

AIR QUALITY REPORT



Data Summaries, Trends, and Program Activities (2010-2014)

CITY OF HUNTSVILLE, ALABAMA
NATURAL RESOURCES & ENVIRONMENTAL
MANAGEMENT DIVISION

AQR / 07/15

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ABSTRACT

The 2015 edition of Huntsville's Air Quality Report presents detailed local air quality data for the period from 2010 – 2014. In addition, long-term trends in air quality are examined, and the present status of compliance with National Ambient Air Quality Standards (NAAQS) is discussed. Finally, this report summarizes emissions sources in the Huntsville area and briefly outlines activities being implemented as elements of Huntsville's air pollution control program. Huntsville is presently designated as an attainment area for all criteria pollutants, i.e. those pollutants for which the federal Environmental Protection Agency (EPA) has established NAAQS. However, the trend in recent years toward progressive tightening of the ambient standards suggests there will be an ongoing challenge in ensuring that Huntsville continues to enjoy designation as an attainment area.

FOREWORD

The City of Huntsville Division of Natural Resources is pleased to present the 2015 edition of our report on ambient air quality in Huntsville. The 2015 edition focuses on the period from 2010-2014. As in the past, the report includes statistical evaluation of the data and summarizes long-term trends in Huntsville's air quality. Information on emissions sources in Huntsville is included in the report, along with a summary of Natural Resources' permitting and inspection activities over the past two years.

The long-term trends in ambient air pollutant concentrations underscore the progress that Huntsville has made to provide clean air for its citizens, and attest to the substantial investment our Nation and our local community have made in environmental protection. At present, Huntsville is classified as an attainment area for all criteria pollutants. However, in keeping with the trend toward progressive tightening of the NAAQS (National Ambient Air Quality Standards), it is anticipated that the Environmental Protection Agency (EPA) will promulgate a more stringent standard for ground-level ozone by the end of calendar year 2015 and has proposed a revised standard in the range of 0.065 – 0.070 ppm. Meeting such a stringent ozone standard may prove to be particularly challenging.

As the percentage of total air pollutant emissions contributed by industry continues to decline, it is becoming more important for each of us to do what we can to minimize our individual contribution to air pollution. Toward that end, Natural Resources has developed a list of simple actions that people can take to help lower air pollutant concentrations even further. These pollution prevention actions are included in this report. With concerted efforts by industry, government and the general public, we can continue to enjoy the benefits of clean air without the restrictions imposed on economic growth that have often characterized areas of the country that fail to meet Federal air quality standards.

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AMBIENT AIR MONITORING

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

The federal Clean Air Act (42 USC § 7401, *et seq.*) requires the Environmental Protection Agency to establish, periodically review, and if necessary, revise National Ambient Air Quality Standards (NAAQS). NAAQS must be developed for air pollutants that may endanger the public health and welfare, and whose presence in the ambient air results from numerous or diverse mobile or stationary sources. Primary standards are set at levels necessary to protect the public health, with an adequate margin of safety, whereas secondary standards are set at levels necessary to protect the public welfare. Examples of air pollution effects harmful to public welfare include damage to materials, vegetation damage, visibility impairment, etc.

Prior to promulgating a new or revised NAAQS, EPA must issue “air quality criteria for an air pollutant” that summarize the latest scientific knowledge on the effects of that pollutant on public health or welfare. For this reason, the pollutants for which NAAQS have been established are typically referred to as “criteria pollutants.” There are currently six criteria pollutants: carbon monoxide, lead, nitrogen oxides, sulfur dioxide, ozone and particulate matter. Actually, there is a suite of standards addressing particulate matter since different effects on public health and welfare are associated with different size classes of inhalable particles.

Table 1 lists the pollutants for which National Ambient Air Quality Standards have been established; the levels of the primary and secondary standards, and the associated averaging times. Subsequent sections of this report provide additional information on each of the criteria pollutants. This includes a brief summary of health effects associated with exposure to elevated concentrations of these pollutants, levels of these pollutants measured in Huntsville’s air, and trends in their concentrations over time.

TABLE 1
NATIONAL AMBIENT AIR QUALITY STANDARDS
(40 CFR Part 50)

POLLUTANT	PRIMARY (HEALTH STD.) AVERAGING TIME	CONCENTRATION	SECONDARY (WELFARE STD.) AVERAGING TIME	CONCENTRATION
PARTICULATE PM ₁₀	24- HOUR	150 µg/m ³	SAME AS PRIMARY	SAME AS PRIMARY
PARTICULATE PM _{2.5}	ANNUAL ARITH. MEAN	12 µg/m ³	SAME AS PRIMARY	15 µg/m ³
	24- HOUR	35 µg/m ³		SAME AS PRIMARY
SULFUR DIOXIDE	1- HOUR	75 PPB	3- HOUR	.5 PPM
CARBON MONOXIDE	8- HOUR	9 PPM	NO SECONDARY STANDARD	---
	1- HOUR	35 PPM		
¹ OZONE	MAX. DAILY 8-HOUR AVERAGE	.075 PPM	SAME AS PRIMARY	SAME AS PRIMARY
NITROGEN DIOXIDE	1-HOUR	100 PPB	---	---
	ANNUAL	53 PPB (100 µg/m ³)	SAME AS PRIMARY	SAME AS PRIMARY
LEAD	ROLLING 3- MONTH AVERAGE	0.15 µg/m ³	SAME AS PRIMARY	SAME AS PRIMARY

¹ In December 2014, EPA published a proposal in the *Federal Register* to tighten the 8-hour ozone standard to the range of 0.065 – 0.070 ppm. EPA is currently scheduled to promulgate final revisions to the ozone standard in October 2015.

AMBIENT AIR MONITORING

It is primarily the responsibility of State and Local air pollution control agencies across the country to monitor the ambient air for compliance with the NAAQS. In Huntsville, ambient air monitoring is conducted by the City of Huntsville Department of Natural Resources and Environmental Management. For purposes of determining NAAQS compliance, monitoring must be conducted in accordance with EPA-approved methodologies, using standard operating procedures and a quality assurance program that adheres to federal requirements. Monitoring data is routinely reported to EPA, the local media, and is published on the City of Huntsville website at the following address:

<http://www.huntsvilleal.gov/NatRes/airdata.php>

As in most parts of the United States, the monitoring of criteria pollutants in Huntsville presently focuses on ozone and particulate matter. A description of Huntsville's current air monitoring network can be found in Table 2. The table includes information on the pollutants measured, methodologies used, and operating schedules. As shown in the table, a number of monitors and meteorological instruments are located at the air monitoring station on Airport Road, near the geographical center of the City (Site 014). Pollutants currently monitored at Site 014 include ozone, coarse particulate matter (PM₁₀), and fine particulate matter (PM_{2.5}). Fine particles are sampled using both a continuous monitor and filter-based methods at this site. In addition, until early in 2015 a fine particulate speciation monitor provided data on the chemical composition of PM_{2.5} in Huntsville's air. Meteorological parameters tracked include wind speed, wind direction and ambient temperature. Air monitoring Site 014 is shown in Figure 1.

In addition to the main monitoring site on Airport Road, the current monitoring network consists of three additional PM₁₀ monitors, located on South Memorial Parkway, Pulaski Pike and at the Municipal Garage in downtown Huntsville. A second ozone monitoring site operates on Capshaw Road in the western area of the City and has been in operation since July 2011. The Capshaw site is shown in Figure 2. The locations of Huntsville's current air monitoring sites are shown in Figure 3.

The Department of Natural Resources (formerly named the City of Huntsville Air Pollution Control Department) began monitoring ambient air quality in Huntsville in 1963. Monitoring for each of the criteria pollutants has been conducted for varying lengths of time in Huntsville, but routine monitoring of several of these pollutants has been discontinued because the measured levels were so far below the NAAQS. Figure 4 shows a map of the Huntsville area and the location of all sites employed in the monitoring network since the inception of Huntsville's air monitoring program in 1963. Table 3 provides information on each of these monitoring sites, including the location, pollutant(s) measured, methods utilized, sampling schedule and the time period during which the monitoring station was operational.

TABLE 2**CURRENT AIR MONITORING SITES**

Site ID	Location	Pollutant(s) Monitored	Methodology	Operational Schedule	Monitoring Objective	Spatial Scale	Site Type	Begin Sampling	End Sampling
002	5006 Pulaski Pike	PM ₁₀	SSI Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	01/01/91	Active
003	Madison St. - Garage	PM ₁₀	SSI Hi – Vol	Weekday	Population	Neighborhood	SPM	04/01/93	Active
004	11525 S. Memorial Pkwy	PM ₁₀	SSI Hi – Vol	6 – Day	High Conc.	Middle	SLAMS	06/28/90	Active
014	Old Airport – Airport Rd.	PM ₁₀	SSI Hi – Vol	6 – Day	Population	Urban	SLAMS	07/01/88	Active
		PM _{2,5}	SSI Lo – Vol	3 - Day	Population	Urban	SLAMS	01/01/99	Active
		PM _{2,5}	SSI Lo - Vol	Continuous	Population	Urban	SPM	10/09/03	Active
		Ozone	UV Photometric	Continuous	Population	Neighborhood	SLAMS	01/01/75	Active
022	1130 Capshaw Road	Ozone	UV Photometric	Continuous	High Conc.	Urban	SLAMS	07/01/11	Active

Figure 1 – Air Monitoring Site 014

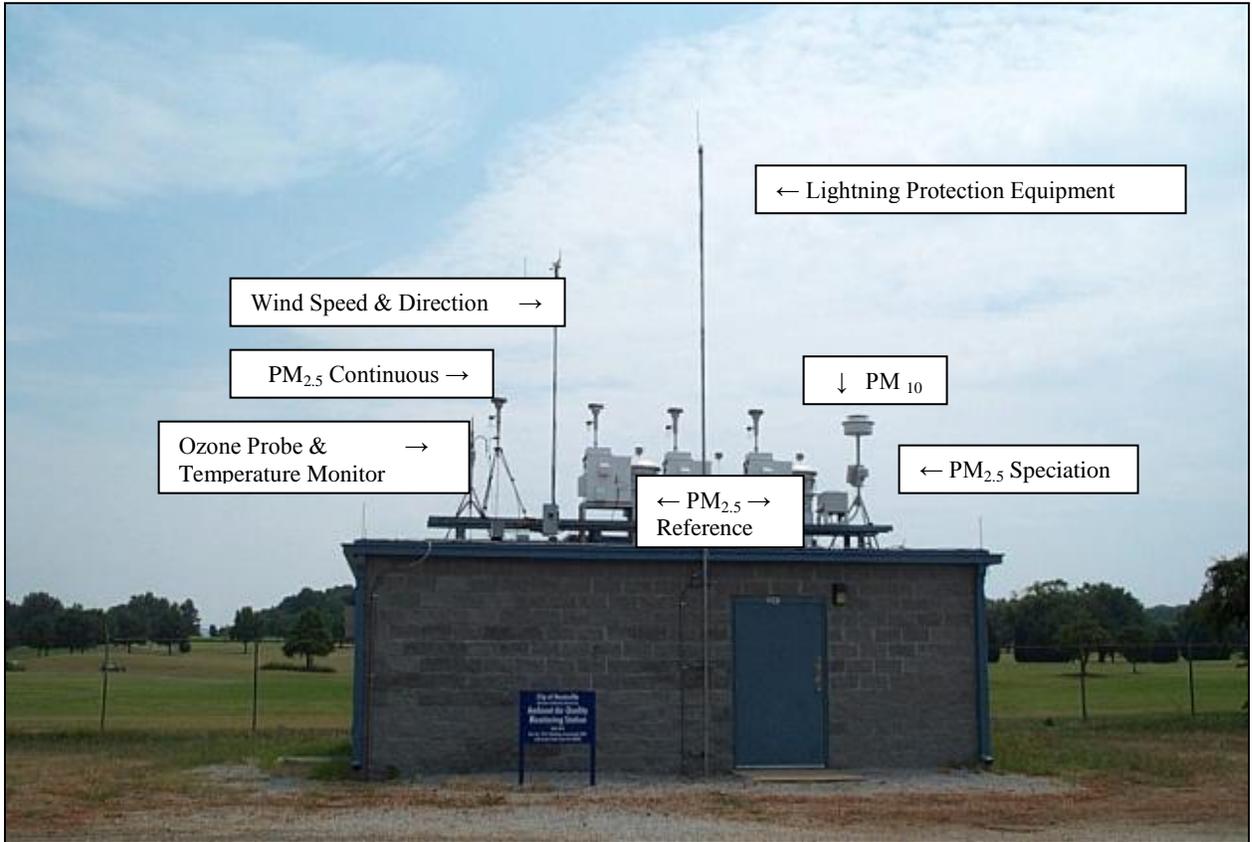
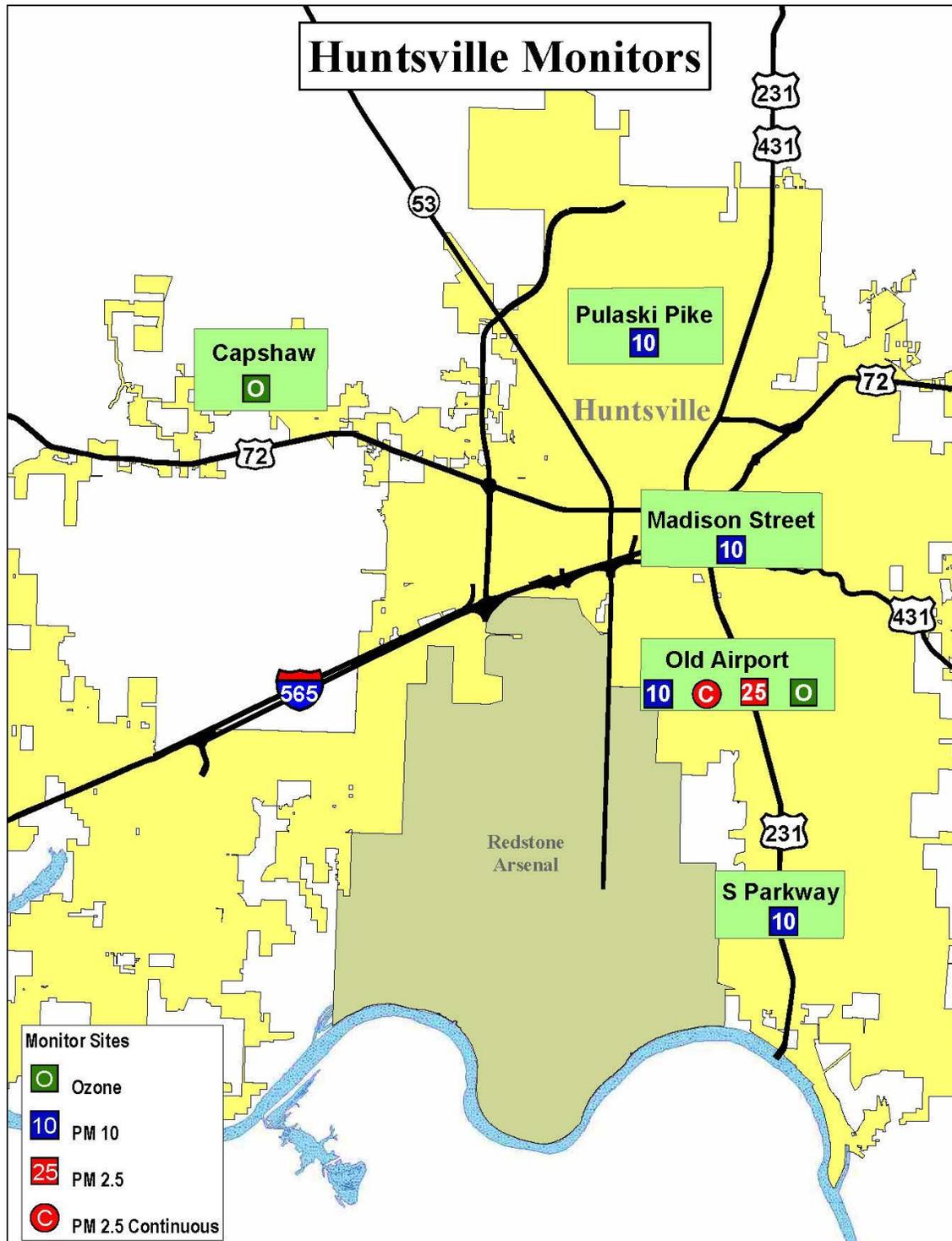


Figure 2 – Air Monitoring Site 022



Figure 3 – Current Air Monitoring Sites



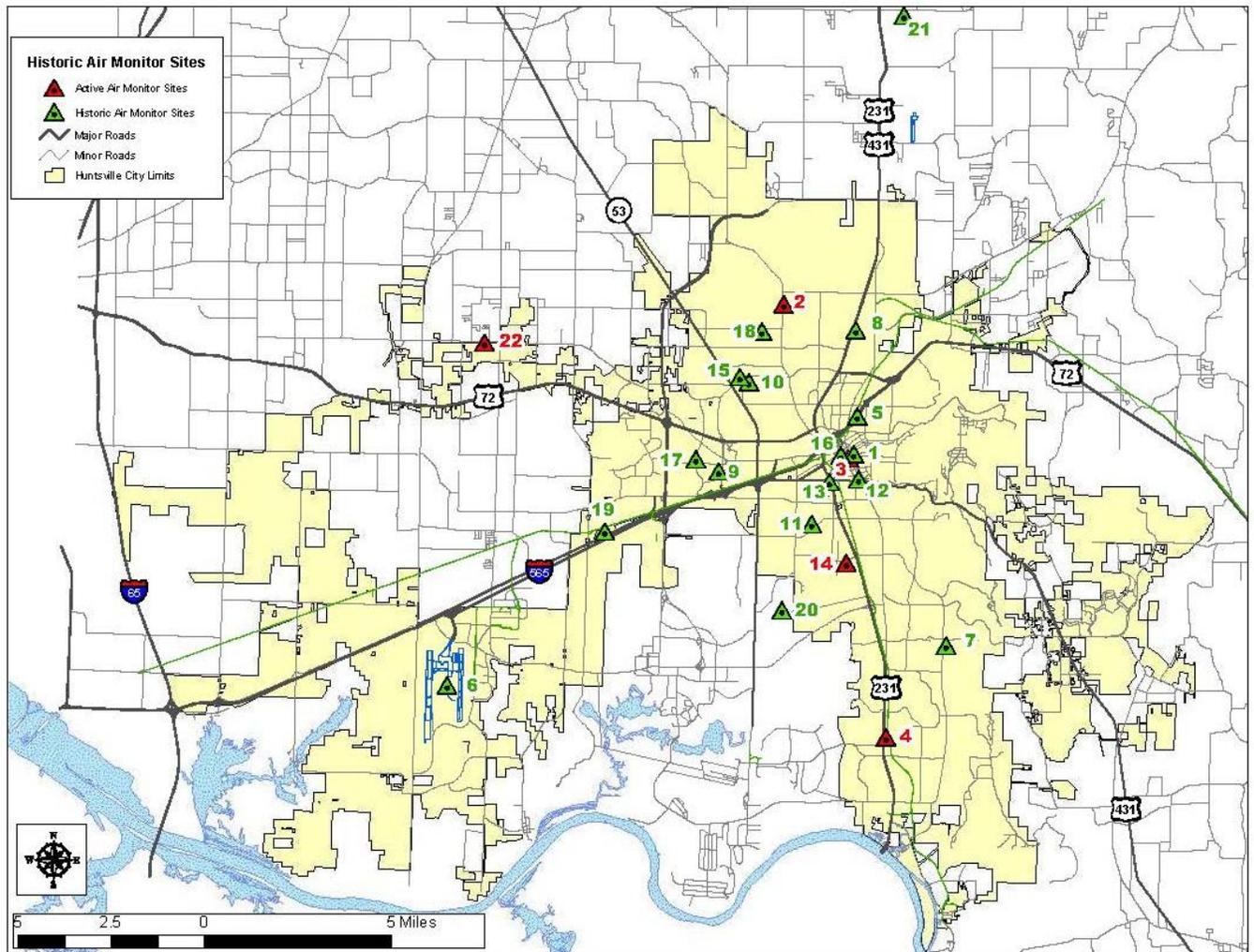


Figure 4 - Historic Air Monitoring Locations in Huntsville, Alabama

MAP CODE	SITE LOCATION	SITE ID #	MAP CODE	SITE LOCATION	SITE ID #
1.	EUSTIS STREET	001	12.	SIVLEY ROAD	012
2.	PULASKI PIKE*	002	13.	GOVERNORS DR. & PKWY.	013
3.	MADISON STREET	003	14.	OLD AIRPORT	014
4.	SOUTH PARKWAY*	004	15.	ED WHITE SCHOOL	015
5.	DALLAS STREET	005	16.	CHURCH & CLINTON	016
6.	HSV. AIRPORT	006	17.	WYNN DRIVE*	017
7.	BAILEY COVE	007	18.	STONER FIELD	018
8.	NORTH PARKWAY*	008	19.	WAH CHANG	019
9.	UNIV. OF AL. HSV.	009	20.	MSW (SWDA)	020
10.	HIGHLANDS ELE. SCH.	010	21.	AL A&M RESEARCH FACILITY	021
11.	HSV. VOCATIONAL SCH.	011	22.	CAPSHAW ROAD	022

*(Fire Station)

