secondary particles to PM<sub>2.5</sub> concentrations in the city, and the fact that PM<sub>2.5</sub> is a regional pollutant (EPA estimated nearly 60 percent of PM<sub>2.5</sub> within the eastern United States is secondary sulfate). Because of its regional nature, spatial averaging over an area provides a more accurate assessment of public health risk than examining peak concentrations.

Currently, neither EPA nor NYSDEC nor NYCDEP has approved models or analytical procedures to be used for project-specific PM<sub>2.5</sub> studies. However, it is possible to estimate a potential maximum increase in PM<sub>2.5</sub> concentrations due to combustion sources using techniques originally developed for PM<sub>10</sub> impact assessment. (Since PM<sub>10</sub> consists of all particulate matter smaller than 10 micrometers in diameter, it includes PM<sub>2.5</sub>.) This analysis involves calculating the percentage of PM<sub>2.5</sub> in the PM<sub>10</sub> being emitted in tailpipe exhaust and fugitive dust. No conclusive methodology exists to indicate whether or not fugitive dust should be included in this calculation; therefore, this analysis conservatively includes fugitive dust.

To approximate the maximum increase in PM<sub>2.5</sub> concentrations from project-generated vehicles at the station excavation and spoils removal site in the 90s, the PM<sub>2.5</sub>/PM<sub>10</sub> ratio in tailpipe exhaust as well as paved road dust was estimated. While studies have shown percentages of PM<sub>2.5</sub> to PM<sub>10</sub> in road dust as low as 0.10, EPA suggests using a value of 0.25 ("Fugitive Particulate Matter Emissions," MRI/EPA OAQPS, April 1997). Conversely, exhaust emissions from mobile sources are about 90 percent PM<sub>2.5</sub>. These proportions were applied to PM<sub>10</sub> emissions from all sources at the construction sites analyzed to determine the concentrations of PM<sub>2.5</sub> from those sources.<sup>1</sup>

The modeling of localized PM<sub>10</sub> concentrations conducted for the Second Avenue Subway indicated that the annual average increases in PM<sub>10</sub> concentrations from on-street emissions would be no more than 3.9 µg/m<sup>3</sup> on a 24-hour average and 1.0 µg/m<sup>3</sup> and on an annual average throughout the study area. Using the above assumptions and emissions ratios, in locations along

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<sup>1</sup> Engine exhaust emissions constituted 27 percent of the total PM<sub>10</sub> emissions at the construction sites from all sources. Engine-emitted PM<sub>2.5</sub> would therefore be 27 percent x 90 percent = 24.3 percent of the total PM<sub>10</sub>. Total PM<sub>2.5</sub> would include an additional 25 percent of the dust component of PM<sub>10</sub>, that is 24.3 percent + 25 percent (100 percent - 24.3 percent) = 43.2 percent of the total PM<sub>10</sub>. Engine exhaust constituted 32 percent of the total on-road PM<sub>10</sub> emissions (including road dust). Thus, using a similar calculation, engine-emitted PM<sub>2.5</sub> would be 28.8 percent of the all on-road PM<sub>10</sub> and total PM<sub>2.5</sub> would be 45.8 percent of all on-road PM<sub>10</sub>.



the main access roads throughout the study area not adjacent to excavation and spoils removal activities, project-generated construction vehicle emissions (on-street emissions) would result in an increase in PM<sub>2.5</sub> of 1.8 µg/m<sup>3</sup> on a 24-hour average basis, of which 1.0 µg/m<sup>3</sup> would be from diesel engine emissions and the remainder would be from fugitive dust (as noted above, including fugitive dust may be overly conservative). Further, it should be noted that the increases in particulate matter concentrations described below and attributable to dust are likely to be overestimated, generating conservative results.<sup>1</sup>

The maximum local increases in annual average PM<sub>2.5</sub> concentrations would be 0.5 µg/m<sup>3</sup>, of which 0.3 µg/m<sup>3</sup> would be from diesel engine emissions and the remainder from fugitive dust. This increase would represent the maximum impact of the project adjacent to access roads where project-related trucks would be passing, and where traffic diversions would occur due to the construction activity; at other locations, project-related vehicles would contribute less.

