2000 Annual Air Quality Report

A Comprehensive Particulate Monitoring Site

AIR QUALITY DIVISION
Michigan Department of Environmental Quality

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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

2000 Annual Air Quality Report

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Acknowledgments:

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Cover photo credit: Digital image by Mark Baron of Allen Park (26-163-0001 particulate monitoring station located in Wayne County (Left to right: Co-located $PM_{2.5}$ samplers - Federal Reference Method (FRM) 40-CFR Part 50 - Appendix L for determination of fine particulate matter, $PM_{2.5}$ fine particulate chemical speciation sampler, $PM_{2.5}$ fine particulate Tapered Element Oscillating Microbalance (TEOM) sampler, and PM_{10} particulate sampler – Federal Reference Method (FRM) 40-CFR Part 50 – Appendix M.

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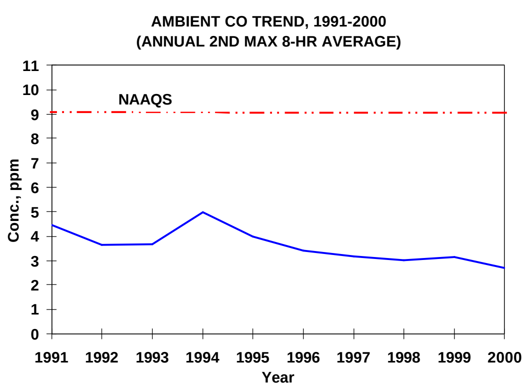
CHAPTER 1: Executive Summary

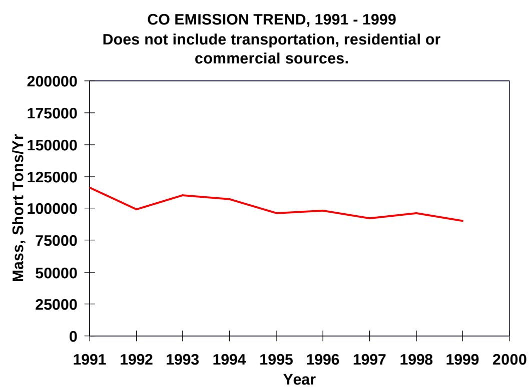
The Federal Clean Air Act of 1963, as amended in 1970, 1977, and 1990, requires the United States Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) that define the maximum permissible levels of pollutants for the protection of human health and welfare. This summary provides an assessment of Michigan air quality relative to these national air quality standards based upon the monitoring of ambient air quality from a statewide air quality surveillance network.

Carbon Monoxide (CO)

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

Carbon monoxide (CO) is a colorless, odorless, tasteless gas. This pollutant is produced mostly by the incomplete combustion of fuels used for transportation, heating, electric power generation, and as a by-product of some industrial processes.





Statewide annual 2nd maximum 8-hour carbon monoxide levels over the decade have generally remained at one-third of the 9.0 ppm standard. A peak in the statewide average level during 1994 was due to two exceedances of the standard at the Evergreen site in Detroit on 1/10/94 and 12/23/94. No exceedances of either 8-hour or 1-hour carbon monoxide standards have occurred in the last six years. At present, all Michigan areas are designated as being in attainment with the 1-hour and 8-hour standards.

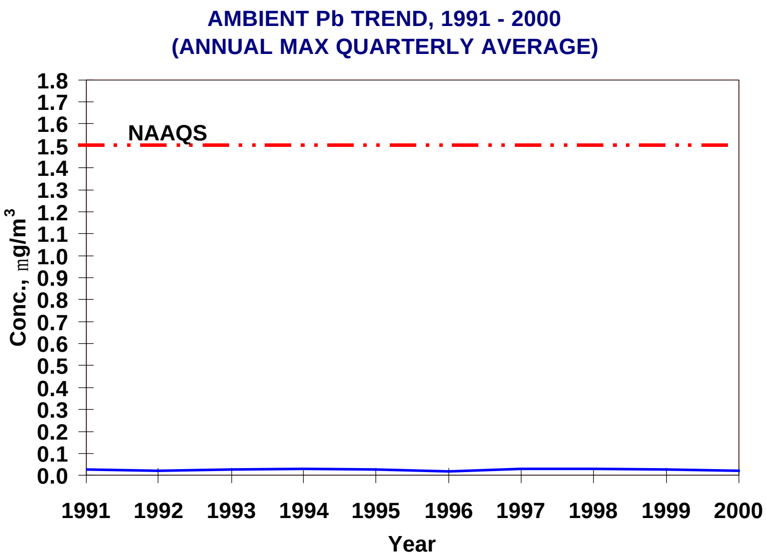
Statewide carbon monoxide emission totals for Michigan industry have shown a decline over the past decade. Recent carbon monoxide emission estimates are approximately 20% less than the estimates at the beginning of the decade.

Health and Welfare Effects: Carbon Monoxide effects the central nervous system by limiting oxygen distribution to the body. People with impaired circulatory systems are vulnerable at lower levels than healthy individuals. Exposure to CO impairs visual perception, work capacity, manual dexterity, learning ability, and the performance of complex tasks.

Lead (Pb)

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

Lead (Pb) emissions generated from gasoline additives, nonferrous smelters and battery plants have significantly decreased over the past 25 years. Statewide average ambient lead levels continue to remain low. This is partly due to the removal of alkylated lead from automotive gasoline, which began during the 1970s. Over the past decade, statewide average lead concentrations have remained at levels less than 1/10th of the standard. The highest level during 2000 (0.04 µg/m^3) occurred at a Detroit and a Grand Rapids monitor site. All metropolitan areas in Michigan are in attainment with the lead standard.

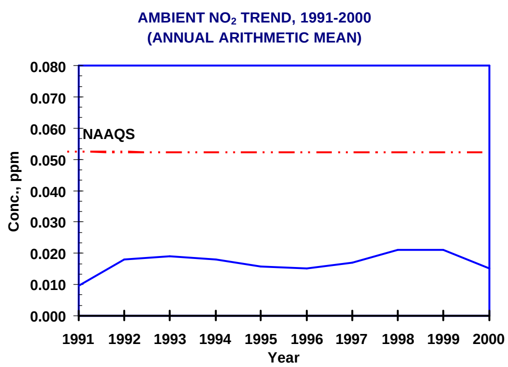


Health and Welfare Effects: Exposure to lead can occur via ingestion or inhalation. Low levels of lead affect enzymatic functions and homeostasis. Lead may also be a factor in high blood pressure and heart disease in middle-aged white males. The nervous system is most sensitive to effects from lead and changes can occur as a result of low doses. Larger exposures can result in behavioral and learning disorders.

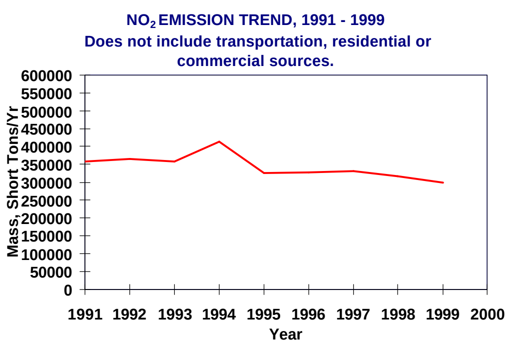
Nitrogen Dioxide (NO_2)

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

Nitrogen dioxide (NO^2) is a reddish-brown gas with a strong odor created from the burning of fossil fuels. Oxides of nitrogen form when nitrogen and oxygen in our air combine due to high temperature combustion.



Monitoring results show that ambient nitrogen dioxide levels have remained at the 0.02 ppm level for most of the decade, which is much less than 1/2 of the standard. There has not been an exceedance of the NO_2 standard during the decade. All Michigan areas are in attainment with the standard.



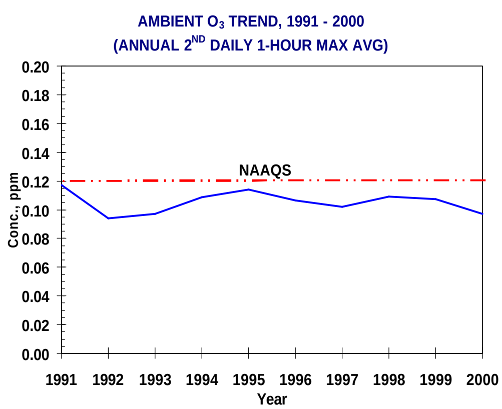
Recent emission inventory estimates of larger industrial sources indicate nitrogen dioxide emission reductions during the decade. Recent statewide nitrogen dioxide emission estimates for Michigan industry are near 300,000 short tons/year.

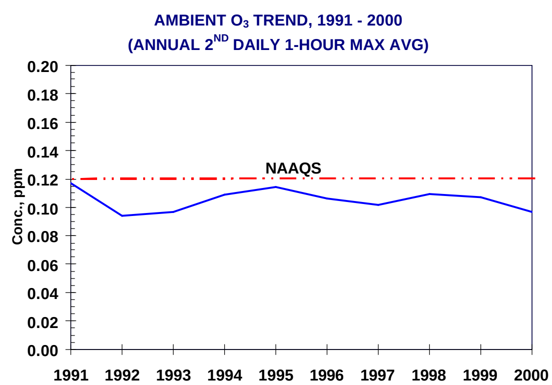
Health and Welfare Effects: The respiratory system is susceptible to effects caused by exposure to nitrogen dioxide. Asthmatics are more sensitive to the effects from exposure to nitrogen dioxide. Nitrogen oxides are precursors to ground-level ozone formation and acid rain.

Ozone (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 1.0 over the last 3 years.
Secondary NAAQS (1-hour):	Same as the primary NAAQS (1 hour).
Remanded NAAQS (8-hour):	Fourth highest daily maximum 8-hour average, averaged over 3 years, not to exceed 0.08 ppm.
Remanded NAAQS (8-hour):	Same as primary 8-hour standard.

Note: On May 14, 1999, the U.S. Circuit Court of Appeals for the District of Columbia remanded the standard for re-evaluation. EPA later reinstated the 1-hour standard until there is resolution of implementation issues for the 8-hour standard.



