NOACA
Technical Memorandum

AIR QUALITY TRENDS IN NORTHEAST OHIO
2003 UPDATE

Planning For Greater Cleveland

June 2004

5558t

NOACA

Planning For Greater Cleveland

The Northeast Ohio Areawide Coordinating Agency (NOACA) is a public Organization serving the counties of and municipalities & townships within Cuyahoga, Geauga, Lake, Lorain and Medina (covering an area with 2.1 million people). NOACA is the agency designated or recognized to perform the following functions:

- **Serve as the Metropolitan Planning Organization (MPO), with responsibility for comprehensive cooperative and continuous planning for highways, public transit, and bikeways, as defined in the Transportation Equity Act for the 21st Century.**
- **Perform continuous water quality, transportation-related air quality and other environmental planning functions.**
- **Administer the area clearinghouse function, which includes providing local government with the opportunity to review a wide variety of local or state applications for federal funds.**
- **Conduct transportation and environmental planning and related demographic, economic and land use research.**
- **Serve as an information center for transportation and environmental and related planning.**
- **At NOACA Governing Board direction, provide transportation and environmental planning assistance to the 172 units of local, general purpose government.**

The NOACA Governing Board is composed of 38 local public officials. The Board convenes monthly to provide a forum for members to present, discuss and develop solutions to local and areawide issues and make recommendations regarding implementation strategies. As the area clearinghouse for the region, the Board makes comments and recommendations on applications for state and federal grants, with the purpose of enhancing the region's social, physical, environmental and land use/transportation fabric. NOACA invites you to take part in its planning process. Feel free to participate, to ask questions and to learn more about areawide planning. For more information, call:

(216) 241-2414

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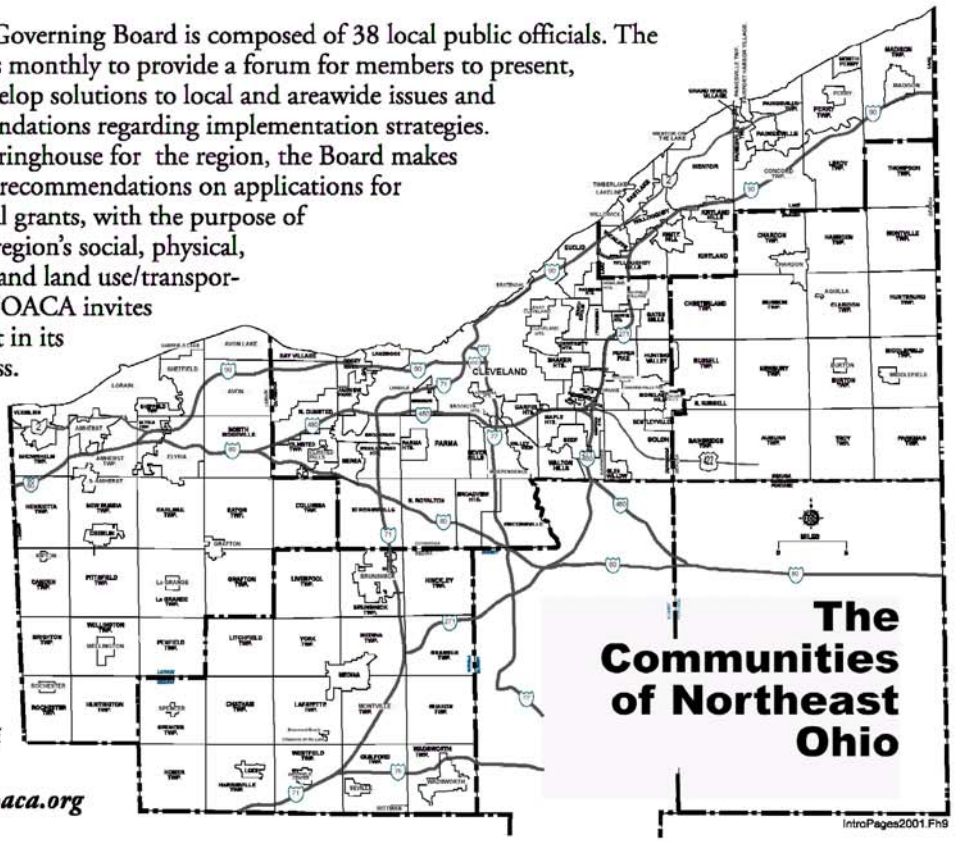

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Abstract:

This report presents information on air quality trends in Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, and Summit counties for the six criteria pollutants: carbon monoxide; lead; nitrogen dioxide; ozone; particulate matter; and sulfur dioxide. These are the pollutants for which the Clean Air Act requires the United States Environmental Protection Agency (USEPA) to establish National Ambient Air Quality Standards (NAAQS). The NAAQS are the maximum allowable atmospheric concentrations for each pollutant. The NAAQS are intended to protect people by preventing adverse health impacts from excessive pollution concentrations.

Trends are generally reported for the 1994 to 2003 time period. Data is generally reported for those counties still under some form of nonattainment classification for the pollutant under discussion. Due to the area's long involvement in planning for ozone, trends for this pollutant are provided from the early 1980's to the present.

The report also briefly discusses recent regulatory issues affecting the criteria pollutants.

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Introduction

This document summarizes information on emission and air quality conditions in Northeast Ohio pertaining to the six criteria pollutants (ozone, particulate matter, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead) for which USEPA has set National Ambient Air Quality Standards (NAAQS).

This document can also be downloaded from the NOACA web site at http://www.noaca.org. Additional information on air quality conditions in Northeast Ohio can also be viewed on line at http://neoair.noaca.ohiou.edu/.

All ozone related materials reflect conditions in the eight-county, Cleveland/Akron/Lorain Consolidated Metropolitan Statistical Area (CMSA). This area is currently designated attainment for the 1-Hour Ozone NAAQS.

Materials for other pollutants are presented based upon the availability of monitoring data. Many monitors have been removed over time in areas that attain the standards for which they were established. The table on the following page broadly summarizes data for each of the pollutants.

Summary of Criteria Pollutant Air Pollution Status for Northeast Ohio

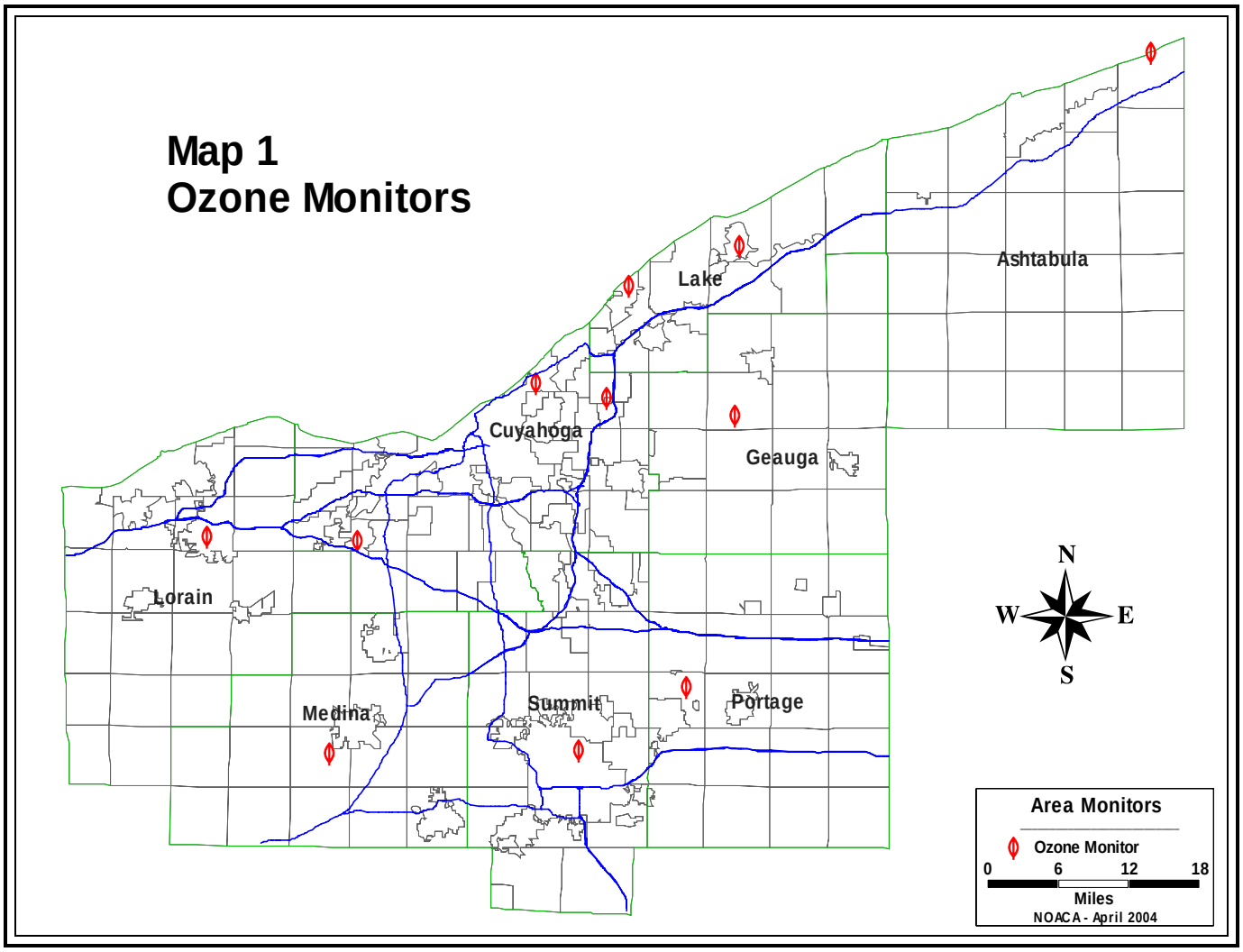
Pollutant	Recent Trend Direction	Designated Attainment Status	Major Contributing Sources	Monitored Counties
Ozone (1-Hr)	Level	Attainment	Autos, Industry, Solvents, Other Fossil Fueled Engines	Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage, Summit
Ozone (8-Hr)	Level	Moderate Nonattainment	Same as Previous	Same as Previous
Particulate Matter Less than 10 microns Daily	Level	Attainment	Autos, Industry, Construction Sites, Tilled Fields, Unpaved Roads, Stone Crushing, and Burning of Wood	Cuyahoga, Lake, Lorain, Summit
Particulate Matter Less than 10 microns Annual	Level	Attainment	Same as Previous	Same as Previous
Particulate Matter Less than 2.5 microns Daily	Level	Not yet designated (Currently attaining)	Same as Previous	Cuyahoga, Lake, Lorain, Summit
Particulate Matter Less than 2.5 microns Annual	Level	Not yet designated (Currently not attaining)	Same as Previous	Same as Previous
Carbon Monoxide 1-Hour	Level	Attainment	Autos and Other Combustion Engines, Other Combustion Sources	Cuyahoga, Lake, Summit
Carbon Monoxide 8-hour	Level	Attainment	Same as Previous	Same as Previous
Sulfur Dioxide 24-hour	Level	All areas are to be designated as attainment as of 09/07/2004	Electric Utilities and Other Industrial Combustion Sources, Non-Road Engines	Ashtabula, Cuyahoga, Lake, Lorain, Summit
Nitrogen Dioxide	Level	No designated areas (Currently attaining)	Motor Vehicles, Electric Utilities, and Other Industrial, Commercial, and Residential Sources that Burn Fuels	Cuyahoga
Lead	Decreasing	One unclassified area remains (Currently attaining)	Metal Processing Plants	Cuyahoga

Ozone Trends

Ozone is the only criteria pollutant that is almost exclusively the result of atmospheric reactions rather than direct emission from a source. Ozone is formed when, in the presence of sunlight, oxides of nitrogen (NOx) hydrocarbons (HC) and oxygen interact in a series of chemical reactions that lead to the formation of O_3. With increasing temperatures and the stagnation of air masses, these reactions can lead to O_3 levels that are unhealthy for human exposure. Ozone is highly reactive and irritates sensitive tissues with which it comes in contact. This can result in watery itchy eyes, scratchy throat, and lung congestion. This pollutant is particularly injurious to those with preexisting respiratory conditions, children and the elderly.