The maximum increase in PM<sub>10</sub> concentrations from either open-cut station excavation or TBM spoils removal activities would be about 17.6 µg/m<sup>3</sup> on a 24-hour average and 4.2 µg/m<sup>3</sup> for the annual average. These maximum increases would occur only in areas immediately adjacent to the construction sites. (These numbers include the contributions of both on-street vehicular and construction site emissions.) Using the assumptions and ratios described above, maximum cumulative increases in total average PM<sub>2.5</sub> levels (including diesel exhaust and fugitive dust) adjacent to construction activities would be 7.5 µg/m<sup>3</sup> on a 24-hour basis and 1.8 µg/m<sup>3</sup> on an annual basis. Of those concentrations, 4.3 µg/m<sup>3</sup> and 1.0 µg/m<sup>3</sup>, on 24-hour and annual basis, respectively, would be from diesel engine exhaust (i.e., excluding fugitive dust). This would occur only in the immediate vicinity of the construction sites, and project contributions would decrease substantially as distance from the construction site increased.

Based on the model results for the construction activities, similar effects would likely occur at other locations along the Second Avenue alignment where comparable construction activities would take place. The duration of construction at locations where TBM spoils for long tunnel segments would be removed (in the 90s construction zone, in the 30s construction zone, potentially near Houston Street, and at Water Street near Coenties Slip) would be sustained over a longer period than at locations where only station excavation is required.

The maximum predicted 24-hour average increases of PM<sub>2.5</sub> from diesel exhaust would not exceed NYSDEC's and NYCDEP's interim guidance threshold value of 5 µg/m<sup>3</sup>. The maximum predicted 24-hour increase of PM<sub>2.5</sub> including both diesel exhaust and fugitive dust would exceed those values. Including background concentrations, cumulative daily PM<sub>2.5</sub> concentrations during construction would be below the applicable NAAQS in the study area.

On an annual average basis, the maximum predicted total local annual increases of fine respirable particulate matter (PM<sub>2.5</sub>) would exceed the NYSDEC's annual threshold value of 0.3 µg/m<sup>3</sup> in the areas immediately adjacent to major construction sites. The maximum predicted annual increase of PM<sub>2.5</sub> from diesel exhaust alone would also exceed NYSDEC's annual threshold value. Some of the background PM<sub>2.5</sub> levels exceed the annual NAAQS.

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<sup>1</sup> In the 1995 Draft PM<sub>10</sub> SIP for New York County, NYSDEC and NYCDEP expressed concerns to EPA regarding the fugitive dust estimates in the PART5 model. Measurements at NYCDEP's Midtown Manhattan monitoring site on Madison Avenue indicated that only 8.5 percent of the particulate matter (as PM<sub>10</sub>) was road dust while the PART5 model predicted dust percentages from 13 to 86 percent.

The NYSDEC and NYCDEP interim guidance thresholds do not apply to temporary sources that do not require an air permit from NYSDEC on approval from NYCDEP. Nevertheless, the NYSDEC criteria can be applied to assess the magnitude of a project's effects and to determine whether reasonable mitigation measures ought to be employed to minimize the generation of PM<sub>2.5</sub> to the maximum extent practicable. As described above, the project's construction activities would be required to follow a dust-suppression program to be set forth in the CEPP. The CEPP will also require contractors to follow the NYCT directives that all contracts for capital construction projects, including the Second Avenue Subway, must use the maximum practicable emission reductions, in the form of ULSD and emissions reduction technologies for all off-road and non-road engines to the maximum extent practicable (see Section D above, "Construction Sites—PM<sub>10</sub>" for details). This directive is in accordance with the policies recommended by NYSDEC and with those of various non-governmental organizations active in New York City who are attempting to minimize pollutant emissions. Moreover, this policy will result in additional future benefits, since the investment in cleaner engines mandated by contracts for the large Second Avenue Subway project will also benefit other construction projects once subway construction activities are completed.

PM<sub>2.5</sub> is a regional pollutant, much like ozone. An analysis of the effects of the project's construction on regional PM<sub>2.5</sub> levels was also conducted for the project, taking into account the combination of construction sites and long-distance trucking. That analysis is provided below, after the discussion of long-distance trucking. More detailed analysis is presented in Appendix I, Section G.