TABLE 3

HISTORIC AIR MONITORING SITES

Site ID	Location	Pollutant(s) Monitored	Methodology	Operational Schedule	Monitoring Objective	Spatial Scale	Site Type	Begin Sampling	End Sampling
001	304 Eustis St.	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	01/01/63	12/31/79
002	5006 Pulaski Pike	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	10/13/70	12/31/90
		PM ₁₀	SSI Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	01/01/91	Active
003	Madison St. - Garage	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	03/23/72	12/31/90
		PM ₁₀	SSI Hi – Vol	6 – Day Weekday	Population	Neighborhood	SLAMS SPM	06/22/90 04/01/93	12/31/97 Active
004	11525 S. Memorial Pkwy	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	10/13/70	06/16/90
		PM ₁₀	SSI Hi – Vol	6 – Day	High Conc.	Middle	SLAMS	06/28/90	Active
005	1201 Dallas St.	SO ₂ /NO ₂ /NO _x	Colorimetric	6 – Day	Population	Neighborhood	SLAMS	01/01/74	07/31/76
006	NOAA (Hsv. Airport)	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	02/22/72	06/16/90
		SO ₂ /NO ₂ /NO _x	Colorimetric	6 – Day	Population	Neighborhood	SLAMS	01/01/73	04/30/78
	(Instrumentation Trailer)	HC/ NMOC/ CH ₄	Flame Ionization	Continuous	Population	Neighborhood	SPM	1978	Months
		NO/NO ₂ /NO _x	Chemiluminescence	Continuous	Population	Neighborhood	SPM	1978	Months
		Ozone	Chemiluminescence	Continuous	Population	Neighborhood	SPM	1978	Months
007	1201 Briar Hollow Trail	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	01/01/73	01/07/77
008	4012 N. Memorial Pkwy	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	01/01/73	01/01/87
009	UAH	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	01/01/73	12/31/78
010	Highlands Elem. School	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	01/01/73	05/01/77
011	Hsv. Vocational School	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	01/01/73	01/01/87
012	101 Sivley Road	SO ₂ /NO ₂ /NO _x	Colorimetric	6 – Day	Population	Neighborhood	SPM	01/01/74	08/31/74
013	Governors Dr. & Pkwy.	SO ₂ /NO ₂ /NO _x	Colorimetric	6 – Day	Population	Neighborhood	SLAMS	01/01/74	06/03/76

Table 3 Continued – Historic Monitoring Sites

Site ID	Location	Pollutant(s) Monitored	Methodology	Operational Schedule	Monitoring Objective	Spatial Scale	Site Type	Begin Sampling	End Sampling
014	Old Airport – Airport Rd	TSP	Hi – Vol	6 – Day / Weekday	Population	Neighborhood	SLAMS	01/05/74	05/01/90
		PM ₁₀	SSI Hi – Vol	6 – Day	Population	Urban	SLAMS	07/01/88	Active
		PM _{2.5}	SSI Lo – Vol	3 - Day	Population	Urban	SLAMS	01/01/99	Active
		PM _{2.5}	SSI Lo – Vol	Continuous	Population	Urban	SPM	10/09/03	Active
		PM _{2.5}	SSI Lo – Vol	6 – Day	Speciation	Urban	SLAMS	01/09/03	01/24/15
		SO ₂ /NO ₂ /NO _x	Colorimetric	6 – Day	Population	Neighborhood	SLAMS	01/01/74	12/31/81
	(Instrumentation Trailer)	HC/ NMOC/ CH ₄ /CO	Flame Ionization	Continuous	Population	Neighborhood	SLAMS	01/01/75	06/01/82
		NO/NO ₂ /NO _x	Chemiluminescence	Continuous	Population	Neighborhood	SLAMS	01/01/76	12/31/86
								01/01/91	12/31/93
		Ozone	Chemiluminescence UV Photometric	Continuous	Population	Neighborhood	SLAMS	01/01/75	Active
		CO	Gas Filter Correlation	Continuous	Population	Neighborhood	SLAMS	06/01/86	12/31/00
015	Ed White School	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	01/01/77	01/01/87
016	Church St. (near Clinton)	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS		Months
	(Instrumentation Trailer)	HC/ NMOC/ CH ₄	Flame Ionization	Continuous	Population	Neighborhood	SPM	1978	Months
		NO/NO ₂ /NO _x	Chemiluminescence	Continuous	Population	Neighborhood	SPM	1978	Months
		Ozone	Chemiluminescence	Continuous	Population	Neighborhood	SPM	1978	Months
017	305 Wynn Drive	TSP	Hi – Vol	6 – Day	Population	Neighborhood	SLAMS	08/13/79	11/01/79
018	Stoner Field	TSP	Hi – Vol	6 – Day	Source Impact	Neighborhood	SPM	01/01/88	12/31/88
019	Wah-Chang	TSP	Hi – Vol	6 – Day	Source Impact	Neighborhood	SPM	06/01/90	12/31/98
020	MSW – (SWDA)	TSP	Hi – Vol	6 – Day	Source Impact	Neighborhood	SPM	06/01/90	12/03/92
021	Alabama A & M Research Facility	Ozone	UV Photometric	Continuous	Max. Conc.	Urban	SPM	03/01/91	10/31/96
022	1130 Capshaw Road	Ozone	UV Photometric	Continuous	Max. Conc	Urban	SLAMS	07/01/11	Active

AIR QUALITY REPORTING

AIR QUALITY INDEX (AQI)

The Air Quality Index (AQI) was developed by EPA as a standardized method for reporting air quality data to the public. The Index converts the concentrations of all monitored air pollutants to a single number on a scale from 0 to 500. The criteria pollutant with the highest concentration relative to the NAAQS (National Ambient Air Quality Standard) determines the daily AQI. The AQI system consists of six descriptive categories of ambient air quality, ranging from good to hazardous, each of which is represented by a specific color code as shown in Table 4. AQI values that are below 100 represent days with acceptable air quality, i.e. days for which the descriptor is “good” or “moderate.” Conversely, an AQI value above 100 indicates poor air quality and is associated with potential adverse health effects. As air quality deteriorates, people initially affected are those included in sensitive groups within the population (an AQI between 101 and 150). As pollutant concentrations continue to increase, the health effects become progressively more severe and the number of people who experience adverse health effects becomes progressively larger as indicated in Table 5.

TABLE 4

Air Quality Index (AQI) - Reporting Categories

AQI Value	AQI Descriptor	AQI Color Code
0 - 50	GOOD	 GREEN
51 - 100	MODERATE	 YELLOW
101 - 150	UHEALTHY FOR SENSITIVE GROUPS	 ORANGE
251 - 200	UNHEALTHY	 RED
201 - 300	VERY UNHEALTHY	 PURPLE
301 - 500	HAZARDOUS	 MAROON

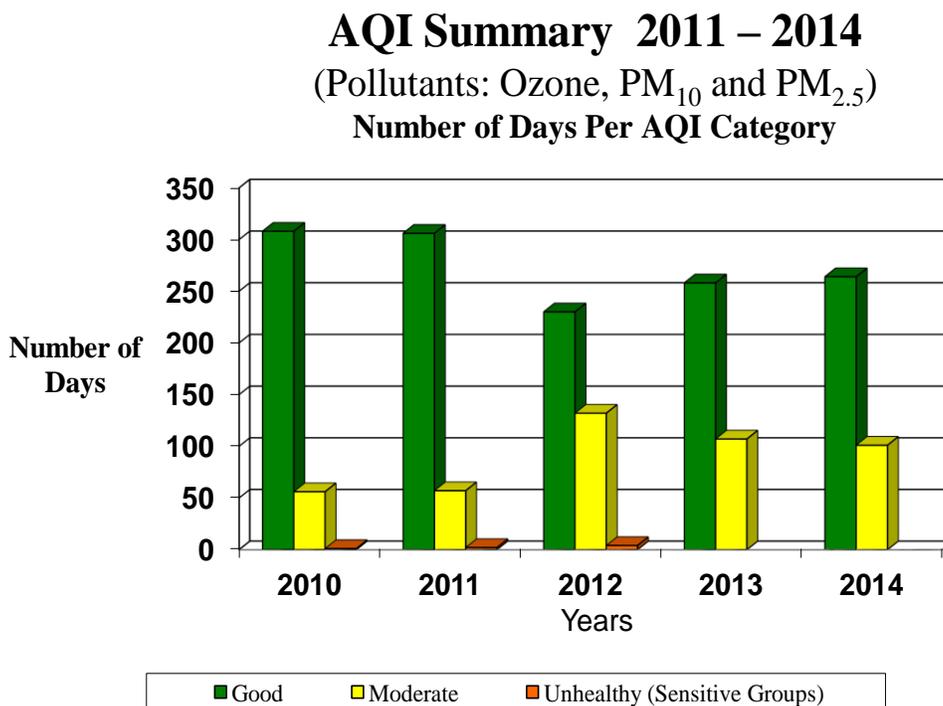
TABLE 5
AQI Descriptors

AQI Descriptor	AQI Value	AQI Descriptor Meaning
GOOD	0 - 50	Air quality is considered satisfactory, and air pollution poses little or no risk.
MODERATE	51 - 100	Air quality is acceptable; however, for some pollutants there may be a moderate health concern for a very small number of people who are unusually sensitive to air pollution.
UNHEALTHY FOR SENSITIVE GROUPS	101 - 150	Members of sensitive groups may experience health effects. The general public is not likely to be affected.
UNHEALTHY	151 - 200	Everyone may begin to experience health effects; members of sensitive groups may experience more serious health effects.
VERY UNHEALTHY	201 - 300	Health alert: everyone may experience more serious health effects.
HAZARDOUS	301 - 500	Health warnings of emergency conditions. The entire population is more likely to be affected.

[Reference: AirNow, a cross-agency U.S. Government web site www.airnow.gov]

A summary of Huntsville’s air quality over the past five years using the AQI reporting format is shown in Figure 5. As shown in Figure 5, for most days in Huntsville the AQI is below 100, or in the good to moderate AQI descriptor category. Occasionally, the air quality is unhealthy for sensitive groups. Note that the breakpoints in the AQI are adjusted downward when a more stringent NAAQS is established. E.g. a pollutant concentration that would be characterized as “Good” under the previous NAAQS may be characterized as “Moderate” under a revised, more stringent NAAQS.

Figure 5 – Summary of Huntsville’s Air Quality Using the AQI Reporting For



The Department reports air quality data to the local news media for the current day by mid-afternoon (Mondays – Fridays). At the time of reporting, the index for the current day is based on partial data for the highest 8-hour ozone concentration, the average PM_{2.5} concentration and the measured PM₁₀ concentration. By mid-afternoon there is sufficient ozone and PM_{2.5} data for the day to report the AQI category with a high degree of accuracy, but the precise value of the AQI is not actually calculated until the following day.

The AQI for the previous day, and the measured pollutant concentrations are posted on the Division’s website Mondays – Fridays. In addition, meteorologists with the Alabama Department of Environmental Management (ADEM) prepare air quality forecasts, and this information is provided on the Department’s website using the standardized color codes and descriptor formats shown in Tables 4 & 5. Cautionary statements regarding the specified pollutant and level of the AQI are also included when appropriate.

National AIRNow Mapping Program

The AIRNow mapping program is a collaborative effort between Federal, State and Local Air Pollution Control Agencies, media and international partners, to disseminate near real-time air quality information to the public in an easily understood format. Ozone and fine particulate data are recorded and stored by data loggers at monitoring sites across the nation. At designated times throughout each day the data is retrieved from the data loggers and transmitted to EPA's data collection center via an automated Data Transfer System. At the data collection center, these data are used to generate maps and forecasts of ozone and fine particulate concentrations for participating areas. The data can be viewed on the AIRNow web site at www.airnow.gov. At the time of reporting, the data has not undergone a full quality assurance (QA) evaluation and may be subject to changes based on the results of the QA evaluations. The Department of Natural Resources began online reporting of data in 2004.

AIR QUALITY DATA

OZONE

Ozone, which is a major constituent of smog, is a colorless to pale bluish gas characterized by a pungent odor. Although ozone is a molecular form of oxygen, the oxygen necessary for respiration in aerobic plants and animals is diatomic oxygen (O_2) whereas ozone is triatomic oxygen (O_3). Ozone is a powerful oxidizing agent and the harmful effects of elevated ozone concentrations on human health and welfare are related to its reactivity and oxidizing strength. Tropospheric ozone, i.e. ground level ozone, is formed through chemical reactions of precursor emissions of volatile organic compounds and nitrogen oxides in the presence of sunlight. Because sunlight and high temperatures accelerate these reactions, peak ozone concentrations typically occur during the summer months.

Ozone is a strong absorber of short-wavelength radiation. For this reason, stratospheric ozone (ozone in the upper atmosphere) is beneficial to life because it shields the earth from harmful ultraviolet radiation. However, high concentrations of ozone at ground level are a major health and environmental concern. Acute effects from ozone exposure include inflammation of the lungs, impaired breathing, coughing, chest pain, nausea, and throat irritation. Chronic effects from repeated exposure may include increased susceptibility to respiratory infection, permanent damage to lung tissues, and diminished breathing capacity. People most susceptible to adverse health consequences from ozone exposure are children, adults engaged in prolonged exertion outdoors, and individuals who suffer from respiratory diseases, such as asthma. Cautionary health effects and recommended actions for the various AQI (Air Quality Index) categories are shown in Table 8. In addition to harmful health effects, elevated ozone concentrations are deleterious to human welfare because of vegetation damage, reduced crop yield and damage to materials, such as rubber and fabric.

In high concentrations, ozone has beneficial uses as a disinfectant and deodorizer. Because it is such a strong oxidizing agent, it can be used to kill bacteria and eliminate foul odors by oxidizing malodorous organic and reduced sulfur compounds. Perhaps for this reason, a number of ozone generators are marketed as “air purifiers.” However, ozone is ineffective in controlling biological contaminants or removing odors when present at concentrations that do not pose a risk to health. The use of these devices is not recommended.

The most recent revision to the National Ambient Air Quality Standard (NAAQS) for ground level ozone was promulgated by EPA on March 12, 2008, significantly strengthening the standard to provide additional protection of public health and welfare. The primary and secondary 8-hour standard was lowered from 0.08 ppm (parts per million) to 0.075 ppm. With the addition of a significant figure, and the resulting elimination of the need to round measured ozone values for comparison with the NAAQS, the effect of the revision was to tighten the standard from 0.084 ppm to 0.075 ppm. The increased stringency of the standard resulting from EPA’s most recent review is in keeping with the trend toward promulgation of progressively lower ambient air quality standards evidenced in recent years.

Although the most recent revision to the ozone NAAQS constitutes a significant strengthening of the standard, during the course of the review that resulted in promulgation of the

2008 revision, the Clean Air Science Advisory Committee (CASAC) had actually recommended the standard be tightened even further. For this reason, EPA announced that the agency would reconsider the 2008 ozone NAAQS decision, and on January 19, 2010 published a proposed rule that would lower the primary ozone standard to a level within the range of 0.060 – 0.070 ppm. They also proposed to accelerate the promulgation of the final standard and shorten the process of non-attainment designations, while simultaneously staying the implementation of the 2008 standard revision. Following a series of delays in issuing a final rule reflecting the reconsideration of the ozone standard, in July 2011 EPA submitted a final rule to OMB (Office of Management and Budget) for review prior to publication in the *Federal Register*. Following OMB review, at the direction of the President, EPA announced in September 2011 that any revision to the ozone NAAQS would be in accordance with the schedule set forth in the Clean Air Act.

A proposed rule to again strengthen the ozone standard was published in the *Federal Register* on December 17, 2014. In this proposed rule, EPA indicates that the revised standard will be in the range of 0.065 to 0.070 ppm, but the agency is taking comment on levels both above and below this range. It is anticipated that a final rule will be promulgated in October 2015. Under the Clean Air Act, not later than one year after a NAAQS revision State Governors are required to submit recommendations to EPA regarding how areas within the State should be classified for purposes of compliance with federal ambient air quality standards, i.e. whether areas should be classified as attainment, non-attainment or unclassifiable and what the geographic extent of those areas should be. EPA could then make final designations as early as 2017, but the statute allows EPA to delay designation for an additional year if further information is needed to make final designations.

As noted previously, the 8-hour ozone standard of 0.075 ppm established in 2008 replaced the 0.08 ppm 8-hour standard promulgated in 1997. The 1997 8-hour standard was significantly tighter than the former ambient standard for ozone, which had been in place for many years. Established in 1979, the previous NAAQS for ozone differed both in form and magnitude from the 1997 standard, being set at a level of 0.12 ppm but based on 1-hour average ozone concentrations rather than 8-hour averages. Thus, the level of the 1997 standard was dramatically lower than the previous ozone NAAQS, but the form of the standard was less stringent because of the longer averaging time. The net effect of these changes in magnitude and form was a significant strengthening of the ambient standard for ozone.

Under the current NAAQS for ozone, i.e. the standard promulgated in March 2008, attainment of the standard is achieved when the fourth-highest measured 8-hour ozone concentration, averaged over three years, is less than or equal to 0.075 ppm. Thus, for any given day the measured concentrations are evaluated and the 8-hour block of time during the day that yields the highest 8-hour average ozone concentration is selected. The average ozone concentration during that block of time is recorded and reported. Over the course of a year, the fourth highest measured 8-hour ozone concentration is used in subsequent calculations to determine compliance with the standard. Finally, the fourth-highest measured 8-hour ozone concentration for each of three successive years is used to determine the three-year average of the fourth highest measured 8-hour ozone concentration. This is the value used to determine whether attainment of the NAAQS has been achieved, and is referred to as an area's "Design Value."

Huntsville’s current three-year average ozone concentration, calculated as described above for the years 2012 through 2014, stands at 0.068 ppm, comfortably below the level of the NAAQS (0.075 ppm). Maximum daily eight-hour concentrations are shown in Table 6. The fourth highest eight-hour concentrations from 1975 through 2014 are shown in Figure 6. As stated, measured ozone concentrations in Huntsville are currently below the level of the NAAQS. However, Huntsville’s current design value of 0.068 ppm is only slightly below the upper end of the range included in EPA’s December 2014 proposal to revise the ozone standard and is somewhat higher than the lower end of the proposed range (0.065 – 0.070 ppm).

Table 6

MAXIMUM 8-HOUR OZONE AVERAGES

8- HOUR DAILY MAXIMA (PPM)										
SITE	LOCATION	YEAR	SAMPLING PERIOD	# OF DAYS	METH.	1st	DATE	4th	DATE	DAYS >.075
014	OLD AIRPORT	2010	MAR-OCT	243	087	.081	5/6	.071	5/5	1
014	OLD AIRPORT	2011	MAR-OCT	239	087	.078	6/16	.072	6/9	2
014	OLD AIRPORT	2012	MAR-OCT	246	087	.082	6/27	.076	6/30	4
014	OLD AIRPORT	2013	MAR-OCT	245	087	.067	3/15	.064	5/15	0
014	OLD AIRPORT	2014	MAR-OCT	245	087	.069	8/15	.064	4/24	0

As shown in Figure 6, ozone concentrations have declined over time in Huntsville. This is evidenced by the trend line. As noted previously, the current three-year average of the fourth highest annual eight –hour ozone concentration in Huntsville (0.068 ppm) is well below the NAAQS (0.075 ppm). However, despite the significant decline in ambient ozone concentrations over the years, Huntsville may not meet a revised ozone standard, particularly if the level of the standard is toward the lower end of the proposed range of 0.065 – 0.070 ppm.

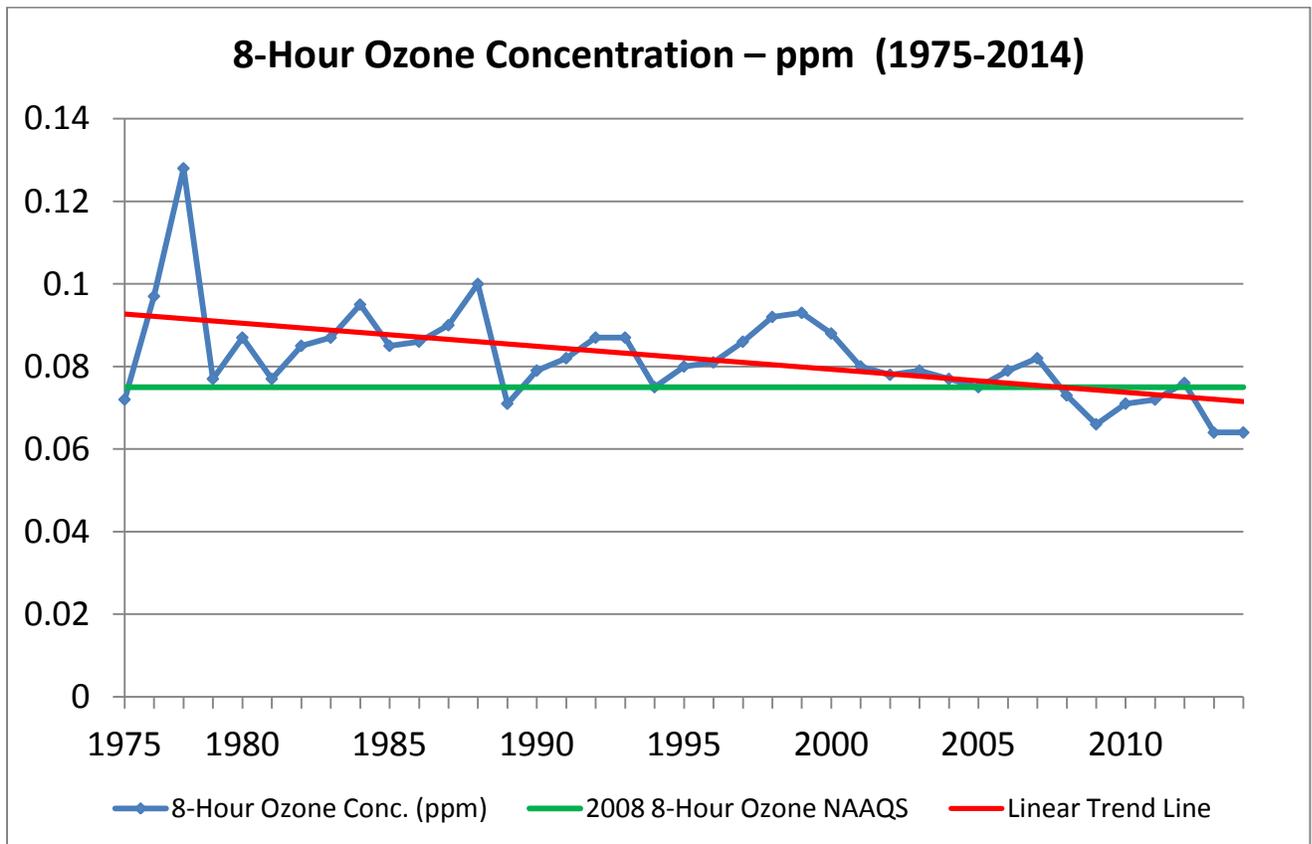
Regression analysis of the eight-hour ozone data from 1975 through 2014 yields the following trend line equation:

$$0.09376 - (0.00056x) = \text{ozone concentration in year } x$$

The negative slope of the regression line indicates that eight-hour ozone concentrations in Huntsville have declined over the past forty years. Based on the results of the trend analysis, the predicted eight-hour concentration in year 40 (2014) would be 0.09376 ppm – 0.00056 ppm (40) = 0.07136 ppm. Although the overall slope of the trend line is downward, it is evident from examination of Figure 6 that there is substantial variation in the eight-hour ozone concentration from year to year. In fact, the trend is not strongly linear. The coefficient of linear correlation is fairly low (r = 0.5591) and the value of r² = 0.3126 (r² is the coefficient of linear determination).