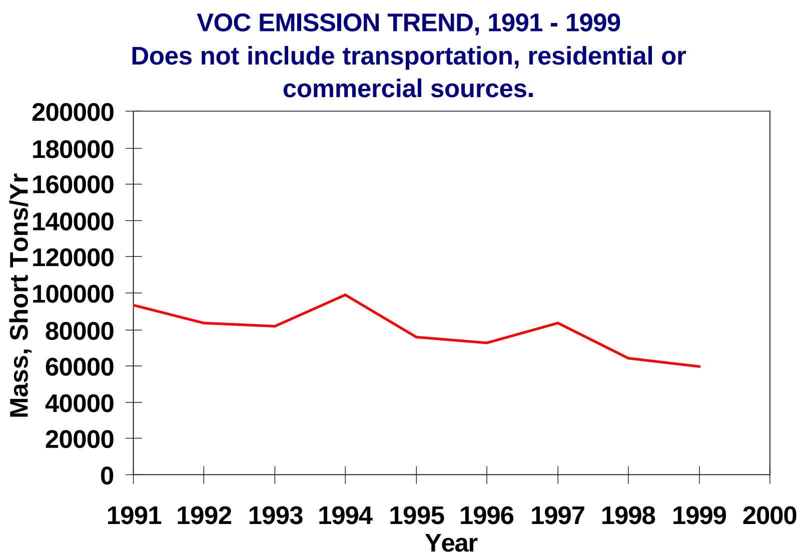


Ground-level ozone (O_3) is an air pollutant that is formed as a result of photochemical reactions, involving emissions of nitrogen oxides and volatile organic compounds in the presence of ultraviolet radiation. Ambient ozone levels are influenced by temperature, with the warmer summers having a greater incidence of exceedance of the 1-hour ozone standard. Extremely hot, dry summer weather is conducive to the formation of ozone. Cooler temperatures prevailed during year 2000 and only three single day exceedances occurred at monitoring sites in Holland, Muskegon, and Scottville. Elevated ozone concentrations at these and other monitors located along the Lake Michigan shoreline can be attributed to long-range transport.

Statewide ground-level 8-hour average ozone trends, measured as the average 4^{th} highest maximum, were periodically found to be above 85 ppb over the past decade. These trends are influenced by summer climatological conditions and long-range emissions transport. Lake Michigan shoreline ozone monitors at Benzonia, Scottville, Muskegon, Holland, and Coloma, as well as downwind monitors from Detroit (Detroit E. Seven Mile, Warren, New Haven, Port Huron, and Otisville) recorded 4^{th} highest 8-hour ozone levels above 85 ppb over the past three years.

All Michigan areas have been redesignated attainment with the 1-hour ozone standard. Designations with respect to the remanded 8-hour standard can not be made until U.S. Federal Courts make a final determination regarding the 8-hour standard.

Statewide volatile organic compound emission estimates provided by Michigan industry show a steady decline in emissions during the decade. Recent emission estimates were near the 60,000 short tons/year level.



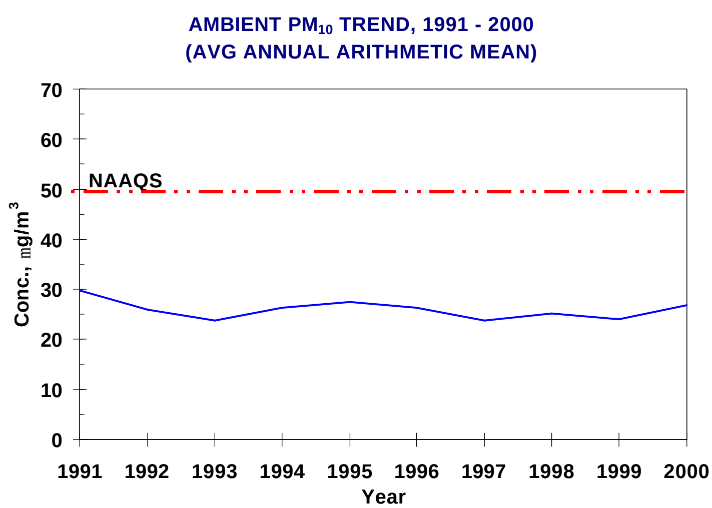
Health and Welfare Effects: In the troposphere (where we live and breathe) ozone is a harmful pollutant that irritates the respiratory system, and can cause coughing and chest pain upon deep inspiration. Ground-level ozone is the major component of photochemical smog. It is also responsible for crop damage and increased deterioration of rubber, dyes, paints and fabrics. In the stratosphere, ozone protects the earth from the sun's harmful ultraviolet light.

Particulate Matter (PM_{10} and $PM_{2.5}$)

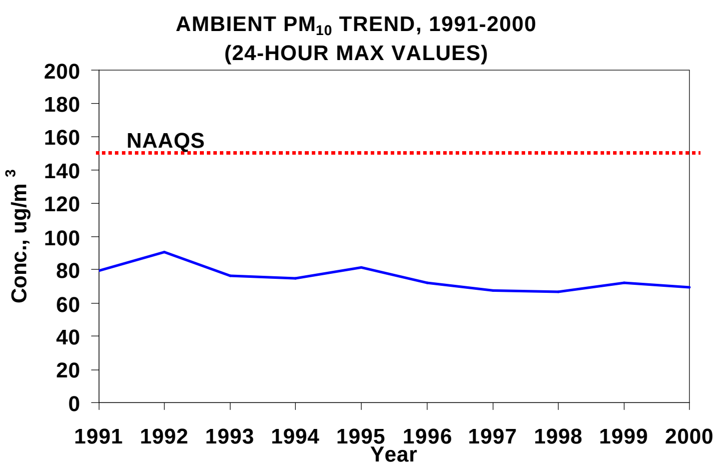
Primary PM_{10} NAAQS: Annual arithmetic mean not to exceed 50 µg/m^3 (based on a 3-year average) 24-hour concentration limit 150 µg/m^3. Average number of expected exceedances per year not to exceed 1.0 over the most recent 3-year period.
Secondary PM_{10} NAAQS: Same as primary standard.

Note: On July 18, 1997, EPA revised the 24-hour PM_{10} standard to be based on a 3-year average of the 99th percentile of the 24-hour PM_{10} concentration. The U.S. Circuit Court of Appeals for the District of Columbia vacated the standard on May 14, 1999.

Particulate matter is a broad classification of material that consists of solid particles, fine liquid droplets, or condensed liquids sorbed onto solid particles. Particulates with a diameter of less than 10 µm in diameter are defined as PM_{10} while very fine particles equal to less than 2.5 µm in diameter are defined as $PM_{2.5}$.

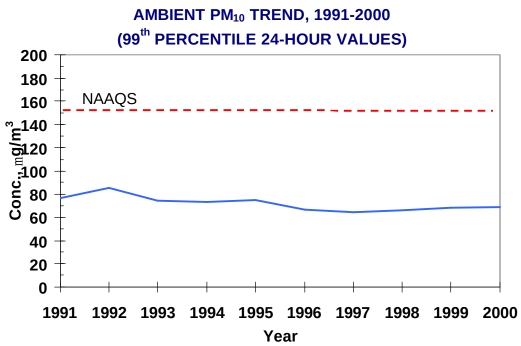


Statewide average annual arithmetic mean PM_{10} levels over the decade have remained at nearly ½ of the standard. Recent three-year averages of the annual arithmetic means from individual monitoring sites revealed that Wayne County monitors located in Dearborn and Detroit had the highest PM_{10} particulate levels at 39 µg/m^3 and 36 µg/m^3, respectively.



Over the decade, the statewide 24-hour maximum value trend was nearly ½ of the standard. In October 1999, the Wayne County Dearborn monitor site had a 24-hour concentration of 156 µg/m^3, which is just above the 150 µg/m^3 standard. During 2000, 24-hour maximum values approached the standard, with a value of 146 µg/m^3 in Detroit at National Chemical Services.

Michigan is designated attainment with PM_{10} particulate standards.



With the alteration of the 24-hour standard to a 99th percentile level, slight differences were observed. For most monitoring where limited numbers of samples were collected, the 99th percentile value corresponds to the maximum value for that year.

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

Note: On May 14, 1999, the U.S. Circuit Court of Appeals for the District of Columbia remanded the $PM_{2.5}$ standards for further consideration. Presently the standards are in litigation.

Due to the recent emergence of $PM_{2.5}$ monitoring, long-term historical trend information is unavailable. Based on monitoring results for the recent two years when monitor deployment began, statewide average annual mean concentrations have recorded values near 14 µg/m^3. Preliminary monitoring results (1999-2000) indicate annual arithmetic mean concentrations greater than 15 µg/m^3 in Southeastern Michigan (Wayne County). The highest annual mean concentration occurred at the Dearborn monitoring site. Preliminary results based on only two years of monitoring indicate the annual arithmetic mean would be the more important standard with respect to future nonattainment area designations when compared to the 24-hour 98th percentile levels. The highest annual 24-hour 98th percentile level (50.2 µg/m^3) occurred in Wayne County during 1999.

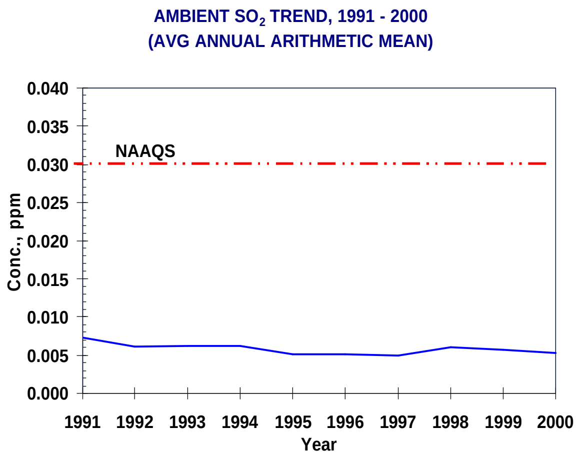
Three years of $PM_{2.5}$ monitoring have not yet been completed. Nonattainment area designations for fine particulate matter have not been made.

Health and Welfare Effects: Exposure to particulate matter affects breathing and the defenses of the lungs, and aggravates existing respiratory and cardiovascular disease. 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. Fine particulate matter less than 10 microns in diameter is especially harmful because it penetrates deep into the lungs. Particulates that lodge in the alveoli remain for longer periods of time as the alveoli have a slow clearance system. Particulate matter impairs visibility, damages materials, and creates soiling.

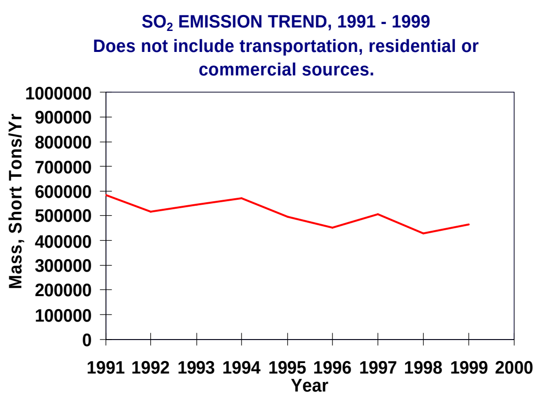
Sulfur Dioxide (SO_2)

Primary NAAQS:	Annual arithmetic mean not to exceed 0.030 ppm. 24-hour concentrations not to exceed 0.14 ppm more than once/year.
Secondary NAAQS:	3-hour concentrations not to exceed 0.50 ppm more than once/year.

Sulfur dioxide (SO_2) is a colorless, irritating gas formed by the burning of sulfur-containing material. It can react with other atmospheric chemicals to form sulfuric acid. Electric power generation and industrial processes that burn coal and oil generate SO_2. Other sources include refineries and smelters.



