SOUTH BRONX ENVIRONMENTAL STUDIES

Public Health and Environmental Policy Analysis

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NOTE: Chapter 2 on waste transfer was prepared by Carlos Restrepo, Doctoral Candidate at the NYU Robert F. Wagner Graduate School of Public Service and Graduate Research Assistant at the NYU-Wagner Institute for Civil Infrastructure Systems (ICIS), who is the Program Manager for the project, and Cary Hirschstein, Graduate Research Assistant (MUP candidate 2004). Chapter 3 was prepared by and under the direction of Jose Holguin-Veras of Rensselaer Polytechnic Institute, formerly at The City College of New York (CCNY). Chapter 4, Air Quality, Chapter 5, the asthma and air pollution literature review, and Appendix C were prepared by Carlos Restrepo. Water quality information and the Chapter 6 write-up were prepared by Cary Hirschstein. Demographic information for Chapter 1 was compiled by Jennifer Lara, Graduate Research Assistant at ICIS (through May 2002; MUP 2002) and initial transportation and traffic information was compiled by David Klebenov, Graduate Research Assistant at ICIS (through 2001; MPA 2001).

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EXECUTIVE SUMMARY

Objectives and Background

The quality of the environment in communities with large minority populations has been a growing concern particularly with respect to public health given the potential for greater exposure among minorities and the lower availability of health services to address such exposures. A public health and environmental policy analysis is being conducted by the Institute for Civil Infrastructure Systems (ICIS) at New York University's Wagner Graduate School of Public Service (NYU-Wagner) to address some of these issues in the South Bronx. The Wagner School study is part of a larger project funded by the U.S. EPA about environmental issues in the South Bronx, NY that aims to provide relationships among air quality, transportation, waste transfer activity, and demographic characteristics in the South Bronx.

The overall South Bronx Environmental Studies project is a consortium of citizen groups from the South Bronx, New York University's Office of the President, the Nelson Institute of Environmental Medicine (NIEM), and the Robert F. Wagner Graduate School of Public Service Institute for Civil Infrastructure Systems (ICIS) with the support of Congressman José E. Serrano. Professor Rae Zimmerman of NYU-Wagner/ICIS and Lung Chi Chen of the NIEM are co-Principal Investigators of the research. Wagner team members are listed in Appendix A.

The <u>first phase</u> of the environmental policy project, which is the subject of this draft report, provides a foundation for environmental policy studies by means of:

- the identification and acquisition of environmental, demographic and transportation databases and relevant literature to assess relationships among transportation patterns, solid waste transport, air quality, and characteristics of the population
- the identification of problems associated with the suitability of those databases for addressing key questions about the relationship between environmental conditions and waste transfer in the South Bronx, and
- the building of a community knowledge base about environmental conditions in the study area to support a community training program

Participation by community groups in identifying problems and ways of addressing them are an integral and ongoing part of the overall project.

The <u>second phase</u> is a more in-depth analysis that expands the air quality and transportation analyses, and includes:

- a model-based characterization of selected transportation and associated air quality patterns and trends within the study area, focusing on traffic-related particulate matter and
- a framework for the evaluation of alternative policies toward the future role of waste transfer stations in the South Bronx in light of transportation and air quality patterns and trends, for example, by evaluating alternative scenarios for the future of these facilities.

Summary of Findings

Population Characteristics and Trends

- The South Bronx area is comprised of five community districts in the southwestern portion of the borough (also the county) of the Bronx in New York City.
- Its total population in 2000 stood at 522,412, which represents about 40% of the population of the Bronx.
- 39% of this population is Black and 60% is Hispanic. This represents a higher percentage of Blacks and Hispanics than resides in Bronx County, the City, and New York State.
- The percentages of the population that are Black and Hispanic are above Federal guidelines that define minority populations for the purposes of identifying environmental justice issues associated with federal actions.
- Additionally, the percentage of the population that lived below the poverty level in 1989 was 39%. This is over 10% higher than the portion of the population that have incomes below the 1989 poverty level in Bronx County, almost 20% higher than those in New York City and about three times than those in New York State and the United States.
- The South Bronx growth rate between 1990 and 2000 of 11.8% is slightly higher than that of Bronx county (10.7%) and the City (9.4%), and double that of New York State (5.5%).
- Population sectors within the South Bronx have changed in size over the past decade in different ways between 1990 and 2000: the Black population has declined (by 3.5%) while the Hispanic population has increased dramatically (by 18.8%).

Waste Transfer Stations in the South Bronx

According to the NYC Solid Waste Management Plan, New Yorkers discard over 13,000 tons of residential trash every day. In addition, it is estimated that the city generates over 20,000 tons per day of commercial waste. In order to discard this waste New York City has about 85 private waste transfer stations. These transfer stations are generally located in neighborhoods that are zoned for manufacturing uses. Because several areas in the South Bronx are designated for such uses, it has a disproportionate share of these facilities. Approximately three dozen waste transfer stations, or about 41-45% of the city's total number of these stations, are estimated to be located there. Meanwhile, the South Bronx has about 6.5% of the City's population.

As a result of waste transfer and other commercial activities, it is estimated that more than 3,000 trucks drive through the Hunts Point peninsula of the South Bronx every day. Due to such high levels of diesel truck traffic, residents have been complaining for years about air and noise pollution. Many residents believe the diesel fumes associated with traffic generated by these activities are associated with the asthma rates observed in the South Bronx. These rates are among the highest in the United States and have been steadily increasing since 1980.

Identifying and characterizing waste transfer stations and similar kinds of facilities in the South Bronx is difficult. Chapter 2, Waste Transfer Stations in the South Bronx, describes waste transfer stations believed to operating in the South Bronx at the time this report was written.

Transportation and Traffic

A key project objective is to evaluate the sufficiency of existing data to characterize traffic in the South Bronx as a basis for understanding the impact of waste transfer operations in the South Bronx.

Traffic demand connected with waste transfer is a function of the existing location of transfer stations and the routes taken for the transport of municipal solid waste to and from those facilities. The South Bronx currently has about a dozen and a half waste transfer stations that the City has identified for municipal solid waste that have existed for many years, and locations of these are known. The NYC Solid Waste Management Plan of October 2000 identifies a new proposed site within the South Bronx that is a refurbished pre-existing site and anticipates relying primarily on barge traffic rather than truck traffic for waste transport.

Existing traffic patterns of trucks as they travel to and from the existing stations are not clearly known, since transportation data is not available to determine that. Thus, the transportation data are not sufficiently detailed to model traffic conditions in order to ascertain associations between truck traffic and waste transfer operations. Gaps in coverage occur spatially in that data which are primarily available for streets around the perimeter of the South Bronx. Gaps also occur temporally in that the data, since the data are not collected continuously. Moreover, traffic data collection does not necessarily coincide with the location of air quality monitoring points or where waste transfer-related truck traffic occurs.

Air Quality

Existing Air Quality Data

The major government-maintained air quality database is the Aerometric Information Retrieval System (AIRS). The U.S. EPA administers the database and the NYS Department of Environmental Conservation operates the network of air monitoring stations. The major air pollutants that are measured are currently targeted to the National Ambient Air Quality Standards (NAAQS) under the Clean Air Act.

A preliminary review of existing air quality information from the AIRS database from 1996 through 2000 shows that when pollutant concentrations are compared with the EPA standards, carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter (PM_{10}), and sulfur dioxide (SO_2) are consistently below the established standards. Ozone (O_3) concentrations sometimes exceed the 1-hr standard during the summer months. Fine particulate matter ($PM_{2.5}$) exceeds the annual standard at some stations but not the 24-hr standard. Given these results it seems as though ozone (O_3) and fine particulate matter ($PM_{2.5}$) are the pollutants of most concern in Bronx county.

New Air Quality Sampling (Nelson Institute Of Environmental Medicine (NYU-NIEM)

The New York University School of Medicine's Nelson Institute of Environmental Medicine (NIEM) has conducted supplemental air quality monitoring with a mobile air quality monitoring laboratory equipped with a number of specialized pieces of equipment. An analysis of this data is contained in the NIEM Phase I report. Appendix E contains graphs for preliminary NIEM data (which has now been updated and is contained in the NIEM report).

Asthma and Air Pollution

Chapter 5 consists of a literature review of the association between asthma and air pollution. This literature review is framed within a broader discussion of asthma. According to the literature, asthma is a very complex, multi-factorial disease that affects millions of people in the United States. Over the last three decades, the number of people afflicted with asthma has increased dramatically. This increase is particularly high for children. The causes of such an increase are poorly understood. Although genetic predisposition seems to be an important risk factor for the development of asthma, most scientists believe that the rates of increase observed over the last few decades are too rapid to be explained by genetic factors alone. Modern hygiene practices that prevent the immune system to mature properly in the early years of a person's life, as well as a sedentary lifestyle, have also been cited as potential causes for the rise in asthma prevalence. Other environmental factors such as environmental tobacco smoke, low birth-weight, nutrition, and exposure to dust mites, cockroaches and other allergens are also considered risk factors.

The relationship between asthma and air pollution is also complex and poorly understood. It is unlikely that air pollution alone is to blame for rising prevalence rates. In general, asthma rates are rising in developed countries in spite of the fact that substantial improvements in their air quality has occurred over the last few decades. A study from Germany compared asthma rates in Leipzig and Munich and found that although air quality is much better in the latter, asthma rates there are much higher. Similarly, a study of asthma mortality in Philadelphia found that while asthma death rates were on the rise, air quality, as measured by ambient concentrations of criteria pollutants, was improving.

However, there is strong evidence in the literature on the association between asthma and air pollution that asthma, as measured by symptoms, hospitalization rates or hospital emergency department visits, is exacerbated when ambient concentrations of air pollutants increase. It is often said in the literature that air pollutants may trigger exacerbations of asthmatic and allergic symptoms in people with asthma. In addition, there may be synergistic effects between air pollution and aeroallergens. The pollutants that are most commonly cited as being responsible for the exacerbation of asthma are $PM_{2.5}$, PM_{10}, SO_2, O_3 and NO_2. More recently, attention has been focused on diesel exhaust particles, which are a major source of $PM_{2.5}$. This is of particular relevance to the South Bronx, as trucks and buses are a major source of this form of pollution.

Water Quality

This section reviews the history, water quality and restoration efforts in the South Bronx's waters, including the Bronx River, Harlem River, Westchester Creek and the Upper East River/ Western Long Island Sound. An examination of the environmental quality of these waters found similar problems across each. Pollutants such as PCBs (polychlorinated biphenyls), pathogens and floatables have all been of primary environmental concern in these waters in recent years. Pathogen contamination remains a problem for the Bronx River, while fish advisories warn of PCB contamination in the Harlem River and Upper East River.

Attention has specifically been given to hypoxic conditions due to low levels of dissolved oxygen in the Western Long Island Sound, attributed to an excessive discharge of nitrogen by area wastewater treatment plants. New York City launched a Nitrogen Control Program in the 1990s to curb the nitrogen discharge and its effects. However, problems still persist today, and New York City was recently ordered to upgrade all four of its Upper East River/ Western Long Island Sound wastewater treatment facilities.

Combined sewer overflow has been an area of concern in the Bronx watershed, as floatables in the Harlem River and sludge/sediment problems in Westchester Creek have arisen, in part from combined sewer overflow. New York City's Combined Sewer Overflow Abatement Program has begun to address adverse water quality impacts of inadequate combined sewer overflow facilities.

The report draws from several data sources that present findings of water quality monitoring and assessment. The New York State Department of Environmental Conservations' *Section 303(d) List of Impaired Waters Requiring a Total Maximum Daily Load* serves to report state water quality monitoring and assessment efforts, prioritizing substandard waters for analysis. The New York State Department of Health's *Health Advisories for Chemicals in Sportfish and Game* provides valuable insight for characterizing current water quality trends. A third resource is the NYC Department of Environmental Protection's annual *Harbor Water Quality Report*, which assesses the performance of the City's pollution prevention programs.

CHAPTER 1. INTRODUCTION

1.1 Study Design and Approach

Phase I of the South Bronx public health and environmental policy analysis is being conducted by the Institute for Civil Infrastructure Systems (ICIS) at NYU's Wagner Graduate School of Public Service. It is part of a larger study funded by the U.S. EPA about environmental issues in the South Bronx, NY that aims to provide relationships among air quality, transportation, waste transfer activity, and demographic characteristics in the South Bronx.

The specific objectives and approach in Phase I consist of:

- Identification, collection, and characterization of existing transportation and air quality data
- Provision of geocoded transportation data, incorporating it into a GIS system and mapping it as a basis for route selection for the NIEM mobile laboratory
- Preparation of project Maps: study area base map, maps of the area's basic demographic characteristics for the community groups – for race, ethnicity, and poverty – at the Census tract level, and preliminary traffic maps
- Identification of gaps in transportation and air quality data and its suitability for the second phase of the project, e.g., in terms of temporal, spatial, and parameter coverage (to be obtained from the first phase of the study)
- Participation in project meetings with project team members, including NIEM and the community groups to frame the problems, coordinate the work, and exchange data
- Preparation of a literature review, focused on air pollution and asthma, incorporating the U.S.EPA Air Quality Criteria Document for Particulate Matter, and other related information sources for use by the community

Phase I outputs provide the inputs to a Phase II analysis that will include:

- Refinements of the Determination of Data Suitability for Proposed Models
- Descriptions and Characterization of Waste Transfer Operations in the South Bronx to provide a basis for the transportation and air quality analyses
- Transportation Analysis
- Air Quality Analysis, incorporating outputs of the transportation analysis and applicable NIEM Data
- Development and Analysis of Policy Scenarios

1.2 Population Characteristics and Trends[1]

A necessary data component of an environmental justice study is demographics information. For the South Bronx study, demographic data collection focused on the US Census Bureau's decennial censuses. The Census provides socio-economic and demographic information for the entire United States. Data can be viewed for different geographic areas and for different

[1] This section was prepared by Jennifer Lara, former Graduate Research Assistant at NYU-Wagner School's ICIS.

variables (including a variety of combinations of variables). The geographic areas for which Census data are tabulated includes very large units such as the Nation, states, metropolitan regions and cities. Smaller units are counties, zip codes, Tracts, Block Groups, and Blocks. The block is the smallest unit of analysis. Census data is appropriate for the South Bronx project for the following reasons:

- data age - the data was collected in April 2000, making it among the newest data available
- data variety - the data set includes a large number of variables related to population and household characteristics
- data comparability over time - demographic changes over time can be studied by comparing data from different census years
- geographic variability - data is available from the national to the block level, allowing for comparison of the distribution of different populations

1.2.1 Geographic scope

During initial meetings, NYU and the four community groups agreed upon the geographic scope of the study. The study area encompasses Community Board Districts (CD) 1, 2, 3, 4 and 9. The study area is shown in a map at the end of this chapter. Community Board Districts are meaningful geographic boundaries in New York City, but do not correspond exactly with other geographic definitions. For the purposes of this study, we chose to correspond CDs with census geographic boundaries by including in the demographic analysis any census tracts that fell within a given CD. Using this definition, the study area includes a total of 141 census tracts, which are comprised of 1813 census blocks.

1.2.2 Availability of data

Demographic data for the South Bronx have been identified from the Census at both the block and tract levels for 1990 and 2000. Although collection of the data has focused on the tract level, block level data is accessible through the census website (American FactFinder located on the internet at http://factfinder.census.gov/servlet/BasicFactsServlet). Block level basic information, including total population, race and ethnicity and number of housing units has been collected from the New York City Department of City Planning website.

Currently, the data from the 1990 Census is the most recent for which complete results are available. Although all 2000 Census data have been collected, the more detailed data was not scheduled to be published for a couple of years following its date of collection. This more detailed data includes income, and contract rent paid. The short form data (from the questionnaire sent to 100% of US households) of the 2000 Census has been released and is available from the Census website. This data includes information about the following items:

- Population count
- Age
- Race
- Hispanic origin
- Household relationship

- Sex
- Tenure (whether a household rents or owns its home)
- Vacancy characteristics

1.2.3 Findings

When Year 2000 Census data became available, ICIS used this new data to compare shifts in basic demographics in the study area between 1990 and 2000. The tract data for basic variables were used to create maps and graphs of population distribution and rates of change in the Black and Hispanic population between 1990 and 2000. In addition, population below poverty in 1989 (the most recent available data) was mapped and compared with the percentage of the population below the poverty level from the borough to the national level.

- The South Bronx area is comprised of five community districts in the southwestern portion of the borough of the Bronx in New York City.
- Its total population in 2000 stood at 522,412, which represents about 40% of the population of the Bronx.
- 39% of this population is Black and 60% is Hispanic. This represents a higher percentage of Blacks and Hispanics than resides in Bronx County, the City, and New York State.
- The percentages of the population that are Black and Hispanic are above Federal guidelines that define minority populations for the purposes of identifying environmental justice issues associated with federal actions.
- Additionally, the percentage of the population that lived below the poverty level in 1989 was 39%. This is over 10% higher than the portion of the population that have incomes below the 1989 poverty level in Bronx County, almost 20% higher than those in New York City and about three times than those in New York State and the United States.
- The South Bronx growth rate between 1990 and 2000 of 11.8% is slightly higher than that of the county (10.7%) and the City (9.4%), and double that of New York State (5.5%).
- Population sectors within the South Bronx have changed in size over the past decade in different ways between 1990 and 2000: the Black population has declined (by 3.5%) while the Hispanic population has increased dramatically (by 18.8%).

This data show that minorities and the poor are more concentrated in the South Bronx than in the county, the City, or the state.

1.3 Transportation and Waste Transfer

The description of traffic and transportation data during Phase I has been completed and described extensively in Chapter 3. A more detailed assessment of needs for traffic modeling for Phase II is underway. A traffic analysis is being designed in Phase II for the following scenarios:

- existing conditions
- a “no-action” future which takes into account current near-term changes, and
- at least one future scenario (more if resources permit) that reflect alternative policies with respect to waste transfer operations (e.g., closures, changes in volume handled, routes taken by vehicles, etc.)

The outputs of the transportation analysis provides (1) traffic estimates for the air quality analysis which are based on available traffic data and (2) traffic simulation to describe the flow in the network in terms of individual vehicles, refined estimates of travel times, and delays.

The steps for the traffic analyses encompass:

- Definition of study area boundary and network definition in conjunction with the community
- Assessment of modeling needs
- Review of existing data, refining the assessments in Phase I, as to their sufficiency for proposed modeling (advanced modeling are expected to reduce data collection requirements) as well as to produce traffic estimates for air quality analysis
- Transportation demand modeling for both passenger traffic and commercial. Demand modeling will use inputs such as the transport network and zoning system, passenger population, trip generation patterns for passengers, income from the Census (which affects trip generation). Freight inputs will be in the form of the location of businesses and freight generators and their size to derive demand patterns in terms of origins and destinations, traffic (volume of vehicles), travel times (very aggregated), and average speeds per vehicle category by link and other outputs for freight transportation.
- Traffic simulation using forecasts from the demand model will produce a second set of forecasts for travel characteristics (more refined travel times and speeds) for the study area.

1.4 Air Quality

Phase I findings are described in Chapter 4. The major government-maintained air quality database is the Aerometric Information Retrieval System (AIRS). The U.S. EPA administers the database and the NYS Department of Environmental Conservation operates the network of air monitoring stations. The major air pollutants that are measured are currently targeted to the National Ambient Air Quality Standards (NAAQS) under the Clean Air Act.

A preliminary review of existing air quality information from the AIRS database from 1996 through 2000 shows that when pollutant concentrations are compared with the EPA standards, carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter (PM_{10}), and sulfur dioxide (SO_2) are consistently below the established standards. Ozone (O_3) concentrations sometimes exceed the 1-hr standard during the summer months. Fine particulate matter ($PM_{2.5}$) exceeds the annual standard at some stations but not the 24-hr standard. Given these results, ozone (O_3) and fine particulate matter ($PM_{2.5}$) appear to be the pollutants of most concern in Bronx county.

During Phase II, the outputs from the transportation analyses will provide inputs to air quality modeling for specific waste transfer scenarios.

The focus of the air quality analysis in the Phase II study, being conducted by Egan Environmental, Inc. of Boston, MA, will be on estimates of particulate matter from vehicular sources. The air quality analysis will be consistent with the alternatives used in the transportation modeling – e.g., existing conditions, a no action alternative, and one or more scenarios related to waste transport. The analysis will be performed in two stages – emission estimation and ambient air quality estimation.

Outputs from the transportation modeling conducted by Dr. Holguin-Veras will be used as inputs to the air emissions modeling. Emission estimates will provide inputs to air quality dispersion modeling to project ambient air quality as a result of the existing patterns of and changes in traffic flow. These ambient air quality estimates will then be related to (1) National Ambient Air Quality Standards (NAAQS), (2) NIEM measurements from the mobile laboratory, (3) and possibly other reference points.

1.4.1 Emission Estimation

The first step in estimating air quality impacts from transportation is to estimate emissions from traffic existing and forecasted for the area (as described above).

Particulate emission estimates will be obtained for transportation sources using calculation methods from the U.S. EPA Part 5 Highway Vehicle Particulate Emission Modeling (available at www.epa.gov/orcdizux/part5.htm). Using inputs from the transportation models in the form of vehicle size/weight and type and fuel type, the modeling calculates particle emission factors in the form of grams/mile for particles of up to 10 microns in size. The transportation models also provide the dimensions of transportation routes, established as roadway links. Each of the links will have geographical starting and ending points and assigned volume flow rates of the different categories of vehicle mix. Emissions from the waste transfer operations at the stations will be used as inputs to the model as point or area type sources.

1.4.2 Ambient Air Quality

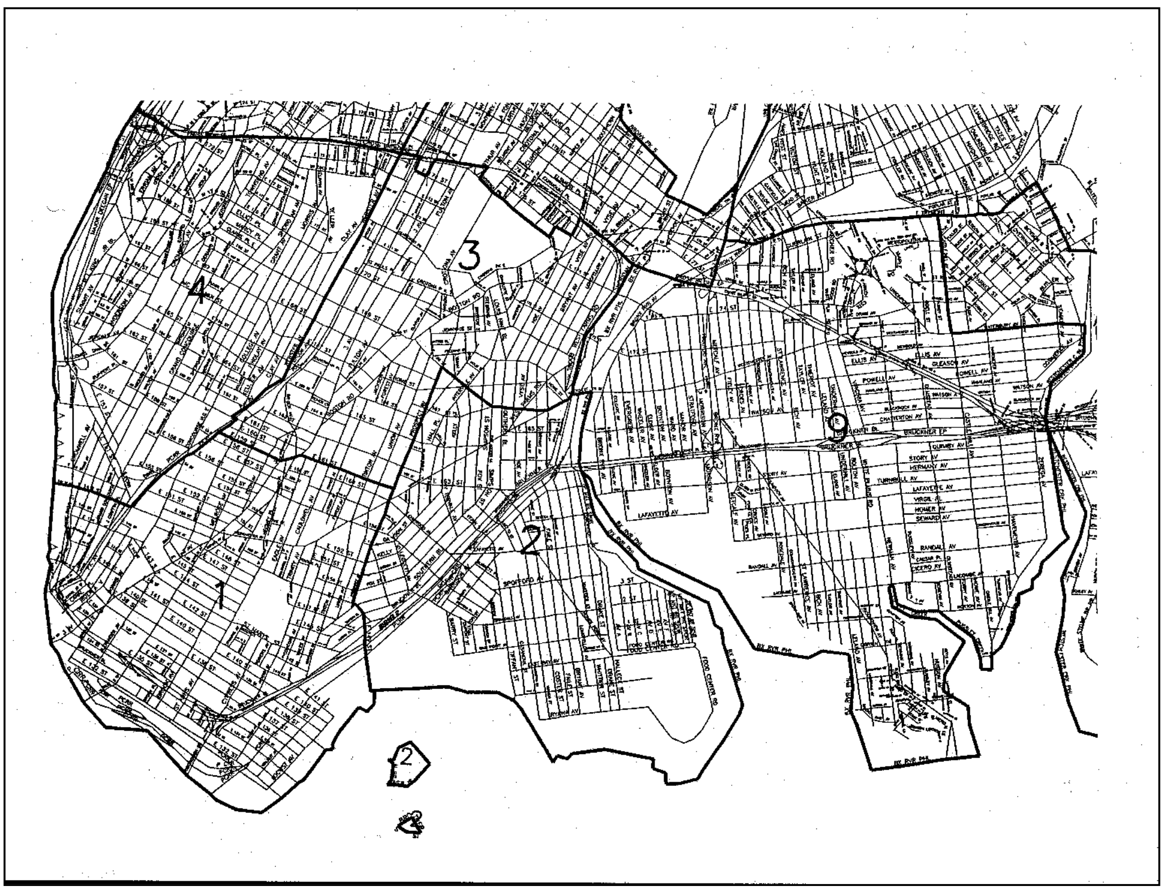
The second step is to estimate the concentration of transportation-based particulate matter in the ambient air using the CAL3QHR dispersion model for transportation-source related studies. This combination of models allows ambient air concentrations to be predicted both close to and far from the source locations.

The emissions estimates will be in a compatible format to be readily input to CAL3QHR. The modeling effort will involve using the supplied emissions projections in conjunction with appropriate meteorological data for the study area. The NYSDEC, the Port Authority of NY and NJ, and other agencies that routinely collect this data will be contacted with respect to the most appropriate selection of a source of meteorological data.

Three emission scenarios are assumed to be provided for the estimation of particulate matter. The first would be an estimate of present emissions. This would be used to relate model predictions with results from the measurement program using NIEM mobile lab measurements and NYS DEC measurements, taking into account the limitations posed by the differences in conditions under which the different data sets have been generated. This would be limited to selected time periods of the measurements when wind directions are such that reasonable comparisons can be made. The second and third emission scenarios would be for the two cases described under the transportation section or others that the group decides on. Model outputs for all three scenarios would be compared to standards and other reference points. Other comparative frameworks would be considered, such as relative differences in air quality among the scenarios.

1.4.3 Development and Analysis of Policy Scenarios

One or more scenarios will be defined by the project team in collaboration with the community for selected future changes in waste handling, for example in waste transfer operations, that can impact traffic and air quality. An example of one type of scenario pertains to changes in existing waste transfer operations, such as changes in operation, location, truck routes, etc. of the facilities. For such a scenario, implications for transportation will be evaluated by means of the modeling described earlier. Changes in the location of waste transfer stations, for example, can be accommodated in the model by changing the parameters that represent the size and market share of the waste transfer stations. Similarly, another type of scenario – the widening of a street (required, for example, if truck traffic increased as a result of increased waste transfer operations) - is represented as an increase in the street's capacity (which is an input) and so forth.



Bronx County Community Districts 1, 2, 3, 4 and 9.
Source: City of New York, Department of City Planning. Bronx County Community District Base Map.

CHAPTER 2. WASTE TRANSFER STATIONS IN THE SOUTH BRONX[2]

One of the main environmental and safety concerns of community residents in the South Bronx is the amount of traffic in the area. Some of the biggest sources of traffic are numerous waste facilities that use diesel trucks to move waste into and out of the area, as well as the resources needed to process these wastes. As discussed in Chapter 5 of this report, emissions from diesel fuel have been shown to contribute to adverse health effects such as asthma.[3] Examples of waste processing facilities are private solid waste transfer stations, city-owned marine transfer stations, waste water treatment plants, combined sewer overflow outfalls, sludge treatment facilities, recycled materials handling facilities, junkyards, auto salvage yards, scrap metal and construction debris processing facilities, yard waste and composting sites, and medical waste disposal plants.[4]

2.1 Solid Waste, Waste Transfer Stations, and Traffic in the South Bronx

It is estimated that New Yorkers discard over 13,000 tons of residential trash every day. In addition, it is estimated that the city generates over 20,000 tons per day of commercial waste. In order to discard this waste New York City has an estimated 85 private waste transfer stations.[5] These transfer stations are generally located in neighborhoods that are zoned for manufacturing uses. Because several areas in the South Bronx are designated for such uses, it has a disproportionate share of these facilities. It is estimated that about 34-38 waste transfer stations, or about 41-45% of the city's total number of these stations, are located there. Meanwhile, the South Bronx has about 6.5% of the City’s population.

Waste transfer stations are facilities where solid waste is unloaded from trash collection trucks. The waste is then compacted and screened for materials in the waste stream that can be recycled. In addition, inappropriate wastes not allowed at disposal facilities are separated out. The resulting waste is then reloaded into larger vehicles for transport to a final disposal site. Although transfer stations reduce overall traffic by consolidating loads from trash collecting trucks to larger vehicles, they increase traffic in the area surrounding them. Air emissions at these stations come from unloading dry, dusty waste delivered to the station, and exhaust from trucks, loaders and other equipment.[6]

In addition to waste transfer stations there are a number of other waste-generating or waste handling activities in the area that are of concern to community residents. These include factories, incinerators, and sewage plants, as well as the diesel trucks used to move goods and

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[2] This chapter was prepared by Carlos Restrepo, Doctoral candidate at NYU’s Wagner School and Graduate Research Assistant at ICIS, with assistance from Cary Hirschstein Graduate Research Assistant at ICIS.
[3] See Pandya, Robert J., Gina Solomon, Amy Kinner and John R. Balmes. "Diesel Exhaust and Asthma: Hypotheses and Molecular Mechanisms of Action." *Environmental Health Perspectives*. Vol. 110. Supplement 1. February 2002. Pages, 103-112.
[4] Maantay, Juliana. 2002. "Race and Waste: Options for Equity Planning in New York City." *Planners Network No. 145*.
[5] Bradley, James. October 1996. "Garbage Wars." *City Limits New York's Urban Affairs News Magazine*. http://www.citylimits.org
[6] United States Environmental Protection Agency, 2001. Waste Transfer Stations: Involved Citizens Make a Difference. EPA530-K-01-003.

waste products in and out of the area. For example, the Hunts Point area is bordered on the north by the Bruckner Expressway. In the southern part of the community there is a sewage-pelletization plant. In the eastern part there is the Hunts Point Cooperative Market, the world's largest wholesale food distribution center. In addition, there are over two dozen waste transfer stations around the waterfront. As Kathleen McGowan wrote in City Limits, "the peninsula is a crossroads for nearly all the city's produce, more than half of the city's putrescible garbage, nearly all the city's sewage sludge and as many as two million truck trips a year. Even in smelly New York City, there's nowhere that compares."[7]

As a result of all these activities, it is estimated that more than 3,000 trucks drive through the Hunts Point peninsula every day, and residents have been complaining for years about air and noise pollution.[8] Many residents believe the diesel fumes associated with traffic generated by these activities are associated with the asthma rates observed in the South Bronx. These rates are among the highest in the United States and have been steadily increasing since 1980.

Community residents in the South Bronx have also complained about bad odors in their neighborhoods as a result of some of these activities. A recent source of friction between community residents and EPA was the latter's decision to grant a new air permit to the New York Organic Fertilizer Co., which processes about 40% of the city's sewer sludge. In 1995-96, this company was cited nine times for city air quality-code violations. In 1998, the New York Organic Fertilizer Co. invested $2 million to upgrade its facility in Hunts Point. Despite these improvements, community residents feel that emissions from the plant result in terrible odors in the area and contribute to the area's high asthma rates.[9]

2.2 Diesel Emission Reduction Initiatives

Currently, there are some efforts to curb air pollution from diesel truck traffic in these neighborhoods. For example, Beer Distributors will replace 15 of its 200 diesel trucks with trucks that run on compressed natural gas. This will be accomplished with partial funding from local, state and federal officials at a cost of $63,000 per vehicle.[10]

Similarly, the first Clean Air Communities (CAC) project was awarded to Sustainable South Bronx, the New York Power Authority and IdleAire Technologies Corporation. The main purpose of this project will be to install and utilize innovative truck stop electrification technology at the Hunts Point Cooperative Market. The CAC is a partnership between the Natural Resources Defense Council (NRDC), the New York State Department of Environmental Conservation (NYDEC), Consolidated Edison and Northeast States Clean Air Foundation (NESCAF)/ Northeast States for Coordinated Air Use Management (NESCAUM), with guidance from New York City community-based organizations and prominent environmental, health and academic entities. This will be the first operational anti-idling advanced electrification project in

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[7] McGowan, Kathleen. May, 1999. "Breathing Lessons*." City Limits New York's Urban Affairs News Magazine*.

[8] Flanagan, Jane. April 30, 2001. "Community Board OKs plan for trucks in Hunts Point." The Bronx Beat Online. http://www.jrn.columbia.edu/studentwork/bronxbeat/043001/trucks0430_01.shtml - Access date: August 23, 2002.

[9] Richman, Mike and Bill Egbert. "Fuming over factory odors". *Daily News*. July 26, 2002.

[10] Martinez, Jose. "Beer biz toasts use of cleaner fuel." *Daily News*. February 5, 2002.

the country. The project partners will design, construct and operate a system capable of accommodating 32 trucks on a 24-hour per day basis. When fully operational, the project is expected to eliminate over 2,000 tons of pollutants each year, including over 15 tons of NO_x, 2,000 tons of carbon dioxide (CO_2) and nearly a ton of toxic particulate matter annually.[11]

2.3 Existing Waste Transfer Facilities in the South Bronx

Identifying and characterizing waste transfer stations and similar kinds of facilities in the South Bronx is difficult. Some sources indicate that the permitted facilities represent only an estimated one third of the total number of waste-related facilities in the Bronx. [12] The following is a list of the waste transfer stations believed to be operating in the South Bronx at the time of writing of this report. This information may need to be validated if it is to be used in future phases of the project. It is compiled from the various secondary sources listed below the table.

Name	Address	Zip Code	Community Board	Classification
Con Agg Recycling	980 East 149 th St.	10455	1	FMTS
Bronx County Recycling	475 Exterior St.	10451	1	FMTS
Harlem River Yard	98 Lincoln Ave.	10454	1	PSWTS
IESI of New York	329 Canal Pl.	10451	1	PSWTS
Republic Services of NY Hauling LLC	920 East 132nd St.	10454	1	PSWTS
Waste Management	891 East 135th St.	10454	1	PSWTS
Waste Management	900 East 138th St.	10454	1	PSWTS
AJ Recycling, Inc.	320 Faile St.	10474	2	C&D
Bronx City Recycling	1390 Viele Ave.	10474	2	FMTS
Hunts Point Recycling	315 Casanova St.	10474	2	PSWTS
IESI New York Corporation	325 Casanova St.	10474	2	PSWTS
J. Danna & Sons, Inc.	318 Bryant Ave.	10474	2	C&D
Kids Waterfront Corporation	1264 Viele Ave.	10474	2	C&D
Metropolitan Transfer Station	288 Hunts Point Ave.	10451	2	PSWTS
Waste Management - Gunhill Transfer	636 Truxton St.	10474	2	C&D
Paper Fibers Corporation	960 Bronx River Ave.	10473	9	PSWTS
Con Edison	?			
Crystal Waste Paper	227 Rider Ave.	10451		
American Marine Rail	500 Oak Point Ave.	10474	2	PSWTS
Continental Recycling/ Waste Management	315 Baretto St.	10474	2	C&D
East Bay Recycling	400 Casanova St.	10474	2	PSWTS
G&M Transfer, Inc.	216 Manida St.	10474	2	C&D
Gunhill Trucking	620 Truxton St.	10474	2	C&D
Integrated Recycling	334 Tiffany St.	10474	2	PSWTS, C&D
S&K Acquisitions	Whitter & Randall St.	10474	2	REC
Waste Management	Oak Point & Barry Ave.	10474	2	PSWTS

[11] See: "EPA Administrator Christie Whitman Joins In Announcing First Clean Air Communities Project *Nation's First Advanced Electrification Project to Reduce Idling Truck Emissions"* at: http://www.nescaum.org/pdf/press/080601-CACproj.pdf - access date: August 30, 2002.
[12] Maantay, Juliana. 2002. "Race and Waste: Options for Equity Planning in New York City." *Planners Network No. 145*. http://www.lehman.cuny.edu/geography/stu_fac_program.htm (access date: August 29, 2002).

Waste Management/ USA Waste Services of NY	510 Faile St.	10474	2	PSWTS
City Waste Services of New York	529 Coster St.	10474		
East End Sanitation Corporation	835 Tilden St.	10474		
Greater Eastern Transfer LLC	1381 Oakpoint Ave.	10474		
Mid Bronx Haulage Corp./ Victory Sanitation Lim.	408 Coster St.	10474		
National Waste Services				
O'Brien Sanitation Corporation	155 Bruckner Blvd.	10454		
Orlando Brothers Sanitation	920 East 132nd St.	10454		
Sanitation Salvage Corporation	421 Manida St.	10474		
Trans County Sanitation, Inc.	240 Brinsmade Ave.	10465		
Vinko Industries, Inc.	430 Baretto St.	10474		

Classification of waste transfer stations:

PSWTS=Putrescible Solid Waste Station
FMTS=Fill Material Waste Stations
C&D=Construction and Demolition Stations
REC=Recycling and Recovery Stations

Sources of information:

- The New York State Department of Sanitation
- BAGS (Big Apple Garbage Sentinel), John McCrory: Waste Transfer Stations in the South Bronx. http://www.johnmccrory.com/bags/background/bg_05.html
- SBCAC (South Bronx Clean Air Coalition): Waste Transfer Stations, Station Locations. http://www.crp.cornell.edu/projects/southbronx/gis/wts.html
- AT&T White Pages. http://www.anywho.com

2.4 Future Plans for Waste Transfer Activities

The future of waste transfer activities in the South Bronx will be affected by the City's future solid waste management activities. A description of some of the planned activities is included in the Final Environmental Impact Statement (FEIS) for the NYC SWMP Draft Modification (October 2000).[13] This FEIS was prepared by the Department of Sanitation to go along with the City's Comprehensive SWMP. This plan describes new infrastructure required to meet the needs for waste transfer and transportation out of the city resulting from the closure of the Fresh Kills Landfill. This new infrastructure will be required to transfer and transport between 10,000 and 13,000 tons of non-recyclable, Department-managed, waste to out-of-City disposal facilities on

[13] The full document is found at: http://www.ci.nyc.ny.us/html/dos/html/swmp2k.html

any given day. The facilities in the Bronx considered for upgrading in the FEIS to accommodate these changes are:

- Republic Services, Inc., an existing permitted facility on 132nd Street in the Port Morris section of the South Bronx in Community Board 1.
- Harlem River Yard (HRY) truck to rail transfer station, an existing permitted transfer station in the Harlem River Yard Inter-modal Transportation and Distribution Center in Community Board 1. It is situated on approximately 96 acres of property owned by the New York State Department of Transportation.
- American Marine Rail, a 5.6 acre site on the East River at 500 Oak Point Avenue in the Hunt's Point section of the South Bronx. This is in Community Board 2.
- Bronx MTS. This station was closed in 1997 because it was replaced by transfers from Republic Services, Inc. It is located in the Hunts Point area of the South Bronx, in Community Board 2.

According to the report the proposed facility changes would not have a significant impact on traffic or air pollution in the area.

CHAPTER 3. TRANSPORTATION AND TRAFFIC: Identification and Assessment of Data Sources[14]

The transportation and traffic modeling activities in the South Bronx project are going to require data from a number of different sources. In general terms, data will be required about: (a) the morphology and characteristics of the transportation network (e.g., location of streets, width, number of lanes); (b) the demand characteristics and traffic patterns of both passenger and freight (e.g., number of passenger-trips, amount of freight transported, location of waste transfer stations and other major generators); and (c) the operational characteristics of the traffic control systems (e.g., signal settings, cycle time).

This report is intended to: (a) briefly describe the data sources that have been identified as useful for the purposes of this investigation; (b) assess qualitatively the adequacy of these datasets; and (c) identify any potential areas in which more data is needed. For the sake of brevity, these analyses focus on the main features of the different data sets. The different data sets (and data sources) are categorized according to the main groups described in the previous paragraph.

3.1 Morphology and Characteristics of the Transportation Network in the Study Area

3.1.1 Best Practice Model's transportation network

The New York Metropolitan Transportation Council (NYMTC), which is the regional Metropolitan Planning Organization (MPO) in the New York City area, has been developing the "Best Practice Model" (BPM). The BPM is a sophisticated modeling system that, although not yet fully developed, has the potential to be an invaluable tool for project analyses. As part of the development of the BPM, different data sets have been assembled.

One such data set is a Geographic Information System (GIS) that contains the key features of the different links comprising the transportation network in New York City. The BPM's GIS network contains information about: number of lanes, street direction, travel speeds, and the like. The BPM's network has been cleaned up by NYMTC's contractors and is periodically updated. For the most part, the BPM's network has a great deal of detail in the segments of the transportation network serving passenger transportation. It includes links representing streets, highways, arterials, subways and bus-only lanes. All relevant characteristics of the transportation network (e.g., travel speeds, link capacities, turning restrictions, number of lanes) are incorporated in the BPM passenger network.

One area that needs improvement is the BPM's freight transportation network (e.g., truck routes, location of terminals, rail links). NYMTC staff has long recognized that both the coverage and the quality of information about the freight transportation network are not nearly as good as the ones corresponding to the passenger transportation network. A new research project, to be

[14] This chapter was written by Jose Holguin-Veras, Ph.D., P.E., Associate Professor, Department of Civil and Environmental Engineering, Rensselaer Polytechnic Institute formerly at the City University of New York.

conducted by the City College of New York funded by NYMTC, is intended to fill the existing gaps in the BPM's freight network by creating an up to date GIS of the freight (mostly truck) transportation network in the New York City area.

3.1.2 National Transportation Atlas Database

The National Transportation Atlas Database (NTAD) is a compendium of GIS datasets put together by the U.S. Department of Transportation (USDOT). It contains basic information about all transportation modes, both passenger and freight related. The NTAD is going to be used as the starting point for the description of the freight network in the South Bronx.

The definition of the network starts with the definition of its boundaries. In this study, although the main focus is on the South Bronx area, it is necessary to keep in mind that the South Bronx is part of a regional freight network. In modeling goods movements the network is described differently than the traditional passenger demand models. This is due to the nature of multi-channel distribution of products, which involves some storage or distribution facility in addition to manufacturing and consumption. Thus, in defining the freight network, the different components have to be identified: nodes, origins/destinations, intermediate links, highway, freeway, arterial, local, rail, and commodity flows. However, in a multi-commodity environment, there is a need for more explicit identification of origin/destination nodes as follows: manufacturing facilities, primary resource and agriculture facilities, distribution centers (warehouses), retail facilities, residences, offices and service facilities, and transportation facilities (ports, truck terminals, airports, and intermodal yards).

These definitions are going to be undertaken using the NTAD GIS databases. For illustration purposes, Figures 1 to 4 have been included because they provide an idea about the complexity of the freight network in the area, and the data that could be obtained from the NTAD. Other potential sources of information include:

- **Highway Links:** This category involves freeways, arterials and local roads. This link data is again available in several models developed for the study area.
- **Railroad Links:** These links are links that are specifically obtained for railroads and available in a database generated as part of this study. In a recent study by NYC EDC some of the major railroads are studied and issues related to freight transported using these rail lines are discussed (Transportation and Commerce Unit of NYC Economic Development Corporation (NYCEDC), 1994). These major NYC freight rail lines are:
    - Conrail –Hudson Division, New Haven Division
    - New York Cross Harbor Railroad
    - Long Island Railroad
    - Staten Island Railroad
    - South Brooklyn Railway

However, recent changes in the railroad industry and possible new additions have to be incorporated into the network database in order to have a realistic representation of railroad network in the area. Again, it should be strongly emphasized that, it might be difficult or even impossible to automatically merge an existing network with another network due to the inherent inconsistencies in the numbering and classification of links. It is thus necessary to carefully study the network database and identify inconsistencies and /or differences in each database.