With 37 degrees of freedom, the critical values of r are as follows: $r = 0.2673$ at $\alpha = 0.10$, $r = 0.316$ at $\alpha = 0.05$ and $r = 0.4076$ at $\alpha = 0.01$. Thus, although the data are not strongly linear, the downward trend is statistically significant at the level $\alpha = 0.01$. This means that there is a 99 % probability that eight-hour ozone concentrations are actually decreasing over time. Conversely, there is roughly a 1 % probability that the apparent downward trend is the result of random year-to-year variation. With respect to statistical significance, the downward trend is very strong.

Figure 6 – Ozone Concentrations (4th Maximum 8-hour average) in Huntsville, AL from 1975-2014.



The one hour ozone standard which had been in place for many years was revoked effective June 2005 for those areas (such as Huntsville) that were designated attainment under the eight-hour standard as revised in 1997. The following data are presented for comparative purposes in tracking trends with respect to the prior one-hour ozone NAAQS (as adopted in 1979). Because the standard was achieved when the number of days with one hour concentrations above 0.12 ppm, averaged over a three year period, was less than or equal to one, the second-highest one-hour ozone concentration is used to track trends with respect to compliance with the prior standard. Maximum one-hour concentrations are shown in Table 7, and the second-highest one-hour concentrations for the years 1975 through 2014 are shown in Figure 7.

Peak ozone concentrations have been declining over time in Huntsville, as evidenced by the downward slope of the trend lines in Figures 6 and 7. The trend analysis for the second-highest annual one-hour ozone concentration from 1975 – 2014 yielded the following regression equation:

$$0.12062 - (0.00096x) = \text{ozone concentration in year } x$$

Again, the negative slope of the regression line indicates that one-hour ozone concentrations have declined in Huntsville over the past forty years. Based on trend analysis the predicted one-hour ozone concentration for year 40 (2014) would be $0.12062 \text{ ppm} - (0.00096 \text{ ppm})(40) = 0.082 \text{ ppm}$. As is the case for 8-hour ozone concentrations, there is substantial variation in one-hour ozone concentrations from year-to-year, so the downward trend is not strongly linear. The coefficient of linear correlation is fairly low ($r = 0.6345$) and the value of $r^2 = 0.4026$. With 37 degrees of freedom, the critical values of r are as follows: $r = 0.2673$ at $\alpha = 0.10$, $r = 0.316$ at $\alpha = 0.05$ and $r = 0.4076$ at $\alpha = 0.01$. Thus, although the data are not strongly linear, the downward trend is statistically significant at the level $\alpha = 0.01$. With respect to statistical significance, the downward trend is very strong.

AQI ranges, health effects and cautionary statements for ozone are shown in Table 8.

TABLE 7

Maximum 1- Hour Ozone Averages

1- HOUR DAILY MAXIMA (PPM)										
Site	Location	Year	Sampling Period	Valid Days Meas.	Method	1st	Date	2nd	Date	Days > .125
014	OLD AIRPORT	2010	MAR-OCT	243	087	.089	5/6	.080	8/12	0
014	OLD AIRPORT	2011	MAR-OCT	239	087	.099	7/1	.084	5/29	0
014	OLD AIRPORT	2012	MAR-OCT	246	087	.097	6/28	.090	5/30	0
014	OLD AIRPORT	2013	MAR-OCT	245	087	.078	3/15	.077	8/30	0
014	OLD AIRPORT	2014	MAR-OCT	245	087	.078	8/5	.072	8/6	0

Figure 7 – Second maximum 1-hour ozone concentrations (1-hour averages) in Huntsville, AL from 1975-2014. The 1979 1-Hour ozone NAAQS was revoked for the Huntsville area in 2005.

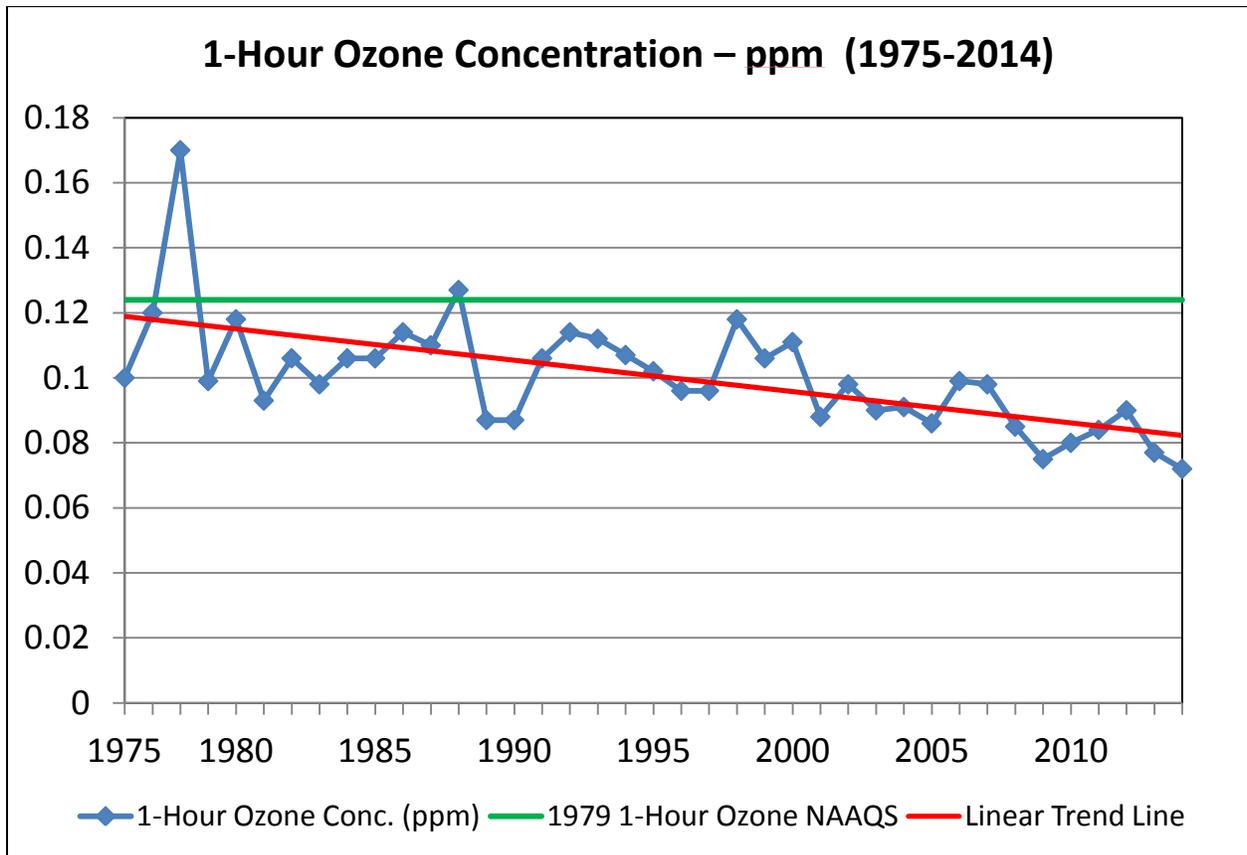


TABLE 8

AIR QUALITY DATA

Ozone Health Effects & Cautionary Statements Associated With AQI Categories		
AQI Category	Ozone Concentration	Health Effects & Cautionary Statements
Good	1-Hr ----- 8-Hr 0.000 – 0.059 ppm	None
Moderate	1-Hr ----- 8-Hr 0.060 – 0.075 ppm	Unusually sensitive individuals may experience respiratory symptoms, and should consider limiting prolonged or heavy outdoor exertion.
Unhealthy for Sensitive Groups	1-Hr 0.125 – 0.164 ppm 8-Hr 0.076 – 0.095 ppm	Increasing likelihood of respiratory symptoms and breathing discomfort in active children and adults and people with lung disease, such as asthma. These groups should reduce prolonged or heavy outdoor exertion.
Unhealthy	1-Hr 0.165 – 0.204 ppm 8-Hr 0.096 – 0.115 ppm	Greater likelihood of respiratory symptoms and breathing difficulty in active children and adults and people with lung disease, such as asthma; possible respiratory effects in general population. People in sensitive groups should avoid prolonged or heavy outdoor exertion, and everyone else, especially children should reduce prolonged or heavy outdoor exertion.
Very Unhealthy	1-Hr 0.205 – 0.404 ppm 8-Hr 0.116 – 0.374 ppm	Increasingly severe symptoms and impaired breathing likely in active children and adults and people with lung disease, such as asthma; increasing likelihood of respiratory effects in general population. Sensitive groups should avoid all outdoor exertion and everyone else, especially children should reduce outdoor exertion.
Hazardous	1-Hr > 0.404 ppm 8- Hr > 0.374 ppm (use 1-Hr)	Severe respiratory effects and impaired breathing likely in active children and adults and people with lung disease, such as asthma; increasingly severe respiratory effects likely in general population. Everyone should avoid all outdoor exertion.

PARTICULATE MATTER

“Particulate matter” is a general term for a complex mixture of solid particles (dust, soot, salt crystals, etc.) and liquid droplets suspended in the ambient air. NAAQS for particulate matter address both coarse and fine particulate matter. Coarse particulate matter consists of particles with an aerodynamic diameter less than or equal to 10 micrometers (PM₁₀). Sources of coarse particulate include industrial processes, windblown dust and dust from traffic on unpaved roads. Sources of fine particulate matter or PM_{2.5} (i.e. particles with an aerodynamic diameter less than or equal to 2.5 micrometers) include industrial processes, fuel combustion and motor vehicle exhaust. Fine particulates are also formed in the atmosphere when gaseous emissions of sulfur dioxide, nitrogen dioxide and volatile organic compounds participate in atmospheric chemical reactions to form secondary particles.

Health studies indicate that fine particles are most damaging to human health because they penetrate and remain in the deepest passages of the lungs. Decreased lung function, respiratory irritation, coughing, aggravated asthma, and irregular heartbeat are among the possible health effects of short-term exposure to elevated particulate levels. Long-term exposure may result in development of chronic bronchitis. Exposure to unhealthy levels of particulate matter in the air can contribute to the premature death of people with heart or lung disease. Health effects are most pronounced in children, the elderly, people with existing respiratory conditions, such as asthma or chronic obstructive pulmonary disease, and those with heart disease. Additional information on health effects of particulate matter may be found in Table 11, which presents health effects and cautionary statements associated with various categories of the AQI.

Effects on human welfare associated with particulate pollution include impaired visibility. Fine particles are a major contributor to haze. Other welfare effects include soiling of stone and other materials, acidification of lakes and streams, effects on the nutrient balance of terrestrial and aquatic ecosystems and damage to forests and sensitive agricultural crops.

On October 17, 2006 EPA revised the particulate matter NAAQS, tightening the fine particulate matter 24-hour standard to provide additional human health protection. More specifically, the 24-hour fine particulate matter NAAQS was lowered from 65 $\mu\text{g}/\text{m}^3$ to 35 $\mu\text{g}/\text{m}^3$. EPA also retained the PM₁₀ (coarse particulate) 24-hour daily standard of 150 $\mu\text{g}/\text{m}^3$ (99th percentile), but revoked the annual standard, citing a lack of scientific evidence indicating that long term exposure to coarse particles contributed to significant health effects. The annual fine particle standard was lowered from 15.0 $\mu\text{g}/\text{m}^3$ to 12.0 $\mu\text{g}/\text{m}^3$ in a Final Rule published in the *Federal Register* on January 15, 2013.

The 2006 and 2013 revisions to the particulate matter NAAQS continued a long trend toward progressive tightening of the standards and increased emphasis on smaller inhalable particles. The first NAAQS for particulate matter was promulgated by EPA in 1971 and established standards for Total Suspended Particulate (TSP) in the ambient air. The method utilized for TSP measurement effectively included all suspended particles up to an aerodynamic diameter of roughly 45 μm . The 24-hour standard was set at 260 $\mu\text{g}/\text{m}^3$, not to be exceeded more than once per year, and the annual geometric mean was set at 75 $\mu\text{g}/\text{m}^3$. In 1987, PM₁₀

standards replaced the NAAQS for TSP, and were set at 150 $\mu\text{g}/\text{m}^3$ (24-hour standard, not to be exceeded more than once per year) and 50 $\mu\text{g}/\text{m}^3$ annual arithmetic mean. Following review of additional health effects studies, EPA again revised the particulate matter standard in 1997 to focus on even smaller particles, i.e. $\text{PM}_{2.5}$, while making a slight change to the form of the 24-hour PM_{10} standards established a decade earlier. The numeric value of the 24-hour standard remained at 150 $\mu\text{g}/\text{m}^3$, but the metric used for NAAQS compliance was changed from the second highest measured value to the 99th percentile. The $\text{PM}_{2.5}$ 24-hour standard was set at 65 $\mu\text{g}/\text{m}^3$ (98th percentile, averaged over three years), and the annual standard was set at 15.0 $\mu\text{g}/\text{m}^3$ (arithmetic mean, averaged over three years). As discussed previously, the 24-hour $\text{PM}_{2.5}$ standard was lowered from 65 $\mu\text{g}/\text{m}^3$, to 35 $\mu\text{g}/\text{m}^3$ in 2006 and the annual standard was lowered from 15.0 $\mu\text{g}/\text{m}^3$ to 12.0 $\mu\text{g}/\text{m}^3$ in 2013. Huntsville continues to meet the particulate matter NAAQS despite the increased stringency of the standards.

Coarse Particulate Matter (PM_{10})

In Huntsville, all recorded PM_{10} measurements have been below the NAAQS. Natural Resources operates four PM_{10} monitoring stations, but there is very little spatial variation across the City. Three of the four sites utilize the Federal Reference Method (FRM) for PM_{10} , whereas the fourth site is a Special Purpose Monitor (SPM) which is operated using a slightly modified method. More specifically, this monitor collects samples over a 24-hour period that commences in mid-afternoon each day rather than at midnight, thereby allowing more timely reporting of information for the daily Air Quality Index (AQI). Composite data for the three FRM PM_{10} sites over the past five years are shown in Table 9. Data from the three FRM PM_{10} monitoring sites in Huntsville were pooled to produce the composite annual arithmetic means. A composite representation of annual arithmetic mean measurements from 1988 through 2014 is shown in Figure 8. Maximum 24-hour concentrations are also shown in Table 9. As noted in the table the maximum measured concentrations fall far below the 24-hour daily standard of 150 $\mu\text{g}/\text{m}^3$.

As shown in Figure 8, particulate concentrations in the ambient air in Huntsville have declined over the past twenty-seven years. Trend analysis yielded the following linear regression equation:

$$\text{PM}_{10} = 29.62 \mu\text{g}/\text{m}^3 - (0.596 \mu\text{g}/\text{m}^3)\text{x}$$

Where PM_{10} = the expected PM_{10} concentration in year x, and x = the number of the year (1988 =1, 1989 =2, etc). The negative slope of the trend line indicates that PM_{10} concentrations have been declining. Based on the regression equation, the predicted concentration in Year 27 (2014) would be $29.62 \mu\text{g}/\text{m}^3 - (0.596 \mu\text{g}/\text{m}^3 \text{ per year})(27 \text{ years}) = 13.5 \mu\text{g}/\text{m}^3$.

The downward trend in Huntsville's PM_{10} concentrations is statistically significant at any reasonable value of α . The coefficient of linear determination is fairly high ($r^2 = 0.798$). The coefficient of linear correlation ($r = 0.893$) is well above the critical value of r with 25 degrees of freedom at the significance level $\alpha = 0.01$ ($r_{\text{critical}} = 0.49$). Thus, there is greater than a 99 % probability that the PM_{10} concentrations in Huntsville have been actually declining over time and the apparent downward trend is not the result of random year-to-year fluctuations.

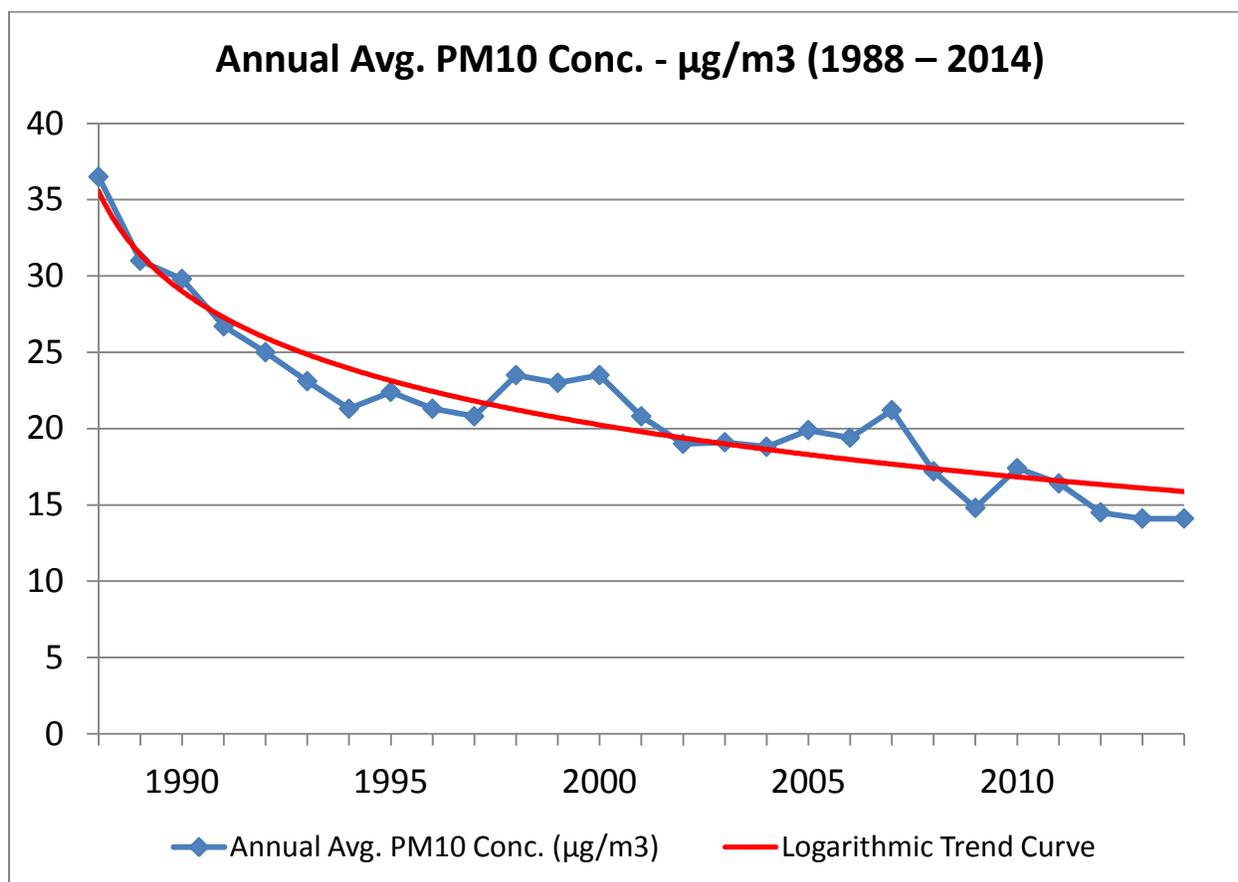
Table 9

PM₁₀ 24- Hour Maximum Concentrations & Annual Means (µg/m³)

(Composite Data)

YEAR	Sampling Period	Number Obs.	Sampling Schedule	Max 24 – Hr	Date	NAAQS EXCEEDANCES		
						Annual Arith. Mean	24 – Hr NAAQS	Prior Annual NAAQS
2010	Jan – Dec	181	6- Day	46	10/11	17.4	NO	NO
2011	Jan – Dec	175	6- Day	37	6/08	16.4	NO	NO
2012	Jan – Dec	177	6- Day	32	3/28	14.5	NO	NO
2013	Jan – Dec	180	6-Day	38	4/10	14.1	NO	NO
2014	Jan – Dec	178	6-Day	59	10/02	14.1	NO	NO

Figure 8 – Composite Mean PM₁₀ Concentrations in Huntsville



Although the linear regression analysis indicates that the downward trend in PM₁₀ concentrations is statistically significant at any reasonable significance level, the results of a logarithmic regression analysis are even more compelling. [Note: a logarithmic regression plots the x values logarithmically and finds the least squares fit, i.e. the best straight line, through the curvilinear data that has been thus linearized.] Logarithmic regression yielded a curve that fits the data remarkably well, and it is this curve that is shown in Figure 8. The logarithmic form of the regression equation is given below:

$$PM_{10} = 35.56 - 5.974 \cdot \ln(x)$$

Logarithmic regression yielded very high values for the coefficient of linear correlation ($r = 0.95$) and the coefficient of linear determination ($r^2 = 0.90$). Thus, while the linear regression equation accounts for roughly 80 % of the variability in the average annual particulate matter concentrations over time, the logarithmic regression equation accounts for 90 % of that variation. As noted above, $r_{critical} = 0.49$ at significance level $\alpha = 0.01$ with 25 degrees of freedom. Again, the conclusion is that the downward trend in PM₁₀ concentrations is statistically significant at any reasonable significance level and is not the result of random year-to-year variation in the data. The predicted PM₁₀ concentration in Year 27 using the logarithmic regression equation is given by: $PM_{10} = 35.56 - 5.974 \cdot \ln(27) = 15.9 \mu\text{g}/\text{m}^3$. This value is somewhat higher than that predicted by the linear regression equation ($13.5 \mu\text{g}/\text{m}^3$).