Statewide annual arithmetic mean levels have remained near 1/4th of the standard over the decade. During 2000, the highest annual mean sulfur dioxide concentration (0.008 ppm) of all monitoring sites occurred in Wayne County. The Detroit W. Fort monitor site in Wayne County had the highest detected 24-hour concentration in February 2000. Twenty years ago (in 1982) the last nonattainment area was redesignated to attainment. The state has continued to maintain attainment since that date.



Statewide sulfur dioxide emission estimates for Michigan industry have shown a decline in emissions over the decade. The Clean Air Act-Title IV Acid Rain Program Phase I and II sulfur dioxide emission limitations and State fuel sulfur content restrictions are credited with the reduced sulfur dioxide emissions. Recent emission estimates are at the 460,000 short tons/year level.

Health and Welfare Effects: and individuals with chronic lung and/or cardiovascular disease, children, and exposure to sulfur dioxide aggravates existing respiratory and cardiovascular disease. Asthmatics and the elderly are most susceptible. Sulfuric acid, which can be a by-product of sulfur dioxide emissions, acidifies lakes, streams, and soils, and corrodes building surfaces.

CHAPTER 2: Background Information

Purpose of Report:

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

- Describe the National Ambient Air Quality Standards (NAAQS),
- Identify the types of ambient air quality monitoring that was conducted throughout the state of Michigan,
- Provide an assessment of air quality with respect to the NAAQS,
- Identify state air quality trends for the past decade and provide a comparison to national air quality trends.

The Executive Summary of this report describes trends in air quality in Michigan over the decade (1991-2000) for each of the criteria pollutants for which NAAQS have been established. The trend charts contained in the Executive Summary illustrate the overall change in air quality for each criteria pollutant. For ozone and carbon monoxide, the second highest value (design value) determines if compliance with the NAAQS is achieved. The values for all stations that were in operation during each year are averaged and compared to the standard. The units used to express the data were chosen to relate to the NAAQS. These charts can be compared to those in the National Air Quality and Emissions Trends Report (**1**) so that the reader may relate Michigan's air quality observations with respect to national averages. Due to differences in the two databases, this represents only a crude comparison of Michigan's air quality trends to national trends. Emission trends that reflect stationary sources are also shown in the Executive Summary. Emission data is expressed in short tons per year.

Chapter 2 provides background information about the development of NAAQS and how compliance with the standards is determined. 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 summarized. An overview of the review and revisions to the NAAQS for ozone, particulates (PM_{10} and $PM_{2.5}$), nitrogen dioxide, sulfur dioxide, and carbon monoxide are also presented.

Chapter 3 provides a more in-depth analysis of air quality trends in Michigan. A description of the chemical and physical properties of each criteria pollutant, its common sources, toxicology and environmental effects, attainment status, long-term trends statewide and by metropolitan statistical area, 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 (OMB) June 30, 1999 metropolitan area boundaries. The projected impact of the new ozone 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.
In the creation of charts to show the minimum, maximum, and average levels, in many cases, the limited number of sites operating during a given year in the state preclude an in-depth statistical analysis or trend analysis. In some instances, data were

excluded in determining minimum, maximum, and average levels due to completeness or intent to assess localized impacts of a particular industrial emission source that may not be representative of the broader MSA area. The maximum and minimum values were used to illustrate the range in the values.

Ambient monitoring programs related to inorganic (trace metals) and organic toxic pollutants are discussed in Chapter 4. Special studies are summarized in Chapter 5, and meteorological information 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 and industrial source 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 AQD Internet web site. A limited number of print copies are available, as well. The Department also provides real time air monitoring information at its web site.

National Ambient Air Quality Standards (NAAQS):

The Federal Clean Air Act of 1963, as amended in 1970, 1977, and 1990, requires the EPA to establish National Ambient Air Quality Standards, which define the maximum permissible concentrations for certain pollutants. Section 108 of the amended Act 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 (a) pollutant in ambient air. Under Section 109 of the Act, the Administrator establishes National Ambient Air Quality Standards (NAAQS) for each pollutant for which air quality criteria have been issued. Section 109(b)(1) requires the EPA to set standards "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 (TSP), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), and photochemical oxidants. On October 5, 1978, the EPA promulgated an additional ambient air quality standard for lead (Pb). The air quality standard for ozone (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 fine particles with diameters less than ten microns (PM_{10}).

The EPA revised both the ozone and particulate standards on July 18, 1997. In addition, a new standard for particulate material with a diameter of less than 2.5 micrometers ($PM_{2.5}$) was introduced. On May 14, 1999, the Circuit Court of Appeals for the District of Columbia remanded the revised ozone and particulate standards to the EPA for re-evaluation. The current Air Quality Standards are summarized by pollutant in the Executive Summary 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 ppm used for carbon monoxide, reflect the effects of acute or short-term toxic 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: National Ambient Air Quality Standards (NAAQS) in Effect During 2000 for Criteria Pollutants.

Pollutant	Primary (Health Related): Type of Average	Primary (Health Related): Standard Level Concentration[a]	Secondary (Welfare Related): Type of Average	Secondary (Welfare Related): 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	
	Remanded 4th Highest 8-Hour Daily Maximum[d, g]	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	
Remanded $PM_{2.5}$	Annual Arithmetic Mean[f, g]	15 $\mu g/m^3$	Same as Primary Standard	
	98th percentile 24-hour[f, g]	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 1, as determined according to Appendix H of the Ozone NAAQS.

[d] The 8-hour standard is met when the 3-year average of the annual 4th highest daily maximum 8-hour ozone concentration is less than or equal to 0.08 ppm.

[e] Particulate standards when using PM_{10} (Particles less than 10 μm in diameter) as the indicator pollutant. The annual standard is attained when the expected annual arithmetic mean concentration is less than or equal to 50 $\mu g/m^3$ (3-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 1.

[f] Particulate standards when using $PM_{2.5}$ (particles less than 2.5 μm in diameter) as the indicator pollutant. The annual 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 3 years. If spatial averaging is used, the annual averages from all monitors within the area may be averaged in the calculation of the 3-year mean. The 24-hour standard is met when the 98th percentile value, averaged over 3 years, is less than or equal to 65 $\mu g/m^3$.

[g] On May 14, 1999, the Circuit Court of Appeals for the District of Columbia remanded the 8-hour ozone and fine particulate standards to the EPA.

Determining Compliance with the National Ambient Air Quality Standards NAAQS:

In order 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 National Ambient Air Quality Standards (NAAQS)

Pollutant	Criteria
CO	Compliance with the carbon monoxide standard is met when the 35 ppm 1- hour average standard is not exceeded more than once per year, and the 9 ppm 8-hour average standard is not exceeded more than once per year. An 8-hour average shall be considered valid if at least 75% for the hourly average are available. In the event that 6 or 7 hourly averages are available, the 8-hour average shall be 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% complete or derived from manual methods that are 75% complete for the scheduled sampling days in each calendar quarter.
O_3 1-hour	The area is in compliance with the standard when the 3-year average of the expected number of exceedance days per calendar year is equal to or less than 1 using the interpretative procedure described in 40 CFR 50 Appendix H (**7**)
O_3 8-hour	The remanded 8-hour primary and secondary 0.08 ppm standards are met when the 3-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**) Note: The 8-hour ozone standard was remanded by the court, and is currently under re-evaluation.
PM_{10}	The annual primary and secondary standards are met when the annual arithmetic mean concentration averaged over 3 years is less than or equal to 50 $\mu g/m^3$ using the procedures in 40 CFR 50 Appendix K (**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 1.
$PM_{2.5}$	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 3-year average of the 98^{th} 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**). Note: The $PM_{2.5}$ standards were remanded by the court, and are currently under re-evaluation.
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 3-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% 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 Air Quality Division (AQD), Michigan Department of Environmental Quality (DEQ), city or county agencies, as well as industries. A description of this air monitoring network can be found in the *2001 NAMS/SLAMS and Special Purpose Monitors Network Annual Review for Michigan*. (**16**). **Figures 2-1** and **2-2** show the geographical locations where ambient air monitoring was conducted during year 2000. **Table 2-3** further identifies the types of monitoring conducted at each monitoring site location.

