2001 Annual Air Quality Report

Visibility Monitoring Site In The Seney National Wildlife Refuge

AIR QUALITY DIVISION
Michigan Department of Environmental Quality

THE DEPARTMENT OF ENVIRONMENTAL QUALITY PROVIDES EQUAL OPPORTUNITIES FOR EMPLOYMENT AND FOR ACCESS TO MICHIGAN'S NATURAL RESOURCES. BOTH STATE AND FEDERAL LAWS PROHIBIT DISCRIMINATION ON THE BASIS OF RACE, COLOR, NATIONAL ORIGIN, RELIGION, DISABILITY, AGE, MARITAL STATUS OR SEX UNDER THE CIVIL RIGHTS ACT OF 1964 AS AMENDED, MI PA 453 AND MI PA 220, TITLE V OF THE REHABILITATION ACT OF 1973 AS AMENDED, AND THE AMERICANS WITH DISABILITIES ACT. FOR INFORMATION OR ASSISTANCE REGARDING THIS PUBLICATION, CONTACT THE MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY, AIR QUALITY DIVISION, PO BOX 30260, LANSING, MI 48909.

Printed by authority of Michigan Department of Environmental Quality.
Total number of copies printed: 600 Total Cost: $2631.56 Cost Per Copy: $4.38

DEQ **Michigan Department of Environmental Quality**

Jennifer Granholm, Governor
Steven E. Chester, Director

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

2001 ANNUAL AIR QUALITY REPORT

AIR QUALITY DIVISION
PO BOX 30260
LANSING MI 48909

January 2003

DEQ homepage: http://www.michigan.gov/deq then click on "Air"

Acknowledgments:

This publication was prepared by the Air Quality Evaluation Section (AQES) and other staff of the Michigan Department of Environmental Quality, Air Quality Division. Copies of this report can be obtained at 517-373-7023. It is also available on the department's website at: **http://www.michigan.gov/deq** click on "Air," "Air Quality," "Ambient Monitoring," then look under the heading "Reports."

AQES, Air Monitoring Unit Staff:

Craig Fitzner
Mary Ann Heindorf, Ph.D.
Keith Martin
Randy Chase
Charles Wandrie
Eric Hansen
Deborah Sherrod
Marc Foreman
Ann Chevalier
Navnit Ghuman
Amy Robinson
Jason Duncan
Matthew Nowak
Bryan Schroeder
John Harrison III
Daniel Ling
Sheila Blais

AQES, Strategy Development Unit Staff: Neal Conatser

AQES, Emissions, Reporting & Assessment Unit Staff: James Stewart, Rick Dalebout

AQES, Toxics Unit: Bob Sills and Mike Depa

Air Quality Division Public Outreach Coordinator: Laura DeGuire

The Air Quality Division also wishes to acknowledge the significant contributions that were provided by the staff of the City of Grand Rapids, Air Pollution Control Division, which operates and maintains air monitoring equipment.

City of Grand Rapids, Air Pollution Control Division Staff: William Endres and Mark Bird

Cover photo: The 2001 visibility monitoring site in the Seney National Wildlife Refuge. This refuge was established in 1935 for the protection and production of migratory birds and other wildlife. The 21,150-acre wilderness area is located in the Upper Peninsula. To advise the public about visibility, the Midwest Regional Planning Organization has established a visibility network throughout the upper Midwest. The Air Quality Division is participating by providing technical support for a site in the Seney National Wildlife Refuge and will also conduct quarterly performance audits. Data collection began in January 2002. Funding for the Air Quality Division support is provided by the Midwest Regional Planning Organization; the U.S. Fish and Wildlife Service will operate the site. Other locations include Chicago, IL; Indianapolis, IN; Cincinnati, OH; Mayville, WI; and Isle Royale National Park, Grand Portage, MN. Near real-time data is available on the Internet at **http://www.mwhazecam.net**.

The Seney monitoring station has continuous monitors for regional haze, ozone, fine particulate, and meteorological measurements. A digital camera will provide visibility images that are updated every 15 minutes. The station will also be used to collect speciated fine particulate data.

TABLE OF CONTENTS

Page

Chapter 1: Executive Summary 1

Chapter 2: Background Information 3
- NAAQS 3
- Determining Compliance with the NAAQS 5
- Michigan Air Monitoring Networks 5
- Metropolitan Statistical Areas 9
- Monitoring Techniques 10

Chapter 3: Air Quality Trends in Michigan 11

Chapter 3.1: Carbon Monoxide Trends 11
- Introduction 11
- CO Effects 11
- NAAQS for CO 12
- CO Monitoring in Michigan 12
- Attainment/Nonattainment Status of CO in Michigan 13
- Long-Term Trends in CO 14
- CO Trends by MSA & Location 15

Chapter 3.2: Lead Trends 16
- Introduction 16
- Pb Effects 16
- NAAQS for Pb 17
- Pb Monitoring in Michigan 17
- Attainment/Nonattainment Status of Pb in Michigan 19
- Long-Term Trends in Pb 19

Chapter 3.3: Nitrogen Dioxide Trends 20
- Introduction 20
- NO_2 Effects 20
- NAAQS for NO_2 20
- NO_2 Monitoring in Michigan 20
- Attainment/Nonattainment Status of NO_2 in Michigan 21
- Long-Term Trends in NO_2 22
- NO_2 Trends by MSA & Location 22

Chapter 3.4: Ozone Trends 24
- Introduction 24
- O_3 Effects 25
- NAAQS for O_3 25
- O_3 Monitoring in Michigan 25
- Attainment/Nonattainment Status of O_3 in Michigan 28
- Long-Term Trends in O_3 29
- O_3 Trends by MSA & Location 31

TABLE OF CONTENTS (Continued)

Page

Chapter 3.5: Particular Matter (PM_{10}, $PM_{2.5}$, $PM_{2.5}$ Chemical Speciation, & TSP) Trends 37
Introduction 37
Particulate Matter Effects 38
NAAQS for Particulate Matter 39
Monitoring for PM_{10} in Michigan 39
Attainment/Nonattainment Status of PM_{10} 40
Long-Term Trends in PM_{10} 40
PM_{10} Trends by MSA & Location 42
Monitoring for $PM_{2.5}$ in Michigan 44
Attainment/Nonattainment Status of $PM_{2.5}$ in Michigan 45
$PM_{2.5}$ Trends by MSA & Location 48
Monitoring for $PM_{2.5}$ Chemical Speciation in Michigan 48

Chapter 3.6: Sulfur Dioxide Trends 50
Introduction 50
SO_2 Effects 50
NAAQS for SO_2 50
SO_2 Monitoring in Michigan 51
Attainment/Nonattainment Status of SO_2 in Michigan 52
Long-Term Trends in SO_2 52
SO_2 Trends by MSA & Location 53

Chapter 4: Toxic Pollutants in Michigan 55
Introduction 55
Toxic Effects Assessment 55
Monitoring Data Importance and Availability 56
The Michigan Toxics Air Monitoring Program 57
Detroit Air Toxics Pilot Project: 63
PBTs 65

Chapter 5: Special Projects 68
Air Quality Index 68
Ozone Action! 70
O_3 Mapping 72
Daily Fine Particulate $PM_{2.5}$ Concentrations Website 73

Chapter 6: Meteorological Summary 74
Climatological Summary 74
2001 Temperature and Precipitation Data for Michigan 74
Meteorological Monitoring in Michigan 76

Chapter 7: References by Chapter 79

TABLE OF CONTENTS (Continued)

Page

List of Appendices

Appendix A: Criteria Pollutant Summary for 2001 90
Appendix B: Precision & Accuracy Report for 2001 96
Appendix C: 2001 Data Summary for Trace Metals, VOCs, & Carbonyl Compounds 100
Appendix D: Ozone Exceedances 1992 to 2001 117
Appendix E: AQD Acronyms and Definitions 122
Appendix F: AQD District Office Locations 125

List of Figures

Chapter 2: Background Information
Figure 2-1: Michigan Air Monitoring Network Map 6
Figure 2-2: Southeast Michigan Air Monitoring Network Map 7
Figure 2-3: Michigan Metropolitan Areas 9

Chapter 3.1: Carbon Monoxide Trends
Figure 3.1-1: Air Quality Monitors for CO Active in 2001 13
Figure 3.1-2: Range of Maximum 1-Hour CO Levels, 1992-2001 14
Figure 3.1-3: Range of Maximum 8-Hour CO Levels, 1992-2001 14
Figure 3.1-4: CO Levels by MSA, 1992-2001 15
Figure 3.1-5: CO Levels by Location, 1992-2001 15

Chapter 3.2: Lead Trends
Figure 3.2-1: Air Quality Monitors for Pb Active in 2001 18
Figure 3.2-2: Range of Maximum Quarterly Lead Levels, 1992-2001 20

Chapter 3.3: Nitrogen Dioxide Trends
Figure 3.3-1: Air Quality Monitors for NO_2 Active in 2001 21
Figure 3.3-2: Range of Annual Arithmetic Mean At Detroit's Linwood and E. Seven Mile Monitoring Sites, 1992-2001 22
Figure 3.3-3: NO_2 Levels by MSA, 1992-2001 23

Chapter 3.4: Ozone Trends
Figure 3.4-1: Air Quality Monitors for O_3 Active in 2001 26
Figure 3.4-2: 4^{th} Highest 8-Hr O_3 Values Averaged by Site Greater Than 0.08 ppm, 1999-2001 29
Figure 3.4-3: Range of Maximum 1-Hour O_3 Levels, 1992-2001 30
Figure 3.4-4: Trends in 4^{th} Maximum 8-Hour O_3 Concentrations 30
Figure 3.4-5: Observed Number of Exceedances of the 1-Hour O_3 Standard, 1980-2001 30
Figure 3.4-6: Number of Days with 8-Hour O_3 Levels Greater Than 0.08 ppm, 1980-2001 31
Figure 3.4-7: 1-Hour O_3 Levels Averaged by MSA, 1992-2001 32
Figure 3.4-8: Annual 4^{th} Highest 8-Hour O_3 Levels Averaged Across the MSA, 1992-2001 32
Figure 3.4-9: 4^{th} Highest 8-Hr O_3 Values Averaged by Location, 1992-2001 36

TABLE OF CONTENTS (Continued)

Page

List of Figures (Continued)

Chapter 3.5: Particular Matter (PM_{10}, $PM_{2.5}$, $PM_{2.5}$ Chemical Speciation, & TSP) Trends

Figure 3.5-1: Air Quality Monitors for PM_{10} Active in 2001 40
Figure 3.5-2: Range of Annual Arithmetic Means for PM_{10} Levels, 1992-2001 40
Figure 3.5-3: Range of Maximum 24-Hour PM_{10} Levels, 1992-2001 41
Figure 3.5-4: Range of 24-Hour 99th Percentile PM_{10} Levels, 1992-2001 41
Figure 3.5-5: PM_{10} Levels by MSA, 1992-2001 42
Figure 3.5-6: PM_{10} Levels by MSA, 1992-2001 42
Figure 3.5-7: 24-Hour 99th Percentile PM_{10} Levels by MSA, 1992-2001 43
Figure 3.5-8: Air Quality Monitors for $PM_{2.5}$ Active in 2001 45
Figure 3.5-9: $PM_{2.5}$ Levels by MSA, 1999-2001 48
Figure 3.5-10: $PM_{2.5}$ TEOM & $PM_{2.5}$ Chemical Speciation Particulate Monitors Active in 2001 49

Chapter 3.6: Sulfur Dioxide Trends

Figure 3.6-1: Air Quality Monitors for SO_2 Active in 2001 51
Figure 3.6-2: Range of SO_2 Annual Arithmetic Means, 1992-2001 52
Figure 3.6-3: Range of Maximum 24-Hour SO_2 Levels, 1992-2001 52
Figure 3.6-4: Range of Maximum 3-Hour SO_2 Levels, 1992-2001 53
Figure 3.6-5: Annual Mean SO_2 Levels by MSA, 1992-2001 53
Figure 3.6-6: Maximum 24-Hour SO_2 Levels Averaged by MSA, 1992-2001 54
Figure 3.6-7 Average Annual SO_2 Levels by Location, 1992-2001 54

Chapter 4: Toxic Pollutants in Michigan

Figure 4.1-1: MITAMP Monitors Active in 2001 58
Figure 4.1-2: Location for Detroit Pilot Project 63
Figure 4.1-3 Rural Background Site 64

Chapter 5: Special Projects

Figure 5.1-1: AQI 70
Figure 5.1-2: *Ozone Action!* Website 71
Figure 5.1-3: Screen Capture of AIRNOW Ozone Midwest Map Website 72

Chapter 6: Meteorological Summary

Figure 6.1-1: Northern Lower Peninsula Observed Average Daily Temperatures vs. Mean Daily Temperatures 75
Figure 6.1-2: Northern Lower Peninsula Average Monthly Precipitation vs. Mean Monthly Precipitation 75
Figure 6.1-3: Southern Lower Peninsula Observed Average Daily Temperature vs. Mean Daily Average Temperatures 75
Figure 6.1-4: Southern Lower Peninsula Observed Monthly Precipitation vs. Mean Monthly Precipitation 75
Figure 6.1-5: Upper Peninsula Observed Average Daily Temperatures vs. Mean Daily Average Temperatures 75
Figure 6.1-6: Upper Peninsula Observed Average Monthly Precipitation vs. Mean Monthly Precipitation 75
Figure 6.1-7: Meteorological Stations in Michigan 77

TABLE OF CONTENTS (Continued)

Page

List of Tables

Chapter 2: Background Information

Table 2-1: NAAQS in Effect During 2001 For Criteria Pollutants 4
Table 2-2: Criteria for the Determination of Compliance with the NAAQS 5
Table 2-3: Michigan Air Sampling Network Station Locations in 2001 8

Chapter 3.4: Ozone Trends

Table 3.4-1: Summary of Attainment Status of 1-Hour O_3 Standard 28
Table 3.4-2: 4th Highest 8-Hr O_3 Values Averaged for Three-Year Increments, 1995 to 2001 33

Chapter 3.5: Particulate Matter (PM_{10}, $PM_{2.5}$, $PM_{2.5}$ Chemical Speciation & TSP) Trends

Table 3.5-1: Values Exceeding the 24-Hour Standard (150 $\mu g/m^3$) for PM_{10} In Michigan, 1992-2001 43
Table 3.5-2: Annual Mean $PM_{2.5}$ Concentrations by Individual Monitoring Station, 1999-2001 46
Table 3.5-3: 24-Hour 98^{th} Percentile $PM_{2.5}$ Concentrations by Individual Monitoring Station, 1999-2001 47

Chapter 4: Toxic Pollutants in Michigan

Table 4.1-1: Chemical Compounds Monitored at MITAMP Sites During 2001................. 59
Table 4.1-2: Non-Industrial Sites Collecting Air Toxics Data in Michigan......................... 62

Chapter 5: Special Projects

Table 5.1-1: The AQI (Effective 10/4/99) 68
Table 5.1-2: The AQI Colors and Health Statements.. 69

Chapter 6: Meteorological Summary

Table 6.1-1: Meteorological Data Collected in Michigan During Year 2001 78

CHAPTER 1: Executive Summary

The Federal Clean Air Act (CAA), as amended, requires the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) that define the maximum permissible levels of pollutants for the protection of human health and welfare.

The purpose of this report is to provide a summary of air quality data and trends in Michigan. The intent is to:

- Describe the NAAQS and how compliance is determined,
- Identify the types and techniques of ambient air quality monitoring that was conducted throughout the state of Michigan,
- Provide an assessment of air quality trends by criteria pollutant in Michigan with respect to the NAAQS,
- Describe toxic pollutants in Michigan and source specific monitoring of ambient air toxics,
- Discuss special projects, and
- Provide a meteorological summary of data and monitoring in Michigan.

Chapter 2 provides background information about the development of NAAQS and how compliance with the standards is determined with an overview of the review and revisions to the NAAQS for carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter less than or equal to 10 or 2.5 microns in diameter (PM_{10} and $PM_{2.5}$, respectively), and sulfur dioxide (SO_2). Michigan's air monitoring network (including maps and identification of individual monitoring sites), descriptions of data generated by the network, as well as the technical details, assumptions, and methods used to produce this report are also included.

Chapter 3 provides an in-depth analysis of air quality trends in Michigan for each of the criteria pollutants for which NAAQS have been established. A description of the chemical and physical properties of each criteria pollutant, its common sources, toxicology and environmental effects, NAAQS, monitoring in Michigan, attainment status, long-term trends statewide and by metropolitan statistical area (MSA), and relationships to national averages are discussed, and references are given. The MSA grouping is based on the U.S. Office of Management and Budget June 30, 1999 metropolitan area boundaries. The projected impact of the new O_3 and fine particulate $PM_{2.5}$ NAAQS on Michigan is presented using available monitoring data, the intent of which is to identify those areas in the state that exceed the NAAQS.

Chapter 4 discusses ambient monitoring programs related to inorganic (trace metals) and organic toxic pollutants. Described are the variety of substances that are classified as toxic air pollutants, or air toxics. In general, air toxics can be sub-categorized as toxic metals, organic substances, and other substances. The organic toxics classification is further divided into sub-categories that include volatile organic compounds (VOCs), carbonyl compounds, semi-volatile compounds, polycyclic aromatic hydrocarbons/ polynuclear aromatic hydrocarbons (PAHs/PNAs), pesticides polychlorinated biphenyls (PCBs), and polycyclic organic matter (POM). Also included in Chapter 4 are the efforts being made to develop a comprehensive air toxics monitoring strategy to provide a network characterizing ambient levels of air toxics, including atmospheric deposition.

Special studies with website locations are summarized in Chapter 5. Meteorological information that includes climatological summary, temperature and precipitation data, and meteorological monitoring in Michigan is given in Chapter 6.

As in previous versions of the Annual Air Quality Reports, the appendices contain Quick Look Reports. These Quick Look Reports provide a summary of statistical information for individual ambient criteria pollutant monitoring throughout the state. Precision and Accuracy Reports, and tables that contain the levels of air toxics, are also included in the Appendices.

The annual report is available via the Michigan Department of Environmental Quality (MDEQ) Internet website at **http://www.michigan.gov/deq** then click on “Air,” “Air Quality,” “Ambient Monitoring,” then look under “Reports.” A limited number of print copies are available as well and can be requested at 517-373-7023. Real time air monitoring information for O_3 and $PM_{2.5}$ is also available at the above website under “On-line Services.” Other pollutants will be added in the near future.

CHAPTER 2: Background Information

This chapter provides a summary of the NAAQS and how compliance is determined, the identification of the types and techniques of ambient air quality monitoring that was conducted throughout the state of Michigan, and a map of the MSAs and how these areas are used when designating nonattainment for air pollutants relative to the NAAQS.

NAAQS:

The CAA requires the EPA to establish NAAQS, which define the maximum permissible concentrations for certain pollutants. Section 108 of the CAA required the EPA Administrator to: identify pollutants that may reasonably be anticipated to endanger public health or welfare; and to issue air quality criteria that reflect the latest scientific knowledge useful in indicating the kind and extent of all identifiable effects on public health or welfare that may be expected from the presence of such pollutants in ambient air. Under Section 109 of the CAA, the EPA Administrator establishes NAAQS for each pollutant for which air quality criteria have been issued. Section 109(b)(1) requires the EPA to set standards where "the attainment and maintenance are requisite to protect public health" with "an adequate margin of safety."

In early 1971, the EPA established standards for five "criteria" pollutants: suspended particulate matter (total suspended particulates or TSP), SO_2, NO_2, CO, and photochemical oxidants. On October 5, 1978, the EPA promulgated an additional ambient air quality standard for Pb. The air quality standard for O_3 replaced the photochemical oxidant standard on February 8, 1979. In July 1987, the particulate matter standards were revised by EPA to place greater importance on PM_{10}.

The EPA revised both the O_3 and particulate standards on July 18, 1997. In addition, a new standard for $PM_{2.5}$ was introduced. The current Air Quality Standards are summarized by pollutant in Chapter 3 and in **Table 2-1**.

There are two types of air quality standards, primary and secondary. The primary standard is designed to protect the public health with an adequate margin of safety. Permissible levels were chosen to protect the health of the most susceptible individuals in a population, including children, the elderly, and those with chronic respiratory ailments. In selecting the margin of safety for the primary standard, the EPA considers such factors as the nature and severity of the health effects involved, the size of the sensitive population(s) at risk, and the kind and degree of uncertainties that must be addressed. The secondary standard is designed to protect public welfare or ensure quality of life.

Air quality conditions described by the secondary standard may be the same as the primary standard. Secondary standards are chosen to limit economic damage, as well as deleterious effects on soil, water, crops, vegetation, manmade materials, animals, wildlife, visibility and climatic factors, and personal comfort/well-being.

The ambient levels established by the standards have various averaging times to address health impacts. Short averaging times, like the 1-hour maximum level of 35 parts per million (ppm) used for CO, reflect the effects of acute effects. The long-term averaging times, like the annual mean concentrations for PM_{10}, $SO_{2,}$ and NO_2, are designed to protect against chronic effects.

Table 2-1 standard level concentrations are listed as ppm, microgram per cubic meter ($\mu g/m^3$), and/or milligram per cubic meter (mg/m^3).

Table 2-1: NAAQS in Effect During 2001 for Criteria Pollutants.

Pollutant	Primary (Health Related)		Secondary (Welfare Related)	
	Type of Average	**Standard Level Concentration**	**Type of Average**	**Standard Level Concentration**
CO	8-hour [b]	9 ppm (10 mg/m^3)	No Secondary Standard	
	1-hour [b]	35 ppm (40 mg/m^3)	No Secondary Standard	
Pb	Maximum Quarterly Average	1.5 $\mu g/m^3$	Same as Primary Standard	
NO_2	Annual Arithmetic Mean	0.053 ppm (100 $\mu g/m^3$)	Same as Primary Standard	
O_3	Maximum Daily 1-hour Average [c]	0.12 ppm (235 $\mu g/m^3$)	Same as Primary Standard	
	4th Highest 8-Hour Daily Maximum [d]	0.08 ppm (157 $\mu g/m^3$)	Same as Primary Standard	
PM_{10}	Annual Arithmetic Mean [e]	50 $\mu g/m^3$	Same as Primary Standard	
	24-hour [e]	150 $\mu g/m^3$	Same as Primary Standard	
$PM_{2.5}$	Annual Arithmetic Mean [f]	15 $\mu g/m^3$	Same as Primary Standard	
	98th percentile 24-hour [f]	65 $\mu g/m^3$	Same as Primary Standard	
SO_2	Annual Arithmetic Mean	80 $\mu g/m^3$ (0.03 ppm)	3-hour [b]	1300 $\mu g/m^3$ (0.50 ppm)
	24-hour [b]	365 $\mu g/m^3$ (0.14 ppm)		

[a] Parenthetical value is an approximately equivalent concentration.

[b] Not to be exceeded more than once per year.

[c] The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than one, as determined according to Appendix H of the Ozone NAAQS.

[d] The 8-hour standard is met when the three-year average of the annual fourth highest daily maximum 8-hour O_3 concentration is less than or equal to 0.08 ppm.

[e] The annual PM_{10} standard is attained when the expected annual arithmetic mean concentration is less than or equal to 50 $\mu g/m^3$ (three-year average); the 24-hour standard is attained when the expected number of days above 150 $\mu g/m^3$ is equal or less than one per year.

[f] The annual $PM_{2.5}$ standard is met when annual average of the quarterly mean $PM_{2.5}$ concentrations is less than or equal to 15 $\mu g/m^3$, when averaged over three years. If spatial averaging is used, the annual averages from all monitors within the area may be averaged in the calculation of the three-year mean. The 24-hour standard is met when the 98th percentile value, averaged over three years, is less than or equal to 65 $\mu g/m^3$.

Determining Compliance with the NAAQS:

To demonstrate compliance with the NAAQS, EPA has defined specific criteria for each pollutant. These criteria are summarized in **Table 2-2.**

Table 2-2: Criteria for the Determination of Compliance with the NAAQS

Pollutant	Criteria
CO	Compliance with the CO standard is met when the 35 ppm 1-hour average standard and/or the 9 ppm 8-hour average standard is not exceeded more than once per year. An 8-hour average is considered valid if at least 75 percent for the hourly average are available. In the event that 6- or 7-hourly averages are available, the 8-hour average is estimated on the basis of the average concentration for that time period.
Pb	Values are collected for three consecutive months (by calendar quarter), averaged, and then compared to the 1.5 $\mu g/m^3$ standard.
NO_2	Compliance is met when the annual arithmetic mean concentration does not exceed the 0.053 ppm standard, and is based on either hourly data that are 75 percent complete or derived from manual methods that are 75 percent complete for the scheduled sampling days in each calendar quarter.
O_3 1-hour	The area is in compliance with the standard when the three-year average of the expected number of exceedance days per calendar year is equal to or less than one using the interpretative procedure described in 40 CFR 50 Appendix H (**7**)
O_3 8-hour	The 8-hour primary and secondary 0.08 ppm standards are met when the three-year average of the 4th highest daily maximum 8-hour average concentration is less than or equal to 0.08 ppm as determined with 40 CFR 50 Appendix I (**8**).
PM_{10}	The annual primary and secondary standards are met when the annual arithmetic mean concentration averaged over three years is less than or equal to 50 $\mu g/m^3$ using the procedures in 40 CFR 50 Appendix J (**9**). The 24-hour primary and secondary standards are met when the expected number of days per calendar year above 150 $\mu g/m^3$ is equal or less than one.
$PM_{2.5}$	The annual and secondary standards are met when the annual arithmetic mean concentration is less than or equal to 15 $\mu g/m^3$ using the procedures identified in 40 CFR 50 Appendix N. The 24-hour primary and secondary standards are met when the three-year average of the 98th percentile 24-hour concentration using the procedures in 40 CFR 50 Appendix N is less than or equal to 65 $\mu g/m^3$ (**10**).
SO_2	To determine compliance, the annual average concentration shall not exceed 0.030 ppm, the 24-hour average concentration shall not exceed 0.14 ppm more than once per calendar year, and the three-hour average concentration shall not exceed 0.5 ppm more than once per calendar year. The respective averages shall be based upon hourly data that is at least 75 percent complete.

Michigan Air Monitoring Networks:

The Michigan Air Sampling Network (MASN) is designed to measure air quality throughout the state. The network is operated by the MDEQ's Air Quality Division (AQD), local agencies, and industry. **Figures 2-1** and **2-2** show the geographical locations where ambient air monitoring was conducted during year 2001. **Table 2-3** also identifies the types of monitoring conducted at each monitoring site and includes each site's Aerometric Information Retrieval System (AIRS) identification number. Since the measurable concentration of a given air contaminant at a particular time and place is highly dependent on meteorological conditions, wind speed and direction instruments, barometric pressure, solar radiation, and relative humidity are also monitored at some of these locations.

Figure 2-1: Michigan Air Monitoring Network Map

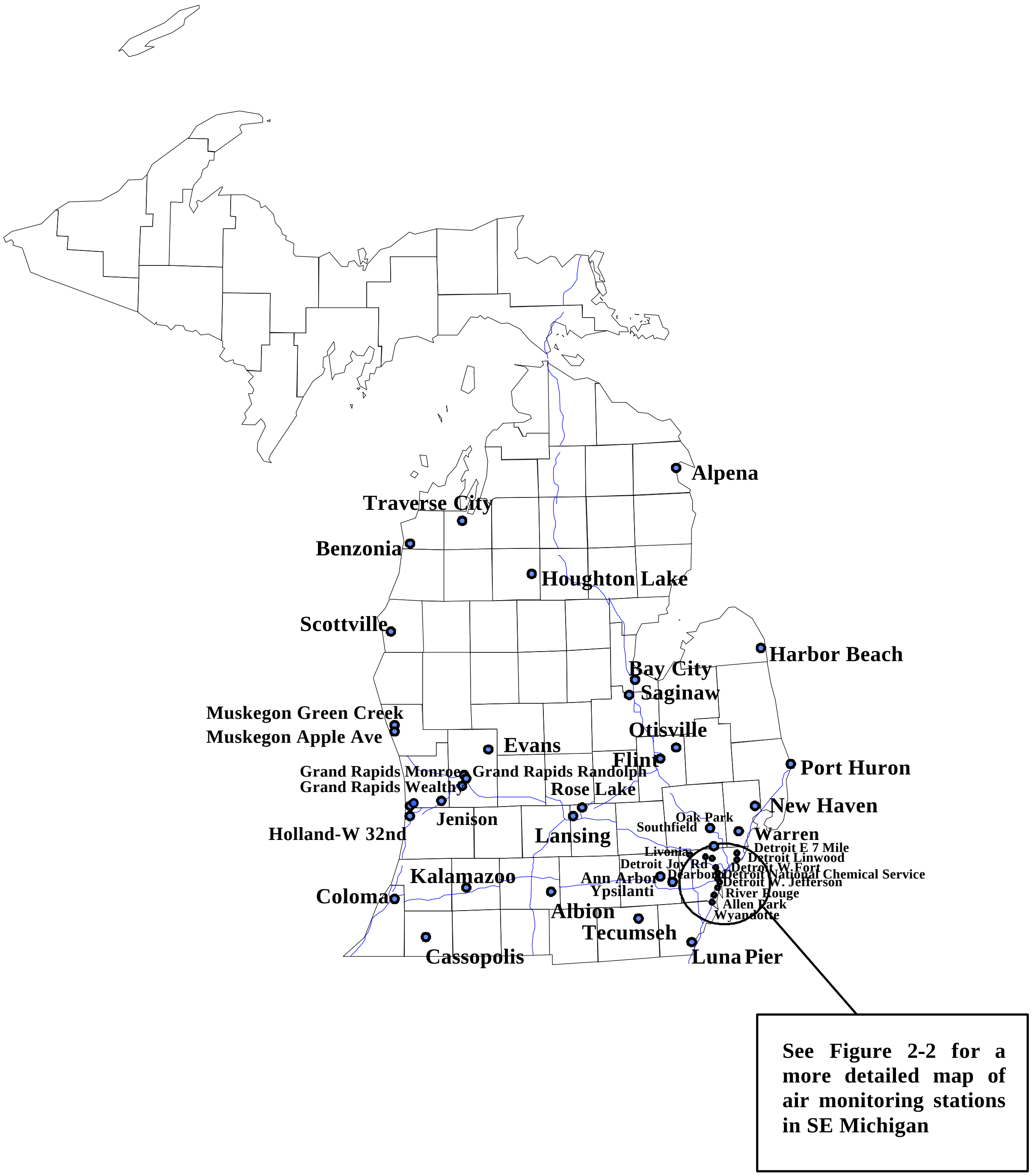
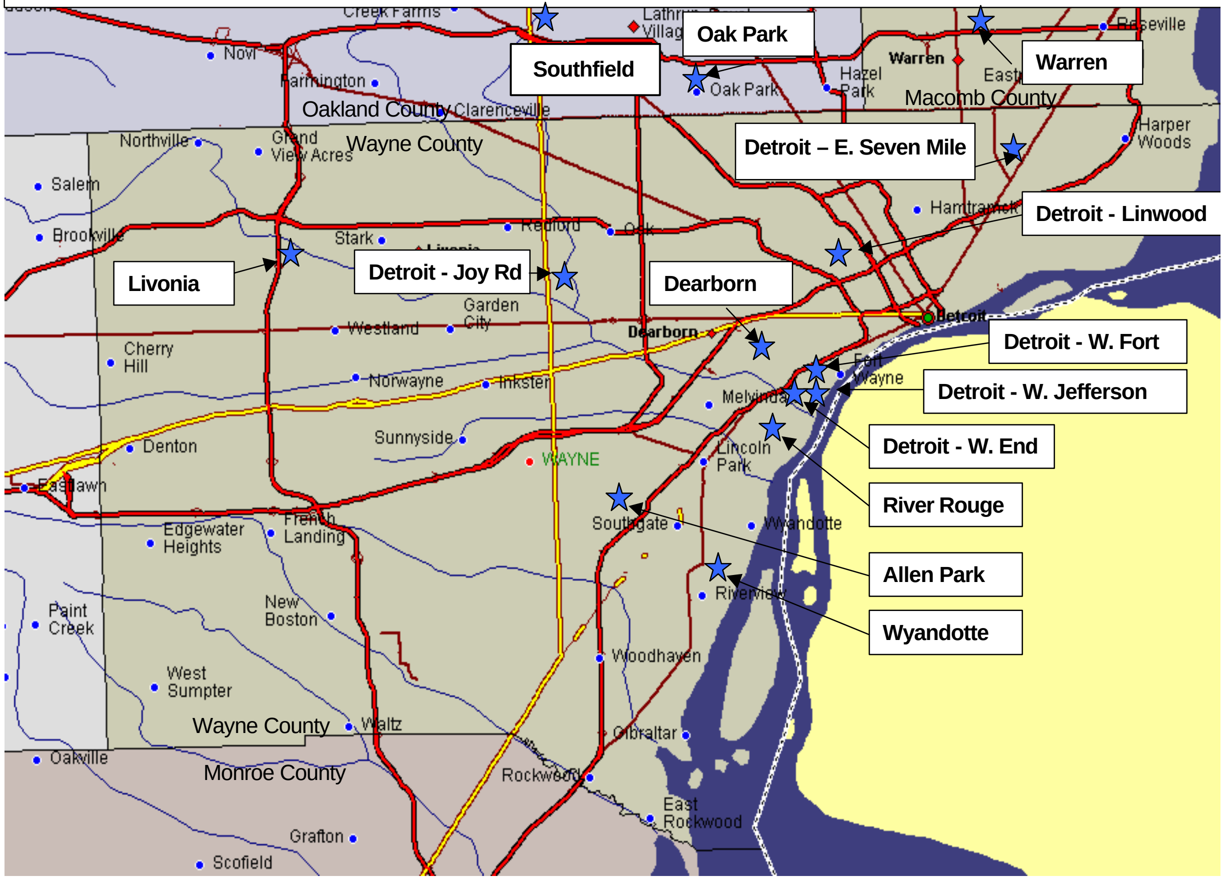


Figure 2-2: Southeast Michigan Air Monitoring Network Map



The AQD verifies, analyzes, and collates all data collected by the MASN. Industries voluntarily, or under agreement or order, submit air monitoring data to the AQD. Data collected and reported thereby must meet minimum quality assurance requirements established by the AQD and EPA, as outlined in 40 CFR Part 58 and its Appendices (**17**).

All sampling sites are selected and/or approved by the AQD. Selection of site locations and types of sensors are based on scientific evaluation of locale, need, nearby sources, and the previously described federal network design requirements defined in 40 CFR Part 58. Criteria used are consistent with EPA siting guidelines and generally accepted monitoring practices. Monitors are placed in most counties containing significant air pollution sources. The monitoring network is continuously under review for adequacy, site acceptability, and cost effectiveness.

In the early years of air monitoring, major monitoring emphasis was placed upon TSP and SO_2. However, with the reduction of the levels of those pollutants, increased emphasis has been placed on other criteria pollutants such as O_3 and fine particulates.

Table 2-3: Michigan Air Sampling Network Station Location in 2001

Site Name	AIRS ID	Carbon Monoxide	Lead	Nitrogen Dioxide	Ozone	Particulate Matter PM_{10}	Particulate Matter $PM_{2.5}$	Sulfur Dioxide	Toxic Organics	Carbonyl Aldehydes/Ketone	Trace Metals	Meteorological Parameters
Albion	260250003					√						
Allen Park	261630001	√	√		√	√	√*¦		√	√	v	√
Alpena	260070005						√					√
Ann Arbor	261610005						√					
Bay City	260170014						√					
Benzonia	260190003				√							
+Cassopolis	260270003				√							
Coloma	260210014				√		√					√
Dearborn	261630033		√			√¦	√	√	√	√	v	√
Detroit - E. Seven Mile Rd	261630019		√	√	√		√*	√	√	√	v	√
Detroit - Joy Road	261630026	√										
Detroit - Linwood	261630016	√	√	√	√		√	√				
Detroit - W. End.	261630092					√						
Detroit - W. Fort	261630015		√			√	√	√	√	√	√	v
Detroit - W. Jefferson	261630027		v					√	√	√	v	
Evans	260810022				√							√
Flint	260490021		√		√	√	√	√			√	√
Grand Rapids - Monroe St	260810020	√			√	√	√¦	√				√
Grand Rapids - Randolph	260810021		√						√	√	√	√
Grand Rapids - Wealthy St	260810007					√						
Harbor Beach	260630007				√							√
Holland	260050003				√		√					√
Houghton Lake	261130001		√		√				√	√	√	√
Jenison	261390005				√		√					√
Kalamazoo	260770008				√		√¦					√
Lansing	260650012			√	√		√¦					√
Livonia	261630025	√				√	√					
Luna Pier	261150005						√					
Muskegon - Apple Ave	261210040						√					
Muskegon - Green Creek Rd	261210039				√							√
New Haven	260990009				√		√					√
Oak Park	261250001	√			v		√					√
Otisville	260492001				√							√
Port Huron	261470005				√		√	√				√
River Rouge	261630005		√			√		√	√	√	√	
Bath Twp.	260370001				√							
Saginaw	261450018						√¦					√
++Sault Ste. Marie - Marquette Ave.	260330902						v					
++Sault Ste. Marie - Easterday Ave	260330901						v*					
Scottville	261050007				√							√
+++Southfield	261250010		v				v*		√	√	v	v
Tecumseh	260910007				√							√
Traverse City	260550003						√					
Warren	260991003	√			√			√				
Wyandotte	261630036						√					
Ypsilanti	261610008		√		√		√¦		√	v	√	√

√ data collected

* $PM_{2.5}$ chemical speciation monitor at site

■ TEOM (tapered element oscillating microbalance) provides hourly concentrations

+Cassopolis monitor is managed by Indiana Department of Environmental Management.

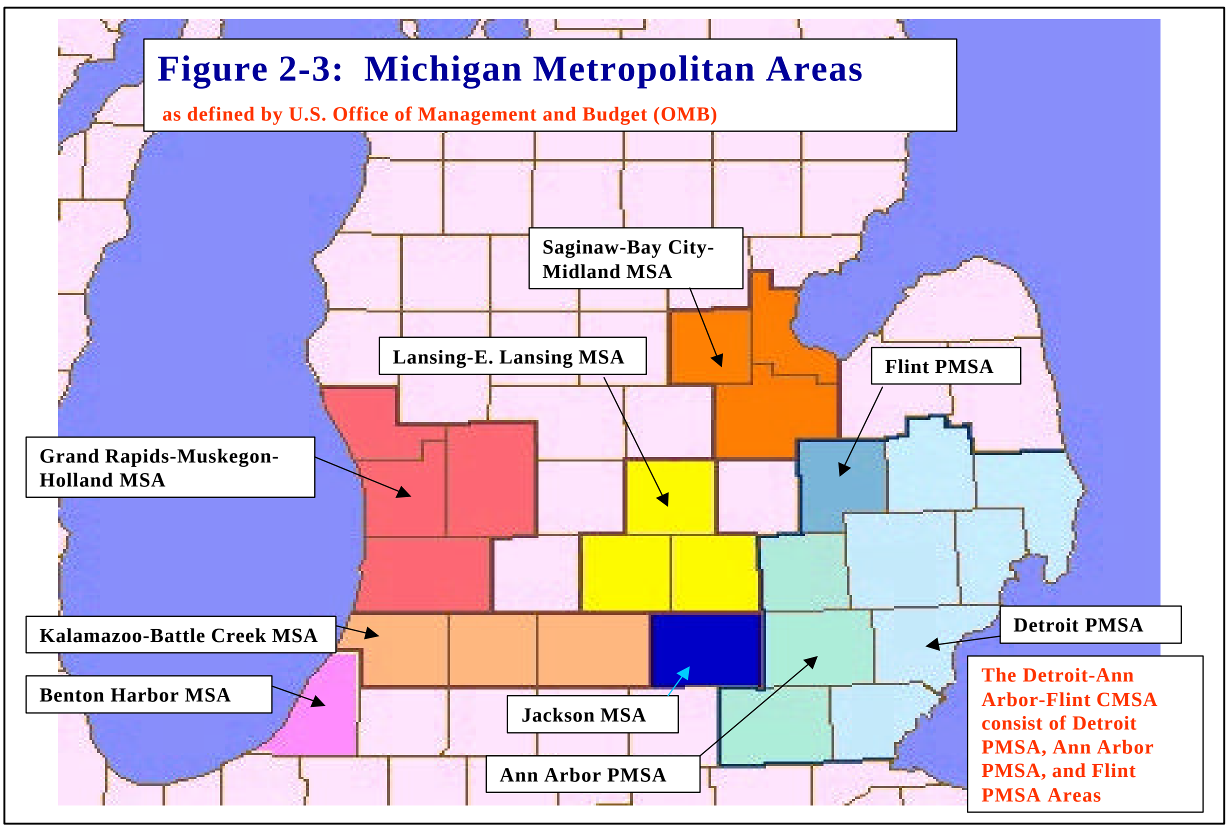
++Sault Ste. Marie monitors are managed by the Inter-Tribal Council of Michigan, Inc.

+++Southfield monitor was used in the special Detroit Air Toxics Pilot Project (pilot project discussed in Chapter 4).

Metropolitan Statistical Areas:

Michigan is divided into smaller areas called Metropolitan Statistical Areas or MSAs. An MSA is designated as a large population nucleus, together with adjacent communities, that have a high degree of economic and social integration. An MSA must include at least (a) one city with a population of 50,000, or (b) a Bureau of Census defined urbanized area of at least 50,000 inhabitants and a total population of at least 100,000. The boundaries for an MSA usually coincide with one or more county boundaries. The largest city of the central county along with adjacent counties has at least 50 percent of their population in urbanized areas surrounding the largest city. Outlying or adjacent counties are included within the MSA if they meet specified commuting requirements with the central county, or contain urbanized areas and population density. MSAs that have a population of at least one million comprise a Consolidated Metropolitan Statistical Area (CMSA). Primary Metropolitan Statistical Areas (PMSAs**)** are single counties or groups of counties that make up a mega-metropolitan area. A PMSA is the combination of an MSA with the surrounding metropolitan area. A CMSA usually contains a group of PMSAs that have significant economic and social integration.

Based on the June 30, 1999 data[1], the Michigan MSA, PMSA, and CMSAs are shown in **Figure 2-3.** There are six MSAs and one CMSA, comprising three PMSAs in Michigan. The EPA has historically relied upon metropolitan area boundaries when designating nonattainment areas for air pollutants relative to NAAQS.



[1] Census data may be obtained through the Internet from the U.S. Census Bureau at: http://www.census.gov/

Monitoring Techniques:

Air pollutants are generally monitored above ground level near the breathing zone as specified by a variety of EPA reference or equivalent methods. Detailed explanations of these methods may be found in 40 CFR Part 58, Appendix C. Network design requirements for state and local air monitoring stations, and national air monitoring stations, are provided in 40 CFR Part 58, Appendix D. Complete methods, quality assurance procedures, auditing procedures, and references are given in the series of publications: Quality Assurance Handbook for Air Pollution Measurement Systems Volumes I to V, EPA-600/Series (**18-22**). The EPA has provided specifications to the states in determining proper site selection (**19-29**) of a monitoring station. On-line information is now available at: **http://www.epa.gov/ttnamti1/**.

CHAPTER 3: Air Quality Trends in Michigan

This chapter provides an assessment of Michigan air quality relative to NAAQS based upon the monitoring of ambient air quality from a statewide air quality surveillance network. Following are the air quality trends in Michigan for the criteria pollutants - carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter (PM_{10} and $PM_{2.5}$), and sulfur dioxide.

Chapter 3.1: Carbon Monoxide Trends

Introduction:

Carbon monoxide (CO) is an odorless, tasteless, colorless, poisonous gas that is created from incomplete combustion of carbon-containing fuels and waste materials. It is primarily produced from fossil fuels consumed for transportation, heating, industrial processes, and electrical generation.

Motor vehicle CO emissions contribute nearly 60 percent of the total national emissions (**1**). In urban areas with traffic congestion, motor vehicle emissions may represent 95 percent of all CO emissions (**1, 2**). Much of the national scale emission reductions over the past decade are attributed to motor vehicle emissions controls. New tailpipe emission standards, and the use of oxygenated fuels in some areas, has resulted in a decrease of on-road motor emissions of 24 percent despite a nationwide increase in vehicle miles traveled of 23 percent over the last decade. In 1994, a CO emission standard of 10 grams (g) per mile was implemented for new cars and light-duty trucks at a temperature of 20°F (**13, 14**). With the replacement of older vehicles with vehicles subject to more stringent emission standards, significant motor vehicle emission reductions have occurred and are reflected in ambient CO monitoring data in later years.

Statewide CO emission totals for Michigan industry have shown a decline over the decade time period. CO emission estimates were 20 percent less than what the emissions were at the beginning of the decade. At present, all Michigan areas are designated in attainment with the 1-hour and 8-hour standards.

Previous winter day emission inventories have shown that the majority of CO emissions are attributed to on-road mobile sources (84 percent) in the Detroit-Ann Arbor area. Fossil fuel combustion from electrical utility, industrial, commercial, and residential sources, as well as iron, steel manufacturing, and foundries were the leading stationary sources of CO in this area (**3, 4**).

CO Effects:

CO enters the bloodstream through the lungs and binds to hemoglobin in the red blood cells. Hemoglobin normally carries oxygen to organs and tissues, but because CO binds with the hemoglobin 240 times more readily than oxygen, the amount of oxygen distributed throughout the body is reduced. CO reacts with blood hemoglobin to form carboxyhemoglobin (COHb), a more stable compound than oxyhemoglobin (O_2Hb). The health effects are more severe for those who suffer from cardiovascular disease, especially those with angina and peripheral vascular disease, because their circulatory systems are less efficient at carrying oxygen. Healthy individuals are affected at higher concentrations (**6**).

At elevated levels, CO can cause visual impairment, interfere with mental acuity by reducing learning ability/manual dexterity, and can decrease work performance in completion of complex tasks (**1**). The severity of the reduced mental acuity effect is related to the time duration of exposure and the concentration of CO.

Primary sources of exposure to elevated levels of CO are the exhaust from idling automobiles, unvented gas or kerosene space heaters, gas ranges with continuous pilot flame ignition, and cigarette smoke. Indoor air CO exposure levels in excess of 50 ppm can occur during startup and idling of motor vehicles in attached residential garages and the use of unvented gas or kerosene space heaters (**5**).

NAAQS for CO:

Primary NAAQS:	8-hour average not to exceed 9 ppm more than once/year. 1-hour average not to exceed 35 ppm more than once/year.
Secondary NAAQS:	None.

An 8-hour standard of 9 ppm (10 mg/m^3) and a 1-hour standard of 35 ppm (40 mg/m^3) are the two primary standards for CO, which are not to be exceeded more than once each year (**7**). There is no secondary standard for CO. The 8-hour standard is considered to be the more controlling form because there has not been an exceedance of the 1-hour standard on a national level since 1990 (**6**).

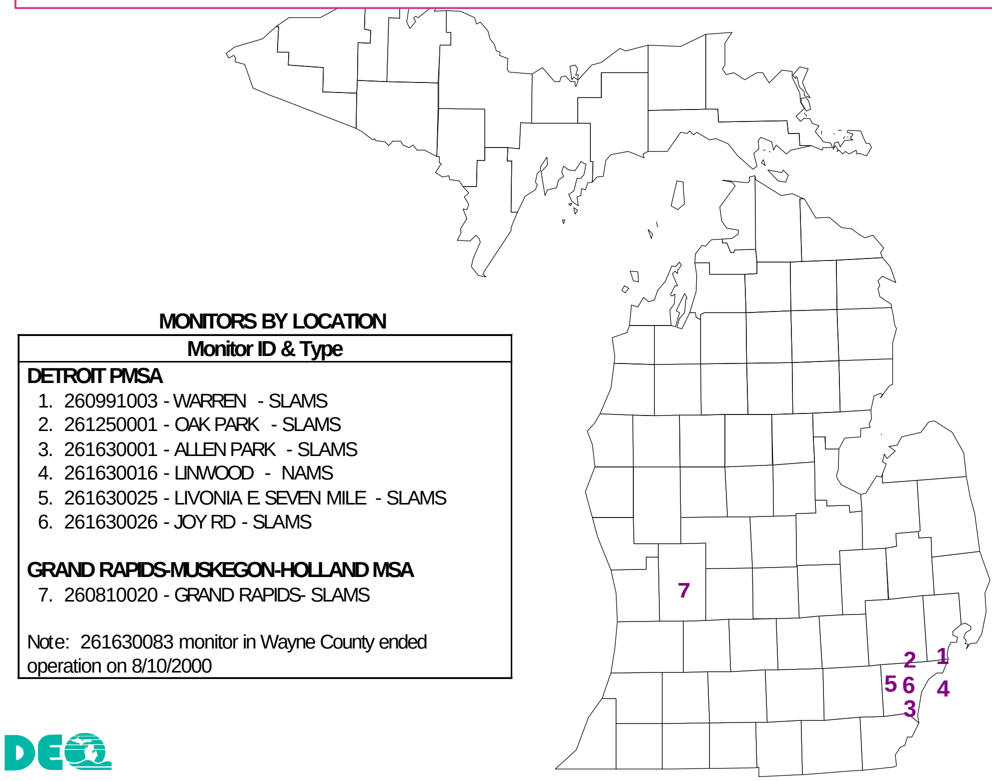
The NAAQS for CO were originally promulgated on April 30, 1971 (**5**). On August 17, 2000, the EPA National Center for Environmental Assessment announced the final completion of their air quality criteria for CO (**8**). The purpose of this review is to provide an assessment of the latest relevant scientific information that may have an impact on the next periodic review of the NAAQS. Although the criteria document has been completed, a staff paper has not yet been developed with a recommendation to either retain or revise the CO NAAQS.

CO Monitoring in Michigan:

All MSAs with populations greater than 500,000, as determined by the most recent census, are required to have two national air monitoring stations (NAMS) for CO. One of the sites, also known as a type “a” NAMS site, should be designed to measure peak concentrations in major traffic, urban downtown areas at a microscale level (**9**). A microscale air volume is associated with distances that cover several meters (m) to about 100 m. A type “b” NAMS site must be located in a highly-populated area to assess population exposure at a larger neighborhood or middle scale (**9**). Neighborhood air masses cover an extended area of the city with homogeneous land use extending from 0.5 kilometers (km) to 4 km. Middle scales cover several city blocks and range from 100 m to 0.5 km. The type “a” NAMS monitor for the Detroit MSA is located at Fort Street and is sited to detect “high spikes” in CO concentrations in downtown Detroit. The Joy Road site replaced the old population-oriented type “b” NAMS monitor that was previously located at the Evergreen site for the Detroit MSA. On April 29, 1999, the MDEQ and the Wayne County Department of the Environment requested that the Linwood CO monitor be designated as the category “b” CO site for Detroit. The request was accepted by the EPA regional office, and is still awaiting final approval by the EPA Office of Air Quality Planning and Standards (**10**).

In addition to the Detroit NAMS sites, five other CO monitors operated in the Detroit area to determine neighborhood scale population exposure. These are part of the State and Local Air Monitoring Stations (SLAMS) sites. These Detroit SLAMS area monitors include Warren, Oak Park, Allen Park, E. Seven Mile Road, and Joy Road. A single SLAMS monitoring station in Grand Rapids at Monroe also monitors population exposure to CO. **Figure 3.1-1** shows the respective site locations where CO monitoring was conducted during 2001.

Figure 3.1-1: Air Quality Monitors for CO Active in 2001

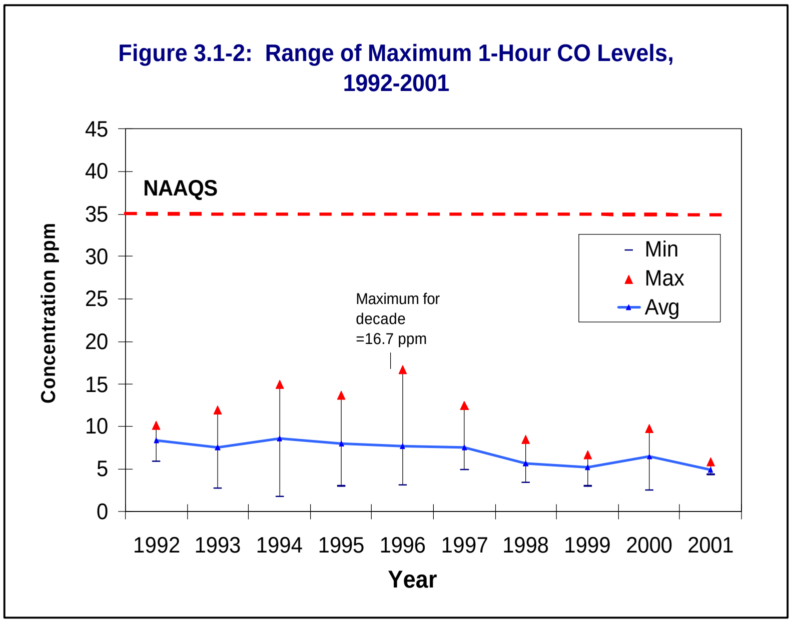


Attainment/Nonattainment Status of CO in Michigan:

The majority of monitoring stations are located in the Detroit MSA due to the large urban population. Prior to 1999, the portions of Wayne, Oakland, and Macomb Counties were designated as nonattainment or unclassified. Monitoring data collected since 1995 shows the NAAQS are being met, so these areas were officially redesignated to attainment status on August 30, 1999 (**11**). As of January 29, 2001, there were 16 nonattainment areas for CO nationwide classified as either moderate or serious nonattainment areas (38 counties) (**12**). All of the CO nonattainment areas are located in the Pacific Northwest or Southwest states, with the exception of one nonattainment area in New York/New Jersey.