### REGIONAL EMISSIONS FROM CONSTRUCTION-RELATED SPOILS AND MATERIALS TRANSPORT

Because of the large scale and extended duration of the construction required for the Second Avenue Subway, the construction would increase regional concentrations of ozone precursors—NO<sub>x</sub> and VOCs—as well as fine particulate matter (PM<sub>2.5</sub>), all of which are pollutants of concern on a regional basis. Although such increases would be unavoidable, NYCT would implement pollution control measures during construction to limit increases of these pollutants to the extent practicable, as described earlier.

For comparative purposes, the amount of these pollutants predicted to be emitted throughout the region because of the transportation of spoils and materials during construction of the new subway was calculated for several scenarios with different transportation distances. Details regarding this analysis are presented in Appendix I. This analysis has been revised since completion of the SDEIS to use updated assumptions and to allow clear comparison of the emissions associated with barging and trucking. This analysis provides a means for assessing and comparing the expected regional airborne emissions from the range of construction materials delivery and spoils removal scenarios that might occur. For such activities, NO<sub>x</sub>, VOCs, and PM<sub>2.5</sub> would be the primary pollutants of concern. Emission factors for trucks were calculated using the EPA PART5 MOBILE5b. Emission factors for the transport of barged material were calculated using procedures published by the EPA (EPA, 1999). The predicted emission factors for truck and barge transport, presented in Table 11-5 below, are given in the comparative format of tons emitted per cubic yard-mile transported.

Overall, barging is expected to result in an improvement to air quality over trucking-only options. The use of barges would significantly reduce regionwide diesel engine emissions of PM<sub>2.5</sub> resulting from the project during construction.

**Table 11-5**  
**Emission Factors by Transportation Mode<sup>1</sup>**

Mode and Year	Emission Factor [grams per cubic yard-mile transported]			
	PM <sub>2.5</sub>	VOC	NO <sub>x</sub>	Weighted Ozone Precursors – VOC equivalents ([NO <sub>x</sub> ]/0.75) + [VOC]
Truck 2005 <sup>2</sup>	0.0497	0.132	0.715	1.085
Truck 2010 <sup>2</sup>	0.0426	0.130	0.491	0.785
Truck 2015 <sup>2</sup>	0.0392	0.130	0.377	0.633
Barge (Current) <sup>3,4</sup>	0.0151	0.00552	0.711	0.954
<b>Notes:</b>				
1 This table is new for the FEIS.				
2 10 CY truck at 35 mph returning empty				
3 4075 CY barge at 6.4 knots returning empty (includes auxiliary engine)				
4 Barge calculations are based on a 1999 study, and assume no change throughout the construction period.				

NO<sub>x</sub> and VOCs are both ozone precursors. Emissions of VOCs per cubic yard-mile would be significantly lower for barge transport than for trucks. Conversely, NO<sub>x</sub> emissions would be nearly equal in 2004 and lower for trucks thereafter. Per ton emitted, the impact of NO<sub>x</sub> on ozone formation in the New York region is higher than that of VOCs—for each ton of VOC reduced in the ozone SIP, 0.75 tons of NO<sub>x</sub> can be substituted. Total ozone formation potential, represented as VOC equivalent emissions, is presented in Table 11-5 above. VOC equivalent emissions are equal to the VOC emissions plus NO<sub>x</sub> emissions divided by a factor of 0.75. VOC equivalent emissions during the first years of the project, when much of the spoils will be removed, would be lower per cubic yard-mile for barge transport than for trucks. Beginning in 2007, truck VOC equivalent emissions would be lower. This analysis does not assume that emissions from tug engines may improve if new marine engine regulations were to be mandated (current regulations are voluntary).

Overall, the use of barges for spoils and materials transport would significantly reduce the emissions of both particulate matter and VOCs. In later years, the benefits due to lower VOC emissions would be offset by the relatively higher NO<sub>x</sub> emissions from barge tugs. If large quantities of spoils and materials are to be transported in the early years of the project, there would be a distinct benefit to the use of barges. Additionally, the significant benefit of reduced PM<sub>2.5</sub> emissions would be most pronounced near the emission sources. In the case of trucks, the source is quite often near highly populated areas, whereas emissions from barge tugs would occur mostly over water. The relative increase in NO<sub>2</sub> emissions due to the use of barges would not occur near sensitive land uses. Background levels of NO<sub>x</sub> are well below the NAAQS, so local increases are not of concern, whereas PM<sub>2.5</sub> annual levels may currently exceed the NAAQS.