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

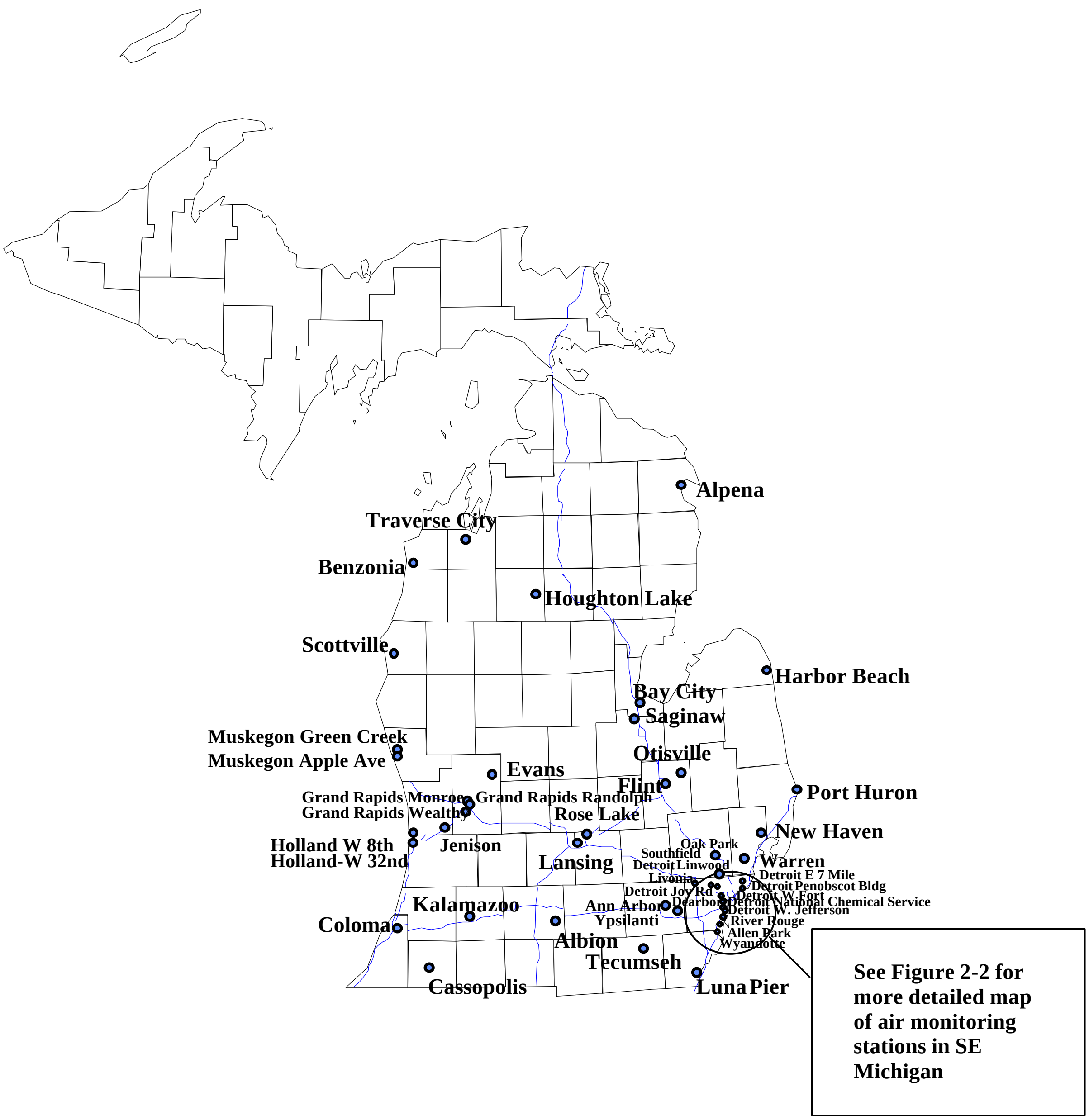
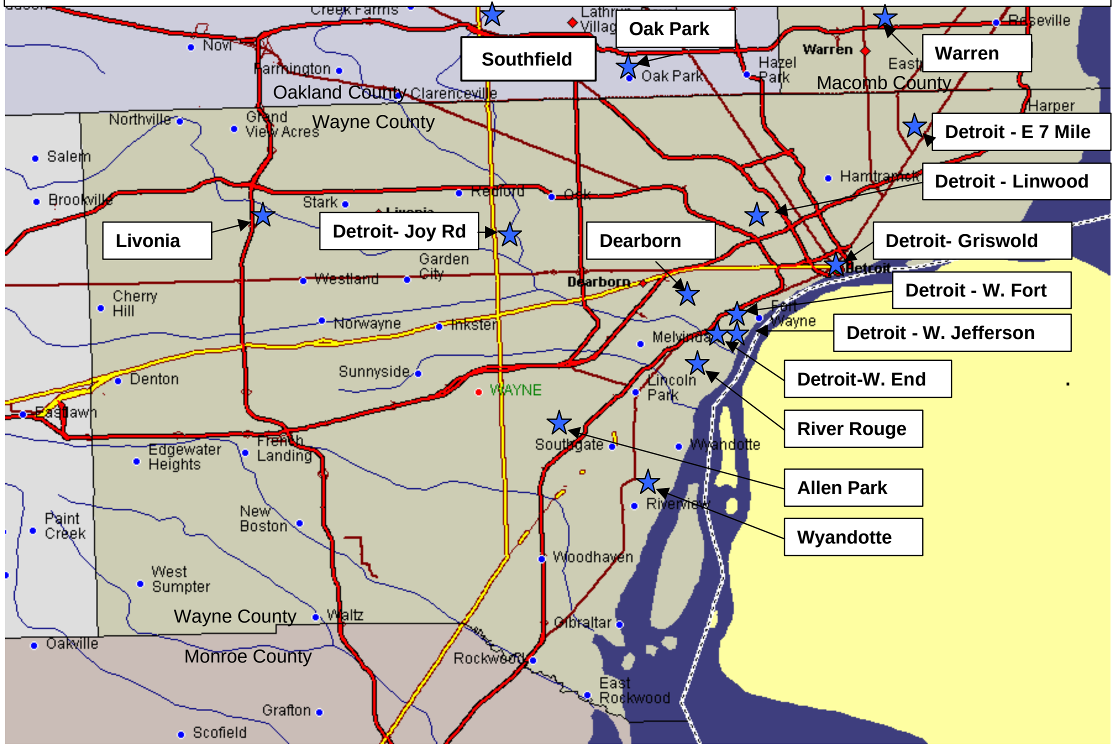


Figure 2-2: Southeast Michigan Air Monitoring Network Map



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 the Code of Federal Regulations 40 CFR Part 58 and its Appendices (**17**).

All sampling sites are selected and/or approved by the AQD. Selection of site locations and type of sensors is 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. A county without monitors is presumed to be in compliance with the air quality standards, except for ozone, which is a regional pollutant. 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 total suspended particulates and sulfur dioxide. However, with the reduction of the levels of those pollutants, increased emphasis has been placed on the other criteria pollutants, primarily ozone, and fine particulates.

Table 2.3: Michigan Air Sampling Network Station Locations in 2000

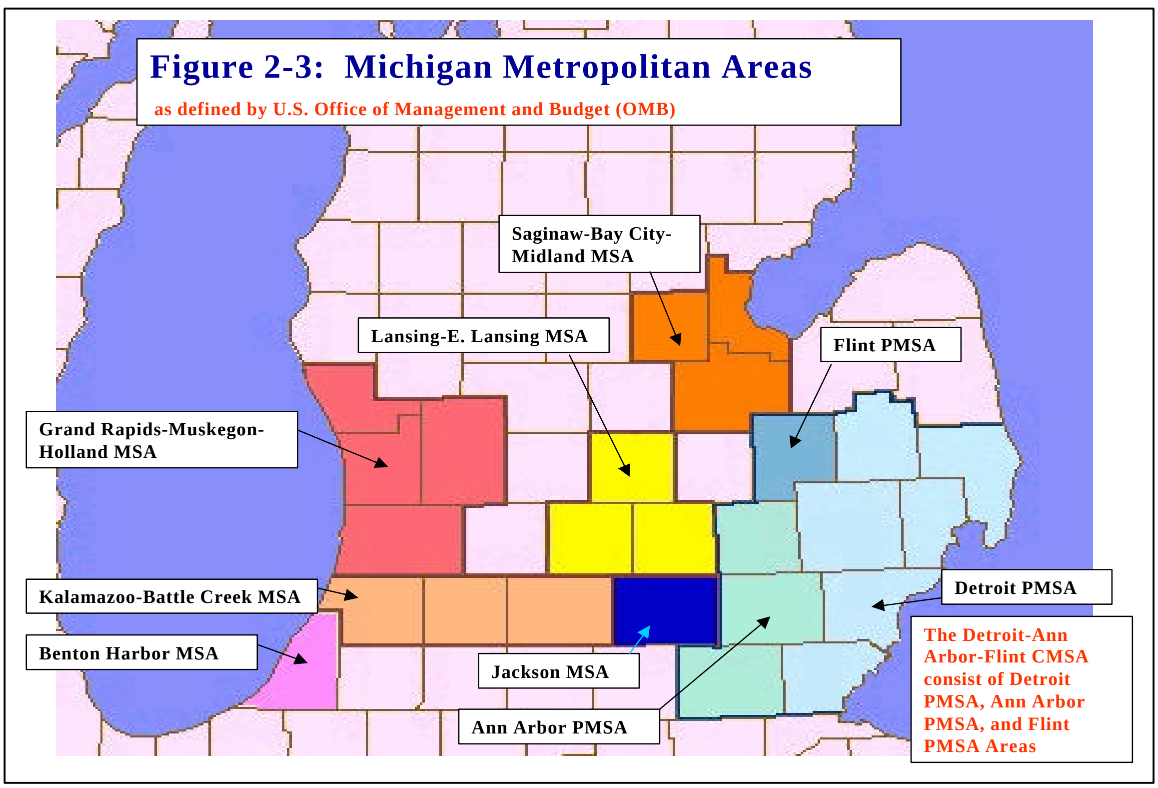
Site Name	AIRS ID	City	County	Carbon Monoxide	Lead	Nitrogen Dioxide	Ozone	Particulate Matter PM10	Particulate Matter PM2.5	Sulfur Dioxide	Toxic Organics	Carbonyl Aldehydes/Ketones	Trace Metals	Meteorological Parameters
Holland	260050003	Holland	Allegan				√		√					√
Alpena	260070005	Alpena	Alpena						√					√
Bay City	260170014	Bay City	Bay						√					
Benzonia	260190003	Benzonia	Benzie				√							√
Coloma	260210014	Coloma	Berrien				√		√					√
Albion	260250003	Albion	Calhoun					√						
Cassopolis	260270003	Cassopolis	Cass				√							
Rose Lake	260370001	Bath Twp	Clinton				√							
Flint	260490021	Flint	Genesee		√		√	√	√	√			√	√
Otisville	260492001	Otisville	Genesee				√							√
Traverse City	260550003	Traverse City	Grand Traverse						√					
Harbor Beach	260630007	Sand Beach Twp	Huron				√							√
Lansing	260650012	Lansing	Ingham			√	√		√					√
Kalamazoo	260770008	Kalamazoo	Kalamazoo				√		√					√
Grand Rapids Wealthy St	260810007	Grand Rapids	Kent					√						
Grand Rapids Monroe St	260810020	Grand Rapids	Kent	√			√	√	√	√				√
Grand Rapids Randolph	260810021	Grand Rapids	Kent		√						√	√	√	√
Evans	260810022	Oakfield Twp	Kent				√							√
Tecumseh	260910007	Tecumseh	Lenawee				√							√
New Haven	260990009	New Haven	Macomb				√		√					√
Warren	260991003	Warren	Macomb	√			√			√				
Scottville	261050007	Scottville	Mason				√							√
Houghton Lake	261130001	Merrit	Missaukee		√	√	√				√	√	√	√
Luna Pier	261150005	Erie	Monroe						√					
Muskegon Green Creek Rd	261210039	Muskegon	Muskegon				√							√
Muskegon Apple Ave	261210040	Muskegon	Muskegon						√					
Oak Park	261250001	Oak Park	Oakland	√			√		√					√
Southfield	261250010	Southfield	Oakland						*					
Jenison	261390005	Georgetown Twp	Ottawa				√		√					√
Holland	261390009	Holland	Ottawa					√						
Saginaw	261450018	Saginaw	Saginaw						√					√
Port Huron	261470005	Port Huron	St Clair				√		√	√				√
Ann Arbor	261610005	Ann Arbor	Washtenaw						√					
Ypsilanti	261610008	Ypsilanti	Washtenaw		√		√		√		√		√	√
Allen Park	261630001	Allen Park	Wayne	√	√		√	√	√*					√
River Rouge	261630005	River Rouge	Wayne		√			√		√	√	√	√	
Detroit-W. Fort	261630015	Detroit	Wayne		√			√	√	√	√	√	√	
Detroit-Linwood	261630016	Detroit	Wayne	√	√	√	√		√	√				
Detroit-E. Seven Mile	261630019	Detroit	Wayne		√	√	√		√*	√				√
Livonia	261630025	Livonia	Wayne	√				√	√					
Detroit-Joy Road	261630026	Detroit	Wayne	√										
Detroit-W. Jefferson	261630027	Detroit	Wayne							√				
Dearborn	261630033	Dearborn	Wayne		√			√	√	√				√
Wyandotte	261630036	Wyandotte	Wayne						√					
Detroit-Griswold	261630083	Detroit	Wayne	√										
Detroit-W. End	261630092	Detroit	Wayne					√						

* $PM_{2.5}$ chemical speciation monitor at site
Cassopolis monitor is managed by Indiana Department of Environmental Management.