Long-Term Trends in CO:

Figure 3.1-2, provides the maximum 1-hour CO levels for the Michigan air sampling network for the decade. Over the 10-year period, the statewide annual average trend line has been less than one quarter of the 35 ppm NAAQS.



Maximum 1-hour values of individual sites for the decade have ranged between 16.7 ppm (1996) to the lowest recorded value of 5.9 ppm on November 3, 2001, at Detroit's Linwood monitor.

The 8-hour statewide averages have dropped to levels less than half of the 8-hour 9.0 ppm NAAQS.

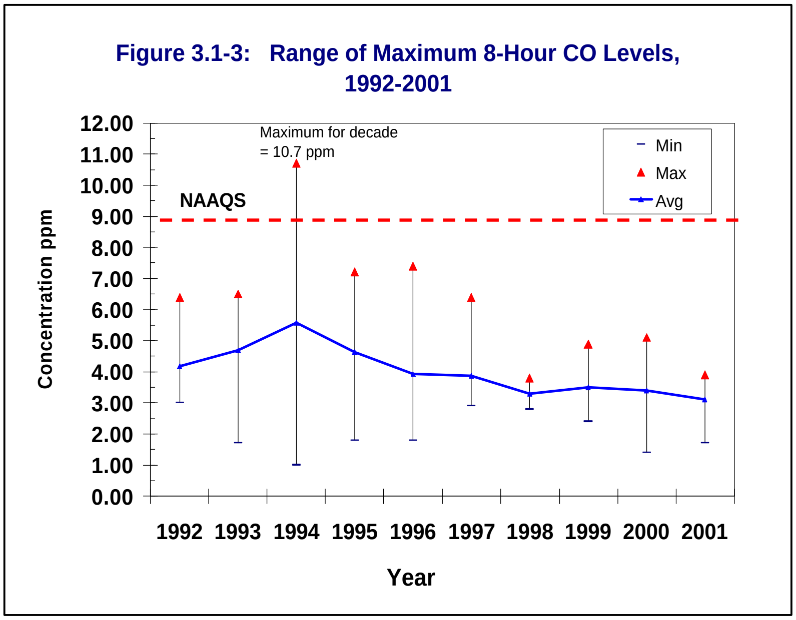


Figure 3.1-3 indicates that the mean trend line levels of CO measured over an 8-hour time period have generally decreased from 1995 through 2001. The maximum 8-hour readings exceeded the NAAQS at one location in December of 1994. No excursions of the 8-hour standard have occurred since.

When comparing individual monitoring sites for the decade, the highest annual 8-hour readings ranged from 10.7 ppm in 1994 to a low of 3.9 ppm in 2001. The highest 8-hour value occurred in November 2001 at Oak Park in Oakland County.

During 1994, there were two exceedances of the 8-hour NAAQS at the Evergreen station in Detroit. No exceedances of either 8-hour or 1-hour CO standards have occurred in the last seven years.

CO Trends by MSA & Location:

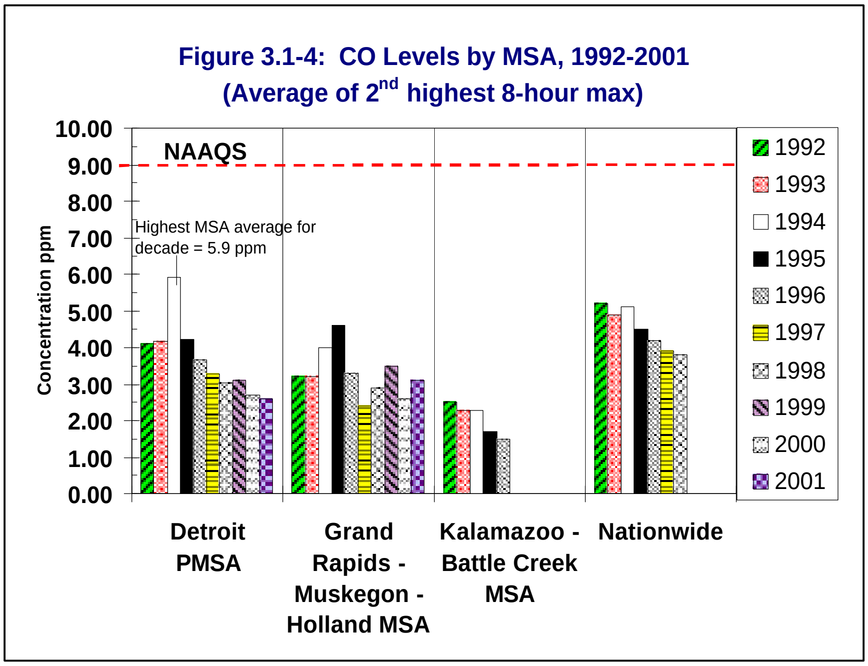
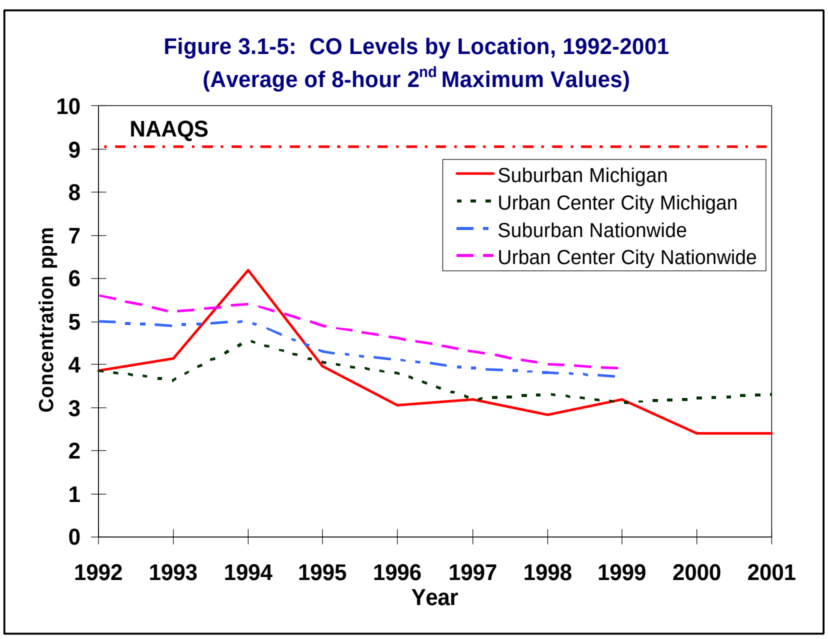


Figure 3.1-4 provides a comparison of the second highest 8-hour average values from Michigan MSAs with nationwide averages (EPA information on nationwide averages are only available through 1998). The greatest average value occurred in the Detroit PMSA in 1994 (5.9 ppm) due to exceedances at the Evergreen site, but the number of sites that are reflected in the computation of the area average would limit the impact of a single site on the average. With the exception of 1994 (Detroit PMSA) and 1995 (Grand Rapids-Muskegon-Holland MSA), Michigan's MSAs historically have better air quality when compared to nationwide trend site averages.

Annual spatial average CO concentrations in Detroit have decreased in recent years to nearly half of the 5.9 ppm level experienced in 1994, and are currently at 2.6 ppm. CO concentrations peaked in the Grand Rapids-Muskegon-Holland MSA during 1995 at 4.6 ppm before further declining to 3.1 ppm in 2001.



Additional historical comparisons were performed, which investigated suburban and urban center city CO concentrations on both a state and nationwide scale (EPA's information on nationwide averages are only available through 1999). **Figure 3.1-5** shows CO concentration levels as an average of the 8-hour 2nd maximum values for suburban and urban areas. Urban areas generally experienced higher CO concentrations than their suburban counterparts. In Michigan, suburban locations have generally exhibited lower CO values than their national counterparts, with the exception of 1994. Similarly, Michigan urban areas historically had lower CO average values than the nationwide averages.

Chapter 3.2: Lead Trends

Introduction:

From the 1920s until the 1970s, automotive gasoline contained alkyl lead (Pb) compounds to prevent engine knocking. Alkyl Pb compounds combine with other fuel additives during combustion to produce Pb oxides and compounds that are emitted with motor vehicle exhaust. Alkyl Pb content of gasoline began to be controlled in 1975 when motor vehicles were equipped with catalytic converters to reduce automotive hydrocarbon and CO emissions. Pb additives were found to impair performance of catalytic converters of motor vehicle emission control systems (**1**). Phase-out of Pb additives occurred when epidemiological studies found that Pb particulate emissions from motor vehicles presented a significant harm to urban populations, especially children (**1**). The CAA of 1990 required elimination of Pb in motor vehicle fuels. Since 1996, motor vehicle gasoline may not exceed 0.05 g (grams) per gallon (**1**). The changes in gasoline formulations have had a marked impact on Pb emissions from motor vehicles. Today, Pb emissions from on-road mobile sources contribute less than one percent of all national emissions (**2**). Monitored ambient Pb air pollution levels along the nation's roadways reflect a 97 percent decrease (**2**). National trend studies of population-oriented monitors between 1990 and 1999 have shown a 60 percent reduction in the maximum quarterly Pb concentration (**6**).

As a result of the phase-out of Pb additives in gasoline, industrial and combustion sources are the dominant Pb emission sources. Metallurgical processes such as smelting/refining of Pb, copper, and zinc, and the production of iron, steel, gray iron, brass, and bronze emit Pb. Pb acid batteries, Pb oxide/pigments, Pb glass, portland cement, and solder production are also industrial Pb emission sources (**3**). Pb is an impurity in coal, oil, and waste oil, as well as municipal solid waste and sewage sludge incineration, and may be released to the atmosphere during their combustion (**3**). Smelters and battery plants are now the major sources of Pb nationwide (**4, 5, 6).**

Pb emissions generated from gasoline additives, nonferrous smelters, and battery plants have significantly decreased over the past 25 years. Statewide average ambient Pb levels continue to remain low. Most of the reduction is due to the removal of alkylated Pb from automotive gasoline, which began during the 1970s.

Over the past decade, statewide average Pb concentrations have remained at levels less than one tenth of the standard. The highest levels occurred at W. Fort Street in Detroit and in Dearborn, with maximum quarterly Pb concentrations at 0.06 $\mu g/m^3$ and 0.05 $\mu g/m^3$, respectively.

Pb Effects:

Exposure to Pb can occur by inhalation or ingestion of food, water, soil, or dust particles. Pb is accumulated in the body, primarily in the blood, bones and in the soft tissues. The half-life of Pb stored in bone tissue is 25 years but only 25 to 50 days in soft tissues and blood. Anemia was associated with chronic exposure at blood Pb concentrations of 50-60 micrograms per deciliter (µg/dl) in adults, and in children at 40-70 µg/dl (**8**). Studies show that Pb may be a factor in high blood pressure and heart disease (**5, 7, 9**). The central nervous system of children and fetuses are susceptible to damage when exposed to low dose levels of Pb. Lower IQ scores and neurological impairment, such as seizures, mental retardation, and behavioral disorders, have been associated with increased Pb exposure (**10**). Blood Pb levels declined nationwide from 1976 to 1991, coinciding with changes in the Pb content of gasoline (**7**).

Airborne Pb can also adversely effect plant growth. At concentrations of 2-10 $\mu g/m^3$, Pb can inhibit plant growth and effect plant species diversity, and affect the microbial ecology of bacteria and fungi of soils. Reduced decomposition, nitrification, and a reduction in the number of invertebrates have been associated with Pb exposure. For aquatic ecosystems receiving atmospheric deposition into area source urban runoff and industrial/municipal effluents, Pb exposure has been associated with increased mortality and impaired reproduction in aquatic invertebrates. Blood and neurological changes also occur in fish (**10**).

NAAQS for Pb:

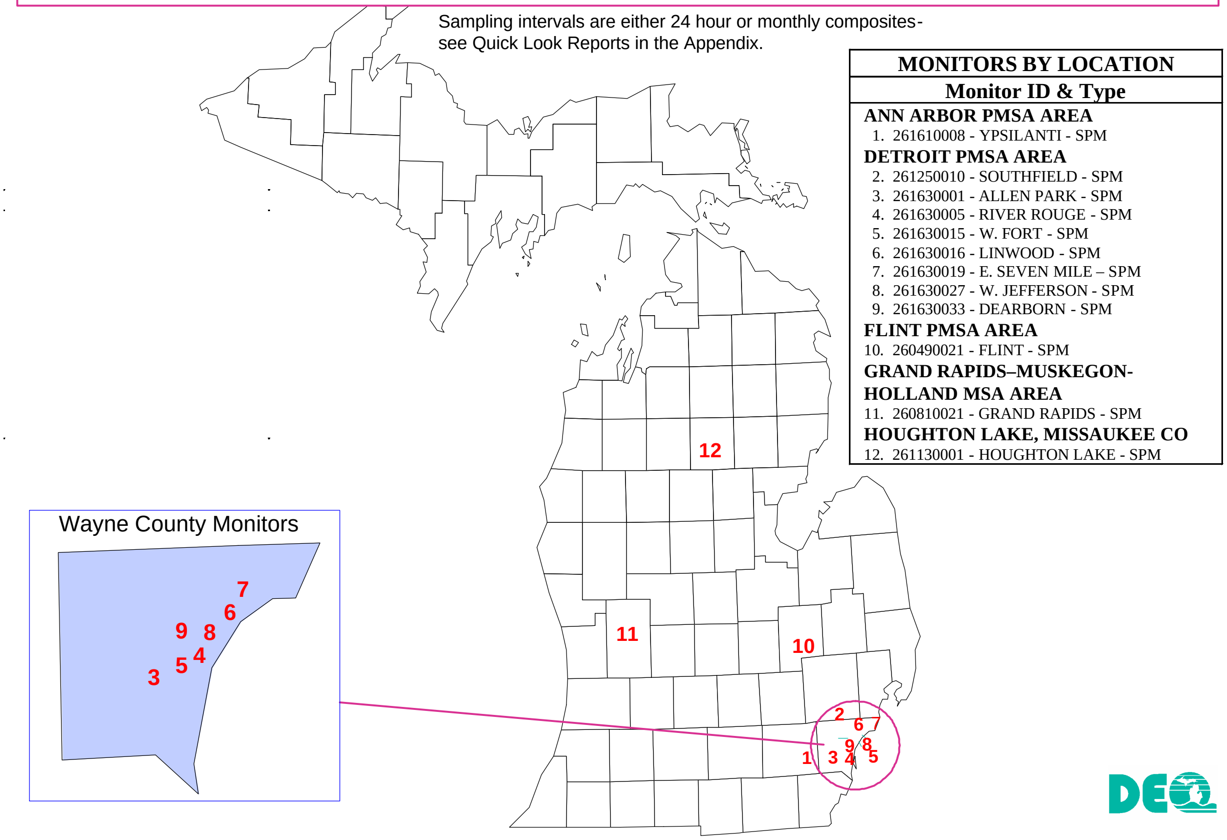
Primary NAAQS:	Maximum quarterly average not to exceed 1.5 $\mu g/m^3$.
Secondary NAAQS:	Same as primary standard.

The NAAQS for Pb specifies that the average of all the Pb samples collected during a calendar quarter may not exceed 1.5 $\mu g/m^3$ (**11**). Due to changes in Pb emission source characterization in 1997, the EPA proposed the focus of surveillance monitoring be changed from mobile source-oriented to an industrial source-oriented monitoring strategy (**12**). With the phase-out of alkylated Pb additives in motor fuels, there was no longer the need to assess Pb levels near major highways. There are no large sources of Pb in Michigan and no point source-oriented monitoring is being conducted in the state.

Pb Monitoring in Michigan:

In Michigan (see **Figure 3.2-1**), a total of 12 Pb monitoring sites operated during 2001, including a single Detroit NAMS at E. Seven Mile Road (26-163-0019). All sites continue to demonstrate concentrations well below the NAAQS.

Figure 3.2-1: Air Quality Monitors for Pb Active in 2001



Although the change in the federal surveillance regulations allows for the discontinuance of many monitors, Michigan has continued Pb monitoring in the Detroit PMSA, Flint PMSA, and Grand Rapids-Muskegon-Holland MSA. As part of the Michigan Toxics Air Monitoring Program (MITAMP) and the Detroit Air Toxics Pilot Project (discussed in Chapter 4), the filters from several TSP monitors are analyzed for several metals, including Pb. As part of MITAMP, trace metal analysis was performed at Grand Rapids, Flint, River Rouge, Detroit at W. Fort Street, and Houghton Lake. The special purpose monitor (SPM) at Detroit's W. Fort Street is located so that maximum Pb levels in a middle scale air mass are monitored. The monitor stations in Flint at Whaley Park and Detroit at River Rouge measure maximum Pb levels on a neighborhood scale. A new MITAMP site began in Ypsilanti on May 30, 2000.

These MITAMP SPMs, which monitor metals, provide ambient Pb measurements collected for a 24-hour period every six to twelve days. The Detroit Air Toxics Pilot Project is part of a much larger national study that involves characterization of spatial and temporal variability of ambient air toxics concentrations. As part of this investigation, ambient Pb concentrations were collected for a 24-hour period every six to twelve days at monitoring sites located in Ypsilanti and the Detroit PMSA at E. Seven Mile Road, W. Fort Street, River Rouge, Dearborn, Allen Park, Southfield, and W. Jefferson. Therefore, Pb monitoring was expanded during years 2001 and 2002 as part of the Detroit Air Toxics Pilot Project.

Attainment/Nonattainment Status of Pb in Michigan:

All areas in Michigan are designated as attainment for Pb (**13**). As of January 29, 2001, there were only six nonattainment areas in the United States for Pb (**14**).

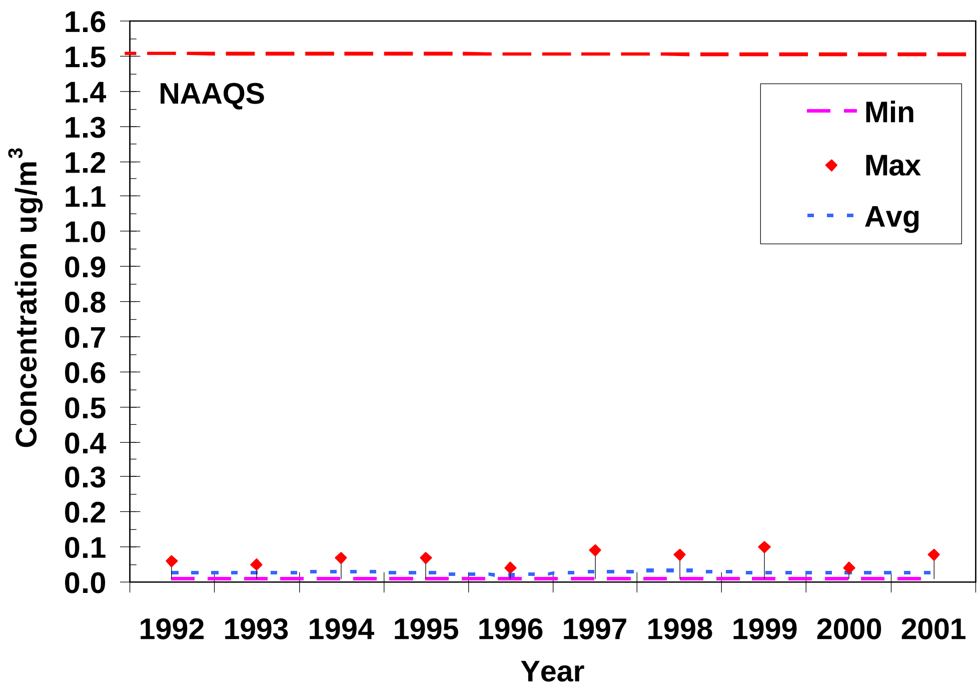
Violation of the Pb NAAQS are only known to occur near large industrial sources such as Pb smelters (**6**). In Michigan, atmospheric ambient Pb levels have consistently remained significantly low at all monitored locations.

Long-Term Trends in Pb:

Average Pb levels of monitors in Michigan (see **Figure 3.2-2**) have remained at less than one-tenth of the national air quality standard over the past decade. Historically, Michigan's ambient Pb levels have been less than the national average.

The statewide average of the quarterly maximum Pb levels over the decade has typically remained below 0.02 $\mu g/m^3$. The statewide quarterly maximum Pb concentration (.08 $\mu g/m^3$) during 2001 occurred at the Allen Park monitor site during the fourth calendar quarter. The highest statewide quarterly Pb concentration (0.10 $\mu g/m^3$) over the decade occurred at Detroit's W. Fort Street site during the first calendar quarter of 1999.

Figure 3.2-2: Range of Maximum Quarterly Lead Levels, 1992-2001



Chapter 3.3: Nitrogen Dioxide Trends

Introduction:

Nitrogen dioxide (NO_2) is a reddish brown gas at high concentrations. Upon dilution it becomes yellow or invisible. It is formed by oxidizing nitric oxide (NO), has a pungent odor at high concentrations, and has an odor similar to bleach at lower levels. NO_2 is a precursor in ozone (smog) formation and can be oxidized to form nitric acid; one of the compounds found in acid rain, which contributes to the acidification of freshwater aquatic systems (**1**). NO_2 and SO_2 (sulfur dioxide) can react with other substances in the atmosphere to form acidic products that can be deposited in rain, fog, snow, or as particulate matter (**2**). Nitrate particles and NO_2 can block the transmission of light, thus causing visibility impairment in urban areas (**2**).

NO_2 Effects:

Exposure to NO_2 occurs through the pulmonary system. NO_2 irritates the lungs and asthmatics are more sensitive to its effects than the general population. Exercise increases the ventilation rate and hence exposure to NO_2. Some studies have shown a relationship between indoor NO_2 exposures and increased respiratory illness in young children (**3, 4, 5**).

NAAQS for NO_2:

Primary NAAQS:	Annual arithmetic mean not to exceed 0.053 ppm.
Secondary NAAQS:	Same as primary standard.

The annual arithmetic average of all of the hourly NO_2 samples collected during a year may not exceed 0.053 ppm.

NO_2 Monitoring in Michigan:

The map in **Figure 3.3-1** shows the locations of Michigan's three NO_2 monitors operating during the year 2001. Of the three sites, two are located in Detroit (Wayne County), and one is in Lansing (Ingham County). During the 1991 Lake Michigan Ozone Study (LMOS), the number of ambient monitoring stations for NO_2 reached a maximum of 13.

NO_2 NAMS are required in urban areas with population totals greater than 1,000,000. Detroit is the only urban area in Michigan meeting this population requirement and has two NAMS sites. The location at Linwood measures neighborhood scale air masses in the city with the largest emissions of oxides of nitrogen (NOx), whereas the E. Seven Mile Road monitor is an urban scale monitor site further downwind of peak NOx emission sources (**4**).

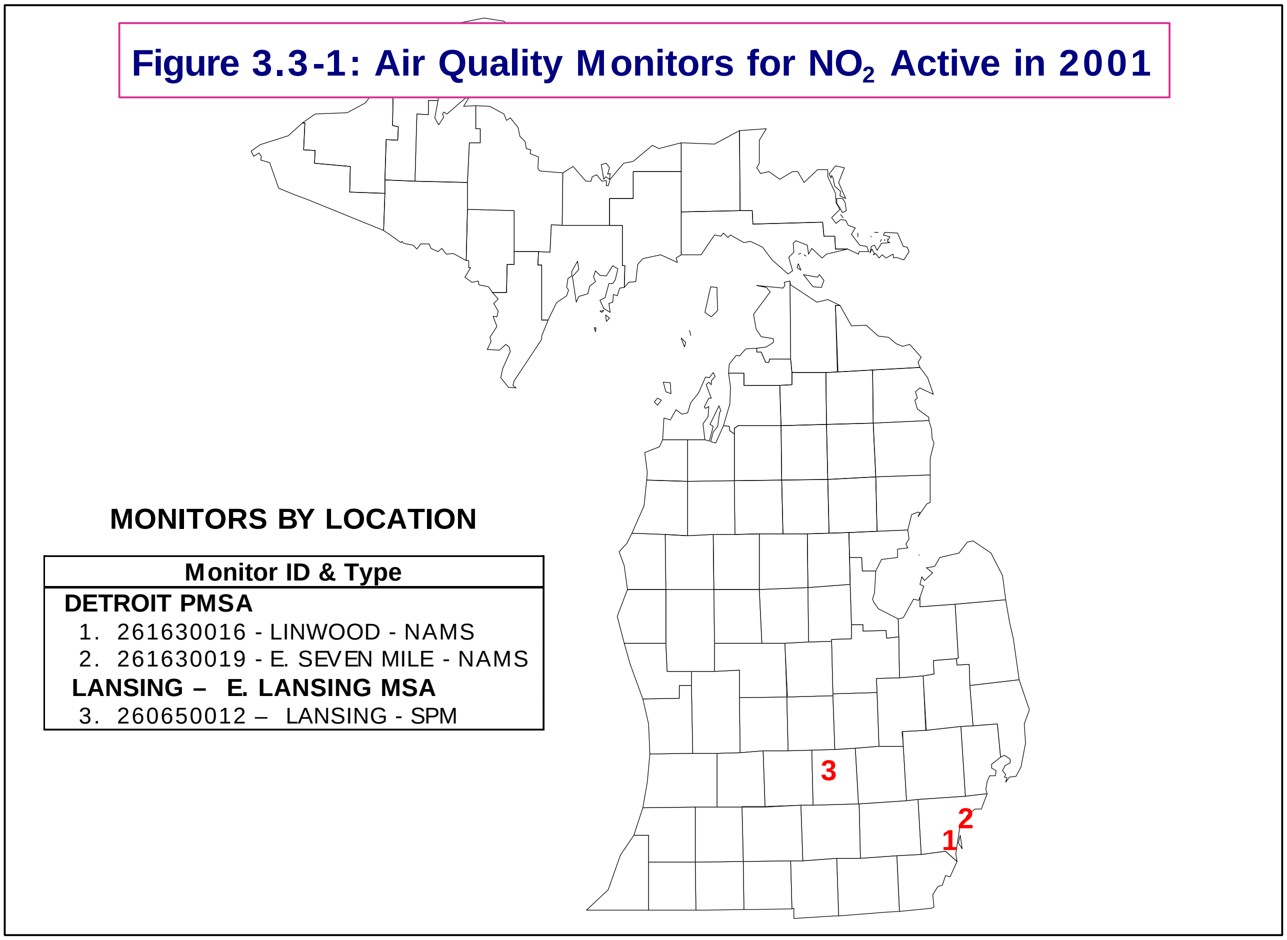


Figure 3.3-1: Air Quality Monitors for NO_2 Active in 2001

Historical air monitoring results since the 1980s have shown very little likelihood of the exceedance of the NAAQS. As part of future photochemical modeling efforts, NO_2 monitoring was conducted in Houghton Lake for the identification of rural NO_2 levels. On December 19, 2000, a Lansing monitoring site was established to assess neighborhood scale NO_2 levels in that urban area, but very limited monitoring data is available.

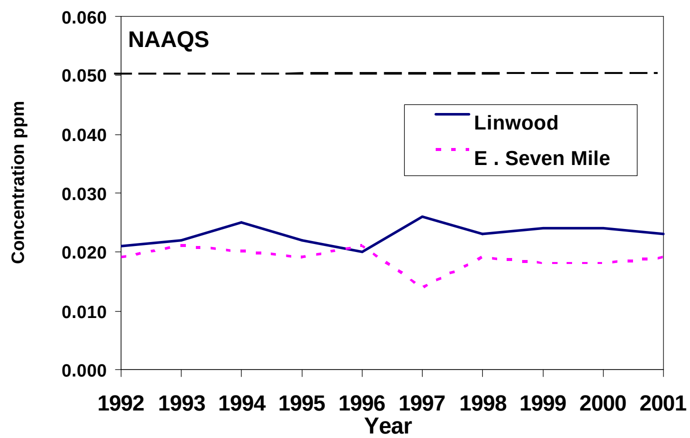
Attainment/Nonattainment Status of NO_2 in Michigan:

Since the NAAQS were established on March 3, 1978, all of the areas in Michigan (and most of the nation) have been in attainment for NO_2 (**6, 7**). Los Angeles was the only urban area nationwide that had recorded violations of the NAAQS for NO_2. In July 1998, EPA announced the redesignation of the South Coast Air Basin, the last remaining NO_2 nonattainment area in the nation, to attainment (**6**, **8**).

Long-Term Trends in NO_2:

As shown in **Figure 3.3-2**, the average NO_2 levels are well below the NAAQS. Air monitoring measurements for the past decade at Detroit's Linwood and E. Seven Mile Road monitoring sites have shown an annual arithmetic mean NO_2 concentrations at less than half of the 0.053 ppm NAAQS. During 2001, these two monitoring sites' annual arithmetic mean NO_2 concentrations were 0.023 ppm and 0.019 ppm, respectively, whereas, the Lansing site had an annual arithmetic mean concentration of 0.013 ppm.

Figure 3.3-2: Range of Annual Arithmetic Means At Detroit's - Linwood & E. Seven Mile Monitoring Sites, 1992-2001



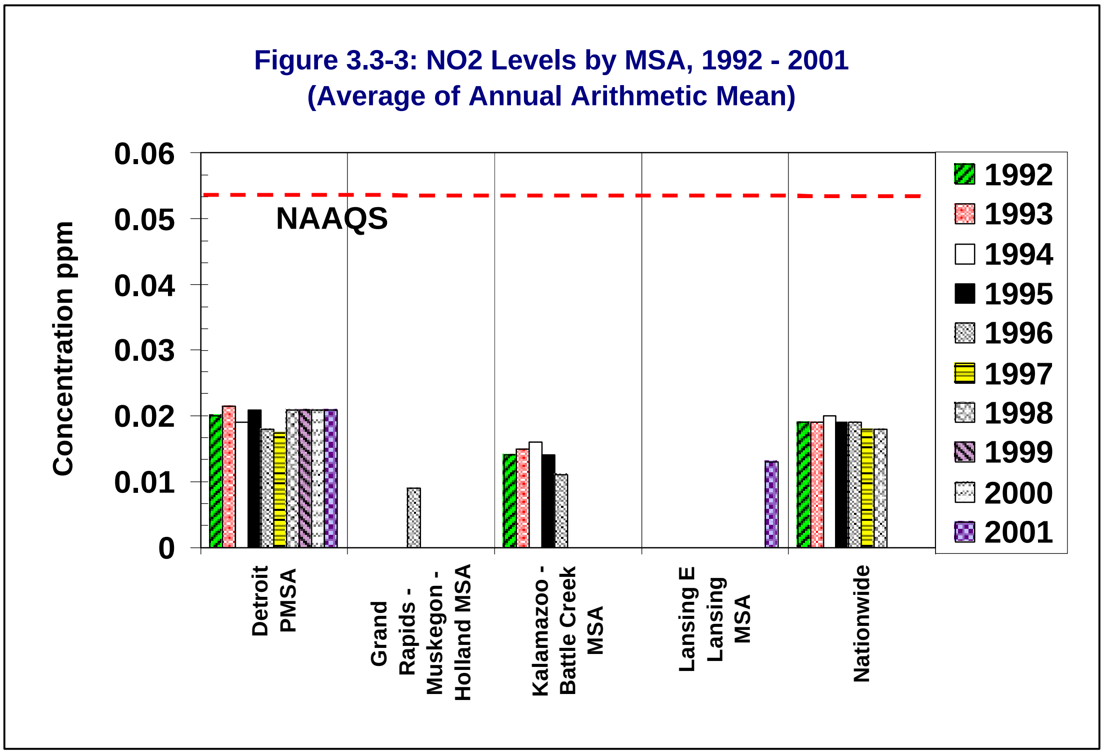
The national annual mean had a reduction of 10 percent (**1**) over the past decade (1990-1999) and 25 percent over the last 20 years. Title IV, Section 407 (Acid Deposition Control) of the 1990 CAA required the establishment of NOx annual average emission for coal-fired electric utility units in two phases. The 1990 amendments set a national goal of reducing NOx emissions by two million tons from that of the 1980 emission level. Phase 1 NOx emission limitations began on January 1, 1996, and affected dry-bottom wall-fired and tangentially-fired boilers (**9**). By 1998, a total of 265 coal-fired utility units were subject to the Phase 1 emission reductions. The national Phase 1 emission reductions have resulted in emissions that are 29 percent lower than the 1990 national emissions total of 265 utility units (**6**). During a second phase starting January 1, 2000, the remaining Group 1 boilers are subject to more stringent NOx emission limits with annual average limitations of 0.46 pound per millimeter british thermal units (lb/mmBtu) for dry-bottom wall-fired boilers and 0.40 lb/mmBtu for tangentially-fired boilers. Group 2 boilers (wet bottom wall-fired boilers, cyclones, cell-burner technology boilers, and vertically-fired boilers) are also subject to emission limitation reductions (**9**).

NO_2 Trends by MSA & Location:

Figure 3.3-3 compares the mean of the annual average NO_2 levels for several MSAs that implemented NO_2 monitoring in Michigan (reflecting the revised June 30, 1999 metropolitan area boundaries).

Over the previous ten years, the highest average NO_2 levels observed statewide have occurred in the Detroit PMSA. Trends show the Detroit PMSA average annual NO_2 level at about 0.02 ppm, and are comparable to the historical nationwide averages (EPA's information on nationwide averages are only available through 1998). The Kalamazoo-Battle Creek MSA air monitoring results had better air quality than the nationwide averages. Recent data for Lansing also showed a lower average than other metropolitan areas.

There hasn't been an exceedance of the NO_2 standard in Michigan. During 2001, the highest annual arithmetic mean value from all individual monitoring sites was at Detroit's Linwood site with a mean of 0.023 ppm. During the decade, the largest annual mean values measured in Michigan generally occurred at this monitor site.



Chapter 3.4: Ozone Trends

Introduction:

Ozone (O_3) is an air pollutant that is formed as a result of photochemical reactions involving the precursor air pollutants NOx and VOC or hydrocarbons in the presence of sunlight. Ultraviolet radiation of the sun initiates the complex sequence of photolytical reactions in the troposphere (the atmosphere nearest the earth's surface). O_3 mixed with fine particles is also called photochemical smog. Smog itself can be a brownish, acrid mixture of many gases and particles, while O_3 is a colorless gas. The color, odor, and astringency of smog are due to compounds other than O_3 (**1**). A more detailed explanation of the chemical reactions and the mechanisms involved in the formation of O_3 and other photochemical oxidants can be found in the EPA criteria document on O_3 (**2, 3**).

The O_3 contained in smog is known as "tropospheric" or groundlevel O_3. A layer of O_3, found in the stratosphere (approximately 10 to 22 miles above the earth's surface), is responsible for shielding the earth's surface from the sun's harmful ultraviolet rays that cause skin cancer. The common phrase, "hole in the ozone," refers to the O_3 in this layer. Aerosol propellants and various refrigerants contain chlorofluorocarbons which, once released, migrate into the upper atmosphere. Once there, a complex series of chain reactions occur that destroy the O_3 molecules and create a thinning of the protective O_3 layer. The O_3 from these two atmospheric layers generally do not mix.

Tropospheric O_3 can be transported long distances (hundreds of miles) under favorable meteorological conditions. As a result, the long-range transport of pollutants impacts the air quality of regions downwind of the area of formation. This has been a particular concern to Michigan, as well as the northeastern states. The LMOS and Southeast Michigan Ozone Study (SEMOS) are two former special projects that studied O_3 formation and modeled the transport of O_3 into Michigan. Other studies, such as that performed by the Ozone Transport Assessment Group (OTAG), attempted to evaluate O_3 formation and transport over various spatial scales covering the Midwest and eastern half of the United States, with analysis of more than 600 monitoring stations and assessment of meteorological conditions (**4**).

O_3 (a secondary air pollutant) is formed through a complex series of photochemical reactions involving VOCs (**5, 6**) and NOx. NOx is the term used to describe the total of NO, NO_2, and other oxides of nitrogen that are considered important due to their role in the formation of O_3.

VOCs or hydrocarbon emissions occur from both anthropogenic and biogenic emission sources. Anthropogenic emission sources include: motor vehicles; storage/transport and marketing of petroleum products; industrial processes such as production or use of organic chemicals, paints, polymers, resins, surface coatings, plastic product manufacturing, coke production/byproducts, petroleum product processing, and degreasing; and combustion of fuels. Biogenic sources include oils or resins naturally emitted from vegetation (trees and plants) such as terpenes and isoprenes.

O_3 Effects:

Human exposure to elevated O_3 can result in lung inflammation and aggravation of pre-existing respiratory asthmatic disease causing more severe asthmatic symptoms and requiring medical treatment (**7**). Other effects associated with O_3 exposure include increased respiratory related hospital admissions, increased susceptibility to respiratory infection by suppression of the immune system (alveolar macrophage decrement), decreased lung function, and increased respiratory symptoms such as chest pain, shortness of breath, throat irritation, and cough (**5, 6, 7, 8, 9**). Individuals most susceptible to the effects of O_3 exposure include individuals with a pre-existing or chronic respiratory disease, children who are active outdoors, and adults who actively exercise or work outdoors (**5, 7, 8, 9**).

O_3 also impacts vegetation and forest ecosystem stability in suppression of growth or exacerbates the effects of other environmental stresses that result in changes in population diversity (**8**). These vegetation and forest ecosystem changes occur as a result of: agricultural crop and forest yield reductions; foliar injury; diminished resistance to pest and pathogens; greater susceptibility of injury from other environmental agents; reduced survivability of tree seedlings; and decreased population number in those species that are sensitive to O_3 (**5**, **8, 9**).

NAAQS for O_3:

Primary NAAQS (1-hour):	Maximum daily 1-hour average concentration limit of 0.12 ppm with the average number of expected exceedances per year not to exceed one over a three year period.
Secondary NAAQS (1-hour):	Same as the primary NAAQS (1 hour).
Primary NAAQS (8-hour):	Fourth highest daily maximum 8-hour average, averaged over three years, not to exceed 0.08 ppm.
Secondary NAAQS (8-hour):	Same as primary 8-hour standard.

The 1-hour O_3 standard is set at a level of 0.12 ppm. This "exceedance-based" standard is violated when 1-hour averages of O_3 concentrations exceed 0.12 ppm more than once per year when averaged over a three-year period.

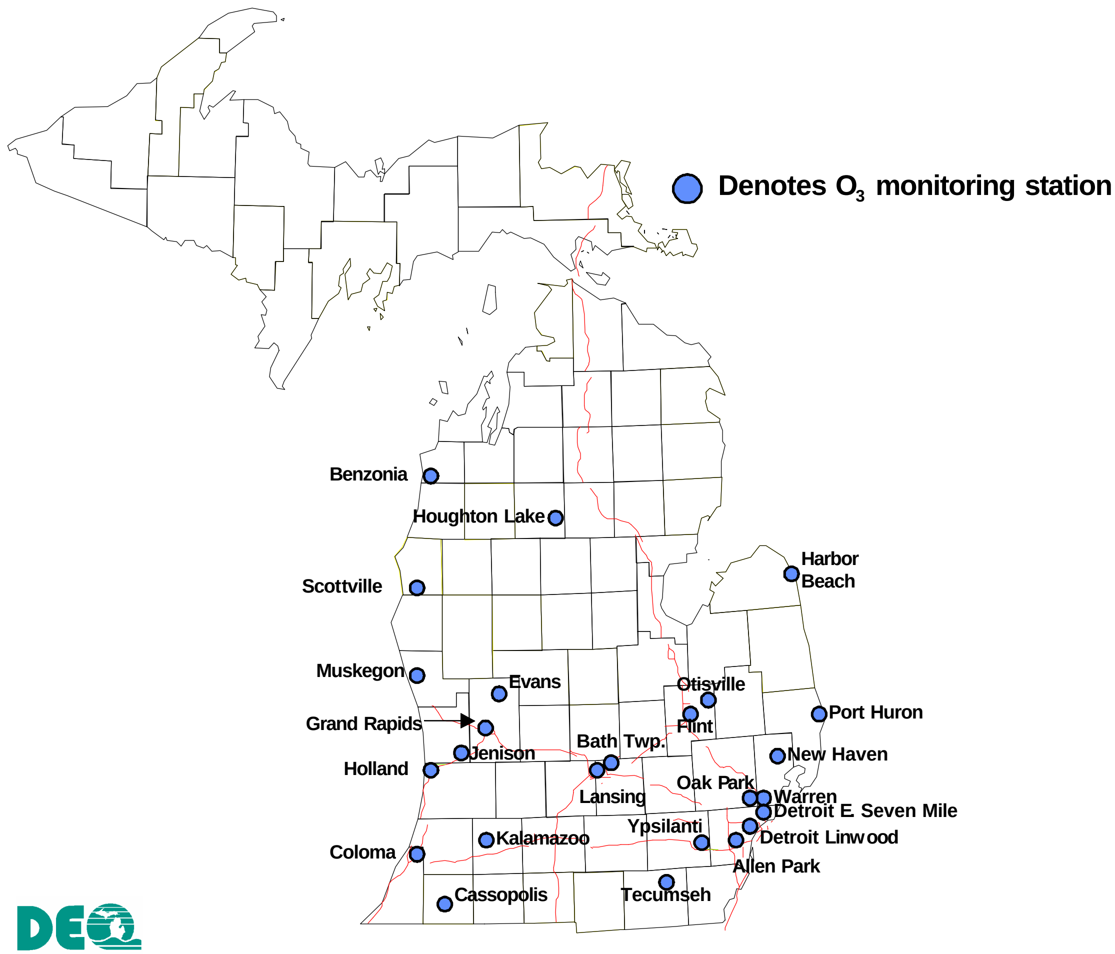
On July 18, 1997, the EPA issued a new 8-hour O_3 standard. This average-based standard is set at a level of 0.08 ppm, with a form based on the three-year average of the annual fourth highest daily maximum 8-hour average O_3 concentration measured at each monitor within an area.

O_3 Monitoring in Michigan:

The Michigan monitoring season for O_3 is April 1 through September 30 each year (**10**). During 2001, as shown in **Figure 3.4-1**, 24 O_3 monitoring stations were operated by state and local agencies in Michigan, and one station in Cassapolis was operated by the State of Indiana.

Monitor ID and Type
ANN ARBOR PMSA
1. 261610008 - YPSILANTI - SLAMS
BENTON HARBOR MSA
2. 260210014 - COLOMA - SLAMS
DETROIT PMSA
3. 260990009 - NEW HAVEN - SLAMS
4. 260991003 - WARREN - NAMS
5. 261250001 - OAK PARK - SLAMS
6. 261470005 - PORT HURON - SLAMS
7. 261630001 - ALLEN PARK - SLAMS
8. 261630016 - LINWOOD - NAMS
9. 261630019 - E. SEVEN MILE - SLAMS
FLINT PMSA
10. 260490021 – FLINT - NAMS
11. 260492001 - OTISVILLE - NAMS
GRAND RAPIDS-MUSKEGON-HOLLAND MSA
12. 260050003 - HOLLAND - SLAMS
13. 260810020 - GRAND RAPIDS - NAMS
14. 260812022 - EVANS - SLAMS *
15. 261210039 - MUSKEGON - SLAMS
16. 261390005 – JENISON - SLAMS
KALAMAZOO-BATTLE CREEK MSA
17. 260770008 - KALAMAZOO - SLAMS
LANSING-E. LANSING MSA
18. 260370001 - BATH TWP. - NAMS
19. 260650012 - LANSING - NAMS
HOUGHTON LAKE, MISSAUKEE CO
20. 261130001 - HOUGHTON LAKE - OTHER
BENZONIA, BENZIE COUNTY
21. 260190003 – BENZONIA - SLAMS
CASSOPOLIS, CASS CO
22. 260270003 – CASSOPOLIS - SLAMS
HARBOR BEACH, HURON CO
23. 260630007 - HARBOR BEACH - SLAMS
TECUMSEH, LENAWEE CO
24. 260910007 - TECUMSEH - SLAMS
SCOTTVILLE, MASON CO
25. 261050007 – SCOTTVILLE - SLAMS

Figure 3.4-1: Air Quality Monitors for O_3 Active in 2001



* On May 19, 1999, a request was submitted to the EPA to have the Evans O_3 monitor classified as a NAMS monitor. The Evans monitor replaced the former Parnell (260810020) monitor site.

Monitoring networks often extend beyond the vicinity where most precursor emissions occur because of the time it takes for O_3 to form from the reaction of NOx and VOC emissions. Upwind and background sites are chosen so that transported O_3 and its precursors entering an area may be measured. These stations are situated according to the predominant morning upwind direction from a metropolitan area. As an example, Tecumseh measures O_3 coming into Ann Arbor and the Detroit metropolitan area. The monitor near Houghton Lake in Missaukee County is an SPM that provides background concentrations in a remote rural environment.

Some monitors are used to determine the extent of regional O_3 transport into Michigan populated areas. The monitoring sites located at Coloma, Holland, Jenison, Muskegon, Scottville, and Benzonia receive regional O_3 transport across or along the Lake Michigan shoreline from other major urban areas. The Port Huron monitor is located downwind of the Detroit urban area. The Harbor Beach monitor, which is further north and downwind of the Port Huron monitor, provides additional monitoring of regional O_3 transport into Michigan's "thumb" area.

O_3 monitoring is conducted in urban areas located immediately downwind of areas where maximum precursor emissions occur. These O_3 measurements are generally gathered near the downwind boundary of the central business district and monitors measure levels contained within a neighborhood scale air mass in major populated areas. These stations also provide information about urban air quality and population exposure. Monitors at E. Seven Mile Road, Linwood, and Allen Park in Wayne County, and Ypsilanti in Washtenaw County are located within the Detroit and Ann Arbor PMSAs and provide an indication of population exposure at the neighborhood scale. O_3 is also measured at a neighborhood scale in Flint, Lansing, and Grand Rapids.

Maximum O_3 concentrations occur downwind from metropolitan areas that produce precursor emissions. O_3 monitoring sites that are intended for detecting maximum O_3 concentrations are typically located 10-30 miles from the edge of the urban area. The monitors at Otisville, Bath Township, Evans, Warren, and New Haven are situated downwind of urban areas (Flint, Lansing-E. Lansing MSA, Grand Rapids, and Detroit) to detect maximum concentrations of O_3 contained within urban scale air masses. Additional SLAMS population exposure monitor sites at Oak Park and Cassopolis provide the benefit measuring maximum O_3 concentration of urban scale air masses. Cassopolis is operated by the State of Indiana as a downwind site for the South Bend area.

The stations at Holland, Benzonia, Coloma, and Scottville sample larger regional scale air masses. Regional scale air masses transport ozone from larger metropolitan areas into other metropolitan or rural areas. Monitoring is useful for quantifying the amount of O_3 that is generated outside of the receiving impacted area and for determining the effectiveness of control strategies at local and regional scales (3). A monitoring site near Houghton Lake is used to characterize rural background level O_3 concentrations.

Attainment/Nonattainment Status of O_3 in Michigan:

All Michigan counties are now designated as attainment for the 1-hour O_3 standard. **Table 3.4.1** provides a brief summary of the attainment status for various Michigan counties.

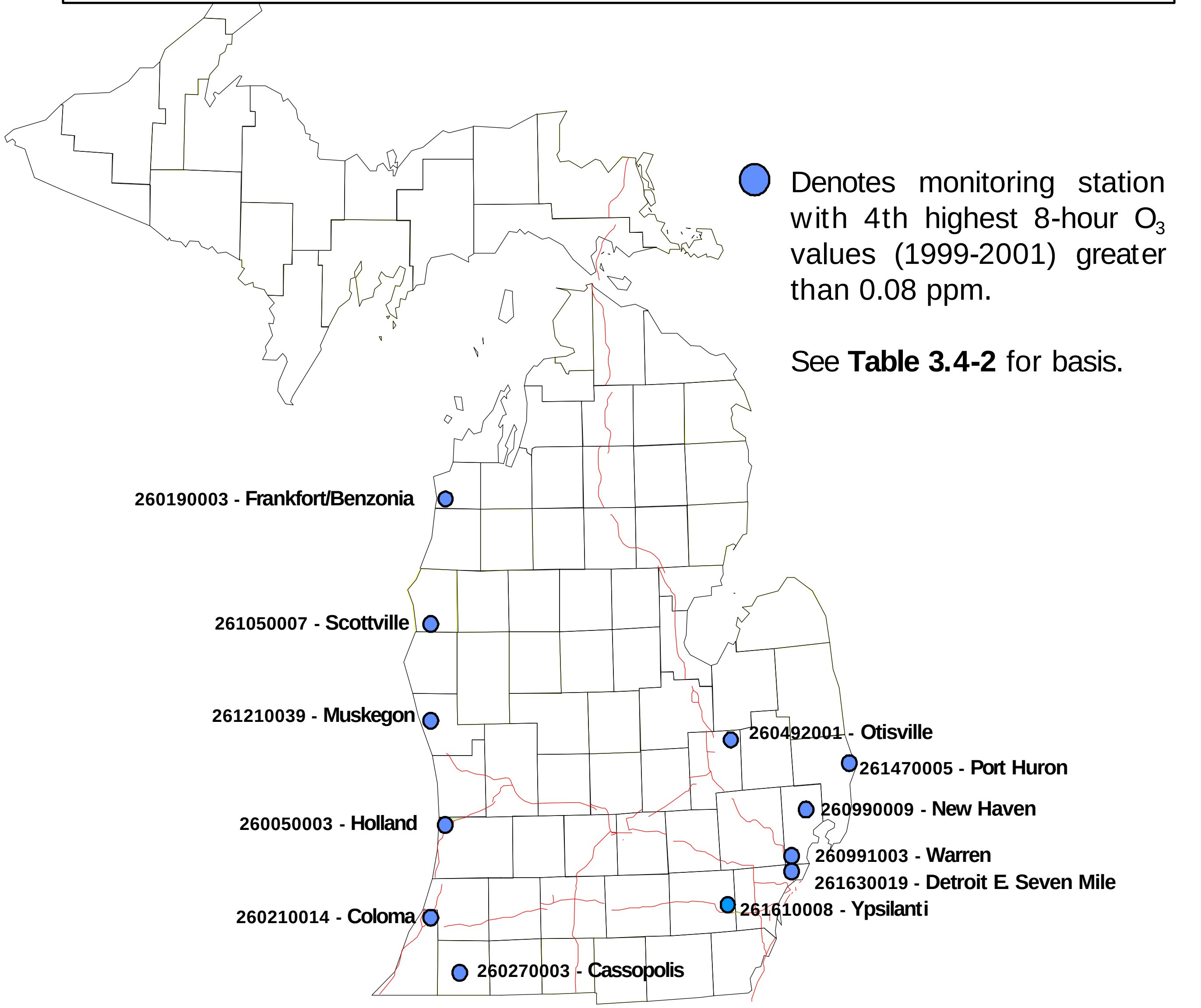
Table 3.4-1: Summary of Attainment Status of 1-hour O_3 Standard

Area	County	Attainment Date	Federal Register (FR) Notice of Attainment
Detroit-Ann Arbor-Flint CMSA	Livingston	4/6/95	60 FR 12459, 3/7/95
	Macomb	4/6/95	60 FR 12459, 3/7/95
	Monroe	4/6/95	60 FR 12459, 3/7/95
	Oakland	4/6/95	60 FR 12459, 3/7/95
	St. Clair	4/6/95	60 FR 12459, 3/7/95
	Washtenaw	4/6/95	60 FR 12459, 3/7/95
	Wayne	4/6/95	60 FR 12459, 3/7/95
	Genesee	1/16/01	65 FR 67629, 11/13/00
Grand Rapids-Muskegon-Holland MSA	Kent	6/21/96	61 FR 31831, 6/21/96
	Ottawa	6/21/96	61 FR 31831, 6/21/96
	Muskegon	10/18/00	65 FR 52651, 8/30/00
Saginaw-Bay City-Midland MSA	Bay	1/16/01	65 FR 67629, 11/13/00
	Midland	1/16/01	65 FR 67629, 11/13/00
	Saginaw	1/16/01	65 FR 67629, 11/13/00
Other areas	Allegan	1/16/01	65 FR 70490, 11/24/00

As of January 2001, there were 75 1-hour O_3 nonattainment areas nationwide (**12**). Although designations can not yet be made for the 8-hour standard, EPA has estimated a total of 332 counties where the 8-hour standard would be exceeded based on O_3 concentrations over the three-year period from 1997-1999 (**13**).