Fine Particulate Matter (PM_{2.5})

PM₁₀ consists of particles with an aerodynamic diameter less than or equal to 10 micrometers, whereas the cut-point for PM_{2.5} is only 2.5 micrometers. Thus, PM_{2.5}, referred to as fine particulate matter, consists of that fraction of PM₁₀ made up of very small particles. As evidenced by the changing form of the particulate matter NAAQS, it is this fine particle fraction of airborne particulate matter that is of greatest concern from a human health standpoint. Based on the results of local particulate monitoring measurements, roughly 65 % of the particles measured as PM₁₀ in Huntsville are very fine particles, or PM_{2.5}. Annual average and maximum 24-hour PM_{2.5} concentrations are shown in Table 10. Table 11 lists the AQI cautionary statements and identifies the groups most at risk from exposure to elevated concentrations of fine particulate matter in the ambient air.

As discussed previously, EPA revised the fine particulate 24-hour standard in 2006, and revised the annual standard in 2013. Compliance with the daily standard is met when the 98th percentile of the 24-hour measured PM_{2.5} concentration, averaged over a 3-year period, is less than or equal to $35 \mu\text{g}/\text{m}^3$. Compliance with the annual standard is achieved if the arithmetic average annual PM_{2.5} concentration, averaged over three years, is less than or equal to $12.0 \mu\text{g}/\text{m}^3$. The initial designations under the revised 24-hour standard were made in December 2008 and the initial designations under the revised annual standard were made in December 2014. Huntsville currently meets the NAAQS for fine particulate matter as indicated in Table 10. For purposes of comparison with the NAAQS, Huntsville's three-year average of the annual mean concentration is $9.0 \mu\text{g}/\text{m}^3$, comfortably below the $12.0 \mu\text{g}/\text{m}^3$ standard. Similarly, the three-year average of the 98th percentile 24-hour concentration is $19 \mu\text{g}/\text{m}^3$, well below the standard of $35 \mu\text{g}/\text{m}^3$.

Table 10

PM-2.5 DATA – Site 014

DAILY MAXIMUM CONCENTRATIONS and 98th PERCENTILES – ANNUAL MEANS ($\mu\text{g}/\text{m}^3$)

Year	Sampling Period	Number Obs.	Sampling Schedule	Max. 24-Hour Conc.	Date	24-Hour 98 th %	3-Yr Avg.	Annual Mean	3-Yr Avg.	NAAQS EXCEEDANCES	
										Daily NAAQS	Annual NAAQS
2010	JAN – DEC	120	3- DAY	21.1	1/14	20.2	23	11.6	11.2	NO	NO
2011	JAN – DEC	117	3-DAY	25.8	8/31	25.1	22	11.3	11.0	NO	NO
2012	JAN – DEC	120	3- DAY	20.5	3/28	18.5	21	9.3	10.7	NO	NO
2013	JAN – DEC	121	3- DAY	18.3	12/03	16.2	20	8.6	9.7	NO	NO
2014	JAN – DEC	120	3- DAY	29.3	7/01	21.2	19	9.0	9.0	NO	NO

Annual average PM_{2.5} concentrations in Huntsville's ambient air exhibit an overall downward trend, as shown in Figure 9. Trend analysis yielded the following regression equation:

$$PM_{2.5} = 16.568 \mu\text{g}/\text{m}^3 - (0.4675 \mu\text{g}/\text{m}^3)x$$

Where PM_{2.5} = the expected PM_{2.5} concentration in year x; and x = the number of the year (1999 = 1; 2000 = 2, etc.). Thus, in Year 16 (2014), the expected PM_{2.5} concentration would be $16.568 \mu\text{g}/\text{m}^3 - (0.4675 \mu\text{g}/\text{m}^3 \text{ per year})(16 \text{ years}) = 9.09 \mu\text{g}/\text{m}^3$. The downward trend in Huntsville's PM_{2.5} concentrations is statistically significant at the level $\alpha = 0.01$. The coefficient of linear determination, $r^2 = 0.8612$, and the coefficient of linear correlation, $r = 0.928$. At significance level $\alpha = 0.01$, with 14 degrees of freedom, $r_{\text{critical}} = 0.623$. Thus, there is greater than a 99 % probability that the PM_{2.5} concentrations in Huntsville have been actually declining over time and that the apparent downward trend is not the result of random year-to-year fluctuations.

Huntsville is also in attainment of the 24-hour fine particulate matter NAAQS. With a PM_{2.5} sampling schedule of 1-in-3 days, the 98th percentile equates to the 3rd highest daily concentration each year. Figure 10 shows the third-highest daily PM_{2.5} concentration each year since monitoring commenced in 1999, with the exception of 2008. In 2008, daily sampling was conducted, so the 98th percentile does not coincide with the third highest measured value. Rather, for 2008 the seventh highest measured value, which coincides with the 98th percentile, is shown in the Figure.

The trend line for maximum 24-hour fine particulate matter concentrations also slopes downward, and although not as strong as the regression results for average annual fine particulate matter concentrations, this downward trend is also significant at the level $\alpha = 0.01$. The linear regression equation appears below:

$$PM_{2.5} = 38.275 \mu\text{g}/\text{m}^3 - (1.204 \mu\text{g}/\text{m}^3)x$$

Where PM_{2.5} = the expected PM_{2.5} concentration in year x; and x = the number of the year (1999 = 1; 2000 = 2, etc.). Thus, in Year 16 (2014), the expected 98th percentile maximum PM_{2.5} concentration would be $38.275 \mu\text{g}/\text{m}^3 - (1.204 \mu\text{g}/\text{m}^3 \text{ per year})(16 \text{ years}) = 19.0 \mu\text{g}/\text{m}^3$. The year-to-year variation in maximum PM_{2.5} concentrations is rather large, but the downward trend is nonetheless significant at $\alpha = 0.01$. The coefficient of linear determination, $r^2 = 0.5836$ and the coefficient of linear correlation, $r = 0.7639$. With 14 degrees of freedom, the critical value of $r = 0.4973$ at the significance level $\alpha = 0.05$, and $r_{\text{critical}} = 0.6226$ at $\alpha = 0.01$. Thus, there is greater than a 99 % probability that maximum daily PM_{2.5} concentrations are actually declining over time, and the apparent downward trend is not the result of random year-to-year variation

Figure 9 – Annual Arithmetic Mean PM_{2.5} Concentrations in Huntsville

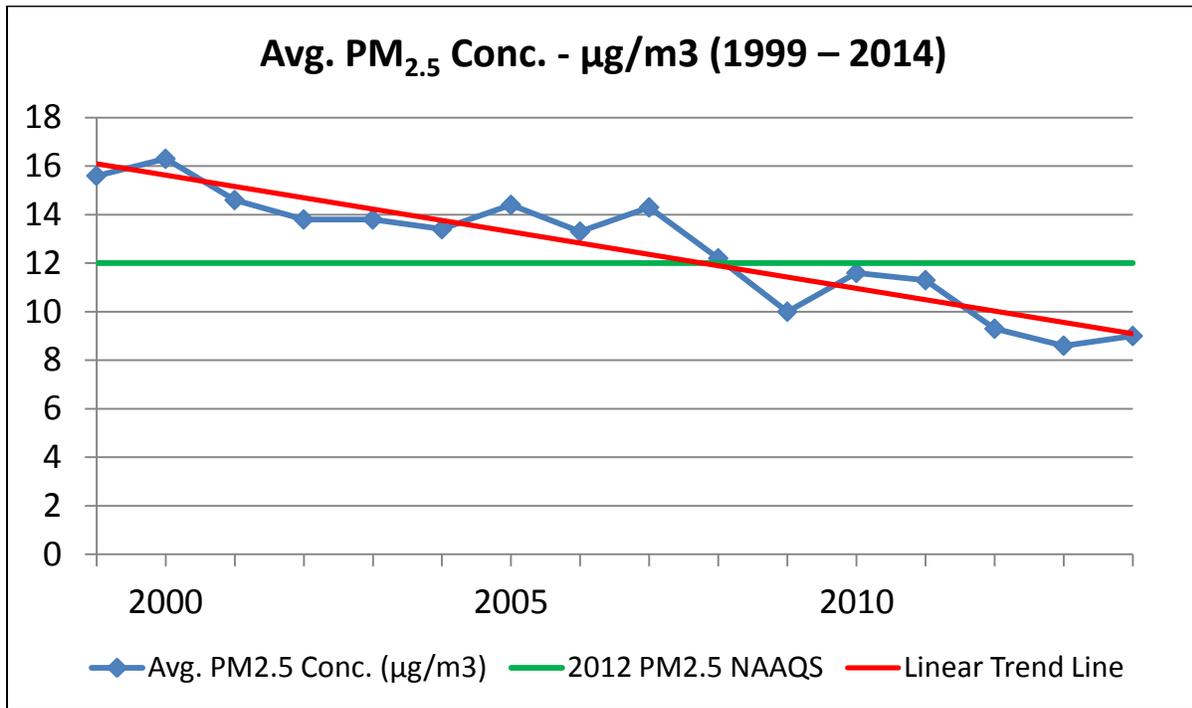
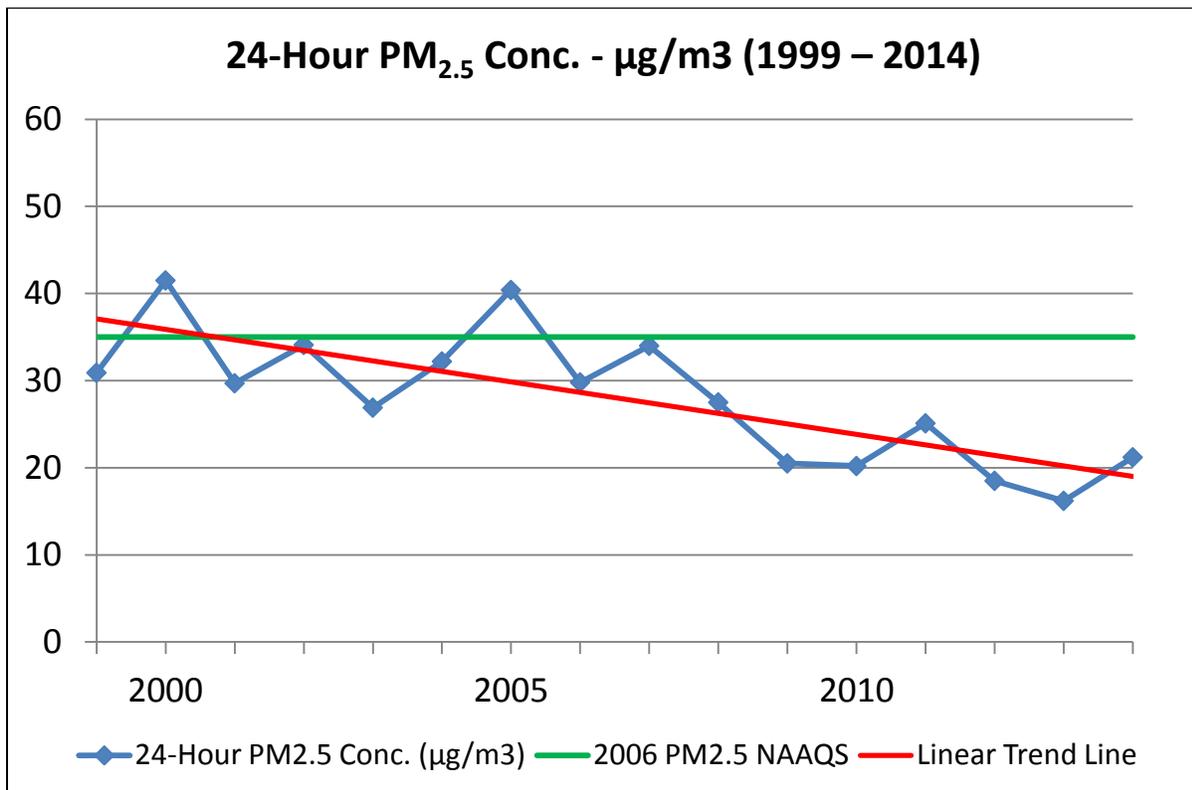


Figure 10 – 24-Hour Maximum PM_{2.5} Concentrations in Huntsville (98th Percentile)



Chemical Speciation of PM_{2.5}

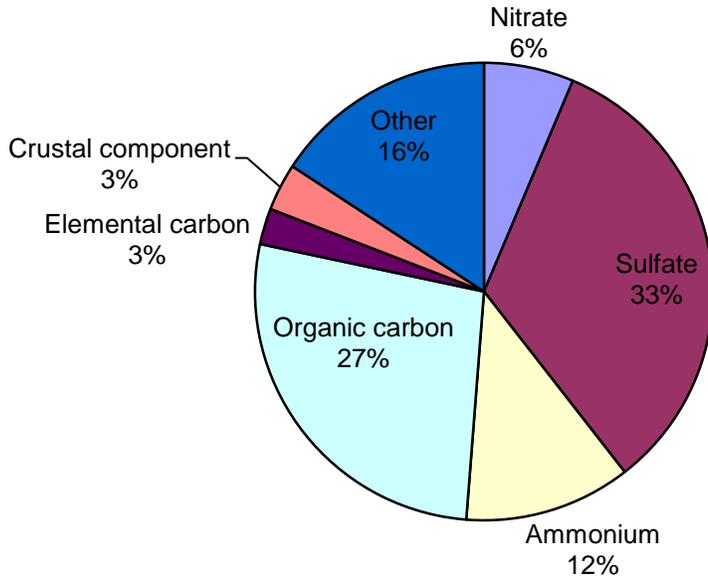
Chemical speciation of fine particulate provides information on the composition of the fine particulate matter in the ambient air. Samples are collected on several different types of filters simultaneously, and these filters are subsequently analyzed in the laboratory. Although speciation sampling is not used to determine compliance with the PM_{2.5} NAAQS, characterization of the chemical constituents of fine particulate is potentially useful in identifying possible emissions sources and in developing control strategies to reduce ambient concentrations. Speciated PM_{2.5} data is also of value in determining whether elevated ambient fine particulate matter concentrations have resulted from an exceptional event.

PM_{2.5} particle mass consists of various ions (sulfates, nitrates, ammonium, sodium, and potassium); trace elements; and total carbon (organic, and elemental). Sources of PM_{2.5} (fine particles) include fuel combustion, photochemical, industrial and geological processes. A significant fraction of PM_{2.5}, primarily sulfate and nitrate, forms as secondary pollutants in the atmosphere. Sulfur dioxide and nitrogen oxides, emitted largely from the combustion of fossil fuels, are oxidized in a complex series of atmospheric chemical reactions to form sulfate and nitrate, respectively. Thus these particles are secondary pollutants i.e. they are not emitted directly but form in the atmosphere as gaseous pollutants undergo a series of chemical reactions. Other fine particles are emitted directly, e.g. as soot from combustion processes, or fine dust from industrial processes. The composition of fine particles shows dramatic variation in different parts of the United States. Sulfate salts constitute a much higher fraction of the total fine particulate matter in the eastern U.S. than in the western states.

Natural Resources began chemical speciation sampling in 2003 and suspended sampling in early 2015 as a result of EPA's decision to reduce the size of the national speciation monitoring network. Averaged fine particulate matter composition data for 2003 and for 2014, with constituent percentages, are presented as pie charts in Figure 11. The correlation of PM_{2.5} mass collected on the speciation and FRM sampler filters is quite good, with measured concentrations generally agreeing within $\pm 2 \mu\text{g}/\text{m}^3$. Although there are some seasonal differences in the chemical composition of fine particulate matter in Huntsville, there was relatively little variation from year-to-year in the first several years of speciation sampling in Huntsville. As shown in Figure 11, more recent data show lower relative contributions of sulfate, ammonium and organic carbon to total fine particulate matter mass. This suggests that the dramatic reduction in the total mass of fine particles in the ambient air in recent years is largely the result of lower concentrations of these constituents, reflecting more stringent regulation of emissions from power plants, lower sulfur levels in motor fuels, and tighter emission standards for automobiles and diesel engines.

Figure 11 – Chemical Composition of Fine Particulate Matter in Huntsville’s Ambient Air in 2003 and 2014.

2003 PM_{2.5} Speciation Data



2014 PM_{2.5} Speciation Data

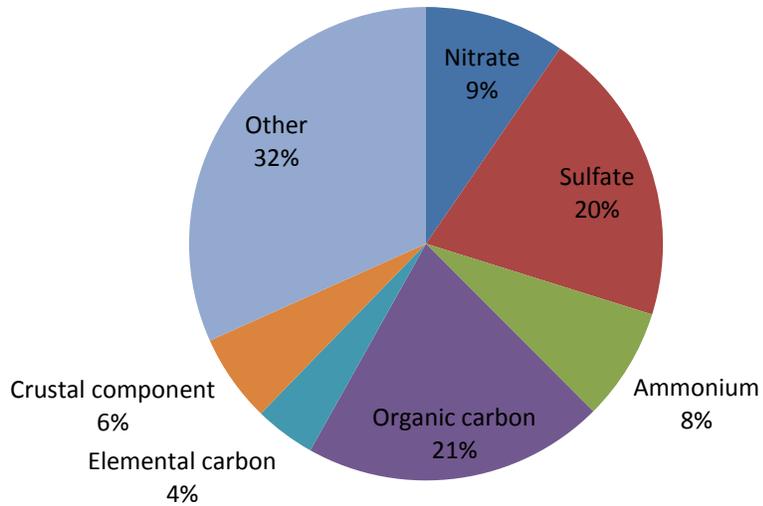


TABLE 11

Particulate Matter Health Effects & Cautionary Statements Associated With AQI Categories		
AQI Category	Particulate Concentration	Health Effects & Cautionary Statements
Good	PM _{2.5} 0 – 12.0 µg/m ³ PM ₁₀ 0 – 54.0 µg/m ³	None
Moderate	PM _{2.5} 12.1 – 35.4 µg/m ³ PM ₁₀ 55.0– 154.0 µg/m ³	Respiratory symptoms possible in unusually sensitive individuals, possible aggravation of heart or lung disease in people with cardiopulmonary disease and older adults. Unusually sensitive people should consider reducing prolonged or heavy outdoor exertion.
Unhealthy for Sensitive Groups	PM _{2.5} 35.5 – 55.4 µg/m ³ PM ₁₀ 155.0– 254.0 µg/m ³	Increasing likelihood of respiratory symptoms in sensitive individuals, aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and older adults. People with heart or lung disease, older adults and children should reduce prolonged or heavy exertion.
Unhealthy	PM _{2.5} 55.5 – 150.4 µg/m ³ PM ₁₀ 255.0 – 354.0 µg/m ³	Increased aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and older adults; increased respiratory symptoms in general population. People with heart or lung disease, older adults and children should avoid prolonged or heavy exertion; everyone else should reduce prolonged or heavy exertion.
Very Unhealthy	PM _{2.5} 150.5 – 250.4 µg/m ³ PM ₁₀ 355.0 – 424.0 µg/m ³	Significant aggravation of heart or lung disease and premature mortality in people with cardiopulmonary disease and older adults; significant increase in respiratory effects in general population. People with heart or lung disease, older adults and children should avoid all physical activity outdoors; everyone else should avoid prolonged or heavy exertion.
Hazardous	PM _{2.5} > 250.4 µg/m ³ PM ₁₀ > 424.0 µg/m ³	Serious aggravation of heart or lung disease and premature mortality in persons with cardiopulmonary disease and older adults; serious risk of respiratory effects in general population. Everyone should avoid all activity outdoors; people with heart or lung disease, older adults and children should remain indoors and keep activity levels low.

