The Impact of Traffic on Ambient Air Quality in the Chelsea Creek Communities

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Abstract

The project was performed to assist the Urban Environmental Initiative of the US Environmental Protection Agency in assessing ambient air quality as related to traffic in the Chelsea and East Boston areas. The project team monitored air quality as well as conducted traffic counts, ultimately mapping the results using graphical analysis software and on GIS layers. By analyzing all data collected, recommendations were formulated and offered to the EPA as well as community partners.

Executive Summary

Due to the numerous health problems that can result from poor air quality, air pollution is a serious issue in the United States. Air pollution is caused by many different chemicals that are emitted into the air by a number of sources, including vehicles and factories. The U.S. Congress has made many attempts to improve the air quality in the nation. In July of 1970, the Environmental Protection Agency (EPA) was formed to protect human health and the environment of the United States by setting national standards for clean air, land, and water.[1] On December 31, 1970 the United States Congress passed the Clean Air Act in an attempt to identify various classes of pollutants harmful to people and to the environment and to set standards in hopes of improving ambient air quality.[2] The Clean Air Act has been amended twice since its passing and new federal and state laws have been also passed to address the issue of air pollution.

Many scientific studies have linked breathing particulate matter (PM) to a series of significant health problems, including aggravated asthma, an increase in respiratory symptoms, like coughing, and difficult or painful breathing, chronic bronchitis, decreased lung function and premature death.[3] Particulate matter, or black carbon, is the soot emitted from diesel vehicles. Black carbon works like a sponge, absorbing organic compounds, thus it can be a tracer for toxic chemicals that are in the ambient air.[4]

Air quality is a persistent problem in the Boston, MA area due to the large population, extensive transportation facilities and numerous factories that exist in this region. Every day, more than 600 thousand citizens travel in and around the Boston area, many using public transportation such as the train or bus, many of which are fueled by diesel. Diesel trucks as well as private vehicles are also quite numerous in Boston. Among all the vehicles traveling throughout Boston, diesel trucks emit the largest amounts of particulate matter.

Many studies concerning air quality have been conducted nationally and locally since the formation of the Environmental Protection Agency and the institution of national laws protecting the air of the United States. Local organizations, such as the Chelsea Creek Action Group (CCAG), are attempting to assist the EPA in improving the environment in their communities. The Environmental Protection Agency and the Chelsea Creek Action Group began the Chelsea Creek Community Based Comparative Risk Assessment (CRA) in 1999 to identify, understand, and assess targeted environment, public health, and social issues

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[1] Environmental Protection Agency [Internet] Washington D.C.; [updated 2003 Jan 15; cited 2003 Feb 21]. Available from http://www.epa.gov/history/org/origins/reorg.htm

[2] Clean Air Trust [Internet] [cited 2003 Feb 22]. Available from http://www.cleanairtrust.org/nepa2cercla.html

[3] Environmental Protection Agency [Internet] Washington D.C.; [updated 2003 Jan 15; cited 2003 Feb 22]. Available from http://www.epa.gov/air/urbanair/pm/hlth1.html

impacting the quality of life for Chelsea and East Boston residents.[5] The Chelsea Creek Action Group (CCAG) is a coalition of the Chelsea Green Space and Recreation Committee and the East Boston Neighborhood of Affordable Housing. The CCAG works to make the Chelsea Creek more inviting to the citizens, remediate contaminated land and raise awareness among residents concerning the value of local natural resources. The CCAG works to connect the communities of Chelsea and East Boston through newsletters, events and fairs, environmental workshops, boat tours, and walks.[6]

The first goal of the Comparative Risk Assessment was met in the summer of 1999, when a Resident Advisory Committee conducted surveys and held meetings to obtain detailed information about Chelsea Creek residents and their environmental concerns. Through these meetings and surveys, the Resident Advisory Committee found that the top environmental and health worries of the Chelsea Creek residents were air quality, respiratory illness, water quality, traffic, noise pollution and open space. More specifically, one of the concerns of the members of the communities is the connection between the pollution in the air and the emissions of particulate matter from diesel trucks. The CRA looks at the amount of traffic passing through the Chelsea Creek communities daily, but it recommends that the air quality in specific high traffic areas.

The Massachusetts Department of Environmental Protection has monitored air pollutants in Massachusetts communities at numerous locations since 1995. Three monitoring stations were placed within the Chelsea Creek communities: Breman Street, Powder Horn Hill and Visconti Street. The monitoring station in Chelsea at Powder Horn Hill measured NO_2, SO_2, CO, and PM; the station in East Boston at Visconti Street measured CO. Both of these stations, however, were terminated in 1999. The remaining monitoring site, Breman Street in East Boston, still measures NO_2, SO_2, CO, and PM. The overall air quality of the greater Boston area, as measured by these three monitoring sites, was within the limits established by the Clean Air Act.

The three monitoring sites, however, may not be a good representation of ambient air quality in the Chelsea Creek communities due to the fact that they were placed at high elevations, rather than at elevations where many citizens congregate. The air quality at breathing level may not be the same as the air quality at a greater altitude, as air quality is affected by outside factors such as humidity, temperature, wind patterns and traffic. There is insufficient information to conclude whether or not the ambient air quality at ground level in the Chelsea Creek communities conforms to the Clean Air Act regulations.

EPA regulations allow no more than 0.10 grams particulate matter per brake horsepower

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[4] Dr. Tony Hansen. [2003 Feb 24]. Meeting to discuss aethalometers, diesel emissions, and particulate matter.

[5] Environmental Protection Agency [Internet] Washington D.C.; [updated 2003 Jan 15; cited 2003 Feb 22]. Available from http://www.epa.gov/region1/eco/uei/boston/bgoals01.html

[6] Chelsea Creek Action Group [Internet] [cited 2003 Feb 10] Available from http://www.chelseacollab.org/greenspace/ccag.htm

hour (g/bhp-h) to be emitted into the air by any diesel mobile source manufactured between the years 1994 and 2003.[7] Diesel vehicles manufactured before 1994 are not regulated, however, due to the fact they were produced before these regulations were in place. In order to determine whether there is a significant correlation between the air quality in the Chelsea Creek communities and the high amounts of traffic and trucks passing through the area, the air quality at ground level had to be quantified.

This project assisted the EPA and Chelsea Creek communities by collecting information relating traffic and air quality at the ground level. The team attempted to help improve air quality and public health standards in the Chelsea Creek communities by analyzing the collected traffic and air quality information in order to formulate a set of recommendations. These possible solutions were proposed to the EPA, as well as the community partners of Chelsea Creek. Over the course of this project, the project team was able to determine the level of traffic at specific intersections as well as deliver a measurement of the air quality at these same sites. Analyses of those two results were delivered to the EPA along with recommendations to improve air quality in the Chelsea Creek Community.

To collect traffic and air quality information, we conducted field research at ground level "hot spots" in the Chelsea Creek communities of Chelsea and East Boston. To determine traffic levels, we manually counted the traffic and its turning movements. The traffic was recorded by type, with focus on diesel vehicles like trucks and buses. To measure air quality, we used a portable aethalometer to measure the black carbon in the air. Wind conditions were also noted, at an hourly rate for each day data was collected. Data collection was conducted every weekday over 8-hour time spans, 6am-2pm & 10am – 6pm.

Once the traffic and air quality collection was completed, analysis of information began. The team investigated the possibility of a correlation between traffic and air quality. The correlations found were used in the formulation of possible solutions to improve air quality and public health in the Chelsea Creek communities. These recommendations include more strict enforcement of truck exclusion routes and synchronization of traffic lights. By fulfilling our aforementioned objectives, we hoped to improve the overall quality of life in the Chelsea Creek communities.

[7] Diesel Net [Internet] [cited 2003 Feb 22] Available from http://www.dieselnet.com/standards/us/hd.html

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1 INTRODUCTION

Due to the numerous health problems that can result from poor air quality, air pollution is a serious issue in the United States. Air pollution is caused by many different chemicals that are emitted into the air by a number of sources, including vehicles and factories. The U.S. Congress has made many attempts to improve the air quality of the nation. In July of 1970, the Environmental Protection Agency was formed to protect human health and the environment of the United States by setting national standards for clean air and water.[8] On December 31, 1970 the United States Congress passed the Clean Air Act in an attempt to identify various classes of pollutants harmful to people and to the environment and to set standards in hopes of improving ambient air quality.[9] The Clean Air Act has been amended twice and new laws passed to further the efforts to help decrease air pollution.

Air pollution directly leads to poor ambient air quality, which negatively impacts the health of affected citizens. Many scientific studies have linked breathing particulate matter (PM) to a series of significant health problems including aggravated asthma, an increase in respiratory symptoms like coughing and difficult or painful breathing, chronic bronchitis, decreased lung function and premature death.[10]

Ambient air quality is an issue of great concern especially in large cities and their surrounding areas. Air quality is a persistent problem in the Boston, MA area due to the large population, vast transportation facilities and numerous factories that exist in this region. Every day over 600 thousand citizens travel in and around the Boston area, many using public transportation such as the train or bus, which are diesel fueled. Diesel trucks as well as private vehicles are also quite numerous in Boston. Among all the vehicles traveling throughout Boston, diesel trucks emit the largest amounts of particulate matter.

Many studies concerning air quality have been conducted nationally and locally since the formation of the Environmental Protection Agency and the institution of national laws protecting the air of the United States. In the Chelsea Creek communities, local organizations are working to help citizens deal with issues pertaining to their surrounding environment. The Environmental Protection Agency and the Chelsea Creek Action Group recently began the Chelsea Creek Community Based Comparative Risk Assessment (CRA) to identify, understand, and assess targeted environment, public health, and social issues impacting the quality of life for Chelsea and East

[8] Environmental Protection Agency [Internet] Washington D.C.; [updated 2003 Jan 15; cited 2003 Feb 21]. Available from http://www.epa.gov/history/org/origins/reorg.htm
[9] Clean Air Trust [Internet] [cited 2003 Feb 22]. Available from http://www.cleanairtrust.org/nepa2cercla.html
[10] Environmental Protection Agency [Internet] Washington D.C.; [updated 2003 Jan 15; cited 2003 Feb 22]. Available from http://www.epa.gov/air/urbanair/pm/hlth1.html

Boston residents.[11] One of the concerns most often mentioned by the residents was the air quality of the communities. The members of the communities are concerned that there is a direct connection between the pollution in the air and the emissions of particulate matter from diesel trucks. The CRA studies the amount of traffic passing through the Chelsea Creek communities daily, but does not monitor the air quality in specific high traffic areas.

The overall air quality of the greater Boston area complies with the regulations established by the Clean Air Act, however, the air quality at ground level in the Chelsea Creek Communities may not. Until this project, there was insufficient data in this area to conclude whether or not the Chelsea Creek Communities conform to the Clean Air Act regulations. The regulations set by the EPA are that no more than 0.10 grams particulate matter per brake horsepower hour (g/bhp-h) shall be emitted into the air by any diesel mobile source manufactured between the years 1994 and 2003.[12] Trucks manufactured before 1994 are not regulated because they were produced before the regulations were set in place. In order to determine whether there is a significant correlation between the air quality in the Chelsea Creek communities and the abundant amount of diesel vehicles and trucks passing through the area, the air quality at ground level had to be quantified.

This project assisted the EPA and Chelsea Creek Communities by collecting information relating traffic and air quality at the ground level. The team analyzed this traffic and air quality information to formulate a set of recommendations to improve air quality and improve public health standards in the Chelsea Creek Communities. These possible solutions were proposed to the EPA, as well as the community partners of Chelsea Creek. By fulfilling these objectives, we had hoped to improve the overall quality of life in the Chelsea Creek communities.

[11] Environmental Protection Agency [Internet] Washington D.C.; [updated 2003 Jan 15; cited 2003 Feb 22]. Available from http://www.epa.gov/region1/eco/uei/boston/bgoals01.html

[12] Diesel Net [Internet] [cited 2003 Feb 22] Available from http://www.dieselnet.com/standards/us/hd.html

2 BACKGROUND

The Chelsea Creek Community Based Comparative Risk Assessment determined traffic and air quality to be of high priority to the residents of the area. This background chapter will discuss Chelsea and East Boston, the organizations involved in this project and will offer information about traffic and air quality.

General information including geographical location and the history of the Chelsea and East Boston will be detailed in the background to give the reader an understanding of the area in which we will be working Information relating to the Chelsea Creek Community groups will give the reader an insight of who is involved in the communities and our project. Given that traffic and air quality are the top priority issues of the Chelsea Creek Community Based Comparative Risk Assessment, these subjects are the focus of our project. Traffic and air quality information, standards and regulations will also be described in this background chapter.

2.1 Chelsea Creek and Communities

The Chelsea Creek communities are comprised of the city of Chelsea and the neighborhood of East Boston. The Chelsea Creek is the body of water that divides East Boston and Chelsea. (Figure 1).

Figure 1. Map of Chelsea Creek[13]

This is an extremely important body of water, for it provides access to industries that line the creek. The creek is utilized mainly for transportation of goods and services to these industries by boat; in fact, it is given the term Designated Port Area (DPA), meaning that it can only be used for industrial and commercial purposes. Due to the high volume of industrial buildings that line it, Chelsea Creek is one of the most polluted bodies of water in the state of Massachusetts. It is in the hopes of the community members that Chelsea Creek may one day be clean enough for public use and recreation.

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[13] Map Point [Internet]. [cited 2003 Jan 25]. Available from http://www.microsoft.com/mappoint/net/

2.1.1 The City of Chelsea

Chelsea has a diverse population of about 35,080 people comprised of 50% Latino, 40% Caucasian, and 10% a mixed variety of other ethnic groups. The city was first settled in 1624 and encompasses about 1.8 square miles of land (Figure 3). The economy in the city of Chelsea is quite low, in fact, almost one quarter of the population lives below the poverty level.

Figure 2. Tobin Bridge Leading Into Chelsea.[14]

In 1995, a new City Charter was implemented by the city of Chelsea. This gave most of the executive and administrative powers to an appointed City Manager above an elected City Council comprised of eleven members. This gave much more stability to the government and gave hope to the members of the community of a much better place to live. The City Manager looks highly upon a healthy environment and a solid educational system. Since the new charter began, three new schools have been built and the effort to improve the environment has been increased tremendously (Figure 2).[14]

Figure 3. Map of Chelsea.[15]

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[14] City of Chelsea [Internet]. [cited 2003 Jan 20]. Available from http://www.ci.chelsea.ma.us.gov/default.html
[15] Ibid.

2.1.2 East Boston

The neighborhood of East Boston (Figure 4) has a population of about 33,000 people comprised of nearly 71.6% Caucasians. Many different ethnic groups such as Canadians, Russians, and Jewish immigrants have populated the city. By the early 1900's East Boston was inhabited by Italian-Americans, but now is mainly populated by Caucasians. Originally there were five separate islands in Boston Harbor, but over a span of 150 years they were connected by a variety of filling procedures to make the neighborhood of East Boston.

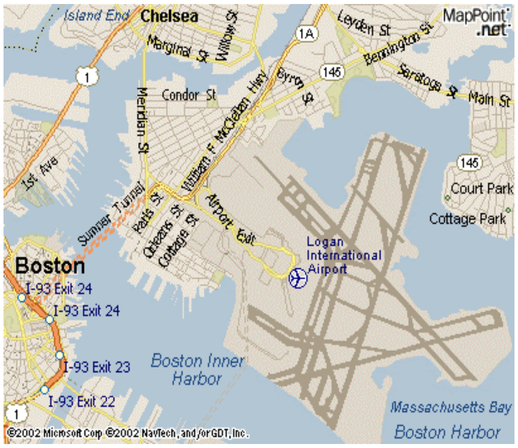

Figure 4. Map of East Boston[16]

East Boston (**Error! Reference source not found.**) has the lowest rate of economic growth in Massachusetts and its poverty rate continues to rise each and every year. The main style of housing is comprised of wooden triple-deckers which were built during the 1920's. These houses are so old that they are beginning to deteriorate and the city cannot afford to replace them.

Figure 5. Logan Airport Seen From East Boston.[17]

Logan Airport consumes almost two-thirds of East Boston, making it difficult for the city to develop. The citizens have to deal with not only the construction taxes but also the construction itself in order to expand the airport with the growing need for travel in the Boston area.[18]

2.2 Organizations Involved in the Chelsea Creek Communities

There are numerous organizations that deal with environmental and public health issues in the Chelsea and East Boston area. At the top of these organizations is the Environmental Protection Agency (EPA). The EPA's mission is to safeguard the natural environment—air, water, and land—upon which life exists.[19] Non-governmental community groups in the Chelsea Creek Communities, such as the Chelsea

[16] Map Point [Internet]. [cited 2003 Jan 25]. Available from http://www.microsoft.com/mappoint/net/

[17] East Boston.com [Internet]. [cited 2003 Jan 20]. Available from http://www.eastboston.com
[18] East Boston [Internet]. [cited 2003 Jan 20]. Available from http://www.eastboston.com/histoc.htm
[19] Environmental Protection Agency [Internet]. Washington D.C.; [updated 2003 Jan 15; cited 2003 Feb 10]. Available from http://www.epa.gov/epahome/aboutepa.htm

Creek Action Group (CCAG), the Neighborhood of Affordable Housing (NOAH) and the Chelsea Green Space and Recreation Committee (Chelsea Green Space), assist the EPA in its quest to improve the environment.

2.2.1 Environmental Protection Agency (EPA)

During the 1960s, there was widespread public demand for a cleaner environment. In response to the country's demand, the White House and Congress established the Environmental Protection Agency in July of 1970. Prior to the formation of the EPA, a variety of national organizations were used to monitor the environment and human health. These organizations, such as the Federal Water Quality Administration and the National Air Pollution Control Administration, were brought together to form the EPA.[20]

The Environmental Protection Agency works to set standards and goals for cleaner land, water and air and reduce environmental risk. Federal laws regulating pollutants are implemented by the EPA to ensure the health of the United States citizens. To better serve the United States, the EPA set up ten regional offices around the nation; New England is in Region 1.

The Urban Environmental Initiative (UEI) is a program that was introduced in Region 1 by the EPA in efforts to better monitor the environment and public health around largely populated areas. Three cities, Boston, MA, Hartford, CT, and Providence, RI have active UEI programs. In Boston, the Urban Environmental Initiative program concentrates on public health and environmental issues such as open space and air quality.[21] The UEI strives to work with community groups to identify concerns and problems and raise awareness of these issues.[22]

2.2.2 Neighborhood of Affordable Housing (NOAH)

In July of 1987, East Boston formed the Neighborhood of Affordable Housing (NOAH). The NOAH is a community organization working to improve the quality of life for the community. Their mission is to expand access to affordable housing and to rehabilitate, stabilize and preserve current East Boston housing. The NOAH offers a number of programs including Real Estate and Commercial Development, Homeowner and Homebuyer Services, Building and Environmental Programs, Rental Housing, Economic Development, and Resource Development.[23]

2.2.3 Chelsea Green Space and Recreation Committee (Chelsea Green Space)

The Chelsea Green Space and Recreation Committee was formed in 1994 by residents concerned

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[20] Ibid.

[21] Environmental Protection Agency [Internet]. Washington D.C.; [updated 2002 Nov 18; cited 2003 Feb 10]. Available from http://www.epa.gov/NE/eco/uei/boston/index.html

[22] Environmental Protection Agency [Internet]. Washington D.C.; [updated 2002 Nov 18; cited 2003 Feb 10]. Available from http://www.epa.gov/NE/eco/uei/index.html

with the lack of open space in the city of Chelsea. Since 1994, Chelsea Green Space has broadened its mission to include many other environmental issues such as combating the hazards caused by the Eastern Minerals salt pile, developing plans to restore Mill Creek and studying the impact of truck traffic on air quality in Chelsea. Their goal is to maximize Chelsea's historic, environmental, recreational and scenic resources.[24]

2.2.4 Chelsea Creek Action Group (CCAG)

The Chelsea Creek Action Group (CCAG) is a coalition of the Chelsea Green Space and Recreation Committee and East Boston's Neighborhood of Affordable Housing. The CCAG works to make Chelsea Creek more inviting to the citizens, remediate contaminated land and raise awareness among residents concerning the value of local natural resources. The CCAG strives to connect the two communities through newsletters, events and fairs, environmental workshops, boat tours, and walks.[25]

The Chelsea Creek Community Based Comparative Risk Assessment (CRA; see APPENDIX B CHELSEA CREEK COMMUNITY BASED COMPARATIVE RISK ASSESSMENT) is a project that was begun by the CCAG in 1999. This project was instituted as a way to help address environmental issues in the Chelsea Creek Communities. The CRA goals are to collect information from Chelsea Creek residents on their greatest environmental and health matters of the communities, to collect scientific data on these concerns, and to provide a way for community residents to work together to improve these concerns.[26]

The first goal of the Comparative Risk Assessment was met in the summer of 1999, when a Resident Advisory Committee conducted surveys and held meetings to obtain detailed information about Chelsea Creek residents and their environmental concerns. Through these meetings and surveys, the Resident Advisory Committee found that the top environmental and health concerns of the Chelsea Creek residents were air quality, respiratory illness, water quality, traffic, noise pollution and open space. Of these six issues, air quality as related to traffic has yet to be studied. (see Appendix B)

2.3 Air Quality in the Chelsea Creek Communities

Air quality is a problem that every major city must deal with. Different cities deal with this problem in dissimilar ways. If solutions to the air quality issues in the Chelsea Creek area are to be considered, then we must look at how past studies have approached the subject.

2.3.1 EPA Air Quality Studies in Chelsea

The first major step towards improving the environmental conditions in Chelsea began with the

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[23] Neighborhood of Affordable Housing [Internet]. [cited 2003 Jan 20]. Available from http://www.noahcdc.org
[24] Chelsea Green Space [Internet]. [cited 2003 Jan 20]. Available from http://www.chelseacollab.org/greenspace/
[25] Chelsea Creek Action Group [Internet]. [cited 2003 Feb 10]. Available from http://www.chelseacollab.org/greenspace/ccag.htm
[26] Ibid.

launch of the comparative risk assessment. The CRA (see Appendix B) started as a 100,000-dollar grant from the EPA to conduct a two-year study about the environmental risks for residents in Chelsea and East Boston living close to Chelsea Creek. The risk assessment was established to identify the main environmental and health risks in the Chelsea Creek vicinity. These identified risks were then used to help the communities conduct studies and propose solutions for reducing the recognized risks. This effort's main goal was to turn Chelsea Creek into a valuable environmental and economic asset to the communities.[27]

To identify the concerns of the local residents, the Chelsea Creek Action Group (CCAG) conducted surveys for the comparative risk assessment. Members of the CCAG visited various public locations in the Chelsea Creek area where a variety of people could be surveyed. There were two versions of the survey that differed in length and the respondent had the option of choosing either one. With these surveys, the CCAG was able to get an idea of the areas of concern. With the data from these surveys, it was determined that noise pollution, open space, respiratory disease, air quality, water quality and traffic were the main concerns of the public.[28]

2.3.2 Air Quality Regulations

The Clean Air Act (CAA) was one of the first nationwide environmental acts that regulated the pollution that is released put into the air. It was enacted in 1970, amended in 1977 and further amended in 1990. With the Clean Air Act, the U.S. government is now able to regulate the amount of pollutants a company releases into the atmosphere.

The Clean Air Act not only gives the government the power to regulate big business, but it also gives the Environmental Protection Agency a basis by which they can oversee the emissions that cars give off as a result from burning gasoline. Automobiles, diesel trucks, buses and other types of mobile source polluters all fall under the scope of this program. Out of all the many different toxins that are monitored in mobile source emissions, particulate matter is the toxin that the EPA takes special care in regulating.

2.3.3 Particulate Matter

A major portion of our project will require us to take samples of the ambient air in areas of the Chelsea Creek Communities. We will be measuring the air for various pollutants, but the major subject of our research will be particulate matter (PM). Particulate matter is composed of several different compounds and can be formed several different ways. For the purpose of our project we will be focusing on particulates that are formed and emitted from the exhaust system of automobiles that burn diesel fuel. Particulate matter is composed of the following components: toxic organic compounds, heavy metals, black carbon and

[27] Environmental Protection Agency; "EPA Targets Chelsea and East Boston for Environmental and Health Risk Study" [Internet]. [cited 2003 Jan 19]. Available from http://www.epa.gov/region01/pr/1999/030599.html

[28] Ibid.

water.[29]

Particulates come in varying sizes, from the large particles of 10 micrometers (μm) in diameter or larger, to extremely small, less than 2.5 μm. The smaller particles pose a greater threat to human health because the human body's natural defenses cannot capture the smaller particles. Particulate matter has been known to contribute to many human ailments including shortness of breath, lung damage, asthma, and in some cases premature death.[30]

Particulate matter is the result of the poor combustion of diesel gasoline.

Year	CO (g/bhp-hr)	NO_x (g/bhp-hr)	PM (μm)
1988	15.5	10.7	0.60
1991	15.5	5.0	0.25
1994	15.5	5.0	0.10

Table 1. Emission Standards for Heavy-Duty Diesel Engines[31]

Due to the variance in size of PM, the EPA has had to place a limit on the size particles to be regulated. The human body's natural defenses are able to protect the body from large pieces (> 0.02 μm in diameter) of PM, so the U.S. EPA decided on a diameter size that is less than 0.10 μm is an acceptable size for regulation.[31]

2.4 Traffic in the Chelsea Creek Communities

The government is able to keep our neighborhoods safe and clean with the help of the communities. By the Environmental Protection Agency monitoring the current state of the environment, people can work with them in neighborhood projects. The EPA has an effective tool to help these groups make their projects a reality by establishing laws and regulations to help improve public health. Most of these regulations are several decades since their inception but are still very effective in bringing about change.

2.4.1 Truck Emission Regulations

Due to the overall scrutiny of the EPA on emissions resulting from mobile sources the EPA has found that the major contributors to particulate matter pollution are diesel trucks. With this knowledge the EPA has been able to use many tests to monitor diesel truck manufacturers. The Supplemental Emission Test is used to monitor engines on sustained driving conditions, such as long highway hauls. Since not all driving conditions occur in a sustained setting, the Not To Exceed (NTE) test was devised to monitor emissions over all driving conditions, not just during a specific condition. These two methods, along with field testing, allow the Environmental Protection Agency to keep diesel engines within the legal limits of the Clean Air Act.

As well as having many regulations dealing with diesel engines during driving, there is also a set of

[29] Air Info Now [Internet]. [cited 2003 Jan 21]. Available from http://wwwmairinfonow.org/html/ed_particulate.html
[30] Ibid.
[31] DieselNet: Heavy-Duty Truck and Bus Engines [Internet]. [cited 2003 Jan 22]. Available from http://www.dieselnet.com/standards/us/hd.html

regulations that pertain to the time when a truck is idling. Along with a national program individual states have idling regulations. In Massachusetts a truck can idle for no longer than 5 minutes unless it is being serviced. Most trucking firms install computer programs that monitor this and will shut an engine down if the idling time exceeds the state limit.

2.4.2 Truck Emission Standards

Since the EPA enforces regulation on diesel manufacturers, they measure particulate matter there needs to be a standard that any EPA official can compare data to. In the case of Particulate matter the form of measurement is a combination of the size of the particle and the amount of particulate over a given distance. In Table 1 the reader can see that the particulate matter is measured in diameter size.

3 METHODOLOGY

Through collection of information relating traffic and air quality, the team assisted the EPA and Chelsea Creek Communities in an effort to improve air quality and reduce public health hazards in the East Boston and Chelsea area. The team collected and analyzed traffic and air quality information which was used to formulate a set of recommendations to propose to the EPA and the community partners of Chelsea Creek.