Figure 1: New York / New Jersey Area Major Highway Network (National Atlas Database, 1996)

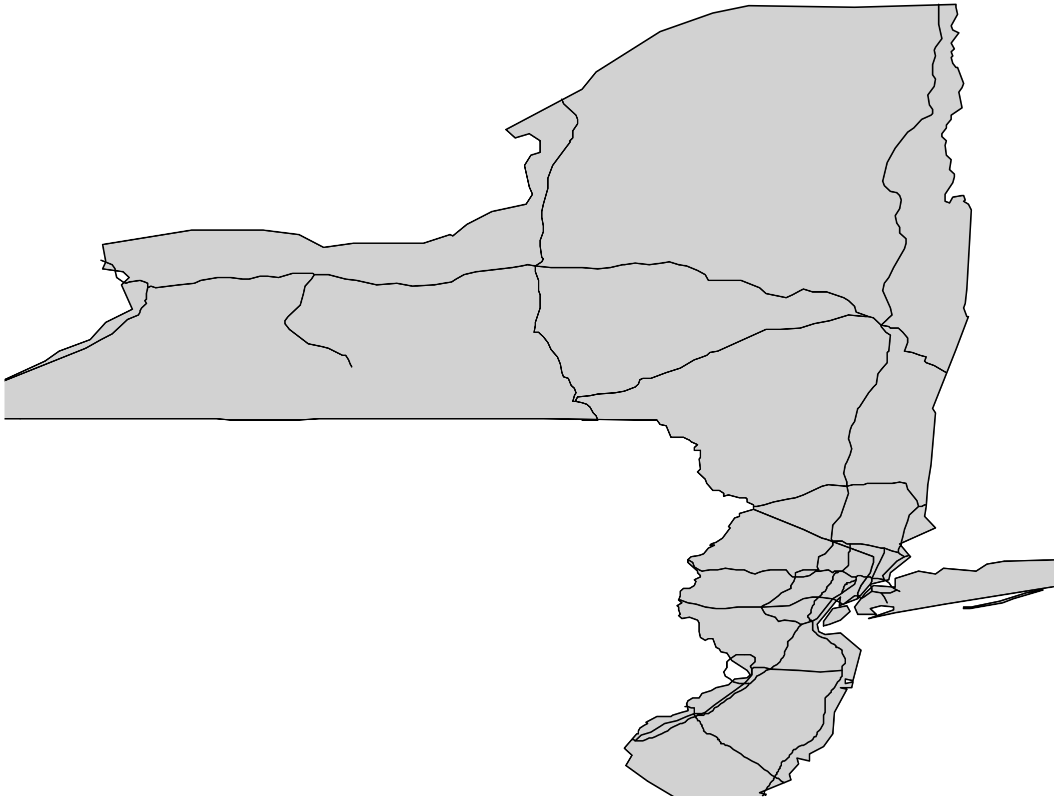


Figure 2: New York / New Jersey Area Railroad Network (National Atlas Database, 1996)

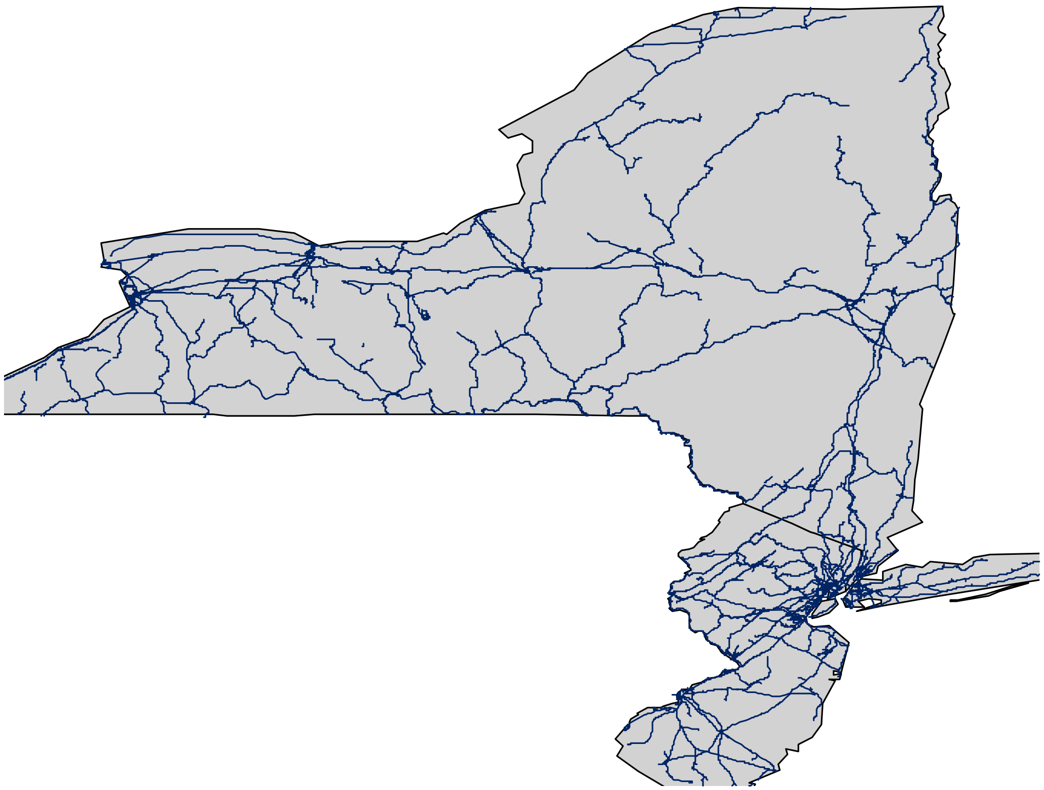


Figure 3: New York / New Jersey Area Terminals (National Atlas Database, 1996)

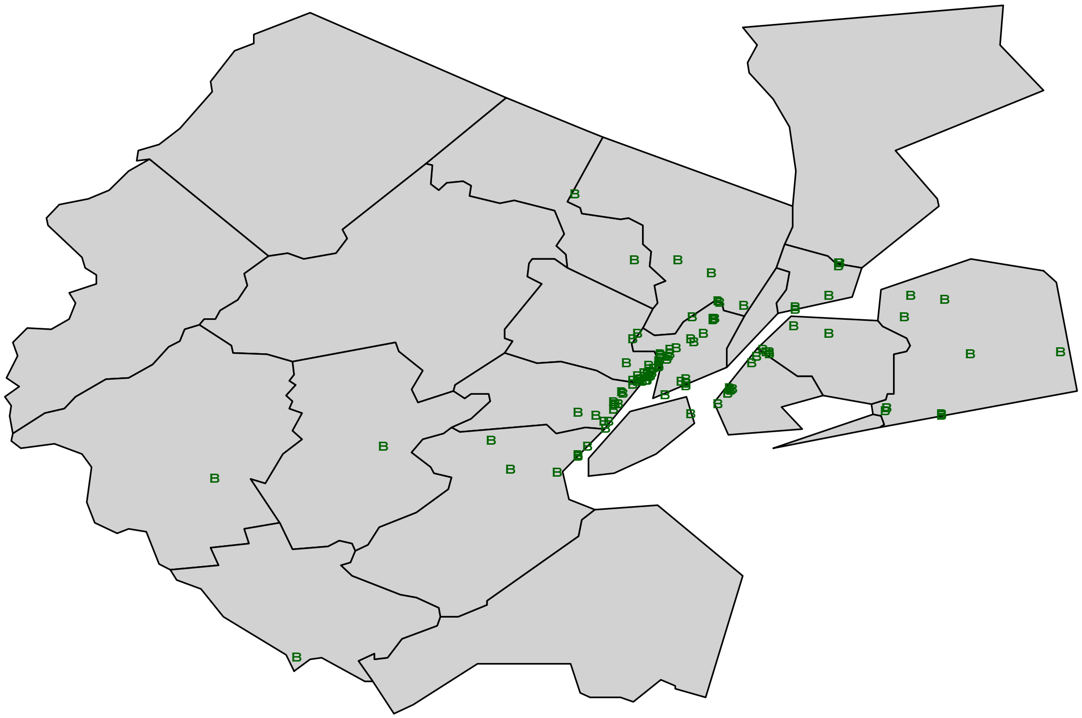
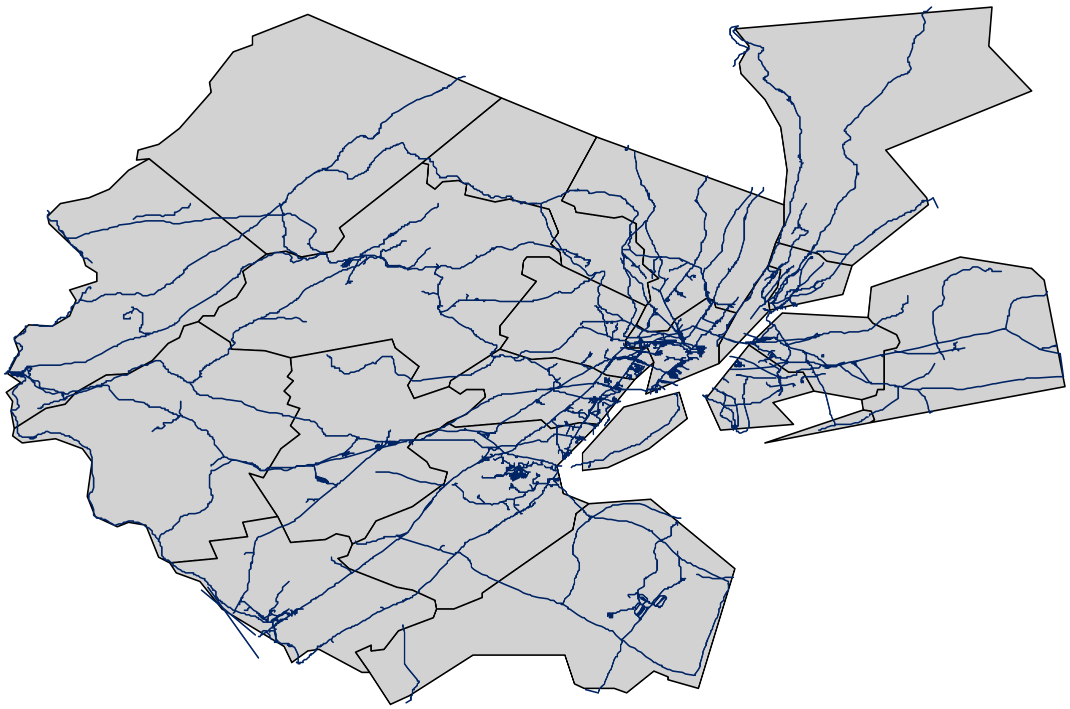


Figure 4: Northern New Jersey -New York City Railroad Network (National Atlas Database, 1996)



3.1.3 City College of New York (CCNY) truck network

The City College of New York (CCNY) is conducting a research project, funded by NYMTC, that is aimed at creating a unified and consistent freight network in the New York City area. Given the lack of other freight modes, it is anticipated that the "freight" network will primarily consist of truck related transportation links. This project will consolidate information from different sources to create a freight network useful for planning and modeling purposes. The freight transportation network developed as part of this project will be used directly in the analyses of the transportation system of the South Bronx.

3.2 Demand Characteristics and Traffic Patterns of Both Passenger and Freight

3.2.1 Household Interview Survey (HIS)

The Household Interview Survey (HIS) was conducted by NYMTC, in collaboration with the North Jersey Transportation Planning Authority (NJTPA), to gather data about trip characteristics and personal activities of a sample of households in the North Jersey and New York City regions. The HIS collected data about: (a) socio-economic characteristics of the household members (e.g., household income, number of family members, number of vehicles); (b) general characteristics of passenger travel demand (e.g., number of trips, mode used, travel times, costs); and (c) activity data (e.g., trip chains, purpose of the trip).

The HIS is one of the most important data sets for passenger travel demand modeling in the New York City area. This is because of its relative timeliness (the interviews were conducted in 1999) and the breadth and detail of the data collected. It is anticipated that the HIS will be an important data set for modeling transportation demand in the South Bronx.

3.2.2 New York State Department of Transportation (NYSDOT) traffic data

The New York State Department of Transportation (NYSDOT) has a two facet traffic count program aimed at collecting traffic pattern data on state and non-state highways. On state highways, predominantly arterials, NYSDOT conducts 24-hour machine counts all year round at 100 permanent stations, throughout New York City. The machine traffic counts are complemented with manual traffic counts aimed at obtaining estimates of traffic composition by type of vehicle. The Highway Data Services Bureau unit of NYSDOT aggregates the counts. On non-state highways, including city and local streets such as those in the study area, the state conducts similar counts at only 900 stations in the whole of New York, over a period of 3 years. The traffic counts are conducted for a selected week per station, which means each location has a record of a week's count every three years.

In general terms, although the NYSDOT traffic count program conforms to standard practices of traffic engineering, the level of geographic coverage as discussed above is not sufficient for detailed traffic modeling specific to South Bronx. This can be clearly appreciated in Figure 5 that shows a spatial traffic data produced by the NYSDOT traffic count program. As shown, the available traffic data only covers the main primary highway system.

Figure 5: Traffic counts from NYSDOT

Another limitation to modeling traffic in the study area is that the NYSDOT traffic data for the area is not collected on a continuous basis (e.g., daily, hourly, all year round). This introduces the challenge of trying to reconcile traffic data corresponding to different seasons, months and days of the week to data that may resemble a "typical day." However, it should be highlighted that using the NYSDOT data may be appropriate if the analyses do not require a highly detailed traffic simulation of the study area.

Traffic data is also collected by private companies, universities, state and city agencies either for planning and/or research studies. However valid and useful for reference purposes, it is not likely that these disjoint data sets would be of significant value to this investigation. The disjointedness is a function of varying content, geographical location, time period, data formatting and other elements primarily based on the objective of the study.

3.2.3 Commodity Flow Survey (CFS)

The CFS is the most important source of freight transportation demand data in the United States. It is a shipper-based survey in which shippers are asked to provide information about all the shipments sent during one week randomly selected from each quarter (a total of four weeks in the target year). The survey is conducted by the United States Census Bureau with funds provided by the Bureau of Transportation Statistics (BTS). The CFS is conducted approximately every five years. The last CFS was conducted in 1997, and the next CFS is planned for 2002.

The CFS has two major limitations. The first and most obvious one is that the CFS is conducted every five years (the most current, the CFS 97, is five years old) and, due to the major changes that have taken place in the economy, it is likely that the CFS 1997 does not provide an accurate depiction of the freight movements taking place in today's economy. The second limitation is related to the lack of geographic detail provided by the CFS data publicly available. This is because the U.S. Bureau of the Census–in order to protect the commercial interest of the respondents–significantly reduces the level of geographic detail of the disclosed data to prevent identification of individual firms. However, in spite of the limitations described above, using the CFS remains the only practical option for the vast majority of modeling projects (a consequence of the prohibitive cost of collecting freight data).

The project team anticipates the use of the CFS 1997, in combination with logistic information (e.g., location and size of terminals), to produce estimates of freight origin-destination matrices that are consistent with the traffic counts and other sources of secondary data. These techniques have been successfully applied to a number of different projects, most recently for the Analyses of the North-East Intermodal Transportation Corridor (NITC). These techniques, collectively know as origin-destination synthesis, use secondary information (e.g., business location information, traffic counts) to make educated guesses about the underlying freight transportation flows.

3.2.4 ZIP Code Business Patterns

The "ZIP Code Business Patterns" is a product of the U.S. Bureau of the Census. It contains information about number of establishments (and number of employees) by ZIP code classified by industry type (using Standard Industrial Classification, SIC, codes). These datasets are a useful inputs to the process of origin-destination synthesis because they provide a good idea about the geographic distribution of businesses. These data sets are very useful to identify the geographic location of major freight generators.

In the South Bronx project, the datasets corresponding to the period 1994-1999 (2000 has not been released yet) will be used to estimate the location and relative size of the major freight generators in the study area. The information about location and size of firms (measured by number of employees and SIC code) will be used to complement the analyses of freight generation.

3.2.5 Population Census Data

The U.S Population Census provides the more comprehensive data set about the socio-economic characteristics of the population in the study area. The Population Census provides useful and highly detailed information at the census tract level about the socio-economic characteristics of the population (e.g., household income, auto ownership) as well as basic information about transportation demand (e.g., transportation mode used in the journey to work). The data collected in the Census, both 1990 and 2000, would support the process of analytical estimation of the passenger transportation demand in the study area.

3.3 Operational Characteristics of the Traffic Control Systems

3.3.1 Signal settings

Traffic simulations of the study area most likely will require basic information about the settings of the traffic signals in the study area (e.g., green times per phase, amber times, red times, type of controller). This is because signal settings are known to have a significant impact upon traffic flow.

The New York City Department of Transportation (NYCDOT), the agency in charge of local traffic control, maintains a database containing basic information about signal settings. However, since the signal settings could be modified by local engineers, it is not certain that this database is up to date. In order to gather the signal settings data needed for this project, the following steps would have to be taken: (a) contact the NYCDOT to obtain whatever signal settings information they have; and (b) manually time the signal phases and to conduct spot checks to verify the accuracy of the NYCDOT data.

3.3.2 Link and path travel time data

One of the best resources for calibration of the traffic simulation are link and path travel time data. Unfortunately, neither NYCDOT nor any other transportation agency, have a program for systematically collecting estimates of link and path travel times. Link travel time data can be estimated directly through the use of location technologies such as Global Positioning Systems (GPS) or through fixed roadside readers spaced regularly along the roadway. Traditionally, link travel time estimates are produced indirectly through the use of data collection devices that measure traffic volumes and spot speeds. Given that NYCDOT is also a member of TRANSCOM, link travel time estimates could be produced through the TRANSMIT system over the network covered by the TRANSMIT system.

Currently the best link travel time estimates can be produced through the data that are collected from its inductive loop detectors that are primarily being used for optimizing its signal timings. A rather new technology that could be used to acquire estimates of link travel times is GPS. Vehicles equipped with GPS receivers and sufficient storage capacity can store the GPS tracks that can then be mapped into a Geographic Information System (GIS). Subsequently estimates of link as well as path travel times can be produced. Currently, an operational test is under way by the Transportation Information and Decision Engineering (TIDE) center (www.njtide.org), where the functionality of the in-vehicle navigation system (Co-Pilot – www.alk.com) is tested for the collection of link and path travel times. A summary of the current results of the use of this technology for link travel time estimation will be presented as well as an assessment for its potential use for this project.

Some of the routes of the freeway network in South Bronx that fall under TRANSCOM's System for Managing Incidents and Traffic (TRANSMIT) are expected to be equipped with E-ZPASS roadside readers at frequent intervals between 1 to 2 miles. TRANSCOM can provide 15 minute link travel time data (average and variance) for each TRANSMIT link. A preliminary study will be undertaken that will identify the potential for installation of additional TRANSMIT readers throughout the study area for link and path travel time estimation per vehicle class (passenger cars, trucks, buses). This preliminary study will identify the potential costs and the associated benefits of installing the TRANSMIT system in the study area.

Estimates of link travel times can also be produced indirectly through the use of traffic counts and speed measurements through the use of inductive loop detectors. An assessment of the location and functionality of inductive loop detectors in the study area would be desirable. NYCDOT would have to be contacted for this purpose to obtain the location of loop detectors, the data that are collected, and the operational status of each loop detector.

CHAPTER 4. CHARACTERIZATION OF AMBIENT AIR QUALITY IN THE SOUTH BRONX: Existing Data[15]

Note: Figures accompanying this chapter follow the text at the end of the chapter.

4.1 Introduction

This report analyzes air quality in Bronx County using data provided by the New York State Department of Environmental Conservation. The data are for the period 1996-2000, and were collected by the stations listed in Table 1. All but one of these stations are within the South Bronx Study Area. The only air quality monitoring station in Bronx County that is not within the study area is the station that measures carbon monoxide (CO) concentrations. The pollutants included in the report are those that are defined for ambient air quality under the National Ambient Air Quality Standards (NAAQS), and include carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), and sulfur dioxide (SO_2). Lead is not included. The standards for the NAAQS pollutants are given in Table 9. The data analyzed consist of 24 hourly measurements per day for each pollutant. These values were averaged to obtain a daily value for each pollution measurement. In addition, the maxima and minima for each pollutant were identified. The exception to this is particulate matter (PM_{10}), for which only one daily measurement is provided every six days of the year. These measurements are explained in greater detail below.

Table 1. NYS DEC Air Quality Sampling Station Locational Information

Station ID	Location	Height Above Ground	Within Study Area?
709403	IS 155 470 Jackson Ave.	16 meters	Yes
709405	Morrisania, 1225-57 Gerard Ave.	15 meters	Yes
709406	Bronx Botanical Garden, 200th St. at Southern Blvd.	15 meters	No
709407	IS 52 681 Kelly St., off 156th St.	15 meters	Yes
709408	IS 74 730 Bryant Ave.	15 meters	Yes
709409	PS 154 333 E. 135th St.	15 meters	Yes

[15] This chapter was prepared by Carlos Restrepo, Doctoral candidate at NYU's Wagner School and Graduate Research Assistant at ICIS.

The locations of these stations are shown in Figure 1. The only station not shown on the Map is 709406, which is located further north by the Bronx Botanical Garden.

Table 2 shows the dates for which data are available for all of the pollutants.

Table 2. Data Availability for NAAQS Pollutants at NYS DEC Monitoring Stations

Pollutant	**Year**	**Station**	**Dates**
Carbon Monoxide (CO)	1996	709406	01/01 - 10/31
	1997	709406	01/17 - 12/31
	1998	709406	01/01 - 12/31
	1999	709406	01/01 - 12/31
	2000	709406	01/01 - 08/28 and 08/30 - 12/31
Nitrogen Dioxide (NO_2)	1996	709405	01/01 - 12/05 and 12/17 - 12/31
		709406	01/01 - 10/19
	1997	709403	11/07
		709405	01/01 - 01/14 and 03/06 - 12/31
		709406	02/22 - 12/31
	1998	709405	01/01 - 12/31
		709406	01/01 - 04/14 and 05/14 - 12/31
	1999	709403	03/23 - 04/03 and 04/21 - 07/14
		709405	01/01 - 03/22 and 03/24 - 12/31
		709406	01/01 - 12/31
		709407	10/07 - 11/17
	2000	709405	01/01 - 01/13 and 01/15 - 05/01
		709406	01/01 - 12/31
		709407	01/10 - 08/02 and 08/30 - 12/06 and 12/18 - 12/31
Ozone (O_3)	1996	709405	04/01 - 10/31
		709406	01/01 - 11/01
	1997	709403	05/21 - 11/05
		709405	04/01 - 11/03
		709406	01/17 - 12/31
	1998	709405	03/28 - 08/04 and 08/28 - 11/02
		709406	01/01 - 12/31

	1999	709403	02/23 - 06/17
		709405	04/01 - 11/01 and 12/06 - 12/07 and 12/09 - 12/10
		709406	01/01 - 12/31
		709407	11/01 - 12/31
	2000	709405	03/31 - 05/01
		709406	01/01 - 08/28 and 08/30 - 12/31
		709407	01/01 -12/31
Sulfur Dioxide (SO_2)	1996	709403	01/01 - 12/31
		709405	01/01 - 12/31
	1997	709403	01/01 - 12/31
		709405	01/01 - 12/31
	1998	709403	01/01 - 12/31
		709405	01/01 - 12/31
	1999	709403	01/01 - 07/14
		709405	01/01 - 01/20 and 02/05 - 12/05 and 12/09 - 12/31
		709407	10/05 - 12/31
	2000	709405	01/01 - 05/01
		709406	05/05 - 12/31
		709407	01/01 - 12/31
Fine Particulate Matter ($PM_{2.5}$)	1999	709403	01/01 - 07/14
		709407	10/22 - 12/31
	2000	709407	01/01 - 12/31
		709408	03/07 - 03/10 and 03/13 - 11/21 and 11/26 - 12/12 and 12/22 - 12/31
		709409	03/17 - 12/28

4.1.1 Carbon Monoxide (CO)

Carbon monoxide (CO) is a colorless, odorless, poisonous gas. It is produced by the incomplete combustion of carbon. The main sources of CO are internal combustion engines, especially motor vehicles. Morbidity studies suggest that increases in the ambient level of carbon monoxide may be associated with higher rates of heart failure (Hester and Harrison, 1998) among other effects.

CO is one of the criteria pollutants for which the U.S. Environmental Protection Agency (EPA) has developed a National Ambient Air Quality Standard (NAAQS). The standards are 9 ppm for an 8-hour average, and 35 ppm for a 1-hour average.[16]

Table 3 summarizes the measurements of CO for the period under consideration. Average values refer to daily averages of 24 hourly measurements. The term maxima refers to the first maximum value selected from each of the 24 hourly measurements taken each day. The term minima also refers to the minimum value taken from each of the 24 hourly measurements for each day.

Table 3. Carbon Monoxide Measurements

Year	**Type of Value**	**Number of Valid Observations**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
1996	Average	305	.1000	2.2250	.624146	.286963
	Maxima	305	.3000	5.7000	1.329836	.780811
	Minima	305	.0000	.8000	.281639	.165406
1997	Average	349	.0000	2.4750	.620503	.281493
	Maxima	349	.0000	7.4000	1.319484	1.001533
	Minima	349	.0000	1.6000	.325215	.160084
1998	Average	356	.3477	1.9352	.691225	.235231
	Maxima	356	.4674	4.7439	1.275619	.690074
	Minima	356	.1517	.8937	.410865	.119129
1999	Average	364	.2278	2.1120	.703290	.272414
	Maxima	364	.3759	6.2000	1.310090	.864749
	Minima	364	.0000	.9483	.429167	.123404
2000	Average	365	.2741	2.3017	.670144	.250891
	Maxima	365	.3803	6.0402	1.187983	.730603
	Minima	365	.1682	.9652	.427876	.120171

Figure 2 shows the yearly averages for carbon monoxide. The measurements are only available from one station located outside the study area, in the Bronx Botanical Garden. They show substantial yearly variations, with the values for 1998-00 significantly higher than those for 1996-97. As Figures 3-7 show, the daily maxima for carbon monoxide are well below the 1-hour NAAQS standard.

4.1.2 Nitrogen Dioxide (NO_2)

NO_2 is a type of nitrogen oxide (NO_x) compound produced when fuel is burned at high temperatures. The main sources of this type of pollutant are combustion plants and transportation vehicles. These compounds can be converted to nitrates in the atmosphere, and can return to earth as components of rain or snow. This process is called acid precipitation (Findley and Farber, 1996, p. 98).

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[16] The National Ambient Air Quality Standards are summarized in Table 9 and listed at: http://www.epa.gov/airs/criteria.html

According to summaries of the literature, studies addressing the associations between NO_2 and human health are not conclusive. So far, significant direct health effects have not been observed. It is believed that long-term exposures to NO_2 may have some health effects, and may allow other factors to have greater effects on individuals (Hester and Harrison, 1998, p.15).

The National Ambient Air Quality Standard for Nitrogen Dioxide (NO_2) is an annual arithmetic mean of 0.053 ppm.

Table 4 summarizes the measurements of NO_2 for the period under consideration. Average values refer to daily averages of 24 hourly measurements. The term maxima refers to the first maximum value selected from each of the 24 hourly measurements taken each day. The term minima also refers to the minimum value taken from each of the 24 hourly measurements taken each day. Figure 8 gives average values for nitrogen dioxide between 1996 and 2000. The NO_2 values are consistently below the annual standard.

Table 4. Nitrogen Dioxide Measurements

Year	**Station**	**Type of Value**	**Number of Valid Obs.**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
1996	405	Average	351	0.0075	0.0717	3.544E-02	1.080E-02
		Maxima	351	0.0120	0.1160	5.219E-02	1.719E-02
		Minima	351	0.0020	0.0580	2.248E-02	8.909E-03
	406	Average	284	0.0085	0.0664	3.176E-02	1.005E-02
		Maxima	284	0.0160	0.1050	5.049E-02	1.528E-02
		Minima	284	0.0010	0.0500	1.754E-02	8.189E-03
1997	405	Average	313	0.0153	0.0728	3.527E-02	9.936E-03
		Maxima	313	0.0270	0.1810	5.404E-02	1.884E-02
		Minima	313	0.0080	0.0490	2.151E-02	7.880E-03
	406	Average	313	0.0120	0.0606	2.999E-02	8.811E-03
		Maxima	313	0.0230	0.1110	4.942E-02	1.615E-02
		Minima	313	0.0040	0.0470	1.623E-02	6.967E-03
1998	405	Average	365	0.0134	0.0742	3.623E-02	1.090E-02
		Maxima	365	0.0196	0.1299	5.361E-02	1.819E-02
		Minima	365	0.0081	0.0500	2.186E-02	7.496E-03
	406	Average	335	-0.0002	0.0600	3.022E-02	8.568E-03
		Maxima	335	-0.0002	0.0974	4.697E-02	1.492E-02
		Minima	335	-0.0002	0.0429	1.685E-02	6.829E-03
1999	403	Average	97	0.0150	0.0584	3.274E-02	9.105E-03
		Maxima	97	0.0318	0.1121	5.282E-02	1.450E-02
		Minima	97	0.0084	0.0471	1.797E-02	7.516E-02
	405	Average	362	0.0124	0.0639	3.294E-02	8.646E-03
		Maxima	362	0.0157	0.1081	4.848E-02	1.495E-02
		Minima	362	0.0073	0.0429	2.053E-02	6.887E-03

	406	Average	365	0.0116	0.0576	2.880E-02	8.318E-03
		Maxima	365	0.0174	0.1056	4.573E-02	1.407E-02
		Minima	365	0.0047	0.0443	1.598E-02	6.905E-03
	407	Average	42	0.0159	0.0526	3.146E-02	9.179E-03
		Maxima	42	0.0252	0.0846	4.458E-02	1.310E-02
		Minima	42	0.0000	0.0382	1.965E-02	9.668E-03
2000	405	Average	121	0.0187	0.0583	3.325E-02	8.270E-03
		Maxima	121	0.0238	0.0975	4.565E-02	1.193E-02
		Minima	121	0.0104	0.0452	2.250E-02	7.396E-03
	406	Average	365	0.0106	0.0609	2.884E-02	8.700E-03
		Maxima	365	0.0156	0.1025	4.466E-02	1.432E-02
		Minima	365	0.0050	0.0470	1.674E-02	7.060E-03
	407	Average	319	0.0114	0.0660	3.161E-02	1.026E-02
		Maxima	319	0.0135	0.1136	4.787E-02	1.582E-02
		Minima	319	0.0058	0.0534	1.907E-02	8.384E-03

4.1.3 Ozone (O_3)

Ozone is an unstable, toxic form of oxygen. It results from the combination of hydrocarbons and NOx and sunlight in the atmosphere. Hydrocarbons result from unburned and wasted fuel. Although hydrocarbons are not toxic in the concentrations normally found in the atmosphere, ozone can cause eye and lung irritation, damage to vegetation, offensive odor, and thick haze (Findley and Farber, 1996, p. 98).

O_3 is considered a very important pollutant in terms of health effects. Clear effects on hospital admissions, morbidity and mortality have been reported at all levels of exposure. Ozone is a seasonal pollutant, being most prevalent in the summer months. As a result, its effects are also most prevalent in the summer (Hester and Harrison, 1998, p. 20).

The National Ambient Air Quality Standards for Ozone (O_3) are: 1-hour average 0.12 ppm and 8-hour average 0.08 ppm.

Table 5 summarizes the measurements of O_3 for the period under consideration. Average values refer to daily averages of 24 hourly measurements. The term maxima refers to the first maximum value selected from each of the 24 hourly measurements taken each day. The term minima also refers to the minimum value taken from each of the 24 hourly measurements taken each day. Figure 9 summarizes average values for ozone between 1996 and 2000.

Table 5. Ozone Measurements

Year	**Station**	**Type of Value**	**Number of Valid Obs.**	**Minimum**	**Maximum**	**Mean**	**St. Dev.**
1996	405	Average	214	0.0028	0.0508	1.868E-02	9.256E-03

		Maxima	214	0.0060	0.1080	4.134E-02	1.876E-02
		Minima	214	0.0000	0.0230	4.028E-03	3.931E-03
	406	Average	302	0.0008	0.0528	1.777E-02	1.010E-02
		Maxima	302	0.0030	0.1260	3.916E-02	2.144E-02
		Minima	302	0.0000	0.0220	2.844E-03	4.373E-03
1997	403	Average	167	0.0033	0.0707	1.985E-02	1.162E-02
		Maxima	167	0.0068	0.1220	4.359E-02	2.349E-02
		Minima	167	0.0000	0.0240	3.674E-03	3.732E-03
	405	Average	215	0.0043	0.0643	2.141E-02	1.105E-02
		Maxima	215	0.0090	0.1240	4.354E-02	2.093E-02
		Minima	215	0.0000	0.0240	5.391E-03	4.688E-03
	406	Average	349	0.0003	0.0684	1.654E-02	1.136E-02
		Maxima	349	0.0010	0.1280	3.595E-02	2.258E-02
		Minima	349	0.0000	0.0240	2.344E-03	4.072E-03
1998	405	Average	197	0.0031	0.0610	2.311E-02	1.167E-02
		Maxima	197	0.0056	0.1218	4.421E-02	2.114E-02
		Minima	197	0.0008	0.0316	7.627E-03	6.265E-03
	406	Average	364	0.0009	0.0467	1.520E-02	8.750E-03
		Maxima	364	0.0018	0.0885	3.153E-02	1.668E-02
		Minima	364	0.0000	0.0270	3.206E-03	3.396E-03
1999	403	Average	128	0.0032	0.0531	2.135E-02	9.520E-03
		Maxima	128	0.0070	0.1047	4.016E-02	1.761E-02
		Minima	128	0.0000	0.0205	5.269E-03	4.909E-03
	405	Average	219	0.0005	0.0545	1.877E-02	1.127E-02
		Maxima	219	0.0030	0.1276	4.131E-02	2.369E-02
		Minima	219	-0.0010	0.0293	4.129E-03	4.705E-03
	406	Average	365	-0.0004	0.0636	1.804E-02	1.246E-02
		Maxima	365	0.0026	0.1412	3.665E-02	2.441E-02
		Minima	365	-0.0049	0.0333	4.519E-03	4.737E-03
	407	Average	66	0.0002	0.0198	6.696E-03	4.507E-03
		Maxima	66	0.0010	0.0359	1.623E-02	7.734E-03
		Minima	66	-0.0011	0.0119	1.420E-03	2.429E-03
2000	405	Average	32	0.0003	0.0221	1.119E-02	4.946E-03
		Maxima	32	0.0015	0.0397	2.456E-02	8.079E-03
		Minima	32	-0.0006	0.0080	1.791E-03	2.254E-03
	406	Average	365	0.0014	0.0715	1.611E-02	9.537E-03
		Maxima	365	0.0036	0.1116	3.363E-02	1.844E-02
		Minima	365	-0.0006	0.0322	3.254E-03	3.716E-03
	407	Average	366	0.0011	0.0710	1.468E-02	9.628E-03
		Maxima	366	0.0023	0.1098	3.119E-02	1.822E-02
		Minima	366	-0.0006	0.0374	2.600E-03	3.693E-03

Figures 10-22 compare the 1-hr. maxima, 24-hr. average, and 1-hr. minima to the 1-hr standard. As shown, the maxima values, which are most relevant for the comparison with the standard, come close or surpass the standard in the summer months when ozone concentrations are highest in several graphs.

4.1.4 Sulfur Dioxide (SO_2)

Sulfur oxides (SO_x) are a type of corrosive, poisonous gases that are produced when fuels containing sulfur are burned. The main sources of these pollutants are electric utilities and industrial plants (Findley and Farber, 1996, p. 98).

SO_2 has been associated with changes in airways resistance. Although the evidence on normal subjects appears to be inconclusive, asthmatic subjects show changes at concentrations of 1,430 ug/m3, while undergoing heavy exercise in clinical studies. Concentrations of SO_2 above 500 ug/m3 have also been associated with increases in daily deaths from respiratory illnesses (Hester and Harrison, 1998, p. 4-12).

The National Ambient Air Quality Standards for Sulfur Dioxide (SO_2) are: annual arithmetic mean 0.03 ppm, 24-hour average 0.14 ppm, and 3-hour average 0.50 ppm.

Table 6 summarizes the measurements of SO_2 for the period under consideration. Average values refer to daily averages of 24 hourly measurements. The term maxima refers to the first maximum value selected from each of the 24 hourly measurements taken each day. The term minima also refers to the minimum value taken from each of the 24 hourly measurements taken each day.

Table 6. Sulfur Dioxide Measurements

Year	**Station**	**Type of Value**	**Number of Valid Obs.**	**Minimum**	**Maximum**	**Mean**	**St.Dev.**
1996	403	Average	353	0.0001	0.0529	9.541E-03	8.042E-03
		Maxima	353	0.0010	0.1390	2.148E-02	1.775E-02
		Minima	353	0.0000	0.0220	3.649E-03	4.200E-03
	405	Average	362	0.0009	0.0598	1.416E-02	9.668E-03
		Maxima	362	0.0020	0.1360	2.713E-02	1.979E-02
		Minima	362	0.0000	0.0380	6.903E-03	5.322E-03
1997	403	Average	339	0.0000	0.0435	8.031E-03	7.198E-03
		Maxima	339	0.0000	0.0940	1.998E-02	1.719E-02
		Minima	339	0.0000	0.0260	2.668E-03	3.718E-03
	405	Average	347	0.0003	0.0431	1.173E-02	7.686E-03
		Maxima	347	0.0020	0.0970	2.408E-02	1.589E-02
		Minima	347	0.0000	0.0260	5.259E-03	4.233E-03
1998	403	Average	365	0.0012	0.0390	9.198E-03	6.171E-03
		Maxima	365	0.0018	0.0890	1.960E-02	1.382E-02
		Minima	365	0.0000	0.0220	3.903E-02	2.995E-03
	405	Average	365	0.0012	0.0412	1.095E-02	7.383E-03
		Maxima	365	0.0024	0.1190	2.174E-02	1.484E-02

		Minima	365	-0.0002	0.0242	4.862E-03	4.118E-03
1999	403	Average	195	0.0022	0.0375	1.040E-02	6.338E-03
		Maxima	195	0.0040	0.0784	2.222E-02	1.386E-02
		Minima	195	0.0005	0.0191	4.418E-03	3.299E-03
	405	Average	347	0.0007	0.0521	1.134E-02	7.222E-03
		Maxima	347	0.0019	0.1391	2.245E-02	1.592E-02
		Minima	347	0.0000	0.0267	5.422E-03	3.858E-03
	407	Average	88	0.0035	0.0443	1.400E-02	7.083E-03
		Maxima	88	0.0070	0.0975	2.904E-02	1.739E-02
		Minima	88	0.0003	0.0271	6.655E-03	4.176E-03
2000	405	Average	362	0.0013	0.0453	1.147E-02	8.312E-03
		Maxima	362	0.0020	0.1090	2.285E-02	1.652E-02
		Minima	362	0.0008	0.0275	5.465E-03	4.444E-03
	407	Average	366	0.0018	0.0511	1.141E-02	7.924E-03
		Maxima	366	0.0029	0.1115	2.323E-02	1.699E-02
		Minima	366	0.0006	0.0222	5.419E-03	4.102E-03

As Figures 23-34 indicate, the annual averages for SO_2 are below the annual EPA standard for the period under consideration, and for all the stations for which data is available.

4.1.5 Fine Particulate Matter ($PM_{2.5}$)

Particulate matter refers to solids and liquids of different sizes that are produced primarily by stationary fuel combustion and industrial processes. Fine particulate matter refers to solids and liquids of 2.5 microns or less in diameter.

The National Ambient Air Quality Standards for $PM_{2.5}$ are: annual arithmetic mean: 15 ug/m^3; and 24-hour average: 65 ug/m^3.

Table 7 summarizes the measurements of $PM_{2.5}$ for 1999-2000. Average values refer to daily averages of 24 hourly measurements. The term maxima refers to the first maximum value selected from each of the 24 hourly measurements taken each day. The term minima also refers to the minimum value taken from each of the 24 hourly measurements taken each day.

Table 7. Fine Particulate Matter ($PM_{2.5}$) Measurements

Year	Station	Type of Value	Number of Valid Obs.	Minimum	Maximum	Mean	St. Dev.
1999	403	Average	179	2.36	42.48	15.0102	7.3818
		Maxima	179	10.63	68.13	27.3573	11.6771
		Minima	179	-0.09	29.70	4.9651	5.5451
	407	Average	71	3.85	35.35	14.5529	7.7393
		Maxima	71	7.89	74.10	26.6844	15.2434
		Minima	71	-0.49	22.28	6.0422	5.3184

2000	407	Average	347	4.0100	45.2348	15.0891	8.1434
		Maxima	347	8.5156	91.8000	27.2858	13.8132
		Minima	347	-6.1252	33.8881	5.7938	5.5720
	408	Average	282	3.4316	38.6814	14.7026	7.6417
		Maxima	282	7.1787	85.6373	26.7518	13.9153
		Minima	282	-14.4700	31.1654	6.2446	5.6003
	409	Average	287	3.6816	43.9767	15.3363	8.3506
		Maxima	287	6.2302	79.9681	25.9227	14.0060
		Minima	287	0.1432	37.0340	7.7110	5.4841

Figures 35-40 show the annual averages compared to the annual standard and the daily averages compared to the 24-hour standard. These graphs indicate that the annual standard is exceeded for several monitoring stations. The daily average data, on the other hand, indicates that the measurements are below the 24-hour standard.

4.1.6 Particulate Matter (PM_{10})

The National Ambient Air Quality Standards for PM_{10} are: annual arithmetic mean 50 ug/m^3; and the 24-hour average is 150 ug/m^3. According to the graph shown below the measurements for PM_{10} are below the annual standard.

Table 8 summarizes the measurements of PM_{10} for the period under consideration. Average values refer to daily averages of 24 hourly measurements. The term maxima refers to the first maximum value selected from each of the 24 hourly measurements taken each day. The term minima also refers to the minimum value taken from each of the 24 hourly measurements taken each day. As Figure 41 shows the annual PM_{10} measurements are below the annual standard.

Table 8. Particulate Matter (PM_{10}) Measurements

Year	Station	Type of Value	Number of Valid Obs.	Minimum	Maximum	Mean	St.Dev.
1996	403	Average	55	9.0000	45.0000	22.5636	8.0156
	405	Average	55	11.0000	73.0000	26.3090	10.9152
1997	403	Average	59	9.0000	75.0000	25.2881	12.0888
	405	Average	57	6.0000	58.0000	23.5263	10.9546
1998	403	Average	51	8.0000	54.0000	22.7254	11.1661
	405	Average	51	7.0000	60.0000	24.3333	11.0338
1999	407	Average	12	8.0000	27.0000	15.7500	5.8794
2000	407	Average	51	9.0000	50.0000	21.1176	9.4628

4.2 Conclusions

This section analyzes ambient pollution concentrations for the period 1996-2000. The data included cover carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), fine particulate matter (PM $_{2.5}$) and particulate matter (PM_{10}). Although the data for each monitoring station do not always include data for the entire period there are enough data points each year to get an idea of what pollutant concentrations were in the study area for the period under consideration.

Two pollutants, ozone and sulfur dioxide, show strong seasonal variations. Ozone concentrations are highest in the summer months when temperatures are highest. Sulfur dioxide shows the opposite trend with its concentrations being highest during the winter months when temperatures are lowest.

The comparison of the pollutant concentrations with the EPA standards indicates that carbon monoxide (CO), nitrogen dioxide (NO_2), particulate matter (PM_{10}), and sulfur dioxide (SO_2) are consistently below the established standards. Ozone (O_3) concentrations sometimes exceed the 1-hr standard during the summer months. Fine particulate matter (PM $_{2.5}$) exceeds the annual standard at some stations but not the 24-hr standard. Given these results it seems as though ozone (O_3) and fine particulate matter (PM $_{2.5}$) are the pollutants of most concern in Bronx county.

Table 9. NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)
Federal Clean Air Act and Amendments

Air Pollutant	**Standard (Primary)**	**Averaging Time**
Carbon monoxide	9 ppm 35 ppm	8 hours 1 hour
Lead	1.5 ug/m3	3 months
Nitrogen oxides	0.05 ppm	1 year
Ozone	0.08 ppm	8 hours
Particulate Matter (PM) – 10 microns	50 ug/m3 150 ug/m3	1 year 24 hours
Particulate Matter (PM) – 5 microns	15 ug/m3 65 ug/m3	1 year 24 hours
Sulfur dioxide	0.03 ppm 0.14 ppm 0.50 ppm	1 year 24 hours 3 hours

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FIGURES FOR AMBIENT AIR QUALITY MEASUREMENTS, SOUTH BRONX, NEW YORK

Figure 1. Map of NYSDEC Ambient Air Quality Monitoring Stations, South Bronx, New York

Figure 2.