Ozone levels cannot be controlled directly but can be controlled indirectly by regulating NOx and HC emissions. Significant sources of NOx include industries such as steel and electric that use coal and other fossil fuels for heat generation, the automobile, and all other fossil fuel powered engines. Significant sources of HC include the automobile, other gasoline powered engines, and industries or business that use solvents.

Eleven monitors located throughout Northeast Ohio monitor ozone concentrations. Map 1 depicts their locations.



Ozone (O_3) trends can be viewed from several different angles. The first is from the standpoint of how well the area has done in meeting the National Ambient Air Quality Standards (NAAQS) over time. Since attaining the standards, and thereby protecting human health, is the overall goal of air quality planning, it is a common means of reviewing air quality status. The second viewing angle is from the standpoint of actual monitored concentrations. Viewing concentrations across time allows one to assess whether there is a trend in the pollutant in question. The third angle is evaluating the emission levels of the pollutants that contribute to ozone formation. Tracking changes in these pollutant levels can help explain observed changes in ozone levels.

The reader has to understand two terms, "exceedance" and "violation", and how they apply to the standard in order to view ozone trends from a standards based viewpoint. When a monitor records an ambient pollution concentration that is greater than the NAAQS, the event is classified as an exceedance. Different NAAQS have different methods for determining when an exceedance or an accumulation of exceedances results in a violation. A violation indicates that the area is not in attainment of the NAAQS.

Currently the area is in the process of transitioning from the 1-hour standard to the 8-hour standard. The "Current Regulatory Issues Related to Ozone" section of this document contains additional information related to the transition. Since the area remains in a transitional state on the ozone standard issue, the region's compliance with both the 1-hour and 8-hour standards will be reviewed.

Under the 1-hour standard, monitors are allowed to exceed the standard once per year on average. Three years worth of data are reviewed to determine this average. Practically speaking, this means that a monitor cannot have more than three exceedances in any three year period. If it does, the area is in violation.

The 8-hour standard is more complex. It does not matter how many times a monitor exceeds the 8-hour standard per year. In order to attain the standard, the three year average of its fourth high values must be less than the standard. This is a considerably more difficult standard to attain. However, it is more stable. It is unlikely that an area can move back and forth from attainment to nonattainment under the 8-hour standard as has occurred in some areas under the 1-hour standard.

Chart 1 summarizes historic exceedance information for ozone under the 1-hour standard for three subareas of the maintenance area. The subareas are the NOACA area, the maintenance area portions of Akron Metropolitan Area Transportation Study (AMATS) area, and Ashtabula County, which is not a member of either MPO.

The 2003 summer season was more temperate than the 2002 summer season. None-the-less 2003 saw enough heat over a few days to generate a total of five exceedances of the 1-hour standard.

Chart 2 displays the average number of days in each of the region's sub areas with 8-hour standard exceedances for 1992-2002 in northeast Ohio. There is no clear indication of a trend in this data set. 2002 stands out as a particularly bad year, but this is to be expected given the weather that year.

Chart 1

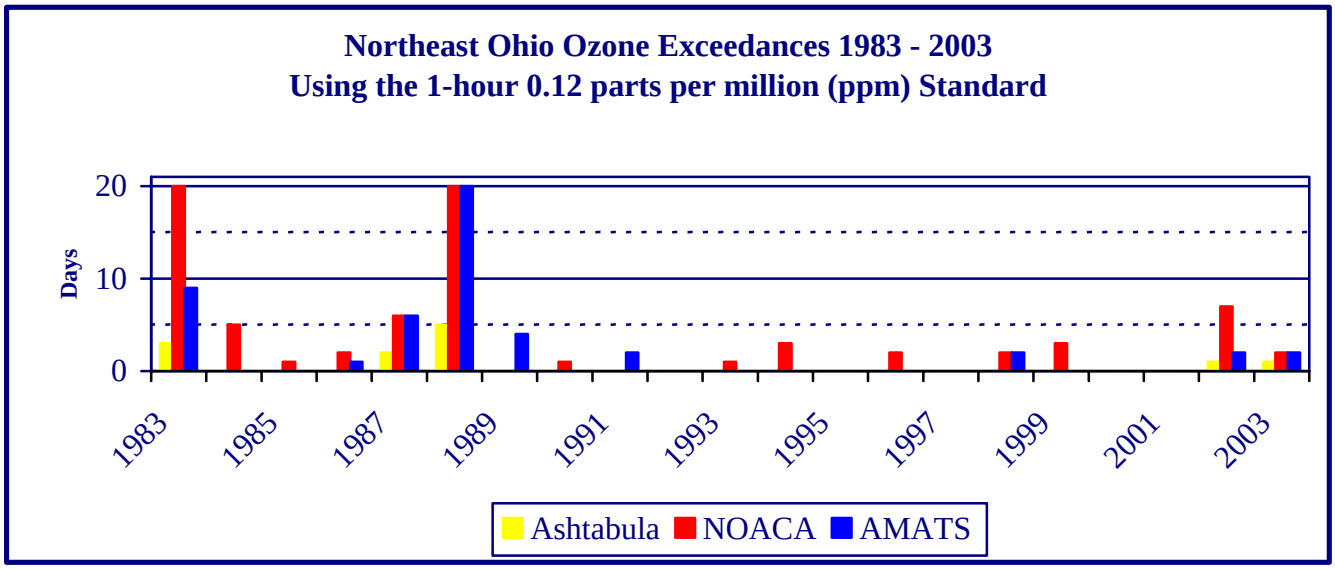


Chart 2

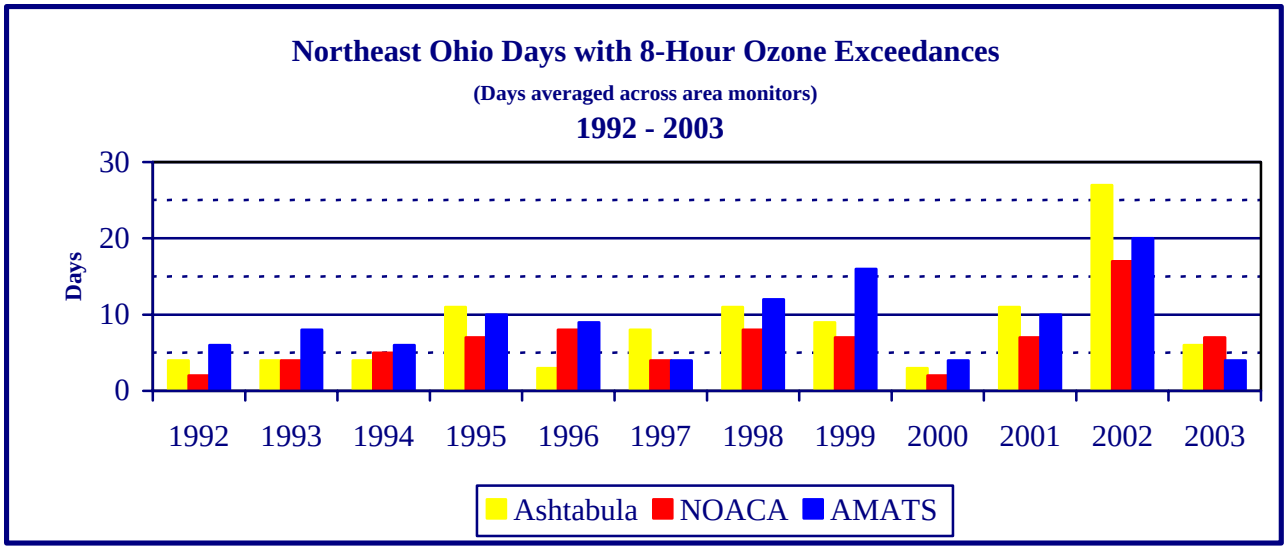
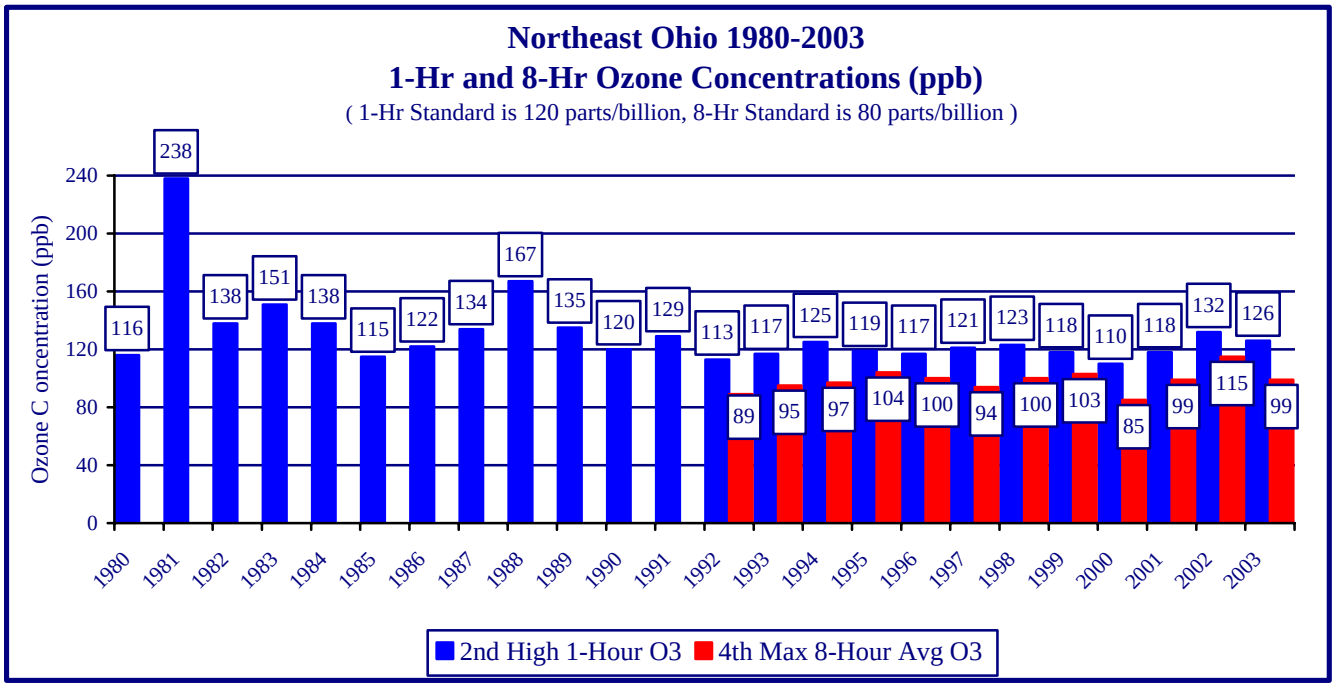