CARBON MONOXIDE

Carbon monoxide is a colorless and odorless, poisonous gas produced by the incomplete combustion of fuel. Since most carbon monoxide emissions are due to transportation sources in the Huntsville area, maximum concentrations typically occur near intersections of major roadways during rush hour traffic. Carbon monoxide binds to hemoglobin in red blood cells, limiting the amount of oxygen carried in the blood and thereby reducing the amount of oxygen transported to the body cells for respiration. Continued lack of oxygen affects the brain and the heart, in that order. At high concentrations (much higher than found in the ambient air), death can result from deep or prolonged inhalation of carbon monoxide. Deadly concentrations of carbon monoxide may result from the venting of combustion gases to the interior of buildings. Additional information on health effects of carbon monoxide may be found in Table 13, which presents health effects and cautionary statements associated with various categories of the Air Quality Index (AQI). The current primary NAAQS for carbon monoxide have been in place since they were initially established in 1971. The most recent review of the carbon monoxide NAAQS was completed in 2011.

Maximum one -hour and eight-hour ambient carbon monoxide concentrations measured in Huntsville from 1996 – 2000 are shown in Table 12. The long-term trend in one-hour carbon monoxide concentrations, representing typical neighborhood exposure levels, is shown in Figure 12, and the eight-hour trend is shown in Figure 13.

TABLE 12

**Second Maximum Carbon Monoxide 1-Hour & 8-Hour Averages in
Huntsville, Alabama (1996 – 2000)**

SITE ID	YEAR	SAMPLING PERIOD	NUMBER OBS.	METH.	1-Hour		8-Hour		NAAQS EXCEEDANCES	
					2nd MAX	DATE	2nd MAX	DATE	1-HOUR > 35 (PPM)	8-HOUR > 9 (PPM)
014	1996	JAN-DEC	7848	51	4.1	01/14	3.0	02/09	0	0
014	1997	JAN-DEC	7883	51	4.4	12/19	3.1	12/20	0	0
014	1998	JAN-DEC	7694	51	4.1	01/04	3.0	01/04	0	0
014	1999	JAN-DEC	8309	51	4.7	03/02	4.5	03/03	0	0
014	2000	JAN-DEC	8501	51	3.2	01/07	2.5	01/07	0	0

Figure 12 – Carbon Monoxide 1-Hour Concentrations in Huntsville, Alabama

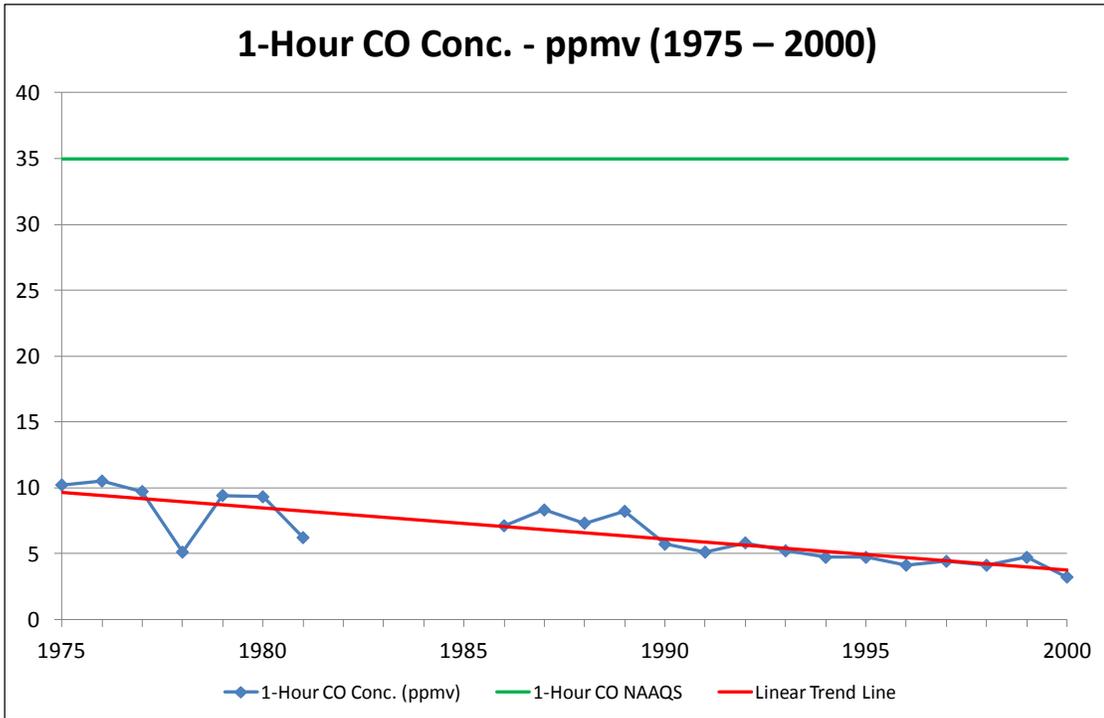
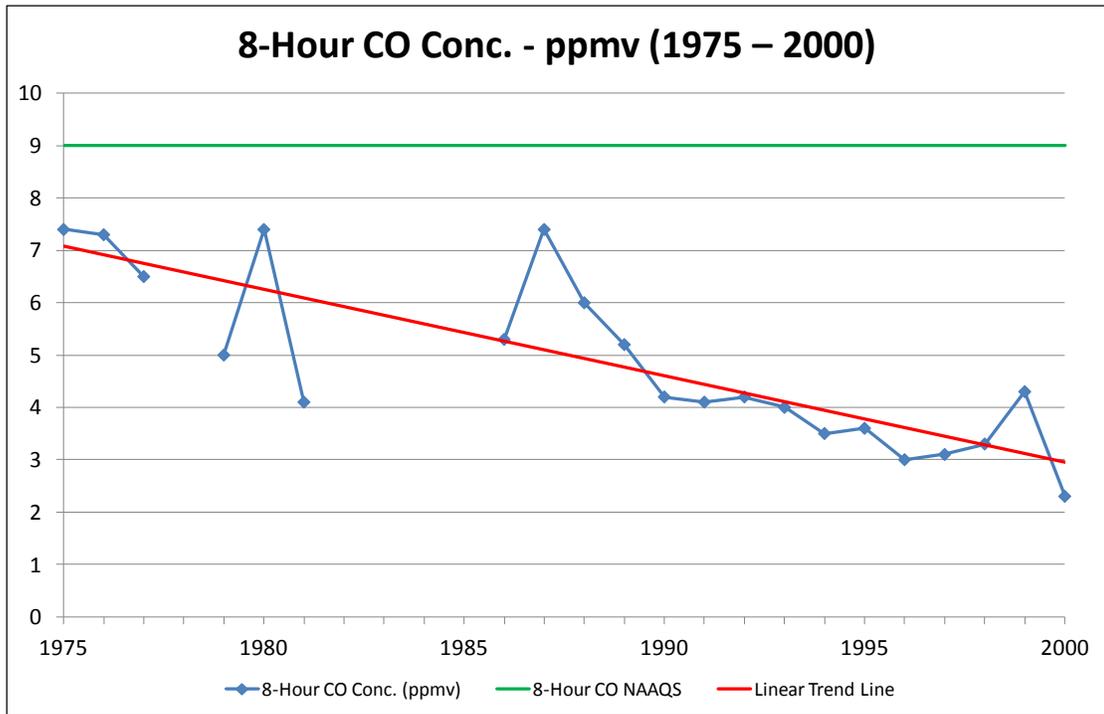


Figure 13 – Carbon Monoxide 8-Hour Concentrations in Huntsville, Alabama



As shown in Figures 12 and 13, concentrations of carbon monoxide in the ambient air in Huntsville declined during the twenty-six year monitoring period. Trend analysis yielded the following regression equation for 1-hour maximum CO concentrations:

$$\text{CO (ppm)} = 9.846 \text{ ppm} - (0.235 \text{ ppm}) x$$

Where CO = the expected carbon monoxide concentration in year x, and x = the number of the year (1975=1, 1976=2, etc.). Thus, in 2000 (Year 26), the predicted CO concentration would be $9.846 \text{ ppm} - (0.235 \text{ ppm/year})(26 \text{ years}) = 3.73 \text{ ppm}$. The downward trend in carbon monoxide concentrations in Huntsville is statistically significant. Regression analysis yielded a coefficient of linear determination, $r^2 = 0.72$. The value of the coefficient of linear correlation ($r = 0.85$) is much higher than the critical value of r for any reasonable value of α ($r_{\text{critical}} = 0.54$ at $\alpha = 0.01$ with 20 degrees of freedom). In other words, there is greater than a 99 % probability that the apparent downward trend in CO concentrations is not the result of random year-to-year variation and that CO concentrations were actually declining.

Not surprisingly, trend analysis of the eight-hour carbon monoxide data yielded similar results. For 8-hour CO concentrations, the regression equation is:

$$\text{CO (ppm)} = 7.245 \text{ ppm} - (0.165 \text{ ppm}) x$$

Where CO = the expected carbon monoxide concentration in year x, and x = the number of the year (1975=1, 1976=2, etc.). Thus, in 2000 (Year 26), the predicted CO concentration would be $7.245 \text{ ppm} - (0.165 \text{ ppm/year})(26 \text{ years}) = 2.96 \text{ ppm}$. This downward trend is also statistically significant. The coefficient of linear determination, $r^2 = 0.67$, and the coefficient of linear correlation, $r = 0.82$ ($r_{\text{critical}} = 0.55$ at $\alpha = 0.01$ with 19 degrees of freedom).

Since measured carbon monoxide concentrations were well below the federal standards, and concentrations were declining, monitoring of the carbon monoxide in Huntsville's ambient air was discontinued in December 2000. This allowed Natural Resources monitoring personnel to devote more time to deployment and operation of the fine particulate monitoring equipment, and operation of the climate-controlled weighing laboratory.

TABLE 13

Carbon Monoxide Health Effects & Cautionary Statements Associated With AQI Categories		
AQI Category	Carbon Monoxide Concentration	Carbon Monoxide Health Effects & Cautionary Statements
Good	0.0 – 4.4 ppm	None
Moderate	4.5 – 9.4 ppm	None
Unhealthy for Sensitive Groups	9.5 – 12.4 ppm	Increasing likelihood of reduced exercise tolerance due to increased cardiovascular symptoms, such as chest pain, in people with heart disease. People with heart disease, such as angina, should limit heavy exertion and avoid sources of CO, such as heavy traffic.
Unhealthy	12.5 – 15.4 ppm	Reduced exercise tolerance due to increased cardiovascular symptoms, such as chest pain, in people with heart disease. People with heart disease, such as angina, should limit moderate exertion and avoid sources of CO, such as heavy traffic.
Very Unhealthy	15.5 – 30.4 ppm	Significant aggravation of cardiovascular symptoms, such as chest pain, in people with heart disease. People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic.
Hazardous	> 30.4 ppm	Serious aggravation of cardiovascular symptoms such as chest pain, in people with heart disease; impairment of strenuous activities in general population. People with heart disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic; everyone else should limit heavy exertion.

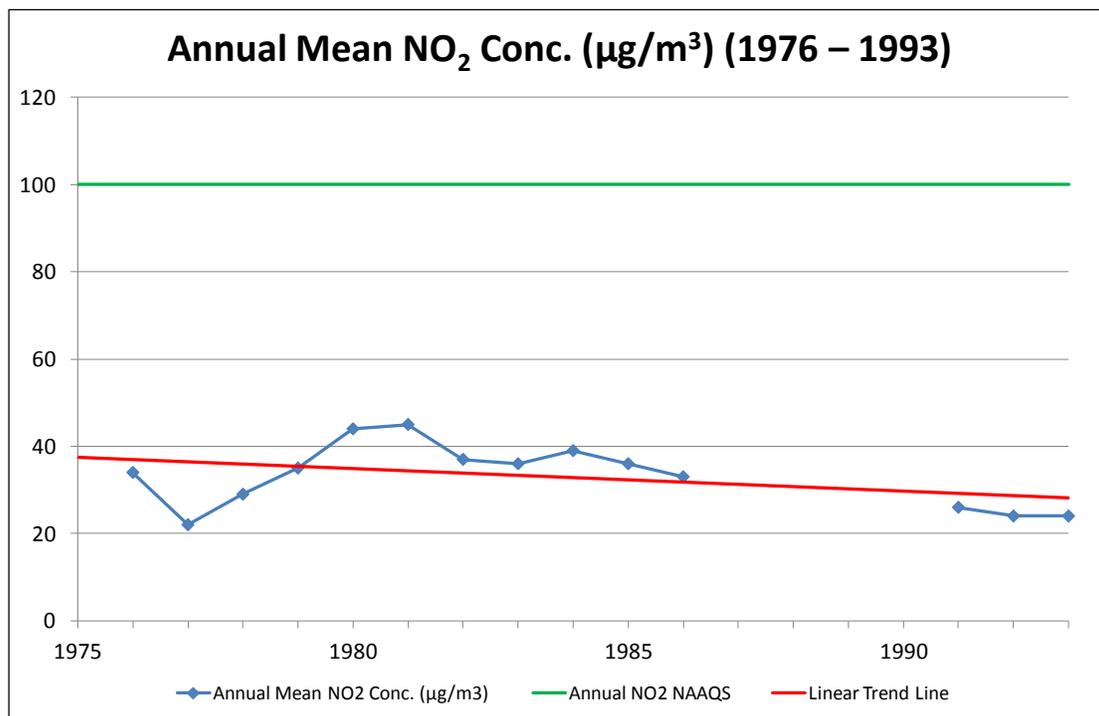
NITROGEN DIOXIDE

Nitrogen dioxide (NO₂) is a poisonous, highly reactive, yellowish-brown gas. It is generated in the atmosphere primarily by the oxidation of nitric oxide (NO). Oxides of nitrogen (NO_x) are emitted by mobile sources, stationary combustion sources, and some industrial processes. Oxides of nitrogen can irritate the lungs, cause bronchitis and pneumonia, and lower resistance to respiratory infections. Additional information on health effects of nitrogen dioxide may be found in Table 14, which presents health effects and cautionary statements associated with various categories of the AQI.

Although health effects associated with exposure to elevated concentrations of nitrogen oxides can be serious, measured concentrations in the ambient air in Huntsville have been far below the threshold at which health effects are evident. For this reason, the most serious problem associated with nitrogen oxides in Huntsville involves their role in forming secondary pollutants in the atmosphere. As noted in the discussion of ozone, oxides of nitrogen and volatile organic compounds react in the presence of sunlight to form ozone. Oxides of nitrogen are also precursors of the nitrate fraction of fine particulate matter. Ozone (smog) and fine particulate matter (PM_{2.5}) are the pollutants of greatest concern in Huntsville. Nitrogen oxides also exert harmful effects on human welfare. Nitrogen oxides and sulfur oxides are the principal contributors to acid rain, and deposition of nitrates affect the nutrient balance of terrestrial and aquatic ecosystems.

In Huntsville all measurements of NO₂ have been far below the NAAQS of 100 µg/m³ (53 ppb) annual arithmetic mean as shown in Figure 14. Because concentrations have been far below the standards, monitoring on a routine basis was discontinued in 1994.

Figure 14 – Annual Mean NO₂ Concentrations in Huntsville, Alabama



EPA completed the most recent review of the NAAQS for nitrogen dioxide in February 2010. The annual standard of 53 ppb was retained, but a short-term primary standard was added. This 1-hour standard was set at 100 ppb and takes the form of the 98th percentile maximum 1-hour nitrogen oxide concentration measured during each calendar year, averaged over a three-year period. Furthermore, EPA promulgated monitoring requirements for the revised nitrogen dioxide NAAQS that necessitate establishing one or more roadside monitoring stations in metropolitan areas with a population of 500,000 people or more.

The overall trend in nitrogen dioxide concentrations in Huntsville was downward from 1976 -1993, as shown in Figure 14, but the downward trend is not statistically significant. Regression analysis yielded the following equation:

$$\text{NO}_2 (\mu\text{g}/\text{m}^3) = 37.5 \mu\text{g}/\text{m}^3 - (0.52 \mu\text{g}/\text{m}^3 \text{ per year}) x$$

Where NO_2 = the expected nitrogen dioxide concentration in year x, and x = the number of the year (1976=1, 1977=2, etc.). Thus, in 1993 (Year 18), the predicted NO_2 concentration would be $37.5 \mu\text{g}/\text{m}^3 - (0.52 \mu\text{g}/\text{m}^3/\text{year})(18 \text{ years}) = 28.1 \mu\text{g}/\text{m}^3$. However, the coefficient of linear determination is low ($r^2 = 0.15$). The value of the coefficient of linear correlation ($r = 0.39$) is lower than the critical value of r for any reasonable value of α ($r_{\text{critical}} = 0.46$ at $\alpha = 0.10$ with 12 degrees of freedom). In other words, the year-to-year variation in average annual NO_2 concentrations is large in relation to the decrease in concentrations over time. Although the trend was downward, this trend is not statistically significant.

TABLE 14

Nitrogen Dioxide Health Effects & Cautionary Statements Associated With AQI Categories		
AQI Category	Nitrogen Dioxide Concentration	Health Effects & Cautionary Statements
Good	0.0 – 0.053 ppm	None
Moderate	0.054 – 0.100 ppm	Individuals who are unusually sensitive to nitrogen dioxide should consider limiting prolonged outdoor exertion.
Unhealthy for Sensitive Groups	0.101 – 0.360 ppm	People with lung disease, such as asthma, children and older adults should limit prolonged outdoor exertion.
Unhealthy	0.361 – 0.64 ppm	People with lung disease, such as asthma, children and older adults should avoid prolonged outdoor exertion. Everyone else should limit prolonged outdoor exertion.
Very Unhealthy	0.65 – 1.24 ppm	People with lung disease, such as asthma, children and older adults should avoid all outdoor exertion. Everyone else should limit outdoor exertion.
Hazardous	> 0.124 ppm	No additional cautionary statements are currently available.

SULFUR DIOXIDE

Sulfur dioxide (SO₂) is a corrosive and poisonous gas produced by the burning of sulfur-containing fuel and by certain industrial processes, such as metal smelting. As a corrosive gas, sulfur dioxide is a respiratory irritant. Short-term exposure to elevated SO₂ concentrations can cause coughing, wheezing and shortness of breath, particularly in asthmatic individuals. Longer term exposures can cause bronchitis, and aggravate other respiratory diseases and cardiovascular disease. Additional information on health effects of sulfur dioxide may be found in Table 15, which presents health effects and cautionary statements associated with various categories of the AQI.

Adverse effects on human welfare associated with elevated sulfur dioxide concentrations are also related to its corrosive properties. SO₂ can corrode metal, stone, and concrete and cause vegetation damage. It is a major contributor to acid rain and thus contributes to acidification of soils, lakes and streams. It is also a precursor to the sulfate fraction of fine particulate matter (the largest constituent of fine particulate in Huntsville) and contributes to visibility impairment

All measured sulfur dioxide concentrations in Huntsville have been far below the NAAQS, as shown in Figure 15. Routine sulfur dioxide monitoring from 1974 through 1981 showed a maximum annual concentration of 0.003 ppm and a maximum 24-hour concentration of 0.017 ppm. These concentrations were roughly an order of magnitude below the NAAQS (0.03 ppm and 0.14 ppm, respectively) in place at the time. Because such low concentrations were observed, routine monitoring for SO₂ was discontinued in 1981. A short term monitoring project conducted from November 1993 through May 1994 indicated that ambient levels remained far below the NAAQS (0.015 ppm maximum 24-hour concentration).

In June 2010, EPA revised the NAAQS for sulfur dioxide, revoking the annual and 24-hour standards and promulgating a much more stringent short-term standard. The new 1-hour standard was set at 75 ppb and takes the form of the 99th percentile of maximum daily 1-hour concentrations, averaged over three years. Monitoring for sulfur dioxide is required based on a population weighted emissions index applied to each Core Based Statistical Area (CBSA). Because point source emissions of sulfur dioxide are low in the immediate area of Huntsville, monitoring for sulfur dioxide is not required.

The overall trend in sulfur dioxide concentrations in Huntsville was slightly upward from 1974 -1994, as shown in Figure 15, but the upward trend is not statistically significant. Regression analysis yielded the following equation:

$$\text{SO}_2 \text{ (ppm)} = 0.0058 \text{ ppm} + (0.00033 \text{ ppm per year}) x$$

Where SO₂ = the predicted sulfur dioxide concentration in year x, and x = the number of the year (1974=1, 1975=2, etc.). Thus, in 1994 (Year 21), the predicted SO₂ concentration would be 0.0058 ppm + (0.00033 ppm/year)(21 years) = 0.013 ppm. However, the coefficient of linear determination is low (r² = 0.17), and the value of the coefficient of linear correlation (r = 0.41) is lower than the critical value of r for any reasonable value of α (r_{critical} = 0.55 at α = 0.10 with 8 degrees of freedom). In other words, the year-to-year variation in 24-hour maximum SO₂

concentrations is large in relation to the increase in concentration over time, and the trend is not statistically significant.

