Air Quality in the Over the Bridge (OTB) Savin Hill Neighborhood of North Dorchester, MA

A thesis

submitted by

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ABSTRACT

This thesis was an analysis of the Environmental Protection Agency's Criteria Air Pollutants (NAAQS) in the near highway neighborhood of Savin Hill "Over the Bridge" (OTB) in North Dorchester, Massachusetts. CO, NO_2, SO_2, O_3, $PM_{2.5}$ and PM_{10} concentrations were measured during the morning and evening rush hour commutes of Interstate 93 for 2 weeks in both the summer of 2007 and the winter of 2008. Meteorological and traffic influences were also assessed.

Results demonstrated higher pollutants concentrations than allowed by the NAAQS during multiple sampling periods. Seasonal differences in concentrations of pollutants were observed. Variability between sampling sites differed markedly between pollutants. The prevailing wind direction placed the OTB neighborhood downwind of the highway pollutant emissions during both summer and winter sampling periods. Travel times between Braintree and Boston did not display an impact on pollutant concentrations.

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1.0 Introduction

The Environmental Protection Agency (EPA) established National Ambient Air Quality Standards (NAAQS) to protect citizens from adverse health effects and to provide a basis for control of air pollution. Air pollution comes from many sources including industrial processes, energy production, and automotive traffic. These National Standards provide a level of protection for the citizens of the United States; however, there may be smaller geographical areas within the United States, such as areas downwind of power or industrial plants, or near major urban roadways, where there may be higher concentrations of pollutants than the limits set in the standards.

1.1 Purpose of Thesis

The purpose of this thesis was to measure ambient air pollutant concentrations at various locations around the Savin Hill "Over the Bridge" (OTB) area of North Dorchester, MA to determine if residents of this neighborhood are exposed to higher levels of air pollution due to proximity to a major roadway. Meteorological and traffic influences were also assessed in this thesis. The hypothesis I examined in my thesis was that residents of the Savin Hill OTB area of North Dorchester, during the morning and evening rush hour commute, are exposed to higher concentrations than allowed by the National Air Quality Standards of five of the six Criteria Pollutants that have been linked to increased risk of asthma. I documented changes in concentrations of the Criteria pollutants based on location in and around this neighborhood. I investigated if seasonal differences in temperature and wind affected pollutant concentrations in the OTB neighborhood and if travel times between Boston and Braintree on I-93 display any impact on pollutant concentrations.

1.2 Prevalence of Asthma

Asthma is one condition significantly affected by air pollution. The number of Americans being diagnosed with asthma has risen since the early 1980's and continues to climb. Asthma is a disease characterized by recurrent attacks of breathlessness and wheezing, which vary in severity and frequency from person to person. This condition is due to inflammation of the air passages in the lungs and affects the sensitivity of the nerve endings in the airways so they become easily irritated. In an attack, the lining of the passages swell causing the airways to narrow and reducing the flow of air in and out of the lungs (World Health Organization, 2011).

1.2.1 Prevalence of Asthma in the US

According to the United States Department of Health and Human Services (USDHHS), the number of Americans diagnosed with asthma doubled between 1980 and 1996, to an estimated fifteen million people. Data from the Centers for Disease Control (CDC) show that in 2003, an estimated 29.8 million people in the U.S. had been diagnosed with asthma during their lifetime, 19.8 million people currently were diagnosed with asthma, and 11.0 million people had an asthma attack in the previous year (CDC website 3, 2006).

In 2008, the prevalence of asthma was at 8.2% of the US population affecting 24.6 million people (17.5 million adults and 7.1 million children). Asthma attack prevalence—the proportion of the population with at least one attack in the previous year—was 4.2%. That is, 12.8 million people (8.7 million adults and 4.0 million children), or 52% of those with asthma, had attacks and were at risk for adverse outcomes such as ER visits or hospitalization (CDC website 4, 2011). Within population subgroups it was higher among females, children, persons of non-Hispanic black and Puerto Rican race or ethnicity, persons with family income below the poverty level, and those residing in the Northeast and Midwest regions of the U.S. In 2008, persons with asthma missed 10.5 million school days and 14.2 million work days due to their asthma. In 2007, there were 1.75 million asthma-related emergency department visits and 456,000 asthma hospitalizations. Asthma emergency visit and hospitalization rates were higher among females than males, among children than adults, and among black than white persons (CDC website 4, 2011).

1.2.2 Prevalence of Asthma in Boston and Boston Neighborhoods

According to the Health of Boston 2001, an annual report prepared by the Boston Public Health Commission on the status of the health of its residents, Boston Emergency Medical Services provided basic life support treatment for asthma 467 times in 2000. The neighborhoods of North and South Dorchester accounted for 33% of these service calls (Boston Public Health Commission 1, 2001). The overall trend for Boston from 1994 to 1999 was a decrease of 42.2%

in the number of hospitalizations for children under 5 for asthma. In North Dorchester, however, the hospitalization rate for males under 5 was 22.9% above the Boston average and for females under 5 it was 34.2% above the Boston average (Boston Public Health Commission 1, 2001).

The asthma hospitalization rate for Boston's Black children under age five was almost three times the rate for Asian children and three and a half times the rate for White children in 2007. With the exception of 2002, Black children consistently had the highest asthma hospitalization rate from 1998 through 2007 (Boston Public Health Commission 3, 2009).

The asthma hospitalization rate in 2008 for Black and Latino children in Boston was three times the rate of Asian children and four times the rate of white children (Boston Public Health Commission 2, 2010). In the same year, 16% of adults living in North Dorchester reported having asthma, which was the highest neighborhood percentage for the city as a whole. Overall, Boston had a rate of 10% of adults reported as having asthma (Boston Public Health Commission 2, 2010).

1.3 Air Pollution and Asthma

Several studies have shown that long term exposure to air pollution is associated with decreased lung function and development (Rojas-Martinez et al. 2007; Balmes et al. 2009; Kan et al. 2007; Kim et al. 2004). One study done in Sao Paulo, Brazil examined various phases of mouse lung growth on mice exposed to ambient $PM_{2.5}$ 20 meters (m) from the roadside near a heavy traffic area for 24 hours/day for 8 months. One group of mice was exposed to unfiltered ambient air and the control group was exposed to filtered air. After the first generation, a crossover of mothers and pups occurred resulting in four groups of pups: non-exposed, prenatal, postnatal, and pre+post natal. Pressure volume was also taken on the older groups. The pre+post natal group had the lowest surface to volume ratio in 15-day and 90-day-old mice when compared with non-exposed group ($p = 0.036$), demonstrating significant decreased lung growth as compared to the non-exposed group. Decreased lung volumes were also significant ($p = 0.001$) (Mauad et al. 2008).

Another study examined human lung development over an 8-year period. This prospective study, the Children's Health Study, followed 1,759 children from schools in 12 Southern California communities and measured lung function annually from the ages of 10 to 18 between 1993 and 2001 (Gauderman et al. 2004). They measured pulmonary function using Forced Vital Capacity (FVC), Forced Expiratory Volume (FEV), and Maximal Mid-expiratory Flow Rate (MMEF). FVC is the volume delivered during an expiration made as forcefully and completely as possible starting from full inspiration. FEV is the volume delivered during the FVC maneuver, usually in the first second of the FVC (American Lung Association Website, 2010). MMEF or sometimes labeled as PEF (Peak Expiratory Flow) is the measure of maximum expiratory flow occurring just after the start of a forced expiration from the point of maximum inspiration (total lung capacity) (National Asthma Council Australia Website, 2010). Air pollution monitoring stations were established in each of the 12 study communities and average hourly levels of O_3, NO_2, PM_{10} and 2-week filter samples of $PM_{2.5}$ and acids were recorded. Deficits in lung development in smaller increases in FEV1 and FVC levels than expected for all pollutants were observed. Exposure to these pollutants demonstrated significant negative correlations in increase of FEV1 in communities with higher concentrations of NO_2 ($p = 0.005$), acid vapor ($p = 0.004$), $PM_{2.5}$ ($p = 0.04$), and elemental carbon ($p = 0.007$). Cumulative deficits in increase in lung function during the eight-year study resulted in a strong association between exposure to air pollution and clinically low FEV1 at age 18. The estimated proportion of children with low FEV1 was 4.9 times higher in the most polluted communities compared to the least polluted community. FEV1 is monitored in those with asthma and a low FEV1 is seen in those with asthma and chronic obstructive pulmonary disease (COPD). If the FEV1 and FEV1/FVC are low, this is called obstructive lung disease. This is seen most commonly in asthma or diseases that affect the airways and how fast a child can breathe out (The Children's Hospital, 2011). There was also an association found between a correlated set of pollutants that include NO_2, acid vapor, $PM_{2.5}$ and elemental carbon and deficits in lung function (Gauderman et al. 2004).

1.4 Asthma and Automobile Exhaust

The increase in asthma and adverse respiratory symptoms across the US has been linked in studies to automobile exhaust (Mortimer et al. 2002; Levy et al. 2003; Yu et al. 2000; Delfino et al. 2003). One study analyzed air data taken from

Atlanta, Georgia during the 1996 Summer Olympic Games. The study assessed the impact on acute asthmatic events in children of the significant drop in traffic volume and lower ozone levels associated with the Games. The study found a 22.5% decrease in weekday morning traffic volume during the Games and a 28% decrease in peak daily ozone levels. The reduction in ozone levels was associated with a drop of 41.6% in acute care billings for asthma in the Georgia Medicare claims file and an 11.1% drop in acute asthma cases in two pediatric emergency departments (Friedman et al. 2001).

Exposure to traffic-related pollutants has been linked with increased risk of asthma (McConnell et al. 2006) and associated with respiratory symptoms (Kim et al. 2004; Bayers-Oglesby et al. 2006; Pernard-Morand et al. 2006) when linked with distance to the nearest roadway. The risk of wheezing was tested in a nested case control study in Nottingham, England in 1995-1996 (Venn et al. 2001). Data were collected for parental reported respiratory symptoms of wheeze, lifestyle factors and residential postcode. Home proximity to the nearest main road using Geographical Information System (GIS) software was estimated using the midpoint of the postcode. Primary (n=6,147) and secondary (n=3,709) school children were included in this study. Of the 1,541 primary school children living within 150 m of a main road, there was a trend toward an increase in risk of wheeze with increasing proximity to the road, especially within 90 m of the roadway. Overall, a higher significance was shown between distance to main road and risk of wheeze for girls than boys (P*interaction* = 0.02). Of the 859 secondary school students living within 150 m of a main road, there was a positive association between risk of wheeze and proximity to the roadside. The greatest increase in risk of wheeze came within 60 m of the roadside. Overall, among children living within 150 m of a main road, the risk of wheeze increased with increasing proximity to the road (OR = 1.08; 95% CI = 1.00, 1.16) per 30-meter increment in primary schoolchildren and OR = 1.16 (95% CI = 1.02, 1.32) in secondary schoolchildren (Venn et al. 2001). This study demonstrates living within 90 meters of a main roadway is associated with an increase in risk of wheezing illness in children.

A study conducted in 2003 recruited a new cohort from 13 Southern California cities; nine are the same communities that were included in the original 12 in the Children's Health Study (Gauderman et al. 2004). The population consisted of 5,341 students who completed a questionnaire sent home to their parents. Residential exposure assessment was done using the distance of the homes to the nearest major road as estimated using GIS and categorized as <75 m, 75-150 m, >150-300 m and >300 m. Lifetime history of doctor diagnosed asthma and prevalent asthma and wheeze were evaluated in this questionnaire. The control group was those residing > 300 m from the roadway. Residence within 75 m of a major road was associated with an increased risk of lifetime asthma (OR = 1.29, 95% CI = 1.01, 1.86), prevalent asthma (OR = 1.50; 95% CI = 1.16, 1.95) and wheeze (OR = 1.40; 95% CI = 1.09. 1.78). Susceptibility increased within long term residence with no parental history of asthma for lifetime asthma (OR = 1.85; 95% CI = 1.11, 3.09), prevalent asthma (OR = 2.46; 95% CI = 0.48, 4.09) and recent wheeze (OR = 2.74; 95% CI = 1.71, 4.39). This study found that there were decreased levels of risk to background rates after 150 - 200 m from the roadway. The ORs show increased risk of lifetime asthma, prevalent asthma, and wheeze within 75 m of the major roadway. The ORs for susceptibility increased with long-term residential exposure (McConnell et al. 2006). This study linked asthma prevalence to close proximity to traffic on a major roadway.

1.5 Background

The Southeast Expressway Corridor (I-93) of Massachusetts (Figure 1-1) is one of the busiest sections of roadway in New England with average weekday traffic volume of 179,700 vehicles per day in 2007 (Massachusetts Highway Department, 2011). It consists of the Expressway with the High Occupancy Vehicle (HOV) lane, Morrissey Blvd., the MBTA Red Line, and the Old Colony Line Commuter rail service. Morrissey Blvd. is parallel to the Expressway and acts as a service road between Kosciusko Circle at Columbia Road in South Boston and Neponset Circle in South Dorchester and traffic volumes on this roadway are among the highest in the City of Boston due to overflow volumes from the Expressway with over 40,000 vehicles per day in 2007 (Boston Region Metropolitan Planning Organization, 2011). The percentage of truck traffic during the peak hours was 3% and the percentage of truck traffic during the day was 4% on I-93 in 2006 (Massachusetts Highway Department, 2011).

Another problem for these roadways is a deficiency in the HOV lane connection from the Southeast Expressway to the Central Artery Project. The high volume of traffic flowing into the city during the morning commute from the

South Shore of MA is slowed at the Savin Hill area where the HOV zipper lane ends and the traffic must merge back into four lanes of traffic on the Expressway. In the evening when traffic leaving the city to the south on this section of highway is high, one lane is taken from the northbound highway for the HOV lane and causes traffic delays in the northbound direction. These two major high volume roads bound the small OTB neighborhood in Savin Hill in North Dorchester and therefore impact local air quality.

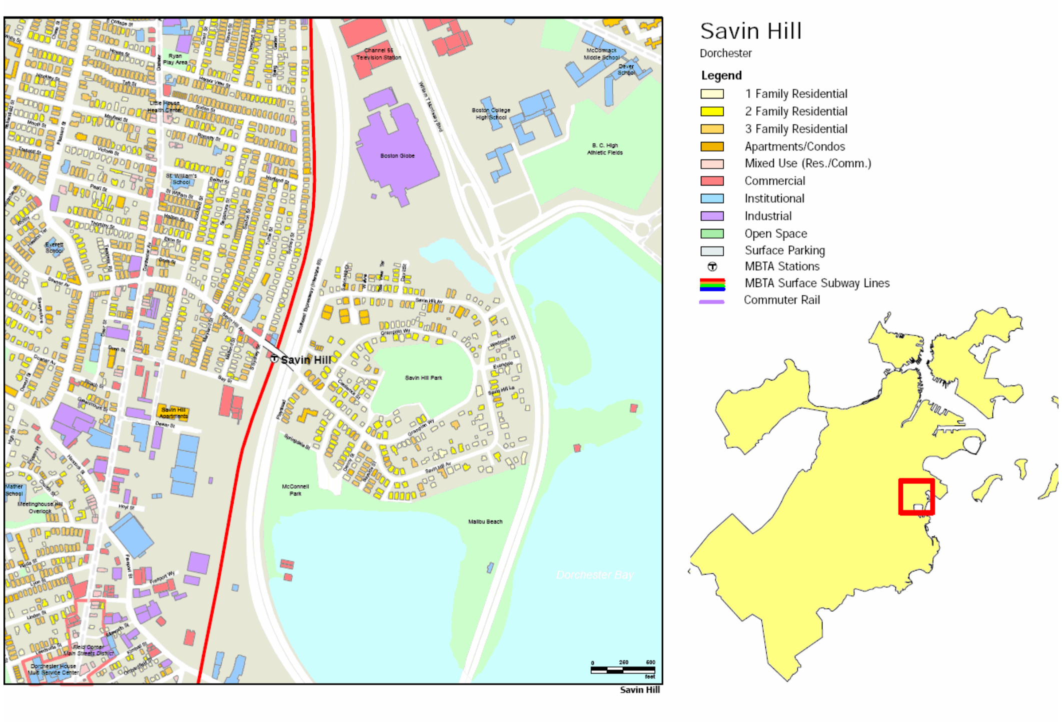

Figure 1-1 Savin Hill OTB neighborhood bound by the Southeast- Expressway to the West and Morrissey Blvd. to the East

Source Boston Redevelopment Authority

The OTB neighborhood is located in between these two major roadways (Figure 1-1) and residents may be exposed to high concentrations of pollutants emitted by vehicles traveling on these roadways to and from Downtown Boston. Studies previously cited indicated associations of proximity to major roads and exposure to pollutants (McConnell et al. 2006; Kim et al. 2004; Bayers-Oglesby et al. 2006; Venn et al. 2001; Balmes et al. 2008). A study in California indicated that traffic exposure was associated with decreased lung function in adults with asthma and this was a function of distance of their homes to the nearest major roadway. Concentrations of pollutants emitted by motor vehicles are highest within 150 m and remain elevated up to 300 meters from roadways, but fall off markedly after that point (Balmes et al. 2009).

The Swiss Cohort Study on Air Pollution and Lung Disease in Adults found that living close to main streets or in a dense street network increases the risks of certain respiratory symptoms in adults, particularly for asthma-related symptoms such as attacks of breathlessness and wheezing and for bronchitis symptoms such as regular cough and production of phlegm. The findings support their hypothesis that traffic exhausts are relevant to respiratory health (Bayer-Oglesby et al. 2006). Another study found that living within 75 m of a major road was associated with an increased risk of lifetime asthma. Susceptibility to developing asthma also increased for long-term residents living in close proximity to roadways with no family history of asthma (McConnell et al. 2006).

1.6 Air Pollutants

The Clean Air Act requires EPA to set National Ambient Air Quality Standards (NAAQS) for six criteria pollutants pollutants considered harmful to public health and the environment. The Criteria Air pollutants established by the Clean Air Act consist of six principal pollutants: nitrogen dioxide, ozone, sulfur dioxide, particulate matter, carbon monoxide, and lead (EPA website 4, 2010). These pollutants are emitted from many sources except for ozone, which is formed when NO_x and VOCs react in the presence of sunlight, and PM, which can be directly emitted or formed in reactions with nitrogen oxides, sulfur oxides, ammonia, organic compounds, and other gases in the atmosphere (EPA website 4, 2010).

The Clean Air Act established two types of national air quality standards. Primary standards set limits to protect public health, including the health of sensitive populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings. The Clean Air Act requires periodic review of the science upon which the standards are based and the standards themselves (US EPA Website 6, 2010).

Some studies have suggested that these standards are too high to protect public health for all episodes of air pollution and should be lowered (Schildcrout et al. 2006; Hazucha and Lefhon, 2007). The studies present evidence of higher episodes of air pollution in different seasons that have greater short-term concentrations than the NAAQS protect for. Mortimer et al. indicated that summer air pollution is related to asthma symptoms and decreased pulmonary function among children with asthma when air pollution concentrations are at levels below the current US air quality standards (Mortimer et al. 2002). It is worth noting that the concentration of ozone and PM to meet the air quality standards were lowered since this study. Zhu et al. indicates PM concentrations are much higher in the winter than in other seasons (Zhu et al. 2004).

1.7 Health Effects of Criteria Air Pollutants

Nitrogen dioxide (NO_2) can cause respiratory symptoms such as coughing, wheezing, and shortness of breath, and can affect lung function in people with respiratory disease. Short-term exposure for children can increase the risk of respiratory illness while long-term exposure may cause permanent structural changes in the lungs. Sources of NO_2 are motor-vehicle exhaust and fuel combustion sources such as electric power generating facilities (US EPA Ecosystems Assessment Unit, 2004).

A study of 990 children in eight North American cities was performed to investigate the relationship between ambient concentrations of PM_{10}, SO_2, warm season O_3, CO and NO_2; and asthma exacerbations (daily symptoms and use of rescue inhalers) as part of the pre-randomization phase of the Childhood Asthma Management Program (CAMP). CAMP is a National Heart, Lung, and Blood Institute-sponsored clinical trial that recruited children from eight North American cities: Albuquerque, New Mexico; Baltimore, Maryland; Boston, Massachusetts; Denver, Colorado; San Diego, California; Seattle, Washington; St. Louis, Missouri; and Toronto, Ontario, Canada. The purpose of this study was to evaluate the long-term effects of daily use of inhaled anti-inflammatory medication on asthma status and lung growth in children with mild to moderate asthma (Schildcrout et al. 2006). Pollutant concentrations were obtained from the

Aerometric Info Retrieval System through EPA for the U.S. cities and from Environment Canada for Toronto. One- and two-pollutant models were used. The outcome variables of any asthma symptoms versus none and the number of rescue inhaler uses were studied in these models. The effects of 0, 1, and 2-day lags along with the 3-day moving sum of these lags were included in the models. The strongest effects were seen with 2-day lags, where 1 ppm change in CO and a 20 ppb change in NO_2 were associated with symptom OR = 1.08; 95% CI = 1.02, 1.15 and OR = 1.09; 95% CI = 1.03, 1.15 respectively and with rate ratios of rescue inhaler use RR = 1.06; 95% CI = 1.01, 1.10 and RR = 1.05; 95% CI = 1.01, 1.09, respectively (Schildcrout et al. 2006). This study demonstrated increased symptoms of asthma as well as increased use of rescue inhalers due to increase in pollutant concentrations of NO_2 and CO in ambient air.

Ozone can irritate the respiratory system, causing coughing, throat irritation, and/or uncomfortable sensation in the chest. It can reduce lung function and make it more difficult to breathe deeply and vigorously. It can also exacerbate asthma and increase susceptibility to respiratory infections. Ozone is formed in the atmosphere by the reaction of nitrogen oxides and hydrocarbons in the presence of sunlight and is highest on summer afternoons (US EPA Ecosystems Assessment Unit, 2004). A study of ozone variation trends in Hong Kong demonstrated that O_3 concentration was negatively related to nitric oxide and NO_x, positively to NO_2, and that a strong relationship existed between O_3 levels and NO_2/NO. Meteorology considerations were also analyzed and O_3 levels increased with increasing solar radiation and outdoor temperature, and decreased with increases in wind speed. The UV light from the sun photochemically reacts with nitrogen oxides to form free radical reactive species. O_3 production and concentration depend on the presence of the nitrogen oxides. NO_2 is dissociated by sunlight to form reactive ground state oxygen atoms, O and NO, and then the O atom reacts rapidly with O_2 to form O_3 (Wang et al. 2003).

In a study by Bromberg and Koren, exercising volunteers exposed in chambers to as little as 0.08 ppm ozone for several hours exhibited impaired lung function and irritative lower airway symptoms. The effect of exposure of healthy volunteers to O_3 was a loss of ability to take in a deep breath, accompanied by symptoms of tracheal irritation and cough which were enhanced by deep breaths (Bromberg and Koren, 1995). These authors state: "Prolonged exposure with exercise induced increased ventilation to as little as 0.08 ppm O_3 causes decreased lung function, and because summertime ambient air O_3 levels commonly fluctuate within the 0.08 – 0.12 ppm range for many hours, there has been sentiment in favor of an additional ozone NAAQS at a concentration lower than 0.12 ppm, but averaged over a multi-hour time period" (Bromberg and Koren, 1995). The concentration to meet the standard was lowered from an eight-hour average of 0.08 ppm to 0.075 ppm in May 2008 and is still calculated as the three-year average of the fourth highest daily maximum eight-hour average ozone concentrations measured at each monitor within an area over each year (US EPA website 3, 2010).

The effects of ozone on lung development were studied in rats that were pair-fed to control body size and weight. Rats were exposed to filtered air or to

0.64 to 0.96 ppm O_3 for eight hours per night for 42 nights. A control group was exposed to filtered air. Half the rats were analyzed after the 42 days and the other half were analyzed after a 42-day post exposure period where all rats were exposed to filtered air only. The result was larger saline- and fixed-lung volumes in rats exposed daily to the eight-hour ozone concentrations of 0.96 ppm as well as lower body weight and length compared to the control group. After the post-exposure period of 42 days, the inflammation in the lungs was decreased, but the larger fixed lung volume remained for those rats exposed to higher concentrations of O_3 (Tyler et al. 1987).

Sulfur dioxide affects people with asthma as they are vulnerable to its health effects, which include narrowing of the airways, wheezing, chest tightness, and shortness of breath. Long-term exposure to both SO_2 and fine particles can cause an increase in asthma symptoms, alter the lungs' defense mechanisms, and exacerbate existing cardiovascular disease. Major sources of SO_2 include power plants and industrial boilers (US EPA Ecosystems Assessment Unit, 2004). Coal was banned in Dublin, Ireland in 1990 and a study was done 72 months after the ban to measure concentrations of black smoke and SO_2 in the air. After the ban on coal, the ambient concentrations of black smoke and SO_2 in Dublin decreased by two-thirds and one-third respectively. The average concentration of SO_2 decreased by 11.1 ug/m^3 and there was a 5.7% decrease in non-trauma age-standardized deaths in Dublin. The largest decrease was seen in estimated respiratory death rates at 15.5% with an estimated 116 fewer deaths. Average annual cardiovascular death rates were estimated to have decreased by about 10% (Clancy et al. 2002).

Carbon monoxide may cause chest pain and other cardiovascular symptoms in people with cardiovascular disease who are exposed, particularly while exercising. In healthy individuals, exposure to high concentrations of CO can affect mental alertness and vision. Motor vehicles are the most significant source of CO, which forms when the carbon in fuels does not undergo complete combustion and mineralization (US EPA Ecosystems Assessment Unit, 2004). A study of asthmatics in Padua, Italy found decreased lung function associated with levels of CO that were lower than the European Standards. It found a significant association between decreased lung function in adult asthmatics and CO. The researchers indicated that this was one of only a few studies that found a significant association between these. They indicated that CO might be a marker for other gases in their study. The primary effect of CO exposure at outdoor concentrations well above what were found in this study is hypoxia, which results in confusion, headache and nausea (Canova et al. 2010).

Particulate matter 2.5 and 10 can accumulate in the respiratory system. Inhalable coarse particles are larger than 2.5 um and smaller than 10 um in diameter. PM $_{2.5}$, known as fine particles, are 2.5 um in diameter and smaller. PM_{10} measurements contain both fine and coarse particles (US EPA Website 8, 2011). Ultra-fine particles are those particles smaller than 0.1 um in diameter (US EPA Website 9, 2011). Exposure for people with existing heart or lung problems results in an increased risk of premature death or admission to a hospital or emergency room. Children and those with existing lung disease may not be able to breathe as deeply as they normally would, and may experience symptoms of coughing or shortness of breath. PM can increase susceptibility to respiratory infections and exacerbate existing respiratory disease. Sources of fine particles include all types of combustion (motor vehicles, power plants, wood burning, etc.) and some industrial processes (US EPA Ecosystems Assessment Unit, 2004).

Specific health effects associated with short term exposure to fine particles (PM $_{2.5}$) include premature death in people with heart and lung disease, non-fatal heart attacks, increased hospital admissions, ER visits and doctor visits for respiratory diseases and cardiovascular diseases, coughing, wheezing, and shortness of breath, and irregular heartbeat (US EPA Website 5, 2010). Health effects associated with long term exposure to $PM_{2.5}$ include premature death in people with heart and lung diseases, including death from lung cancer, reduced lung function, and development of chronic respiratory disease in children (US EPA Website 5, 2010). Health effects associated with short term exposure to coarse particles PM_{10} include premature death for those with heart or lung disease, increased hospital admissions and doctor visits for heart disease and respiratory disease, increased respiratory symptoms in children, and decreased lung function. Available evidence does not support a link between long-term exposure to coarse particles and health problems (US EPA Website 5, 2010).

The Harvard Six Cities Study conducted in the 1970's was completed to study the human health effects of air pollution. In this study, a cohort of 8,111 adults who participated in the Harvard Six Cities Study was followed prospectively. The study estimated the effects of air pollution, especially particulate matter, on mortality, while controlling for other health risk factors such as smoking, sex, and age in the 8,111 adults in six US cities. Those cities are Watertown, MA, Harriman, TN, St. Louis, MI, Steubenville Ohio, Portage WI, and Topeka KS. Smoking was most strongly associated with lung cancer and cardiopulmonary disease. Air pollution was positively associated with mortality due to lung cancer and cardiopulmonary disease. This association of particulate air pollution to mortality was observed even after controlling for other risk factors such as cigarette smoking, age, sex, education level, body mass index and occupational exposure (Dockery et al. 1993). Using data from the Six Cities Study, another study on the concentration-response relation between $PM_{2.5}$ and daily deaths found a linear relationship to concentration of $PM_{2.5}$ and daily deaths (Schwartz et al. 2002).

A study conducted in Roxbury, MA measured $PM_{2.5}$, polycyclic aromatic hydrocarbons (PAH), and ultra fine particulate matter in near road and at varying distances from the road using a DustTrak in summer 2001. Traffic counts were also measured. There was one stationary site and eight other sites for a total of nine sampling locations. Some sites were located downwind and upwind of the stationary site. Concentration ranges were not substantially different for $PM_{2.5}$ as they were for PAH’s and ultra fine particles. This study indicated that there is less spatial variability in $PM_{2.5}$ over a small geographic area than for PAH and ultra fine particulates. The primary limitation identified in this study was the close proximity of the sampling locations (25m apart) (Levy et al. 2003).