Chart 3 displays second maximum 1-hour ozone concentrations (the old standard's design value) and 4th maximum 8-hour average ozone concentrations across time. Despite the fluctuations caused by varying climate conditions annually, it is clear that the quality of the region's air has improved since the 1980s. It is also clear that there has been little change in the past decade. This is to be expected since emission reductions during this period have been small compared to those resulting from major new automobile and industry controls implemented during the 1980s. Moderate long-term reductions can be expected as older vehicles are retired and new vehicles replace them. Larger reductions are expected to occur as new NOx controls required by the NOx SIP are implemented at major coal burning facilities in the next few years. Comparing the data for 8-hour ozone averages to the standard of 85 parts per billion, it is clear that the area does not currently attain the new Ozone NAAQS.

Chart 3



Finally, ozone concentrations are directly impacted by changes in the levels of the pollutants, hydrocarbons (HC) and nitrous oxides (NO_X), which contribute to ozone's formation. Decreases in the amount of NO_X and HC in the atmosphere generally result in decreases in the amount of O_3 formed under a given set of conditions. Since the actual ambient ozone concentration is strongly dependent upon climate conditions, reductions in O_3 concentrations based on reductions in its precursors can be difficult to identify until sufficient data has been accumulated to allow for removal of climate effects through analysis.

Significant reductions have been made in both NOx and HC emission since the 1970's in northeast Ohio. Reductions have been gained from both emission controls on industrial processes and from technological improvements in the automobile. Reductions are also gained as a result of the automobile inspection and maintenance program effort in our area. Recently, reductions are even being gained from smaller sources, which are known as area sources. One such emission reduction is associated with the development of better gasoline storage tank filling, fuel tank filling, and storage tank evaporative controls.

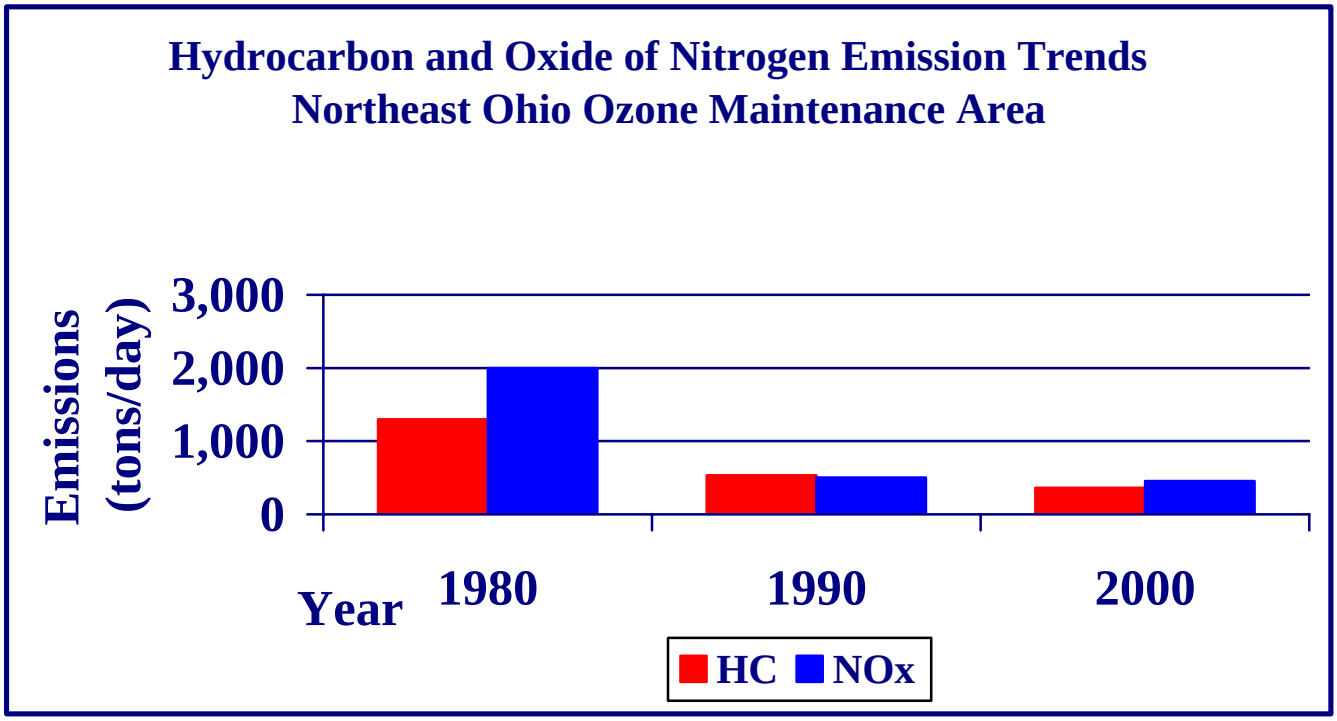
Trends for these pollutants are shown in Chart 4. Due to the absence of monitoring for these pollutants, the trends data are based on inventory and modeling work done for the State Implementation Plan for Ozone and not direct measurements of these sources. 1980 data are very rough estimates based on available historic inventory data.

Current Regulatory Issues Pertaining to Ozone

USEPA released final designations on April 30, 2004 (69 FR 23857). These became effective on June 15, 2004. The regulations designated the former one-hour nonattainment area in northeast Ohio as a moderate nonattainment area under the new standards. The specific planning requirements for this area based on that designation are not yet known. The planning requirements are to be released later this year. In the interim,

NOACA is coordinating with the Ohio EPA to prepare for any efforts it may need to take in the development of the new State Implementation Plan for Ozone.

Chart 4



Particulate Matter Trends

Particulate matter (PM) is the term applied to both solid and liquid droplets suspended in the atmosphere. It can be emitted directly from a source or result from chemical reactions in the atmosphere. It is a pollutant of concern to human health because inhalation of these particles can lead to irritated nose, throat, and lung tissues. This irritation can easily create or worsen existing respiratory problems. Direct sources of particulate matter include industries that combust fossil fuels, fuel powered engines, the automobile, and fugitive emissions from stockpiles of earth and gravel. USEPA has focused on increasingly small particles in setting standards. This is because the smaller the particle, the deeper it can be inhaled into the respiratory system and become lodged there.

A subscript number generally follows references to PM. This number is the largest diameter of the particles covered by the standard or discussion. Thus $PM_{2.5}$ refers to particles less than or equal to 2.5 microns in diameter; PM_{10} refers to particles less than or equal to 10 microns in diameter. The term fine particulate is also used in reference to $PM_{2.5}$. To gain a sense of the particle sizes discussed here, note that the average human hair is about 70 microns in diameter. PM_{10} is, therefore, one seventh the diameter of a human hair and $PM_{2.5}$ is only one twenty-eighth of that diameter.

There are two existing PM_{10} NAAQS: an annual standard and a daily standard. The annual standard is 50 micrograms per cubic meter. A monitor is in attainment if its three year average concentration is less than or equal to the standard.

The 24-hour standard is 150 micrograms per cubic meter. A monitor is in attainment if its three-year exceedance average is less than or equal to one.

There are no nonattainment counties for the existing PM_{10} standard in Northeast Ohio. Cuyahoga County was redesignated attainment for the PM_{10} Standards effective January 10, 2001 (65 FR 77308). There are eight monitors for PM_{10} in Cuyahoga County. The majority are in and along the industrialized portions of the Cuyahoga River valley. Two are near Cleveland Hopkins International Airport. There are also four additional monitors in other areas in Northeast Ohio. Map 2 displays monitor locations.