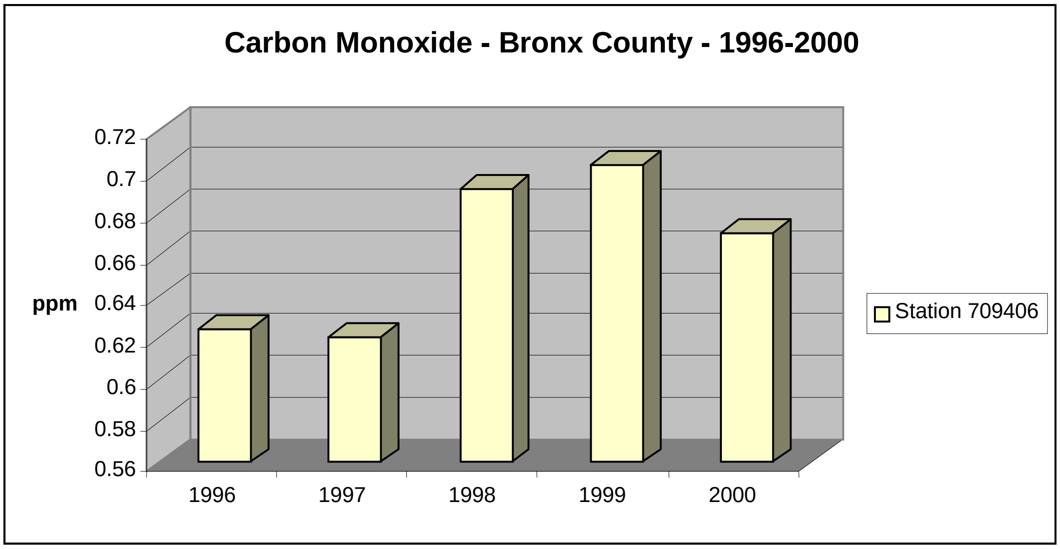


Figure 3.

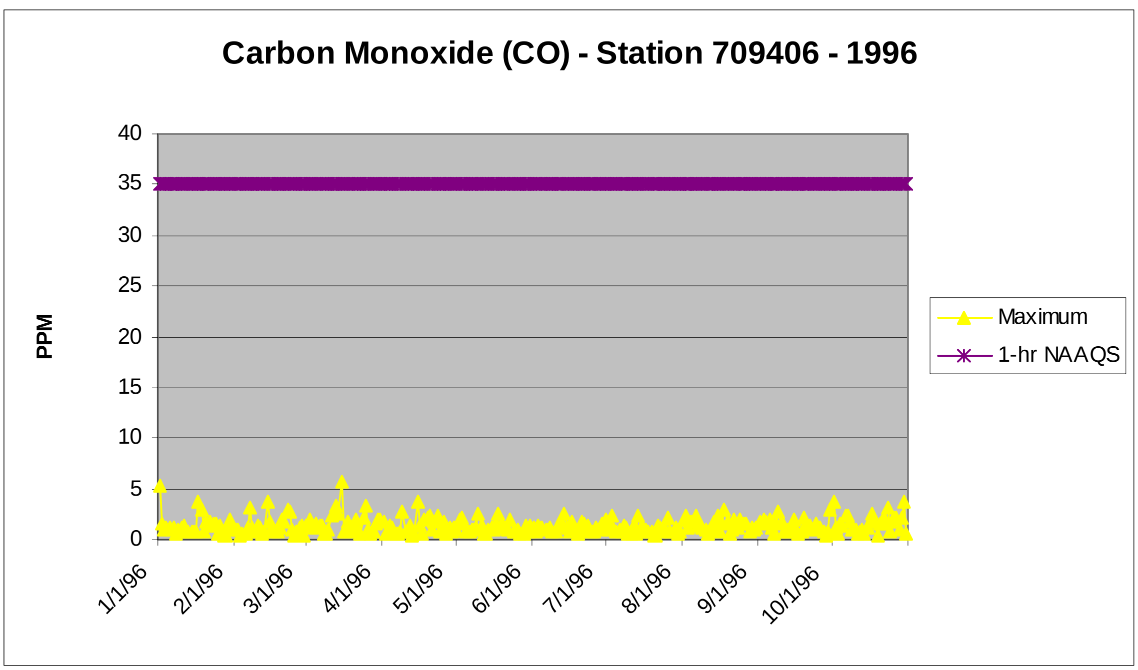


Figure 4.

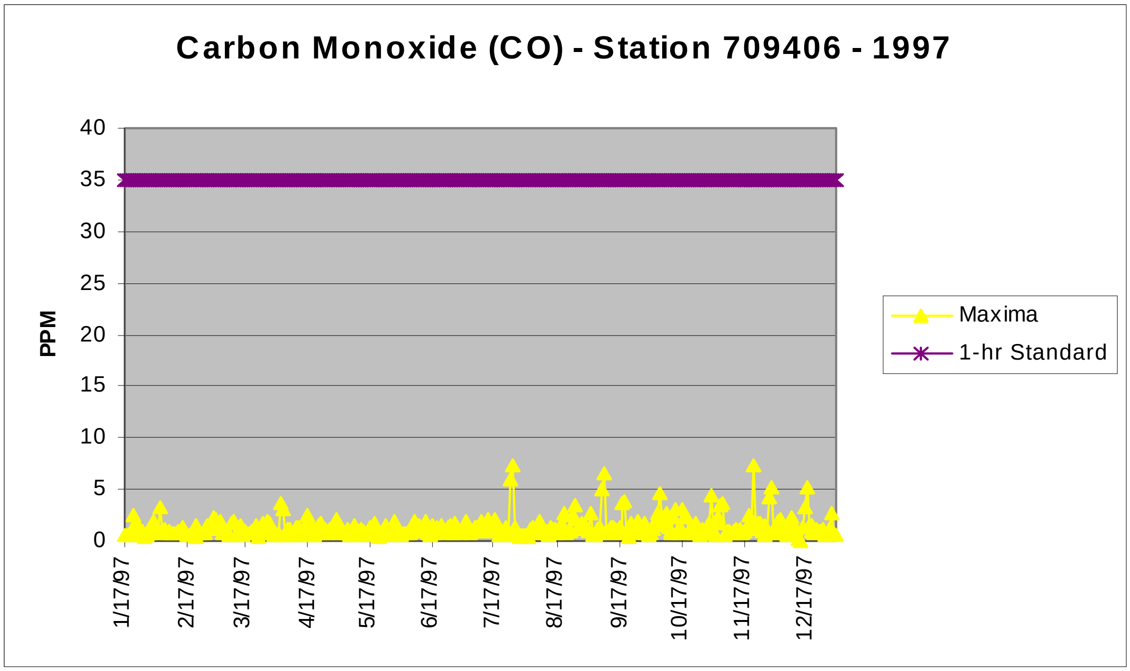
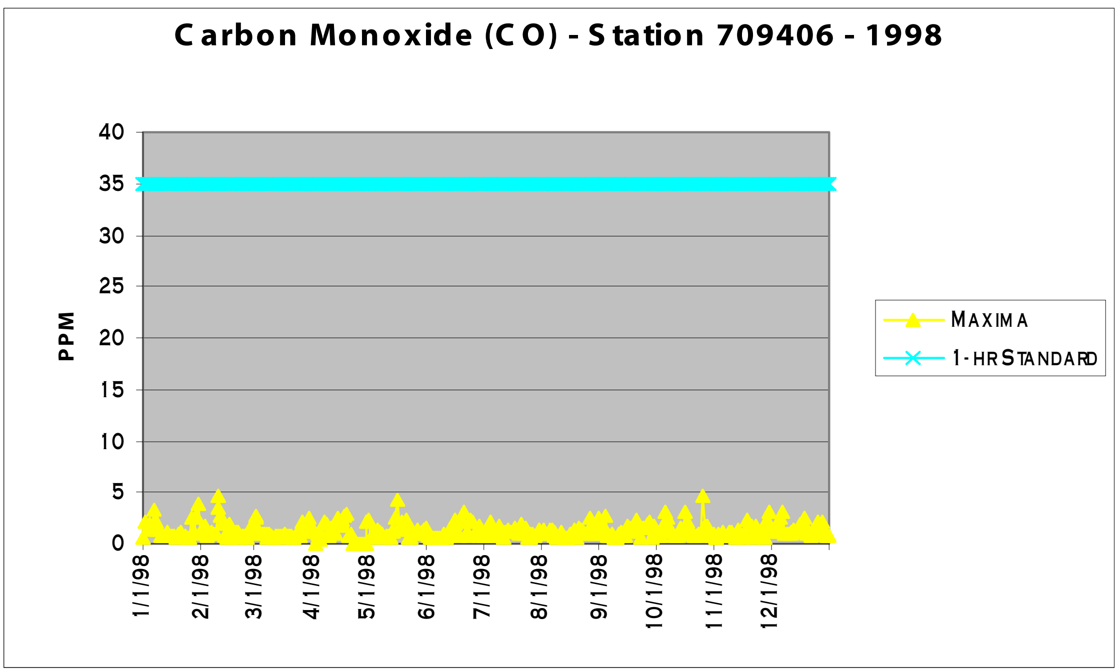


Figure 5.



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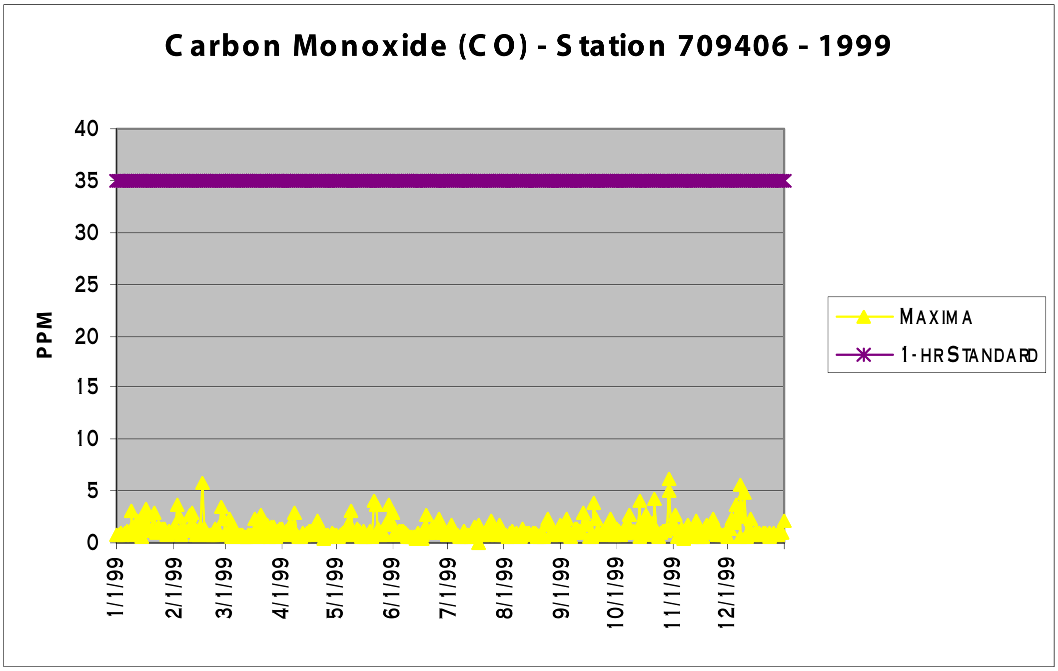

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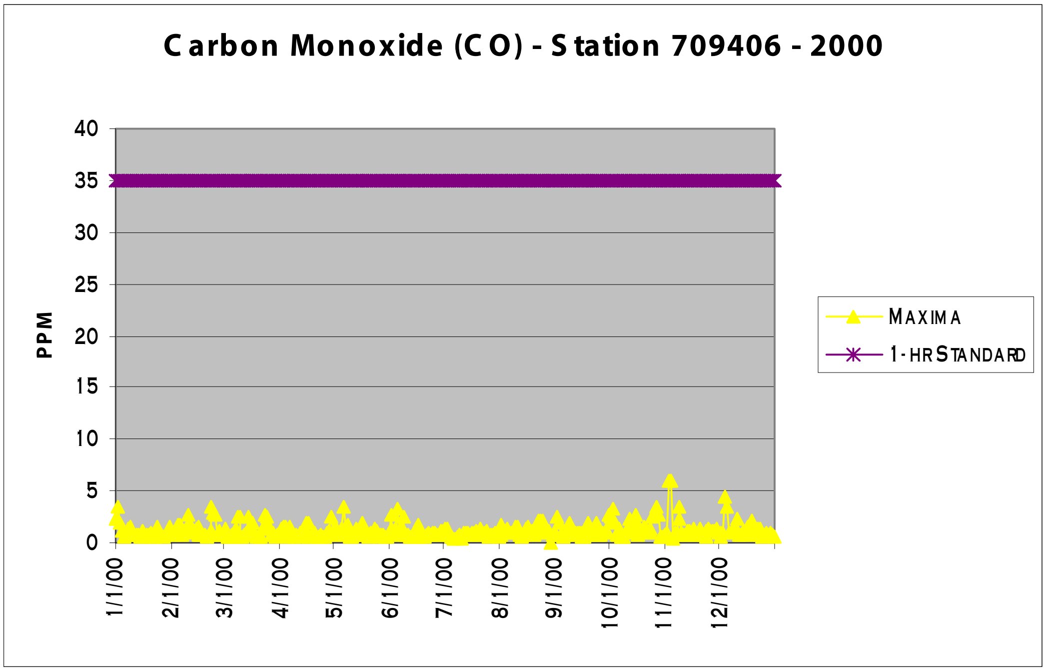


Figure 8.

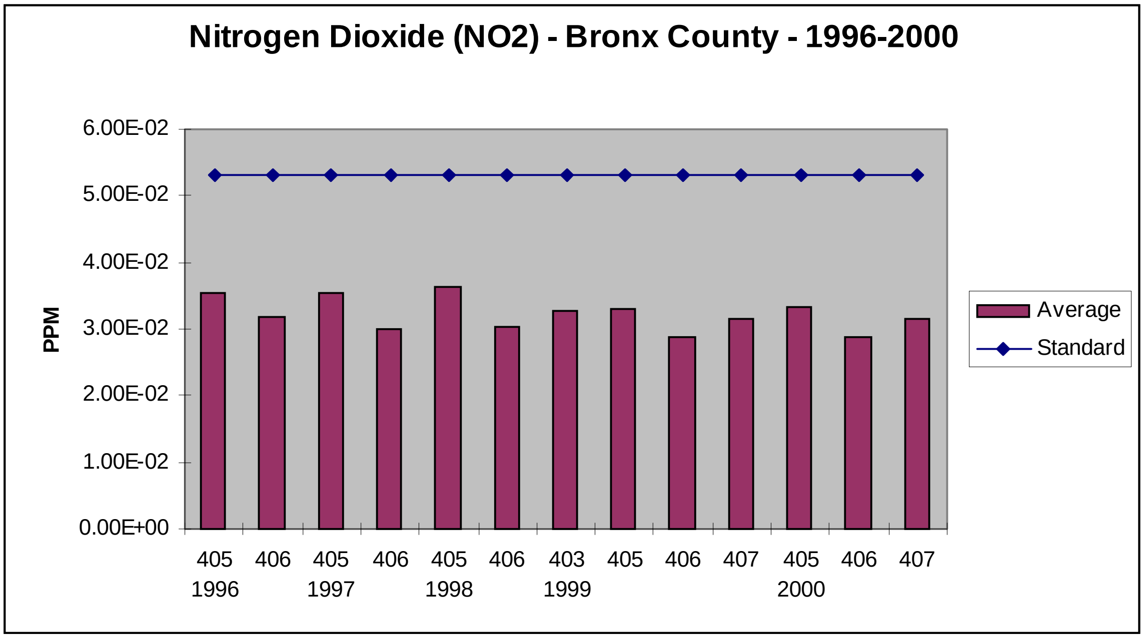


Figure 9.

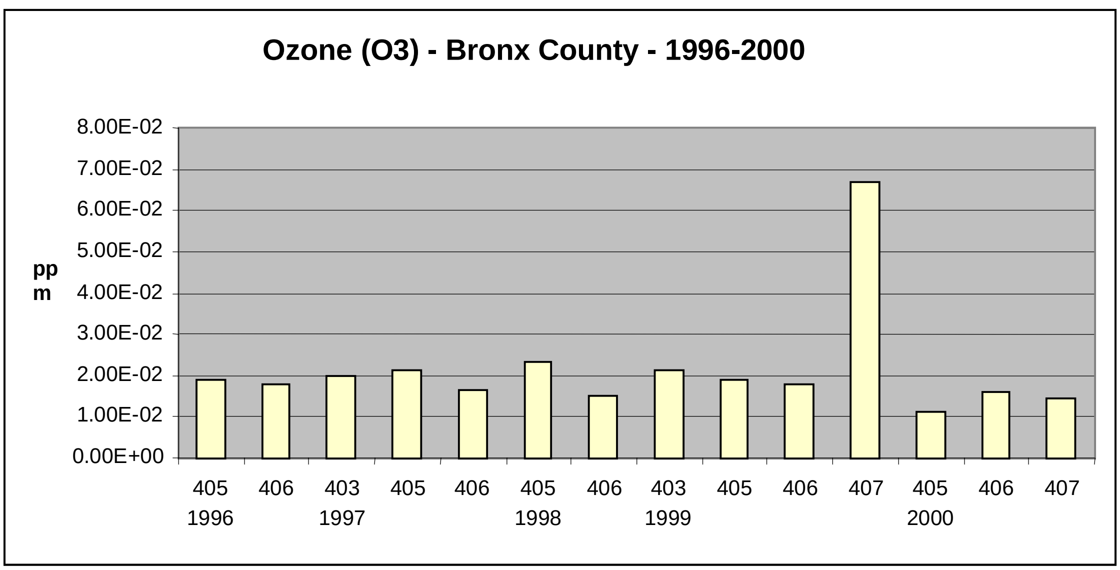


Figure 10.

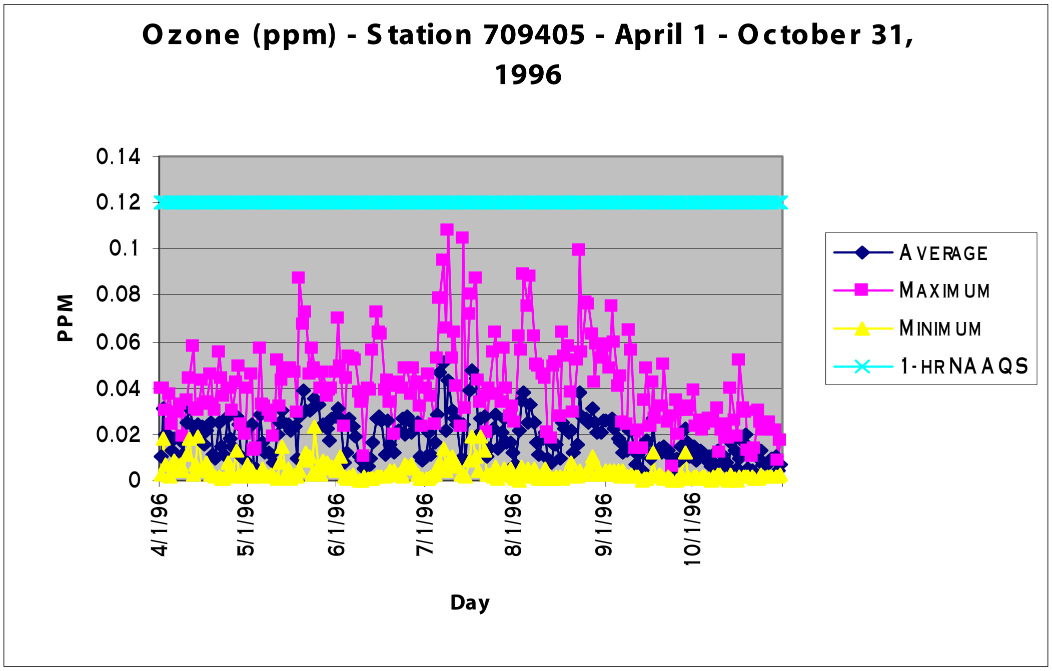
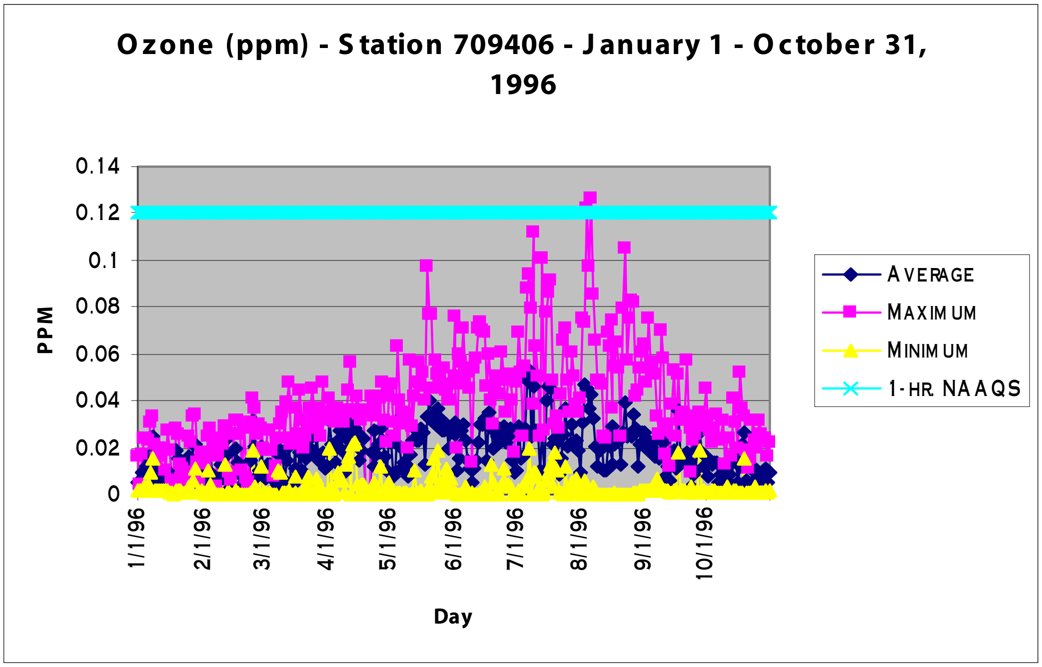


Figure 11.



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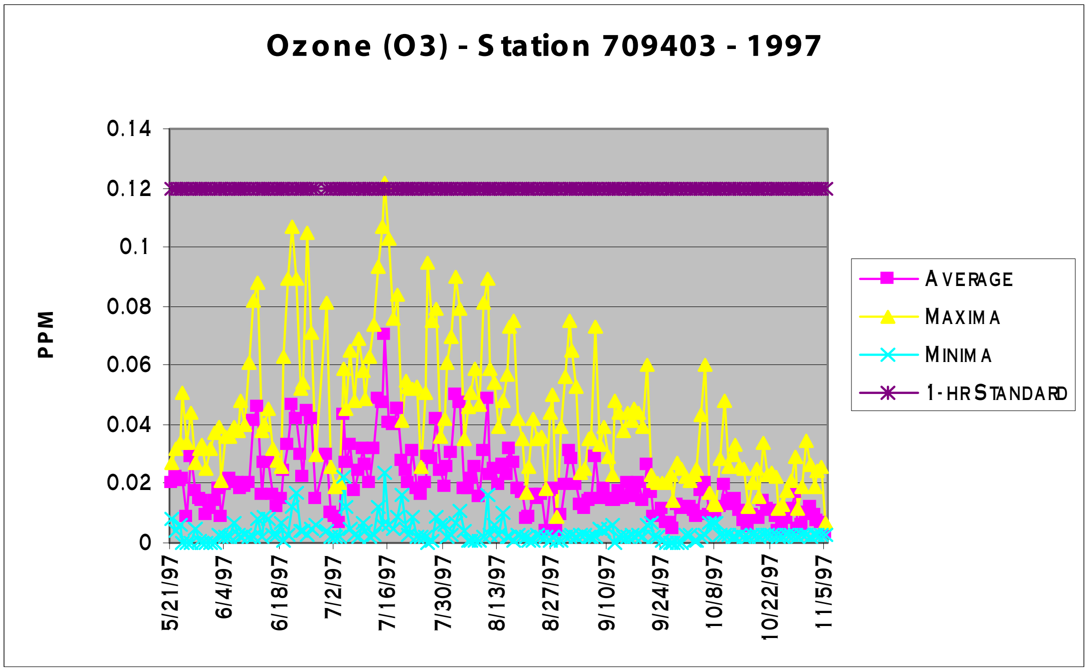

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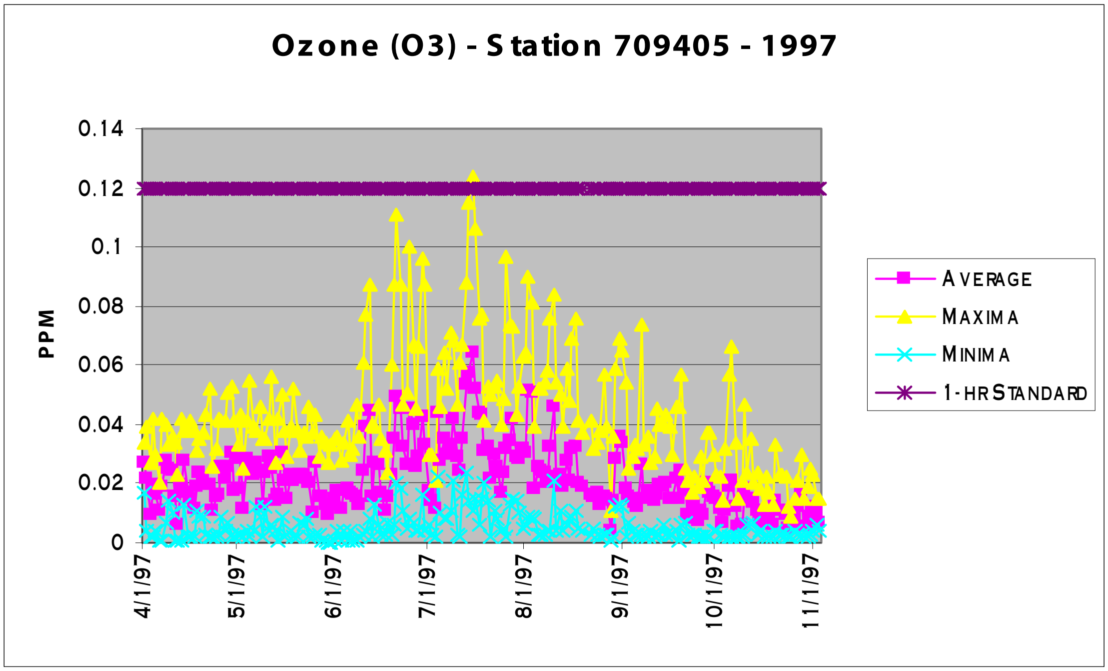
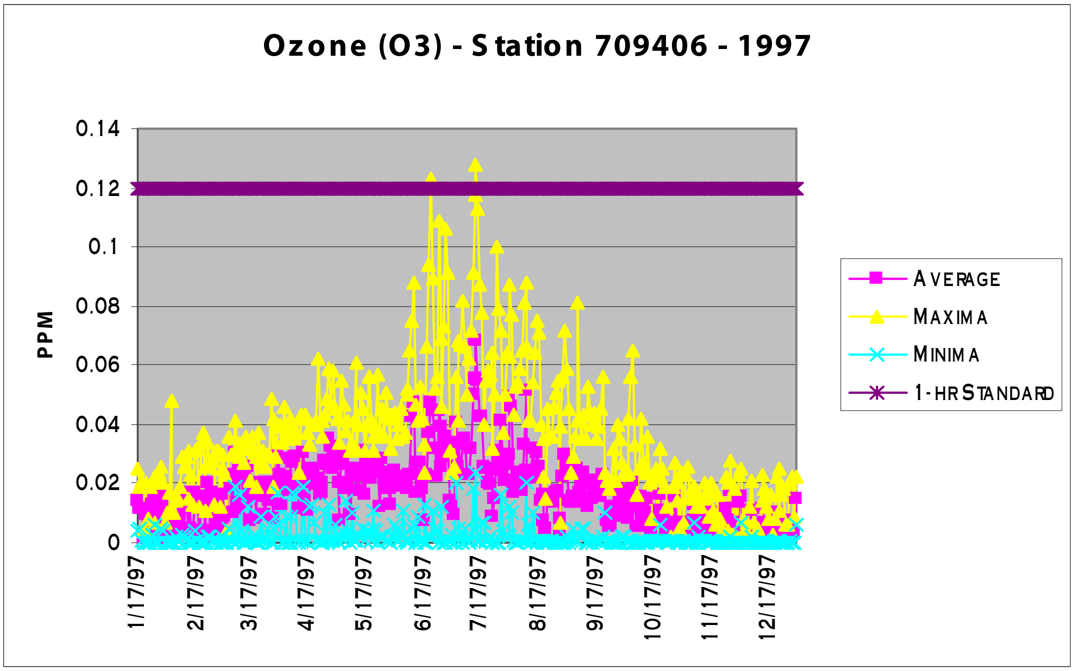


Figure 14.



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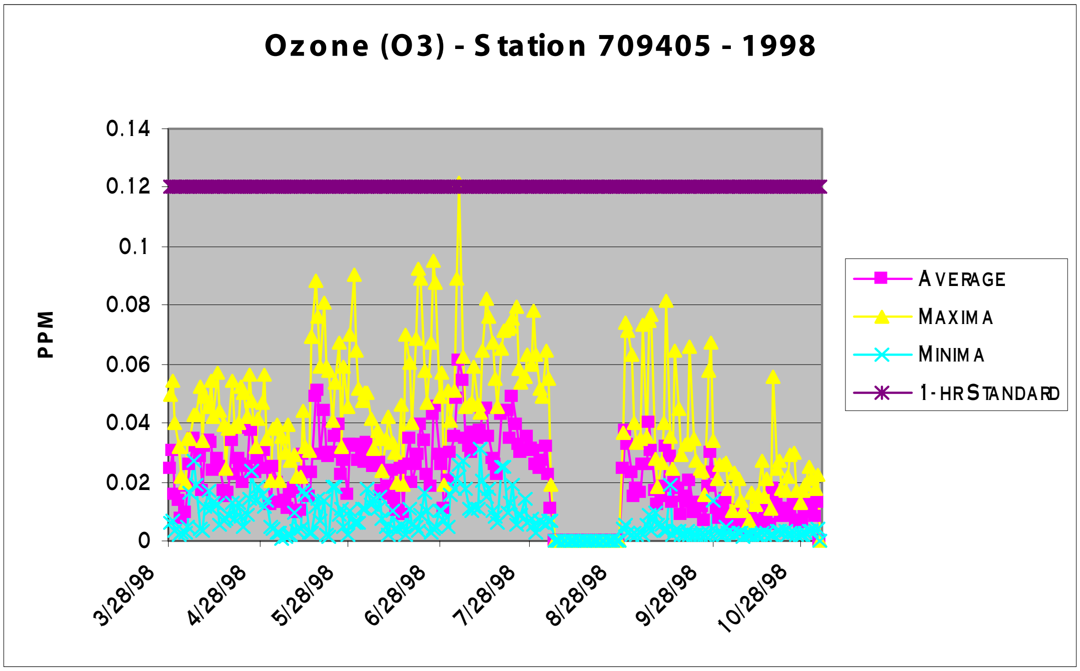

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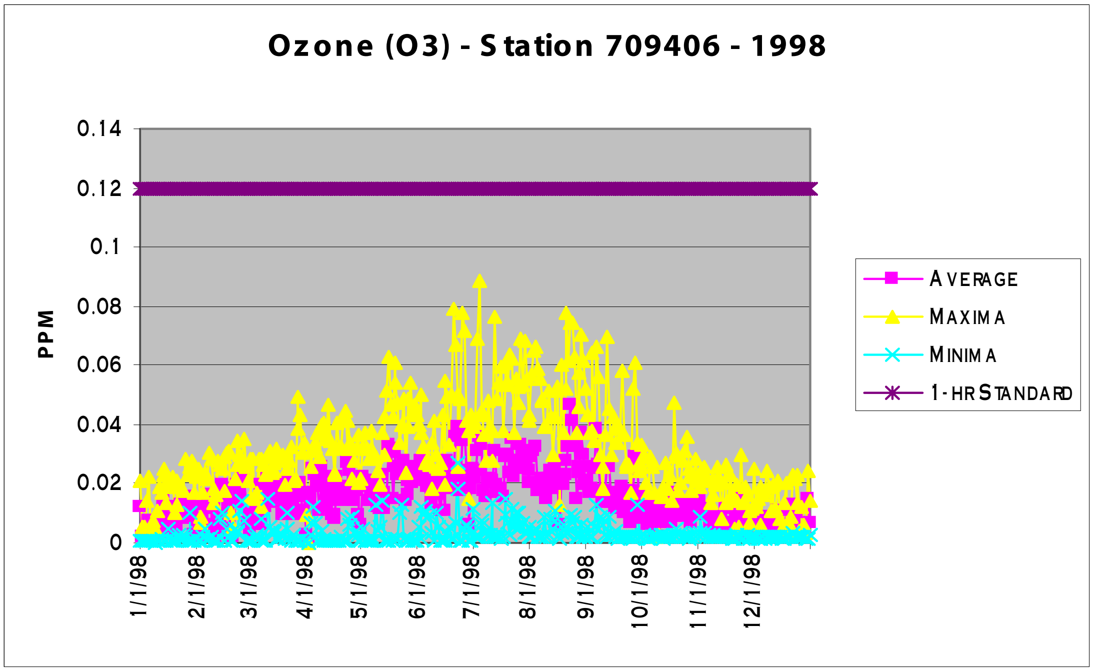

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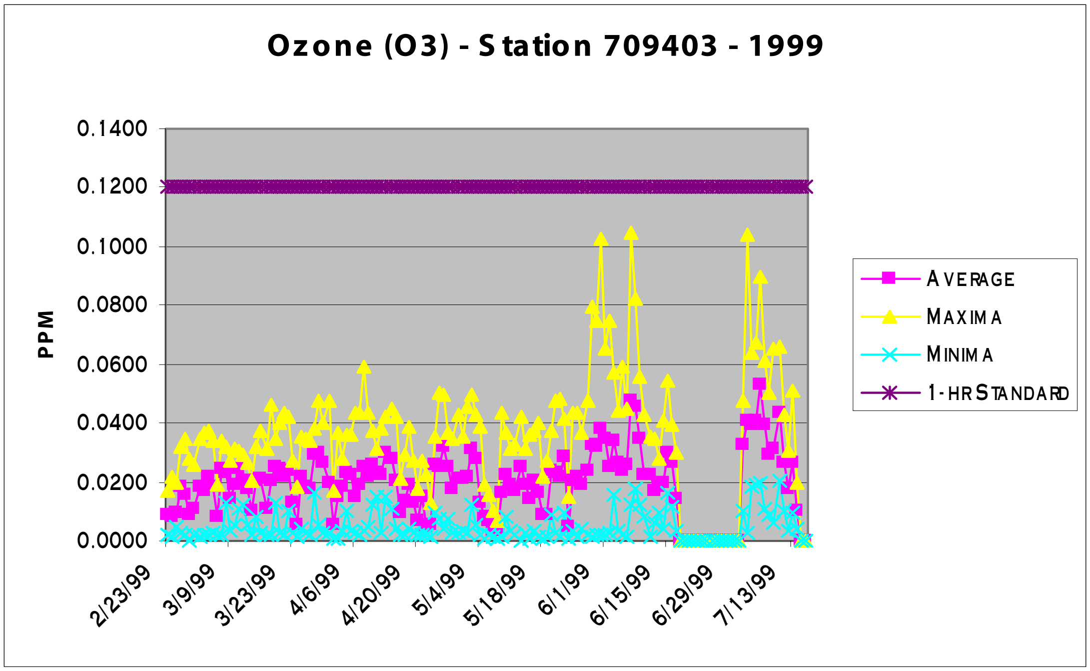

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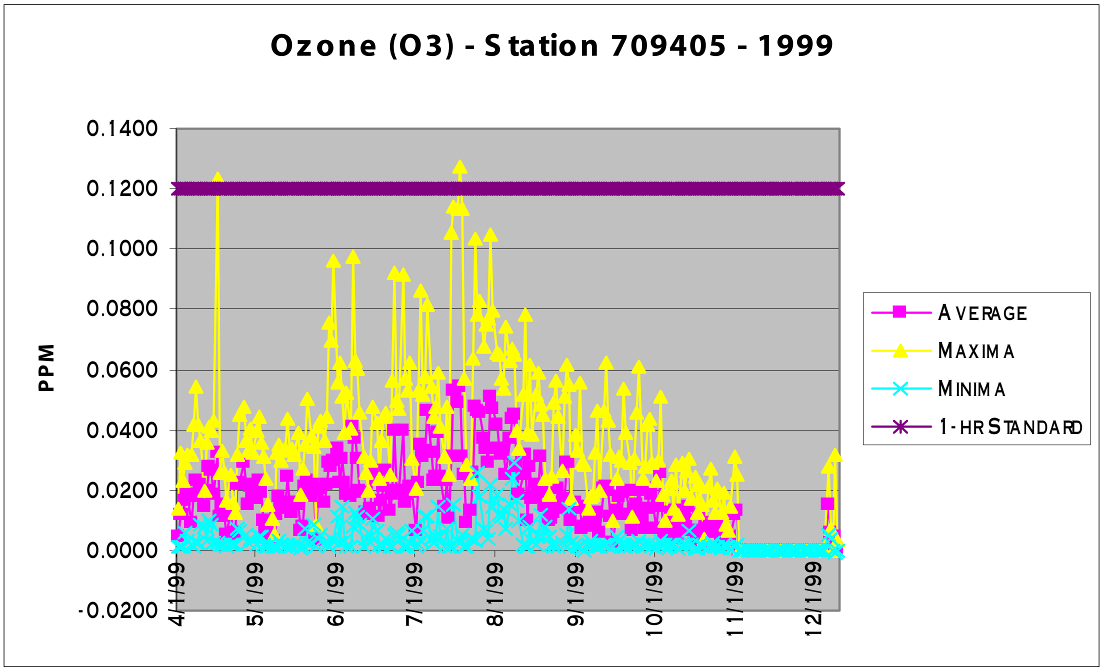

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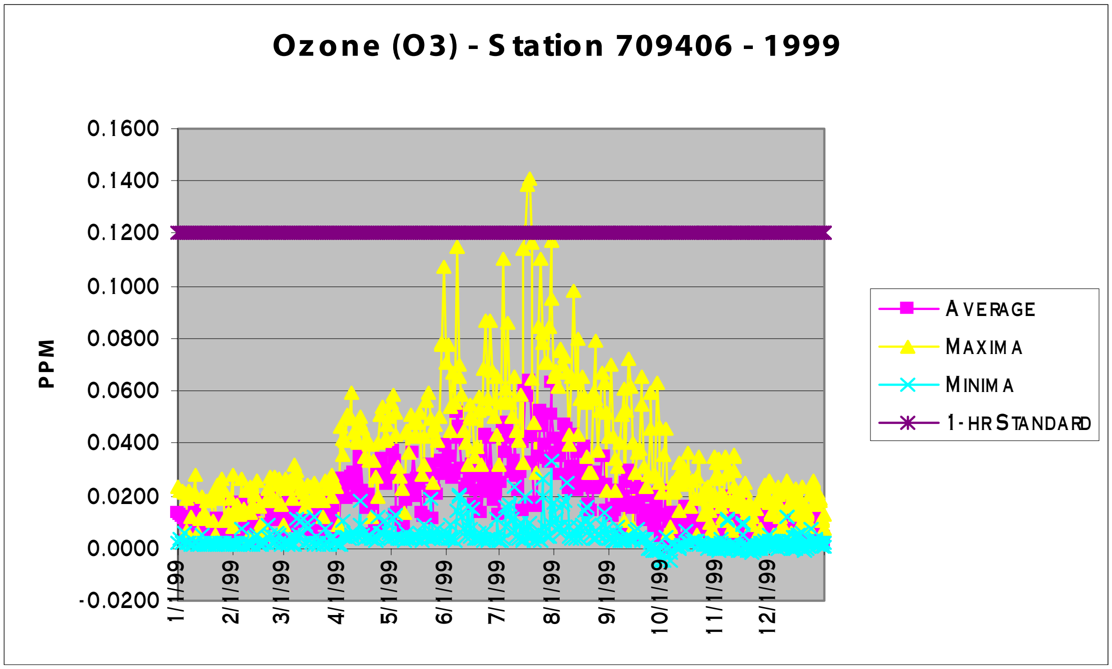

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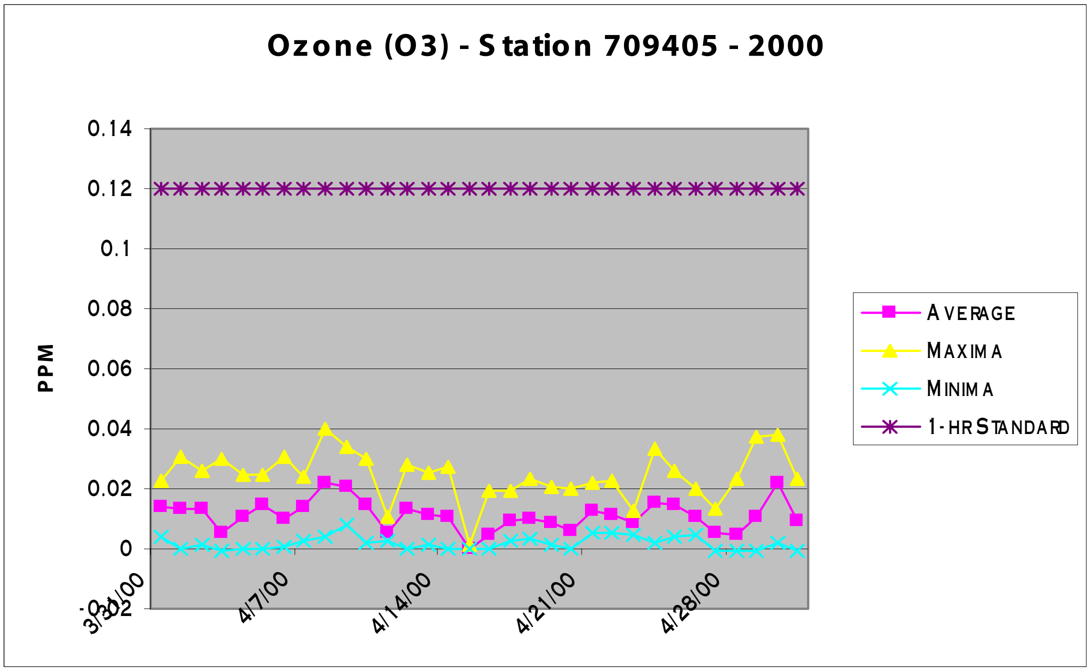

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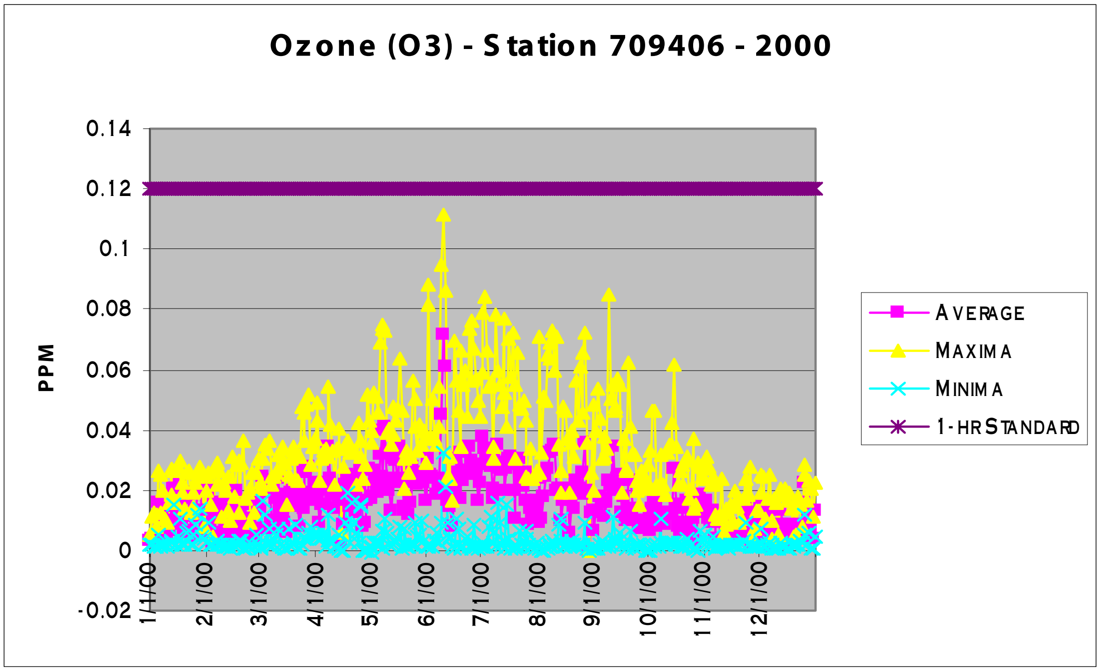