The following objectives were fulfilled to help reach our goal:

1. Determine level of traffic at "hot spots"
2. Measure air quality at ground level "hot spots"
3. Analyze impact of determined traffic levels on air quality
4. Formulate and present recommendations to EPA regarding policies to improve air quality in the Chelsea Creek communities

The sections of this methodology chapter will detail the objectives mentioned above:

- **Section 3.1** includes the domain of inquiry and defines the boundaries of the air quality testing and traffic counting that was performed.
- **Section 3.2** defines the geographical location of the study and shows the specific areas where the sampling was conducted.
- **Section 3.3** outlines the process by which the team determined traffic counts at "hot spots".
- **Section 3.4** outlines the process by which the team measured air quality at ground level "hot spots".
- **Section 3.5** details the steps that were taken to analyze the impact of traffic levels on air quality measurements at ground level "hot spots".

3.1 Domain of Inquiry and Definitions

In this project, the subject that was studied specifically is the particulate matter at ground level, in relation to traffic. Particulate matter is the dust, black carbon, etc. released by vehicle exhaust fumes. For this project, ground level was defined as three feet above the ground at intersections within the city. The height of three feet was chosen because it best represents the height of breathing of people, while ensuring the stability of the apparatus. The types of "hot spots" that were studied in this project were high traffic areas identified by community members. Traffic "hot spots" are defined as intersections/roads with high diesel truck traffic travel

3.2 Spatial and Temporal Coverage

Our project focused on the communities of Chelsea Creek: Chelsea and East Boston. High traffic areas in the Chelsea Creek Communities were the specific areas of interest for our project. Key intersections were chosen by the community groups based on community feedback. These high traffic areas were located at the intersections of Jefferson & Webster, Powder Horn Hill and Broadway & Williams in Chelsea, the intersection of Condor St. & Meridian St. and Route 1A in East Boston.

The collection of information was conducted over a four week period spanning from the dates of March 20, 2003 to April 18, 2003 of the project term. Compilation of the results for the final project began in the fifth week of the project term. Analysis of this information also began in the fifth week and continued through the end of the project term.

3.3 Determination of Traffic Levels

The number and types of vehicles that traveled through certain intersections in a given time period were counted. All types of vehicles were counted and recorded according to their traffic movement. The type of intersection determined the amount of persons conducting the traffic counts. For a four way intersection, four persons recorded the traffic flow. Each person was responsible for only one directional flow of traffic in order to reduce the probability of human error. The persons were positioned at the corners of the intersection and counted the traffic approaching from their left. The traffic movement made through the intersection will be noted (i.e. left turn, right turn, straight).

All traffic counted was categorized by the type of vehicle. The categories were as follows:

- C – automobiles, pickup trucks, motorcycles, SUVs
- B – buses
- T2 – commercial trucks, i.e. delivery trucks; 2 axles
- T3 – tractor trailer trucks; 3 axles
- T4 – tractor trailer trucks; 4 or more axles

To obtain a good estimation of traffic flow in and around the key intersections, counting was performed at each intersection seven times, in blocks of eight hours. The counting days and times for all four locations are as follows:

- Monday – 6am-2pm
- Tuesday – 6am-2pm
- Wednesday – 6am-2 pm
- Thursday – 10am-6am

- Friday – 6am-2pm

The time blocks chosen cover expected periods of high traffic ("rush hour" – 6am-10am) as well as expected periods of lesser traffic (10am-2pm). This schedule was followed as closely as possible, but due to unforeseeable circumstances, times were adjusted. For a detailed schedule of all data collection times please refer to the calendar in the appendices (see

APPENDIX F FIELD FORMS AND SCHEDULE).

3.4 Measurement of Air Quality

To collect the air quality data the Magee Scientific Portable Aethalometer (see

APPENDIX E AETHALOMETER FIELD OPERATING PROTOCOL) were used to measure the black carbon. Black Carbon (BC) measurements were taken at the sites using a continuous filtration and optical transmission technique. A flow rate of 4 liters per minute was used to gather the samples. A Harvard (cascade) Impactor and filter was used to limit particulate size to 2.5µm (microns). All BC data, flow rates and system parameters were saved through a floppy disk drive located in the aethalometer. These data files were easily imported to Microsoft Excel and Microsoft Access to be used for analysis.

The particulate matter was measured by the aethalometer at the identified key intersections. The locations studied were the same intersections of traffic counts: Jefferson & Webster, Powder Horn Hill and Broadway & Williams in Chelsea, the intersection of Condor St. & Meridian St. in East Boston and Route 1A in East Boston. Wind speed was taken at hourly intervals from Logan Airport.

The aethalometer was transported in a 56-quart mobile cooler. Using minimal foam padding, the aethalometer was stabilized in the cooler to reduce vibrations to ensure proper operation. A marine battery was used as the primary power supply for the operation of the aethalometer and was also transported in the cooler. The hand-held anemometer was attached to a broom handle which was in turn attached to the cooler. The Harvard Impactor of the aethalometer was also attached to the broom handle, at a height of three feet above the ground. The cooler-apparatus was placed on a corner of the intersection with a traffic-counting person, allowing the air quality of the intersection to be best measured.

Air quality measurements were taken simultaneously with traffic counts. The days and times of air quality measurement for all key locations are again as follows:

- Monday – 6am-2pm
- Tuesday – 6am-2pm
- Wednesday – 6am-2 pm
- Thursday – 10am-6am
- Friday – 6am-2pm

3.5 Mapping of Truck Exclusion Routes

Using previous studies concerning truck exclusion routes of Chelsea and East Boston, a map was created, identifying these routes in relation to sensitive areas. Sensitive areas in the communities include schools and retirement homes.

3.6 Determination of Correlation between Traffic Levels and Air Quality

In order to establish an association or relationship between air pollution and traffic emissions, the collected data was analyzed extensively. There were three logical steps taken to ascertain this connection. First, traffic level information was analyzed. Second, air quality data was analyzed, and finally, patterns in the two sets of information were identified.

Once the traffic and air quality data were analyzed, the correlation between the two sets of information was identified. In order to establish a connection between traffic counts and air pollution, we explored the relationship between high traffic and particulate matter concentrations. Using Microsoft Excel and Microsoft Access the particulate matter concentrations were graphed versus traffic counts in order to demonstrate a correlation between the two different sets of data.

4 RESULTS & ANALYSIS

This study included traffic counts as well as air quality monitoring. These two fields were analyzed both separately and together to investigate if there was a correlation between the two. The following sections contain our results and the analysis that was performed on the air quality and traffic data. Graphical analysis software, computer databases, and Geographical Information System (GIS) were used to create and display the results.

4.1 Traffic Levels in the Chelsea Creek Communities

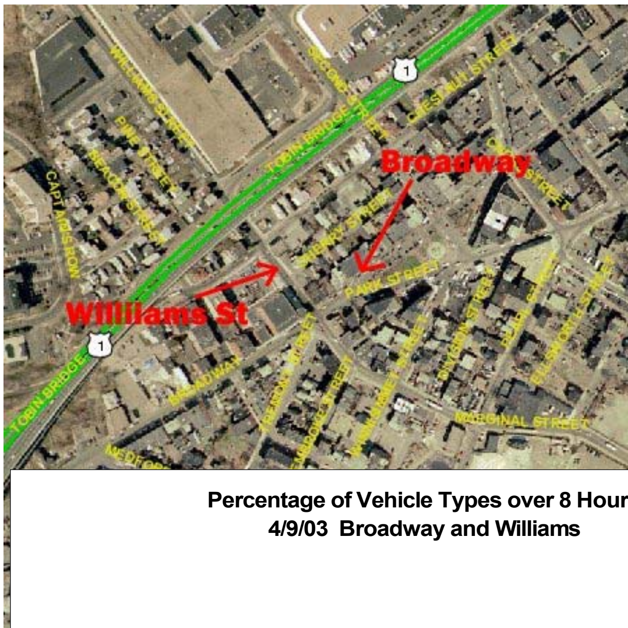
Since traffic was identified as a concern in the communities of Chelsea and East Boston, we conducted traffic counts at intersections specified by community members.

4.1.1 Chelsea

In Chelsea we studied three sites: Powder Horn Hill, Broadway & Williams St., and Jefferson Ave & Webster Ave. The intersections of Broadway & Williams St. and Jefferson Ave & Webster Ave. were identified by the Chelsea Green Space and Recreational Committee. The Powder Horn Hill site was used as a background source of air quality data.

4.1.1.1 Broadway & Williams

Broadway & Williams is a large thoroughfare into the downtown Chelsea area. Williams provides direct access to industrial areas, Meridian Street Bridge, and the on-ramp to the Tobin Bridge. Due to its close proximity to the Chelsea Creek, a designated port area, many oil companies use this intersection to access their distribution centers. Broadway & Williams is a 4-way intersection with an additional, small, one way road (entrance only). For convenience and the lack of traffic on this road, we did not incorporate this road into the traffic counts at this intersection. The flow of traffic is controlled by a standard traffic light (red/yellow/green) for each of the four traffic directions.



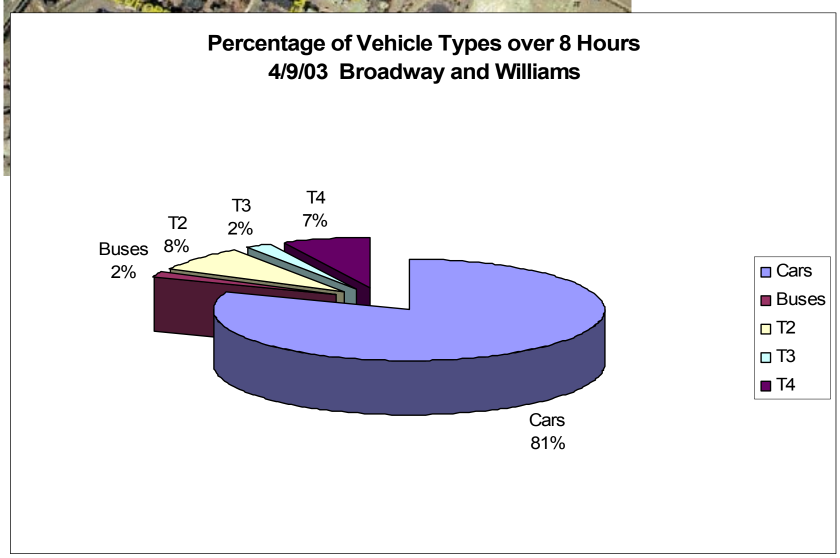


Figure 7. Percentage of Vehicle Types Over 8 Hours: Broadway and Williams, 4/9/03.

Despite the large number of diesel vehicles that travel through the intersection, we found that the vast majority of vehicular traffic through the intersection consisted of cars. The breakdown of vehicle traffic at Broadway and Williams is shown in Figure 7. The blue portion of the graph represents the amount of cars that traveled through the intersection within an 8 hour time period. The percentage of cars for this intersection during this time period totals 81%. The diesel vehicles (buses, T2, T3 and T4) make up less than a quarter of the total vehicle traffic.

Using the traffic counts that we had from this intersection, we were able to extrapolate and project an average number of vehicles traveling through the intersection each day of the week. Figure 8 shows the breakdown of the traffic types and the estimated total amounts of each that travels through the Broadway and Williams intersection. The graph shows the day for highest car travel to be Thursday; the day for highest T2 travel is Tuesday; the day for highest bus, T3 and T4 travel is estimated to be Wednesday.

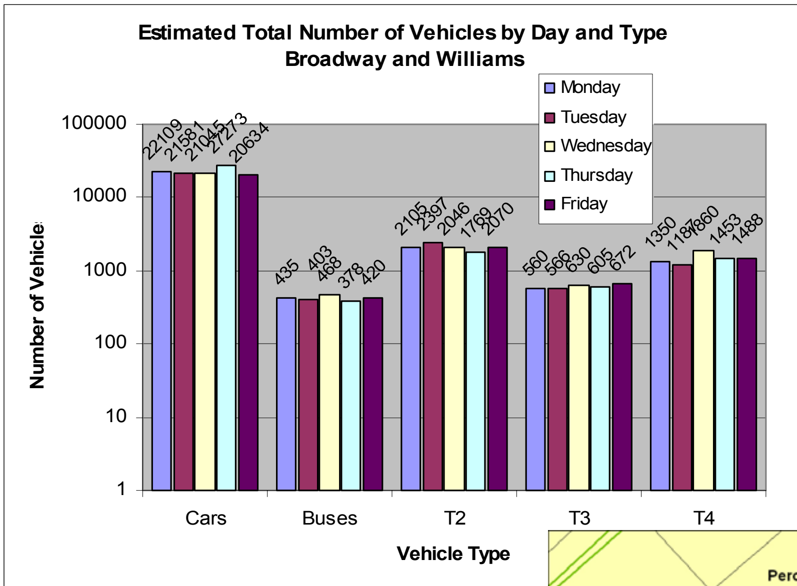


Figure 8. Estimated Total Number of Vehicles by Day
Williams.

The breakdown of vehicle traffic is also shown in Figure 9. This figure shows a pie chart of the traffic by the type of vehicle for each street section. The different sizes of the pie chart depict the volume traveling through the street section. Cars are represented by the red portion, while the diesel vehicles are the yellow, pink, blue and green. It is visibly obvious that cars make up the majority of the traffic volume on each section of the streets.

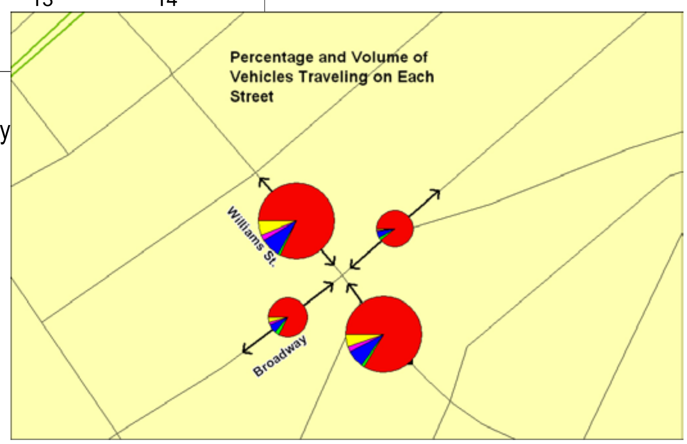


Figure 9. Percentage and Volume of Vehicles Traveling on Each Street at Broadway and Williams.

This information was also represented using bar charts. In Figure 10, a bar chart for each street section is shown. Each bar represents an hour of the day during which traffic counts were conducted. The total number of vehicles that traveled out of or into that street section is represented by the height of the bar. It is obvious that Williams Street is much more traveled than Broadway. The peak travel time on Williams Street was found to be around 5pm (17:00, final bar).

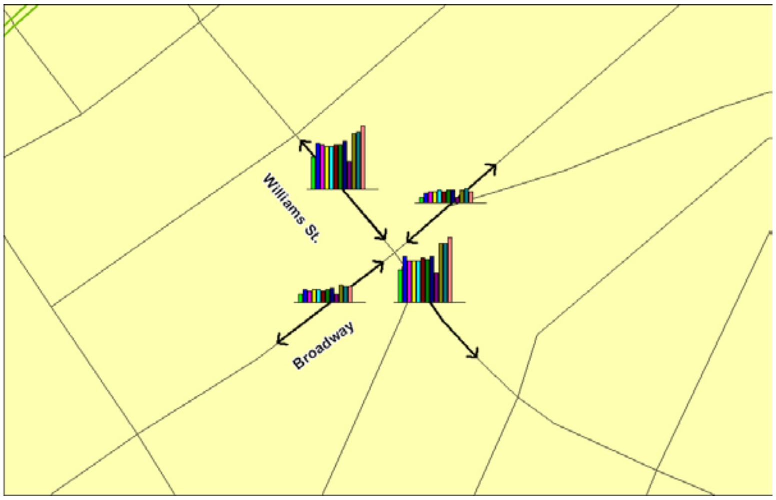


Figure 10. Volume of Hourly Traffic Traveling on Each Street at Broadway and Williams.

4.1.1.2 Jefferson Ave. & Webster Ave.

The intersection of Jefferson Ave & Webster Ave is a major traffic artery for many different types of vehicles. As one can see in the aerial photograph, Jefferson and Webster is located directly on a major exit off of the highway Route 1A. The 3-way intersection traffic is only regulated by a pair of stop signs for the traffic exiting Jefferson. Webster has the right of way for all traffic through the intersection.

Due to this site's location to Rt. 16, a designated truck route, there is a high volume of diesel truck traffic passing through the intersection. Even with this increased amount of truck traffic, we still found that the majority of traffic through the intersection was due to cars.

Figure 11. Aerial View of Jefferson & Webster

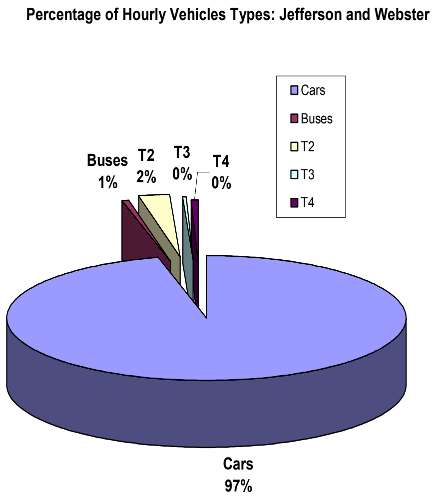
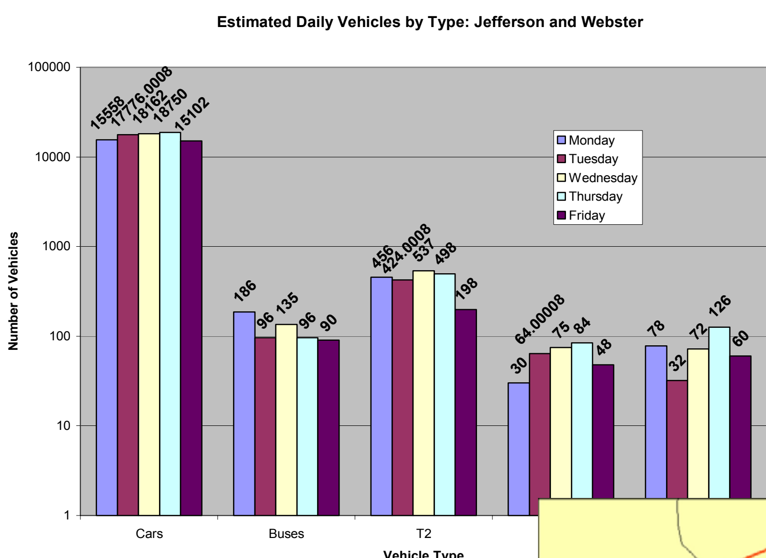


Figure 12 is a pie chart showing the breakdown of the vehicle types that travel through the intersection of Jefferson and Webster. Cars, represented by the blue portion of the graph, make up the vast majority of the vehicle traffic through this intersection (97%). There were T3 and T4 trucks that traveled through the intersection, but they were in such small amounts that the percentages of T3 and T4 are rounded to 0%.

Figure 12. Percentage of Vehicle Types for Jefferson and Webster.



Using the traffic counts, we were able to estimate the total number of vehicles traveling through the intersection during a 24 hour period. The figure on the left (Figure 13) is a bar chart showing the estimated total number of each vehicle type by day of the week. Using a logarithmic scale, one is able to see how the traffic of each vehicle type differs by day. Surprisingly, traffic at this intersection is not highest on Mondays and Fridays, as is expected due to weekend traffic.

Figure 13. Estimated Daily Vehicles by Type fo

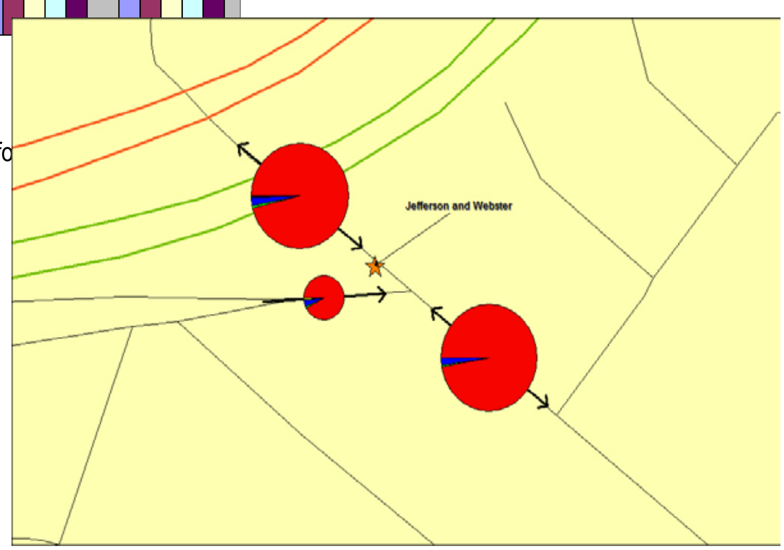


Figure 14. Percentage and Volume of Vehicles For Each Street Section: Jefferson and Webster.

In Figure 14, the size of each pie represents the total volume of vehicles traveling through the intersection. The traffic traveling both ways on Webster Ave is dramatically higher than the traffic coming from Jefferson.

Each slice of the pie represents a different designation of vehicle. The red slice, which completely overwhelms each pie, represents the number of cars through the street section. The other colors; blue, green, pink and yellow, each represent one of the other vehicle designations.

In Figure 15, one can see that we have averaged the hourly traffic rates for the intersection over the

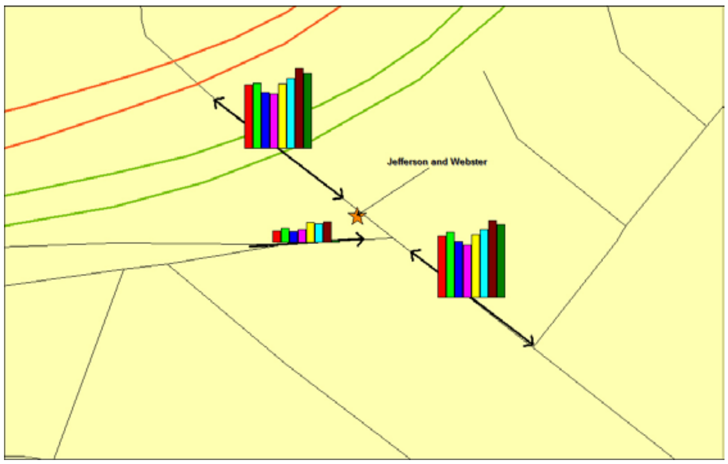


Figure 15. Hourly Traffic Averages for the week of 4/8/03 at Jefferson and Webster

course of the week we were there. Each bar represents an hour of counting time: i.e. red = 6am and green = 7am. The figure shows a noticeable drop in traffic after the rush hour, as we expected. This trend is found on all three roads of the intersection and is a good representation of the increase in rush hour traffic.

4.1.1.3 *Powder Horn Hill*

Figure 16. Aerial View of Powder Horn Hill & Crest Avenue.

Atop Powder Horn Hill there is located a Veteran's Hospital and housing complex. The area is mostly residential, with the exception of the hospital. We considered the intersection at Powder Horn Hill to be a four-way intersection. Along with three sections of road, there is an entrance to a parking lot for the hospital, which was counted as the fourth road.

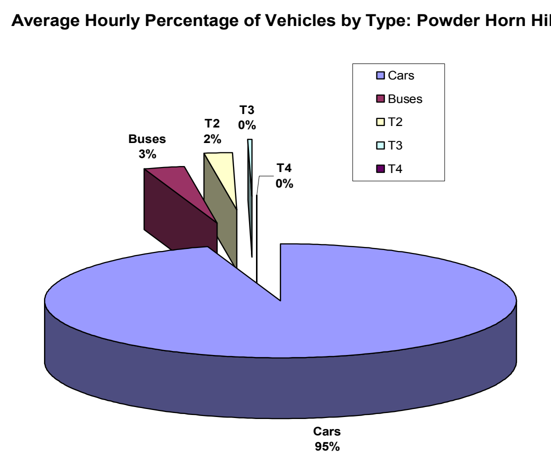


Figure 17. Average Percentage of Vehicle Types at Powder Horn Hill.

Powder Horn Hill had the least amount of traffic of all intersections studied. As can be seen in Figure 17, cars make up almost the entire amount of vehicle traffic (95%). There are few buses and T2s that travel through the intersection at Powder Horn Hill, most likely to transport people and supplies to and from the hospital. Figure 18 gives the daily breakdown of the estimated number of vehicles for a 24 hour period. Since we were only able to conduct traffic counts twice at Powder Horn Hill, this information can only be estimated for Monday and Wednesday (see Figure 18). As can be seen by the height of the bars, there is a great difference in daily car numbers as compared to all other vehicle types. With the estimates performed, Wednesday is expected to be busier than Monday.

The traffic counts from Powder Horn Hill are represented in Figure 19 and Figure 20. In Figure 19, a pie chart for each street section is used to demonstrate the volume of traffic by vehicle type. As in all other intersections, car traffic (red) makes up the vast majority of the vehicle traffic, as compared to the diesel vehicles (green, blue, pink and yellow).

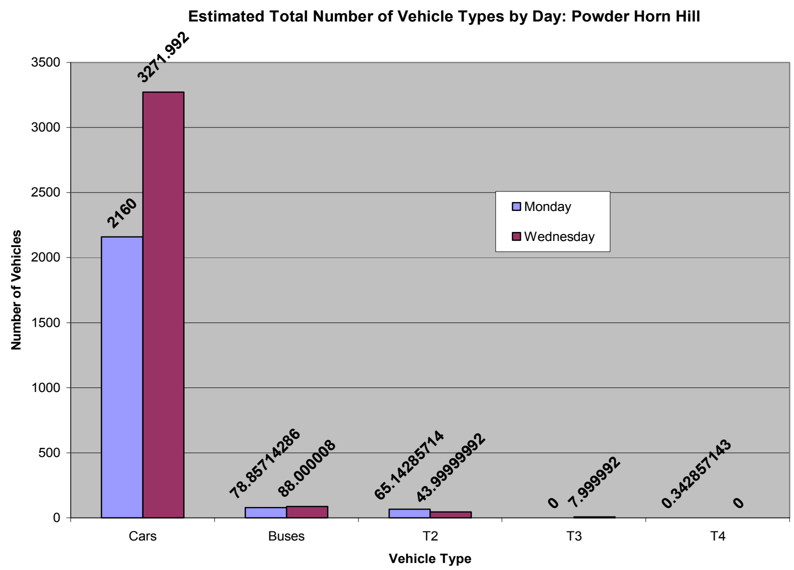


Figure 18. Estimated Total Number of Vehicles by Day at Powder Horn Hill.

In Figure 20, bar charts for each street section are shown. The bars represent the volume of all traffic passing through the specific street section each hour of the times during which traffic counts were conducted. Here it is obvious that the traffic at this intersection is very low.

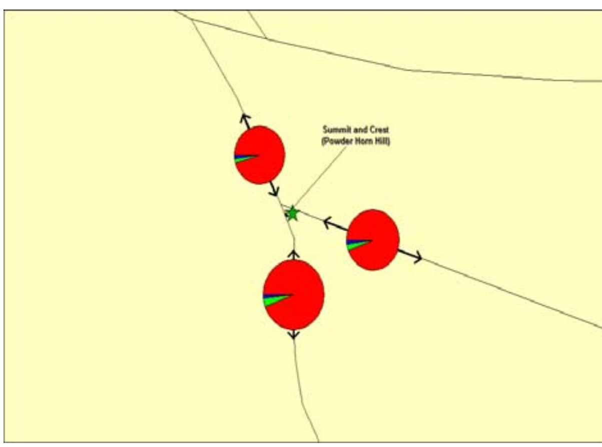


Figure 19. Percentages and Volumes of Traffic Traveling on Each Street of Powder Horn Hill.