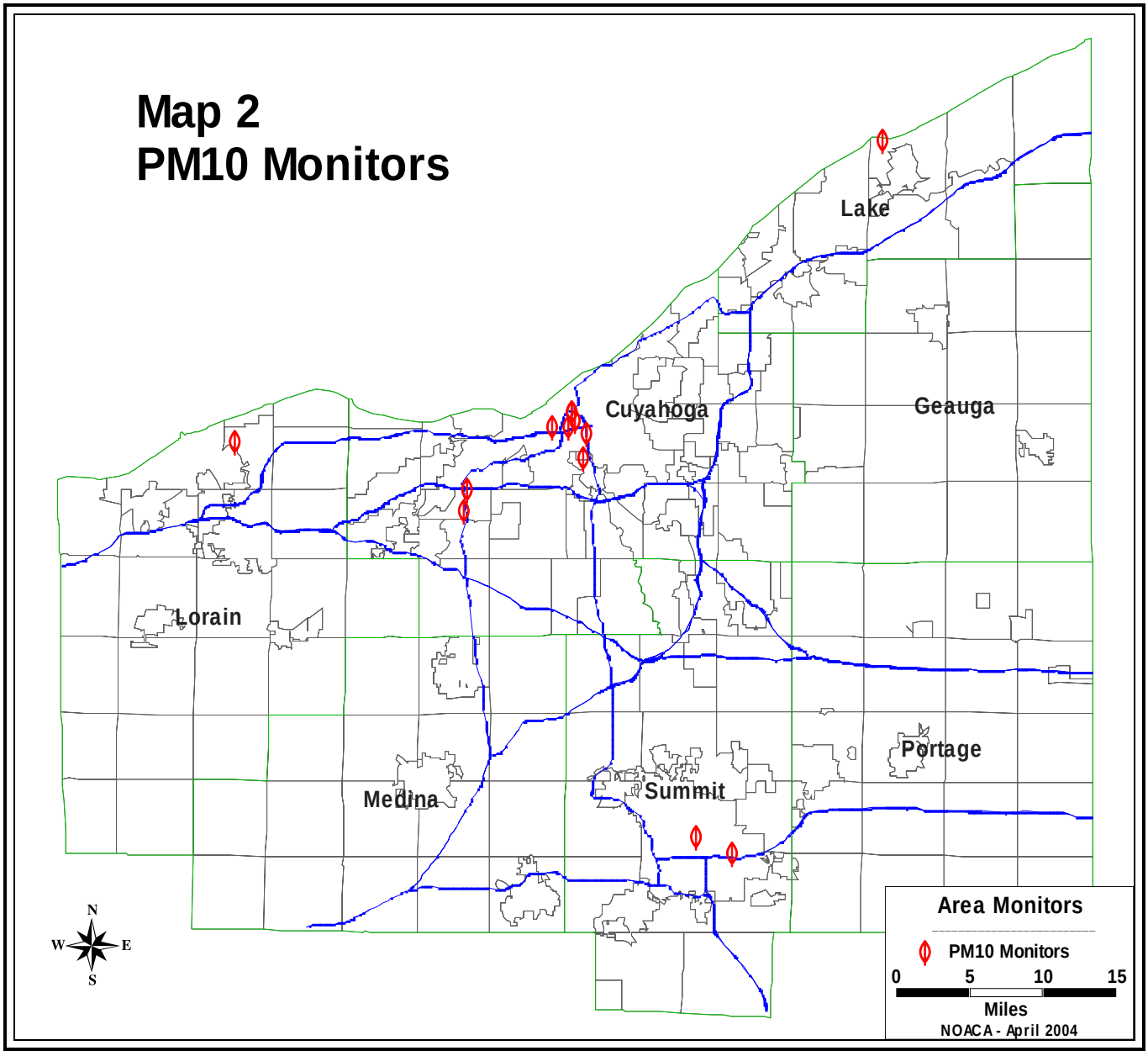


Chart 5 displays exceedance information for PM_{10} in Cuyahoga County. No violations of the annual standard have occurred in the 1988 - 03 period. As indicated by Chart 5, exceedances of the daily standard have occurred periodically. No monitor has violated the daily standard since the mid-90s, however.

Chart 5

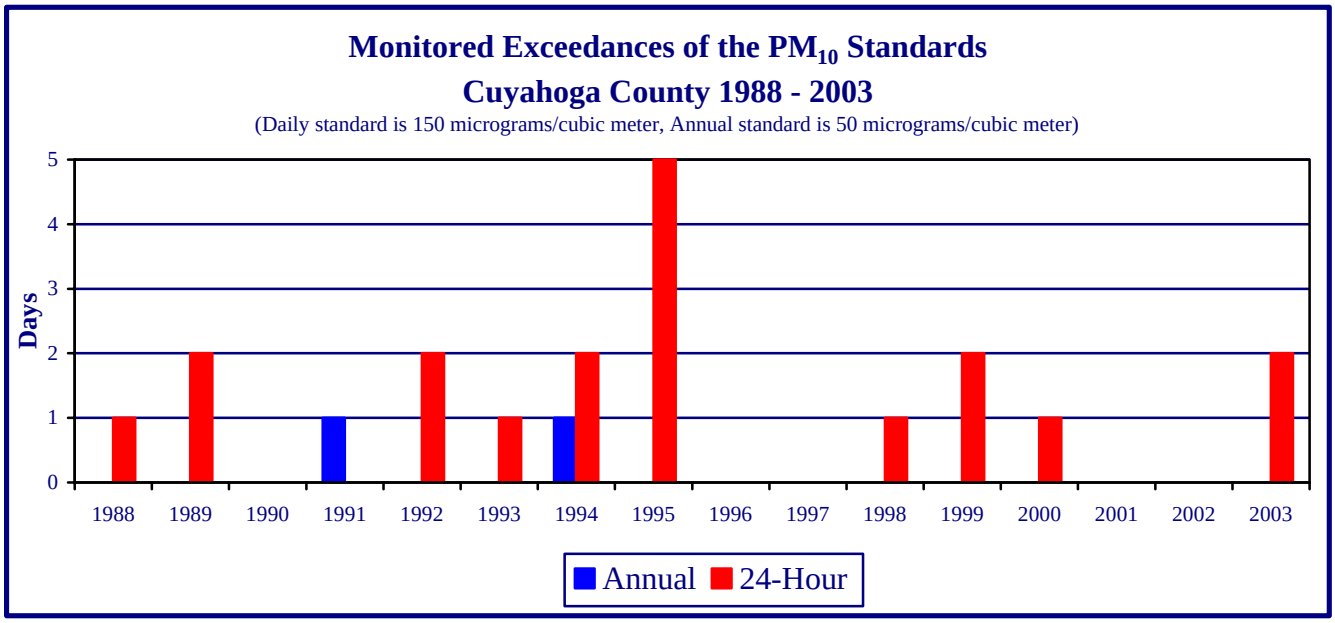
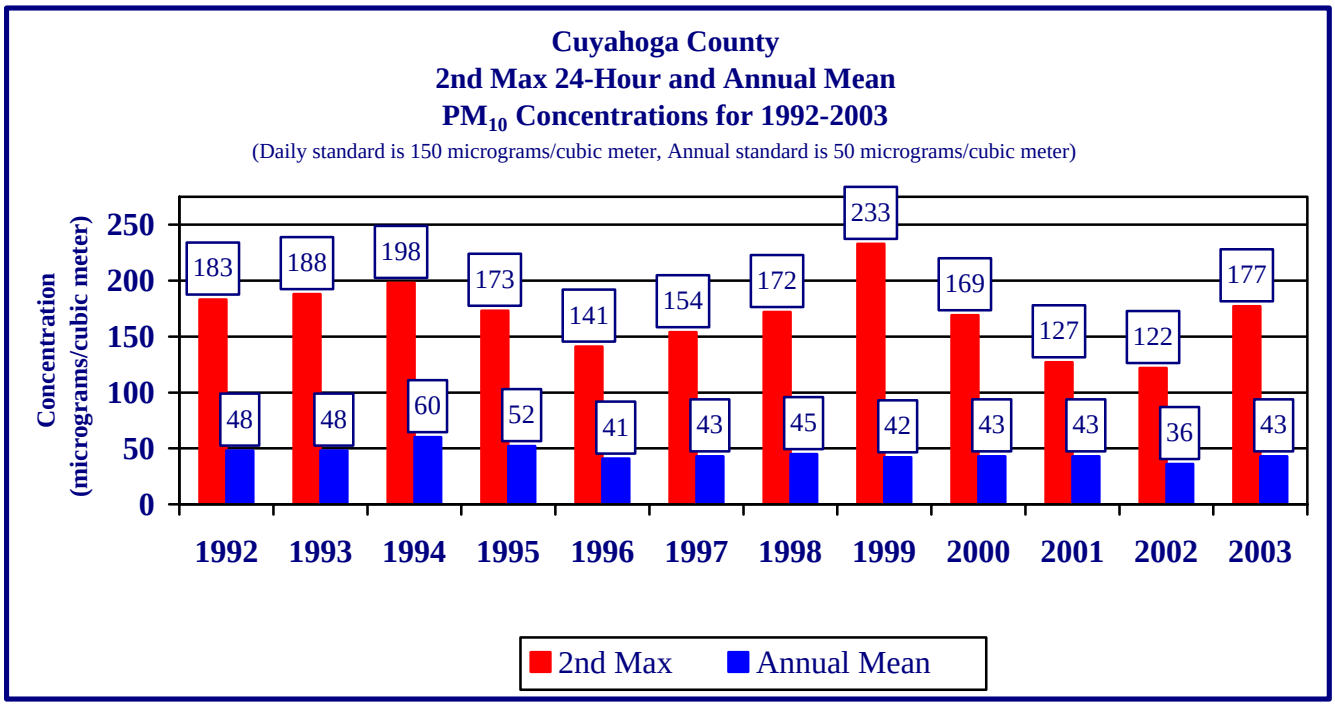


Chart 6 displays the 2nd max 24-hour and annual mean concentrations observed in Cuyahoga County from 1992 to 2003. The trend for this pollutant is essentially flat.

Chart 6



Similar to the 8-hour ozone standard situation, implementation of the $PM_{2.5}$ standard was delayed by legal challenges. Currently USEPA expects to designate areas under the $PM_{2.5}$ standard by the end of 2004.

Monitoring for this pollutant began in 1999. During 2003 there were 22 monitors operating in 15 different locations throughout the region. There are instances where there are multiple monitors in a single location because there are two different types of monitoring available. One type generates continuous readings throughout the day. The other generates a single daily reading based on the weight of a filter collected once a day from the monitors. Map 3 shows monitoring locations for this pollutant during 2003. Most of these monitors are located near heavy industrial boilers or electric generation units.

Chart 7 displays 1999-2003 monitor data for Northeast Ohio counties monitoring this pollutant.