Figure 15 – Maximum 24-Hour SO₂ Concentrations in Huntsville, Alabama

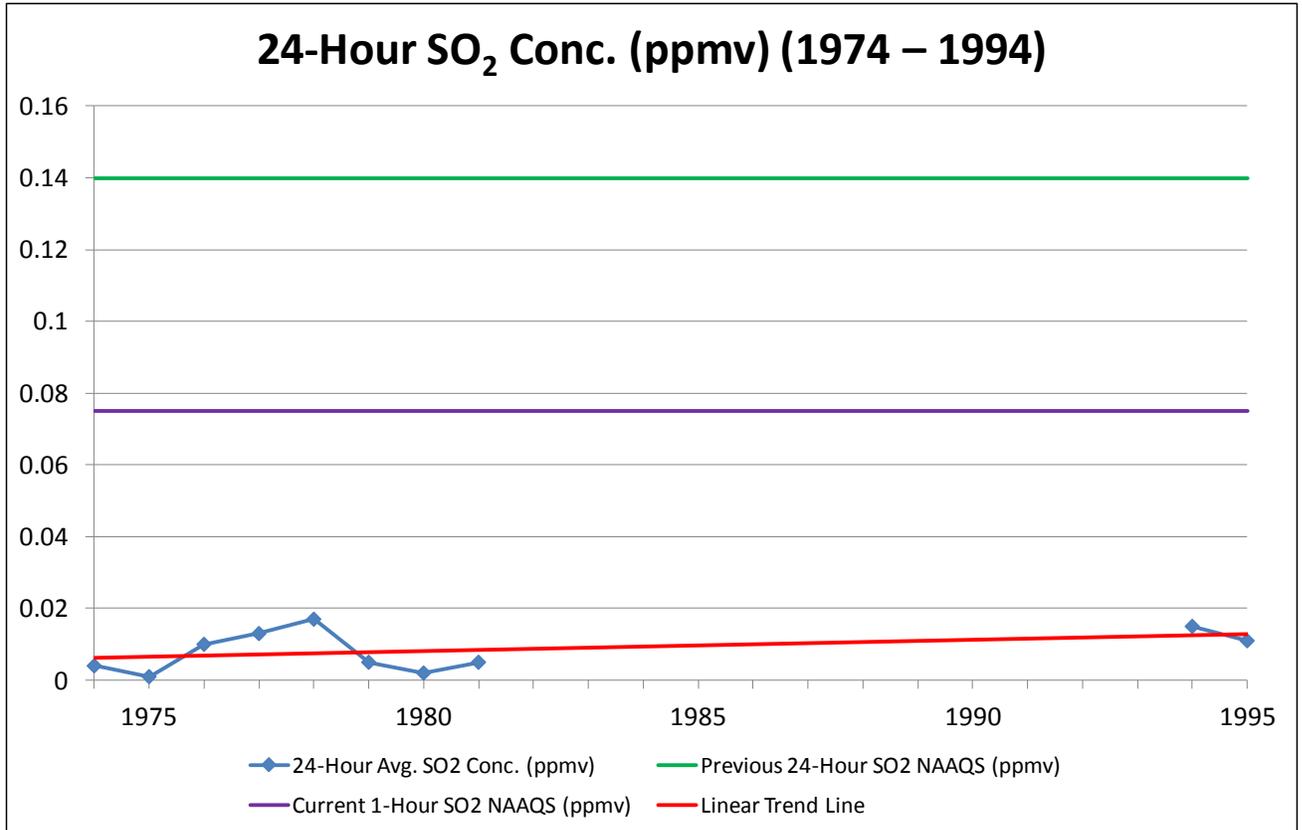


TABLE 15

Sulfur Dioxide Health Effects & Cautionary Statements Associated With AQI Categories		
AQI Category	Sulfur Dioxide Concentration	Health Effects & Cautionary Statements
Good	0.000 – 0.035 ppm	None
Moderate	0.036 – 0.075 ppm	None
Unhealthy for Sensitive Groups	0.076 – 0.185 ppm	Increasing likelihood of respiratory symptoms, such as chest tightness and breathing discomfort, in people with asthma. People with asthma should consider limiting outdoor exertion.
Unhealthy	0.186 – 0.304 ppm	Increased respiratory symptoms, such as chest tightness and wheezing in people with asthma; possible aggravation of heart or lung disease. Children, asthmatics, and people with heart or lung disease should limit outdoor exertion.
Very Unhealthy	0.305 – 0.604 ppm	Significant increase in respiratory symptoms, such as wheezing and shortness of breath, in people with asthma; aggravation of heart or lung disease. Children, asthmatics, and people with heart or lung disease should avoid outdoor exertion; everyone else should reduce outdoor exertion.
Hazardous	> 0.604 ppm	Severe respiratory symptoms, such as wheezing and shortness of breath, in people with asthma; increased aggravation of heart or lung disease; possible respiratory effects in general population. Children, asthmatics, and people with heart or lung disease should remain indoors; everyone else should avoid outdoor exertion.

LEAD

Lead is the only metal for which a NAAQS has been promulgated, although a number of heavy metals are regulated as Hazardous Air Pollutants. As an air pollutant it is present in the form of very small particles. Lead is physically harmful when ingested or inhaled. Once in the body, it accumulates in the blood, bone, and soft tissue, and affects the blood-forming organs, kidneys, and the nervous system. In fetuses and children, elevated lead levels in the blood interfere with normal brain development.

Historically, the most significant source of lead emissions was motor vehicles fueled with leaded gasoline, although certain industrial processes such as lead smelting operations may cause localized problems. Tetraethyl lead was used as an octane booster (“anti-knocking agent”) in gasoline for many years and is still used to boost the octane of aviation fuels. After enactment of the Clean Air Act, EPA promulgated regulations requiring the phase-out of lead from highway vehicle fuels. Although initially imposed because the lead in gasoline poisoned catalytic converter catalysts, the gradual elimination of leaded gasoline has had a dramatic effect in reducing lead concentrations in the ambient air nationwide. The phase-out of leaded gasoline for highway vehicles began in 1975 and was completed in 1995.

On October 15, 2008 EPA revised the NAAQS for lead, the first revision since a NAAQS for lead was initially established in 1978. The revision of the NAAQS was prompted by current data from recent health studies indicating adverse effects on neurological development at ambient lead concentrations below the level of the previous standard. Consequently, the lead NAAQS was lowered dramatically, from 1.5 to 0.15 $\mu\text{g}/\text{m}^3$, an order-of-magnitude change. The tendency in recent years has been toward progressive tightening of the ambient standards for several pollutants, notably particulate matter, ozone, and as evidenced here, lead. In the agency’s most recent review of the lead ambient air quality standard, EPA proposed to retain the current lead NAAQS in January 2015.

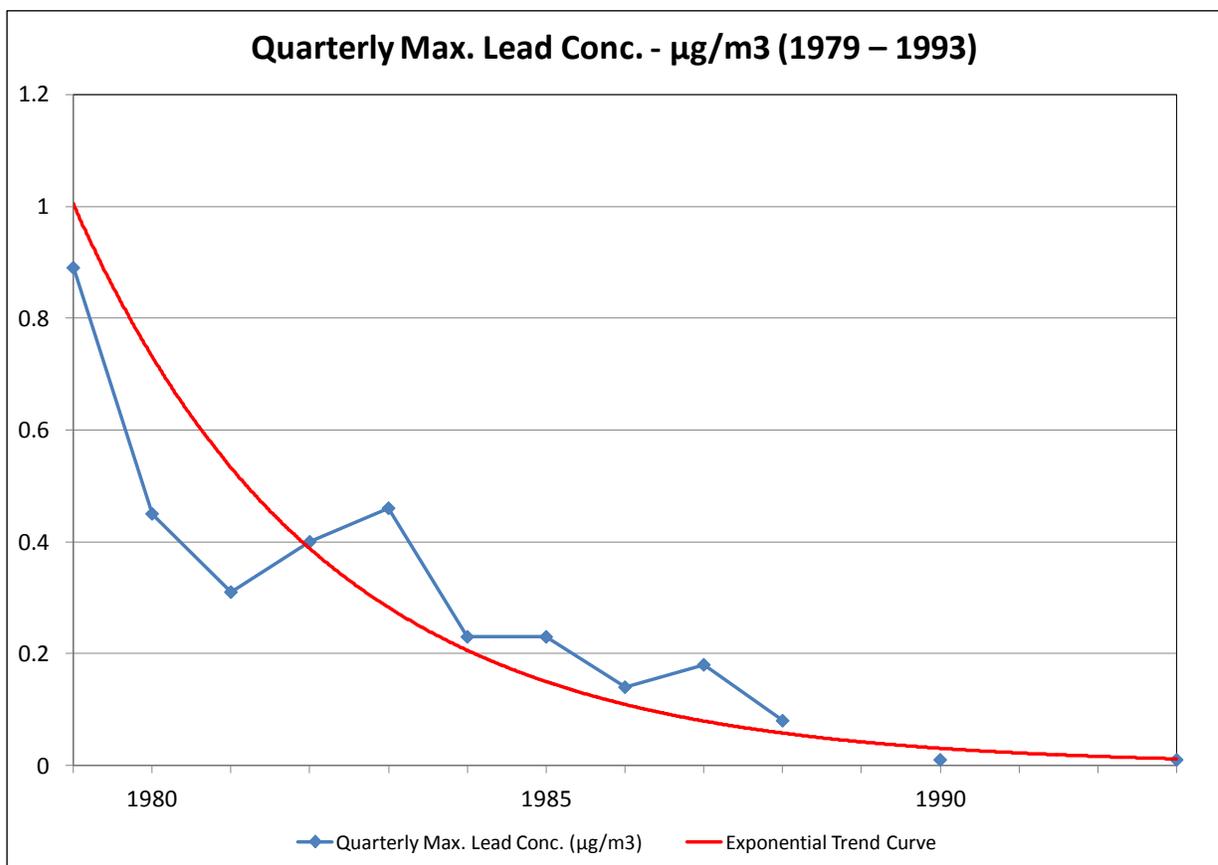
The phase-out of leaded gasoline for automobiles resulted in dramatic reductions in the concentration of lead in the ambient air across the country, as noted above, and virtually all areas of the country have been in attainment of the lead NAAQS for many years. With measured levels far below the NAAQS in most areas of the country, the size of the nationwide lead ambient monitoring network had been substantially reduced. However, with the more recent revision of the ambient standard, deployment of a fairly robust lead monitoring network again became necessary. In conjunction with the lead NAAQS revision, EPA also imposed additional requirements for lead monitoring on State and Local air pollution control agencies. EPA is requiring monitoring in areas with industrial sources that emit ≥ 0.5 tons per year (TPY) of lead, with airports that emit ≥ 1.0 TPY of lead and in areas with a population $\geq 500,000$ in which a National Core (NCore) multi-pollutant monitoring site is located. Ambient monitoring for lead in Huntsville is not required because none of these criteria are met in the Huntsville area.

In addition to the fact that Huntsville does not meet the screening criteria that trigger the requirement for re-establishing an ambient lead monitoring station, available data indicate that ambient lead concentrations here are well below even the tighter NAAQS for lead. As discussed

in some detail below, measured ambient lead concentrations had fallen to levels well below the revised NAAQS by the early 1990's, when lead monitoring was discontinued in Huntsville. More recent measurements of lead concentrations as a component of fine particulate matter speciation analyses are consistent with these results. However, these results are probably somewhat lower than those that would be obtained from lead concentration data obtained using the Federal Reference Method for lead, which entails analysis of TSP (Total Suspended Particulate) rather than the analysis of the fine particulate matter fraction of TSP.

Lead concentrations in Huntsville's ambient air for the period 1977-1993 are shown in Figure 16. As shown in the Figure, by the early 1990's, ambient lead concentrations had dropped below the detection limit at that time (approximately $0.01 \mu\text{g}/\text{m}^3$), and were only a tiny fraction of the NAAQS in place at that time. As a result, lead monitoring using the FRM (Federal Reference Method) was permanently discontinued in 1993. [Note: the reference method for lead entails analysis of TSP (Total Suspended Particulate) filters.]

Figure 16 – Ambient Lead Concentrations in Huntsville, Alabama



More recently, lead analyses were resumed as a component of the chemical speciation of fine particulate matter. Maximum quarterly average lead concentrations, based on PM_{2.5} filter analyses, are presented below:

Highest Quarterly Average Ambient Lead Concentrations in Huntsville Based on PM_{2.5} Filter Analyses (2003-2014)

<u>Year</u>	<u>Concentration (µg/m³)</u>
2003	0.0036
2004	0.0023
2005	0.0044
2006	0.0021
2007	0.0051
2008	0.0030
2009	0.0013
2010	0.0013
2011	0.0016
2012	0.0013
2013	0.0014
2014	0.0006

Recall that the FRM (Federal Reference Method) for lead entails analysis of TSP (Total Suspended Particulate) filters, whereas the data shown above reflect analysis of only the fine particulate matter fraction of TSP. Consequently, these data cannot be directly compared to the lead concentrations shown in Figure 16. Nevertheless, these data do support the conclusion that lead concentrations are very low in the ambient air in Huntsville.

As noted above, the phase-out of leaded gasoline has resulted in dramatic reductions in ambient lead concentrations across the country. Not surprisingly, this same pattern has been observed in Huntsville, as evidenced in Figure 16. Trend analysis of lead concentrations in Huntsville from 1979-1993 yielded the following linear regression equation:

$$Pb (\mu\text{g}/\text{m}^3) = 0.63 \mu\text{g}/\text{m}^3 - (0.05 \mu\text{g}/\text{m}^3 \text{ per year}) x$$

Where Pb = the expected lead concentration in year x, and x = the number of the year (1979=1, 1980=2, etc.). Thus, in 1993 (Year 15), the predicted lead concentration in the ambient air would be $0.63 \mu\text{g}/\text{m}^3 - (0.05 \mu\text{g}/\text{m}^3/\text{year})(15 \text{ years}) = -0.12 \mu\text{g}/\text{m}^3$. Obviously, the actual concentration of lead in the ambient air cannot be less than 0, but the best-fit linear regression line does cross the x-axis. The coefficient of linear determination is quite high ($r^2 = 0.73$), and the value of the coefficient of linear correlation ($r = 0.86$) is higher than the critical value of r at any reasonable level of significance ($r_{\text{critical}} = 0.71$ at $\alpha = 0.01$ with 10 degrees of freedom).

Although the fit of the linear regression line is rather good, an exponential regression provides an even better fit to the lead concentration data over time in Huntsville. This is to be

expected given the principal reason for the dramatic reduction in lead concentrations in Huntsville and across the country. Lead concentrations in the ambient air dropped rather rapidly as unleaded fuel replaced leaded fuel, but then leveled off at very low concentrations as the phase-out of leaded gasoline for highway vehicles neared completion. Therefore, it is not surprising that exponential regression results provide a better fit to the measured lead concentrations over time. [Note: Exponential regression analysis entails taking the logarithm of the lead concentration, while leaving the time scale linear and then finding the least-squares line through the curvilinear data that has been thus linearized.] It is the exponential regression curve that is shown in Figure 16 rather than the linear trend line. The logarithmic form of the exponential regression equation is given below:

$$\ln (\text{Pb}) = 0.321 - (0.317) x$$

This equation can be rewritten in its exponential form: $\text{Pb} = 1.38 e^{-0.317x}$

Exponential regression yielded very high values for the coefficient of linear correlation ($r = 0.929$) and the coefficient of linear determination ($r^2 = 0.863$). Thus, while the linear regression equation accounts for 73 % of the variability in the highest quarterly average lead concentrations over time, the exponential regression equation accounts for 86 % of that variation. As noted above, $r_{\text{critical}} = 0.71$ at significance level $\alpha = 0.01$ with 10 degrees of freedom. Again, the conclusion is that the downward trend in lead concentrations is statistically significant at any reasonable level of α and is not the result of random year-to-year variation in the data. The predicted lead concentration in Year 15 using the exponential regression equation is given by: $\text{Pb} = 1.38 e^{-0.317(15)} = 0.012 \mu\text{g}/\text{m}^3$. Note that the exponential regression equation does not (and cannot) predict a negative lead concentration, in contrast to the linear regression model.

POLLEN

Pollen is a natural air contaminant which occurs during periods when plants are pollinating. Pollination is the transfer of pollen from one plant to another and is an essential step in the sexual reproduction of most seed plants. In the flowering plants, the pollen grains (the male gametophytes) are produced in the anthers of the flower's stamens. In pollination, the pollen grains are transferred to the stigma of the pistil, the female part of the flower. The pollen grains germinate, and release sperm cells that fertilize the ovules in the ovary of the pistil. The fertilized ovules then grow to form the seeds of the angiosperms (the flowering plants). Different species of flowering plants rely on insects, birds, small mammals, or the wind to carry the pollen grains to the stigma. The gymnosperms (pines, cedars, etc.) are wind-pollinated. The pollen and ovules are produced in male and female cones, respectively, and in pollination the pollen grains are carried by the wind to the female cones, where they germinate and fertilize the ovules.

Wind pollinated seed plants, such as many trees, grasses and flowering weed species, are the principal sources of pollen in Huntsville's ambient air. Airborne pollen is a major allergen responsible for seasonal allergic rhinitis. Upon contact with the nasal membrane, pollens release proteins which may cause an allergic response in sensitive persons.

In a widely used, non-technical classification system, pollen is divided into three main groups: tree pollen, grass pollen, and weed pollen. In general, tree pollen is less allergenic than grass and weed pollens. In Huntsville, most trees pollinate from January through May releasing large amounts of pollen over a fairly short period of time. Tree pollen is typically very buoyant and can be carried on wind currents for many miles. It can be seen by the naked eye as a yellow residue on automobiles, driveways, and lawn furniture in early spring.

A relatively large number of people are allergic to pollen from various grass species. Grasses pollinate from April through August in the Huntsville area. Grass pollen is released in smaller amounts than tree pollen. It is typically carried less than a mile, due in part to the relatively low release height.

Weed pollen is the most allergenic. In the Huntsville area, a number of weed species pollinate from June through late fall producing small amounts of pollen over a long period. Ragweed is the most abundant weed pollen occurring from August to October.

The American Academy of Allergy, Asthma and Immunology (AAAAI) maintains the pollen counting certification program. In August 1994, Natural Resources began reporting pollen counts to a national database as a certified pollen counting station. The pollen counts were also posted on the Department's web site. Due to retirement of the Department's long-time pollen counter, pollen counts have temporarily been discontinued while her successor goes through the certification process.

Pollen is identified and categorized by thirty principal genera according to AAAAI guidelines. Pollen counts are reported as pollen grains per cubic meter. The reported pollen count is based on the most predominant pollen type and is reported using the scale shown in

Table 16. Pollen 24-hour maximum concentrations and monthly means from 2009 through mid-2013 are shown in Figures 17 and 18, respectively.

TABLE 16

Pollen Type	POLLEN COUNT SCALE	Category
TREE POLLEN	0 - 99 100 - 199 200 - 299 300 - 399+	LOW MODERATE HIGH VERY HIGH
GRASS POLLEN	0 - 24 25 - 49 50 - 74 75 - 100+	LOW MODERATE HIGH VERY HIGH
RAGWEED POLLEN	0 - 49 50 - 99 100 - 149 150 - 200+	LOW MODERATE HIGH VERY HIGH

If the pollen count falls within these categories, allergy sufferers who are allergic to the above pollens may experience symptoms of hay fever or asthma, as indicated below.¹

- ABSENT** No symptoms
- LOW** Only individuals extremely sensitive to these pollens will experience symptoms.
- MODERATE** Many individuals sensitive to these pollens will experience symptoms.
- HIGH** Most individuals with any sensitivity to these pollens will experience symptoms.
- VERY HIGH** Almost all individuals with any sensitivity at all to these pollens will experience symptoms. Extremely sensitive people could have severe symptoms.