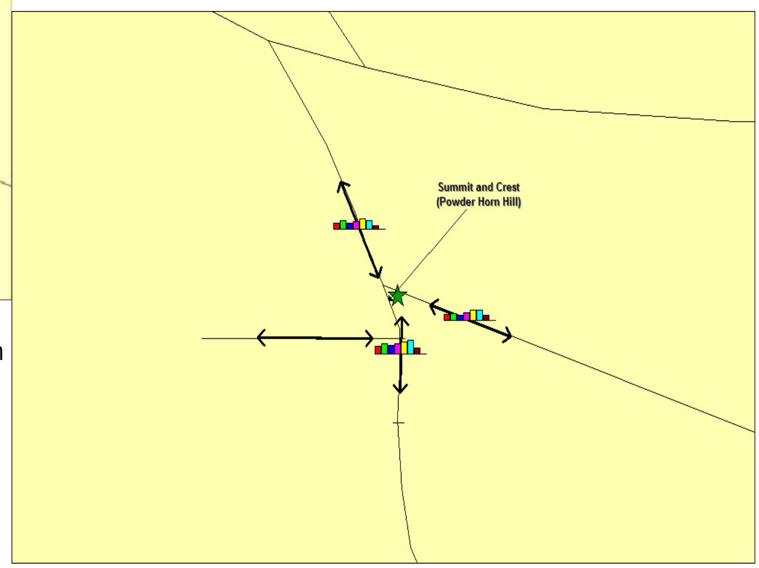


Figure 20. Volume of Hourly Traffic Traveling on Each Street at Powder Horn Hill.

4.1.2 East Boston

Two sites were studied in East Boston: Condor & Meridian and Route 1A. These sites were identified as areas of concerns by the resident members of East Boston's Neighborhood of Affordable Housing.

4.1.2.1 Condor St & Meridian St

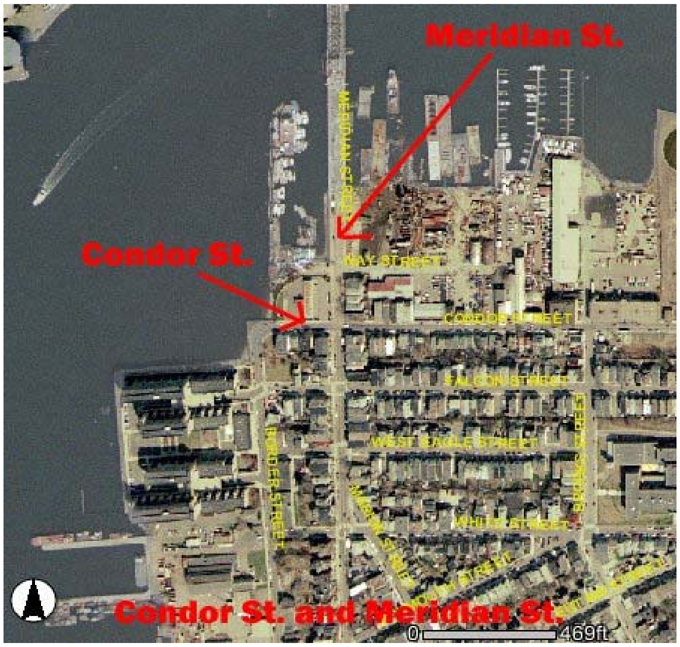


Figure 21. Aerial View of Condor & Meridian.

Condor and Meridian is a relatively busy intersection in East Boston. Meridian Street provides access to Chelsea via the Meridian Street Bridge. A large number of oil companies use this area of the street as a way of getting to the oil distribution center located in Chelsea on the opposite side of Chelsea Creek. Traffic through this intersection is controlled with a set of standard traffic lights.

Here, as well as with other traffic intersections, it has been found that the volume of non-diesel vehicles represents an overwhelming majority of vehicular traffic. At the Condor and Meridian intersection the number of non-diesel vehicles was over ninety percent. Diesel traffic causes a majority of the black carbon pollution even thought it is a minority of the overall traffic levels.

Figure 24 shows the total number of vehicles organized by day and type. This graph shows how much of a drastic difference there is between car volume and diesel vehicle volume at the Condor and Meridian site.

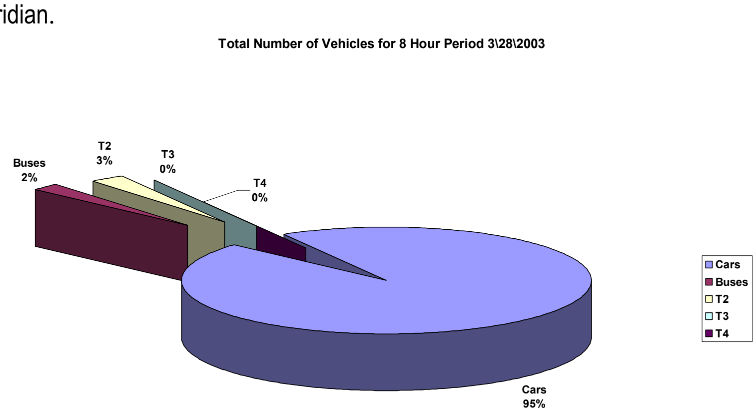


Figure 22. Percentage of Vehicle Types Over 8 Hours: Condor and Meridian, 3/28/03.

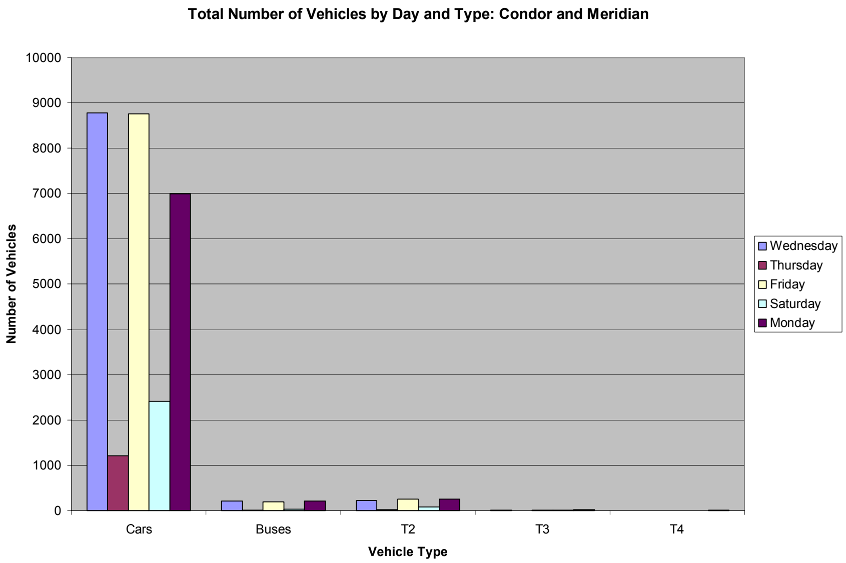


Figure 24. Estimated Total Number of Vehicles by Day and Type: Condor & Meridian.

The next figure (Figure 23) summarizes the overall amount of traffic and the breakdown of vehicle types for the intersection of Condor and Meridian. This figure was formed using the data acquired from the week of sampling at this intersection. The pie on each double-sided arrow represents all the traffic going into and out of each street segment. The overall size of each pie signifies the volume of traffic recorded for the segments and the portions of each pie show the breakdown of vehicle types. The overwhelming red portions signify the percentage of cars and the other, much smaller wedges stand for the different types of diesel vehicles. From this figure, one can conclude that cars traveling over Meridian Street make up a majority of the traffic moving through this intersection.

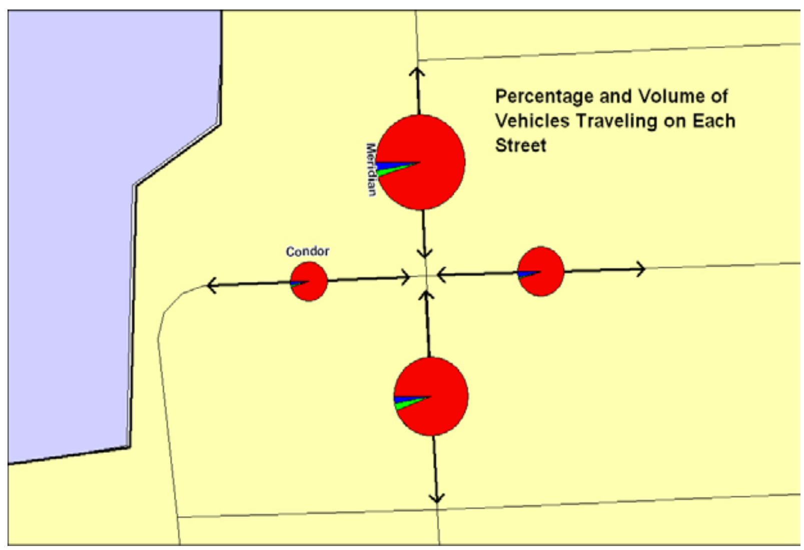


Figure 23. Pie Graph representation of traffic results at Condor and Meridian

Figure 25 summarizes the overall traffic level averages for each sampling hour over the entire data collection period at Condor and Meridian. The individual columns on each bar graph represent the hourly averages for all vehicle traffic. From this figure valuable observations can be gathered. It can be seen again here that the majority of the traffic through this intersection is traveling over Meridian Street. The change in height of the traffic columns illustrates the changing behavior of traffic levels. The first small rise in the height of the columns shows the spike in traffic levels due to the morning rush hour. The second larger spike depicts the increase of traffic during the afternoon rush hour.

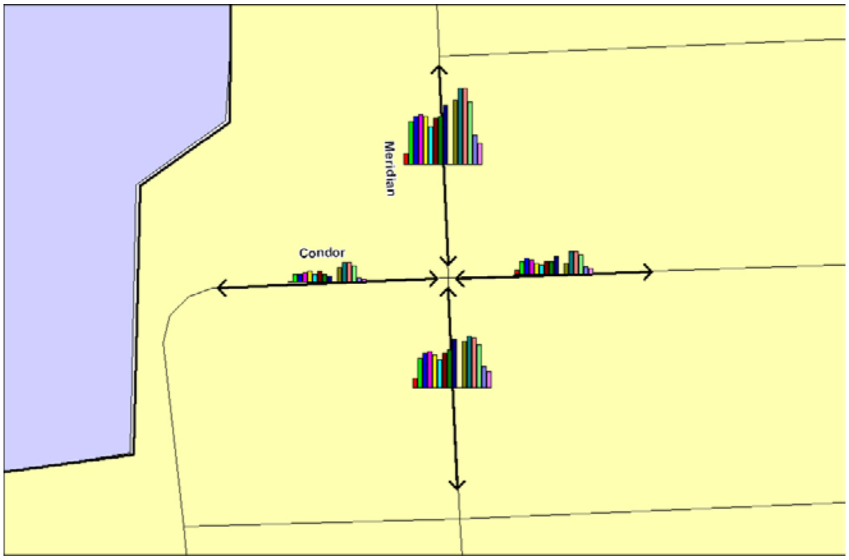


Figure 25. Bar Chart for traffic results at Condor and Meridian.

4.1.2.2 Route 1A

Route 1A is a busy highway leading to the airport and giving access to a busy industrial park (Figure 26). The intersecting street, Boardman, leads towards a residential area where there is also a T-stop. The traffic traveling within this intersection is made up of a significant portion of trucks. This intersection proved to be the busiest overall, as well as in diesel vehicular traffic. The traffic at this intersection was regulated by a four-way traffic light (red/yellow/green).

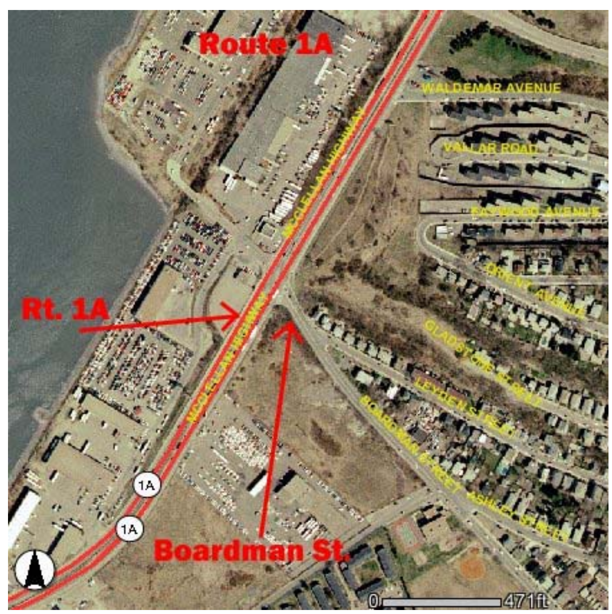


Figure 26. Aerial View of Route 1A & Boardman.

As shown in Figure 27, the large majority of vehicles that traveled through the intersection that day were cars. When compared with the pie charts of the other intersections, this is not a surprising observation since our overall results showed that more than 80% cars traveled through every intersection that we studied. This does not mean, however, that there were not a very large amount of trucks and buses traveling through the intersection. When compared with the same time frame at a different intersection, the results are quite clear. Only 483 diesel vehicles traveled through Condor St. and Meridian St. between the hours of 6:30 am and 2:00 pm, whereas 2,410 diesel vehicles traveled through the intersection of Route 1A and Boardman St. This variance in numbers is due to the fact that the

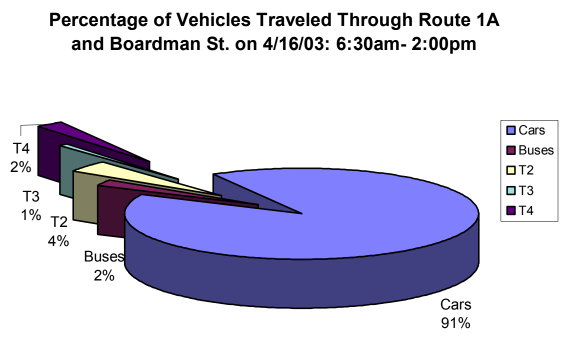


Figure 27. Percentage of Vehicles Traveling Through Route 1A and Boardman.

intersection of Route 1A and Boardman St. is located near an industrial park, meaning that a number of trucks must travel in and out of this area every day to deliver and retrieve goods and services. There is also a vastly large contrast between the total number of vehicle counts at each intersection. The total count of vehicles for the same time frame at the intersection of Condor St. and Meridian St. is only 7,479, but at the intersection of Route 1A and Boardman St. the total count of vehicles is 25,109. This means that 17,630 more vehicles traveled through the intersection of Route 1A and Boardman St. This is due to the fact that not only is Route 1A a high traffic area for trucks going in and out of the industrial park, but is also a high traffic area for cars going in, out, and around the airport. This intersection is just miles away from the airport and sees most of the traffic from there.

Figure 28 shows a breakdown of the percentage and volume of vehicles traveling on each street. It is obvious that the majority of vehicles travel on Route 1A. This is due to the fact that it is a busy highway with access to both an industrial area and Logan Airport. This figure also shows that the majority of vehicles traveling through the intersection are cars and that 2 axle trucks outweigh the amount of trucks and buses traveling through the area.

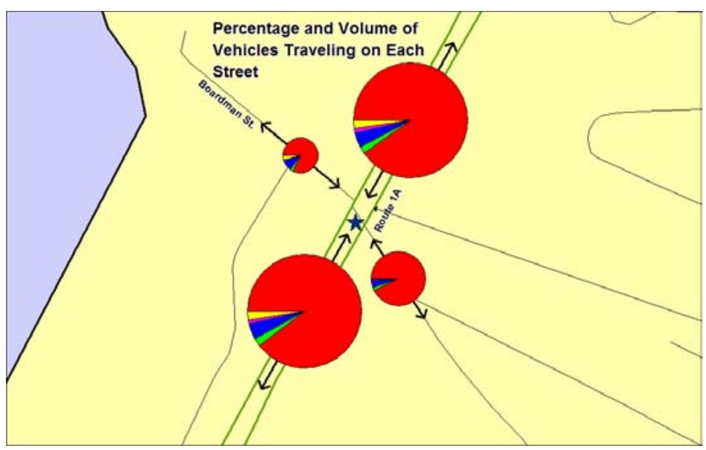


Figure 28. Percentage and Volume of Vehicles Traveling on Each Street of Route 1A and Boardman.

Figure 29 shows the average volume of vehicles traveling on each street per hour. This also shows the overwhelming number of vehicles traveling on Route 1A and only a few on Boardman St. The light green bar, representing 7:00 am, shows the morning rush hour and the dark green bar, representing 1:00 pm, shows the afternoon rush hour.

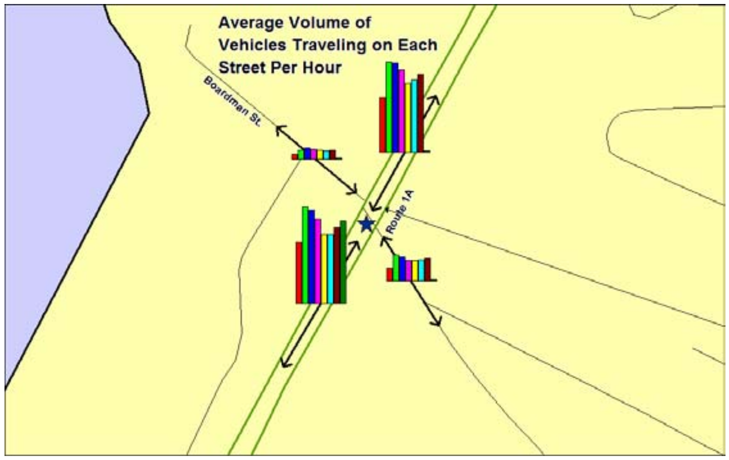


Figure 29. Average Volume of Vehicles Traveling on Each Street, Per Hour, at Route 1A and Boardman.

4.2 Air Quality Measurements in the Chelsea Creek Communities

The air quality, specifically particulate matter, was measured using the portable aethalometer. The black carbon concentration of particulate matter was recorded. Using graphical analysis software, we developed the graphs in this section to display the air quality results found at each intersection.

4.2.1 <u>Chelsea</u>

There were three locations that we included in our study in Chelsea. The intersections Jefferson Ave. & Webster Ave., Broadway & Williams St., and Powder Horn Hill were identified as areas of concern by the community groups.

4.2.1.1 Broadway St & Williams St

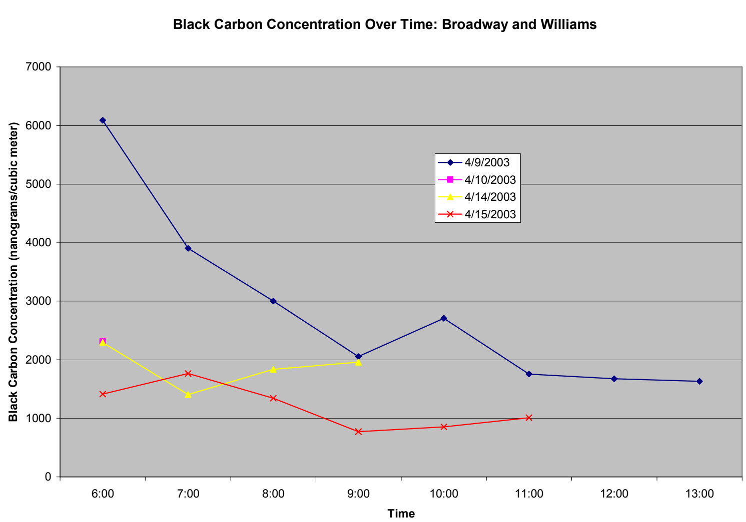


Figure 30. Graph of Black Carbon Concentrations at Broadway and Williams.

Figure 30 depicts the black carbon concentration at the intersection of Broadway and Williams. Each day during which air quality monitoring was conducted at this intersection is shown by a different colored line. Hourly averages of the air quality were used in attempts to "smooth" outliers. Despite using hourly averages, extremely high black carbon concentrations were seen at 6:00 and 7:00 (Figure 30). As shown in the figure, it appears that the black carbon concentration does not follow a pattern from day to day.

4.2.1.2 Jefferson Ave & Webster Ave.

Figure 31 depicts the black carbon concentration at the intersection of Jefferson and Webster. Each day during which air quality monitoring was conducted at this intersection is shown by a different colored line. Hourly averages of the air quality were used in attempts to "smooth" outliers. One can see that on 4/3/03 (pink line, Figure 31) the black carbon concentration was quite erratic, jumping from low to high and then back down to low. April 4th (yellow) and April 8th (purple) seem to somewhat follow a pattern of black carbon concentrations when using hourly averages. However, a daily pattern (for all weekdays) is not observed in the data collected during this project.

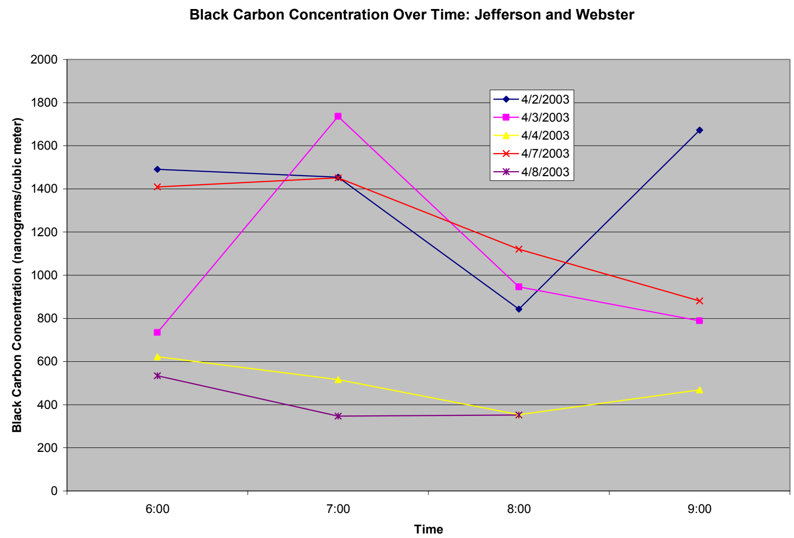


Figure 31. Graph of Black Carbon Concentrations at Jefferson and Webster.

4.2.1.3 Powder Horn Hill

The black carbon concentrations at Powder Horn Hill are shown in Figure 32. Only one day of air monitoring was conducted at this site, so no daily comparisons can be made. However, one can notice the drastic difference between the black carbon concentrations early in the morning (6:15 am), as compared to the lower concentrations for the rest of the day.

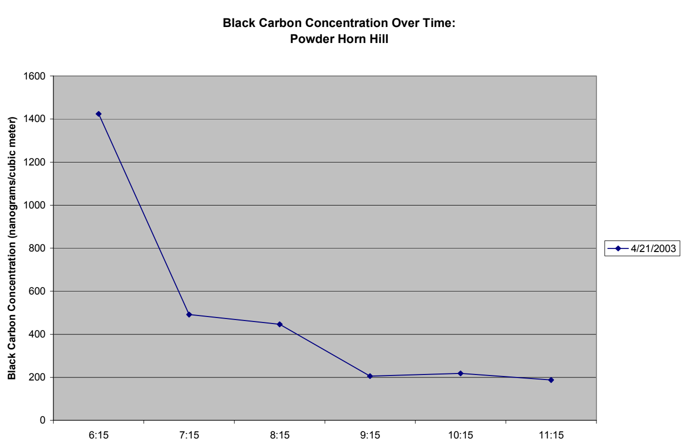


Figure 32. Graph of Black Carbon Concentrations at Powder Horn Hill.

4.2.2 East Boston

There were two locations that the team studied in East Boston. The intersections of Condor St. & Meridian St. as well as Route 1A & Boardman St. were sites pointed out to us for our investigation by Chelsea Creek Action Group members.

4.2.2.1 Condor St & Meridian St

The black carbon concentrations at Condor and Meridian are shown in Figure 33 in hourly averages for each day studied. Each day during which air quality monitoring was conducted at this intersection is shown by a different colored line. Hourly averages of the air quality were used in attempts to "smooth" outliers. As one can see, even hourly averages were unable to produce a smooth line of black carbon concentrations. The black carbon concentrations for all four days were quite erratic. As with the other sites, no definitive patterns of daily black carbon concentrations were found in the data collected.

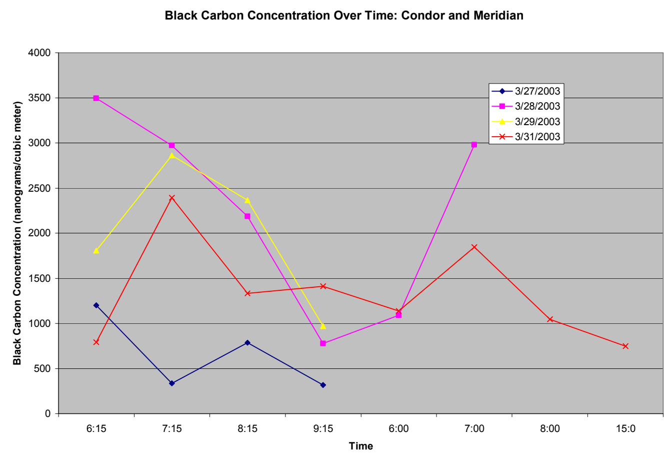


Figure 33. Graph of Black Carbon Concentrations at Condor and Meridian.

4.2.2.2 Route 1A

The black carbon concentrations at the intersection of Route 1A and Boardman are shown in Figure 34. The two days during which air quality monitoring was conducted at this intersection are shown by a different colored line. Hourly averages of the air quality were used in attempts to "smooth" outliers. The black carbon concentration for April 17th (pink) appears to remain closely the same throughout the day. However, for

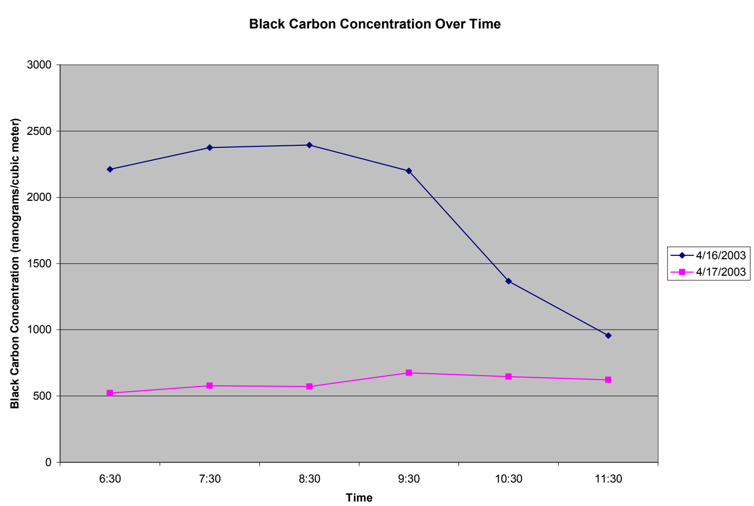


Figure 34. Graph of Black Carbon Concentrations at Route 1A.

April 16th (blue), there is a drastic drop in the black carbon concentration between 9:30 and 10:30. As shown in the Figure 34, it appears that the black carbon concentration does not follow a pattern between Wednesday (16th, blue) and Thursday (17th, pink).

4.3 Correlation Between Traffic and Air Quality

After analyzing the traffic counts and black carbon concentrations alone, we attempted to find a correlation between diesel traffic and the black carbon concentrations. In order to accomplish this, we used graphical analysis software graphing the black carbon concentration versus the diesel vehicle traffic for each day of each site. In this section, we will present our overall results and analysis of the correlations.