Metropolitan Statistical Areas (MSAs):

The state of Michigan is divided into smaller areas or *Metropolitan Statistical Areas (MSAs)*. An MSA is designated by the U.S. Office of Management and Budget as containing a large population nucleus, together with adjacent communities, that have a high degree of economic and social integration within that nucleus. An MSA area 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. MSA areas that have a population of at least 1 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 Office of Management and Budget data[1], the Michigan MSA, PMSA, and CMSA areas are shown in **Figure 2-3.** There are six MSAs and one CMSA area, comprising three PMSAs in Michigan. The EPA has historically relied upon metropolitan area boundaries when designating nonattainment areas for air pollutants relative to NAAQS. Michigan was previously divided into six Air Quality Control Regions, but this concept is no longer used.



[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 just 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 and may be obtained at the Internet address at the end of the listed references for this chapter.

CHAPTER 3: Air Quality Trends in Michigan

Carbon Monoxide

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% of all CO emissions (**1, 2**). Previous winter day emission inventories have shown that the majority of CO emissions are attributed to on-road mobile sources (84%) in the Detroit/Ann Arbor Consolidated Metropolitan Statistical 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**).

Peak CO levels usually occur during the coldest winter months due to lower fuel combustion and emission control efficiencies in motor vehicles, and during temperature inversion conditions that entrap CO emissions. Because motor vehicles are a leading contributor of CO emissions, national efforts have been focused on control of their emissions. Tailpipe emission requirements and new vehicle design technologies have significantly reduced such emissions, but have been offset by an increase in the vehicle miles traveled. On a national scale, total CO emissions have decreased 5% since 1997, while on-road motor vehicle emissions have declined by 2% (**2**).

Carbon Monoxide Effects:

CO enters the bloodstream through the lungs and binds to hemoglobin in the red blood cells. Diffusion occurs rapidly across the alveolar and capillary membranes, and more slowly across the placental membrane (**5**). 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 also affected, but only at elevated concentrations (**6**).

At elevated levels, CO can cause visual impairment, interfere with mental acuity by reducing learning ability/manual dexterity, and decreasing 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 the carbon monoxide. Primary sources of exposure to elevated levels of CO for the typical individual are the exhaust from idling automobiles (older and poorly maintained models), unvented gas or kerosene space heaters, older 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**).

National Ambient Air Quality Standards for Carbon Monoxide:

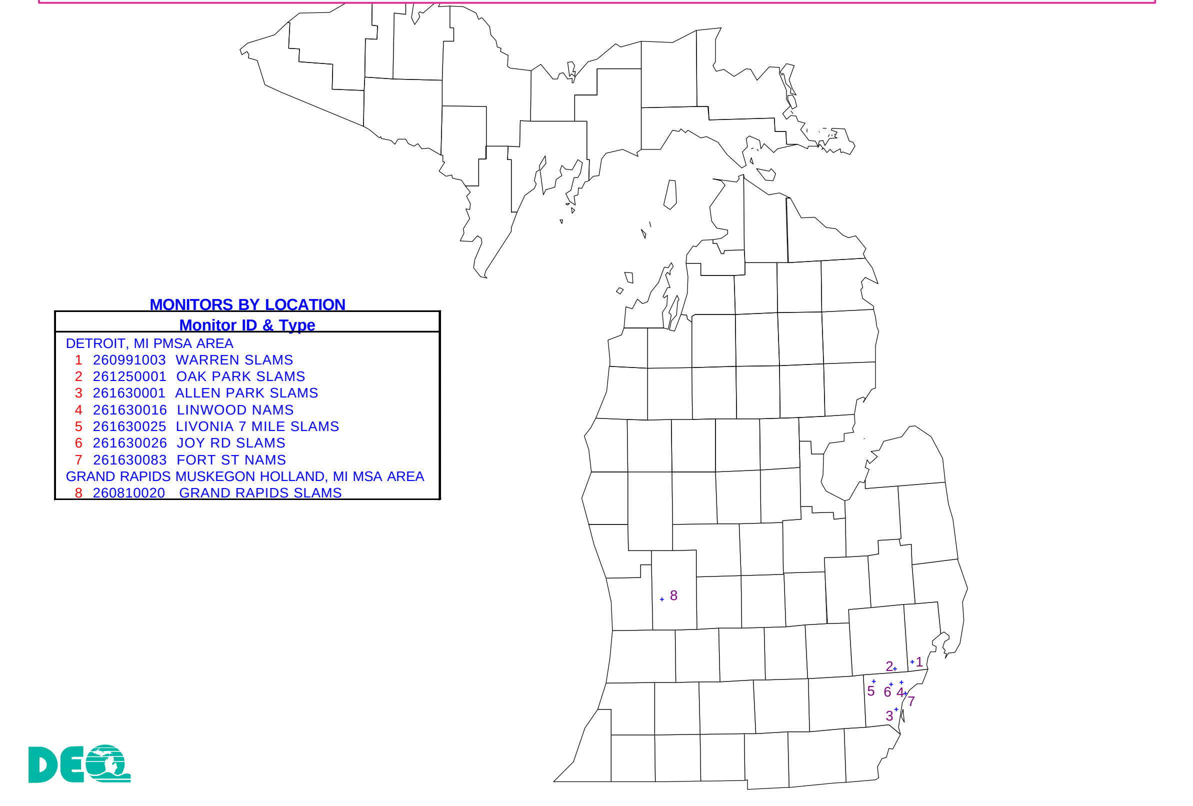
An 8-hour standard of 9 ppm (10 mg/m^3) and a 1-hour standard of 35 ppm (40 mg/m^3) are the two primary standards for CO, which are not to be exceeded more than once each year (**7**). There is no secondary standard for CO. The 8-hour standard is considered to be the more controlling form because there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

The National Ambient Air Quality Standards (NAAQS) for CO were originally promulgated on April 30, 1971 (**5**). On August 17, 2000, the U.S. EPA National Center for Environmental Assessment announced the final completion of their air quality criteria for carbon monoxide (**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 had been completed, a staff paper has not yet been developed with a recommendation to either retain or revise the CO NAAQS.

Carbon Monoxide Monitoring in Michigan:

According to the NAAQS for CO, all metropolitan statistical areas (MSA) with populations greater than 500,000, as determined by the most recent census, are required to have two national air monitoring stations (NAMS). 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 to about 100 meters. A type “b” NAMS site shall be located in a high-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 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 Michigan Department of Environmental Quality 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 Office of Air Quality Planning and Standards (**10**).

Figure 3.1-1: Air Quality Monitors for CO Active in 2000



In addition to the Detroit NAMS sites, five other CO monitors were operated in the Detroit area to determine neighborhood scale population exposure. These Detroit area monitors include Warren, Oak Park, Allen Park, E. Seven Mile Road, and Joy Road. A single 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 year 2000.

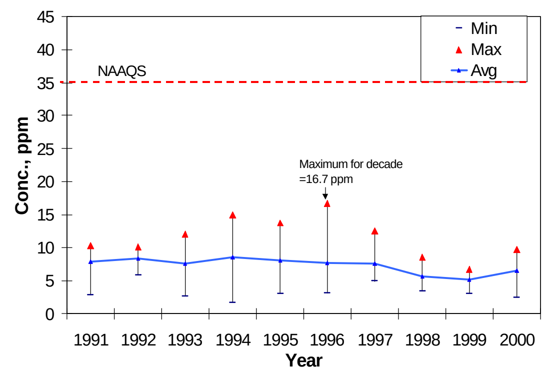
Attainment/Nonattainment Status of CO in Michigan:

The majority of monitoring stations are located in the Detroit metropolitan statistical area 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**). There were 16 nonattainment areas for CO nationwide classified as either moderate or serious nonattainment areas (38 counties) as of January 29, 2001 (**12**). All of the CO nonattainment areas are located in the Pacific Northwest or Southwest states, with the exception of just one nonattainment area in New York/New Jersey.

Long-Term Trends in Carbon Monoxide:

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-fourth of the 35 ppm NAAQS.

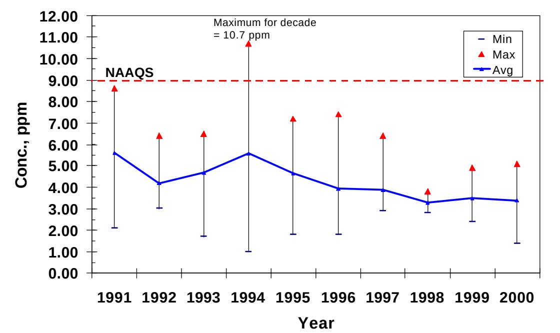
Figure 3.1-2: Range of Maximum 1-Hour CO Levels, 1991-2000



Maximum 1-hour values of individual sites for the decade have ranged between 6.7 (1999) to 16.7 (1996) ppm with 9.8 ppm, the maximum recorded value in 2000.

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 although the mean trend line levels of CO measured over an 8-hour time period have generally decreased from 1991 through 2000, the maximum 8-hour readings still exceeded the NAAQS on December 23, 1994 at the former Evergreen monitor site.

Figure 3.1-3: Range of Maximum 8-Hour CO Levels, 1991-2000

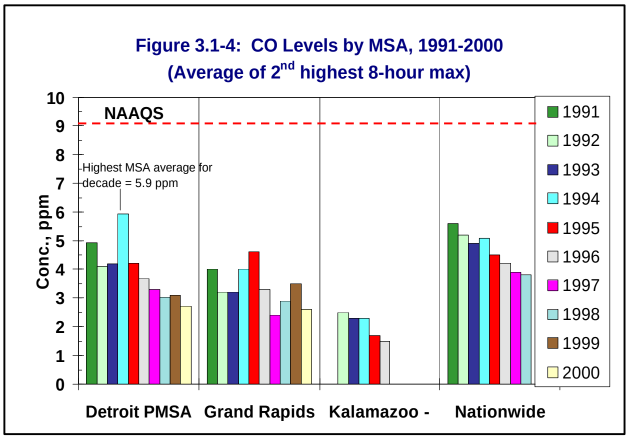


When comparing individual monitoring sites for the decade, the highest annual 8-hour readings ranged from 3.8 ppm in 1998 to 10.7 ppm in 1994. In 2000, the highest 8-hour value was 5.1 ppm.

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 six years.