Three years of recent data were analyzed to project the impact of an 8-hour standard on Michigan. **Figure 3.4-2** illustrates monitoring sites where the three-year average of the fourth highest 8-hour value is greater than 0.08 ppm, and shows the fourth highest 8-hour O_3 levels from 1999-2001 along with the computed three-year moving average increments for the respective time period. The results show that counties near the Lake Michigan shoreline and in and downwind of Detroit, typically record fourth highest 8-hour O_3 values greater than 0.08 ppm.

Figure 3.4-2: 4th Highest 8-Hr O_3 Value Averaged by Site Greater Than 0.08 ppm, 1999 to 2001



Long-Term Trends in O_3:

As shown in **Figure 3.4-3**, maximum 1-hour O_3 concentrations over the decade occurred at four-year time intervals (1995 and 1999). During these peak years, the statewide average of maximum values reached 0.127 ppm (1995) and 0.120 ppm (1999). This value is calculated by averaging the statewide maximum seasonal 1-hour O_3 level that occurred at each monitoring site. Extremely hot weather, typically conducive to O_3 formation, occurred during the respective years and contributed to the increased average O_3 values, as shown by the upward trends.

In the year 2001, the statewide average obtained from the maximum 1-hour O_3 concentration was 0.116 ppm. In 1992, the statewide average reached a low for the decade of 0.102 ppm.

The highest 2001 1-hour O_3 concentration of 0.153 ppm occurred at Harbor Beach. Over the decade, the highest detected 1-hour O_3 concentration of 0.184 ppm occurred at the Port Huron site on May 22, 1996.

Figure 3.4-3: Range of Maximum 1-Hour O_3 Levels, 1992-2001

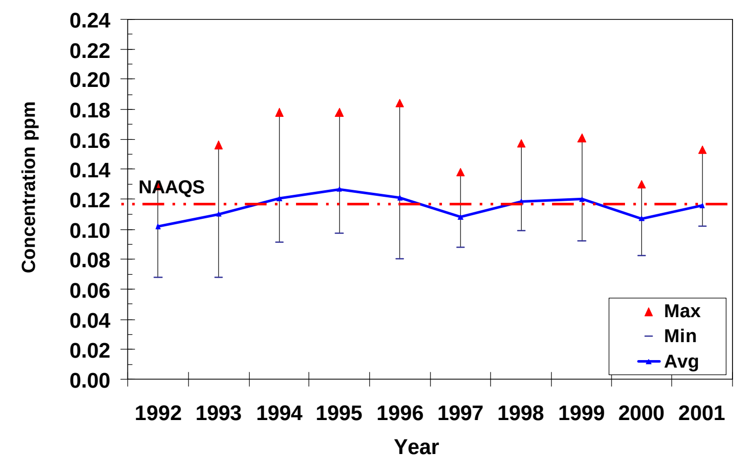


Figure 3.4-4: Trends in 4th Maximum 8-Hour O_3 Concentrations

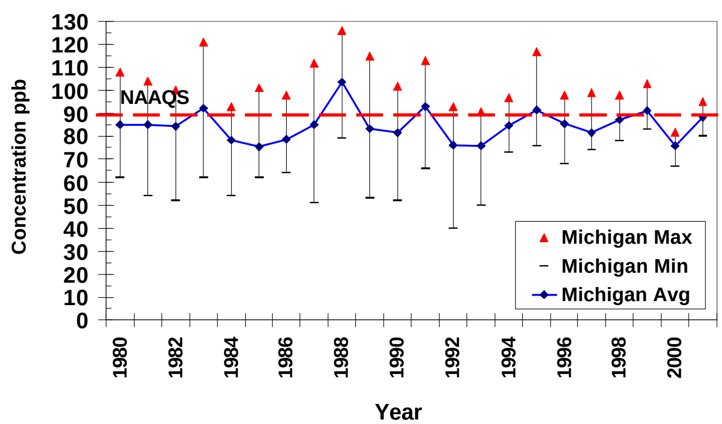


Figure 3.4-4 shows the statewide averages of the fourth highest annual 8-hour O_3 concentration.

During the time period from 1980 to 2001, peak 8-hour O_3 levels typically occurred at three- to five-year intervals, with the highest values reached in 1988. Recent data for 2001 shows the statewide average as slightly above the standard at 88 parts per billion (ppb).

The number of exceedances of the 1-hour standard on a statewide basis is shown in **Figure 3.4-5** from 1980-2001. In 2001, five exceedances of the 1-hour O_3 standard were recorded. A description of the 1-hour O_3 exceedances for recent years can be found in **Appendix D**.

Figure 3.4-5: Observed Number of Exceedances of 1-Hr O_3 Standard, 1980-2001

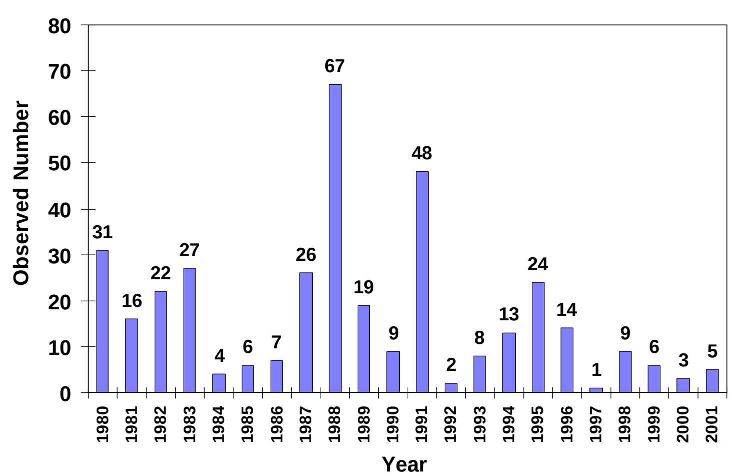
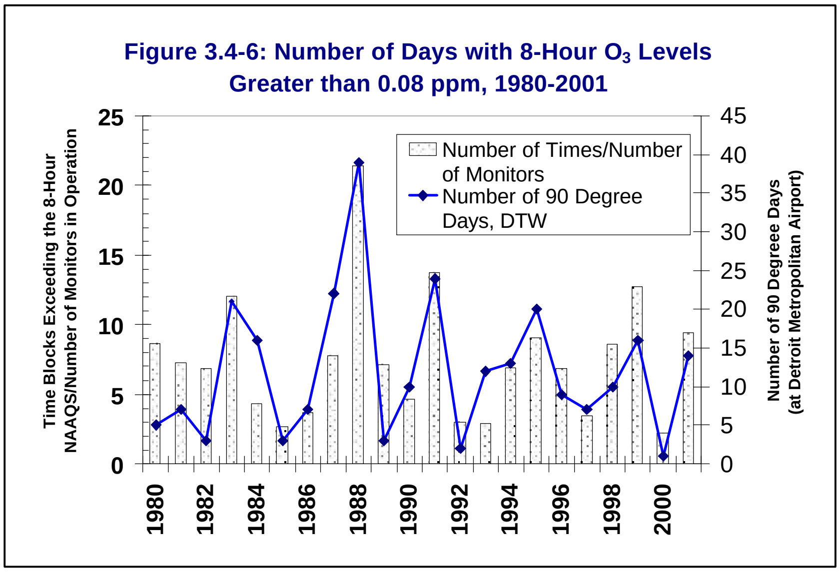


Figure 3.4-6 compares the number of occasions that an 8-hour O_3 reading was greater than or equal to 0.08 ppm with the number of 90°F days (≥ 90°F). The National Weather Service collected the temperature data at the Detroit Metropolitan Airport. The total number of 8-hour readings statewide was divided by the number of monitor sites that were in operation each year to provide a relative indication of the magnitude of 8-hour O_3 values.



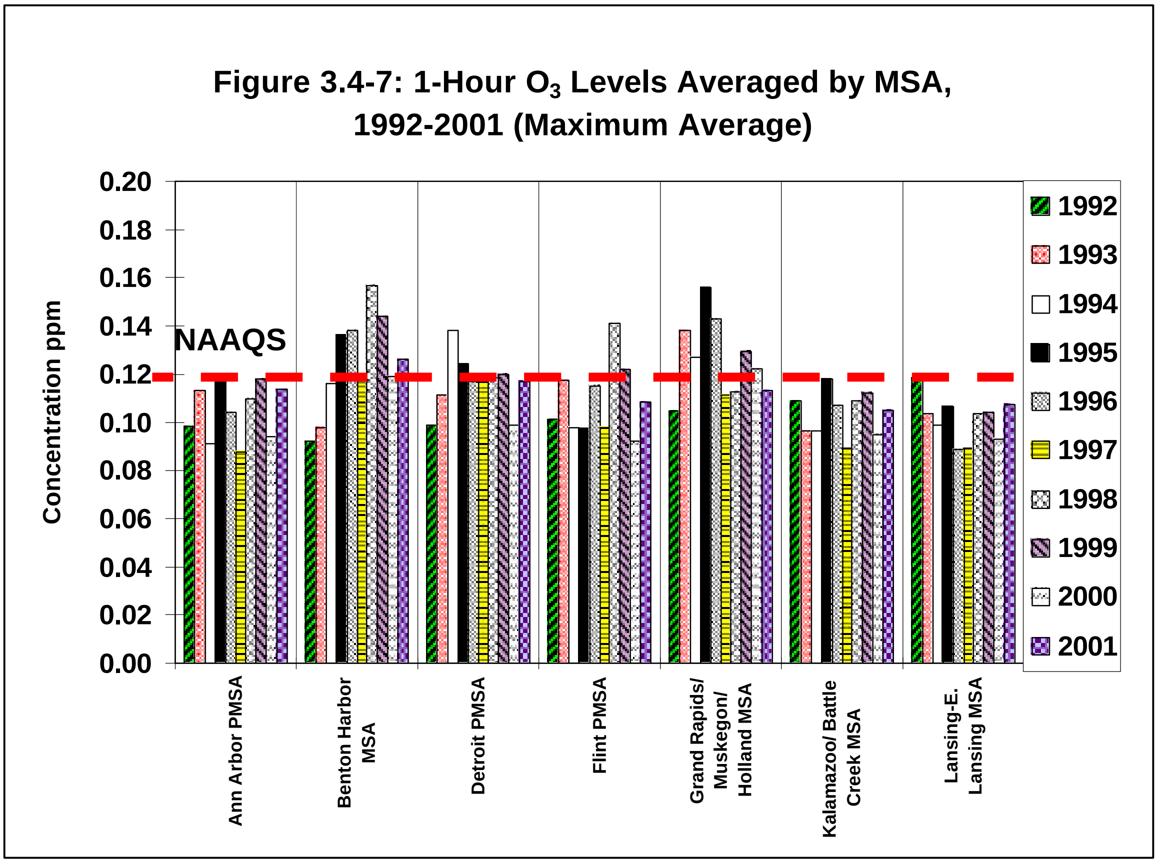
This comparison shows the influence of temperature with respect to elevated O_3 levels. Over the past 22 years, a typical summer would average 12 days when the temperature would exceed 90°F. Peak occurrences in the number of 90°F days have occurred at three- to five-year time intervals.

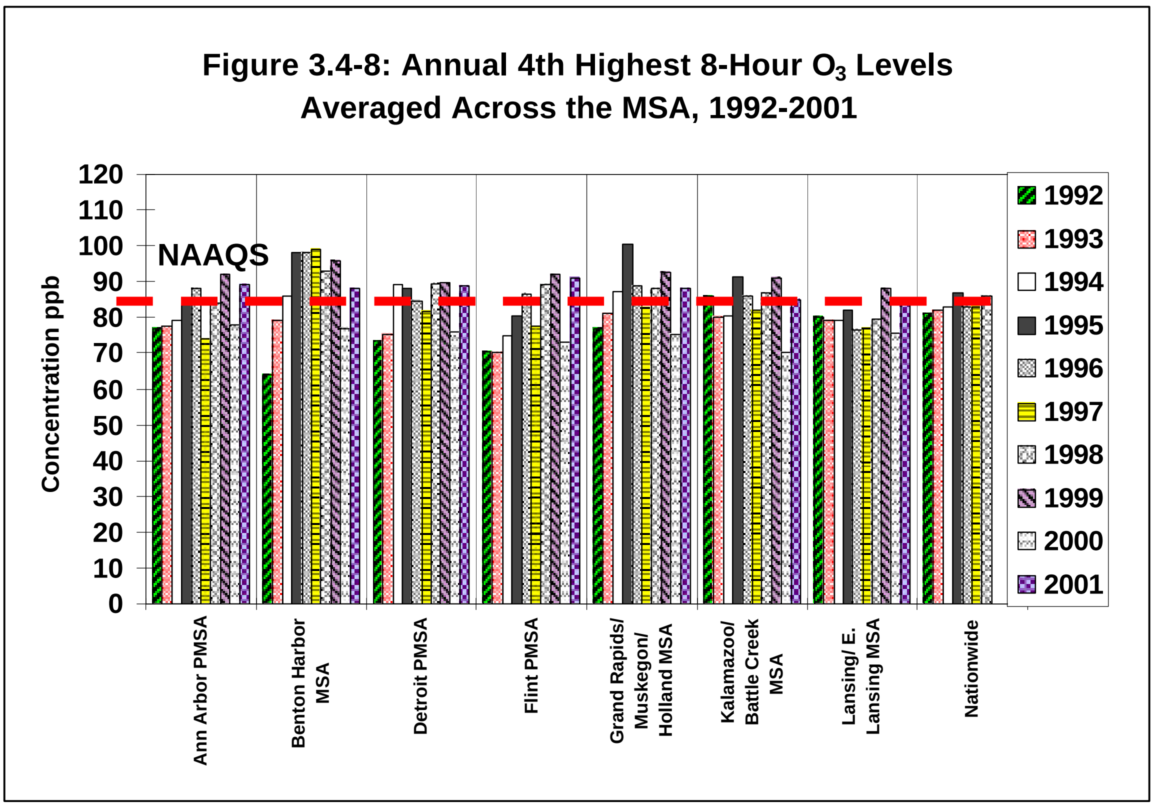
Comparing the number of 90°F days over the time period from 1980 through 2001, the highest number of 90°F days occurred in 1998 (39 days), while the lowest number occurred in 2000 (one day). In 2001, warmer temperatures again prevailed with 14 90°F days. During the mid-1990s, the relative number of 90°F days is generally greater than the number of elevated O_3 values. This is especially evident from 1993 until 1995. However, in 1998, 1999, and 2001, elevated 8-hour O_3 averages were proportionally greater relative to the number of 90°F days.

O_3 Trends by MSA & Location:

Over the past decade, concentrations above the 0.12 ppm 1-hour standard have been recorded in the Benton Harbor MSA, Detroit PMSA, Flint PMSA, and Grand Rapids-Muskegon-Holland MSA. O_3 monitors not included within a metropolitan area have recorded elevated 1-hour O_3 levels above 0.12 ppm. The Scottville and Harbor Beach sites have recorded elevated concentrations due to sub-regional transport of O_3 (see **Appendix D**). Maximum hourly O_3 values are broken down by MSA in **Figure 3.4-7**.

Figure 3.4-8 shows the 4th highest 8-hour O_3 values averaged for each MSA. According to the 8-hour O_3 levels graph, all Michigan MSAs periodically experience 8-hour values greater than 85 ppb. As with the 1-hour O_3 data, there are O_3 monitors that are not included within a MSA that have 8-hour O_3 values greater than 85 ppb. O_3 monitoring sites at Benzonia, Cassopolis, and Scottville had yearly 8-hour O_3 values exceeding 8 ppb (see **Table 3.4-2**).





The following **Table 3.4-2** shows the 4^{th} highest 8-hour O_3 values, averaged at three-year increments.

Table 3.4-2: 4th Highest 8-Hr O_3 Values Averaged at Three-Year Increments, 1995-2001

AIRS ID Site Name		1995	1996	1997	1998	1999	2000	2001
260050003-Holland	4th Highest 8-hr Value ppm	0.110	0.090	0.095	0.097	0.091	0.080	0.092
	Three-year Average ppm	0.094	0.097	0.098	0.094	0.094	0.089	0.087
	Rounded to 0.01 ppm	0.09	0.10	0.10	0.09	0.09	0.09	0.09
260190003–Frankfort/ Benzonia	4th Highest 8-hr Value ppm	0.099	0.085	0.078	0.090	0.097	0.081	0.091
	Three-year Average ppm	0.089	0.089	0.087	0.084	0.088	0.089	0.089
	Rounded to 0.01 ppm	0.09	0.09	0.09	0.08	0.09	0.09	0.09
260210014-Coloma	4th Highest 8-hr Value ppm	0.098	0.098	0.099	0.093	0.096	0.077	0.088
	Three-year Average ppm	0.087	0.094	0.098	0.096	0.096	0.088	0.087
	Rounded to 0.01 ppm	0.09	0.09	0.10	0.10	0.10	0.09	0.09
260270003-Cassopolis	4th Highest 8-hr Value ppm	0.099	0.095	0.090	0.091	0.095	0.079	0.088
	Three-year Average ppm	0.089	0.094	0.094	0.092	0.092	0.088	0.087
	Rounded to 0.01 ppm	0.09	0.09	0.09	0.09	0.09	0.09	0.09
260370001-Bath Twp.	4th Highest 8-hr Value ppm	0.076	0.068	0.078	0.078	0.087	0.074	0.087
	Three-year Average ppm	0.077	0.074	0.074	0.074	0.081	0.079	0.082
	Rounded to 0.01 ppm	0.08	0.07	0.07	0.07	0.08	0.08	0.08
260490021-Flint	4th Highest 8-hr Value ppm	0.082	0.089	0.076	0.089	0.089	0.072	0.091
	Three-year Average ppm	0.076	0.082	0.082	0.084	0.084	0.083	0.084
	Rounded to 0.01 ppm	0.08	0.08	0.08	0.08	0.08	0.08	0.08
260492001-Otisville	4th Highest 8-hr Value ppm	0.079	0.084	0.079	0.089	0.095	0.074	0.091
	Three-year Average ppm	0.074	0.078	0.080	0.084	0.087	0.086	0.086
	Rounded to 0.01 ppm	0.07	0.08	0.08	0.08	0.09	0.09	0.09
260550903-Traverse City	4th Highest 8-hr Value ppm				0.081	0.083		
	Three-year Average ppm							
	Rounded to 0.01 ppm							
260630007-Harbor Beach	4th Highest 8-hr Value ppm	0.083	0.084	0.075	0.087	0.090	0.072	0.088
	Three-year Average ppm	0.080	0.083	0.080	0.082	0.084	0.083	0.083
	Rounded to 0.01 ppm	0.08	0.08	0.08	0.08	0.08	0.08	0.08
260650012-Lansing	4th Highest 8-hr Value ppm	0.088	0.085	0.076	0.081	0.089	0.077	0.083
	Three-year Average ppm	0.082	0.084	0.083	0.080	0.082	0.082	0.083
	Rounded to 0.01 ppm	0.08	0.08	0.08	0.08	0.08	0.08	0.08
260770905-Kalamazoo[1]	4th Highest 8-hr Value ppm	0.093	0.085	0.082	0.087	0.091	0.070	0.085
	Three-year Average ppm	0.084	0.085	0.086	0.084	0.086	0.082	0.082
260770008-Kalamazoo	Rounded to 0.01 ppm	0.08	0.09	0.09	0.08	0.09	0.08	0.08

Table 3.4-2: 4th Highest 8-Hr O_3 Values Averaged at Three-Year Increments, 1995-2001 (Continued)

AIRS ID Site Name		1995	1996	1997	1998	1999	2000	2001
260770906-Kellogg	4th Highest 8-hr Value ppm	0.090	0.087					
	Three-year Average ppm		0.086					
	Rounded to 0.01 ppm		0.09					
260810020-Grand Rapids	4th Highest 8-hr Value ppm	0.094	0.087	0.077	0.079	0.085	0.068	0.083
	Three-year Average ppm	0.086	0.088	0.086	0.081	0.080	0.077	0.078
	Rounded to 0.01 ppm	0.09	0.09	0.09	0.08	0.08	0.08	0.08
260812001-Parnell	4th Highest 8-hr Value ppm	0.098	0.086	0.079	0.087	0.094	0.073	0.085
	Three-year Average ppm	0.086	0.089	0.087	0.084	0.086	0.084	0.084
260810022-Evans	Rounded to 0.01 ppm	0.09	0.09	0.09	0.08	0.09	0.08	0.08
260910007-Tecumseh	4th Highest 8-hr Value ppm	0.089	0.085	0.076	0.086	0.083	0.082	0.086
	Three-year Average ppm	0.082	0.086	0.083	0.082	0.081	0.083	0.083
	Rounded to 0.01 ppm	0.08	0.09	0.08	0.08	0.08	0.08	0.08
260990009-New Haven	4th Highest 8-hr Value ppm	0.092	0.091	0.090	0.098	0.096	0.075	0.095
	Three-year Average ppm	0.091	0.093	0.091	0.093	0.094	0.089	0.088
	Rounded to 0.01 ppm	0.09	0.09	0.09	0.09	0.09	0.09	0.09
260991003-Warren	4th Highest 8-hr Value ppm	0.090	0.090	0.081	0.090	0.090	0.077	0.094
	Three-year Average ppm	0.086	0.089	0.087	0.087	0.087	0.085	0.087
	Rounded to 0.01 ppm	0.09	0.09	0.09	0.09	0.09	0.09	0.09
261050006-Ludington[2]	4th Highest 8-hr Value ppm	0.110	0.093	0.086	0.087	0.101	0.081	0.093
	Three-year Average ppm	0.095	0.096	0.096	0.088	0.091	0.089	0.091
261050007-Scottville	Rounded to 0.01 ppm	0.10	0.10	0.10	0.09	0.09	0.09	0.09
261130001-Houghton Lake	4th Highest 8-hr Value ppm				0.079	0.091	0.073	0.084
	Three-year Average ppm						0.081	0.082
	Rounded to 0.01 ppm						0.08	0.08
261210039-Muskegon	4th Highest 8-hr Value ppm	0.117	0.097	0.084	0.092	0.103	0.078	0.095
	Three-year Average ppm	0.096	0.101	0.099	0.091	0.093	0.091	0.092
	Rounded to 0.01 ppm	0.10	0.10	0.10	0.09	0.09	0.09	0.09
261250001-Oak Park	4th Highest 8-hr Value ppm	0.084	0.074	0.076	0.089	0.088	0.075	0.090
	Three-year Average ppm	0.082	0.081	0.078	0.079	0.084	0.084	0.084
	Rounded to 0.01 ppm	0.08	0.08	0.08	0.08	0.08	0.08	0.08
261390005-Jenison	4th Highest 8-hr Value ppm	0.083	0.084	0.079	0.085	0.091	0.077	0.086
	Three-year Average ppm		0.084	0.082	0.082	0.085	0.084	0.084
	Rounded to 0.01 ppm		0.08	0.08	0.08	0.09	0.08	0.08

Table 3.4-2: 4th Highest 8-Hr O_3 Values Averaged at Three-Year Increments, 1995-2001 (Continued)

AIRS ID Site Name		1995	1996	1997	1998	1999	2000	2001
261470005-Port Huron	4th Highest 8-hr Value ppm	0.094	0.086	0.079	0.091	0.091	0.080	0.084
	Three-year Average ppm	0.089	0.088	0.086	0.085	0.087	0.087	0.085
	Rounded to 0.01 ppm	0.09	0.09	0.09	0.09	0.09	0.09	0.09
261470030-Algonac	4th Highest 8-hr Value ppm	0.100	0.088	0.087				
	Three-year Average ppm	0.093	0.094	0.091				
	Rounded to 0.01 ppm	0.09	0.09	0.09				
261610005-Ann Arbor 261610007-Ann Arbor[3] 261610008-Ypsilanti	4th Highest 8-hr Value ppm	0.084	0.088	0.074	0.084	0.092	0.078	0.092
	Three-year Average ppm	0.079	0.083	0.082	0.082	0.083	0.084	0.087
	Rounded to 0.01 ppm	0.08	0.08	0.08	0.08	0.08	0.08	0.09
261630001-Allen Park	4th Highest 8-hr Value ppm	0.078	0.082	0.075	0.079	0.087	0.067	0.080
	Three-year Average ppm	0.073	0.078	0.078	0.078	0.080	0.077	0.078
	Rounded to 0.01 ppm	0.07	0.08	0.08	0.08	0.08	0.08	0.08
261630016-Detroit's Linwood	4th Highest 8-hr Value ppm	0.077	0.079	0.079	0.086	0.084	0.077	0.087
	Three-year Average ppm	0.078	0.082	0.078	0.081	0.083	0.082	0.082
	Rounded to 0.01 ppm	0.08	0.08	0.08	0.08	0.08	0.08	0.08
261630019-Detroit's E. Seven Mile	4th Highest 8-hr Value ppm	0.091	0.086	0.088	0.093	0.092	0.080	0.092
	Three-year Average ppm	0.089	0.090	0.088	0.089	0.091	0.088	0.088
	Rounded to 0.01 ppm	0.09	0.09	0.09	0.09	0.09	0.09	0.09

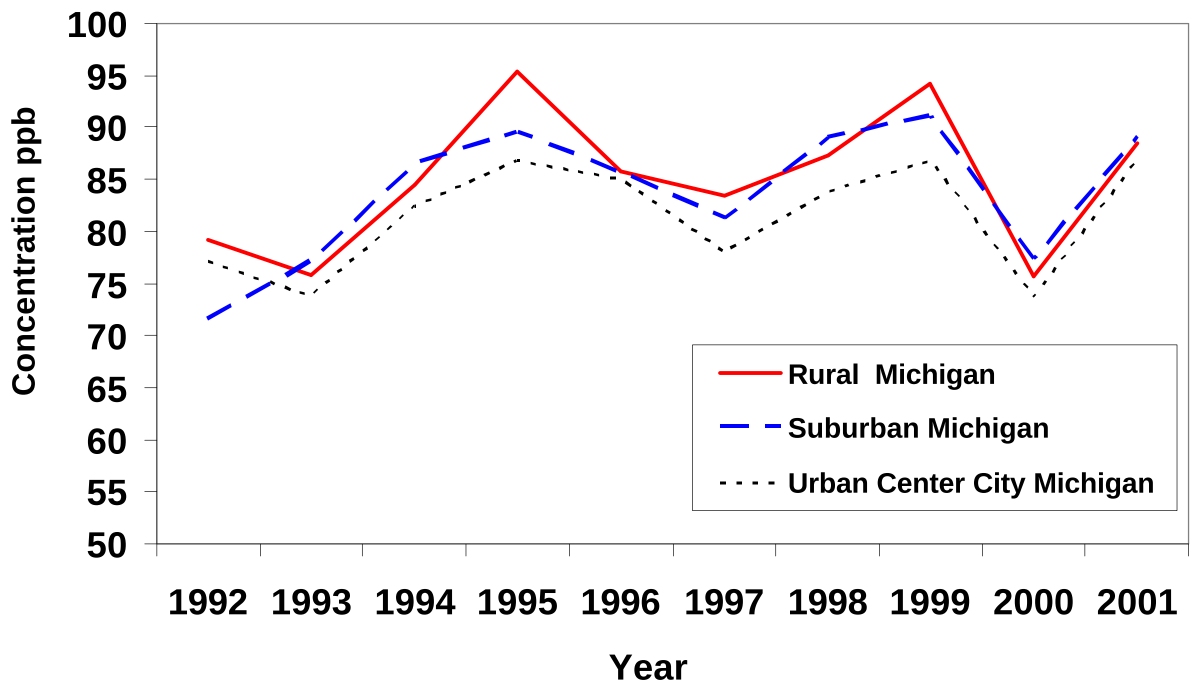
1. Kalamazoo site monitor operation was taken over by MDEQ on 10/96, and site ID number changed.
2. Ludington site monitor was closed in 10/97 due to loss of site access, and relocated to Scottville.
3. Ann Arbor site monitor was later relocated five miles Northeast of the former site location, and later moved to Ypsilanti due to site access difficulty.

NOTE: Years 1995-2000 data was obtained from the Michigan SPOTS database while 2001 data was obtained from EPA Air Quality Subsystem data.

O_3 is formed downwind of areas that emit the precursor pollutants (VOC and NOx). These precursor pollutants photochemically react in the atmosphere to form O_3 at locations other than where the precursor pollutants originated. This explains the increase in suburban O_3 concentrations when compared to urban center city sites on both a state and national scale.

Higher O_3 concentrations are attributed to regional O_3 transport into Western Michigan shoreline counties. Monitors located downwind of Detroit also experience regional O_3 transport. Similar trends are observed for Michigan rural, suburban, and urban center city areas based on the fourth highest 8-hour O_3 level. **Figure 3.4-9** shows that Michigan rural areas periodically detect higher O_3 concentrations than urban center city and suburban monitor sites.

Figure 3.4-9: 4th Highest 8-Hour O_3 Levels Averaged by Location, 1992 - 2001



Chapter 3.5: Particulate Matter (PM_{10}, $PM_{2.5}$, $PM_{2.5}$ Chemical Speciation, & TSP) Trends

Introduction:

Particulate matter is a broad classification of material that consists of solid particles, fine liquid droplets, or condensed liquids absorbed onto solid particles. Airborne particulates are not a single pollutant, but rather a mixture of many subclasses of many different air pollutants (**1**). Primary sources that generate particulate emissions include combustion, incineration, construction, mining, metals smelting, metal processing, and grinding. Other sources include motor vehicle exhaust, road dust, wind blown soil, forest fires, ocean spray, and volcanic activity (**2, 3, 4**). Secondary particulates are different from primary particulates in that they are created from condensable vapors formed from a chemical reaction involving gas phase precursors or by other processes involving reactions of gases. Examples of secondary particulates include:

- Atmospheric sulfate products formed from the atmospheric oxidation of SO_2 (sulfur dioxide),
- Atmospheric nitrate products such as ammonium nitrate formed from sequential reactions that transform NOx into nitric acid vapor and then react with ammonia,
- Sequential reactions involving nitric acid reacting with sodium chloride/calcium carbonate thereby releasing hydrochloric/carbon dioxide (CO_2) and the calcium nitrate or sodium nitrate particulate products.

Particulate matter in the atmosphere may also be categorized according to size because of the different health impact from particles of different diameters.

TSP: Particles with diameters of less than 50 micrograms (µm) are classified as total suspended particulates or TSP. Particles that are greater than 50 µm in diameter do not remain in the atmosphere for appreciable lengths of time and present no health risk because they are too large to be inhaled. Most anthropogenic particulate emissions fall into the size range classified as TSP.

PM_{10}: Particles less than 10 µm in diameter are defined as PM_{10}. The PM_{10} sized particles usually result from fly ash from power plants, carbon black from automotive industries, various manufacturing processes, wood stoves and fire places, agriculture and forestry practices, and fugitive dust sources. Fugitive dust is estimated to be responsible for 68 percent of all PM_{10} emissions nationwide, followed by agriculture and forestry (**5**).

In the United States, PM_{10} emissions from fuel combustion, industrial processes, and transportation each contribute about one-third of the traditionally inventoried particulate source categories. Incomplete burning of diesel fuel emits particles that are primarily made of carbon or are carbonaceous in nature. This source category, however, only accounts for six percent of total PM_{10} emissions nationwide. The vast majority of emissions are from natural sources, agriculture, forestry, wildfires, managed burning, and fugitive dust from paved and unpaved roads.

$PM_{2.5}$: Particles equal to or less than 2.5 µm in diameter are called $PM_{2.5}$. The $PM_{2.5}$ material may come directly from emissions (primary) or may be formed through photochemical reactions of gases in the atmosphere.

Monitoring efforts have focused on episodic variation in $PM_{2.5}$ concentrations. The EPA has encouraged the use of continuous monitoring instrumentation to provide hourly $PM_{2.5}$ concentrations (**6**). At least one continuous fine particulate analyzer is required at a core monitoring $PM_{2.5}$ site in a metropolitan area with a population greater than one million. It is used to provide temporal resolution of fine particulate concentration (**9**). In some situations, continuous fine particulate PM analyzers may be used to reduce sampling frequency of federal reference method (FRM) gravimetric analytical determination (**9**, **10**).

$PM_{2.5}$ Chemical Speciation: In 1999, due to increasing attention given to the relation of precursor pollutants to the formation of fine particulates, EPA developed a strategic plan to establish a national $PM_{2.5}$ chemical speciation monitoring network (consisting of approximately 54 sites in 43 states) (**6, 7, 8**). Fifty speciation sites are required to be deployed nationally (**9**). The national $PM_{2.5}$ chemical speciation monitoring sites will be used to assess trends and develop mitigation approaches to reduce ambient aerosol emissions (**7**). Ten sites are sampled daily to further assess health effects in relation to exposure levels (**6**). Future activities include annual and seasonal characterization of aerosols, air quality trends analysis in relation to the development of control programs, and evaluation of the monitoring data in the development of emission control strategies (**7**).

Particulate Matter Effects:

Exposure to particulate matter affects breathing and the defenses of the lungs, and aggravates existing respiratory and cardiovascular disease. Particle size is the major factor that determines which particles will enter the lungs and how deeply the particles will penetrate. Fine particulate matter less than 10 microns in diameter are especially harmful because it penetrates deep into the lungs (alveoli), possibly damaging lung tissue and changes may occur in the immune system (**2**, **3, 7**). Particulates that lodge in the terminal respiratory units of the alveoli remain for longer periods of time as the alveoli have a slow clearance system. More serious effects may occur depending on the exposure, concentration, and the chemical nature of the particulate. Asthmatics and individuals with chronic lung and/or cardiovascular disease, people with influenza, the elderly, and children are most susceptible (**11**). Particulate matter impairs visibility, damages materials, and creates soiling.

Retention of particulates is dependent on the deposition site and particle physical and chemical characteristics (**1**). Epidemiological studies investigating public health studies involving fine particulate matter exposure have found associations between exposure levels and decreased lung function, increased hospital admissions and emergency room visits, increased respiratory symptoms and disease, and premature death.

Particulate matter may also damage building surfaces and damage vegetation (**2**). $PM_{2.5}$ is considered to be an important visibility-reducing component of urban and regional haze. Deposition of acid aerosols and salts may increase corrosion of metals and impact plant tissue by corroding leaf surfaces and interfering with plant metabolism (**11**).

NAAQS for Particulate Matter:

In 1971, the NAAQS were established for TSP. The primary TSP standard was 260 μg/m^3 over a 24-hour period and 75 μg/m^3 as the annual geometric mean. A secondary 24-hour standard was established at 150 μg/m^3.

The particulate standard was revised from TSP to PM_{10} on July 1, 1987. Research demonstrated smaller size particles present a greater health risk.

Primary PM_{10} NAAQS:	Annual arithmetic mean not to exceed 50 μg/m^3 (based on a three-year average) 24-hour concentration limit 150 μg/m^3. Average number of expected exceedances per year not to exceed one over the most recent three-year period.
Secondary PM_{10} NAAQS:	Same as primary standard.

The State of Michigan still uses TSP monitoring for long-term studies and for industrial monitoring. In addition, TSP filters are analyzed to determine the concentration of airborne metal particulates.

On July 18, 1997, the EPA promulgated new standards for particulate material. The PM_{10} standard was revised and a new standard was added for $PM_{2.5}$. The EPA determined health concerns with respect to fine particulate warranted adopting a new standard. The final form of the $PM_{2.5}$ standard consists of an annual as well as a 24-hour average. Compliance with both the 24-hour and annual standards is based on data averaged over a three-year period.

$PM_{2.5}$ NAAQS:	Annual arithmetic mean not to exceed 15 μg/m^3 (based on a three-year average) 98th percentile of 24-hour concentration not to exceed 65 μg/m^3 (based on a three-year average).
Secondary $PM_{2.5}$ NAAQS:	Same as primary standard.

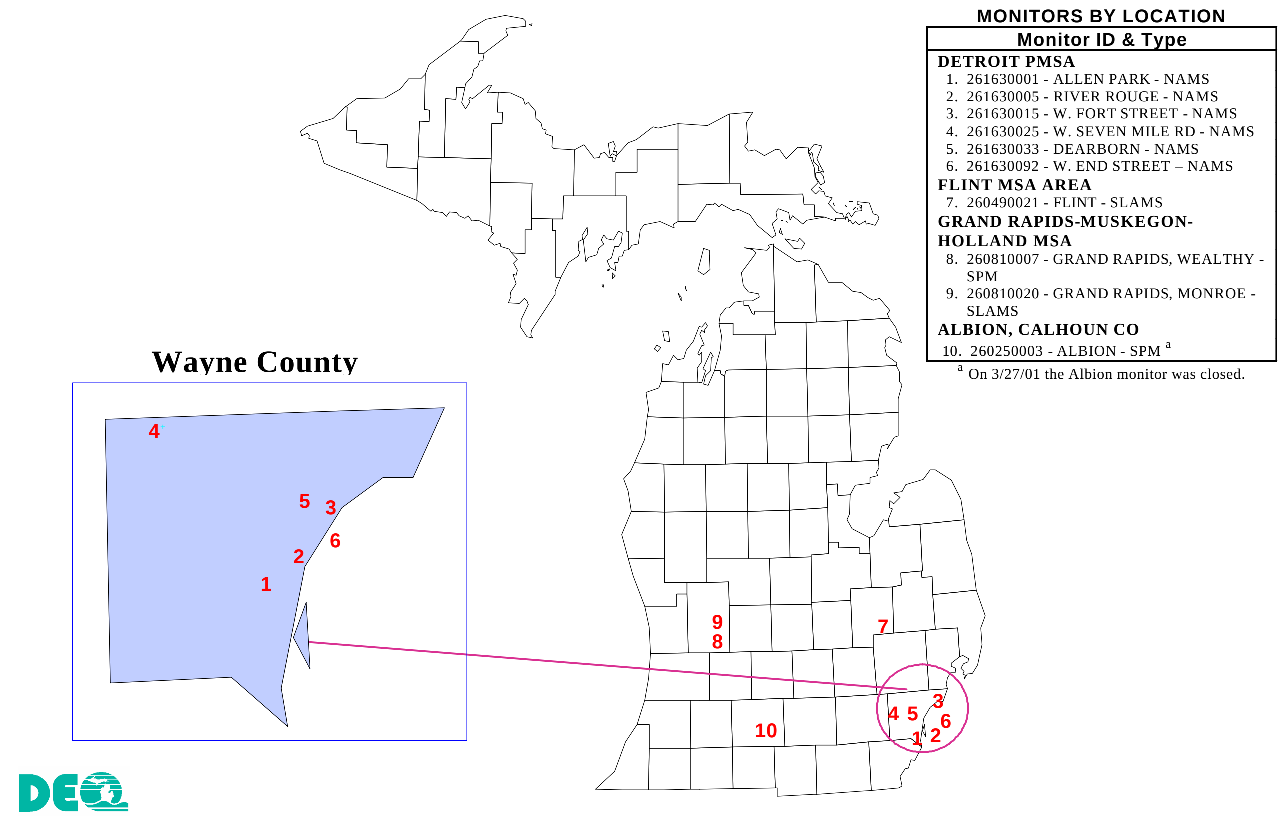
Monitoring for PM_{10} in Michigan:

The map in **Figure 3.5-1** identifies the locations of the 10 PM_{10} monitoring stations that were operated in Michigan during 2001. The majority of these monitors are located in Michigan's largest populated urban areas. Of the 10 PM_{10} sites, six are located in the Detroit PMSA, one in the Flint PMSA, two in the Grand Rapids-Muskegon-Holland MSA, and a SPM was used to monitor fugitive dust in Albion.

Population exposure to neighborhood scale PM_{10} air masses is performed in the Flint PMSA, the Detroit PMSA at Allen Park and Seven Mile Road, and the Grand Rapids-Muskegon-Holland MSA at Monroe. Additional neighborhood scale maximum PM_{10} concentrations monitoring is performed in the Detroit PMSA at River Rouge, W. Fort Street, Dearborn, and W. End Street, and in the Grand Rapids-Muskegon-Holland MSA at Wealthy Street (**13**).

Samples are generally collected every sixth day. On April 1, 2000, a co-located continuous PM_{10} TEOM (tapered element oscillating microbalance) monitor was established at the Dearborn site, and monitoring frequency was reduced from daily to every six days.

Figure 3.5-1: Air Quality Monitors for PM_{10} Active in 2001



Attainment/Nonattainment Status of PM_{10} in Michigan:

All areas of the state are in attainment with the PM_{10} NAAQS. As of January 2001, there were 73 PM_{10} nonattainment areas nationwide (**15**).

Long-Term Trends in PM_{10}:

Since 1992, the average arithmetic mean PM_{10} levels across the state decreased by six percent as shown in **Figure 3.5-2**.

Figure 3.5-2: Range of Annual Arithmetic Means for PM_{10} Levels, 1992-2001

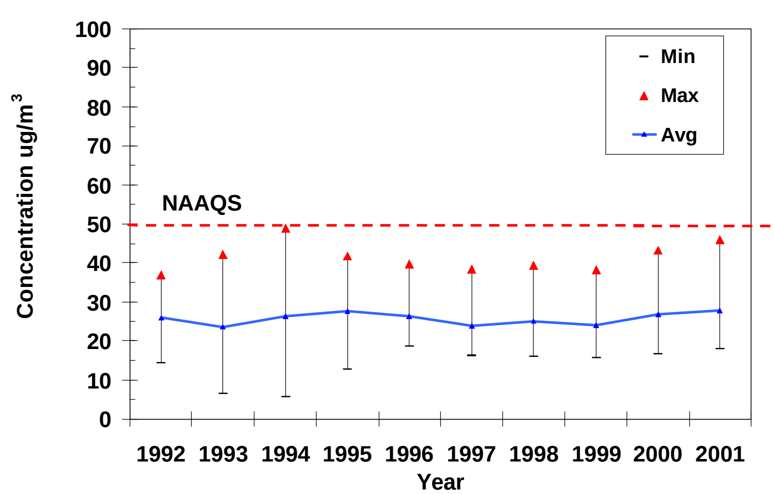
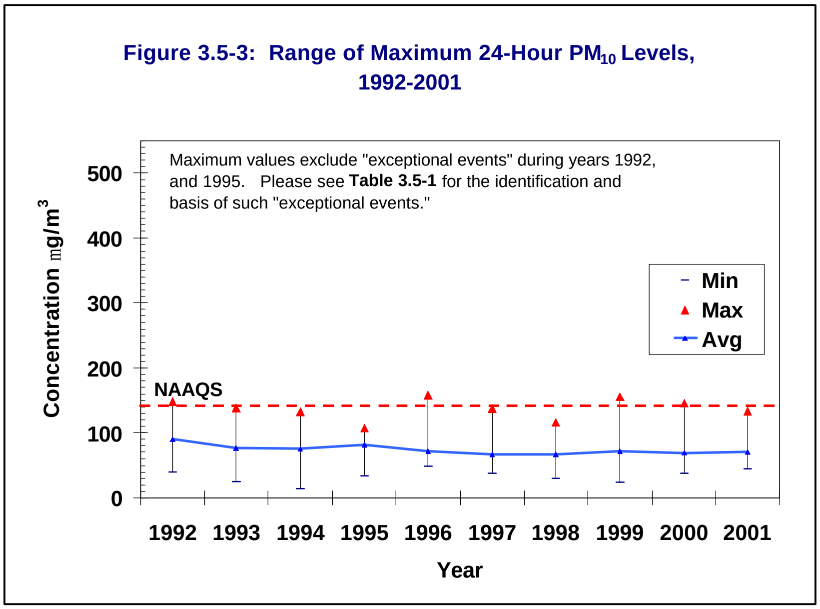


Figure 3.5-3 identifies the trend in the 24-hour PM_{10} values in Michigan over the past decade.



Statewide annual mean PM_{10} levels have remained near the 25 µg/m^3, (half of the 50 µg/m^3 NAAQS). Maximum annual mean PM_{10} levels during 2001 peaked at 46 µg/m^3. The highest annual mean for an individual PM_{10} monitoring station in Michigan during 2001 was detected at Detroit's W. End site.

Average 24-hour levels have been relatively constant at around 70 µg/m^3. Maximum values measured during excessive wind conditions or due to malfunction of particulate control equipment at a stationary source are not representative of ambient air quality. They are considered "exceptional events" under federal criteria and are not included in this figure.

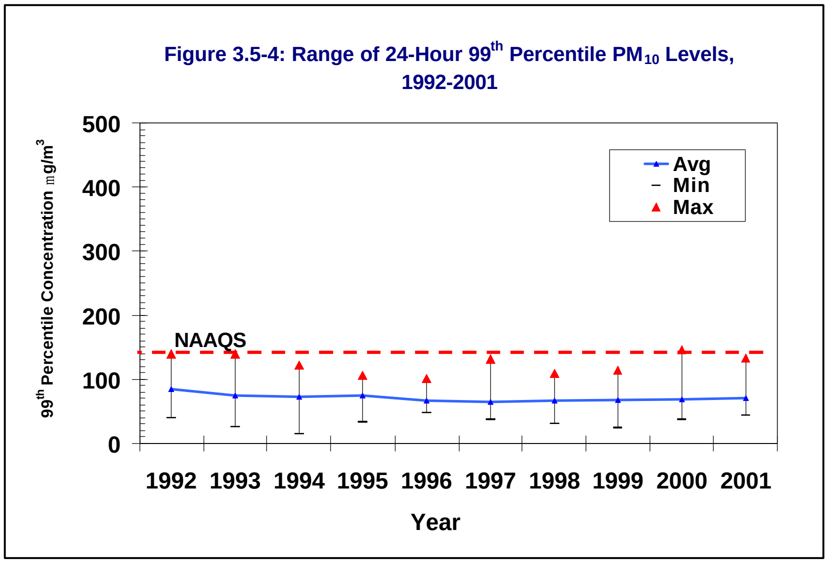


Figure 3.5-4 shows the alteration of the 24-hour PM_{10} standard to the 99th percentile level. In most instances where the number of samples were collected is small, the percentile value is the same as the maximum value for that year.

PM_{10} Trends by MSA & Location:

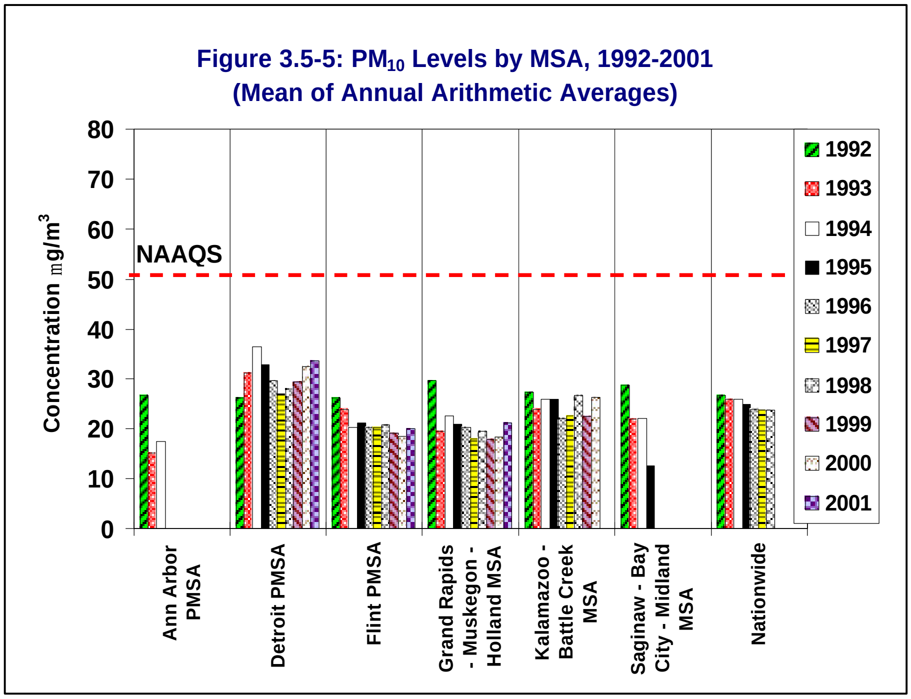
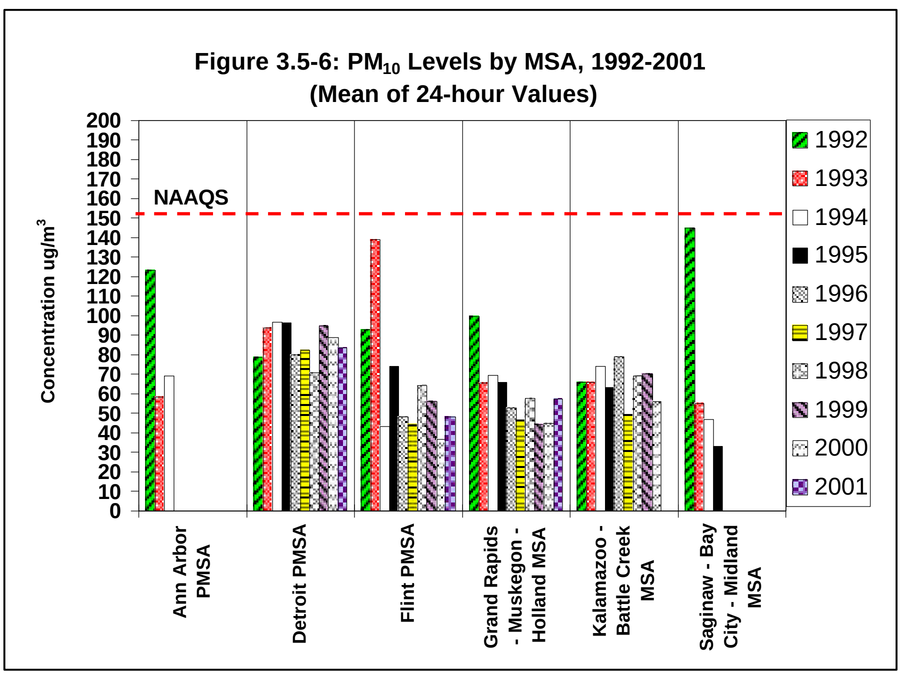


Figure 3.5-5 compares the mean of the annual arithmetic average PM_{10} levels for all MSAs where monitoring was conducted during the decade. For the Detroit PMSA, the highest annual average occurred during 1994 (36 µg/m^3). In 2001, Detroit's annual average PM_{10} level was 34 µg/m^3. For the Grand Rapids-Muskegon-Holland MSA, comprised of four counties, the annual average peaked during 1992 at 30 µg/m^3. In more recent years, this MSA experienced a significant reduction with an annual average level at 21 µg/m^3 in 2001.

When historically comparing Michigan MSAs to national averages (EPA's information on nationwide averages for PM_{10} are only available through 1998), most Michigan areas demonstrate better air quality than their national counterparts. The exception is the Detroit monitor, a highly urbanized PMSA where PM_{10} annual averages over the decade have consistently remained above national annual averages.



Average 24-hour PM_{10} levels were calculated for all MSAs as shown in **Figure 3.5-6**. The highest average 24-hour PM_{10} levels over the decade occurred during the early 1990s.

Figure 3.5-7 shows the effect of the alteration of the standard to the 99th percentile form for metropolitan areas.

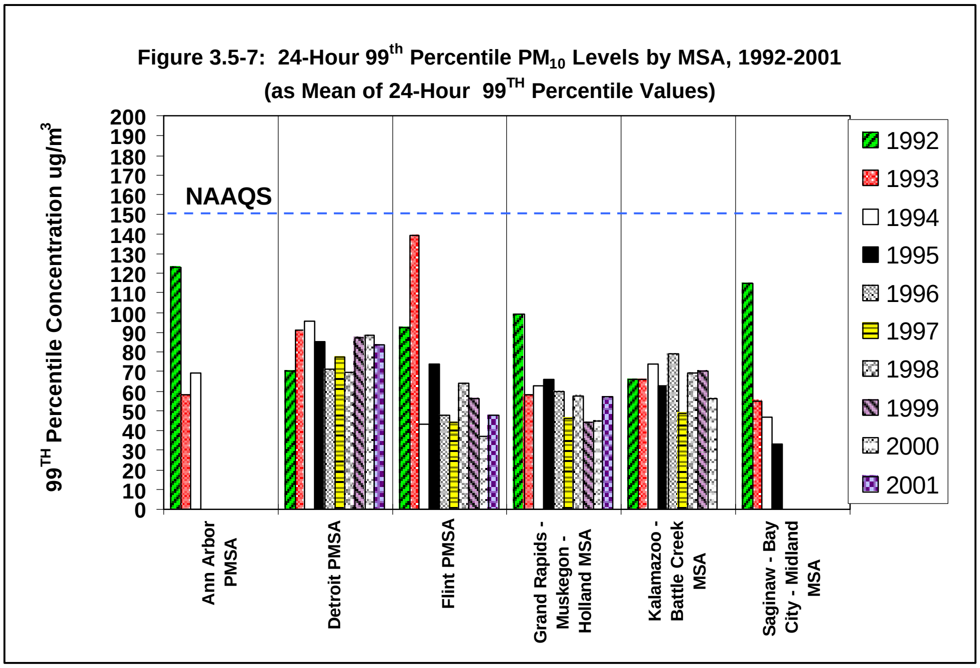


Table 3.5-1 lists the 24-hour exceedances observed over the past decade. During 1995, there were two exceedances of the 24-hour PM_{10} standard. Both of these occurred at the Dearborn site on March 14 and 15 when levels reached 183 µg/m³ and 159 µg/m³, respectively. The rupture of a nearby industrial bag house released excessive particulate emissions over a two-day period. Extreme wind on June 17, 1992, contributed to two exceedances in Bay City and Detroit (Dearborn) which were determined to be exceptional events.