4.3.1 Chelsea

Three sites, identified as priority intersections by the members of Chelsea Green Space, were studied in Chelsea: Broadway & Williams, Jefferson & Webster, and Powder Horn Hill.

4.3.1.1 Broadway & Williams

While conducting traffic counts at the intersection of Broadway and Williams, there was a noticeably pungent diesel emission odor. The intersection was quite busy and did include a somewhat substantial volume of diesel vehicle traffic. Figure 35 shows a graph of the black carbon concentration as compared to diesel traffic, both in 15 minute increments/averages. This graph, however, is somewhat hard to follow and it is difficult to observe a pattern, if any. At some points (11:45-13:45), a pattern between the two seems possible. To further investigate this, hourly averages of the black carbon and hour traffic counts were compared (Figure 36). The hourly graph also includes a line depicting

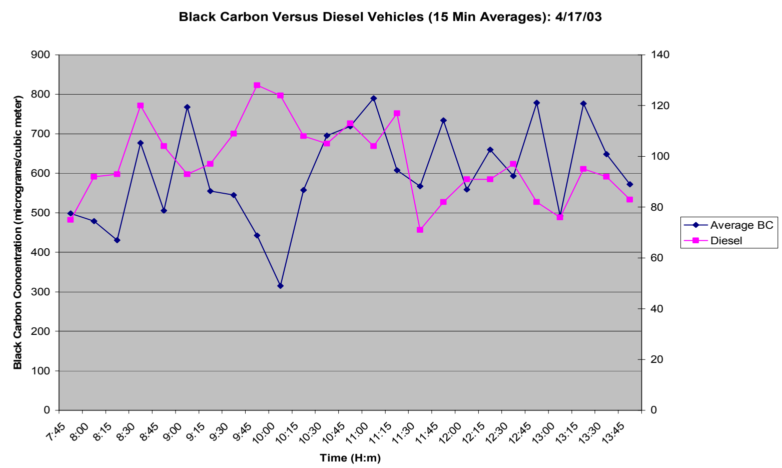


Figure 35. Broadway and Williams: Black Carbon Concentrations Versus Diesel Vehicles by 15 Minute Averages.

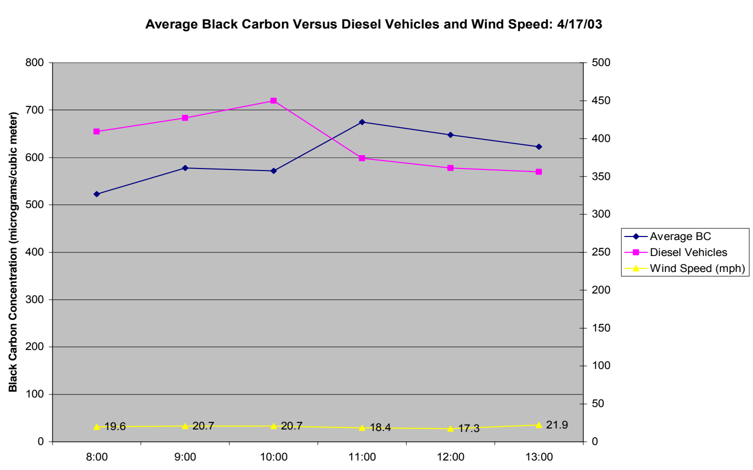


Figure 36. Broadway and Williams: Black Carbon Versus Diesel Vehicles and Wind Speed in One Hour Averages.

the changes in the wind speed during the times at which air monitoring was conducted. A slight pattern between the black carbon concentration and diesel traffic was more noticeable in the hourly graph.

4.3.1.2 Jefferson & Webster

While at the intersection of Jefferson and Webster, we noticed a spike in the overall amount of traffic in the rush hour time span, 7am -10am. At 11:45 am, a large peak in the black carbon concentration (blue line) is seen in Figure 37. If there was a correlation between black carbon concentration and diesel traffic, there would also be a peak in the number of diesel vehicles at this time. However, at 11:45, the diesel vehicles are at a near minimum. The results presented in Figure 37 do not seem to show a pattern between black carbon and diesel vehicles.

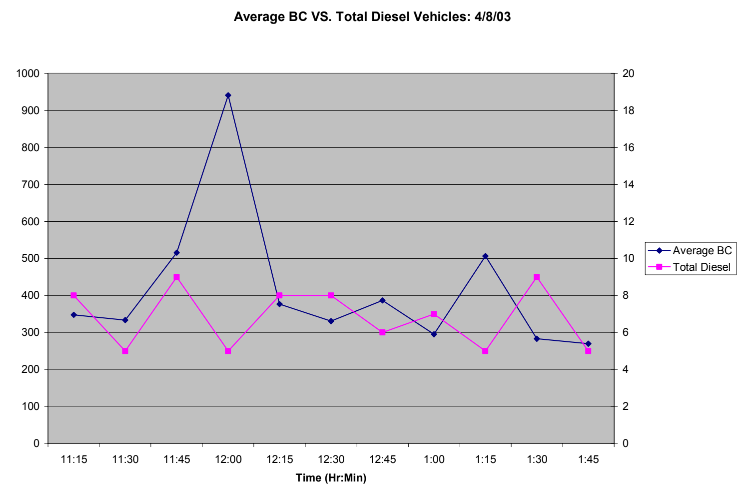


Figure 37. Hourly Averages of Black Carbon Concentration Versus Diesel Vehicles: Jefferson and Webster.

In an attempt to "smooth" outlying data points, we graphed this data using time intervals of one hour (Figure 38). Also on this graph, wind speeds were presented (yellow) to see if they had an impact on the black carbon concentration. Although the outlying data points were smoothed out, there is still no trend found between the black carbon and diesel vehicles. If wind was a determining factor in effecting the black carbon concentration, there would be a noticeable relationship in the slopes of the lines. If the wind were blowing toward the aethalometer, the relationship would be directly proportional; if the wind were blowing away from the aethalometer, the relationship would be inversely proportional. Since we were not able to measure the wind direction, we cannot conclude that the wind was blowing towards the aethalometer, creating the directly proportional relationship between the black carbon concentration (blue) and the wind (yellow) in Figure 38.

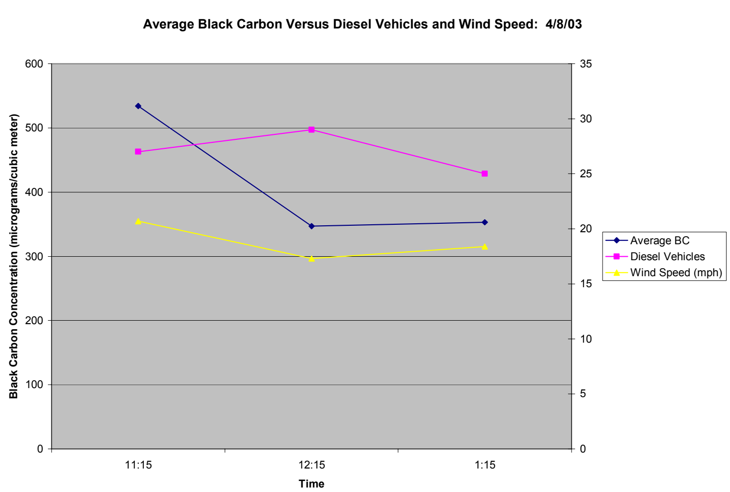


Figure 38. Average Black Carbon Concentration Versus Diesel Vehicles and Wind Speed: Jefferson and Webster.

4.3.1.3 Powder Horn Hill

As can be seen in Figure 39, the 15 minute averages of black carbon concentration produce an erratic line on the graph. In this graph, it is difficult to see if there is a correlation between the diesel vehicles and the black carbon concentration. To smooth out the line of the graph, a one hour average for the black carbon and totals for one hour of diesel vehicles were graphed against each other (Figure 40). In this figure, there is a visible jump in diesel traffic around 8:15. If a correlation between the diesel traffic (pink) and the concentration of black carbon (blue) were present, there would be a proportional relationship among the two lines. As seen in Figure 40, there does not appear to be a relationship. To see if this could have been affected by wind speed, the yellow line was added. Here, it appears as though the black carbon may be directly affected by the wind speed, in that as the wind increases, the black carbon decreases. However, this cannot be confidently concluded, due to the fact that the wind direction is unknown.

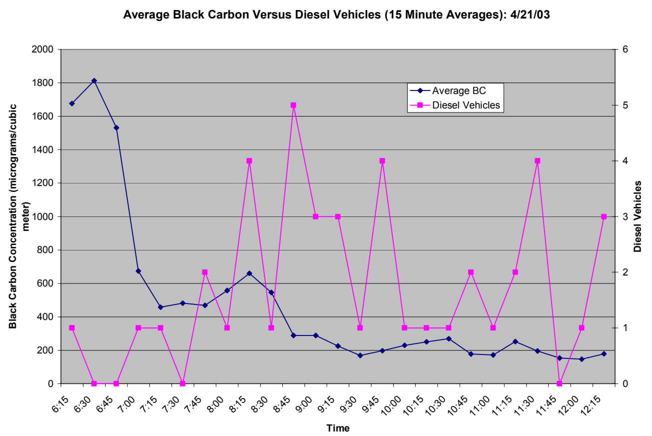


Figure 39. Powder Horn Hill: Black Carbon Versus Diesel Vehicles in 15 Minute Averages.

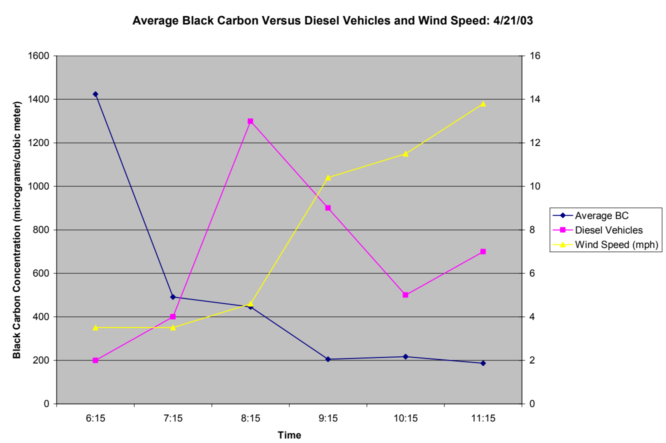


Figure 40. Powder Horn Hill: Black Carbon Concentration Versus Diesel Vehicles and Wind Speed in One Hour Averages.

4.3.2 East Boston

Two sites, identified by the community members of East Boston, were studied: Condor & Meridian and Route 1A.

4.3.2.1 Condor & Meridian

To determine whether there is a correlation between black carbon and the level of diesel vehicles, black carbon concentrations were graphed versus diesel vehicle totals. The figure below depicts black carbon (BC) concentration versus diesel vehicle levels over time intervals of 15 minutes. If there was a clear link between BC and diesel vehicle traffic at this particular intersection, then ideally there would be proportional spikes in BC and diesel levels around the same time. By examination of the results in **Error! Reference source not found.**, one can see that some spikes occur around the same time. However, even though these spikes appear to take place at the same time they are not proportional to each other. Therefore, the results in Figure 42 do not provide us with substantial evidence to conclude that there is a clear correlation between diesel vehicle traffic and black carbon concentration.

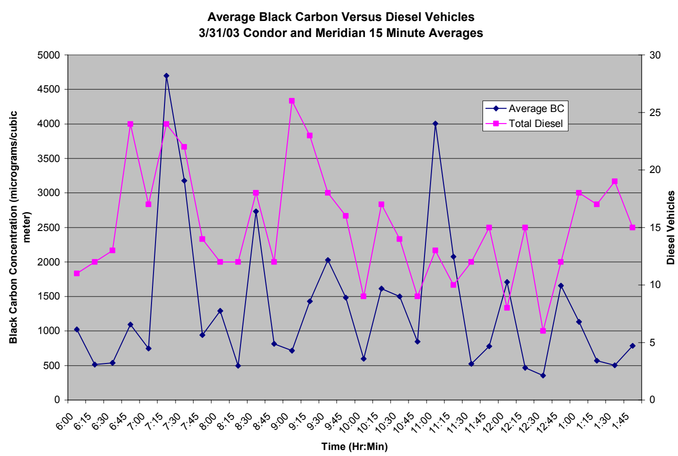


Figure 41. Average Black Carbon Concentrations Versus Diesel Vehicles in 15 Minute Averages: Condor and Meridian.

It was thought that the variable of varying wind speeds might be the cause of these inconsistencies in Figure 41. In order to determine if this was true, wind speed was plotted along with black carbon concentration and diesel traffic levels over time in Figure 42. Since the wind data was recorded in hourly averages, the diesel traffic and BC levels had to be averaged in the same manner. To support the idea of wind causing the inconsistencies in the data, spikes would have to be observed in average BC following an increase in wind and diesel vehicle levels. This does not occur in a noticeable pattern in Figure 42.

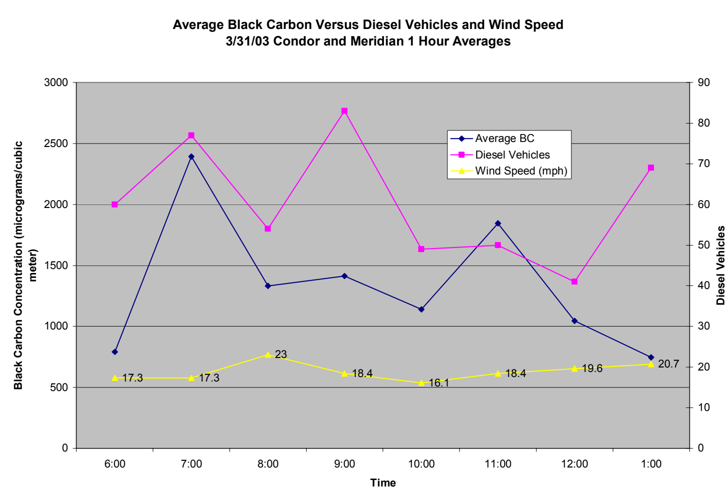


Figure 42. Average BC vs. Diesel Vehicles vs. wind speed over time: Condor & Meridian.

4.3.2.2 Route 1A

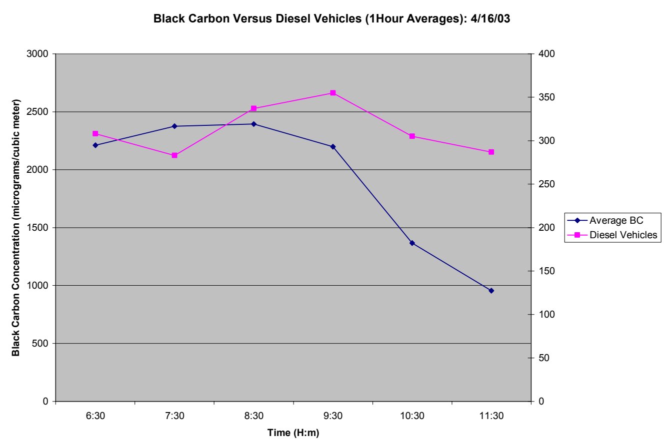


Figure 43. Black Carbon Versus Diesel Vehicles in 15 Minute Averages: Route 1A

Figure 43 shows the hourly averages of black carbon concentration versus the hourly averages of diesel vehicle counts for the intersection of Route 1A and Boardman St. From 6:30 am to 9:30 am the trend in both lines is opposite, showing no correlation between a peak in black carbon concentrations and a peak in diesel vehicles, however, from 9:30 am to 11:30 am both lines do show the same trend and drop dramatically. This type of inconsistency in data makes it difficult to conclude one way or the other if there is a direct correlation between air quality and traffic.

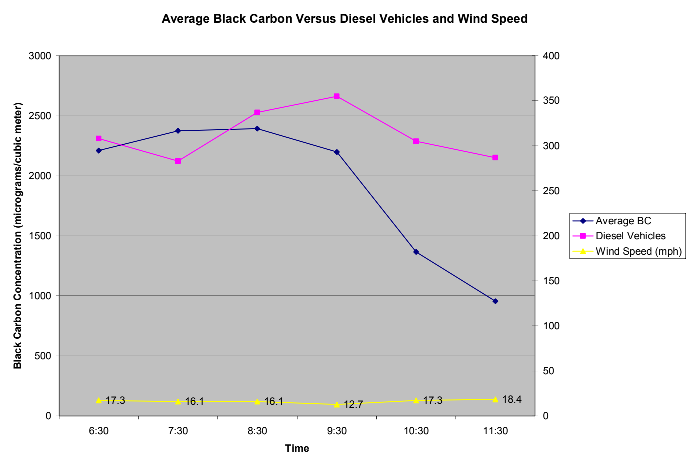


Figure 44. Average Black Carbon Versus Wind Speed: Route 1A.

Figure 44 shows the hourly averages of black carbon concentrations versus the hourly averages of diesel vehicle counts and wind speed for the intersection of Route 1A and Boardman St. Wind speed and direction can have a large impact on the validity of the aethalometer readings due to the fact that black carbon emissions can be blown towards or away from the Harvard Impactor. This graph, however, shows very little to no change in the wind speed and does not follow any kind of trend line with the hourly average of diesel vehicles and hourly average of black carbon concentration. This means that we cannot solidly conclude that wind speed had a direct effect on these results.

5 CONCLUSIONS AND RECOMMENDATIONS

Upon completion of the analysis of our results, we were not able to come to any solid conclusions. In this section, we will present possible reasons for our inconclusive results, recommendations to better improve further projects and studies.

5.1 Conclusions

The analysis of the results presented yielded an inconclusive correlation between diesel traffic and black carbon pollution. The inconclusive correlation was further supported by the regression analysis performed on the black carbon concentrations and diesel vehicle data. With a regression analysis, an R^2 value of 1.0 depicts a perfect set of data, showing the actual data is the same as the expected. Data that produces an R^2 value above 0.5 can be construed as possessing a proportional relationship. We performed a regression analysis on all five sites studied. The R^2 values are presented in Table 2. All R^2 values for our sites were below 0.5, meaning we could not conclude a proportional relationship between black carbon concentrations and diesel vehicles. The main reason for this outcome is attributed to the large number of environmental variables encountered during the data collection period. The major variables that were identified were wind speed & direction, ambient humidity, temperature and precipitation.

Studied Site	R^2 value
Broadway & Williams	0.033
Jefferson & Webster	0.141
Powder Horn Hill	0.283
Condor & Meridian	0.122
Route 1A	0.396

Table 2. R-squared Values From Regression Analysis.

The variable of temperature was most likely to have caused the majority of the inconsistencies in our results. The optimum operating temperature for the aethalometer is from 40 degrees to 80 degrees Fahrenheit. Several times at each data collection site the aethalometer was in use in weather conditions where the temperature was below 40 degrees Fahrenheit. To compound the problem, up to 50 degree temperature differences between test days were not uncommon. In addition, vehicular gas emissions from diesel vehicles behave differently at dissimilar temperatures.

Wind speed and direction was another major variable which certainly had a considerable effect upon our results. Wind direction and speed varies constantly and this behavior has unpredictable effects on the black carbon levels. Gusts of wind can blow the clouds of diesel vehicle exhaust away from the position of the aethalometer and create irregularities in the data.

Humidity and precipitation are other variables that can have an effect on experimental results and are difficult to control. Precipitation in the form of snow was encountered at the Condor & Meridian test site and this might have had some influence on the data.

Another major variable which had an effect on the results of the study was the short amount of time spend at each of the five different test sites. To help control the variables described above, it would have been better to test for an extended amount of time at one site rather than a short time at five sites. With longer testing periods, it would have been easier to identify trends in weather and environmental conditions and account for these conditions in the analysis of the results.

Regardless of the wide array of variables described above, there are some useful conclusions that can be made concerning traffic at the five studied sites. For all the sites tested, non-diesel traffic made up the greater part of all vehicular traffic and creates a small fraction of black carbon compared to diesel vehicles. Furthermore, this fraction of all diesel vehicles which emit large amounts of visible black smoke are the source of the majority of black carbon pollution. As a result of all of the variables described above, the relation between diesel vehicle traffic and black carbon air pollution has been determined to be inconclusive.

5.2 Recommendations

With the completion of our data collection and analysis we were able to come up with several conclusions that we presented in our last section. Another important portion of our project was to come up with some recommendations to help change the air quality in the Chelsea Creek area. Over the course of our analysis we found that our data did not support our initial thought that diesel trucks were a direct cause for the elevated counts of black carbon in the atmosphere. Although we did not come to the conclusion that we had initially hoped for, we did formulate several recommendations that would possibly lead to a more conclusive study than ours.

5.2.1 Recommendations For Replication of Methodology

The most important recommendation that we were able to come up with was pertaining to the length of the study. Over the course of our project we conducted field test at five locations over a time span of four weeks. During this time encountered a widely variable weather situation. We also conducted the testing during a limited time period, 6am - 2pm. Both of these constraints limited the amount of viable data that was collected. By lengthening the amount of time spent collecting data, in both the short term and the long term, we can expect the results to be more favorable. While conducting the test in the early spring we encountered weather that ranged from below freezing levels to temperature in the mid 80's. With variable weather conditions, there is no doubt that our results were affected. By opening up the test to encompass at least a one year period we can incorporate all weather conditions into the study. On a more immediate scale, by opening the daily study times to a 24 hour study period, we can include all traffic patterns in the research since there is a significant difference in traffic amounts between morning and night.

Another portion of the study that can be altered to help in the collection of viable data would be to reduce the number of sites studied down to one intersection. When we were spreading our collective efforts over 5 intersections we were not collecting the most viable data for each site. One of the factors that led us to this conclusion was that we just did not collect enough data to return reliable data. With the short time span and the jumping around to different locations we were limited in the amount of data that we could have collected. By increasing the time spent at the site, and limiting the number of sites the results that would be collected would be more accurate of the relationship between air quality and diesel truck emissions.

Wind direction and speed played a large part in this project and we feel it should be studied more carefully in the future. Even though we collected the wind speed from the Logan International Airport website every day, only a regional view of the wind was available. A more detailed intersection specific account of the wind would benefit the project more. Wind patterns in an urban setting, with buildings, trees, and other obstructions are completely different than the wind patterns located on an open air field. Using a handheld anemometer along with a wind vane to determine the direction of the wind would allow the wind to be accurately represented in the final studies. The purpose of the wind vane would allow the group to see if any outside sources are influencing the black carbon counts. For example if there is a gas station located 3 blocks to the south of the intersection, you can determine if spikes in the BC count was due to the wind blowing from the gas station or if the wind had no part in it at all.

5.2.2 Recommendations to Improve Air Quality in Chelsea Creek

Unfortunately, as we mentioned earlier, we did not find a reliable correlation between diesel truck emissions and air quality. That doesn't mean that a correlation doesn't exist. Depending on the success of a future study using the recommendations we have suggested, we have also generated a few recommendations if a correlation is found.

Buses in the MBTA fleet were noticed to be a large contributor to air pollution in the Chelsea Creek communities. One possible solution would be to pressure the MBTA into retiring older, "dirtier" buses and introducing natural gas "clean" buses. Natural gas buses emit water and CO_2 as end products after combustion. By completely eliminating the need for diesel fuel the MBTA buses can improve their ability to serve the general public, through cleaner air.

With the elimination of buses from the list of possible polluters we can now concentrate on diesel trucks. While collecting data for our project we noticed that trucks emitted the most visible black carbon when starting to move from a dead stop. One way to help reduce this source of pollution would be to synchronize the traffic lights in the area to promote an easy flow of traffic. If a truck can travel through a major traffic artery without stopping then there should be a dramatic reduction in the amount of black carbon.

5.3 Methodological Variations for Further Studies

In this section, we detail possible variations to our methodology help succeed in finding a correlation between diesel traffic and air quality.

5.3.1 Move Location of Aethalometer

One possibility for the discrepancy in our data for this project may have been related to the distance of the aethalometer from the intersection. We arbitrarily picked a corner to place the aethalometer, but by doing this, the aethalometer may have only recorded the black carbon from the vehicles traveling closest to it. In a large intersection, such as Route 1A and Boardman St., this may not be acceptable, because it cannot reach the large amount of black carbon emission from the far side of the intersection. The only effective way to measure an equal amount of black carbon coming from all diesel vehicles would be to somehow place the Harvard Impactor in the very center of the intersection or to place one aethalometer at each corner of the intersection.

5.3.2 Adjust Height of Harvard Impactor

Another possibility for a more localized type of study would be to have two aethalometers at an intersection and to place one Harvard Impactor at the height of bus exhaust and the other at the height of truck emissions. This would be sure to accurately measure each type of diesel vehicle and could possibly distinguish between which diesel vehicle emitted the most black carbon into the air.

5.3.3 Additional Aethalometers For Each Intersection

By using more than one aethalometer for each intersection, the margin of error for the collection of air quality data will be greatly reduced. By placing two aethalometers at each corner of the intersection, and placing one at bus emission level and one at truck emission level, the amount and accuracy of data will be enhanced. With a large amount of aethalometers, the type of vehicle that emits the most amount of black carbon into the air can be identified so that type of vehicle can then be targeted.

5.3.4 Study Areas of High Pedestrian Traffic

In this study, we did not include specific areas of high pedestrian traffic, but only intersections in East Boston and Chelsea that were considered the most traveled by diesel vehicles. This did not take into consideration the fact that these areas may not be close to any large number of people who might be breathing the black carbon into their lungs. Instead of targeting intersections of high diesel traffic it may be more logical to target intersections of high pedestrian traffic so that we may know how poor the air quality is where people are most affected.

5.3.5 Areas of Schools and Rest Homes

Along with studying areas of high pedestrian traffic, it also seems logical to study an area where there is a rest home or school. School buses are known to be one of the dirtiest types of diesel vehicle and could be affecting young children each and every day they travel to school. By getting close to the school or rest home, it can be determined exactly how much black carbon these health sensitive people are breathing deep into their lungs causing future ailments.

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APPENDIX A. ANNOTATED BIBLIOGRAPHY

Atkisson, Arthur, and Richard S. Gaines, eds. Development of Air Quality Standards. Columbus: Charles E. Merrill Publishing Co., 1970.

This book is actually a symposium of air quality standards and their development. Included within are chapters of the evolution of air quality criteria, models for decision making, classifying human response to air pollution, abatement strategies, vehicular air pollution, and quality standards for the control of air pollution.

There are a few areas in this book that may be of a help to the team. The description and tips given to help classify citizens' responses may be useful if the team were to have to questions citizens of Chelsea and East Boston. Studies of mortality and morbidity are mentioned, as well as previous nationwide studies of sickness due to pollution. A few studies of different cities, both in the U.S. and international, are described. In another section, "Determining Optimal Air Quality Standards" is outlined. This may help as a comparison to the levels we will be determining.

Although these sections, after a brief re-through seem like they may be of help, the publishing date of the book may be a problem. This symposium was published in 1970, just a few years after the introduction of air pollution standards and five years before the formation of the EPA. It is quite probable that any standards outlined in this book are outdated. However, it might be useful as a source of comparison to current standards.

Baumbach, Gunter, et al. Air Quality Control. Germany: Springer-Verlag Berlin Heidelberg, 1996.

This book explains the origins of air pollutants and their effects on the atmosphere, plants, animals and humans. It also exposes techniques for reducing emissions from many different types of sources. The information that could be very useful in this book is the methods it describes for reducing air pollutants because it is directly related to this project. The information that would not be useful in this book is the extreme detail it goes into describing various chemical transformations relating to air pollutants.

Clement, Raymond, and Ron Kagel, eds. Emissions From Combusion Processes: Origin, Measurement, Control. Michigan: Lewis Publishers, Inc., 1990.