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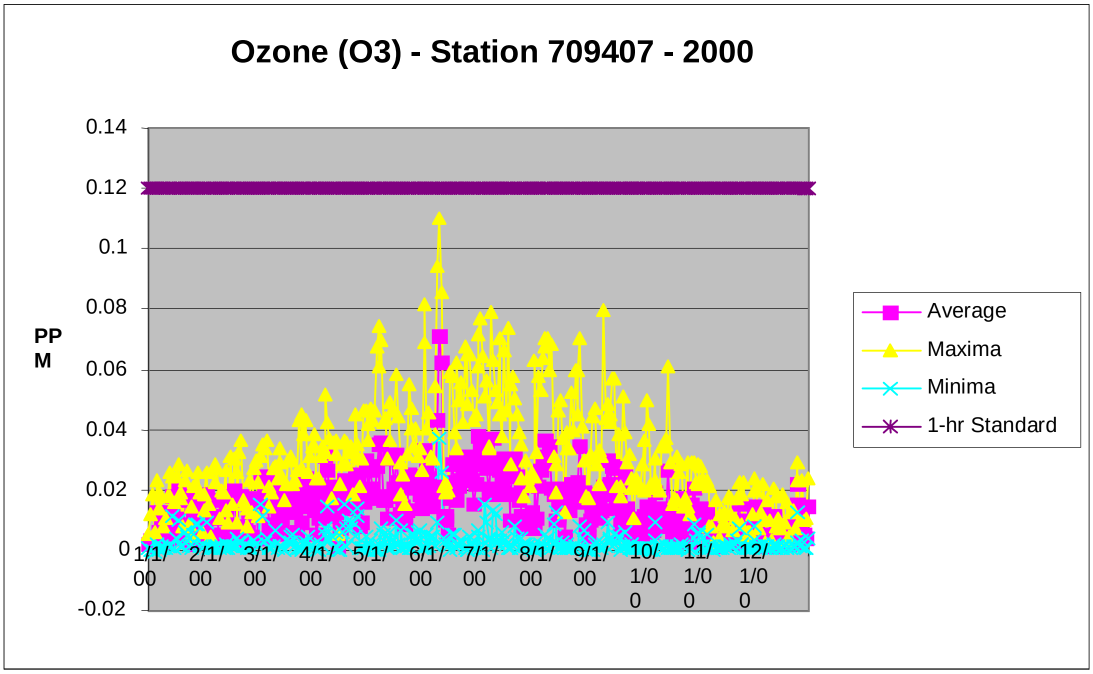

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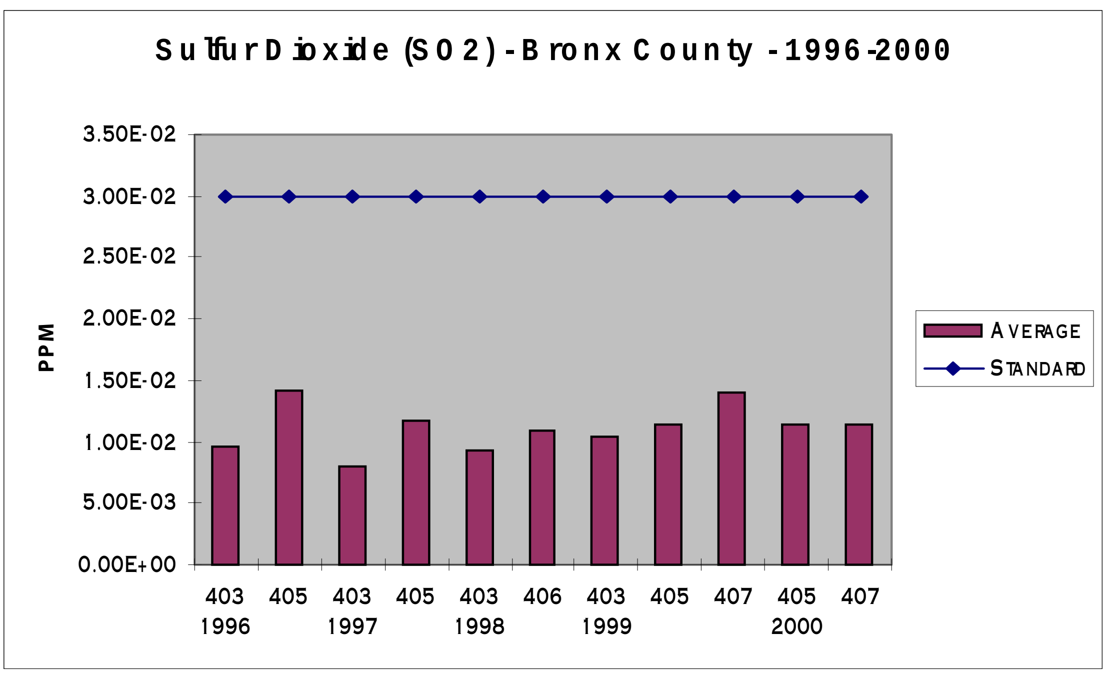

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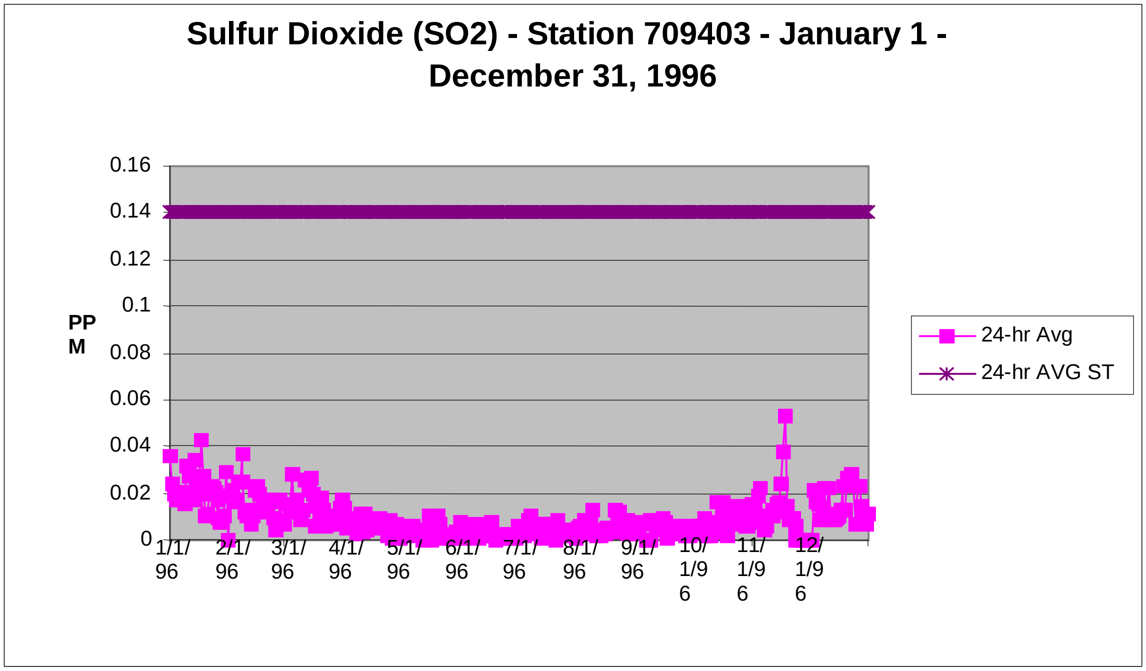

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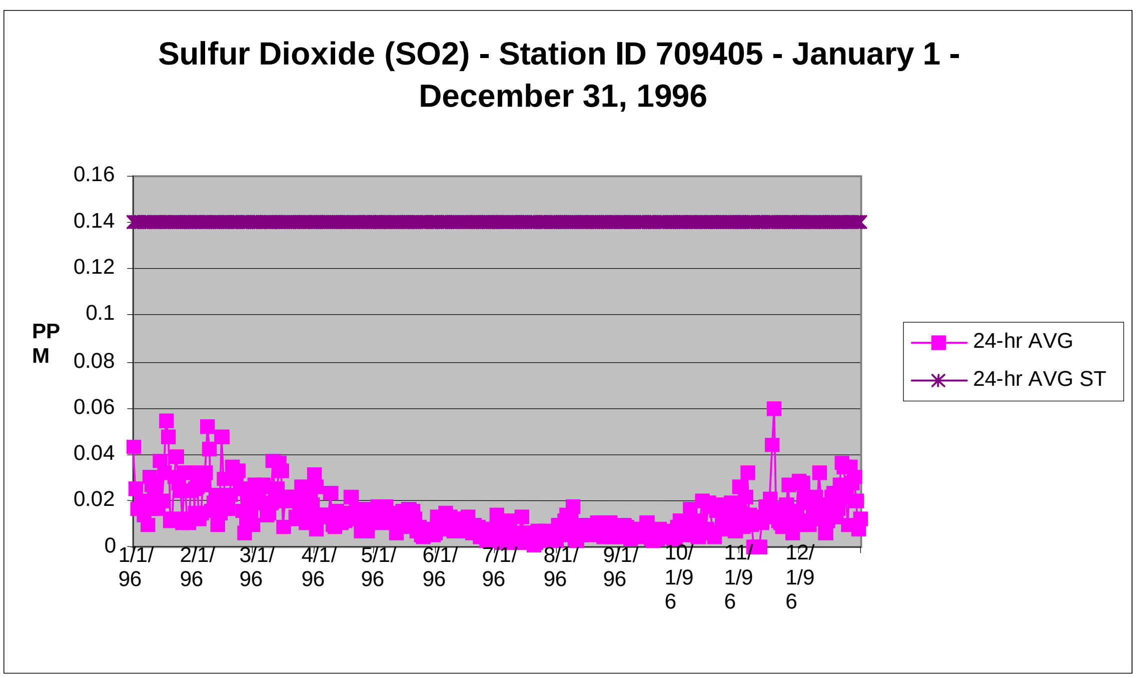

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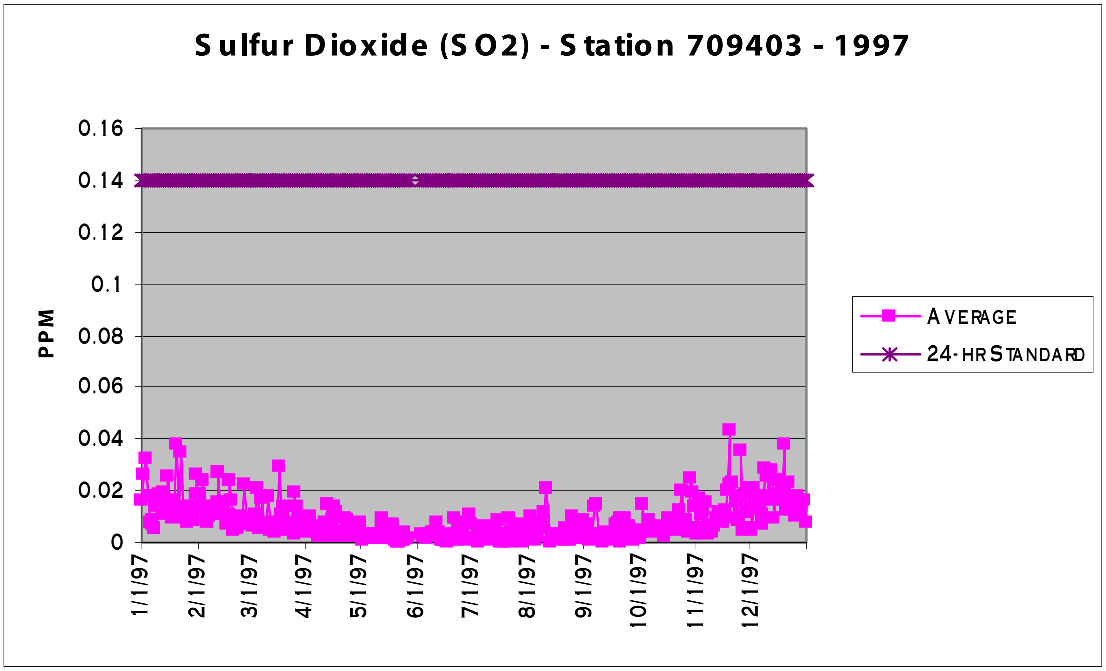

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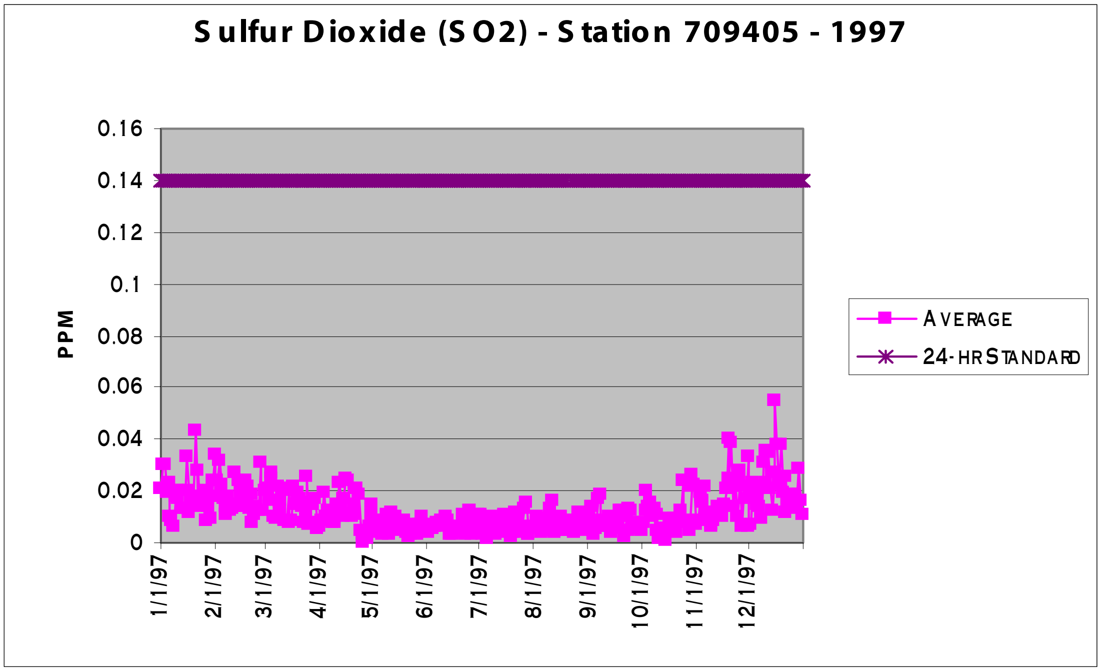

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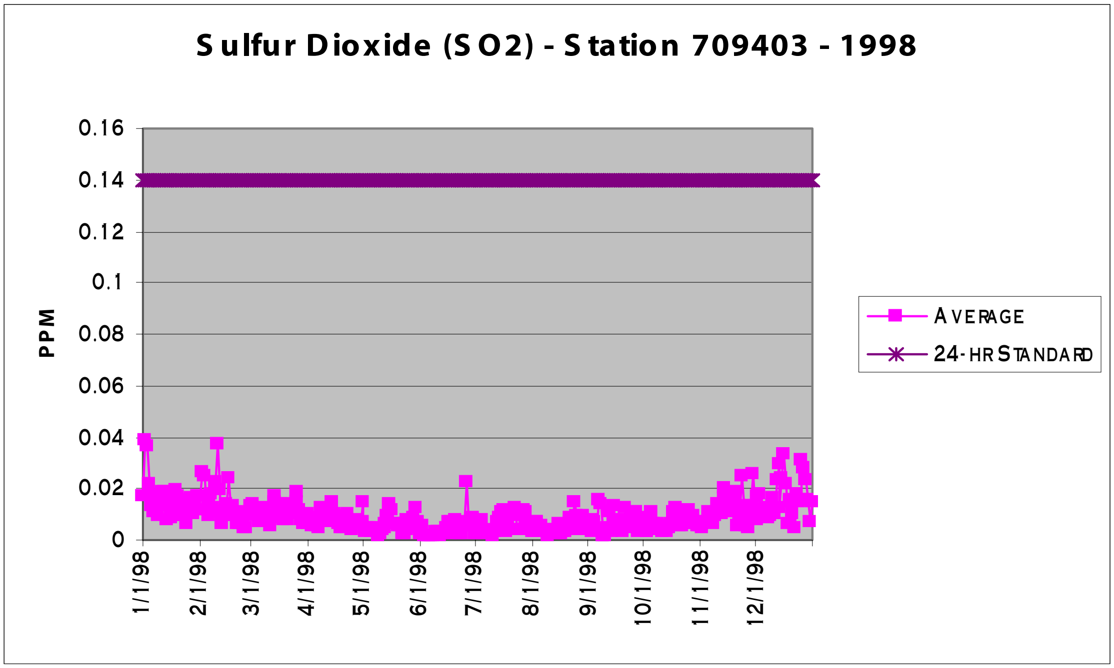

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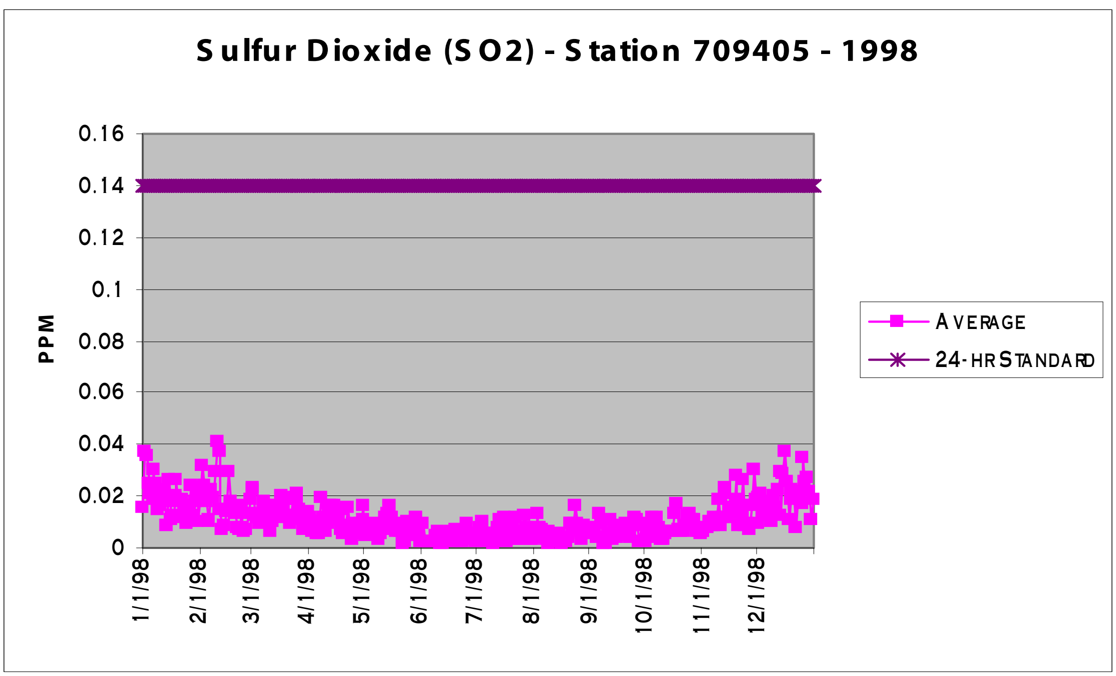

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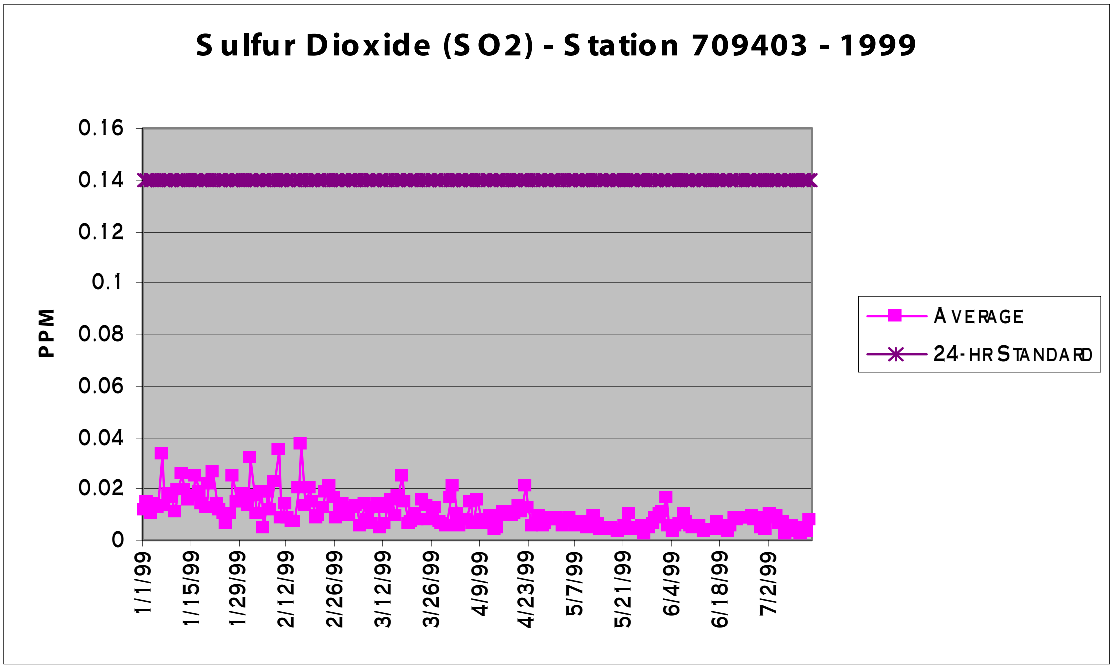

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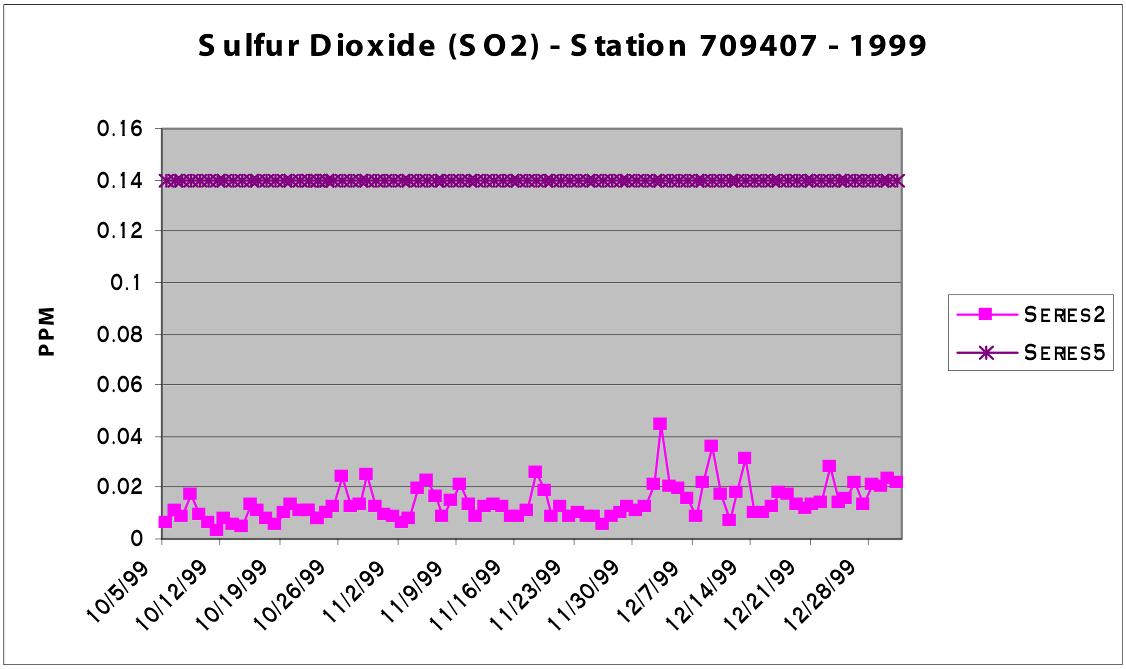

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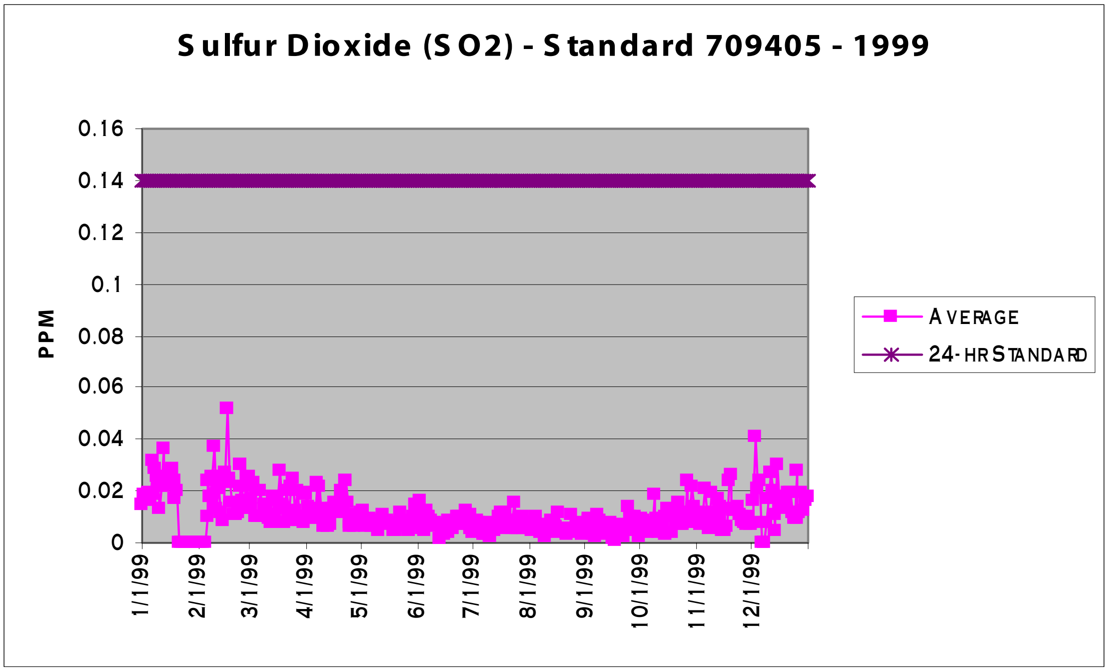

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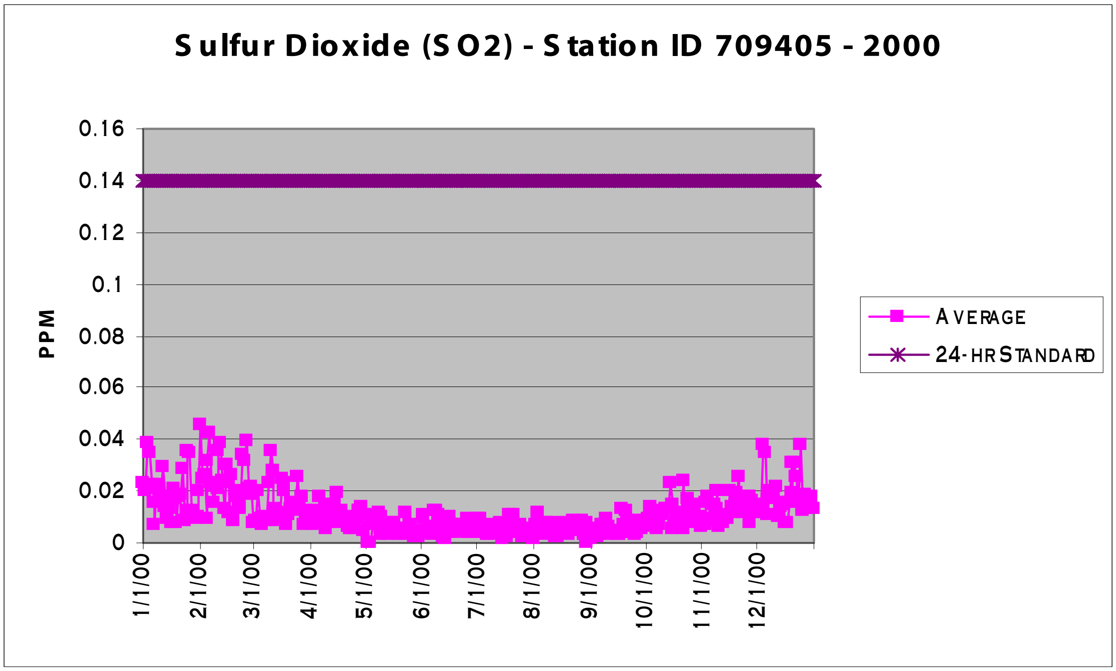

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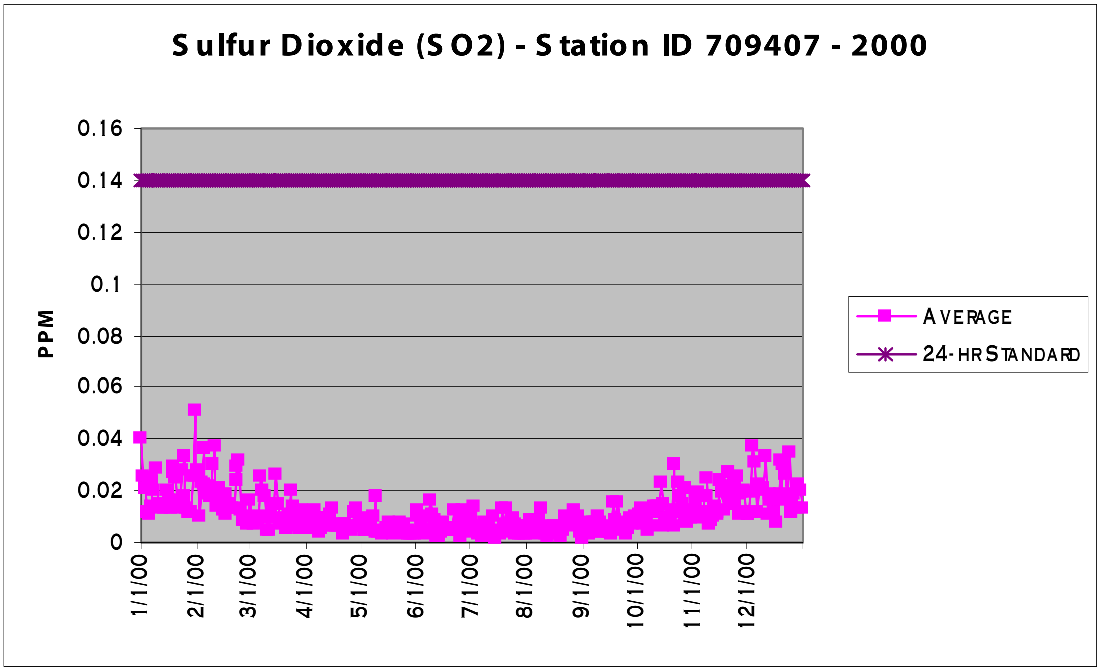

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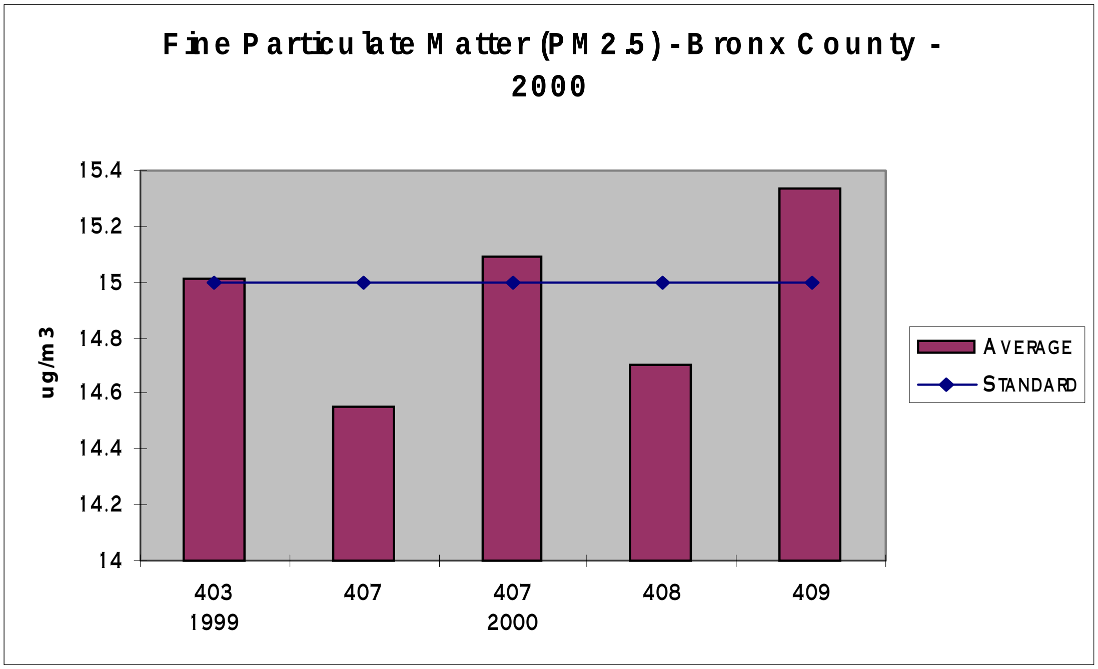

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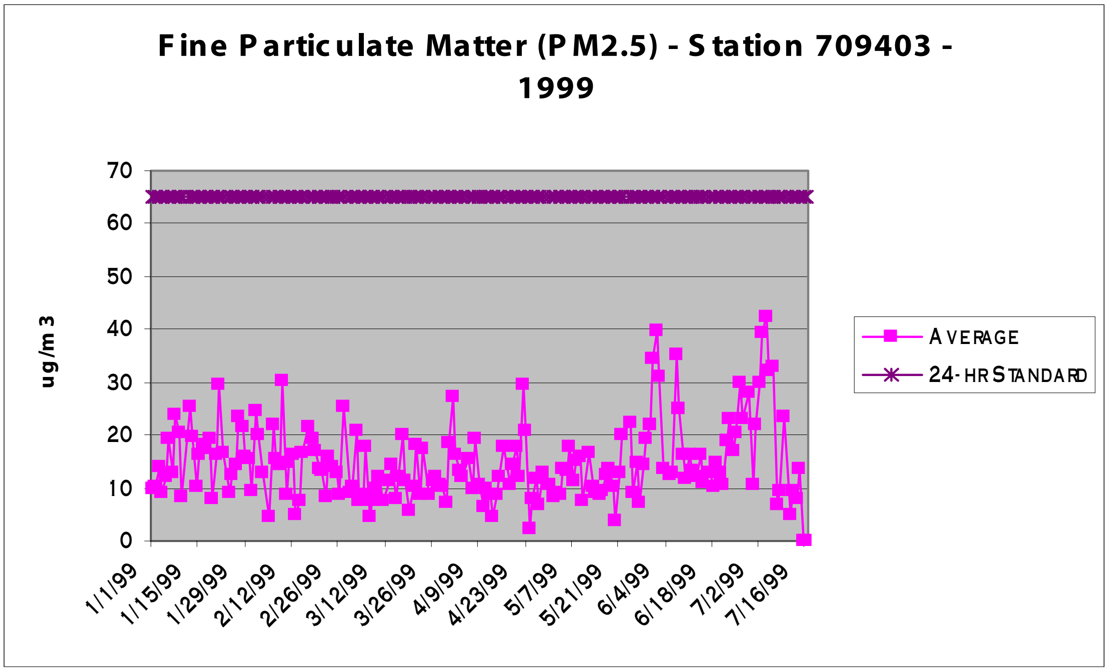

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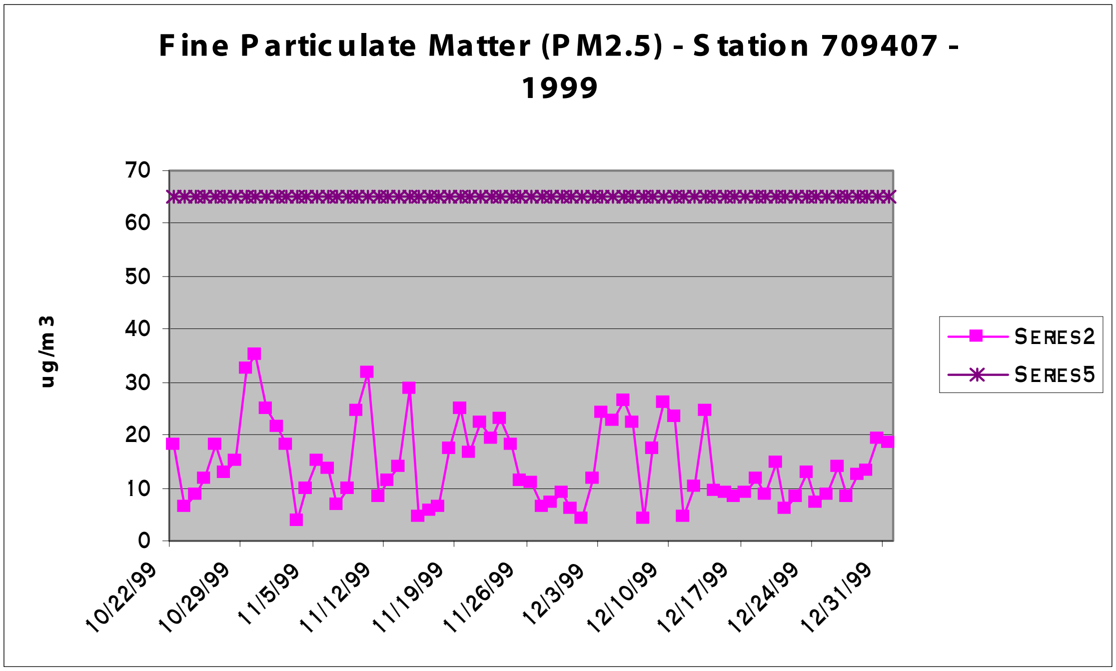

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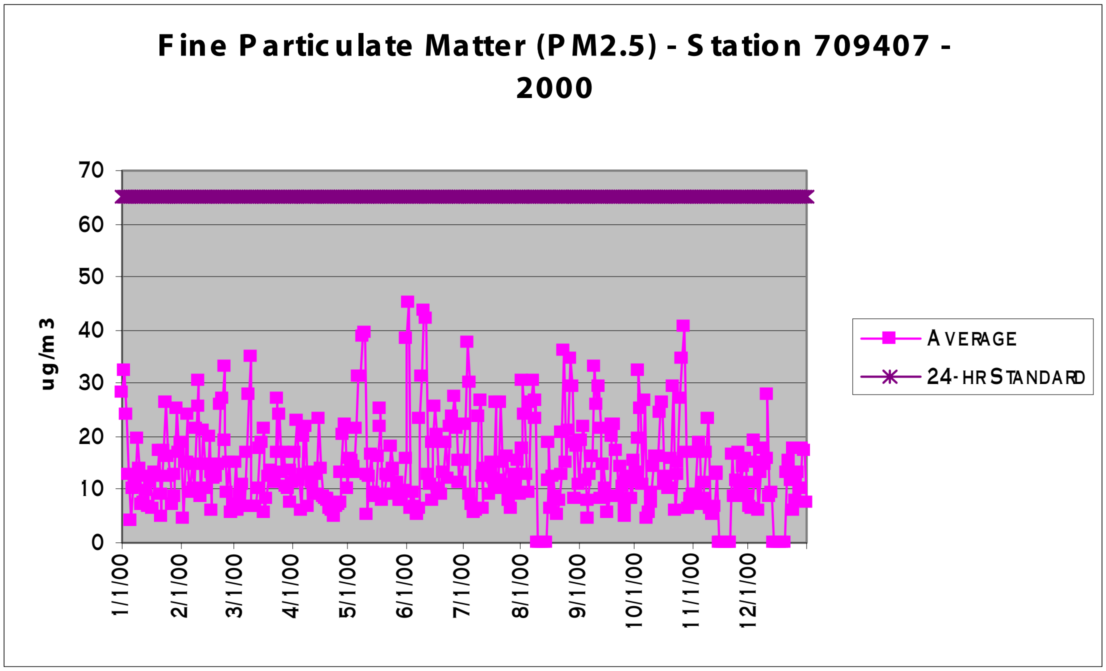

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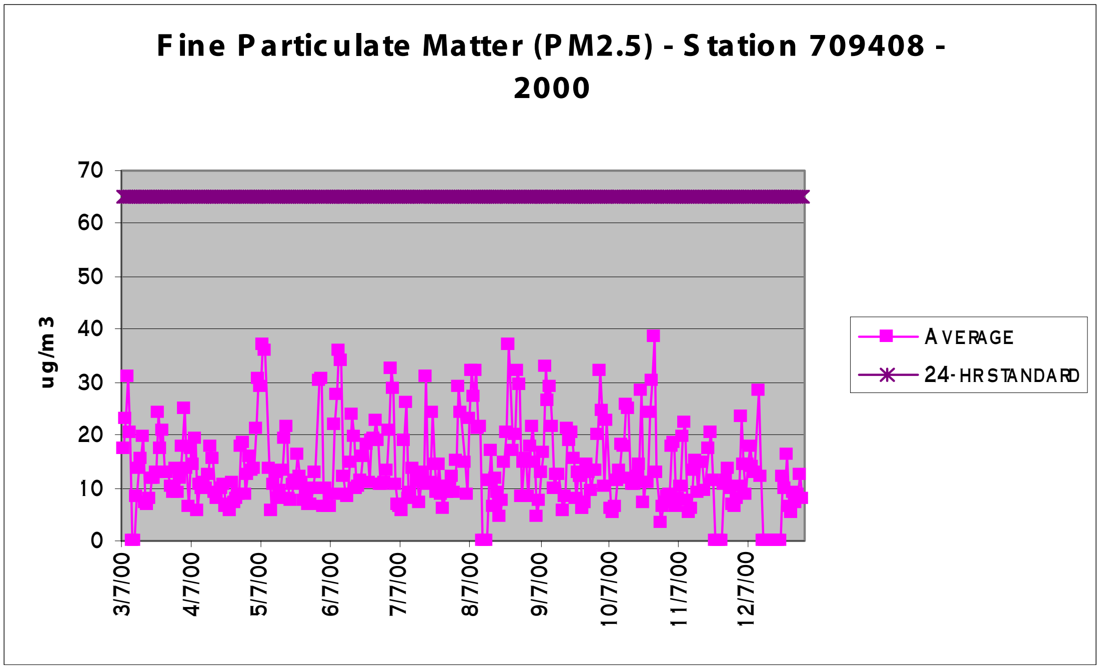

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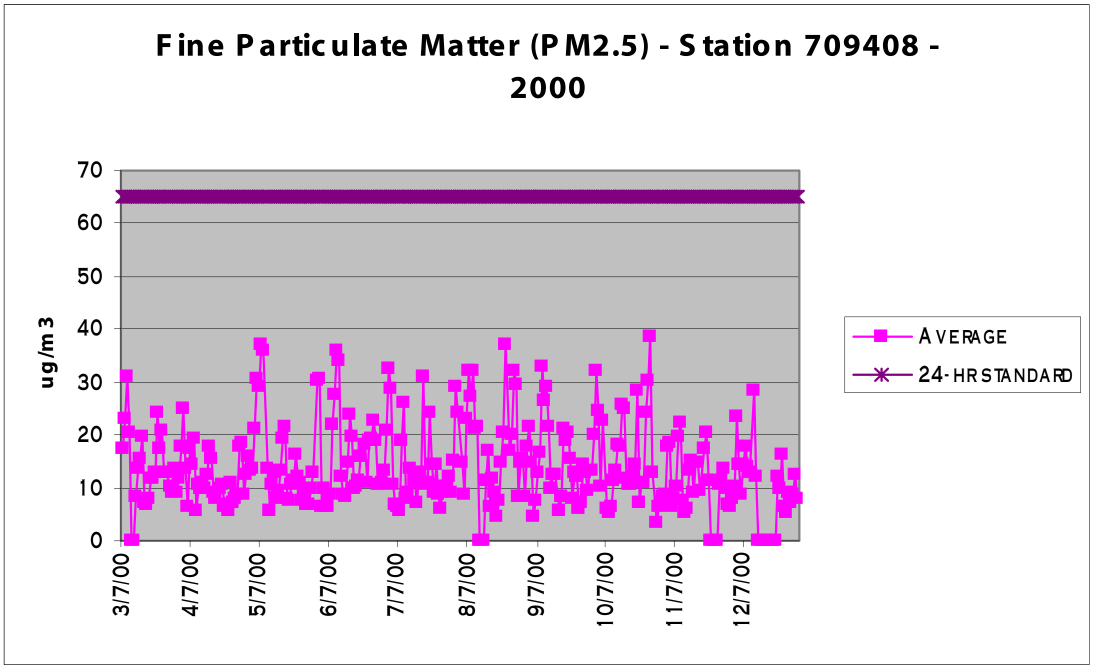

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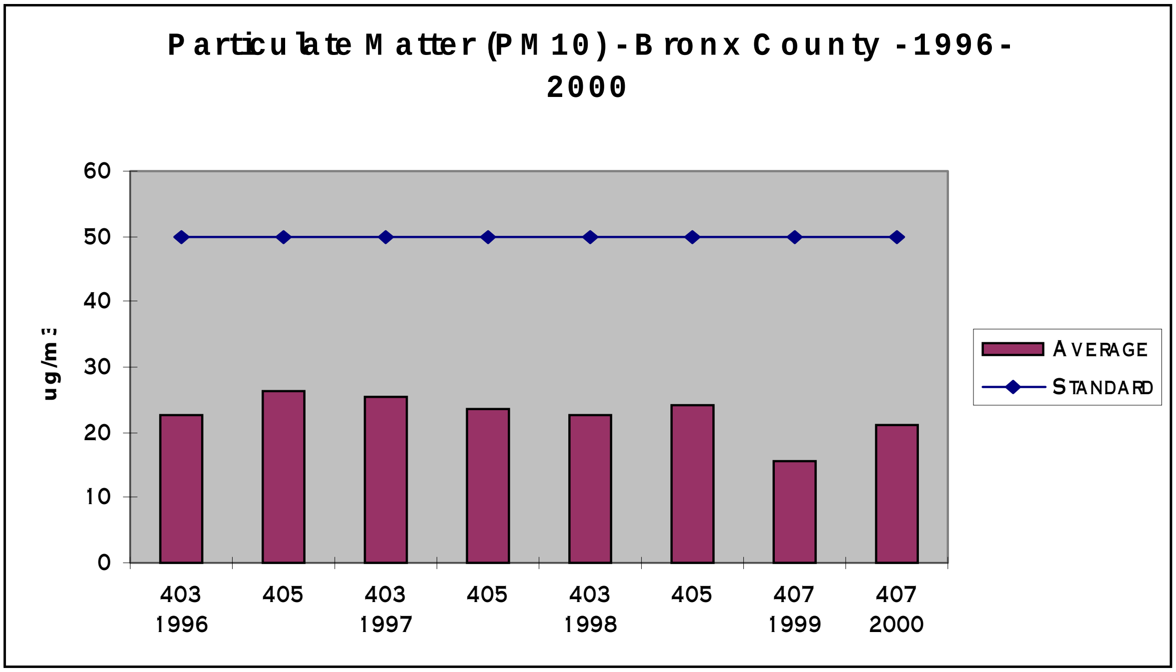

CHAPTER 5. ASTHMA AND AIR POLLUTION: A LITERATURE REVIEW[17]

5.1 Introduction

Over the last three decades, the incidence and severity of asthma in industrialized countries such as the United States, New Zealand, Australia, Canada, Sweden, and others have increased dramatically. In the United States, asthma is now the number one reason children are admitted to hospitals and the number one cause of school absenteeism.[18] According to the American Lung Association, 24.7 million Americans have been diagnosed with asthma and the costs associated with asthma are estimated to be around $12.7 billion. Between 1980 and 1994 the number of asthma cases increased by 75%. The increase was even higher for children under the age of 4 years. That group saw an increase of 160% during the same period.[19] About 5,000 people die from asthma in the United States every year.[20] Among children, the number of deaths attributed to asthma increased by 78% between 1980 and 1993.[21] Although some believe part of this increase is due to better asthma diagnosis, most doctors believe the increase is real.[22]

In the United States, asthma rates are also associated with poor neighborhoods. In New York City, for example, East Harlem, where the average annual household income is about $19,000, has asthma hospitalization rates of about 222.8 per 10,000 per year. On the other hand, five high income areas in Manhattan, Queens and the Rockaways, the latter with an average annual household income of over $100,000, have hospitalization rates for asthma that are zero.[23] Although the reason for such disparities is poorly understood, it is believed to be caused by the following factors: poor households have less access to medical care, are less able to afford the medications they need, and live in environments where asthma triggers are more likely to be found.[24]

This section of the report reviews the literature on the association between asthma and air pollution. The first section briefly describes asthma and the symptoms associated with it. The second section examines asthma rates in Bronx County. The third section provides a description of some of the causes and risk factors associated with asthma. As the section shows, there are many possible factors that could be responsible for the rising rates of asthma observed in recent years. One of those risk factors could be air pollution. The fourth section examines the association between asthma and air pollution. A representative sample of epidemiological studies

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[17] This chapter was written by Carlos Restrepo, Ph.D candidate at NYU's Wagner School and Graduate Research Assistant at ICIS and Project Manager for the NYU-Wagner portion of the South Bronx project. This chapter was developed from material used in Carlos Restrepo's doctoral dissertation, "Asthma and Air Pollution in New York City."