¹ American Academy of Allergy, Asthma and Immunology

Figure 17

POLLEN (2009 - 2013) Maximum 24-Hour Count

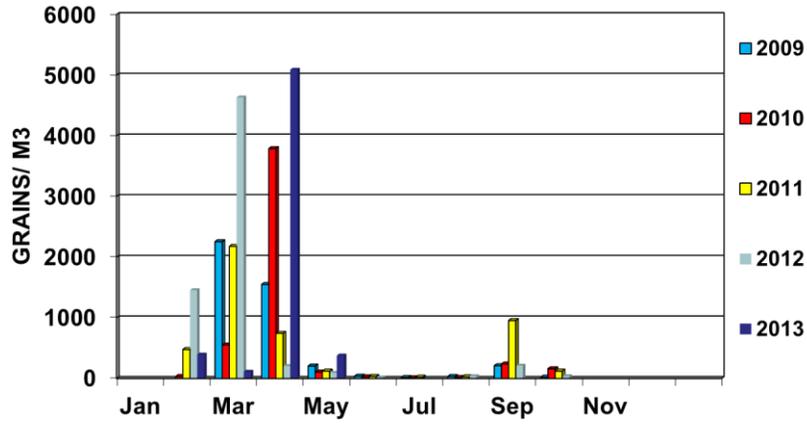
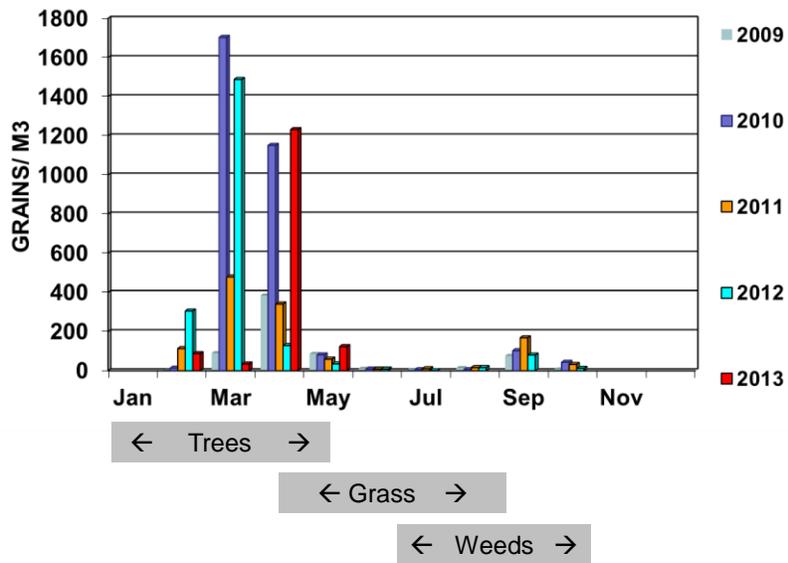


Figure 18

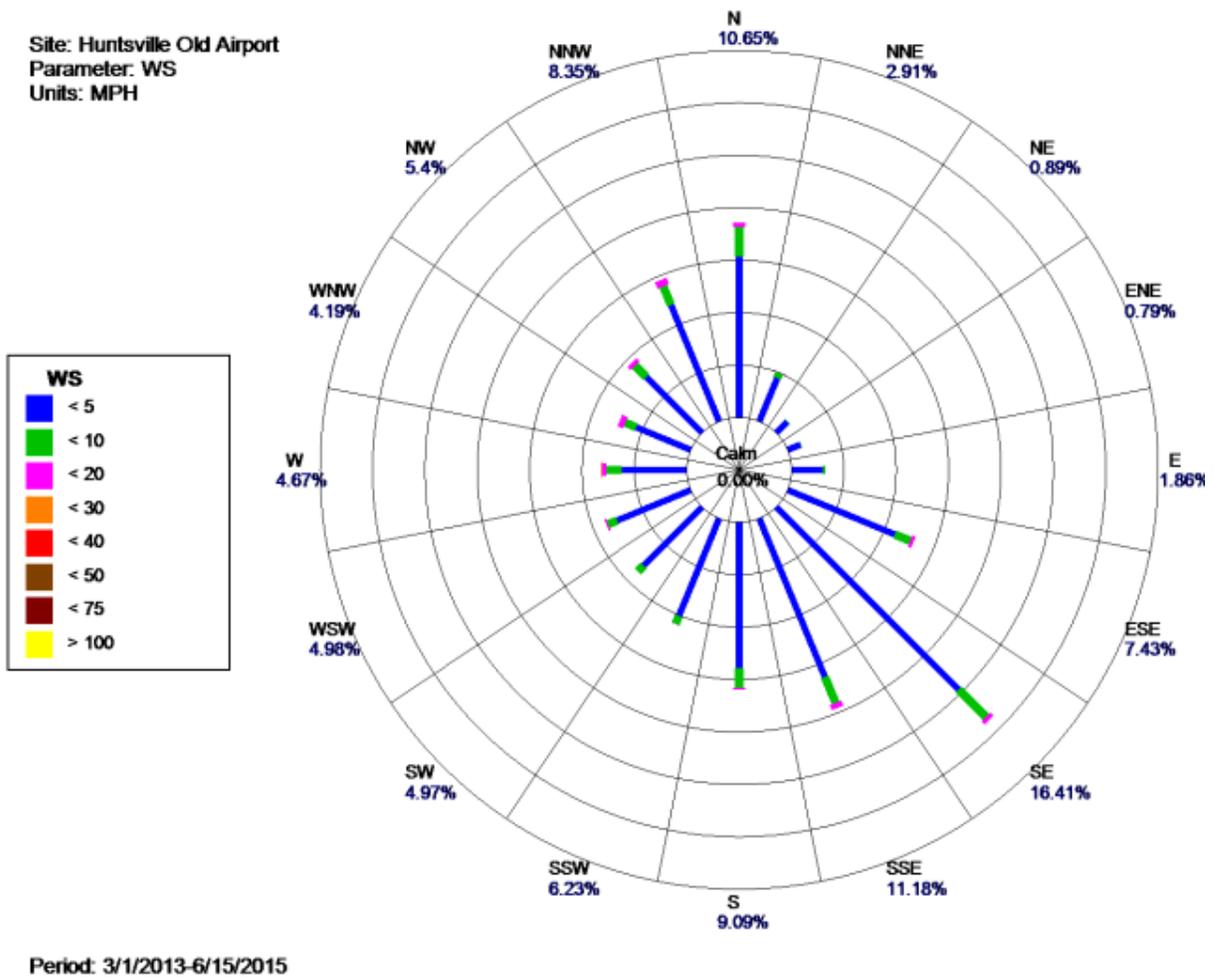
POLLEN (2009 – 2013) Monthly Averages



METEOROLOGY

Wind speed and wind direction are fundamental parameters used in evaluating the movement and dispersion of pollutants within an airshed. In addition to monitoring concentrations of the criteria pollutants in Huntsville’s ambient air, Natural Resources continuously monitors several meteorological parameters at the City’s air quality monitoring station on Airport Road. These are wind direction, wind speed and temperature. A 16- point wind rose summarizing wind speed and wind direction measurements for March 2013 – June 2015 at Site 014 is shown in Figure 19.

Figure 19 – Wind Rose Showing Surface Wind Speed and Direction at Site 014 (Airport Road) in Huntsville for March 2013 – mid-June 2015.



EMISSIONS INVENTORY

CRITERIA POLLUTANTS

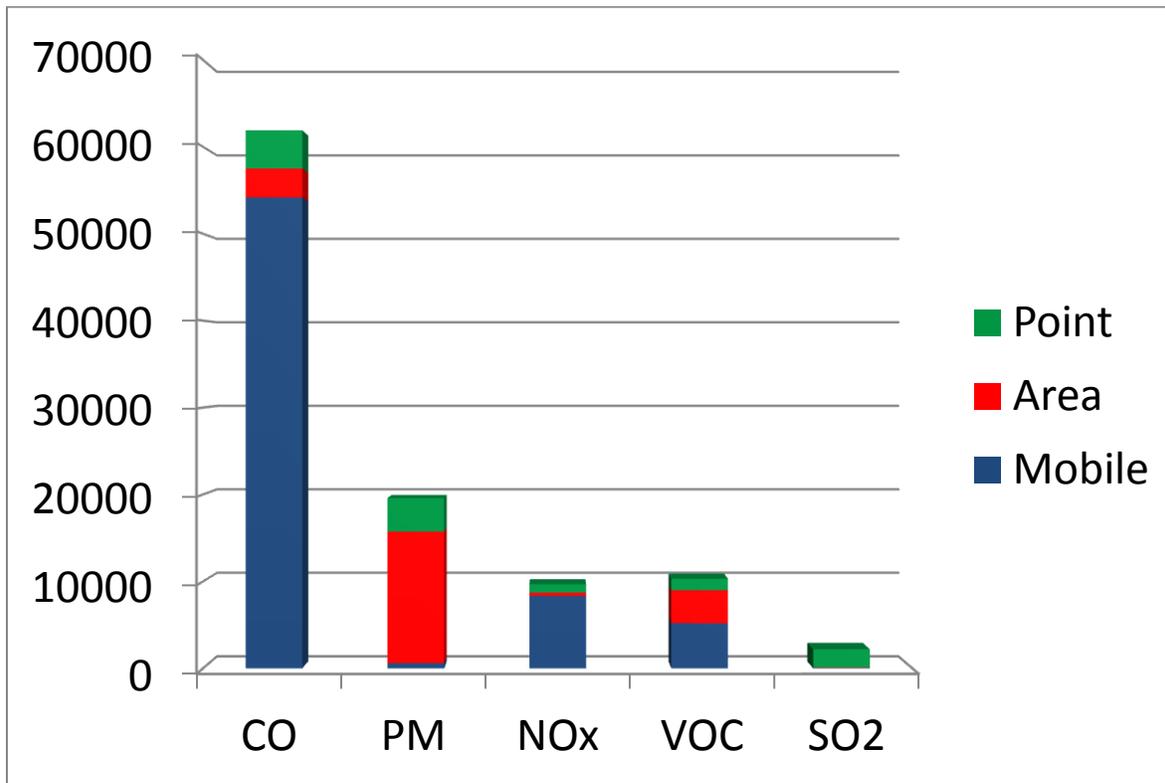
In previous editions of the Air Quality Report, Natural Resources included a criteria pollutant emissions inventory that showed the relative contribution of Industrial, Mobile, and Area sources to total criteria pollutant emissions within the City of Huntsville. The criteria pollutants are those pollutants for which an ambient air quality standard has been established (Reference Table 1). However, a different approach is taken in this current Report. Rather than presenting emissions totals for the City of Huntsville, which includes portions of Madison and Limestone Counties, as in previous reports, this Report presents emission totals for Madison County. This is consistent with the approach the Department has taken in developing the Greenhouse Gas emissions inventory for the area and is also consistent with the approach employed by the Environmental Protection Agency in developing the National Emissions Inventory (NEI). In fact, the emissions data presented here are taken from EPA's NEI, which includes emissions summaries for each county in the Nation. Natural Resources simply extracted the information for Madison County and organized that data into the format presented here. The most recent NEI data, along with background information on the methodology EPA utilized to compile the NEI can be accessed at:

<http://www.epa.gov/ttnchie1/net/2011inventory.html>

The emissions inventory represents measured and calculated emissions from industrial and regulated area sources; mobile source emissions based on computer modeling and VMT (Vehicle Miles Traveled) information, and generalized estimates of emissions from non-regulated area sources. The contribution of each source category to total criteria pollutant emissions in Madison County for year 2011 is shown in Figure 20 and is summarized in Table 17. Note that Figure 20 and Table 17 do not include biogenic emissions, i.e. emissions that result from natural biological processes. Examples of biogenic emissions include VOC (Volatile Organic Compound) emissions from vegetation and nitrogen oxide emissions from biological activity in soils. Although EPA includes estimates of biogenic emissions in the NEI, the data presented here do not.

EPA compiles the NEI from data supplied by State and Local air pollution control agencies across the country. Natural Resources submits data for point sources within the corporate limits of Huntsville and ADEM (Alabama Department of Environmental Management) provides point source data for areas outside the corporate limits of Huntsville. ADEM also provides VMT estimates from ALDOT (Alabama Department of Transportation) which EPA uses to model mobile source emissions in Madison County. In addition, ADEM reviews information used by EPA in developing estimates of area source emissions.

Figure 20 – Total Annual Emissions in Madison County, Alabama (Tons per Year) for Year 2011. (Taken from the National Emissions Inventory)



Point Sources (Industrial Sources)

Air emissions from industrial sources are produced primarily from combustion equipment and industrial processes that release pollutants into the air. Examples of point sources in the Huntsville area include industrial boilers, furnaces, dryers and ovens, surface coating operations (painting and priming), degreasing and surface cleaning operations, asphalt production, raw materials handling, and electronics manufacturing. Emissions from industrial sources are often reduced through the installation of pollution control equipment, or by incorporating manufacturing processes that emit fewer pollutants. Industrial sources within the City of Huntsville are required to obtain a Permit from Natural Resources to ensure compliance with Air Pollution Control Rules and Regulations. During the permitting process, anticipated air emissions are quantified and necessary controls are specified. Actual emissions are then verified and updated by subsequent compliance testing, monitoring and performance of regular periodic compliance inspections by Natural Resources. For point sources in Madison County that are outside the corporate limits of the City of Huntsville, ADEM is the permitting authority. Examples of point sources in Madison County outside the Huntsville City limits include facilities on Redstone Arsenal and the Solid Waste Disposal Authority Waste-to-Energy plant.

Table 17- Criteria Pollutant Emissions Inventory for Madison County, Alabama for Year 2011. All pollutant emissions are shown in Tons Per Year (TPY). (Data taken from the National Emissions Inventory).

	<u>CO</u>	<u>PM₁₀</u>	<u>NO_x</u>	<u>SO₂</u>	<u>VOC</u>
Point Sources:					
Industrial Fuel Combustion	4,215.8	3,607.6	931.2	2,033.7	136.7
Chemical Manufacturing	42.4	22.6			
Mining		159.5			
Industrial Processes NEC	123.3	33.4	1 2.3	63.4	94.3
Pulp & Paper	8.2	13.5	0.8		1.8
Storage & Transfer					66.4
Solvent Degreasing					359.9
Surface Coating					665.3
Waste Disposal					
<i>Point Source Sub-Total</i>	<i>4,389.7</i>	<i>3,836.6</i>	<i>944.3</i>	<i>2,097.1</i>	<i>1,333.4</i>
Mobile Sources:					
Aircraft	622.1	14.0	143.9	18.7	49.9
Commercial Marine	11.4	1.9	56.3	0.7	1.3
Locomotives	46.8	11.1	301.9	3.3	16.6
Non-Road Equipment	12,469.6	117.4	1,259.7	4.4	982.2
On-Road Vehicles	41,014.4	450.3	6,585.7	37.6	4,132.7
<i>Mobile Source Sub-Total</i>	<i>54,164.4</i>	<i>594.6</i>	<i>8,347.4</i>	<i>64.7</i>	<i>5,182.8</i>
Area Sources:					
Agricultural Dust		3,343.6			
Commercial Cooking	42.7	110.7			15.0
Construction Dust		3,269.9			
Paved Road Dust		2,432.4			
Unpaved Road Dust		5,597.4			
Agricultural/ Prescribed Burning	2,141.3	229.7	36.8	18.5	480.9
Wildfires	162.6	16.7	2.4	1.3	38.4
Commercial Fuel Combustion	148.6	31.3	225.3	3.9	10.7
Residential Fuel Combustion	849.9	117.4	113.3	9.4	159.4
Gas Stations					658.7
Misc. Non-Industrial NEC		0.1	1.3	0.2	352.2
Consumer/ Commercial Solvent Use					1,689.6
Dry Cleaning					1.5
Non-industrial Surface Coating					391.7
<i>Area Source Sub-total</i>	<i>3,345.1</i>	<i>15,149.2</i>	<i>379.2</i>	<i>33.3</i>	<i>3,798.3</i>
<u>GRAND TOTAL</u>	<u>61,899.1</u>	<u>19,580.4</u>	<u>9,670.9</u>	<u>2,195.1</u>	<u>10,314.5</u>

Mobile Sources

Mobile sources of air emissions include aircraft, watercraft, locomotives, non-road vehicles (construction equipment, agricultural equipment and recreational vehicles), and on-road vehicles (automobiles, trucks, buses and motorcycles). The majority of the ozone precursor emissions (NO_x and VOC's) in Madison County are emitted by mobile sources, as shown in Table 17. Within the Tennessee Valley region, transportation and fossil fuel combustion for electrical power generation are the predominant sources of NO_x.

As noted previously, EPA developed mobile source emissions estimates for Madison County using Vehicle Miles Travelled (VMT) data supplied by ADEM as input to a mobile source emissions model. The model currently used by EPA to estimate on-road mobile source emissions is the MOVES (Motor Vehicle Emission Simulator) model. The version of the model used for the 2011 NEI is MOVES2010b. Non-road mobile source emissions were estimated using the NONROAD model.

Substantial reductions in emissions from individual vehicles have resulted from Federal limitations on fuel volatility (RVP) and sulfur content and from increasingly stringent national tailpipe emission standards. EPA has also developed a suite of emission standards limiting emissions from non-road mobile sources. However, there have also been significant increases in VMT, both locally and nationally. Even though modern automobiles are much cleaner than their predecessors, and new non-road equipment is well-controlled, mobile sources collectively remain very significant emissions sources in the Huntsville area.

Area Sources

Area sources include stationary sources that individually emit a small quantity of pollutants, but are collectively significant contributors to overall emissions because of the large number of sources within the source category. Examples of area sources include dry cleaners, gasoline stations and other small businesses, as well as consumer surface coating usage and construction activities. Also included within the area source category are agricultural and prescribed burning activities, wildfires, and roadway dust.

Historically, area sources have generally not been subject to category-specific air pollution control regulations, although gasoline dispensing facilities and dry cleaners that use perchloroethylene as the cleaning fluid have been subject to specific regulatory requirements for many years. However, under the framework established by the Clean Air Act Amendments of 1990, a large number of area source categories have more recently become subject to regulations promulgated by EPA at the national level. This has primarily been driven by statutory provisions that address emissions of Hazardous Air Pollutants (HAP), as discussed in greater detail in the section of this report dealing with HAP emissions. In addition to dry cleaners and gas stations, automobile paint and body shops, furniture refinishers, small painting operations, plating shops, metal fabrication and finishing facilities and bulk fuel facilities are now subject to Federal air pollution control regulations. National area source regulations frequently require the use of pollution control equipment to limit particulate HAP emissions (primarily heavy metals) and implementation of management practices to limit evaporative losses of volatile HAPs, many of

which are also regulated as VOCs. As noted above, additional information on HAPs can be found in the HAP section of this Report.

Air Pollution Control Strategies

Air pollution control strategies in urban areas of the Eastern U.S. historically focused on the reduction of VOC's because of their role as precursors in ozone formation. In more recent years, an increased emphasis has been placed on the importance of NO_x reductions to ozone attainment strategies. In fact, in the southeastern United States ozone formation is largely NO_x-limited, i.e. reductions in NO_x emissions are far more effective in reducing ambient ozone concentrations than reductions in VOC emissions. Ozone continues to be a pollutant of primary concern in Huntsville, and many other areas nationwide. In fact, despite dramatic improvements to ambient air quality in the Huntsville area, the increasing stringency of the National Ambient Air Quality Standard (NAAQS) for ozone presents a continuing challenge to maintain Huntsville's attainment status. This is discussed at some length in the Ozone section of this Report. Ozone precursors (VOC's and NO_x) are emitted by all of the principal source categories, i.e. by industrial point sources, regulated area sources, non-regulated area sources, and mobile sources. Relative contributions to total VOC emissions are shown in Figure 21, and similar information is presented for NO_x in Figure 22.

VOC emissions can be controlled by pollution control equipment that utilizes adsorption, oxidation (catalytic or non-catalytic) or condensation. However, the currently preferred approach emphasizes the application of pollution prevention practices. Pollution Prevention approaches to VOC emission control include (where possible): the elimination of VOC's from processes; designing process and storage equipment so as to minimize evaporation of organic solvents; the substitution of raw materials with lower VOC content and the development of best management work practices.

Emissions of nitrogen oxides result primarily from fuel combustion, but NO_x is emitted from a number of industrial processes as well. High temperatures resulting from fuel combustion cause nitrogen and oxygen in the combustion air to react to form nitrogen oxides. Any nitrogen in the fuel will also be oxidized to form nitrogen oxides.

As shown in Figure 22, mobile sources are the dominant source of NO_x emissions within Madison County. Regionally, combustion of fossil fuels for electrical power generation is also an important contributor to overall emissions of nitrogen oxides. Programs that have been implemented at the national level, such as the Tier 2 tailpipe standards (Tier 3 standards will be phased in beginning in 2017), standards for heavy-duty diesel engines, and national low-sulfur gasoline and diesel fuel requirements have resulted in significant reductions in NO_x emissions from mobile sources. Dramatic reductions in nitrogen oxide emissions from coal-fired power plants have also resulted from progressively more stringent regulation under the Clean Air Act. These include the regulations under the Acid Rain Program, the NO_x SIP (State Implementation Plan) Call, and CAIR (the Clean Air Interstate Rule). The "next generation" of more stringent regulations for coal-fired power plants, the Cross-State Air Pollution Rule (CSAPR) was long-delayed by court actions, but is now being implemented. Large declines in NO_x emissions from power generation in the Tennessee Valley have also resulted from retirement of a significant

portion of the Tennessee Valley Authority coal-fired power generation capacity and the installation of additional emission control equipment on remaining coal-fired units. EPA’s “Clean Power Plan,” which targets greenhouse gas emissions from EGU’s (Electricity Generating Units) will impose added pressure to retire coal-fired units in the coming years.

Figure 21 – VOC Emissions Sources in Madison County, Alabama in 2011. (Based on National Emissions Inventory data).

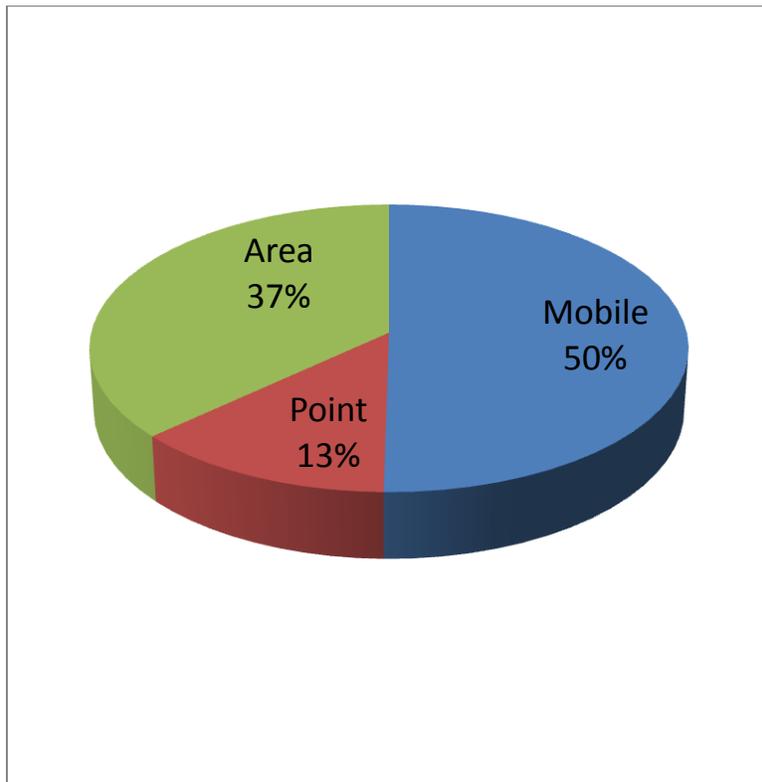
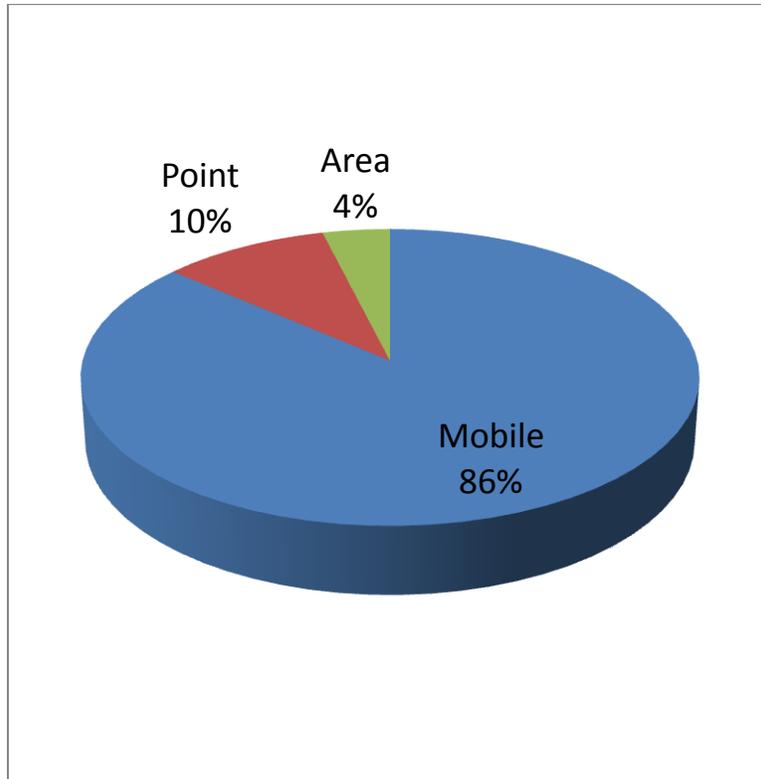


Figure 22 – NO_x Emissions Sources in Madison County, Alabama in 2011. (Based on National Emissions Inventory data).