This book pertains to the combustion emissions that are the results of rotating kilns, steel mills, and paper mills. Unfortunately, there is no data for mobile sources (cars, trucks, busses, etc.) emissions in the book. A good source for stationary and industrial information but that is not within the scope of our project.

Lave, Lester B., and Gilbert S. Omenn. Clearing the Air: Reforming the Clean Air Act. Washington, D.C.: The Brookings Institution, 1981.

This book covers mostly the history of the Clean Air Act in the 1970's and gives information about the regulation of the automobile and stationary source emissions. This would be somewhat useful if looking for trends that will be set for the United States as far as keeping the air clean for the future. The only problem is that this book was published in 1981, giving us standards for 20 years ago. These regulations may not be the same as the ones today, and may only tell us how emission standards were set back then, not now.

Strauss, Werner, ed. Air Pollution Control, Part III. New York: John Wiley & Sons, Inc., 1978.

This book gives a large amount of information on techniques on sampling, measuring, analyzing, and mapping vehicle emission data. It compares methods on collecting data, but has no information about an aethalometer. This book may be useful on giving advice about mapping, sampling, and analyzing emission data in *general*, but does not get into the specifics of using an aethalometer to collect this data. It also was published back in 1978, and may not be recent enough to give us accurate information.

Alley, F. C., and C. David Cooper. Air Pollution Control, A Design Approach, Second Edition. Illinois: Waveland Press, Inc., 1994.

This book was published mainly to be used as a text book for undergraduate students. The first few chapters are dedicated to introducing the subject of air pollution and describing each of the main areas of air pollution. Later chapters go on to describe equipment of air pollution, properties of gas and vapors, atmospheric dispersion and even a chapter on mobile sources of air pollution. Included are appendices of conversion factors and properties of air and other materials.

This book was published in 1994, making it one of the most current sources found so far. The first chapter will serve as an excellent introduction to the Federal Legislation, causes, sources and effects of the pollution and the air quality trends. It will provide brief, background information of the subject matter. The chapter on the properties of gases and vapors may be a good reference during the actual testing of the air quality in Chelsea and East Boston. The chapter concerning mobile sources will provide some background information on vehicle emissions and emission controls as of 1994. The final chapters of the book describe air pollution through meteorology and atmospheric dispersion. These chapters will give the team a good idea of how the air quality is affected by natural weather occurances. This book will probably be of help throughout the entire project.

Grad, Frank P., et al. The Automobile and the Regulation of Its Impact on the Environment. Oklahoma: The University of Oklahoma Press, 1975.

In this book, there is plenty of knowledge that is related to automobiles and how they are regulated in terms of environmental impacts. Some of the topics covered include emission standards, air quality, the impact of the emissions, and ideas on how to change emissions. This text would do well for a base knowledge of the topc, but it is slightly outdated for some of the technical aspects of the project.

Boubel, Richard W., et al. Fundamentals of Air Pollution, Third Edition. San Diego: Academic Press, Inc., 1994.

This book covers many topics relating to air pollution including its effects on surrounding objects, the measurement of air pollution and effective ways for controlling air pollution. The areas of this book that are particularly useful are the sections on methods of ambient air sampling, techniques for controlling air pollution and emission standards. The area of relative disinterest is the section regarding the effects of pollution. This information is not really related well to the topic of our project.

United States. Environmental Protection Agency. Office of Air Quality Planning and Standards. "Evaluating Transportation Controls to Reduce Motor Vehicle Emissions in Major Metropolitan Areas." Tech Report EPA.9/2:1364. Washington, D.C.: 1970.

This technical reference presents findings from research undertaken by the EPA to evaluate the effectiveness of transportation controls to reduce car emissions in major cities. Topics of interest in this report include the sections on the modification of traffic flow techniques, improvements in public transportation and motor vehicle restraints. The only areas of this source that seem totally useless is some of the outdated data that is presented from various car models that are over 30 years old.

United States. Environmental Protection Agency. Office of Air Quality Planning and Standards. "Prediction of the Effects of Transportation Controls on Air Quality in Major Metropolitan Areas." Tech Report EPA.9/2:1363. Virginia: 1972.

This technical report contains information and data on vehicle emissions in several different major metropolitan areas and includes information on how to redirect traffic flow and its effects on the area. This would be extremely useful information for our project since we are concerned about whether or not we will be affecting the surrounding areas and how. This technical report was published in the 1970's as well, and the effects of a redirection of traffic flow may have been different back then. This may cause an issue of outdated information.

"Environmental Protection Agency" n.d. http://www.epa.gov (27 Jan 2003).
This is the official website for the EPA. The website contains the regulations and standards for the U.S., as well as for individual states. Links to webpages concerning air quality and traffic are included.

"Mass.Gov".n.d. http://mass.gov (27 Jan 2003).
This website contains information about the government of Massachusetts. Also included are links to the department of Health and Human Services, which might be useful for health references or data and links to information about public transportation, which might include some information concerning emissions.

"2001 Annual Report on Air Quality in New England" n.d.
http://www.epa.gov/region1/oeme/Annual_Report_2001.pdf (27 Jan 2003)
This webpage is found through the EPA website and the New England Regional EPA. It contains the air quality studies performed in New England in 2001. Included are national air quality standards, ambient air quality data and regional data.

"Massachusetts Department of Environmental Protection" n.d.
http://www.state.ma.us/dep/ (27 Jan 2003)
This website contains links to emissions testing and environmental results programs. Also included is information concerning the specific regions of Massachusetts and the statutes and regulations.

"Department of Transportation" n.d. http://www.dot.com (27 Jan 2003)
This website gives information concerning public transportation and regulations.

U.S. Environmental Protection Agency. United States Government.
Jan. 24th, 2003 www.epa.gov

This is the Official Website for the Environmental Protection Agency (EPA). There is information on here regarding EPA Policy and the History of the EPA

Fleming, Peyton. "EPA targets Chelsea and East Boston for Environmental and Health Risk Study", March 4, 1999; Release # 99-3-6 http://www.epa.gov/region01/pr/1999/030599.html

This article discusses the EPA's commitment to Work with Chelsea, MA to increase Environment Awareness through a risk assessment plan. It gives a good background for this years project.

Magee Scientific Company. "Magee Scientific Company: The Aethalometer". http://www.mageesci.com

This is the website for a company that manufactures the aethalometer. On this website there is an instruction manual, a list of possible uses for this technology and Data Chart Templates. I'm not sure if this is the model that we will be using but it can still give us a basic knowledge of what the device we will be using can do.

Bongiovanni, Roseann. "Chelsea Green Space and Recreation Committee". http://www.chelseacollab.org/greenspace/

The Official Website for the Chelsea Green Space and Recreation Committee. This website will give some history into the formation of one of our sponsors. It also contains information about the mission statement and past work that the committee has done.

Brilon, Werner. Traffic and mobility: simulation, economics, environment. New York: Springer, 1999.

This book has some very interesting general information about what is being done in to help reduce traffic emissions by altering traffic flow. This information includes: analysis of traffic flow, traffic flow modeling, fuel consumption and emissions, modeling of regional and local air pollution based on dynamical simulation of traffic, interaction of traffic and other anthropogenic emissions in polluted regions and their environment, and an assessment of traffic impacts in urban areas based on dynamic traffic simulation. All of this information would be extremely helpful to our project.

Harmon, Daniel E. The Environmental Protection Agency. Philadelphia: Chelsea House Publishers, 2002.

This book includes general information about the EPA including its history, purpose, and operations. This would be helpful in educating us as to how the EPA actually works and where they came from.

Irwing, John S. A historical look at the development of regulatory air quality models for the United States Environmental Protection Agency. Silver Spring, Md.: U.S. Department of Commerce, 2002.
This book includes information about air quality models that have been produced by the EPA and the evolution of those models. It will not only give us helpful information about the trends of air quality in the United States over the past couple years, but will also show us the most efficient way of modeling air quality data.

Kim, Michael W. Analysis of EPA's recent settlement with diesel engine manufacturers regarding disagreement over emissions standards compliance. Boston: MIT, 1999.
This is a document written by a student at MIT and would be extremely helpful since it concerns the reactions of the diesel engine manufacturers to an enforcement of specific emissions standards. One of the results of our project may be indirectly to change the emissions standards in the Chelsea Creek area, and it is pertinent to know how the community will react, specifically diesel truck drivers and manufacturers.

"City of Chelsea, MA" .n.d <http://www.ci.chelsea.ma.us/> (27 Jan 2003).
This is the official governmental website for Chelsea, MA and would provide us with general information about the Chelsea area.

Pearson, John K. Improving Air Quality: Progress and Challenges for the Auto Industry. Warrendale: SAE Inc., 2001.
This book describes in detail the present state of knowledge regarding the nature of air pollution. It describes in detail the ways in which the automobile industry can be changed to improve the environment. This reference provides important information on particulate pollution.

Bretschneider, B. and J. Kurfurst. Air Pollution Control Technology. Oxford: Elsevier, 1987.
This book deals with the sources of air pollution, their effects on the environment and methods to limit it. It can provide us with ways to potentially reduce air pollutants.

Devinny, Joseph S. Biofiltration for Air Pollution Control. Boca Raton: CRC Press, 1999.
This book describes the method of biofiltration for cleaning the atmosphere. It describes a relatively inexpensive way to effectively control air pollution. This method of pollution control could prove to be useful for our project.

"Clean Air World" STAPPA/ALAPCO .n.d <http://www.cleanairworld.org> (25 Jan 2003).
This is a website provided by STAPPA and ALAPCO, two national associations for the control of air pollution. This site is useful because the site provides easy access to air quality issues around the world.

"Natural Resources Defense Council" NRDC .n.d <http://www.nrdc.org> (25 Jan 2003).
This is the official website of the National Resources Defense Council. This site provides a large amount of information regarding the topic of particulate air pollution and its sources. This information would be important for our project.

APPENDIX B CHELSEA CREEK COMMUNITY BASED COMPARATIVE RISK ASSESSMENT

CHELSEA COMMUNITY BASED COMPARATIVE RISK ASSESSMENT INTRODUCTION

The communities of Chelsea and East Boston are joined by the Chelsea River (the Creek), a body of water that flows through the Mystic River Watershed and into the Boston Inner Harbor. The Creek is a "Designated Port Area", which requires that development along the Creek be reserved for marine industrial uses. The designation does not generally allow for public access or recreational use of any waterfront area. Instead, the Creek is host to industry, parking lots, a multi-ton salt pile, and fuel storage for industrial and commercial enterprises. Over time, these uses have given rise to numerous 21E hazardous waste sites along the Creek as well as abandoned or contaminated properties.

Local residents are aware of the environmental problems facing them each day, but do not have easy access to the scientific information or data that is necessary to validate their concerns to the local, state, and federal agencies responsible for addressing these problems. Two community organizations, Chelsea Green Space and Recreation Committee and Neighborhood of Affordable Housing, came together in 1997 as the Chelsea Creek Action Group to specifically address environmental issues related to the Creek. The Chelsea Creek Community Based Comparative Risk Assessment (CRA) was a two-year effort funded by US Environmental Protection Agency and the Greater Boston Urban Resources Partnership to involve and inform residents about environmental issues, gather and analyze available data on community-selected issues, and determine action steps to address some of the problems.

A Unique Approach to Understanding Community Risks

Risk Assessment is a tool created to compare and rank environmental problems based on the potential for environmental and public health impacts. Traditionally, risk assessments draw together a number of experts in fields such as toxicology, economics, and natural resources. These experts are expected to use "pure science" to assess the risk to public health from contaminants, and identify appropriate resource investment or mitigation measures. This approach does not generally allow for public participation or input into the process.

The Chelsea Creek Community-Based Comparative Risk Assessment (Chelsea Creek CRA) was intended to focus the limited amount of time and resources to address community priorities and concerns. The goal was to take the best part of a traditional risk assessment (gathering & analyzing existing data on environmental problems) and add a new component into the process – community involvement. Instead of only being informed of the end results of a project, residents would take center stage to select the issues to be addressed through the Chelsea Creek CRA. Residents would have a seat at the table and be involved in making decisions throughout the project. Another innovation for the Chelsea Creek CRA was to focus on identifying action steps that individuals, community groups, and government could work on to address existing problems. The result of this new approach was to create an information tool for Chelsea and East Boston communities to validate concerns, dispel misperceptions, understand the problems, and help guide the investment of their time to gain maximum benefit and results.

The Chelsea Creek CRA Process

In the first stage of the project, a Coordinating Committee was established to help design a workplan to guide the two-year process. Members of the Coordinating Committee included representatives from Chelsea Greenspace and Recreation Committee, Neighborhood of Affordable Housing, US EPA New England's Urban Environmental Program (UEP), and the Greater Boston Urban Resources Partnership. The workplan identified the following tasks for the project:

· Organize a process, leadership structure, and timeline for the Chelsea Creek CRA.
· To brainstorm, identify and prioritize environmental, health, and quality of life (social) issues that may be addressed by this project, begin establishing the structure of advisory committees and begin articulating criteria to evaluate risks.
· To narrow down and finalize the list of issues to be analyzed using preliminary screening criteria.
· To gather available data from multiple sources on each of the issues identified, analyze data, prioritize concerns, and identify format for chapter reports.
· To develop strategies and action steps to manage and minimize the risks identified and prioritized in earlier phases.
· To publicize the report results and appropriate action steps identified, generate public interest and input into the plan, and generate appropriate government support for action steps.

CCAG staff and volunteers engaged local residents to help identify key environment, public health and social issues that were important to residents for the project. 325 people (165 Chelsea residents, 154 East Boston residents, 6 did not specify) were interviewed or surveyed. The survey and questionnaire were not designed to collect demographic information about the respondents, however, 119 of the respondents (37%) either completed a survey in Spanish or otherwise identified themselves as primarily Spanish speaking. Once the survey was complete, the results were compiled into a report, and the results were publicized through two public meetings in December 2000. During those meetings, participating residents identified the following key topics of concern:

ENVIRONMENTAL ISSUES

PUBLIC HEALTH ISSUES

SOCIAL ISSUES

Open space
Lack of trees
Condor Street
Air pollution
Water quality
Trash
Not enough trash cans
Dirty streets
Odor
Indoor air quality (Massport soundproofed homes)
Salt pile
Oil tanks
Creek link to airport
Heavy ship and oil traffic
Environmental injustice
Airport (pollution and noise)
Brook & Havre Street restaurant lot (pollution & noise)

Auto body shops - black smoke and spray painting on Condor Street (illegal parking)

Asthma
Respiratory problems
Cancer

Rodents
Drinking water quality
Headaches
Miscarriages
Animal waste

Traffic
Too many trucks
Rude drivers
Noise
Parking
Violence
Gangs
Gangs closely related to drugs
Kids out late
Drugs
Lack of respect for people & property
Police (not there when needed)
Spitting
Housing - affordability, Availability
Families are leaving
Hunger
Pot holes/bad streets
Blight
Graffiti and vandalism
Lack of accountability
Inequality
Chelsea as sacrifice area
Cultural differences compared to others

In January 2001 the Coordinating Committee formed the two leadership committees that would work together to gather information and analyze results – the Resident Advisory Committee (RAC) and the Technical Advisory Committee (TAC).

The RAC was made up of volunteer residents from East Boston and Chelsea, the head of the TAC (EPA New England), and a coordinator from Neighborhood of Affordable Housing who led the meetings. This committee met approximately every six weeks for over a year, and played a leadership role in guiding and focusing research on the six issues, as well as reviewing chapters of the report. The RAC reviewed the list of issues generated through the surveys and public meetings and decided to create a set of criteria to determine which issues to focus on for the Chelsea Creek CRA. The criteria used to select the final issues were:

- Issues must be "visible", a problem that residents can see, instead of a lack of something
- Issues must be equally pertinent to East Boston and Chelsea residents
- Issues must represent a community concern; frequency of times an issue was mentioned by people surveyed is important
- Issues should capture many impacts/players – an "umbrella" issue
- Should be an issue that needs research
- Report should not focus on Logan Airport, but other issues that may pose serious public health and environmental risk
- Group must have some level of control to affect change on the issue

The RAC reviewed all of the issues, discussed how they each related to the criteria, and voted to concentrate on the following issues for the report:

Environmental Issues

Public Health Issues

Social Issue

Ambient Air Quality
Water Quality (in the creek)
Open & Green Space

Asthma/Respiratory Disease
Noise

Traffic

In addition to addressing the six priority issues, the RAC members were interested in having one outcome of the project be a "resource guide" to provide residents information on critical stakeholders on issues of concern. The resource guide includes information on property ownership along the Creek, as well as information on State, City, and Federal programs and contacts and was developed by the RAC during this project.
The TAC included members from academia, non-profits organizations, state and federal agencies, local government, and health professionals, as well as the head of the RAC. Members provided technical assistance, information, and data on the targeted issues identified by the communities of Chelsea and East Boston (i.e. urban rivers, noise impacts, air quality). Each member of the technical committee served as a liaison to the resources and information is his or her organization and helped create and finalize chapters on each target issue. The TAC met on a monthly basis for over a year.

One of the many joint decisions that the committees had to make was to determine a format for presenting the data collected during the project. The groups decided on the following elements for each chapter:

1. Overview of issue (what the issue is, regulations, standards, etc)
2. Review of existing Chelsea and East Boston specific data related to the issue

3. Brief analysis of existing data and potential concerns to public health and the environment
1.
4. GIS maps of available data and information for Chelsea and East Boston
5. Current projects or activities in Chelsea and East Boston related to the issue
6. Greatest areas of concern for Chelsea and East Boston residents related to the issue
7. Opportunities to address the problems of greatest concerns
8. Contact List

After the chapters were drafted, the RAC and TAC had several opportunities to edit and revise each chapter. The chapters greatly benefitted from input from this team approach to writing, and resulted in a product that many had a hand in producing and are ready to put to use in future projects. In order to stay in contact with a larger group of residents to inform and engage them on the findings from the report, a series of information presentations were given at meetings or local community groups including CCAG, non-profit organizations, and churches. A final launch of the report findings is planned for Fall/Winter 2002, and meetings will be scheduled with local, state and federal agencies to share findings and seek their commitment to help implement target action steps. The report will be made available on the Internet, in hardcopy at public libraries in East Boston and Chelsea, and at the offices of Neighborhood of Affordable Housing and the Chelsea Human Services Collaborative.

CHELSEA CREEK COMMUNITY BASED COMPARATIVE RISK ASSESSMENT
CHAPTER 5: TRAFFIC

1. Overview of Traffic in the Chelsea Creek Community

Traffic is a concern to every community. Traffic poses risks of injury to pedestrians and children playing near the street plays an integral role in the public and environmental health of a community. Both Chelsea and East Boston are densely populated communities located adjacent to several major roadways serving the City of Boston, including Routes 1, 1A and 16. Chelsea and East Boston are also home and adjacent to many industries that use trucks to transport their goods. As a result, there are a large number of trucks that pass through these communities on a daily basis.

There are many public and environmental health concerns related to traffic. Vehicle exhaust, fumes from gas stations and fuel storage, tire dust, and evaporating paints from auto body shops contribute to air pollution, affecting human health1 (for more on Air Quality and Noise, see Chapters 2 and 6). The water quality of local rivers like the Chelsea Creek is also affected by transportation. Cars and other vehicles release metals such as cadmium, chromium, copper, lead, and mercury as a result of tire and brake wear, as well as through the exhaust pipe. These metals settle on the ground and are washed by rain into rivers. Water also becomes polluted as a result of improperly disposed of motor oil. In addition, it is estimated that 250 million gallons of oil leak from motor vehicles each year. Oil and road salt that are deposited on roadways also wash into water bodies such as the Creek. In addition to the air and water quality issues surrounding transportation, heavy traffic has been found to lower property values, undermine the cohesiveness of a community, increase crime, and cause noise pollution.

Even though there are many environmental and public health problems associated with traffic, there is no one agency that regulates traffic and its effects. The Federal EPA establishes water and air quality standards that relate to traffic such as the Non-point Source Management Program and vehicle emission standards, and the Massachusetts Department of Environmental Protection (DEP) implements these regulations. Roadways are also regulated by more than one governmental body. Jurisdiction of roadways fall under Federal, State, or local regulations, and under policies of independent authorities. Some of the highways are controlled by the Massachusetts Highway Department (MHD), and others by the Massachusetts Turnpike Authority (MTA) and the Metropolitan District Commission (MDC). Local governments also have the power to impose truck exclusions under Chapter 85 of the Massachusetts General Laws. Given this complexity of oversight, it can be difficult for a community to get information on the regulatory process let along alone change traffic patterns and use of a particular roadway.

2. Review of Existing Chelsea and East Boston Traffic Information

There is little data on traffic within the communities of Chelsea and East Boston, and the research that exists has been conducted as part of a more comprehensive study of the greater metropolitan area. Much of the research has focused on trucks most likely due to the size and weight of trucks and the potential for trucks to impact road conditions and air quality. Many of the residents surveyed as part of the Comparative Risk Assessment specifically mentioned trucks as a traffic concern. Specific available data, gathered by the Central Transportation Planning Staff (CTPS), includes the following:2

· 775 trucks use the Carter Street exit (Chelsea) off of Route 1 daily
· 67 of these trucks are classified "hazardous," 8.6% of the total number of trucks exiting on a daily basis
· The Tobin Bridge carries over 5,000 trucks daily

In addition to the data above, research has been done by the CTPS on the number of daily truck trips within Chelsea and East Boston. The data is not broken down into types of trucks, nor is truck density within these communities addressed.

Average daily vehicle counts are also available for specific intersections and roadways. The Massachusetts Highway Department publishes Massachusetts Traffic Volume Counts each year for different intersections. The data from Chelsea and East Boston is listed below in Table 1.

Table 1 Average Daily Traffic Counts for Chelsea and East Boston

1995

1996

1997

1998

1999

2000

Chelsea

Beacon Street Under Route 1

1100

1500

Eastern Ave., North of Griffin Way

17,500

East Boston

Chelsea St. Bridge

21,800

Meridian Street Bridge

24,900

Route 1A at Ramp to Logan Airport

31,600

Route 1A, Callahan Tunnel Outbound

49,567

36,494

Route 1A, Sumner Tunnel Inbound

47,093

44,414

41,518

37,392

35,119

Saratoga Street, West of Boardman Street

7,500

8,100

Massachusetts Highway Department, Massachusetts Traffic Counts

Community members have also done some traffic counts along major truck routes. The Chelsea Green Space and Recreation Committee Youth Environmental Crew counted cars, diesel trucks, buses, and other vehicles at the heavily trafficked intersection of Marginal Street and Williams Street. The study covered two two-hour periods during the work day; an average of 3400 vehicles, 285 of which were trucks, entered the intersection during each 2 hours period.

While all traffic is a priority issue to residents, truck traffic in residential areas is of particular concern. Chapter 85 of the Massachusetts General Laws grants municipalities in Massachusetts the power to exclude trucks from a section of roadways. All truck exclusions within Massachusetts must include the following characteristics:3

- The excluded roadway must be owned by the municipality
- The size of the truck to be excluded must be specified, usually greater then 2.5 tons carrying capacity
- The time period during which the exclusion is in force is specified
- Only through traffic is excluded; local access is allowed
- MHD must grant a permit before any "No Trucks" signs are posted

All truck exclusions must be approved by the MHD. A municipality interested in changing the status of a roadway to exclude trucks, must submit a proposal to the MHD. The proposal must include significant analysis supporting its application and show that "a suitable alternate route is available."4 There are a number of truck exclusions in place within both Chelsea and East Boston. These exclusions are outlined in Table 2. All truck exclusions listed are in effect 24 hours a day.

Table 2 Truck Exclusions in Chelsea and East Boston

Municipality	Permit Number	Exclusion Street Name	From	To	Alternate Route
Chelsea	E-B-057-6040	Broadway	Crescent Ave.	Eastern Ave.	Truck route established by city
	E-B-057-6040	Broadway	Gerrish Ave.	Williams St.	Truck route established by city
	E-B-057-6040	Chestnut St.	Williams St.	Everett Ave.	Truck route established by city

E-B-057-6040

Cross St.

Broadway

Park St.

Truck route established by city

E-B-057-6040

Everett Ave.

Tobin Bridge On-Ramp

Broadway

Truck route established by city

E-B-057-6040

Library St.

Highland St.

Broadway

Truck route established by city

E-B-057-6040

Nichols St.

Eustis St.

Everett city line

Truck route established by city

E-B-057-6040

Park St.

Williams St.

Central Ave.

Truck route established by city

E-B-057-6040

Pearl St.

Williams St.

Park St.

Truck route established by city

E-B-057-6040

Second St.

Arlington St. Extension at NE X-Way

Park St.

Truck route established by city

E-B-057-6040

Spencer Ave.

Cary Ave.

Eastern Ave.

Truck route established by city

E-B-057-6040

Stockton St.

Eastern Ave.

Parkway Plaza

Truck route established by city

E-B-057-6040

Webster Ave.

Tobin Bridge Off-Ramp

Eastern Ave.

Truck route established by city

E-B-058-7019 A

Tremont St.

Medford St.

Williams St.

Broadway, Williams St., Winnisimmet St.

E-B-058-7019 A

Medford St.

Broadway

Tremont St.

Broadway, Williams St., Winnisimmet St.

E-B-058-7019 A

Beacon St.

Broadway

Winnisimmet St.

Broadway, Williams St., Winnisimmet St.

E-B-058-7019 B

Beacon St.

Broadway

Chestnut St.

Broadway, Williams St., Chestnut St.

East Boston

13129

Maverick St.

Chelsea St.

Airport Rd.

3. Analysis of Existing Traffic Data

The data that are available for Chelsea and East Boston do not fully portray the impacts on air quality, noise, and road congestion that traffic imposes on the community. Traffic counts do not reflect the impact of air quality of vehicles idling in traffic jams or along curbs. Road congestion increases the number of vehicles standing idling. Idling by trucks, buses, and cars as they wait to load or unload passengers or cargo also represents a source of air pollutants. Unless a vehicle requires engine power to be maintained, idling for more than five minutes is against Massachusetts state law (Massachusetts General Law Chapter 90, Section 16A). Data on the prevalence of idling vehicles is not available.

While a survey of road signs revealed that most of the truck exclusion routes are marked with a sign indicating limits on vehicle size, exclusions may not be strictly enforced. Compliance with local truck exclusions is the jurisdiction of the City Police. In addition, the establishment of truck exclusions concentrates truck traffic on other streets. A comprehensive truck route evaluation should be conducted in order to determine if truck patterns should be further altered.

Although truck traffic has particular impacts on the communities of Chelsea and East Boston, non-truck traffic affects the community as well. Chelsea has one of the highest car insurance rates in the state of Massachusetts. The number of traffic accidents in the community has been sited as a reason for this. However, there has not been a study to determine how many of the accidents involve drivers from outside of Chelsea. A survey of police accident reports would serve to determine the percent of accidents that involve residents. Further, a traffic study would serve to determine the percentage of truck and non-truck traffic within Chelsea and East Boston.

Chelsea is located just a few miles from the city of Boston, yet the commute for some residents can take as long as 2 hour, and can involve two or three transfers.5 This is due to a lack of comprehensive public transportation. In 1995, the cities of Boston, Chelsea, Everett, Somerville, Cambridge, and Brookline signed a compact in which each of these cities “commit to identify economic development, social services, retail, educational, residential and parkland projects to be integrated with the MBTA’s circumferential transit project and to incorporate both the transit elements and other projects into each municipalities’ General Plan.”[6] The Circumferential Ring Regional Planning Compact hinges on the development of a 14 mile circular transit corridor which would connect the “spokes of Boston’s downtown-centered transit system.” Although the proposed Urban Ring would carry as many passengers as the orange and red lines, there has not been any move to begin this project.