[18] See Zoller Steitz, Matt. "Documentarian Bill Moyers Explores the Dangers Toxins Pose to Kids." Newhouse News Service. May 9, 2002.

[19] See Spake, Amanda. "Don't Breathe the Air." U.S. News & World Report. July 1, 2002. Pg. 36.

[20] See Ruppel Shell, Ellen. "Does Civilization Cause Asthma?" *The Atlantic Monthly*. May 2000. This article can be accessed at: http://www.theatlantic.com/issues/2000/05/shell.htm - access date: September 9, 2002.

[21] See Noble, Holcomb B. "Study Shows Big Asthma Risk for Children in Poor Areas." *The New York Times*. July 27, 1999.

[22] See Stolberg, Sheryl Gay. "Poor Fight Baffling Surge in Asthma." *The New York Times*. October 18, 1999.

[23] See Noble, 1999, op cit.

[24] See Stolberg, 1999, op cit.

that have looked at this association is described. A more detailed list of studies that have examined this topic is provided in the accompanying appendix. Finally, the fifth section provides some concluding remarks.

5.2 What is Asthma?

Asthma is a respiratory disease characterized by bronchial hyperresponsiveness, bronchial constriction, airway inflammation and recurrent airflow obstruction. It is accompanied by respiratory symptoms such as wheezing, dyspnea, coughing, and chest tightness. The development of asthma is multifactorial, and is currently poorly understood. Among the risk factors mentioned in the literature as potential causes of asthma are genetic predisposition, inheritance of atopy, and environmental factors such as allergen exposure, environmental tobacco smoke, socioeconomic status, nutrition, low birth weight, history of infections, and ambient levels of air pollution.[25]

The constriction of the airways in asthmatics is triggered by histamines, which are produced by the immune system as a reaction to foreign substances. Histamines act to bring more blood and lymph fluid to the site where a foreign substance is found in order for immune cells to fight these substances and for blood to carry them away. Histamines are released by mast cells, which store a variety of inflammatory mediators, and this process is triggered by their immunoglobulin E (IgE) proteins which are in turn activated by the molecules to which they have been sensitized. The result is intermittent episodes of wheezing, coughing and breathlessness in the afflicted individuals. In severe cases, asthma attacks can result in death.[26]

5.3 Asthma in Bronx County

Bronx County has some of the highest rates of asthma in the United States. Rates of death from asthma are about three times higher in the Bronx than the national average. Hospitalization rates are about five times higher. In some neighborhoods in the Bronx it is estimated that 20% of the children have asthma.[27] Within New York City the disparity in asthma hospitalization rates is very pronounced. According to a study, hospitalization rates for asthma in Bronx County and East Harlem are 21 times higher than that of affluent parts of the city.[28]

As the following graph shows, Bronx county has the highest pediatric asthma (children 0-4 years) hospitalization rates in the New York area. New York county (Manhattan) has the second highest rate. Richmond county (Staten Island) and Upstate New York, which according to the definition used by the NYS Department of Health includes all of New York State except New

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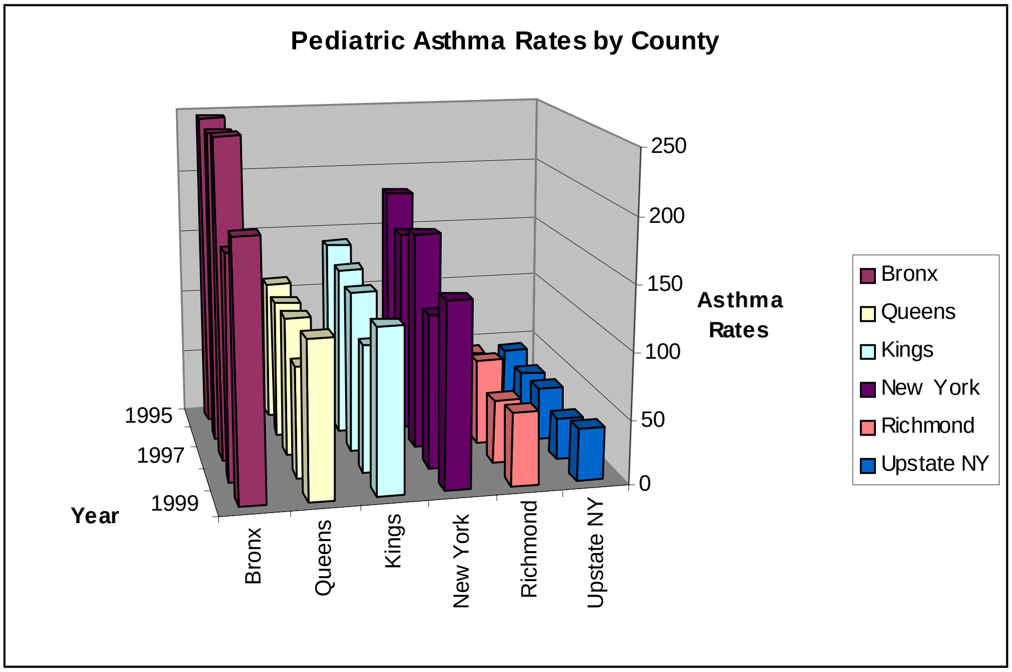
[25] See Pandya, Robert J., Gina Solomon, Amy Kinner and John R. Balmes. "Diesel Exhaust and Asthma: Hypotheses and Molecular Mechanisms of Action." *Environmental Health Perspectives*. Vol. 110, Supplement 1, February 2002. Pages 103-112.

[26] This section is drawn from Ridley, Matt, "Asthma, Environment, and the Genome," *Natural History*, March 2000.

[27] See Ruppel Shell, Ellen. "Does Civilization Cause Asthma?" *The Atlantic Monthly*. May 2000. This article can be accessed at: http://www.theatlantic.com/issues/2000/05/shell.htm - access date: September 9, 2002.

[28] See Stolberg, 1999, op cit.

York City, have pediatric asthma hospitalization rates that are significantly lower than those of the other counties included in the graph.[29]



5.4 Causes of Asthma

Asthma is a very complex disease with many factors contributing to its development and exacerbation. Recently, some authors have started to explore the idea of asthma as consisting of several subtypes. These include allergic asthma, exercise-induced asthma, asthma caused by bacterial and fungal infections, asthma in the elderly, and others. These different types of asthma have different triggers and may respond differently to treatments and interventions.[30]

Although the causes of asthma are poorly understood there are a number of theories that try to explain why the incidence of the disease is increasing. A number of factors are known to trigger the disease. These include cockroaches, dust mites, molds, hair from pets, diesel fumes, ozone, sulfur dioxide, nitrogen dioxide, pollen, tobacco smoke, stress, cold and dry air, metal vapors, paint, and others.[31] However, these triggers are not believed to be the cause of the disease.

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[29] This graph was constructed using data available in the internet: Bronx County - http://www.health.state.ny.us/nysdoh/cfch/pbronx.htm; Queens County - http://www.health.state.ny.us/nysdoh/cfch/pqueen.htm; Kings County - http://www.health.state.ny.us/nysdoh/cfch/pkings.htm; New York County - http://www.health.state.ny.us/nysdoh/cfch/pmanha.htm; Richmond County - http://www.health.state.ny.us/nysdoh/cfch/prichm.htm; and Upstate New York - http://www.health.state.ny.us/nysdoh/cfch/upstate.htm

[30] See Immunotherapy Weekly, "Study highlights new ways to cut inner-city kids' asthma severity," May 15, 2002.

[31] See Ridley, Matt. "Asthma, Environment, and the Genome." *Natural History*. March 2000.

One of the more popular theories for a cause of asthma is modern hygiene. Some scientists believe that children are increasingly growing up in very clean environments. As a result of being inoculated against diseases and having easy access to antibiotics, children are not developing the kinds of immune responses to tackle challenges posed by allergens.[32] Since asthma usually appears before the age of six, scientists are now trying to understand what happens during the first years of a child's life that causes asthma.[33]

Another theory for why asthma rates are increasing in developed countries has to do with a sedentary lifestyle. Children who do not engage in vigorous exercise and are exposed to indoor allergens like dust mites, cockroaches, and cigarette smoke may be more likely to develop asthma. In neighborhoods such as the South Bronx children may have less access to playgrounds and parks and as a result they may not get an adequate amount of exercise.[34]

Genetics also seems to play an important role in the development of asthma. A recent genome-wide scan on 460 Caucasian families identified a locus on chromosome 20p13 that is linked to asthma.[35] Genetic susceptibility to asthma also appears to vary by ethnic group. This is one possible reason why African-Americans and Hispanics have higher rates of asthma than whites in the United States. The prevalence of asthma in children between 6 months and 11 years of age living in the United States varies according to ethnic group as follows: Puerto Rican, 11.2%; non-Hispanic Blacks, 5.9%; Cubans, 5.2%; non-Hispanic whites, 3.3%; Mexican-Americans, 2.7%.[36] The case for a genetic predisposition to the disease was bolstered by the finding that isolated populations have high rates of asthma. For example, the island of Tristan da Cunha in the mid-Atlantic has a population of about 300 people who are descendents of 15 settlers. Three of the original settlers were known to have asthma and today about one-third of the population is afflicted with this disease. This high rate of incidence is not related to air pollution or the presence of allergens in the environment.[37]

Similarly, a retrospective study of 5,864 twins in Norway aged 18-25 indicated that the relative risk of asthma development among twins whose co-twins had a history of asthma compared to those whose co-twin did not was 17.9 (95% CI=10.3-31.0) for identical twins but only 2.3 (95% CI=1.2-4.4) for fraternal twins. The study concluded that 75% of the variation in the propensity to asthma was explained by genetics. Given the complexity of asthma, scientists do not know whether more than one gene is responsible for the disease or different combinations of genes determine asthma in different individuals. Despite the importance of genetics, the recent upward trends in asthma cannot be explained by genetic variation alone as they are too high. Hence, environmental factors are considered to be the main determinants of asthma expression.[38]

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[32] See Ellen, 2002, op cit.
[33] See Stolberg, 1999, op cit.
[34] See McGowan, Kathleen. "Breathing Lessons." *City Limits New York's Urban Affairs News Magazine*. May, 1999.
[35] See Eerdewegh, Paul Van et al. "Association of the ADAM33 gene with asthma and bronchial hyperresponsiveness." *Nature*. Vol. 418. 25 July 2002.Pages 426-430.
[36] See Bates, David. 1995. "Observations on Asthma." *Environmental Health Perspectives*. 103 (Suppl 6): 243-247.
[37] See Ridley, Matt. "Asthma, Environment, and the Genome." *Natural History*. March 2000.
[38] See Sears, Malcolm R.. "Epidemiology of childhood asthma." *The Lancet*. Vol. 350, October 4, 1997, pages 1015-1020.

Premature birth may be another significant factor leading to the development of the disease. In addition, diet may also play a role in the development of asthma. A study concluded that children of mothers who eat fatty fish and leafy green vegetables have less asthma than other children.[39] Similarly, tobacco smoke may is also considered a risk factor. According to a study that looked at 523 children aged 4-16 years who had physician-diagnosed asthma, children with asthma who are exposed to environmental tobacco smoke (ETS) are more likely to have increased respiratory symptoms such as cough and wheeze, increased school absences and decreased lung function.[40]

Another factor considered important in the development and exacerbation of asthma is air pollution. A significant number of studies have tried to establish as association between air pollution and asthma morbidity and mortality. The remainder of this section of the report examines the literature on this subject.

5.5 Asthma and Air Pollution

The association between air pollution and asthma remains poorly understood. Since exposure is always to a mix of pollutants it is difficult for epidemiological studies to define causal agents in the mix. Asthma has been linked to a number of pollutants. The most commonly studied are the criteria pollutants which are regulated in the United States by the Clean Air Act. The criteria pollutants are carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$) and lead (Pb). Of these, lead is not considered relevant to the development or exacerbation of asthma. One of the ways air pollutants may affect asthmatics is by promoting airway sensitization to airborne allergens in predisposed subjects. Laboratory studies suggest that pollutants can attach themselves to allergens such as pollen and increase their allergenic potential. Pollutants can induce airway inflammation and they can also facilitate the access of inhaled allergens to the cells of the immune system.[41]

Recent attention has been focused on diesel exhaust particles. This is an important component of fine particulate matter ($PM_{2.5}$). These particles, which have a diameter of 2.5 microns or less are considered to be particularly dangerous to long-term human health because they are able to penetrate deep into the respiratory system and the lungs. Diesel exhaust is of particular concern to residents of the South Bronx because a large number of diesel trucks drive in and out of the area as a result of activities such as waste transfer stations and other commercial activities. As a result, a section on the association between asthma and diesel exhaust particles has been included in this section. In addition, urban toxic pollutants are believed to play a role in asthma development and exacerbation. A section that discusses this association as presented in the literature is also included.

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[39] See Ellen, 2002, op cit.

[40] See Editor's Choice, "Involuntary smoke exposure affects severity among children," Medical Letter on the CDC & FDA, September 6, 2002.

[41] See D'Amato, G. "Environmental urban factors (air pollution and allergens) and the rising trends in allergic respiratory diseases." *Allergy*. 2002, 57 Suppl 72:30-3.

5.5.1 Asthma and Criteria Air Pollutants

The association between asthma and air pollutants during a period of rising asthma morbidity is puzzling. Air pollution in known to be a trigger of asthma attacks in controlled laboratory studies. In addition, a number of epidemiological studies suggest that asthma morbidity increases when air quality deteriorates. Despite these results, asthma rates have increased in developed countries at a time when air pollution concentrations have been decreasing. In addition, asthma rates are not necessarily higher in geographical locations that have poor air quality. For example, a study carried out in Germany in the early 1990s showed that highly polluted Leipzig has a lower incidence of asthma than Munich, which has much cleaner air. Similarly, Hong Kong has better air quality than Beijing but its asthma rate is four times higher. Indonesia has little asthma but New Zealand and Sweden, both countries with clean air, have very high asthma rates.[42] Complicating matters still further, men and women may respond differently to different pollutants. Ozone from gasoline vehicles seems more likely to trigger asthma in men and particulate pollution seems more likely to trigger the disease in women.[43]

The epidemiological studies summarized in this section are observational studies rather than experimental studies, since participants are not assigned at random to air pollution exposures. In general, the exposure of the participant is not directly observed, and the concentration of airborne particles and other air pollutants at one or more stationary air monitors is used as a proxy for individual exposure to ambient air pollution. In most of these studies multiple-regression is used to study the association between a health outcome such as hospital admissions or hospital emergency department visits for asthma, and ambient air pollution concentrations. The models normally control for weather variables such as temperature and humidity, day of week, and other relevant factors.

Although it is difficult to ascertain what pollutants are responsible for asthma exacerbation in epidemiological studies, some authors rank the relevance of pollutants to asthma from strongest to weakest as follows: fine particulate matter ($PM_{2.5}$) particulate matter (PM_{10}) sulfur oxides (SO_x) ozone (O_3) nitrogen oxides (NO_x).[44] Carbon monoxide (CO) has also been associated with asthma in some studies. Literature reviews of the association between criteria air pollutants and asthma by Koren (1995) and Bates (1995) support the idea the criteria pollutants exacerbate asthma. The review indicates that asthmatics are more sensitive to the effects of ozone, sulfur dioxide, particulate matter and nitrogen dioxide. Exposure to even low levels of SO_2 is known to alter lung function in asthmatics. Such responses are known to vary according to temperature, humidity and exercise level. Similarly, epidemiological studies suggest there is also an association between asthma and particulate matter (PM_{10}) levels. Ozone has also been associated with exacerbation of asthma in such studies, however, many authors feel it is difficult to separate the effects of ozone from those of acid aerosols and SO_2. The effects of ambient concentrations of NO_2 on asthmatics is difficult to measure because NO_2 is also an indoor air

[42] See McGowan, Kathleen. "Breathing Lessons." *City Limits New York's Urban Affairs News Magazine*. May, 1999.
[43] See Ridley, Matt. "Asthma, Environment, and the Genome." *Natural History*. March 2000.
[44] See Leikauf, George D., Sharon Kline, Roy E. Albert, C. Stuart Baxter, David I. Bernstein, Jonathan Bernstein and C. Ralph Buncher. "Evaluation of a Possible Association of Urban Air Toxics and Asthma." *Environmental Health Perspectives*. Vol. 103, Supplement 6, September 1995. Pages 253-271.

pollutant. Concentrations of this pollutant can sometimes be higher indoors than outdoors. In addition, the results of studies that measure the association between NO_2 and asthma are inconsistent. There is some evidence from Finland and Great Britain that supports the idea that rising concentrations of ambient NO_2 are associated with asthma exacerbation.[45]

Similarly, Peden (1999) conducted a review of the literature on exposures of asthmatics to air pollutants. He concludes that there is substantial epidemiologic evidence that demonstrates that exposure to increased levels of ambient air pollutants is associated with increases in asthma morbidity. The pollutants of interest in studies that examine the association between asthma and pollution include ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and respirable particulate matter. Among the particulate matter pollutants of interest are diesel exhaust particles, acid aerosols and endotoxin.[46]

Specific studies that find an association between asthma and ambient air pollution are numerous. Table 1 summarizes a representative sample of epidemiological studies that have looked at this association. These studies are described in the rest of this section. Additional information about other studies that have examined this issue is found in EPA's *Air Quality Criteria for Particulate Matter*. This document describes and summarizes a number of studies that have looked at the association between particulate matter (PM) and other air pollutants, and human health effects.[47] The purpose of that document is to synthesize the available information on this topic in order to promulgate a PM standard. Among the health effects examined is asthma. Most of the studies included find there is an association between air pollution and asthma morbidity or mortality. Appendix C contains a list of additional references to studies related to asthma and air pollution included in that document.

Table 1.

Authors	**Location of Study**	**Period of Study**	**Subjects of Study**	**Pollutants found to exacerbate asthma**
Thurston et al (1997)	Connecticut	1991-1993	Asthma attacks among children	O_3
Lang et al (1994)	Philadelphia	1969-1991	Asthma mortality	No significant association found
Lipsett et al (1997)	Santa Clara County, California	1986-1992	Asthma ER visits	PM_{10} and NO_2
Sunyer et al (1997)	Barcelona, Helsinki, Paris and London	1986-1992	Asthma hospital admissions and visits to ER	NO_2, SO_2, and O_3
Anderson et al	London	1987-1992	Asthma daily	O_3, NO_2, SO_2 and

[45] SeeKoren, Hillel S. 1995. "Associations between Criteria Air Pollutants and Asthma." *Environmental Health Perspectives*. 103 (Suppl 6): 235-242; and Bates, David V. 1995. "Observations on Asthma." *Environmental Health Perspectives*. 103 (Suppl 6): 243-247.
[46] See Peden, David B. 1999. "Controlled Exposure of Asthmatics to Air Pollutants." In Holgate, Stephen T, Jonathan M. Samet, Hillel S. Koren and Robert L. Maynard. Air *Pollution and Health*. New York: Academic Press. Pages 865-880.
[47] See USEPA. 2002. *Air Quality Criteria for Particulate Matter (Third External Review Draft)*. This document can be accessed at: http://cfpub.epa.gov/ncea/cfm/partmatt.cfm - access date: September 24, 2002.

(1998)			hospital admissions	black smoke
Guo et al (1999)	Taiwan	1995-1996	Asthma prevalence in middle-school children	CO and NO_x
Norris et al (1999)	Spokane and Seattle, Washington	1995-1996	Asthma emergency department visits	CO, $PM_{2.5}$ and elemental carbon
Desqueyroux et al (2002)	Paris	1995-1996	Asthma attacks among people with severe asthma	PM_{10} and O_3
Sunyer et al (2002)	Barcelona, Spain	1985-1995	Asthma deaths and hospital visits	NO_2 and O_3
Lee et al (2002)	Seoul, South Korea	1997-1999	Asthma hospitalizations for children 15 years old and younger	PM_{10}, SO_2, NO_2, O_3 and CO
McConnell et al (2002)	Southern California	1994-1998	Development of asthma in children who play sports	O_3

According to a study by Thurston et al (1997) carried out in 1991-93, high concentrations of ozone were associated with higher numbers of asthma attacks among children at a summer camp in Connecticut. The study measured symptoms and change in lung function (morning to evening). [48]

Lang et al (1994) studied asthma mortality in Philadelphia during the period 1969-1991. The compared rates of death from asthma with trends in the concentrations of major air pollutants such as ozone, carbon monoxide, nitrogen dioxide, particulate matter (PM_{10}) and sulfur dioxide. They found that during this period, the rate of death from asthma decreased from 1.68 per 100,000 people in 1969 to 0,68 per 100,000 in 1977. The rate of death then increased 0.92 per 100,000 in 1991. However, between 1965 and 1990 the concentrations of air pollutants declined substantially. The authors found that the highest rates of death from asthma in Philadelphia were found in census tracts with the highest percentage of poor people and minority residents.[49]

The association between exacerbations of asthma and ambient air pollution was studied by Lipsett et al (1997) for Santa Clara County, California. They used data for PM_{10}, coefficient of haze (COH), nitrogen dioxide (NO_2) and ozone (O_3). COH measurements were used to predict missing PM10 measurements. The study controlled for temperature, precipitation and relative humidity. The authors found consistent relationships between emergency room (ER) visits for asthma and PM_{10}. Same day NO_2 concentrations were also associated with ER visits but ozone concentrations were not. The estimates of relative risks for PM_{10} provided by the study are temperature-dependent. The authors estimated that a 60 µg/m^3 change in PM10 (2-day lag) corresponds to RRs of 1.43 (95% CI = 1.18-1.69) at 20°F; 1.27 (95% CI=1.13-1.42) at 30°F; and

[48] Thurston, G. D.; Lippmann, M.; Scott, M. B.; Fine, J. M. (1997) Summertime haze air pollution and children with asthma. *Am. J. Respir. Crit. Care Med*. 155: 654-660.

[49] See Lang, David and Marcia Polansky. 1994. "Patterns of Asthma Mortality in Philadelphia from 1969 to 1991." *The New England Journal of Medicine*. Vol. 331, No. 23, pages 1542-1546.

1.11 (95% CI = 1.03-1.19) at 41°F. The study concludes that there is an association between PM_{10} and ER visits for asthma in Santa Clara County.[50]

Sunyer et al (1997) assessed the association between urban air pollution and emergency admissions for asthma during the years 1986-92 in Barcelona, Helsinki, Paris and London. The outcome measure was daily counts of asthma admissions and visits to the emergency room in adults aged 15-64 years, and in children aged 0-15 years. Poisson regression was used to model the association, and the covariates used were short-term fluctuations in temperature and humidity, viral epidemics, day of week effects, and seasonal and secular trends. Estimates were obtained for each city. According to their results daily admissions for asthma in adults increased significantly with increasing ambient levels of nitrogen dioxide (NO_2). The relative risk per 50 $\mu g/m^3$ was 1.029. The association between black smoke and admissions for asthma was not found to be significant. For ozone the results differed among cities. For children, daily admission increased significantly with sulfur dioxide (SO_2) (RR 1.075) and non-significantly with black smoke (RR 1.030) and with NO_2. No association was found between O_3 and children admissions for asthma. The authors conclude that NO_2 and SO_2 may be important in exacerbating asthma in European cities.[51]

Another example is provided by Anderson et al (1998). They investigated the relationship between daily hospital admissions for asthma and air pollution in London for the period 1987-92. They also examined the possible confounding and modifying effects of airborne pollen. Poisson regression was used to estimate the relative risk of daily asthma admissions associated with changes in ozone (O_3), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and particles (black smoke). Hospital admissions were grouped into all ages, and the age groups 0-14, 15-64 and 65+ years. The models controlled for time trends, seasonal factors, calendar effects, influenza epidemics, temperature, humidity, and autocorrelation. The independent effects of pollutants were estimated, as well as interactions with aeroallergens. The latter included pollen counts. According to the results, ozone was significantly associated with admissions in the 15-64 age group. Nitrogen dioxide with the 0-14 and 65+ age groups, sulfur dioxide in the 0-14 age group, and black smoke in the 65+ age group. Cumulative lags of up to three days generally showed stronger and more significant effects than single day lags. The evidence provided by the study does not indicate that there is confounding by pollens, and little indication that there is an interaction between pollens and pollutants.[52]

Guo et al (1999) compared the prevalence of asthma with climate and air pollutant data to determine the relationship between asthma prevalence and these factors. The authors used a nationwide survey of respiratory illness and symptoms in middle-school students in Taiwan. Lifetime prevalence of physician-diagnosed asthma and of typical asthma symptoms were

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[50] See Lipsett, Michael, Susan Hurley, and Bart Ostro. "Air Pollution and Emergency Room Visits for Asthma in Santa Clara County, California." Environmental Health Perspectives. 105:216-222 (1997).

[51] See Sunyer, J.; Spix, C.; Quénel, P.; Ponce-de-León, A.; Pönka, A.; Barumandzadeh, T.; Touloumi, G.; Bacharova, L.; Wojtyniak, B.; Vonk, J.; Bisanti, L.; Schwartz, J.; Katsouyanni, K. (1997) Urban air pollution and emergency admissions for asthma in four European cities: the APHEA project. Thorax 52: 760-765.

[52] See Anderson, H. R.; Ponce de Leon, A.; Bland, J. M.; Bower, J. S.; Emberlin, J.; Strachen, D. P. (1998) Air pollution, pollens, and daily admissions for asthma in London 1987-92. Thorax 53: 842-848.

compared to air monitoring station data. Temperature, relative humidity, sulfur dioxide, nitrogen oxides, ozone, carbon monoxide, and PM_{10} were included in the analysis. After adjusting for age, history of atopic eczema, and parental education the authors found an association between prevalence of asthma and air pollution, especially for carbon monoxide and nitrogen oxides, for both girls and boys.[53]

Norris et al (1999) studied the relationship between a meteorological index of air stagnation and visits to the emergency department for asthma in Spokane and Seattle, both in Washington state. The data for Spokane was for a period of approximately two years, and the data for Seattle was for a 15 month period. The stagnation persistence index represents the number of hours during the 24 hour day when surface wind speeds are less than the annual hourly median value. The authors modeled the association using a generalized additive Poisson regression model. According to the results of the study, the relative rate of association between a visit to the emergency department for asthma and the stagnation persistence index was 1.12 in Spokane and 1.21 in Seattle for an increase of 11 and 10 hours respectively, of low wind speed in a given day. The authors conclude that increased air stagnation is shown to be a surrogate for the accumulation of the products of incomplete combustion. These products include carbon monoxide and fine particulate levels of organic and elemental carbon. The index used was more strongly associated with emergency hospital visits for asthma than any of the individual measured pollutants.[54]

In Paris, Desqueyroux et al (2002) carried out a study of the association between air pollution and asthma among people with severe asthma. For a period of 13 months, 60 persons with severe asthma were monitored by their physician while daily levels of SO_2, PM_{10}, NO_2 and O_3 were recorded. The results suggest there is an association between asthma attacks and ambient levels of PM_{10} and O_3. The odds ratio (OR) for an increase of 10 $\mu g/m^3$ of PM_{10} was 1.41 (95% CI 1.16-1.71). The delay between exposure and asthma attacks were 3 to 5 days for PM_{10} and 2 days for O_3.[55]

Similarly, Sunyer et al (2002) examined the association between NO_2 and O_3 on the risk of dying from asthma attacks in Barcelona, Spain. Patients over 14 years of age who died from asthma during the period 1985-95 and who visited one of the four largest hospitals in the city were included in the study. This included 467 men and 611 women. Air pollution, pollen and spore levels were obtained from city monitoring stations. According to the results, NO_2 was associated with all causes of death for asthmatic patients. The adjusted odds ratio (OR) for an increase of the interquartile range was 1.50 (95% CI=1.09-2.64). Ozone also increased the risk of death among asthmatic patients. The OR was 1.90 (95% CI=1.09-3.30) during spring and summer. The

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[53] See Guo, Y. L.; Lin, Y.-C.; Sung, F.-C.; Huang, S.-L.; Ko, Y.-C.; Lai, J.-S.; Su, H.-J.; Shaw, C.-K.; Lin, R.-S.; Dockery, D. W. (1999) Climate, traffic-related air pollutants, and asthma prevalence in middle-school children in Taiwan. *Environmental Health Perspectives*. 107: 1001-1006.

[54] Norris, G.; Young-Pong, S. N.; Koenig, J. Q.; Larson, T. V.; Sheppard, L.; Stout, J. W. (1999) An association between fine particles and asthma emergency department visits for children in Seattle. *Environmental Health Perspectives*. 107: 489-493.

[55] See Desqueyroux, H, JC Pujet, M Prosper, F Squinazi and I Momas. 2002. "Short-term effects of low-level air pollution on respiratory health of adults suffering from moderate to severe asthma." *Environ Res*, May 2002, 89 (1):29-37.

study did not find an association between air pollutants, pollen and spores. The authors conclude that NO_2 and O_3 may exacerbate severe asthma and cause death among asthmatic subjects.[56]

In Seoul, Korea, Lee et al (2002) investigated the association between asthma hospitalizations and air pollution concentrations for children aged 15 years or younger. They estimated the relative risk of hospitalization associated with an interquartile range (IQR) increase in pollutant concentrations. The estimated relative risk of asthma hospitalization for PM_{10} (IQR=40.4 $\mu g/m^3$) was 1.07 (95% CI = 1.04-1.11). For SO_2 (IQR=4.4 ppb) it was 1.11 (95% CI=1.06-1.17). For NO_2 (IQR=14.6 ppb) it was 1.15 (95% CI=1.10-1.20). For O3 (IQR=21.7 ppb) it was 1.12 (95% CI1.07-1.16). For CO (IQR=1.0 ppm) it was 1.16 (95% CI=1.10-1.22). They conclude that air pollution at observed concentrations in Seoul, Korea is harmful to asthmatic children.[57]

McConnell et al (2002) investigated the relation between newly-diagnosed asthma and team sports in a cohort of children exposed to different concentrations and mixtures of air pollutants in southern California. The authors selected 3,535 children without a history of asthma from 12 communities and followed them for a period of five years. They estimated the risk of asthma in children playing team sports in six communities with high concentrations of ozone and six communities with low concentrations. In addition, these communities had high or low concentrations of nitrogen dioxide, particulate matter and inorganic-acid vapor. The results of the study suggest that compared to children who played no sports, the relative risk of developing asthma in children playing three or more sports was 3.3 (95% CI 1.9-5.8) in areas of high ozone concentrations. Sports did not have an effect in areas of low ozone concentration. Exposures to the other pollutants did not alter the effect of team sports. The authors conclude that air pollution and outdoor exercise could contribute to the development of asthma in children.[58]

5.5.2 Asthma and Diesel Exhaust

As mentioned in the section on Waste Transfer of this report, diesel truck traffic and diesel exhaust are a major concern among residents of the South Bronx. It is commonly believed by residents that the pollution associated with diesel trucks is responsible for the high rates of asthma observed in the area. These concerns are actually shared by residents of other parts of the city, and were echoed recently by New York City Mayor Michael Bloomberg, who said that, "Our kids are coming down with asthma at an alarming rate. The air is being polluted by these trucks." This comment was in reference to diesel trucks used to transport garbage to waste transfer stations around the city and to points outside the city.[59]

Diesel vehicles constitute one of the biggest sources of air pollution. In New York City, it is estimated that diesel vehicles, which make up about 2% of the city's total vehicle fleet, are

[56] See Sunyer, J, X Basagaña, J. Belmonte and JM Antó. 2002 "Effect of nitrogen dioxide and ozone on the risk of dying in patients with severe asthma." *Thorax*, 57:687-93.
[57] See Lee, JT, H Kim, H Song, YC Hong, YS Cho, SY Shin, YJ Hyun and YS Kim. "Air pollution and asthma among children in Seoul, Korea." *Epidemiology*, July 2002, 13(4):481-4.
[58] See McConnell, Rob, Kiros Berhane, Frank Gilliland, Stephanie J. London, Talat Islam, W. James Gauderman, Edward Avol, Helene G. Margolis and John M Peters. "Asthma in exercising children exposed to ozone: a cohort study." *The Lancet*. Vol. 359, February 2, 2002. Pages 386-391.
[59] See Lisberg, Adam. "Big Apple garbage to avoid N.J. route; Less congestion, pollution for region." The Record (Bergen County, NJ). August 1, 2002.

responsible for about half of the particulate pollution. These vehicles include diesel powered trucks and other heavy industrial transport vehicles, backhoes, and buses, including the city's 5,500 school buses.[60] Although ambient levels of particulate matter (PM_{10}) have been decreasing over time, diesel exhaust particles (DEP), which are a major sources of fine particulate matter ($PM_{2.5}$), remain a serious concern. The potential role of diesel exhaust in the development and exacerbation of asthma has recently become an important research topic.

A research team at the UCLA School of Medicine's Division of Clinical Immunology and Allergy led by Dr. Andrew Saxon has examined the relationship between asthma and diesel fuel. Using volunteer human subjects, they found that instilling allergens among individuals who are sensitive to them in the presence of diesel exhaust particles equivalent to concentrations found in the air in Los Angeles for a period of one to three days resulted in a fivefold increase in total allergic protein level and a 50-fold increase in the number of reaction inducing allergic antibodies. Such results suggest there is an interaction between genes that may predispose individuals to asthma or cause it and diesel exhaust particles.[61]

Diesel Exhaust Particles (DEP) act as airway irritants at relatively high levels. At lower levels, they promote the release of specific cytokines, chemokines, immunoglobulins, and oxidants in the upper and lower airway. The release of these substances culminates in airway inflammation, mucus secretion, serum leakage into the airways, and bronchial muscle contraction. Some authors believe there may be synergistic effects between air pollutants such as DEPs and aeroallergens.[62] Although air quality as measured by criteria pollutants is improving, diesel truck traffic has increased. The combination of diesel exhaust particles (DEP) and ragweed pollen seem to produce a much stronger response in people than either element by itself. It is believed that diesel particles carry allergens such as pollen deeper into the lungs or amplify their aggravating effects.[63]

5.5.3 Asthma and Urban Toxic Pollutants

Several synthetic chemicals are known to cause asthma attacks. These include chemicals used in the manufacture of plastics. Examples include isocyanates, trimellitic anhydride and phthalic anhydride. The relationship between these substances and asthma has been observed during accidents or in occupational settings. For example, after an accident that involved the overturning of a tanker and the spilling of its load of toluene diisocyanate onto a highway, the police officers who directed traffic at the scene developed chronic asthma.[64] Approximately 5-10% of workers exposed to toluene diisocyanate, other polyisocyanates and their monomeric precursors develop occupational asthma. Causative agents in occupational settings where accidental exposures to large doses have resulted in asthma include chlorine, toluene

[60] SeePerl, Rebecca. "Diesel-burning school buses may pose health threat to kids." National Public Radio. August 26, 2002.
[61] See "Breathing Easier" at: http://www.research.ucla.edu/chal/28.htm -access date: August 27, 2002.
[62] See Pandya, Robert J., Gina Solomon, Amy Kinner and John R. Balmes. "Diesel Exhaust and Asthma: Hypotheses and Molecular Mechanisms of Action." *Environmental Health Perspectives*. Vol. 110, Supplement 1, February 2002. Pages 103-112.
[63] See McGowan, Kathleen. "Breathing Lessons." *City Limits New York's Urban Affairs News Magazine*. May, 1999.
[64] Ridley, Matt. "Asthma, Environment, and the Genome." *Natural History*. March 2000.

diisocyanate, hydrazine, sulfur dioxide, acetic acid and ammonia. The list of suspected asthmagens is: styrene, formaldehyde, acetaldehyde, propionaldehyde, nickel and compounds, anhydrides, methylene diphenyl diisocyanate, chromium and compounds, toluene diisocyanate, cadmium and compounds, cobalt and compounds, hydrazine, acrolein, methyl isocyanate, and p-Phenylenediamine. [65]

5.6 Conclusions

Asthma is a very complex, multifactorial disease that affects millions of people in the United States. Over the last three decades the number of people afflicted with asthma has increased dramatically. This increase is particularly high for children. The causes of such an increase are poorly understood. Although genetic predisposition seems to be an important risk factor for the development of asthma, most scientists believe that the rapid rates of increase over the last few decades is too rapid to be explained by genetic factors alone. Modern hygiene practices which prevent the immune system to mature properly in the early years of a person's life, as well as a sedentary lifestyle, have also been cited as potential causes for the rise in asthma prevalence. Other environmental factors such as environmental tobacco smoke, low birthweight, nutrition, and exposure to dust mites, cockroaches and other allergens are also considered risk factors.

The relationship between asthma and air pollution is also complex and poorly understood. It is unlikely that air pollution alone is to blame for rising prevalence rates. In general, asthma rates are rising in developed countries that have seen substantial improvements in their air quality over the last few decades, while at the same time recording increases in asthma rates. A study from Germany compared asthma rates in Leipzig and Munich and found that although air quality is much better in the latter, asthma rates there are much higher. Similarly, a study of asthma mortality in Philadelphia found that while asthma death rates were on the rise, air quality, as measured by ambient concentrations of criteria pollutants, was improving.

However, there is strong evidence in the literature on the association between asthma and air pollution that asthma, as measured by symptoms, hospitalization rates or hospital emergency department visits, is exacerbated when ambient concentrations of air pollutants increase. It is often said in the literature that air pollutants may trigger exacerbations of asthmatic and allergic symptoms in people with asthma. In addition, there may be synergistic effects between air pollution and aeroallergens. The pollutants that are most commonly cited as being responsible for the exacerbation of asthma are $PM_{2.5}$, PM_{10}, SO_2, O_3 and NO_2. More recently, attention has been focused on diesel exhaust particles, which are a major source of $PM_{2.5}$. This is of particular relevance to the South Bronx, as trucks and buses are a major source of this form of pollution. As mentioned in the section on air quality, according to the New York State Department of Environmental Conservation (NYSDEC) data it seems that in the Bronx the pollutants of most concern are O_3 and $PM_{2.5}$. The latter is closely related to diesel vehicles and traffic, and both could be exacerbating asthma rates in the area.

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[65] See Leikauf, George D., Sharon Kline, Roy E. Albert, C. Stuart Baxter, David I. Bernstein, Jonathan Bernstein and C. Ralph Buncher. "Evaluation of a Possible Association of Urban Air Toxics and Asthma." *Environmental Health Perspectives*. Vol. 103, Supplement 6, September 1995. Pages 253-271.

CHAPTER 6. WATER QUALITY IN THE SOUTH BRONX WATERSHED[66]

6.1 Overview

The South Bronx waterfront is one that is rich in history, ranging from heavy industry to summer resort getaways, yet now facing environmental hazards as a result of past years of pollution and poor water resource management. This review will examine the history, water quality and restoration efforts in the South Bronx's waters, including the Bronx River, Harlem River, Westchester Creek and the Upper East River/ Western Long Island Sound.[67] Figure 1 shows an aerial photograph of the region and its waterbodies.