In my research, I collected ambient air samples at locations in and around the Savin Hill OTB neighborhood located in northern Dorchester, MA and analyzed them for concentrations of five of the six Criteria Pollutants. These five pollutants are nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), carbon monoxide (CO), and particulate matter (PM) (PM_{10} and $PM_{2.5)}$ (EPA website 4, 2010). I did not include lead (Pb) as a contaminant in my air sampling since in 1996, "Massachusetts discontinued ambient air monitoring of lead at all but one site in Boston because air quality levels were well below the National Ambient Air Quality Standards (NAAQS) and the level of detection for the measurement method" (Boston Public Health Commission 1, 2001). By choosing nine sampling points across the study area, I examined if different areas around the study area were exposed to higher levels of these NAAQS primary pollutants from the major roadways surrounding it.

2.0 Methodology

This section describes the methods and instrumentation used to sample air quality in the OTB (over the bridge) neighborhood in North Dorchester, MA. It also includes information regarding analytical methods used to analyze the data.

2.1 Area of Study OTB Neighborhood in North Dorchester, MA

The main reason I chose this area for study is that I live in the OTB neighborhood and I also have asthma. I wanted to know if the close proximity to the congested highway exposed the area to high levels of pollutants from the automobile exhaust. I chose nine sampling locations in and around the study area in order to take my samples (Figure 2-1). I will refer to each location as the number assigned on Figure 2-1 for ease of reference.

Locations 1 and 9 are both west of I-93 and were chosen to assess air pollutants on the western side of the highway. Location 2 is located across McConnell Field and across Dorchester Bay from both Morrissey Blvd. and I-93. This is the southern sampling point in the neighborhood and the most exposed to I-93. Location 3 was chosen as the eastern most sampling point and is closest to Morrissey Blvd. Locations 4 and 6 are centrally located on the straight away from the bridge that goes directly over the highway on Savin Hill Ave. This bridge connects the OTB neighborhood to the rest of the Savin Hill neighborhood. Location 5 is located at the top of Savin Hill Park and is the central sampling location as

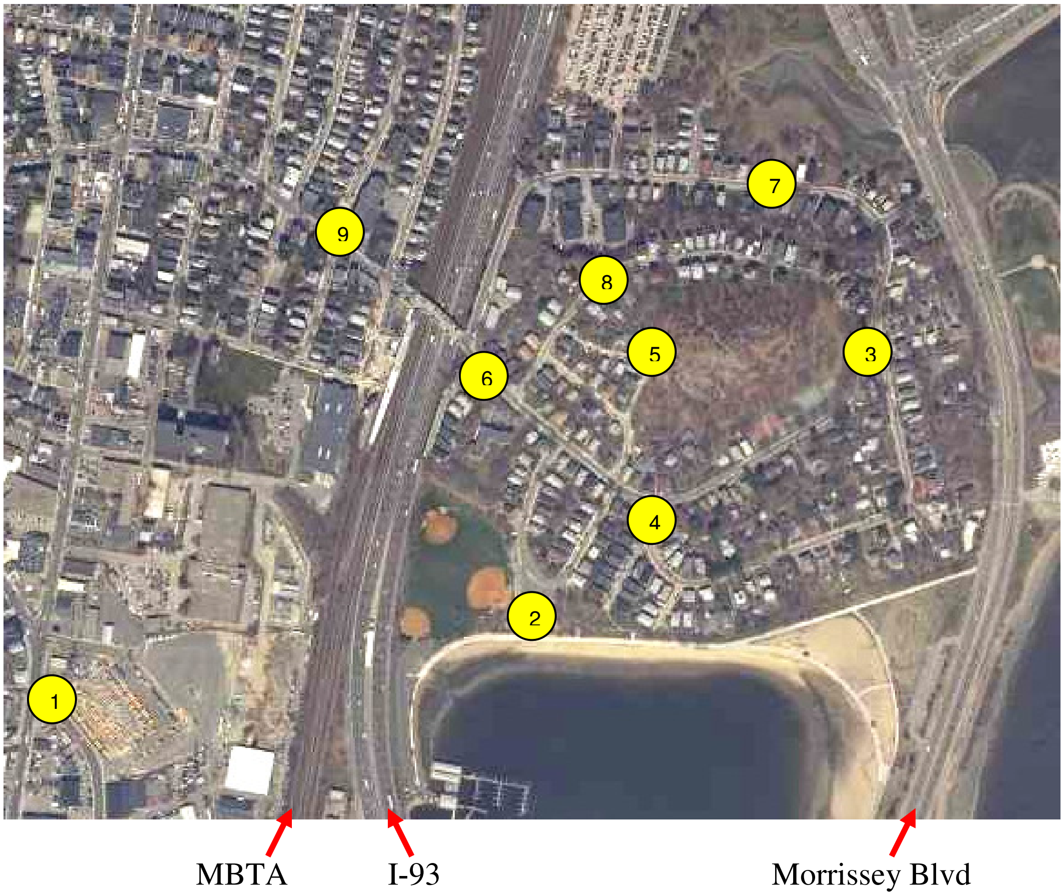

Figure 2-1. Sampling Locations in Savin Hill OTB Study Area
(BRA website, 2010)

1. 43 Freeport Street
2. McConnell Park / Malibu Beach Parking Lot
3. Intersection of Savin Hill Avenue and Evandale Terrace
4. Intersection of Savin Hill Avenue and Grampian Way
5. Intersection of Caspian Way and Rockmere Street
6. Grampian Way at Motley School Condos
7. Patten's Cove Park across from 324 Savin Hill Ave.
8. Overlook across from 37 Grampian Way
9. Intersection of Savin Hill Avenue and Saxton Street

well as the highest in elevation. Locations 7 and 8 are the northern sampling locations. Location 7 is lower in elevation and faces north toward the Boston Globe building and Morrissey Blvd. across Patten's Cove just a few feet above sea level. Location 8 is facing northwest toward I-93 and Downtown Boston.

This location is located on an overlook that is approximately 40 to 60 feet in elevation from sampling Location 7 below.

2.2 Equipment

Four different types of air monitoring instrumentation were utilized to obtain my air quality data. The VRAE Multi Gas Monitor® was used to obtain NO_2 and SO_2 measurements. The Eagle Portable Multi Gas Detector® was used to measure for O_3. Both instruments were obtained through a rental agreement with Pine Environmental Services, Inc. of Woburn, MA. The DustTrak Aerosol Monitor Model 8520® was used to obtain samples for $PM_{2.5}$ and PM_{10}. This instrument was borrowed from Harvard School of Public Health through the help of Environmental Defense, a national non-profit organization dedicated to protecting the environmental rights of all people, including future generations. These rights include access to clean air and water. The last instrument used was the Q-Trak IAQ Monitor model 8550/8551® to obtain samples for CO. It was borrowed from the US Environmental Protection Agency (USEPA).

The VRAE Multi Gas Monitor® was initially calibrated by staff at Pine Environmental Services for each sampling round in the summer of 2007 and the winter of 2008. The VRAE monitor was calibrated to detect NO_2, SO_2 and O_2 with electrochemical sensors. The range of detection for NO_2 and SO_2 was 0-20ppm with a resolution of 0.1ppm each. The SO_2 response time was 35 seconds where as the NO_2 response time was 25 seconds. Re-calibration was needed daily using span gases purchased from Pine Environmental to ensure accurate readings. This re-calibration consisted of filling tedlar bags with the span gases and ensuring the VRAE read them according to their specified concentrations. The SO_2 and NO_2 had span gas concentrations of 5 ppm each (RAE systems Website, 2010).

The RKI Eagle® was calibrated prior to receipt and was not required to be recalibrated daily. This instrument was used to monitor 0_3 concentrations using an electrochemical gas sensor that had a range of 0 – 1.00 ppm. The resolution was 0.01 ppm. For each sampling period this instrument was turned on and its diagnostic self tests were run prior to sampling. The response time for the RKI Eagle® reading was 30 seconds (RKI Instruments Website, 2010).

The DustTrak Aerosol Monitor® was initially calibrated by TSI Inc., manufacturer of the unit. This instrument was used to obtain samples for $PM_{2.5}$ and PM_{10} and utilized a 90-degree light scattering, laser diode sensor that had a range of 0.001 – 100mg/m^3 with a resolution of 0.001 mg/m^3. Each day a zero calibration needed to be performed prior to the afternoon reading. I cleaned the $PM_{2.5}$ nozzle every week as directed in the manual to ensure accurate readings (TSI website 1, 2010).

The Q-Trak IAQ Monitor® for CO gas was calibrated daily using the span gas provided by the USEPA. The electrochemical sensor had a range of 0 – 500 ppm and a resolution of 1 ppm. The response time was less than 60 seconds (TSI website 2, 2010).

2.3 Sampling Methodology

Air pollutant concentrations were measured for five out of the six NAAQS Criteria Pollutants: O_3, NO_2, SO_2, CO, and PM (2.5 and 10). Table 2-1 lists the NAAQS concentrations for short- and long-term exposure (US EPA website 3, 2010). I collected summer and winter data for two weeks in each season to be able to analyze the data for seasonal differences in concentrations. My summer sampling period was July 16th to July 27th 2007. My winter sampling period was February 18th to February 29th, 2008. Since I was interested in the workweek rush hour timeframes, samples were only collected Monday through Friday.

Samples were collected once per hour at each location during the morning and evening rush hour. Four samples were collected each morning and four samples were collected each evening for each pollutant at each location. Morning rush hour samples were collected from 6:30 am to approximately 10:30 am. Evening rush hour samples were collected from 3:30 pm until approximately 7:30 pm. Samples were not collected during any period of precipitation as accurate samples would not be obtained during these events and the equipment could become damaged.

Travel times for the Southeast Expressway/I-93/Rte. 3 between Braintree and Boston were recorded using SmarTraveler Traffic Reports (SmarTraveler Website, 2008) each hour during both the morning and evening rush hours during the workweek. Travel times were collected for both the Northbound and Southbound traffic directions during each rush hour time frame from 6:30 am to approximately 10:30 am and 3:30 pm to approximately 7:30 pm. Travel times were given in minutes in each direction.

Weather conditions for temperature, wind speed and wind direction were obtained from Boston, Logan International Airport, MA (KBOS) from the National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NOAA Website, 2008). The hourly reports were obtained from 6:00 am to 11:00 am and from 3:00 pm until 8:00 pm during the daily sampling time periods.

2.4 Data Analysis

My initial approach to analyzing the data was through statistical analysis. All of my pollutant concentration data were entered into SPSSInc\ PASWStatistics18. I first checked the normality of all the data and attempted to transform the data since the data collected were found to be not normal. Each transformation I attempted did not achieve normality. I realized I would have to attempt to use non-parametric statistics in my analysis of the data. Since my initial thoughts were to compare the means of each of my locations to each other and the NAAQS, I chose to use the Kruskal-Wallis Test. This test produced medians as opposed to means, thus would not result in what I wanted to initially compare in my thesis, which would be the statistical means of my concentrations to the NAAQS. I determined that a descriptive graphical analysis of the data rather than a statistical analysis would be the best approach to analyzing the data.

All of my pollutant concentrations that had non-detect levels were given half the detection limit of the piece of equipment used to obtain the sample concentration. A four-hour moving average was taken in order to smooth the data for graphing. The moving average works to smooth out random fluctuations in the data, sharpening the focus of the trends and allowing general trends in the data to show up more clearly (Berthouex and Brown, 2002). All four-hour average units for $PM_{2.5}$ and PM_{10} were converted from mg/m^3 to ug/m^3 in order to correspond to the NAAQS units of measure.

All of these four-hour moving average concentrations were plotted using bar graph plots for their two week summer and two week winter sampling periods using Microsoft Excel. A reference line was added to each graph to correspond to the NAAQS concentration. Due to the high percentage of non-detect readings for CO and SO_2 in summer and O_3 and CO in winter, these graphs will not be included for analysis as they are well below the NAAQS as well as below the detection limit.

The travel times were averaged over their morning and evening sampling periods for both northbound and southbound travel lanes to obtain the average travel time in minutes for the morning and evening commute per day. These average travel times were plotted graphically using Microsoft Excel.

The temperature data were averaged using a four-hour moving average from the NOAA KBOS hourly reports and the results were plotted graphically using Microsoft Excel. The wind speed and wind direction data were plotted using Lakes Environmental WRPlotview® software to create a Wind Rose Plot. A separate Wind Rose Plot Graph was done for the summer 2007 and winter

2008. The graph categorizes wind speed and direction using frequencies of the data in order to get the predominant wind direction per season as well as average wind speeds. The data were converted to Lakes Format to be entered into the software. Lakes Format is a Microsoft Notepad document that must start with the title “Lakes Format” and the following column information as shown in Table 2-2.

1	Station ID
2	Year
3	Month (1-12)
4	Day (1 – 31)
5	Hour (0-23)
6	Wind Direction (degrees)
7	Wind Speed (Knots)

Table 2-2: Lakes Format Column information for Notepad document for upload of wind data into Lakes Environmental WRPLOT® software.

Wind direction was converted from compass points to degrees. Wind speed was converted from miles per hour to knots for analysis, and all numbers were rounded to the nearest whole knot. Using all the graphs produced, comparisons were made using the four-hour moving average concentrations to the NAAQS as well as analysis between locations. I wanted to compare the levels I obtained over eight hours during the high traffic times (four hours in the morning and four hours in the evening) to the eight-hour or 24-hour NAAQS. NO_2 only has a one-hour or annual standard. Therefore, NO_2 concentrations were compared to the one-hour NAAQS standard. O_3 concentrations were compared to the eight-hour. NAAQS Standard. SO_2, $PM_{2.5}$ and PM_{10} concentrations were compared to the 24-hour NAAQS standard.

Temperature and wind speed/direction graphs were descriptively analyzed for any potential association with the pollutant concentrations. Travel times were also descriptively analyzed for any potential connection with the pollutant concentrations.

3.0 Results

This section includes graphical plots of the four-hour moving average concentrations for each pollutant studied at each of the nine locations where measurements were obtained. This section also includes graphical results for average daily temperature as well as wind rose plots of wind speed and direction over the summer 2007 and winter 2008 and graphical results of northbound and southbound commuting times for the summer 2007 and the winter 2008 sampling periods.

3.1 Air Quality Pollutant Concentration Graphs for all locations

All data tables associated with the air quality pollutant graphs found in this section are located in Appendix 2 for summer 2007 and Appendix 3 for winter 2008. Due to the high percentage of non-detect readings for CO and SO_2 in summer 2007 as well as CO and O_3 in winter 2008, graphs for these pollutants are not included as the measurement data are well below the NAAQS.

3.1.1 NO_2 four-hour moving average concentration in summer 2007

Figure 3-1 shows the four-hour moving average concentrations of NO_2 in ppm for each of the nine sampling locations in the summer 2007 sampling period. There is a reference line for the NAAQS one-hour standard of 0.10 ppm NO_2. There does appear to be a diurnal pattern in pollution concentrations increasing and decreasing in a similar daily time frame over the nine locations; however there appears to be a difference in concentration when comparing these increases and decreases. Pollutant concentrations show high peaks above all other locations over the same time frame at Location 4 with a four-hour moving average concentration peak of 3.35 ppm and at Location 6 with a peak of 3.18 ppm on July 27th. Another high peak is observed for Location 1 with a four-hour moving average concentration peak of 2.48 ppm on July 18th. Most locations have an increase in NO_2 concentration on the 18th into the 19th with the highest peak of that period being at Location 1. Location 2 has a peak of 1.55 ppm on July 19th, the day after the peak at Location 1. Another increase period is at the end of the sampling period from the 26th to the 27th with high peak concentrations at locations 4 and 6. Most areas are under 1.0 ppm over the course of sampling period; however there are many days on which measurements are above the NAAQS one-hour standard of 0.10 ppm at all locations.

3.1.2 NO_2 four-hour moving average concentration in winter 2008

Figure 3-2 shows the four-hour moving average concentrations of NO_2 in ppm for each of the nine sampling locations in the winter 2008 sampling period. There is a reference line for the NAAQS one-hour standard of 0.10 ppm NO_2. Pollutant concentrations are above the NAAQS for three to four out of the total eight sampling days at all locations. The graphs indicate that the levels of NO_2 are elevated in this entire area over many of the four-hour average concentration plots over all days, not just the peak episodes which are three to four times higher than the standard. There appears to be a diurnal pattern in pollution concentrations over the nine locations similar to the summer 2007 sampling period and there also appears to be a difference in concentrations when comparing these increases and decreases. Pollutant concentrations show highest peaks on February 20th, 21st, 26th into the 27th, and on the 29th. The four-hour moving average pollutant concentrations ranges from 0.05 ppm at Location 1 to 0.58 ppm at Location 6 on the 20th, 0.25 ppm at location 4 to 0.65 ppm at Location 7 on the 21st, 0.35 ppm at Location 7 to 0.55 ppm at Location 2 on the 26th into the 27th, and 0.24 ppm at Location 1 to 0.73 ppm at location 8 on the 29th. Location 6 shows a high concentration period from the 19th through to the 21st with elevated concentrations over the NAAQS over this entire period, with a peak of 0.53 ppm on the 20th. Location 8 has the highest four-hour moving average pollutant concentration of 0.73 ppm on February 29th, which is over seven times the NAAQS one-hour standard for NO_2. Overall concentrations of NO_2 are lower during the winter sampling period and higher during the summer.

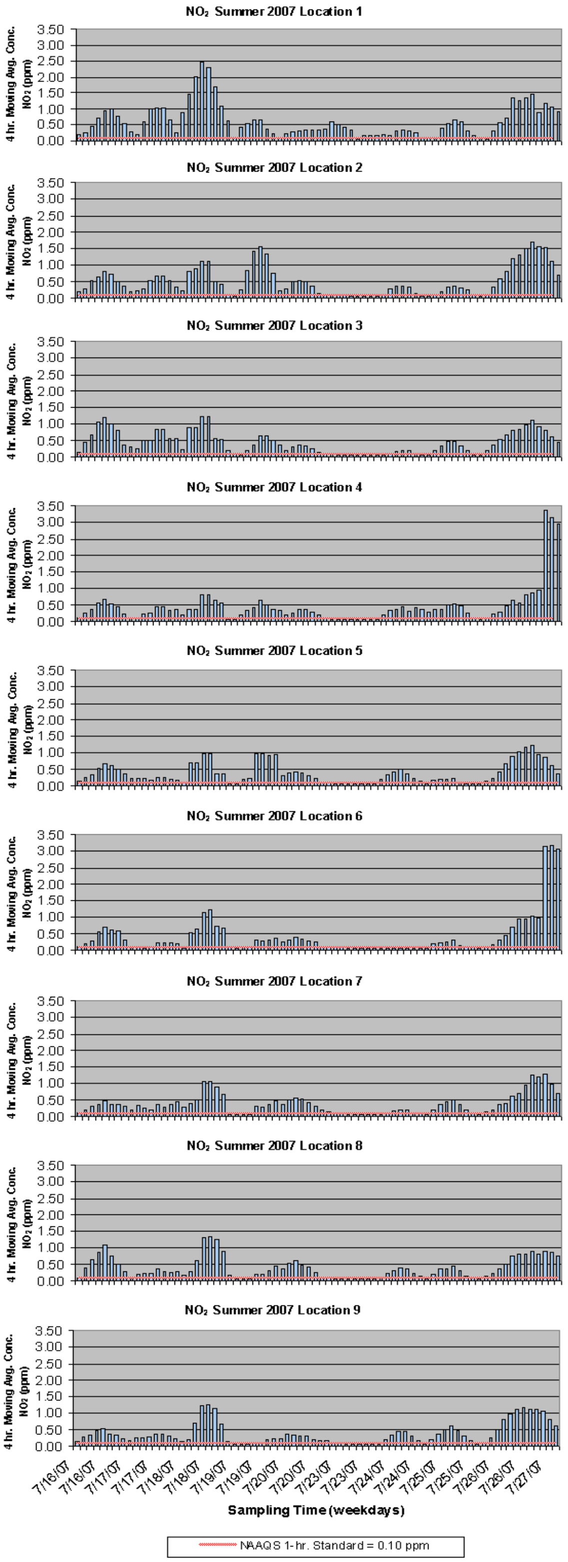

Fig. 3-1: Four-hour moving average concentration of NO_2 summer 2007.

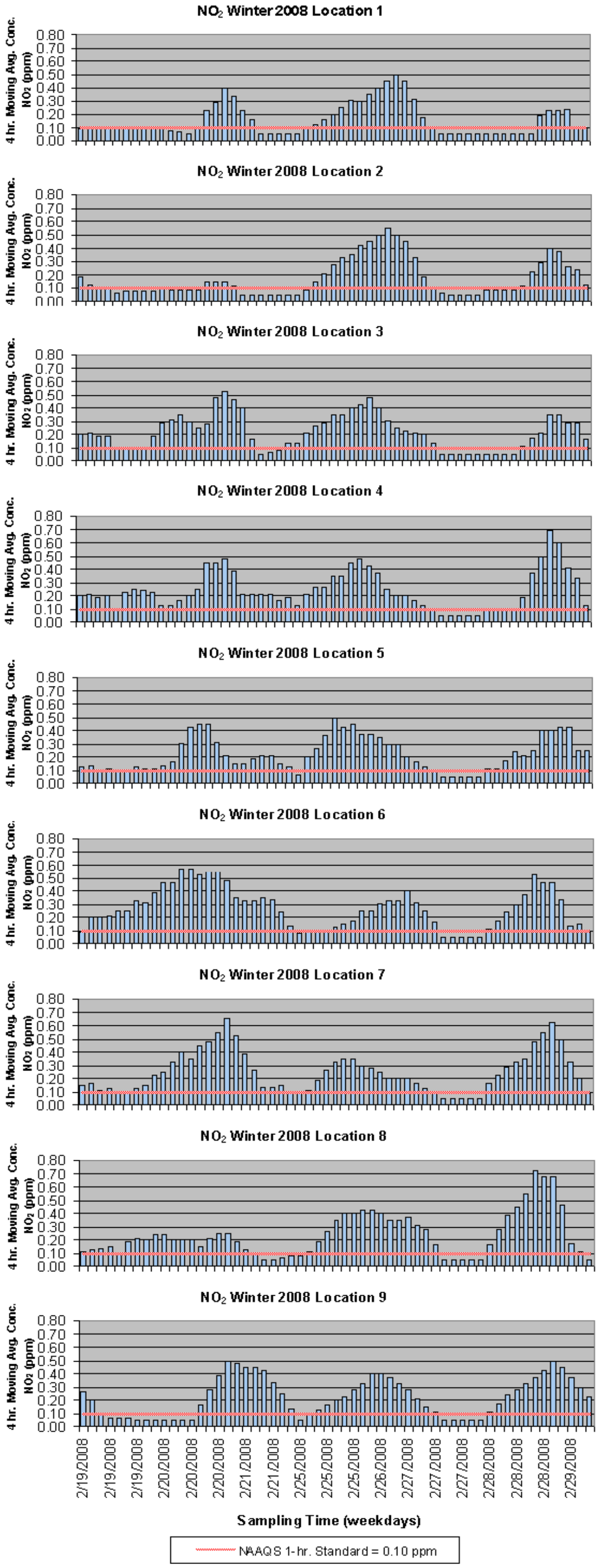

Fig. 3-2: Four-hour moving average concentration of NO$_2$ winter 2008.

3.1.3 $PM_{2.5}$ four-hour moving average concentration in summer 2007

Figure 3-3 shows the four-hour moving average concentrations of $PM_{2.5}$ in ug/m^3 for each of the 9 sampling locations in the summer 2007 sampling period. There is a reference line for the NAAQS 24-hr standard of 35 ug/m^3 $PM_{2.5}$. Pollutant concentrations show highest peaks at all locations on July 18th, 19th, and 20thwith a drop in concentrations over the weekend from Friday July 20th to Monday July 23rd. Another peak period is the 25th and 26th. The four-hour moving average concentrations are above the NAAQS 24-hour standard of 35 ug/m^3 on the 18th to the 20th with a peak four-hour moving average concentration range of 82.75 ug/m^3 at Location 5 to 94.75 ug/m^3 at Location 8 on July 18th and a peak four-hour moving average concentration range of 89.5 ug/m^3 at Location 9 and 105.75 ug/m^3 at Location 3. Concentrations are also over the standard on the 25th into the 26th as well with peak concentrations of 55.0 to 58.75 ug/m^3 found across all sites. There appears to be very similar concentrations among the nine locations with little variability due to location within the sampling area.

3.1.4 $PM_{2.5}$ four-hour moving average concentration in winter 2008

Figure 3-4 shows the four-hour moving average concentrations of $PM_{2.5}$ in ug/m^3 for each of the nine sampling locations in the winter 2008 sampling period. There is a reference line for the NAAQS 24-hour standard of 35 ug/m^3 $PM_{2.5}$. Pollutant concentrations show highest peaks at all locations the beginning of the second week on February 25th and 26th. There are low concentrations for the first week, which have readings only for Tuesday the 19th through Thursday the 21st due to inclement weather on both the 18th and the 22nd. After the peak on the morning of the 26th, concentrations drop back below the standard from the 27th to the 29th. Location 9 has an increase in $PM_{2.5}$ on the 29th to 27.25 ug/m^3, which is below the standard, but almost three times higher than any other location on that day. No readings were collected in the evening sampling period on the 26th due to inclement weather conditions. Peak concentrations range from a four-hour moving average concentration of 33.5 ug/m^3 at Location 5 to 39.0 ug/m^3 at Location 2 on the 25th and 69.75 ug/m^3 at Location 3 to 77.0 ug/m^3 at Location 2 on the 26th. There appears to be very similar concentrations among the nine locations with little variability due to location within the sampling area. Overall concentrations of $PM_{2.5}$ are lower during the winter sampling period and higher during the summer.

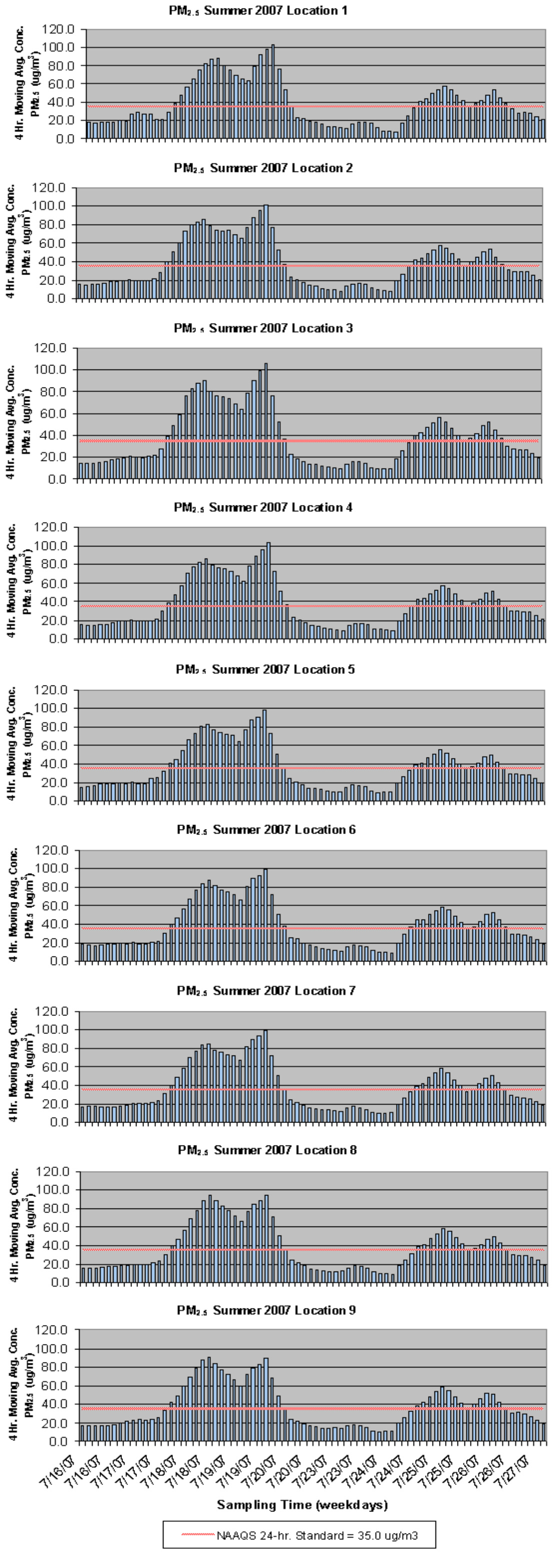

Fig. 3-3: Four-hour moving average concentration of $PM_{2.5}$ summer 2007.

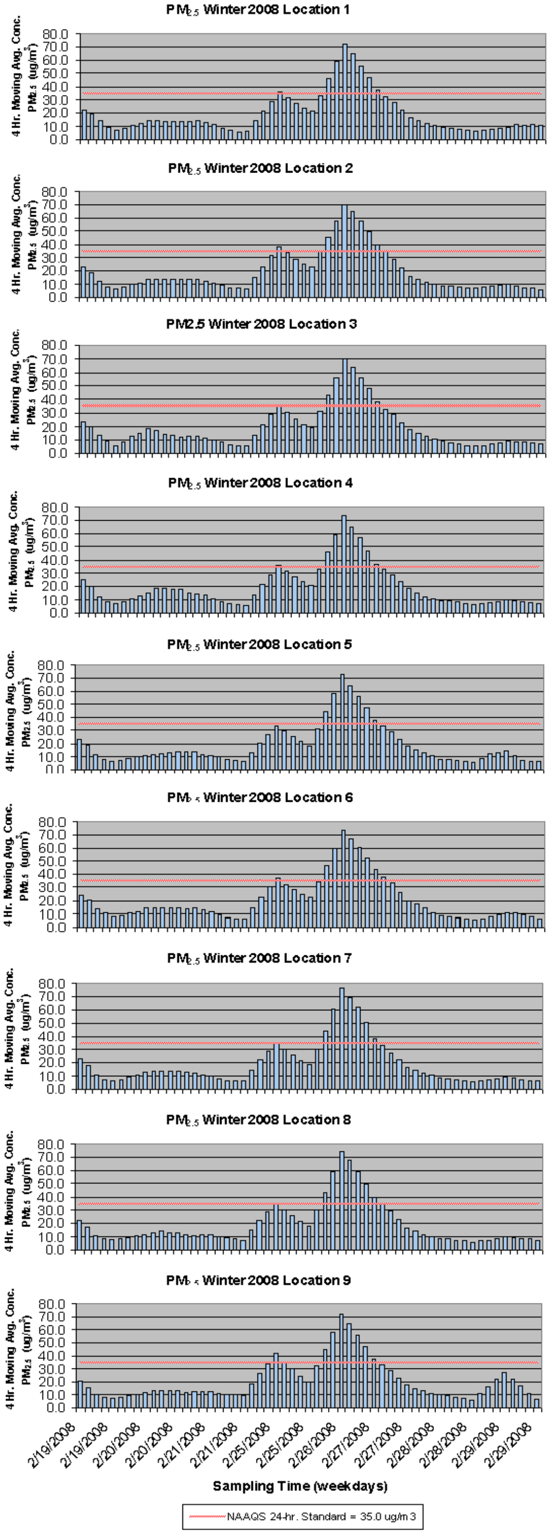

Fig. 3-4: Four-hour moving average concentration of $PM_{2.5}$ winter 2008.