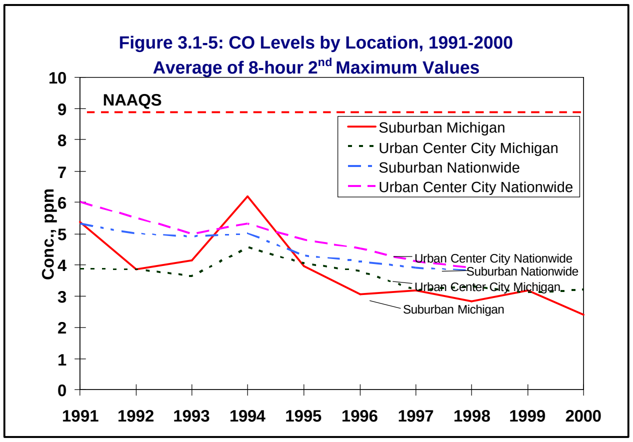
Trends by MSA & Location:

Figure 3.1-4 provides a comparison of the second highest 8-hour average values from Michigan MSAs with respect to nationwide averages. The greatest average value occurred in the Detroit PMSA area 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 years 1994 (Detroit PMSA) and 1995 (Grand Rapids – Muskegon - Holland MSA), Michigan's MSA areas have better air quality when compared to nationwide trend site averages.



The Detroit PMSA area reached its highest spatial average CO concentration level of 5.9 ppm during 1994. Annual spatial average CO concentrations in Detroit have decreased in recent years to nearly half of the level experienced in 1994. CO concentrations peaked in the Grand Rapids – Muskegon – Holland MSA during 1995, at 4.6 ppm, before further declining to its low concentration of 2.6 ppm in year 2000.

Additional comparisons were performed, which investigated suburban and urban center city CO concentrations on both a state and nationwide scale. **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 year 1994, when the national average was surpassed. Similarly, Michigan urban areas had lower CO average values than the nationwide averages.

Much of the national scale emission reductions over the past decade have been attributed to motor vehicle emissions controls. The imposition of tailpipe standards use of oxygenated fuels for high CO areas, and the phase-in of motor vehicle tailpipe (cold-weather testing) standards have reduced motor vehicle emissions. As a result of the amendments to the Clean Air Act, a national emission of 10 grams/mile was applied to cars and light-duty trucks at a temperature of 20°F beginning in 1994 (**13, 14**). With the replacement of older vehicles with vehicles subject to the lower emission standards, significant motor vehicle emission reductions have occurred and are reflected in ambient CO monitoring data of later years after 1994. Although nationwide there has been a 23% increase in vehicle miles traveled (VMT), on-road motor emissions have decreased 24% during the past decade (**2**).

Lead

Introduction:

From the 1920s until the 1970s, automotive gasoline contained alkyl lead compounds to prevent engine knocking. Alkyl lead compounds combine with other fuel additives during combustion to produce lead oxides and compounds that are emitted with motor vehicle exhaust. Alkyl lead content of gasoline began to be controlled in 1975 when motor vehicles were equipped with catalytic converters to reduce automotive hydrocarbon and carbon monoxide emissions. Lead additives were found to impair performance of catalytic converters of motor vehicle emission control systems (**1**). Phase-out of lead additives occurred when epidemiological studies found that lead particulate emissions from motor vehicles presented a significant harm to urban populations, especially children (**1**). The Clean Air Act Amendments of 1990 required elimination of lead in motor vehicle fuels. Since 1996, motor vehicle gasoline may not exceed 0.05 gram/gallon (**1**). The changes in gasoline formulations have had a marked impact on lead emissions from motor vehicles. Today, lead emissions from on-road mobile sources contribute less than 1% of all national emissions (**2**). Monitored ambient lead air pollution levels along the nation's roadways have reflected a 97% decrease (**2**).

As a result of the phase-out of lead additives in gasoline, industrial and combustion sources are the dominant lead emission sources. Metallurgical processes such as smelting/refining of lead, copper, and zinc; and the production of iron, steel, gray iron, brass and bronze emit lead. Lead acid batteries, lead oxide/pigments, lead glass, portland cement, and solder production are also industrial lead emission sources (**3**). Smelters and battery plants are now the major sources of lead nationwide (**4, 5, 6).** Lead 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**).

Lead Effects:

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

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

National Ambient Air Quality Standards for Lead:

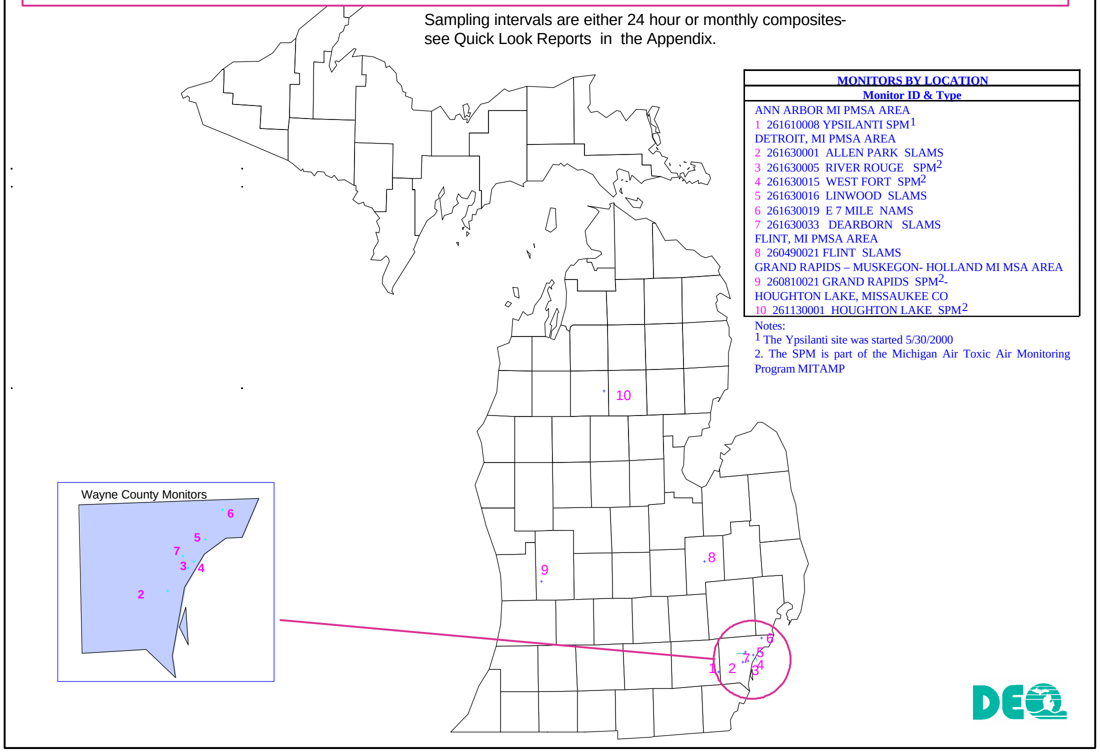
The National Ambient Air Quality Standards for lead specifies that the average of all the lead samples collected during a calendar quarter may not exceed 1.5 $\mu g/m^3$ (**11**).

Due to changes in lead emission source characterization in 1997, the EPA proposed the focus of surveillance monitoring for the lead standard changed from mobile source-oriented monitoring to a industrial source-oriented monitoring strategy (**12**). With the phase-out of alkylated lead additives in motor fuels, there was no longer the need to assess lead levels near major highways. EPA issued a final rule in 1999 that allowed many lead monitoring stations to be discontinued, while maintaining a core lead monitoring network in urban areas to track continued compliance with the lead NAAQS. One NAMS site must be located in one of the two largest MSA/CMSA cities with the greatest population (**2**). In the Region 5 area, monitoring continues in the Chicago-Gary-Kenosha CMSA and the Detroit-Ann Arbor-Flint CMSA (**3**). The purpose of the single NAMS monitoring site is to assess trends in the maximum lead concentration within the CMSA area, and is not impacted from a single, stationary lead source (**3**). In addition, monitoring must continue where one or more violations of the quarterly Pb NAAQS have been recorded over the previous eight quarters. In Michigan, there were no exceedances of the lead NAAQS, so the latter monitoring does not apply. EPA continues its focus on point sources and their impact on neighboring populations. All point sources (stationary sources emitting five or more tons per year) are considered candidates for additional lead monitoring (**2**). Since there are no large sources of lead in Michigan, no point source oriented monitoring is being conducted in the state.

Lead Monitoring in Michigan:

In Michigan (see **Figure 3.2-1**), a total of 10 lead monitoring sites operated during 2000. As a result of the revised federal regulations concerning ambient air surveillance for lead, a single Detroit NAMS at E. Seven Mile (26-163-0019) was retained to provide an indication of Detroit population exposure ambient lead levels.

Figure 3.2-1: Air Quality Monitors for Pb Active in 2000



Although the change in the federal surveillance regulations allows for the discontinuance of many monitors, Michigan has continued lead monitoring in the Detroit PMSA, Flint PMSA, and Grand Rapids-Muskegon-Holland MSA. As part of the Michigan Air Toxics Air Monitoring Program (MITAMP), the filters from several total suspended particulate (TSP) monitors are analyzed for several metals, including lead. A new MITAMP site began in Ypsilanti on May 30, 2000. These MITAMP special purpose metals monitors (SPM) provide ambient lead measurements in Grand Rapids, near Houghton Lake, River Rouge, and Detroit W. Fort Street. Samples at the MITAMP monitor sites are collected for a 24-hour period every 12 days. The SPM monitor at W. Fort Street in Detroit is located so that maximum lead levels in a middle scale air mass are monitored. The stations in Whaley Park in Flint and River Rouge monitor in Detroit measure maximum lead levels on a neighborhood scale. The new SPM monitor at Ypsilanti will supplement future trace metal analysis that will be conducted as part of an air toxics pilot study in Detroit. Therefore, lead monitoring will continue to occur at several sites in the Detroit area. During year 2000, monthly composite samples were collected in Detroit Urban Area at Allen Park Goddard Street, W. Fort Street, Linwood, E. Seven Mile, and Dearborn.

Attainment/Nonattainment Status of Lead in Michigan:

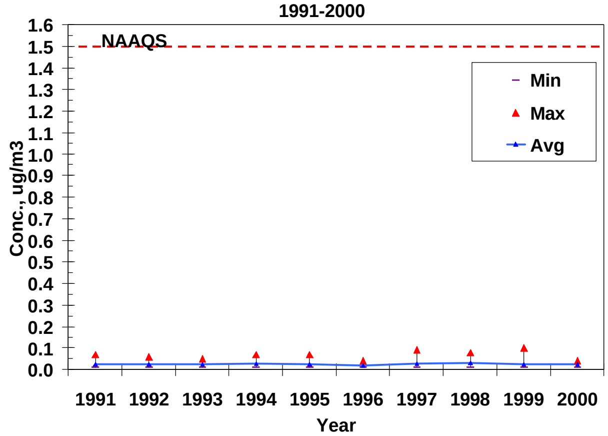
All areas in Michigan are designated as attainment for lead (**13**). As of January 29, 2001, there were only six nonattainment areas in the United States for lead (**14**).

National trend studies of population oriented monitors between 1990 and 1999 have shown a 60% reduction in the maximum quarterly lead concentration (**6**).
Violation of the lead NAAQS are only known to occur near large industrial sources such as lead smelters (**6**). In Michigan, atmospheric ambient lead levels have consistently remained significantly low throughout all monitored locations.