Figure 1
www.mapquest.com

[66] This chapter was written by Cary Hirschstein, Graduate Research Assistant at NYU-Wagner's ICIS.
[67] This report does not include a review of drinking water monitoring, assessment and quality.

An examination of the environmental quality of these waters found similar problems across each. For example, pollutants such as PCBs (polychlorinated biphenyls), pathogens and floatables have all been of primary environmental concern in these waters in recent years. Attention has specifically been given to hypoxic conditions due to low levels of dissolved oxygen in the Western Long Island Sound, primarily due to area wastewater treatment plants discharging excessive levels of nitrogen into the water. Adverse water quality impacts of inadequate combined sewer overflow facilities also have begun to be addressed.

6.2 Water Quality Monitoring and Assessment

The Federal Clean Water Act serves as a regulatory guide for state water quality monitoring and assessment programs based on criteria and standards. These programs aim to protect and sustain the propagation of aquatic and watershed wildlife populations, as well as uphold the quality of water resources for human uses. The Clean Water Act requires states to develop appropriate water quality standards and conduct effective monitoring programs. States are mandated to report on water quality status, including the determination of whether or not these standards support designated uses. Within New York State, it is the responsibility of the New York State Department of Environmental Conservation (NYS DEC) to conduct these programs.

The NYS DEC's activities result in the release of a series of documents on water quality, culminating in the *New York State List of Impaired Waters Requiring a Total Maximum Daily Load*. Section 303(d) of the Clean Water Act requires states to identify waterbodies that do not meet quality standards. Released every four years, this list serves to report findings of state water quality monitoring and assessment efforts, prioritizing substandard waters for analysis.[68] The waterbodies included on this list serve as priority candidates for development of a Total Maximum Daily Load (TMDL) analysis for the specific pollutants impairing the waterbody. A TMDL defines the capacity of the waterbody to absorb a pollutant and still meet water quality standards, accounting for seasonal variations and a margin of safety. Following the issue of the Section 303(d) list, a period of two years is targeted for TMDL analysis and development for priority waters. Designation as a "priority water" means that priority will be given to addressing water quality issues in the waterbody, though it does not necessarily guarantee that TMDLs will be completed over the following two years.

The basis for water quality management is the Water Classification System, which categorizes all surface and ground waters according to their determined usages. These usages include:

> "Drinking Water Supply, Shellfishing, Public Bathing, Recreation, Fish Consumption, Aquatic Life Support, Habitat/Hydrology, Aesthetics."[69]

In this classification process, the New York State Department of Environmental Conservation's Division of Water (NYS DOW) evaluates the physical, chemical and biological characteristics of the waterbody, considering impacting economic and social factors. The NYS DOW receives input from the NYS DEC Division of Fish, Wildlife and Marine Resources and the New York State

[68] New York State Water Quality Monitoring Strategy; <http://www.dec.state.ny.us/website/dow/strategy.pdf>; (accessed 30 August 2002).
[69] Section 305(b) Assessment Methodology; <http://www.dec.state.ny.us/website/dow/asmtmeth.pdf>; (accessed 30 August 2002).

Department of Health (NYS DOH), upon which they offer a recommendation for classification. This recommendation undergoes public review and a hearing before finalization.[70]

Once classified, these waterways are subject to standards that apply to the particular usage category. Traditional standards measured include pesticides, priority organics, non-priority organics, metals, ammonia, chlorine, other inorganics, nutrients, pH, siltation, organic enrichment/ low dissolved oxygen, salinity/TDS/chlorides, thermal modifications, flow alteration, pathogen indicators, and oil and grease.[71] Each usage category, however, has a separately defined value for each of these parameters.

The NYS DEC monitors water quality, comparing concentrations of chemical and physical properties of the water to appropriate standards, in an effort to determine if the designated uses of a waterbody are supported. This monitoring process not only includes water sampling, but also bottom sediment and biological tissue sampling of macroinvertebrates and fish. The latter two assessment techniques offer a more longitudinal view of water conditions, while water sampling merely offers "snapshots" of water conditions.[72] Thus, the NYS DEC monitors contaminant levels in fish and game through tissue sampling, and the NYS DOH issues advisories when sportfish and game have contaminant levels that exceed federal standards.[73] The NYS DOH's *Health Advisories for Chemicals in Sportfish and Game* therefore provides valuable insight and plays a key role in characterizing current water quality trends.

All of these monitoring tools are incorporated into the Statewide Waters Monitoring Program, a conglomeration of various state division monitoring programs.[74]

The NYS DEC describes all of these actions as the "Cycle of Water Quality Monitoring and Management." This cycle consists of:

> "(1) the Assessment of Water Quality and impact on resources (2) the Determination of Causes/Pollutants (3) the Identification of Sources contributing to the problem (4) the Development/Implementation of Corrective Strategy to address the causes/sources and correct a verified problem, and (5) the Re-Assessment of Water Quality and impact on resources."[75]

These processes are referred to as a cycle, as one always returns to assessment to review the status of water quality.

Another valuable resource for determining NYC water quality status is the NYC Department of Environmental Protection's (NYC DEP) annual *Harbor Water Quality Report*. The goal of this report is to assess the performance of NYC's pollution prevention programs and guide their future development. Several water quality standards are measured in the survey. Levels of dissolved oxygen for bottom and surface waters indicate habitat conditions, as dissolved oxygen is critical for

[70] New York State Water Quality Monitoring Strategy.
[71] New York State Department of Environmental Conservation Division of Water; New York Water Quality 2000; <http://www.dec.state.ny.us/website/dow/305b00.pdf>; (accessed 10 September 2002).
[72] Ibid.
[73] New York State Department of Health. May 2002. <http://www.health.state.ny.us/nysdoh/environ/fish.htm>.
[74] New York State Water Quality Monitoring Strategy.
[75] Ibid.

respiration. Fecal coliform bacteria, found in the intestines of humans and animals, is measured to check sewage waste contamination levels. Chlorophyll 'a' is a plant pigment; levels indicate phytoplankton abundance and blooms reflect nutrient buildup in the waterbody. Lastly, Secchi Transparency measurements examine levels of suspended solid concentrations and plankton. The 2001 report subdivided the New York Harbor into four main subsections, discussing specific monitoring results and trends for each.[76] This report will examine the Upper East River/Western Long Island Sound section, an area containing six water quality monitoring stations.

Yet another source of information on water quality issues is the United States Environmental Protection Agency's (US EPA) National Sediment Contaminant Point Source Inventory, a database of point source pollutant discharges with potential sediment contamination capabilities. It also serves as a screening-level analysis of chemicals, geographic areas, and industries as potential sources of sediment contamination. This document is merely an informational research guide, with no immediate or direct regulatory consequence.[77]

Several nongovernmental organizations have taken the initiative to work for the protection and restoration of the Bronx watershed. The Bronx Council for Environmental Quality, the Bronx River Alliance, Sustainable South Bronx and the NYC Environmental Justice Alliance work on local environmental issues in the metropolitan area. Organizations such as Save the Sound, Clean Sound, Soundkeeper and the Long Island Sound Foundation specifically serve the Long Island Sound with various restoration, advocacy, education and outreach efforts.

6.3 Water Management Facilities

6.3.1 Wastewater treatment plants

New York City currently operates fourteen wastewater treatment plants in the metropolitan area, serving five boroughs and treating over 1.3 billion gallons of wastewater per day[78]. These plants treat municipal wastewater, industrial process wastewater and stormwater, and then discharge the treated product into approved surface waters. The US EPA's Office of Wastewater Management works with local EPA regions and states to regulate wastewater treatment, and the Clean Water Act serves as the framework in guiding these processes.[79]

The NYC DEP manages NYC's wastewater treatment facilities. In the past decade, NYC's wastewater treatment plants have implemented several pollution measures to improve treatment processes. These include a Nitrogen Control program focused on limiting nitrogen discharge, an Improved Combined Sewer Overflow (CSO) program that aims to reduce overflow of untreated

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[76] New York City Department of Environmental Protection; 2001 New York Harbor Water Quality Report; < http://www.ci.nyc.ny.us/html/dep/pdf/hwqs2001.pdf>; (accessed 16 August 2002).
[77] United State Environmental Protection Agency; The National Sediment Contaminant Point Source Inventory: Analysis of Facility Release Data; <http://www.epa.gov/waterscience/cs/vol3/nsi-vol3.pdf>; (accessed 10 September 2002).
[78] New York City Sues for Allegedly Violating Discharge Permits. New York City Department of Environmental Protection. 11 February 2002. <http://www.ci.nyc.ny.us/html/dep/html/depresp.html>.
[79] United States Environmental Protection Agency; Wastewater Primer; <http://www.epa.gov/OWM/primer.pdf>; (accessed 11 September 2002).

waste and debris, and an Industrial Pretreatment Program that requires target industries to remove specified toxins from their wastewater before release into the sewer system.[80]

6.3.2 Combined sewer overflows

Combined sewers are designed to collect rainfall runoff, domestic sewage and industrial wastewater within the same pipe system, transporting the combined sewage to a local wastewater treatment facility. During period of heavy rainfall, the wastewater volume can exceed the capacity of the sewer, causing an overflow that brings untreated human and industrial waste, toxic chemicals and debris to the surface. This represents a major pollution concern for over 770 cities in the U.S., including parts of New York City.[81]

Recognizing the priority of this issue, the City has taken action. A NYC CSO Abatement Program and NYC DEP Catch Basin Hooding Program are currently in place to address floatables and pathogens in several waters, including the Harlem River, Westchester Creek and the Upper East River/ Western Long Island Sound.[82] Initiated in the mid-1990s, the NYC DEP's Floatables Control Program served to reduce the amount of floatables entering city waterbodies. The program was comprised of hooding and cleaning catch basins (approximately 137,000 citywide, implemented in three phases), boom and skimmer operations at some CSO outfalls, construction of CSO retention and treatment facilities, and public education outreach.

The US EPA's CSO Control Policy provides a foundation for the National Pollutant Discharge Elimination System, aimed at controlling the CSO problem. The policy consists of four fundamental principles to guide states in the development of a cost-effective means to achieve local environmental initiatives:

> "(1) Clear levels of control to meet health and environmental objectives; (2) Flexibility to consider the site-specific nature of CSOs and find the most cost-effective way to control them; (3) Phased implementation of CSO controls to accommodate a community's financial capability; and (4) Review and revision of water quality standards during the development of CSO control plans to reflect the site-specific wet weather impacts of CSOs."[83]

Overall, New York City has committed $1.5 billion for construction of CSO abatement facilities from 1998 to 2008.[84] A 1996 study reported that NYC increased capture of CSO from 18% to

[80] Ibid.
[81] Combined Sewer Overflows. United States Environmental Protection Agency. 26 June 2002. <http://cfpub.epa.gov/npdes/home.cfm?program_id=5>.
[82] New York State Waters De-Listed from 1998 Section 303 (d) List.
[83] Combined Sewer Overflows CSO Control Policy. United States Environmental Protection Agency. 16 August 2002. <http://cfpub.epa.gov/npdes/cso/cpolicy.cfm?program_id=5>.
[84] New York/ New Jersey Harbor Estuary Program: Successes and Challenges, Highlights of Program Accomplishes and Challenges for the Future, February 2001; <http://www.harborestuary.org/pdf/SC.pdf>; (accessed 23 August 2002).

40% with their CSO abatement projects, and were almost in complete compliance with EPA's minimum standards for CSO controls.[85]

6.4 Sources of Data for Ambient and Effluent Water Quality

The water quality databases that potentially encompass the waters in and around the South Bronx include:

Water Quality – Ambient (e.g., for surface waters)

NYC DEP, *New York Harbor Water Quality Survey* (1909 to the present). Portions relevant to the South Bronx are the Upper East River-Western Long Island Sound area; 53 sites monitored citywide at fixed monitoring sites every other week for fecal coliform, dissolved oxygen, nutrients, plankton, chlorophyll-A, biological oxygen demand, and metals. http://www.hudsonriver.org/hep/datadepo.htm

Interstate Environmental Commission (formerly, the Interstate Sanitation Commission) *Water quality surveys* (1971 - 1986). Monthly data is collected for Temperature, Dissolved Oxygen, Nitrogen, Phosphorous, Chlorophyll. http://www.hudsonriver.org/hep/datadepo.htm

NYC Waterfront Revitalization Plan (1992 and recent proposed update) from the NYC Department of City Planning, delineates coastal, wetland, and floodplain areas.

New York New Jersey Harbor Estuary Program (2000), Contaminant Assessment Reduction Project (CARP), http://www.harborestuary.org/carp.htm

U.S. Army Corps of Engineers *NY and NJ Harbor Navigation Study* data. Special surveys by the NYC DEP and the NYS DEC for water quality planning and facility evaluations

Water Quality – sources and effluent discharges (Qualitative, descriptive reviews)

NYS DEC, Division of Water. National/State Pollutant Discharge Elimination System (N/SPDES) – "Descriptive Data of Municipal Wastewater Treatment Plants in New York State, "December 1999. ("DESCDATA"). This report is current through November 1999 and represents an 80 percent response rate from Publicly Owned Treatment Works (POTWs) in the State. http://www.dec.state.ny.us/website/regs/750.htm

[85] Long Island Sound Study; Comprehensive Management Conservation and Management Plan for Long Island Sound; < http://www.epa.gov/region01/eco/lis/motion.pdf>; (accessed 23 August 2002).

6.5 Waterbody Characteristics of the South Bronx

6.5.1 The Bronx River

6.5.1.1 Background

Dating back before the turn of the 19th century, the Bronx River valley served as an industrial corridor to New York City. Coal-powered trains ran by on the New York Central Railroad, and at least twelve mills operated along the river. However, with industry came intense pollution. A New York State commission described the Bronx River in 1896:

> "'Into this stream of varying flow, all kinds of sewage refuse and factory waste finds its way. Barn yards, privies, cesspools, gas-house refuse, the watery part of the White Plains' sewage disposal works, drains from hoses in Tuckahoe, Bronxville, Mount Vernon, Woodlawn and Williamsbridge deposit their unsanitary and foul-smelling contributions.'"[86]

Led by William W. Niles, the 1907 Parkway Act created the Bronx River Parkway Commission to preserve the watershed. The project began in 1913 with the acquisition of 1,338 parcels of land surrounding the Bronx River. The commission ordered the removal of 370 buildings and the clearing of 17,000 dead trees. Over 30,000 new trees and 140,000 shrubs would be planted in the new park, as well as an expansive 369,000 yards of pavement laid for the new parkway. The drive was originally intended for recreational automobile use, a new concept at the time. The project ran a total cost of $16.5 million.[87]

Today, the pollution of the Bronx River remains a pertinent issue. The river has long been known as a dumping ground, even for unwanted automobiles. In August 2000, the National Guard was enlisted to remove an estimated twenty cars from the Bronx River.[88]

The river has recently suffered even at the hands of unlikely community organizations. In March of 2001, the Bronx Zoo was criticized for allowing up to 200,000 gallons of runoff containing animal waste into the river per day. The zoo invested $1.25 million on river improvements following the incident.[89] Most recently, the New York Botanical Gardens, located in the Bronx, was sued for discharging 250 gallons of water into the river daily. The discharged water included soap residues, small amounts of pesticides and/or fertilizers.[90]

The Bronx River spans 20 miles, flowing south and emptying into the Upper East River/ Western Long Island Sound. Its width is as small as 15 feet as it enters the Bronx Borough, but increases to about 800 feet wide and 40 feet deep as it enters the Upper East River.[91]

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86 Callahan, Tom. "A Parkway With Roots in Pollution Fight." New York Times 19 November 2000, p.27.
87 Ibid.
88 Martinez, Jose. "Bronx River Cleanup: National Guard Raising Cars from Waterway." Daily News 29 August 2000, p.1.
89 Wilson, Greg. "Zoo Agrees to Clean River of Waste Runoff." Daily News 16 March 2001, p.1.
90 Rabin, Roni. "Botanical Garden Cleans Up." Newsday 17 January 2002, p.A7.
91 New York City. Department of City Planning. Plan for the Bronx Waterfront. 1993. New York: NYCDCP, 93-41.

6.5.1.2 Bronx River water quality

Of all the pollutants, pathogen contamination has plagued the Bronx River for years, viewed as a high priority area for future analysis and restoration. New York State listed the lower Bronx River as a high priority water body for TMDL development in the 2002 Section 303(d) List of Impaired Waters. Pathogens were listed as the main pollutant, with urban, storm runoff and combined sewer overflow as the main sources of pollution.[92] In 1998, New York State also listed the Bronx River as an impaired water, designated as a priority for TMDL development. Pathogens were the primary impairment, reported in the 1998 Section 303 (d).[93]

6.5.1.3 Current restoration projects

In 1997, the Urban Resources Partnership and Partnerships for Parks formed the Bronx River Working Group to coordinate watershed restoration, education and outreach efforts. Supported by an EPA Wetlands Protection grant and financial assistance from the U.S. Department of Transportation, the continuously expanding alliance consists of 50 community groups, non-profits, businesses and government agencies.[94] The group is currently known as the Bronx River Alliance.

The Bronx Council for Environmental Quality (BCEQ) has recently worked alongside local environmental groups in various Bronx River wetland restoration and water quality monitoring efforts. The BCEQ sought to gain congressional support to involve the Army Corps of Engineers for habitat restoration, research and construction within the Bronx River Watershed. According to the BCEQ, the NYC Soil & Water Conservation District now considers the Bronx River as a priority area for completion of a soil survey. The NYS Bond Act has apportioned over a million dollars to New York City Parks for stream bank stabilization. The Gaia Institute, a local BCEQ partner, has been documenting this work and designing wetland areas in Bronx and Soundview Parks.[95]

Lastly, in August 2000, a state grant of $16,500 was given to fund a Bronx River restoration project, seeking to promote volunteer water quality monitoring, habitat restoration and outreach.[96]

No other Bronx River restoration projects are known.

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[92] New York State 2002 Section 303 (d) List of Impaired Waters Requiring a TMDL; <http://www.dec.state.ny.us/website/dow/303dlist.pdf>; (accessed 21 August 2002).

[93] New York State 1998 Section 303 (d) List of Impaired Waters Requiring a TMDL; <http://www.dec.state.ny.us/website/dow/303d98.pdf>; (accessed 21 August 2002).

[94] The Bronx River Watershed Community Cooperation in Urban Watershed Restoration. 13 October 2000. <http://www.cleanwater.gov/success/bronx.html>.

[95] The Gaia Institute. 24 January 2002. <http://www.gaia-inst.org>.

[96] Brenner, Elsa. "The Environment: $372,000 Worth of Grants Awarded." New York Times 6 August 2000, 14WC, p.2.

6.5.2 The Harlem River

6.5.2.1 Background

The Harlem River, a 7.6 mile tidal strait, separates Manhattan from the Bronx.[97] Flowing to the south, it connects the Hudson and East rivers and serves as a shipping shortcut between the Long Island Sound and river ports north of New York City.

Some of the first industrial developments along the Harlem River were water-based industries such as boat construction, in the early 1800s. Recreational activities such as sculling were very popular at the time. In the 1880s, the Putnam Division rail line into Manhattan was built alongside the river, transforming the character of the area. Harlem River industry bloomed, most notably marked by the upriver Isaac Johnson Foundry at Spuyten Duyvil. The river was dredged in 1895 to allow ships to pass between the Hudson and the Sound.[98]

From World War II until the 1950s, the Harlem River waterfront experienced a significant decline as many old industries moved away. Since the 1960s, industry has not grown much and the land has seen an increasing shift towards residential and community use.[99]

6.5.2.2 Harlem River water quality

Harlem River, an outlet for the Lower Hudson River, is directly affected by the larger river's water quality problems. PCB contamination of fish is a primary concern for both waterbodies. The *New York State Department of Health 2002-2003 Health Advisories for Chemicals in Sportfish and Game* lists several fish consumption advisories for the Harlem River. The NYS DOH advises against consumption of American eel, due to PCB contamination. Likewise, they suggest that residents eat no more than one meal per month of Atlantic needlefish, bluefish, striped bass and white perch. As a general advisory for sportfish, the NYS DOH recommends no more than one meal (considered a half-pound) per week of fish taken from the state's freshwaters, and some marine waters at the mouth of the Hudson River, including the Harlem River. A special health advisory is also given to children under 15 and women of childbearing age, as they should not eat any fish from waterbodies included on the list. Chemicals may have a greater effect on developing organs and fetuses, and can be passed in mother's milk.[100]

The 2000-2001 Chemicals in Sportfish and Game advisory had the same recommendations for the Harlem River.[101]

The Lower Hudson is listed as a priority group one watershed in the National Sediment Contaminant Point Source Inventory, with divalent metal as the dominant chemical class.[102]

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97 New York City. Department of City Planning. Plan for the Bronx Waterfront.
98 Ibid.
99 Ibid.
100 New York State Department of Health; 2002-2003 Health Advisories: Chemicals in Sportfish and Game; <http://www.health.state.ny.us/nysdoh/environ/02fish.pdf>; (accessed 14 August 2002).
101 New York State Department of Health; 2000-2001 Health Advisories: Chemicals in Sportfish and Game; <http://www.epa.gov/waterscience/316b/subject.pdf >; (accessed 14 August 2002).

1998 Section 303(d) listed the Harlem River as a priority waterbody designated for TMDL development, due to pathogens and floatables from combined sewer overflow.[103] However, the river was recently de-listed due to consideration that it does not qualify for TMDL development priority, as the NYS DEC issued a 2000 revision of waters de-listed from the 1998 Section 303(d) list. Because of legal, time and resource constraints, there was considerable question whether all waterbodies on the 1998 Section 303(d) list could truly be considered as impaired. In some cases, waters previously presented in other reports were carried over to the 303(d) list without any supporting water quality data.[104] In the case of the Harlem River, the revision explains that New York City has addressed the source of the pollution with its CSO Abatement Program and the Catch Basin Hooding Program.[105]

There was no mention of the Harlem River in the recent New York State 2002 Section 303(d) List.[106]

6.5.2.3 Current restoration projects

As discussed in the *Water Management Facilities* section, New York City's CSO Abatement Program and Catch Basin Hooding Program has improved environmental conditions in New York City's waterbodies since its inception in the mid-1990s. An increased focus on the condition of the Harlem River's floatables served as a primary reason for its de-listing from the 1998 Section 303(d) List. NYC's comprehensive sewer abatement program is scheduled for completion between 2001 and 2006.[107]

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[102] National Sediment Contaminant Point Source Inventory; <http://www.epa.gov/waterscience/cs/vol3/appndx_b.pdf>; (accessed 13 August 2002).
[103] New York State 1998 Section 303 (d) List of Impaired Waters Requiring a TMDL.
[104] National Academy of Science; Assessing the TMDL Approach to Water Quality Management; <http://books.nap.edu/html/tmdl/>; (accessed 12 September 2002).
[105] New York State Waters De-Listed from 1998 Section 303 (d) List; <http://www.dec.state.ny.us/website/dow/delist.pdf>; (accessed 22 August 2002).
[106] New York State 2002 Section 303 (d) List of Impaired Waters Requiring a TMDL.
[107] Ibid.

6.5.3 Westchester Creek

6.5.3.1 Background

The Siwanoy Indians were the original inhabitants of this watershed until a 1643 Dutch acquisition. Anne Hutchinson was one of the first European settlers, establishing a nearby colony along the Hutchinson River in 1642.[108] In 1654, Thomas Pell of Fairfield, Connecticut, encouraged 15 men to settle at the head of Westchester Creek, a village called Westchester, marking the first permanent European settlement in the Bronx.[109]

A century and a half later, the shore alongside Westchester Creek served as an estate for Isaac Clason, now know as Clason's Point. By the early 1900s, the Soundview Peninsula (the land east of the Bronx River and west of Westchester Creek) had become a very popular summer resort, complete with beach clubs, summer cottages, marinas and an amusement park. However, following the introduction of local subway and highway lines in the 1920s, much of the area was converted to year-round residences.[110]

6.5.3.2 Westchester Creek water quality

According to New York State, Westchester Creek's water quality is in satisfactory condition. The New York State 1998 Section 303(d) list designated Westchester Creek as a priority waterbody for TMDL development, listing a sludge/sediment impairment, with a potential CSO source.[111] However, a 2002 revision of the 1998 report de-listed Westchester Creek as a waterbody no longer considered priority for TMDL development. The 2002 revision sites that CSO discharges have been identified as the source of the sludge/ sediment creating the oxygen demand in the creek.[112] As discussed above, CSO discharges are currently being addressed with the CSO Abatement Program.

The Westchester Creek was not listed as a priority waterbody for TMDL development in the 2002 Section 303(d) list of impaired waters. Likewise, there were no fish consumption advisories for the waterbody. [113]

6.5.3.3 Current restoration projects

CSO discharges have been identified as the source of the sludge/ sediment creating an oxygen demand in the creek. New York City's CSO Abatement Program has begun to address that issue, as discussed in the section on Harlem River restoration projects, above.

No further information on Westchester Creek restoration is available.

[108] New York City. Department of City Planning.
[109] The Bronx on the Web: Bronx History: A Chronology. The New York Public Library. <http://www2.nypl.org/home/branch/bronx/brchron.cfm>; (accessed 23 August 2002).
[110] New York City. Department of City Planning.
[111] New York State 1998 Section 303 (d) List of Impaired Waters Requiring a TMDL.
[112] New York State Waters De-Listed from 1998 Section 303 (d) List.
[113] New York State 2002 Section 303 (d) List of Impaired Waters Requiring a TMDL.

6.5.4 Upper East River/ Western Long Island Sound

6.5.4.1 Background

The Upper East River/ Western Long Island Sound is classified by the NYC DEP as the northeastern portion of New York Harbor, from Hell's Gate in the East River, up into the Western Long Island Sound, ending at the Throgs Neck Bridge.[114] This body of water separates the western end of Long Island from Manhattan and Bronx counties.

The entire East River spans 14 miles, with main-channel depths of 35 feet from Throgs Neck westward to the Upper New York Harbor. The average velocity of the current is 4 knots at Hell's Gate, but much less at other points. With respect to the upper portion of the river, the conditions of the Long Island Sound provide for flood currents that set westward and an ebb that sets eastward.[115]

Water pollution control in the East River has been of concern since the late 1800s, though the construction of an extensive wastewater treatment system did not begin until 1931. Water quality initiatives in the area were greatly advanced by the Clean Water Act of the 1970s.[116] 1985 marked a monumental moment for environmentalists, as the United States Congress, EPA, and the states of New York and Connecticut launched the Long Island Sound Study, aimed at researching and addressing the Sound's most crucial environmental issues.[117]

6.5.4.2 Upper East River/ Western Long Island Sound water quality

The level of dissolved oxygen (DO) in the Upper East River/ Western Long Island Sound has been of primary concern for the past two decades. In the mid-1980s, water quality engineers recognized that wastewater treatment plants were expelling excessive levels of nitrogen, causing hypoxia in the waterbody. High levels of nitrogen produced algae blooms, creating hypoxic conditions as large amounts of decaying matter depleted DO levels. In waters with low DO, fish are forced to move to new oxygen-rich waters or else face death.[118] In fact, as late as 1999, Long Island experienced an enormous decline in the lobster population as a result of high nitrogen levels.[119]

In the late 1980s, the NYC DEP initiated a nitrogen control program that sought to create new standards for fourteen local wastewater treatment plants and implement new biological nutrient removal technologies.[120] Since then, the trend in DO levels has improved. According to the

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[114] New York City Department of Environmental Protection; 2001 New York Harbor Water Quality Report.
[115] Ecology. Accessed 10 September 2002. <http://www.vanalen.org/workshops/east_river/general/ecology.htm>.
[116] Ibid.
[117] Long Island Sound Study; Sound Health: Status and Trends in the Health of Long Island Sound; <http://www.epa.gov/region01/eco/lis/soundhealthtoc.html>; (accessed 22 August 2002).
[118] Grant, Steve. "'Amazing' Discovery in the Sound; Startling Changes Found in Organism Populations May Mean That Excess Nitrogen is Changing the Sound's Ecology." The Hartford Courant 10 June 2000, p.B1.
[119] Long Island Sound Study; Sound Health 2001: Status and Trends in the Health of Long Island Sound; <http://www.epa.gov/region01/eco/lis/fact15.pdf>; (accessed 22 August 2002).
[120] Nitrogen Control Program. New York City Department of Environmental Protection. 11 February 2002. < http://www.ci.nyc.ny.us/html/dep/html/nitrogen.html>.

NYC DEP *2001 Harbor Water Quality Report*, all six water quality testing stations in the Upper East River/ Western Long Island Sound showed surface waters that met or exceeded standards, and only two showed averages below standards for bottom waters. Bottom waters tend to have lower DO levels, where bacterial respiration consumes more oxygen than is replenished, and waters remain stagnant especially in the summer months. DO levels have increased almost 2 mg/l for surface waters and 1.5 mg/l for bottom waters since 1970.[121]

Despite this improvement in DO, the western Sound still faces some crucial problems as a result of past environmental mistakes. In 2001, trends in the size of the populations of lobsters, oysters and some fish species were only flat or declining.[122] In 2000, research suggested that nitrogen levels might have permanently altered the species composition of the Sound, as one foraminifera species collapsed in the Western Sound, while another began to flourish.[123] The 2002 section 303(d) still identified portions of the Long Island Sound as priority waters for TMDL development, citing fish advisories for the Western Sound.[124]

Other than dissolved oxygen, PCB contamination presents a severe environmental danger. A state health department survey found Hunts Point, South Bronx, to be one of several New York City locations where residents often catch and eat fish contaminated with PCBs.[125] The 2002-2003 NYS DOH fish consumption advisory suggests that adults limit themselves to no more than one meal (half-pound) per month of Atlantic needlefish, bluefish, striped bass and white perch due to PCB contamination. The NYS DOH advises against any consumption of American eel and Mergansers (waterfowl) for similar reasons. People should limit themselves to one meal per week of marine bluefish and eels, and consume no more than two meals a month of any waterfowl. A general advisory recommends that adults consume no more than one meal per week of fish from the East River up to the Throgs Neck Bridge.[126]

The 2000-2001 NYS DOH fish consumption advisory placed the same recommendations as above.[127]

The *2001 Harbor Water Quality Report*, released by the NYC DEP, provided in-depth analyses of dissolved oxygen, fecal coliform, chlorophyll ‘a’ and Secchi Transparency values for New York City’s waterbodies, including the Upper East River/ Western Long Island Sound.[128] Dissolved oxygen results were discussed above.

Fecal coliform levels showed a similar pattern to that of DO, with a slight increase in 2001 and two of six Upper East River testing stations exceeding NYS DEC standards. Weather and illegal connections are suspected causes for the rise. However, on a positive note, there has been a consistent overall decreasing trend in fecal coliform levels from 1975 to 2000.[129]

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[121] New York City Department of Environmental Protection; 2001 New York Harbor Water Quality Report.
[122] Fagin, Dan. “EPA Report: Signs of a Healthier Sound.” Newsday, 1 April 2001, p.A25.
[123] Grant, Steve.
[124] New York State 2002 Section 303 (d) List of Impaired Waters Requiring a TMDL.
[125] Wolfer, Sondra. “Weighing River-Fish Risk: Pollutants are Found in People.” Daily News 23 June 2002, p.1.
[126] New York State Department of Health; 2002-2003 Health Advisories: Chemicals in Sportfish and Game.
[127] New York State Department of Health; 2000-2001 Health Advisories: Chemicals in Sportfish and Game
[128] New York City Department of Environmental Protection; 2001 New York Harbor Water Quality Report.
[129] Ibid.

Half of the testing stations had average values of chlorophyll 'a' that indicated eutrophic conditions, according to the NYC DEP. In the past couple decades, there has been an increase in chlorophyll 'a' from 1985 to 1997, followed by a sharp decrease until 2000. However, the Western Sound experienced a recent surge in chlorophyll "a" in 2001, indicating nutrient buildup. As of 2001, a new plan was in development to further reduce nutrient discharges into the waterbody, including an upgrade of all treatment plants and development of TMDLs for the waterbody. The plan should be completed by 2014.[130]

The Secchi measure for water transparency showed a decrease from 4.6 ft to 4.4 ft from 2000 to 2001. This result is expected with higher chlorophyll levels, equating to more particles in the water. Since 1986, Secchi transparency has varied between 3 ft and 6 ft, and has decreased continuously from the early 1990s until 1995. A matching increasing trend countered until 2000, when it was reversed again.[131]

6.5.4.3 Current restoration projects

In 1985 the U.S. EPA received congressional funding to begin the Long Island Sound Study (LISS), a program to research, monitor and assess the quality of the Long Island Sound. In 1987, Congress designated the Sound as an "Estuary of National Significance," under the National Estuary Program.[132] A year later, development began on a Comprehensive Conservation and Management Plan. Approved in 1994, it focused on seven topics:

> "(1) low dissolved oxygen (hypoxia), (2) toxic contamination, (3) pathogen contamination, (4) floatable debris, (5) the impact of these water quality problems, and habitat degradation and loss, on the health of living resources, (6) land use and development resulting in habitat loss and degradation of water quality, and (7) public involvement and education."[133]

Hypoxia was deemed to be the most pressing environmental problems facing the Sound.[134]

Four of New York City's wastewater treatment plants discharge water into the Upper East River/Western Long Island Sound, with a combined discharge capacity of 680 million gallons per day (MGD). These include Hunts Point, located in the South Bronx (200 MGD), Queens' Tallmans Island (80 MGD) and Bowery Bay treatment facilities (150 MGD), and the Wards Island Treatment Plant (250 MGD)[135]. Besides the Hunts Point control plant, six other parties

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[130] Ibid.
[131] Ibid.
[132] Long Island Sound Study; Sound Health: Status and Trends in the Health of Long Island Sound.
[133] New York State Department of Environmental Conservation, Connecticut Department of Environmental Protection; A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound, December 2000; <http://www.dec.state.ny.us/website/dow/tmdllis.pdf>; (accessed 15 August 2002).
[134] Ibid.
[135] New York City Drainage Areas and Water Pollution Control Plants. New York City Department of Environmental Protection. 11 February 2002. <http://www.ci.nyc.ny.us/html/dep/html/drainage.html>.

were issued water discharge permits in the Bronx, the majority of which are classified as petroleum bulk stations and terminals[136].

In recent years, NYC's wastewater treatment plants have implemented several pollution prevention programs, including the Nitrogen Control and Improved CSO programs discussed above. An Industrial Pretreatment Program requires target industries to remove specified toxins from their wastewater before release into the sewer system. Despite these efforts, pollution still plagues the Upper East River. In March of 1998, two lawsuits were brought against NYC for violation of federal and state laws in the operation and maintenance of its water control facilities. One was filed by the NYS DEC, and another by the State of Connecticut and Soundkeeper, a nongovernmental environmental advocacy organization. NYC argues that it has been in compliance with all regulations.[137]

In resolution of the ongoing litigation, the NYS DEC issued an order in 2001 requiring the NYC DEP to upgrade the aforementioned Upper East River Water Pollution Control Plants. Step-Feed Biological Nitrogen Removal was chosen for implementation, a new nitrogen reduction technology that enhances the step-feed activated sludge wastewater treatment process. In April 2001, the EPA approved the TMDL for nitrogen established by New York and Connecticut, which requires a 58.5% reduction of nitrogen from dischargers to the Sound. In an effort to meet these TMDL requirements, the mandatory upgrades for nitrogen discharges by these four wastewater treatment plants are estimated to cost $1.4 billion.[138]

6.6 Environmental Organizations of the Bronx Watershed

The following is a list of governmental and nongovernmental organizations that provide a range of services relating to the Bronx watershed.

6.6.1 Environmental Government Organizations of the Bronx Watershed

- **Long Island Sound Study**
  "The Long Island Sound Study (LISS) is a cooperative effort involving researchers, regulators, user groups and other concerned organizations and individuals." They seek to "protect and improve the health of the Sound by implementing the Sound's Comprehensive Conservation and Management Plan completed in 1994."

  EPA LIS Office
  Stamford Government Center
  888 Washington Blvd
  Stamford, CT 06904-2152

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[136] Envirofacts Information About Bronx County, NY. United State Environmental Protection Agency. 3 September 2002. <http://oaspub.epa.gov/enviro/ef_home3.html?p_zipcode=bronx%2C+ny&p_type=county>.
[137] New York City Sues for Allegedly Violating Discharge Permits.
[138] New York State Department of Environmental Conservation; Order-on-Consent for Upgrades at Five (5) Wastewater Treatment Plants in NYC; <http://www.dec.state.ny.us/website/dow/nyc_orders.html>; (accessed 15 August 2002).

Phone: (203) 977-1541
http://www.epa.gov/region01/eco/lis/

- **New York City Department of Environmental Protection**

  Department of Environmental Protection
  Customer Service Center
  59-17 Junction Boulevard, 10th Floor
  Flushing, NY 11373
  Phone: (718) 337-4357
  http://www.ci.nyc.ny.us/html/dep/home.html

- **New York City Department of Parks and Recreation**

  The Arsenal, Central Park
  830 5th Avenue
  New York, NY 10021
  Phone: (800) 201-PARK
  http://nyc.gov/html/dpr/home.html

- **New York City Soil and Water Conservation District**

  290 Broadway, 24th floor
  New York, NY 10007
  Phone: (212) 637-3877
  e-mail: shinot@aol.com

- **New York State Department of Environmental Conservation**

  Region 2: Bronx, Kings, New York, Queens and Richmond counties
  Acting Regional Director: Thomas Kunkel
  1 Hunter's Point Plaza
  47-40 21st Street
  Long Island City, NY 11101-5407
  Phone: (718) 482-4900
  http://www.dec.state.ny.us/

- **New York State Department of Health**

  Commissioner Novello, Antonia C., M.D., M.P.H., Dr.P.H
  Office of the Commissioner
  Corning Tower, Empire State Plaza
  Albany, NY 12237
  (518) 474-2011
  http://www.health.state.ny.us/homens.html

- **New York Department of State**

  123 William Street
  New York, NY 10038-3804
  Phone: (212) 417-5800
  e-mail: info@dos.state.ny.us
  http://www.dos.state.ny.us/

- **United States Environmental Protection Agency**

  Region 2
  290 Broadway
  New York, NY 10007-1866
  Phone: 212-637-5000
  http://www.epa.gov/

6.6.2 Environmental Non-Government Organizations of the Bronx Watershed

- **Bronx Council for Environmental Quality**
  Dedicated to "an aesthetic and unpolluted environment with a natural and historic heritage" in the Bronx.
  e-mail: bceq@earthlink.net
  http://www.bceq.org

- **Bronx River Alliance (formerly Bronx River Working Group)**
  Coordinates watershed restoration, education and outreach.
  Bronx River Alliance:
  Brian Aucoin (718) 430-1864
  Abby Feinstein (718) 430-1846
  Elyse Leon (718) 430-4665
  1 Bronx River Parkway
  Bronx, NY 10462
  http://www.cleanwater.gov/success/bronx.html

- **Clean Sound**
  “An all volunteer, not-for-profit, tax exempt corporation, established in 1990 to remove fixed and floatable pollutants from Long Island Sound and all contributing watershed areas, to work to restore degradated habitats, and to inform others about the pollution problems facing the Long Island Sound.
  Phone: 203-929-6195
  20 Ojibwa Road
  Shelton, CT 06484
  e-mail: Info@cleansound.org
  http://www.cleansound.org

- **The Gaia Institute**
  "The work of the Gaia Institute couples ecological engineering and restoration with the integration of human communities in natural systems." The Gaia Institute "explores, through research and development, design and construction, how human activities and waste products can be treated to increase ecological productivity, biodiversity, environmental quality, and economic well being."
  440 City Island Ave.
  Bronx, NY 10464
  Phone : 718-885-1906
  e-mail: GaiaInstituteLab@aol.com
  http://www.gaia-inst.org

- **Long Island Sound Foundation**
  "The Long Island Sound Foundation was established in 1992 to fill a void within the environmental community and to promote a greater awareness and understanding of Long Island Sound as a natural resource and treasure." Their goal is to "facilitate the exchange of information and enhance the ability of individuals and organizations to address issues impacting Long Island Sound."
  1080 Shennecossett Road
  Groton, CT 06340
  Phone: 860.405.9166
  e-mail: mail@lisfoundation.org
  http://www.lisfoundation.org

- **NYC Environmental Justice Alliance**
  Founded in 1991, the NYCEJA is a citywide network that links grass roots organizations low-income neighborhoods and communities of color in their struggle against environmental racism. Their work includes the collection and documentation of environmental data.
  115 West 30th Street, Suite 709
  NY, NY 10001
  Phone: 212-239-8882
  http://www.nyceja.org

- **Partnership for Parks**
  A joint program of the City Parks Foundation and the City of New York/Parks and Recreation, their mission is to encourage community support for and involvement in NYC's Parks. Connected with the Bronx River Alliance.
  The Arsenal, Central Park
  New York, NY 10021
  Phone: 212.360.1310
  e-mail: Cassandra.Smith@parks.nyc.gov
  http://www.partnershipsforparks.org

- **Save the Sound**
  "A bi-state, non-profit membership organization dedicated to the restoration, protection, and appreciation of Long Island Sound and its watershed through advocacy, education and research."
  20 Marshall Street
  South Norwalk, CT 06854
  phone: 203-354-0036
  http://www.savethesound.org

- **Soundkeeper**
  "Soundkeeper is dedicated to the protection and enhancement of the biological, physical, and chemical integrity of Long Island Sound and its watershed." Their "daily work is patrolling, investigating, intervening, and raising public awareness of the Sound's problems."
  PO Box 4058
  Norwalk, CT 06855
  Phone: 1-800-933-SOUND
  e-mail: info@soundkeeper.org / http://www.soundkeeper.org

- **Sustainable South Bronx**
  Founded by Majora Carter in March of 2001, Sustainable South Bronx seeks to research and devise strategies that will result in the implementation of real projects for the South Bronx based on the plans of the community.
  889 Hunts Point Ave.
  Bronx, NY 10474
  Phone: 718-617-4668

6.7 Conclusion

Though the problems of the Bronx Watershed have received significant attention in past decades, critical environmental problems still persist. Pollutants such as PCBs, pathogens and floatables present an environmental hazard to the ecosystem and to South Bronx residents. Pathogen contamination remains a problem for the Bronx River, while fish advisories warn of PCB contamination in the Harlem River and Upper East River. However, many residents continue to consume fish caught in South Bronx waters, unaware of the potential health consequences.

Attention has specifically been given to hypoxic conditions due to a low dissolved oxygen crisis in the Upper East River/ Western Long Island Sound, attributed to an excessive discharge of nitrogen by area wastewater treatment plants. New York City launched a Nitrogen Control Program in the 1990s to curb the nitrogen discharge and its effects. However, problems still persist today, and New York City was recently ordered to upgrade all four of its Upper East River/ Western Long Island Sound wastewater treatment facilities.

Combined sewer overflow has been an area of considerable concern in New York City, and has a negative environmental impact on the South Bronx watershed. Floatables in the Harlem River and sludge/sediment problems in Westchester Creek originate from combined sewer overflow. Adverse water quality impacts of inadequate combined sewer overflow facilities have begun to be addressed by New York City's Combined Sewer Overflow Abatement Program, which has produced significant successes in recent years.

APPENDICES

Appendix A. Project Team Members from NYU's Wagner School/ICIS

Appendix B. Summary of Project Meetings and Activities

Appendix C. Asthma and Air Pollution Literature Review: Additional List of Relevant Studies

Appendix D. List of Selected Project Data Sets

Appendix E. Selected Study Area Graphics: Study Area Boundaries, Demographics, Traffic, and Air Quality

APPENDIX A. PROJECT TEAM MEMBERS FROM NYU'S ROBERT F. WAGNER GRADUATE SCHOOL OF PUBLIC SERVICE INSTITUTE FOR CIVIL INFRASTRUCTURE SYSTEMS (ICIS)

Rae Zimmerman (Co-Principal Investigator), Professor and Director of ICIS
Jose Holguin-Veras, Ph.D., P.E., Transportation Consultant, Associate Professor, Rensselaer Polytechnic Institute, formerly Associate Professor, Institute of Transportation Studies, CUNY
Kyriacos C. Mouskos, Ph.D., Transportation Consultant, Research Professor, City College of New York Institute for Transportation Systems
Carlos Restrepo, Ph.D Candidate, Graduate Research Assistant
Cary Hirschstein, Graduate Research Assistant (Master of Urban Planning candidate, 2004)
Jennifer Lara, Graduate Research Assistant (Master of Urban Planning, 2002)
David Klebenov, Graduate Research Assistant (Master of Public Administration, 2002)

Other team members are from NYU's Office of the President and Nelson Institute of Environmental Medicine (NIEM), the Office of Congressman José E. Serrano, and South Bronx Community Groups (The Point Community Development Corporation, We Stay/Nos Quedamos, Sports Foundation Inc., and Youth Ministries for Peace and Justice Inc.).