3.1.5 PM_{10} four-hour moving average concentration in summer 2007

Figure 3-5 shows the four-hour moving average concentrations of PM_{10} in ug/m^3 for each of the nine sampling locations in the summer 2007 sampling period. There is a reference line for the NAAQS 24-hour standard of 150 ug/m^3 PM_{10}. Pollutant concentrations show highest peaks at all locations on July 18th and 20th. Another peak period is on the 25th and 26th both of which follow a pattern similar to the summer 2007 $PM_{2.5}$ data peaks, as shown in Figure 3-3. The four-hour moving average concentrations are below the NAAQS 24-hour standard of 150 ug/m^3 over the entire summer 2007 study period. Peak four-hour moving average concentrations range from 89.0 ug/m^3 at Location 2 to 97.0 ug/m^3 at Location 8 on July 18th; and range from 94.75 ug/m^3 at Location 9 to 107.5 ug/m^3 at Location 3 on the 20th. There appear to be similar concentrations among the nine locations with little variability due to location within the sampling area. These pollutants also appear to follow a similar cycle compared to the summer 2007 $PM_{2.5}$ graph with little variation based on location within the sample area, as shown in Figure 3-3.

3.1.6 PM_{10} four-hour moving average concentration in winter 2008

Figure 3-6 shows the four-hour moving average concentrations of PM_{10} in ug/m^3 for each of the nine sampling locations for the winter 2008 sampling period. There is a reference line for the NAAQS 24-hr standard of 150 ug/m^3 PM_{10}. The pollutants follow a cycle similar to the $PM_{2.5}$ concentration graph with little variation based on location within the sample area, as shown in Figure 3-4.

Pollutant concentrations show highest peaks at all locations at the beginning of the second week on February 25th and 26th. There are low concentrations for the first week which have readings taken only on Tuesday the 19th through Thursday the 21st due to inclement weather on both the 18th and the 22nd. After the peak on the morning of the 26th, concentrations drop below the NAAQS from the 27th to the 29th. Only Location 9 had an increase in PM_{10} on the 29th to 45.75 ug/m^3, which was still below the standard. No readings were collected in the evening sampling period on the 26th due to inclement weather conditions. Peak concentrations range from a four-hour moving average concentration of 33.5 ug/m^3 at Location 5 to 39.0 ug/m^3 at Location 2 on February 25th and 69.75 ug/m^3 at Location 3 to 76.5 ug/m^3 at Location 7 on February 26th. The PM_{10} peak periods on the 25th and 26th follow a similar pattern of the $PM_{2.5}$ data peaks on the same dates, as shown in Figure 3-4. Average concentrations are below the NAAQS 24-hr standard of 150 ug/m^3 over the entire winter 2008 study period. Overall concentrations of PM_{10} are lower during the winter sampling period and higher during the summer.

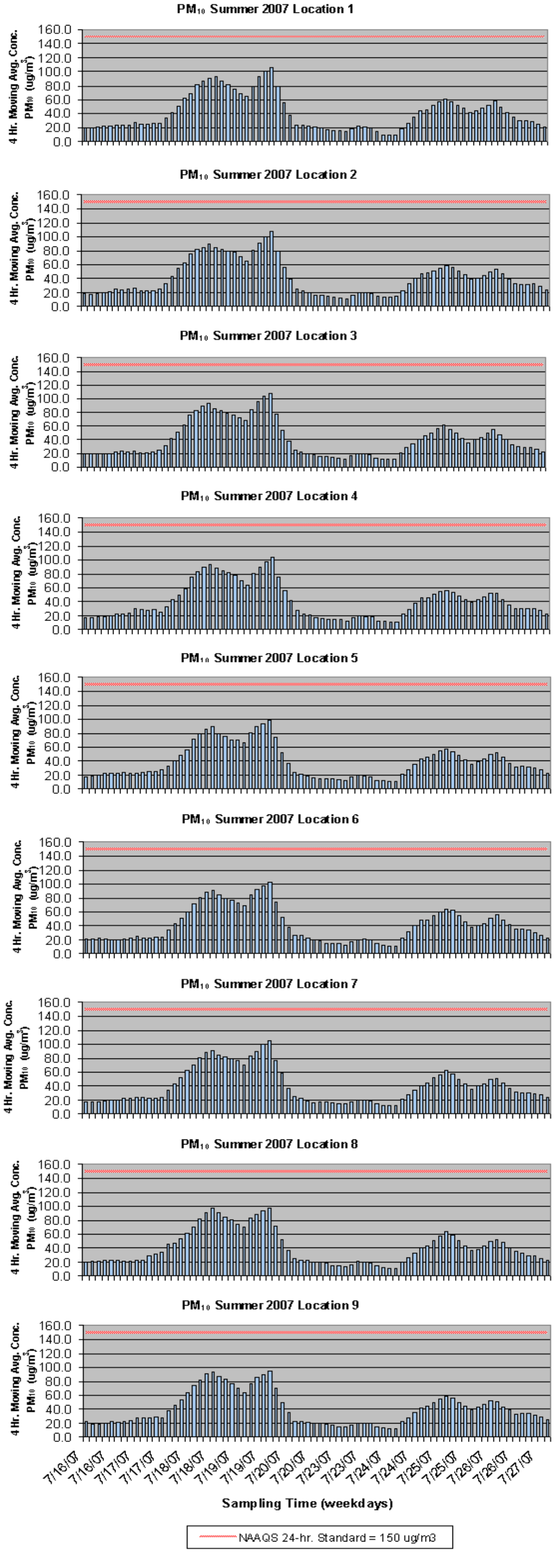

Fig. 3-5: Four-hour moving average concentration of PM_{10} summer 2007.

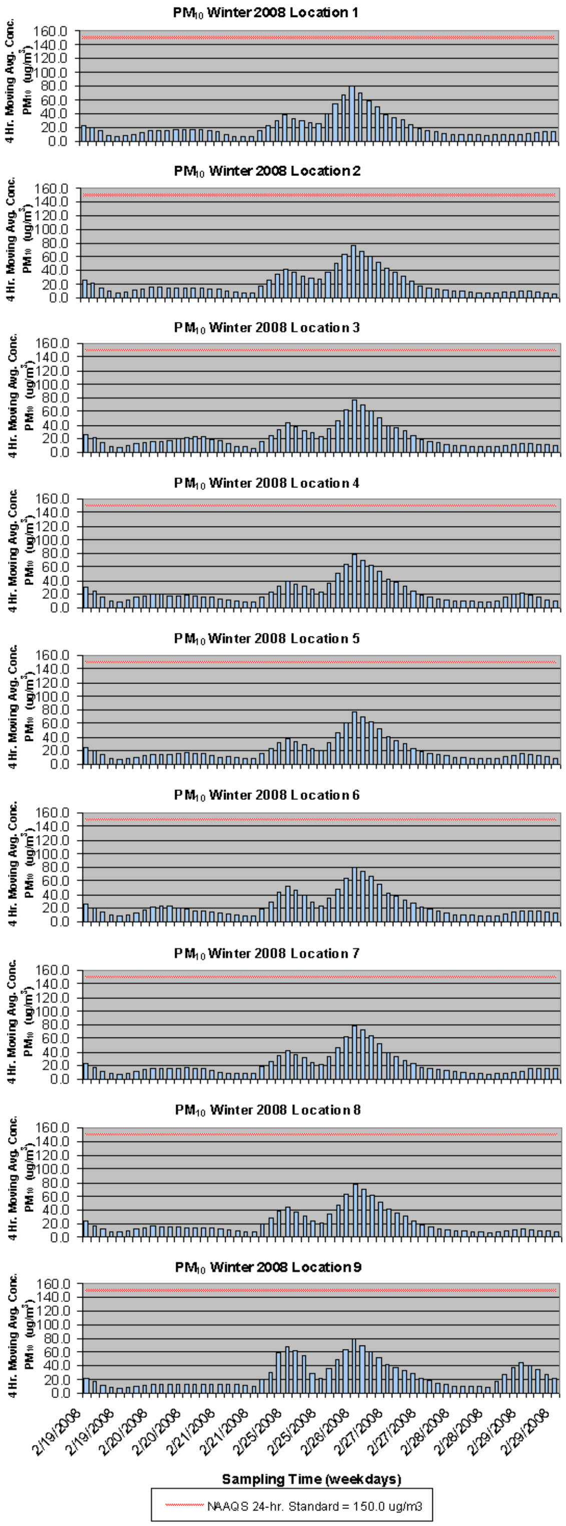

Fig. 3-6: Four-hour moving average concentration of PM$_{10}$ winter 2008.

3.1.7 O_3 4-hr moving average concentration in summer 2007

Figure 3-7 shows the four-hour moving average concentrations of O_3 in ppm for each of the nine sampling locations in the summer 2007 sampling period. There is a reference line for the NAAQS 8-hr standard of 0.075 ppm O_3. Pollutant concentrations show a diurnal cycle with daily peaks associated with the evening concentrations each day and lowest levels in the morning. The first week indicates the start of increasing O_3 and then on the 18th and 19th, O_3 levels decrease to low levels. The second week shows another pattern in which the O_3 concentrations are increasing from the 23rd to the 27th, with a four-hour moving average concentration peak shown on Thursday evening, July 26th. Location 7 concentrations drop off on the 27th to a four-hour moving average concentration of 0.005 ppm O_3 or half the detection limit, whereas all other locations still increase to approximately 0.040 ppm $O_{3.}$ The four-hour moving average concentration exceeds the NAAQS only on the 26th at all locations. Locations 5 and 8 have the highest average concentrations of O_3 on the 26th, 0.83 and 0.85 ppm O_3 respectively. Winter 2008 concentrations were mostly below the detection limit and do not approach the NAAQS; therefore, they were not plotted graphically. Overall concentrations of O_3 are higher during the summer sampling period.

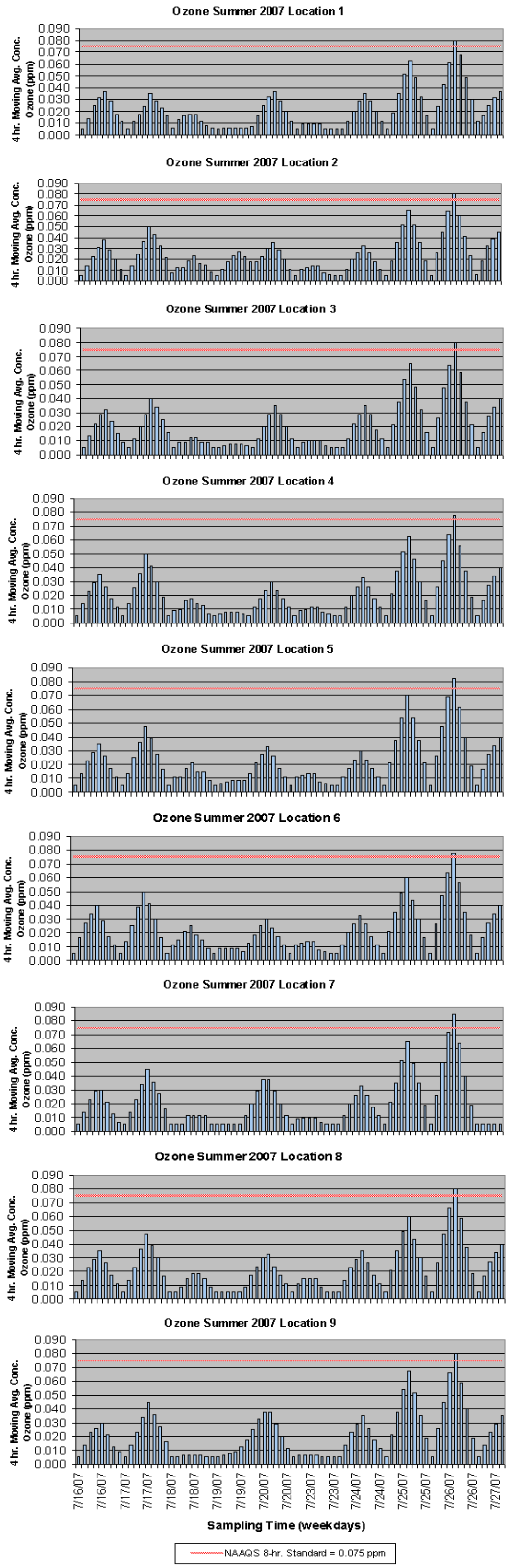

Fig. 3-7: Four-hour moving average concentration of O_3 summer 2007.

3.1.8 SO_2 four-hour moving average concentration in winter 2008

Figure 3-8 shows the four-hour moving average concentrations of SO_2 in ppm for each of the nine sampling locations in the winter 2008 sampling period. There is a reference line for the NAAQS 24-hr standard of 0.14 ppm SO_2. Pollutant concentrations are low during most of the sampling period, with three locations having peak concentrations on the 19th and 20th at or above the NAAQS 24-hr standard. The peak four-hour moving average concentration was 0.19 ppm at Location 2 and 0.14 ppm at Location 6 on the 20th. Location 8 had a peak four-hour moving average concentration of 0.38 ppm on the 19th and 0.14 ppm on the 20th. Most of the samples are below the detection limit at all locations with the exception of these peaks. Summer 2007 concentrations were mostly below the detection limit and did not approach the NAAQS; therefore, they were not plotted graphically. Concentrations of SO_2 are highest on February 19th and 20th at Locations 2, 6, and 8 during the winter sampling period.

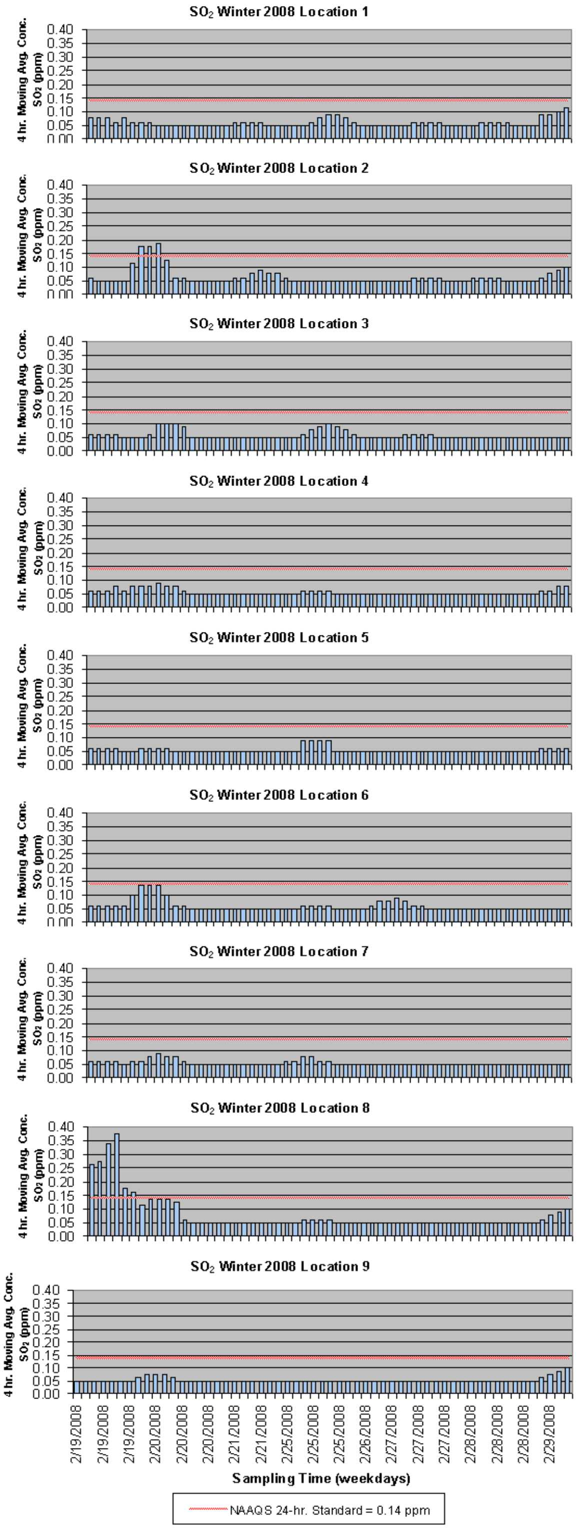

Fig. 3-8: Four-hour moving average concentration of SO_2 winter 2008.

3.2 Meteorological Data Graphs

All data tables associated with the meteorological graphs found in this section are located in Appendix 4 for summer 2007 and Appendix 5 for winter 2008.

3.2.1 The four-hour moving average temperature July 2007

Figure 3-9 shows the four-hour moving average temperature for the July 2007 sampling period.

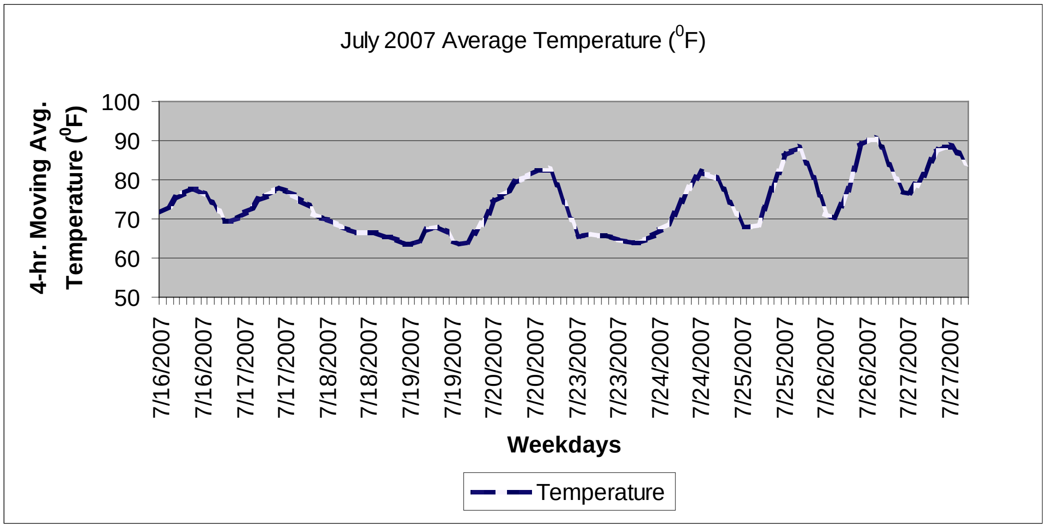

Fig. 3-9: Four-hour moving average temperature July 2007.

The temperature ranged from the low 60s to around 90^0F over the summer sampling period. A daily heating cycle is evident with peaks showing the daily high temperatures and the dips showing the morning lows. Daytime heating and evening cooling patterns during this period are evident. The first week of sampling is cooler with most of the daily averages below 80^0F and the second week with high temperatures over 80^0F each day. Light rain occurred during the evening sampling period on Thursday July 19th, and therefore no samples were obtained. Temperatures are lower during this time frame as reflected on the graph.

3.2.2 The four-hour moving average temperature February 2008

Figure 3-10 shows the four-hour moving average temperature for the February 2008 sampling period.

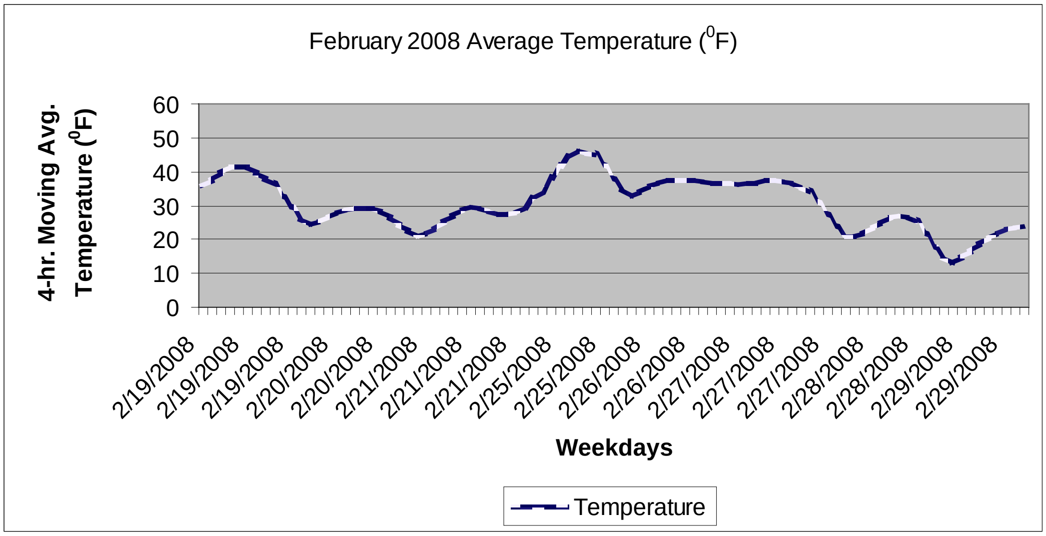

Fig. 3-10: Four-hour moving average temperature February 2008.

The temperature range is from the low teens to the upper 40s (^{0}F) over the winter sampling period. A daily heating cycle is also evident during this sampling period, but has less daily range than during the summer months. This is seen with peaks showing the daily high temperatures and the dips showing the lows. A cooling trend is shown each week with the start of each week higher in temperature than the end of the each week. Temperatures start off in the 40s (^{0}F) both weeks and drop to a low of 20^{0}F on the 21st and to a low in the lower teens (^{0}F) by the 29th. A rain event occurred all day on February 19th and also during the evening sampling period on February 26th. A snow event occurred on February 22nd. During all of these events, no samples were collected.

3.2.3 Wind Rose Plot July 2007

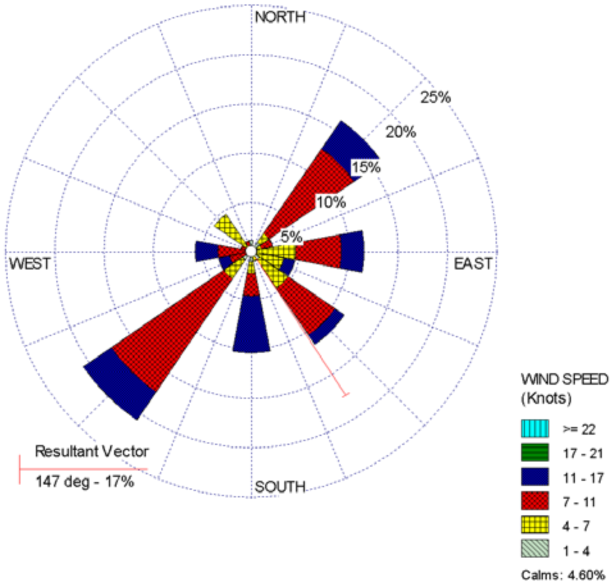

Fig. 3-11: Wind Rose Plot of July 16th to July 29th 2007 Wind Data. Data obtained from Boston, Logan International Airport, MA (KBOS)

The Summer 2007 Wind Rose Plot in Figure 3-11 shows winds originating predominantly from the southwest and northeast, with lesser frequency of winds originating from the south, south east, east and west. The highest frequency of wind speeds from all directions is found in the 7 – 11 knot range. The resultant vector shows an overall average wind direction for this period of south southeast.

3.2.4 Wind Rose Plot February 2008

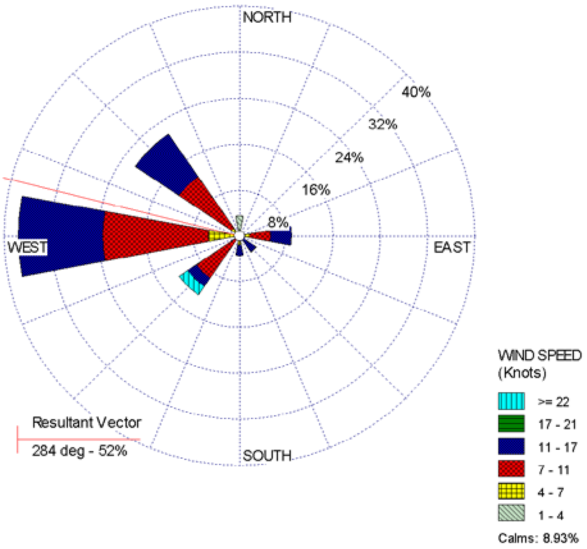

Fig. 3-12: Wind Rose Plot of February 19th to 29th 2008 Wind Data. Data Collected from Boston, Logan International Airport, MA (KBOS)

The Winter 2008 Wind Rose Plot in Figure 3-12 shows winds originating predominantly from the west, northwest and southwest, with lesser frequency of winds originating from the south, southeast, east and north. The highest frequencies of wind speeds from all directions are found in the 7–11 and 17-21 knot ranges. The resultant vector shows an overall average wind direction for this period of west northwest.

3.3 Travel Times between Braintree and Boston, MA

All data tables associated with the travel time graphs found in this section are presented in Appendix 6 for summer 2007 and Appendix 7 for winter 2008.

3.3.1 Average morning rush-hour commute travel times between Braintree and Boston, MA July 2007

Figure 3-13 shows the average morning rush hour commute travel times in both the north and southbound direction between Braintree and Boston, MA over the July 2007 sampling period.

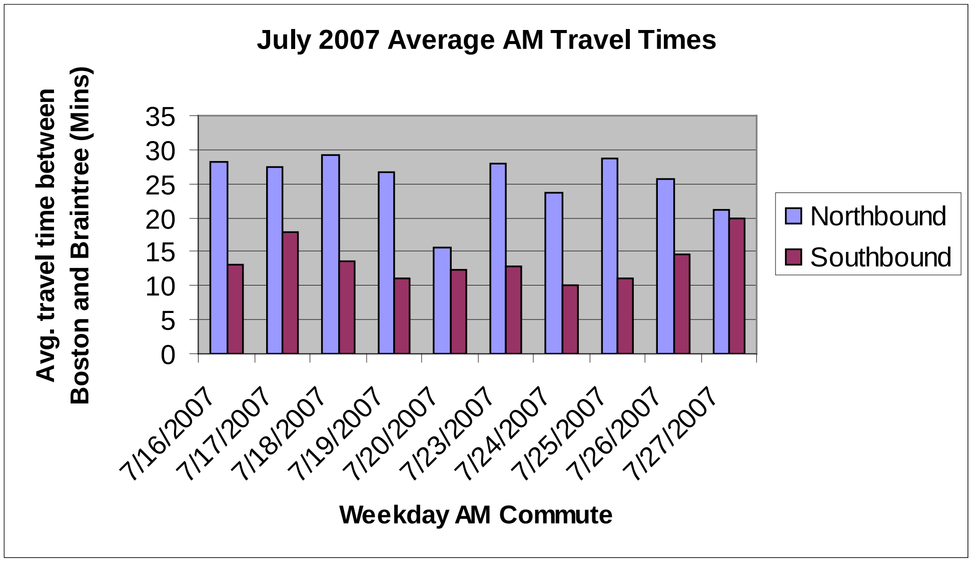

Fig. 3-13: Average morning rush-hour travel times between Braintree and Boston, MA July 2007.

Most of the northbound or inbound travel times range from 25 to 30 minute rides into the city with the exception of Friday of each week with July 20th showing an average travel time of 15 minutes and July 27th showing a 20 minute average travel time. The southbound commute time is less than the northbound commute time with an average time of 10 to 15 minutes over the period, with the exception of Friday July 27th where the northbound and south bound travel times average about 20 minutes during the morning commute.

3.3.2 Average evening rush-hour commute travel times between Braintree and Boston, MA July 2007

Figure 3-14 shows the average evening rush hour commute travel times in both the northbound and southbound directions between Braintree and Boston, MA over the July 2007 sampling period.

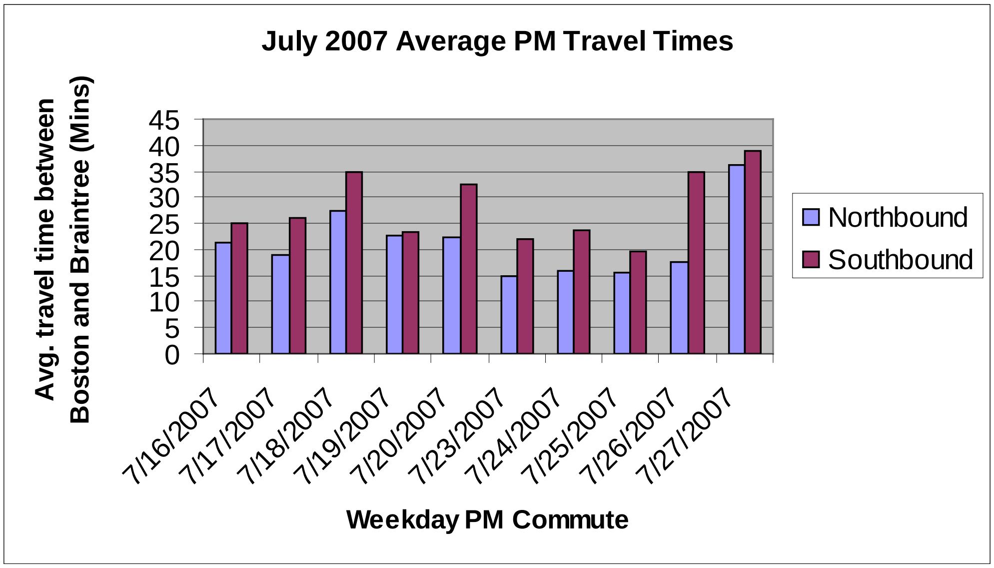

Fig. 3-14: Average evening rush-hour travel times between Braintree and Boston, MA July 2007.