Table 3.5-1: Values Exceeding the 24-Hour Standard (150 mg/m³) for PM_{10} in Michigan, 1992 to 2001

Year	Total Number of Exceedances Per Year	Site (s)	Date	24-Hour Value, mg/m³
1992	3	26-017-0910	6/17/92	494 *
		26-017-0910	12/25/92	286 *
		26-163-0033	6/17/92	158 *
1993	0	None		
1994	0	None		
1995	2	26-163-0033	3/14/95	183**
		26-163-0033	3/15/95	159**
1996	1	26-163-0033	9/5/96	158
1997	0	None		
1998	0	None		
1999	1	26-163-0033	10/25/99	156
2000	0	None		
2001	0	None		

*** Occurred during a "wind event".**

**** Occurred during industrial baghouse rupture.**

Monitoring for $PM_{2.5}$ in Michigan:

$PM_{2.5}$ sampling design provides a community-oriented fine particulate monitoring network that is representative of neighborhood and larger spatial scales. The fine particulate monitoring network is focused toward MSAs with populations greater than 200,000 individuals (**9**). The number of “core monitors” is dependent on the population level comprising the MSA. Therefore the Detroit MSA has the largest number of monitors, while Ann Arbor, Grand Rapids, Flint, Kalamazoo, Lansing, Muskegon, and Saginaw have fewer “core monitor” sites. Two core $PM_{2.5}$ monitors are required for each MSA with populations greater than 500,000 (Detroit and Grand Rapids). The EPA requires one core $PM_{2.5}$ monitor for MSAs with populations greater than 200,000 and less than 500,000 (**9**).

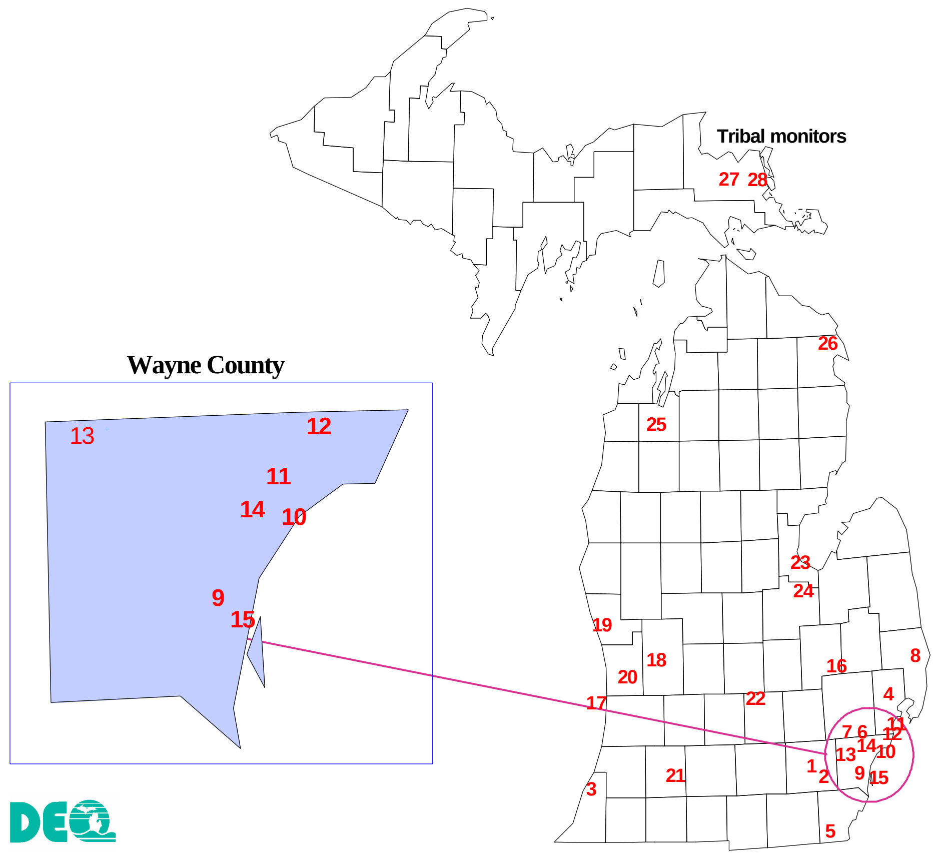
Of Michigan’s 28 $PM_{2.5}$ monitoring sites, six are co-located with PM_{10} monitoring sites to allow for fine and coarse particulate comparisons to be made with respect to fractional size. Co-located PM_{10} and $PM_{2.5}$ sites include Flint, Grand Rapids at Monroe, and the Detroit PMSA monitoring sites at Allen Park, W. Fort Street, E. Seven Mile Road, and Dearborn.

Figure 3.5-8 identifies the locations of the $PM_{2.5}$ monitoring network in Michigan. Of these 28 monitoring sites, 12 were located in the Detroit PMSA, four in the Grand Rapids-Muskegon-Holland MSA, two in Ann Arbor PMSA, two in the Saginaw-Bay City-Midland MSA, and one each in the Benton Harbor MSA, Flint PMSA, Kalamazoo-Battle Creek MSA, and Lansing-E. Lansing MSA. In addition to these urban area “core monitors,” other monitors assess population exposures to urban and neighborhood scale air masses. Community-oriented (core) monitoring sites are located beyond the zone of influence of single sources to provide neighborhood to urban scale representation (**14**). These sites may be located in urban, commercial, and residential areas where people are exposed to fine particulate matter. $PM_{2.5}$ monitors are also located to characterize background or regional fine particulate transport collectively from upwind sources.

The locations for the Michigan sites were selected using the EPA siting criteria for community-oriented (core), regional transport, and regional background sites (**14, 9**). Siting criteria along with population distribution, emissions from stationary sources, the locations of existing O_3 and PM_{10} sites, and Michigan geography determined on the final design of the Michigan network. In addition to the MDEQ network, there were two tribal sites located in Sault Ste. Marie.

Maximum exposure $PM_{2.5}$ level concentrations for the Detroit PMSA are measured at New Haven, W. Fort Street in Detroit, and Dearborn. Regional background/transport $PM_{2.5}$ levels are measured at Coloma, Luna Pier, and Port Huron.

Figure 3.5-8: Air Quality Monitors for $PM_{2.5}$ Active in 2001



MONITORS BY LOCATION

Monitor ID & Type

ANN ARBOR PMSA
1. 261610005 - ANN ARBOR - SLAMS *
2. 261610008 - YPSILANTI - SLAMS [a]

BENTON HARBOR MSA
3. 260210014 - COLOMA - SLAMS

DETROIT PMSA
4. 260990009 - NEW HAVEN - SLAMS
5. 261150005 - LUNA PIER - SLAMS
6. 261250001 - OAK PARK - SLAMS*
7. 261250010 - SOUTHFIELD - SPM
8. 261470005 - PORT HURON - SLAMS
9. 261630001 - ALLEN PARK - SLAMS*
10. 261630015 - W. FORT - SLAMS
11. 261630016 - LINWOOD - SLAMS*
12. 261630019 - E. SEVEN MILE - SLAMS
13. 261630025 - LIVONIA - SLAMS*
14. 261630033 - DEARBORN - SLAMS
15. 261630036 - WYANDOTTE - SLAMS*

FLINT PMSA
16. 260490021 - FLINT - SLAMS *

GRAND RAPIDS-MUSKEGON-HOLLAND MSA
17. 260050003 - HOLLAND - SLAMS
18. 260810020 - GRAND RAPIDS -SLAMS*
19. 261210040 - MUSKEGON - SLAMS
20. 261390005 - JENISON - SLAMS

KALAMAZOO-BATTLE CREEK MSA
21. 260770008 - KALAMAZOO - SLAMS *

LANSING–E. LANSING MSA
22. 260650012 - LANSING - SLAMS *

SAGINAW-BAY CITY-MIDLAND MSA
23. 260170014 - BAY CITY - SLAMS [b]
24. 261450018 - SAGINAW - SLAMS *

TRAVERSE CITY, GRAND TRAVERSE CO
25. 260550003 - TRAVERSE CITY -SLAMS

ALPENA, ALPENA CO
26. 260070005 – ALPENA – SLAMS

SAULT STE MARIE, CHIPPEWA CO
27. 260330901 - TRIBAL, EASTERDAY-SLAMS
28. 260330902 - TRIBAL, MARQUETTE AVE

* Pending approval for NAMS designation

Attainment/Nonattainment Status of $PM_{2.5}$ in Michigan:

EPA has not yet carried out attainment/nonattainment designation for $PM_{2.5}$.

Because deployment of monitoring for fine particulates $PM_{2.5}$ began in 1999, long-term trend information is unavailable. The statewide annual arithmetic mean $PM_{2.5}$ concentration of the four calendar quarters in 2001 was 13.8 $\mu g/m^3$. The highest fourth-quarter annual mean of individual monitoring sites for 2001 occurred in Dearborn at 19.6 $\mu g/m^3$. Three years of monitoring data indicate that the 15.0 $\mu g/m^3$ annual mean standard will be the limiting standard in future nonattainment area designations. **Table 3.5-2** provides the annual mean $PM_{2.5}$ concentrations by individual monitoring station for 1999-2001.

Table 3.5-2: Annual Mean $PM_{2.5}$ Concentrations by Individual Monitoring Station, 1999-2001 (Annual Mean, Rounded to Nearest 0.1 $\mu g/m^3$)

AIRS ID	Partial Year 1999	2000	2001	Mean
260050003 - Holland	12.1	11.7	12.8	12.2
260070005 - Alpena		7.6	9.8	8.7
260170014 - Bay City		10.1	11.5	10.8
260210014 - Coloma	12.3	12.1	13.2	12.5
260330901 - Sault Ste. Marie Tribal #1			8.2	8.2
260330901 - Sault Ste. Marie Tribal #2			7.9	7.9
260330902 - Sault Ste. Marie Tribal			7.9	7.9
260490021 - Flint	12.0	13.0	13.1	12.7
260550003 - Traverse City		8.6	9.3	9.0
260650012 - Lansing #1	12.6	13.1	14.0	13.2
260650012 - Lansing #2	12.9	13.6	13.3	13.3
260770008 - Kalamazoo #1	14.9	15.1	15.6	**15.2**
260770008 - Kalamazoo #2	14.7	14.7	14.6	14.7
260810020 - Grand Rapids #1	13.8	13.8	14.4	14.0
260810020 - Grand Rapids #2	13.9	13.8	14.2	14.0
260990009 - New Haven	12.7	13.4	13.6	13.2
261150005 - Luna Pier		15.2	15.3	**15.3**
261210040 - Muskegon #1	12.2	11.9	12.6	12.2
261210040 - Muskegon #2	14.5	11.0		12.8
261250001 - Oak Park	14.2	15.4	14.7	14.8
261250010 - Southfield			17.1	**17.1**
261390005 - Jenison	12.9	13.2	13.8	13.3
261450018 - Saginaw #1	9.8	10.5	11.5	10.6
261450018 - Saginaw #2	10.4	9.8	10.3	10.2
261470005 - Port Huron #1	13.2	14.4	14.0	13.9
261470005 - Port Huron #2			13.2	13.2
261610005 - Ann Arbor	12.8	13.2	13.5	13.2
261610008 - Ypsilanti #1	14.2	14.3	14.5	14.3
261610008 - Ypsilanti #2			13.8	13.8
261630001 - Allen Park #1	16.7	15.6	17.3	**16.5**
261630001 - Allen Park #2	19.6	16.0	16.2	**17.3**
261630015 - Detroit - W. Fort St.	17.7	18.1	18.3	**18.0**
261630016 - Detroit - Linwood	17.1	15.5	15.8	**16.1**
261630019 - Detroit - E Seven Mile Rd		14.5	14.5	14.5
261630025 - Livonia	13.1	14.6	14.6	14.1
261630033 - Dearborn	17.0	20.1	19.6	**18.9**
261630036 - Wyandotte	16.3	17.6	18.2	**17.4**

Note: The annual $PM_{2.5}$ standard is met when the three-year average is less than or equal to 15.0 $\mu g/m^3$. For the purpose of comparing calculated values to the standard, the average annual means is rounded to the nearest 0.1 $\mu g/m^3$. The annual mean was based on data contained in the EPA Air Quality Subsystem. For more information, see FR 62(138) 62(138), page 99, Part 50, Appendix N and EPA's Guidelines on Data Handling Conventions for the PM NAAQS (EPA-454/R-99-008).

In 2001, the statewide average of the 24-hour 98th percentile $PM_{2.5}$ level of monitoring sites was 39 $\mu g/m^3$. The highest 24-hour 98th percentile $PM_{2.5}$ level of all monitoring sites (48.3 $\mu g/m^3$) occurred at the Allen Park monitor.

Table 3.5-3 provides a more detailed assessment of the 24-hour 98TH percentile $PM_{2.5}$ concentrations for 1999-2001. The available monitoring data indicates that Michigan ambient air quality levels are less than the 65 µg/m^3 standard.

Table 3.5-3: 24-Hour 98th Percentile $PM_{2.5}$ Concentrations by Individual Monitoring Station, 1999-2001 (98th Percentile, Rounded to Nearest 1 mg/m^3)

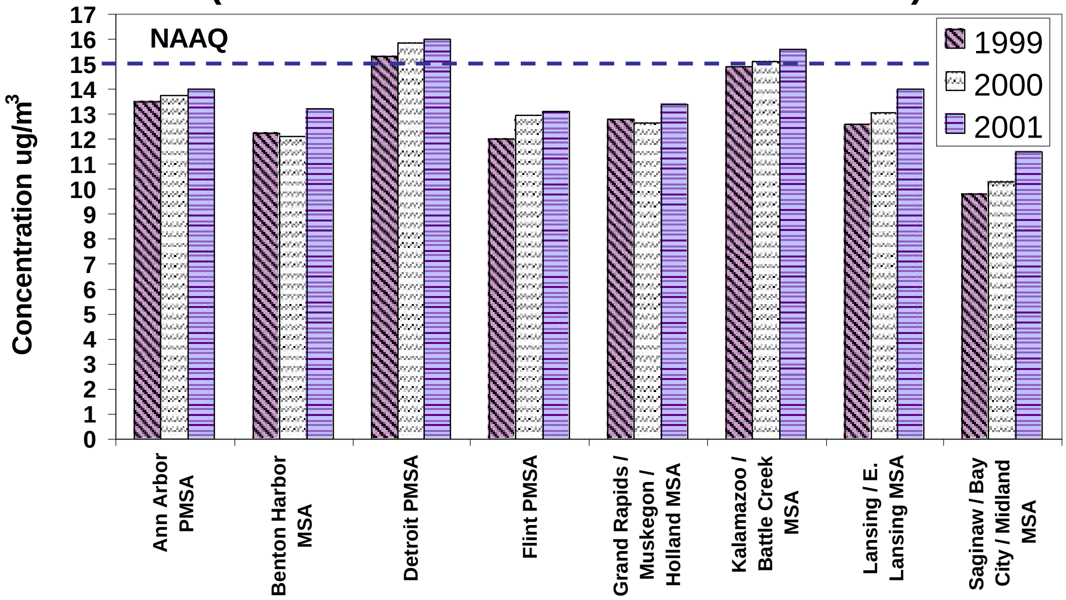
AIRS ID	1999	2000	2001	Mean
260050003 - Holland	36.5	35.7	42.1	38
260070005 - Alpena		25.4	35.1	30
260170014 - Bay City		27.7	34.2	31
260210014 - Coloma	35.4	29.7	32.3	32
260330901 - Sault Ste. Marie #1			27.9	28
260330901 - Sault Ste. Marie #2			25.4	25
260330902 - Sault Ste. Marie			28.0	28
260490021 - Flint	32.8	32.2	38.0	34
260550003 - Traverse City		27.2	32.7	30
260650012 - Lansing #1	34.6	37.2	37.2	36
260650012 - Lansing #2	36.8	35.3	40.4	38
260770008 - Kalamazoo #1	38.0	35.5	40.0	38
260770008 - Kalamazoo #2	38.7	36.5	36.0	37
260810020 - Grand Rapids #1	38.8	40.5	43.5	41
260810020 - Grand Rapids #2	39.3	28.1	39.4	36
260990009 - New Haven	31.9	33.2	42.0	36
261150005 - Luna Pier		37.2	39.2	38
261210040 - Muskegon #1	38.1	35.0	34.9	36
261210040 - Muskegon #2	39.1	23.5		31
261250001 - Oak Park	42.8	40.7	39.4	41
261250010 - Southfield			44.2	44
261390005 - Jenison	38.7	33.7	35.0	36
261450018 - Saginaw #1	31.0	27.5	34.6	31
261450018 - Saginaw #2	34.3	28.4		31
261470005 - Port Huron #1	44.5	33.1	40.5	39
261470005 - Port Huron #2			35.9	36
261610005 - Ann Arbor	38.2	33.1	38.5	37
261610008 - Ypsilanti #1	40.6	30.3	39.7	37
261610008 - Ypsilanti #2			39.0	39
261630001 - Allen Park #1	49.0	41.8	48.3	46
261630001 - Allen Park #2	44.1	34.6	40.1	40
261630015 - Detroit - W. Fort St.	50.2	44.5	42.9	46
261630016 - Detroit - Linwood	51.7	44.0	46.0	47
261630019 - Detroit - E Seven Mile Rd		42.0	42.0	42
261630025 - Livonia	38.4	35.9	44.7	40
261630033 - Dearborn	45.1	45.1	43.2	44
261630036 - Wyandotte	45.0	42.7	46.6	45

Note: The 24-hour $PM_{2.5}$ standard is met when the three-year average of the 98th percentile is less than or equal to 65.0 µg/m^3. For the purpose of comparing calculated values to the standard the three-year average of the 98TH percentile values is rounded to the nearest 1.0 µg/m^3. The 98TH percentile value was obtained from the EPA Air Quality Subsystem.

$PM_{2.5}$ Trends by MSA & Location:

Fine particulate $PM_{2.5}$ monitoring recently began in Michigan so historical long-term $PM_{2.5}$ trends for the decade are unavailable. **Figure 3.5-9** shows the annual mean (considering an average of the four calendar quarters) for years 1999 through 2001. Based upon this limited data of only three years, the highest concentration of $PM_{2.5}$ was observed in the Detroit PMSA. The Kalamazoo-Battle Creek MSA had the second highest MSA average. For all remaining MSAs, annual mean $PM_{2.5}$ levels were generally between 10 $\mu g/m^3$ to 14 $\mu g/m^3$.

Figure 3.5-9: $PM_{2.5}$ Levels by MSA, 1999-2001 (Annual Arithmetic Mean Concentration)

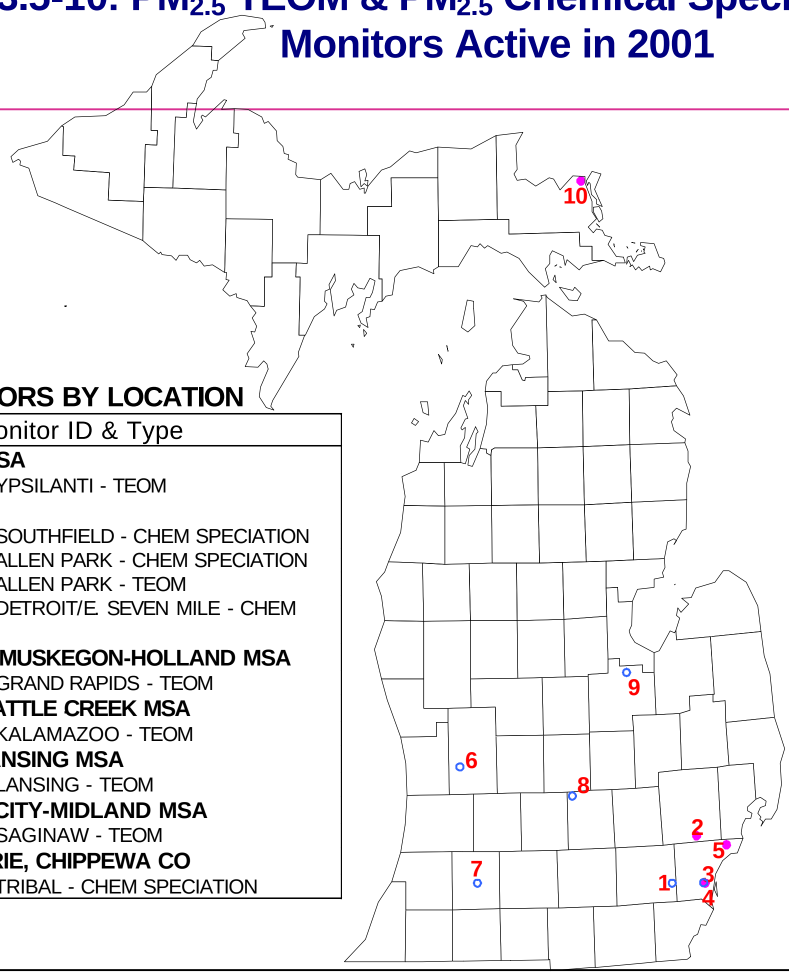


Monitoring for $PM_{2.5}$ Chemical Speciation in Michigan:

Efforts are being devoted toward the expansion of a chemical speciation network for analytical determination of chemical constituents that comprise the fine particulate $PM_{2.5}$ fraction. Four $PM_{2.5}$ chemical speciation monitor sites were established at Allen Park, Southfield, and Detroit's E. Seven Mile Road, and in Sault Ste. Marie. Allen Park is a NAMS trend chemical speciation monitor site, while the Southfield and Detroit's E. Seven Mile Road are chemical speciation SPM. The Southfield monitor site is located near the I-696 freeway, and will be used to chemically speciate fine particulate matter of motor vehicle emissions. The chemical speciation monitor at Detroit's E. Seven Mile Road is co-located with a gas chromatograph. These chemical speciation SPMs will operate for the duration of the Detroit Air Toxics Pilot Project. A tribal-operated monitor located at Lake Superior State University in Sault Ste. Marie provides particulate levels in Michigan's Upper Peninsula. These four chemical speciation monitors provide $PM_{2.5}$ chemical constituent concentrations of ammonium ion, antimony, arsenic, aluminum, beryllium, barium, bromine, cadmium, calcium, chromium, cobalt, copper, chlorine, cerium, cesium, europium, gallium, gold, hafnium, indium, iridium, iron, lanthanum, Pb, manganese, mangnesium, mercury, molybdenum, niobium, nitrate, organic and elemental carbon, phosphorus, potassium, rubidium, samarium, scandium, selenium, silicon, silver, sodium, strontium, sulfate, sulfur, tin, tantalum, terbium, titanium, vanadium, yitrium, wolfram, zinc, and zirconium.

Michigan expanded its $PM_{2.5}$ monitoring through the utilization of both continuous TEOM and chemical speciation air monitors. **Figure 3.5-10** shows the site locations of these monitors. TEOM monitors are beneficial in providing $PM_{2.5}$ concentrations on an hourly basis; they supplement the fine particulate data collected by manual monitors. During 2001, TEOM monitors operated in Allen Park, Grand Rapids, Lansing, Kalamazoo, Ypsilanti, and Saginaw. For more information regarding the TEOM network, see Chapter 5: Special Projects.

Figure 3.5-10: $PM_{2.5}$ TEOM & $PM_{2.5}$ Chemical Speciation Particulate Monitors Active in 2001



MONITORS BY LOCATION

Monitor ID & Type
ANN ARBOR PMSA
1. 261610008 - YPSILANTI - TEOM
DETROIT PMSA
2. 261250010 - SOUTHFIELD - CHEM SPECIATION
3. 261630001 - ALLEN PARK - CHEM SPECIATION
4. 261630001 - ALLEN PARK - TEOM
5. 261630001 - DETROIT/E. SEVEN MILE - CHEM SPECIATION
GRAND RAPIDS-MUSKEGON-HOLLAND MSA
6. 260810020 - GRAND RAPIDS - TEOM
KALAMAZOO-BATTLE CREEK MSA
7. 260770008 - KALAMAZOO - TEOM
LANSING– E. LANSING MSA
8. 260650012 - LANSING - TEOM
SAGINAW-BAY CITY-MIDLAND MSA
9. 261450018 - SAGINAW - TEOM
SAULT STE MARIE, CHIPPEWA CO
10. 260330901 - TRIBAL - CHEM SPECIATION

Chapter 3.6: Sulfur Dioxide Trends

Introduction:

Sulfur dioxide (SO_2) is a colorless, irritating gas formed by the burning of sulfur-containing material, and is odorless at typical ambient concentrations. It can react with other atmospheric chemicals to form sulfuric acid (H_2SO_4). When a sulfur-bearing fuel is combusted, the sulfur is oxidized to form SO_2 and then it reacts with other emissions to form aerosols. In liquid form, it is found in clouds, fog, rain, aerosol particles, and in surface liquid films on these particles. Both SO_2 and NO_2 are precursors to acidic deposition in the formation of acid rain (**3**). SO_2 reacts with ammonia in the atmosphere to form ammonium sulfate $(NH_4)_2SO_4$, a common chemical form of sulfate-related fine particulate material ($PM_{2.5}$) in the Midwest. Other sulfate-containing chemical species less prevalent in fine particles include ammonium bisulfate (NH_4HSO_4) (**4, 5**). Odor thresholds for SO_2 range between 0.4 ppm to 8.0 ppm (**1**).

Fuel combustion sources such as coal-fired power plants are the largest anthropogenic sources of SO_2 nationwide (**6**). Electrical utility plants produce approximately 64 percent of annual SO_2 emissions (**3**). SO_2 is also emitted from other industrial processes, such as non-ferrous smelters, iron ore smelters, petroleum refineries, pulp and paper mills, transportation sources, and steel mills that utilize fuels containing sulfur. Area sources include residential, commercial, and industrial space heating. Volcanic eruptions are natural sources of SO_2 (**2**).

SO_2 Effects:

Exposure to elevated levels of SO_2 aggravates existing cardiovascular and pulmonary disease. Asthmatics, children, and the elderly are especially sensitive to its effects. Asthmatic individuals receiving short-term exposures during moderate exertion may experience reduced lung function and symptoms such as wheezing, chest tightness, or shortness of breath (**6**). Depending on the concentration, SO_2 may also cause symptoms in people who do not have asthma. Where SO_2 is emitted, particulate material is also often formed and emitted. SO_2 and particulate matter may exert a synergistic toxic effect (**7**). Together, they may cause respiratory illness, alteration in defense and clearance, and aggravation of existing cardiovascular disease (**6**).

Vegetation exposed to SO_2 can develop leaf foliar injury, and experience impaired growth (yield), reduced species diversity, and population number (**6**). H_2SO_4 is a component of acid rain, which can cause acidification of soils and water, and erosion of building surfaces. H_2SO_4 and its reaction products with ammonia can also lead to visibility degradation (**2**).

NAAQS for SO_2:

Primary NAAQS:	Annual Arithmetic Mean not to exceed 0.030 ppm. 24-hour concentration limit not to exceed 0.14 ppm more than once/year.
Secondary NAAQS:	3-hour concentrations not to exceed 0.5 ppm more than once/year.

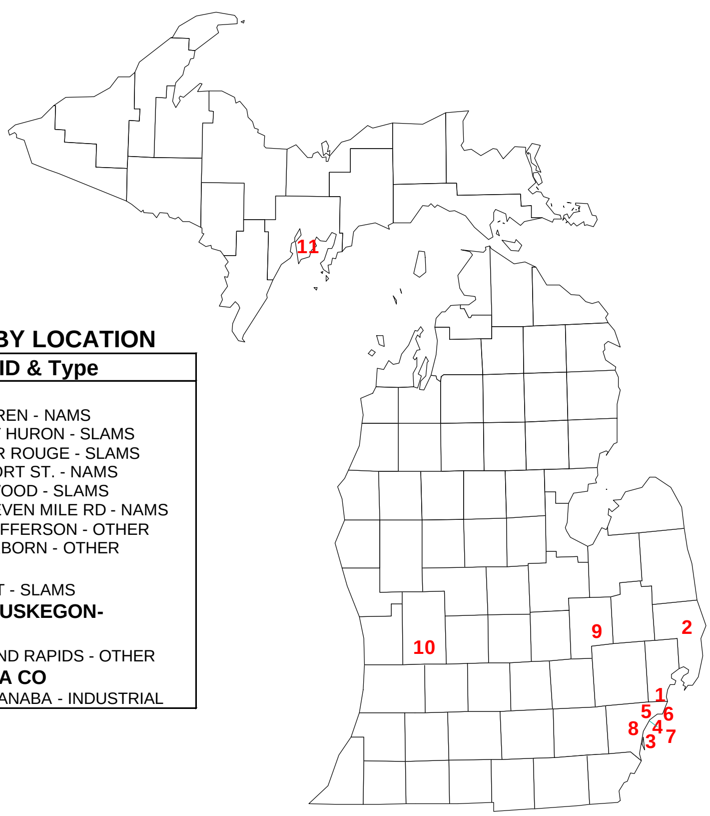
There are two primary standards for SO_2, an annual arithmetic average and a 24-hour average. The NAAQS are met if the annual arithmetic average does not exceed 0.030 ppm

(80 µg/m^3), and the 24-hour average 0.14 ppm (365 µg/m^3) is not exceeded more than once per year. There is also a secondary standard for SO_2. It is met if a 3-hour average does not exceed 0.50 ppm (1300 µg/m^3) more than once per year (**10**). **Note:** In May of 1996, the EPA made a technical change that expressed the NAAQS for SO_2 in terms of ppm rather than µg/m^3. The actual levels of the standard were not changed.

SO_2 Monitoring in Michigan:

The map in **Figure 3.6-1** shows the locations of Michigan SO_2 monitoring stations that operated during year 2001. In total, there were 11 SO_2 monitors. One is an industrial site in Escanaba, eight are located within the Detroit PMSA, one in the Grand Rapids-Muskegon-Holland MSA, and one in the Flint PMSA. Three NAMS sites (W. Fort Street, E. Seven Mile Road, and Warren) in the Detroit PMSA are used as neighborhood scale trend monitoring sites. The NAMS site at W. Fort Street in Detroit has been situated so that maximum SO_2 levels can be monitored. Additional monitoring stations within the Detroit PMSA at Port Huron, River Rouge, W. Jefferson, and Dearborn have been located to measure maximum SO_2 concentrations of neighborhood or middle scale air parcels.

Figure 3.6-1: Air Quality Monitors for SO_2 Active in 2001



MONITORS BY LOCATION

Monitor ID & Type
DETROIT PMSA
1. 260991003 - WARREN - NAMS
2. 261470005 - PORT HURON - SLAMS
3. 261630005 - RIVER ROUGE - SLAMS
4. 261630015 - W. FORT ST. - NAMS
5. 261630016 – LINWOOD - SLAMS
6. 261630019 – E. SEVEN MILE RD - NAMS
7. 261630027 - W. JEFFERSON - OTHER
8. 261630033 - DEARBORN - OTHER
FLINT PMSA
9. 260490021 – FLINT - SLAMS
GRAND RAPIDS-MUSKEGON-HOLLAND MSA
10. 260810020 - GRAND RAPIDS - OTHER
ESCANABA, DELTA CO
11. 260410902 – ESCANABA - INDUSTRIAL

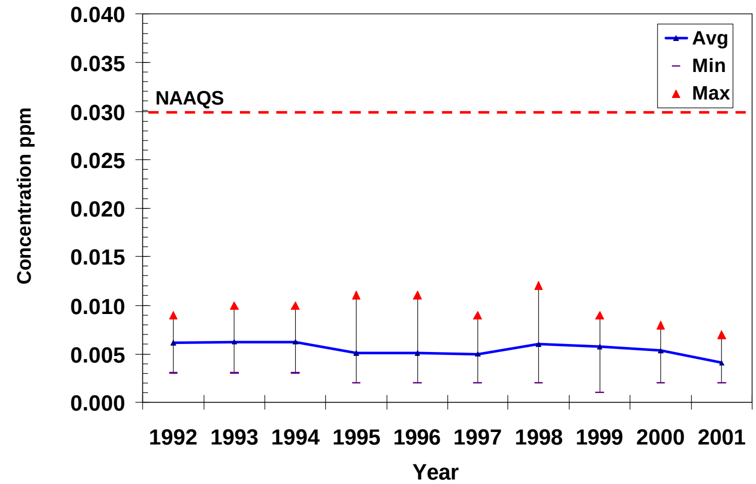
Attainment/Nonattainment Status of SO_2 in Michigan:

Over twenty years ago, on October 20, 1982, the last remaining SO_2 nonattainment area in Michigan was redesignated to attainment (**9**). Michigan has continued to maintain attainment status since that date. The CAA-Title IV Acid Rain Program, Phase I and II SO_2 emission limitations, and Michigan's regulations for the use of low sulfur coal in all power plants contribute to continuing attainment status.

As of January 29, 2001, there were 28 nonattainment areas nationwide for SO_2 that comprise 25 counties (**10**).

Long-Term Trends in SO_2:

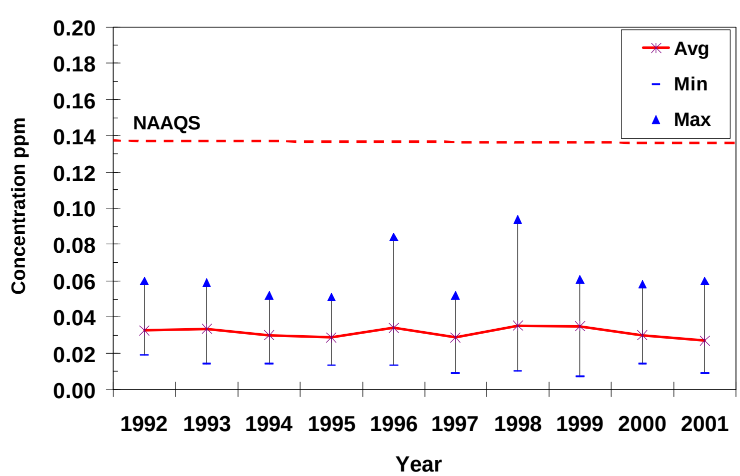
Figure 3.6-2: Range of SO_2 Annual Arithmetic Means, 1992-2001



Average SO_2 levels monitored in the state have consistently been below the 0.03 ppm annual air quality standard as shown in **Figure 3.6-2**. Over the past decade, the statewide annual mean SO_2 concentration of Michigan air sampling network sites ranged between 0.004 ppm to 0.006 ppm.

Annual averages over the ten-year period (1992-2001) decreased by nearly one third. The highest annual mean concentration during 2001 occurred at Port Huron and at Detroit's W. Fort Street site, whereas, the respective sites had an annual mean concentration of 0.007 ppm. Although the Dearborn monitor had an annual mean of 0.008 ppm, it was based on a few months of air monitoring. Operation of the Dearborn monitor ceased on May 9, 2001.

Figure 3.6-3: Range of Maximum 24-Hour SO_2 Levels, 1992 - 2001



Trends for 24-hour maximum levels have followed a pattern similar to that of the annual mean.

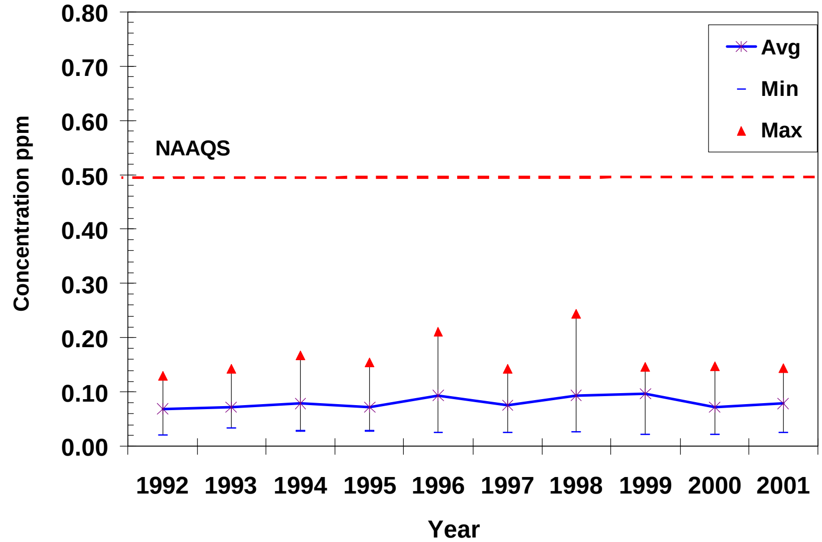
Figure 3.6-3 shows the 24-hour statewide average of Michigan air sampling network sites remained near the 0.03 ppm level, significantly less than the 24-hour NAAQS of 0.14 ppm.

During 2001, 0.06 ppm was the highest monitored 24-hour SO_2 concentration which occurred at the Port Huron monitoring site.

Figure 3.6-4 shows no exceedances of the 3-hour secondary standard for SO_2 occurring at Michigan SO_2 sites during the decade.

When 3-hour maximum values are averaged, SO_2 levels ranged between 0.06 ppm to about 0.10 ppm during the decade. These values are significantly less than the 0.5 ppm secondary NAAQS. At this shorter 3-hour averaging time, the Port Huron monitor site had the highest detected SO_2 level at 0.14 ppm during 2001.

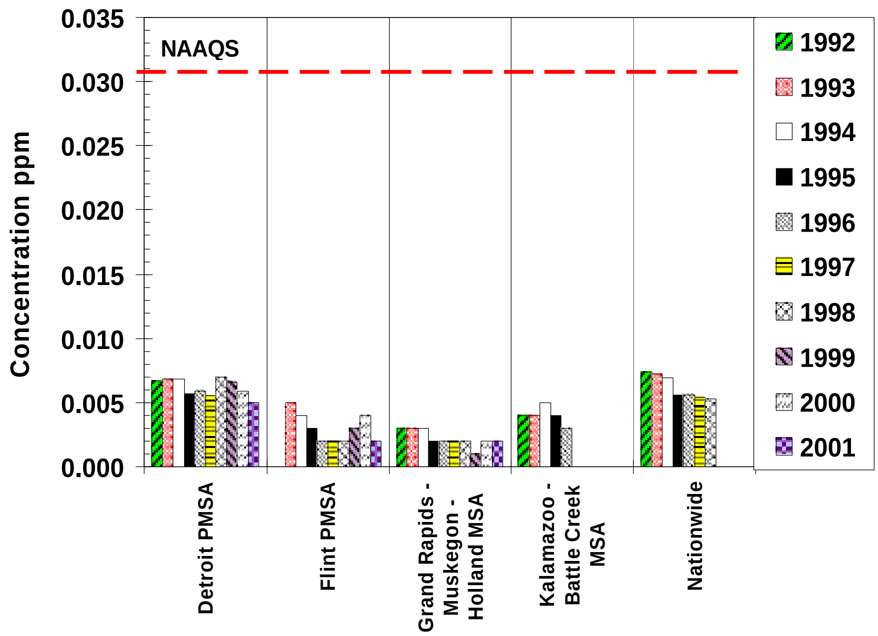
Figure 3.6-4: Range of Maximum 3-Hour SO_2 Levels, 1992-2001



SO_2 Trends by MSA & Location:

Figure 3.6-5 compares the mean of the annual average SO_2 levels for MSAs in Michigan over the past decade. SO_2 levels have decreased in all Michigan MSAs. Historically, monitored SO_2 levels of the Detroit PMSA were comparable to the national average (nationwide averages only available through 1998), while Flint PMSA, Grand Rapids-Muskegon-Holland MSA, and Kalamazoo-Battle Creek MSA monitor sites were less than the national average.

Figure 3.6-5: Annual Mean SO_2 Levels by MSA, 1992 - 2001

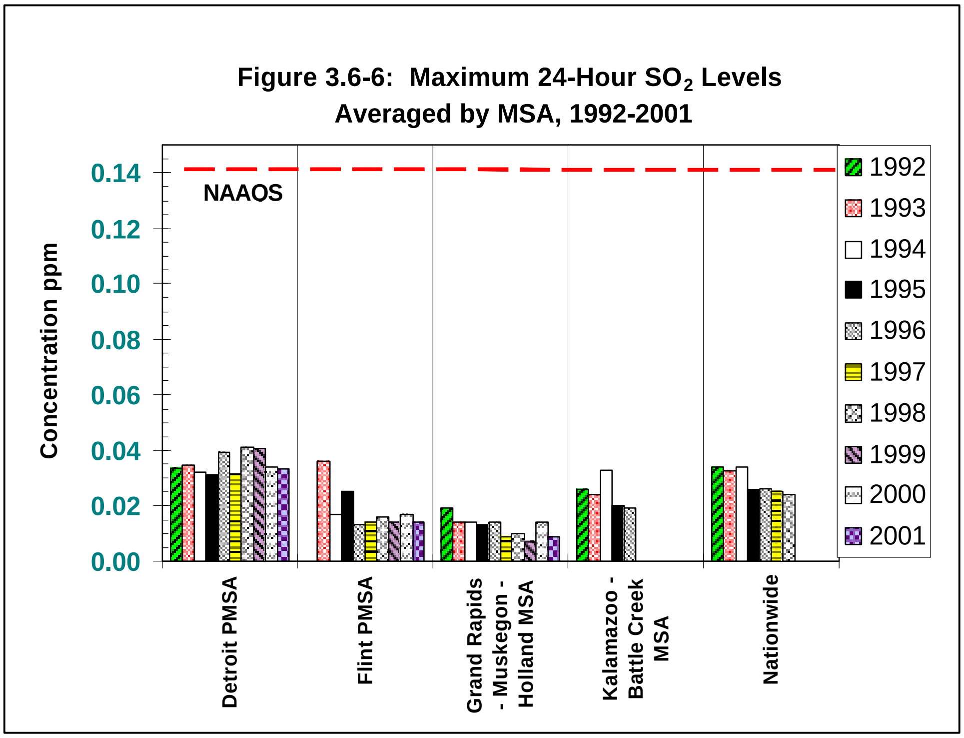


Annual mean values for 2001 were 0.005 ppm for the Detroit PMSA, 0.002 ppm at the Flint PMSA, and 0.002 ppm for the Grand Rapids-Muskegon-Holland MSA.

During the last year of monitoring (1996), the annual mean for the Kalamazoo-Battle Creek MSA was 0.003 ppm. Monitoring in the Lansing-East Lansing MSA and the Saginaw-Bay City-Midland MSA was discontinued in the 1980s because the MSAs were in attainment.

Figure 3.6-6 provides the SO_2 concentrations for each MSA in terms of the 24-hour average and shows that all are well below the 24-hour average NAAQS of 0.14 ppm.

At the shorter 24-hour time period, the Detroit PMSA experienced higher SO_2 levels in recent years than their national counterparts, while other Michigan MSAs historically had better air quality than the national average (EPA information on nation-wide averages are only available through 1998).



The CAA Title IV Acid Rain Program Phase I and II SO_2 emission limitations are credited with national emission reductions at electric utilities during 1995 through 2000 (6). The intent of this program is to reduce, by 2010, annual SO_2 emissions by 10 million tons below that of the 1980 levels. Electric utility emissions would be capped at 8.95 million tons per year (11).

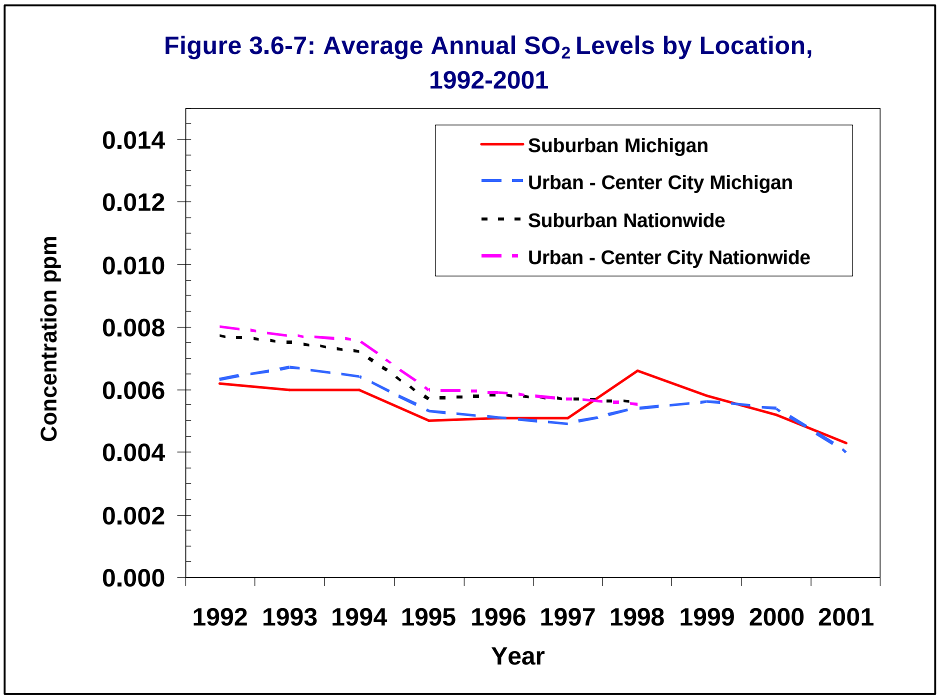


Figure 3.6-7 shows Michigan urban and suburban areas have generally experienced a reduction in the average annual mean SO_2 level. Annual ambient mean SO_2 concentrations for urbanized and suburban areas decreased from 0.006 ppm in 1991 to 0.004 ppm in 2001. A slight increase was detected for 1998 and 1999 before declining in the latter part of the decade.

CHAPTER 4: Toxic Pollutants in Michigan

Introduction:

The previous chapters of this report addressed the six air pollutants that have NAAQS, also referred to as the criteria pollutants. In addition to those pollutants, a wide variety of substances are classified as toxic air pollutants, or air toxics. The exact compounds and substances included in this category are determined by the various state and federal regulations that address these materials. For example, under the CAA, the EPA specifically addresses a group of 188 hazardous air pollutants (HAPs). In Michigan, under the State's air regulations, toxic air contaminants (TACs) are defined as all non-criteria pollutants that may be "…harmful to public health or the environment when present in the outdoor atmosphere in sufficient quantities and duration." The definition of TACs goes on to list 41 substances which are not TACs, indicating that all others are TACs.

In general, air toxics can be subcategorized as toxic metals, organic substances, and other substances. The metals include aluminum (Al), arsenic (As), beryllium (Be), barium (Ba), cadmium (Cd), chromium (Cr), cobalt (Co), copper (Cu), iron (Fe), mercury (Hg), manganese (Mn), molybdenum (Mo), nickel (Ni), lead (Pb), vanadium (V), and zinc (Zn). The organic toxics classification is further divided into sub-categories that include VOCs, carbonyl compounds (aldehydes and ketones), semi-volatile compounds, polycyclic aromatic hydrocarbons/polynuclear aromatic hydrocarbons (PAHs or PNAs), pesticides, polychlorinated biphenyls (PCBs), and polycyclic organic matter (POM). The other substances include asbestos and radionuclides such as radon.

With such a large, diverse group of substances that may be considered air toxics, regulatory agencies have developed shorter lists for the purpose of addressing particular concerns. For example, some initiatives have targeted those substances that are persistent and/or bioaccumulative (discussed further below), and the EPA has developed an Integrated Urban Air Toxics Strategy with a focus on 33 substances (the Urban HAPs List; 64 FR No. 137, p. 38706). The air toxics also pose a challenge due to monitoring and analytical methods that are either unavailable for some compounds (e.g., acrolein) or extremely expensive for others (e.g., dioxins). During 2001, the MDEQ's AQD and the EPA made significant efforts to develop monitoring strategies for air toxics, to determine where (and for what substances) future monitoring efforts should be focused to best address data needs and objectives. Those strategies are still under development and revision. In 2001, the AQD drafted a comprehensive air toxics monitoring strategy to provide a network characterizing ambient levels of air toxics, including atmospheric deposition.

Toxic Effects Assessment:

The air toxics have a widely ranging assortment of potential toxic effects. Examples include: the aggravation of asthma; irritation to the eyes, nose, and throat; carcinogenicity; developmental toxicity; nervous system effects; and various other effects on internal organs. Some substances tend to have only one most "critical" effect, while others may have several. Some effects of concern appear with a short period of exposure, while others may appear after long-term exposure or after a long period of time has passed since the exposure ended; and, most toxic effects are not unique to one substance. For these (and other) reasons, it is frequently very difficult to conclusively associate environmental levels and potentially linked public health impacts. Also, some effects may be of concern only after the substance has settled (deposited) to the ground, followed by exposure through an oral pathway such as the eating of fish or produce. Further complicating the assessment of air toxics concerns is the broad range of susceptibility that various people may have.

The evaluation of the significance of air toxics levels is hindered by several factors. Unlike the six criteria pollutants, there are no health-protective NAAQS for the air toxics. Instead, air quality assessment utilizes various short-term and long-term screening levels estimated to be safe considering the critical effects of concern for specific substances. This is made more difficult by the lack of complete toxicity information for many substances. For some air toxics, the analytical detection limits are too high to consistently measure the amount present; and in some cases, the risk assessment-based "safe" levels are below the detection limits. There are also data gaps regarding the potential for interactive toxic effects for co-exposure to multiple substances present in emissions and in ambient air. Also, there is generally more complete information on the ambient air levels of the criteria pollutants than the air toxics. All of these factors make it difficult to accurately assess the potential health concerns of air toxics.

Monitoring Data Importance and Availability:

Data on the ambient levels of air toxics are needed to assess what people are exposed to. Exposure may occur either directly by inhalation or indirectly after certain persistent pollutants have been deposited on the ground. Regarding the adequacy of the available data, four recent reviews are the most noteworthy.

- The Michigan's Relative Risk Task Force Report on Air Quality Issues (**1**) concluded that, "Because of errors in the ambient air monitoring database, an assessment of the relative risk associated with the hazardous air pollutants is not possible. The Task Force recommends that the MDEQ makes it a high priority to collect high quality ambient air data on the hazardous air pollutants so that such an assessment can be conducted in the near future."

- The Michigan Environmental Science Board (MESB) (**2**) evaluated the MDEQ's environmental standards' protectiveness for children's health. They found that the available data on the levels of air toxics were insufficient to conduct a risk assessment for any segment of the population.

- Another MESB report (**3**), on the subject of environmental quality indicators, found that, "…it would be very valuable to have an extensive database of measured levels of toxic air pollutants, to observe trends and to evaluate the health risks of the levels. Unfortunately, the currently available data are quite limited in scope."

- The Southeast Michigan Council of Governments (**4**) evaluated environmental indicators for southeast Michigan and concluded, in part, that "Because of the limited extent of sampling information, the existing database is not as complete as necessary for ambient toxic concentrations to be used as a comprehensive environmental indicator."

Efforts to develop an overall air toxics monitoring strategy and network have been noted in the Introduction. Currently, the AQD is conducting a relatively intensive Pilot Project study of air toxics in the Detroit area, supported by a grant from EPA (see the Detroit Air Toxics Pilot

Project in this section). The EPA will utilize the data from Detroit and other pilot project locations to design a national air toxics monitoring network.

Due to the lack of a comprehensive national air toxics monitoring database and the many challenges of developing one, the EPA has developed a National Scale Air Toxics Assessment (NATA). The NATA project utilized a 1996 emissions inventory and dispersion modeling to estimate potential ambient air concentrations, and the public's exposure levels and health risks. EPA intends to update and repeat that assessment every three years.

Air toxics monitoring efforts in 2001 can be separated into four types on the basis of the objectives of the studies, and are further described in this section.