APPENDIX B. SUMMARY OF PROJECT MEETINGS AND ACTIVITIES

Project Meetings

This project has had input from and interactions with the four community groups who are part of the project: The Point CDC, the Sports Foundation, Inc., Nos Quedamos and the Youth Ministries of Peace and Justice. The most recent meetings, held in 2002 through September of 2002, are described below:

February 14, 2002 and March 14, 2002. Members of the NYU-Wagner/ICIS group met with the community organizations and NIEM. At each of these meetings, the NYU-Wagner/ICIS group shared information and circulated a status report and colored graphics with a CD containing the graphics for selected demographic, transportation and air quality data (see Appendix D).

March 25th, 2002. Carlos Restrepo, Graduate Research Assistant, met with members of the community group and NIEM in order to discuss the design of the technical information for easy communication to members of the community. The meeting was held at Youth Ministries regarding the use of the South Bronx project's data for display at the April 11 Alternative Fuels event. Jessica Clemente from the NIEM and representatives from Youth Ministries and Hunts Point were present at the meeting. The content of the information was discussed, and included a description of the project and the data the van is collecting; a description of where the project is going and what is left to be done; a series of questions that this project and any follow-up projects should address; and a list of action steps for community groups/members. Examples of the questions that should be addressed in the future include the possible impact of switching from diesel to CNG buses on air quality and the causes of high asthma rates in the Bronx. One future event for the community groups that was discussed was inviting community members to an internet cafe and explaining the contents of the South Bronx project web page. Restrepo prepared graphics of his work on asthma rates in Bronx county for display.

April 11, 2002. NYU-Wagner/ICIS team members participated in the National Alternative Fuels Day and Environmental Summit held at Hostos Community College, as well as earlier events the previous year.

June 13, 2002. Meeting held at the Sports Foundation. At this meeting there was a discussion about whether the van would collect data over the summer months. The School of Environmental Medicine presented an overview of the "backpack study" of children with asthma. Carlos Restrepo of the NYU-Wagner/ICIS team discussed the draft of the Phase I report, focusing mostly on the air quality section. Comments were requested by July 15.

July 17, 2002. A meeting and tour of the NYU School of Medicine Institute of Environmental Medicine facilities in Sterling Forest was held. Paulina Maciejczyk made a presentation about metal and organic molecules analysis, and Lung Chi discussed his five part proposal on asthma disparities in NYC that would be complementary to this project. Carlos Restrepo of the NYU-Wagner/ICIS team discussed the draft of the Phase I report again, along with the group's work for Phase II, in particular, Dr. Holguin Veras' work on transportation modeling and Dr. Bruce Egan's work on air quality modeling in the South Bronx.

September 25, 2002. Project meeting planned to review status of existing work.

Presentations at Professional Societies

In order to obtain input on data analysis approaches from analogous studies throughout the country as well as to communicate information about the South Bronx project, presentations at professional conferences have begun. In 2002, the following presentations were made:

Transportation Research Board annual meeting, January 15, 2002. The preliminary findings of the project were presented in a poster session entitled, "Environmental Equity and Trucking: Case of the South Bronx Waste Transfer Facility," in Session #596 Environmental Justice; HP-16, P02-5435. The session consisted of a dozen and a half presentations from municipalities and communities around the country on their experiences with environmental justice and transportation issues. The TRB environmental justice subcommittee of the community outreach committee organized the poster session. A copy of the poster and over a dozen and a half graphics comprising the poster that describe the overall South Bronx Study were made available to the community groups. The component graphics are attached to this report in Appendix D.

American Planning Association annual conference, Chicago, IL, April 14, 2002. Panel on "Equality in Public Infrastructure Services" – Paper presentation by R. Zimmerman, "A Framework for the Evaluation of Social Equity in Public Infrastructure Facilities," which used the South Bronx project to illustrate issues arising in connection with public service equity.

APPENDIX C. ASTHMA AND AIR POLLUTION LITERATURE REVIEW: ADDITIONAL LIST OF RELEVANT STUDIES

This Appendix includes a list of references that examine the association between asthma and air pollution. These studies are described and summarized in the document *Air Quality Criteria for Particulate Matter (Third External Review Draft)*, published by U.S. Environmental Protection Agency/Office of Research and Development (2002). The document is available for download at: http://cfpub.epa.gov/ncea/cfm/partmatt.cfm

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APPENDIX D. LIST OF SELECTED PROJECT DATA SETS
for
Public Health and Environmental Policy Analysis
Phase I

Data sets have been identified and collected (or identified through internet linkages for retrieval) for study area geography, population, transportation and air quality. A number of these data sets have been described within the chapters. This Appendix gives a listing of data files that are available and in what form, some characteristics of the databases (e.g., location of transportation monitoring stations), and/or the data itself (in the case of Toxic Release Inventory data).

Population:

- Identification and characterization of key population data and applicable census tract and block identifiers for the South Bronx community districts from the U.S. Bureau of the Census for 2000 with summary tables by Community District and comparisons with county, city, state and U.S. data, and preliminary preparations for a community guide the use and understanding of this information

Transportation:

- Data from New York State Department of Transportation (NYSDOT), New York City Department of Transportation (NYCDOT), and the Port Authority of New York and New Jersey (PANYNJ) with supplemental data sought from the Metropolitan Transportation Authority (MTA) and other agencies in the New York area were described in Chapter 3

- Traffic data monitoring stations from NYS DOT and NYC DOT are presented in this Appendix

Air Quality:

- Existing databases for ambient air quality (NAAQS pollutants) from the NYSDEC are part of the Aerometric Information Retrieval System (AIRS) and were described in Chapter 4

- Selected emission sources from the Toxic Release Inventory (TRI) database for the Bronx are presented in this Appendix

A. Study Area Geography

	Format	Document Type
New York City Boroughs and Bronx Community Board Districts	Map	Word
Study Area Community Board Districts	List	Access Report
Census Tracts by Community Board Districts	Map List	Word Access Report
Study Area Census Tracts	List	Access Report
Study Area Census Blocks: Grouped by Census Tract	List	Access Report

B. Population: Census Variables and Data

	Format	Document Type
Summary File 1 Technical Documentation (the entire document is available, but two chapters of particular interest are listed below) Chapter 5: List of Tables (Matrices) - includes variables available on the block level Chapter 6: Summary Table Outlines – includes variables available on the block level	Text	PDF
1990 and 2000 Basic Variables Comparison (across geographic levels - study area to national)	Table	Excel
Population Below Poverty Level in 1989 (by census tract)	Map	Word
Comparison of Population Below Poverty Level in 1989 (across geographic levels - study area to national)	Bar Chart	Word
Black Population in 2000 (by census tract)	Map	Word
Comparison of Black Population in 2000 (across geographic levels - study area to national)	Bar Chart	Word
Hispanic Population in 2000 (by census tract)	Map	Word
Comparison of Hispanic Population in 2000 (across geographic levels - study area to national)	Bar Chart	Word
1990-2000 Percent Change in Population (total population, black population and Hispanic population)	Bar Chart	Word
1990-2000 Comparison of Percent Change in Total Population across geographic levels (study area to national)	Bar Chart	Word

C. Transportation Data

	Format	Document Type
New York State Department of Transportation Sample Data 1998, 1999 and 2000 (description of DOT data)	Text	Word
New York State Department of Transportation On-State Traffic Data – 1999 and 2000 (description of DOT data and monitoring site locations)	Text	Word
1999 Bridge Traffic (description of data)	Text	Word
1999 Bridge Traffic Data (data for major bridges)	Spreadsheet	Excel
George Washington Bridge Data – 1980-2000	Spreadsheet	Excel
South Bronx Traffic Volume	Map	Word

Traffic Monitoring Station Locations

New York State Department of Transportation Traffic Samples

In 1998 and 1999, the New York State Department of Transportation (DOT) conducted traffic samples throughout different parts of New York City and State. The Team's research found ten (10) traffic sampling sites that fell within the study area.

The DOT samples give average weekday data for traffic flows at each monitoring station. The data was compiled during a one-month period at each site.

Average weekday data were calculated from raw data collected over the monitoring period. The average data describes the number of vehicles in each vehicle class per ending hour of sample. There are separate averages for each lane in each direction (e.g. lane 1 southbound, lane 2 southbound, lane 3 northbound.) The study uses standard FHWA vehicle classification F1-F13, and also includes the average number of axles per class.

Monitoring Locations:

Sample Month	Location
February 98	Grand Concourse over Metro North Railroad Bridge
May 98	Brook Avenue from 146th to 147th Street
March 98	EL Grant Highway over Interstate 95
February 98	Bruckner Boulevard Bridge over Conrail Pt. Morris
March 98	Willis Avenue over Interstate 87
September 98	Cross-Bronx Expressway between Sheridan Expressway and Bronx River Parkway
March 1999	174th St. - on bridge over Rte. 895I
May 1999	Lafayette Avenue IS over Route 195SI
March 1999	Westchester Avenue on bridge over Bronx River
June 1999	Cross Bronx Expressway, Station 32

New York State Department of Transportation Off-State Traffic Data

This data set was collected in 1999 by the New York State Department of Transportation (DOT). The data are comprised of hourly counts over a 24-hour period. Traffic data were collected using automated recorders at each location. Off-State roads refer to local roads as opposed to expressway, highways and thruways.

There are 65 monitoring stations in the 1999 off-State data set that fall within the established study area of the South Bronx, listed below. The data are organized into raw counts per each monitoring day, per hour. DOT also provides averages for weekday hours and axle-factored weekday hours.

Monitoring Locations:

Start Date	Location
04/17/1999	Grand Concourse between E. 161 St. and E. Tremont Ave.
04/12/1999	Grand Concourse between Interstate 87 and East 138th St.
04/10/1999	Grand Concourse between E. 138th and E. 161st Sts.
04/10/1999	Halleck St. between Hunt's Point Ave. and Edgewater Rd.
04/10/1999	Hunts Point Ave. between East Bay Ave. and Southern Ave.
04/10/1999	Jerome Ave. between Macombs Dam Bridge approach and E. 167th St
04/10/1999	Leggett Ave. between Randall Ave. and Bruckner Blvd.
04/10/1999	Macombs Dam Bridge between NY county line and IN87
04/10/1999	Macombs Dam Bridge between IN87 and Jerome Ave.
04/10/1999	Melrose Ave. between 3Rd. Ave. and E. 165 St.
01/11/1999	E. 161 St. between Woodcrest Ave. and Macombs Dam Bridge
10/19/1999	E. 161 St. between River St and Grand Blvd./ Concourse
10/19/1999	E. 161 St. between Grand Concourse and Elton Ave.
01/25/1999	E. 163 St. between Washington Ave. and Rev. J Polite
04/10/1999	E. 163 St. between Westchester Ave. and Bruckner Blvd.
04/10/1999	Edgewater Rd. between Halleck St. and Westchester Ave.
04/17/1999	Grant Hwy between E 167 St. and IN 95
04/10/1999	Elton Ave. between E. 161 and E. 163 St.
04/10/1999	Garrison Ave. between Tiffany and Edgewater Rd.
04/10/1999	Bruckner between Willis Ave. and E. 135th St.
04/10/1999	Bruckner between Triboro and E. 149 St.
04/10/1999	Bruckner between E. 149 St and Leggett Ave.
04/10/1999	Bruckner between Leggett Ave. Tiffany St.
04/10/1999	Bruckner between Tiffany St. and Sheridan Xpway
04/18/1999	Bruckner between Pelham Pkwy Ramps and Sheridan Xpway
02/20/1999	Bruckner between Sheridan and Bronx River Pkwy
04/18/1999	Bruckner between Bronx River Pkwy and White Plains Rd.
04/17/1999	Crotona between Boston Rd. and IN95
04/17/1999	E. 135 St. between Alexander Ave. and Willis Ave.
04/17/1999	E. 138 St. between NY CO line and IN 87

01/11/1999	E. 138th St. between IN 87 and Third. Ave.
01/25/1999	E. 138 St. between Third Ave. and Willis Ave.
04/17/1999	E. 138 St. between Willis Ave. and Bruckner Blvd.
01/25/1999	E. 151 St. between Cromwell Ave. and GR conc/Blvd.
04/17/1999	E. 138 St. between Willis Ave. and Bruckner Blvd.
10/19/1999	E. 153 St. between Southbound En 87I and River Ave.
04/17/1999	E. 157 St. between 87I SB and Westchester County Line
04/10/1999	Prospect Ave. between Southern Blvd. and E. 163 St.
01/11/1999	Alexander Ave. between E. 132 St and E. 135 St.
04/13/1999	Barreto St. between Garrison Ave. and Bruckner Blvd.
04/10/1999	Boone Ave. between Westchester and Interstate 895 Ramp
04/13/1999	Boston Rd. between 3Rd. St and Crotona Ave.
04/13/1999	Boston Rd. between Crotona Ave. and Southern Blvd.
04/13/1999	Boston Rd. between Southern Blvd. and E. Tremont Ave.
04/20/1999	Boston Rd. between Bronx River Pkwy and E. Fordham Rd.
01/26/1999	Boston Rd. between E. Fordham Rd. and Bronx County line
04/10/1999	Brown Pl. between Terminal Ent and E. 134 St.
04/10/1999	Bruckner between Third Ave. and Willis Ave.
04/10/1999	Prospect Ave. between Southern Blvd. and E. 163 St.
04/10/1999	Prospect Ave. between E. 163 St. and Boston Rd.
04/10/1999	Randall Avenue between Truxton St. and Hunts Pt. Ave.
04/10/1999	Rev. J. Polite Ave. between Westchester Ave. and E. 163 St.
04/10/1999	River Ave. between E. 149 St. and Park N Ride
04/10/1999	Southern Blvd. between E. 163 St. and Westchester Ave.
04/13/1999	Southern Blvd. between Westchester Ave. and Boston Rd.
04/13/1999	Southern Blvd. between Boston Rd. and E. Tremont Ave.
04/12/1999	Third Ave. between NY County line and Bruckner Blvd.
04/17/1999	Third Ave. between Bruckner Blvd. And IN87
04/10/1999	Tiffany Street between Randall St. and Bruckner Expwy.
04/10/1999	Third Ave. between IN87 and Willis Ave.
04/10/1999	Third Ave. between E. Willis Ave. and E. 163 St.
04/10/1999	Willis Ave. between NY County line and Bruckner Blvd.
04/10/1999	Willis Ave. between Bruckner Blvd. and IN87
04/10/1999	Whitlock St. between Bruckner Blvd. En and Westchester Ave.
04/17/1999	Grand Blvd./ Concourse between E. 167 St. and Cross Bronx Expwy.

New York State Department of Transportation On-State Traffic Data

This data set was collected in 1999 by the New York State Department of Transportation (DOT). The data are comprised of hourly counts over a 24-hour period. Traffic data were collected using automated recorders at each location. On-State roads refer to State and Federal expressway, highways and thruways.

There are 16 monitoring stations in the 1999 on-State data set that fall within the established study area of the South Bronx, listed below. The data is organized into raw counts per each monitoring day, per hour. DOT also provides averages for weekday hours and axle-factored weekday hours.

Monitoring Locations

Start Date	Location
06/14/1999	95I between Acc Bronx River Parkway and Acc Westchester Ave.
06/14/1999	95I between NY County Line and Acc 87I Major Deegan Expwy.
06/14/1999	95I between Acc 87I Major Deegan Expwy. And Acc Jerome Ave.
06/14/1999	95I between end Ft. 1 OLAP Webster Ave. to Acc Crotona Ave.
06/14/1999	95I between Acc Crotona Ave. and Acc895 Sheridan Expwy.
07/19/1999	278I between 87I Major Deegan Expwy. and Exit 46 895I Sheridan Expwy.
03/29/1999	278I between Exit 46 895I Sheridan Expwy. and Bronx River Pkwy.
07/19/1999	278I between Bronx River Pkwy. North and White Plains Rd. Castle Hill
07/19/1999	278I between White Plains Rd. Castle Hill and 95I Cross Bronx Expwy.
04/05/1999	87I between 278I Major Deegan and Bruckner and Acc. Willis Ave.
04/05/1999	87I between Acc. Grand Concourse and Acc. East 138th St.
04/05/1999	87I between Acc. East 138th St. and Acc. Macombs Dam Bridge
07/19/1999	295I between Acc. Cross Bronx Extension and Acc. 95I end 295I
07/19/1999	295I between Acc. 278I and Acc. Westchester Ave.
07/19/1999	895I between Acc. Westchester Ave. and Acc. 95I end 895I
05/24/1999	695I between 295I (C.B.E. Extn.) and 95I

D. Selected Air Quality Emission Data:

TOXIC RELEASE INVENTORY, 1999 DATA, BRONX COUNTY, NEW YORK

1. TRI On-site and Off-site Reported Releases (in pounds), of All Chemicals, Bronx County, State of New York, 1999, All Industries

Row #	Chemical	Total Air Emissions	Surface Water Discharges	Underground Injection	Releases to Land	Total On-site Releases	Total Off-site Releases	Total On- and Off-site Releases
1	BENZOYL PEROXIDE	5	.	.	.	5	250	255
2	CERTAIN GLYCOL ETHERS	515	.	.	.	515	.	515
3	CHROMIUM COMPOUNDS	.	.	.	.	.	.	.
4	LEAD COMPOUNDS	.	.	.	.	.	.	.
5	THIOUREA	.	.	.	.	.	.	.
6	TOLUENE	516	.	.	.	516	.	516
7	TRICHLOROETHYLENE	14,835	.	.	.	14,835	.	14,835
8	XYLENE (MIXED ISOMERS)	1,496	.	.	.	1,496	.	1,496
9	ZINC COMPOUNDS	250	.	.	.	250	1,250	1,500
	Total	17,617	-	-	-	17,617	1,500	19,117

2. TRI Transfers Off-site for Further Waste Management (in pounds), of All Chemicals, Bronx County, State of New York, 1999, All Industries

Row #	Chemical	Transfers To Recycling	Transfers To Energy Recovery	Transfers To Treatment	Transfers To POWs	Other Off-site Transfers	Total Transfers Off-site for Waste Management
1	BENZOYL PEROXIDE	.	.	.	250	.	250
2	CERTAIN GLYCOL ETHERS	.	.	.	.	.	.
3	CHROMIUM COMPOUNDS	.	.	.	.	.	.
4	LEAD COMPOUNDS	.	.	.	.	.	.
5	THIOUREA	.	.	.	.	.	.
6	TOLUENE	.	.	.	.	.	.
7	TRICHLOROETHYLENE	1,333	.	.	.	.	1,333
8	XYLENE (MIXED ISOMERS)	.	.	.	.	.	.
9	ZINC COMPOUNDS	.	.	.	.	.	.
	Total	1,333	-	-	250	-	1,583

3. Quantities of TRI Chemicals in Waste (in pounds), of All Chemicals, Bronx County, State of New York, 1999, All Industries

Row #	Chemical	Recycled On-site	Recycled Off-site	Energy Recovery On-site	Energy Recovery Off-site	Treated On-site	Treated Off-site	Quantity Released On and Off-site	Total Waste Managed	Waste Due to Catastrophic or One Time Events
1	BENZOYL PEROXIDE	.	.	.	.	.	48	23	71	-
2	CERTAIN GLYCOL ETHERS	680	.	.	.	.	.	515	1,195	-
3	CHROMIUM COMPOUNDS	.	.	.	.	.	.	.	.	.
4	LEAD COMPOUNDS	.	.	.	.	.	.	.	.	.
5	THIOUREA	-	-	-	-	-	-	-	-	-
6	TOLUENE	615	.	.	.	.	.	515	1,130	-
7	TRICHLOROETHYLENE	.	1,328	.	-	-	-	14,835	16,163	-
8	XYLENE (MIXED ISOMERS)	1,095	.	.	.	.	.	1,496	2,591	-
9	ZINC COMPOUNDS	.	.	.	.	.	1,138	160	1,298	-
	Total	2,390	1,328	-	-	-	1,186	17,544	22,448	-

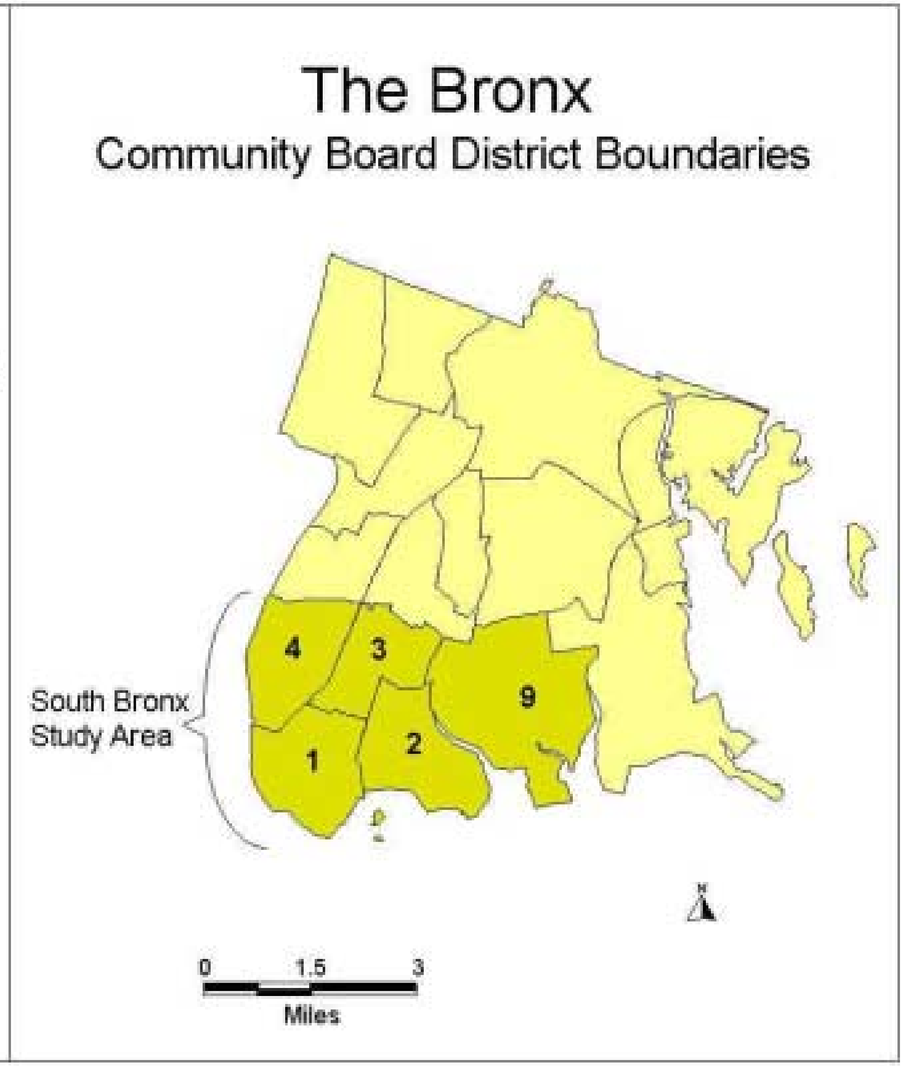
Source of all tables: www.epa.gov/tri

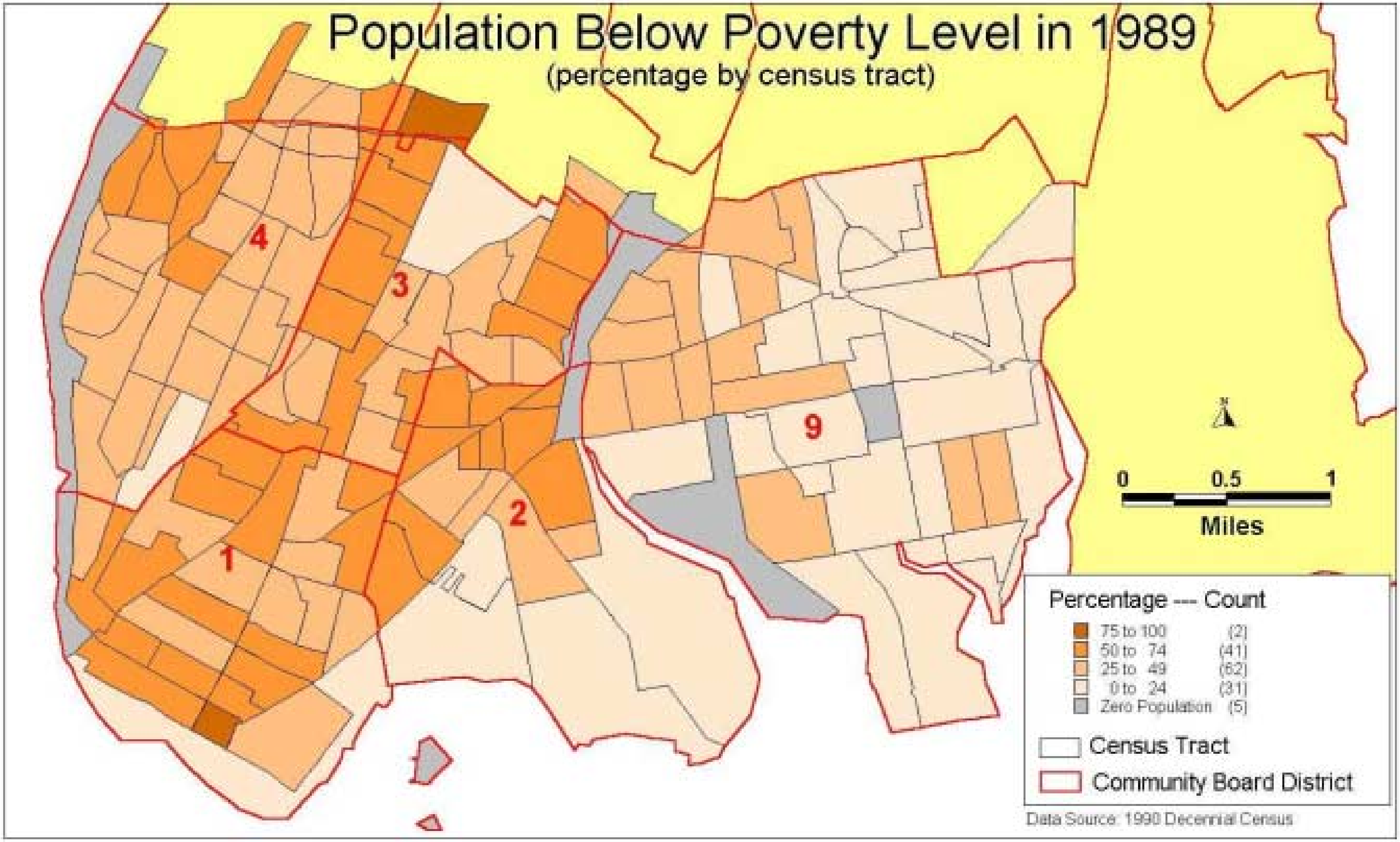
APPENDIX E. SELECTED STUDY AREA GRAPHICS: STUDY AREA BOUNDARIES, DEMOGRAPHICS, TRAFFIC, AND AIR QUALITY

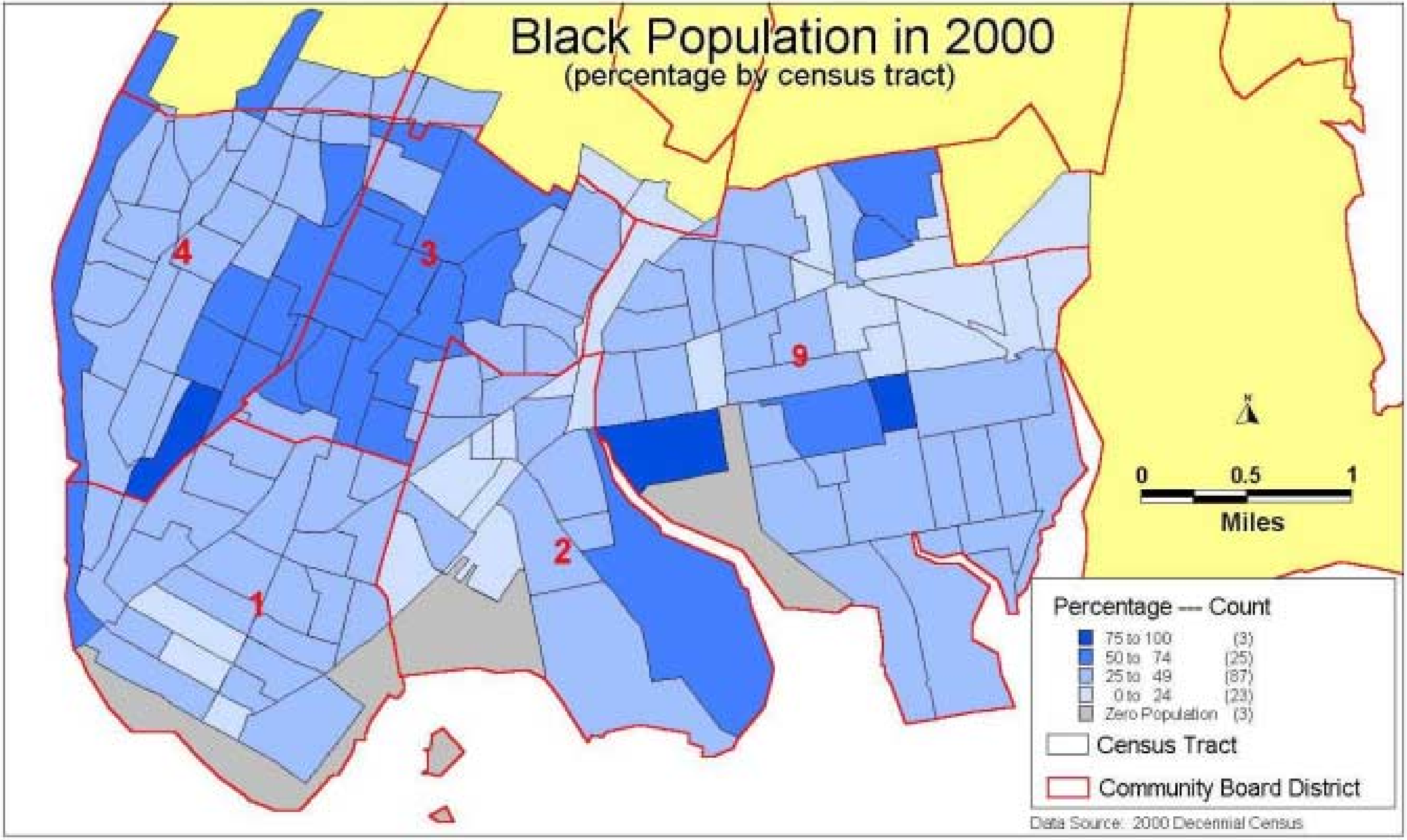
1. New York City Borough Boundaries / The Bronx / Community Board District Boundaries
2. Map: Black Population in 2000 (percentage by census tract)
3. Map: Hispanic Population in 2000 (percentage by census tract)
4. Map: Map: Population Below Poverty Level in 1989 (percentage by census tract)
5. Comparison of Percent Change in Total Population (1990-2000)
6. South Bronx Percent Change in Population (1990-2000)
7. Comparison of Black Population in 2000 (Percentage of Total Population)
8. Comparison of Hispanic Population in 2000 (Percentage of Total Population)
9. Comparison of Population Below Poverty in 1989 (Percentage of Total Population)
10. Map: Municipal Solid Waste Transfer Stations and NYS DEC Monitoring Sites
11. Map: South Bronx Traffic Volume
12. Map: Location of NYSDEC Air Quality Monitoring Stations
13. NYSDEC Monitoring Station Results
14. Map: Selected Sites for Summer Monitoring by NIEM (summer 2000)

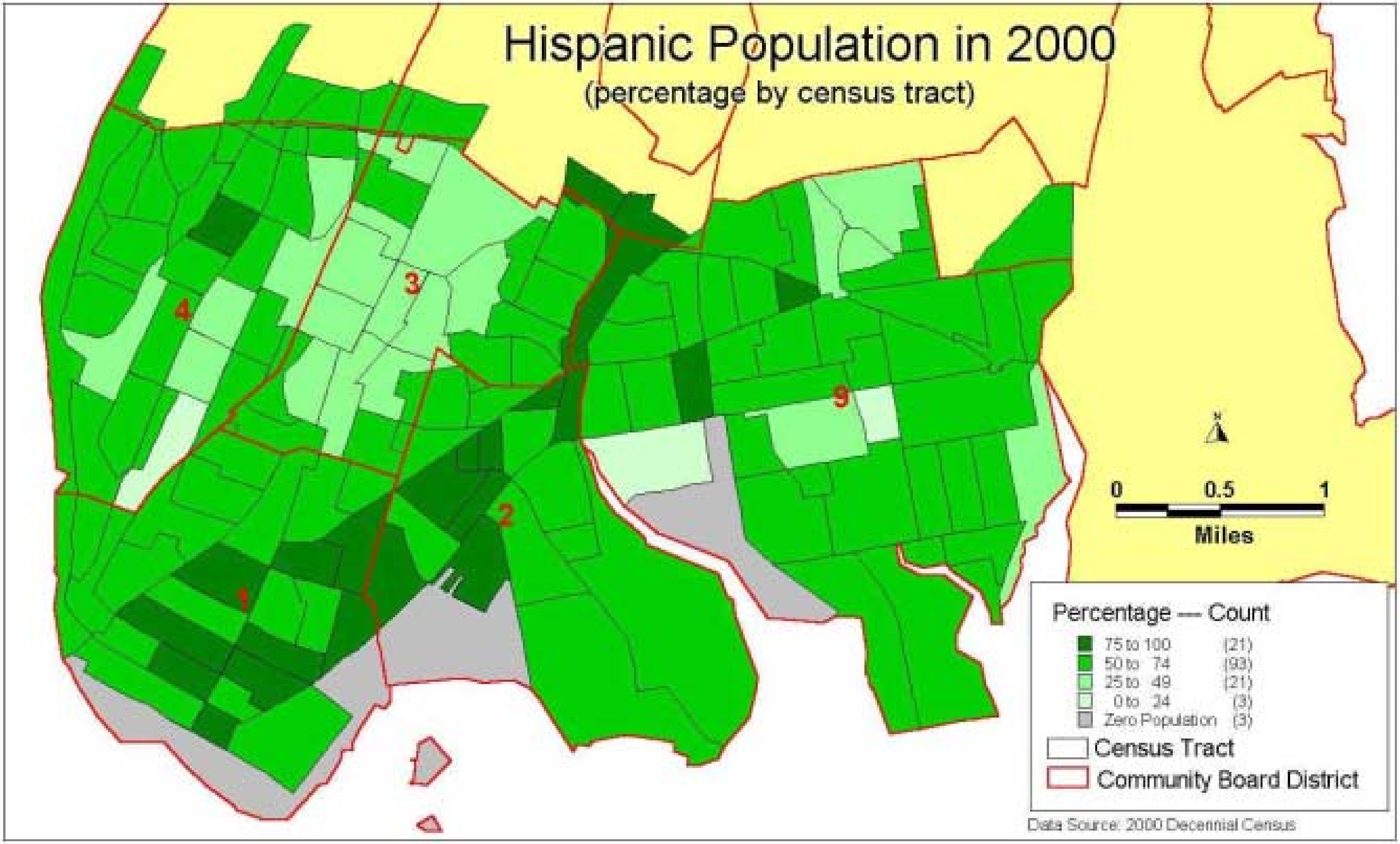
15.-19. Maps: Summer Monitoring Results


New York City
Borough Boundaries
The Bronx
Manhattan
Queens
Brooklyn
Staten Island
0
5
10
Miles

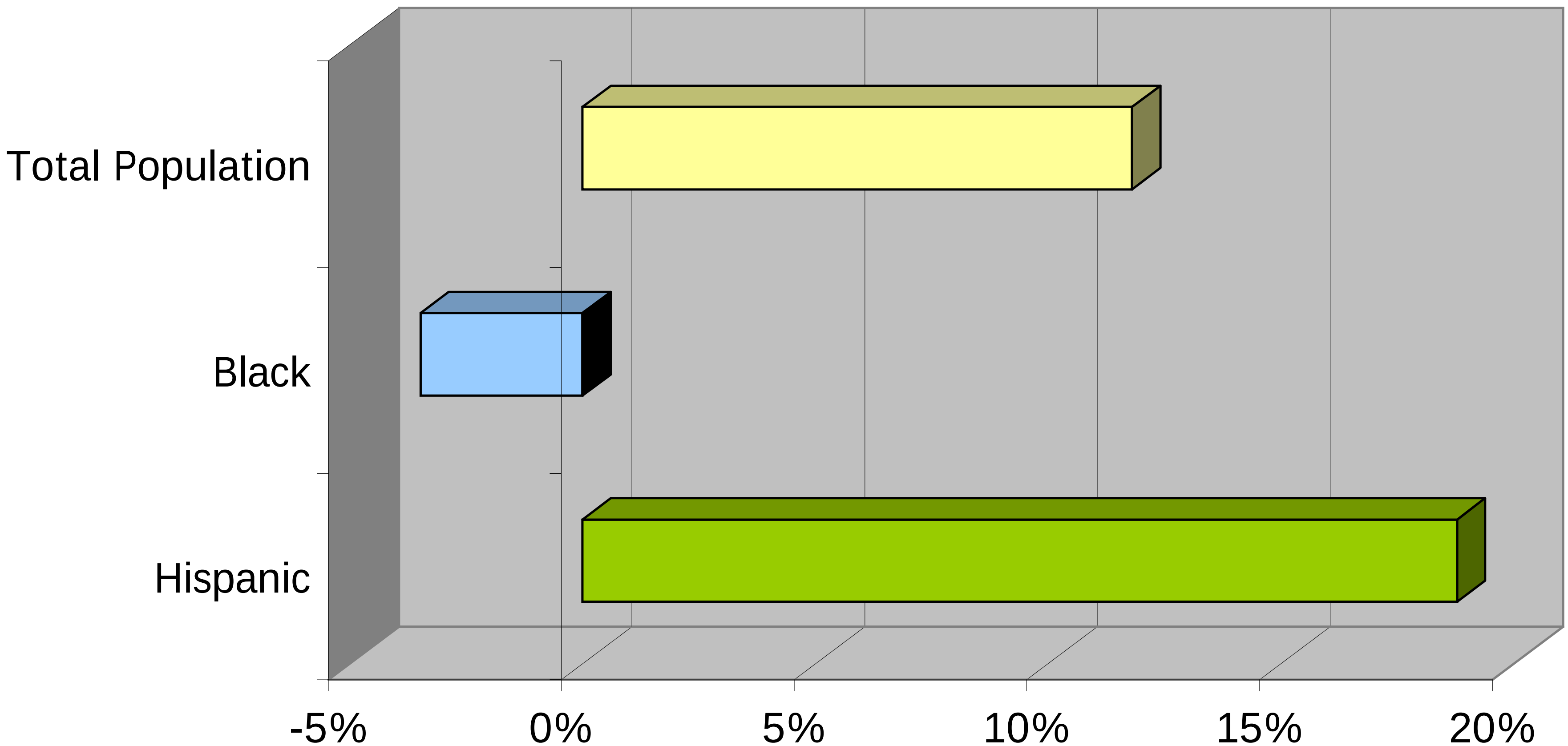

The Bronx
Community Board District Boundaries
4
3
9
South Bronx
Study Area
1
2
0
1.5
3
Miles


Population Below Poverty Level in 1989
(percentage by census tract)
4
3
1
2
9
0
0.5
1
Miles
Percentage --- Count
75 to 100 (2)
50 to 74 (41)
25 to 49 (62)
0 to 24 (31)
Zero Population (5)
Census Tract
Community Board District
Data Source: 1990 Decennial Census


Black Population in 2000
(percentage by census tract)
4
3
9
1
2
0
0.5
1
Miles
Percentage --- Count
75 to 100 (3)
50 to 74 (25)
25 to 49 (87)
0 to 24 (23)
Zero Population (3)
Census Tract
Community Board District
Data Source: 2000 Decennial Census

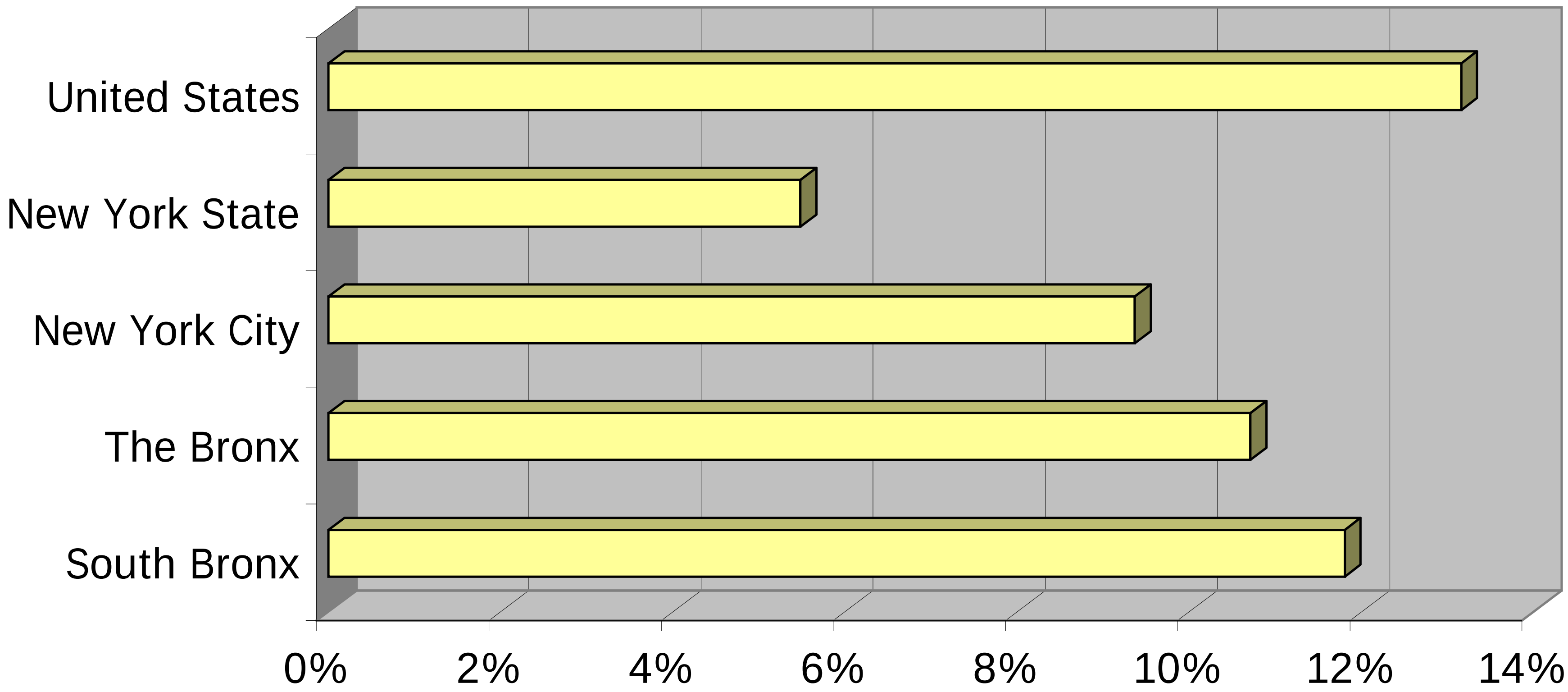

Hispanic Population in 2000
(percentage by census tract)
4
3
1
2
9
0
0.5
1
Miles
Percentage --- Count
75 to 100 (21)
50 to 74 (93)
25 to 49 (21)
0 to 24 (3)
Zero Population (3)
Census Tract
Community Board District
Data Source: 2000 Decennial Census

South Bronx
Percent Change in Population (1990-2000)