Most of the northbound or inbound travel times range from 15 to 25 minute rides into the city with the exception of Friday July 27th showing an average travel time of 35 minutes. The southbound average commuting time does not differ as much from the northbound commute time as the morning graph indicates. The southbound evening rush hour commute has an average time of 20 to 35 minutes over the period, with the exception of Friday July 27th when the northbound and southbound travel times are over 35 minutes during the evening commute.

3.3.3 Average morning rush-hour travel times between Braintree and Boston, MA February 2008

Figure 3-15 shows the average morning rush-hour commute travel times in both the northbound and sound bound directions between Braintree and Boston, MA over the February 2008 sampling period.

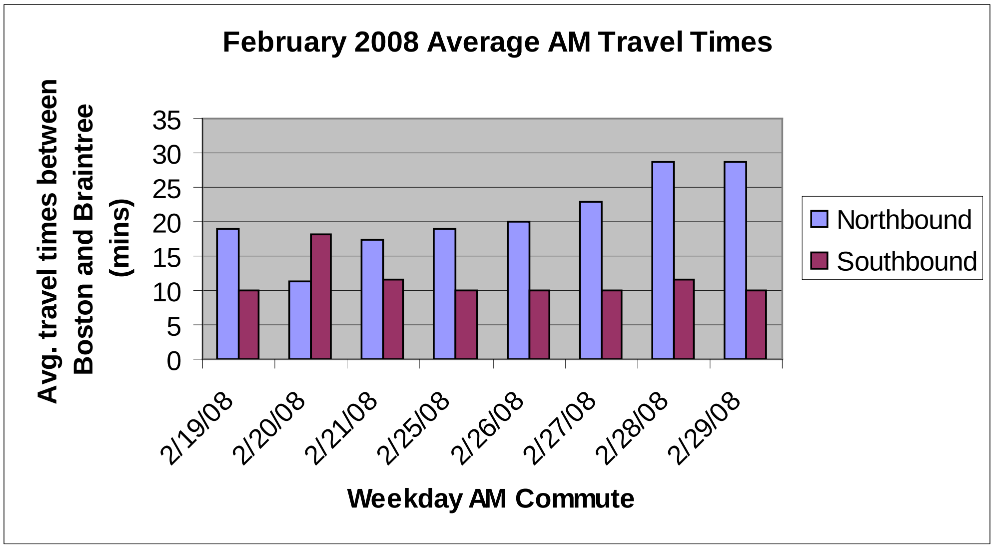

Fig. 3-15: Average morning rush-hour travel times between Braintree and Boston, February 2008.

Most of the northbound or inbound travel times range from 15 to 25 minute rides into the city. The southbound commute is less than the northbound commute during the morning rush hour with an average time of 10 to 12 minutes over the period. The first week of sampling was the Massachusetts February 2008 School vacation week where all primary and secondary schools have a week off. This could account for the lower northbound travel times during the morning commute during the first week of the sampling period than occur during the second week. During the second week, the graph shows a difference between northbound and southbound travel times.

3.3.4 Average evening rush-hour commute travel times between Braintree and Boston, MA February 2008

Figure 3-16 shows the average evening rush-hour commute travel times in both the northbound and southbound directions between Braintree and Boston, MA over the February 2008 sampling period.

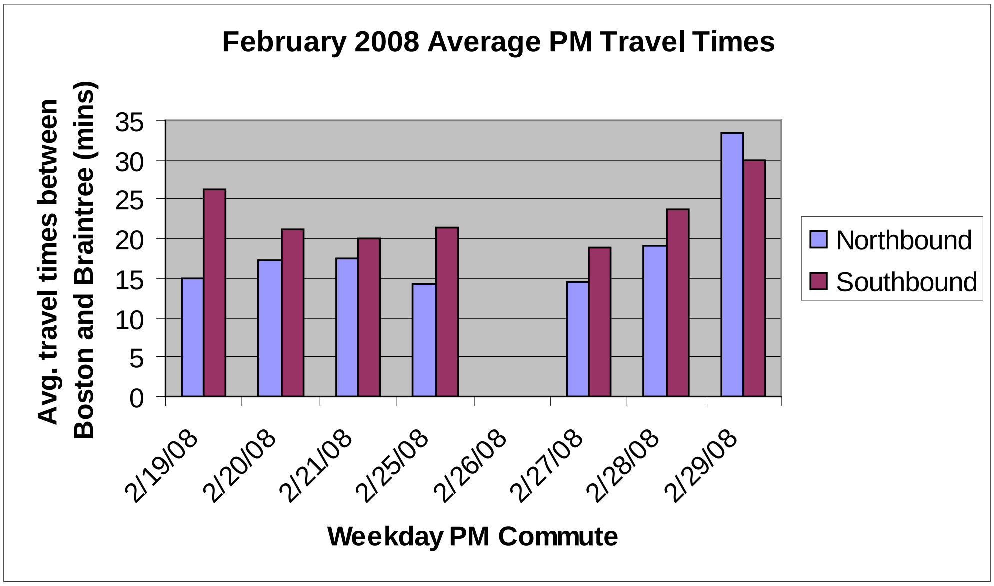

Fig. 3-16: Average evening rush-hour travel times between Braintree and Boston, February 2008.

Most of the northbound or inbound travel times range from 15 to 20 minute rides into the city with the exception of Friday, February 29th with a northbound commute time of over 30 minutes. The Southbound commute has higher average travel times than the northbound commute during the evening rush hour with an average time of 20 to 30 minutes over the period. The first week of sampling was the Massachusetts February 2008 School vacation week where all schools have a week off.

4.0 Discussion

This section includes the discussion of the overall results of my thesis, including possible factors influencing the concentrations of each air pollutant studied. This includes discussion of seasonal and meteorological influences as well as the results of the I-93 travel time analysis.

4.1 Overview of Findings

Concentrations of NO_2, O_3, and $PM_{2.5}$ were higher than the NAAQS over multiple sampling periods in the study neighborhood as shown in the graphical plots. Statistical hypothesis testing was unable to be done in this thesis as discussed in the methodology section, so descriptive graphical analysis was performed. This demonstrated episodes of higher levels of pollutants than allowed by the NAAQS.

A principal source of air pollutants for this neighborhood is motor vehicle exhaust generated on the major highways and other roadways surrounding the study area. Prevailing winds generally blow from the northwest in winter and the southwest in summer for the Boston Harbor area (National Park Service, Dept. of the Interior Website, 2010). This places the Savin Hill OTB neighborhood directly downwind of I-93 in both seasons. During the thesis sampling periods, winds blew from the southwest and northeast for summer and mainly from the west during the winter based on the hourly data from Boston Logan International Airport (KBOS) (Figures 3-11 and 3-12). This wind direction distributed air pollutants over the neighborhood, and affected air quality for the residents.

A study by Oguri and Hasegawa found that the concentration of vehicle emissions downwind of a highway source decreased with distance from an urban highway with heavy traffic. They used Particle Induced X-Ray Emissions (PIXE) Analysis to determine the concentration of particles emitted from vehicles traveling on the Loop-No.7 highway just outside of Tokyo, Japan. The authors attributed a concentration decrease in pollutants with distance from the highway by dispersion into the atmosphere. They did not find a clear relationship in the upwind direction. They concluded that the analysis of particulate samples collected simultaneously at three sampling sites measured downwind of the highway demonstrated that regions 300 to 400 meters from the highway can be affected by emissions from automobile traffic (Oguri and Hasegawa, 2001). They also performed a numerical calculation on the atmospheric dispersion near the highway using an analytical plume model, taking into account vertical mixing height and dispersion to further support their findings. My study looked only at wind direction and not at any other meteorological factors. Figure 2-1 from the Boston Redevelopment Authority, shows the width of the Savin Hill OTB neighborhood from the Southeast Expressway to Morrissey Blvd. is approximately 600m. The majority of the sampling locations were located within approximately 300m east of the highway with two located on the western side of the highway (Locations 1 and 9) and one at approximately 500m east of the highway (Location 3) closest to Morrissey Blvd.

A study of ultra fine particles, those particles smaller than 0.1 um in diameter (US EPA Website 9, 2011), demonstrated that wind speed and direction influenced particle concentration distribution in a near highway environment (Zhu et al., 2002). The authors found that the stronger the wind speed, the lower the total particle number concentration. Wind speed can play a role in dilution and dispersion of particulate emissions measured in the study area. Many of the pollutants followed diurnal concentration patterns due to traffic and sunlight as well as daytime increase in sunlight and temperatures during the summer sampling period.

4.2 Particulate Matter 2.5 and 10

$PM_{2.5}$ and PM_{10} concentrations did not differ significantly among location over the entire sampling area. There was no evidence in the graphical analysis demonstrating different patterns of concentrations of the particulate pollution or significant variability over the sampling area. The concentrations of PM_{10} did not exceed the NAAQS 24-hr standard of 150 ug/m^3 at any time during the sampling periods. $PM_{2.5}$ did exceed the NAAQS 24-hr standard of 35.0 ug/m^3 during multiple episodes over both summer and winter sampling periods. Peak four-hour moving average concentrations for $PM_{2.5}$ were between 89.5ug/m^3 and 105.75 ug/m^3 in summer and 69.75 ug/m^3 to 77.0 ug/m^3 in winter. Higher concentrations were demonstrated in the summer sampling period for both $PM_{2.5}$ and PM_{10}.

A regional and seasonal comparison study of $PM_{2.5}$ in the United States found that there were higher concentrations of $PM_{2.5}$ in the summer months than winter months in the northeast (Bell et al, 2007). The authors constructed a database of 52 $PM_{2.5}$ component concentrations for 187 U.S. counties from 2000-

2005. They found that seven of the 52 components contribute more than one percent of the $PM_{2.5}$ total mass for the yearly average or any of the seasonal averages across all 187 counties. They found a large contributor of total PM in the northeast during the summer months is sulfate (SO_4) at 26%. The SO_4 emissions result from diesel powered motor vehicles, electric power generation, and industrial processes. They also found sodium ion $PM_{2.5}$ concentrations are higher in coastal regions, relating to sea salt, accounting for 1% of the total PM in the northeast during the summer months (Bell et al, 2007).

Sea salt is a possible contributing factor to the PM concentrations due to the coastal location of the study area. The Mystic Power Generating Station, 56th largest power generating facility in the U.S. by summer capacity (US Energy Information Administration Website, 2011), is located to the north of the study area and is another potential contributor to PM, especially in the summer sampling period when electricity demand is high and there was a wind component from the northeast.

Another possible reason that the PM concentrations were higher in the summer than the winter sampling periods may be due to the humidity levels that could have affected the DustTrak monitoring equipment. Levy et al. indicated that a previous study using a DustTrak monitor during the summer had concentrations of $PM_{2.5}$ a factor of 2.1 times greater than concentrations from an integrated personal exposure monitor (Levy et al., 2003). These researchers also found a 2.8-fold difference in $PM_{2.5}$ concentrations between the DustTrak and a

Tapered Element Oscillating Microbalance in a previous study (Levy et al., 2003). They indicated this was due to humidity and other factors in the summer season.

4.3 Ozone

Ozone is a secondary air pollutant, formed from primary precursor pollutants (e.g. in motor vehicle engine exhaust) such as NO_x and hydrocarbons. In the presence of sunlight, NO_2 is cleaved to NO + O and allows formation of O_3 (O_2 + O). By reconversion of NO to NO_2 in reactions involving hydrocarbons, and photochemical recycling of NO_2, O_3 can accumulate in ambient air (Bromberg and Koren, 1995). The authors Bromberg and Koren indicated that there is a morning lag time producing peak concentrations of O_3 midday, thus allowing for elevated O_3 concentrations for many hours over populous areas such as the Northeastern USA. A study of ozone variation trends in Hong Kong concluded that O_3 concentrations are positively related to NO_2 and negatively related to NO (Wang et al., 2003). Therefore, a decrease in NO levels should correspond to an increase in NO_2 and O_3. NO levels were not analyzed in this research; however both O_3 and NO_2 concentrations were high during the summer monitoring period. Wang et al. also concluded that O_3 levels generally rise with increases in solar radiation and outdoor temperature, and with decreases in wind speed. Figure 3-7 shows the diurnal pattern of O_3 concentrations with a peak in the midday and a low in the early morning. With increasing solar radiation and the heating of the day, O_3 increased in concentration with the influence of vehicular emissions from the highway. Peak outdoor temperatures from July 24th to the 27th were in the upper 80s to 90°F and wind speeds from the southwest were between 6 to 15 knots. The highest levels of ozone were recorded on July 26th with all locations exceeding the O_3 NAAQS of 0.075 ppm. Winds on this date were higher and measured approximately 15 knots; the high temperature was 92°F. Just as with the PM concentrations, there was no evidence in the graphical analysis demonstrating any different patterns of concentration of the O_3 pollution from each location, and little variability was indicated over the sample area.

4.4 Nitrogen Dioxide

Concentrations of NO_2 were higher than the NAAQS at all locations in both summer and winter sampling periods. The NAAQS one-hour standard for NO_2 is 0.1 ppm. Summer concentrations were overall higher than the winter concentrations found in this study. On July 19th, there was a high concentration of 2.5 ppm NO_2 at Location 1, on the western side of the highway. This concentration was 25-fold higher than the standard. The winds on this sampling date were from the southeast, thus placing Location 1 downwind of the highway. This concentration was approximately twice the concentration of any other sample locations on that date. Location 9, on the western side of the highway, also had a high concentration on this date, but when plotted graphically the concentration was similar to the eastern sampling locations. One reason that Location 1 had this higher level could be that the area southeast of this location is Dorchester Bay, and the wind would have less interference from vegetation and urban buildup to slow down the trajectory of the pollutants. Another aspect of

Location 1 is that Freeport Street itself has local traffic buildup due to a traffic light as it intersects Dorchester Avenue. This stop and go traffic could contribute to the NO_2 concentrations found at Location 1. On July 27th, during another sampling period, the winds were mainly from the southwest. Location 4 and 6 had NO_2 concentrations over 3.0 ppm. All locations had elevated readings for this sampling period; however these two locations had the highest concentrations. One reason for these elevated concentrations might be that Locations 4 and 6 are both situated at stop signs. This stop and go traffic could contribute to the higher NO_2 readings at these locations. Temperatures were also in the upper 80s^{0}F. In the winter sampling periods, the highest concentrations were found when the winds were out of the west, west northwest, and west southwest. This wind direction places the study area downwind of the highway pollution emissions.

4.5 Sulfur Dioxide

SO_2 had higher concentrations in winter, with the highest four-hour moving average concentrations from Location 8 on February 19th. The 24-hour NAAQS of 0.14 ppm for SO_2 was exceeded on February 19th with a peak concentration of 0.38 ppm at Location 8 and 0.18 ppm at Location 2. A peak concentration of 0.14 ppm, just at the NAAQS, was found at Location 6 on this date. Winds were from the west, west northwest and west southwest over the course of the sampling on this date making the sampling area downwind of the highway. These three sampling locations are the closest locations directly east of the I-93 corridor and all are open to the surrounding highway (Figure 2-1).

Potential influences on these locations could be winter heating from the densely populated areas around Savin Hill and the MBTA Commuter rail trains. A large condominium complex (Ledgeview/Linda Lane Condominiums) that uses oil to heat over 90 units is located directly below sampling Location 8 and could be a contributing factor to the elevated readings there. The Boston Public School Bus parking facility on Freeport Street is also located to the west southwest of these sampling locations across the highway; however this week was the Massachusetts February 2008 School Vacation week so the parking facility should not influence the higher readings since school buses would not have been running. Truck traffic on I-93 was between 3 and 4% in 2006 and could also be a contributor to the SO_2 concentrations due to diesel exhaust (Massachusetts Highway Department, 2011).

4.6 Carbon Monoxide and Seasonal Non-detect Readings for Ozone and Sulfur Dioxide

Due to the high percentage of non-detect readings for CO and SO_2 in summer 2007 as well as CO and O_3 in winter 2008, graphs for these pollutants are not included for analysis as they are well below the NAAQS. CO readings were mainly non-detect and all actual readings were below the NAAQS. Prior to the mid 1980's, Massachusetts was frequently in violation of the CO standard. However, with the adoption of control programs, CO emissions have decreased since then. According to the Commonwealth of Massachusetts 2009 Air Quality report, "The last violation in the state of the CO NAAQS occurred in 1986. The entire state has been in attainment since April 2002" (Executive Office of Environmental Affairs, Air Assessment Branch 2, 2009). The fact that the CO was mainly non-detect with a few samples ranging from 2.00 to 8.00 ppm could also be a result of a limitation of the equipment borrowed from the EPA. The Q-Trak IAQ Monitor had a resolution of 1 ppm so many of the readings could be between zero and one. Another possible limitation could be that this piece of equipment is an Indoor Air Quality Monitor and may not have been sensitive enough for the outdoor ambient sampling conditions. I did not find any studies that used the Q-Trak IAQ monitor for outdoor sampling, although the manual does not indicate that it should only be used indoors. The overall outcome for CO in both seasons during this study was that concentrations never exceeded the NAAQS.

The O_3 readings I found in the winter sampling period were mainly non-detect. This was expected as ground-level ozone is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOCs) in the presence of sunlight and hot weather. As a result, ozone is known as a summertime air pollutant. Motor vehicle exhaust is a contributor to these precursor pollutants that help form ozone (US EPA Website 7, 2010).

4.7 Travel Times

Travel times were obtained from the SmarTraveler traffic reports over the course of this thesis study period (SmarTraveler Website, 2008). An increase in travel times in both directions on Fridays during the summer monitoring period could be due to the weekend vacation bound travelers to Cape Cod to the south and New Hampshire/Maine to the north of Boston. These are both common vacation destinations for Massachusetts residents on the weekends during the summer. Travel times for the first week of sampling during the winter sampling period appear to be lower possibly due to the Massachusetts February 2008 School vacation. Travel times increased during the second week and travel times peaked again on Friday in both directions in the evening sampling time. During the morning commute, southbound travel times were less than the northbound travel times in both seasons, and differed by as much as 50% (Figures 3-13 and 3-15). During the evening commute, there was little difference between the northbound and southbound travel times as both were similar in time (Figures 3-14 and 3-16).

5.0 Conclusions and Recommendations

My research focused on air quality in the Over the Bridge (OTB) neighborhood of North Dorchester, MA and its relationship to the proximity of major roadways and local meteorological conditions. In order to test my hypothesis that residents of the Savin Hill OTB area of North Dorchester, during the morning and evening rush hour commute, are exposed to higher concentrations than allowed by the National Air Quality Standards of five of the six Criteria Pollutants that have been linked to increased risk of asthma, I documented changes in concentrations of the Criteria pollutants based on location in and around this neighborhood and compared these concentrations to the NAAQS for each air pollutant. I also investigated if seasonal differences in temperature and wind affected pollutant concentrations in the OTB neighborhood and if travel times between Boston and Braintree on I-93 display any impact on pollutant concentrations.

5.1 Conclusions

Based on my research and graphical analysis of pollutant concentrations over nine sampling locations in the Savin Hill OTB neighborhood of North Dorchester, MA, as well as analysis of meteorological conditions and travel times between Boston and Braintree, MA, I have formulated the following conclusions

1. There were higher concentrations than the NAAQS during multiple sampling periods for $PM_{2.5}$, NO_2 and O_3 in summer 2007 and $PM_{2.5}$, NO_2, and SO_2 in winter 2008;
2. Seasonal differences in concentrations of pollutants were observed;
3. There was little variability in concentration for $PM_{2.5}$, PM_{10} and O_3 when comparing the nine sampling locations;
4. There was variability in concentration of NO_2 and SO_2 when comparing the nine sampling locations;
5. The prevailing wind direction placed the OTB neighborhood downwind of the highway pollutant emissions during both summer and winter sampling periods;
6. Travel times between Braintree and Boston did not display an impact on pollutant concentrations.

5.2 Recommendations for Further Study

In this thesis, I monitored concentrations of five out of six of the EPA's Criteria Air Pollutants in the Savin Hill OTB neighborhood of North Dorchester, Massachusetts. I measured concentrations of CO, NO_2, SO_2, O_3 and $PM_{2.5}$ and PM_{10} during the morning and evening rush hour commutes of I-93 for two weeks in both the summer of 2007 and the winter of 2008. Increasing viable public transportation options to the south of Boston in the form of more commuter rail lines as well as zero and low emission buses for commuters could decrease the amount of cars traveling on the Southeast Expressway and help decrease air pollution in the area. Allowing zero and low emission vehicles to travel in the HOV lane of the Southeast Expressway with a single occupant could be an incentive for commuters to purchase these vehicles and be able to decrease their travel time travel into the city.

Other options could be adopting more stringent emissions standards such as California has done, to decrease the amount of pollutants emitted from all vehicles, thus decreasing the pollution in these near highway areas in order to protect the citizens of Massachusetts from the adverse health effects of vehicular pollution. Increasing telecommuting options for workers, who work mainly online, especially during forecasted high pollution episodes, could help alleviate some of the high concentrations of air pollutants on these days.

In the short term, aside from the almost impossible task of significantly decreasing the amount of vehicles that travel on I-93 daily or the amount of pollution they emit, the best recommendation would be public outreach to inform the public in general, and more specifically, those residents living in close proximity to the highway, of the potential adverse health effects of these increased pollution concentrations. This thesis conducted an analysis of the pollutants in a near highway neighborhood over a brief period of time and was able to demonstrate increased levels of some pollutants above the NAAQS. Further study is needed over a larger time frame; with more sophisticated and localized sampling and meteorological equipment, to obtain data in order to better qualify the episodes of higher pollution that the public should be made aware of and what they can do to better protect themselves.

One such study is already underway along the I-93 corridor since the completion of this thesis. It is called the Community Assessment of Freeway Exposure and Health (CAFEH). It is a project by Tufts University researchers and Boston-area community groups like the Dorchester Environmental Health Coalition, supported by a five-year, $2.5 million grant from the National Institute of Environmental Health Sciences, to study the health effects of pollution exposure in neighborhoods adjacent to major highways (CAFEH website, 2010). Somerville, South Boston, Chinatown and Dorchester are all communities included in this study. This type of study can help determine what level of public outreach is needed and in which areas to protect those residents from unhealthy exposure levels of pollutants emitted from vehicular traffic along this highway. It will help determine what time(s) of the day residents should limit their ambient air exposure and what actions such as home air filtration, shutting windows, and limiting outdoor activities in these areas, can be done that will limit exposure. This information is also valuable to urban planning to determine appropriate locations for new schools, residential projects, and playgrounds.

Appendix 1. National Ambient Air Quality Standards

Table 2-1: National Ambient Air Quality Standards
Source: http://epa.gov/air/criteria.html

	Primary Standards		Secondary Standards	
Pollutant	**Level**	**Averaging Time**	**Level**	**Averaging Time**
Carbon Monoxide	9 ppm (10 mg/m^3)	8-hour (1)	None	
	35 ppm (40 mg/m^3)	1-hour (1)		
Lead	0.15 $\mu g/m^3$ (2)	Rolling 3-Month Average	Same as Primary	
	1.5 $\mu g/m^3$	Quarterly Average	Same as Primary	
Nitrogen Dioxide	53 ppb (3)	Annual (Arithmetic Average)	Same as Primary	
	100 ppb	1-hour (4)	None	
Particulate Matter (PM$_{10}$)	150 $\mu g/m^3$	24-hour (5)	Same as Primary	
Particulate Matter (PM$_{2.5}$)	15.0 $\mu g/m^3$	Annual (6) (Arithmetic Average)	Same as Primary	
	35 $\mu g/m^3$	24-hour (7)	Same as Primary	
Ozone	0.075 ppm (2008 std)	8-hour (8)	Same as Primary	
	0.08 ppm (1997 std)	8-hour (9)	Same as Primary	
	0.12 ppm	1-hour (10)	Same as Primary	
Sulfur Dioxide	0.03 ppm	Annual (Arithmetic Average)	0.5 ppm	3-hour (1)
	0.14 ppm	24-hour (1)		
	75 ppb (11)	1-hour	None	

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(1) Not to be exceeded more than once per year.

(2) Final rule signed October 15, 2008.

(3) The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard

(4) To attain this standard, the 3-year average of the 98th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 100 ppb (effective January 22, 2010).

(5) Not to be exceeded more than once per year on average over 3 years.

(6) To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m3.

(7) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m3 (effective December 17, 2006).

(8) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.075 ppm. (effective May 27, 2008)

(9) (a) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

(b) The 1997 standard—and the implementation rules for that standard—will remain in place for implementation purposes as EPA undertakes rulemaking to address the transition from the 1997 ozone standard to the 2008 ozone standard.

(c) EPA is in the process of reconsidering these standards (set in March 2008).

(10) (a) EPA revoked the 1-hour ozone standard in all areas, although some areas have continuing obligations under that standard ("anti-backsliding").

(b) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1.

(11) (a) Final rule signed June 2, 2010. To attain this standard, the 3-year average of the 99th percentile of the daily maximum 1-hour average at each monitor within an area must not exceed 75 ppb.