4. Potential Concerns for Public Health and the Environment

Air

Vehicles emit a number of pollutants which negatively impact public health. Table 3 lists some of the pollutants emitted by vehicles, and the potential health implications of these pollutants.

Table 3 - Potential Health Implications of Vehicle Emissions

Pollutant	Potential Health Implication
Hydrocarbons	React with nitrogen oxides and sunlight to form ground-level ozone. Ozone irritates the eyes, damages the lungs and aggravates respiratory problems. A number of exhaust hydrocarbons are toxic, and have the potential to cause cancer.
Particulate Matter (PM2.5)	Very small particles can be inhaled into the lower respiratory system. PM2.5 can cause asthma and other respiratory problems. PM2.5 has also been linked to heart attacks and lung cancer.
Carbon Monoxide	Reduces the flow of oxygen to the bloodstream. In urban areas where carbon monoxide is more concentrated, the central nervous system and heart are affected. Symptoms include headache, fatigue, and dizziness.
Carbon Dioxide	Does not directly impair human health, but it is a greenhouse gas and thus contributes to the potential for global warming

A link has been established between pollutants produced by traffic and increased asthma incidence. Researchers have found that as levels of certain air pollutants increase, the number of asthma-related hospital admissions also rises. For example, a study in Birmingham UK showed that children with diagnosed asthma were more likely to live within 500 meters of a main road than children admitted for non-respiratory reasons, or children chosen at random from the community. This conclusion is further demonstrated by a study of paved road dust conducted by members of the Environmental Engineering Science Department of the California Institute of Technology. In the study more than 30 different biologic source materials were found in paved road dust. Among the materials identified were: pollen, pollen fragments, animal dander, mold, exhaust particulates, tire dust, brake lining wear dust and plant fragments. These materials are known to exacerbate allergenic disease in humans. Most significantly, the study found that when paved road dust is re-suspended into the atmosphere by passing vehicle traffic, allergen concentrations in the air are increased above the levels that would occur without the vehicle traffic.7

A study of childhood asthma attacks during the 1996 Summer Olympics in Atlanta supported these findings. During the Olympic Games, traffic count dropped considerably because of efforts to discourage residents from driving into the city. The reduction in traffic corresponded to improved air quality and a 42 percent reduction in medical visits for asthma attacks (Friedman, et al., 2001).

In addition to triggering asthma attacks, air pollutants such as ozone may also cause asthma in exercising children (McConnell, et al., 2002). This is of particular concern since many of the parks in Chelsea and East Boston are located close to major roadways (see Chapters 3 and 4).

An analysis of nationwide emissions has shown that vehicular emissions account for more than 50 percent of all hazardous air pollutants (HAPs) released to the atmosphere. The impact of traffic on air quality is directly linked to the number of vehicle miles driven, and therefore, community planning and development to encourage other modes of transportation should be implemented to reduce traffic and vehicular emissions. For more information on the links between traffic, air quality, and asthma, see Chapters 2 and 5.

Noise

Residents of Chelsea and East Boston have expressed concern over noise and vibrations generated by traffic, specifically truck traffic, through their communities. Parameters that contribute to traffic noise and vibrations include: pavement surface roughness, vehicle weight, vehicle speed, and the vehicle suspension system.8 Another source of noise related to traffic is Jake brakes. Jake brakes are engine compression brakes that are used by truckers on steep grades and when a trucker wishes to save wear and tear on a truck's normal brakes. It is possible to ban the use of Jake brakes if it can be shown that they are not necessary in the specified area.9 More information on noise is included in Chapter 6.

Diesel Exhaust

Although diesel engines use less fuel per mile traveled than gasoline engines, diesel burning vehicles produce some of the emissions with the highest impact on health. Diesel produces a large quantity of nitrogen oxides (NOx) which contributes to the formation of ozone (O3) smog. Diesel also produces particulate matter (PM) consisting of small particles (less than 2.5 microns in diameter). These particles are the most harmful type of particulate matter because they can be inhaled more deeply into the respiratory system.10 Diesel is used extensively by trucks, buses, construction equipment, and by some trains.

Small particulate matter produced by diesel combustion has been linked to heart attacks and asthma, and there is increasing evidence that diesel exhaust or diesel particulate matter may cause lung cancer in humans. Non-cancerous effects such as lung damage and respiratory problems are also associated with exposure to diesel exhaust.11

Traffic Injuries

Over recent years there have been several accidents involving trucks exiting too quickly off the Tobin Bridge and crashing into the homes of Chelsea residents. In June of 2000, a truck careened off the Tobin Bridge and crushed a car on Chestnut Street. The woman driving the car was killed. In May, 2001, a truck exiting from Route 1 beyond the Tobin Bridge lost control and crashed into a home, injuring three residents. These incidents have highlighted the concerns of the residents about traffic safety and trucks in residential neighborhoods.

5. GIS Maps of Available Traffic Data and Information

The attached map shows the primary routes through and around Chelsea and East Boston. The roads shown in green are part of the National Highway System (NHS), meaning that federal funds may be used for road maintenance. Some of these routes are owned by the state, others are locally owned but have a state route number, and others are owned by the MDC. Routes within the NHS generally cannot have truck exclusions, and parkways with existing truck exclusions (such as Storrow Drive) which were included in the NHS had to have alternative truck routes designated.

The map also shows local roads through Chelsea and East Boston where truck exclusions are already in place. As shown in pink, there are numerous exclusions in Chelsea, which concentrates truck traffic on Marginal Street.

There is not enough traffic count data to produce a map showing the areas that might be impacted most by traffic, but the map produced for noise impacts (See Chapter 6) shows the locations of industrial and commercial enterprises which might contribute to heavy traffic flow. Residential areas which are likely to be the most impacted by noise and traffic are also shown on this map.

6. Current Traffic Projects or Activities in Chelsea and East Boston

Chelsea and East Boston residents have long worked to improve traffic conditions in the community as they relate to traffic injuries, air quality, traffic congestion, and parking. The Chelsea Green Space and Recreation Committee conducted traffic surveys over a two-day period at the Marginal Street and Williams Street intersection, and individual residents have done traffic counts near their homes to assess the impact of trucks and other vehicles. A broader effort to study traffic in the Chelsea Creek community could be built on these efforts.

Chelsea residents have been working on two traffic related projects: closing and rerouting of trucks from the Beacon Street off-ramp and the implementation of resident-only parking restrictions near the court house. The Beacon Street off-ramp is now closed to all trucks over eight tons. Signs and other means of diverting trucks have been installed.

7. Greatest Traffic Concerns for Residents

Many of the residents surveyed listed truck traffic as a primary concern both because of air quality impacts and because of safety concerns for drivers, pedestrians, and residents. The routing of trucks through residential neighborhoods is of particular concern because of the noise created by trucks and because it puts residents in close proximity with the effects of truck traffic.

Other vehicular traffic including passenger cars, buses, barges, and construction equipment are also a concern because of their contributions to air pollution, congestion, and traffic injuries. Limited access to public transportation and city planning that encourages car-dependency are two longer-term issues that should be addressed in order to reduce vehicular traffic through the community.

8. Recommendations to Address the Greatest Traffic Problems

The highest priorities for Chelsea Creek residents fall into two categories: efforts to mitigate the effects of truck traffic and longer-term traffic planning work.

Community Actions

· Work with the Cities of Chelsea and Boston to improve signage throughout the community. Truck exclusion routes should be checked to see if they are marked, and missing signs should be noted and reported.
· Distribute truck exclusion map to local trucking companies
· Distribute anti-idling information to buses, trucks, and cars and work with local police to increase enforcement of anti-idling laws.
· Conduct vehicle counts at more intersections using standardized methodology

Longer-Term Priorities

· Work with U.S. EPA, truck companies, and Massachusetts Port Authority to encourage the use of low-sulfur diesel in trucks and buses. Prioritize industries related to airport services and buses.
· Work with neighboring communities to conduct traffic and truck route planning.The impacts of increased parking capacity and new construction should also be included
· Work to improve public transportation to East Boston and Chelsea. Evaluate ridership and MBTA investment and the feasibility of light rail.
· Establish alternative transportation methods such as bike and walking lanes and carpooling.
· Review traffic accident data (police reports, 911 calls) to determine the percentage of traffic accidents that involve out-of-town drivers, and the percentage that involve drivers from Chelsea and East Boston.
· Urge the Cities of Chelsea and Boston to conduct a study to examine the impacts of airport and airport related traffic on the region

Personal Choices

· Limit vehicle use by using public transportation or carpooling.
· Choose a high fuel efficiency car

21. Contact List

The following is a list of government agencies and community organizations which are involved in transportation planning and traffic issues.

Boston Metropolitan Planning Organization (617) 973-7100
www.ctps.org/bostonmpo

Central Transportation Planning Staff, Bill Kuttner (617) 973-7132
www.ctps.org

Massport Community Affairs Office, Dorothy Steele (617) 568-3705

Publications:

Brugge, Doug, Zenobia Lai, Christina Hill, William Rand. Traffic Injury Data, Policy and Public Health: Lessons from Boston Chinatown. 2001 (Draft Publication)

Conservation Law Foundation. Take Back Your Streets: How to Protect Communities from Asphalt and Traffic. CLF, January 1998.

Conservation Law Foundation. City Routes, City Rights: Building Livable Neighborhoods and Environmental Justice by Fixing Transportation. CLF, June 1998.

Friedman, Michael S., Kenneth E. Powell, Lori Hutwagner, LeRoy M. Graham, W. Gerald Teague. Impact of chnges in transportation and commuting behaviors during the 1996 summer Olympic games in Atlanta on air quality and childhood asthma. JAMA. Vol 285(7). February 21, 2001.

McConnell, Rob, Kiros Berhane, Frank Gilliand, Stephanie J. London, Talat Islam, W. James Gauderman, Edward Avol, Helene G. Margolis, John M. Peters. Asthma in exercising children exposed to ozone: a cohort study. The Lancet. Vol 359. February 2, 2002.
1City Routes, City Rights: Building Livable Neighborhoods and Environmental Justice by Fixing Transportation. Conservation Law Foundation. June 1998, page 13.
2Ibid, 40
3Ibid, 25
4Ibid, 26
5Conservation Law Foundation: Where is the Urban Ring? http://clf.org/advocay/urban1.htm
6Ibid
7Miguel, Ann et. al. "Allergens in Paved Road Dust and Airborne Particles." Environmental Science Technology. 33 (23), 4159-4168, 1999
8Ibid, 88
9Ibid
10City Routes, City Rights: Building Livable Neighborhoods and Environmental Justice by Fixing Transportation. Conservation Law Foundation. June 1998, page 56
11Ibid

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. Overview of Ambient Air Quality in the Chelsea Creek Community

Ambient air quality, or the quality of air outdoors, is a concern in every community , especially urban communities that have a hi gh concentrati on of industri es and traffic. Poor ambient air quality can cause short-term and long-term health problems. Air pollution in urban ar eas consists of a number of chemical com pounds that are emitted by a variety of sources. In 1970, the U.S. Congress enacted the Clean Air A ct to address many of the problems caused by ai r pollution. Al though there has been much improvement in over all ai r quality, air pollution continues to cause health problems in urban areas. Air pollution is difficult to monitor because i t does not stay in one place. Depending on weather conditions, including wi nd patter ns, temper ature, and humidity , and th e characteri stics of the parti cular pollut ants, air pol luti on can travel for many mil es, affecting air quality far from the pol lution source. For example, coal-burning power plants in the mid West contribute to acid rain in New England, and many of the pollut ants affecting air quality in C helsea and East Boston origi nate in other areas. In the same way , pollu tion generat ed in C helsea and East Boston migrates to neighbor ing communi ties, and pollutan ts generated in Revere, Everett , and Low ell affect the Ch elsea Cr eek neighborhood. Sour ces located wi thin C helsea and East Boston are discussed throughout this chapter since the Chelsea Creek communities are the focus of this project.

Chelsea an d East Boston have many differen t sour ces of ambient ai r pol lut ion. C helsea C reek is a hi ghly industrial area w ith many oil tank farms and acti ve facil iti es which em it or release a range of poll utants to the atmosphere. L ogan A ir por t is a major sour ce of n itrous oxides, benzene, and other products of fuel combustion such as formaldehyde and particulate matter. Although air traffic contributes heavily to air pollution in the Chelsea Creek community , this project does not specifically address the impacts of the airport. There are other community groups whose focus is the airport, and it was determined that this project would examine other sources of air pol lution. H owever , some considerati on of ai rport r elated impacts is inevitable. For example, much of the ground traffic through the community is related to the airport. Traffic is discussed in more detail i n C hapter 5.

Ther e is a lar ge range of health impacts related to air qu al ity . Pollutants may cause al ler gy -like symptoms such as eye, nose, and throat irritation or trigger asthma attacks. Exposure to parti culates in the air may increase sensitiv ity to other aller gens. Over tim e, exposure to air pollut ion can also cause damage to the neurol ogical, r eproductive, and respirator y systems of the body and lower immuni ty to other diseases. Many air toxics are also know n or suspected carci nogens, or cancer causing agen ts (EPA, 1991).

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Ai r qual ity is regul ated on both the federal and State level. Th e federal EPA establi shes air quality requir ements throu gh the C lean A ir A ct, and the M assachusetts Department of Environmental Protection (MA DEP) conducts on-going monitoring, issues permits, and develops regulations to cont rol emissions and meet t hese standards. L ik e all states, the MA DEP must also w rite “State Implementat ion Plan s” (SIPs) to dem onstr ate how they will meet the goals of the Clean Ai r Act. T hese SIPs must be reviewed and approved by the EPA.

The Nat ional A mbient A ir Quality Standards (NAAQS) ar e health-based limits for cr iter ia poll utan ts, common air poll utan ts that are present in m ost communit ies. T hese include: carbon monoxide (C O), nitrogen diox ide (NO2), sulfur di oxide (SO2), ozone (O 3), lead (Pb), and part iculate matt er (parti cles) wit h a diam eter less than 10 m icrons, PM10 (a hum an hair is about 70 mi crons in di ameter). N ew regulations to monit or an d redu ce the l evels of much smaller part icles, PM2.5, will be implemented over th e next few y ears. PM2.5 has been l ink ed to respiratory disease and heart attacks (Buckeridge, et al., 2001, Peters, et al., 2001).

Monitori ng station s around the United States measure these pollutan ts to determ ine air quality on an on-going basis. States that do not comply w ith the federal standards for the cri teria poll utants m ust develop pl ans for improvin g air quality (State Implementation Plans). States m ay work to limit new sources of ai r pol lut ion or r educe exi sting sources by using new and improved technologies such as filters in order to improve air quality.

Another gr oup of air pollu tants is the Hazar dous Ai r Pol lutants (HA Ps), 188 chemicals th at may cause serious health and environmental effects. HA Ps include some w ell-know n poll utan ts such as benzene, which is found in petroleum pr oducts, perch lor oethy lene, product used by some dry cleaners, and dioxi ns, w hich ar e often generated by incinerati on. H APs are regulated by permits issued to large industrial sources and standards for vehicle fuel quality and efficiency. Industrial release of HAPs is regulated under the Federal Clean Air Act and enforced by the MA DEP. All major industrial sources such as chemical manufacturing plants or petrol eum refiner ies are requir ed to comply wi th “maxim um achievable control technology” (MAC T) as established by the EPA. Industries that emi t large amount s (> 25 tons per year total) of pollutants are also required to obtain a Title V air permit and report the volum e of pollut ants released each y ear. Permit holder s pay a per mit fee, and these funds go tow ards ai r pol lut ion contr ol pr ogram s in the state. Some industries that gener ate lower amounts of HAPs are also requ ired to com ply with MACT technol ogy and w ill be r equi red to obtain Title V permits in 2005.

2. Review of Existing Chelsea and East Boston A mbient A ir Q uality Information

Cri ter ia P oll uta nts

The MA DEP has monitored cri teria air pollu tants in Massachusetts commu nities at 56 different locations since 1995. Initial ly , thr ee monitor ing station s were located in East Boston and C helsea. One of the two East Boston m onitors, located on Breman Str eet, i s still in place; this m onitor measures NO2, SO2, CO, and PM. The Chelsea monitor at Powder Horn Hill

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measured NO 2, SO2, and O3 concentrations, and the Vi sconti Street mon itor in East Boston measured C O. Both of these moni tori ng sites were disconti nued in 1999. The historical records from all three monitoring sites show that levels of criteria pollutants other than ozone have consisten tly been within r egulatory limi ts.

Hazardous Air Pollutants (HAPs)

There is limi ted monitori ng of HAPs in the ambient air because of the diffi cul ty and high cost of measurin g the compou nds. Mon itor ing for H AP emissions is conducted by industrial facilities and reported as part of permit requirements. EPA and the DEP also conduct on-site inspections of facilities to ensure compliance with the regulations. The EPA is also working to estim ate pol lut ant concentrations and publi c exposur e using computer models under a National Scale Air Toxics Assessment (NATA) project.

The NATA program combi nes information from the National Toxics Inventory and T oxics Rel ease Inventory databases whi ch tr ack t he emissions of very lar ge industr ial sources, area source data including smaller sources such as gas stations and dry cleaners, vehicular emissions based on traffic volume, and wind patterns to calculate annual average ambient concentrations of some of the most hazardous HAPs. Based on the emissions from industrial sources, the amount of on-road and off-road vehicular miles traveled, and the potential for air toxics to linger in t he atm osphere or travel long di stances, the NATA program models the expect ed ambient air concentrat ions and exposure for 33 of the 188 H APs w hich h ave been identified as public health priorities.

The results provide in formation on the estim ated air quality by County as well as estimates of how much air pollution is contributed by m otor vehicles, industrial sources, and background levels. This information is useful because it indicates where air control measures may have the greatest effect. For exam ple, in New Englan d, it is projected that emi ssions from on-road vehicles account for 55 percent of the ambient benzene. 17 percent is from area sources, and 27 percent is from background sources (Backgroun d concentrations are from naturally occurring sources or are transported over long distance from other locations). Only 1 percent is from poin t source emissions. This breakdow n vari es depending on t he compound of concern.

Estimates of ambient concentrati ons of the 33 HAPs in Suffolk C ounty as calculated by a draft version of NATA are show n in Table 3. Ni ne compounds (benzene, 1,3-but adien e, carbon tetrachlor ide, chloroform, chromium, ethy lene dibromide, eth y lene dichl ori de, formaldehyde, and methyl chloride) have been identified as the toxics of greatest concern in New England because th e ambi ent con centr ations of these pollutan ts are above th e cancer benchmar k concentrations (th e concen tration above w hich excess cancer risk i s a concer n) in all six New England states. Table 3 compares the estimated concentrations of these pollutants to the cancer benchmark values; as shown, the residents of Suffolk C ounty may be subject to unacceptable cancer ri sk from air toxics.

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It should be not ed that cancer benchmarks are only one part of the im pact on public health. There are many other health impl ications w hich are not included in thi s table. For example, the r isks of elevated respiratory, cardiac, and immunological di sease are not i nclu ded in the can cer benchmark. NATA indicates that t he risk of non-cancer health impacts are also hi gh in Su ffolk C ounty . In additi on, th ese risk factors are developed for aver age individuals. The elderly , the very young, or other populations may be more susceptible to the effects of air pollution.

It is estimated, based on modeling results, that about 30 percent of the HAPs come from onroad vehicl es such as cars, truck s, and buses (see Figure 1). An addi tional 20 percent are from non-road vehicles including planes, lawn mow ers, boats, and construction equipment. The impact of vehicle emissions on air quality is significant given the proximity of both communities to several major roadways, Logan Airport, and Chelsea Creek wh ich is an active port. This assessment is based on the average vehicle miles traveled for Suffolk C ounty; it is lik ely that m odeling un derestimates the level of air toxics present in C helsea and East Boston because of the high concentration of vehicular traffic in the area.

3. Analysis of Existing Air Quality Data

There is very little measured air quality data available for specific municipalities, including Chelsea and East Boston. The criteria pollutant monitor in East Boston provides some ongoing m easur e of NO2, SO2, C O, but vol ati le organi c compounds, diesel exhaust, an d tr affic related emissions w hich ar e lik ely to be high are not m easured. It is im portan t to not e that the Chelsea monitor was located in a residential area away from major truck traffic and industrial emissions. W hil e thi s placement al low s the monitors to represent air qual ity over a broader area, it also means that the monitors do not capture the worst air quality conditions from the m ore den sely popul ated and industr ial section of Chelsea al ong the C helsea C reek . Powder H orn Hill is also a hi gh elevati on poi nt w here air disper sion of poll utan ts are l ik ely to be high er than other points in C helsea. Readings from t his mon itor therefore m ay under estimate t he pollutan t concentrations in sur rounding areas.

The Chelsea C reek neighbor hood i s not uniq ue in its l ack of HA Ps data. The model s

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described in thi s chapter are useful for setting pri orities on a State wi de basis, but may not be adequate to describe the air quality im pacts on local communities. The model is designed to identify possible poll uti on impacts throughout t he coun ty and i s used for long-term air toxics planning. Since Chelsea and East Boston have heavily traveled highways, an airport, an active port with dense truck and barge traffic, and numerous industrial sites including petroleum storage tank s, the nati onal scale modelin g data most l ik ely does not repr esent the actual conditions to which residents are exposed.

The modeling data is uncertain at a local level because it is a regional scale effort, intended to provide dat a on r egional trends, and because the inv entor y of sources input in to th e model are incomplete. Each state determines which facili ties the in ventory for th at state will inclu de, and methodologies vary . For example, the petroleum storage tanks located in Chelsea and East Boston ar e not i nclu ded in the 1996 National Toxics Inventory (NT I) data base, bu t fuel storage faciliti es in M aine simi lar to th e tank s located in C helsea an d East Boston ar e incl uded in that state's inventory. M aine reported tank emissions of benzene, ethylbenzene, methyl tert-buty l ether , poly cyclic organic matter, toluene, and xy lenes. A ll of these compounds are considered HAPs and impose public health impacts including cancer risks. Both benzene and poly cyclic organic matter ar e on the list of 33 compounds on wh ich the NATA program is based. Although the EPA an d the MA DEP are continuall y wor ki ng to improve the national toxics inventory of sources, it is very resource and time intensive work. The most recent version of the NTI, based on 1996 data, is available on the web at: http://www.epa.gov/air/data/ntidb.html.

Because ambient air qu ality estimates are only available on a county -wide basis, it is not possible to do a dir ect compari son betw een air qu ality in t he C helsea C reek area an d other communities. How ever, a comparison of Suffolk County with other parts of the state indi cates that Suffolk County is estimated to have consider ably higher concentrat ions of air pollutants than the state overall.

4. Potential Concerns for Public Health and the Environment

Air qual ity is a concern to the r esidents of the Chelsea C reek ar ea because it can cause public health problems. Toxic air pollutants affect the air we breathe, and pollutants may also settle on soil and water and affect r esident s through other routes of exposure. For example, chil dren who crawl on soil or pl ay near the C reek may be exposed t o air poll utan ts. Fi sh and other aquat ic species m ay also be affected by the sett ling of air pol lut ants on the w ater. However, the primary route of exposure is through breathing polluted air. Table 4 shows some of the sources of the cri ter ia pol lutan ts an d the potent ial health effects.

The 33 HAPs that are of greatest concern have a range of health effects. Some of the compounds are known to be cancer-causing. O thers may increase the risk of respiratory or neur ologi cal dam age, and others are "endocri ne disrupt ors", m eaning th at th ey affect
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hormonal sy stems. The ni ne air tox ics of greatest concern to N ew England states are listed on Table 5.

In addition to th e pollu tants of greatest concern , ther e are other chemical releases that are repor ted to the EPA Toxics Release Inventory (TR I) program. Chemicals repor ted to the T RI program by industries in Chelsea and East Boston are incl uded in Table 6. The TRI program requires that certain industries with over 10 employees report chemical releases to the environment. Although the TRI database provides valuable information, it is important to note that not al l in dustri al rel eases are included in this list. It shoul d also be noted th at inclusion on thi s list does not necessaril y mean that the release results in an env ironmental or public health r isk to Chel sea an d East Boston resident s.

5. GIS Maps of Available Air Q uality and Information

The attached map show s some of the lar gest sources of HA Ps in t he C helsea C reek community as well as the m ajor road w ays whi ch border th e neighborhoods. More inform ation on truck an d traffic patterns is avail able in Chapter 5.

6. Curr ent A ir Q uality Projects or A ctivities in Chelsea/East Boston

On a n ational level , the EPA is work ing to improve air qual ity by issuing techn ology standards for both industrial sources and mobile sources of air pollutants. Overall, air quality has impr oved. Since 1988, there has been a 74 percent decrease in air toxics released by l arge industr ies in New England. How ever, since the in dustries located in C helsea and East Boston are not included in this category, this statistic does not necessarily reflect changes in air quality in this community .

There is also a national pr ogram to h elp residents protect th emselves from the health effects of ozone. The Air Quality Index pr ogram rates air qual ity on a scale of hazar dous to good ever y day during the summer w hen ozone levels are hi ghest. The dail y ratin g is reported in newspapers and the radio and is also available on the internet at www.epa.gov/airnow /where. The Index i ncludes gui delines of what acti viti es are safe and if sensitive indi vidual s such as those w ith asthma or respiratory disease should avoid outdoor activities.