Data Source: 1990 and 2000

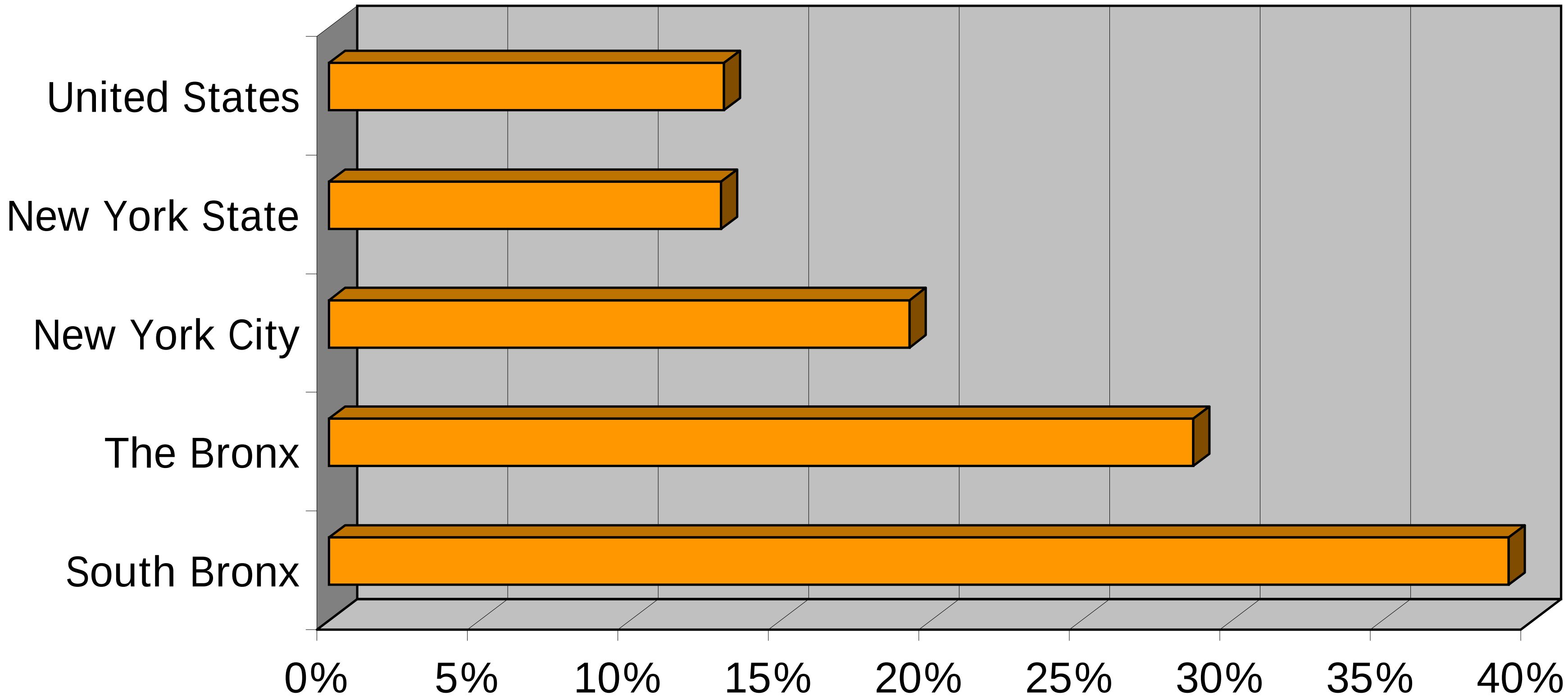
Comparison of Percent Change in Total Population (1990-2000)



Data Source: 1990 and 2000

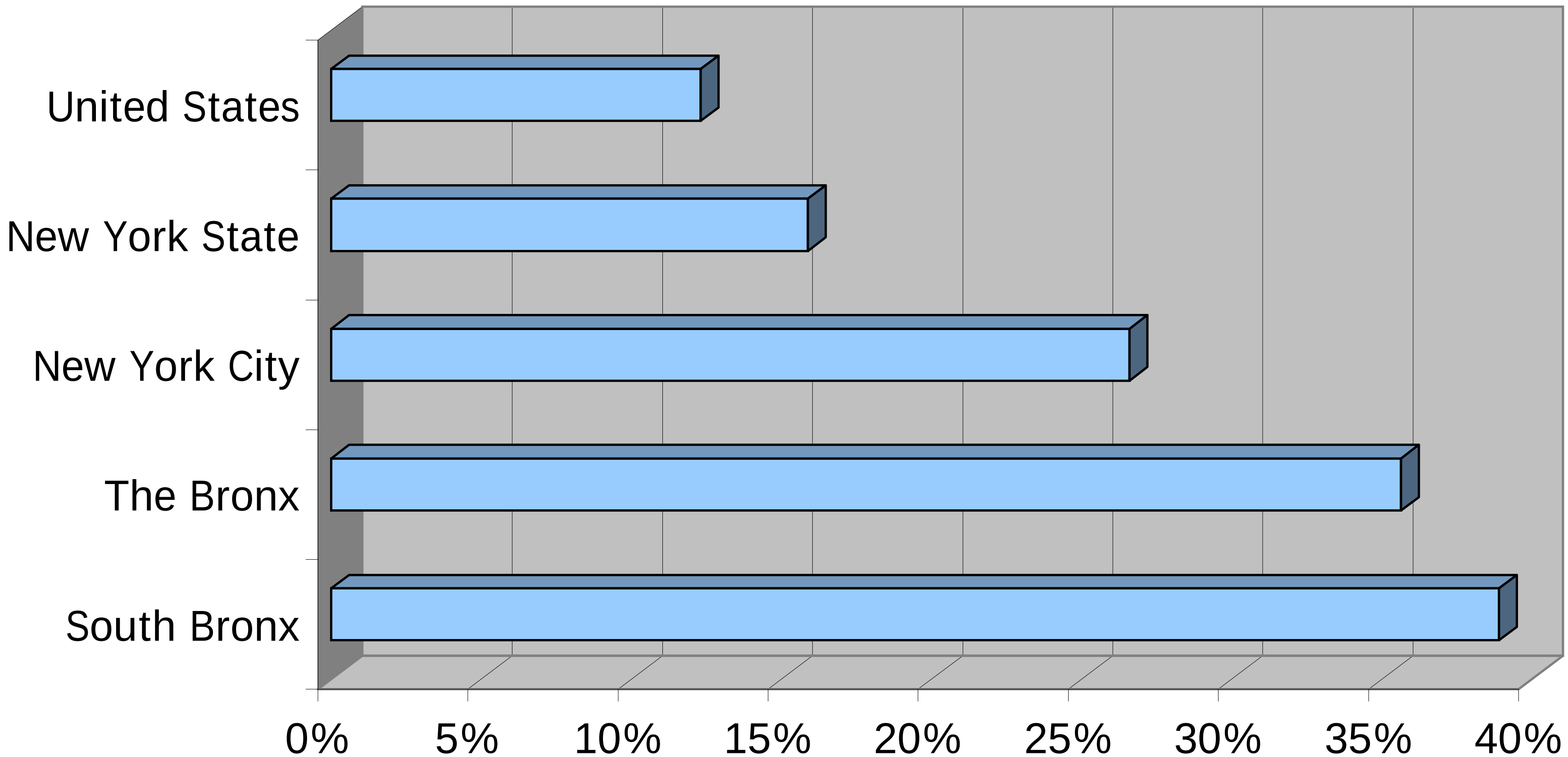
Comparison of Population Below Poverty in 1989

(Percentage of Total Population)



Data Source: 1990 Decennial

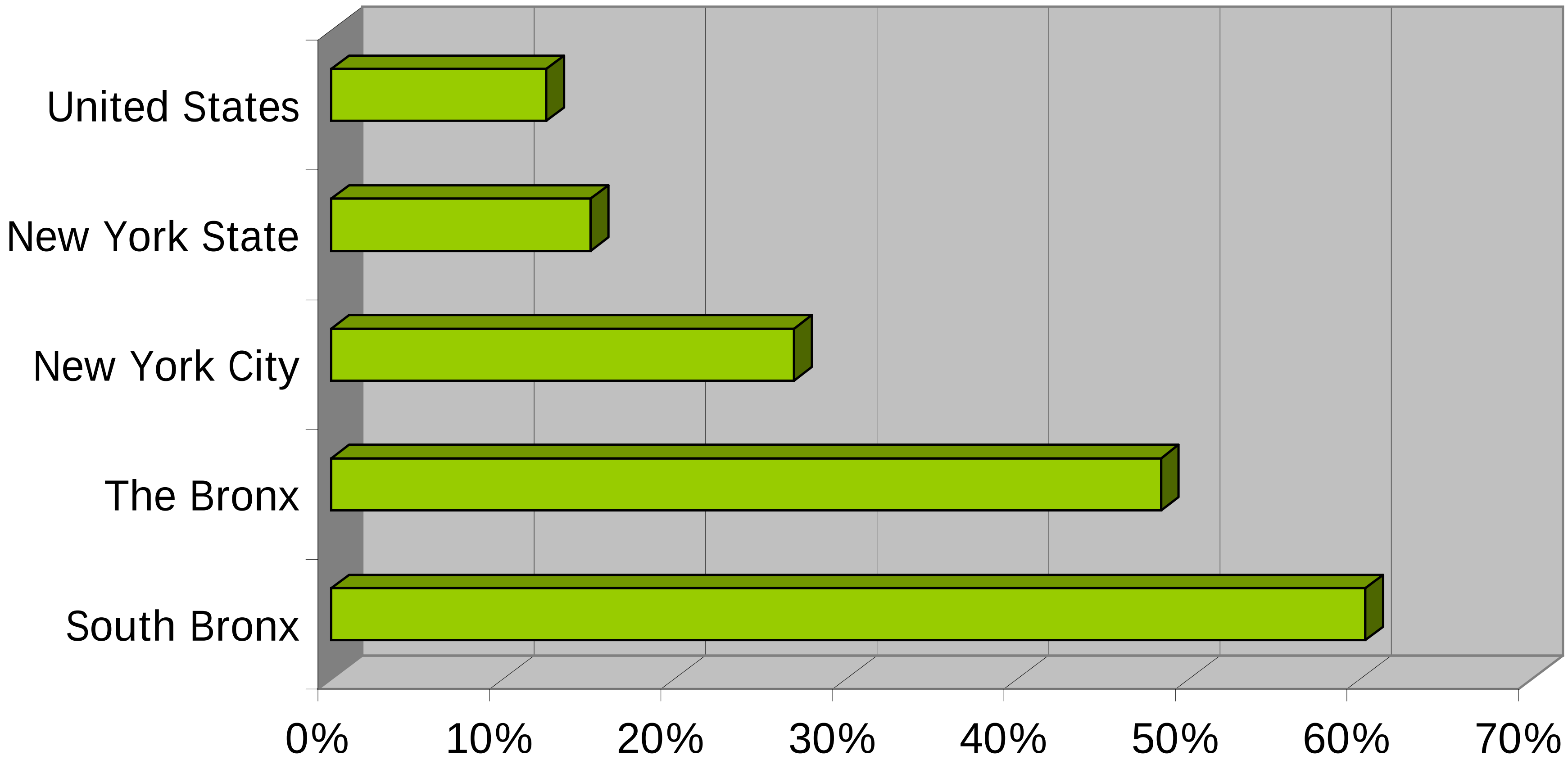
Comparison of Black Population in 2000
(Percentage of Total Population)



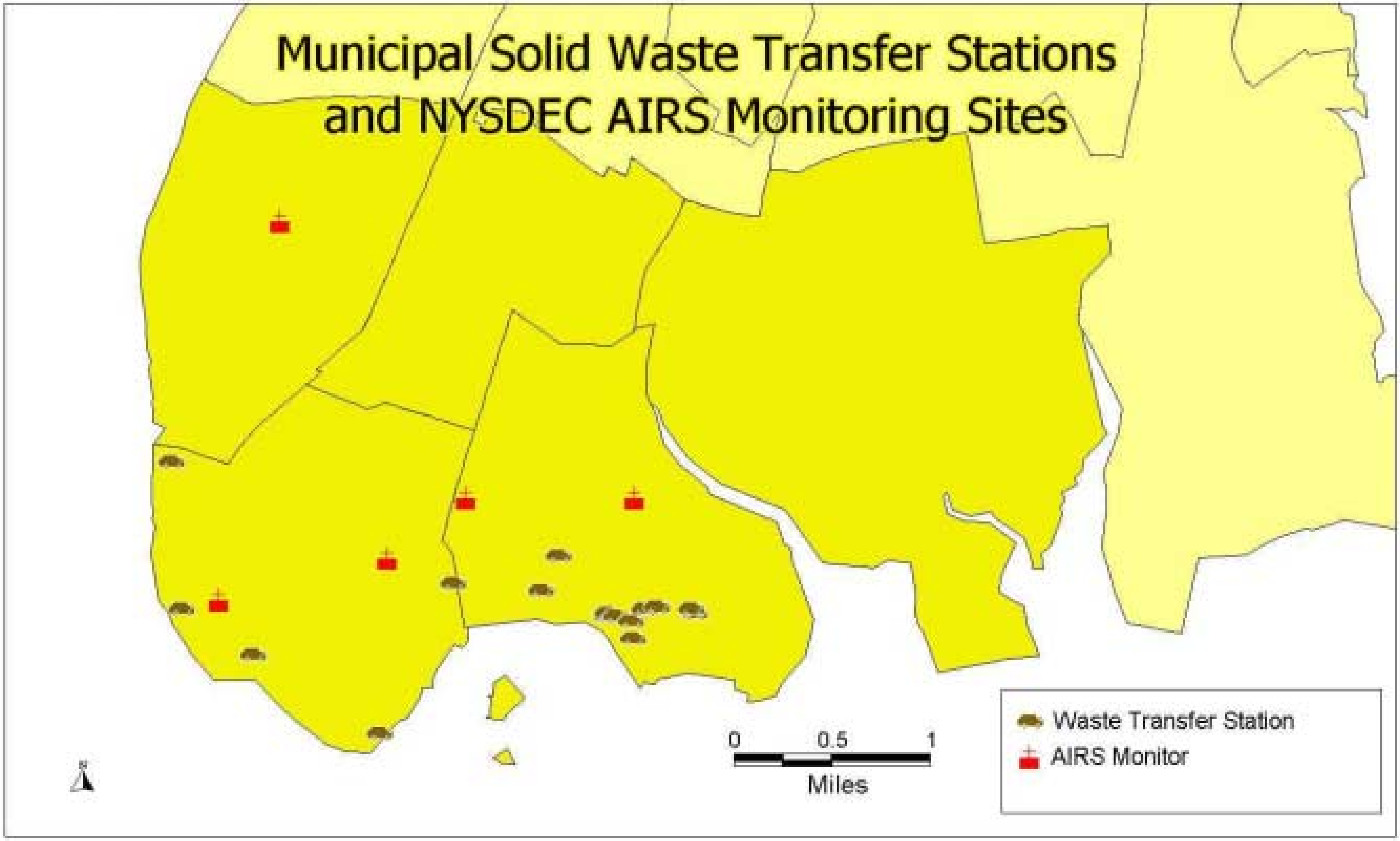
Data Source: 1990 and 2000

Comparison of Hispanic Population in 2000

(Percentage of Total Population)



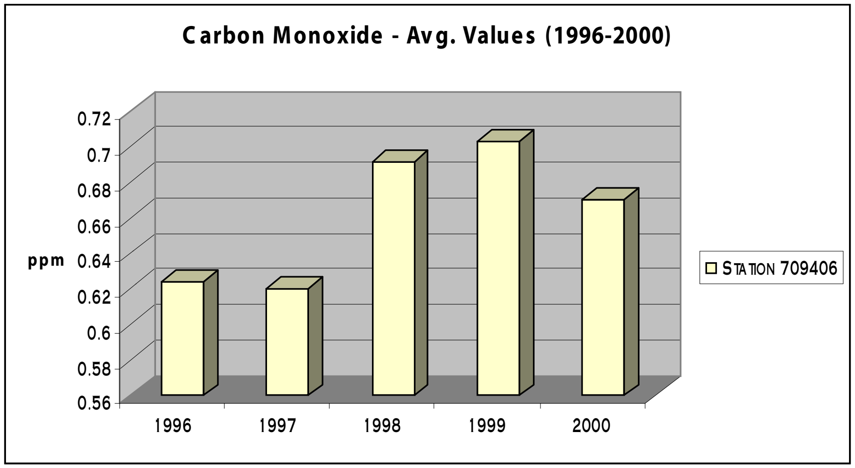
Data Source: 1990 and 2000

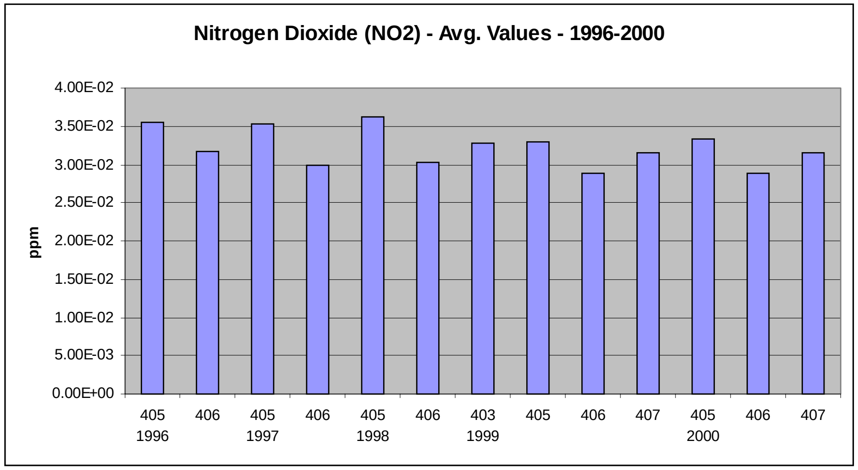

Municipal Solid Waste Transfer Stations
and NYSDEC AIRS Monitoring Sites
0
0.5
1
Miles
Waste Transfer Station
AIRS Monitor

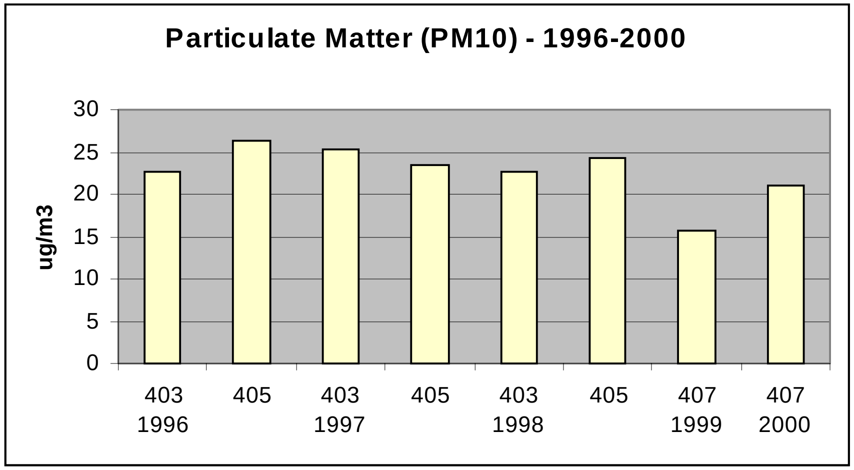
Location of NYSDEC Air Quality Monitoring Stations

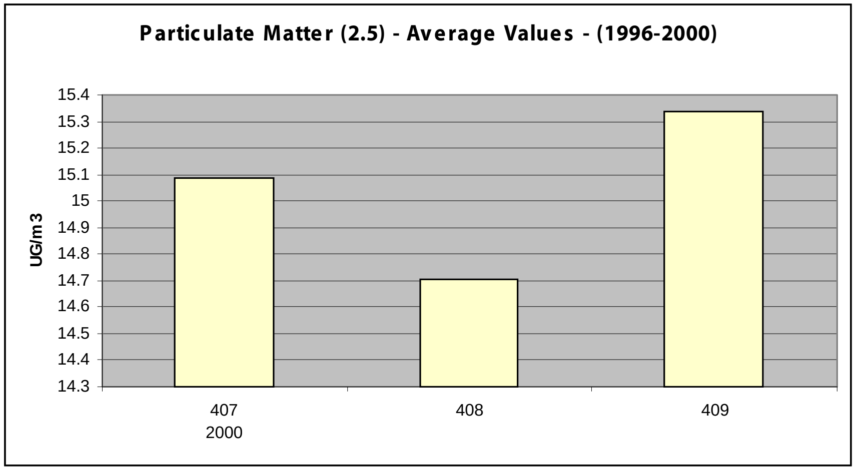
Station ID	Location	Height Above Ground
709403	IS 155, 470 Jackson Avenue	16 meters
709405	Morrisania, 1225-57 Gerard Avenue	15 meters
709407	IS 52, 681 Kelly Street, off 156th Street	15 meters
709408	IS 74, 730 Bryant Avenue	15 meters
709409	PS 154, 333 E. 135th Street	15 meters

NYSDEC Monitoring Station Results





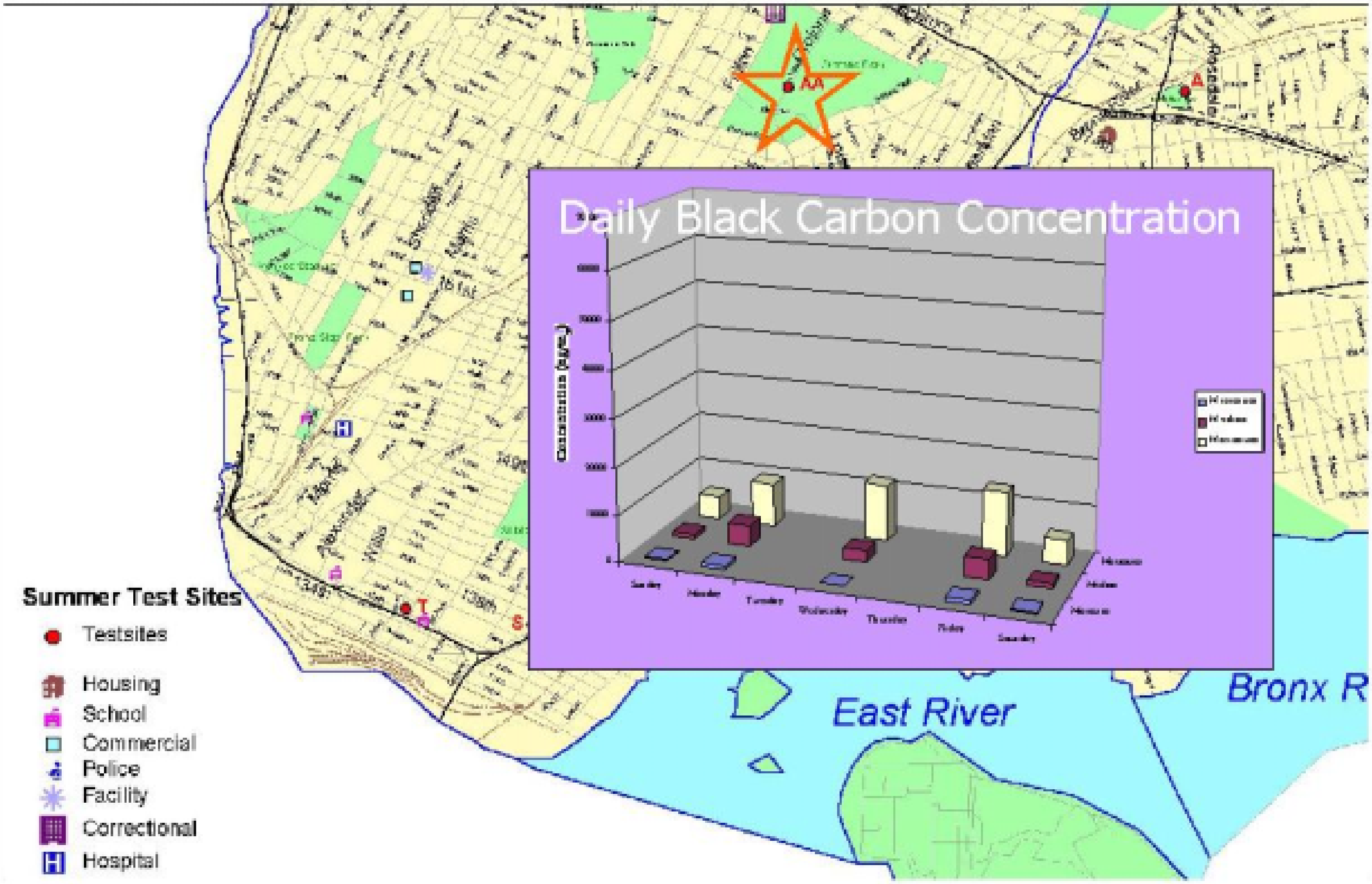




Selected Sites For Summer Monitoring

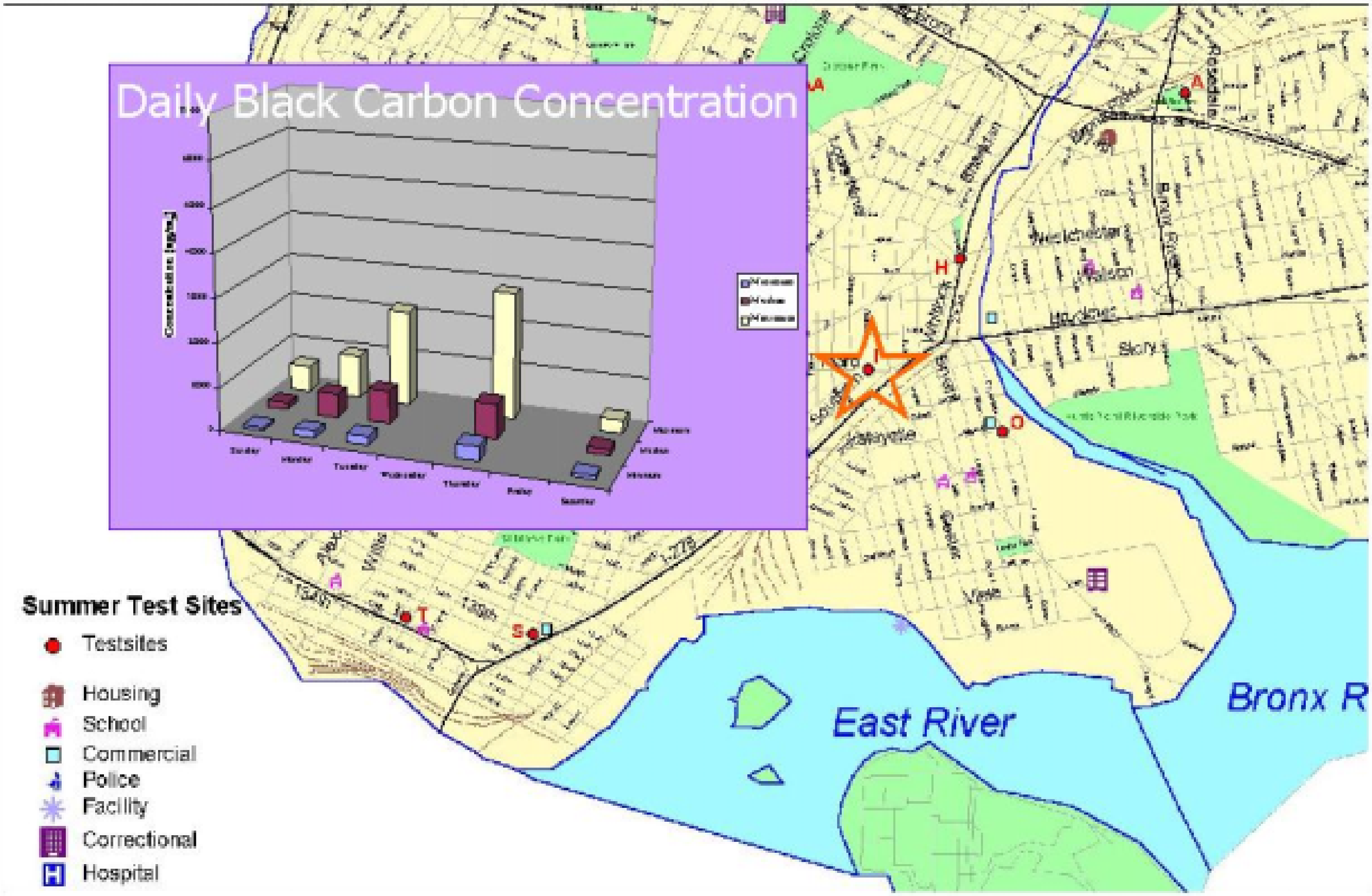
Source: NYU School of Medicine, Institute of Environmental Medicine

Crotona Park



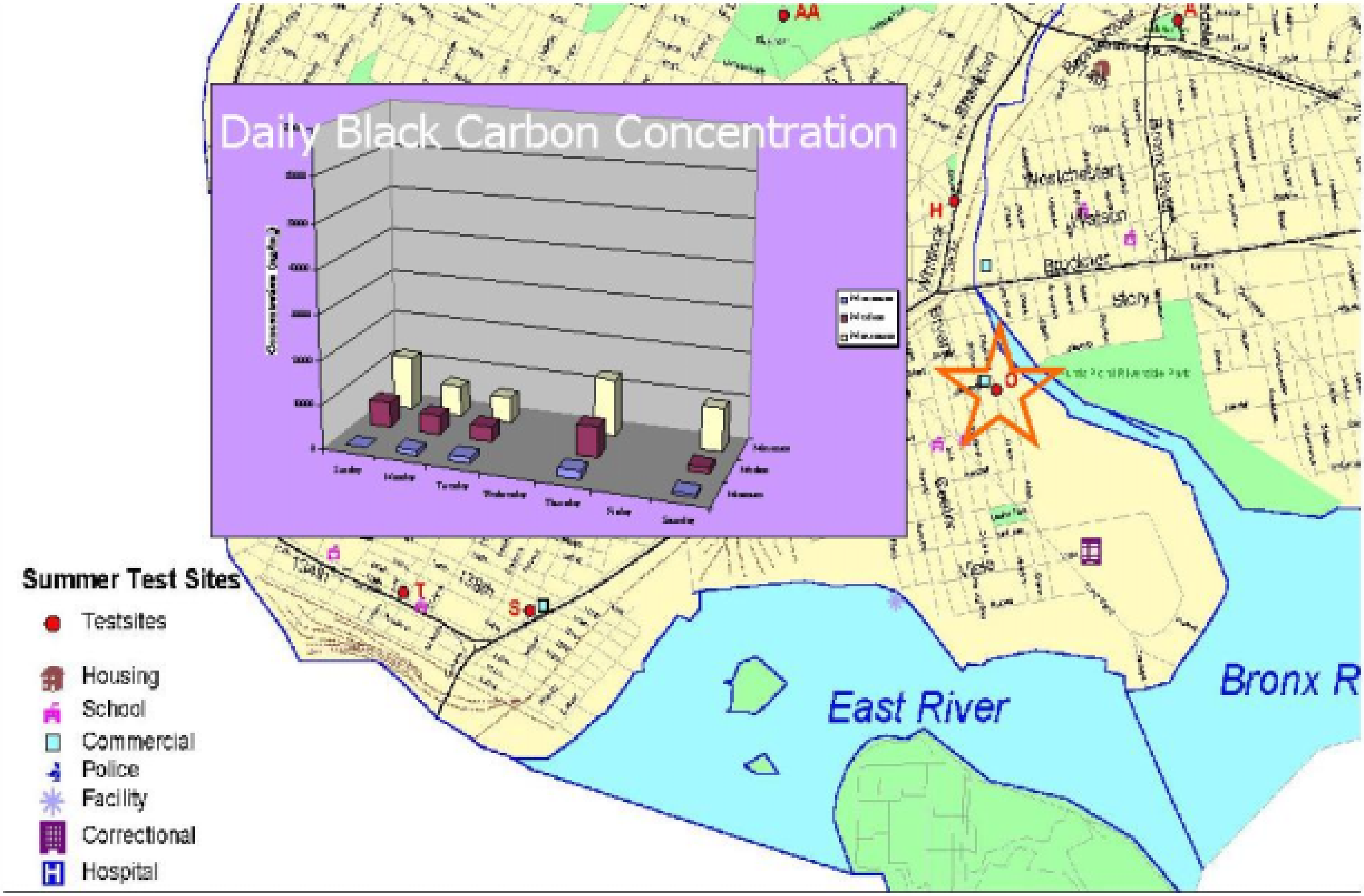
Source: NYU School of Medicine, Institute of Environmental Medicine

163rd Street & Hunts Point Avenue



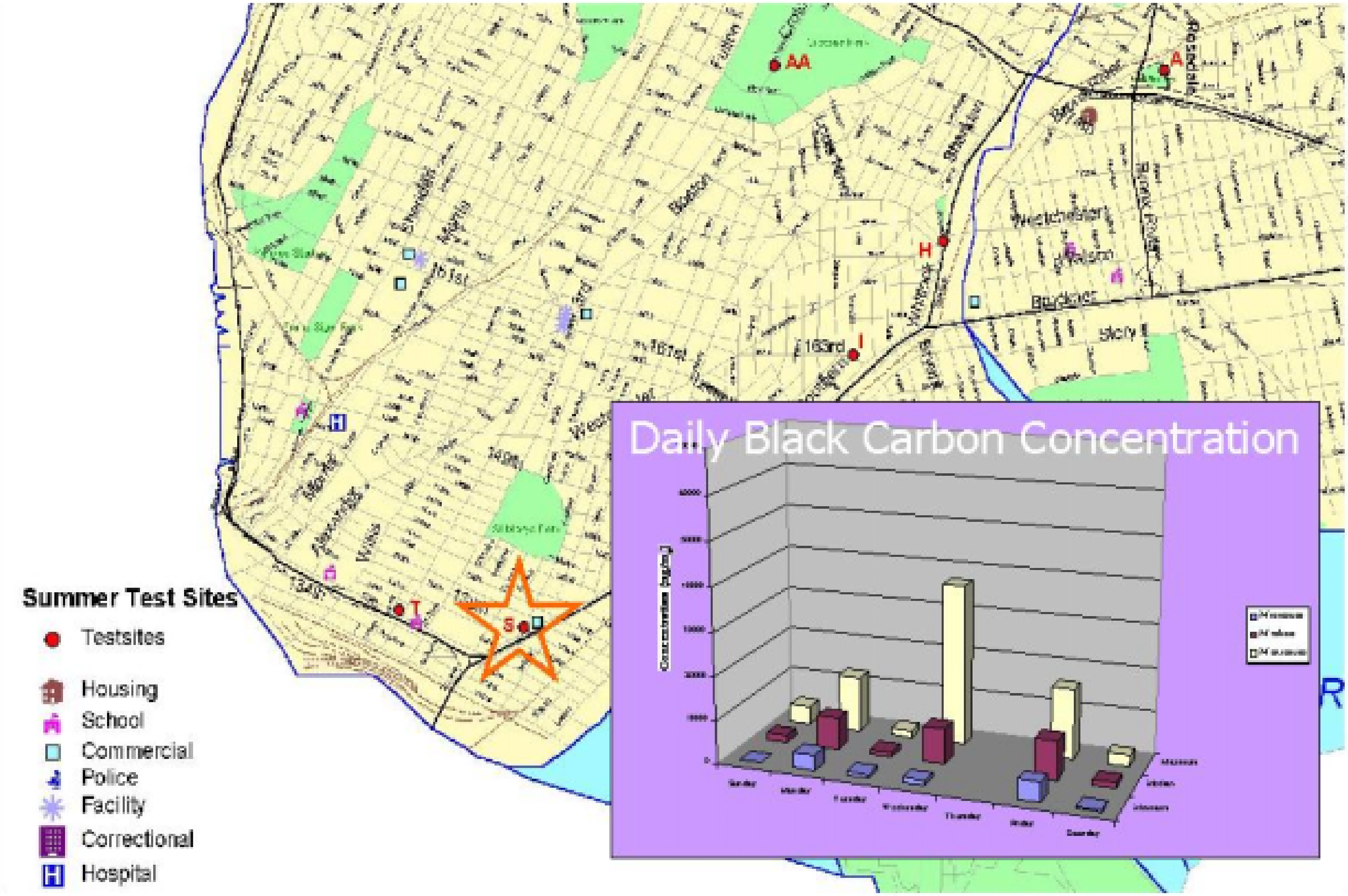
Source: NYU School of Medicine, Institute of Environmental Medicine

Lafayette Avenue & Edgewater Avenue



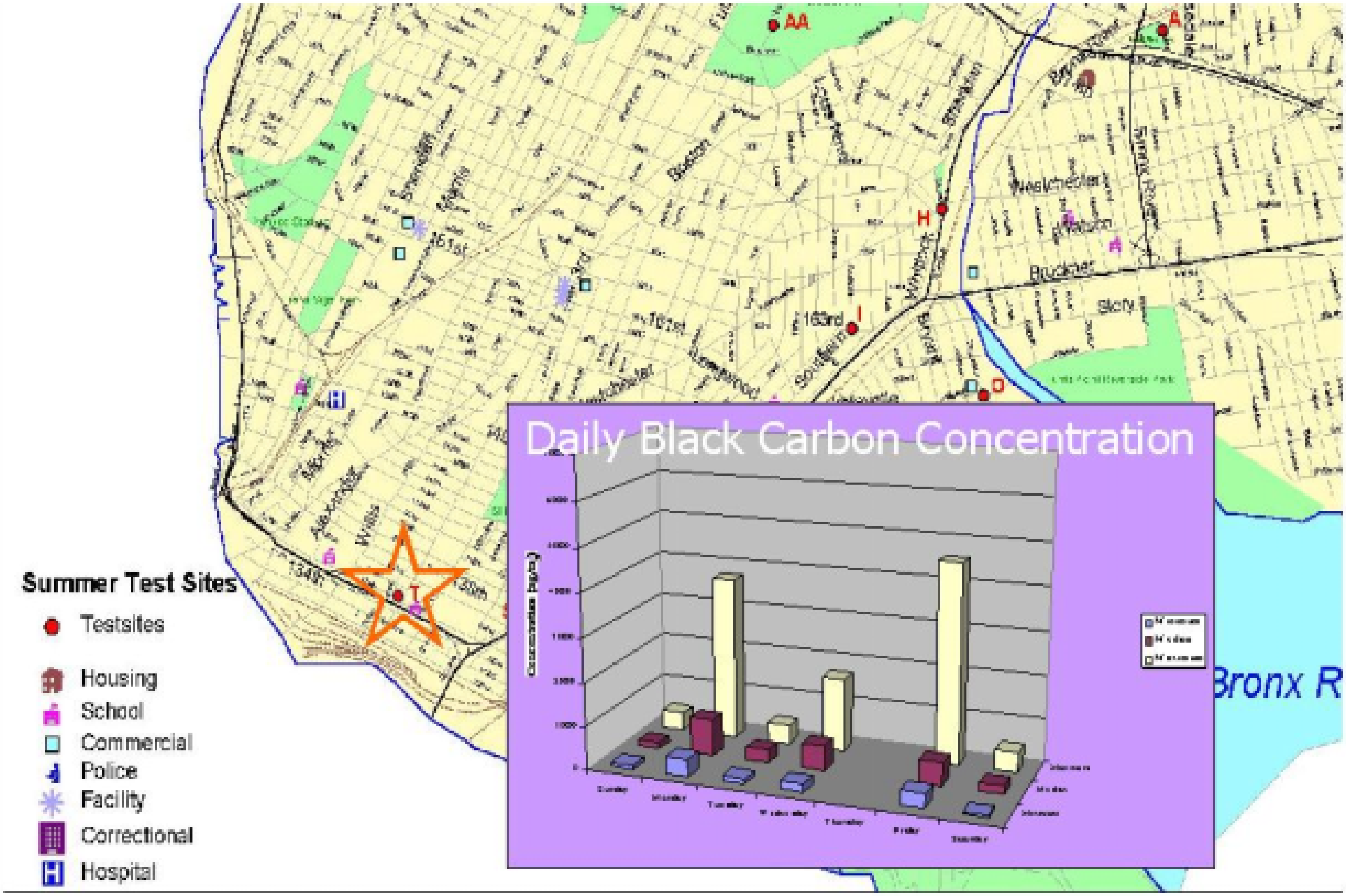
Source: NYU School of Medicine, Institute of Environmental Medicine

138th Street & Bruckner Boulevard



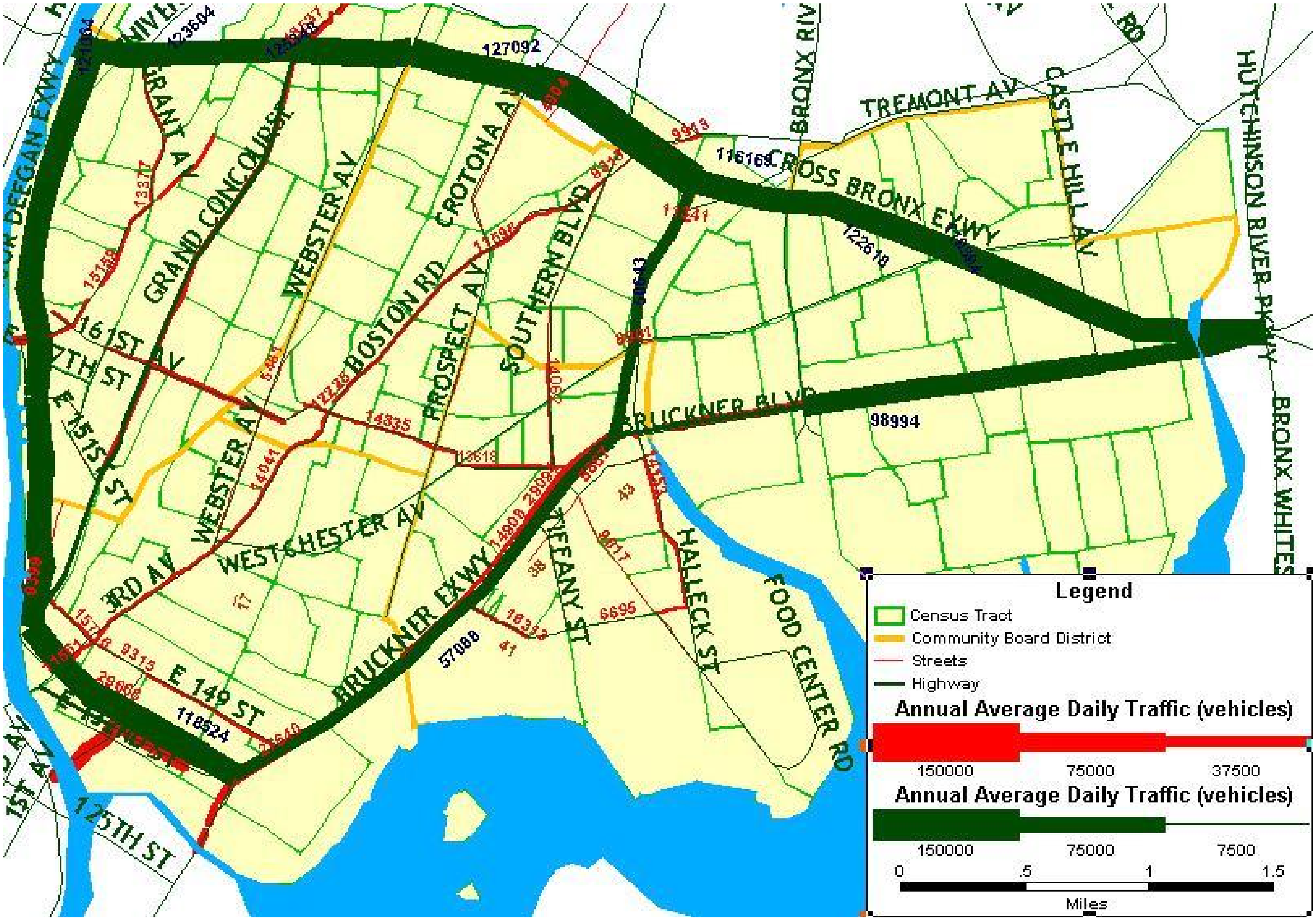
Source: NYU School of Medicine, Institute of Environmental Medicine

PS 43: 135th Street & Brown Place



Source: NYU School of Medicine, Institute of Environmental Medicine

South Bronx Traffic Volume



Source: New York State Department of Transportation,1999-2000