Appendix 2. Air Quality Data
Summer 2007
All Locations

Location #1: 43 Freeport Street

		Concentration					
Date	**Time**	**PM $_{2.5}$ (mg/m^3)**	**PM $_{10}$ (mg/m^3)**	**O$_3$ (ppm)**	**NO$_2$ (ppm)**	**SO$_2$ (ppm)**	**CO (ppm)**
7/16/07	6:30 AM	0.021	0.020	ND	0.2	ND	ND
7/16/07	7:25 AM	0.014	0.016	ND	0.2	ND	ND
7/16/07	8:23 AM	0.020	0.022	ND	0.2	ND	ND
7/16/07	9:19 AM	0.018	0.019	ND	0.2	ND	ND
7/16/07	4:00 PM	0.016	0.023	0.04	0.4	ND	2
7/16/07	4:57 PM	0.019	0.020	0.05	1.0	ND	1
7/16/07	5:46 PM	0.018	0.023	0.03	1.2	ND	ND
7/16/07	6:44 PM	0.019	0.020	0.03	1.2	ND	ND
7/17/07	6:26 AM	0.024	0.028	ND	0.6	ND	ND
7/17/07	7:15 AM	0.017	0.022	ND	0.1	ND	ND
7/17/07	8:10 AM	0.048	0.024	ND	0.2	ND	8
7/17/07	8:59 AM	0.027	0.034	ND	0.3	ND	2
7/17/07	3:36 PM	0.015	0.021	0.03	0.2	ND	1
7/17/07	4:27 PM	0.018	0.023	0.03	1.7	ND	ND
7/17/07	5:41 PM	0.024	0.027	0.03	1.8	ND	2
7/17/07	6:25 PM	0.028	0.032	0.05	0.4	ND	1
7/18/07	6:39 AM	0.045	0.051	ND	0.2	ND	ND
7/18/07	7:24 AM	0.058	0.056	ND	0.2	ND	ND
7/18/07	8:20 AM	0.060	0.060	ND	0.2	ND	ND
7/18/07	9:00 AM	0.064	0.080	0.01	3.0	ND	ND
7/18/07	3:58 PM	0.079	0.080	0.03	2.4	ND	ND
7/18/07	4:48 PM	0.097	0.105	0.02	2.5	0.1	ND
7/18/07	5:47 PM	0.087	0.085	0.01	2.0	ND	1
7/18/07	6:35 PM	0.087	0.091	0.01	2.2	ND	ND
7/19/07	6:32 AM	0.081	0.095	ND	0.1	ND	2
7/19/07	7:16 AM	0.066	0.072	ND	0.1	ND	ND
7/19/07	8:10 AM	0.066	0.070	ND	0.1	ND	ND
7/19/07	9:10 AM	0.064	0.065	ND	ND	ND	ND
7/19/07	3:43 PM	0.065	0.066	0.01	1.4	ND	1
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	6:10 PM	0.058	0.059	ND	0.6	ND	1
7/20/07	6:42 AM	0.13	0.130	ND	0.6	ND	1
7/20/07	7:35 AM	0.114	0.119	ND	ND	ND	ND
7/20/07	8:37 AM	0.092	0.094	0.01	0.2	ND	1
7/20/07	9:17 AM	0.077	0.081	0.01	ND	ND	1
7/20/07	3:38 PM	0.02	0.022	0.04	0.2	0.1	1
7/20/07	4:29 PM	0.023	0.024	0.04	0.4	0.1	ND
7/20/07	5:15 PM	0.023	0.024	0.04	0.4	0.1	ND
7/20/07	6:25 PM	0.026	0.026	0.03	0.3	0.1	ND

7/23/07	6:40 AM	0.016	0.021	ND	0.3	ND	ND
7/23/07	7:27 AM	0.012	0.016	ND	0.4	ND	ND
7/23/07	8:31 AM	0.017	0.020	ND	0.4	ND	ND
7/23/07	9:15 AM	0.018	0.022	ND	0.4	ND	ND
7/23/07	3:38 PM	0.007	0.010	0.02	1.2	ND	ND
7/23/07	4:21 PM	0.011	0.015	ND	ND	ND	ND
7/23/07	5:36 PM	0.012	0.014	ND	ND	ND	ND
7/23/07	6:32 PM	0.014	0.016	ND	ND	ND	ND
7/24/07	6:44 AM	0.026	0.031	ND	ND	ND	ND
7/24/07	7:26 AM	0.02	0.024	ND	0.5	ND	ND
7/24/07	8:15 AM	0.011	0.012	ND	ND	ND	ND
7/24/07	9:15 AM	0.009	0.011	ND	ND	ND	ND
7/24/07	3:42 PM	0.006	0.008	0.03	0.2	ND	ND
7/24/07	4:23 PM	0.009	0.010	0.04	0.4	ND	ND
7/24/07	5:42 PM	0.008	0.007	0.04	0.6	0.1	ND
7/24/07	6:25 PM	0.007	0.008	0.03	0.2	0.1	ND
7/25/07	6:38 AM	0.044	0.048	ND	0.1	ND	ND
7/25/07	7:25 AM	0.042	0.042	ND	ND	ND	ND
7/25/07	8:20 AM	0.039	0.041	ND	ND	ND	ND
7/25/07	9:00 AM	0.038	0.041	ND	ND	ND	ND
7/25/07	4:00 PM	0.056	0.059	0.06	0.3	ND	1
7/25/07	4:54 PM	0.063	0.066	0.07	1.2	ND	ND
7/25/07	5:34 PM	0.056	0.059	0.07	0.6	ND	ND
7/25/07	6:40 PM	0.056	0.059	0.05	0.5	0.1	ND
7/26/07	6:40 AM	0.039	0.044	ND	0.1	ND	ND
7/26/07	7:32 AM	0.040	0.048	ND	ND	ND	ND
7/26/07	8:35 AM	0.032	0.039	ND	ND	ND	1
7/26/07	9:15 AM	0.030	0.036	ND	ND	ND	ND
7/26/07	3:36 PM	0.052	0.057	0.08	ND	0.1	2
7/26/07	4:34 PM	0.053	0.061	0.08	1.1	ND	ND
7/26/07	5:25 PM	0.054	0.054	0.08	1.1	ND	ND
7/26/07	6:22 PM	0.053	0.057	0.08	0.6	ND	ND
7/27/07	6:34 AM	0.021	0.023	0.03	2.6	ND	ND
7/27/07	7:30 AM	0.024	0.030	ND	0.8	ND	ND
7/27/07	8:21 AM	0.031	0.031	ND	1.3	ND	ND
7/27/07	9:10 AM	0.033	0.034	ND	1.1	ND	ND
7/27/07	3:42 PM	0.025	0.028	0.05	0.4	ND	1
7/27/07	4:42 PM	0.021	0.022	0.04	1.9	ND	ND
7/27/07	5:26 PM	0.019	0.016	0.03	0.9	ND	ND
7/27/07	6:18 PM	0.018	0.016	0.03	0.5	ND	ND

Location #2: McConnell Park/Malibu Beach Parking Lot

		Concentration					
Date	Time	PM $_{2.5}$ (mg/m^3)	PM $_{10}$ (mg/m^3)	O_3 (ppm)	NO_2 (ppm)	SO_2 (ppm)	CO (ppm)
7/16/07	6:40 AM	0.017	0.020	ND	ND	ND	ND
7/16/07	7:36 AM	0.015	0.019	ND	0.2	ND	ND
7/16/07	8:40 AM	0.017	0.018	ND	0.2	ND	ND
7/16/07	9:28 AM	0.013	0.016	ND	0.3	ND	ND
7/16/07	4:10 PM	0.015	0.017	0.04	0.4	ND	ND
7/16/07	5:10 PM	0.017	0.025	0.04	1.3	ND	1
7/16/07	6:02 PM	0.018	0.020	0.04	0.5	ND	ND
7/16/07	6:53 PM	0.017	0.020	0.03	1.1	ND	ND
7/17/07	6:39 AM	0.022	0.033	ND	ND	ND	ND
7/17/07	7:23 AM	0.019	0.022	ND	0.3	ND	ND
7/17/07	8:21 AM	0.020	0.027	ND	0.1	ND	ND
7/17/07	9:09 AM	0.021	0.023	ND	0.4	ND	ND
7/17/07	3:49 PM	0.019	0.018	0.04	0.1	ND	ND
7/17/07	4:36 PM	0.020	0.023	0.05	0.5	0.1	ND
7/17/07	5:48 PM	0.020	0.023	0.05	1.2	ND	ND
7/17/07	6:41 PM	0.027	0.038	0.06	0.8	ND	ND
7/18/07	6:46 AM	0.046	0.048	0.01	0.1	ND	ND
7/18/07	7:33 AM	0.065	0.066	0.01	ND	ND	ND
7/18/07	8:30 AM	0.062	0.065	ND	0.4	ND	ND
7/18/07	9:03 AM	0.066	0.068	ND	0.4	ND	ND
7/18/07	4:08 PM	0.100	0.100	0.03	2.4	ND	ND
7/18/07	5:09 PM	0.090	0.093	0.01	0.4	ND	ND
7/18/07	5:57 PM	0.075	0.080	0.03	1.3	ND	ND
7/18/07	6:42 PM	0.078	0.083	0.02	0.3	ND	ND
7/19/07	6:40 AM	0.072	0.082	ND	ND	ND	ND
7/19/07	7:23 AM	0.072	0.080	ND	ND	ND	ND
7/19/07	8:25 AM	0.072	0.075	ND	ND	ND	ND
7/19/07	9:13 AM	0.079	0.077	ND	ND	ND	ND
7/19/07	3:54 PM	0.054	0.055	0.03	0.9	ND	5
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	6:17 PM	0.054	0.054	0.03	2.4	ND	ND
7/20/07	6:53 AM	0.122	0.135	0.03	2.4	ND	1
7/20/07	7:43 AM	0.118	0.119	0.02	0.5	ND	ND
7/20/07	8:45 AM	0.086	0.094	0.01	ND	ND	ND
7/20/07	9:23 AM	0.079	0.081	0.01	0.1	ND	ND
7/20/07	3:52 PM	0.022	0.024	0.03	0.3	ND	ND
7/20/07	4:36 PM	0.023	0.026	0.04	0.7	0.1	ND
7/20/07	5:24 PM	0.025	0.026	0.04	0.9	ND	ND
7/20/07	6:39 PM	0.023	0.025	0.03	0.3	ND	ND

7/23/07	6:52 AM	0.011	0.012	ND	0.1	ND	ND
7/23/07	7:32 AM	0.011	0.015	ND	0.1	ND	ND
7/23/07	8:40 AM	0.013	0.015	ND	ND	ND	ND
7/23/07	9:23 AM	0.016	0.022	ND	0.2	ND	ND
7/23/07	3:47 PM	0.004	0.006	0.03	ND	ND	ND
7/23/07	4:31 PM	0.008	0.009	0.01	ND	ND	ND
7/23/07	5:43 PM	0.010	0.013	0.01	ND	ND	ND
7/23/07	6:44 PM	0.011	0.016	ND	ND	ND	ND
7/24/07	6:54 AM	0.023	0.029	ND	0.1	ND	ND
7/24/07	7:35 AM	0.019	0.022	ND	ND	ND	ND
7/24/07	8:25 AM	0.012	0.013	ND	ND	ND	ND
7/24/07	9:20 AM	0.009	0.010	ND	ND	ND	ND
7/24/07	3:52 PM	0.006	0.018	0.03	0.2	ND	ND
7/24/07	4:32 PM	0.013	0.013	0.04	0.8	ND	ND
7/24/07	5:50 PM	0.008	0.013	0.03	0.4	ND	ND
7/24/07	6:30 PM	0.007	0.011	0.03	ND	ND	ND
7/25/07	6:52 AM	0.050	0.056	ND	0.1	ND	ND
7/25/07	7:33 AM	0.041	0.051	ND	ND	ND	ND
7/25/07	8:30 AM	0.039	0.042	ND	0.1	ND	ND
7/25/07	9:05 AM	0.038	0.038	ND	ND	ND	ND
7/25/07	4:15 PM	0.057	0.062	0.06	0.3	ND	ND
7/25/07	5:01 PM	0.060	0.063	0.07	0.3	ND	ND
7/25/07	5:41 PM	0.057	0.055	0.07	0.7	ND	ND
7/25/07	6:54 PM	0.055	0.056	0.06	0.1	ND	ND
7/26/07	6:52 AM	0.044	0.050	ND	0.1	ND	ND
7/26/07	7:39 AM	0.039	0.043	ND	0.1	ND	ND
7/26/07	8:44 AM	0.033	0.033	ND	ND	ND	ND
7/26/07	9:25 AM	0.029	0.030	ND	ND	ND	ND
7/26/07	3:40 PM	0.056	0.054	0.09	0.2	ND	ND
7/26/07	4:47 PM	0.058	0.060	0.08	1.0	ND	ND
7/26/07	5:32 PM	0.057	0.055	0.08	1.1	ND	ND
7/26/07	6:30 PM	0.042	0.046	0.07	0.9	ND	1
7/27/07	6:46 AM	0.025	0.028	0.01	1.8	ND	ND
7/27/07	7:37 AM	0.025	0.027	ND	1.5	ND	ND
7/27/07	8:28 AM	0.034	0.031	ND	1.8	ND	ND
7/27/07	9:18 AM	0.035	0.039	ND	1.7	ND	ND
7/27/07	3:58 PM	0.025	0.030	0.06	1.3	ND	ND
7/27/07	4:50 PM	0.025	0.030	0.06	1.3	ND	ND
7/27/07	5:33 PM	0.016	0.018	0.03	0.1	ND	ND
7/27/07	6:28 PM	0.015	0.017	0.03	0.1	ND	ND

Location #3: Intersection of Savin Hill Avenue and Evandale Terrace

		Concentration					
Date	Time	PM $_{2.5}$ (mg/m^3)	PM $_{10}$ (mg/m^3)	O_3 (ppm)	NO_2 (ppm)	SO_2 (ppm)	CO (ppm)
7/16/07	6:45 AM	0.015	0.015	ND	ND	ND	ND
7/16/07	7:40 AM	0.015	0.017	ND	ND	ND	ND
7/16/07	8:44 AM	0.015	0.021	ND	0.3	ND	ND
7/16/07	9:32 AM	0.014	0.022	ND	0.2	ND	ND
7/16/07	4:20 PM	0.015	0.016	0.04	1.2	ND	ND
7/16/07	5:13 PM	0.015	0.016	0.04	1.0	ND	ND
7/16/07	6:08 PM	0.018	0.024	0.03	1.8	ND	ND
7/16/07	6:59 PM	0.017	0.022	0.02	0.8	ND	ND
7/17/07	6:45 AM	0.020	0.025	ND	0.4	ND	ND
7/17/07	7:27 AM	0.020	0.021	ND	0.3	ND	ND
7/17/07	8:27 AM	0.020	0.022	ND	ND	ND	ND
7/17/07	9:14 AM	0.022	0.024	ND	0.5	ND	1
7/17/07	3:53 PM	0.018	0.018	0.03	0.2	ND	ND
7/17/07	4:41 PM	0.019	0.020	0.04	1.3	ND	ND
7/17/07	5:53 PM	0.024	0.029	0.04	0.1	ND	1
7/17/07	6:45 PM	0.026	0.031	0.05	1.8	ND	1
7/18/07	6:51 AM	0.043	0.046	ND	0.2	ND	ND
7/18/07	7:40 AM	0.063	0.064	ND	0.2	ND	1
7/18/07	8:36 AM	0.063	0.064	ND	0.1	ND	ND
7/18/07	9:08 AM	0.068	0.070	ND	0.4	ND	1
7/18/07	4:20 PM	0.111	0.110	0.02	2.9	ND	ND
7/18/07	5:14 PM	0.089	0.091	ND	0.2	ND	ND
7/18/07	6:02 PM	0.082	0.089	0.02	1.4	ND	ND
7/18/07	6:47 PM	0.079	0.082	ND	0.4	ND	ND
7/19/07	6:45 AM	0.071	0.080	ND	0.3	ND	ND
7/19/07	7:28 AM	0.072	0.076	ND	ND	ND	ND
7/19/07	8:31 AM	0.081	0.076	ND	ND	ND	ND
7/19/07	9:17 AM	0.070	0.073	ND	ND	ND	ND
7/19/07	4:00 PM	0.052	0.063	0.01	ND	ND	1
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	6:21 PM	0.051	0.061	0.01	0.6	ND	ND
7/20/07	7:02 AM	0.141	0.141	ND	0.7	ND	ND
7/20/07	7:53 AM	0.118	0.120	ND	1.2	ND	ND
7/20/07	8:51 AM	0.087	0.091	ND	ND	ND	ND
7/20/07	9:26 AM	0.077	0.078	ND	0.1	ND	1
7/20/07	3:56 PM	0.023	0.022	0.03	0.2	ND	ND
7/20/07	4:42 PM	0.022	0.024	0.04	0.4	0.1	ND
7/20/07	5:29 PM	0.024	0.025	0.04	0.5	ND	ND
7/20/07	6:45 PM	0.020	0.027	0.03	0.3	0.1	ND
7/23/07	6:55 AM	0.010	0.012	ND	0.1	ND	ND

7/23/07	7:36 AM	0.011	0.013	ND	0.1	ND	ND
7/23/07	8:43 AM	0.014	0.017	ND	0.1	ND	ND
7/23/07	9:31 AM	0.018	0.022	ND	0.1	ND	ND
7/23/07	3:53 PM	0.005	0.009	0.02	ND	ND	ND
7/23/07	4:34 PM	0.008	0.010	0.01	ND	ND	ND
7/23/07	5:50 AM	0.010	0.012	ND	ND	ND	ND
7/23/07	6:48 PM	0.014	0.015	ND	ND	ND	ND
7/24/07	7:00 AM	0.024	0.028	ND	ND	ND	ND
7/24/07	7:39 AM	0.017	0.020	ND	ND	ND	ND
7/24/07	8:30 AM	0.009	0.012	ND	ND	ND	ND
7/24/07	9:24 AM	0.009	0.011	ND	ND	ND	ND
7/24/07	3:58 PM	0.006	0.009	0.03	ND	ND	ND
7/24/07	4:41 PM	0.012	0.012	0.05	0.3	ND	ND
7/24/07	5:54 PM	0.008	0.012	0.03	0.3	ND	ND
7/24/07	6:34 PM	0.009	0.011	0.03	0.1	ND	ND
7/25/07	6:57 AM	0.046	0.049	ND	ND	ND	ND
7/25/07	7:38 AM	0.040	0.043	ND	ND	ND	ND
7/25/07	8:34 AM	0.038	0.037	ND	ND	ND	ND
7/25/07	9:14 AM	0.034	0.036	ND	ND	ND	ND
7/25/07	4:20 PM	0.057	0.065	0.07	0.6	ND	ND
7/25/07	5:07 PM	0.060	0.060	0.07	0.6	ND	ND
7/25/07	5:45 PM	0.055	0.065	0.07	0.6	0.1	ND
7/25/07	6:59 PM	0.053	0.056	0.05	ND	ND	ND
7/26/07	6:58 AM	0.040	0.042	ND	0.1	ND	ND
7/26/07	7:45 AM	0.037	0.039	ND	ND	ND	ND
7/26/07	8:48 AM	0.031	0.033	ND	ND	ND	ND
7/26/07	9:28 AM	0.028	0.030	ND	ND	ND	ND
7/26/07	3:44 PM	0.054	0.056	0.09	0.6	ND	ND
7/26/07	4:52 PM	0.053	0.056	0.09	0.8	ND	1
7/26/07	5:37 PM	0.060	0.059	0.07	0.7	ND	ND
7/26/07	6:33 PM	0.040	0.050	0.07	0.6	ND	1
7/27/07	6:52 AM	0.024	0.026	ND	1.1	ND	ND
7/27/07	7:42 AM	0.026	0.025	ND	1.0	ND	ND
7/27/07	8:32 AM	0.029	0.033	ND	1.2	ND	1
7/27/07	9:21 AM	0.032	0.034	ND	1.1	ND	ND
7/27/07	4:02 PM	0.022	0.024	0.05	0.4	ND	ND
7/27/07	4:53 PM	0.022	0.025	0.05	0.6	ND	ND
7/27/07	5:39 PM	0.018	0.021	0.03	0.3	0.1	ND
7/27/07	6:31 PM	0.016	0.020	0.03	0.5	0.1	ND

Location #4: Intersection of Savin Hill Avenue and Grampian Way

		Concentration					
Date	**Time**	**PM $_{2.5}$ (mg/m^3)**	**PM $_{10}$ (mg/m^3)**	**O_3 (ppm)**	**NO_2 (ppm)**	**SO_2 (ppm)**	**CO (ppm)**
7/16/07	6:50 AM	0.017	0.018	ND	ND	ND	ND
7/16/07	7:43 AM	0.016	0.017	ND	0.2	ND	ND
7/16/07	8:50 AM	0.015	0.017	ND	ND	ND	ND
7/16/07	9:37 AM	0.015	0.017	ND	0.2	ND	ND
7/16/07	4:26 PM	0.014	0.019	0.04	0.6	ND	ND
7/16/07	5:17 PM	0.015	0.019	0.04	0.6	ND	ND
7/16/07	6:12 PM	0.017	0.020	0.03	0.9	ND	ND
7/16/07	7:02 PM	0.017	0.019	0.03	0.6	ND	ND
7/17/07	6:48 AM	0.021	0.028	ND	ND	ND	ND
7/17/07	7:31 AM	0.019	0.025	ND	0.2	ND	ND
7/17/07	8:31 AM	0.02	0.022	ND	ND	ND	ND
7/17/07	9:19 AM	0.022	0.049	ND	ND	ND	ND
7/17/07	3:57 PM	0.015	0.017	0.04	ND	ND	2
7/17/07	4:44 PM	0.019	0.021	0.05	0.8	ND	ND
7/17/07	5:57 PM	0.023	0.031	0.05	0.1	0.1	1
7/17/07	6:49 PM	0.027	0.030	0.06	0.8	ND	ND
7/18/07	6:55 AM	0.047	0.049	ND	0.1	ND	ND
7/18/07	7:46 AM	0.058	0.061	ND	0.3	ND	ND
7/18/07	8:43 AM	0.058	0.061	ND	0.2	ND	ND
7/18/07	9:13 AM	0.065	0.066	ND	0.2	ND	ND
7/18/07	4:30 PM	0.1	0.111	0.02	0.8	ND	ND
7/18/07	5:17 PM	0.086	0.095	0.01	0.3	ND	ND
7/18/07	6:06 PM	0.079	0.087	0.03	2.0	ND	ND
7/18/07	6:51 PM	0.078	0.083	0.01	0.1	ND	ND
7/19/07	6:49 AM	0.075	0.086	ND	0.1	ND	ND
7/19/07	7:32 AM	0.073	0.082	ND	ND	ND	ND
7/19/07	8:36 AM	0.073	0.074	ND	ND	ND	ND
7/19/07	9:20 AM	0.071	0.072	ND	0.1	ND	ND
7/19/07	4:04 PM	0.055	0.057	0.01	0.6	ND	ND
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	6:24 PM	0.049	0.051	0.01	0.6	ND	ND
7/20/07	7:08 AM	0.14	0.143	ND	0.4	ND	ND
7/20/07	7:57 AM	0.111	0.107	ND	0.9	ND	ND
7/20/07	8:54 AM	0.083	0.086	ND	ND	ND	1
7/20/07	9:29 AM	0.077	0.078	ND	ND	ND	1
7/20/07	3:59 PM	0.021	0.031	0.03	0.3	0.1	ND
7/20/07	4:45 PM	0.024	0.027	0.03	0.4	0.1	ND
7/20/07	5:32 PM	0.026	0.029	0.03	0.3	0.1	ND
7/20/07	6:44 PM	0.021	0.023	0.03	0.5	ND	ND

7/23/07	6:58 AM	0.011	0.014	ND	0.2	ND	ND
7/23/07	7:39 AM	0.011	0.015	ND	0.1	ND	ND
7/23/07	8:47 AM	0.013	0.018	ND	ND	ND	ND
7/23/07	9:35 AM	0.016	0.020	ND	0.1	ND	ND
7/23/07	3:56 PM	0.006	0.010	0.02	ND	ND	ND
7/23/07	4:38 PM	0.008	0.011	0.01	ND	ND	ND
7/23/07	5:55 PM	0.01	0.014	0.01	ND	ND	ND
7/23/07	6:51 PM	0.012	0.014	ND	ND	ND	ND
7/24/07	7:04 AM	0.026	0.031	ND	ND	ND	ND
7/24/07	7:43 AM	0.017	0.020	ND	ND	ND	ND
7/24/07	8:33 AM	0.011	0.011	ND	ND	ND	ND
7/24/07	9:27 AM	0.009	0.010	ND	ND	ND	ND
7/24/07	4:01 PM	0.007	0.008	0.03	0.6	ND	ND
7/24/07	4:45 PM	0.015	0.018	0.04	0.6	ND	ND
7/24/07	5:57 PM	0.007	0.009	0.03	0.2	ND	ND
7/24/07	6:37 PM	0.007	0.008	0.03	0.4	ND	ND
7/25/07	7:01 AM	0.051	0.057	ND	ND	ND	ND
7/25/07	7:42 AM	0.042	0.044	ND	1.0	ND	ND
7/25/07	8:38 AM	0.039	0.044	ND	ND	ND	ND
7/25/07	9:17 AM	0.037	0.040	ND	ND	ND	ND
7/25/07	4:24 PM	0.056	0.057	0.07	0.4	ND	ND
7/25/07	5:11 PM	0.06	0.063	0.07	0.9	ND	ND
7/25/07	5:50 PM	0.057	0.057	0.06	0.7	ND	ND
7/25/07	7:01 PM	0.056	0.051	0.05	0.2	ND	ND
7/26/07	7:02 AM	0.042	0.044	ND	ND	ND	ND
7/26/07	7:49 AM	0.039	0.041	ND	ND	ND	ND
7/26/07	8:51 AM	0.030	0.036	ND	ND	ND	ND
7/26/07	9:31 AM	0.030	0.036	ND	ND	ND	ND
7/26/07	3:48 PM	0.055	0.060	0.09	0.2	0.1	1
7/26/07	4:56 PM	0.054	0.057	0.08	0.6	ND	ND
7/26/07	5:42 PM	0.058	0.057	0.08	0.3	ND	ND
7/26/07	6:36 PM	0.035	0.036	0.06	0.8	ND	1
7/27/07	6:53 AM	0.024	0.025	ND	0.8	ND	ND
7/27/07	7:46 AM	0.024	0.026	ND	0.4	ND	ND
7/27/07	8:35 AM	0.033	0.033	ND	1.2	ND	ND
7/27/07	9:24 AM	0.035	0.037	ND	1.1	ND	ND
7/27/07	4:09 PM	0.022	0.025	0.05	1.1	ND	ND
7/27/07	4:56 PM	0.023	0.025	0.05	10.0	ND	ND
7/27/07	5:43 PM	0.020	0.021	0.03	0.4	ND	ND
7/27/07	6:34 PM	0.019	0.021	0.03	0.3	ND	ND

Location #5: Intersection of Caspian Way and Rockmere Street

		Concentration					
Date	Time	PM $_{2.5}$ (mg/m^3)	PM $_{10}$ (mg/m^3)	O$_3$ (ppm)	NO$_2$ (ppm)	SO$_2$ (ppm)	CO (ppm)
7/16/07	6:55 AM	0.016	0.016	ND	ND	ND	ND
7/16/07	7:47 AM	0.015	0.017	ND	0.3	ND	ND
7/16/07	8:54 AM	0.016	0.021	ND	0.2	ND	ND
7/16/07	9:40 AM	0.013	0.017	ND	ND	ND	ND
7/16/07	4:34 PM	0.018	0.021	0.04	0.5	ND	3
7/16/07	5:21 PM	0.018	0.020	0.04	0.6	ND	1
7/16/07	6:16 PM	0.023	0.030	0.03	1.0	ND	ND
7/16/07	7:06 PM	0.015	0.019	0.03	0.6	ND	ND
7/17/07	6:51 AM	0.02	0.023	ND	0.2	ND	ND
7/17/07	7:35 AM	0.02	0.023	ND	0.2	ND	ND
7/17/07	8:34 AM	0.019	0.022	ND	0.4	ND	ND
7/17/07	9:22 AM	0.022	0.024	ND	0.1	ND	ND
7/17/07	4:01 PM	0.016	0.026	0.04	0.2	ND	ND
7/17/07	4:48 PM	0.019	0.027	0.05	0.2	ND	ND
7/17/07	6:01 PM	0.038	0.025	0.05	0.2	0.1	1
7/17/07	6:52 PM	0.028	0.031	0.05	0.4	ND	1
7/18/07	7:00 AM	0.044	0.046	ND	0.2	ND	ND
7/18/07	7:51 AM	0.056	0.058	ND	ND	ND	ND
7/18/07	8:45 AM	0.053	0.058	ND	ND	ND	ND
7/18/07	9:17 AM	0.063	0.064	ND	0.1	ND	ND
7/18/07	4:38 PM	0.094	0.107	0.03	2.6	ND	ND
7/18/07	5:23 PM	0.082	0.087	ND	ND	ND	ND
7/18/07	6:10 PM	0.082	0.088	0.03	1.2	ND	ND
7/18/07	6:56 PM	0.073	0.075	0.02	0.1	ND	ND
7/19/07	6:53 AM	0.072	0.068	ND	ND	ND	ND
7/19/07	7:36 AM	0.068	0.070	ND	ND	ND	ND
7/19/07	8:39 AM	0.073	0.072	ND	ND	ND	ND
7/19/07	9:24 AM	0.07	0.073	ND	ND	ND	ND
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	6:28 PM	0.044	0.052	0.01	0.6	ND	ND
7/20/07	7:12 AM	0.123	0.125	0.01	0.2	ND	ND
7/20/07	8:12 AM	0.11	0.109	0.01	3.0	ND	ND
7/20/07	8:57 AM	0.084	0.087	ND	ND	0.1	1
7/20/07	9:32 AM	0.073	0.077	0.01	0.4	ND	ND
7/20/07	4:03 PM	0.024	0.022	0.03	0.3	0.1	ND
7/20/07	4:49 PM	0.023	0.024	0.04	0.5	0.1	ND
7/20/07	5:37 PM	0.026	0.026	0.03	0.4	ND	ND
7/20/07	6:47 PM	0.023	0.023	0.03	0.5	ND	ND

7/23/07	7:02 AM	0.009	0.010	ND	0.2	ND	ND
7/23/07	7:40 AM	0.011	0.014	ND	0.1	ND	ND
7/23/07	8:49 AM	0.014	0.018	ND	0.1	ND	ND
7/23/07	9:38 AM	0.017	0.021	ND	0.1	ND	ND
7/23/07	3:59 PM	0.006	0.009	0.03	ND	ND	ND
7/23/07	4:42 PM	0.007	0.011	0.01	ND	ND	ND
7/23/07	5:59 PM	0.01	0.013	0.01	ND	ND	ND
7/23/07	6:55 PM	0.015	0.016	ND	ND	ND	ND
7/24/07	7:07 AM	0.026	0.030	ND	ND	ND	ND
7/24/07	7:47 AM	0.017	0.018	ND	ND	ND	ND
7/24/07	8:37 AM	0.009	0.012	ND	ND	ND	ND
7/24/07	9:30 AM	0.009	0.010	ND	ND	ND	ND
7/24/07	4:04 PM	0.008	0.009	0.03	0.6	ND	ND
7/24/07	4:48 PM	0.011	0.015	0.03	0.6	ND	ND
7/24/07	6:00 PM	0.01	0.010	0.03	0.4	ND	ND
7/24/07	6:39 PM	0.01	0.010	0.03	0.4	ND	ND
7/25/07	7:04 AM	0.047	0.049	ND	0.1	ND	ND
7/25/07	7:46 AM	0.039	0.042	ND	ND	ND	ND
7/25/07	8:41 AM	0.036	0.040	ND	ND	ND	ND
7/25/07	9:19 AM	0.034	0.040	ND	ND	ND	ND
7/25/07	4:28 PM	0.055	0.060	0.07	0.5	ND	1
7/25/07	5:14 PM	0.061	0.061	0.07	0.2	0.1	ND
7/25/07	5:53 PM	0.053	0.056	0.07	0.1	0.1	ND
7/25/07	7:04 PM	0.051	0.054	0.07	0.1	0.1	ND
7/26/07	7:05 AM	0.041	0.042	ND	ND	ND	ND
7/26/07	7:52 AM	0.038	0.038	ND	ND	ND	ND
7/26/07	8:53 AM	0.031	0.032	ND	ND	ND	ND
7/26/07	9:35 AM	0.029	0.031	ND	ND	ND	ND
7/26/07	3:52 PM	0.051	0.054	0.09	0.4	ND	2
7/26/07	4:59 PM	0.054	0.058	0.09	0.4	0.1	1
7/26/07	5:46 PM	0.057	0.059	0.09	0.8	0.1	1
7/26/07	6:41 PM	0.034	0.036	0.06	1.0	ND	1
7/27/07	6:57 AM	0.024	0.028	ND	1.4	ND	ND
7/27/07	7:49 AM	0.024	0.025	ND	0.9	ND	ND
7/27/07	8:39 AM	0.032	0.037	ND	1.4	ND	ND
7/27/07	9:27 AM	0.034	0.039	ND	1.2	ND	ND
7/27/07	4:12 PM	0.023	0.025	0.05	0.3	ND	ND
7/27/07	4:59 PM	0.022	0.023	0.05	0.6	ND	ND
7/27/07	5:47 PM	0.018	0.020	0.03	0.3	ND	ND
7/27/07	6:37 PM	0.017	0.018	0.03	0.3	ND	ND