HAZARDOUS AIR POLLUTANTS

The phrase “air toxics” is a generic term that refers to chemicals in the ambient air that cause adverse health effects in humans, whether because they are known or suspected of causing cancer or because they have been linked to other serious health effects. The degree to which inhalation of a specific chemical affects a person’s health depends on many factors, including the concentration the person is exposed to, the duration and frequency of exposure, the toxicity of the chemical species, and the person’s state of health and sensitivity. Unlike the term “air toxics,” the term “Hazardous Air Pollutant” has a precise legal meaning and refers to a chemical compound or group of compounds specifically identified as such in the Clean Air Act Amendments of 1990. Thus, Hazardous Air Pollutants (HAP) are those air toxics targeted by Congress for regulation under the Clean Air Act. HAPs are emitted by all of the principal source categories (i.e. industrial, area and mobile sources) and include chemicals such as benzene, found in gasoline, perchlorethylene, used by some dry cleaning facilities, and methylene chloride, used as a solvent and paint stripper in commercial and industrial operations.

In the Clean Air Act Amendments (CAAA) of 1990, Congress listed 189 HAPs¹, and directed EPA to identify categories of sources emitting the listed HAPs in “major” amounts, i.e. potential emissions of 10 Tons Per Year (TPY) or more of any single HAP, or 25 TPY or more of any combination of HAPs. EPA was further mandated to develop technology-based standards to reduce emissions from the identified source categories. These technology-based standards are referred to as MACT standards (Maximum Achievable Control Technology standards). For a number of years following enactment of the CAAA, EPA devoted a great deal of effort toward development of MACT standards for a large number of categories of major stationary sources of HAP emissions. Initial development of technology-based standards has been completed. The Federal MACT standards are incorporated into State and Local law, and the Division of Natural Resources enforces these requirements within the City of Huntsville. Thus, HAP emissions from major sources are now subject to comprehensive regulation, both nationally and locally.

Although Congress directed EPA to focus initially on regulation of major sources of HAP emissions, and to base these regulations on available technology for each major source category, this actually constitutes only the first round of HAP regulation under the CAAA. Congress also directed EPA to examine the extent to which emissions of HAP from major sources continue to pose an unacceptable risk to human health following the application of MACT. Additional requirements may be, and in some cases have been imposed as the result of EPA’s obligatory review of the MACT standards. These are referred to as “residual risk standards.” EPA has not yet completed the process of promulgating residual risk standards for the HAP major source categories.

Finally, Congress also directed EPA to reduce the risk from exposure to air toxics in urban areas by developing and implementing the “Urban Air Toxics Strategy.” This entails identification of the HAPs that pose the greatest risk to human health in urban areas, followed by development of regulatory standards that control HAP emissions from the area source categories that contribute 90 % of the emissions of these “urban air toxics.” Under this program, EPA identified 33 HAPs and targeted 70 area source categories for regulation. In developing area source standards, EPA had the authority to impose MACT requirements (the level of control imposed on major sources) or to impose less stringent requirements equivalent to Generally Available Control Technology (GACT). Over the past several years, EPA has promulgated a large number of these area source standards, generally choosing to impose GACT rather than MACT. Promulgation of these standards has greatly expanded the universe of smaller facilities subject to federal regulation under the Clean Air Act, and implementation of these standards poses an ongoing challenge for State and Local air pollution control agencies.

With the increased emphasis on toxic pollutant emissions under the Clean Air Act, the development of a HAP emissions inventory has become increasingly important in the assessment of overall air quality, and in evaluating the risks associated with exposure to toxic air pollutants, particularly in urbanized areas. From 2000 through 2004, Natural Resources received a series of

¹ Congress authorized EPA to revise the list of HAPs included in the statute by either adding additional compounds or “delisting” compounds identified by Congress in the initial list. Since enactment of the CAAA of 1990, EPA has delisted caprolactam and methyl ethyl ketone and has modified the definition of the group of chemical compounds identified as “glycol ethers” to eliminate ethylene glycol mono-butyl ether (“butyl cellusolve”). Thus, the list of HAPs currently includes 187 chemical compounds or groups of compounds.

EPA grants to develop, update and expand a HAP emissions inventory for Huntsville. Initially the inventory consisted of emissions from the larger regulated sources only, i.e. major and synthetic minor sources. The initial inventory was subsequently expanded to include the minor regulated industrial sources (referred to as “true minors”), and area sources that had been subject to regulation for a number of years (gasoline dispensing facilities and drycleaners). The HAP inventory was later expanded even further to include HAP emission estimates for other categories of area sources.

The past several editions of the Air Quality Report included updated HAP emissions inventories for the City of Huntsville. However, this Report utilizes a different approach, harmonizing the HAP inventory with the approach and geographical scope of the criteria pollutant emissions inventory presented in the preceding section of this Report. Thus, the HAP emissions information presented in Table 18 show emissions for Madison County rather than within the corporate limits of Huntsville, and utilizes the National Emissions Inventory as the information source. Table 18 shows the HAP’s with the ten highest annual emissions rates in Madison County, based on NEI data. As with the criteria pollutant inventory, the emission totals shown in Table 18 do not include biogenic HAP emissions although they are included in the NEI. Note that several of the HAP’s listed in Table 18 are emitted by mobile sources. Notably, toluene, xylene, hexane, benzene, trimethylpentane and ethyl benzene are constituents of gasoline. Thus, mobile sources are not only significant sources of criteria pollutant emissions locally, but are significant sources of HAP emissions as well.

Table 18- Hazardous Air Pollutant Emissions Inventory for Madison County, Alabama for Year 2011. All pollutant emissions are shown in Tons Per Year (TPY).

	<u>Toluene</u>	<u>Xylene</u>	<u>Hexane</u>	<u>Methanol</u>	<u>Benzene</u>
Point Sources:					
Industrial Fuel Combustion	0.1		0.9		0.3
Industrial Processes NEC	0.1	1.1	0.7	0.5	
Storage & Transfer	0.6	0.2	0.5	0.7	0.5
Surface Coating	98.7	19.5	140.6	12.6	
Waste Disposal	2.4	1.3		0.1	0.1
<i>Point Source Sub-Total</i>	<i>101.9</i>	<i>22.1</i>	<i>142.6</i>	<i>13.9</i>	<i>0.9</i>
Mobile Sources:					
Aircraft	0.6	0.4		0.8	0.9
Locomotives	0.1	0.1	0.1		
Non-Road Equipment	46.7	45.9	9.4		23.6
On-Road Vehicles	388.4	258.7	84.3		105.4
<i>Mobile Source Sub-Total</i>	<i>434.7</i>	<i>304.9</i>	<i>93.9</i>	<i>0.8</i>	<i>129.9</i>
Area Sources:					
Commercial Cooking	0.6	0.1			1.6
Agricultural/ Prescribed Burning	5.2	2.0	0.1		10.0
Wildfires	0.4	0.2			0.7
Residential Fuel Combustion	1.6	0.5			6.1
Gas Stations	61.7	28.9	14.2		2.9
Misc. Non-Industrial NEC	14.6	7.9	8.2		0.6
Consumer/ Commercial Solvent Use	3.8	2.3		189.1	
Non-industrial Surface Coating	49.0	9.7	92.6		
<i>Area Source Sub-total</i>	<i>136.8</i>	<i>51.4</i>	<i>115.2</i>	<i>189.1</i>	<i>21.9</i>
<u>GRAND TOTAL</u>	<u>673.4</u>	<u>378.5</u>	<u>351.7</u>	<u>203.8</u>	<u>152.7</u>

Note 1: The sum of emissions for the source categories may not equal the totals shown due to rounding.

Note 2: Only emissions of those HAP's with the 10 highest totals are shown in the Table.

Table 18 (cont')- Hazardous Air Pollutant Emissions Inventory for Madison County, Alabama for Year 2011. All pollutant emissions are shown in Tons Per Year (TPY).

	<u>Trimethylpentane</u>	<u>Styrene</u>	<u>Formaldehyde</u>	<u>Ethyl Benzene</u>	<u>Ethylene Glycol</u>
Point Sources:					
Industrial Fuel Combustion		0.1	0.9		
Industrial Processes NEC		112.3		0.9	0.5
Pulp & Paper			0.2		
Storage & Transfer					
Solvent Degreasing					
Surface Coating	0.6			4.2	22.8
Waste Disposal				0.1	
Point Source Sub-Total	0.6	112.5	1.1	5.2	23.3
Mobile Sources:					
Aircraft		0.1	5.4	0.1	
Commercial Marine			0.1		
Locomotives			0.7		
Non-Road Equipment	20.9	0.6	16.6	10.9	
On-Road Vehicles	85.2	3.0	53.9	70.8	
Mobile Source Sub-Total	106.2	3.8	76.7	81.8	0.0
Area Sources:					
Commercial Cooking		0.6	1.3	0.1	
Agricultural/ Prescribed Burning			24.8		
Wildfires			1.7		
Commercial Fuel Combustion			0.1		
Residential Fuel Combustion			6.9		
Gas Stations	15.3			7.7	
Misc. Non-Industrial NEC	5.6			2.7	
Consumer/ Commercial Solvent				0.4	66.5
Non-industrial Surface Coating				2.5	
Area Source Sub-total	20.8	0.6	34.8	13.5	66.5
<u>GRAND TOTAL</u>	<u>127.6</u>	<u>116.8</u>	<u>112.7</u>	<u>100.4</u>	<u>89.8</u>

Note 1: The sum of emissions for the source categories may not equal the totals shown due to rounding.

Note 2: Only emissions of those HAP's with the 10 highest totals are shown in the Table.

GREENHOUSE GAS EMISSIONS

Over the past decade, emissions of “greenhouse gases,” i.e. gaseous compounds implicated in global climate change, have become subject to regulation under the Clean Air Act. Although EPA had previously taken the position that they lacked the authority to regulate greenhouse gases under the Clean Air Act, and that the Clean Air Act was an ineffective and inappropriate vehicle for such regulation, in *Massachusetts v. EPA* (549 U.S. 497, (2007)) the United States Supreme Court held that EPA does have the authority under the Clean Air Act to regulate greenhouse gas emissions from motor vehicles. Subsequent to this court decision, EPA promulgated an “endangerment” finding, a necessary procedural step in regulating greenhouse gas emissions from motor vehicles, in late 2009. A number of federal regulations addressing greenhouse gas emissions from motor vehicles, and certain new stationary sources, have since been promulgated. EPA has proposed to regulate carbon dioxide emissions from power plants under the “Clean Power Plan,” which is expected to be finalized later this year.

The six principal greenhouse gases, and those subject to federal regulation, are carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆). Of these, carbon dioxide, methane and nitrous oxide are the greenhouse gases typically included in local emissions inventories. By convention, greenhouse gas emissions are generally expressed in terms of “carbon dioxide equivalents (CO₂eq)” since carbon dioxide is the greenhouse gas emitted in largest amounts and is the most prevalent greenhouse gas in the atmosphere. Natural Resources has developed greenhouse gas emissions inventories for Madison County for the years, 2000, 2005 and 2010. The reports outlining the methodology used in developing these inventories and the summaries of Madison County greenhouse gas emissions can be accessed at the following web address:

<http://www.hsvcity.com/NatRes/airdata.php#blank>

AIR POLLUTION CONTROL ACTIVITIES

In addition to ongoing monitoring of ambient air quality in Huntsville, the Department of Natural Resources implements a program of air pollution control. As a local air pollution control agency, Natural Resources enforces federal, state and local regulations. Air Pollution control activities performed by the Division include permit application reviews and permit issuance, industrial and commercial compliance inspections, citizen complaint investigations, asbestos inspections, indoor air quality evaluations and control of open burning activities. A synopsis of these and other activities performed by the Department in 2013 and 2014 is provided in Table 19.

PERMITTING

The issuance of Permits is a mechanism used to ensure compliance with air pollution control rules and regulations. Facilities with emissions of regulated pollutants are required to apply for an Air Permit, a Synthetic Minor Operating Permit or a Major Source Operating Permit. The type of Permit required is based on the magnitude of actual and potential emissions from the facility. Permit application review includes an engineering evaluation of processes, equipment, emissions, and control technologies, as well as dispersion modeling for assessment of air toxics impacts. The time frame for permit issuance engineering review depends on the complexity of the facility and applicable regulations. Upon completion of the review, the Department issues a permit which reflects applicable requirements and necessary controls. Provisions for tracking emissions of regulated pollutants are included in the Permit.

COMPLIANCE INSPECTIONS

Stack testing is required for a number of facilities to demonstrate initial and continued compliance with specific emission limits contained within their Permit. All compliance stack testing is witnessed by Division personnel to assure that established protocols and methodologies are followed. Periodic inspections of permitted facilities are conducted to assure continued compliance, to document any changes which may have occurred since the last inspection and to evaluate and promote opportunities for voluntary emission reductions through pollution prevention.

COMPLAINTS

Citizen complaint investigation provides a service to the public and also serves to alert the Department to potential air pollution problems. Departmental staff respond quickly to resolve complaints whenever violations of air pollution control rules and regulations may have occurred. Complaints involving odors, dust, smoke, and open burning are the most common.

ASBESTOS

The asbestos National Emission Standards for Hazardous Air Pollutants (NESHAP) require that an asbestos survey be conducted prior to initiation of demolition or renovation of

industrial, institutional and commercial buildings. Regulated Asbestos Containing Materials (RACM) must be removed by a certified abatement contractor prior to any planned renovation or demolition activities which would disturb the material. The NESHAP further specifies containment and control measures that will prevent the release of asbestos fibers to the ambient air during the course of RACM removal. Department personnel inspect demolition, renovation and abatement projects to ensure compliance with the requirements of the asbestos NESHAP.

INDOOR AIR

Indoor air pollutants can accumulate inside homes and office spaces to a level which can cause adverse health effects, especially in sensitive individuals. These health effects may include allergic reactions or respiratory problems. The seriousness of associated health problems vary widely depending on the susceptibility of the person and length of exposure to the pollutant. Indoor air pollutants are produced from a number of sources, including combustion products, personal hygiene products, pest control products, home maintenance consumer products, and emissions from building construction materials. Among the common indoor air contaminants are carbon monoxide, formaldehyde, mold spores, organic gases, radon, asbestos, and tobacco smoke.

Although the Clean Air Act established a comprehensive program to regulate emissions to the ambient air, there is not a corresponding regulatory scheme applicable to indoor air quality. The Occupational Safety and Health Administration (OSHA) has established permissible exposure levels for a number of chemicals in the workplace, but these do not apply to residential premises. The Department thus has no regulatory authority with respect to indoor air quality, but does provide information on indoor air pollution, sources of pollutants, and corrective action alternatives to interested Huntsville residents as a public service. Indoor air inspections are performed at the request of Huntsville homeowners who are unable to determine possible sources or who have difficulty in selecting an appropriate remedy.

OPEN BURNING

Open burning activities are regulated by the Division through the issuance of permits. Permits may be obtained to burn vegetative materials on a tract of land undergoing development provided that the burning is conducted at an approved site and an air curtain destructor is used to minimize smoke emissions. Open burning activities are monitored by Division personnel to ensure that permit conditions are satisfied. Following promulgation of the eight-hour ozone and fine particulate matter NAAQS in 1997, the Alabama Department of Environmental Management prohibited open burning in Madison County (and several other counties across the State) during the months of May through September. The “burning ban” has since been extended through October and expanded to include additional counties within the State. Natural Resources enforces this prohibition within the City of Huntsville.

**Table 19 - Synopsis of Division Activities
CY 2013 – 2014**

ACTIVITY	2013	2014
Air Pollution Control		
Air Permits Issued/ Renewed	23	35
Major Source Permitting Actions	3	3
Industrial Facility Inspections	58	50
Compliance Tests	1	1
Notices of Violation/ Administrative Orders	-0-	-0-
Penalties	\$ -0-	\$ -0-
Regulated Area Source Inspections	221	10
Complaints	14	37
Asbestos Inspections	32	18
Blasting		
Permits Issued	14	16
Site Inspections	1	8
Citations	-0-	-0-
Complaints	4	8
Storm Water		
Compliance Inspections	55	58
Citations	-0-	-0-
Complaints	19	29
Open Burning		
Permits Issued	18	11
Site Inspections	34	30
Citations	-0-	-0-
Noise		
Complaints	56	95
Citations	4	3

VOLUNTARY MEASURES TO REDUCE POLLUTION

Significant reductions in ozone forming pollutants have been achieved through industrial initiatives to control and/or prevent pollution, implementation of transportation improvement plans, and national efforts to reduce automobile tailpipe emissions and lower the volatility (evaporation rate) of gasoline. While these measures remain vitally important to protect air quality, continued progress is becoming increasingly dependent on voluntary commitments by industry and involvement of individual citizens.

INDUSTRIAL EFFORTS

The Air Pollution Control Board of the City of Huntsville established the Air Pollution Control Achievement Awards Program in 1997. The program was established to recognize voluntary efforts to reduce air pollutant emissions by industrial, institutional and commercial facilities within the City. Only those projects which go beyond regulatory requirements for controlling emissions are eligible for recognition. In addition to highlighting the achievements of the award recipients, the program is intended to promote implementation of pollution prevention projects by other facilities in the area, and increase public awareness of air pollution control measures. Table 20 identifies the award recipients for the past five years. A description of the projects for which these awards were given can be accessed on the Department's web site.

TABLE 20
Industrial Air Pollution Control Achievement Award Recipients
2011 - 2014

Year	Award Recipients
2014	The Boeing Company
	Northrop Grumman Corporation
	Sanmina Corporation
	Toyota Motor Manufacturing Alabama
2013	The Boeing Company
	Sanmina Corporation
	Toyota Motor Manufacturing Alabama
	Northrop Grumman Corporation*
2012	ADTRAN, Inc.
	The Boeing Company
	National Copper & Smelting Company
	Huntsville Hospital
	Saint-Gobain Ceramic Materials
	The Boeing Company*
	ADTRAN, Inc.**
2011	ADTRAN, Inc.
	The Boeing Company
	National Copper & Smelting Company
	Huntsville Hospital
	Northrop Grumman
	Toyota Motor Manufacturing, Alabama
	ADTRAN, Inc.*
	The Boeing Company*
	Toyota Motor Manufacturing, Alabama*

* *Environmental Awareness and Education Award*

** *Clay Durrett Air Quality Stewardship Award*

CITIZEN EFFORTS

A personal commitment by each of us to reduce our contribution to air pollution could help Huntsville maintain air quality that is protective of public health and conducive to continued economic vitality. Some actions that can be taken by individual citizens to reduce pollution from vehicles include:

- **Maintain your vehicle properly:** Vehicles on the road account for more than 50% of Huntsville's air pollution. Keeping your vehicle properly tuned reduces pollution, improves fuel economy and prolongs engine life.
- **Keep tires properly inflated:** Tires that are under inflated by just 4- pounds reduce fuel efficiency by up to a half-mile per gallon. Proper inflation saves money and reduces pollution by improving fuel economy.
- **Limit engine idling:** Idling for more than 30 seconds burns more gas than restarting the engine. Avoid long idles in drive through lanes. Park and walk in.
- **Refuel vehicles after 6:00 P.M.:** When temperatures are high more gasoline evaporates when refueling your tank. If you pump gas during the cooler part of the day, more of the gas you pay for stays in your tank.
- **Use manufacturer's recommended fuel for your vehicle:** Unless your car needs high-octane gasoline, use of 'premium' will not improve performance or emissions – it will just cost you more.
- **Combine errands and reduce trips:** Combine errands into one sensible trip. This reduces the total mileage (saving time and gas). Engines operate more efficiently once they've warmed up. A car that has set for more than an hour pollutes up to five times more than when the engine is warm.
- **Don't top off the tank:** Topping off the tank forces harmful gas vapors from the tank into the air. It is safer and causes less pollution if you don't try to add more fuel after the pump has shut itself off.
- **Ride share, car pool or use the Shuttle:** The average driver spends 55¢ per mile including ownership and maintenance cost. Ride share, car pool or use the Shuttle to save money and reduce pollution.

Additional actions that can be taken to reduce pollution from consumer product use and lawn/garden equipment can be obtained from the Division or viewed at the Division Web Site.