One site along the Second Avenue Subway alignment—Pier 6—has been identified as appropriate for a barging operation. The proximity of Pier 6 to the alignment makes it a suitable location for transporting spoils and materials coming and going to construction sites in the southern portion of the alignment. Under current plans, barges could be used to support the

## Second Avenue Subway FEIS

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tunnel and station excavation and construction processes for all construction south of 4th Street (Phase 4).

An analysis was undertaken to show the estimated total emissions for the duration of the project of VOCs, NO<sub>x</sub>, and PM<sub>2.5</sub> from spoils and materials transport. This analysis was conservatively conducted to show the estimated total emissions that would result if all spoils and materials from the entire alignment were transported by trucks. A second assessment was then prepared to compare the average emissions that would result if barges vs. trucks were used in the area south of 4th Street, to be constructed as the project's Phase 4 in the current phasing plan.

### *Effects of Emissions Assuming All Spoils and Materials Are Transported By Trucks*

The maximum and average predicted volumes of spoils and materials per year, distance traveled, and the resulting estimated total emissions for the duration of the project of VOCs, NO<sub>x</sub>, and PM<sub>2.5</sub>, if all spoils and materials for the entire alignment were transported by trucks are presented in Table 11-6. Calculations were prepared for both a typical construction year and the anticipated peak construction year. Three scenarios were analyzed, assuming spoils would be transported to a range of 25, 50, and 100 miles within the region (with a round-trip distance of 50, 100, and 200 miles respectively). Materials were assumed be supplied via a 100-mile round trip. Since the project's construction could span approximately 16 years, over which the truck engine emission factors would diminish over time, emissions from 2005, 2010, and 2015 are presented for comparison (the majority of transport activity is expected in earlier years of the project). Since the peak year is not known at this time, both typical and peak annual emissions are presented for all three years.

The estimated typical annual emissions related to spoils transport over the duration of the proposed project range from 4.3 to 17.5 tons of VOCs, 12.6 to 94.9 tons of NO<sub>x</sub>, and 1.3 to 6.6 tons of PM<sub>2.5</sub>, depending on the year and the range of spoils and materials transport. The peak year emissions would range from 7.2 tons of VOCs, 20.9 tons of NO<sub>x</sub>, and 2.2 tons of PM<sub>2.5</sub> per year for the 25-mile spoils transport range scenario in 2015, to 29.1 tons of VOCs, 157.9 tons of NO<sub>x</sub>, and 11.0 tons of PM<sub>2.5</sub> per year for the 100-mile range scenario in 2005.

To put these results in perspective, according to the "New York State Implementation Plan for Ozone" (NYSDEC, 1998), the total predicted emissions of NO<sub>x</sub> from on-road sources are 92,637 and 89,133 tons per year for 2005 and 2007, respectively. The maximum predicted VOC emissions are 60,919 and 59,349 tons per year for 2005 and 2007, respectively. The maximum projected NO<sub>x</sub> emissions from the spoils removal and material delivery represent 0.17 percent and 0.27 percent of the 2005 and 2007 emissions, respectively. The maximum projected VOC emissions represent 0.05 percent 0.03 percent of the 2005 and 2007 emissions, respectively. These levels are a large contribution from a single project, but a small amount in a regional context.

### *Comparative Analysis of Effects of Emissions: Trucks vs. Barges*

As described above, an analysis was also conducted to compare the typical annual barge tug emissions with truck emissions. The goal of this analysis was to show the different emissions that would result from barges vs. trucks if barges were used to transport spoils and materials over the 25-, 50-, and 100-mile distances for the portion of the alignment south of 4th Street. Table 11-7 shows the results of this comparison.