Location #6: Grampian Way and Savin Hill Avenue at Motley School Condo's

		Concentration					
Date	Time	PM $_{2.5}$ (mg/m^3)	PM $_{10}$ (mg/m^3)	O$_3$ (ppm)	NO$_2$ (ppm)	SO$_2$ (ppm)	CO (ppm)
7/16/07	6:58 AM	0.019	0.020	ND	ND	ND	ND
7/16/07	7:50 AM	0.019	0.018	ND	ND	ND	ND
7/16/07	8:58 AM	0.019	0.021	ND	ND	ND	ND
7/16/07	9:44 AM	0.017	0.022	ND	0.3	ND	ND
7/16/07	4:36 PM	0.015	0.022	0.05	0.4	ND	2
7/16/07	5:24 PM	0.016	0.021	0.05	0.4	ND	1
7/16/07	6:21 PM	0.021	0.019	0.03	1.2	ND	1
7/16/07	7:10 PM	0.019	0.018	0.03	0.8	ND	ND
7/17/07	6:55 AM	0.02	0.022	ND	ND	ND	ND
7/17/07	7:40 AM	0.019	0.022	ND	0.3	ND	ND
7/17/07	8:38 AM	0.019	0.024	ND	ND	ND	ND
7/17/07	9:26 AM	0.023	0.031	ND	ND	ND	1
7/17/07	4:05 PM	0.016	0.016	0.04	0.1	ND	ND
7/17/07	4:52 PM	0.019	0.022	0.05	ND	ND	ND
7/17/07	6:06 PM	0.025	0.026	0.06	0.2	0.1	1
7/17/07	6:57 PM	0.027	0.032	0.05	0.6	ND	1
7/18/07	7:04 AM	0.052	0.054	ND	0.1	ND	ND
7/18/07	7:52 AM	0.055	0.058	ND	ND	ND	ND
7/18/07	8:48 AM	0.055	0.059	ND	0.1	ND	ND
7/18/07	9:22 AM	0.065	0.067	ND	ND	ND	ND
7/18/07	4:42 PM	0.096	0.102	0.03	2.0	ND	ND
7/18/07	5:25 PM	0.09	0.094	0.02	0.4	ND	ND
7/18/07	6:13 PM	0.084	0.089	0.03	2.2	ND	ND
7/18/07	7:00 PM	0.077	0.082	0.02	0.3	ND	ND
7/19/07	6:57 AM	0.074	0.075	ND	ND	ND	ND
7/19/07	7:39 AM	0.072	0.074	ND	ND	ND	ND
7/19/07	8:45 AM	0.076	0.078	ND	ND	ND	ND
7/19/07	9:27 AM	0.067	0.066	ND	0.1	0.1	2
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	6:31 PM	0.049	0.056	0.02	0.2	ND	ND
7/20/07	7:16 AM	0.13	0.136	ND	0.1	ND	ND
7/20/07	8:17 AM	0.112	0.114	ND	0.8	ND	ND
7/20/07	9:01 AM	0.081	0.088	ND	ND	ND	1
7/20/07	9:36 AM	0.074	0.072	0.01	0.3	ND	1
7/20/07	4:06 PM	0.023	0.022	0.03	0.4	ND	ND
7/20/07	4:52 PM	0.027	0.029	0.03	0.3	0.1	ND
7/20/07	5:40 PM	0.027	0.030	0.03	0.2	ND	ND

7/20/07	6:51 PM	0.024	0.023	0.03	0.7	ND	ND
7/23/07	7:07 AM	0.016	0.022	ND	0.1	ND	ND
7/23/07	7:43 AM	0.013	0.014	ND	0.1	ND	ND
7/23/07	8:53 AM	0.015	0.018	ND	0.1	ND	ND
7/23/07	9:41 AM	0.018	0.021	ND	0.2	ND	ND
7/23/07	4:02 PM	0.007	0.010	0.03	0.1	ND	ND
7/23/07	4:46 PM	0.01	0.011	0.01	ND	ND	ND
7/23/07	6:03 PM	0.012	0.013	0.01	ND	ND	ND
7/23/07	6:58 PM	0.015	0.014	ND	ND	ND	ND
7/24/07	7:10 AM	0.026	0.030	ND	ND	ND	ND
7/24/07	7:50 AM	0.016	0.023	ND	ND	ND	ND
7/24/07	8:41 AM	0.01	0.017	ND	ND	ND	ND
7/24/07	9:34 AM	0.009	0.010	ND	ND	ND	ND
7/24/07	4:07 PM	0.01	0.010	0.03	0.1	ND	ND
7/24/07	4:52 PM	0.011	0.013	0.04	0.1	0.1	ND
7/24/07	6:04 PM	0.008	0.009	0.03	ND	ND	ND
7/24/07	6:43 PM	0.008	0.011	0.03	ND	ND	ND
7/25/07	7:08 AM	0.052	0.057	ND	0.1	ND	ND
7/25/07	7:50 AM	0.048	0.048	ND	ND	ND	ND
7/25/07	8:44 AM	0.039	0.044	ND	ND	ND	ND
7/25/07	9:22 AM	0.038	0.041	ND	ND	ND	ND
7/25/07	4:32 PM	0.057	0.060	0.07	0.7	ND	ND
7/25/07	5:19 PM	0.067	0.071	0.06	0.1	ND	ND
7/25/07	5:57 PM	0.056	0.067	0.06	0.2	ND	ND
7/25/07	7:08 PM	0.055	0.059	0.05	0.2	ND	ND
7/26/07	7:08 AM	0.047	0.052	ND	ND	ND	ND
7/26/07	7:55 AM	0.035	0.041	ND	ND	ND	ND
7/26/07	8:57 AM	0.031	0.032	ND	ND	ND	ND
7/26/07	9:39 AM	0.027	0.028	ND	ND	ND	ND
7/26/07	3:56 PM	0.056	0.060	0.09	0.3	ND	ND
7/26/07	5:04 PM	0.058	0.056	0.09	0.3	0.1	ND
7/26/07	5:50 PM	0.061	0.060	0.07	0.6	ND	ND
7/26/07	6:44 PM	0.036	0.044	0.06	0.6	ND	1
7/27/07	7:00 AM	0.024	0.031	ND	1.3	ND	ND
7/27/07	7:52 AM	0.026	0.032	ND	1.3	ND	ND
7/27/07	8:41 AM	0.031	0.038	ND	0.6	ND	ND
7/27/07	9:31 AM	0.033	0.038	ND	0.9	ND	ND
7/27/07	4:17 PM	0.022	0.025	0.05	1.1	ND	ND
7/27/07	5:03 PM	0.020	0.023	0.05	10.0	ND	ND
7/27/07	5:50 PM	0.017	0.020	0.03	0.7	ND	ND
7/27/07	6:40 PM	0.018	0.019	0.03	0.4	ND	ND

Location #7: Patten's Cove Park at 324 Savin Hill Avenue

		Concentration					
Date	**Time**	**PM $_{2.5}$ (mg/m^3)**	**PM $_{10}$ (mg/m^3)**	**O$_3$ (ppm)**	**NO$_2$ (ppm)**	**SO$_2$ (ppm)**	**CO (ppm)**
7/16/07	7:00 AM	0.015	0.018	ND	ND	ND	ND
7/16/07	7:54 AM	0.015	0.018	ND	ND	ND	ND
7/16/07	9:03 AM	0.020	0.018	ND	0.2	ND	ND
7/16/07	9:48 AM	0.017	0.017	ND	0.2	ND	ND
7/16/07	4:43 PM	0.016	0.017	0.04	0.4	ND	ND
7/16/07	5:29 PM	0.016	0.017	0.04	0.4	ND	ND
7/16/07	6:28 PM	0.017	0.025	0.03	0.5	ND	ND
7/16/07	7:14 PM	0.016	0.020	0.01	0.6	ND	ND
7/17/07	6:59 AM	0.016	0.018	ND	ND	ND	ND
7/17/07	7:44 AM	0.02	0.027	ND	0.3	ND	ND
7/17/07	8:40 AM	0.021	0.025	ND	0.3	ND	ND
7/17/07	9:30 AM	0.025	0.026	ND	0.2	ND	ND
7/17/07	4:09 PM	0.016	0.017	0.04	0.5	0.1	ND
7/17/07	4:56 PM	0.021	0.021	0.04	ND	0.1	ND
7/17/07	6:10 PM	0.025	0.026	0.05	0.1	0.1	ND
7/17/07	7:00 PM	0.029	0.030	0.05	0.8	ND	1
7/18/07	7:07 AM	0.05	0.059	ND	0.2	ND	ND
7/18/07	7:57 AM	0.057	0.059	ND	0.4	ND	ND
7/18/07	8:51 AM	0.057	0.059	ND	0.4	ND	ND
7/18/07	9:28 AM	0.071	0.071	ND	0.1	ND	ND
7/18/07	4:46 PM	0.094	0.096	ND	0.7	ND	ND
7/18/07	5:30 PM	0.087	0.096	ND	0.9	ND	ND
7/18/07	6:17 PM	0.084	0.090	0.3	2.5	ND	ND
7/18/07	7:05 PM	0.072	0.078	ND	0.1	ND	ND
7/19/07	7:01 AM	0.07	0.077	ND	ND	ND	ND
7/19/07	7:43 AM	0.075	0.083	ND	ND	ND	ND
7/19/07	8:49 AM	0.075	0.079	ND	ND	ND	ND
7/19/07	9:31 AM	0.068	0.069	ND	0.1	ND	ND
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	6:34 PM	0.051	0.051	ND	ND	ND	ND
7/20/07	7:21 AM	0.13	0.132	ND	ND	ND	ND
7/20/07	8:22 AM	0.11	0.106	ND	1.0	ND	ND
7/20/07	9:05 AM	0.085	0.111	ND	ND	ND	1
7/20/07	9:40 AM	0.072	0.071	0.03	0.4	ND	ND
7/20/07	4:10 PM	0.021	0.023	0.04	0.4	0.1	ND
7/20/07	4:57 PM	0.024	0.028	0.04	0.7	ND	ND
7/20/07	5:45 PM	0.027	0.027	0.04	0.6	ND	ND
7/20/07	6:54 PM	0.022	0.021	0.03	0.6	ND	ND

7/23/07	7:12 AM	0.012	0.012	ND	0.3	ND	ND
7/23/07	7:45 AM	0.013	0.014	ND	0.2	ND	ND
7/23/07	8:57 AM	0.015	0.019	ND	0.1	ND	ND
7/23/07	9:44 AM	0.019	0.023	ND	0.2	ND	ND
7/23/07	4:05 PM	0.008	0.012	0.02	ND	ND	ND
7/23/07	4:50 PM	0.009	0.013	0.01	ND	ND	ND
7/23/07	6:07 PM	0.014	0.015	ND	ND	ND	ND
7/23/07	7:06 PM	0.016	0.016	ND	ND	ND	ND
7/24/07	7:14 AM	0.023	0.027	ND	ND	ND	ND
7/24/07	7:54 AM	0.015	0.020	ND	ND	ND	ND
7/24/07	8:44 AM	0.01	0.014	ND	ND	ND	ND
7/24/07	9:39 AM	0.009	0.011	ND	ND	ND	ND
7/24/07	4:10 PM	0.008	0.010	0.03	0.1	ND	ND
7/24/07	4:56 PM	0.011	0.012	0.04	0.3	ND	ND
7/24/07	6:07 PM	0.012	0.013	0.03	0.2	ND	ND
7/24/07	6:47 PM	0.011	0.013	0.03	0.2	ND	ND
7/25/07	7:12 AM	0.046	0.046	ND	ND	ND	ND
7/25/07	7:55 AM	0.036	0.039	ND	ND	ND	ND
7/25/07	8:47 AM	0.037	0.038	ND	ND	ND	ND
7/25/07	9:35 AM	0.037	0.039	ND	ND	ND	ND
7/25/07	4:36 PM	0.059	0.061	0.07	0.6	ND	ND
7/25/07	5:23 PM	0.062	0.070	0.06	0.7	ND	ND
7/25/07	6:02 PM	0.055	0.058	0.07	0.4	ND	ND
7/25/07	7:11 PM	0.056	0.059	0.06	0.3	ND	ND
7/26/07	7:12 AM	0.040	0.043	ND	0.1	ND	ND
7/26/07	8:00 AM	0.034	0.041	ND	ND	ND	ND
7/26/07	9:01 AM	0.029	0.031	ND	ND	ND	ND
7/26/07	9:43 AM	0.028	0.030	ND	ND	ND	ND
7/26/07	4:00 PM	0.054	0.058	0.09	0.4	ND	ND
7/26/07	5:08 PM	0.056	0.054	0.1	0.3	0.1	ND
7/26/07	5:55 PM	0.054	0.056	0.09	0.7	ND	ND
7/26/07	6:50 PM	0.036	0.038	0.06	0.2	ND	ND
7/27/07	7:04 AM	0.024	0.029	ND	1.2	ND	ND
7/27/07	7:55 AM	0.025	0.026	ND	0.7	ND	ND
7/27/07	8:44 AM	0.030	0.033	ND	1.7	ND	ND
7/27/07	9:34 AM	0.030	0.035	ND	1.4	ND	ND
7/27/07	4:20 PM	0.021	0.026	ND	1.0	ND	ND
7/27/07	5:06 PM	0.020	0.023	ND	1.1	ND	ND
7/27/07	5:53 PM	0.019	0.026	ND	0.4	ND	ND
7/27/07	6:44 PM	0.017	0.020	ND	0.3	ND	ND

Location #8: Overlook across from 37 Grampian Way

		Concentration					
Date	**Time**	**PM $_{2.5}$ (mg/m^3)**	**PM $_{10}$ (mg/m^3)**	**O_3 (ppm)**	**NO_2 (ppm)**	**SO_2 (ppm)**	**CO (ppm)**
7/16/07	7:07 AM	0.017	0.022	ND	ND	ND	ND
7/16/07	7:56 AM	0.015	0.022	ND	ND	ND	ND
7/16/07	9:07 AM	0.016	0.020	ND	ND	ND	ND
7/16/07	9:51 AM	0.015	0.016	ND	0.2	ND	ND
7/16/07	4:46 PM	0.016	0.024	0.04	1.3	ND	ND
7/16/07	5:34 PM	0.016	0.024	0.04	1.0	ND	ND
7/16/07	6:33 PM	0.018	0.022	0.03	1.0	ND	ND
7/16/07	7:18 PM	0.018	0.021	0.03	1.0	ND	ND
7/17/07	7:03 AM	0.018	0.020	ND	ND	ND	ND
7/17/07	7:47 AM	0.018	0.021	ND	ND	ND	ND
7/17/07	8:44 AM	0.019	0.021	ND	ND	ND	ND
7/17/07	9:33 AM	0.023	0.028	ND	0.2	ND	ND
7/17/07	4:12 PM	0.018	0.016	0.04	0.5	ND	ND
7/17/07	5:00 PM	0.02	0.052	0.04	0.2	0.1	ND
7/17/07	6:15 PM	0.025	0.032	0.06	ND	0.1	ND
7/17/07	7:05 PM	0.028	0.037	0.05	0.8	ND	ND
7/18/07	7:14 AM	0.05	0.060	ND	0.1	ND	ND
7/18/07	8:01 AM	0.054	0.058	ND	0.1	ND	ND
7/18/07	8:53 AM	0.054	0.058	ND	0.1	ND	ND
7/18/07	9:32 AM	0.068	0.068	ND	0.4	ND	ND
7/18/07	4:50 PM	0.099	0.101	ND	0.5	ND	ND
7/18/07	5:35 PM	0.092	0.101	0.02	1.4	0.1	ND
7/18/07	6:23 PM	0.096	0.093	0.03	3.0	ND	ND
7/18/07	7:08 PM	0.092	0.093	0.02	0.5	ND	ND
7/19/07	7:07 AM	0.074	0.075	ND	ND	ND	ND
7/19/07	7:47 AM	0.071	0.073	ND	ND	ND	ND
7/19/07	8:56 AM	0.075	0.080	ND	0.1	ND	ND
7/19/07	9:34 AM	0.067	0.069	ND	ND	ND	ND
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	6:36 PM	0.049	0.056	ND	ND	ND	ND
7/20/07	7:26 AM	0.117	0.125	ND	0.1	ND	ND
7/20/07	8:27 AM	0.107	0.104	ND	0.6	ND	ND
7/20/07	9:09 AM	0.083	0.088	ND	ND	ND	ND
7/20/07	9:43 AM	0.072	0.071	0.02	0.5	ND	1
7/20/07	4:15 PM	0.021	0.023	0.04	0.6	0.1	ND
7/20/07	5:02 PM	0.024	0.027	0.03	0.3	0.1	ND
7/20/07	5:49 PM	0.026	0.026	0.03	0.8	0.1	ND
7/20/07	6:58 PM	0.023	0.022	0.03	0.7	ND	ND
7/23/07	7:16 AM	0.012	0.014	ND	0.1	ND	ND

7/23/07	7:48 AM	0.012	0.024	ND	0.1	ND	ND
7/23/07	9:02 AM	0.013	0.019	ND	0.1	ND	ND
7/23/07	9:47 AM	0.016	0.022	ND	0.1	ND	ND
7/23/07	4:09 PM	0.007	0.010	0.03	ND	ND	ND
7/23/07	4:55 PM	0.011	0.011	0.02	ND	ND	ND
7/23/07	6:11 PM	0.013	0.016	ND	ND	ND	ND
7/23/07	7:10 PM	0.017	0.015	ND	ND	ND	ND
7/24/07	7:18 AM	0.023	0.023	ND	ND	ND	ND
7/24/07	7:57 AM	0.019	0.028	ND	ND	ND	ND
7/24/07	8:48 AM	0.011	0.012	ND	ND	ND	ND
7/24/07	9:43 AM	0.01	0.011	ND	ND	ND	ND
7/24/07	4:14 PM	0.007	0.009	0.04	0.2	ND	ND
7/24/07	5:01 PM	0.012	0.014	0.04	0.6	0.1	ND
7/24/07	6:12 PM	0.009	0.009	0.03	0.4	ND	ND
7/24/07	6:51 PM	0.009	0.010	0.03	0.4	ND	ND
7/25/07	7:16 AM	0.046	0.047	ND	ND	ND	ND
7/25/07	7:59 AM	0.036	0.037	ND	ND	ND	ND
7/25/07	8:51 AM	0.035	0.037	ND	ND	ND	ND
7/25/07	9:29 AM	0.036	0.038	ND	ND	ND	ND
7/25/07	4:40 PM	0.057	0.060	0.07	0.6	ND	ND
7/25/07	5:27 PM	0.062	0.070	0.06	0.7	ND	ND
7/25/07	6:07 PM	0.057	0.061	0.06	0.2	ND	ND
7/25/07	7:15 PM	0.059	0.060	0.05	0.3	ND	ND
7/26/07	7:16 AM	0.043	0.046	ND	ND	ND	ND
7/26/07	8:05 AM	0.036	0.038	ND	ND	ND	ND
7/26/07	9:04 AM	0.031	0.032	ND	ND	ND	ND
7/26/07	9:47 AM	0.030	0.032	ND	ND	ND	ND
7/26/07	4:09 PM	0.051	0.052	0.09	0.4	0.1	7
7/26/07	5:12 PM	0.053	0.057	0.09	0.4	ND	ND
7/26/07	5:59 PM	0.054	0.056	0.08	0.6	0.1	1
7/26/07	6:55 PM	0.040	0.043	0.06	0.6	0.1	1
7/27/07	7:08 AM	0.025	0.036	ND	1.4	ND	ND
7/27/07	7:58 AM	0.025	0.026	ND	0.7	ND	ND
7/27/07	8:48 AM	0.032	0.033	ND	0.6	ND	ND
7/27/07	9:39 AM	0.034	0.035	ND	0.9	ND	ND
7/27/07	4:22 PM	0.023	0.025	0.05	1.0	ND	ND
7/27/07	5:09 PM	0.021	0.022	0.05	1.1	ND	ND
7/27/07	5:57 PM	0.016	0.019	0.03	0.5	ND	ND
7/27/07	6:50 PM	0.017	0.019	0.03	0.4	ND	ND

Location #9: Intersection of Savin Hill Avenue and Saxton Street

		Concentration					
Date	Time	PM $_{2.5}$ (mg/m^3)	PM $_{10}$ (mg/m^3)	O_3 (ppm)	NO_2 (ppm)	SO_2 (ppm)	CO (ppm)
7/16/07	7:11 AM	0.017	0.040	ND	0.1	ND	ND
7/16/07	8:00 AM	0.017	0.018	ND	0.2	ND	ND
7/16/07	9:12 AM	0.017	0.019	ND	0.2	ND	ND
7/16/07	9:58 AM	0.014	0.014	ND	ND	ND	ND
7/16/07	4:55 PM	0.016	0.022	0.04	0.7	ND	ND
7/16/07	5:39 PM	0.017	0.021	0.04	0.4	ND	ND
7/16/07	6:37 PM	0.019	0.023	0.02	0.7	ND	1
7/16/07	7:25 PM	0.017	0.021	0.02	0.4	ND	ND
7/17/07	7:07 AM	0.018	0.018	ND	ND	ND	ND
7/17/07	7:50 AM	0.025	0.027	ND	0.2	ND	ND
7/17/07	8:48 AM	0.024	0.029	ND	0.3	ND	1
7/17/07	9:38 AM	0.024	0.034	ND	0.1	ND	ND
7/17/07	4:18 PM	0.022	0.019	0.04	0.4	ND	ND
7/17/07	5:04 PM	0.022	0.029	0.04	0.2	ND	ND
7/17/07	6:19 PM	0.027	0.032	0.05	0.4	ND	1
7/17/07	7:12 PM	0.03	0.031	0.05	0.5	ND	1
7/18/07	7:18 AM	0.055	0.061	ND	0.3	ND	ND
7/18/07	8:06 AM	0.055	0.060	ND	ND	ND	ND
7/18/07	8:56 AM	0.055	0.061	ND	ND	ND	ND
7/18/07	9:38 AM	0.072	0.074	ND	0.2	ND	1
7/18/07	4:53 PM	0.097	0.103	ND	0.5	ND	ND
7/18/07	5:41 PM	0.089	0.088	0.01	2.1	ND	ND
7/18/07	6:27 PM	0.091	0.096	ND	2.1	ND	ND
7/18/07	7:13 PM	0.084	0.086	ND	0.4	ND	ND
7/19/07	7:11 AM	0.068	0.080	ND	ND	ND	ND
7/19/07	7:52 AM	0.064	0.070	ND	ND	ND	ND
7/19/07	8:59 AM	0.071	0.070	ND	ND	ND	1
7/19/07	9:39 AM	0.06	0.065	ND	0.1	0.1	ND
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	N/A	*999*	*999*	*999*	*999*	*999*	*999*
7/19/07	6:41 PM	0.044	0.054	0.01	0.1	ND	ND
7/20/07	7:31 AM	0.111	0.117	0.01	ND	ND	ND
7/20/07	8:30 AM	0.099	0.106	0.01	0.2	ND	ND
7/20/07	9:12 AM	0.076	0.082	0.02	ND	ND	ND
7/20/07	9:47 AM	0.072	0.074	0.03	0.5	ND	1
7/20/07	4:23 PM	0.024	0.023	0.04	0.2	0.1	ND
7/20/07	5:06 PM	0.024	0.023	0.04	0.2	0.1	ND
7/20/07	5:54 PM	0.023	0.022	0.04	0.6	0.1	ND
7/20/07	7:02 PM	0.023	0.024	0.03	0.3	0.1	ND

7/23/07	7:20 AM	0.015	0.017	ND	0.1	0.1	ND
7/23/07	7:53 AM	0.013	0.018	ND	0.2	ND	ND
7/23/07	9:06 AM	0.015	0.020	ND	0.2	ND	ND
7/23/07	9:51 AM	0.019	0.023	ND	0.2	ND	ND
7/23/07	4:12 PM	0.009	0.012	0.01	ND	ND	ND
7/23/07	5:01 PM	0.014	0.014	ND	ND	ND	ND
7/23/07	6:15 PM	0.016	0.014	ND	ND	ND	ND
7/23/07	7:13 PM	0.017	0.015	ND	ND	ND	ND
7/24/07	7:22 AM	0.022	0.026	ND	ND	ND	ND
7/24/07	8:02 AM	0.017	0.022	ND	ND	ND	ND
7/24/07	8:52 AM	0.01	0.017	ND	ND	ND	ND
7/24/07	9:47 AM	0.01	0.012	ND	ND	ND	ND
7/24/07	4:18 PM	0.008	0.009	0.04	0.1	ND	ND
7/24/07	5:06 PM	0.012	0.013	0.04	0.6	ND	ND
7/24/07	6:15 PM	0.011	0.012	0.03	0.6	ND	ND
7/24/07	6:55 PM	0.01	0.013	0.03	0.5	ND	ND
7/25/07	7:21 AM	0.044	0.047	ND	ND	ND	ND
7/25/07	8:05 AM	0.035	0.038	ND	ND	ND	ND
7/25/07	8:54 AM	0.037	0.040	ND	ND	ND	ND
7/25/07	9:36 AM	0.039	0.039	ND	ND	ND	ND
7/25/07	4:44 PM	0.056	0.062	0.07	0.6	ND	ND
7/25/07	5:29 PM	0.06	0.058	0.07	0.7	ND	ND
7/25/07	6:11 PM	0.06	0.057	0.07	0.6	ND	ND
7/25/07	7:17 PM	0.059	0.058	0.06	0.5	ND	ND
7/26/07	7:20 AM	0.041	0.047	ND	ND	ND	ND
7/26/07	8:08 AM	0.032	0.036	ND	ND	ND	ND
7/26/07	9:07 AM	0.032	0.036	ND	ND	ND	ND
7/26/07	9:50 AM	0.033	0.037	ND	ND	ND	ND
7/26/07	4:08 PM	0.063	0.062	0.09	0.3	ND	ND
7/26/07	5:17 PM	0.054	0.054	0.08	0.6	0.1	ND
7/26/07	6:04 PM	0.055	0.054	0.09	1.0	ND	1
7/26/07	7:02 PM	0.030	0.036	0.06	1.4	ND	ND
7/27/07	7:12 AM	0.028	0.031	ND	0.9	ND	ND
7/27/07	8:02 AM	0.031	0.034	ND	1.1	ND	ND
7/27/07	8:55 AM	0.031	0.031	ND	1.3	ND	ND
7/27/07	9:44 AM	0.033	0.037	ND	1.2	ND	ND
7/27/07	4:26 PM	0.021	0.033	0.04	0.8	ND	ND
7/27/07	5:13 PM	0.021	0.024	0.04	0.9	ND	ND
7/27/07	6:02 PM	0.017	0.020	0.03	0.4	ND	ND
7/27/07	6:57 PM	0.017	0.021	0.03	0.3	ND	ND

Appendix 3. Air Quality Data
Winter 2008
All Locations

Location #1: 43 Freeport Street

		Concentration					
Date	Time	PM $_{2.5}$ (mg/m^3)	PM $_{10}$ (mg/m^3)	O_3 (ppm)	NO_2 (ppm)	SO_2 (ppm)	CO (ppm)
2/19/08	6:42 AM	0.020	0.023	ND	ND	0.1	ND
2/19/08	7:32 AM	0.028	0.028	ND	ND	ND	ND
2/19/08	8:37 AM	0.026	0.028	ND	ND	0.1	ND
2/19/08	9:38 AM	0.015	0.014	ND	0.2	ND	ND
2/19/08	3:41 PM	0.008	0.007	ND	ND	0.1	ND
2/19/08	4:35 PM	0.008	0.009	ND	0.1	ND	ND
2/19/08	5:33 PM	0.006	0.006	ND	0.1	ND	ND
2/19/08	6:32 PM	0.007	0.007	ND	0.1	0.1	ND
2/20/08	6:32 AM	0.014	0.013	ND	0.1	ND	ND
2/20/08	7:40 AM	0.015	0.013	ND	0.1	ND	ND
2/20/08	8:46 AM	0.013	0.015	ND	0.1	ND	ND
2/20/08	9:37 AM	0.013	0.015	ND	0.1	ND	ND
2/20/08	3:39 PM	0.014	0.016	ND	ND	ND	ND
2/20/08	4:36 PM	0.013	0.018	ND	ND	ND	ND
2/20/08	5:35 PM	0.013	0.018	ND	ND	ND	ND
2/20/08	6:36 PM	0.013	0.017	ND	ND	ND	ND
2/21/08	6:30 AM	0.015	0.017	ND	0.3	ND	ND
2/21/08	7:32 AM	0.015	0.017	ND	0.5	ND	ND
2/21/08	8:25 AM	0.009	0.009	ND	0.3	ND	ND
2/21/08	9:37 AM	0.005	0.009	ND	0.5	ND	ND
2/21/08	3:40 PM	0.006	0.005	ND	ND	0.1	ND
2/21/08	4:32 PM	0.006	0.007	ND	ND	ND	ND
2/21/08	5:33 PM	0.006	0.007	ND	ND	ND	ND
2/21/08	6:26 PM	0.006	0.006	ND	ND	ND	ND
2/25/08	6:35 AM	0.038	0.039	ND	ND	ND	ND
2/25/08	7:32 AM	0.036	0.037	ND	ND	ND	ND
2/25/08	8:39 AM	0.035	0.036	ND	ND	ND	ND
2/25/08	9:31 AM	0.035	0.036	ND	ND	ND	ND
2/25/08	3:37 PM	0.021	0.023	ND	0.2	ND	ND
2/25/08	4:35 PM	0.018	0.023	ND	0.2	0.1	ND
2/25/08	5:30 PM	0.022	0.026	ND	0.2	0.1	ND
2/25/08	6:35 PM	0.025	0.029	ND	0.2	0.1	ND
2/26/08	6:37 AM	0.068	0.080	ND	0.4	ND	ND
2/26/08	7:39 AM	0.068	0.078	ND	0.4	ND	ND
2/26/08	8:36 AM	0.075	0.078	ND	0.2	ND	ND
2/26/08	9:31 AM	0.077	0.083	ND	0.4	ND	ND
2/26/08	3:39 PM	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	4:36 PM	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	5:35 PM	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	6:36 PM	*999*	*999*	*999*	*999*	*999*	*999*