New MACT stan dards wi ll be comi ng out in the next few y ears w hich will fur ther reduce emissions from industries. In addition, EPA-New England is working to bring petroleum companies together to review existing technologies and community concerns and determine way s to reduce emissions. The C helsea Cr eek Action Group and the W aterfront A ssociation of Chelsea have also been working to reduce emissions from the fuel storage tanks.
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Table 4 - Sources and Potential Effects of Cr iteria Pollutants

Pollutants	Sources	Po te nt ial Heal th Eff ect s	Who is Most Vul ner able?
Nitro gen Dio xid e (NO_2)	High-temperature combustion, (automo biles and pow er pl ant s)	Lun g and r espirato ry system irritation, lowered resistence to	

infection
Children, people with
resp ir ato ry dise ase
including asthma
Sulfur Dioxi de
(SO2)
C om busti on o f fuel
containing sulfur
(mai nly , coal and o il),
met al smel ting a nd ot her
indu strial p rocesses
Asthma tr igg er, w hee zin g, ch est
tightness, or shortness of breath.
Supp ressed imm une r esponse,
aggravation of existing
cardiovascular
disease
People with
cardiovascular
disease or chronic lung
disease, as well as
children and the elderly
Ozon e (O 3) Formed by a reaction
between volatile organic
compou nds and NO 2 in
the presence of heat and
sunlight
Supp ressed imm une r esponse,
aggravation of pre-existing
respiratory diseases such as
asthma, decreases in lung
function, chest pain and cough.
Prem ature agin g of the lun gs
and/or chronic respiratory
ill nesse s
Out doo r w or k ers,
people with pre-existing
respira tory disease such
as asthma and chronic
obstru ctive lu ng disease
Particulate
Matter (PM)
Fine parti culate (PM 2.5)
is from fuel combustion
(mo tor v ehicles, po wer
generation, i ndustrial
facilities, residential
firepl aces, w ood stoves).
C oarse par ticles
(PM10) are generally
from vehicles traveling
on un pav ed r oad s,

materials handling, and
crushing and
grindin g operation s, as
well as windblown dust.
PM2.5 is associated with
in cre ased h ear t an d lu ng d isease
and aggravation of asthma and
other disease. PM10 is
prim arily associated
with the aggravation of
respiratory condition s, such as
asthma.
Elderly, people with
cardio pulmo nary disease,
such as asthma, and
children
Lead (Pb) Met al processing,
smelters, battery
manufacturing
Neu rological
im pai rm ent s, su ch a s seiz ur es,
mental retardation, and
behavioral disorders
C hild ren
Carbon
Mono xid e (CO)
Fuel combustion, vehicle
exh au st
Reduces oxygen delivery
through body ; lowered agility
and learning ability.
People who suffer from
car dio vasc ul ar d isease
(EPA N ational A ir Q uality : Status and T rends, 1998)
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Table 5 - Air Toxics of Greatest Concern in New England
Pollutants Sources Potential Health Effects
from Long-Term Exposure
Benzene gas stations, auto exhaust,
indu strial sou rces
reproductive, immune, and blood
system disorder s, carcino gen
1,3 Butadiene mot or veh icl es, o il r efin eri es,
chemical manufacturing
cardiovascular disease, probable
carcin ogen
Carbon Tetrachlorine no longer manu factured but still
present in background ambient air
liver , ki dney dam age, decreased
fertilit y , pro bable car cinog en
Chloroform solvent, water chlorination byproduct,
pulp and paper mills

liver and cen tral n ervou s system
disease, pro bable car cinog en
Ch romium industrial processes, coal and oil
burning, catalytic converters and
brak es
pulmo nary disease, skin
sensitivity, gastrointestinal and
im mun e sy stem im pac ts,
carcin ogen
Ethy lene Dibrom ide pesticide, gasolin e additi ve,
indu strial p rocesses
kidn ey, l iver, and testicular
im pacts, pr obab le carcin ogen
Ethy lene Dichloride plastic and v iny l man ufacturi ng,
solvent
liver , ki dney , and imm une sy stem
im pacts, pr obab le carcin ogen
Form aldehyde chemical manufacturing, wood
pr eserv ati on , pl aster , co smeti cs,
pho togra phy suppl ies
probable carcinogen, respiratory
and reproductive effects
Methy l Ch loride wo od, coal, and pl astic
combustion, manufacturing
liv er, k idn ey , an d br ain im pac ts,
possible car cinog en
(EPA N ew Englan d, A ir T oxics of G reatest C oncer n in N ew Englan d. EPA W eb Site)
Chelsea Green Space and Recreation Commi ttee has been working to increase and improve
urban par ks along C helsea C reek . In addi tion to aestheti c considerations, increased green
space has a positive impact on air quality (see Open Space chapter). On-going community
involvement in airport planning has also focused on air quali ty concerns.
The EPA and DEP are w ork ing to improve the NATA models to ensure that they provi de an
accurate picture of air quality conditions in each county. There are also on-going monitoring
efforts to evaluate the model and determ ine if modeling result s over or under estim ate actual
conditions.
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Table 6 - Chemicals Reported to the EPA Toxic Release Invent ory
Air Emissions in C helsea and East Bost on
Pollutants Sources Potential Health Effects from
Long Term Exposure
An timon y com pounds Smel ting, coal fired p ow er
plan ts, pip ing, an d batt eries
Eye, skin, and lung irritation,
stomach pain and ulcers, reproductive
and kidney im pacts
C opper Sm elt in g, ce rt ain fun gici des,
indu stries, sewage
Liver and kidney disease, damage to
blood cells, stomach problems, skin
rash (Cu at low levels is a necessary
micronutrient)
Cy clohexane Industrial solvent Nausea, diz ziness, respi rato ry , ey e,

and skin irritation.
Di(2-ethylhexy l)phthalate Fl exi bl e pl asti c, ch ild ren 's to y s,
tubing, vinyl
Stomach irritation, reproductive and
developmental effects
ethylbenzene Gasoli ne and oth er fuels, carp et
glues, varnishes, and paints
Dizziness, throat and eye irritation,
tightening of the chest, liver and
kid ney damage
Meth y l ter t-but y l eth er (M TB E) Ad ded to gaso line t o pro duce
clea ner bu rn ; ru no ff from ro ads,
vehicl e fum es
Heada che s, n au sea, d izz in ess
n-hexane Industr ial solv ents, gasoli ne,
quick -dry ing glu es
Mu scle weakn ess, temporary paralysis
Naphthalene Fossil fuel or w ood bu rnin g,
cigarette smoke, m othballs
Fat igu e, l ack of ap pet ite , re stle ssness,
pale sk in, n ausea and sto mach
pro blem s
Poly cyclic arom atic compou nds Fuel burning, vehicle exhaust,
asphalt production, gril led food,
cigarette smoke
C ancer
Tert-butyl alcohol Industrial solvent,
manufacturing
Dizz iness, nau sea, skin and ey e
irritation.
1,2,4-trimethylbenzene C om po nen t o f gaso lin e, p ain ts,
cleaners
Headaches, fatigu e, skin , ey e, and
respiratory irritation.
Toluene Fuel processing, vehicle exhaust,
nail poli sh, paint, in dustrial
pro cesses
Fat igu e, co nfu sion , w eak ness,
mem or y loss, diz zin ess
Xy lene Petroleum, vehicle exhaust,
industrial solvents, paint
Headaches, loss of balance and
coordination, eye, skin, and lung
irritation
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7. Greatest Air Quality Concerns for Chelsea and East Boston Residents

The greatest concern regarding air quality is the impact that air toxics may have on the health of the community . Many of the HA Ps of greatest concern in Suffolk C ounty are lik ely to be present in high concentrations in Chelsea and East Boston because of the high traffic volume. However, without air monitoring data, the extent to which the public health risk in the community is elevated and which of the HAPs is of greatest concern is unknown.

Pulm onary diseases i ncl uding asthma, lung cancer, and chr onic obst ru cti ve pulmonary disease

(COPD) are related to air quali ty . For more on respir atory diseases, see Ch apter 4. T here are other potential health effects associated w ith air poll utan ts as well, but a detailed epidem iol ogical study would be necessary to determine i f health outcomes in the C helsea Creek communities differ from other parts of Boston.

8. Recommendations to Address the Gr eatest A ir Quality Problems

The highest priori ties for the C helsea C reek r esidents include improvi ng the avai lable ai r quality data for their community and reducing t he sour ces of pollutan ts in C hel sea an d East Boston. Some recommended steps tow ards these goals are:

Community Actions

• Work with the M assachusetts Office of T echni cal A ssistance to devise way s to reduce emissions from fu el storage tanks.
• Distr ibute information on vehi cle emissions and idli ng to bus, truck, and car dri vers and w ork with police to enforce laws.
• Encourage residents to use public transportati on to reduce vehicle use.
• Revi se and enforce existing tr uck routes to reduce traffic in resident ial areas.
• Work to include tank farms on Massachusetts National Toxics Inventory (NT I) list.
• Encour age voluntar y reduction in emissions from i ndustri es and individuals.

Longer-Term Pr ior ities

• Replace the criteria pollutant monitor which was removed from Chelsea in 1999.
• Implement new monitoring strategies to collect data on local air quality.
• Conduct fine particulate sampling in the heavily trafficked Chelsea Creek area to determine the extent of diesel truck traffic impacts on air quality.
• Determine the HAPs of greatest concern in the community and conduct sampling around the C hel sea C reek nei ghborhoods.
• Conduct diesel metabolite testing on r esidents simi lar t o study conducted in W est Harlem t o demonstrate t he impact of high traffic volume on resident s.
• Work with Feder al, St ate, and Local agen cies to enforce or dinances and regulations.

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Personal Actions

• Use public tr ansportati on as much as possible an d car pool t o redu ce vehicle usage.
• Turn off car engi nes w hen waiting for more than five minutes.
• Check www.airbeat.org or local newspapers for air quality alerts during the summer to see if conditions are safe for outdoor acti vities.

9. Contact List

The foll owi ng is a li st of government agencies and community organi zation s whi ch are involved in the management or monitoring of air quality in the C helsea Creek community .

U.S. EPA N ew England
Office of Environmental Stewardship, Enforcement Unit, Deborah Brown . . (617) 918-1706
Ai r Per mits Program Unit , Susan Lancey . . . . (617) 918-1656
MA State U nit , David W ebster . . . . (617) 918-1791

Massachusetts State/New England Programs
New England States For C oordinated A ir Use Management, Gi nger Law rence (617) 367-8540
MA DEP, Air Quality Planning and Evaluation, Azin Kavian . . . . (617) 574-6801

Community and Municipal Organizations
Chelsea Health and Human Services, Luis Prado . . . . (617) 889-8266
Chelsea Creek Action Group, Roseann Bongiovanni . . . . (617) 889-6080

References:

Kinney, Patrick L., M aneesha Aggarwal, Mary E. Northridge, Nicole A.H. Janssen, and Peggy Shepard. Airborn e Concentrations of PM2.5 and Di esel Exhau st Particl es on H arlem Sidewalks: A Community-Based Pilot Study. *Env ironm ental Health Perspectives*, Vol . 108, No. 3 March 2000.

Peters, Annette, Douglas W. Dockery , Jam es E. Mul ler, Murray A. Mi ttleman. Increased

Particulate Air Pollution and the Triggering of Myocardial Infarction. *Circ ul ati on ,* 2001: 103:2810.
U.S. EPA. Evaluating Exposures to Toxic A ir Pollu tants: A Citi zen' s Guide. M arch 1991. EPA 450/3-90-023.
http://www.epa.gov/region1/eco/airtox/index.html - The EPA-New England w ebsite on air toxics provides information on specific compounds of concern and projected concentrations of ai r pollutan ts.

Other Publicat ions:

Friedman, Mi chael S., Kenneth E. Pow ell, Lor i Hutw agner, LeR oy M. Gr aham, Gerald W . Teague. Impact of Changes in Transportation and Commuting Behavior s Durin g the 1996 Summer Ol ympic Games in A tlant a on A ir Q uali ty and C hildhood A sthma. *Journal o f the American Me d ic a l Asso c i at ion.* Februar y 2001. Vol. 285(7): 897-905.
U.S. EPA. Smog - Who Does it Hurt. July 1999. EPA-452/K-99-001.
U.S. EPA. Tak ing T oxics Ou t of the A ir. August 2000. EPA 452/K-00-002.
U.S. EPA. R isk Assessment for Toxic Ai r Pollutants: A Ci tizens Guide. March 1991. EPA 450/3-90-024.

. Overview of Ambient Air Quality in the Chelsea Creek Community

Ambient air quality, or the quality of air outdoors, is a concern in every community , especially urban communities that have a hi gh concentrati on of industri es and traffic. Poor ambient air quality can cause short-term and long-term health problems. Air pollution in urban ar eas consists of a number of chemical com pounds that are emitted by a variety of sources. In 1970, the U.S. Congress enacted the Clean Air A ct to address many of the problems caused by ai r pollution. Al though there has been much improvement in over all ai r quality, air pollution continues to cause health problems in urban areas. Air pollution is difficult to monitor because i t does not stay in one place. Depending on weather conditions, including wi nd patter ns, temper ature, and humidity , and th e characteri stics of the parti cular pollut ants, air pol luti on can travel for many mil es, affecting air quality far from the pol lution source. For example, coal-burning power plants in the mid West contribute to acid rain in New England, and many of the pollut ants affecting air quality in C helsea and East Boston origi nate in other areas. In the same way , pollu tion generat ed in C helsea and East Boston migrates to neighbor ing communi ties, and pollutan ts generated in Revere, Everett , and Low ell affect the Ch elsea Cr eek neighborhood. Sour ces located wi thin C helsea and East Boston are discussed throughout this chapter since the Chelsea Creek communities are the focus of this project.

Chelsea an d East Boston have many differen t sour ces of ambient ai r pol lut ion. C helsea C reek is a hi ghly industrial area w ith many oil tank farms and acti ve facil iti es which em it or release a range of poll utants to the atmosphere. L ogan A ir por t is a major sour ce of n itrous oxides, benzene, and other products of fuel combustion such as formaldehyde and particulate matter. Although air traffic contributes heavily to air pollution in the Chelsea Creek community , this project does not specifically address the impacts of the airport. There are other community groups whose focus is the airport, and it was determined that this project would examine other sources of air pol lution. H owever , some considerati on of ai rport r elated impacts is inevitable. For example, much of the ground traffic through the community is related to the airport. Traffic is discussed in more detail i n C hapter 5.

Ther e is a lar ge range of health impacts related to air qu al ity . Pollutants may cause al ler gy -like symptoms such as eye, nose, and throat irritation or trigger asthma attacks. Exposure to parti culates in the air may increase sensitiv ity to other aller gens. Over tim e, exposure to air pollut ion can also cause damage to the neurol ogical, r eproductive, and respirator y systems of the body and lower immuni ty to other diseases. Many air toxics are also know n or suspected carci nogens, or cancer causing agen ts (EPA, 1991).

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Ai r qual ity is regul ated on both the federal and State level. Th e federal EPA establi shes air quality requir ements throu gh the C lean A ir A ct, and the M assachusetts Department of Environmental Protection (MA DEP) conducts on-going monitoring, issues permits, and develops regulations to cont rol emissions and meet t hese standards. L ik e all states, the MA DEP must also w rite “State Implementat ion Plan s” (SIPs) to dem onstr ate how they will meet the goals of the Clean Ai r Act. T hese SIPs must be reviewed and approved by the EPA.
The Nat ional A mbient A ir Quality Standards (NAAQS) ar e health-based limits for cr iter ia poll utan ts, common air poll utan ts that are present in m ost communit ies. T hese include: carbon monoxide (C O), nitrogen diox ide (NO2), sulfur di oxide (SO2), ozone (O 3), lead (Pb), and part iculate matt er (parti cles) wit h a diam eter less than 10 m icrons, PM10 (a hum an hair is about 70 mi crons in di ameter). N ew regulations to monit or an d redu ce the l evels of much smaller part icles, PM2.5, will be implemented over th e next few y ears. PM2.5 has been l ink ed to respiratory disease and heart attacks (Buckeridge, et al., 2001, Peters, et al., 2001).
Monitori ng station s around the United States measure these pollutan ts to determ ine air quality on an on-going basis. States that do not comply w ith the federal standards for the cri teria poll utants m ust develop pl ans for improvin g air quality (State Implementation Plans). States m ay work to limit new sources of ai r pol lut ion or r educe exi sting sources by using new and improved technologies such as filters in order to improve air quality.
Another gr oup of air pollu tants is the Hazar dous Ai r Pol lutants (HA Ps), 188 chemicals th at may cause serious health and environmental effects. HA Ps include some w ell-know n poll utan ts such as benzene, which is found in petroleum pr oducts, perch lor oethy lene, product used by some dry cleaners, and dioxi ns, w hich ar e often generated by incinerati on. H APs are regulated by permits issued to large industrial sources and standards for vehicle fuel quality and efficiency. Industrial release of HAPs is regulated under the Federal Clean Air Act and enforced by the MA DEP. All major industrial sources such as chemical manufacturing plants or petrol eum refiner ies are requir ed to comply wi th “maxim um achievable control technology” (MAC T) as established by the EPA. Industries that emi t large amount s (> 25 tons per year total) of pollutants are also required to obtain a Title V air permit and report the volum e of pollut ants released each y ear. Permit holder s pay a per mit fee, and these funds go tow ards ai r pol lut ion contr ol pr ogram s in the state. Some industries that gener ate lower amounts of HAPs are also requ ired to com ply with MACT technol ogy and w ill be r equi red to obtain Title V permits in 2005.

2. Review of Existing Chelsea and East Boston A mbient A ir Q uality Information

Cri ter ia P oll uta nts

The MA DEP has monitored cri teria air pollu tants in Massachusetts commu nities at 56 different locations since 1995. Initial ly , thr ee monitor ing station s were located in East Boston and C helsea. One of the two East Boston m onitors, located on Breman Str eet, i s still in place; this m onitor measures NO2, SO2, CO, and PM. The Chelsea monitor at Powder Horn Hill
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measured NO 2, SO2, and O3 concentrations, and the Vi sconti Street mon itor in East Boston measured C O. Both of these moni tori ng sites were disconti nued in 1999. The historical records from all three monitoring sites show that levels of criteria pollutants other than ozone have consisten tly been within r egulatory limi ts.

Hazardous Air Pollutants (HAPs)

There is limi ted monitori ng of HAPs in the ambient air because of the diffi cul ty and high cost of measurin g the compou nds. Mon itor ing for H AP emissions is conducted by industrial facilities and reported as part of permit requirements. EPA and the DEP also conduct on-site inspections of facilities to ensure compliance with the regulations. The EPA is also working to estim ate pol lut ant concentrations and publi c exposur e using computer models under a National Scale Air Toxics Assessment (NATA) project.
The NATA program combi nes information from the National Toxics Inventory and T oxics Rel ease Inventory databases whi ch tr ack t he emissions of very lar ge industr ial sources, area

source data including smaller sources such as gas stations and dry cleaners, vehicular emissions based on traffic volume, and wind patterns to calculate annual average ambient concentrations of some of the most hazardous HAPs. Based on the emissions from industrial sources, the amount of on-road and off-road vehicular miles traveled, and the potential for air toxics to linger in t he atm osphere or travel long di stances, the NATA program models the expect ed ambient air concentrat ions and exposure for 33 of the 188 H APs w hich h ave been identified as public health priorities.

The results provide in formation on the estim ated air quality by County as well as estimates of how much air pollution is contributed by m otor vehicles, industrial sources, and background levels. This information is useful because it indicates where air control measures may have the greatest effect. For exam ple, in New Englan d, it is projected that emi ssions from on-road vehicles account for 55 percent of the ambient benzene. 17 percent is from area sources, and 27 percent is from background sources (Backgroun d concentrations are from naturally occurring sources or are transported over long distance from other locations). Only 1 percent is from poin t source emissions. This breakdow n vari es depending on t he compound of concern.

Estimates of ambient concentrati ons of the 33 HAPs in Suffolk C ounty as calculated by a draft version of NATA are show n in Table 3. Ni ne compounds (benzene, 1,3-but adien e, carbon tetrachlor ide, chloroform, chromium, ethy lene dibromide, eth y lene dichl ori de, formaldehyde, and methyl chloride) have been identified as the toxics of greatest concern in New England because th e ambi ent con centr ations of these pollutan ts are above th e cancer benchmar k concentrations (th e concen tration above w hich excess cancer risk i s a concer n) in all six New England states. Table 3 compares the estimated concentrations of these pollutants to the cancer benchmark values; as shown, the residents of Suffolk C ounty may be subject to unacceptable cancer ri sk from air toxics.

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It should be not ed that cancer benchmarks are only one part of the im pact on public health. There are many other health impl ications w hich are not included in thi s table. For example, the r isks of elevated respiratory, cardiac, and immunological di sease are not i nclu ded in the can cer benchmark. NATA indicates that t he risk of non-cancer health impacts are also hi gh in Su ffolk C ounty . In additi on, th ese risk factors are developed for aver age individuals. The elderly , the very young, or other populations may be more susceptible to the effects of air pollution.

It is estimated, based on modeling results, that about 30 percent of the HAPs come from onroad vehicl es such as cars, truck s, and buses (see Figure 1). An addi tional 20 percent are from non-road vehicles including planes, lawn mow ers, boats, and construction equipment. The impact of vehicle emissions on air quality is significant given the proximity of both communities to several major roadways, Logan Airport, and Chelsea Creek wh ich is an active port. This assessment is based on the average vehicle miles traveled for Suffolk C ounty; it is lik ely that m odeling un derestimates the level of air toxics present in C helsea and East Boston because of the high concentration of vehicular traffic in the area.

3. Analysis of Existing Air Quality Data

There is very little measured air quality data available for specific municipalities, including Chelsea and East Boston. The criteria pollutant monitor in East Boston provides some ongoing m easur e of NO2, SO2, C O, but vol ati le organi c compounds, diesel exhaust, an d tr affic related emissions w hich ar e lik ely to be high are not m easured. It is im portan t to not e that the Chelsea monitor was located in a residential area away from major truck traffic and industrial emissions. W hil e thi s placement al low s the monitors to represent air qual ity over a broader area, it also means that the monitors do not capture the worst air quality conditions from the m ore den sely popul ated and industr ial section of Chelsea al ong the C helsea C reek . Powder H orn Hill is also a hi gh elevati on poi nt w here air disper sion of poll utan ts are l ik ely to be high er than other points in C helsea. Readings from t his mon itor therefore m ay under estimate t he pollutan t concentrations in sur rounding areas.

The Chelsea C reek neighbor hood i s not uniq ue in its l ack of HA Ps data. The model s

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described in thi s chapter are useful for setting pri orities on a State wi de basis, but may not be adequate to describe the air quality im pacts on local communities. The model is designed to identify possible poll uti on impacts throughout t he coun ty and i s used for long-term air toxics planning. Since Chelsea and East Boston have heavily traveled highways, an airport, an active port with dense truck and barge traffic, and numerous industrial sites including petroleum storage tank s, the nati onal scale modelin g data most l ik ely does not repr esent the actual conditions to which residents are exposed.

The modeling data is uncertain at a local level because it is a regional scale effort, intended to provide dat a on r egional trends, and because the inv entor y of sources input in to th e model are incomplete. Each state determines which facili ties the in ventory for th at state will inclu de, and methodologies vary . For example, the petroleum storage tanks located in Chelsea and East Boston ar e not i nclu ded in the 1996 National Toxics Inventory (NT I) data base, bu t fuel storage faciliti es in M aine simi lar to th e tank s located in C helsea an d East Boston ar e incl uded in that state's inventory. M aine reported tank emissions of benzene, ethylbenzene, methyl tert-buty l ether , poly cyclic organic matter, toluene, and xy lenes. A ll of these compounds are considered HAPs and impose public health impacts including cancer risks. Both benzene and poly cyclic organic matter ar e on the list of 33 compounds on wh ich the NATA program is based. Although the EPA an d the MA DEP are continuall y wor ki ng to improve the national toxics inventory of sources, it is very resource and time intensive work. The most recent version of the NTI, based on 1996 data, is available on the web at: http://www.epa.gov/air/data/ntidb.html.

Because ambient air qu ality estimates are only available on a county -wide basis, it is not possible to do a dir ect compari son betw een air qu ality in t he C helsea C reek area an d other communities. How ever, a comparison of Suffolk County with other parts of the state indi cates that Suffolk County is estimated to have consider ably higher concentrat ions of air pollutants than the state overall.

4. Potential Concerns for Public Health and the Environment

Air qual ity is a concern to the r esidents of the Chelsea C reek ar ea because it can cause public health problems. Toxic air pollutants affect the air we breathe, and pollutants may also settle on soil and water and affect r esident s through other routes of exposure. For example, chil dren who crawl on soil or pl ay near the C reek may be exposed t o air poll utan ts. Fi sh and other aquat ic species m ay also be affected by the sett ling of air pol lut ants on the w ater. However, the primary route of exposure is through breathing polluted air. Table 4 shows some of the sources of the cri ter ia pol lutan ts an d the potent ial health effects.

The 33 HAPs that are of greatest concern have a range of health effects. Some of the compounds are known to be cancer-causing. O thers may increase the risk of respiratory or neur ologi cal dam age, and others are "endocri ne disrupt ors", m eaning th at th ey affect

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hormonal sy stems. The ni ne air tox ics of greatest concern to N ew England states are listed on

Table 5.
In addition to th e pollu tants of greatest concern , ther e are other chemical releases that are repor ted to the EPA Toxics Release Inventory (TR I) program. Chemicals repor ted to the T RI program by industries in Chelsea and East Boston are incl uded in Table 6. The TRI program requires that certain industries with over 10 employees report chemical releases to the environment. Although the TRI database provides valuable information, it is important to note that not al l in dustri al rel eases are included in this list. It shoul d also be noted th at inclusion on thi s list does not necessaril y mean that the release results in an env ironmental or public health r isk to Chel sea an d East Boston resident s.

5. GIS Maps of Available Air Q uality and Information

The attached map show s some of the lar gest sources of HA Ps in t he C helsea C reek community as well as the m ajor road w ays whi ch border th e neighborhoods. More inform ation on truck an d traffic patterns is avail able in Chapter 5.

6. Curr ent A ir Q uality Projects or A ctivities in Chelsea/East Boston

On a n ational level , the EPA is work ing to improve air qual ity by issuing techn ology standards for both industrial sources and mobile sources of air pollutants. Overall, air quality has impr oved. Since 1988, there has been a 74 percent decrease in air toxics released by l arge industr ies in New England. How ever, since the in dustries located in C helsea and East Boston are not included in this category, this statistic does not necessarily reflect changes in air quality in this community .

There is also a national pr ogram to h elp residents protect th emselves from the health effects of ozone. The Air Quality Index pr ogram rates air qual ity on a scale of hazar dous to good ever y day during the summer w hen ozone levels are hi ghest. The dail y ratin g is reported in newspapers and the radio and is also available on the internet at www.epa.gov/airnow /where. The Index i ncludes gui delines of what acti viti es are safe and if sensitive indi vidual s such as those w ith asthma or respiratory disease should avoid outdoor activities.

New MACT stan dards wi ll be comi ng out in the next few y ears w hich will fur ther reduce emissions from industries. In addition, EPA-New England is working to bring petroleum companies together to review existing technologies and community concerns and determine way s to reduce emissions. The C helsea Cr eek Action Group and the W aterfront A ssociation of Chelsea have also been working to reduce emissions from the fuel storage tanks.

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Table 4 - Sources and Potential Effects of Cr iteria Pollutants

Pollutants Sources Po te nt ial Heal th Eff ect s Who is Most
Vul ner able?

Nitro gen
Dio xid e (NO2)
High-temperature
combustion,
(automo biles and pow er
pl ant s)
Lun g and r espirato ry system
irritation, lowered resistence to
infection
Children, people with
resp ir ato ry dise ase
including asthma
Sulfur Dioxi de
(SO2)
C om busti on o f fuel
containing sulfur
(mai nly , coal and o il),

met al smel ting a nd ot her
indu strial p rocesses
Asthma tr igg er, w hee zin g, ch est
tightness, or shortness of breath.
Supp ressed imm une r esponse,
aggravation of existing
cardiovascular
disease
People with
cardiovascular
disease or chronic lung
disease, as well as
children and the elderly
Ozon e (O_3) Formed by a reaction
between volatile organic
compou nds and NO_2 in
the presence of heat and
sunlight
Supp ressed imm une r esponse,
aggravation of pre-existing
respiratory diseases such as
asthma, decreases in lung
function, chest pain and cough.
Prem ature agin g of the lun gs
and/or chronic respiratory
ill nesse s
Out doo r w or k ers,
people with pre-existing
respira tory disease such
as asthma and chronic
obstru ctive lu ng disease
Particulate
Matter (PM)
Fine parti culate (PM 2.5)
is from fuel combustion
(mo tor v ehicles, po wer
generation, i ndustrial
facilities, residential
firepl aces, w ood stoves).
C oarse par ticles
(PM10) are generally
from vehicles traveling
on un pav ed r oad s,
materials handling, and
crushing and
grindin g operation s, as
well as windblown dust.
PM2.5 is associated with
in cre ased h ear t an d lu ng d isease
and aggravation of asthma and
other disease. PM10 is
prim arily associated

with the aggravation of
respiratory condition s, such as
asthma.
Elderly, people with
cardio pulmo nary disease,
such as asthma, and
children
Lead (Pb) Met al processing,
smelters, battery
manufacturing
Neu rological
im pai rm ent s, su ch a s seiz ur es,
mental retardation, and
behavioral disorders
C hild ren
Carbon
Mono xid e (CO)
Fuel combustion, vehicle
exh au st
Reduces oxygen delivery
through body ; lowered agility
and learning ability.
People who suffer from
car dio vasc ul ar d isease
(EPA N ational A ir Q uality : Status and T rends, 1998)
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Table 5 - Air Toxics of Greatest Concern in New England
Pollutants Sources Potential Health Effects
from Long-Term Exposure

Benzene gas stations, auto exhaust,
indu strial sou rces
reproductive, immune, and blood
system disorder s, carcino gen
1,3 Butadiene mot or veh icl es, o il r efin eri es,
chemical manufacturing
cardiovascular disease, probable
carcin ogen
Carbon Tetrachlorine no longer manu factured but still
present in background ambient air
liver , ki dney dam age, decreased
fertilit y , pro bable car cinog en
Chloroform solvent, water chlorination byproduct,
pulp and paper mills
liver and cen tral n ervou s system
disease, pro bable car cinog en
Ch romium industrial processes, coal and oil
burning, catalytic converters and
brak es
pulmo nary disease, skin
sensitivity, gastrointestinal and
im mun e sy stem im pac ts,
carcin ogen

Ethy lene Dibrom ide pesticide, gasolin e additi ve,
indu strial p rocesses
kidn ey, l iver, and testicular
im pacts, pr obab le carcin ogen
Ethy lene Dichloride plastic and v iny l man ufacturi ng,
solvent
liver , ki dney , and imm une sy stem
im pacts, pr obab le carcin ogen
Form aldehyde chemical manufacturing, wood
pr eserv ati on , pl aster , co smeti cs,
pho togra phy suppl ies
probable carcinogen, respiratory
and reproductive effects
Methy l Ch loride wo od, coal, and pl astic
combustion, manufacturing
liv er, k idn ey , an d br ain im pac ts,
possible car cinog en
(EPA N ew Englan d, A ir T oxics of G reatest C oncer n in N ew Englan d. EPA W eb Site)

Chelsea Green Space and Recreation Commi ttee has been working to increase and improve urban par ks along C helsea C reek . In addi tion to aestheti c considerations, increased green space has a positive impact on air quality (see Open Space chapter). On-going community involvement in airport planning has also focused on air quali ty concerns.