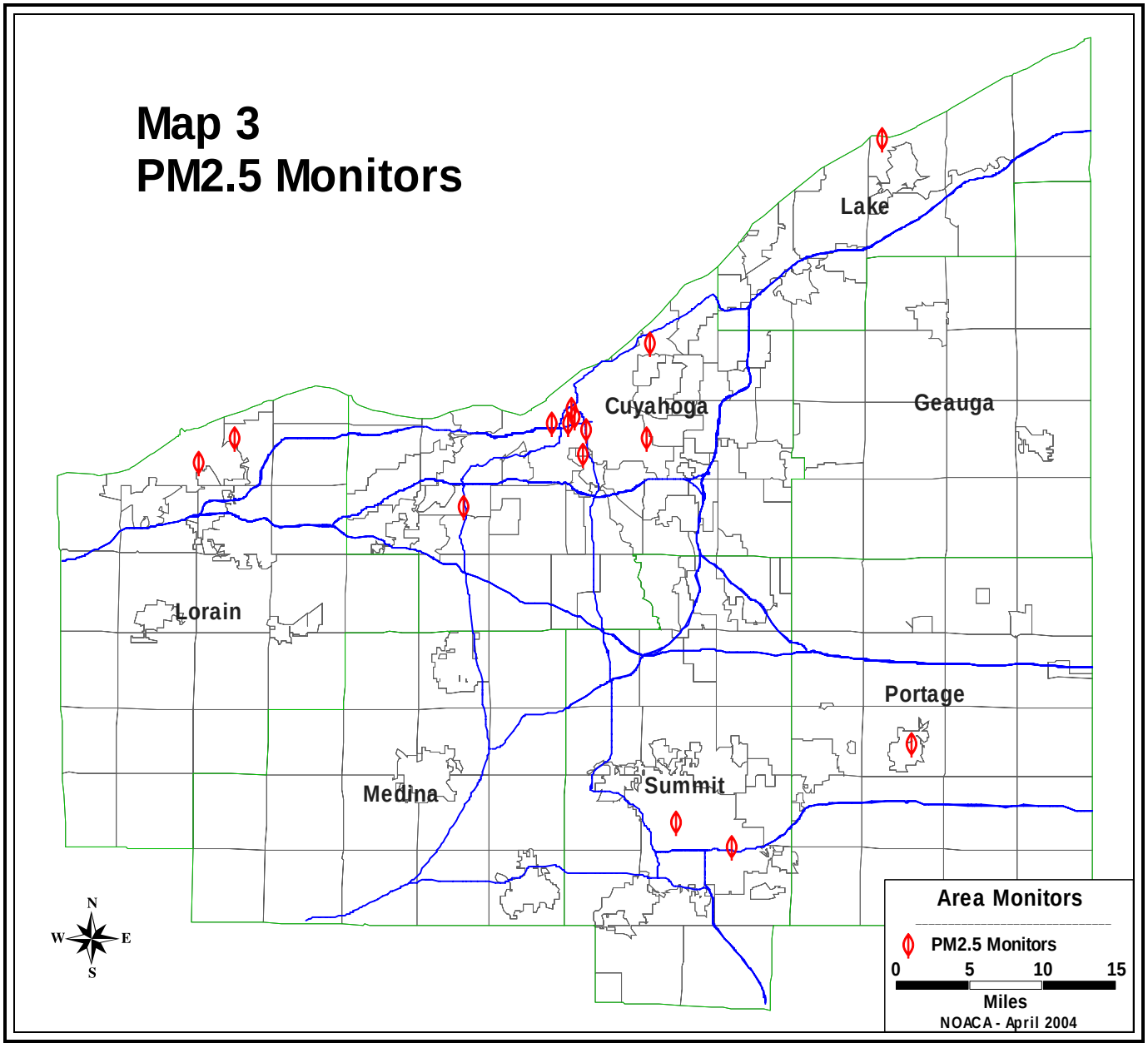
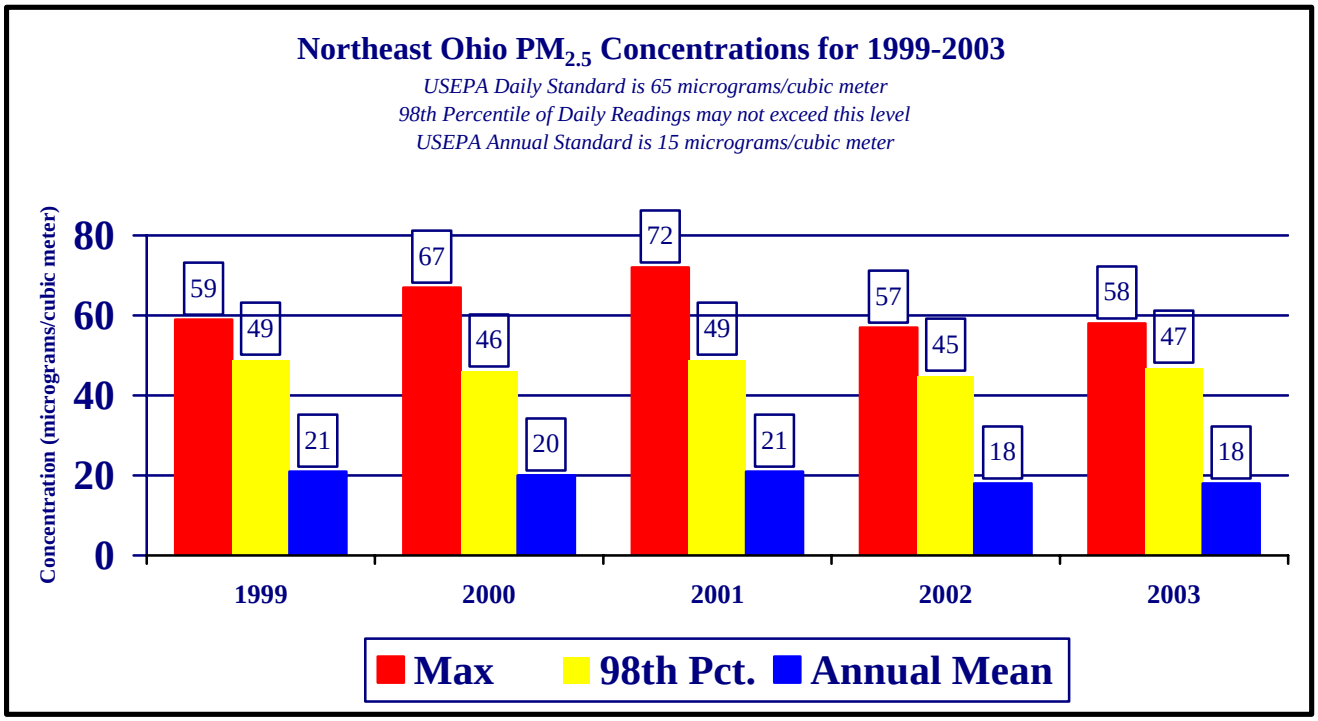


Chart 7

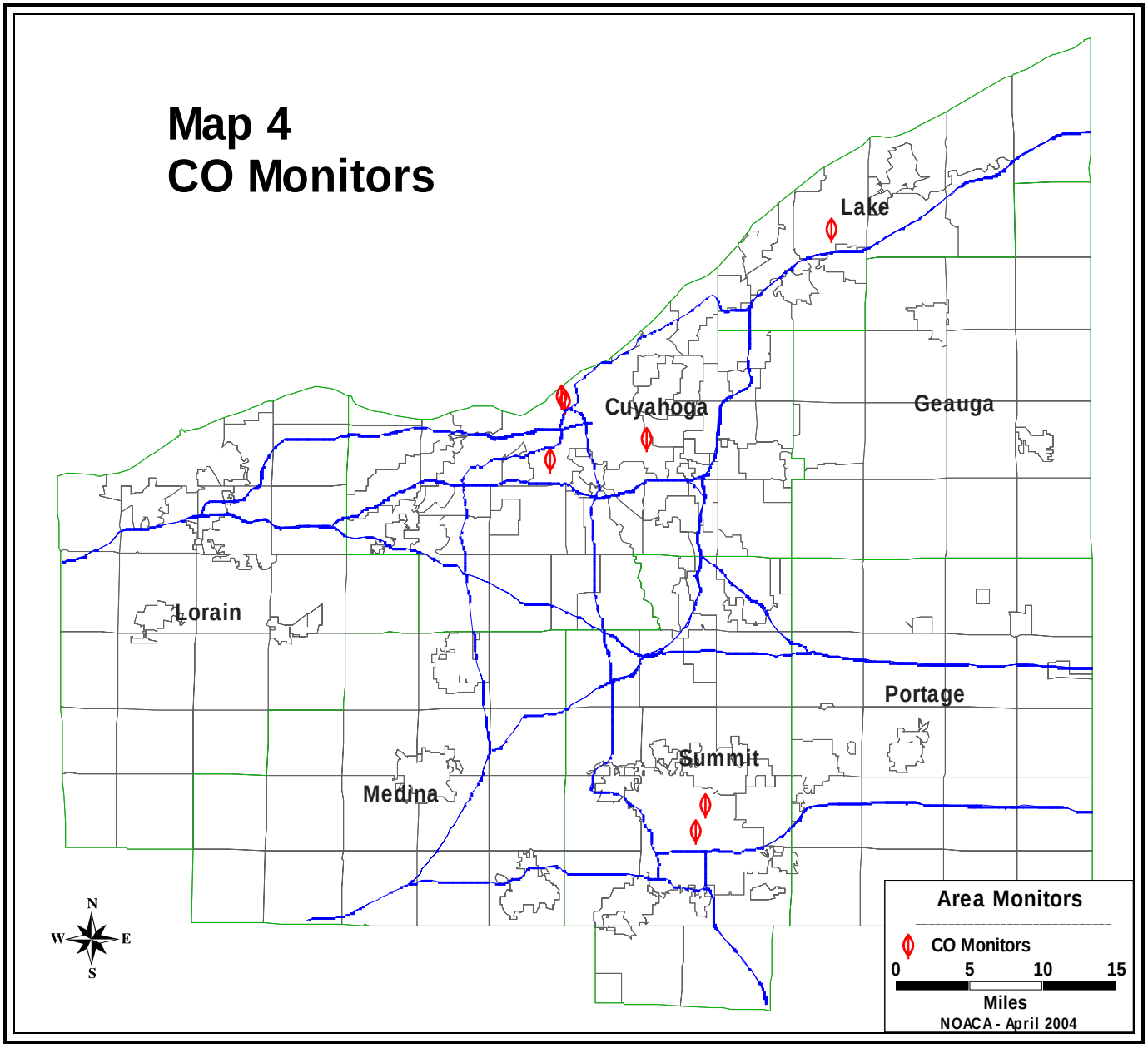


Carbon Monoxide Trends

Carbon monoxide is formed whenever a fuel is burned incompletely due to the absence of sufficient oxygen. It enters the blood stream during normal respiration and results in insufficient oxygen delivery to body tissues. Depending on its concentration, impacts can range from increased discomfort for those with cardiovascular ailments, visual impairment, reduced work capacity, and even death. The primary source of carbon monoxide remains the automobile. Traffic congestion at busy intersections can result in elevated levels of this pollutant.

Similar to particulate matter, there are two primary NAAQS for carbon monoxide. A 1-hour average concentration of 35 parts per million cannot be exceeded more than once per year. Additionally, an 8-hour average concentration of 9 ppm cannot be exceeded more than once per year. There is currently no portion of the Cleveland/Akron/Lorain Metropolitan Area that is designated nonattainment for carbon monoxide. Cuyahoga County was a designated nonattainment area for carbon monoxide from 1978 to1994. Although there is a maintenance plan for Cuyahoga County, new fuel and vehicle technologies make an exceedance of the standard unlikely. Ohio with NOACA's assistance on inventory work, completed a maintenance plan update last year.

There are seven monitors remaining in the area. There are four in Cuyahoga County, one in Lake County, and two in Summit County. Map 4 displays monitoring locations for carbon monoxide. Chart 8 displays 2nd-Max 1-Hour concentration carbon monoxide data for those counties currently operating monitors. Chart 9 displays 2nd-Max 8-Hour concentration data for those counties currently operating monitors.



Sulfur Dioxide Trends

Sulfur Dioxide is released primarily by the combustion of fuels containing sulfur as a contaminant. Coal and gasoline are both contributors to this problem. As a result, coal fueled industries and automobiles remain the primary sources for this pollutant. Its primary impacts on people are similar to ozone impacts. It irritates lung tissue and can exacerbate preexisting respiratory and cardiovascular ailments. In addition, it is a contributor to acid rain. Acid rain deteriorates man-made structures, damages plants, and can alter pH sufficiently to destroy ecosystems. It is also a primary component in the atmospheric reactions that generate $PM_{2.5}$.