2/27/08	6:37 AM	0.039	0.038	ND	0.6	ND	ND
2/27/08	7:38 AM	0.032	0.034	ND	0.6	ND	ND
2/27/08	8:34 AM	0.041	0.044	ND	0.4	ND	ND
2/27/08	9:35 AM	0.037	0.040	ND	0.2	ND	ND
2/27/08	3:34 PM	0.019	0.020	ND	ND	ND	ND
2/27/08	4:35 PM	0.016	0.017	ND	ND	0.1	ND
2/27/08	5:38 PM	0.016	0.018	ND	ND	ND	ND
2/27/08	6:32 PM	0.014	0.016	ND	ND	ND	ND
2/28/08	6:36 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	7:37 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	8:37 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	9:33 AM	0.010	0.011	ND	ND	ND	ND
2/28/08	3:39 PM	0.007	0.008	ND	ND	ND	ND
2/28/08	4:33 PM	0.006	0.010	ND	ND	0.1	ND
2/28/08	5:34 PM	0.006	0.009	ND	ND	ND	ND
2/28/08	6:37 PM	0.006	0.009	ND	ND	ND	ND
2/29/08	6:39 AM	0.010	0.010	ND	ND	ND	ND
2/29/08	7:40 AM	0.010	0.010	ND	ND	ND	ND
2/29/08	8:37 AM	0.007	0.008	ND	0.6	ND	ND
2/29/08	9:36 AM	0.010	0.012	ND	0.2	ND	ND
2/29/08	3:37 PM	0.017	0.016	0.01	ND	0.2	ND
2/29/08	4:33 PM	0.007	0.012	ND	0.1	ND	ND
2/29/08	5:35 PM	0.009	0.013	ND	0.1	0.1	ND
2/29/08	6:36 PM	0.009	0.014	ND	0.1	0.1	ND

Location #2: McConnell Park/Malibu Beach Parking Lot

		Concentration					
Date	**Time**	**PM $_{2.5}$ (mg/m^3)**	**PM $_{10}$ (mg/m^3)**	**O_3 (ppm)**	**NO_2 (ppm)**	**SO_2 (ppm)**	**CO (ppm)**
2/19/08	6:49 AM	0.024	0.025	ND	0.3	0.1	ND
2/19/08	7:42 AM	0.035	0.038	ND	0.2	ND	ND
2/19/08	8:44 AM	0.023	0.027	ND	ND	ND	ND
2/19/08	9:49 AM	0.012	0.015	ND	0.2	ND	ND
2/19/08	3:50 PM	0.006	0.009	ND	ND	ND	ND
2/19/08	4:42 PM	0.007	0.007	ND	0.1	ND	ND
2/19/08	5:40 PM	0.006	0.006	ND	ND	ND	ND
2/19/08	6:38 PM	0.006	0.007	ND	ND	ND	ND
2/20/08	6:37 AM	0.013	0.014	ND	0.1	0.3	ND
2/20/08	7:54 AM	0.015	0.018	ND	0.1	0.3	ND
2/20/08	8:51 AM	0.011	0.016	ND	ND	ND	ND
2/20/08	9:47 AM	0.014	0.015	ND	ND	0.1	ND
2/20/08	3:47 PM	0.014	0.015	ND	0.2	ND	ND
2/20/08	4:43 PM	0.014	0.014	ND	ND	ND	ND
2/20/08	5:43 PM	0.012	0.015	ND	ND	ND	ND

2/20/08	6:42 PM	0.013	0.014	ND	ND	ND	ND
2/21/08	6:37 AM	0.014	0.014	ND	0.2	ND	ND
2/21/08	7:42 AM	0.014	0.014	ND	0.3	ND	ND
2/21/08	8:29 AM	0.008	0.010	ND	ND	ND	ND
2/21/08	9:42 AM	0.008	0.010	ND	ND	ND	ND
2/21/08	3:49 PM	0.007	0.005	ND	ND	0.1	ND
2/21/08	4:39 PM	0.006	0.008	ND	ND	ND	ND
2/21/08	5:42 PM	0.006	0.008	ND	ND	0.1	ND
2/21/08	6:35 PM	0.006	0.008	ND	ND	0.1	ND
2/25/08	6:44 AM	0.042	0.045	ND	ND	ND	ND
2/25/08	7:44 AM	0.040	0.042	ND	ND	ND	ND
2/25/08	8:48 AM	0.039	0.042	ND	ND	ND	ND
2/25/08	9:38 AM	0.033	0.037	ND	ND	ND	ND
2/25/08	3:45 PM	0.022	0.026	ND	0.2	ND	ND
2/25/08	4:45 PM	0.020	0.023	ND	0.3	ND	ND
2/25/08	5:35 PM	0.024	0.028	ND	0.3	ND	ND
2/25/08	6:40 PM	0.028	0.031	ND	0.3	ND	ND
2/26/08	6:45 AM	0.064	0.070	ND	0.4	ND	ND
2/26/08	7:52 AM	0.065	0.071	ND	0.4	ND	ND
2/26/08	8:43 AM	0.076	0.080	ND	0.6	ND	ND
2/26/08	9:43 AM	0.077	0.082	ND	0.4	ND	ND
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/27/08	6:47 AM	0.040	0.041	ND	0.6	ND	ND
2/27/08	7:49 AM	0.038	0.037	ND	0.6	ND	ND
2/27/08	8:41 AM	0.042	0.047	ND	0.4	ND	ND
2/27/08	9:43 AM	0.039	0.044	ND	0.2	ND	ND
2/27/08	3:47 PM	0.019	0.020	ND	0.1	ND	ND
2/27/08	4:47 PM	0.016	0.017	ND	ND	0.1	ND
2/27/08	5:48 PM	0.015	0.017	ND	ND	ND	ND
2/27/08	6:43 PM	0.014	0.015	ND	ND	ND	ND
2/28/08	6:46 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	7:48 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	8:47 AM	0.008	0.011	ND	ND	ND	ND
2/28/08	9:45 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	3:49 PM	0.007	0.009	0.01	0.2	0.1	ND
2/28/08	4:41 PM	0.007	0.006	ND	ND	ND	ND
2/28/08	5:45 PM	0.007	0.006	ND	ND	ND	ND
2/28/08	6:46 PM	0.007	0.006	ND	ND	ND	ND
2/29/08	6:49 AM	0.010	0.010	ND	0.3	ND	ND
2/29/08	7:52 AM	0.010	0.010	ND	0.5	ND	ND
2/29/08	8:54 AM	0.009	0.009	ND	0.3	ND	ND
2/29/08	9:44 AM	0.009	0.010	ND	0.5	ND	ND
2/29/08	3:53 PM	0.007	0.008	0.01	0.2	0.1	ND

2/29/08	4:44 PM	0.005	0.006	ND	ND	0.1	ND
2/29/08	5:41 PM	0.005	0.006	ND	0.2	0.1	ND
2/29/08	6:42 PM	0.005	0.006	ND	ND	0.1	ND

Location #3: Intersection of Savin Hill Avenue and Evandale Terrace

		Concentration					
		PM $_{2.5}$	**PM $_{10}$**	**O_3**	**NO_2**	**SO_2**	**CO**
Date	**Time**	**(mg/m^3)**	**(mg/m^3)**	**(ppm)**	**(ppm)**	**(ppm)**	**(ppm)**
2/19/08	6:53 AM	0.023	0.026	ND	ND	ND	ND
2/19/08	7:48 AM	0.030	0.035	ND	0.2	ND	ND
2/19/08	8:51 AM	0.026	0.026	ND	ND	ND	ND
2/19/08	9:54 AM	0.015	0.014	ND	0.5	0.1	ND
2/19/08	3:57 PM	0.008	0.007	ND	0.1	ND	ND
2/19/08	4:46 PM	0.007	0.006	ND	0.1	ND	ND
2/19/08	5:44 PM	0.005	0.006	ND	ND	ND	ND
2/19/08	6:42 PM	0.005	0.006	ND	0.1	ND	ND
2/20/08	6:41 AM	0.017	0.019	ND	0.1	ND	ND
2/20/08	8:00 AM	0.022	0.017	ND	0.1	ND	ND
2/20/08	8:56 AM	0.015	0.013	ND	ND	0.1	ND
2/20/08	9:51 AM	0.019	0.016	ND	0.5	0.2	ND
2/20/08	3:52 PM	0.012	0.019	ND	0.5	ND	ND
2/20/08	4:47 PM	0.011	0.021	ND	0.2	ND	ND
2/20/08	5:49 PM	0.013	0.023	ND	0.2	ND	ND
2/20/08	6:49 PM	0.012	0.020	ND	0.3	ND	ND
2/21/08	6:42 AM	0.014	0.023	ND	0.3	ND	ND
2/21/08	7:47 AM	0.012	0.023	ND	0.3	ND	ND
2/21/08	8:33 AM	0.007	0.009	ND	1	ND	ND
2/21/08	9:46 AM	0.008	0.013	ND	0.5	ND	ND
2/21/08	3:54 PM	0.006	0.006	ND	ND	ND	ND
2/21/08	4:45 PM	0.005	0.005	ND	ND	ND	ND
2/21/08	5:46 PM	0.005	0.005	ND	ND	ND	ND
2/21/08	6:39 PM	0.005	0.005	ND	ND	ND	ND
2/25/08	6:48 AM	0.037	0.043	ND	0.1	ND	ND
2/25/08	7:48 AM	0.037	0.044	ND	0.1	ND	ND
2/25/08	8:52 AM	0.035	0.041	ND	0.3	ND	ND
2/25/08	9:43 AM	0.030	0.045	ND	ND	ND	ND
2/25/08	3:50 PM	0.019	0.020	0.02	0.4	0.1	ND
2/25/08	4:50 PM	0.018	0.022	ND	0.3	0.1	ND
2/25/08	5:40 PM	0.019	0.024	0.01	0.4	0.1	ND
2/25/08	6:44 PM	0.021	0.024	ND	0.3	0.1	ND
2/26/08	6:50 AM	0.065	0.070	ND	0.4	ND	ND
2/26/08	7:57 AM	0.066	0.071	ND	0.5	ND	ND
2/26/08	8:47 AM	0.073	0.080	ND	0.5	ND	ND
2/26/08	9:44 AM	0.075	0.084	ND	0.5	ND	ND

2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/27/08	6:51 AM	0.040	0.039	ND	0.1	ND	ND
2/27/08	7:55 AM	0.035	0.037	ND	0.1	ND	ND
2/27/08	8:45 AM	0.040	0.043	ND	0.3	ND	ND
2/27/08	9:47 AM	0.038	0.041	ND	0.4	ND	ND
2/27/08	3:50 PM	0.019	0.021	ND	ND	0.1	ND
2/27/08	4:53 PM	0.017	0.017	ND	ND	ND	ND
2/27/08	5:52 PM	0.017	0.018	ND	ND	ND	ND
2/27/08	6:47 PM	0.016	0.016	ND	ND	ND	ND
2/28/08	6:50 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	7:52 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	8:51 AM	0.008	0.009	ND	ND	ND	ND
2/28/08	9:49 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	3:53 PM	0.006	0.009	0.01	ND	ND	ND
2/28/08	4:46 PM	0.005	0.007	0.01	ND	ND	ND
2/28/08	5:49 PM	0.005	0.007	0.01	ND	ND	ND
2/28/08	6:46 PM	0.006	0.008	ND	ND	ND	ND
2/29/08	6:53 AM	0.009	0.010	ND	0.3	ND	ND
2/29/08	7:56 AM	0.008	0.013	ND	0.3	ND	ND
2/29/08	8:58 AM	0.009	0.011	ND	0.2	ND	ND
2/29/08	9:48 AM	0.009	0.013	ND	0.6	ND	ND
2/29/08	3:58 PM	0.008	0.012	0.01	0.3	ND	ND
2/29/08	4:48 PM	0.007	0.010	ND	ND	ND	ND
2/29/08	5:44 PM	0.007	0.010	ND	0.2	ND	ND
2/29/08	6:46 PM	0.007	0.009	ND	0.1	ND	ND

Location #4: Intersection of Savin Hill Avenue and Grampian Way

		Concentration					
		PM $_{2.5}$	PM $_{10}$	O$_3$	NO$_2$	SO$_2$	CO
Date	**Time**	**(mg/m^3)**	**(mg/m^3)**	**(ppm)**	**(ppm)**	**(ppm)**	**(ppm)**
2/19/08	6:59 AM	0.025	0.028	ND	ND	ND	ND
2/19/08	7:51 AM	0.038	0.046	ND	0.2	ND	ND
2/19/08	8:55 AM	0.022	0.025	ND	ND	ND	ND
2/19/08	9:57 AM	0.014	0.018	ND	0.5	0.1	ND
2/19/08	4:00 PM	0.007	0.009	ND	0.1	ND	ND
2/19/08	4:50 PM	0.006	0.007	ND	0.1	ND	ND
2/19/08	5:48 PM	0.007	0.007	ND	0.1	0.1	ND
2/19/08	6:46 PM	0.006	0.007	ND	0.1	ND	ND
2/20/08	6:45 AM	0.014	0.021	ND	0.6	0.1	ND
2/20/08	8:06 AM	0.015	0.024	ND	0.2	ND	ND
2/20/08	9:00 AM	0.016	0.018	ND	ND	0.1	ND

2/20/08	9:55 AM	0.017	0.015	ND	ND	0.1	ND
2/20/08	3:55 PM	0.025	0.020	ND	0.2	ND	ND
2/20/08	4:51 PM	0.017	0.018	ND	0.2	ND	ND
2/20/08	5:54 PM	0.012	0.017	ND	0.2	ND	ND
2/20/08	6:54 PM	0.018	0.019	ND	0.2	ND	ND
2/21/08	6:45 AM	0.015	0.014	ND	0.4	ND	ND
2/21/08	7:50 AM	0.012	0.013	ND	1	ND	ND
2/21/08	8:36 AM	0.009	0.012	ND	0.2	ND	ND
2/21/08	9:49 AM	0.008	0.009	ND	0.3	ND	ND
2/21/08	3:56 PM	0.006	0.011	ND	ND	ND	ND
2/21/08	4:49 PM	0.005	0.006	ND	0.3	ND	ND
2/21/08	5:50 PM	0.005	0.006	ND	0.2	ND	ND
2/21/08	6:44 PM	0.005	0.006	ND	0.3	ND	ND
2/25/08	6:51 AM	0.039	0.040	ND	ND	ND	ND
2/25/08	7:52 AM	0.037	0.038	ND	0.1	ND	ND
2/25/08	8:56 AM	0.035	0.039	ND	0.3	ND	ND
2/25/08	9:46 AM	0.034	0.042	ND	ND	ND	ND
2/25/08	3:53 PM	0.020	0.021	0.02	0.4	0.1	ND
2/25/08	4:53 PM	0.020	0.021	ND	0.3	ND	ND
2/25/08	5:44 PM	0.021	0.022	ND	0.3	ND	ND
2/25/08	6:47 PM	0.022	0.023	ND	0.4	ND	ND
2/26/08	6:54AM	0.069	0.077	ND	0.4	ND	ND
2/26/08	8:00 AM	0.070	0.079	ND	0.7	ND	ND
2/26/08	8:52 AM	0.077	0.076	ND	0.4	ND	ND
2/26/08	9:47 AM	0.079	0.085	ND	0.2	ND	ND
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/27/08	6:54 AM	0.034	0.039	ND	0.2	ND	ND
2/27/08	7:59 AM	0.036	0.046	ND	0.2	ND	ND
2/27/08	8:48 AM	0.039	0.041	ND	0.2	ND	ND
2/27/08	9:51 AM	0.037	0.040	ND	0.2	ND	ND
2/27/08	3:54 PM	0.021	0.023	ND	ND	ND	ND
2/27/08	4:57 PM	0.019	0.018	ND	ND	ND	ND
2/27/08	5:56 PM	0.018	0.017	ND	ND	ND	ND
2/27/08	6:51 PM	0.015	0.015	ND	ND	ND	ND
2/28/08	6:54 AM	0.008	0.009	ND	ND	ND	ND
2/28/08	7:56 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	8:55 AM	0.010	0.011	ND	ND	ND	ND
2/28/08	9:53 AM	0.010	0.011	ND	ND	ND	ND
2/28/08	3:58 PM	0.007	0.009	ND	0.2	ND	ND
2/28/08	4:50 PM	0.006	0.006	ND	ND	ND	ND
2/28/08	5:53 PM	0.006	0.007	ND	ND	ND	ND
2/28/08	6:54 PM	0.006	0.007	ND	ND	ND	ND
2/29/08	6:57 AM	0.010	0.017	ND	0.6	ND	ND

2/29/08	8:00 AM	0.009	0.028	ND	0.8	ND	ND
2/29/08	9:01 AM	0.010	0.025	ND	0.5	ND	ND
2/29/08	9:52 AM	0.009	0.013	ND	0.9	ND	ND
2/29/08	4:01 PM	0.008	0.010	0.01	0.2	0.1	ND
2/29/08	4:52 PM	0.007	0.011	ND	ND	ND	ND
2/29/08	5:47 PM	0.007	0.010	ND	0.2	0.1	ND
2/29/08	6:50 PM	0.007	0.009	ND	ND	ND	ND

Location #5: Intersection of Caspian Way and Rockmere Street

		Concentration					
Date	**Time**	**PM $_{2.5}$ (mg/m^3)**	**PM $_{10}$ (mg/m^3)**	**O_3 (ppm)**	**NO_2 (ppm)**	**SO_2 (ppm)**	**CO (ppm)**
2/19/08	7:01 AM	0.024	0.027	ND	ND	ND	ND
2/19/08	7:54 AM	0.034	0.032	ND	0.2	ND	ND
2/19/08	8:58 AM	0.022	0.026	ND	ND	ND	ND
2/19/08	10:00 AM	0.013	0.014	ND	0.2	0.1	ND
2/19/08	4:04 PM	0.007	0.006	ND	0.1	ND	ND
2/19/08	4:54 PM	0.006	0.006	ND	ND	ND	ND
2/19/08	5:53 PM	0.007	0.006	ND	0.1	ND	ND
2/19/08	6:49 PM	0.007	0.006	ND	0.1	ND	ND
2/20/08	6:50 AM	0.010	0.013	ND	0.1	ND	ND
2/20/08	8:09 AM	0.011	0.016	ND	0.2	0.1	ND
2/20/08	9:04 AM	0.012	0.013	ND	ND	ND	ND
2/20/08	9:58 AM	0.011	0.012	ND	0.1	ND	ND
2/20/08	3:58 PM	0.014	0.014	ND	0.2	ND	ND
2/20/08	4:53 PM	0.013	0.016	ND	0.3	ND	ND
2/20/08	5:59 PM	0.014	0.020	ND	0.6	ND	ND
2/20/08	7:00 PM	0.014	0.020	ND	0.6	ND	ND
2/21/08	6:50 AM	0.013	0.009	ND	0.3	ND	ND
2/21/08	7:54 AM	0.013	0.009	ND	0.3	ND	ND
2/21/08	8:40 AM	0.008	0.010	ND	ND	ND	ND
2/21/08	9:53 AM	0.008	0.012	ND	0.2	ND	ND
2/21/08	3:59 PM	0.010	0.012	ND	ND	ND	ND
2/21/08	4:52 PM	0.005	0.005	ND	0.3	ND	ND
2/21/08	5:55 PM	0.006	0.007	ND	0.2	ND	ND
2/21/08	6:49 PM	0.006	0.008	ND	0.3	ND	ND
2/25/08	6:55 AM	0.035	0.039	ND	ND	ND	ND
2/25/08	7:56 AM	0.034	0.038	ND	ND	ND	ND
2/25/08	9:00 AM	0.034	0.038	ND	0.1	ND	ND
2/25/08	9:49 AM	0.031	0.035	ND	ND	ND	ND
2/25/08	3:57 PM	0.019	0.021	0.01	0.6	0.2	ND
2/25/08	4:56 PM	0.017	0.018	ND	0.3	ND	ND
2/25/08	5:48 PM	0.018	0.019	ND	0.5	ND	ND

2/25/08	6:51 PM	0.019	0.021	ND	0.6	ND	ND
2/26/08	6:54AM	0.071	0.072	ND	0.3	ND	ND
2/26/08	8:00 AM	0.070	0.073	ND	0.4	ND	ND
2/26/08	8:52 AM	0.074	0.076	ND	0.2	ND	ND
2/26/08	9:47 AM	0.076	0.086	ND	0.6	ND	ND
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/27/08	6:58 AM	0.037	0.042	ND	0.2	ND	ND
2/27/08	8:04 AM	0.038	0.040	ND	0.2	ND	ND
2/27/08	8:51 AM	0.039	0.040	ND	0.2	ND	ND
2/27/08	9:54 AM	0.038	0.040	ND	0.2	ND	ND
2/27/08	3:57 PM	0.019	0.019	ND	ND	ND	ND
2/27/08	5:01 PM	0.019	0.019	ND	ND	ND	ND
2/27/08	6:00 PM	0.018	0.018	ND	ND	ND	ND
2/27/08	6:54 PM	0.017	0.018	ND	ND	ND	ND
2/28/08	6:58 AM	0.007	0.010	ND	ND	ND	ND
2/28/08	8:00 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	8:59 AM	0.008	0.010	ND	ND	ND	ND
2/28/08	9:57 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	4:02 PM	0.006	0.009	0.1	0.3	ND	ND
2/28/08	4:53 PM	0.006	0.006	ND	ND	ND	ND
2/28/08	5:57 PM	0.006	0.006	ND	0.3	ND	ND
2/28/08	6:58 PM	0.005	0.007	ND	0.3	ND	ND
2/29/08	7:02 AM	0.018	0.014	ND	0.2	ND	ND
2/29/08	8:04 AM	0.020	0.015	ND	0.2	ND	ND
2/29/08	9:04 AM	0.009	0.013	ND	0.9	ND	ND
2/29/08	9:55 AM	0.009	0.018	ND	0.3	ND	ND
2/29/08	4:04 PM	0.006	0.008	0.01	0.3	0.1	ND
2/29/08	4:58 PM	0.006	0.008	ND	0.2	ND	ND
2/29/08	5:51 PM	0.006	0.008	ND	0.2	ND	ND
2/29/08	6:53 PM	0.006	0.008	ND	0.3	ND	ND

Location #6: Grampian Way and Savin Hill Avenue at Motley School Condo's

		Concentration					
Date	**Time**	**PM $_{2.5}$ (mg/m^3)**	**PM $_{10}$ (mg/m^3)**	**O_3 (ppm)**	**NO_2 (ppm)**	**SO_2 (ppm)**	**CO (ppm)**
2/19/08	7:05 AM	0.025	0.029	ND	ND	ND	ND
2/19/08	7:58 AM	0.034	0.032	ND	0.2	ND	ND
2/19/08	9:00 AM	0.021	0.022	ND	ND	ND	ND
2/19/08	10:03 AM	0.015	0.018	ND	ND	0.1	ND

2/19/08	4:09 PM	0.011	0.008	ND	0.5	ND	ND
2/19/08	4:59 PM	0.007	0.008	ND	0.2	ND	ND
2/19/08	5:58 PM	0.008	0.006	ND	0.1	ND	ND
2/19/08	6:53 PM	0.005	0.006	ND	0.2	0.1	ND
2/20/08	7:04 AM	0.014	0.018	ND	0.5	0.2	ND
2/20/08	8:18 AM	0.014	0.020	ND	0.5	0.2	ND
2/20/08	9:09 AM	0.014	0.023	ND	ND	ND	ND
2/20/08	10:02 AM	0.014	0.024	ND	0.5	0.1	ND
2/20/08	4:02 PM	0.016	0.024	ND	0.8	ND	ND
2/20/08	4:58 PM	0.013	0.016	ND	0.5	ND	ND
2/20/08	6:00 PM	0.014	0.015	ND	0.5	ND	ND
2/20/08	7:03 PM	0.013	0.017	ND	0.5	ND	ND
2/21/08	6:58 AM	0.015	0.013	ND	0.6	ND	ND
2/21/08	7:58 AM	0.015	0.013	ND	0.6	ND	ND
2/21/08	8:44 AM	0.009	0.013	ND	0.5	ND	ND
2/21/08	9:57 AM	0.008	0.008	ND	0.2	ND	ND
2/21/08	4:03 PM	0.005	0.008	ND	0.1	ND	ND
2/21/08	4:56 PM	0.007	0.009	ND	0.5	ND	ND
2/21/08	6:00 PM	0.007	0.009	ND	0.5	ND	ND
2/21/08	6:55 PM	0.007	0.009	ND	0.3	ND	ND
2/25/08	6:59 AM	0.037	0.045	ND	ND	ND	ND
2/25/08	8:00 AM	0.038	0.048	ND	0.1	ND	ND
2/25/08	9:04 AM	0.038	0.068	ND	0.1	ND	ND
2/25/08	9:52 AM	0.034	0.045	ND	ND	ND	ND
2/25/08	4:00 PM	0.019	0.024	0.01	0.1	0.1	ND
2/25/08	5:02 PM	0.022	0.022	ND	0.1	ND	ND
2/25/08	5:52 PM	0.023	0.024	0.01	0.1	ND	ND
2/25/08	6:54 PM	0.024	0.024	ND	0.2	ND	ND
2/26/08	7:04 AM	0.069	0.070	ND	0.2	ND	ND
2/26/08	8:08 AM	0.070	0.075	ND	0.2	ND	ND
2/26/08	8:59 AM	0.076	0.087	ND	0.4	ND	ND
2/26/08	9:54 AM	0.080	0.088	ND	0.2	ND	ND
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/27/08	7:02 AM	0.043	0.045	ND	0.4	0.1	ND
2/27/08	8:09 AM	0.042	0.044	ND	0.3	0.1	ND
2/27/08	8:55 AM	0.045	0.040	ND	0.4	ND	ND
2/27/08	9:57 AM	0.046	0.040	ND	0.5	0.1	ND
2/27/08	4:01 PM	0.020	0.023	ND	ND	ND	ND
2/27/08	5:04 PM	0.021	0.023	ND	ND	ND	ND
2/27/08	6:04 PM	0.020	0.021	ND	ND	ND	ND
2/27/08	6:58 PM	0.018	0.019	ND	ND	ND	ND
2/28/08	7:02 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	8:04 AM	0.009	0.010	ND	ND	ND	ND

2/28/08	9:03 AM	0.009	0.011	ND	ND	ND	ND
2/28/08	10:01 AM	0.008	0.010	ND	ND	ND	ND
2/28/08	4:06 PM	0.006	0.010	0.01	0.3	ND	ND
2/28/08	4:56 PM	0.006	0.007	ND	0.3	ND	ND
2/28/08	6:01 PM	0.006	0.007	ND	0.3	ND	ND
2/28/08	7:02 PM	0.005	0.006	ND	0.3	ND	ND
2/29/08	7:06 AM	0.011	0.015	ND	0.6	ND	ND
2/29/08	8:08 AM	0.011	0.015	ND	0.9	ND	ND
2/29/08	9:08 AM	0.011	0.018	ND	ND	ND	ND
2/29/08	9:59 AM	0.012	0.018	ND	0.3	ND	ND
2/29/08	4:07 PM	0.007	0.015	0.01	0.1	ND	ND
2/29/08	5:02 PM	0.006	0.012	ND	0.1	ND	ND
2/29/08	5:55 PM	0.006	0.011	ND	0.1	ND	ND
2/29/08	6:57 PM	0.006	0.010	ND	0.1	ND	ND

Location #7: Patten's Cove Park at 324 Savin Hill Avenue

		Concentration					
Date	**Time**	**PM $_{2.5}$ (mg/m^3)**	**PM $_{10}$ (mg/m^3)**	**O_3 (ppm)**	**NO_2 (ppm)**	**SO_2 (ppm)**	**CO (ppm)**
2/19/08	7:08 AM	0.029	0.027	ND	ND	ND	ND
2/19/08	8:02 AM	0.034	0.034	ND	0.3	ND	ND
2/19/08	9:04 AM	0.019	0.018	ND	ND	ND	ND
2/19/08	10:07 AM	0.010	0.012	ND	0.2	0.1	ND
2/19/08	4:12 PM	0.008	0.006	ND	0.1	ND	ND
2/19/08	5:03 PM	0.006	0.006	ND	0.1	ND	ND
2/19/08	6:01 PM	0.006	0.006	ND	0.1	ND	ND
2/19/08	6:58 PM	0.006	0.006	ND	0.1	ND	ND
2/20/08	7:08 AM	0.011	0.015	ND	0.1	0.1	ND
2/20/08	8:22 AM	0.014	0.018	ND	0.2	ND	ND
2/20/08	9:13 AM	0.013	0.014	ND	0.2	0.1	ND
2/20/08	10:06 AM	0.013	0.015	ND	0.4	0.1	ND
2/20/08	4:06 PM	0.014	0.018	ND	0.2	ND	ND
2/20/08	5:02 PM	0.013	0.016	ND	0.5	ND	ND
2/20/08	6:05 PM	0.014	0.017	ND	0.5	ND	ND
2/20/08	7:07 PM	0.013	0.016	ND	0.2	ND	ND
2/21/08	7:05 AM	0.012	0.012	ND	0.6	ND	ND
2/21/08	8:02 AM	0.010	0.012	ND	0.6	ND	ND
2/21/08	8:48 AM	0.009	0.009	ND	0.8	ND	ND
2/21/08	10:00 AM	0.007	0.006	ND	0.6	ND	ND
2/21/08	4:06 PM	0.005	0.005	ND	0.1	ND	ND
2/21/08	5:00 PM	0.007	0.009	ND	ND	ND	ND
2/21/08	6:05 PM	0.007	0.009	ND	0.3	ND	ND
2/21/08	7:00 PM	0.007	0.009	ND	0.1	ND	ND
2/25/08	7:03 AM	0.038	0.045	ND	0.1	ND	ND