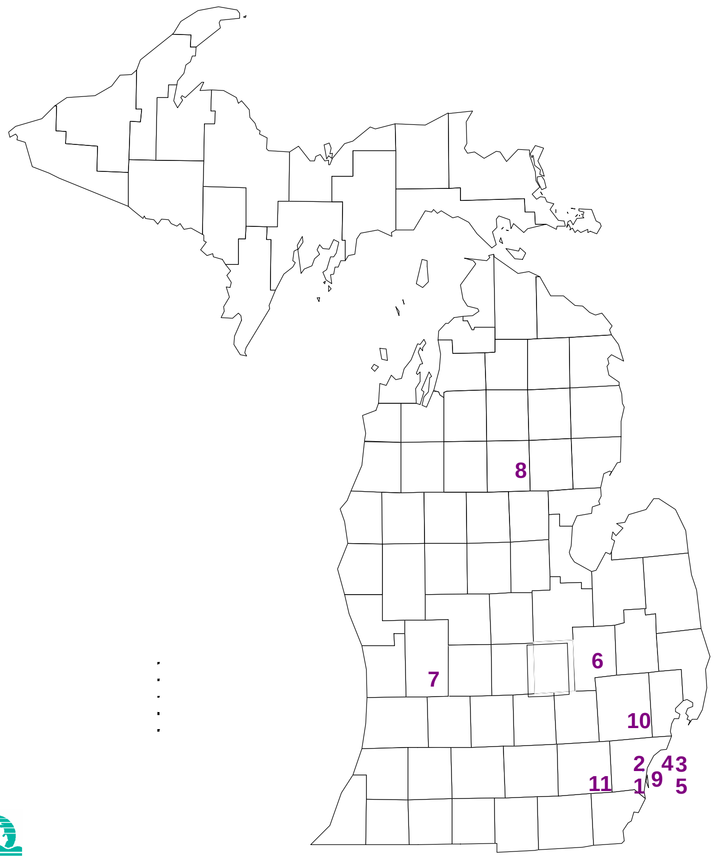
1. The Michigan Toxics Air Monitoring Program (MITAMP) has the purpose of determining the ambient air levels and long-term trends of air toxics in urban areas and a background site.
2. Source specific monitoring is performed for the purpose of determining the source impact caused by emissions of relatively short lists of specific air toxics from certain facilities.
3. The Detroit Air Toxics Pilot Project is an intensive one-year monitoring study (April 2001 to April 2002) designed to determine the levels and variability of high-priority air toxics at eight sites in the Detroit area, in concert with similar studies at nine other sites across the United States.
4. There are special studies of persistent bioaccumulative air toxics (PBTs) with the purpose of characterizing the ambient air levels or deposition rates of these specific substances of concern.

The Michigan Toxics Air Monitoring Program:

The MITAMP was established in January 1990. It was preceded by the 1987-1988 EPA "Urban Toxics Air Monitoring Program." Since the MITAMP's inception, more than 50 toxic organic compounds and up to 15 trace metals have been monitored at various urban locations throughout the state. Carbonyl sampling (aldehydes and ketones) under the MITAMP began in June 1995 (**5**). To collect MITAMP data, the AQD operates monitors using sampling techniques specifically designed for pollutants of interest. High-volume sampler filters are used to collect toxic metals. Evacuated canisters are used to sample for VOCs. On a non-routine basis, samplers using polyurethane foam (PUF) are used to collect PAHs, PCBs, etc. The purpose of this monitoring is to characterize levels of toxic organic compounds and trace metals primarily in urban areas. While MITAMP monitoring sites and equipment were being established, the MDEQ laboratory's analytical methods were still undergoing development. Therefore, VOC analytical data collected from 1990 through 1993 are considered experimental. While some of these MITAMP data have been reported and appeared in previous Air Quality Reports, they should not be used for comparison or exposure assessment purposes. Data collected and analyzed after 1993 are considered valid; however, some errors occurred in converting the data for publication in earlier Air Quality Reports. Another example of problematic data is that in 2001, the EPA determined that the analytical method for acrolein was not accurate, therefore, all historical data for acrolein based on that method is invalid.

Figure 4.1-1 shows the locations of the 11 MITAMP stations where air toxics were measured in 2001. The chemical compounds monitored at these MITAMP stations are listed in **Table 4.1-1**.

Figure 4.1-1: MITAMP Monitors Active in 2001



MONITORS BY LOCATION

Monitor Name & ID
1. Allen Park - 261630001
2. Dearborn - 261630033
3. Detroit, E. Seven Mile Rd. - 261630019
4. Detroit, W. Fort - 261630015
5. Detroit, W. Jefferson - 261630027
6. Flint, Whaley Park - 260490021
7. Grand Rapids, Randolph - 260810021
8. Houghton Lake - 261130001
9. River Rouge - 261630005
10. Southfield - 261250010
11. Ypsilanti - 261610008

See Table 4.1-1 for a list of chemical compounds monitored at each location

Table 4.1-2 presents the non-industrial monitoring sites operational from 1987 to 2001 and the categories of air toxics monitored at those sites.

Seven MITAMP sites were operated in the Detroit area during 2001. (NOTE: Some of these stations were operated as part of the Detroit Air Toxics Pilot Project.) The monitor located on W. Fort Street is the long-term trend toxics site. Monitoring will continue at this location on a long-term basis. The other air toxics monitoring sites may be periodically rotated around the state. Another site is located in Grand Rapids with data collection starting on September 6, 1995. This is located in the urban central city area that is primarily industrial. In July 1998, a “background” toxics site near Houghton Lake became operational. That location was selected to provide data for a relatively unimpacted site (away from large urban areas or high vehicle emissions) as a basis for comparison to urban data. A monitor in Flint is used to collect data for toxic metals. Beginning in 2000, data was collected in Ypsilanti. Appendix C identifies the levels measured in 2001 at the MITAMP monitoring sites.

Table 4.1-1: Chemical Compounds Monitored At MITAMP Sites During 2001

Chemical Compound	Allen Park	Dearborn	Detroit 7 Mile Rd	Detroit W Fort St	Detroit W Jefferson	Flint	Grand Rapids	Houghton Lake	River Rouge	Southfield	Ypsilanti
Aluminum (TSP)				√		√	√	√	√		
Arsenic (TSP)	√	√	√	√	√	√	√	√	√	√	√
Barium (TSP)				√		√	√	√	√		√
Beryllium (TSP)	√	√	√	√	√	√	√	√	√	√	√
Cadmium (TSP)	√	√	√	√	√	√	√	√	√	√	√
Chromium (TSP)	√	√	√	√	√	√	√	√	√	√	√
Cobalt (TSP)				√		√	√	√	√		√
Copper (TSP)				√		√	√	√	√		√
Iron (TSP)				√		√	√	√	√		√
Lead (TSP)	√	√	√	√	√	√	√	√	√	√	√
Manganese (TSP)	√	√	√	√	√	√	√	√	√	√	√
Molybdenum (TSP)				√		√	√	√	√		√
Nickel (TSP)	√	√	√	√	√	√	√	√	√	√	√
Vanadium (TSP)				√		√	√	√	√		√
Zinc (TSP)				√		√	√	√	√		√
1,1,1-Trichloroethane	√	√		√	√		√	√	√	√	√
1,1,2,2-Tetrachlooroethane	√	√		√	√		√	√	√	√	√
1,1,2-Trichloroethane	√	√		√	√		√	√	√	√	√
1,1-Dichloroethane	√	√		√	√		√	√	√	√	√
1,1-Dichloroethene	√	√		√	√		√	√	√	√	√
1,2,4-Trichlorobenzene	√	√		√	√		√	√	√	√	√
1,2,4-Trimethylbenzene	√	√		√	√		√	√	√	√	√
1,2-Dibromoethane	√	√		√	√		√	√	√	√	√
1,2-Dichlorobenzene	√	√		√	√		√	√	√	√	√
1,2-Dichloroethane	√	√		√	√		√	√	√	√	√
1,2-Dichloroethene		√		√			√	√	√		√
1,2-Dichloropropane	√	√		√	√		√	√	√	√	√
1,3,5-Trimethylbenzene	√	√		√	√		√	√	√	√	√
1,3-Butadiene	√	√		√	√		√	√	√	√	√
1,3-Dichlorobenzene	√	√		√	√		√	√	√	√	√
1,4-Dichlorobenzene		√		√			√	√	√		√
2,2,4-Trimethylpentane		√		√			√	√	√		√

Table 4.1-1: Chemical Compounds Monitored At MITAMP Sites During 2001 (Continued)

Chemical Compound	Allen Park	Dearborn	Detroit 7 Mile Rd	Detroit W Fort St	Detroit W Jefferson	Flint	Grand Rapids	Houghton Lake	River Rouge	Southfield	Ypsilanti
2,5-Dimethylbenzaldehyde	√	√	√	√	√		√	√	√	√	√
2-Chloro-1,3-Butadiene	√	√		√	√		√	√	√	√	√
Acetaldehyde	√	√	√	√	√		√	√	√	√	√
Acetone	√	√	√	√	√		√	√	√	√	√
Acetonitrile	√	√		√	√		√	√	√	√	√
Acetylene	√	√			√				√	√	
Acrylonitrile	√	√		√	√			√	√	√	√
Benzaldehyde	√	√	√	√	√		√	√	√	√	√
Benzene	√	√		√	√		√	√	√	√	√
Bromochloromethane	√	√			√				√	√	
Bromodichloromethane	√	√		√	√		√	√	√	√	√
Bromoform	√	√		√	√		√	√	√	√	√
Bromomethane (Methyl Bromide)	√	√		√	√		√	√	√	√	√
Carbon Tetrachloride	√	√		√	√		√	√	√	√	√
Chlorobenzene	√	√		√	√		√	√	√	√	√
Chloroethane	√	√		√	√		√	√	√	√	√
Chloroform	√	√		√	√		√	√	√	√	√
Chloromoethane	√	√		√	√		√	√	√	√	√
Chloromethyl Benzene	√	√		√	√		√	√	√	√	√
Cis-1,2-Dichloroethene	√	√		√	√		√	√	√	√	√
cis-1,3-Dichloropropene	√	√		√	√		√	√	√	√	√
Crotonaldehyde	√	√	√	√	√		√	√	√	√	√
Dibromochloromethane	√	√		√	√		√	√	√	√	√
Dichlorodifluoromethane	√	√		√	√		√	√	√	√	√
Dichlorotetrafluoroethane	√	√			√				√	√	
Ethyl Acrylate	√	√			√				√	√	
Ethyl Tert-Butyl Ether	√	√			√				√	√	
Ethylbenzene	√	√		√	√		√	√	√	√	√
Formaldehyde	√	√	√	√	√		√	√	√	√	√
Halocarbon 113		√		√			√	√	√		√
Halocarbon 114		√		√			√	√	√		√
Hexachloro-1,3-Butadiene	√	√		√	√		√	√	√	√	√

Table 4.1-1: Chemical Compounds Monitored At MITAMP Sites During 2001 (Continued)

Chemical Compound	Allen Park	Dearborn	Detroit 7 Mile Rd	Detroit W Fort St	Detroit W Jefferson	Flint	Grand Rapids	Houghton Lake	River Rouge	Southfield	Ypsilanti
Hexanaldehyde	√	√	√	√	√		√	√	√	√	√
Isovaleraldehyde	√	√	√	√	√		√	√	√	√	√
m,p-Tolualdehyde	√	√	√	√	√		√	√	√	√	√
m/p-Xylene	√	√		√	√		√	√	√	√	√
Methyl Ethyl Ketone	√	√		√	√		√	√	√	√	√
Methyl Isobutyl Ketone	√	√		√	√		√	√	√	√	√
Methyl Methacrylate	√	√			√				√	√	
Methyl Tert-Butyl Ether	√	√		√	√		√	√	√	√	√
Methylene Chloride	√	√		√	√		√	√	√	√	√
n-Butyraldehyde	√	√	√	√	√		√	√	√	√	√
n-Hexane		√		√			√	√	√		√
n-Octane	√	√			√				√	√	
o-Tolualdehyde	√	√	√	√	√		√	√	√	√	√
o-Xylene	√	√		√	√		√	√	√	√	√
Propionaldehyde	√	√	√	√	√		√	√	√	√	√
Propylene	√	√			√				√	√	
Styrene	√	√		√	√		√	√	√	√	√
Tert-Amyl Methyl Ether	√	√			√				√	√	
Tetrachloroethene	√	√		√	√		√	√	√	√	√
Toluene	√	√		√	√		√	√	√	√	√
Trans-1,2-Dichloroethene	√	√			√				√	√	
trans-1,3-Dichloropropene	√	√		√	√		√	√	√	√	√
Trichloroethene	√	√		√	√		√	√	√	√	√
Trichlorofluoromethane	√	√		√	√		√	√	√	√	√
Trichlorotrifluoroethane	√	√			√				√	√	
Valeraldehyde	√	√	√	√	√		√	√	√	√	√
Vinyl Chloride	√	√		√	√		√	√	√	√	√

Note: Summaries of trace metal and VOC analysis results are listed in **Appendix C**.

Table 4.1-2: Non-Industrial Sites Collecting Air Toxics Data in Michigan. (Not all parameters were collected during all years)

			Years Operated																			
County	Location	AIRS ID	87	88	89	90	91	92	93	94	95	96	97	98	99	00	01	VOC's	Carbonyls	Trace Metals as TSP	Trace Metals as PM_{10}	Semi-Volatiles
Allegan	South Haven	260050002						x	x	x				x	x						x	x
Cheboygan	Pellston	260310001						x	x	x											x	
Chippewa	Brimley	260330033					x													x		
Genesee	Flint	260490011		x	x	x	x													x		
Genesee	Flint, Whaley Park	260490021									x	x	x	x	x	x	x			x		
Grand Traverse	Traverse City	260550002					x													x		
Huron	Bay Port	260630003				x	x													x		
Ingham	Lansing	260650013	x	x														x		x		
Ingham	Lansing	260651001		x	x	x	x													x		
Kalamazoo	Kalamazoo	260770002		x	x	x	x	x												x		
Kalamazoo	Portage	260770004				x	x	x	x									x		x		
Kent	Grand Rapids	260810010		x	x	x	x			x	x	x	x	x						x		
Kent	Grand Rapids	260810021									x	x	x	x	x	x	x	x	x	x		
Kent	Wyoming	260812002		x	x	x	x				x	x	x	x						x		
Menominee	Menominee	261090002							x											x		
Midland	Midland	261110007	x	x	x	x	x	x										x		x		x
Missaukee	Houghton Lake	261130001												x	x	x	x	x	x	x		
Muskegon	Muskegon	261210023		x	x	x	x				x	x	x							x		
Oakland	Southfield	261250010															x					
Saginaw	Saginaw	261450002		x	x	x	x													x		
Saint Clair	Port Huron	261470005	x	x	x	x	x											x		x		
Sanilac	Deckerville	261510002						x	x	x											x	
Washtenaw	Ann Arbor	261610002		x	x	x	x													x		
Washtenaw	Dexter	261618001						x	x	x											x	
Washtenaw	Ypsilanti	261610008														x	x	x	x	x		
Wayne	Allen Park	261630001															x	x				
Wayne	Dearborn	261630002	x	x														x		x		x
Wayne	Dearborn	261630033				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Wayne	Detroit, Evergreen	261630014			x	x	x													x		
Wayne	Detroit, W. Fort	261630015				x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Wayne	Detroit, W Jefferson	261630027															x	x	x			
Wayne	Detroit, Linwood	261630016			x	x	x	x	x	x	x	x	x	x	x	x				x		
Wayne	Detroit, E Seven Mile	261630019			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Wayne	River Rouge	261630005							x	x	x	x	x	x	x	x	x	x	x	x		
Wayne	Wayne Co: Weston Trailer	261630032	x	x														x		x		x

Detroit Air Toxics Pilot Project:

Beginning in 2000, a series of pilot project programs were developed by EPA to generate information on the spatial and temporal variability of ambient air toxics concentrations. The Detroit area was selected as one of four large urban areas for the EPA's National Air Toxics Monitoring Pilot Program. The other three large urban areas selected for this pilot include Providence, Seattle, and Tampa. Six smaller urban areas (none in Michigan) were also included in this nationwide initiative. The Detroit pilot study and other pilots will provide valuable information on the levels of air toxics, and the spatial and temporal variability of ambient air toxics in Detroit and in various areas of the country. The data generated from these pilot projects will be used to design a national ambient air monitoring network.

The Detroit Air Toxics Pilot Project involves an intensive one-year air toxics monitoring phase, followed by data compilation, validation, and assessment. The monitoring phase was from April 19, 2001 to April 30, 2002. The Detroit Air Toxics Pilot project includes eight monitoring stations, as shown in **Figure 4.1-2**, measuring ambient levels of substances including VOCs, carbonyls, trace metals (as TSP), PAHs, and hexavalent chromium. Sampling frequencies varied from site to site and were also dependent upon the parameter group being collected. In general, monitoring was conducted at locations where people live, work, and play (population-oriented sites) on the neighborhood scale. For most parameters, at most sites, a once every six-day sampling schedule was used.

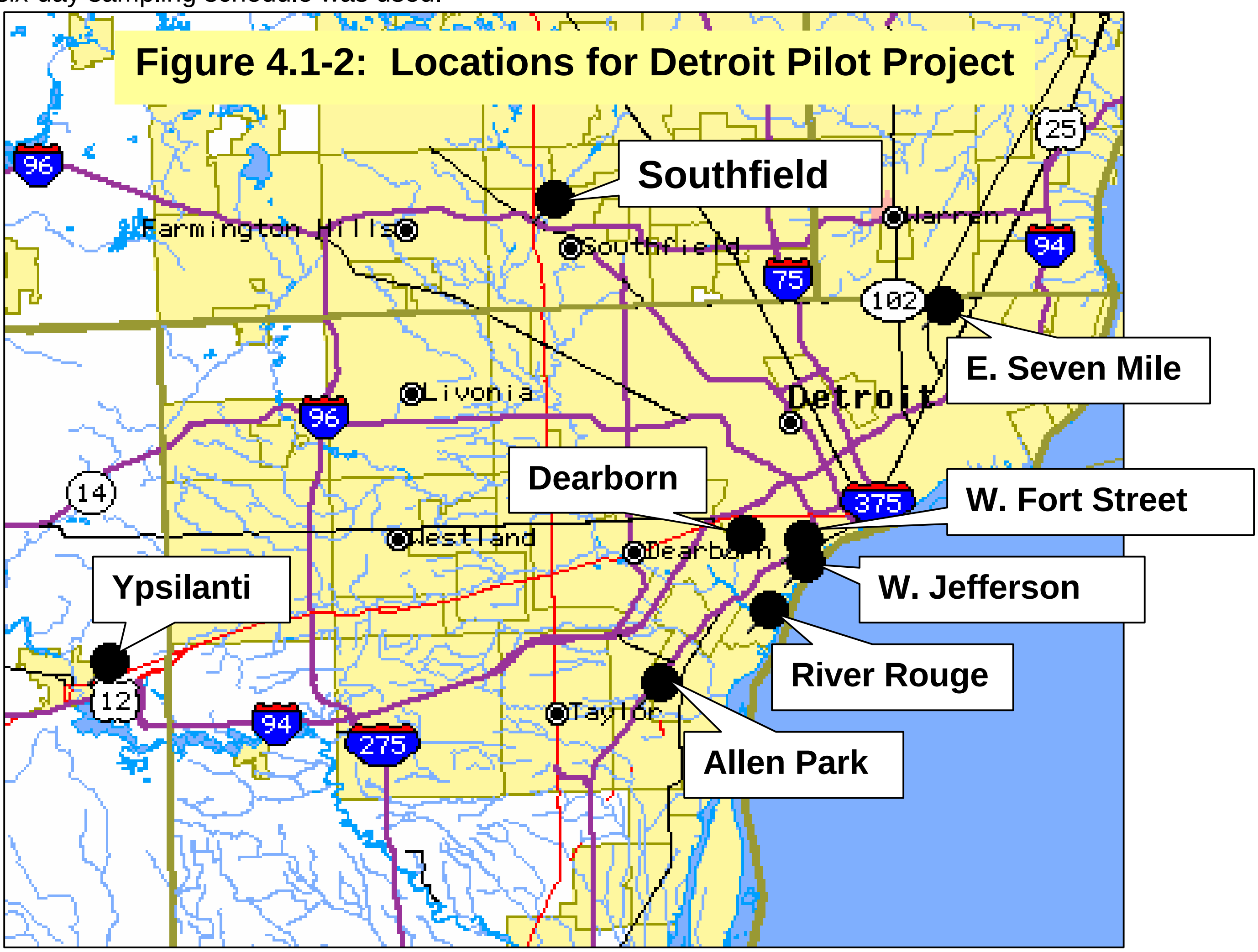
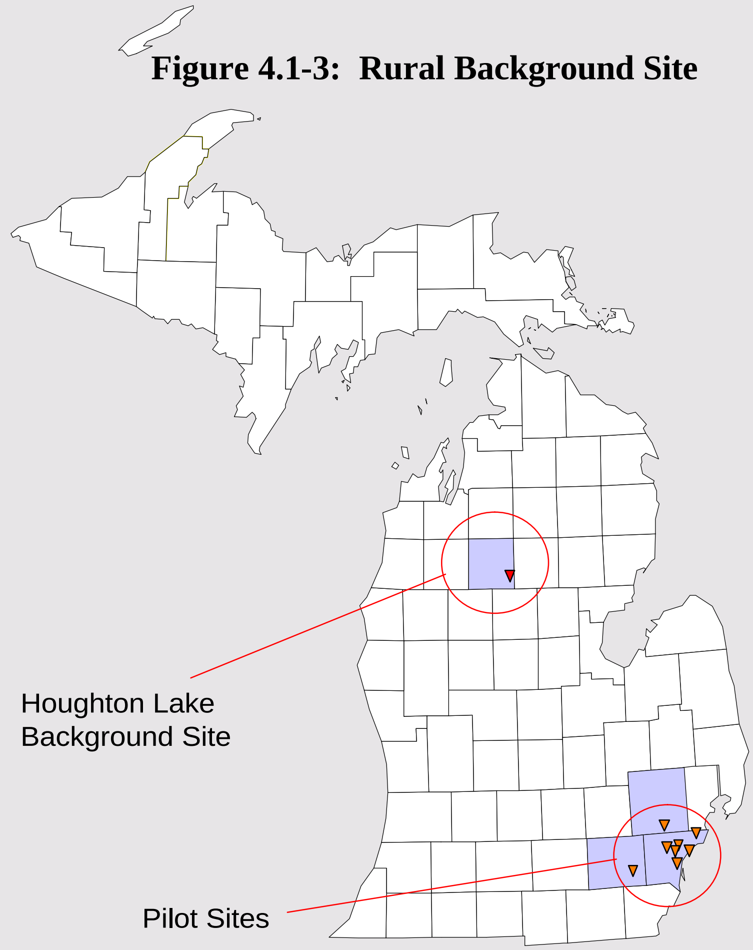


Figure 4.1-2: Locations for Detroit Pilot Project

In addition, the MDEQ also operates a rural background site near Houghton Lake as shown in **Figure 4.1-3**. This data will be made available for the data analysis activities. The study was designed to address the following:

Figure 4.1-3: Rural Background Site



- Provide duplicate sampling to assess both inter-laboratory and intra-laboratory precision at various sites, depending upon space available, to meet inlet separation requirements.
- Assess influences from a mobile source-oriented site (Southfield).
- Assess toxic levels at a maximum impact spot site (Detroit - W. Jefferson).
- Collect daily VOC and carbonyl samples to assess optimal sampling frequency and day-to-day variability (Dearborn).
- Sample hexavalent chromium once every 12 days at the following four sites:

  1) River Rouge Co-located
  2) Southfield
  3) Allen Park
  4) Dearborn

- Determine the degree of spatial variability of levels of air toxics in a major urban area.
- Compare and contrast concentration differences between mobile source-oriented sites, maximum impact sites, and upwind locations.
- Collect elemental carbon, trace metal, and particulate data to assess relative contributions from diesel emissions to air quality. This was performed through a cooperative effort with EPA in allowing early release of $PM_{2.5}$ speciation funds. Except for the trend site at Allen Park which operated once every three days, speciation measurements were collected on a once every six day schedule at E. Seven Mile and at Southfield.

The results of this study are not included in this report because the data are still being compiled, validated, and interpreted. The Data Analysis Plan describing the data analysis routines impacting the design of a national network, was prepared by Battelle and is available on LADCO's website at **http://www.ladco.org/toxics/toxics.htm**. The preliminary report is expected in spring of 2003, with the final report scheduled for September 2003. Additional data analysis will be performed by MDEQ and EPA's Region 5 once the scope and results of Battelle's work are available. Further information on the Detroit Air Toxics Pilot Project is available at the MDEQ website at: **http://www.deq.state.mi.us/dat/**.

PBTs:

Many toxic air pollutants are of concern because they may pose health risks to people breathing air contaminated with these pollutants. A subset of these pollutants, known as persistent bioaccumulative toxics, or PBTs, may not occur at levels high enough in the ambient air to cause concern from direct inhalation, but may pose a health risk through indirect exposure to persistent air pollutants that have been deposited. Such indirect exposures can occur from various routes, such as ingesting contaminated water, soil, meat, dairy products, or fish. Examples of effects that can result from sufficiently high levels or duration of exposure to PBTs include cancer, developmental and reproductive toxicity, and other effects in humans and wildlife.

PBTs enter the environment through a variety of sources including atmospheric deposition. Atmospheric deposition has been shown to be the most significant source of PBTs to remote inland lakes and to some of the Great Lakes **(6, 7, 8)**. Typically, atmospheric deposition of PBTs to the environment occurs via three processes, including:

> *Wet Deposition* refers to gases and particles carried in precipitation (rain, snow, fog, and sleet) that are deposited on land and water surfaces.
>
> *Dry Deposition* refers to pollutants bound to particulate matter that are deposited on water and land surfaces in the absence of precipitation, and
>
> *Gas Absorption or Exchange* refers to pollutants in a gaseous state that cross the air-water interface, and are absorbed in the water column by gas transfer.

Air deposition is one of the crucial elements largely responsible for contamination of lakes and streams by some types of pollutants, including mercury (Hg) and PCBs. Additionally, deposition of certain pollutants like dioxin can contribute to elevated levels in soils.

A comprehensive atmospheric deposition monitoring network has not been established in Michigan due to resource constraints. However, the EPA and Canada have established a limited monitoring network within the Great Lakes Basin in response to the 1990 CAA and the 1987 amended Great Lakes Water Quality Agreement - Annex 15. The Integrated Atmospheric Deposition Network (IADN) was mandated to assess the extent of atmospheric deposition of HAPs to the Great Lakes. Two sites were established in Michigan as part of this network. One is located in Sleeping Bear Dunes on the Lake Michigan shoreline and the other is at Eagle Harbor on the Lake Superior shoreline in the Keweenaw Peninsula. At the IADN sites, precipitation and air samples are collected and analyzed for trace metals including lead, arsenic and cadmium, as well as PCBs, PAHs and pesticides including lindane, dieldrin, endosulfan and DDT (dichlorodiphenyltrichloroethane). This data has been summarized in published articles **(9, 10).**

The IADN serves as an important tool in establishing background concentrations of PBTs and in assessing atmospheric deposition temporal trends for the PBTs listed above. Due to resource constraints, sampling and analysis for Hg and dioxins/furans have not been conducted routinely at the IADN sites.

Although MDEQ does not have funding to support a more extensive monitoring network for PBTs, a few short-term studies have been funded to better understand the levels of PBTs in the atmosphere and to assess loadings. The following is a brief summary of the studies that have been conducted over the past several years.

- One study, funded by the Lake Superior Trust, was awarded to the University of Michigan in 1996 to examine the relationship between Hg emissions to the atmosphere and the impact on both dry and wet deposition to Lake Superior. The final study for this work will be completed in the spring of 2003.

- An urban study, funded by the Detroit Water & Sewage Department, was conducted in 1996 in Detroit. Part of this study was to investigate the atmospheric contributions of Hg, cadmium, and PCBs in urban runoff and in Hg deposition for a nine-month period **(11)**. This limited data set collected in Detroit indicated that dry deposition of Hg bound to particulate matter significantly contributed to the total atmospheric deposition in the city and to levels of Hg in urban runoff**.** The goal, however, was to determine if atmospheric deposition of Hg, PCBs, and cadmium to the Detroit WWTP's headworks was significant. The study determined that atmospheric deposition was not a significant source to this particular facility, and other sources, such as contaminated sediments, were more significant factors.

- The AQD received funding from EPA's Great Lakes National Program Office to further study the elevated DDT levels in southwest Michigan from 1997 to 1999. The results of this study showed that the DDT levels were still elevated in this area, and the ratio of DDT to DDE (a DDT degradation product) indicated no recent release of DDT. The final report for the first year study was completed in 2001, and the final report for the second study year was completed in 2002.

- In 2000, the AQD, the Minnesota Pollution Control Agency, and the Wisconsin Department of Natural Resources received a grant from EPA's Great Lakes National Geographic Initiative to purchase two Hg monitors and a trailer for transportation of the monitors. The monitors have been used to quantify fugitive releases of Hg in the three states **(12)**.

- The AQD, partnering with the University of Michigan, was awarded a grant for $400,000 from the Michigan Great Lakes Protection Fund to develop an Hg monitoring network. The project began in the fall of 2001. Sites were established in urban areas because Michigan currently lacks long-term Hg data from urban areas. This study also continued the long-term event-based Hg deposition recorded at two rural sites in Michigan (Dexter and Pellston) **(13)**.

While several PBT air monitoring and atmospheric deposition studies have been conducted in the past several years, they were for a limited time frame and for a limited set of pollutants. These somewhat fragmented studies demonstrate the need for implementation of a comprehensive, continuous atmospheric deposition network within the state and region. In 2002, the AQD drafted a comprehensive ambient and atmospheric deposition network strategy that outlines AQD's long-term goals for air toxics monitoring, including PBTs. That strategy was finalized in 2002; implementation now depends on securing an adequate funding source.

CHAPTER 5: Special Projects

Air Quality Index:

The Air Quality Index (AQI) is a tool that is used to report daily air quality. It is a relative index used to provide a measure of air quality on a scale of 0 to 500. The higher the AQI value, the greater the level of air pollution and potential for health concerns, in terms of acute health effects over short time periods of 24 hours or less. In **Table 5.1-1**, each air pollutant concentration is related to an index value and the AQI is the highest of the corresponding index values for the monitored air pollutants. The AQI index has limitations in that it does not provide an indication of chronic air pollution exposure over months or years, nor does it reflect additive, synergistic, or antagonistic health effects that may result from exposure from two or more air pollutants.

Table 5.1-1: The AQI (Effective 10/4/99)

		Pollutant Concentration						
AQI Value	**AQI Descriptor**	**$PM_{2.5}$ (24 hr) mg/m^3**	**PM_{10} (24 hr) mg/m^3**	**SO_2 (24 hr) ppm**	**O_3 (8 hr) ppm**	**O_3 (1 hr) ppm**	**CO (8 hr) ppm**	**NO_2 (1 hr) ppm**
500		500.4	604	1.004		0.604	50	2.04
400	Hazardous (AQI > 301)	350.4	504	0.804		0.504	40	1.64
300	Very Unhealthy (AQI 201-300)	250.4	424	0.604	0.374	0.404	30	1.24
200	Unhealthy (AQI 151 - 200)	150.4	354	0.304	0.124	0.204	15	0.64
150	Unhealthy for sensitive groups (AQQ 101 - 150)	65.4	254	0.224	0.104	0.164	12	
100	Moderate (AQI 51-100	40.4	154	0.144	0.084	0.124	9	
50	Good (AQI 0-50)	15.4	54	0.034	0.064		4	
0		0	0	0	0	0	0	

Air quality in Michigan generally falls in the "good" or "moderate" range. Rarely does the state record unhealthy air quality. Occasionally, during the summer months, an area will fall into the "unhealthy for sensitive groups" range. Intermediate AQI levels of 200, 300, and 400 are respectively associated with alert, warning, and emergency episode level notifications used for the communication of air quality impacts during times of extreme pollutant levels (**1**). Michigan has never recorded an AQI above 200.

AQI values are made available to the public and local news agencies (newspapers, television, and radio) on a daily basis. These values are updated daily, are available in table form, and are plotted on a state map with color-coded dots that signify the AQI value on the MDEQ's webpage at **http://www.michigan.gov/deq**, click on "Air" then "AQI Index."

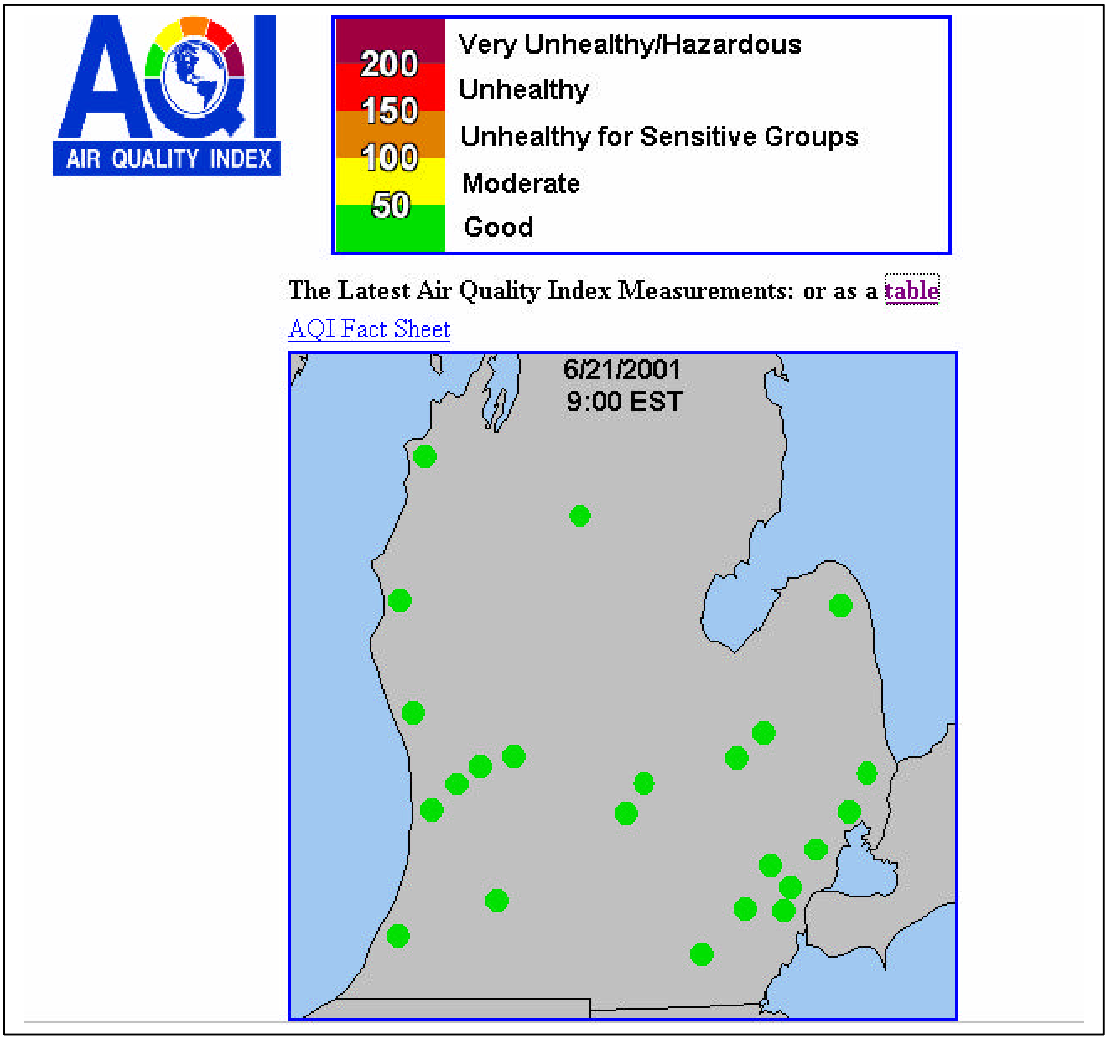
The EPA has assigned a specific color to each AQI category. **Table 5.1-2** identifies the AQI colors and the associated health statements by individual air pollutant. These color codes are used to display AQI values and level of health concern.

Table 5.1-2: The AQI Colors and Health Statements

AQI CATEGORY COLOR & VALUE	O_3		$PM_{2.5}$	PM_{10}	CO	SO_2	NO_2
	8-hour (ppm)	1-hour (ppm)	24-hour (μg/m^3)	24-hour (μg/m^3)	8-hour (ppm)	24-hour (ppm)	1-hour (ppm)
Good **GREEN** **1-50**	**None**	-	**None**	**None**	**None**	**None**	**None**
Moderate **YELLOW** **51-100**	Unusually sensitive people should consider limiting prolonged outdoor exertion.	-	**None**	**None**	**None**	**None**	**None**
Unhealthy For Sensitive Groups **ORANGE** **101-150**	Active children and adults, and people with respiratory disease such as asthma, should limit prolonged outdoor exertion.	Active children and adults, and people with respiratory disease such as asthma, should limit heavy outdoor exertion.	People with respiratory or heart disease, the elderly, and children should limit prolonged exertion.	People with respiratory disease, such as asthma, should limit outdoor exertion.	People with cardiovascular disease, such as angina, should limit heavy exertion and avoid sources of CO, such as heavy traffic.	People with asthma should consider limiting outdoor exertion.	**None**
Unhealthy **RED** **151-200**	Active children and adults, and people with respiratory disease such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children, should limit prolonged outdoor exertion.	Active children and adults, and people with respiratory disease such as asthma, should avoid heavy outdoor exertion; everyone else, especially children, should limit heavy outdoor exertion.	People with respiratory or heart disease, the elderly, and children should avoid prolonged exertion; everyone else should limit prolonged exertion.	People with respiratory disease such as asthma, should avoid outdoor exertion; everyone else, especially the elderly and children should limit prolonged outdoor exertion-	People with cardiovascular disease, such as angina, should limit moderate exertion and avoid sources of CO, such as heavy traffic.	Children, asthmatics, and people with heart or lung disease should limit outdoor exertion.	**None**
Very Unhealthy **PURPLE** **201-300**	Active children and adults, and people with respiratory disease such as asthma, should avoid all outdoor exertion; everyone else, especially children should limit outdoor exertion.	Active children and adults, and people with respiratory disease such as asthma, should avoid all outdoor exertion; everyone else, especially children should limit outdoor exertion.	People with respiratory or heart disease, the elderly, and children should avoid any outdoor activity; everyone else should avoid prolonged exertion.	People with respiratory disease such as asthma, should avoid any outdoor activity; everyone else, especially the elderly and children, should limit outdoor exertion.	People with cardiovascular disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic.	Children, asthmatics, and people with heart or lung disease should avoid outdoor exertion; everyone else should limit outdoor exertion.	Children and people with respiratory disease, such as asthma, should limit heavy outdoor exertion.
Hazardous **MAROON** **301-500**	Everyone should avoid all outdoor exertion.	Everyone should avoid all outdoor exertion.	Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly, and children should remain indoors.	Everyone should avoid any outdoor exertion; people with respiratory disease, such as asthma, should remain indoors.	People with cardiovascular disease, such as angina, should avoid exertion and sources of CO, such as heavy traffic; everyone else should limit heavy exertion.	Children, asthmatics, and people with heart or lung disease should remain indoors; everyone else should avoid outdoor exertion.	Children and people with respiratory disease, such as asthma, should limit moderate or heavy outdoor exertion.

Figure 5.1-1 provides an example map displaying AQI values as color-coded dots for each monitor site throughout the state.

Figure 5.1-1: AQI



Ozone Action!:

Ozone Action! days are declared in southeast and west Michigan when meteorological conditions forecast the formation of excessive ground-level O_3. When 8-hour O_3 levels are expected to exceed 0.08 ppm using the AQI health indicator, an *Ozone Action!* day may be called. On *Ozone Action!* days, voluntary emission reduction activities take place through the cooperative actions of business, industry, government, and the public. Participants are encouraged to take voluntary action to reduce emissions that lead to the formation of O_3. Clean air choices include: avoiding the refueling of vehicles or choosing to refuel during the evening hours when possible; omitting unnecessary travel; selecting alternative transportation options including carpools, taking the bus, walking or biking; deferring the use of gasoline, lawn and recreation equipment (particularly inefficient two-stroke engines); and modifying household activities.

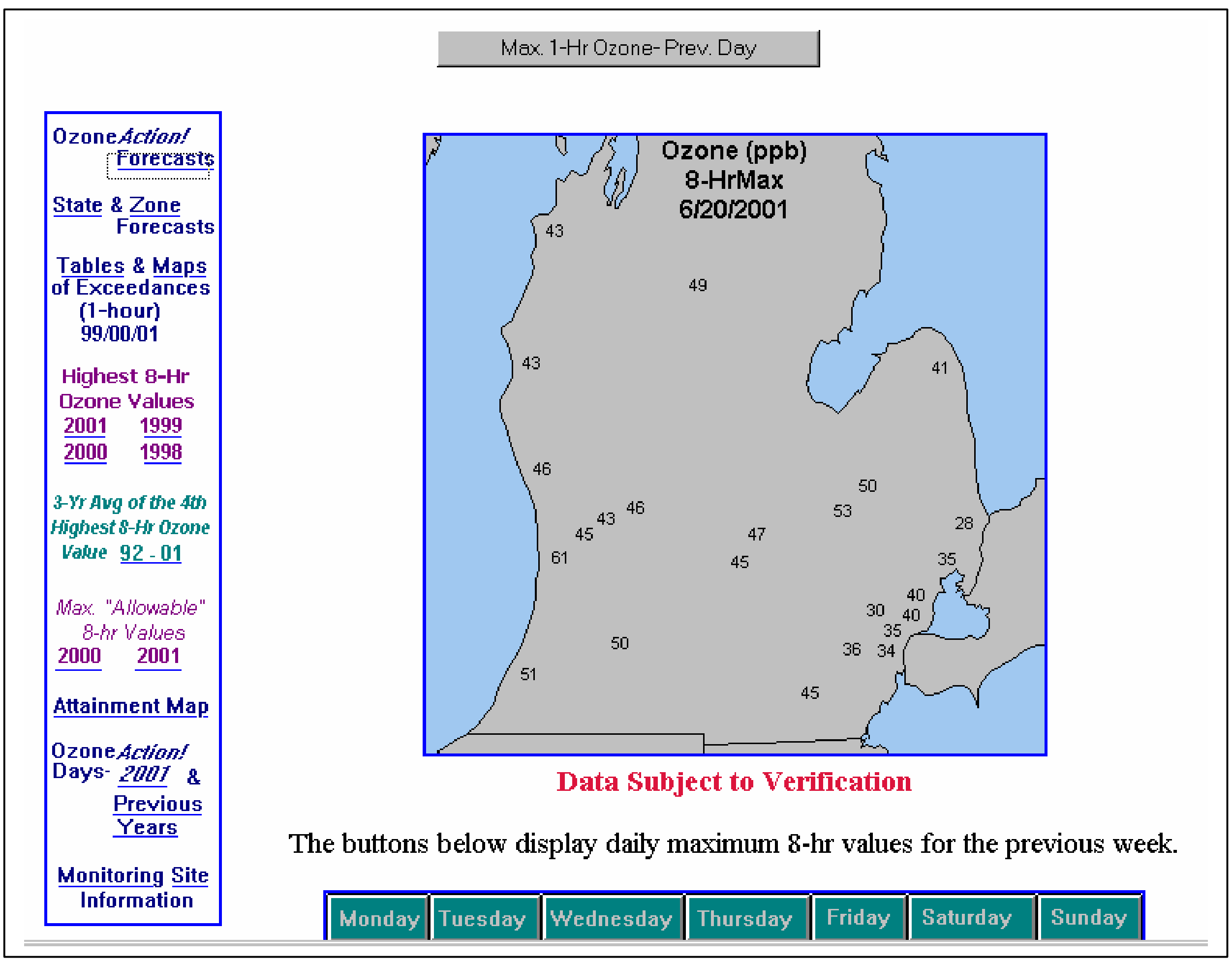
As part of the notification and education process for *Ozone Action!* days in Michigan, the MDEQ's AQD developed a website that can be accessed at **http://www.michigan.gov/deq**, click on "Air," then the "Michigan *Ozone Action!*" quicklink.

This website lists *Ozone Action!* day information and provides current and extended forecasts for both western and southeastern Michigan. Links are provided for two other meteorological sites that provide state and zone weather forecasts, as well as a historical summary by year of declared *Ozone Action!* days for western and southeastern Michigan.

In **Figure 5.1-2**, maximum daily O_3 concentrations are displayed as both 1-hour and 8-hour values by geographical location for Michigan. During the O_3 season, both the 1-hour and 8-hour O_3 values are updated on a near real time basis. O_3 values expressed in both forms are available for the previous week too. Web links are available that provide:

- Exceedances of the 1-hour O_3 standard,
- Highest 8-hour O_3 values by year,
- Three-year average of the 4^{TH} highest 8-hour O_3 values,
- Attainment maps, and
- Monitoring site information showing monitor locations by pollutant.

Figure 5.1-2: *Ozone Action!* Website

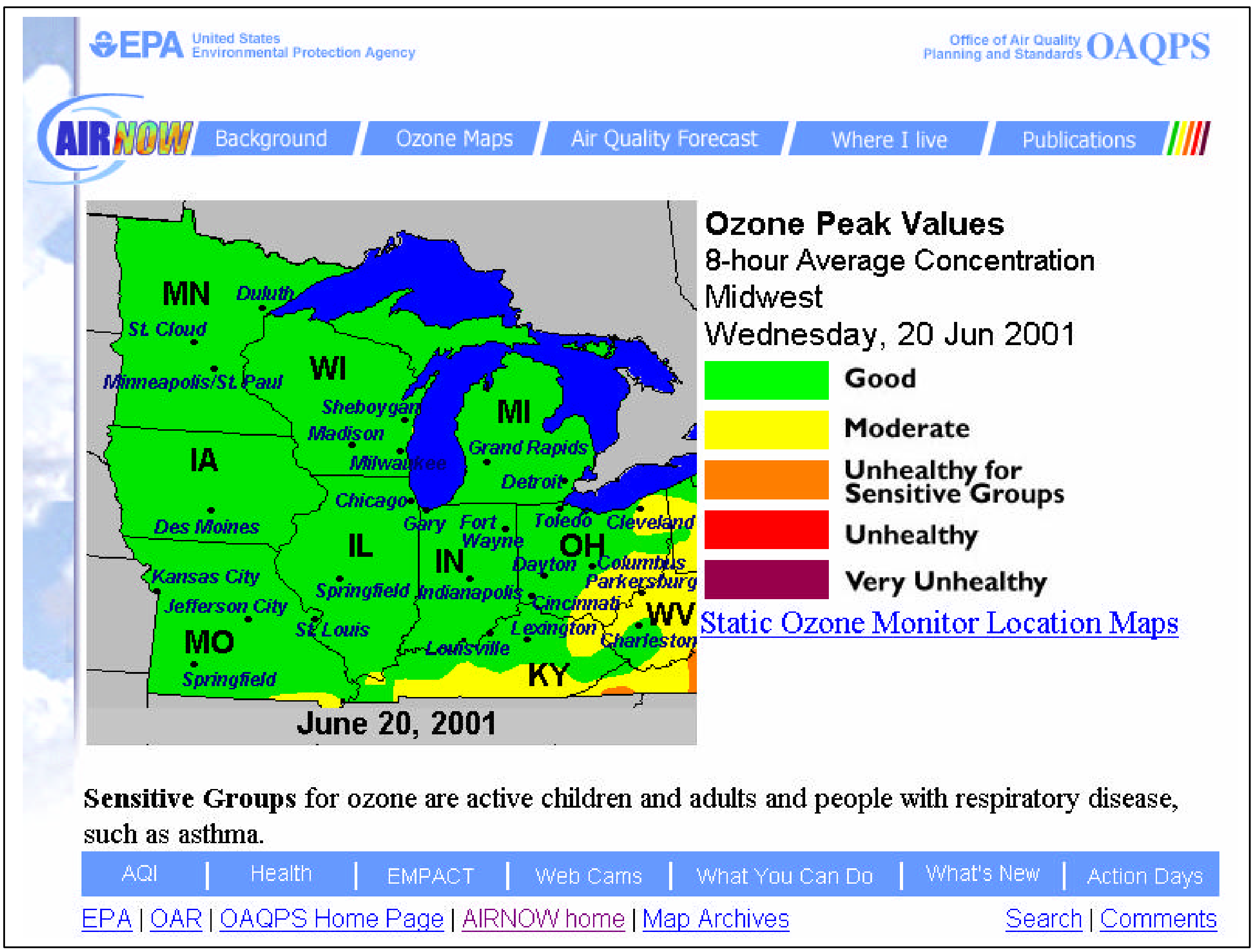


O_3 Mapping:

Michigan supplies hourly O_3 data to EPA for O_3 mapping activities. It is a cooperative effort between EPA, states, and local air pollution control agencies to provide near real time information on groundlevel O_3 concentrations. EPA uses O_3 data to produce maps that display O_3 contours covering the Midwest, New England, Mid-Atlantic, southeastern, south central, and Pacific coastal regions of the country. Color-coded, animated concentration gradient O_3 maps are created that show daily O_3 formation and transport at various spatial scales (national, Midwest, and Lake Michigan basin).

This information is available on the EPA's AIRNOW website at: http://www.epa.gov/airnow. Information can be obtained of current and previous day's O_3 animation showing O_3 formation and transport with time. There are also web links that provide the previous day's 1-hour and 8-hour peak O_3 values as listed in **Figure 5.1-3**. The EPA AIRNOW website is different from the MDEQ daily O_3 concentration website in that the geographical scale is much broader, covering many states, and data maps are generated over a less frequent time interval basis.

Figure 5.1-3: Screen Capture of AIRNOW Ozone Midwest Map Website



Daily Fine Particulate $PM_{2.5}$ Concentrations Website:

Real time fine particulate $PM_{2.5}$ concentrations are made available to the general public from TEOM air monitors. These TEOM units provide hourly concentration measurements of ambient air quality at Grand Rapids, Lansing, Ypsilanti, Kalamazoo, Saginaw, and Allen Park near Detroit. This information is available on the MDEQ website at: **http://www.deq.state.mi.us/aqi/pm25data.shtml**. These monitors supplement the fine particulate $PM_{2.5}$ data that is currently being collected from the FRM, manual air monitoring equipment.

CHAPTER 6: Meteorological Summary

Climatological Summary:

Michigan owes much of its climate to its mid-latitude location. Stretching from about 41.5 degrees (^{o}) to 47.5^o north latitude, Michigan's weather varies dramatically depending upon the seasonal position of the polar jetstream. In the winter, the polar jet passes to the south of Michigan, exposing the state to cold arctic air masses. In the summer, when the polar jet is to the north of the state, Michigan experiences warm weather thanks to air masses originating in the Gulf of Mexico. However, the Great Lakes also have a profound impact upon Michigan's weather.

"Lake-effects" are usually greatest within approximately thirty miles of the lakeshore, but can extend further inland. In the summer, air above the Great Lakes is transported onshore as a cool breeze. In the fall these waters, cooling slower than the surrounding land, can help warm the lakeshore, increasing the number of frost-free growing days. As winter's first cold winds blow across the warm, open lakes, clouds often form to produce intense, localized snowfalls. In the spring, when moisture-laden air passes over a cold lake surface, it may cool enough to cause broad fog banks to form along shoreline areas.

The Great Lakes also help in reducing air pollution in Michigan by raising atmospheric humidity. First, the moisture that the Great Lakes add to the air condenses on small pollutant particles to form cloud droplets. The cloud droplets grow until they are heavy enough to fall out as rain or snow. Second, as the rain and snow fall, they collide with larger pollutant particles, stripping them from the air. Third, high relative humidity reduces the amount of moisture evaporating from the soil, keeping dust from being re-entrained into the air. In addition, lake-effect clouds reflect incoming solar rays to keep summer temperatures cooler and to keep heat from the earth's surface in the winter from escaping to space, keeping winter nights warmer. As a result, less fossil fuel needs to be burned to produce energy for cooling and heating, respectively.

2001 Temperature and Precipitation Data for Michigan:

Figure 6.1.1 - Figure 6.1.6 show average daily temperature and total monthly precipitation amounts as compared to their climatic norms for sites in the Upper Peninsula, and the northern and southern Lower Peninsula. These figures were constructed by averaging data from several National Weather Service (NWS) stations and therefore are not meant to be representative of any one single location in Michigan. Instead, they are intended to depict the regional trends that occurred during the year 2001.