**Table 11-6**  
**Projectwide Average and Maximum Emissions**  
**from Spoils and Material Transport by Truck**

<b>Spoils Transported Range:</b>		<b>100 Mile</b>	<b>50 Mile</b>	<b>25 Mile</b>
Distance [round trip miles]	Spoils	200	100	50
	Material	100	100	100
Average Quantity [CY/year]	Spoils	600,000	600,000	600,000
	Material	1,480	1,480	1,480
2005 Average Emissions [Tons/year]	VOC	17.5	8.8	4.4
	NOx	94.9	47.5	23.8
	PM <sub>2.5</sub>	6.6	3.3	1.7
2010 Average Emissions [Tons/year]	VOC	17.3	8.6	4.3
	NOx	65.2	32.6	16.4
	PM <sub>2.5</sub>	5.7	2.8	1.4
2015 Average Emissions [Tons/year]	VOC	17.3	8.6	4.3
	NOx	50.1	25.1	12.6
	PM <sub>2.5</sub>	5.2	2.6	1.3
Maximum Quantity [CY/year]	Spoils	997,000	997,000	997,000
	Material	4,150	4,150	4,150
2005 Maximum Emissions [Tons/year]	VOC	29.1	14.6	7.3
	NOx	157.9	79.1	39.7
	PM <sub>2.5</sub>	11.0	5.5	2.8
2010 Maximum Emissions [CY/year]	VOC	28.7	14.4	7.2
	NOx	108.4	54.3	27.3
	PM <sub>2.5</sub>	9.4	4.7	2.4
2015 Maximum Emissions [Tons/year]	VOC	28.7	14.4	7.2
	NOx	83.2	41.7	20.9
	PM <sub>2.5</sub>	8.7	4.3	2.2
<b>Notes:</b> This table is new for the FEIS. All spoils removal and materials delivery were assumed to be performed with trucks.				

**Table 11-7**

**Comparative Analysis (Barge vs. Trucks) of Average Emissions from Spoils and Material Transport South of 4th Street**

Transported Range and Mode		100 Mile All Barge	100 Mile All Truck	50 Mile All Barge	50 Mile All Truck	25 Mile All Truck
Distance [round trip miles]	Spoils	200	200	100	100	50
	Material	100	100	100	100	100
Average Quantity [CY/year]	Spoils	378,000	378,000	378,000	378,000	378,000
	Material	1,770	1,770	1,770	1,770	1,770
2005 Average Emissions [Tons/year]	VOC	0.5	11.1	0.2	5.5	2.8
	NOx	59.5	59.9	29.8	30.0	15.1
	PM <sub>2.5</sub>	1.3	4.2	0.6	2.1	1.0
2010 Average Emissions [Tons/year]	VOC	0.5	10.9	0.2	5.5	2.7
	NOx	59.5	41.1	29.8	20.6	10.4
	PM <sub>2.5</sub>	1.3	3.6	0.6	1.8	0.9
2015 Average Emissions [Tons/year]	VOC	0.5	10.9	0.2	5.5	2.7
	NOx	59.5	31.6	29.8	15.8	7.9
	PM <sub>2.5</sub>	1.3	3.3	0.6	1.6	0.8

**Notes:** This table is new for the FEIS.  
 Emission factors from barge tugs are assumed to remain constant.  
 A 25-mile all-barge scenario was not analyzed, since barging spoils for this distance would not be practical and would not likely be pursued.  
 To allow comparison between truck and barge transportation, this table represents the regional addition to Manhattan transport only. Trips within Manhattan are not included.

As shown, the estimated total emissions for barges would be lower than for trucks for both VOCs and PM<sub>2.5</sub>, but the emissions levels for NO<sub>x</sub> would be higher for barges if occurring in later years (assuming no new regulations for emissions from tug engines are in effect). As described above in detail, the overall advantage of barges is limited to the earlier years of the projects. In later years, barges would still emit significantly less particulate matter and VOCs, but due to the decrease of NO<sub>x</sub> emissions from trucks, the overall ozone production potential from the emissions (weighted combined emission of NO<sub>x</sub> and VOCs) would be slightly lower for trucks. As described above, the emission factors for trucks would decline over time, but barge emissions would be constant. Overall, if barges could be used during earlier stages of construction, the comparative benefits of barges over trucks would be greater than if they were used during later construction stages. As described in Chapter 3, however, the current phasing plan for the project incorporates barges in Phase 4 of the project.

Summary

For both the all truck and the truck vs. barges studies, the net emissions throughout the duration of the construction phase would generally decrease with the length of the construction duration. The net emissions are mainly correlated to the distance of travel necessary for the spoils removal and to the transportation mode. If barges can be used to transport some spoils and materials, there would be a benefit to air quality.