The EPA and DEP are w ork ing to improve the NATA models to ensure that they provi de an accurate picture of air quality conditions in each county. There are also on-going monitoring efforts to evaluate the model and determ ine if modeling result s over or under estim ate actual conditions.

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Table 6 - Chemicals Reported to the EPA Toxic Release Invent ory Air Emissions in C helsea and East Bost on

Pollutants Sources Potential Health Effects from Long Term Exposure

An timon y com pounds Smel ting, coal fired p ow er
plan ts, pip ing, an d batt eries
Eye, skin, and lung irritation,
stomach pain and ulcers, reproductive
and kidney im pacts
C opper Sm elt in g, ce rt ain fun gici des,
indu stries, sewage
Liver and kidney disease, damage to
blood cells, stomach problems, skin
rash (Cu at low levels is a necessary
micronutrient)
Cy clohexane Industrial solvent Nausea, diz ziness, respi rato ry , ey e,
and skin irritation.
Di(2-ethylhexy l)phthalate Fl exi bl e pl asti c, ch ild ren ’s to y s,
tubing, vinyl
Stomach irritation, reproductive and
developmental effects
ethylbenzene Gasoli ne and oth er fuels, carp et
glues, varnishes, and paints
Dizziness, throat and eye irritation,
tightening of the chest, liver and

kid ney damage
Meth y l ter t-but y l eth er (M TB E) Ad ded to gaso line t o pro duce
clea ner bu rn ; ru no ff from ro ads,
vehicl e fum es
Heada che s, n au sea, d izz in ess
n-hexane Industr ial solv ents, gasoli ne,
quick -dry ing glu es
Mu scle weakn ess, temporary paralysis
Naphthalene Fossil fuel or w ood bu rnin g,
cigarette smoke, m othballs
Fat igu e, l ack of ap pet ite , re stle ssness,
pale sk in, n ausea and sto mach
pro blem s
Poly cyclic arom atic compou nds Fuel burning, vehicle exhaust,
asphalt production, gril led food,
cigarette smoke
C ancer
Tert-butyl alcohol Industrial solvent,
manufacturing
Dizz iness, nau sea, skin and ey e
irritation.
1,2,4-trimethylbenzene C om po nen t o f gaso lin e, p ain ts,
cleaners
Headaches, fatigu e, skin , ey e, and
respiratory irritation.
Toluene Fuel processing, vehicle exhaust,
nail poli sh, paint, in dustrial
pro cesses
Fat igu e, co nfu sion , w eak ness,
mem or y loss, diz zin ess
Xy lene Petroleum, vehicle exhaust,
industrial solvents, paint
Headaches, loss of balance and
coordination, eye, skin, and lung
irritation
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7. Greatest Air Quality Concerns for Chelsea and East Boston Residents

The greatest concern regarding air quality is the impact that air toxics may have on the health of the community . Many of the HA Ps of greatest concern in Suffolk C ounty are lik ely to be present in high concentrations in Chelsea and East Boston because of the high traffic volume. However, without air monitoring data, the extent to which the public health risk in the community is elevated and which of the HAPs is of greatest concern is unknown.

Pulm onary diseases i ncl uding asthma, lung cancer, and chr onic obst ru cti ve pulmonary disease (COPD) are related to air quali ty . For more on respir atory diseases, see Ch apter 4. T here are other potential health effects associated w ith air poll utan ts as well, but a detailed epidem iol ogical study would be necessary to determine i f health outcomes in the C helsea Creek communities differ from other parts of Boston.

8. Recommendations to Address the Gr eatest A ir Quality Problems

The highest priori ties for the C helsea C reek r esidents include improvi ng the avai lable ai r quality data for their community and reducing t he sour ces of pollutan ts in C hel sea an d East Boston. Some recommended steps tow ards these goals are:

Community Actions

• Work with the M assachusetts Office of T echni cal A ssistance to devise way s to reduce emissions from fu el storage tanks.
• Distr ibute information on vehi cle emissions and idli ng to bus, truck, and car dri vers and w ork with police to enforce laws.
• Encourage residents to use public transportati on to reduce vehicle use.
• Revi se and enforce existing tr uck routes to reduce traffic in resident ial areas.
• Work to include tank farms on Massachusetts National Toxics Inventory (NT I) list.
• Encour age voluntar y reduction in emissions from i ndustri es and individuals.

Longer-Term Pr ior ities

• Replace the criteria pollutant monitor which was removed from Chelsea in 1999.
• Implement new monitoring strategies to collect data on local air quality.
• Conduct fine particulate sampling in the heavily trafficked Chelsea Creek area to determine the extent of diesel truck traffic impacts on air quality.
• Determine the HAPs of greatest concern in the community and conduct sampling around the C hel sea C reek nei ghborhoods.
• Conduct diesel metabolite testing on r esidents simi lar t o study conducted in W est Harlem t o demonstrate t he impact of high traffic volume on resident s.
• Work with Feder al, St ate, and Local agen cies to enforce or dinances and regulations.

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Personal Actions

• Use public tr ansportati on as much as possible an d car pool t o redu ce vehicle usage.
• Turn off car engi nes w hen waiting for more than five minutes.
• Check www.airbeat.org or local newspapers for air quality alerts during the summer to see if conditions are safe for outdoor acti vities.

9. Contact List

The foll owi ng is a li st of government agencies and community organi zation s whi ch are involved in the management or monitoring of air quality in the C helsea Creek community .

U.S. EPA N ew England
Office of Environmental Stewardship, Enforcement Unit, Deborah Brown . . (617) 918-1706
Ai r Per mits Program Unit , Susan Lancey . . . . (617) 918-1656
MA State U nit , David W ebster . . . . (617) 918-1791

Massachusetts State/New England Programs
New England States For C oordinated A ir Use Management, Gi nger Law rence (617) 367-8540
MA DEP, Air Quality Planning and Evaluation, Azin Kavian . . . . (617) 574-6801

Community and Municipal Organizations
Chelsea Health and Human Services, Luis Prado . . . . (617) 889-8266
Chelsea Creek Action Group, Roseann Bongiovanni . . . . (617) 889-6080

References:

Kinney, Patrick L., M aneesha Aggarwal, Mary E. Northridge, Nicole A.H. Janssen, and Peggy Shepard. Airborn e Concentrations of PM2.5 and Di esel Exhau st Particl es on H arlem Sidewalks: A Community-Based Pilot Study. *Env ironm ental Health Perspectives*, Vol . 108, No. 3 March 2000.

Peters, Annette, Douglas W. Dockery , Jam es E. Mul ler, Murray A. Mi ttleman. Increased Particulate Air Pollution and the Triggering of Myocardial Infarction. *Circ ul ati on ,* 2001: 103:2810.

U.S. EPA. Evaluating Exposures to Toxic A ir Pollu tants: A Citi zen' s Guide. M arch 1991. EPA 450/3-90-023.

http://www.epa.gov/region1/eco/airtox/index.html - The EPA-New England w ebsite on air toxics provides information on specific compounds of concern and projected concentrations of ai r pollutan ts.

Other Publicat ions:

Friedman, Mi chael S., Kenneth E. Pow ell, Lor i Hutw agner, LeR oy M. Gr aham, Gerald W .

Teague. Impact of Changes in Transportation and Commuting Behaviors During the 1996 Summer Olympic Games in Atlanta on Air Quality and Childhood Asthma. *Journal of the American Medical Association*. February 2001. Vol. 285(7): 897-905.
U.S. EPA. Smog - Who Does it Hurt. July 1999. EPA-452/K-99-001.
U.S. EPA. Taking Toxics Out of the Air. August 2000. EPA 452/K-00-002.
U.S. EPA. Risk Assessment for Toxic Air Pollutants: A Citizens Guide. March 1991. EPA 450/3-90-024.

APPENDIX C THE CLEAN AIR ACT

SECTION 202

For model years prior to model year 1994, the regulations under section 202(a) applicable to buses other than those subject to standards under section 219 shall contain a standard which provides that emissions of particulate matter (PM) from such buses may not exceed the standards set forth in the following table:

PM STANDARD FOR BUSES

Model year	Standard*
1991	0.25
1992	0.25
1993 and thereafter	0.10

* Standards are expressed in grams per brake horsepower hour (g/bhp/hr).

(g) Light-Duty Trucks up to 6,000 lbs. GVWR and Light-Duty Vehicles; Standards for Model Years After 1993.-

(1) NMHC, CO, and NOx.- Effective with respect to the model year 1994 and thereafter, the regulations under subsection (a) applicable to emissions of nonmethane hydrocarbons (NMHC), carbon monoxide (CO), and oxides of nitrogen (NOx) from light-duty trucks (LDTs) of up to 6,000 lbs. gross vehicle weight rating (GVWR) and light-duty vehicles (LDVs) shall contain standards which provide that emissions from a percentage of each manufacturer's sales volume of such vehicles and trucks shall comply with the levels specified in table G. The percentage shall be as specified in the implementation schedule below:

TABLE G - EMISSION STANDARDS FOR NMHC, CO, AND NOx from light-duty trucks of up to 6,000 lbs. Gvwr and light-duty vehicles

Vehicle type	Column A (5 yrs/50,000 mi)			Column B (10 yrs/100,000 mi)		
	NMHC	CO	NOx	NMHC	CO	NOx
LDTs (0-3,750 lbs. LVW) and light-duty vehicles	0.25	3.4	0.4*	0.31	4.2	0.6*
LDTs (3,751-5,750 lbs. LVW) . . .	0.32	3.4	0.7**	0.40	5.5	0.97

Standards are expressed in grams per mile (gpm).

For standards under column A, for purposes of certification under section 206, the applicable useful life shall be 5 years or 50,000 miles (or the equivalent), whichever first occurs.

For standards under column B, for purposes of certification under section 206, the applicable useful life shall be 10 years or 100,000 miles (or the equivalent), whichever first occurs.

* In the case of diesel-fueled LDTs (0093,750 lvw) and light-duty vehicles, before the model year 2004, in lieu of the 0.4 and 0.6 standards for NOx, the applicable standards for NOx shall be 1.0 gpm for a useful life of 5 years or 50,000 miles (or the equivalent), whichever first occurs, and 1.25 gpm for a useful life of 10 years or 100,000 miles (or the equivalent) whichever first occurs.

** This standard does not apply to diesel-fueled LDTs (3,751095,750 lbs. LVW).

IMPLEMENTATION SCHEDULE FOR TABLE G STANDARDS

Model year Percentage*

1994	40
1995	80
after 1995	100

* Percentages in the table refer to a percentage of each manufacturer's sales volume.

(2) PM Standard.- Effective with respect to model year 1994 and thereafter in the case of light-duty vehicles, and effective with respect to the model year 1995 and thereafter in the case of light-duty trucks (LDTs) of up to 6,000 lbs. gross vehicle weight rating (GVWR), the regulations under subsection (a) applicable to emissions of particulate matter (PM) from such vehicles and trucks shall contain standards which provide that such emissions from a percentage of each manufacturer's sales volume of such vehicles and trucks shall not exceed the levels specified in the table below. The percentage shall be as specified in the Implementation Schedule below.

PM STANDARD FOR LDTS OF UP TO 6,000 LBS. GVWR

Useful life period	Standard*
5/50,000	0.8 gpm
10/100,000	0.10 gpm

The applicable useful life, for purposes of certification under section 206 and for purposes of in-use compliance under section 207, shall be 5 years or 50,000 miles (or the equivalent), whichever first occurs, in the case of the 5/50,000 standard.

The applicable useful life, for purposes of certification under section 206 and for purposes of in-use compliance under section 207, shall be 10 years or 100,000 miles (or the equivalent), whichever first occurs in the case of the 10/100,000 standard.

IMPLEMENTATION SCHEDULE FOR PM STANDARDS

Model year	Standard*	
1994	40%*	
1995	80%*	40%*
1996	100%*	80%*
after 1996	100%*	100%*

* Percentages in the table refer to a percentage of each manufacturer's sales volume.

(h) Light-Duty Trucks of More Than 6,000 lbs. GVWR; Standards for Model Years After 1995.- Effective with respect to the model year 1996 and thereafter, the regulations under subsection (a) applicable to emissions of non-methane hydrocarbons (NMHC), carbon monoxide (CO), oxides of nitrogen (NOx), and particulate matter (PM) from light-duty trucks (LDTs) of more than 6,000 lbs. gross vehicle weight rating (GVWR) shall contain standards which provide that emissions from a specified percentage of each manufacturer's sales volume of such trucks shall comply with the levels specified in table H. The specified percentage shall be 50 percent in model year 1996 and 100 percent thereafter.

APPENDIX D PAST WPI PROJECTS

3.3 Collection of Traffic Data

Traffic is a concern for the Chelsea Creek communities, especially truck traffic after the two devastating truck accidents in the residential area. The residents of Chelsea and East Boston believe there is a traffic problem throughout the communities but there has been no evidence to provide a quantitative foundation for their concerns. Since there is little data about the traffic flow through the residential areas, we collected data at various intersections.

Key intersections were identified by the local agencies based on community feedback from the Community Based Comparative Risk Assessment. We covered one intersection in East Boston and two
24 intersections in Chelsea. It was determined that Central Square in East Boston, the Beacon Street off-ramp of Route 1 in Chelsea, and the intersection of Jefferson Ave and Webster Ave in Chelsea were most likely to be the most dangerous and busiest intersections of Chelsea and East Boston. The Community Based Comparative Risk Assessment has identified other streets; however, we studied only these three intersections due to time constraints. To collect traffic data we used the Traffic Count form in Appendix F Figure 48.

The first step was to visit the intersection to evaluate the complexity of the traffic flows and directions. The number of persons conducting the traffic study depended on the flow of traffic, density of traffic, and the number of possible maneuvers a vehicle could make. A maneuver is a directional path traveled by a vehicle when it encounters an intersection. At an intersection, the vehicles entering the intersection were counted by the maneuver they perform. To minimize human error, one person would examine only one direction of traffic entering the intersection.

Each person was positioned at a "station", the best location to view the traffic flow assigned to study. For example, Figure 7 is a basic four-way intersection. One person would be stationed at each corner to study each direction of traffic entering into the intersection. Station 1 would watch the traffic entering from A, Station 2 would watch the traffic entering from B, Station 3 would watch the traffic entering from C, and Station 4 would watch the traffic entering from D.

Intersections are not always as basic as illustrated above, so the number of stations would be determined by the complexity of the intersection. For example, the basic intersection may have a traffic light that only allows two directions of traffic to flow at once; in this case, only two stations would be necessary because one person would watch two directions of flow. In another case, the flow of traffic from a certain street may be light, so if manageable, a person would take on two directions of traffic flow. There are many possibilities for the number of stations or number of persons needed to conduct a traffic study but the intersection must be evaluated before the actual traffic study can be performed to determine how to manage the study.

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Traffic data was collected on weekdays to indicate traffic trends throughout the week (Monday through Friday). For purposes of repeatability and accuracy, we suggested that the traffic study not be performed on holidays. On four of the five days of the week, a one-hour traffic study was performed; the remaining day was a 12-hour period traffic study from 7:00am to 7:00pm. We suggested the 12-hour traffic study day should be a Tuesday, Wednesday, or a Thursday. We assumed that traffic on those three days is average since they are in the middle of the week.

The traffic counts were done in fifteen-minute intervals. This procedure made a more accurate evaluation of peak traffic times. Every fifteen minutes a line was drawn across the form to separate the time intervals and the new time was marked.

Once all five days of traffic data were collected (one 12-hour period and four 1-hour periods), the four 1-hour period traffic data were extrapolated into a 12-hour period from the ratio of the common time period of 12-hour day to the existing 1-hour period of another day. By extrapolating the data of the four 1-hour days, five consecutive days of 12-hour data can then be used for analysis.

At each intersection, we tracked the distribution of the traffic by maneuvers in order to determine vehicular patterns. We were able to determine the frequency of use for particular roads by the type of vehicle:

trucks, buses, and automobiles. Different types of trucks were categorized by the number of axles: two, three, and four or more axle trucks.

The Traffic Count form has a legend for different types of vehicles and we assigned the following codes: C, B, T2, T3, >T4.

C: This category includes all cars, sport utility vehicles (SUVs), motorcycles, vans, and 4-wheeled trucks.
B: This category includes all buses: school buses, coach buses, MBTA buses. Figure 8
T2: This category includes all 2-axled trucks with six wheels. Figure 10
T3: This category includes all 3-axled trucks. Figure 11
>T4: This category includes trucks with four or more axles. Figure 12

APPENDIX E AETHALOMETER FIELD OPERATING PROTOCOL

Contents

Igloo Cool Roller

1 Magee Scientific Aethalometer

1 Interstate Batteries "RV/Marine Deep Cycle" Battery

1 Car Adapter – 12volt DC Adapter

1 Battery – 12 volt output Adapter

1 small Screwdriver

1 3.5in Floppy Disk

6-ft. of plastic tubing

1 Harvard Impacter (Optional)

Procedure

1. Remove Marine Battery, plastic tubing and both power cords from cooler.
2. Attach tubing to the aethalometer through the drain spout located between the two wheels on the cooler.
3. Connect the two power cables using the Car Adaptor ends.
4. Connect the Power Cable to the battery by connecting the black clamp to the negative terminal. Next connect the red clamp to the Positive terminal.

   CAUTION: Make sure not to let the two clamps touch while either are connected to the battery.
5. Connect the remaining end of the power cord to the Aethalometer.
6. Before turning on the aethalometer be sure that the 3.5in floppy disk is in the aethalometer disk drive.
7. Power up aethalometer and allow it to perform its self diagnostic. Allow 15-20 minutes for the self diagnostic to complete the cycle. Startup will be finished when the screen shows flow data.

8. Once startup is completed adjust flow rate on the flow meter using the screw knob located below the meter. Screwdriver will be provided in the cooler. Counterclockwise to lower the flow rate and clockwise to raise it.

APPENDIX F FIELD FORMS AND SCHEDULE

Name of recorder: ____________________
Date: ____________________
Location: ____________________

C – Cars, Motorcycles, SUV's, Pickup trucks
B – Buses
T2 – 2 axle trucks, delivery and postal trucks
T3 – 3 axle trucks
T4 – 4 or more axle trucks

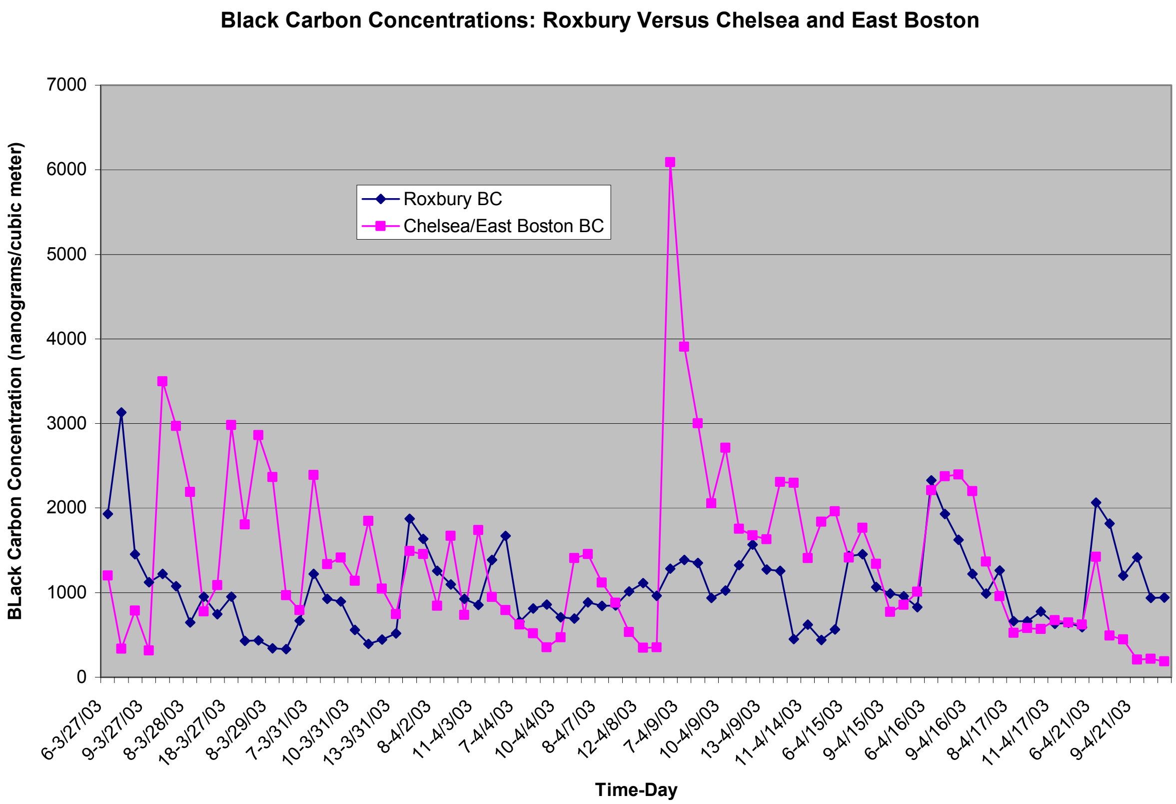
Weather Conditions: (check all that apply) □ Sunny ☼ □ Partly Cloudy □ Mostly Cloudy □ Light Rain □ Rain
*NOTE: If weather conditions change, please make comments below on time and type of change.

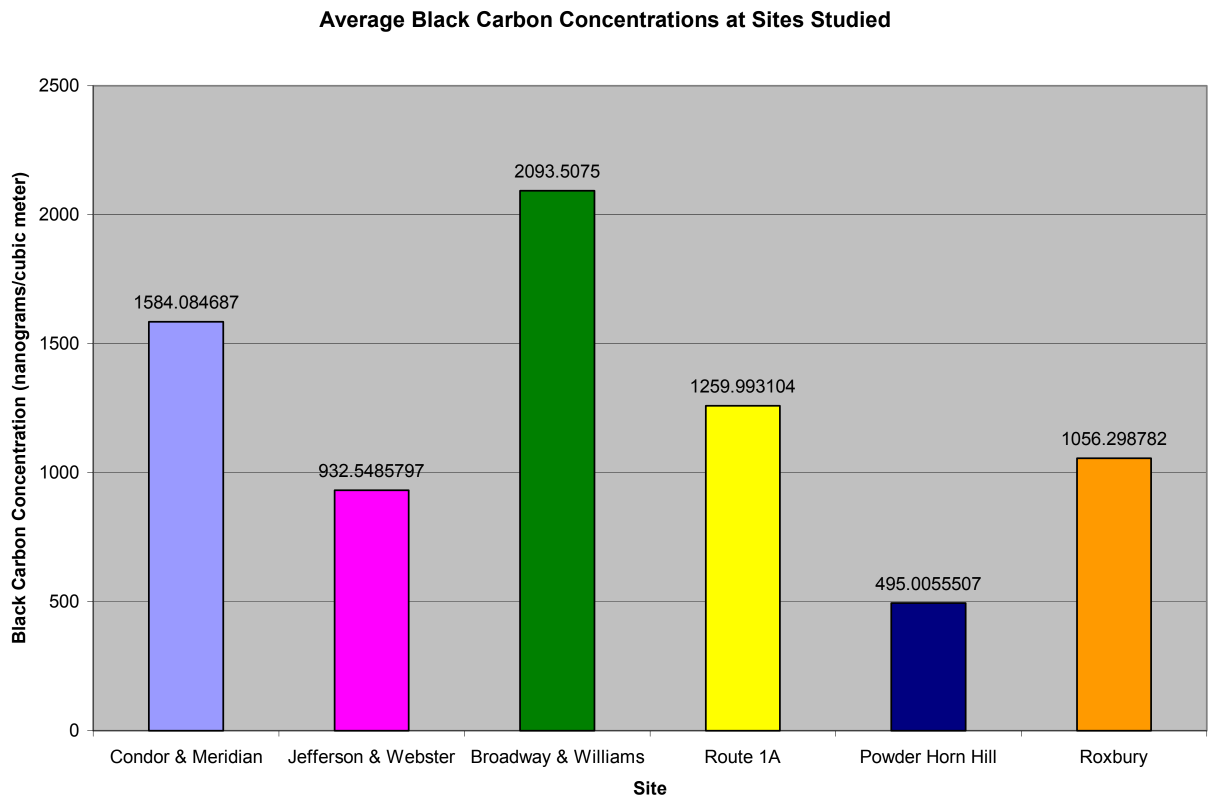
	C			B			T2			T3			T4		
Time	←	↑	→	←	↑	→	←	↑	→	←	↑	→	←	↑	→

COMMENTS:

	Wednesday	Thursday	Friday	Saturday	Sunday	Monday	Tuesday
Condor and Meridian March 26-31	March 26 6am-10am; 3pm-7pm	March 26 6am-10am; 10pm-1am	March 26 6am-10am; 3pm-7pm	March 26 6am-10am	March 26	March 26 6am-2pm	April 1
Jefferson and Webster April 2-8	April 2 6am-10am	April 3 10am-2pm	April 4 6am-10am	April 5	April 6	April 7 6am-10am	April 8 6am-2pm
Broadway and Williams April 9-15	April 9 6am-2pm	April 10 6am-2pm	April 11 6am-10am	April 12	April 13	April 14 6am-2pm	April 15 6am-2pm
Powder Horn Hill April 15-16; April 21	April 16 6am-2pm					April 21 6am-2pm	April 15 10:30am-2pm
Route 1A and Broadman April 16-17	April 16 6:30am-2pm	April 17 6am-2pm					

APPENDIX G ADDITIONAL GRAPHS




Average Black Carbon Concentrations at Sites Studied
Black Carbon Concentration (nanograms/cubic meter)
2500
2000
1500
1000
500
0
1584.084687
932.5485797
2093.5075
1259.993104
495.0055507
1056.298782
Condor & Meridian
Jefferson & Webster
Broadway & Williams
Route 1A
Powder Horn Hill
Roxbury
Site