Figure 6.1-1: Northern Lower Peninsula Observed Average Daily Temperatures vs. Mean Daily Average Temperatures

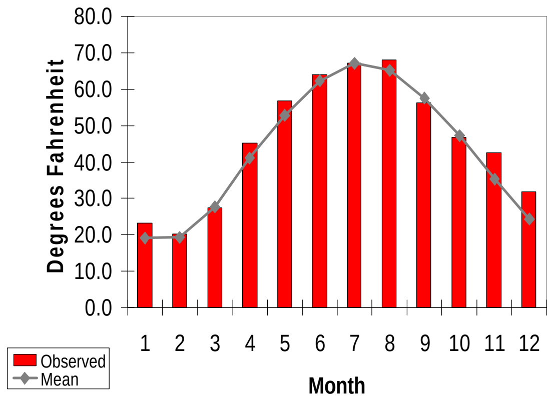


Figure 6.1-2: Northern Lower Peninsula Observed Monthly Precipitation vs. Mean Monthly Precipitation

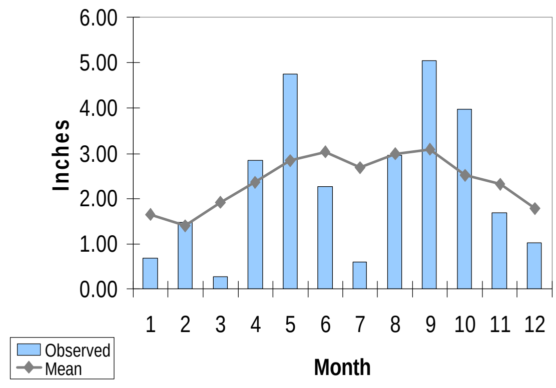


Figure 6.1-3: Southern Lower Peninsula Observed Average Daily Temperatures vs. Mean Daily Average Temperatures

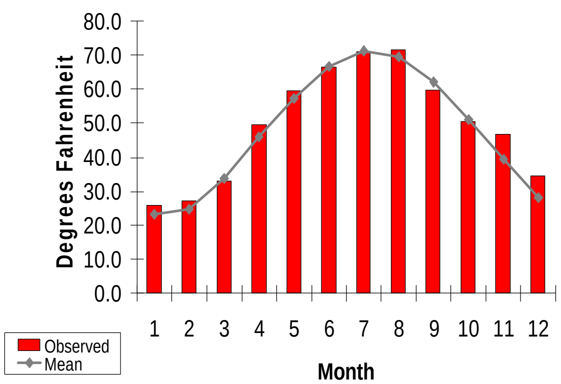


Figure 6.1-4: Southern Lower Peninsula Observed Monthly Precipitation vs. Mean Monthly Precipitation

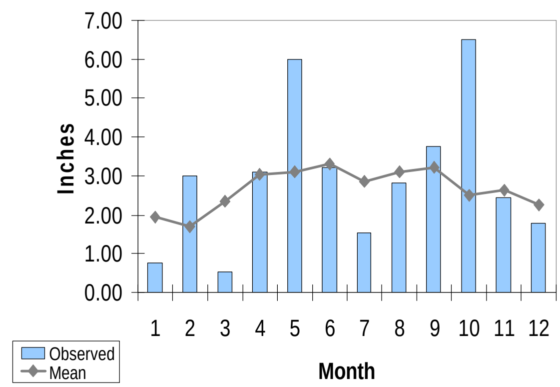


Figure 6.1-5: Upper Peninsula Observed Average Daily Temperatures vs. Mean Daily Average Temperatures

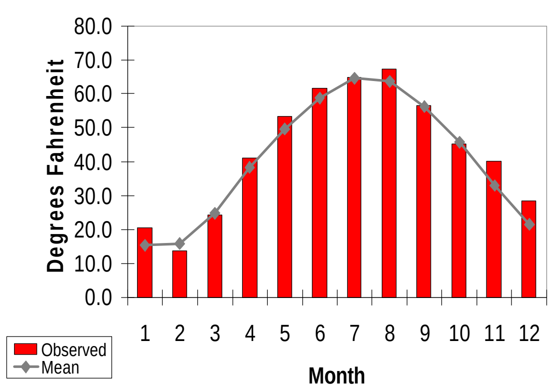
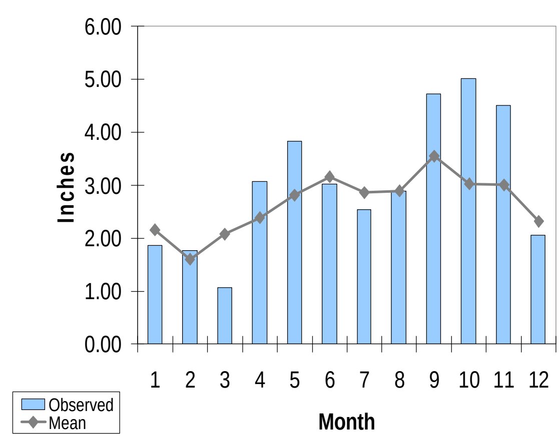


Figure 6.1-6: Upper Peninsula Observed Monthly Precipitation vs. Mean Monthly Precipitation



Meteorological Monitoring in Michigan:

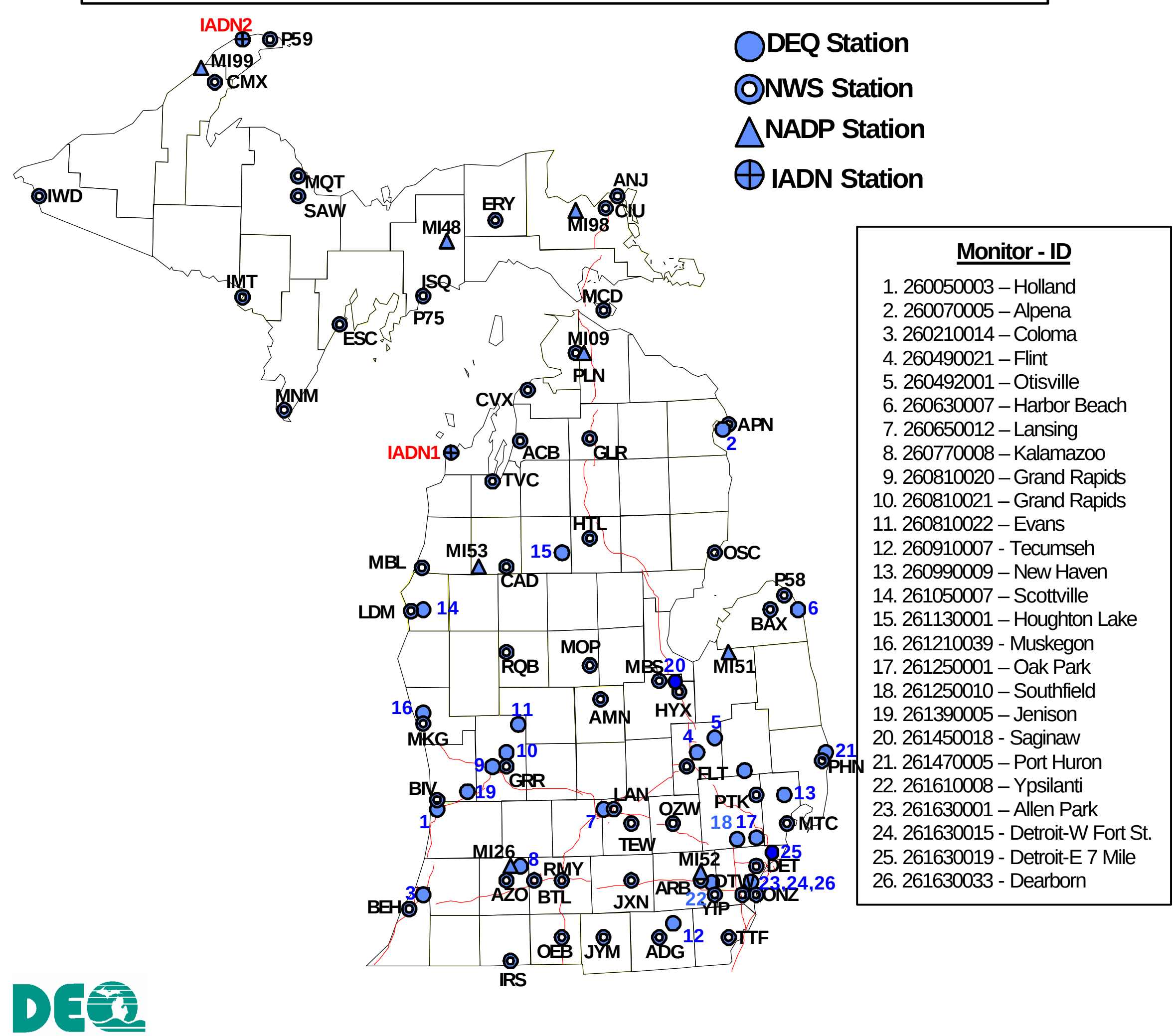
Figure 6.1-7 shows the locations of MDEQ monitoring stations that collect wind speed and wind direction data. These wind data represent a vector sum average over the entire hour. The map also shows the locations where the NWS collects meteorological data. The wind speed and wind direction data are a three- to five-minute reading that represents the whole hour. As part of the IADN, meteorological information is collected at Sleeping Bear Dunes and Eagle Harbor. Daily precipitation measurements are also determined for the National Atmospheric Deposition Program (NADP) by a consortium of academic institutions with the United States Forest Service and the EPA.

NADP Monitors in Michigan	
ID	**Location**
MI09	Douglas Lake
MI26	Kellogg Biological Station
MI48	Seney Natl. Wildlife Refuge
MI51	Unionville
MI52	Ann Arbor
MI53	Wellston
MI97	Isle Royale National Park
MI98	Raco
MI99	Chassell

NWS Meteorological Reporting Stations in Michigan			
ID	**Location**	**ID**	**Location**
ADG	Adrian	JXN	Jackson
AMN	Alma	AZO	Kalamazoo
APN	Alpena	LAN	Lansing
ARB	Ann Arbor	LDM	Ludington
BAX	Bad Axe	MCD	Mackinac Island
BTL	Battle Creek	MBL	Manistee
ACB	Bellaire	P75	Manistique
BEH	Benton Harbor	MQT	Marquette
RQB	Big Rapids	RMY	Marshall
CAD	Cadillac	TEW	Mason
CVX	Charlevoix	MNM	Menominee
CIU	Chippewa	TTF	Monroe
OEB	Coldwater	MOP	Mt. Pleasant
P59	Copper Harbor	MKG	Muskegon
DET	Detroit City	ERY	Newberry
DTW	Detroit Metro	PLN	Pellston
ESC	Escanaba	PTK	Pontiac
FNT	Flint	P58	Port Hope
GLR	Gaylord	PHN	Port Huron
GRR	Grand Rapids	MBS	Saginaw
ONZ	Grosse Isle	ANJ	Sault Ste. Marie
CMX	Hancock	SAW	Sawyer AFB
HYX	H Brown Airport, Saginaw	ISQ	Schoolcraft
JYM	Hillsdale	MTC	Selfridge AFB
BIV	Holland	IRS	Sturgis
HTL	Houghton Lake	TVC	Traverse City
OZW	Howell	OSC	Wurtsmith
IMT	Iron Mountain	YIP	Ypsilanti
IWD	Ironwood		

IADN Monitors in Michigan	
ID	**Location**
IADN1	Sleeping Bear Dunes
IADN2	Eagle Harbor

Figure 6.1-7: Meteorological Stations in Michigan



Other meteorological parameters are monitored by the AQD. **Table 6.1-1** shows which parameters are collected at selected sites across the state.

Table 6-1-1: Meteorological Data Collected in Michigan During Year 2001

Site ID Station	Wind Speed	Wind Direction	Resultant Speed	Resultant Direction	Temp	Relative Humidity	Solar Radiation	Barometric Pressure
260050003 Holland			Ö	Ö	Ö	Ö	Ö	Ö
260070005 Alpena			Ö	Ö	Ö			
260210014 Coloma			Ö	Ö	Ö			
260490021 Flint			Ö	Ö	Ö			Ö
260492001 Otisville			Ö	Ö	Ö			
260630007 Harbor Beach			Ö	Ö	Ö			
260650012 Lansing			Ö	Ö	Ö			Ö
260770008 Kalamazoo			Ö	Ö	Ö			
260770901 Kalamazoo								
260810020 Grand Rapids			Ö	Ö	Ö			Ö
260810021 Grand Rapids			Ö	Ö	Ö			
260810022 Evans			Ö	Ö	Ö			
260910007 Tecumseh			Ö	Ö	Ö			Ö
260990009 New Haven			Ö	Ö	Ö	Ö	Ö	
261050007 Scottville			Ö	Ö	Ö			
261130001 Houghton Lake			Ö	Ö	Ö			Ö
261210039 Muskegon			Ö	Ö	Ö			
261250001 Oak Park			Ö	Ö	Ö			Ö
261250010 Southfield	Ö				Ö			
261390005 Jenison			Ö	Ö	Ö			
261450018 Saginaw			Ö	Ö	Ö			Ö
261470005 Port Huron			Ö	Ö	Ö			
261610008 Ypsilanti			Ö	Ö	Ö			Ö
261630001 Allen Park	Ö	Ö			Ö	Ö		Ö
261630015 Detroit W Fort	Ö	Ö			Ö	Ö		Ö
261630019 Detroit E 7 Mile	Ö	Ö	Ö	Ö	Ö	Ö		Ö
261630033 Dearborn	Ö	Ö			Ö	Ö		Ö

CHAPTER 7: References by Chapter

References: Chapter 2 - Background Information

National Air Quality and Emissions Trends Report, 1998. EPA 454/R-00-003. March 2000. EPA, Office of Air Quality Planning and Standards (OAQPS), Research Triangle Park (RTP), NC, 27711.

EPA Headquarters Press Release – Supreme Court Upholds EPA Position on Smog Particulate Rules. February 27, 2001. EPA, Washington, DC. **http://www.epa.gov/airlinks/court_newsrelease.pdf**.

Particulate Matter ($PM_{2.5}$) Speciation Guidance Document. January 5, 1999. EPA, OAQPS, RTP, NC, 27711.

National Ambient Air Quality Standards for Particulate Matter; Final Rule, 62 FR 38651, July 18, 1997.

Fact Sheet: EPA's Revised Particulate Matter Standards. July 17, 1997. EPA, Office of Air & Radiation (OAR), OAQPS, RTP, NC, 27711. **http://ttnwww.rtpnc.epa.gov/naaqsfin/pmfact.htm**.

National Ambient Air Quality Standards for Particulate Matter; Proposed Rule, 61 FR 65638, December 13, 1996.

Appendix H to Part 50 - Interpretation if the 1-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone. 40 CFR 50, July 1, 1998.

Appendix I to Part 50 - Interpretation of the 8 Hour Primary and Secondary National Ambient Air Quality Standards for Ozone. 40 CFR 50, July 1, 1998.

Appendix K to Part 50 - Interpretation of the National Ambient Air Quality Standards for Particulate Matter. 40 CFR Part 50, July 1, 1998.

Appendix N to Part 50 - Interpretation of the National Ambient Air Quality Standards for Particulate Matter. 40 CFR Part 50, July 1, 1998.

National Ambient Air Quality Standards for Ozone; Final Rule, 62 FR 38855, July 18, 1997.

Guideline on Data Handling Conventions for the 8-Hour Ozone NAAQS. EPA-454/R-98-017, December 1998. EPA, OAQPS, RTP, NC, 27711.

Fact Sheet: EPA Reinstates the 1-Hour Ground-Level Ozone (Smog) Standard. 2000. EPA, OAR, OAQPS, RTP, NC, 27711. **http://www.epa.gov/ttn/oarpg/ramain.html**

Rescinding Findings That the 1-Hour Ozone Standard No Longer Applies in Certain Areas; Final Rule, 65 FR 45181, July 20, 2000.

Francis X. Lyons, EPA Regional Administrator, A letter to Governor John Engler, dated April 28, 2000.

2001 NAMS/SLAMS and Special Purpose Monitors Network Annual Review for Michigan. December 13, 1999. MDEQ, AQD, Lansing, MI, 48909

Environmental Protection Agency Ambient Air Quality Surveillance Regulations. 40 CFR Part 58, July 1, 1998.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume I- Principles. EPA-600/9-76-005. March 1976. EPA, Office of Research and Development (ORD), Environmental Monitoring and Support Laboratory, RTP, NC, 27711

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II - Ambient Air Specific Methods. EPA - 6004-77-027a. May 1977. EPA, ORD, Environmental Monitoring and Support Laboratory, RTP, NC, 27711.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III - Stationary Source Specific Methods. EPA - 600/4-77-027b. August 1977. EPA, ORD, EMSL, RTP, NC, 27711.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume IV - Meteorological Measurements. EPA-600/4-82-060. September 1989 (rev). EPA, ORD, Environmental Monitoring and Support Laboratory, RTP, NC, 27711.

Quality Assurance Handbook for Air Pollution Measurement Systems, Volume V - Precipitation Measurement Systems (Interim Edition). EPA-600/R-94/038e. April 1994. EPA, ORD, Environmental Monitoring and Support Laboratory, RTP, NC, 27711.

Network Design and Optimum Site Exposure Criteria for Particulate Matter. EPA-450/4-87-009. May 1987. EPA, OAQPS, RTP, NC, 27711.

Site Selection for the Monitoring of Photochemical Air Pollutants. EPA-450/3-78-013. April 1987. EPA, OAQPS, RTP, NC, 27711.

Guideline for PM_{10} Episode Monitoring Methods. EPA-450/4-83-005, February 1983, EPA, OAQPS, RTP, NC, 27711.

Optimum Site Exposure Criteria for SO_2 Monitoring. EPA-450/3-77-013, April 1977. EPA, OAQPS, RTP, NC, 27711.

Optimum Sampling Site Exposure Criteria for Lead. EPA-450/4-84-012, February 1984. EPA, OAQPS, RTP, NC, 27711.

Guidance for Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}. December 1997. EPA, OAQPS, RTP, NC, 27711.

Guidance on Ozone Monitoring Site Selection. EPA-454/R-98-002, August 1998, EPA, OAQPS, RTP, NC, 27711.

On-line References:

Nationwide Air Quality Trends **http://www.epa.gov/oar/aqtrnd99/brochure/brochure.pdf**

Status on latest developments regarding legal challenge, court findings, implementation of revised particulate and O_3 standards: **http://www.epa.gov/airlinks/airlinks4.html**

Listing of documents pertaining to 40 CFR Part 58, including siting requirements, attainment determination, methods, and QA/QC. **http://www.epa.gov/ttnamti1/**

MDEQ AQD Website: **http://www.michigan.gov/deq**, click on "Air"

References: Chapter 3.1 - CO Trends

Latest Findings on National Air Quality: 1999 Status and Trends. EPA-454/F-00-002. August 2000. EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/airtrends**

National Air Quality and Emissions Trends Report, 1998. EPA-454/R-00-0003. March 2000. EPA, OAQPS, RTP, NC, 27711.

Winter Day Carbon Monoxide Emission Inventory for Southeast Michigan. March 1995, Michigan Department of Natural Resources (MDNR), AQD, Lansing, MI, 48909.

Winter Day Carbon Monoxide Emissions Inventory for Macomb, Oakland, and Wayne Counties, 1998. MDEQ, AQD, Lansing, MI, 48909.

Air Quality Criteria for Carbon Monoxide. EPA-600/P-00/001F. June 2000, EPA, ORD, Washington, DC 20460.

National Air Quality and Emissions Trends Report, 1994. EPA-454/R-95-014. October 1995. EPA, OAQPS, RTP, NC, 27711.

National Ambient Air Quality Standards for Carbon Monoxide-Final Decision, 59 FR 38906, August 1, 1994.

Air Quality Criteria for Carbon Monoxide (Final) – Notice of Availability of a Final Document. 65 FR 50202, August 17, 2000.

Environmental Protection Agency Ambient Air Quality Surveillance Regulations, 40 CFR Part 58- Appendix D, July 1, 2000.

2001 NAMS/SLAMS and Special Purpose Monitors Network Review for Michigan. December 2000, MDEQ, AQD, Lansing, MI 48909.

Approval and Promulgation of State Implementation Plans; Michigan – Direct Final Rule, 64 FR 35017, June 30, 1999.

CO Nonattainment Area Summary, January 29, 2001. EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/air/oaqps/greenbk/cnsum.html**

Fact Sheet #3: Automobiles and Carbon Monoxide. EPA-400-F-92-005, January 1993, EPA, National Vehicle and Fuel Emissions Laboratory, Ann Arbor, MI, 48105. **http://www.epa.gov/otaq/O3-co.htm**

Fact Sheet OMS-11. Motor Vehicles and the 1990 Clean Air Act. EPA-400-F-92-013, August 1994. EPA, National Vehicle and Fuel Emissions Laboratory, Ann Arbor, MI, 48105. **http://www.epa.gov/otaq/11-vehs.htm**

References: Chapter 3.2 - Pb Trends

Prohibition on Gasoline Containing Lead or Lead Additives for Highway Use. 61 FR 3832, February 2, 1996.

Ambient Air Quality Surveillance for Lead - Final Rule. 64 FR 3030, January 20, 1999.

Guidance for Siting Ambient Air Monitors Around Stationary Lead Sources, EPA-454/R-92-009, August 1997, EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1997. EPA-454/R-98-016. December 1998. EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1996. EPA-454/R-97-013. January 1998. EPA, OAQPS, RTP, NC, 27711.

Latest Findings on National Air Quality: 1999 Status and Trends. EPA-454/F-00-002. August 2000. EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/airtrends**

National Air Quality and Emissions Trends Report, 1995. EPA-454/R-95-014. October 1995. EPA, OAQPS, RTP, NC, 27711.

United Air Toxics Website-Lead and Compounds. September 21, 2000. EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/ttnuatw1/hlthef/lead.html.**

National Air Pollutant Emission Trends, 1900 - 1993. EPA-454/R-94-027. October 1994. EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1998. EPA-454/R-00-003. March 2000. EPA, OAQPS, RTP, NC, 27711.

Environmental Protection Agency Ambient Air Quality Surveillance Regulations. 40 CFR Part 58, May 10, 1979.

Ambient Air Quality Surveillance for Lead – Direct Final Rule. 62 FR 59813. November 5, 1997.

Geographical Designation of Attainment Status, June 1994. MDNR, AQD, Box 30028, Lansing, MI, 48909.

Lead Nonattainment Area Summary, February 1, 2000. EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/air/oaqps/greenbk/lnsum.html**.

References: Chapter 3.3 - NO_2Trends

Latest Findings on National Air Quality: 1999 Status and Trends. EPA-454/F-00-002, August 2000. EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/airtrends.**

Health and Environmental Impacts of NOx, (undated), EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/airprogm/oar/oaqps/nox/hlth.html**.

EPA Measuring Air Quality: the Pollutant Standards Index. EPA-451/K-94-001. February 1994. EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1993. EPA-454/R-94-026. October 1994. EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1994. EPA-454/R-95-014. October 1995. EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1998. EPA-454/R-00-003. March 2000. EPA, OAQPS, RTP, NC, 27711.

Geographical Designation of Attainment Status, June 1994. MDNR, AQD, Box 30028, Lansing, MI, 48909.

National Air Quality and Emissions Trends Report, 1997. EPA-454/R-98-016. December 1998. EPA, OAQPS, RTP, NC, 27711.

Nitrogen Oxides (NOx) Reduction under Phase II of the Acid Rain Program. December 11, 2000. EPA, Clean Air Market Program, Washington, DC, 20460. **http://www.epa.gov/airmarkets/arp/nox/phase2.html**

References: Chapter 3.4 - O_3 Trends

Experimental Design for Performance Measurements of C1 to C4 Carbonyls Using DNPH Coated Silica Gel C18 Cartridges (Undated abstract). EPA, ORD, RTP, NC, 27711. **http://www.epa.gov/ttn/amtic/ord/00196.txt**

Air Quality Criteria for Ozone and Related Photochemical Oxidants - Volume I of III. July 1996. EPA, ORD, Washington DC, 20460.

Guideline on Ozone Monitoring Site Selection. EPA-454/R-98-002. August 1998. EPA, OAQPS, RTP, NC, 27711.

Final Report, Vol I: Executive Summary. June 2, 1997. OTAG Air Quality Analysis Workgroup, OTAG Data Clearinghouse, NC Superconducting Center, RTP, NC, 27709. **http://capita.wustl.edu/OTAG/Reports/AQAFinVol_I/HTML/v1_exsum7.html**

Latest Findings on National Air Quality: 1999 Status and Trends. EPA-454/F-00-002, August 2000. EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/airtrends**.

National Air Quality and Emissions Trends Report, 1998. EPA-454/R-00-003. March 2000. EPA, OAQPS, RTP, NC, 27711.

Fact Sheet – Health and Environmental Effects of Ground-Level Ozone, July 17, 1997. EPA, OAQPS, RTP, NC, 27711.

National Ambient Air Quality Standards for Ozone - Final Rule, 62 FR 38855, July 18, 1997.

National Ambient Air Quality Standards for Ozone; Proposed Rule, 61 FR 65715, December 13, 1996.

Network Design for State and Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS), and Photochemical Assessment Monitoring Stations (PAMS). 40 CFR Part 58 Appendix D, July 1, 2000.

2001 NAMS/SLAMS and Special Purpose Monitors Network Annual Review for Michigan. December 2000. MDEQ, AQD, Lansing, MI, 48909.

Ozone Nonattainment Area Summary, January 29, 2001, EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/air/oaqps/greenbk/onsum.html**

Hemby, J., Ozone and Carbon Monoxide 1997-99 Air Quality Data Update, EPA, Air Quality & Trends Analysis, RTP, NC, 27711 **http://www.epa.gov/oar/aqtrnd99/o3coupdt.pdf**

On-line References:

Ambient O_3 values in Michigan (includes daily maximum values and *Ozone Action!* days-hourly values), lists of exceedances and more on the MDEQ *Ozone Action!* Homepage, **http://www.michigan.gov/deq**, click on “Air” then “Michigan *Ozone Action!*”

Additional information about O_3 and its effects can be found at:

http://www.epa.gov/airprogm/oar/oaqps/airnow/health.html
http://www.epa.gov/nceawww1/ozone.htm
http://www.epa.gov/airprogm/oar/oaqps/airnow/health/index.html#should
http://www.epa.gov/airprogm/oar/oaqps/airnow/health/page2.html#how

References: Chapter 3.5 - Particulate Matter (PM_{10}, $PM_{2.5}$, and TSP) Trends

Air Quality Criteria for Particulate Matter - Volume I of III. EPA-600/P-95/001aF, April 1996. EPA, OAQPS, RTP, NC, 27711.

EPA Measuring Air Quality: the Pollutant Standards Index. EPA-451/K-94-001. February 1994. EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1994. EPA-454/R-95-014. October 1995. EPA, OAQPS, RTP, NC, 27711.

National Air Pollutant Emission Trends, 1900-1993. EPA-454/R-94-027. October 1994. EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1995. EPA-454/R-96-005. October 1996. EPA, OAQPS, RTP, NC, 27711.

Particulate Matter ($PM_{2.5}$) Speciation Guidance (Final Draft). October 7, 1999. EPA, OAQPS, RTP, NC, 27711.

EPA Strategic Plan-Development of the Particulate Matter ($PM_{2.5}$) Quality System for the Chemical Speciation Monitoring Trend Sites. April 16, 1999. EPA, OAQPS, RTP, NC, 27711.

Quality Assurance Guidance Document–3rd Draft. Quality Assurance Project Plan: $PM_{2.5}$ Speciation Trends Network. November 1999. EPA, OAQPS, RTP, NC, 27711.

Revised Requirements for Designation of Reference and Equivalent Methods for $PM_{2.5}$ and Ambient Air Quality Surveillance for Particulate Matter, 62 FR 38763, July 18, 1997.

Guidance for Using Continuous Monitors in PM2.5 Monitoring Networks. EPA-454/R-98-012. May 1998. EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1998. EPA-54/R-00-003. March 2000. EPA, OAQPS, RTP, NC, 27711.

2001 NAMS/SLAMS and Special Purpose Monitors Network Annual Review for Michigan. December 2000. MDEQ, AQD, Lansing, MI, 48909

2000 NAMS/SLAMS and Special Purpose Monitors Network Annual Review for Michigan. December 1999. MDEQ, AQD, Lansing, MI, 48909.

Guidance for Network Design and Optimum Site Exposure for $PM_{2.5}$ and PM_{10}. December 15, 1997. EPA, OAQPS, RTP, NC, 27711.

PM_{10} Nonattainment Area Summary, January 29, 2001, EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/air/oaqps/greenbk/pnsum.html**

On-Line References:

Additional information about particulate matter and its effects can be found at:

http://www.epa.gov/rgytgrnj/programs/artd/air/quality/pmhealth.htm
http://www.epa.gov/nceawww1/partmatt.htm

References: Chapter 3.6 - SO_2 Trends

Odor Thresholds for Chemicals with Established Occupational Health Standards. 1993. American Industrial Hygiene Association, Fairfax, VA, 22031.

National Air Pollutant Emission Trends, 1900 - 1993. EPA-454/R-94-027. October 1994. EPA, OAQPS, RTP, NC, 27711.

Latest Findings on National Air Quality - 1999 Status and Trends. EPA-454/F-00-002. August 2000. EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/airtrends**

Guideline on Speciated Particulate Monitoring. August 1998. Desert Research Institute, Reno, NV 89506.

Particulate Matter ($PM_{2.5}$) Speciation Guidance (Final Draft). October 7, 1999. EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1998. EPA-454/R-00-003. March 2000. EPA, OAQPS, RTP, NC, 27711.

National Air Quality and Emissions Trends Report, 1994. EPA-454/R-95-014. October 1995. EPA, OAQPS, RTP, NC, 27711.

Ambient Air Quality Standards for Sulfur Oxides (Sulfur Dioxide; Intervention Level Program. 63 FR 24782, May 5, 1998.

Geographical Designation of Attainment Status, June 1994. MDNR, AQD, Box 30028, Lansing, MI, 48909.

SO_2 Nonattainment Area Summary, February 2, 2001. EPA, OAQPS, RTP, NC, 27711. **http://www.epa.gov/air/oaqps/greenbk/snsum.html**

Analysis of the Acid Deposition and Ozone Control Act (S. 172), July 2000. EPA, OAR, Clean Air Markets Division, Washington, DC, 20460.

References: Chapter 4 - Toxic Pollutants in Michigan

Wolff, G., 1999. Michigan's Relative Risk Task Force Report on Air Quality Issues. Air Quality Issues Task Force.

Analysis of the MDEQ's Administered Standards to Protect Children's Health. MESB. 2000.

Recommended Environmental Indicators Program for the State of Michigan. MESB. 2001.

A Profile of Southeast Michigan's Environment. Identification of Environmental Indicators and Initial Data Collection. SEMCG. 1999.

Monosmith, C., Michigan Air Toxics Programs. January 1995, MDNR, AQD, Box 30028, Lansing, MI 48909.

Deposition of Air of Pollutants to the Great Waters. First Report to Congress. EPA, OAQPS, RTP. GEPA-453/R-93-055. May 1994.

S.J. Eisenreich, D. L. Swackhamer, and D.T. Long. Monitoring the Great Lakes - Metal Concentrations in Sediments. EPA, Great Lakes National Program Office, Chicago, Illinois. EPA-R995233. January 1996.

Fitzgerald, W.F., Mason, R.P., Vandal, G.M. 1991. Atmospheric cycling and air-water exchange of mercury over mid-continental lacustrine regions. Water, Air, and Soil Pollution **56**:745.

Hillery, B. R., M. F. Simcik, I. Basu, R. M. Hoff, W. M. J. Strachan, D. Burniston, C.H. Chan, K. A. Brice, C. Sweet, R. Hites. 1998. Atmospheric Deposition of Toxic Pollutants to the Great Lakes As Measured by the Integrated Atmospheric Deposition Network. Environmental Science & Technology 32 (10) 2216.

Atmospheric Monitoring of Toxic Pollutants in the Great Lakes. EPA 1998.
http://www.epa.gov/glnpo/air/iadn5.htm

Atmospheric Deposition Study of PCBs, Mercury and Cadmium. Phase 1 Final Report: Project Summary and Recommendations. Detroit Water and Sewage Department. 1998. Contract No. CS-1226 – McNamee.

Identification of Atmospheric Mercury Sources in the Great Lakes' States through an Ambient Monitoring Program. MDEQ AQD; Minnesota Pollution Control Agency, Environmental Outcomes Division; and Wisconsin DNR, Bureau of Air Management. 1999.

Taylor Morgan, J. and G. Keeler. 2000. Monitoring Atmospheric Mercury Species in Michigan. Michigan Great Lakes Protection Fund Proposal. 5/24/00.

On-Line References:

MDEQ, Environmental Assistance Division, "What is an Air Contaminant/Pollutant?
http://www.deq.state.mi.us/ead/pub/factsheet/airconfs.pdf

2. Air toxics links
   - **http://www.epa.gov/ARD-R5/toxics/toxics2.htm**
   - **http://www.epa.gov/glnpo/**
   - **http://www.epa.gov/ngispgm3/iris/index.html**
   - **http://www.epa.gov/ttn/uatw/sitemap.html**

References: Chapter 5 - Special Projects

Air Quality Index Reporting - Final Rule. 64 FR 42530, August 4, 1999

On-Line References:

Region 5 EPA Ozone Action Days, general information and links to other Region 5 states and organizations: **http://www.epa.gov/reg5oair/ozoneday/ozoneday.htm** , **http://www.epa.gov/airnow**

MDEQ, AQD's *Ozone Action!* Day Page: **http://www.deq.state.mi.us/aqi/ozone.shtml**

West Michigan Clean Air Coalition Ozone Action web page: **http://www.wmcac.org/**

SEMCOG Ozone Action web page provides educational and teacher's resource information on O_3, and voluntary efforts for prevention and reduction of air pollutant emissions: **http://www.semcog.org/ozoneaction/**

References: Chapter 6 - Meteorological Summary

On-Line References:

Meteorological Forecasts and Extended Forecasts for OzoneAction! Days data: **http://www.deq.state.mi.us/aqd/eval/amu/o34cast.html**

Wind roses for the Great Lakes IADN sites is periodically published and made available at: **http://www.epa.gov/grtlakes/air/**

Precipitation data for NADP monitoring sites (see **Figure 7.1-7**) is available at: **http://nadp.sws.uiuc.edu/nadpdata/state.asp?state=MI**

Other interesting meteorological sites include:
The Ohio State University Atmospheric Science Homepage: **http://asp1.sbs.ohio-state.edu/**
NWS Welcome Page: **http://www.nws.noaa.gov/**

LIST OF APPENDICES

Appendix A: Criteria Pollutant Summary for 2001

Appendix B: Precision and Accuracy Report for 2001

Appendix C: 2001 Data Summary for Trace Metals, VOCs, and Carbonyl Compounds

Appendix D: Ozone Exceedances 1992 to 2001

Appendix E: AQD Acronyms and Definitions

Appendix F: AQD District Office Locations

Appendix A: Criteria Pollutant Summary for 2001

Appendix A utilizes EPA's Air Quality Subsystem Quick Look Report Data for 2001 to present a summary of ambient air quality data collected for the criteria pollutants at monitoring locations throughout Michigan. The following paragraphs define some of the terms listed in these **Appendix A** reports.

The column listing the number of excursions per site for the primary and secondary standards utilizes running averages for continuous monitors, except for O_3, and does not include averages considered invalid due to limited sampling times. For example, a particulate-mean based only on six months could not be considered as violating the annual standard. As noted, each site is allowed one short-term standard excursion before a violation is determined.

For TSP, Pb, PM_{10} and $PM_{2.5}$ appendices, the #OBS (number of observations) refers to the number of valid 24-hour values gathered. For continuous monitors (SO_2, NO_2, CO, $PM_{2.5}$ TEOM, and O_3), #OBS refers to the total valid hourly averages obtained from the analyzer.

The "greater than" (>) operator heads the column reporting values or observations above the corresponding primary or secondary standards. Notation is also made for the identification of $PM_{2.5}$ FRM (federal reference method), TEOM hourly PM_{10} and $PM_{2.5}$ measurements, and $PM_{2.5}$ speciation monitors (SASS - spiral aerosol speciation sampler). Concentrations of non-gaseous pollutants are generally given in $\mu g/m^3$ at 25°C (Celsius) and one atmosphere pressure, and in ppm for gaseous pollutants.

In annual reports prior to 1989, each site was labeled with a five-digit MASN code number. The AQS site ID is the EPA's code number for these sites and has replaced the MASN number.

$PM_{2.5}$ in mg/m^3 at Local Conditions

Site ID	POC	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	98%	Wtd. Arith. Mean
260050003	1	FRM	Holland	Allegan	2001	362	47.1	42.3	42.1	41.2	42.1	12.8
260070005	1	FRM	Alpena	Alpena	2001	119	40.3	36.7	35.1	31.5	35.1	9.8
260170014	1	FRM	Bay City	Bay	2001	119	43.0	37.5	34.2	32.3	34.2	11.5
260210014	1	FRM	Coloma	Berrien	2001	115	38.6	35.5	32.3	32.3	32.3	13.2
260330901	1	FRM	Sault Ste. Marie	Chippewa	2001	104	31.5	28.3	27.9	25.7	27.9	8.2
260330901	2	FRM	Sault Ste. Marie	Chippewa	2001	49	25.4	21.6	19.6	18.6	25.4	7.9
260330901	5	SASS	Sault Ste. Marie	Chippewa	2001	19	33.5	15.2	8.1	7.7	33.5	7.5
260330902	1	FRM	Sault Ste. Marie	Chippewa	2001	107	30.6	29.7	28.0	25.0	28.0	7.9
260490021	1	FRM	Flint	Genesee	2001	111	49.9	39.1	38.0	37.1	38.0	13.1
260550003	1	FRM	Traverse City	Grand Traverse	2001	115	38.3	36.7	32.7	27.3	32.7	9.3
260650012	1	FRM	Lansing	Ingham	2001	117	43.4	39.7	37.2	37.2	37.2	14.0
260650012	2	FRM	Lansing	Ingham	2001	61	40.8	40.4	37.5	23.9	40.4	13.3
260650012	5	TEOM	Lansing	Ingham	2001	365	89.0	56.0	56.0	51.0	47.0	14.0
260770008	1	FRM	Kalamazoo	Kalamazoo	2001	113	44.1	43.8	40.0	39.3	40.0	15.6
260770008	2	FRM	Kalamazoo	Kalamazoo	2001	57	37.0	36.0	33.7	26.3	36.0	14.6
260770008	3	TEOM	Kalamazoo	Kalamazoo	2001	365	43.0	39.0	39.0	39.0	34.0	11.5
260810020	1	FRM	Grand Rapids	Kent	2001	354	47.7	47.3	43.5	42.5	43.5	14.4
260810020	2	FRM	Grand Rapids	Kent	2001	59	44.5	39.4	34.0	32.9	39.4	14.2
260810020	3	TEOM	Grand Rapids	Kent	2001	215	44.0	40.0	39.0	37.0	37.0	11.8
260990009	1	FRM	New Haven	Macomb	2001	115	45.0	42.6	42.0	37.0	42.0	13.6
261150005	1	FRM		Monroe	2001	111	47.9	45.1	39.2	36.0	39.2	15.3
261210040	1	FRM	Muskegon	Muskegon	2001	121	43.0	38.2	34.9	34.7	34.9	12.6
261250001	1	FRM	Oak Park	Oakland	2001	96	48.3	39.4	37.8	37.7	39.4	14.7
261250010	5	SASS	Southfield	Oakland	2001	43	44.2	35.2	32.4	32.3	44.2	17.1
261390005	1	FRM		Ottawa	2001	116	41.2	35.3	35.0	33.2	35.0	13.8
261450018	1	FRM	Saginaw	Saginaw	2001	118	42.9	36.1	34.6	31.8	34.6	11.5
261450018	2	FRM	Saginaw	Saginaw	2001	1	10.3				10.3	10.3
261450018	3	TEOM	Saginaw	Saginaw	2001	354	51.0	36.0	34.0	34.0	30.0	9.8
261470005	1	FRM	Port Huron	St. Clair	2001	112	45.6	45.1	40.5	39.6	40.5	14.0
261470005	2	FRM	Port Huron	St. Clair	2001	54	38.3	35.9	35.5	25.0	35.9	13.2
261530001	5			Schoolcraft	2001	38	26.0	23.3	18.4	16.4	26.0	7.5
261610005	1	FRM	Ann Arbor	Washtenaw	2001	113	45.4	39.9	38.5	35.5	38.5	13.5
261610008	1	FRM	Ypsilanti	Washtenaw	2001	117	46.6	40.0	39.7	37.2	39.7	14.5
261610008	2	FRM	Ypsilanti	Washtenaw	2001	56	41.7	39.0	33.7	28.4	39.0	13.8
261610008	3	TEOM	Ypsilanti	Washtenaw	2001	365	64.0	60.0	49.0	43.0	34.0	11.1
261630001	1	FRM	Allen Park	Wayne	2001	298	57.3	53.1	48.3	46.3	48.3	17.3
261630001	2	FRM	Allen Park	Wayne	2001	57	40.4	40.1	38.8	32.5	40.1	16.2

$PM_{2.5}$ in µg/m^3 at Local Conditions (Continued)

Site ID	POC	Monitor	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	98%	Wtd. Arith. Mean
261632001	3	TEOM	Allen Park	Wayne	2001	329	56.0	42.0	42.0	41.0	35.0	12.6
261630001	5	SASS	Allen Park	Wayne	2001	97	45.7	42.2	39.9	39.4	42.2	18.2
261630015	1	FRM	Detroit - W. Fort	Wayne	2001	114	51.7	43.5	42.9	42.5	42.9	18.3
261630016	1	FRM	Detroit - Linwood	Wayne	2001	328	50.0	48.2	46.0	43.9	46.0	15.8
261630019	1	FRM	Detroit - E. Seven Mile	Wayne	2001	115	44.6	42.5	42.0	39.7	42.0	14.5
261630019	5	SASS	Detroit - E. Seven Mile	Wayne	2001	47	47.9	47.2	40.3	35.8	47.9	16.3
261630025	1	FRM	Livonia	Wayne	2001	115	51.0	46.0	44.7	36.3	44.7	14.6
261630033	1	FRM	Dearborn	Wayne	2001	115	50.0	47.4	43.2	41.9	43.2	19.6
261630036	1	FRM	Wyandotte	Wayne	2001	113	56.0	52.3	46.6	45.3	46.6	18.2

NO_2 in ppm

Site ID	POC	City	County	Year	#Obs	1-Hour Highest Value	1-Hour 2nd Highest Value	Annual Arith Mean
260650012	1	Lansing	Ingham	2001	6584	0.064	0.058	0.013
261630016	1	Detroit - Linwood	Wayne	2001	7118	0.194	0.074	0.023
261630019	2	Detroit - E. Seven Mile	Wayne	2001	8036	0.186	0.105	0.019

TSP in µg/m^3

Site ID	POC	City	County	Year	#Obs	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Arith Mean	Geo Mean	Geo Std
260410903	1	Escanaba	Delta	2001	61	59	55	54	51	30	27	1.7
260410905	1	Escanaba	Delta	2001	60	48	46	39	38	20	16	2.1
260410906	1	Escanaba	Delta	2001	58	51	44	43	41	20	16	2.2
260410911	1	Escanaba	Delta	2001	61	105	95	87	85	34	26	2.2
261110914	1		Midland	2001	45	97	63	57	55	27	22	1.8
261110917	1	Midland	Midland	2001	45	76	69	68	60	30	26	1.7
261110918	1	Midland	Midland	2001	45	87	62	57	55	26	22	1.8
261150951	1	Monroe	Monroe	2001	51	247	213	197	178	77	65	1.8
261150953	1		Monroe	2001	28	135	113	89	78	45	37	1.9

CO in ppm

Site ID	POC	City	County	Year	#OBS	1-hour Highest Value	1-hour 2nd Highest Value	# > 35	8-hour Highest Value	8-hour 2nd Highest Value	# > 9
260810020	1	Grand Rapids	Kent	2001	692	4.3	4.3	0	3.2	3.1	0
260991003	1	Warren	Macomb	2001	8634	4.7	4.0	0	3.3	2.7	0
261250001	1	Oak Park	Oakland	2001	7726	4.6	4.5	0	3.9	3.0	0
261630001	1	Allen Park	Wayne	2001	8669	5.6	3.8	0	1.7	1.6	0
261630016	1	Detroit - Linwood	Wayne	2001	8097	5.9	5.4	0	3.7	3.4	0
261630025	1	Livonia	Wayne	2001	8703	4.5	2.7	0	2.3	2.0	0
261630026	1	Detroit - Joy Road	Wayne	2001	8668	4.8	4.5	0	3.8	2.9	0

SO_2 in ppm

Site ID	POC	City	County	Year	#OBS	24-hour Highest Value	24-hour 2nd Highest Value	OBS > 0.14	3-hour Highest Value	3-hour 2nd Highest Value	OBS > 0.5	1-hour Highest Value	1-hour 2nd Highest Value	Arith Mean
260410902	1	Escanaba	Delta	2001	8305	0.009	0.007	0	0.046	0.026	0	0.070	0.040	0.002
260490021	1	Flint	Genesee	2001	8100	0.014	0.014	0	0.027	0.021	0	0.036	0.032	0.002
260810020	1	Grand Rapids	Kent	2001	7553	0.009	0.007	0	0.024	0.022	0	0.043	0.031	0.002
260991003	1	Warren	Macomb	2001	8710	0.013	0.011	0	0.042	0.037	0	0.068	0.052	0.002
261470005	1	Port Huron	St Clair	2001	8717	0.060	0.047	0	0.144	0.113	0	0.183	0.170	0.007
261630005	1	River Rouge	Wayne	2001	3038	0.016	0.015	0	0.055	0.036	0	0.075	0.058	0.005
261630015	1	Detroit - W. Fort	Wayne	2001	8671	0.045	0.045	0	0.115	0.106	0	0.224	0.147	0.007
261630016	2	Detroit - Linwood	Wayne	2001	8669	0.028	0.027	0	0.129	0.081	0	0.209	0.112	0.005
261630019	1	Detroit - E. Seven Mile	Wayne	2001	8399	0.020	0.019	0	0.073	0.067	0	0.160	0.087	0.004
261630027	1	Detroit - W. Jefferson	Wayne	2001	3041	0.044	0.035	0	0.098	0.079	0	0.126	0.112	0.007
261630033	1	Dearborn	Wayne	2001	3030	0.032	0.023	0	0.045	0.043	0	0.079	0.075	0.008

Pb in mg/m^3

Site ID	POC	City	County	Year	# OBS	Qtr 1 Arith Mean	Qtr 2 Arith Mean	Qtr 3 Arith Mean	Qtr 4 Arith Mean	# Means > 1.5	Highest Value	2nd Highest Value
260490021	4	Flint	Genesee	2001	57	0.01	0.01	0.01	0.01	0	0.03	0.03
260810021	4	Grand Rapids	Kent	2001	31	0.01	0.01	0.01	0.01	0	0.02	0.02
261130001	1		Missaukee	2001	30	0.00	0.01	0.00	0.00	0	0.02	0.01
261250010	1	Southfield	Oakland	2001	37	0.01	0.01	0.01	0.00	0	0.02	0.01
261390009	1	Holland	Ottawa	2001	46	0.01	0.01	0.02		0	0.10	0.05
261390010	1	Holland	Ottawa	2001	30		0.02	0.01		0	0.05	0.04
261610008	1	Ypsilanti	Washtenaw	2001	31	0.01	0.02	0.01	0.00	0	0.08	0.02
261630001	1	Allen Park	Wayne	2001	6	0.02	0.03			0	0.03	0.03
261630001	2	Allen Park	Wayne	2001	46	0.01	0.01	0.01	0.08	0	1.02	0.04
261630005	1	River Rouge	Wayne	2001	48	0.01	0.03	0.02	0.01	0	0.09	0.05
261630015	2	Detroit - W. Fort	Wayne	2001	6	0.04	0.06			0	0.08	0.05

Pb in mg/m³ (Continued)

Site ID	POC	City	County	Year	# OBS	Qtr 1 Arith Mean	Qtr 2 Arith Mean	Qtr 3 Arith Mean	Qtr 4 Arith Mean	# Means > 1.5	Highest Value	2nd Highest Value
261630015	4	Detroit - W. Fort	Wayne	2001	47	0.01	0.03	0.02	0.02	0	0.05	0.05
261630015	5	Detroit - W. Fort	Wayne	2001	42	0.02	0.03	0.03	0.02	0	0.07	0.07
261630016	1	Detroit - Linwood	Wayne	2001	6	0.02	0.04			0	0.06	0.04
261630019	1	Detroit - E. Seven Mile	Wayne	2001	6	0.02	0.04			0	0.06	0.03
261630019	2	Detroit - E. Seven Mile	Wayne	2001	46	0.01	0.01	0.01	0.01	0	0.04	0.03
261630027	1	Detroit - W. Jefferson	Wayne	2001	41	0.02	0.03	0.03	0.03	0	0.08	0.07
261630033	1	Dearborn	Wayne	2001	6	0.04	0.05			0	0.07	0.05
26163033	2	Dearborn	Wayne	2001	45	0.02	0.02	0.02	0.03	0	0.08	0.06

O_3 (1-Hour) in ppm

Site ID	POC	City	County	Year	Num Meas	Num Req	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Values >0.124 Measured	Values > 0.124 Estimated	Missed Days Assumed < Standard
260050003	1	Holland	Allegan	2001	182	183	0.114	0.113	0.111	0.108	0	0.0	1
260190003	1	Benzonia	Benzie	2001	183	183	0.123	0.116	0.116	0.101	0	0.0	0
260210014	1	Coloma	Berrien	2001	183	183	0.126	0.117	0.113	0.106	1	1.0	0
260270003	1		Cass	2001	159	183	0.122	0.109	0.101	0.094	0	0.0	2
260370001	2	Bath Township	Clinton	2001	183	183	0.105	0.104	0.102	0.101	0	0.0	0
260490021	1	Flint	Genesee	2001	182	183	0.114	0.108	0.103	0.102	0	0.0	1
260492001	1	Otisville	Genesee	2001	183	183	0.103	0.103	0.099	0.098	0	0.0	0
260630007	1		Huron	2001	169	183	0.153	0.109	0.100	0.095	1	1.1	0
260650012	2	Lansing	Ingham	2001	183	183	0.110	0.106	0.099	0.090	0	0.0	0
260770008	1	Kalamazoo	Kalamazoo	2001	183	183	0.105	0.101	0.097	0.093	0	0.0	0
260810020	1	Grand Rapids	Kent	2001	183	183	0.107	0.103	0.095	0.094	0	0.0	0
260810022	1		Kent	2001	183	183	0.109	0.098	0.096	0.093	0	0.0	0
260910007	1	Tecumseh	Lenawee	2001	183	183	0.103	0.103	0.095	0.093	0	0.0	0
260990009	1	New Haven	Macomb	2001	179	183	0.127	0.114	0.108	0.108	1	1.0	0
260991003	1	Warren	Macomb	2001	183	183	0.117	0.116	0.110	0.107	0	0.0	0
261050007	1		Mason	2001	183	183	0.125	0.109	0.105	0.102	1	1.0	0
261130001	1		Missaukee	2001	182	183	0.102	0.094	0.093	0.090	0	0.0	1
261210039	1	Muskegon	Muskegon	2001	182	183	0.121	0.118	0.115	0.113	0	0.0	1
261250001	2	Oak Park	Oakland	2001	174	183	0.114	0.100	0.099	0.099	0	0.0	0
261390005	1		Ottawa	2001	182	183	0.115	0.112	0.098	0.097	0	0.0	1
261470005	1	Port Huron	St .Clair	2001	183	183	0.126	0.122	0.107	0.104	1	1.0	0
261610008	1	Ypsilanti	Washtenaw	2001	183	183	0.124	0.116	0.115	0.110	0	0.0	0
261630001	2	Allen Park	Wayne	2001	179	183	0.114	0.099	0.093	0.091	0	0.0	0
261630016	1	Detroit -Linwood	Wayne	2001	183	183	0.111	0.109	0.101	0.100	0	0.0	0
261630019	2	Detroit - E. Seven Mile	Wayne	2001	183	183	0.111	0.109	0.103	0.103	0	0.0	0

O_3 (8-Hour) in ppm

Site ID	POC	City	County	Year	# Obs	% Obs	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Missed Days Assumed < Standard
260050003	1	Holland	Allegan	2001	362	99	0.102	0.094	0.093	0.092	0
260190003	1	Benzonia	Benzie	2001	4388	100	0.104	0.104	0.094	0.091	0
260210014	1	Coloma	Berrien	2001	4387	100	0.102	0.099	0.093	0.088	0
260270003	1		Cass	2001	3905	86	0.091	0.090	0.089	0.088	0
260370001	2	Bath Township	Clinton	2001	4380	100	0.096	0.095	0.091	0.087	0
260490021	1	Flint	Genesee	2001	4374	99	0.103	0.098	0.095	0.091	0
260492001	1	Otisville	Genesee	2001	4383	100	0.093	0.091	0.091	0.091	0
260630007	1		Huron	2001	4071	92	0.117	0.095	0.089	0.088	0
260650012	2	Lansing	Ingham	2001	4383	100	0.099	0.092	0.084	0.083	0
260770008	1	Kalamazoo	Kalamazoo	2001	4388	100	0.093	0.088	0.088	0.085	0
260810020	1	Grand Rapids	Kent	2001	4386	100	0.088	0.085	0.085	0.083	0
260810022	1		Kent	2001	4376	100	0.093	0.092	0.085	0.085	0
260910007	1	Tecumseh	Lenawee	2001	4375	99	0.096	0.094	0.090	0.086	0
260990009	1	New Haven	Macomb	2001	4292	97	0.105	0.098	0.095	0.095	0
260991003	1	Warren	Macomb	2001	4381	100	0.103	0.101	0.099	0.094	0
261050007	1		Mason	2001	4388	100	0.100	0.099	0.098	0.093	0
261130001	1		Missaukee	2001	4376	99	0.093	0.087	0.084	0.084	0
261210039	1	Muskegon	Muskegon	2001	4361	99	0.101	0.099	0.096	0.095	0
261250001	2	Oak Park	Oakland	2001	4142	94	0.094	0.093	0.091	0.090	0
261390005	1		Ottawa	2001	4348	98	0.094	0.088	0.087	0.086	0
261470005	1	Port Huron	St .Clair	2001	4383	100	0.105	0.103	0.085	0.084	0
261610008	1	Ypsilanti	Washtenaw	2001	4382	100	0.107	0.095	0.095	0.092	0
261630001	2	Allen Park	Wayne	2001	4237	97	0.094	0.092	0.083	0.080	0
261630016	1	Detroit - Linwood	Wayne	2001	4345	99	0.092	0.090	0.088	0.087	0
261630019	2	Detroit - E. Seven Mile	Wayne	2001	4270	97	0.097	0.097	0.094	0.092	0

PM_{10} in mg/m^3

Site ID	POC	Monitor	City	County	Year	# Obs	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	99%	Wtd Arith Mean
260250003	1	GRAV	Albion	Calhoun	2001	15	50	49	43	41	50	24
260490021	1	GRAV	Flint	Genesee	2001	43	48	48	46	44	48	20
260810007	1	GRAV	Grand Rapids	Kent	2001	55	71	47	43	42	71	23
260810020	1	GRAV	Grand Rapids	Kent	2001	61	44	41	39	39	44	18
261390009	1	GRAV	Holland	Ottawa	2001	44	46	42	39	35	46	18
261390010	1	GRAV	Holland	Ottawa	2001	30	68	62	46	37	68	26
261630001	1	GRAV	Allen Park	Wayne	2001	60	59	50	47	46	59	27
261630005	1	GRAV	River Rouge	Wayne	2001	43	71	68	55	53	71	28
261630015	1	GRAV	Detroit - W. Fort	Wayne	2001	59	97	86	85	79	97	40
261630025	1	GRAV	Livonia	Wayne	2001	45	52	52	49	42	52	23
261630033	1	GRAV	Dearborn	Wayne	2001	57	89	61	60	60	89	38
261630033	3	TEOM	Dearborn	Wayne	2001	344	131	130	123	95	95	35
261630092	2	GRAV	Detroit - W. End	Wayne	2001	44	133	114	110	86	133	46

Appendix B: Precision and Accuracy Report for 2001

Appendix B is Michigan's Air Sampling Network 2001 Data Assessment Summary for Criteria Air Pollutants. This is a quality assurance data assessment report and all quality assurance is performed in accordance with the EPA requirements.