Long-Term Trends in Lead:

Average lead 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. The statewide average of the quarterly maximum lead levels over the decade has typically remained below the 0.02 µg/m^3 level. Historically, Michigan's ambient lead levels have been less than the national average.

Figure 3.2-2: Range of Maximum Quarterly Lead Levels, 1991-2000



The statewide quarterly maximum lead concentration (.04 µg/m^3) during 2000 occurred at the Grand Rapids and the Detroit – W. Fort Street monitor sites. At the Grand Rapids site, the maximum concentration occurred during the second calendar quarter. The maxi-mum concentration detected at the Detroit – W. Fort Street site was based on samples collected during the third and fourth calendar quarters of year 2000.

The highest statewide quarterly lead concentration (0.10 µg/m^3) over the decade occurred in Detroit – W. Fort Street during the first calendar quarter of 1999.

Nitrogen Dioxide

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 smells similar to bleach at lower levels. Nitrogen dioxide 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**). Nitrogen oxides and sulfur dioxide can react with other substances in the atmosphere to form acidic products that may be deposited in rain, fog, snow, or as particulate matter (**2**). Nitrate particles and nitrogen dioxide can block the transmission of light, thus causing visibility impairment in urban areas (**2**).

Nitrogen Dioxide Effects:

Exposure to nitrogen dioxide occurs through the pulmonary system. NO_2 irritates the lungs. Asthmatics are more sensitive to the effects of NO_2 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**).

National Ambient Air Quality Standards for Nitrogen Dioxide:

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

Nitrogen Dioxide Monitoring in Michigan:

The map in **Figure 3.3-1** shows the locations of Michigan nitrogen dioxide monitoring stations presently in operation. During the 1991 Lake Michigan Ozone Study, the numbers of ambient monitoring stations for NO_2 reached a maximum of 13 monitors. During year 2000, there were four. Of the four sites, two stations are located in Wayne County in Detroit, one monitoring site is near Houghton Lake in Missaukee County, and one monitoring site is in Lansing (Ingham County).

Nitrogen dioxide National Air Monitoring Stations (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 NOx whereas the E. Seven Mile monitor is an urban scale monitor site further downwind of peak NOx emission sources (**4**).

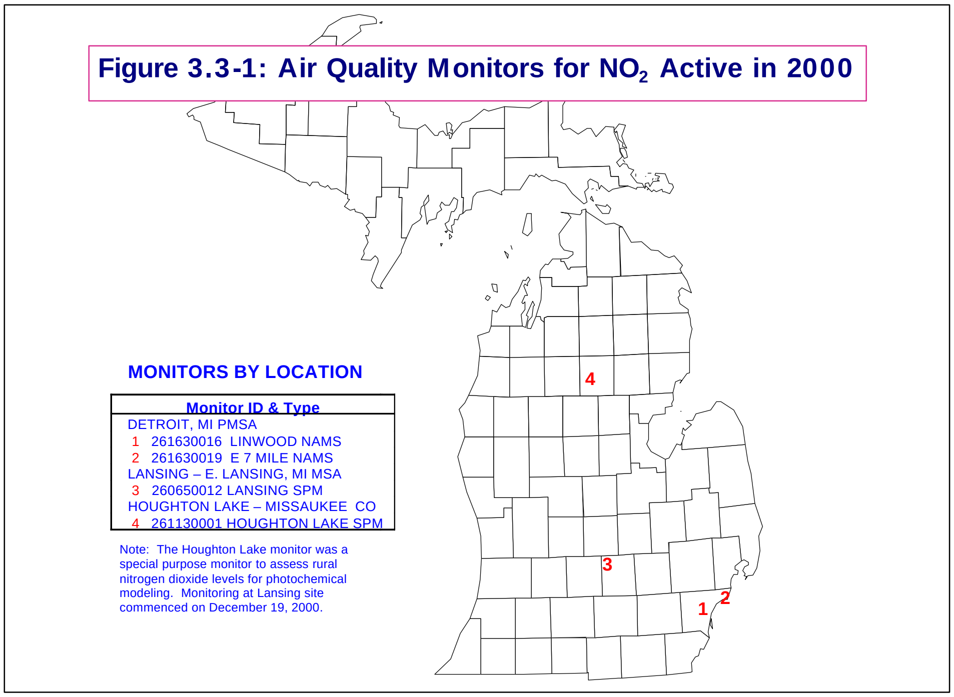


Figure 3.3-1: Air Quality Monitors for NO_2 Active in 2000

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, nitrogen dioxide monitoring was conducted in Houghton Lake for the identification of rural nitrogen dioxide levels. A monitor was later established at the Lansing monitoring site to assess neighborhood scale nitrogen dioxide levels in that urban area. Very limited monitoring data is available for year 2000 at the Lansing monitoring site due the startup of the monitor on December 19, 2000.

Attainment/Nonattainment Status of Nitrogen Dioxide in Michigan:

Since March 3, 1978, all of the areas in Michigan (and most of the nation) have been in attainment for nitrogen dioxide (**6, 7**). The only urban area nationwide that had recorded violations of the NAAQS for NO_2 during the previous 10 years was Los Angeles. In July 1998, EPA had announced the redesignation of the South Coast Air Basin, the last remaining NO_2 nonattainment area in the nation, to attainment (**6**, **8**). On a national scale, monitored NO_2 levels have decreased 25 percent over the past 20 years (**1**).

Long-Term Trends in Nitrogen Dioxide:

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 the Detroit Linwood and E. Seven Mile monitoring sites have shown an annual arithmetic mean NO_2 concentrations at less than half of the 0.053 ppm NAAQS. During year 2000, annual arithmetic mean

NO_2 concentrations at Detroit Linwood and E. Seven Mile monitoring sites were respectively 0.025 ppm and 0.018 ppm. Special purpose monitoring during year 2000 at the rural Houghton Lake monitoring site had an annual arithmetic mean concentration of 0.004 ppm.

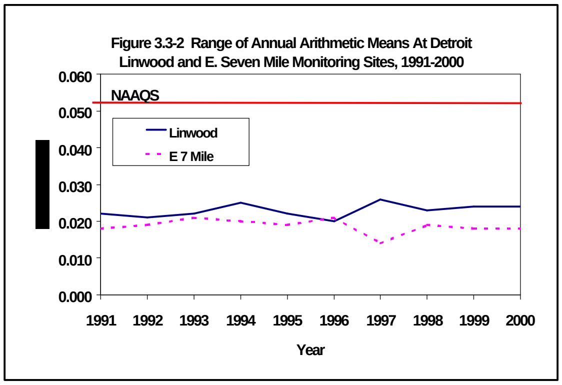


Figure 3.3-2 Range of Annual Arithmetic Means At Detroit Linwood and E. Seven Mile Monitoring Sites, 1991-2000

The national annual mean had a reduction of 10% (**1**) over the past decade (1990-1999). Title IV Section 407 (Acid Deposition Control) of the 1990 Clean Air Act Amendments 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 emission reductions that are 29% lower than the 1990 national emissions total of the 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 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**).

Trends by MSA & Location:

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

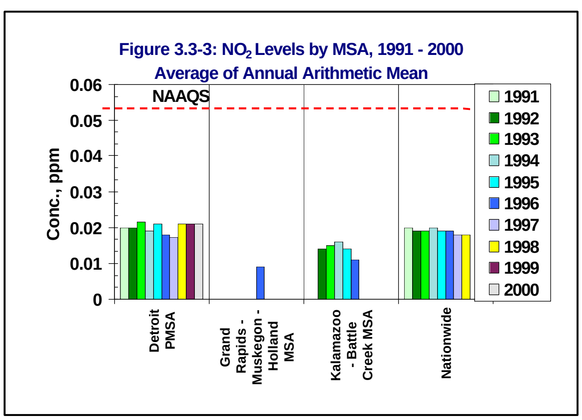


Figure 3.3-3: NO_2 Levels by MSA, 1991 - 2000
Average of Annual Arithmetic Mean

Over the previous ten years, the highest average NO2 levels observed statewide have occurred in the Detroit PMSA area. Trends show that the average annual NO2 level in the Detroit PMSA area at about 0.02 ppm, and at levels comparable to the nationwide averages. When comparing Kalamazoo- Battle Creek MSA air monitoring results to that of the nationwide averages, the respective MSA area had better air quality than the national averages. There hasn't been an exceedance of the NO2 standard in Michigan. During 2000, the largest annual arithmetic mean value from all individual monitoring sites was at the Linwood site with a mean of 0.025 ppm. During the decade, the largest annual mean values measured in Michigan occurred at this site in all but two years (1993 and 1996).

Ozone

Introduction:

Ozone is an air pollutant that is formed as a result of photochemical reactions involving the precursor air pollutants nitrogen oxides and volatile organic compounds (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). Ozone mixed with fine particles is also called photochemical smog. Smog itself is a brownish, acrid mixture of many gases and particles, while ozone is a colorless gas. The color, odor, and astringency of smog are due to compounds other than ozone (**1**). For a more detailed explanation of the chemical reactions and the mechanisms involved in the formation of ozone and other photochemical oxidants, can be found in the EPA criteria document on ozone (**2, 3**).

The ozone contained in smog is known as "tropospheric" or ground level ozone. Another layer of ozone, contained 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 ozone in this layer. Aerosol propellants and various refrigerants that contain chlorofluorocarbons that have been released migrate into the upper atmosphere. Once there, a complex series of chain reactions occurs that involve the formation of free radicals, which destroy the ozone molecules and create a thinning of the ozone layer. The two ozone layers generally do not mix.

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

Tropospheric ozone is dependent upon the availability of nitrogen oxides and volatile organic compounds that are the reactants in the photochemical reaction. Nitrogen oxide (NO_x) is the term used to describe the total of nitric oxide (NO), nitrogen dioxide (NO_2,) and other oxides of nitrogen are considered important due to their role in the formation of ozone. Ozone (a secondary air pollutant) is formed through a complex series of photochemical reactions involving volatile organic compounds (**5, 6**).

Volatile organic compound (VOC) 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, degreasing, and combustion of fuels. Biogenic sources include oils or resins naturally emitted from vegetation (trees and plants) such as terpenes, isoprenes, and other biotic VOCs.

Ozone Effects:

Human exposure to ozone can result in lung inflammation and aggravation of pre-existing respiratory asthmatic disease causing more severe asthmatic symptoms and more medical treatment (**7**). Other effects associated with ozone exposure include increased respiratory related hospital admissions; increased susceptibility to respiratory infection by suppression of immune system (alveolar macrophage decrement); and 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 ozone exposure include those 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**).

Ozone 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 ozone (**5**, **8, 9**).