2/25/08	8:04 AM	0.036	0.041	ND	0.1	ND	ND
2/25/08	9:08 AM	0.035	0.045	ND	0.1	0.1	ND
2/25/08	9:56 AM	0.032	0.036	ND	ND	ND	ND
2/25/08	4:04 PM	0.019	0.022	0.02	0.2	0.1	ND
2/25/08	5:05 PM	0.017	0.021	ND	0.4	ND	ND
2/25/08	5:56 PM	0.018	0.020	ND	0.4	ND	ND
2/25/08	6:58 PM	0.019	0.022	ND	0.3	ND	ND
2/26/08	7:08 AM	0.068	0.071	ND	0.3	ND	ND
2/26/08	8:13 AM	0.070	0.074	ND	0.4	ND	ND
2/26/08	9:03 AM	0.084	0.086	ND	0.2	ND	ND
2/26/08	9:59 AM	0.084	0.086	ND	0.2	ND	ND
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/27/08	7:06 AM	0.041	0.043	ND	0.2	ND	ND
2/27/08	8:14 AM	0.039	0.041	ND	0.2	ND	ND
2/27/08	8:59 AM	0.038	0.037	ND	0.2	ND	ND
2/27/08	10:02 AM	0.037	0.036	ND	0.2	ND	ND
2/27/08	4:05 PM	0.017	0.019	ND	ND	ND	ND
2/27/08	5:09 PM	0.017	0.017	ND	ND	ND	ND
2/27/08	6:09 PM	0.016	0.017	ND	ND	ND	ND
2/27/08	7:02 PM	0.016	0.016	ND	ND	ND	ND
2/28/08	7:06 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	8:08 AM	0.009	0.011	ND	ND	ND	ND
2/28/08	9:07 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	10:05 AM	0.008	0.011	ND	ND	ND	ND
2/28/08	4:10 PM	0.006	0.006	0.01	0.5	ND	ND
2/28/08	5:00 PM	0.006	0.006	0.01	0.3	ND	ND
2/28/08	6:05 PM	0.006	0.006	0.01	0.3	ND	ND
2/28/08	7:07 PM	0.005	0.005	ND	0.2	ND	ND
2/29/08	7:10 AM	0.009	0.011	ND	0.6	ND	ND
2/29/08	8:12 AM	0.009	0.011	ND	0.8	ND	ND
2/29/08	9:12 AM	0.009	0.012	ND	0.6	ND	ND
2/29/08	10:04 AM	0.009	0.012	ND	0.5	ND	ND
2/29/08	4:11 PM	0.006	0.024	0.01	0.1	ND	ND
2/29/08	5:06 PM	0.006	0.013	ND	0.1	ND	ND
2/29/08	5:59 PM	0.007	0.012	ND	0.1	ND	ND
2/29/08	7:01 PM	0.006	0.012	ND	0.1	ND	ND

Location #8: Overlook across from 37 Grampian Way

		Concentration					
Date	**Time**	**PM $_{2.5}$ (mg/m^3)**	**PM $_{10}$ (mg/m^3)**	**O_3 (ppm)**	**NO_2 (ppm)**	**SO_2 (ppm)**	**CO (ppm)**
2/19/08	7:14 AM	0.028	0.034	ND	ND	ND	ND

2/19/08	8:08 AM	0.033	0.030	ND	ND	ND	ND
2/19/08	9:08 AM	0.019	0.019	ND	ND	ND	ND
2/19/08	10:11 AM	0.010	0.014	ND	0.3	0.9	ND
2/19/08	4:16 PM	0.007	0.006	ND	0.1	0.1	ND
2/19/08	5:07 PM	0.009	0.008	ND	0.1	0.3	ND
2/19/08	6:05 PM	0.008	0.007	ND	0.1	0.2	ND
2/19/08	7:03 PM	0.008	0.006	ND	ND	0.1	ND
2/20/08	7:12 AM	0.010	0.018	ND	0.5	ND	ND
2/20/08	8:27 AM	0.011	0.019	ND	0.2	0.1	ND
2/20/08	9:18 AM	0.013	0.013	ND	ND	0.3	ND
2/20/08	10:10 AM	0.012	0.016	ND	0.2	0.1	ND
2/20/08	4:11 PM	0.016	0.016	ND	0.5	ND	ND
2/20/08	5:07 PM	0.014	0.014	ND	ND	ND	ND
2/20/08	6:13 PM	0.010	0.012	ND	ND	ND	ND
2/20/08	7:12 PM	0.011	0.013	ND	0.2	ND	ND
2/21/08	7:09 AM	0.012	0.014	ND	0.3	ND	ND
2/21/08	8:06 AM	0.011	0.013	ND	0.3	ND	ND
2/21/08	8:53 AM	0.012	0.013	ND	0.2	ND	ND
2/21/08	10:04 AM	0.011	0.011	ND	0.2	ND	ND
2/21/08	4:10 PM	0.006	0.005	ND	ND	ND	ND
2/21/08	5:04 PM	0.008	0.009	ND	ND	ND	ND
2/21/08	6:09 PM	0.008	0.009	ND	ND	ND	ND
2/21/08	7:04 PM	0.008	0.010	ND	ND	ND	ND
2/25/08	7:08 AM	0.036	0.049	ND	ND	ND	ND
2/25/08	8:08 AM	0.035	0.046	ND	0.1	ND	ND
2/25/08	9:12 AM	0.035	0.045	ND	0.1	ND	ND
2/25/08	10:00 AM	0.032	0.036	ND	ND	ND	ND
2/25/08	4:09 PM	0.019	0.022	0.01	0.2	0.1	ND
2/25/08	5:09 PM	0.017	0.021	ND	0.4	ND	ND
2/25/08	6:00 PM	0.017	0.020	ND	0.4	ND	ND
2/25/08	7:01 PM	0.018	0.021	ND	0.4	ND	ND
2/26/08	7:12 AM	0.068	0.073	ND	0.4	ND	ND
2/26/08	8:17 AM	0.071	0.076	ND	0.4	ND	ND
2/26/08	9:07 AM	0.080	0.082	ND	0.5	ND	ND
2/26/08	10:03 AM	0.080	0.082	ND	0.4	ND	ND
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/27/08	7:10 AM	0.041	0.042	ND	0.3	ND	ND
2/27/08	8:18 AM	0.037	0.039	ND	0.2	ND	ND
2/27/08	9:04 AM	0.041	0.043	ND	0.5	ND	ND
2/27/08	10:07 AM	0.039	0.042	ND	0.5	ND	ND
2/27/08	4:09 PM	0.019	0.020	ND	ND	ND	ND
2/27/08	5:13 PM	0.018	0.019	ND	ND	ND	ND
2/27/08	6:13 PM	0.017	0.018	ND	ND	ND	ND

2/27/08	7:06 PM	0.013	0.014	ND	ND	ND	ND
2/28/08	7:10 AM	0.008	0.009	ND	ND	ND	ND
2/28/08	8:13 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	9:11 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	10:10 AM	0.009	0.011	ND	ND	ND	ND
2/28/08	4:13 PM	0.006	0.007	ND	0.5	ND	ND
2/28/08	5:04 PM	0.006	0.007	ND	0.5	ND	ND
2/28/08	6:09 PM	0.005	0.006	ND	0.5	ND	ND
2/28/08	7:11 PM	0.005	0.006	ND	0.3	ND	ND
2/29/08	7:14 AM	0.010	0.014	ND	0.9	ND	ND
2/29/08	8:16 AM	0.009	0.014	ND	1.2	ND	ND
2/29/08	9:17 AM	0.010	0.011	ND	0.3	ND	ND
2/29/08	10:08 AM	0.010	0.012	ND	0.3	ND	ND
2/29/08	4:15 PM	0.007	0.008	0.01	ND	0.1	ND
2/29/08	5:11 PM	0.008	0.009	ND	ND	0.1	ND
2/29/08	6:05 PM	0.008	0.009	ND	ND	0.1	ND
2/29/08	7:05 PM	0.007	0.008	ND	ND	0.1	ND

Location #9: Intersection of Savin Hill Avenue and Saxton Street

		Concentration					
Date	**Time**	**PM $_{2.5}$ (mg/m^3)**	**PM $_{10}$ (mg/m^3)**	**O_3 (ppm)**	**NO_2 (ppm)**	**SO_2 (ppm)**	**CO (ppm)**
2/19/08	7:17 AM	0.027	0.029	ND	0.3	ND	ND
2/19/08	8:12 AM	0.028	0.030	ND	0.5	ND	ND
2/19/08	9:14 AM	0.018	0.016	ND	0.2	ND	ND
2/19/08	10:15 AM	0.009	0.012	ND	ND	ND	ND
2/19/08	4:19 PM	0.008	0.009	ND	ND	ND	ND
2/19/08	5:12 PM	0.008	0.008	ND	0.1	ND	ND
2/19/08	6:10 PM	0.007	0.007	ND	ND	ND	ND
2/19/08	7:09 PM	0.006	0.007	ND	ND	ND	ND
2/20/08	7:16 AM	0.012	0.013	ND	ND	ND	ND
2/20/08	8:32 AM	0.012	0.014	ND	ND	ND	ND
2/20/08	9:22 AM	0.011	0.011	ND	ND	0.1	ND
2/20/08	10:15 AM	0.012	0.011	ND	ND	0.1	ND
2/20/08	4:15 PM	0.017	0.017	ND	ND	ND	ND
2/20/08	5:11 PM	0.012	0.013	ND	ND	ND	ND
2/20/08	6:17 PM	0.011	0.014	ND	ND	ND	ND
2/20/08	7:16 PM	0.012	0.011	ND	ND	ND	ND
2/21/08	7:14 AM	0.013	0.013	ND	0.5	ND	ND
2/21/08	8:09 AM	0.013	0.012	ND	0.5	ND	ND
2/21/08	8:56 AM	0.011	0.014	ND	0.5	ND	ND
2/21/08	10:08 AM	0.012	0.013	ND	0.5	ND	ND
2/21/08	4:15 PM	0.009	0.011	ND	0.4	ND	ND
2/21/08	5:09 PM	0.009	0.010	ND	0.4	ND	ND
2/21/08	6:15 PM	0.009	0.010	ND	0.5	ND	ND

2/21/08	7:10 PM	0.009	0.010	ND	0.4	ND	ND
2/25/08	7:12 AM	0.045	0.048	ND	ND	ND	ND
2/25/08	8:11 AM	0.042	0.054	ND	ND	ND	ND
2/25/08	9:17 AM	0.041	0.123	ND	ND	ND	ND
2/25/08	10:05 AM	0.037	0.051	ND	ND	ND	ND
2/25/08	4:19 PM	0.020	0.023	ND	0.2	ND	ND
2/25/08	5:14 PM	0.020	0.021	ND	0.2	ND	ND
2/25/08	6:05 PM	0.020	0.022	ND	0.2	ND	ND
2/25/08	7:06 PM	0.020	0.022	ND	0.2	ND	ND
2/26/08	7:15 AM	0.068	0.077	ND	0.3	ND	ND
2/26/08	8:21 AM	0.070	0.076	ND	0.4	ND	ND
2/26/08	9:12 AM	0.073	0.079	ND	0.4	ND	ND
2/26/08	10:08 AM	0.077	0.085	ND	0.5	ND	ND
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/26/08	N/A	*999*	*999*	*999*	*999*	*999*	*999*
2/27/08	7:14 AM	0.037	0.039	ND	0.3	ND	ND
2/27/08	8:22 AM	0.036	0.038	ND	0.3	ND	ND
2/27/08	9:09 AM	0.039	0.045	ND	0.2	ND	ND
2/27/08	10:11 AM	0.038	0.043	ND	0.3	ND	ND
2/27/08	4:15 PM	0.019	0.020	ND	ND	ND	ND
2/27/08	5:18 PM	0.018	0.025	ND	ND	ND	ND
2/27/08	6:17 PM	0.017	0.022	ND	ND	ND	ND
2/27/08	7:10 PM	0.015	0.017	ND	ND	ND	ND
2/28/08	7:14 AM	0.009	0.010	ND	ND	ND	ND
2/28/08	8:17 AM	0.010	0.010	ND	ND	ND	ND
2/28/08	9:15 AM	0.010	0.010	ND	ND	ND	ND
2/28/08	10:15 AM	0.011	0.011	ND	ND	ND	ND
2/28/08	4:17 PM	0.006	0.010	0.01	0.3	ND	ND
2/28/08	5:08 PM	0.006	0.009	0.01	0.3	ND	ND
2/28/08	6:13 PM	0.006	0.009	0.01	0.3	ND	ND
2/28/08	7:15 PM	0.005	0.008	ND	0.2	ND	ND
2/29/08	7:18 AM	0.027	0.044	ND	0.5	ND	ND
2/29/08	8:21 AM	0.027	0.046	ND	0.5	ND	ND
2/29/08	9:22 AM	0.028	0.047	ND	0.5	ND	ND
2/29/08	10:12 AM	0.027	0.046	ND	0.5	ND	ND
2/29/08	4:19 PM	0.006	0.023	ND	0.3	0.1	ND
2/29/08	5:15 PM	0.006	0.020	ND	0.2	0.1	ND
2/29/08	6:09 PM	0.006	0.020	ND	0.2	0.1	ND
2/29/08	7:09 PM	0.006	0.020	ND	0.2	0.1	ND

ND = Non-Detect
999 = No sample obtained

Appendix 4. Meteorological Data
Summer 2007

Summer 2007 Meteorological Data

Date	Time	Temp (^{0}F)	Wind Direction	Wind Speed (mph)
7/16/2007	6:00 AM	70	NW	7
	7:00 AM	71	NW	7
	8:00 AM	73	NW	7
	9:00 AM	73	NW	6
	10:00 AM	77	Calm	0
	11:00 AM	78	Variable	3
7/16/2007	3:00 PM	79	SE	15
	4:00 PM	77	E	15
	5:00 PM	77	E	10
	6:00 PM	72	E	9
	7:00 PM	70	NE	5
	8:00 PM	68	NE	6
7/17/2007	6:00 AM	69.1	NNW	8
	7:00 AM	71	Calm	0
	8:00 AM	73	Calm	0
	9:00 AM	73.9	Calm	0
	10:00 AM	73.9	SE	6
	11:00 AM	79	SE	7
7/17/2007	3:00 PM	77	SE	9
	4:00 PM	79	SE	13
	5:00 PM	77	ESE	14
	6:00 PM	75.9	ESE	12
	7:00 PM	73.9	ESE	7
	8:00 PM	72	ESE	6
7/18/2007	6:00 AM	71.1	SSW	5
	7:00 AM	69.1	SSE	6
	8:00 AM	70	S	3
	9:00 AM	70	SE	5
	10:00 AM	66	E	7
	11:00 AM	66.9	E	6
7/18/2007	3:00 PM	66	ESE	7
	4:00 PM	68	E	7
	5:00 PM	66	ESE	8
	6:00 PM	66	E	6
	7:00 PM	66	ENE	8
	8:00 PM	64	ENE	6

7/19/2007	6:00 AM	66.2	*999*	*999*
	7:00 AM	62.6	*999*	*999*
	8:00 AM	62.6	*999*	*999*
	9:00 AM	62.9	*999*	*999*
	10:00 AM	70	*999*	*999*
	11:00 AM	72	ESE	7
7/19/2007	3:00 PM	66	E	14
	4:00 PM	64	E	13
	5:00 PM	64	E	13
	6:00 PM	64	ESE	14
	7:00 PM	63	SE	10
	8:00 PM			
7/20/2007	6:00 AM	73	SW	9
	7:00 AM	73	SW	10
	8:00 AM	75	WSW	12
	9:00 AM	77	SW	16
	10:00 AM	79	WSW	13
	11:00 AM	78.1	WNW	10
7/20/2007	3:00 PM	82.9	WSW	14
	4:00 PM	82	*999*	*999*
	5:00 PM	82	*999*	*999*
	6:00 PM	83	*999*	*999*
	7:00 PM	83	*999*	*999*
	8:00 PM	83	*999*	*999*
7/23/2007	6:00 AM	65	NE	12
	7:00 AM	65	NE	10
	8:00 AM	66	NE	12
	9:00 AM	66	NE	16
	10:00 AM	66	NE	14
	11:00 AM	67	NE	16
7/23/2007	3:00 PM	65	NE	13
	4:00 PM	65	NE	13
	5:00 PM	65	NE	12
	6:00 PM	64	NE	13
	7:00 PM	64	NE	10
	8:00 PM	64	NE	13
7/24/2007	6:00 AM	65	SW	5
	7:00 AM	66	S	7
	8:00 AM	68	SW	7
	9:00 AM	70	SW	13

	10:00 AM	72	SW	10
	11:00 AM	74	W	8
7/24/2007	3:00 PM	82	S	9
	4:00 PM	83	SW	13
	5:00 PM	82	W	9
	6:00 PM	81	W	14
	7:00 PM	80	W	12
	8:00 PM	78	W	16
7/25/2007	6:00 AM	70	*999*	*999*
	7:00 AM	69	*999*	*999*
	8:00 AM	67	*999*	*999*
	9:00 AM	67	*999*	*999*
	10:00 AM	69	*999*	*999*
	11:00 AM	71	*999*	*999*
7/25/2007	3:00 PM	84	*999*	*999*
	4:00 PM	86	*999*	*999*
	5:00 PM	87	*999*	*999*
	6:00 PM	88	*999*	*999*
	7:00 PM	89	*999*	*999*
	8:00 PM	88	*999*	*999*
7/26/2007	6:00 AM	72	*999*	*999*
	7:00 AM	72	*999*	*999*
	8:00 AM	72	*999*	*999*
	9:00 AM	70	*999*	*999*
	10:00 AM	68	*999*	*999*
	11:00 AM	84	SE	7
7/26/2007	3:00 PM	88	SE	10
	4:00 PM	91	SW	8
	5:00 PM	92	SW	9
	6:00 PM	90	SW	10
	7:00 PM	88	SW	10
	8:00 PM	82	S	14
7/27/2007	6:00 AM	75	SW	8
	7:00 AM	75	SW	6
	8:00 AM	76	S	8
	9:00 AM	80	SW	8
	10:00 AM	83	S	9
	11:00 AM	86	SE	10
7/27/2007	3:00 PM	90	S	14

4:00 PM	90	S	14
5:00 PM	88	S	15
6:00 PM	86	S	18
7:00 PM	83	S	17
8:00 PM	80	SW	14

999 = Missing data

Appendix 5. Meteorological Data
Winter 2008

Winter 2008 Meteorological Data

Date	Time	Temp (^{0}F)	Wind Direction	Wind Speed (mph)
2/19/2008	6:00 AM	35.1	SW	10
	7:00 AM	34	SW	10
	8:00 AM	36	WSW	13
	9:00 AM	39	SW	15
	10:00 AM	41	WSW	21
	11:00 AM	43	SW	29
2/19/2008	3:00 PM	43	W	20
	4:00 PM	39.9	WNW	16
	5:00 PM	39.9	W	18
	6:00 PM	36	NW	14
	7:00 PM	36	W	16
	8:00 PM	33.1	WNW	14
2/20/2008	6:00 AM	24.1	W	15
	7:00 AM	24.1	WSW	14
	8:00 AM	24.1	W	13
	9:00 AM	26.1	WSW	17
	10:00 AM	27	W	15
	11:00 AM	28.9	W	14
2/20/2008	3:00 PM	30	WNW	14
	4:00 PM	30	WNW	16
	5:00 PM	28.9	W	13
	6:00 PM	28.9	WNW	12
	7:00 PM	28.9	WNW	10
	8:00 PM	28	W	12
2/21/2008	6:00 AM	21	WNW	10
	7:00 AM	19.9	NW	10
	8:00 AM	21.9	NW	9
	9:00 AM	21.9	NW	15
	10:00 AM	24.1	WNW	14
	11:00 AM	25	NW	10
2/21/2008	3:00 PM	30	W	9
	4:00 PM	30	WNW	15
	5:00 PM	30	WNW	10
	6:00 PM	28.9	W	10

	7:00 PM	28	WNW	14
	8:00 PM	27	WNW	13
2/25/2008	6:00 AM	26.1	WSW	9
	7:00 AM	28.9	WSW	9
	8:00 AM	30	WSW	8
	9:00 AM	33.1	WSW	6
	10:00 AM	36	W	7
	11:00 AM	37.9	SW	9
2/25/2008	3:00 PM	46	W	7
	4:00 PM	46.9	W	10
	5:00 PM	46	W	12
	6:00 PM	46	WSW	7
	7:00 PM	44.1	WSW	10
	8:00 PM	44.1	W	16
2/26/2008	6:00 AM	32	calm	0
	7:00 AM	30.9	S	6
	8:00 AM	33.1	calm	0
	9:00 AM	36	ESE	3
	10:00 AM	37	calm	0
	11:00 AM	37	ESE	5
2/26/2008	3:00 PM	37	ENE	5
	4:00 PM	39	calm	0
	5:00 PM	37	E	7
	6:00 PM	37	E	8
	7:00 PM	37	E	14
	8:00 PM	37.9	E	18
2/27/2008	6:00 AM	36	W	8
	7:00 AM	36	W	7
	8:00 AM	37	NW	6
	9:00 AM	37	SW	9
	10:00 AM	37	SW	8
	11:00 AM	37	W	9
2/27/2008	3:00 PM	39	WNW	10
	4:00 PM	37	WNW	14
	5:00 PM	36	W	13
	6:00 PM	35	WNW	15
	7:00 PM	34	WNW	12
	8:00 PM	32	WNW	17

2/28/2008	6:00 AM	21	NW	14
	7:00 AM	21	WNW	16
	8:00 AM	21	NW	13
	9:00 AM	21	NW	13
	10:00 AM	21.9	WNW	15
	11:00 AM	24.1	WNW	14
2/28/2008	3:00 PM	27	WNW	14
	4:00 PM	27	WNW	10
	5:00 PM	28	W	16
	6:00 PM	26.1	WNW	16
	7:00 PM	25	NW	16
	8:00 PM	23	NW	14
2/29/2008	6:00 AM	10.9	NW	10
	7:00 AM	12	NNW	7
	8:00 AM	14	NNW	9
	9:00 AM	16	variable	3
	10:00 AM	18	variable	5
	11:00 AM	19	calm	0
2/29/2008	3:00 PM	23	E	10
	4:00 PM	23	ESE	12
	5:00 PM	23	ESE	14
	6:00 PM	24.1	SE	14
	7:00 PM	25	SE	18
	8:00 PM	24.1	S	14

999 = Missing data

Appendix 6. Travel Time Data
Summer 2007

Summer 2007 Travel times

		Travel times (mins)		Avg. travel times (mins)	
Date	**Time**	**North bound**	**South bound**	**North bound**	**South bound**
7/16/07	6:14 AM	15	10		
	7:16 AM	30	10		
	7:36 AM	30	10		
	8:10 AM	35	10		
	9:29 AM	30	16		
	10:01 AM	30	22	28.3	13.0
7/16/07	3:29 PM	20	20		
	4:30 PM	20	20		
	5:26 PM	20	25		
	6:29 PM	25	35	21.3	25.0
7/17/07	6:13 AM	20	10		
	6:41 AM	20	10		
	7:28 AM	35	15		
	8:49 AM	35	18		
	9:44 AM	30	25		
	10:22 AM	25	30	27.5	18.0
7/17/07	3:24 PM	18	25		
	4:29 PM	20	30		
	5:28 PM	20	30		
	6:29 PM	20	30		
	7:12 PM	16	16	18.8	26.2
7/18/07	6:20 AM	25	10		
	6:36 AM	25	10		
	7:42 AM	35	10		
	8:45 AM	35	20		
	9:48 AM	30	16		
	10:01 AM	25	16	29.2	13.7
7/18/2007	3:34 PM	25	35		
	4:30 PM	25	35		
	5:24 PM	30	35		
	6:38 PM	30	35	27.5	35.0
7/19/07	6:16 AM	18	10		
	7:26 AM	30	10		
	8:06 AM	30	10		
	9:21 AM	30	10		
	9:44 AM	25	16	26.6	11.2

7/19/07	3:25 PM	20	20		
	4:31 PM	20	20		
	5:06 PM	20	20		
	5:33 PM	22	20		
	5:55 PM	30	30		
	6:48 PM	25	30	22.8	23.3
7/20/07	6:28 AM	15	12		
	6:41 AM	15	12		
	7:25 AM	20	10		
	9:57 AM	12	15	15.5	12.3
7/20/07	3:20 PM	14	30		
	4:30 PM	25	30		
	5:26 PM	25	35		
	6:26 PM	25	35	22.3	32.5
7/23/07	6:30 AM	25	10		
	6:44 AM	25	10		
	7:51 AM	30	16		
	8:09 AM	30	18		
	9:40 AM	30	10	28.0	12.8
7/23/07	3:22 PM	17	20		
	4:26 PM	17	26		
	5:19 PM	17	23		
	6:22 PM	12	23		
	7:23 PM	12	18	15.0	22.0
7/24/07	6:23 AM	16	10		
	7:36 AM	30	10		
	9:43 AM	25	10	23.7	10.0
7/24/07	3:28 PM	15	23		
	4:26 PM	17	28		
	5:28 PM	17	28		
	7:57 PM	15	16	16.0	23.8
7/25/2007	6:28 AM	18	10		
	7:00 AM	25	10		
	8:05 AM	35	16		
	8:49 AM	35	10		
	9:40 AM	30	10	28.6	11.2
7/25/07	3:45 PM	16	20		

	4:25 PM	16	20		
	5:28 PM	16	20		
	6:55 PM	15	20		
	7:19 PM	15	18	15.6	19.6
7/26/07	6:28 AM	18	10		
	7:14 AM	25	10		
	7:28 AM	30	10		
	9:02 AM	30	25		
	9:38 AM	25	18	25.6	14.6
7/26/07	3:23 PM	18	45		
	4:28 PM	18	35		
	5:28 PM	18	35		
	5:45 PM	18	35		
	7:01 PM	16	25	17.6	35.0
7/27/07	6:27 AM	18	10		
	7:10 AM	25	10		
	7:33 AM	25	10		
	8:59 AM	20	35		
	9:38 AM	18	35	21.2	20.0
7/27/07	3:23 PM	30	35		
	5:45 PM	45	60		
	6:21 PM	35	35		
	7:25 PM	35	25	36.3	38.8

999 = Missing data

Appendix 7. Travel Time Data
Winter 2008

Winter 2008 Travel times

Date	Time	Travel times (mins)		Avg. travel times (mins)	
		North bound	South bound	North bound	South bound
02/18/08	N/A	*999*	*999*	*999*	*999*
2/19/08	6:27 AM	15	10		
	7:25 AM	20	10		
	8:26 AM	20	10		
	9:30 AM	20	10		
	10:26 AM	20	10	19.0	10.0
2/19/08	3:31 PM	16	25		
	4:29 PM	16	30		
	5:27 PM	12	30		
	6:32 PM	16	20	15.0	26.3
2/20/08	7:03 AM	15	10		
	7:33 AM	10	20		
	8:42 AM	10	25		
	9:30 AM	10	20		
	10:43 AM	12	16	11.4	18.2
2/20/08	3:29 PM	25	20		
	4:29 PM	25	20		
	5:29 PM	12	25		
	6:30 PM	12	25		
	7:20 PM	12	16	17.2	21.2
2/21/08	7:20 AM	15	10		
	8:20 AM	20	16		
	9:32 AM	20	10		
	10:16 AM	15	10	17.5	11.5
2/21/08	3:31 PM	20	20		
	4:25 PM	20	20		
	5:32 PM	15	20		
	6:29 PM	15	20	17.5	20.0
2/22/08	N/A	*999*	*999*	*999*	*999*
2/25/08	6:29 AM	16	10		
	7:26 AM	20	10		
	8:26 AM	20	10		
	9:29 AM	20	10	19.0	10.0

2/25/08	3:28 PM	15	20		
	4:29 PM	18	20		
	5:28 PM	12	20		
	6:34 PM	12	25	14.3	21.3
2/26/08	6:25 AM	15	10		
	7:30 AM	20	10		
	8:30 AM	25	10		
	9:31 AM	20	10	20.0	10.0
2/26/08	N/A	*999*	*999*	*999*	*999*
2/27/08	6:27 AM	16	10		
	7:32 AM	20	10		
	8:30 AM	25	10		
	9:32 AM	30	10	22.8	10.0
2/27/08	3:31 PM	16	19		
	4:27 PM	16	22		
	5:36 PM	13	17		
	6:29 PM	13	17	14.5	18.8
2/28/08	6:29 AM	20	10		
	7:30 AM	30	10		
	8:26 AM	30	16		
	9:28 AM	35	10	28.8	11.5
2/28/08	3:31 PM	15	20		
	4:29 PM	15	25		
	5:30 PM	16	25		
	6:29 PM	30	25	19.0	23.8
2/29/08	6:37 AM	25	10		
	7:32 AM	30	10		
	8:34 AM	30	10		
	9:29 AM	30	10	28.8	10.0
2/29/08	3:30 PM	18	20		
	4:28 PM	45	30		
	5:26 PM	35	35		
	6:25 PM	35	35	33.3	30.0

999 = Missing data

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