2001 DATA ASSESSMENT SUMMARY FOR CRITERIA AIR POLLUTANTS

CO:

YEAR Quarter	PRECISION				ACCURACY						
	No. of Analyzers	No. of Checks	Probability Limits Lower	Upper	No. of Audits	Level 1 Lower	Upper	Level 2 Lower	Upper	Level 3 Lower	Upper
2001	**7**	**116**	**-8**	**+8**	**9**	**-7**	**+4**	**-6**	**+4**	**-5**	**+3**
1st	3	24	-5	+5	2	-4	-2	-4	+4	-3	+3
2nd	3	24	-5	+5	1	*	*	*	*	*	*
3rd	3	22	-5	+5	2	-1	+1	-2	+2	+1	+1
4th	7	46	-10	+11	4	-9	+7	-9	+5	-8	+4

* insufficient number of analyzers to calculate accuracy.

Pb:

YEAR Quarter	PRECISION						ACCURACY			LAB ACCURACY				
	No. of Co-located Samples	No. of Co-located Sites	No. of Samples < Limit	Probability Limits Lower	Upper	No. of Valid Co-located Data Pair	No. of Audits	Level 2 Lower	Upper	No. of Audits	Level 1 Lower	Upper	Level 2 Lower	Upper
2001	**31**	**1**	**31**	*	*	**0**	**8**	**-5**	**+3**	**21**	**-10**	**+3**	**-9**	**+4**
1st	8	1	8	*	*	0	1	*	*	6	-12	+2	-9	+0
2nd	8	1	8	*	*	0	1	*	*	6	-9	-2	-10	+0
3rd	7	1	7	*	*	0	2	-8	+6	7	-4	+3	-4	+4
4th	8	1	8	*	*	0	4	-4	+2	2	-2	+5	-2	+2

* measurements less than EPA's limit; cannot estimate precision

NO_2:

YEAR Quarter	PRECISION				ACCURACY						
	No. of Analyzers	No. of Checks	Probability Limits Lower	Upper	No. of Audits	Level 1 Lower	Upper	Level 2 Lower	Upper	Level 3 Lower	Upper
2001	**2**	**25**	**-6**	**+9**	**2**	**-10**	**-6**	**-10**	**-5**	**-13**	**-3**
1st	1	7	-4	+9	0	*	*	*	*	*	*
2nd	1	9	-6	+10	1	*	*	*	*	*	*
3rd	1	4	-7	+10	0	*	*	*	*	*	*
4th	2	5	-9	+7	1	*	*	*	*	*	*

* insufficient number of checks to calculate accuracy.

2001 DATA ASSESSMENT SUMMARY FOR CRITERIA AIR POLLUTANTS (Continued)

O_3:

YEAR	PRECISION				ACCURACY						
Quarter	No. of Analyzers	No. of Checks	Probability Limits Lower	Upper	No. of Audits	Level 1 Lower	Upper	Level 2 Lower	Upper	Level 3 Lower	Upper
2001	**21**	**308**	**-4**	**+5**	**21**	**-8**	**+3**	**-7**	**+2**	**-7**	**+2**
1st	No data due to ozone season										
2nd	21	161	-4	+5	11	-8	+1	-8	+0	-7	-1
3rd	21	147	-4	+5	10	-7	+5	-6	+3	-6	+3
4th	No data due to ozone season										

Note: Michigan's ozone season runs from April thru September.

PM_{10}:

YEAR	PRECISION						ACCURACY		
Quarter	No. of Co-located Samples	No. of Co-located Sites	No. of Samples < Limit	95% Probability Limits Lower	Upper	No. of Valid Co-located Data Pairs	No. of Audits	Probability Lower	Upper
2001	**63**	**2**	**29**	**-9**	**+21**	**34**	**7**	**-4**	**+6**
1st	15	1	11	-6	+3	4	1	-0	+0
2nd	13	1	6	-10	+19	7	3	-1	+2
3rd	13	1	6	-3	+26	7	0	*	*
4th	22	2	6	-10	+24	16	3	-5	+10

* insufficient number of checks to calculate accuracy.

$PM_{2.5}$:

YEAR	PRECISION						ACCURACY		
Quarter	No. of Co-located Samples	No. of Co-located Sites	No. of Samples < Limit	95% Probability Limits Lower	Upper	No. of Valid Co-located Data Pairs	No. of Audits	Probability Lower	Upper
2001	**346**	**8**	**54**	**-10**	**+12**	**292**	**134**	**-4**	**+3**
1st	84	8	11	-9	+13	73	34	-4	+4
2nd	99	7	9	-10	+12	90	33	-5	+3
3rd	82	7	19	-12	+12	63	34	-4	+3
4th	81	7	15	-10	+9	66	33	-4	+2

2001 DATA ASSESSMENT SUMMARY FOR CRITERIA AIR POLLUTANTS (Continued)

SO_2:

YEAR / Quarter	PRECISION				ACCURACY						
	No. of Analyzers	No. of Checks	Probability Limits		No. of Audits	Level 1		Level 2		Level 3	
			Lower	Upper		Lower	Upper	Lower	Upper	Lower	Upper
2001	**7**	**133**	**-6**	**+7**	**9**	**-12**	**+12**	**-11**	**+11**	**-11**	**+10**
1st	4	28	-8	+6	2	-14	+26	-14	+25	-17	+26
2nd	4	28	-6	+6	3	-11	+3	-9	+1	-5	-4
3rd	4	28	-7	+7	1	*	*	*	*	*	*
4th	7	49	-5	+9	3	-2	+7	-2	+5	-4	+5

* insufficient number of checks to calculate accuracy.

Appendix C: 2001 Data Summary for Trace Metals, VOCs, and Carbonyl Compounds

Appendix C provides a summary with statistics of ambient air concentrations of air toxics taken during 2001. Trace Metals, VOCs, and carbonyl compounds were sampled and then analyzed in a laboratory for monitoring sites categorized as long-term trend monitors. Each monitoring site samples the air for a 24-hour period (midnight to midnight). These air samples are called "daily" values. The frequency of sample collection varies from site to site but is typically done every 6 or 12 days. However, the Dearborn monitor (26-163-0033) collected daily samples once every day. Some of the daily values (data not shown) may be lower than the analytical method detection limit (MDL). The cited MDLs represent the detection limits that are routinely attained. In the calculation of the minimum and maximum averages (also called "means"), zero (0.0 $\mu g/m^3$) or the MDL, respectively, is substituted for non-detected air contaminants.

Trace Metals are also summarized and represent particulates analyzed from HI-VOL filters. Some values are lower than the detection limit because improved instrumental sensitivity was achieved on some days. The cited MDLs represent the detection limits that are routinely attained. In the calculation of the minimum and maximum averages, zero or the MDL is substituted for non-detected levels. Levels of metals were determined from the collection of TSP (total suspended particulates), or the smaller particle fraction referred to as PM_{10}.

Following are the acronyms for the following data:

Chemical Name:	Commonly accepted name of air pollutant analyzed
MDL:	Analytical Method Detection Limit in units of $\mu g/m^3$
Num Obs:	Number of Observations (the number of daily air samples taken during the year)
Num > MDL:	Number of daily samples that were above the method detection limit
Max1:	The first highest daily air concentration during the year
Max2:	The second highest daily air concentration during the year
Max3:	The third highest daily air concentration during the year
Min Mean:	The average air concentration for the year, assuming that the daily samples below the MDL are equal to 0.0 $\mu g/m^3$
Max Mean:	The average air concentration for the year, assuming that the daily samples below the MDL are equal to the MDL

LONG-TERM TREND MONITORING SITES

Allen Park				Units: $\mu g/m^3$		AIRS ID: 261630001		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Arsenic (TSP)	0.016	46	46	0.015	0.008	0.007	0.002	0.002
Beryllium (TSP)	0.010	46	8	0.000	0.000	0.000	0.000	0.008
Cadmium (TSP)	0.024	46	46	0.001	0.001	0.001	0.000	0.000
Chromium (TSP)	0.014	46	46	0.007	0.005	0.005	0.004	0.004
Lead (TSP)	0.010	46	46	1.019	0.041	0.023	0.033	0.033
Manganese (TSP)	0.010	46	46	0.106	0.065	0.052	0.032	0.032
Nickel (TSP)	0.010	46	46	0.007	0.006	0.004	0.002	0.002
1,1,1-Trichloroethane	0.262	24	20	0.335	0.327	0.272	0.194	0.238
1,1,2,2-Tetrachloroethane	0.556	24	0	0.000	0.000	0.000	0.000	0.556
1,1,2-Trichloroethane	0.262	24	0	0.000	0.000	0.000	0.000	0.262
1,1-Dichloroethane	0.360	24	0	0.000	0.000	0.000	0.000	0.360
1,1-Dichloroethene	0.182	24	0	0.000	0.000	0.000	0.000	0.182
1,2,4-Trichlorobenzene	0.200	24	0	0.000	0.000	0.000	0.000	0.200
1,2,4-Trimethylbenzene	0.088	24	24	2.453	2.301	1.428	0.985	0.985
1,2-Dibromoethane	0.415	24	0	0.000	0.000	0.000	0.000	0.415
1,2-Dichlorobenzene	1.200	24	0	0.000	0.000	0.000	0.000	1.200
1,2-Dichloroethane	0.348	24	0	0.000	0.000	0.000	0.000	0.348
1,2-Dichloropropane	0.273	24	0	0.000	0.000	0.000	0.000	0.273
1,3,5-Trimethylbenzene	1.000	24	23	0.981	0.785	0.505	0.332	0.373
1,3-Butadiene	0.089	24	17	0.353	0.287	0.209	0.102	0.128
1,3-Dichlorobenzene	1.200	24	2	0.240	0.060	0.000	0.013	1.113
2,5-dimethylbenzaldehyde	0.056	21	0	0.000	0.000	0.000	0.000	0.056
2-Chloro-1,3-Butadiene	0.109	24	0	0.000	0.000	0.000	0.000	0.109
Acetaldehyde	0.025	21	20	3.290	2.370	2.210	1.419	1.420
Acetone	0.080	21	21	13.650	4.980	3.410	2.481	2.481
Acetonitrile	0.873	24	12	238.000	130.900	105.800	23.581	24.018
Acetylene	0.138	24	24	2.610	2.590	2.190	1.268	1.268
Acrylonitrile	0.847	24	0	0.000	0.000	0.000	0.000	0.847
Benzaldehyde	0.023	21	15	0.498	0.299	0.173	0.088	0.095
Benzene	0.224	24	24	4.370	2.618	2.181	1.488	1.488
Bromochloromethane	0.635	24	0	0.000	0.000	0.000	0.000	0.635
Bromodichloromethane	0.489	24	0	0.000	0.000	0.000	0.000	0.489
Bromoform	0.610	24	0	0.000	0.000	0.000	0.000	0.610
Bromomethane	0.155	24	2	0.523	0.116	0.000	0.027	0.169
Carbon Tetrachloride	0.239	24	24	0.753	0.716	0.691	0.603	0.603
Chlorobenzene	0.184	24	0	0.000	0.000	0.000	0.000	0.184
Chloroethane	0.106	24	6	0.632	0.395	0.384	0.096	0.175
Chloroform	0.332	24	3	0.341	0.244	0.097	0.028	0.319
Chloromethane	0.128	24	24	1.793	1.649	1.541	1.293	1.293
Chloromethyl Benzene	1.000	24	0	0.000	0.000	0.000	0.000	1.000
cis-1,2-Dichloroethene	0.226	24	0	0.000	0.000	0.000	0.000	0.226
cis-1,3-Dichloropropene	0.245	24	0	0.000	0.000	0.000	0.000	0.245
Crotonaldehyde	0.013	21	4	0.744	0.289	0.257	0.067	0.077
Dibromochloromethane	0.503	24	0	0.000	0.000	0.000	0.000	0.503
Dichlorodifluoromethane	0.237	24	24	3.603	3.553	3.529	3.019	3.019
Dichlorotetrafluoroethane	0.350	24	3	0.140	0.140	0.070	0.015	0.321
Ethyl Acrylate	0.655	24	0	0.000	0.000	0.000	0.000	0.655
Ethyl Tert-Butyl Ether	0.627	24	0	0.000	0.000	0.000	0.000	0.627

Allen Park				Units: mg/m³		AIRS ID: 261630001		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Ethylbenzene	0.360	24	24	1.777	1.213	1.057	0.664	0.664
Formaldehyde	0.027	21	21	4.830	4.710	4.190	2.143	2.143
Hexachloro-1,3-Butadiene	0.330	24	0	0.000	0.000	0.000	0.000	0.330
Hexanaldehyde	0.042	21	12	1.026	0.777	0.478	0.180	0.198
Isovaleraldehyde	0.027	21	10	0.359	0.317	0.169	0.077	0.091
m,p-Tolualdehyde	0.042	21	6	0.799	0.270	0.196	0.073	0.103
m/p -Xylene	0.869	24	24	5.160	3.337	2.908	1.838	1.838
Methyl Ethyl Ketone	5.014	24	21	3.680	3.650	3.270	2.002	2.629
Methyl Isobutyl Ketone	3.442	24	0	0.000	0.000	0.000	0.000	3.442
Methyl Methacrylate	0.737	24	0	0.000	0.000	0.000	0.000	0.737
Methyl Tert-Butyl Ether	0.220	24	1	0.252	0.000	0.000	0.010	0.221
Methylene Chloride	0.799	24	24	11544.0	4472.0	1442.0	806.0	806.0
n-Butyraldehyde	0.014	21	18	0.509	0.412	0.400	0.153	0.155
n-Octane	0.280	24	14	2.239	1.129	1.026	0.344	0.461
o-Tolualdehyde	0.035	21	0	0.000	0.000	0.000	0.000	0.035
o-xylene	0.187	24	24	2.254	1.344	1.257	0.803	0.803
Propionaldehyde	0.041	21	13	0.759	0.474	0.460	0.211	0.227
Propylene	0.086	24	24	3.140	1.750	1.421	0.944	0.944
Styrene	0.230	24	15	0.553	0.298	0.255	0.120	0.206
Tert-Amyl Methyl Ether	0.502	24	0	0.000	0.000	0.000	0.000	0.502
Tetrachloroethene	0.482	24	14	2.152	1.618	1.083	0.406	0.607
Toluene	0.264	24	24	11.470	10.680	6.850	3.977	3.977
trans-1,2-Dichloroethene	0.238	24	1	0.396	0.000	0.000	0.016	0.245
trans-1,3-Dichloropropene	0.281	24	0	0.000	0.000	0.000	0.000	0.281
Trichloroethene	0.204	24	2	0.483	0.268	0.000	0.031	0.218
Trichlorofluoromethane	0.270	24	24	3.869	2.803	2.579	1.917	1.917
Trichlorotrifluoroethane	0.536	24	24	1.224	1.147	1.078	0.820	0.820
Valeraldehyde	0.042	21	4	0.190	0.141	0.081	0.023	0.057
Vinyl Chloride	0.500	24	0	0.000	0.000	0.000	0.000	0.500

Dearborn				Units: mg/m³		AIRS ID: 261630033		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic (TSP)	0.016	45	45	0.010	0.008	0.006	0.003	0.003
Beryllium (TSP)	0.010	45	40	0.000	0.000	0.000	0.000	0.001
Cadmium (TSP)	0.024	45	45	0.002	0.001	0.001	0.001	0.001
Chromium (TSP)	0.014	45	44	0.015	0.010	0.010	0.006	0.006
Lead (TSP)	0.010	45	45	0.076	0.060	0.048	0.023	0.023
Manganese (TSP)	0.010	45	45	1.190	0.536	0.433	0.187	0.187
Nickel (TSP)	0.010	45	45	3.162	0.010	0.008	0.074	0.074
1,1,1-Trichloroethane	0.262	304	211	0.926	0.817	0.708	0.161	0.228
1,1,2,2-Tetrachloroethane	0.556	304	0	0.000	0.000	0.000	0.000	0.556
1,1,2-Trichloroethane	0.262	304	0	0.000	0.000	0.000	0.000	0.262
1,1-Dichloroethane	0.360	304	0	0.000	0.000	0.000	0.000	0.360
1,1-Dichloroethene	0.182	304	1	0.506	0.000	0.000	0.002	0.183
1,2,4-Trichlorobenzene	0.200	303	0	0.000	0.000	0.000	0.000	0.200
1,2,4-Trimethylbenzene	0.088	303	294	1374.000	1227.000	5.050	9.716	6.499
1,2-Dibromoethane	0.415	304	0	0.000	0.000	0.000	0.000	0.415
1,2-Dichlorobenzene	1.200	303	1	0.510	0.000	0.000	0.002	1.196
1,2-Dichloroethane	0.348	304	0	0.000	0.000	0.000	0.000	0.348
1,2-Dichloroethene	0.341	72	0	0.000	0.000	0.000	0.000	0.341

Dearborn				Units: mg/m³		AIRS ID: 261630033		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,2-Dichloropropane	0.273	304	0	0.000	0.000	0.000	0.000	0.273
1,3,5-Trimethylbenzene	1.000	303	255	4121.0	3777.0	4.415	26.420	16.701
1,3-Butadiene	0.089	304	192	0.640	0.614	0.574	0.106	0.138
1,3-Dichlorobenzene	1.200	303	57	0.840	0.780	0.720	0.047	0.985
1,4-Dichlorobenzene	1.200	71	7	0.660	0.558	0.504	0.048	1.120
2,2,4-Trimethylpentane	0.079	72	72	2.504	2.439	2.392	0.680	0.706
2,5-dimethylbenzaldehyde	0.056	80	1	0.273	0.000	0.000	0.003	0.060
2-Chloro-1,3-Butadiene	0.109	304	0	0.000	0.000	0.000	0.000	0.109
Acetaldehyde	0.025	80	76	12.090	9.150	6.110	1.885	1.997
Acetone	0.080	80	77	12.320	10.710	9.220	2.609	2.667
Acetonitrile	0.873	304	126	36.200	30.800	22.300	1.870	2.308
Acetylene	0.138	237	235	6.890	6.020	4.960	1.777	1.790
Acrylonitrile	0.847	304	2	0.152	0.130	0.000	0.001	0.841
Benzaldehyde	0.023	80	60	2.205	1.559	0.567	0.180	0.184
Benzene	0.224	304	304	7.940	6.920	6.280	2.041	2.067
Bromochloromethane	0.635	237	0	0.000	0.000	0.000	0.000	0.635
Bromodichloromethane	0.489	304	0	0.000	0.000	0.000	0.000	0.489
Bromoform	0.610	304	1	7.944	0.000	0.000	0.026	0.624
Bromomethane	0.155	304	10	0.355	0.271	0.233	0.006	0.156
Carbon Tetrachloride	0.239	304	303	1.067	1.004	0.942	0.638	0.643
Chlorobenzene	0.184	304	5	0.253	0.225	0.138	0.003	0.182
Chloroethane	0.106	304	15	1.659	0.816	0.737	0.018	0.118
Chloroform	0.332	304	37	0.318	0.292	0.292	0.021	0.307
Chloromethane	0.128	304	304	2.950	2.040	2.020	1.245	1.248
Chloromethyl Benzene	1.000	303	0	0.000	0.000	0.000	0.000	1.000
cis-1,2-Dichloroethene	0.226	304	0	0.000	0.000	0.000	0.000	0.226
cis-1,3-Dichloropropene	0.245	304	0	0.000	0.000	0.000	0.000	0.245
Crotonaldehyde	0.013	80	18	0.398	0.269	0.229	0.031	0.041
Dibromochloromethane	0.503	304	0	0.000	0.000	0.000	0.000	0.503
Dichlorodifluoromethane	0.237	304	304	5.330	4.639	4.639	3.117	3.139
Dichlorotetrafluoroethane	0.350	237	32	0.209	0.140	0.140	0.012	0.313
Ethyl Acrylate	0.655	237	0	0.000	0.000	0.000	0.000	0.655
Ethyl Tert-Butyl Ether	0.627	237	0	0.000	0.000	0.000	0.000	0.627
Ethylbenzene	0.360	304	282	8.190	2.817	2.804	0.831	0.866
Formaldehyde	0.027	80	77	10.710	9.650	9.460	2.941	3.037
Halocarbon 113	0.261	72	71	1.361	1.101	1.040	0.759	0.767
Halocarbon 114	0.294	72	0	0.000	0.000	0.000	0.000	0.294
Hexachloro-1,3-Butadiene	0.330	303	0	0.000	0.000	0.000	0.000	0.330
Hexanaldehyde	0.042	80	63	4.870	2.654	1.955	0.357	0.389
Isovaleraldehyde	0.027	80	44	1.846	1.055	1.027	0.209	0.218
m,p-Tolualdehyde	0.042	80	32	0.790	0.770	0.760	0.091	0.119
m/p -Xylene	0.869	304	287	26.350	8.490	8.190	2.406	2.501
Methyl Ethyl Ketone	5.014	304	207	8.600	7.570	7.040	1.707	2.969
Methyl Isobutyl Ketone	3.442	304	34	3.026	2.977	2.658	0.162	3.180
Methyl Methacrylate	0.737	237	0	0.000	0.000	0.000	0.000	0.737
Methyl Tert-Butyl Ether	0.220	304	59	2.123	1.943	1.727	0.131	0.300
Methylene Chloride	0.799	304	286	690.0	213.9	212.8	7.566	7.390
n-Butyraldehyde	0.014	80	74	3.740	2.735	1.725	0.351	0.377
n-Hexane	1.762	72	19	11.680	5.630	4.080	0.901	2.268
n-Octane	0.280	237	154	1.446	1.306	1.166	0.258	0.347

Dearborn				Units: mg/m³		AIRS ID: 261630033		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
o-Tolualdehyde	0.035	80	0	0.000	0.000	0.000	0.000	0.035
o-xylene	0.187	304	299	10.830	3.900	3.705	1.001	1.028
Propionaldehyde	0.041	80	60	2.510	2.314	1.921	0.454	0.493
Propylene	0.086	237	237	24.200	19.800	19.600	2.352	2.312
Styrene	0.230	304	140	0.723	0.638	0.595	0.097	0.210
Tert-Amyl Methyl Ether	0.502	237	0	0.000	0.000	0.000	0.000	0.502
Tetrachloroethene	0.482	304	168	4.264	3.790	2.321	0.346	0.559
Toluene	0.264	304	304	50.400	32.720	24.180	4.682	4.803
trans-1,2-Dichloroethene	0.238	237	1	0.356	0.000	0.000	0.002	0.239
trans-1,3-Dichloropropene	0.281	304	0	0.000	0.000	0.000	0.000	0.281
Trichloroethene	0.204	304	27	81.500	6.810	3.915	0.329	0.587
Trichlorofluoromethane	0.270	304	303	5.770	4.766	4.485	1.799	1.824
Trichlorotrifluoroethane	0.536	237	237	1.453	1.453	1.377	0.840	0.842
Valeraldehyde	0.042	80	33	1.825	1.206	0.798	0.145	0.177
Vinyl Chloride	0.500	304	0	0.000	0.000	0.000	0.000	0.500

Detroit - E. Seven Mile Rd.				Units: mg/m³		AIRS ID: 261630019		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Arsenic (TSP)	0.016	46	45	0.007	0.006	0.005	0.002	0.002
Beryllium (TSP)	0.010	46	12	0.000	0.000	0.000	0.000	0.007
Cadmium (TSP)	0.024	46	46	0.001	0.001	0.001	0.000	0.000
Chromium (TSP)	0.014	46	46	0.007	0.006	0.004	0.003	0.003
Lead (TSP)	0.010	46	46	0.035	0.030	0.023	0.012	0.012
Manganese (TSP)	0.010	46	46	0.081	0.067	0.054	0.026	0.026
Nickel (TSP)	0.010	46	46	0.011	0.007	0.005	0.003	0.003
2,5-dimethylbenzaldehyde	0.056	43	1	0.273	0.000	0.000	0.006	0.061
Acetaldehyde	0.025	43	43	3.400	3.220	3.130	2.019	2.019
Acetone	0.080	43	43	5.850	5.020	4.980	3.043	3.043
Benzaldehyde	0.023	43	33	0.477	0.420	0.347	0.114	0.119
Crotonaldehyde	0.013	43	7	0.257	0.200	0.143	0.025	0.036
Formaldehyde	0.027	43	43	5.340	4.990	4.890	3.074	3.074
Hexanaldehyde	0.042	43	37	1.247	0.720	0.617	0.240	0.246
Isovaleraldehyde	0.027	43	19	0.246	0.176	0.176	0.051	0.066
m,p-Tolualdehyde	0.042	43	19	0.780	0.343	0.299	0.081	0.104
n-Butyraldehyde	0.014	43	43	0.609	0.598	0.489	0.252	0.252
o-Tolualdehyde	0.035	43	0	0.000	0.000	0.000	0.000	0.035
Propionaldehyde	0.041	43	32	0.787	0.664	0.664	0.312	0.322
Valeraldehyde	0.042	43	18	0.450	0.390	0.281	0.077	0.101

Detroit - W. Fort				Units: mg/m³		AIRS ID: 261630015		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Aluminum (TSP)		5	0	0.000	0.000	0.000	0.000	
Arsenic (TSP)	0.016	49	44	0.009	0.005	0.004	0.002	0.003
Barium (TSP)	0.001	5	5	0.040	0.040	0.040	0.040	0.040
Beryllium (TSP)	0.010	49	40	0.000	0.000	0.000	0.000	0.002
Cadmium (TSP)	0.024	49	45	0.029	0.002	0.002	0.001	0.002
Chromium (TSP)	0.014	49	47	0.041	0.013	0.009	0.006	0.007
Cobalt (TSP)	0.003	5	0	0.000	0.000	0.000	0.000	0.002
Copper (TSP)	0.010	5	5	0.309	0.190	0.060	0.129	0.129

Detroit - W. Fort				Units: mg/m^3		AIRS ID: 261630015		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Iron (TSP)	0.003	5	5	0.640	0.500	0.300	0.390	0.390
Lead (TSP)	0.010	49	49	0.070	0.056	0.049	0.024	0.023
Manganese (TSP)	0.010	49	49	0.189	0.183	0.166	0.093	0.095
Molybdenum (TSP)	0.003	5	0	0.000	0.000	0.000	0.000	0.003
Nickel (TSP)	0.010	49	44	0.037	0.012	0.011	0.004	0.005
Vanadium (TSP)	0.001	5	0	0.000	0.000	0.000	0.000	0.001
Zinc (TSP)	0.001	5	5	0.600	0.240	0.067	0.195	0.195
1,1,1-Trichloroethane	0.262	18	4	0.468	0.312	0.299	0.075	0.279
1,1,2,2-Tetrachloroethane	0.556	18	0	0.000	0.000	0.000	0.000	0.556
1,1,2-Trichloroethane	0.262	18	0	0.000	0.000	0.000	0.000	0.262
1,1-Dichloroethane	0.360	18	0	0.000	0.000	0.000	0.000	0.360
1,1-Dichloroethene	0.182	18	0	0.000	0.000	0.000	0.000	0.182
1,2,4-Trichlorobenzene	0.200	18	0	0.000	0.000	0.000	0.000	0.200
1,2,4-Trimethylbenzene	0.088	18	18	4.269	2.846	2.404	1.223	1.223
1,2-Dibromoethane	0.415	18	0	0.000	0.000	0.000	0.000	0.415
1,2-Dichlorobenzene	1.200	18	0	0.000	0.000	0.000	0.000	1.200
1,2-Dichloroethane	0.348	18	0	0.000	0.000	0.000	0.000	0.348
1,2-Dichloroethene	0.341	18	0	0.000	0.000	0.000	0.000	0.341
1,2-Dichloropropane	0.273	18	0	0.000	0.000	0.000	0.000	0.273
1,3,5-Trimethylbenzene	1.000	18	7	1.226	0.785	0.687	0.251	0.862
1,3-Butadiene	0.089	18	0	0.000	0.000	0.000	0.000	0.089
1,3-Dichlorobenzene	1.200	18	0	0.000	0.000	0.000	0.000	1.200
1,4-Dichlorobenzene	1.200	18	8	82.800	1.020	0.840	4.819	5.486
2,2,4-Trimethylpentane	0.079	18	18	2.486	2.215	1.740	0.745	0.745
2,5-dimethylbenzaldehyde	0.056	20	0	0.000	0.000	0.000	0.000	0.056
2-Chloro-1,3-Butadiene	0.109	18	0	0.000	0.000	0.000	0.000	0.109
Acetaldehyde	0.025	20	20	4.080	3.540	3.420	2.120	2.120
Acetone	0.080	20	20	5.900	3.270	3.060	2.149	2.149
Acetonitrile	0.873	18	1	1.111	0.000	0.000	0.062	0.886
Acrylonitrile	0.847	18	9	2.045	1.614	1.525	0.657	1.080
Benzaldehyde	0.023	20	17	0.451	0.269	0.217	0.109	0.112
Benzene	0.224	18	18	5.800	4.240	3.540	2.234	2.234
Bromodichloromethane	0.489	18	0	0.000	0.000	0.000	0.000	0.489
Bromoform	0.610	18	0	0.000	0.000	0.000	0.000	0.610
Bromomethane	0.155	18	0	0.000	0.000	0.000	0.000	0.155
Carbon Tetrachloride	0.239	18	17	0.891	0.659	0.647	0.536	0.550
Chlorobenzene	0.184	18	0	0.000	0.000	0.000	0.000	0.184
Chloroethane	0.106	18	0	0.000	0.000	0.000	0.000	0.106
Chloroform	0.332	18	2	0.404	0.343	0.000	0.042	0.337
Chloromethane	0.128	18	18	2.580	1.906	1.797	1.269	1.269
Chloromethyl Benzene	1.000	18	0	0.000	0.000	0.000	0.000	1.000
cis-1,2-Dichloroethene	0.226	18	0	0.000	0.000	0.000	0.000	0.226
cis-1,3-Dichloropropene	0.245	18	0	0.000	0.000	0.000	0.000	0.245
Crotonaldehyde	0.013	20	7	0.601	0.200	0.189	0.067	0.076
Dibromochloromethane	0.503	18	0	0.000	0.000	0.000	0.000	0.503
Dichlorodifluoromethane	0.237	18	17	4.160	3.262	3.228	2.588	2.601
Ethylbenzene	0.360	18	14	1.777	1.656	1.409	0.659	0.739
Formaldehyde	0.027	20	20	8.790	7.560	6.810	4.075	4.075
Halocarbon 113	0.222	18	14	4.933	2.570	2.340	1.351	1.401
Halocarbon 114	0.294	18	0	0.000	0.000	0.000	0.000	0.294

Detroit - W. Fort				Units: mg/m³		AIRS ID: 261630015		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Hexachloro-1,3-Butadiene	0.330	18	0	0.000	0.000	0.000	0.000	0.330
Hexanaldehyde	0.042	20	20	0.527	0.478	0.368	0.197	0.197
Isovaleraldehyde	0.027	20	12	0.320	0.176	0.141	0.069	0.080
m,p-Tolualdehyde	0.042	20	9	0.716	0.343	0.319	0.102	0.125
m/p -Xylene	0.869	18	17	5.030	3.883	3.814	1.943	1.991
Methyl Ethyl Ketone	5.014	18	2	8.770	5.060	0.000	0.768	5.226
Methyl Isobutyl Ketone	3.442	18	0	0.000	0.000	0.000	0.000	3.442
Methyl Tert-Butyl Ether	0.220	18	2	0.623	0.453	0.000	0.060	0.255
Methylene Chloride	0.799	18	12	14.320	9.220	3.158	2.254	2.521
n-Butyraldehyde	0.014	20	20	0.818	0.677	0.609	0.332	0.332
n-Hexane	1.762	18	10	9.850	7.880	7.560	3.212	3.995
o-Tolualdehyde	0.035	20	0	0.000	0.000	0.000	0.000	0.035
o-xylene	0.187	18	18	2.553	1.877	1.686	0.944	0.944
Propionaldehyde	0.041	20	20	3.130	2.295	1.027	0.679	0.679
Styrene	0.230	18	8	0.638	0.376	0.318	0.146	0.273
Tetrachloroethene	0.482	18	2	1.299	0.568	0.000	0.104	0.532
Toluene	0.264	18	18	15.010	14.820	10.420	5.743	5.743
trans-1,3-Dichloropropene	0.281	18	1	3.134	0.000	0.000	0.174	0.440
Trichloroethene	0.204	18	1	0.500	0.000	0.000	0.028	0.221
Trichlorofluoromethane	0.270	18	17	10.430	5.091	4.917	3.176	3.191
Valeraldehyde	0.042	20	19	0.489	0.359	0.352	0.211	0.213
Vinyl Chloride	0.500	18	0	0.000	0.000	0.000	0.000	0.500

Detroit - W. Jefferson				Units: mg/m³		AIRS ID: 261630027		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic (TSP)	0.016	41	38	0.010	0.005	0.005	0.002	0.004
Beryllium (TSP)	0.010	41	39	0.002	0.002	0.001	0.000	0.001
Cadmium (TSP)	0.024	41	41	0.002	0.002	0.002	0.001	0.001
Chromium (TSP)	0.014	41	41	0.022	0.015	0.013	0.008	0.008
Lead (TSP)	0.010	41	41	0.079	0.072	0.063	0.030	0.030
Manganese (TSP)	0.010	41	41	1.937	1.007	0.803	0.315	0.315
Nickel (TSP)	0.010	41	41	0.023	0.016	0.014	0.006	0.006
1,1,1-Trichloroethane	0.262	39	34	0.599	0.327	0.327	0.209	0.243
1,1,2,2-Tetrachloroethane	0.556	39	0	0.000	0.000	0.000	0.000	0.556
1,1,2-Trichloroethane	0.262	39	0	0.000	0.000	0.000	0.000	0.262
1,1-Dichloroethane	0.360	39	0	0.000	0.000	0.000	0.000	0.360
1,1-Dichloroethene	0.182	39	0	0.000	0.000	0.000	0.000	0.182
1,2,4-Trichlorobenzene	0.200	39	0	0.000	0.000	0.000	0.000	0.200
1,2,4-Trimethylbenzene	0.088	39	39	5.000	3.336	2.914	1.478	1.478
1,2-Dibromoethane	0.415	39	0	0.000	0.000	0.000	0.000	0.415
1,2-Dichlorobenzene	1.200	39	0	0.000	0.000	0.000	0.000	1.200
1,2-Dichloroethane	0.348	39	0	0.000	0.000	0.000	0.000	0.348
1,2-Dichloropropane	0.273	39	0	0.000	0.000	0.000	0.000	0.273
1,3,5-Trimethylbenzene	1.000	39	39	1.957	1.756	1.619	0.617	0.617
1,3-Butadiene	0.089	39	34	0.709	0.662	0.552	0.202	0.213
1,3-Dichlorobenzene	1.200	39	10	2.520	0.420	0.420	0.112	1.005
2,5-dimethylbenzaldehyde	0.056	2	0	0.000	0.000		0.000	0.056
2-Chloro-1,3-Butadiene	0.109	39	0	0.000	0.000	0.000	0.000	0.109
Acetaldehyde	0.025	2	2	1.336	1.128		1.232	1.232
Acetone	0.080	2	2	3.460	2.092		2.776	2.776

Detroit - W. Jefferson				Units: mg/m³		AIRS ID: 261630027		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Acetonitrile	0.873	39	1	0.821	0.000	0.000	0.021	0.872
Acetylene	0.138	39	38	5.880	4.910	4.440	2.115	2.119
Acrylonitrile	0.847	39	0	0.000	0.000	0.000	0.000	0.847
Benzaldehyde	0.023	2	1	0.169	0.000		0.084	0.096
Benzene	0.224	39	39	146.4	126.3	79.4	21.1	21.1
Bromochloromethane	0.635	39	0	0.000	0.000	0.000	0.000	0.635
Bromodichloromethane	0.489	39	0	0.000	0.000	0.000	0.000	0.489
Bromoform	0.610	39	0	0.000	0.000	0.000	0.000	0.610
Bromomethane	0.155	39	0	0.000	0.000	0.000	0.000	0.155
Carbon Tetrachloride	0.239	39	38	0.879	0.816	0.816	0.626	0.632
Chlorobenzene	0.184	39	0	0.000	0.000	0.000	0.000	0.184
Chloroethane	0.106	39	0	0.000	0.000	0.000	0.000	0.106
Chloroform	0.332	39	9	0.292	0.244	0.195	0.042	0.298
Chloromethane	0.128	39	38	1.937	1.566	1.546	1.211	1.215
Chloromethyl Benzene	1.000	39	0	0.000	0.000	0.000	0.000	1.000
cis-1,2-Dichloroethene	0.226	39	0	0.000	0.000	0.000	0.000	0.226
cis-1,3-Dichloropropene	0.245	39	0	0.000	0.000	0.000	0.000	0.245
Crotonaldehyde	0.013	2	1	0.120	0.000		0.060	0.067
Dibromochloromethane	0.503	39	0	0.000	0.000	0.000	0.000	0.503
Dichlorodifluoromethane	0.237	39	38	6.610	5.380	4.442	3.300	3.306
Dichlorotetrafluoroethane	0.350	39	6	0.140	0.140	0.070	0.014	0.310
Ethyl Acrylate	0.655	39	0	0.000	0.000	0.000	0.000	0.655
Ethyl Tert-Butyl Ether	0.627	39	0	0.000	0.000	0.000	0.000	0.627
Ethylbenzene	0.360	39	39	11.350	6.410	4.680	1.886	1.886
Formaldehyde	0.027	2	2	2.810	1.730		2.270	2.270
Hexachloro-1,3-Butadiene	0.330	39	0	0.000	0.000	0.000	0.000	0.330
Hexanaldehyde	0.042	2	1	0.188	0.000		0.094	0.115
Isovaleraldehyde	0.027	2	1	0.070	0.000		0.035	0.049
m,p-Tolualdehyde	0.042	2	1	0.172	0.000		0.086	0.107
m/p -Xylene	0.869	39	39	19.890	13.220	11.920	4.507	4.507
Methyl Ethyl Ketone	5.014	39	34	7.300	5.030	4.390	2.225	2.868
Methyl Isobutyl Ketone	3.442	39	1	0.859	0.000	0.000	0.022	3.376
Methyl Methacrylate	0.737	39	0	0.000	0.000	0.000	0.000	0.737
Methyl Tert-Butyl Ether	0.220	39	4	0.867	0.612	0.576	0.059	0.257
Methylene Chloride	0.799	39	37	58.600	4.470	3.640	2.541	2.582
n-Butyraldehyde	0.014	2	2	0.130	0.071		0.100	0.100
n-Octane	0.280	38	28	1.469	0.979	0.718	0.277	0.350
o-Tolualdehyde	0.035	2	0	0.000	0.000		0.000	0.035
o-xylene	0.187	39	39	5.720	4.590	4.510	1.665	1.665
Propionaldehyde	0.041	2	1	0.258	0.000		0.129	0.149
Propylene	0.086	39	38	6.890	5.910	5.190	1.868	1.870
Styrene	0.230	39	25	0.978	0.935	0.893	0.277	0.360
Tert-Amyl Methyl Ether	0.502	39	0	0.000	0.000	0.000	0.000	0.502
Tetrachloroethene	0.482	39	17	2.301	0.880	0.880	0.212	0.484
Toluene	0.264	39	39	56.400	42.100	27.610	11.410	11.410
trans-1,2-Dichloroethene	0.238	39	0	0.000	0.000	0.000	0.000	0.238
trans-1,3-Dichloropropene	0.281	39	0	0.000	0.000	0.000	0.000	0.281
Trichloroethene	0.204	39	6	1.501	1.142	1.083	0.149	0.322
Trichlorofluoromethane	0.270	39	39	18.000	5.231	3.028	2.458	2.458
Trichlorotrifluoroethane	0.536	39	38	7.650	1.300	1.147	1.004	1.018

Detroit - W. Jefferson				Units: mg/m^3		AIRS ID: 261630027		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Valeraldehyde	0.042	2	0	0.000	0.000		0.000	0.042
Vinyl Chloride	0.500	39	0	0.000	0.000	0.000	0.000	0.500

Flint, Whaley Park				Units: mg/m^3		AIRS ID: 260490021		
``Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Aluminum (TSP)		57	0	0.000	0.000	0.000	0.000	
Arsenic (TSP)	3.000	57	9	0.007	0.007	0.006	0.001	2.527
Barium (TSP)	0.001	57	57	0.088	0.086	0.086	0.064	0.064
Beryllium (TSP)	0.000	57	0	0.000	0.000	0.000	0.000	0.000
Cadmium (TSP)	0.001	57	0	0.000	0.000	0.000	0.000	0.001
Chromium (TSP)	0.005	57	4	0.002	0.002	0.002	0.000	0.005
Cobalt (TSP)	0.003	57	1	0.001	0.000	0.000	0.000	0.002
Copper (TSP)	0.001	57	57	0.186	0.168	0.155	0.076	0.076
Iron (TSP)	0.003	57	57	1.200	1.100	0.900	0.395	0.395
Lead (TSP)	0.003	57	54	0.031	0.028	0.025	0.010	0.010
Manganese (TSP)	0.001	57	57	0.051	0.039	0.037	0.014	0.014
Molybdenum (TSP)	0.003	57	12	0.007	0.005	0.005	0.001	0.003
Nickel (TSP)	0.005	57	6	0.006	0.004	0.003	0.000	0.005
Vanadium (TSP)	0.001	57	0	0.000	0.000	0.000	0.000	0.001
Zinc (TSP)	0.001	57	57	0.080	0.068	0.063	0.037	0.037

Grand Rapids				Units: mg/m^3		AIRS ID: 260810021		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Aluminum (TSP)		62	0	0.000	0.000	0.000	0.000	
Arsenic (TSP)	3.000	62	12	0.007	0.006	0.005	0.001	2.130
Barium (TSP)	0.001	62	62	0.127	0.100	0.090	0.068	0.068
Beryllium (TSP)	0.000	62	0	0.000	0.000	0.000	0.000	0.000
Cadmium (TSP)	0.001	62	0	0.000	0.000	0.000	0.000	0.001
Chromium (TSP)	0.005	62	33	0.015	0.014	0.009	0.003	0.005
Cobalt (TSP)	0.003	62	7	0.003	0.002	0.001	0.000	0.002
Copper (TSP)	0.001	62	62	0.338	0.263	0.247	0.146	0.146
Iron (TSP)	0.003	62	61	0.990	0.970	0.970	0.529	0.529
Lead (TSP)	0.003	62	62	0.020	0.020	0.019	0.011	0.011
Manganese (TSP)	0.001	62	62	0.084	0.076	0.063	0.030	0.030
Molybdenum (TSP)	0.003	62	16	0.007	0.007	0.005	0.001	0.003
Nickel (TSP)	0.005	62	34	0.060	0.054	0.017	0.005	0.007
Vanadium (TSP)	0.001	62	0	0.000	0.000	0.000	0.000	0.001
Zinc (TSP)	0.001	62	62	0.161	0.145	0.136	0.070	0.070
1,1,1-Trichloroethane	1.100	29	1	0.376	0.000	0.000	0.013	1.075
1,1,2,2-Tetrachloroethane	1.400	29	0	0.000	0.000	0.000	0.000	1.400
1,1,2-Trichloroethane	1.100	29	0	0.000	0.000	0.000	0.000	1.100
1,1-Dichloroethane	0.800	29	0	0.000	0.000	0.000	0.000	0.800
1,1-Dichloroethene	0.800	29	0	0.000	0.000	0.000	0.000	0.800
1,2,4-Trichlorobenzene	1.500	29	0	0.000	0.000	0.000	0.000	1.500
1,2,4-Trimethylbenzene	1.000	29	15	4.170	3.090	2.940	1.118	1.601
1,2-Dibromoethane	0.253	29	0	0.000	0.000	0.000	0.000	0.253
1,2-Dichlorobenzene	1.200	29	0	0.000	0.000	0.000	0.000	1.200
1,2-Dichloroethane	0.800	29	0	0.000	0.000	0.000	0.000	0.800
1,2-Dichloroethene	0.800	29	0	0.000	0.000	0.000	0.000	0.800

Grand Rapids				Units: mg/m³		AIRS ID: 260810021		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,2-Dichloropropane	0.900	29	0	0.000	0.000	0.000	0.000	0.900
1,3,5-Trimethylbenzene	1.000	29	4	0.830	0.490	0.407	0.073	0.935
1,3-Butadiene	0.400	28	3	1.610	1.410	1.060	0.146	0.503
1,3-Dichlorobenzene	1.200	29	0	0.000	0.000	0.000	0.000	1.200
1,4-Dichlorobenzene	1.200	29	1	0.348	0.000	0.000	0.012	1.171
2,2,4-Trimethylpentane	0.079	28	8	3.220	1.770	1.630	0.374	0.431
2,5-dimethylbenzaldehyde	0.300	31	0	0.000	0.000	0.000	0.000	0.300
2-Chloro-1,3-Butadiene	0.109	28	0	0.000	0.000	0.000	0.000	0.109
Acetaldehyde	0.300	31	31	4.485	3.131	2.930	1.896	1.896
Acetone	0.300	31	31	13.501	11.590	8.010	4.217	4.217
Acetonitrile	0.873	28	1	0.870	0.000	0.000	0.031	0.873
Acrylonitrile	0.847	28	0	0.000	0.000	0.000	0.000	0.847
Benzaldehyde	0.300	31	2	0.589	0.567	0.000	0.037	0.318
Benzene	0.600	29	25	3.510	2.870	2.840	1.353	1.436
Bromodichloromethane	0.489	28	0	0.000	0.000	0.000	0.000	0.489
Bromoform	0.610	28	0	0.000	0.000	0.000	0.000	0.610
Bromomethane	0.800	29	1	1.108	0.000	0.000	0.038	0.811
Carbon Tetrachloride	1.300	29	5	0.630	0.570	0.559	0.094	1.169
Chlorobenzene	0.900	29	0	0.000	0.000	0.000	0.000	0.900
Chloroethane	1.300	29	1	0.179	0.000	0.000	0.006	1.261
Chloroform	1.000	29	0	0.000	0.000	0.000	0.000	1.000
Chloromethane	1.000	29	29	1.482	1.400	1.380	1.220	1.220
Chloromethyl Benzene	18.560	28	0	0.000	0.000	0.000	0.000	18.560
cis-1,2-Dichloroethene	0.226	28	0	0.000	0.000	0.000	0.000	0.226
cis-1,3-Dichloropropene	0.900	29	0	0.000	0.000	0.000	0.000	0.900
Crotonaldehyde	0.300	31	2	1.408	0.352	0.000	0.057	0.337
Dibromochloromethane	0.503	28	0	0.000	0.000	0.000	0.000	0.503
Dichlorodifluoromethane	1.000	29	29	3.600	3.360	3.297	2.895	2.895
Ethylbenzene	0.900	29	12	2.560	1.910	1.910	0.680	1.207
Formaldehyde	0.300	31	31	11.447	9.396	9.319	4.879	4.879
Halocarbon 113	1.500	29	5	0.956	0.840	0.840	0.135	1.377
Halocarbon 114	0.133	29	0	0.000	0.000	0.000	0.000	0.133
Hexachloro-1,3-Butadiene	2.100	29	0	0.000	0.000	0.000	0.000	2.100
Hexanaldehyde	0.300	31	7	1.140	0.634	0.540	0.129	0.362
Isovaleraldehyde	0.300	31	0	0.000	0.000	0.000	0.000	0.300
m,p-Tolualdehyde	0.300	31	1	0.741	0.000	0.000	0.024	0.314
m/p -Xylene	0.900	29	23	6.500	4.770	4.520	2.201	2.387
Methyl Ethyl Ketone	5.014	28	0	0.000	0.000	0.000	0.000	5.014
Methyl Isobutyl Ketone	3.442	28	0	0.000	0.000	0.000	0.000	3.442
Methyl Tert-Butyl Ether	0.220	28	0	0.000	0.000	0.000	0.000	0.220
Methylene Chloride	0.700	29	20	5.200	4.160	4.160	1.330	1.547
n-Butyraldehyde	0.300	31	11	1.680	0.790	0.774	0.211	0.405
n-Hexane	1.762	28	1	3.060	0.000	0.000	0.109	1.809
o-Tolualdehyde	0.300	31	0	0.000	0.000	0.000	0.000	0.300
o-xylene	0.900	29	10	2.170	2.170	2.120	0.525	1.114
Propionaldehyde	0.300	31	16	1.167	1.036	0.600	0.274	0.419
Styrene	0.900	29	2	0.980	0.600	0.000	0.054	0.892
Tetrachloroethene	1.400	29	0	0.000	0.000	0.000	0.000	1.400
Toluene	0.800	29	29	13.540	11.660	11.280	4.755	4.755
trans-1,3-Dichloropropene	0.900	29	0	0.000	0.000	0.000	0.000	0.900

Grand Rapids				Units: mg/m³		AIRS ID: 260810021		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Trichloroethene	1.100	29	0	0.000	0.000	0.000	0.000	1.100
Trichlorofluoromethane	0.118	29	6	1.721	1.570	1.510	0.307	0.400
Valeraldehyde	0.300	31	2	0.661	0.450	0.000	0.036	0.316
Vinyl Chloride	1.300	29	0	0.000	0.000	0.000	0.000	1.300