Chart 8

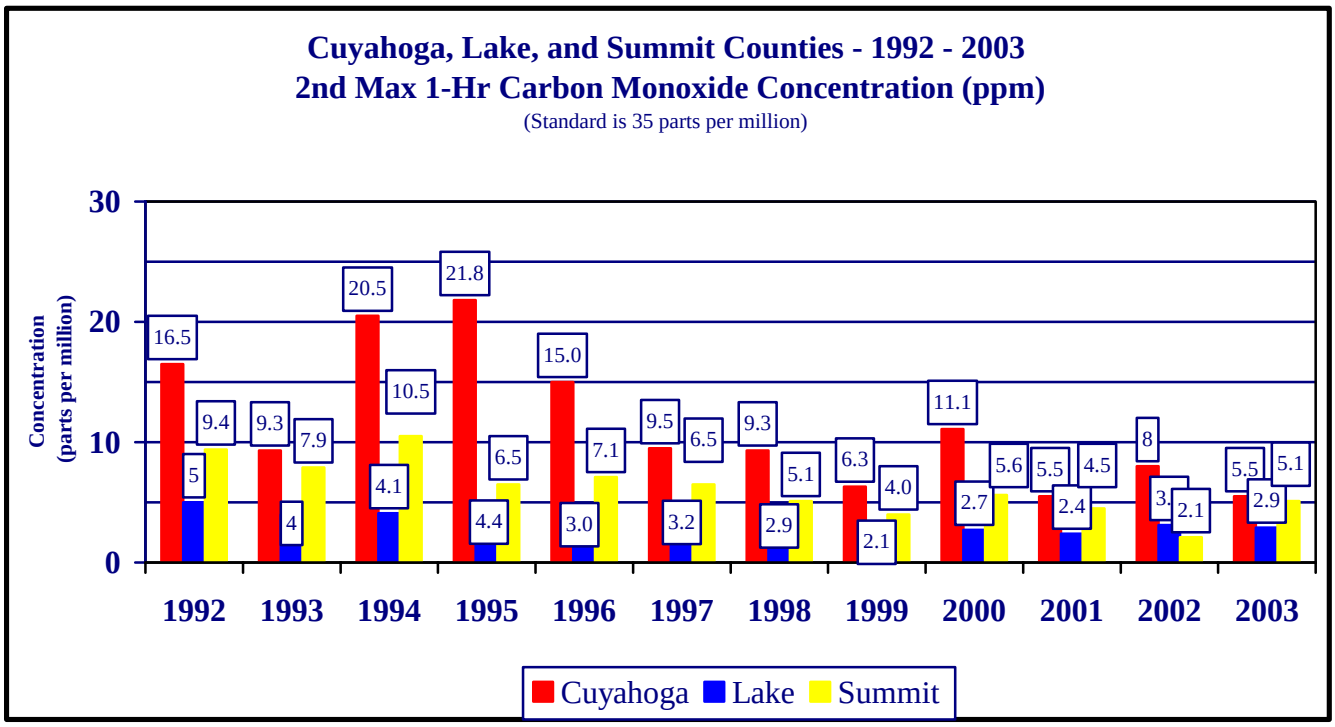
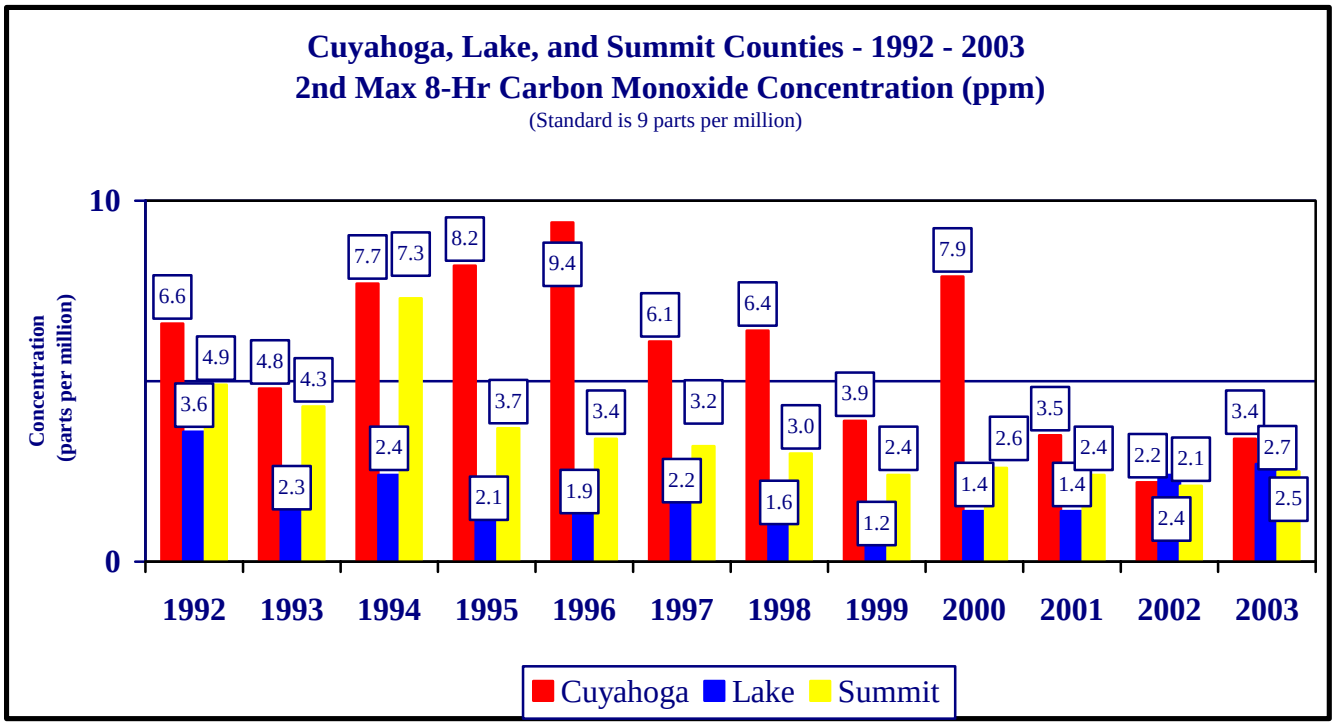


Chart 9



There are two primary NAAQS for sulfur dioxide (SO_2). A 24-hour average concentration of 0.14 ppm may not be exceeded more than once per year. The annual arithmetic mean concentration may not exceed 0.030 ppm. SO_2 is the only criteria pollutant for which a distinct and different secondary NAAQS exists. Secondary NAAQS are set based on the protection of social welfare rather than health. The secondary NAAQS for SO_2 requires that a 3-hour average concentration of 0.50 ppm not be exceeded more than once per year.

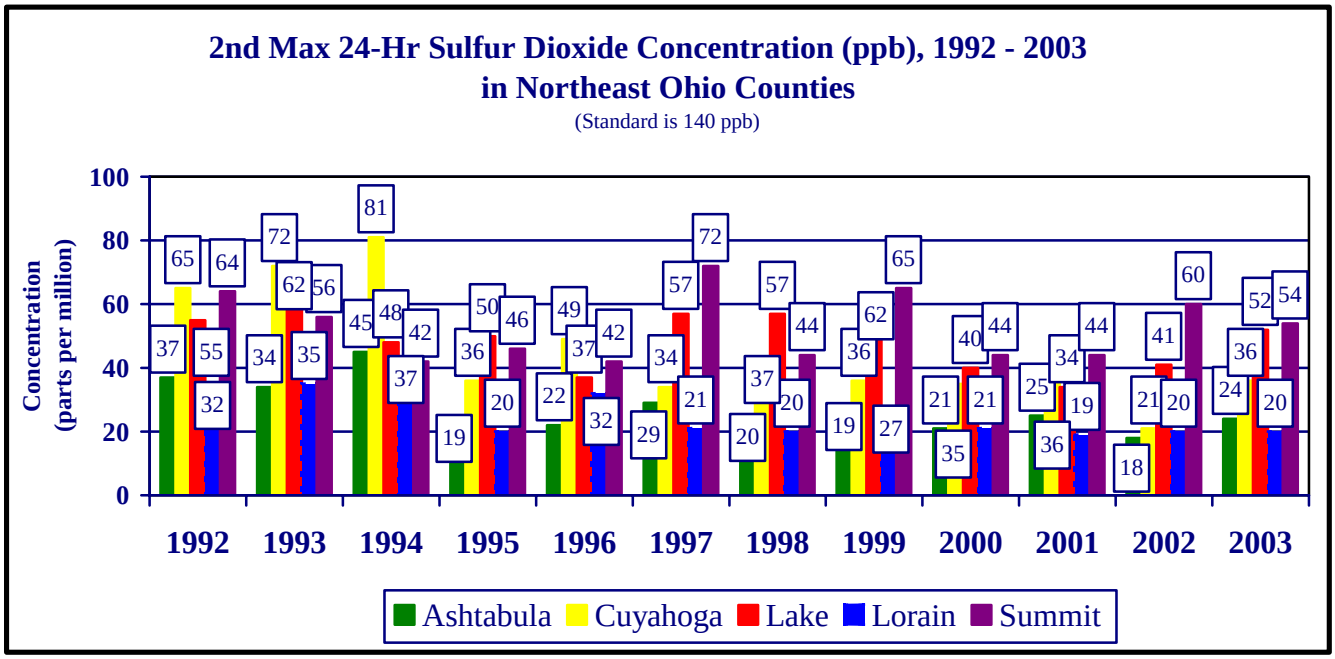
In the absence of a USEPA approved State Implementation Plan (SIP) for SO_2, USEPA promulgated a Federal Implementation Plan (FIP) in 1976. In 1978, USEPA designated areas throughout the state for SO_2. Portions of three northeast Ohio counties (Cuyahoga, Lake, and Lorain) were designated nonattainment at that time. Despite the absence of recent exceedances, these areas have remained designated nonattainment for reasons related to state planning/legislative obligations regarding replacements for FIP requirements. Ohio legislated the necessary FIP requirements for Lake County and it was redesignated to attainment effective September 29, 1999 (64 FR 47113). Ohio has also addressed its obligation for Lorain County SO_2 sources. It was redesignated to attainment effective July 5, 2000.

The remaining nonattainment designations in Cuyahoga County are as follows:

Cuyahoga County with the exception of the township of Olmsted and the cities of Bay Village, Westlake, North Olmsted, Olmsted Falls, Rocky River, Fairview Park, Berea, Middleburg Heights, Strongsville, North Royalton, Broadview Heights, and Brecksville remains designated nonattainment. Cuyahoga County will be redesignated as an attainment area as of 9/07/2004.

There are twelve SO_2 monitors operating in northeast Ohio. Map 5 displays their locations. Chart 10 displays the 2nd-Max 24-Hour sulfur dioxide concentrations for counties conducting monitoring from 1992 through 2003. Chart 11 displays the annual means for the same period.