## E. PERMANENT IMPACTS OF THE PROJECT ALTERNATIVES

### NO BUILD ALTERNATIVE

With the No Build Alternative, no Second Avenue Subway would operate along Second Avenue south to Water Street or along the existing Broadway Line south of 63rd Street. Since no new construction would occur, nor would significant new transit service be introduced to the project area, the No Build Alternative would not have any effect on ambient air quality or trends. Thus, the No Build Alternative would not result in any decrease in areawide traffic volumes and ensuing reduction in regional annual pollutant burdens that are anticipated with the operational Second Avenue Subway, as described below.

### SECOND AVENUE SUBWAY

#### *LOCALIZED POLLUTANT IMPACTS: TRAFFIC*

The Second Avenue Subway would result in a relatively modest decrease in areawide traffic volumes, so localized CO, PM<sub>10</sub>, and PM<sub>2.5</sub> levels in the overall East Side study area would decrease slightly as a result of the project. Therefore, benefits to air quality would occur as a result of those reductions in traffic.

#### *LOCALIZED POLLUTANT IMPACTS: VENTILATION STRUCTURES*

As described in Chapter 2 of this FEIS (“Project Alternatives”), the Second Avenue Subway would include new ventilation structures at each of the 16 new stations. Two such structures would operate at each station, one at each end. These would provide fresh air intake, exhaust, emergency smoke exhaust, and relief of air pressure build-up caused by the movement of trains (the “piston” effect) for each station.

The new structures would typically be 25 to 40 feet wide and up to 75 feet high. Exhaust gratings and louvers would primarily be through the roof to minimize the amount of surface area needed at street level, while fresh air intake would occur through louvers located toward the rear yard. This location for the intake louvers is expected to improve air quality within each station (because the rear yards are farther removed from vehicular traffic than at the street frontage) while also eliminating visibility from the street and providing for greater security than sidewalk vents. Exhaust vents would be placed a minimum of 10 feet from operable windows in other buildings.

In addition to the new ventilation structures at each station, to provide venting to serve the connection to the Broadway Line, improvements would have to be made to the existing 63rd Street MTA vent tower located approximately 100 feet east of Second Avenue on the southeast corner of East 63rd Street.

All stations would also have an air-tempering system, designed to lower station temperatures on hot days. Current plans call for cooling towers to be located on the roofs of buildings; these would be hidden from view by privacy screens. The exhausts and intakes would be designed to have state-of-the-art noise attenuation devices and are planned to be located at least 10 feet away from any neighboring building windows or entrances both to meet code requirements and to minimize any potential adverse impacts to the neighborhood from noise (for a discussion of noise, please see Chapter 12).

**Second Avenue Subway FEIS**

The air generated from the new ventilation structures would be air from the subway’s tunnels and stations. Similar to subway vents throughout this city, this air would include some dust generated by train brakes and the interaction between the train wheels and the rails.

*REGIONAL (MESOSCALE) POLLUTANT IMPACTS*

A mesoscale analysis was performed for 2025 to assess the effect of the Second Avenue Subway, based on its reduction of pollutant burdens relative to the No Build Alternative. Since completion of the SDEIS, the analyses have been refined to use updated speed summary data from the 1999 NYMTC conformity analysis, with the most recently predicted speeds for year 2020 (this is the latest year for which predicted speeds are available). In addition, the modeling inputs were updated to reflect the NYSDEC modeling inputs used to develop the state’s emission budget in the 1998 Ozone SIP (for more information, see Appendix I).

As compared with the No Build Alternative, the Second Avenue Subway would result in reduced vehicular activity, and an ensuing reduction in annual pollutant burdens. The new Second Avenue Subway service would divert trips from automobile to transit, contributing to a net reduction in vehicle miles traveled (VMT). The savings in VMT would also contribute to lower mobile source emissions in the New York Metropolitan Area. As a result, the Second Avenue Subway would improve air quality in the region and would have a positive impact on the State Implementation Plan for the Control of Ozone and Carbon Monoxide. As shown in Table 11-8, the analysis indicated that compared to the No Build Alternative, the project would contribute to an annual reduction of approximately 229 tons of CO, 2.2 tons of NO<sub>x</sub>, 6.5 tons of VOCs, and 39.1 tons of PM<sub>10</sub> compared to the No Build Alternative. The Second Avenue Subway would therefore improve regional air quality and conform to the purpose of the SIP and the 1990 CAAA.