Houghton Lake				Units: mg/m³		AIRS ID: 261130001		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Aluminum (TSP)		30	0	0.000	0.000	0.000	0.000	
Arsenic (TSP)	0.016	30	0	0.000	0.000	0.000	0.000	0.016
Barium (TSP)	0.001	30	30	0.075	0.072	0.067	0.053	0.053
Beryllium (TSP)	0.010	30	0	0.000	0.000	0.000	0.000	0.010
Cadmium (TSP)	0.024	30	0	0.000	0.000	0.000	0.000	0.024
Chromium (TSP)	0.014	30	0	0.000	0.000	0.000	0.000	0.014
Cobalt (TSP)	0.003	30	0	0.000	0.000	0.000	0.000	0.002
Copper (TSP)	0.010	30	30	0.080	0.078	0.078	0.049	0.049
Iron (TSP)	0.003	30	30	0.550	0.320	0.310	0.103	0.103
Lead (TSP)	0.010	30	19	0.016	0.013	0.009	0.004	0.007
Manganese (TSP)	0.010	30	30	0.030	0.016	0.015	0.006	0.006
Molybdenum (TSP)	0.003	30	0	0.000	0.000	0.000	0.000	0.003
Nickel (TSP)	0.010	30	0	0.000	0.000	0.000	0.000	0.010
Vanadium (TSP)	0.001	30	0	0.000	0.000	0.000	0.000	0.001
Zinc (TSP)	0.001	30	30	0.030	0.030	0.027	0.017	0.017
1,1,1-Trichloroethane	0.262	26	0	0.000	0.000	0.000	0.000	0.262
1,1,2,2-Tetrachloroethane	0.556	26	0	0.000	0.000	0.000	0.000	0.556
1,1,2-Trichloroethane	0.262	26	0	0.000	0.000	0.000	0.000	0.262
1,1-Dichloroethane	0.360	26	0	0.000	0.000	0.000	0.000	0.360
1,1-Dichloroethene	0.182	26	0	0.000	0.000	0.000	0.000	0.182
1,2,4-Trichlorobenzene	0.200	26	0	0.000	0.000	0.000	0.000	0.200
1,2,4-Trimethylbenzene	0.088	26	0	0.000	0.000	0.000	0.000	0.088
1,2-Dibromoethane	0.415	26	0	0.000	0.000	0.000	0.000	0.415
1,2-Dichlorobenzene	1.200	26	0	0.000	0.000	0.000	0.000	1.200
1,2-Dichloroethane	0.348	26	0	0.000	0.000	0.000	0.000	0.348
1,2-Dichloroethene	0.341	26	0	0.000	0.000	0.000	0.000	0.341
1,2-Dichloropropane	0.273	26	0	0.000	0.000	0.000	0.000	0.273
1,3,5-Trimethylbenzene	1.000	26	0	0.000	0.000	0.000	0.000	1.000
1,3-Butadiene	0.089	26	0	0.000	0.000	0.000	0.000	0.089
1,3-Dichlorobenzene	1.200	26	0	0.000	0.000	0.000	0.000	1.200
1,4-Dichlorobenzene	1.200	26	5	1.500	1.140	0.780	0.165	1.134
2,2,4-Trimethylpentane	0.079	26	8	0.560	0.510	0.154	0.068	0.123
2,5-dimethylbenzaldehyde	0.056	30	0	0.000	0.000	0.000	0.000	0.056
2-Chloro-1,3-Butadiene	0.109	26	0	0.000	0.000	0.000	0.000	0.109
Acetaldehyde	0.025	30	29	2.852	2.543	1.780	1.035	1.036
Acetone	0.080	30	30	21.320	3.390	3.030	2.257	2.257
Acetonitrile	0.873	26	0	0.000	0.000	0.000	0.000	0.873
Acrylonitrile	0.847	26	0	0.000	0.000	0.000	0.000	0.847
Benzaldehyde	0.023	30	7	0.351	0.300	0.220	0.046	0.063
Benzene	0.224	26	14	0.540	0.510	0.510	0.202	0.306
Bromodichloromethane	0.489	26	0	0.000	0.000	0.000	0.000	0.489
Bromoform	0.610	26	0	0.000	0.000	0.000	0.000	0.610
Bromomethane	0.155	26	0	0.000	0.000	0.000	0.000	0.155

Houghton Lake				Units: mg/m^3		AIRS ID: 261130001		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Carbon Tetrachloride	0.239	26	19	0.690	0.690	0.630	0.421	0.486
Chlorobenzene	0.184	26	0	0.000	0.000	0.000	0.000	0.184
Chloroethane	0.106	26	4	0.253	0.213	0.129	0.028	0.117
Chloroform	0.332	26	19	4.430	2.870	2.580	1.000	1.089
Chloromethane	0.128	26	26	1.850	1.690	1.480	1.236	1.236
Chloromethyl Benzene	1.000	26	0	0.000	0.000	0.000	0.000	1.000
cis-1,2-Dichloroethene	0.226	26	0	0.000	0.000	0.000	0.000	0.226
cis-1,3-Dichloropropene	0.245	26	0	0.000	0.000	0.000	0.000	0.245
Crotonaldehyde	0.013	30	3	0.370	0.230	0.209	0.027	0.039
Dibromochloromethane	0.503	26	0	0.000	0.000	0.000	0.000	0.503
Dichlorodifluoromethane	0.237	26	26	3.282	2.960	2.960	2.721	2.721
Ethylbenzene	0.360	26	0	0.000	0.000	0.000	0.000	0.360
Formaldehyde	0.027	29	29	7.57	6.98	4.93	2.499	3.030
Halocarbon 113	0.261	26	19	0.920	0.902	0.840	0.556	0.626
Halocarbon 114	0.294	26	0	0.000	0.000	0.000	0.000	0.294
Hexachloro-1,3-Butadiene	0.330	26	0	0.000	0.000	0.000	0.000	0.330
Hexanaldehyde	0.042	30	11	6.154	0.410	0.290	0.252	0.279
Isovaleraldehyde	0.027	30	5	0.331	0.110	0.110	0.023	0.046
m,p-Tolualdehyde	0.042	30	0	0.000	0.000	0.000	0.000	0.042
m/p -Xylene	0.869	26	0	0.000	0.000	0.000	0.000	0.869
Methyl Ethyl Ketone	5.014	26	0	0.000	0.000	0.000	0.000	5.014
Methyl Isobutyl Ketone	3.442	26	0	0.000	0.000	0.000	0.000	3.442
Methyl Tert-Butyl Ether	0.220	26	0	0.000	0.000	0.000	0.000	0.220
Methylene Chloride	0.799	26	0	0.000	0.000	0.000	0.000	0.799
n-Butyraldehyde	0.014	30	19	8.570	4.000	3.500	0.671	0.676
n-Hexane	1.762	26	0	0.000	0.000	0.000	0.000	1.762
o-Tolualdehyde	0.035	30	4	0.461	0.150	0.150	0.029	0.059
o-xylene	0.187	26	0	0.000	0.000	0.000	0.000	0.187
Propionaldehyde	0.041	30	8	1.985	1.660	0.728	0.206	0.236
Styrene	0.230	26	0	0.000	0.000	0.000	0.000	0.230
Tetrachloroethene	0.482	26	0	0.000	0.000	0.000	0.000	0.482
Toluene	0.264	26	16	0.790	0.600	0.600	0.289	0.391
trans-1,3-Dichloropropene	0.281	26	0	0.000	0.000	0.000	0.000	0.281
Trichloroethene	0.204	26	0	0.000	0.000	0.000	0.000	0.204
Trichlorofluoromethane	0.270	26	19	1.643	1.570	1.570	1.079	1.152
Valeraldehyde	0.042	30	5	1.027	0.689	0.140	0.069	0.104
Vinyl Chloride	0.500	26	0	0.000	0.000	0.000	0.000	0.500

River Rouge				Units: mg/m^3		AIRS ID: 261630005		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Aluminum (TSP)		5	0	0.000	0.000	0.000	0.000	
Arsenic (TSP)	0.016	48	43	0.013	0.007	0.004	0.002	0.004
Barium (TSP)	0.001	5	5	0.046	0.044	0.044	0.043	0.043
Beryllium (TSP)	0.010	48	13	0.000	0.000	0.000	0.000	0.007
Cadmium (TSP)	0.024	48	43	0.001	0.001	0.001	0.000	0.003
Chromium (TSP)	0.014	48	44	0.010	0.010	0.009	0.005	0.006
Cobalt (TSP)	0.003	5	0	0.000	0.000	0.000	0.000	0.002
Copper (TSP)	0.010	5	5	0.064	0.056	0.050	0.047	0.047
Iron (TSP)	0.003	5	5	0.420	0.360	0.349	0.300	0.300
Lead (TSP)	0.010	48	48	0.089	0.055	0.050	0.019	0.019

River Rouge				Units: mg/m³		AIRS ID: 261630005		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Manganese (TSP)	0.010	48	48	0.260	0.202	0.189	0.071	0.071
Molybdenum (TSP)	0.003	5	1	0.003	0.000	0.000	0.001	0.003
Nickel (TSP)	0.010	48	43	0.009	0.007	0.007	0.003	0.004
Vanadium (TSP)	0.001	5	0	0.000	0.000	0.000	0.000	0.001
Zinc (TSP)	0.001	5	5	0.107	0.090	0.046	0.063	0.063
1,1,1-Trichloroethane	0.262	41	21	1.143	0.327	0.327	0.147	0.275
1,1,2,2-Tetrachloroethane	0.556	41	0	0.000	0.000	0.000	0.000	0.556
1,1,2-Trichloroethane	0.262	41	0	0.000	0.000	0.000	0.000	0.262
1,1-Dichloroethane	0.360	41	0	0.000	0.000	0.000	0.000	0.360
1,1-Dichloroethene	0.182	41	0	0.000	0.000	0.000	0.000	0.182
1,2,4-Trichlorobenzene	0.200	41	0	0.000	0.000	0.000	0.000	0.200
1,2,4-Trimethylbenzene	0.088	41	39	3.444	2.944	2.551	1.042	1.046
1,2-Dibromoethane	0.415	41	0	0.000	0.000	0.000	0.000	0.415
1,2-Dichlorobenzene	1.200	41	1	0.720	0.000	0.000	0.018	1.188
1,2-Dichloroethane	0.348	41	0	0.000	0.000	0.000	0.000	0.348
1,2-Dichloroethene	0.341	20	0	0.000	0.000	0.000	0.000	0.341
1,2-Dichloropropane	0.273	41	0	0.000	0.000	0.000	0.000	0.273
1,3,5-Trimethylbenzene	1.000	41	24	1.123	0.932	0.834	0.255	0.669
1,3-Butadiene	0.089	41	15	0.596	0.548	0.464	0.080	0.136
1,3-Dichlorobenzene	1.200	41	6	0.720	0.180	0.120	0.032	1.057
1,4-Dichlorobenzene	1.200	20	3	0.780	0.588	0.402	0.089	1.109
2,2,4-Trimethylpentane	0.079	20	20	2.089	1.138	0.919	0.703	0.703
2,5-dimethylbenzaldehyde	0.056	20	0	0.000	0.000	0.000	0.000	0.056
2-Chloro-1,3-Butadiene	0.109	41	0	0.000	0.000	0.000	0.000	0.109
Acetaldehyde	0.025	20	20	3.850	3.610	3.450	2.132	2.132
Acetone	0.080	20	20	4.860	2.960	2.770	2.030	2.030
Acetonitrile	0.873	41	0	0.000	0.000	0.000	0.000	0.873
Acetylene	0.138	21	20	5.120	4.890	4.570	2.068	2.075
Acrylonitrile	0.847	41	1	0.159	0.000	0.000	0.004	0.830
Benzaldehyde	0.023	20	18	0.580	0.537	0.260	0.175	0.177
Benzene	0.224	41	40	6.540	5.170	4.850	2.255	2.261
Bromochloromethane	0.635	21	0	0.000	0.000	0.000	0.000	0.635
Bromodichloromethane	0.489	41	0	0.000	0.000	0.000	0.000	0.489
Bromoform	0.610	41	0	0.000	0.000	0.000	0.000	0.610
Bromomethane	0.155	41	1	0.116	0.000	0.000	0.003	0.154
Carbon Tetrachloride	0.239	41	40	0.753	0.741	0.709	0.575	0.581
Chlorobenzene	0.184	41	0	0.000	0.000	0.000	0.000	0.184
Chloroethane	0.106	41	0	0.000	0.000	0.000	0.000	0.106
Chloroform	0.332	41	1	0.097	0.000	0.000	0.002	0.326
Chloromethane	0.128	41	40	1.814	1.797	1.473	1.225	1.228
Chloromethyl Benzene	1.000	41	0	0.000	0.000	0.000	0.000	1.000
cis-1,2-Dichloroethene	0.226	41	0	0.000	0.000	0.000	0.000	0.226
cis-1,3-Dichloropropene	0.245	41	0	0.000	0.000	0.000	0.000	0.245
Crotonaldehyde	0.013	20	7	0.372	0.340	0.229	0.069	0.077
Dibromochloromethane	0.503	41	0	0.000	0.000	0.000	0.000	0.503
Dichlorodifluoromethane	0.237	41	40	4.047	3.751	3.746	2.913	2.919
Dichlorotetrafluoroethane	0.350	21	3	0.070	0.070	0.070	0.010	0.310
Ethyl Acrylate	0.655	21	0	0.000	0.000	0.000	0.000	0.655
Ethyl Tert-Butyl Ether	0.627	21	0	0.000	0.000	0.000	0.000	0.627
Ethylbenzene	0.360	41	38	2.340	2.293	2.124	0.751	0.777

River Rouge				Units: mg/m^3		AIRS ID: 261630005		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Formaldehyde	0.027	20	20	13.900	10.910	9.590	5.832	5.832
Halocarbon 113	0.261	20	20	1.751	1.270	1.063	0.787	0.787
Halocarbon 114	0.294	20	0	0.000	0.000	0.000	0.000	0.294
Hexachloro-1,3-Butadiene	0.330	41	1	1.064	0.000	0.000	0.026	0.348
Hexanaldehyde	0.042	20	20	0.838	0.617	0.613	0.329	0.329
Isovaleraldehyde	0.027	20	12	0.510	0.499	0.457	0.166	0.177
m,p-Tolualdehyde	0.042	20	7	0.799	0.260	0.196	0.077	0.105
m/p -Xylene	0.869	41	38	7.410	6.670	6.070	2.133	2.197
Methyl Ethyl Ketone	5.014	41	20	7.980	6.120	6.090	1.489	4.058
Methyl Isobutyl Ketone	3.442	41	2	1.554	1.308	0.000	0.070	3.344
Methyl Methacrylate	0.737	21	0	0.000	0.000	0.000	0.000	0.737
Methyl Tert-Butyl Ether	0.220	41	7	0.540	0.525	0.457	0.064	0.246
Methylene Chloride	0.799	41	32	62.400	6.690	3.155	2.326	2.501
n-Butyraldehyde	0.014	20	20	0.913	0.824	0.759	0.487	0.487
n-Hexane	1.762	20	6	5.660	3.730	2.659	0.927	2.160
n-Octane	0.280	21	13	0.648	0.606	0.560	0.215	0.322
o-Tolualdehyde	0.035	20	0	0.000	0.000	0.000	0.000	0.035
o-xylene	0.187	41	40	3.081	2.600	2.600	0.923	0.927
Propionaldehyde	0.041	20	20	1.167	1.048	0.972	0.587	0.587
Propylene	0.086	21	20	6.050	4.600	4.020	1.696	1.700
Styrene	0.230	41	21	0.340	0.322	0.304	0.109	0.221
Tert-Amyl Methyl Ether	0.502	21	0	0.000	0.000	0.000	0.000	0.502
Tetrachloroethene	0.482	41	11	15.910	2.098	1.015	0.527	0.880
Toluene	0.264	41	40	13.240	12.410	11.360	4.943	4.949
trans-1,2-Dichloroethene	0.238	21	0	0.000	0.000	0.000	0.000	0.238
trans-1,3-Dichloropropene	0.281	41	0	0.000	0.000	0.000	0.000	0.281
Trichloroethene	0.204	41	5	1.716	1.566	0.965	0.118	0.298
Trichlorofluoromethane	0.270	41	40	3.678	2.579	2.400	1.623	1.629
Trichlorotrifluoroethane	0.536	21	20	1.224	1.201	1.162	0.888	0.914
Valeraldehyde	0.042	20	20	1.129	1.048	0.949	0.646	0.646
Vinyl Chloride	0.500	41	0	0.000	0.000	0.000	0.000	0.500

Southfield				Units: mg/m^3		AIRS ID: 261250010		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Arsenic (TSP)	0.016	37	37	0.006	0.004	0.003	0.001	0.001
Beryllium (TSP)	0.010	37	4	0.001	0.000	0.000	0.000	0.009
Cadmium (TSP)	0.024	37	37	0.001	0.000	0.000	0.000	0.000
Chromium (TSP)	0.014	37	37	0.005	0.005	0.005	0.004	0.004
Lead (TSP)	0.010	37	37	0.017	0.014	0.014	0.007	0.007
Manganese (TSP)	0.010	37	37	0.033	0.032	0.030	0.015	0.015
Nickel (TSP)	0.010	37	37	0.012	0.008	0.008	0.002	0.002
1,1,1-Trichloroethane	0.262	42	37	0.599	0.544	0.327	0.215	0.246
1,1,2,2-Tetrachloroethane	0.556	42	0	0.000	0.000	0.000	0.000	0.556
1,1,2-Trichloroethane	0.262	42	0	0.000	0.000	0.000	0.000	0.262
1,1-Dichloroethane	0.360	42	0	0.000	0.000	0.000	0.000	0.360
1,1-Dichloroethene	0.182	42	0	0.000	0.000	0.000	0.000	0.182
1,2,4-Trichlorobenzene	0.200	42	0	0.000	0.000	0.000	0.000	0.200
1,2,4-Trimethylbenzene	0.088	42	42	4.465	3.140	2.453	1.138	1.138
1,2-Dibromoethane	0.415	42	0	0.000	0.000	0.000	0.000	0.415
1,2-Dichlorobenzene	1.200	42	0	0.000	0.000	0.000	0.000	1.200

Southfield				Units: mg/m³		AIRS ID: 261250010		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
1,2-Dichloroethane	0.348	42	0	0.000	0.000	0.000	0.000	0.348
1,2-Dichloropropane	0.273	42	0	0.000	0.000	0.000	0.000	0.273
1,3,5-Trimethylbenzene	1.000	42	42	1.226	1.030	0.736	0.362	0.362
1,3-Butadiene	0.089	42	38	0.729	0.375	0.375	0.192	0.201
1,3-Dichlorobenzene	1.200	42	10	0.720	0.420	0.300	0.057	0.971
2,5-dimethylbenzaldehyde	0.056	21	0	0.000	0.000	0.000	0.000	0.056
2-Chloro-1,3-Butadiene	0.109	42	0	0.000	0.000	0.000	0.000	0.109
Acetaldehyde	0.025	21	21	2.630	2.250	2.250	1.587	1.587
Acetone	0.080	21	21	6.540	6.470	5.190	3.008	3.008
Acetonitrile	0.873	42	4	6.690	3.900	2.580	0.370	1.160
Acetylene	0.138	42	40	6.710	2.910	2.760	1.575	1.582
Acrylonitrile	0.847	42	0	0.000	0.000	0.000	0.000	0.847
Benzaldehyde	0.023	21	20	0.498	0.390	0.347	0.158	0.159
Benzene	0.224	42	42	6.570	3.730	3.280	1.969	1.969
Bromochloromethane	0.635	42	0	0.000	0.000	0.000	0.000	0.635
Bromodichloromethane	0.489	42	0	0.000	0.000	0.000	0.000	0.489
Bromoform	0.610	42	0	0.000	0.000	0.000	0.000	0.610
Bromomethane	0.155	42	0	0.000	0.000	0.000	0.000	0.155
Carbon Tetrachloride	0.239	42	41	0.879	0.879	0.753	0.620	0.625
Chlorobenzene	0.184	42	0	0.000	0.000	0.000	0.000	0.184
Chloroethane	0.106	42	0	0.000	0.000	0.000	0.000	0.106
Chloroform	0.332	42	4	0.244	0.195	0.146	0.017	0.318
Chloromethane	0.128	42	41	1.855	1.669	1.587	1.239	1.242
Chloromethyl Benzene	1.000	42	0	0.000	0.000	0.000	0.000	1.000
cis-1,2-Dichloroethene	0.226	42	0	0.000	0.000	0.000	0.000	0.226
cis-1,3-Dichloropropene	0.245	42	0	0.000	0.000	0.000	0.000	0.245
Crotonaldehyde	0.013	21	5	0.289	0.172	0.172	0.040	0.050
Dibromochloromethane	0.503	42	0	0.000	0.000	0.000	0.000	0.503
Dichlorodifluoromethane	0.237	42	41	4.096	3.751	3.504	2.969	2.975
Dichlorotetrafluoroethane	0.350	42	4	0.070	0.070	0.070	0.007	0.323
Ethyl Acrylate	0.655	42	0	0.000	0.000	0.000	0.000	0.655
Ethyl Tert-Butyl Ether	0.627	42	0	0.000	0.000	0.000	0.000	0.627
Ethylbenzene	0.360	42	42	3.554	2.427	1.950	0.867	0.867
Formaldehyde	0.027	21	21	4.870	4.730	4.520	2.598	2.598
Hexachloro-1,3-Butadiene	0.330	42	0	0.000	0.000	0.000	0.000	0.330
Hexanaldehyde	0.042	21	12	0.348	0.327	0.327	0.088	0.106
Isovaleraldehyde	0.027	21	8	0.176	0.141	0.141	0.041	0.058
m,p-Tolualdehyde	0.042	21	8	0.760	0.294	0.221	0.082	0.108
m/p -Xylene	0.869	42	42	8.620	7.370	5.460	2.384	2.384
Methyl Ethyl Ketone	5.014	42	36	11.360	6.710	5.560	2.650	3.367
Methyl Isobutyl Ketone	3.442	42	2	1.390	0.806	0.000	0.052	3.330
Methyl Methacrylate	0.737	42	0	0.000	0.000	0.000	0.000	0.737
Methyl Tert-Butyl Ether	0.220	42	4	2.051	0.432	0.216	0.068	0.267
Methylene Chloride	0.799	42	41	1151.000	655.000	454.000	67.754	67.773
n-Butyraldehyde	0.014	21	20	0.400	0.350	0.294	0.146	0.147
n-Octane	0.280	42	32	1.446	1.119	1.119	0.400	0.467
o-Tolualdehyde	0.035	21	0	0.000	0.000	0.000	0.000	0.035
o-xylene	0.187	42	42	3.207	2.644	2.210	0.975	0.975
Propionaldehyde	0.041	21	15	0.529	0.450	0.439	0.223	0.234
Propylene	0.086	42	41	5.940	2.130	2.100	1.328	1.330

Southfield				Units: mg/m^3		AIRS ID: 261250010		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Styrene	0.230	42	25	1.148	0.680	0.553	0.164	0.258
Tert-Amyl Methyl Ether	0.502	42	0	0.000	0.000	0.000	0.000	0.502
Tetrachloroethene	0.482	42	15	1.421	1.151	0.948	0.194	0.504
Toluene	0.264	42	42	14.780	13.090	9.820	4.377	4.377
trans-1,2-Dichloroethene	0.238	42	0	0.000	0.000	0.000	0.000	0.238
trans-1,3-Dichloropropene	0.281	42	0	0.000	0.000	0.000	0.000	0.281
Trichloroethene	0.204	42	2	0.992	0.107	0.000	0.026	0.221
Trichlorofluoromethane	0.270	42	41	3.196	2.955	2.915	1.702	1.709
Trichlorotrifluoroethane	0.536	42	41	1.300	1.224	1.224	0.857	0.870
Valeraldehyde	0.042	21	8	0.369	0.246	0.211	0.075	0.101
Vinyl Chloride	0.500	42	0	0.000	0.000	0.000	0.000	0.500

Ypsilanti				Units: mg/m^3		AIRS ID: 261610008		
Parameter Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic (TSP)	0.016	8	8	0.002	0.001	0.001	0.001	0.001
Barium (TSP)	0.001	23	23	0.072	0.070	0.068	0.057	0.057
Beryllium (TSP)	0.010	31	0	0.000	0.000	0.000	0.000	0.010
Cadmium (TSP)	0.024	31	8	0.000	0.000	0.000	0.000	0.018
Chromium (TSP)	0.014	31	9	0.004	0.002	0.002	0.001	0.011
Cobalt (TSP)	0.003	23	1	0.001	0.000	0.000	0.000	0.002
Copper (TSP)	0.010	23	23	0.229	0.207	0.134	0.088	0.088
Iron (TSP)	0.003	23	23	1.070	0.650	0.556	0.329	0.329
Lead (TSP)	0.010	31	30	0.080	0.019	0.016	0.010	0.010
Manganese (TSP)	0.010	31	31	0.048	0.033	0.028	0.013	0.013
Molybdenum (TSP)	0.003	23	4	0.004	0.003	0.002	0.001	0.003
Nickel (TSP)	0.010	31	10	0.005	0.004	0.002	0.001	0.007
Vanadium (TSP)	0.001	23	0	0.000	0.000	0.000	0.000	0.001
Zinc (TSP)	0.001	23	23	0.110	0.110	0.099	0.044	0.044
1,1,1-Trichloroethane	0.262	20	2	0.283	0.268	0.000	0.028	0.263
1,1,2,2-Tetrachloroethane	0.556	20	0	0.000	0.000	0.000	0.000	0.556
1,1,2-Trichloroethane	0.262	20	0	0.000	0.000	0.000	0.000	0.262
1,1-Dichloroethane	0.360	20	0	0.000	0.000	0.000	0.000	0.360
1,1-Dichloroethene	0.182	20	0	0.000	0.000	0.000	0.000	0.182
1,2,4-Trichlorobenzene	0.200	20	2	0.703	0.689	0.000	0.070	0.250
1,2,4-Trimethylbenzene	0.088	20	19	3533.000	1.914	1.864	177.488	177.492
1,2-Dibromoethane	0.415	20	0	0.000	0.000	0.000	0.000	0.415
1,2-Dichlorobenzene	1.200	20	0	0.000	0.000	0.000	0.000	1.200
1,2-Dichloroethane	0.348	20	1	0.097	0.000	0.000	0.005	0.336
1,2-Dichloroethene	0.341	20	0	0.000	0.000	0.000	0.000	0.341
1,2-Dichloropropane	0.273	20	0	0.000	0.000	0.000	0.000	0.273
1,3,5-Trimethylbenzene	1.000	20	6	0.589	0.589	0.442	0.136	0.836
1,3-Butadiene	0.089	20	0	0.000	0.000	0.000	0.000	0.089
1,3-Dichlorobenzene	1.200	20	0	0.000	0.000	0.000	0.000	1.200
1,4-Dichlorobenzene	1.200	20	3	3.180	0.378	0.342	0.195	1.215
2,2,4-Trimethylpentane	0.079	20	19	2.201	1.935	1.115	0.714	0.718
2,5-dimethylbenzaldehyde	0.056	20	0	0.000	0.000	0.000	0.000	0.056
2-Chloro-1,3-Butadiene	0.109	20	0	0.000	0.000	0.000	0.000	0.109
Acetaldehyde	0.025	20	20	1.820	1.676	1.676	1.153	1.153
Acetone	0.080	20	20	3.080	2.490	2.490	1.778	1.778
Acetonitrile	0.873	20	3	13.960	3.320	2.400	0.984	1.726

Ypsilanti				Units: mg/m³		AIRS ID: 261610008		
Parameter Name	**MDL**	**Num Obs**	**Num > MDL**	**Max1**	**Max2**	**Max3**	**Min Mean**	**Max Mean**
Acrylonitrile	0.847	20	0	0.000	0.000	0.000	0.000	0.847
Benzaldehyde	0.023	20	15	0.468	0.260	0.191	0.096	0.101
Benzene	0.224	20	19	3.083	2.401	2.375	1.380	1.391
Bromodichloromethane	0.489	20	0	0.000	0.000	0.000	0.000	0.489
Bromoform	0.610	20	0	0.000	0.000	0.000	0.000	0.610
Bromomethane	0.155	20	0	0.000	0.000	0.000	0.000	0.155
Carbon Tetrachloride	0.239	20	19	0.735	0.728	0.691	0.572	0.584
Chlorobenzene	0.184	20	0	0.000	0.000	0.000	0.000	0.184
Chloroethane	0.106	20	1	0.319	0.000	0.000	0.016	0.116
Chloroform	0.332	20	6	2.392	2.168	1.384	0.450	0.683
Chloromethane	0.128	20	19	2.310	1.634	1.634	1.273	1.279
Chloromethyl Benzene	1.000	20	0	0.000	0.000	0.000	0.000	1.000
cis-1,2-Dichloroethene	0.226	20	0	0.000	0.000	0.000	0.000	0.226
cis-1,3-Dichloropropene	0.245	20	0	0.000	0.000	0.000	0.000	0.245
Crotonaldehyde	0.013	20	3	0.229	0.057	0.057	0.017	0.028
Dibromochloromethane	0.503	20	0	0.000	0.000	0.000	0.000	0.503
Dichlorodifluoromethane	0.237	20	19	3.963	3.460	3.193	2.796	2.808
Ethylbenzene	0.360	20	12	1.291	1.235	0.906	0.430	0.574
Formaldehyde	0.027	20	20	7.310	5.720	4.840	2.589	2.589
Halocarbon 113	0.261	20	19	1.537	0.818	0.811	0.721	0.734
Halocarbon 114	0.294	20	0	0.000	0.000	0.000	0.000	0.294
Hexachloro-1,3-Butadiene	0.330	20	0	0.000	0.000	0.000	0.000	0.330
Hexanaldehyde	0.042	20	15	0.928	0.519	0.327	0.176	0.187
Isovaleraldehyde	0.027	20	10	0.338	0.211	0.200	0.077	0.091
m,p-Tolualdehyde	0.042	20	7	0.809	0.490	0.250	0.093	0.120
m/p -Xylene	0.869	20	13	3.172	2.990	2.457	1.130	1.434
Methyl Ethyl Ketone	5.014	20	0	0.000	0.000	0.000	0.000	5.014
Methyl Isobutyl Ketone	3.442	20	0	0.000	0.000	0.000	0.000	3.442
Methyl Tert-Butyl Ether	0.220	20	1	0.489	0.000	0.000	0.024	0.233
Methylene Chloride	0.799	20	6	1.619	1.175	1.078	0.322	0.881
n-Butyraldehyde	0.014	20	17	0.359	0.300	0.265	0.110	0.112
n-Hexane	1.762	20	3	2.927	1.850	1.808	0.329	1.827
o-Tolualdehyde	0.035	20	1	0.211	0.000	0.000	0.011	0.044
o-xylene	0.187	20	19	1.426	1.244	1.231	0.622	0.632
Propionaldehyde	0.041	20	9	0.429	0.389	0.379	0.119	0.142
Styrene	0.230	20	11	3.342	3.121	2.921	0.873	0.976
Tetrachloroethene	0.482	20	6	3.269	1.624	0.995	0.384	0.722
Toluene	0.264	20	19	8.540	7.750	7.520	3.810	3.823
trans-1,3-Dichloropropene	0.281	20	0	0.000	0.000	0.000	0.000	0.281
Trichloroethene	0.204	20	4	2.091	0.299	0.280	0.145	0.308
Trichlorofluoromethane	0.270	20	19	3.869	2.573	1.929	1.634	1.648
Valeraldehyde	0.042	20	6	0.397	0.229	0.211	0.056	0.086
Vinyl Chloride	0.500	20	0	0.000	0.000	0.000	0.000	0.500

Appendix D: O_3 Exceedances 1992-2001

Appendix D is a tabulation of O_3 Exceedances from 1992 to 2001. This information is provided in two views. The first view is sorted by Site Location and the second view is sorted by Site I.D.

Exceedances are measured as an 1-hour O_3 averaged concentration level of 0.125 ppm or higher during a 24-hour period (midnight to midnight), with the highest 1-hour O_3 level being reported.

Historical O_3 exceedances for years prior to 1991 can be found in the ***1998 Annual Air Quality Report.***

O_3 EXCEEDANCES FROM 1992 TO 2001 - SORTED BY SITE LOCATION

(Units in ppm)

26-147-0030 ALGONAC		26-163-0001 ALLEN PARK		26-161-0005 ANN ARBOR		26-161-0007 ANN ARBOR		26-037-0001 BATH TWP		26-019-0003 BENZONIA		26-027-0003 CASSOPOLIS, (I.D.E.M.)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
6-16-94	0.133	6-18-94	0.126	Monitoring for O_3 ended in 1996		Monitor started in 1997 Monitor moved in 2000 to Ypsilanti site (26-161-0008)		7-1-92	0.125	6-28-96	0.144	7-14-95	0.150
6-18-94	0.129											5-19-98	0.137
7-14-95	0.135												
7-31-95	0.137												
Monitoring for O_3 ended in 1999													

26-021-0014 COLOMA		26-163-0062 DETROIT, (Temple St)		26-163-0016 DETROIT, (Linwood)		26-163-0019 DETROIT, (E. Seven Mile)		26-161-8001 DEXTER, (EPA)		26-041-0912 ESCANABA		26-081-0020 EVANS		26-133-0901 EVART		26-049-0011 FLINT (Old)		26-049-0021 FLINT (New)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
8-12-95	0.136	Only in service during 1993 for SEMOS special study				6-18-94	0.131	5-21-92	0.126	Monitoring for O_3 ended in 1993		1999 - Monitor relocated from former Grattan Twp/ Parnell site (26-081-2001)		Only in service during 1996		Monitoring for O_3 ended in 1992		5-15-98	0.130
6-13-96	0.125					8-18-94	0.129	Monitoring for O_3 ended in 1992											
6-28-96	0.138					8-26-95	0.126												
5-19-98	0.136																		
9-6-98	0.157																		
7-30-99	0.144																		
8-8-01	0.126																		

26-139-0005 GEORGETOWN TWP		26-081-0020 GRAND RAPIDS		26-081-2001 GRATTAN TWP		26-063-0006 HARBOR BEACH		26-063-0007 HARBOR BEACH		26-005-0003 HOLLAND		26-113-0001 HOUGHTON LAKE (Background Ozone Site		26-143-0901 HOUGHTON LAKE	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
7-13-95	0.133	8-26-93	0.156	7-13-95	0.134	Monitor site used for SEMOS study in 1993. Moved to another site in Harbor Beach (26-063-007)		6-15-94	0.159	8-26-93	0.133			Only in service during 1996	
6-28-96	0.140	6-17-94	0.149	6-28-96	0.128			6-14-01	.0153	6-17-95	0.137				
		7-13-95	0.163	6-29-96	0.125					7-13-95	0.178				
		6-28-96	0.135	Monitoring relocated to Evans (26-081-0020) in 1999						7-14-95	0.145				
		6-29-96	0.127							8-13-95	0.135				
										6-28-96	0.154				
										9-6-98	0.130				
										7-30-99	0.154				
										6-9-00	0.126				

O_3 EXCEEDANCES FROM 1992 TO 2001 - SORTED BY SITE LOCATION (Continued)

(Units in ppm)

26-077-0008 KALAMAZOO		26-077-0905 KALAMAZOO		26-077-0906 KALAMAZOO		26-125-0902 LAKE ORION		26-121-0039 LAKETON TWP		26-065-0012 LANSING		26-159-0901 LAWTON	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
Monitor put in service 1997		7-14-95	0.125	Monitoring for O_3 ended in 1996		Only in service in 1993 for SEMOS study		5-22-92	0.129			Monitoring for O_3 ended in 1992	
		Monitor replaced in 1997 with 26-077-0008						8-26-93	0.141				
								7-6-94	0.146				
								6-17-95	0.142				
								7-13-95	0.171				
								7-14-95	0.130				
								7-31-95	0.136				
								6-28-96	0.158				
								7-30-99	0.154				
								6-9-00	0.129				

26-163-0025 LIVONIA, (Seven Mile Rd)		26-163-2002 LIVONIA, (Schoolcraft Rd)		26-105-0006 LUDINGTON		26-101-8001 MANISTEE NAT'L FOREST (EPA)		26-115-0037 MAYBEE		26-099-0009 NEW HAVEN		26-125-0001 OAK PARK	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
Monitoring for O_3 ended in 1993		Monitoring for O_3 ended in 1993		Monitor started in 1993		Monitoring for O_3 ended in 1992		Only in service in 1993, Site relocated to Tecumseh site (26-091-0007)		5-22-94	0.137	8-3-94	0.127
				8-27-93	0.129					6-16-94	0.142	7-14-95	0.138
				8-30-93	0.125					6-17-95	0.129	7-15-95	0.125
				6-17-95	0.125					7-31-95	0.140		
				7-13-95	0.127					7-12-97	0.138		
				6-27-96	0.128					7-15-98	0.129		
				6-28-96	0.160					8-21-98	0.126		
				7-30-99	0.161					6-12-99	0.147		
				6-9-00	0.130					6-27-01	0.127		
				8-1-01	0.125								

26-049-2001 OTISVILLE		26-147-0005 PORT HURON, (New)		26-043-0901 QUINNESSEC #1		26-043-0902 QUINNESSEC #2		26-161-1001 SALINE		26-091-0007 TECUMSEH		26-055-0903 TRAVERSE CITY		26-157-8001 UNIONVILLE, TUSCOLA CO (EPA)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
6-24-93	0.129	8-14-93	0.147	Monitoring for O_3 ended in 1993		Monitoring for O_3 ended in 1993		Monitoring for O_3 ended in 1993		Monitor started in 1993		Monitor started in 1998		Monitoring for O_3 ended in 1992	
5-15-98	0.152	6-18-94	0.178												
6-11-99	0.131	7-13-95	0.126												
		5-22-96	0.184												
		5-19-98	0.128												
		6-29-01	0.126												

26-099-1003 WARREN		26-103-0930 WITCH LAKE		26-161-0008 YPSILANTI	
Date	Conc	Date	Conc	Date	Conc
8-14-93	0.128	Only in service during 1993. SPM for LMOS Industrial study		In 2000, Monitor relocated from former Ann Arbor site (26-161-0007)	
6-16-94	0.145				
7-6-96	0.125				

O_3 EXCEEDANCES FROM 1992 TO 2001 - SORTED BY SITE I.D.

(Units in ppm)

26-005-0003 HOLLAND	26-019-0003 BENZONIA	26-021-0014 COLOMA	26-027-0003 CASSOPOLIS, (I.D.E.M.)	26-037-0001 BATH TWP	26-041-0912 ESCANABA	26-043-0901 QUINNESSEC #1	26-043-0902 QUINNESSEC #2
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc
8-26-93 0.133	6-28-96 0.144	8-12-95 0.136	7-14-95 0.150	7-1-92 0.125	Monitoring for O_3 ended in 1993	Monitoring for O_3 ended in 1993	Monitoring for O_3 ended in 1993
6-17-95 0.137		6-13-96 0.125	5-19-98 0.137				
7-13-95 0.178		6-28-96 0.138					
7-14-95 0.145		5-19-98 0.136					
8-13-95 0.135		9-6-98 0.157					
6-28-96 0.154		7-30-99 0.144					
9-6-98 0.130		8-8-01 0.126					
7-30-99 0.154							
6-9-00 0.126							

26-049-0011 FLINT (Old)	26-049-0021 FLINT (New)	26-049-2001 OTISVILLE	26-055-0903 TRAVERSE CITY	26-063-0007 HARBOR BEACH	26-065-0012 LANSING	26-077-0008 KALAMAZOO	26-077-0905 KALAMAZOO
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc
Monitoring for O_3 ended in 1992	5-15-98 0.130	6-24-93 0.129	Monitor site started in 1998	6-15-94 0.159		Monitor put in service 1997	7-14-95 0.125
		5-15-98 0.152		6-14-01 .0153			Monitor replace in 1997 with 26-077-0008
		6-11-99 0.131					

26-077-0906 KALAMAZOO	26-081-0020 GRAND RAPIDS	26-081-0020 EVANS	26-081-2001 GRATTAN TWP	26-091-0007 TECUMSEH	26-099-0009 NEW HAVEN	26-099-1003 WARREN
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc
Monitoring for O_3 ended in 1996	8-26-93 0.56	1999 Monitor relocated from former Grattan Township/Parnell site (26-081-2001)	7-13-95 0.134	Monitor site started in 1993	5-22-94 0.137	8-14-93 0.128
	6-17-94 0.149		6-28-96 0.128		6-16-94 0.142	6-16-94 0.145
	7-13-95 0.163		6-29-96 0.125		6-17-95 0.129	7-6-96 0.125
	6-28-96 0.135		Monitoring relocated to Evans (26-081-0020) in 1999		7-31-95 0.140	
	6-29-96 0.127				7-12-97 0.138	
					7-15-98 0.129	
					8-21-98 0.126	
					6-12-99 0.147	
					6-27-01 0.127	

26-101-8001 MANISTEE NAT'L FOREST (EPA)	26-103-0930 WITCH LAKE	26-105-0006 LUDINGTON	26-113-0001 HOUGHTON LAKE, (Background Ozone Site	26-115-0037 MAYBEE
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc
Monitoring for O_3 ended in 1992	Only in service during 1993. SPM for LMOS Industrial study	8-27-93 0.129		Only in service in 1993, Site relocated to Tecumseh site (26-091-0007)
		8-30-93 0.125		
		6-17-95 0.125		
		7-13-95 0.127		
		6-27-96 0.128		
		6-28-96 0.160		
		7-30-99 0.161		
		6-9-00 0.130		
		8-1-01 0.125		

O_3 EXCEEDANCES FROM 1992 TO 2001 - SORTED BY SITE I.D. (Continued)

(Units in ppm)

26-121-0039 LAKETON TWP		26-125-0001 OAK PARK		26-125-0902 LAKE ORION	26-133-0901 EVART	26-139-0005 GEORGETOWN TWP		26-143-0901 HOUGHTON LAKE	26-147-0005 PORT HURON, (New)		26-147-0030 ALGONAC	
Date	Conc	Date	Conc	Date Conc	Date Conc	Date	Conc	Date Conc	Date	Conc	Date	Conc
5-22-92	0.129	8-3-94	0.127	Only in service in 1993 for SEMOS study	Only in service during 1996	7-13-95	0.133	Only in service during 1996	8-14-93	0.147	6-16-94	0.133
8-26-93	0.141	7-14-95	0.138			6-28-96	0.140		6-18-94	0.178	6-18-94	0.129
7-6-94	0.146	7-15-95	0.125						7-13-95	0.126	7-14-95	0.135
6-17-95	0.142								5-22-96	0.184	7-31-95	0.137
7-13-95	0.171								5-19-98	0.128	Monitoring for O_3 ended in 1999	
7-14-95	0.130								6-29-01	0.126		
7-31-95	0.136											
6-28-96	0.158											
7-30-99	0.154											
6-9-00	0.129											

26-157-8001 UNIONVILLE, TUSCOLA CO, EPA	26-159-0901 LAWTON	26-161-0005 ANN ARBOR	26-161-0007 ANN ARBOR	26-161-0008 YPSILANTI	26-161-1001 SALINE	26-161-8001 DEXTER, (EPA)	
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date	Conc
Monitoring for O_3 ended in 1992	Monitoring for O_3 ended in 1992	Monitoring for O_3 ended in 1996	Monitor started in 1997 In 2000, Monitor moved to Ypsilanti site (26-161-0008)	In 2000, Monitor was relocated from former Ann Arbor site (26-161-0007)	Monitoring for O_3 ended in 1993	5-21-92	0.126
						Monitoring for O_3 ended in 1992	

26-163-0001 ALLEN PARK		26-163-0016 DETROIT, (Linwood)	26-163-0019 DETROIT, (E. Seven Mile)		26-163-0025 LIVONIA, (Seven Mile Rd)	26-163-0062 DETROIT, (Temple St)	26-163-2002 LIVONIA, (Schoolcraft Rd)
Date	Conc	Date Conc	Date	Conc	Date Conc	Date Conc	Date Conc
6-18-94	0.126		6-18-94	0.131	Monitoring for O_3 ended in 1993	Only in service during 1993 for SEMOS special study	Monitoring for O_3 ended in 1993
			8-18-94	0.129			
			8-26-95	0.126			

Appendix E: AQD Acronyms and Definitions

AQD ACRONYM	DEFINITION
~	approximately
<	less than
>	greater than
º	degree
AIRS	Aerometric Information Retrieval System
Al	aluminum
AQD	Air Quality Division
AQES	Air Quality Evaluation Section
AQI	Air Quality Index
As	arsenic
Ba	barium
Be	beryllium
Btu	British thermal units
C	Celcius
CAA	Clean Air Act
Cd	cadmium
CFC	chlorofluorocarbon
CFR	Code of Federal Regulations
CMSA	Consolidated Metropolitan Statistical Area
CO	carbon monoxide
Co	cobalt
COHb	carboxyhemoglobin
CO_2	carbon dioxide
Cr	chromium
CU	copper
DDE	a DDT degradation product
DDT	dichlorodiphenyltrichloroethane
DEQ	Department of Environmental Quality
DNR	Department of Natural Resources
EAD	Environmental Assistance Division
EPA	United States Environmental Protection Agency
Fe	iron
FR	Federal Register
FRM	Federal Reference Method
FY	Fiscal Year
g	grams
H_2SO_4	sulfuric acid
HAP	Hazardous Air Pollutant
Hg	mercury

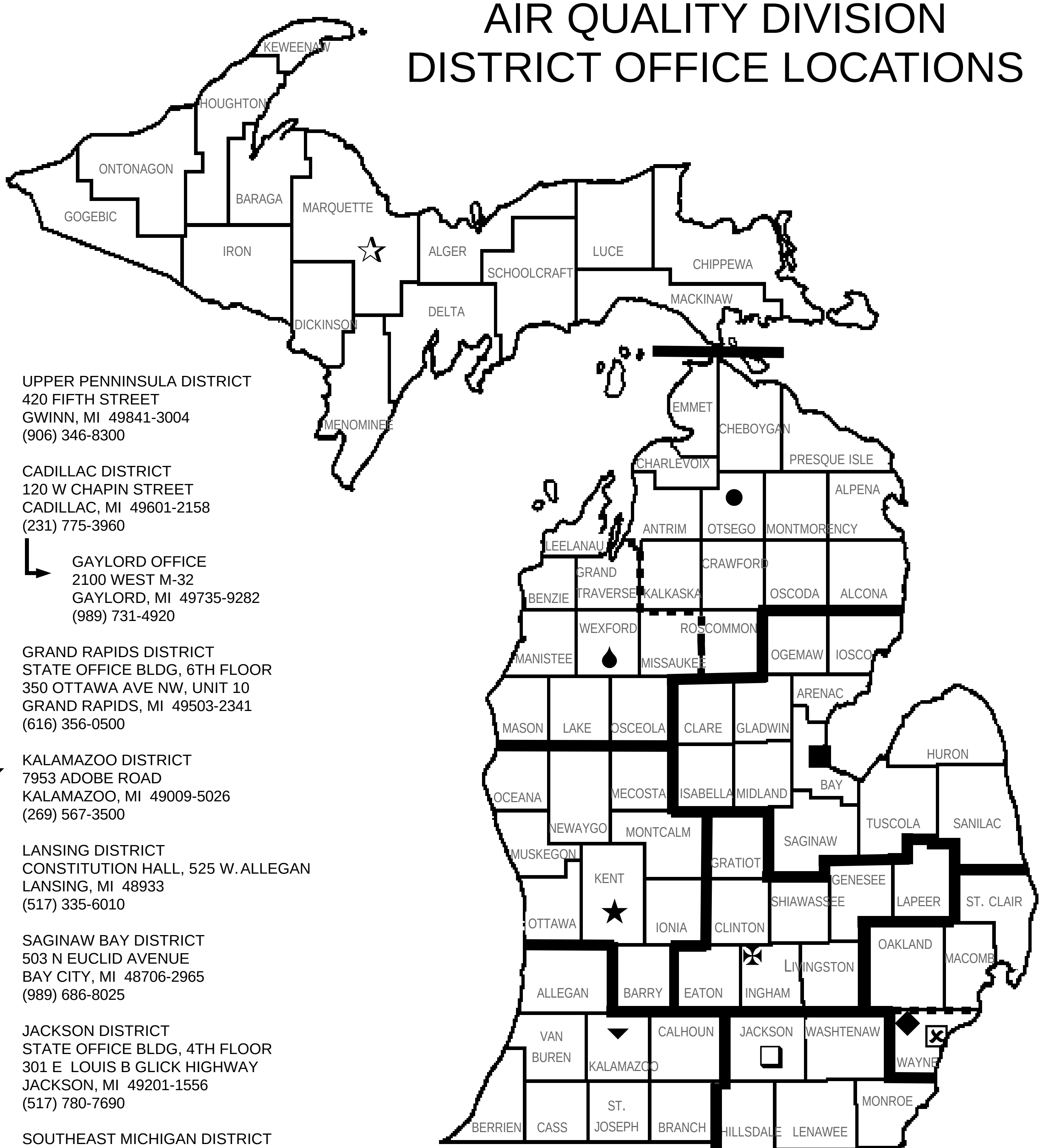
AQD ACRONYM	DEFINITION
IADN	Integrated Atmospheric Deposition Network
IRIS	Integrated Risk Information System
kg	kilogram
km	kilometer
L	liter
LADCO	Lake Michigan Air Director's Consortium
LMOS	Lake Michigan Ozone Study
m	meter
M^3	cubic meter
MASN	Michigan Air Sampling Network
MDEQ	Michigan Department of Environmental Quality
MESB	Michigan Environmental Science Board
mg	milligram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mg/m^3	milligrams per cubic meter
MI	Michigan
MITAMP	Michigan Toxics Air Monitoring Program
ml	millimeter
Mn	manganese
Mo	molybdenum
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standards
NADP	National Atmospheric Deposition Program
NAMS	National Air Monitoring Stations
NATA	National Scale Air Toxics Assessment
ng	nanogram
Ni	nickel
NO	nitrogen oxide
NO_2	nitrogen dioxide
NOx	oxides of nitrogen
NWS	National Weather Service
O_2	oxygen
O_2Hb	oxyhemoglobin
O_3	ozone
OAQPS	Office of Air Quality Planning and Standards (EPA)
OAR	Office of Air and Radiation (EPA)
OBS	Observations
ORD	Office of Research and Development (EPA)
OTAG	Ozone Transport Assessment Group
PAHs	polycyclic aromatic hydrocarbons
PAMS	Photochemical Assessment Monitoring Station
Pb	lead
PBT	Persistent, Bioaccumulative Toxics
PCB	polychlorinated biphenyls

AQD ACRONYM	DEFINITION
PM	Particulate Matter
PM_{10}	Particulate Matter (with an aerodynamic diameter) less than or equal to 10 microns in diameter
$PM_{2.5}$	Particulate Matter (with an aerodynamic diameter) less than or equal to 2.5 microns in diameter
PMSA	Primary Metropolitan Statistical Area
PNAs	polynuclear aromatic hydrocarbons
POM	polycyclic organic matter
ppb	parts per billion
ppm	parts per million
PUF	polyurethane foam (type of sampler)
QA/QC	Quality Assurance/Quality Control
SASS	Spiral aerosol speciation sampler
SEMCOG	Southeast Michigan Council of Governments
SEMOS	Southeast Michigan Ozone Study
SLAMS	State and Local Air Monitoring Stations
SO_2	sulfur dioxide
SPM	Special Purpose Monitoring
TACs	Toxic Air Contaminants
TEOM	Tapered Element Oscillating Microbalance
TSP	Total Suspended Particulates
µg	microgram
µg/dl	micrograms per deciliter
$\mu g/m^3$	micrograms per cubic meter
µm	micrometers
V	vanadium
VOC	Volatile Organic Compounds
WWTP	Waste Water Treatment Plant
Zn	zinc

Appendix F: AQD District Office Locations

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

AIR QUALITY DIVISION DISTRICT OFFICE LOCATIONS



☆ UPPER PENINSULA DISTRICT
420 FIFTH STREET
GWINN, MI 49841-3004
(906) 346-8300

CADILLAC DISTRICT
120 W CHAPIN STREET
CADILLAC, MI 49601-2158
(231) 775-3960

● GAYLORD OFFICE
2100 WEST M-32
GAYLORD, MI 49735-9282
(989) 731-4920

★ GRAND RAPIDS DISTRICT
STATE OFFICE BLDG, 6TH FLOOR
350 OTTAWA AVE NW, UNIT 10
GRAND RAPIDS, MI 49503-2341
(616) 356-0500

▼ KALAMAZOO DISTRICT
7953 ADOBE ROAD
KALAMAZOO, MI 49009-5026
(269) 567-3500

LANSING DISTRICT
CONSTITUTION HALL, 525 W. ALLEGAN
LANSING, MI 48933
(517) 335-6010

■ SAGINAW BAY DISTRICT
503 N EUCLID AVENUE
BAY CITY, MI 48706-2965
(989) 686-8025

❑ JACKSON DISTRICT
STATE OFFICE BLDG, 4TH FLOOR
301 E LOUIS B GLICK HIGHWAY
JACKSON, MI 49201-1556
(517) 780-7690

◆ SOUTHEAST MICHIGAN DISTRICT
38980 SEVEN MILE ROAD
LIVONIA, MI 48152-1006
(734) 953-8905

☒ DETROIT OFFICE
CADILLAC PLACE, SUITE 2-300
3058 WEST GRAND BLVD
DETROIT, MI 48202-6058
(313) 456-4700
(Wayne County sources)

AIR QUALITY INTERNET ADDRESS:
http://www.michigan.gov/deq and select "AIR"

1-30-03