Chart 10



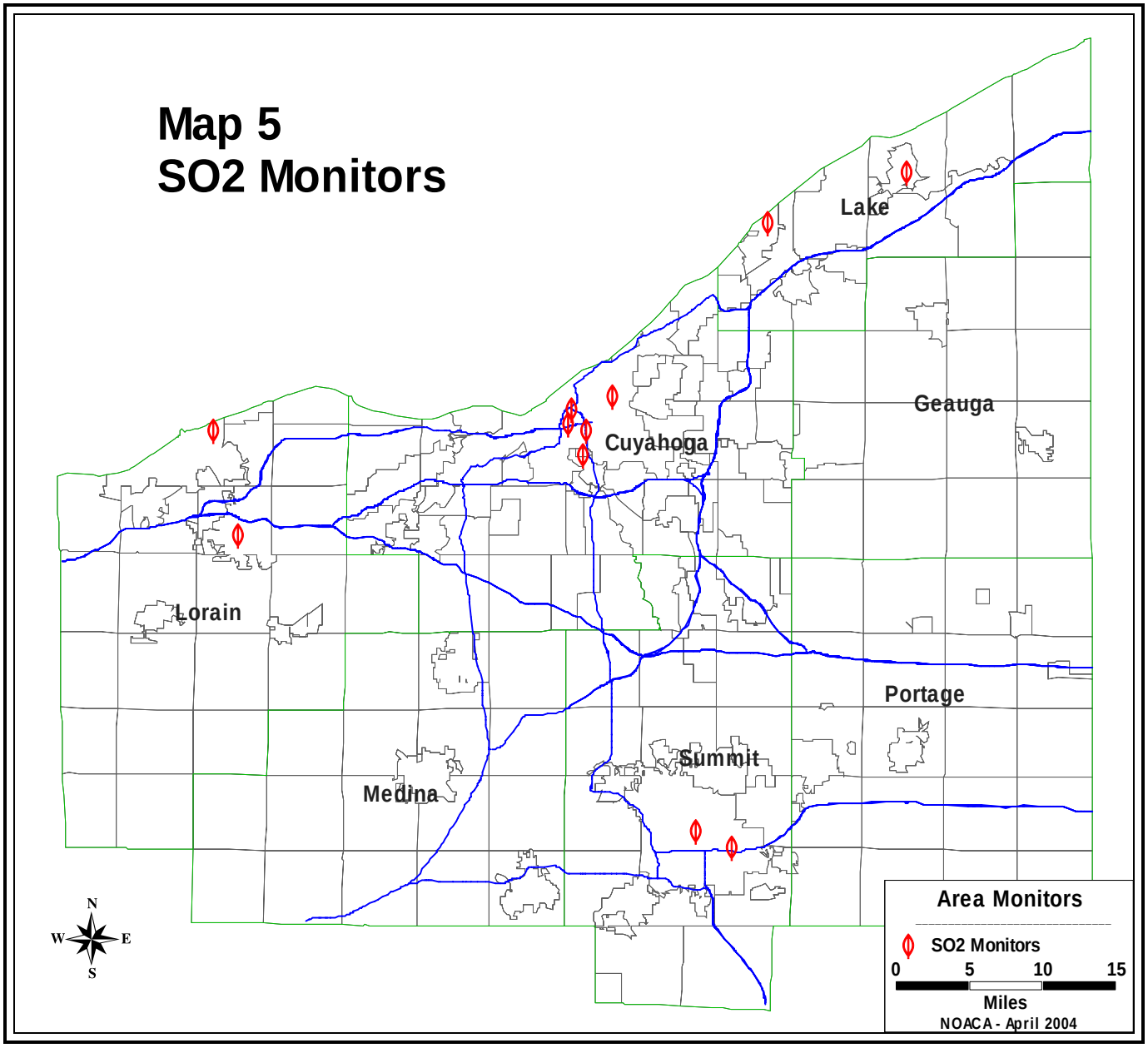
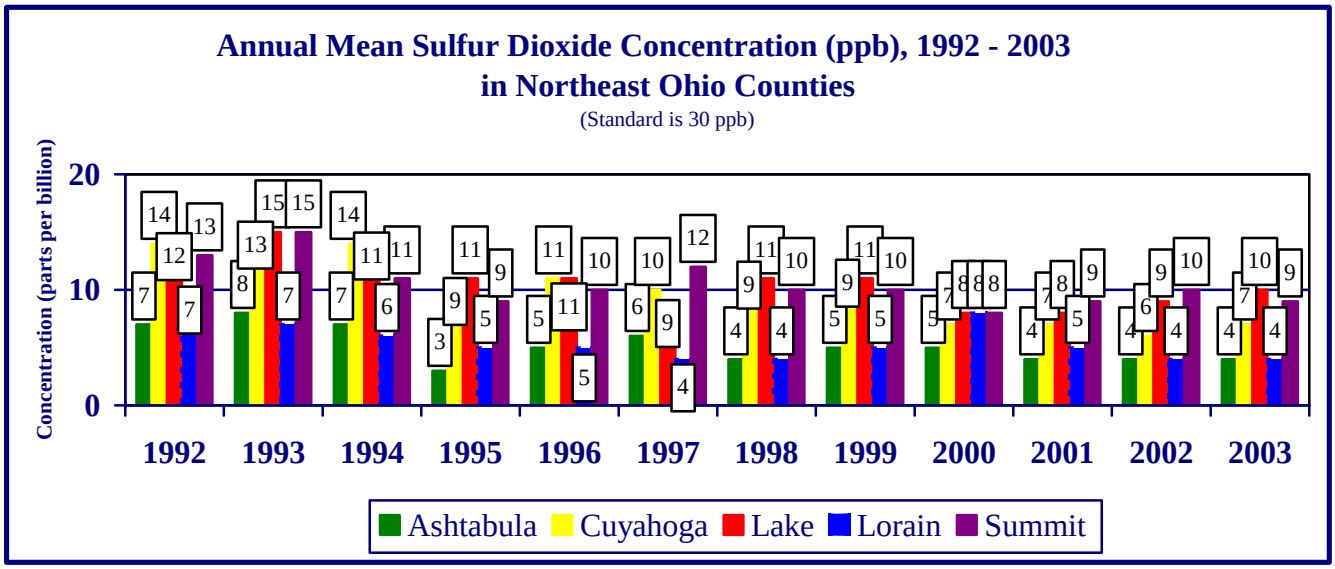

Map 5
SO2 Monitors
Lake
Geauga
Cuyahoga
Lorain
Portage
Summit
Medina
N
W
E
S
Area Monitors
SO2 Monitors
0
5
10
15
Miles
NOACA - April 2004