**Table 11-8  
Change in Regional Pollutant Emissions (tons per year)**

Vehicle Class	Change in Regional VMT/year (millions)	Emission Factors (g/mile)				Change in Regional Emissions (tons/year)			
		CO	NO <sub>x</sub>	VOCs	PM <sub>10</sub>	CO	NO <sub>x</sub>	VOCs	PM <sub>10</sub>
LDGV/LDGT	-28.4	7.321	0.071	0.209	1.252	-228.78	-2.22	-6.53	-39.12
<b>Notes:</b> This table is new for the FEIS. Total change in VMT is from Second Avenue Subway ridership model. Emission factors for CO, NO <sub>x</sub> and VOCs are from modeling runs using EPA's MOBILE5B. Emission factors for PM10 are from modeling runs using EPA's PART5. Calculation: Annual Emissions = VMT * 1,000,000 * Emission Factor / 909,000 g/ton									

**THE NEW YORK STATE AIR QUALITY IMPLEMENTATION PLAN**

As noted earlier, the Clean Air Act conformity requirements require that a currently conforming TIP exist in order for any transportation project to be approved but also limit the conformity status of a TIP and LRTP to a maximum of three years for nonattainment and maintenance areas. The conformity requirements for the New York City metropolitan area have been temporarily waived until September 30, 2005, pursuant to Public Law 107-230 enacted October 1, 2002. A project-level analysis of air quality was conducted for the Second Avenue Subway.



Based on the use of the latest planning assumptions and regional transportation modeling tools, the project-level analysis conducted for the Second Avenue Subway concluded that the completed Second Avenue Subway would result in a reduction in the number of vehicle miles traveled in the region. Further, the results of the localized CO and PM<sub>10</sub> concentration analyses at specific intersections during the subway's construction phase demonstrate that no new exceedances of the NAAQS standards would occur, nor would any existing exceedances worsen. Based on these results, the Second Avenue Subway would conform to the local and regional air quality requirements defined in the SIP, within the framework of the CAAA. Therefore, the Second Avenue Subway would be consistent with the SIP for CO and ozone.

## F. SUMMARY OF SIGNIFICANT ADVERSE IMPACTS AND MITIGATION MEASURES

- The Second Avenue Subway Project's commitments during construction will be set forth in a Construction Environmental Protection Program (CEPP). The CEPP will be the document in which all project commitments and requirements related to construction will be incorporated. NYCT will incorporate relevant portions of the CEPP in all construction contracts, and contractors will be obligated to follow these provisions.
- The CEPP and construction contracts will require that all contractors follow NYCT's directive for capital construction projects to minimize PM emissions from use of diesel-powered construction equipment. Diesel emission controls for non-road equipment will be required. These controls require that all heavy equipment use only ultra-low sulfur diesel fuel in combination with diesel particulate reduction and retrofit technology in all heavy non-road equipment. All diesel equipment would not be permitted to idle for more than 3 consecutive minutes, except in certain limited circumstances.
- Throughout construction, NYCT would mandate dust control measures. The CEPP will include a dust suppression program with aggressive measures to reduce dust and air pollution during construction. A dust suppression program would be developed and monitored by NYCT. This program would include use of dust covers for trucks, spray misting of exposed areas, and using safe chemical dust suppressants to treat and control spoils. In addition, construction sites would be fenced to reduce wind-borne dust.
- The CEPP requirements to reduce emissions of particulate matter from construction activities have been incorporated into the project and taken into account in this analysis. MTA is researching the diesel emissions reduction technologies available, with the objective of stipulating that contractors use the best available emissions reduction technologies, with the first priority being reducing PM emissions, and a secondary objective of reducing other pollutants. With these commitments to controlling the emission of PM from construction activities, PM emissions would be reduced to the extent currently practicable.
- Particulates could be further reduced at construction sites by enclosing areas where spoils from tunnel boring or mining operations would occur, or at station locations where spoils removal would take place for some period of time. These measures are being explored for reduction of air pollutants and mitigation of noise impacts (see Chapter 12).

Once the Second Avenue Subway is operational, the project would result in air quality benefits; thus, no mitigation is required. \*