Chart 11

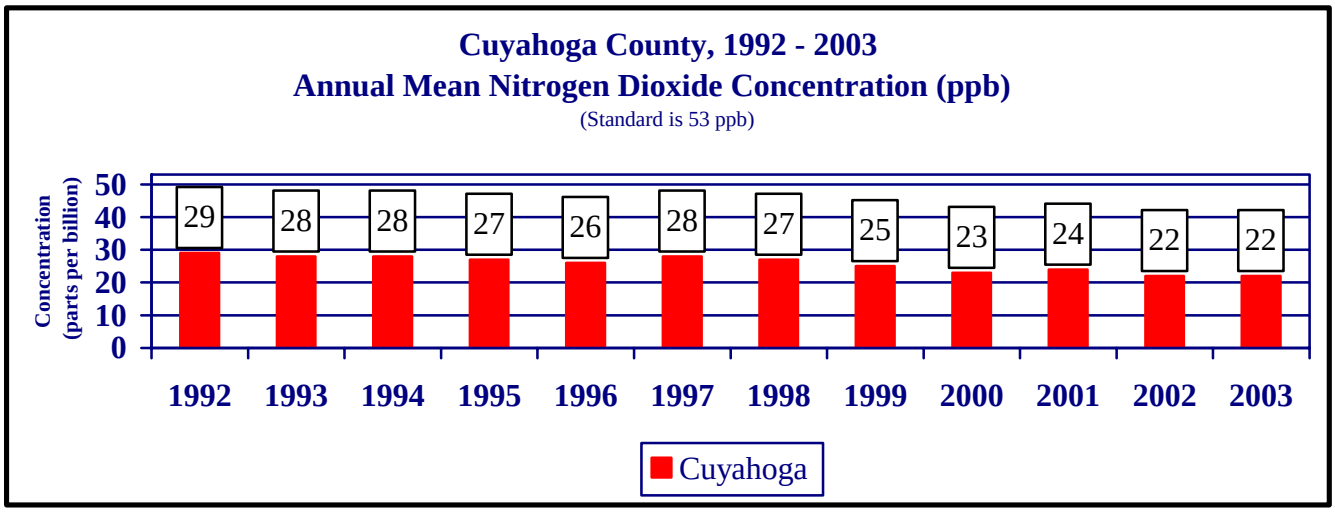


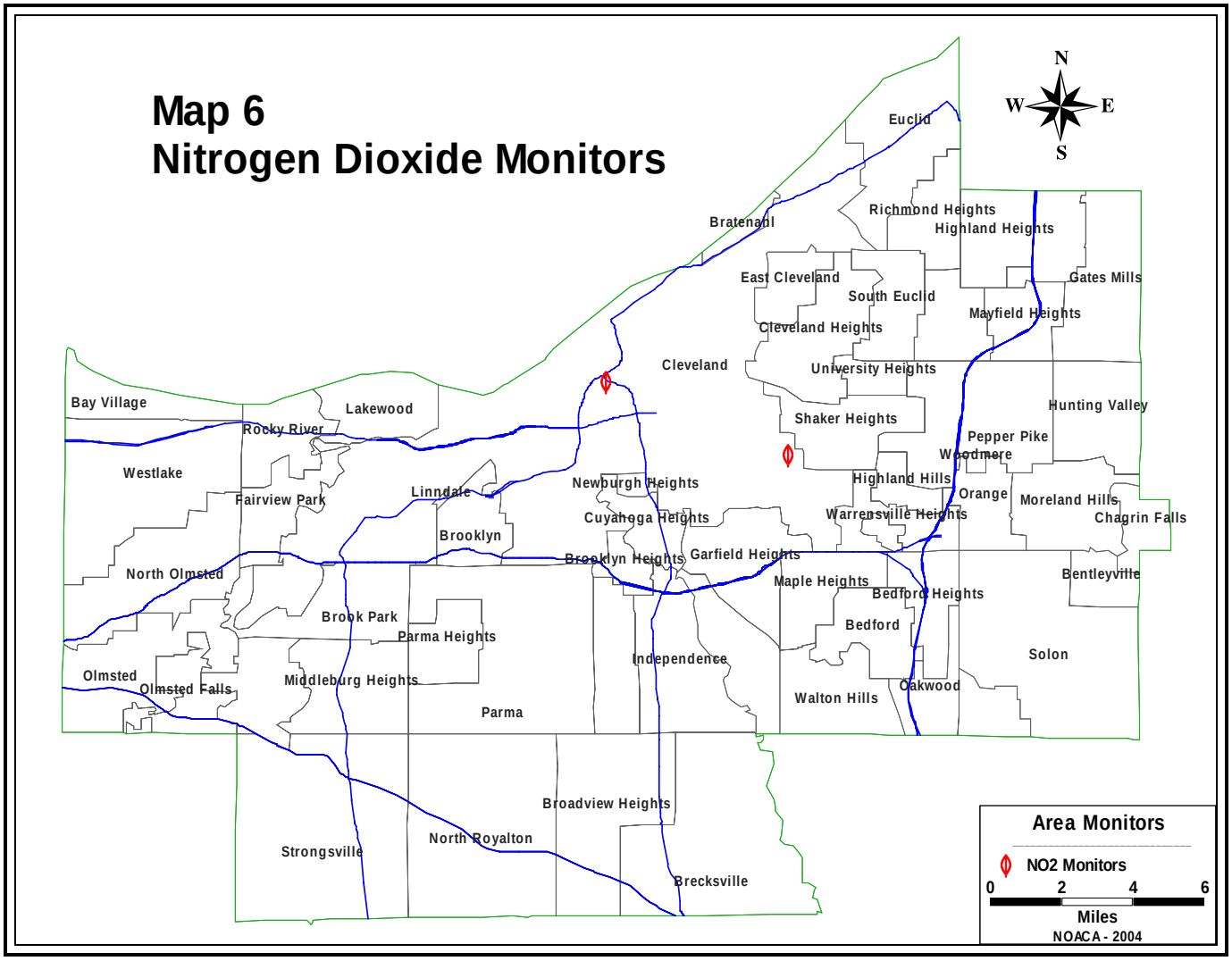
Nitrogen Dioxide Trends

Nitrogen dioxide is formed atmospherically by the oxidation of nitric oxide. Primarily high temperature combustion processes such as those found in the automobile engine and at power plants release nitric oxide. Nitrogen dioxide is a reddish brown gas. It is readily apparent around urban areas during hot, stagnant weather. It can worsen preexisting respiratory conditions and may reduce resistance to lung infection. It also plays a major role in ozone formation, global warming, and stratospheric ozone depletion.

A single NAAQS of an annual arithmetic mean of 0.053 ppm exists for nitrogen dioxide. This mean may not be exceeded without constituting a violation. No portion of the northeast Ohio area is designated nonattainment for nitrogen dioxide. In northeast Ohio, Cuyahoga County is the only county monitoring for this pollutant. It operates two monitors whose locations are depicted in Map 6. Chart 12 displays annual mean concentrations for Cuyahoga County from 1992-2003.

Chart 12



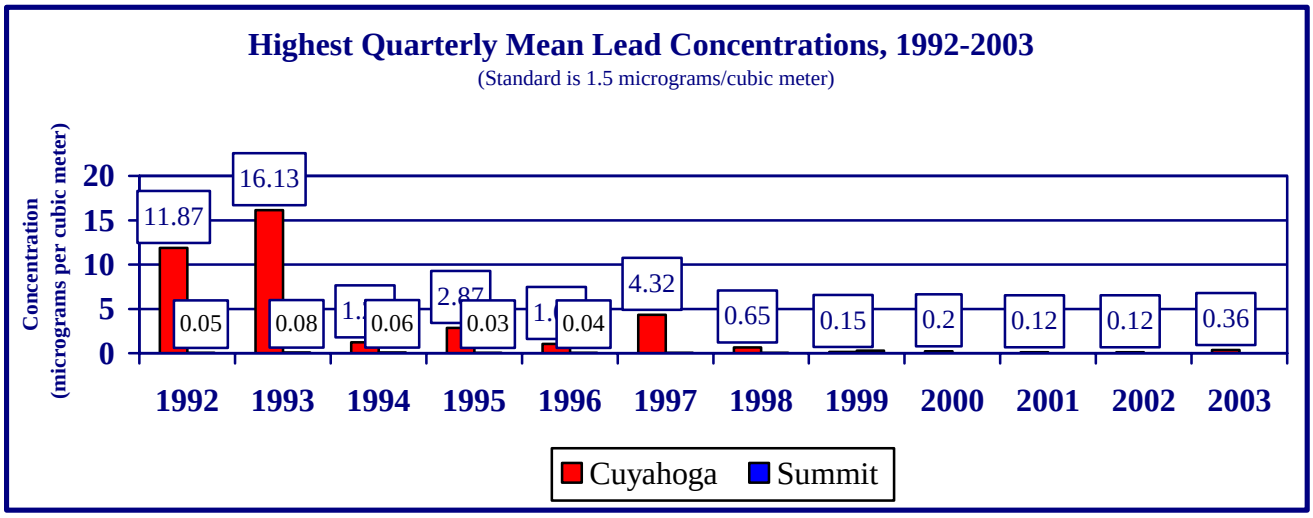


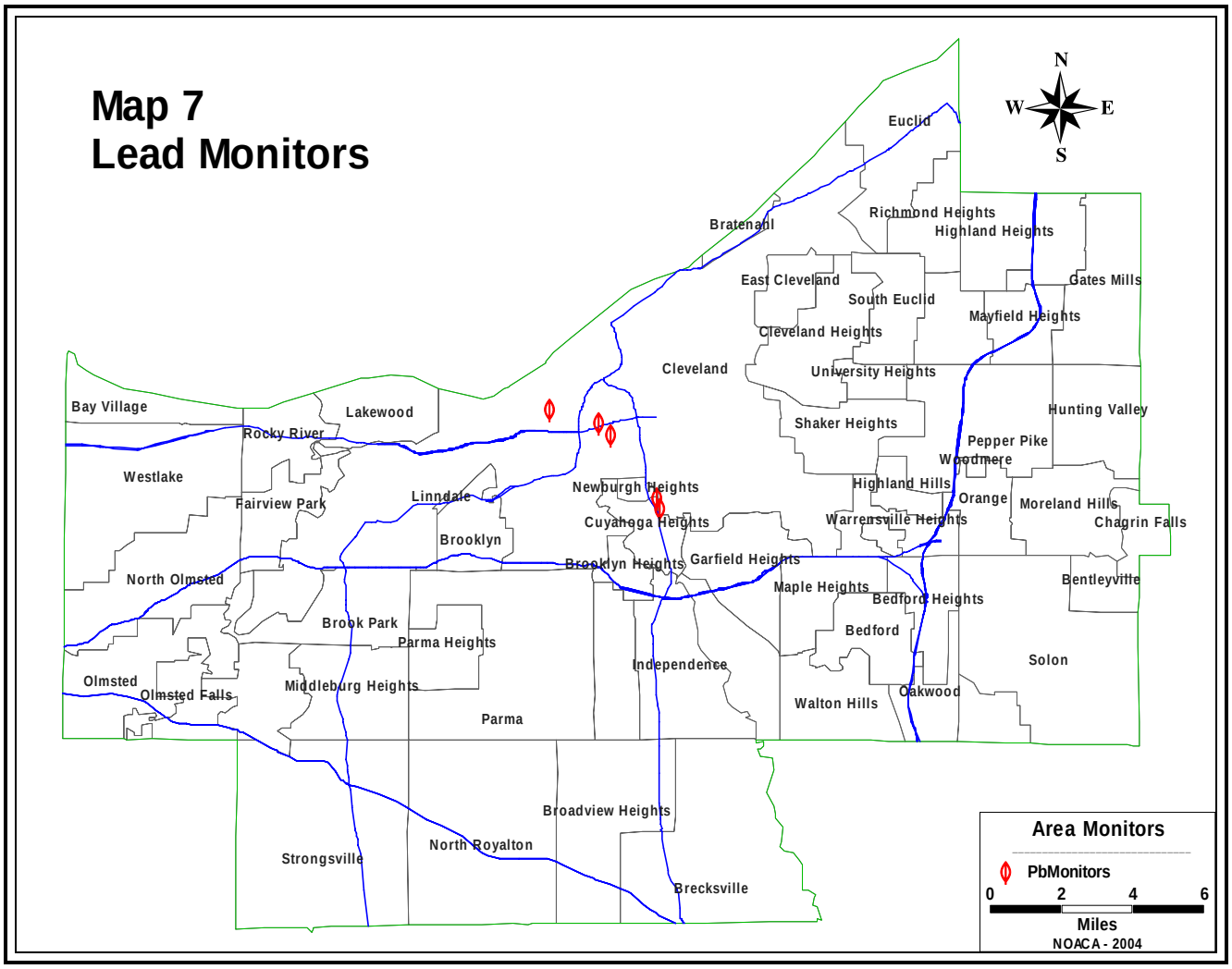
Lead Trends

Historically, leaded gasoline was the primary source of lead emissions. USEPA began efforts to phase out the use of lead in gasoline in the early 1970s. It was not until the December 31 1995 that the use of leaded gasoline in on-road vehicles was banned. Lead additives can and are still used in off-road engines. However, only metal industries and battery manufacturers remain significant contributors to atmospheric lead pollution. Lead accumulates in the body and can damage kidneys, liver, the nervous system and other organs.

A single NAAQS for a quarterly average concentration not to exceed 1.5 micrograms/cubic meter exists. This concentration may not be exceeded without constituting a violation. Once leaded fuel was banned most areas of the country experienced rapid decreases in ambient air lead concentrations. There are no nonattainment areas for lead in our region. Chart 13 displays quarterly lead concentrations for Cuyahoga and Summit Counties from 1992 - 2003. Summit County no longer operates a lead monitor. Five monitors remain in Cuyahoga County. Their location is depicted in Map 7.

Chart 14


Highest Quarterly Mean Lead Concentrations, 1992-2003
(Standard is 1.5 micrograms/cubic meter)
Concentration (micrograms per cubic meter)
20
15
10
5
0
11.87
16.13
0.05
0.08
1.
0.06
2.87
0.03
1.
0.04
4.32
0.65
0.15
0.2
0.12
0.12
0.36
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
Cuyahoga
Summit


Map 7
Lead Monitors
N
W
E
S
Euclid
Bratenahl
Richmond Heights
Highland Heights
East Cleveland
South Euclid
Gates Mills
Mayfield Heights
Cleveland Heights
Cleveland
University Heights
Hunting Valley
Bay Village
Lakewood
Rocky River
Shaker Heights
Pepper Pike
Woodmere
Westlake
Fairview Park
Linndale
Newburgh Heights
Highland Hills
Orange
Moreland Hills
Chagrin Falls
Cuyahoga Heights
Warrensville Heights
Brooklyn
Brooklyn Heights
Garfield Heights
Maple Heights
Bentleyville
North Olmsted
Bedford Heights
Brook Park
Bedford
Parma Heights
Solon
Independence
Olmsted
Olmsted Falls
Middleburg Heights
Walton Hills
Oakwood
Parma
Broadview Heights
North Royalton
Strongsville
Brecksville
Area Monitors
PbMonitors
0
2
4
6
Miles
NOACA - 2004