National Ambient Air Quality Standards for Ozone:

The 1-hour ozone standard is set at a level of 0.12 ppm. This “exceedance-based” standard is violated when 1-hour averages of ozone concentrations exceed 0.12 ppm more than once per year when averaged over a 3-year period.

On July 18, 1997, the EPA issued a final rule on the new 8-hour ozone standard. This 8-hour standard is set at a level of 0.08 ppm, with a form based on the 3-year average of the annual, fourth highest daily maximum 8-hour average ozone concentration measured at each monitor within an area. At this time, implementation of the 8-hour ozone standard has been halted by a remand issued by the court.

Ozone Monitoring in Michigan:

The Michigan monitoring season for ozone is April 1 through September 30 each year (**10**). **Figure 3.4-1** shows the ozone sites that were in operation in 2000.

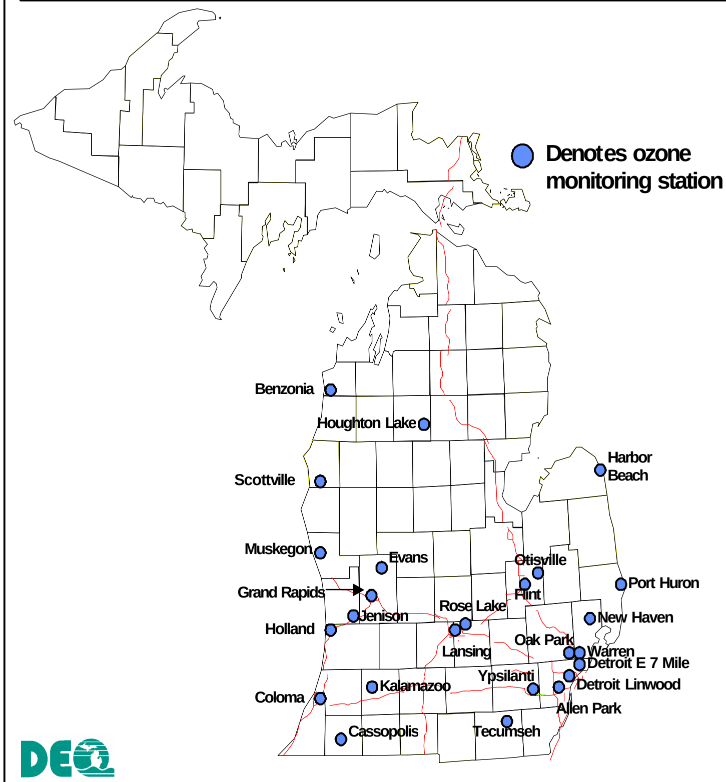
Monitor ID and Type

ANN ARBOR, MI PMSA
1 261610008 YPSILANTI SLAMS **
BENTON HARBOR MSA
2 260210014 COLOMA SLAMS
DETROIT, MI 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, MI 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 ROSE LAKE 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

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

** The new Ypsilanti (261610008) monitor which became operational on 4/1/00 replaced the Ann Arbor (261610007) monitor.

Figure 3.4-1: Air Quality Monitors for O_3 Active in 2000



During 2000, 24 ozone-monitoring stations were operated by state and local agencies in Michigan, and one station in Cassapolis was operated by the State of Indiana.

Monitoring networks often extend beyond where most precursor emissions occur because of the relationship between precursor emissions of nitrogen oxides and volatile organic compounds with respect to the downwind formation of ozone. Upwind and background sites are chosen so that transported ozone 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 ozone coming into Ann Arbor and the Detroit metropolitan area. The monitor near Houghton Lake in Missaukee County is a special purpose monitor that provides background concentrations in a remote rural environment. Some monitors are used to determine the extent of regional ozone transport into Michigan's populated areas. The monitoring sites located at Coloma, Holland, Jenison, Muskegon, Scottville, and Benzonia receive regional ozone 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 regional ozone transport air monitoring into Michigan's "thumb" area.

Ozone monitoring is conducted in urban areas that are located immediately downwind of locations where maximum precursor emissions occur. These ozone measurements are generally gathered near the downwind boundary of the central business district and 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, Linwood and Allen Park in Wayne County, and the Ypsilanti site in Washtenaw County, are located within the Detroit/Ann Arbor Consolidated Metropolitan Statistical Area, and provide an indication of population exposure at the neighborhood scale air mass level.

The new Ypsilanti monitoring site, which replaces the former Ann Arbor site, began operation in on April 1, 2000 (**11**).

Population exposures to ozone are also measured at neighborhood scale in Flint, Lansing, and Grand Rapids. These monitors are designed to meet NAMS siting criteria in the assessment of neighborhood scale high population density in the fringe of their respective central business area (**10**).

Maximum ozone concentrations occur downwind from metropolitan areas that produce precursor emissions. Ozone monitoring sites that are intended to detect maximum ozone concentrations are typically located 10 to 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 MSA, Grand Rapids, and Detroit) to detect maximum concentrations of ozone contained within urban scale air masses. Measurements made on this scale reflect maximum concentrations that result from the larger Michigan metropolitan areas. Additional SLAMS population exposure monitor sites at Oak Park and Cassopolis provide the benefit measuring maximum ozone concentration of urban scale air masses. Population exposure oriented monitors that also sample urban scale air masses are located at Oak Park and Cassopolis. Cassopolis is operated by the State of Indiana for the South Bend area.

Some monitoring stations are located to characterize ozone concentrations that are the result of long-range transport. 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 ozone that is generated outside of a receiving impacted area to assess the effectiveness of control strategies at local and regional scales (**3**). A monitoring site in Missaukee County near Houghton Lake is used to characterize rural background level ozone concentrations.

Attainment/Nonattainment Status of Ozone in Michigan:

All Michigan counties are now designated as being in attainment for the 1-hour ozone 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 Ozone Standard

Area	County	Attainment Date	Federal Register Notice of Attainment
Detroit –Ann Arbor	Livingston Macomb Monroe Oakland St. Clair Washtenaw Wayne	4/6/95 4/6/95 4/6/95 4/6/95 4/6/95 4/6/95 4/6/95	60 FR 12459, 3/7/95 60 FR 12459, 3/7/95 60 FR 12459, 3/7/95 60 FR 12459, 3/7/95 60 FR 12459, 3/7/95 60 FR 12459, 3/7/95 60 FR 12459, 3/7/95
Flint	Genesee	1/16/01	65 FR 67629, 11/13/00
Grand Rapids	Kent Ottawa	6/21/96 6/21/96	61 FR 31831, 6/21/96 61 FR 31831, 6/21/96
Muskegon	Muskegon	10/18/00	65 FR 52651, 8/30/00
Saginaw-Bay City - Midland	Bay Midland Saginaw	1/16/01 1/16/01 1/16/01	65 FR 67629, 11/13/00 65 FR 67629, 11/13/00 65 FR 67629, 11/13/00
Other areas	Allegan Mason Oceana Other counties	1/16/01 11/15/90 11/15/90	65 FR 70490, 11/24/00

Elsewhere in the United States, as of January 2001, there were 75 1-hour ozone nonattainment areas nationwide (**12**). More than one hundred million people reside in 266 counties in ozone nonattainment areas (**12**). Although designations can not yet be made for the remanded 8-hour standard, EPA has estimated a total of 332 counties where the 8-hour standard would be exceeded based on ozone concentrations over the 3-year period from 1997-1999 (**13**).

Three years of recent data were analyzed according to the remanded standard to project the impact of an 8-hour standard on Michigan. **Figure 3.4-3** illustrates monitoring sites where the 3-year average of the fourth highest 8-hour value is greater than 0.08 ppm. **Table 3.4-2** shows the fourth highest 8-hour ozone levels from 1994-2000 along with the computed 3-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 ozone values that exceed 0.08 ppm.

Figure 3.4-3: 4th Highest 8-Hr Ozone Value Averaged by Site Greater than 0.08 ppm for Years 1998 to 2000

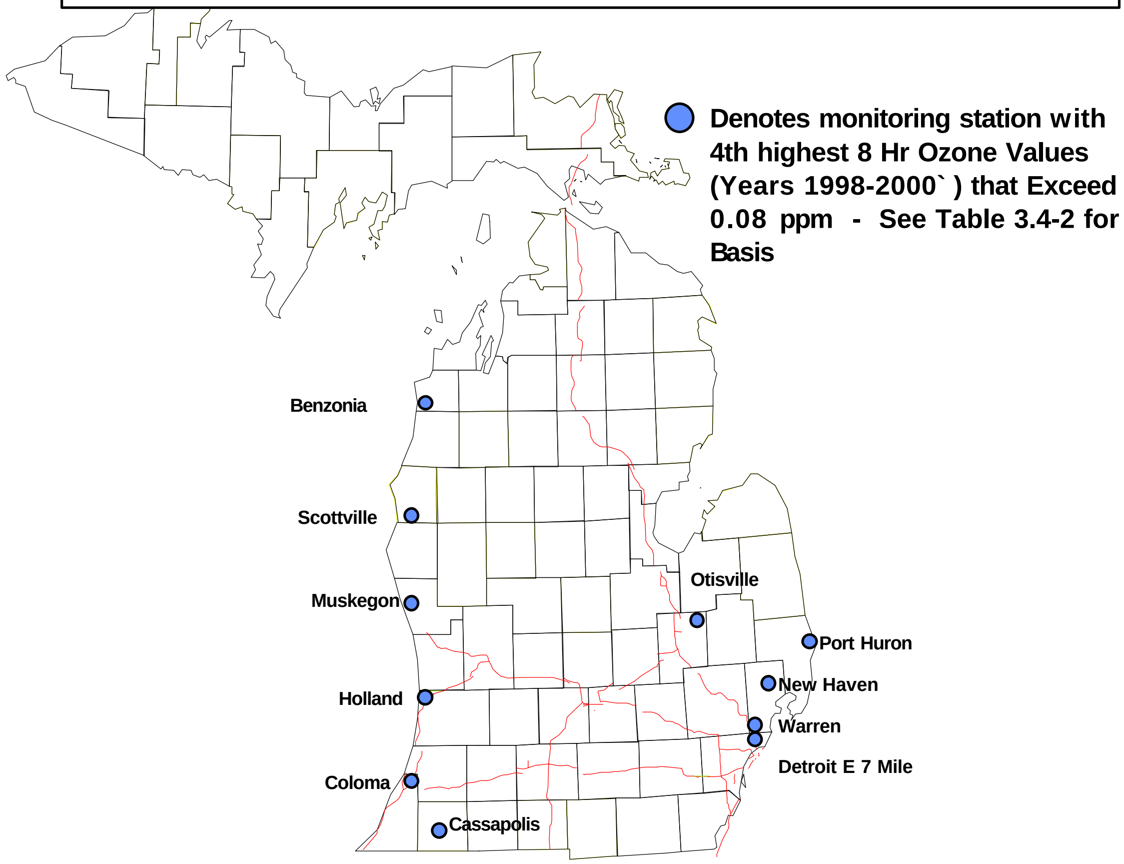


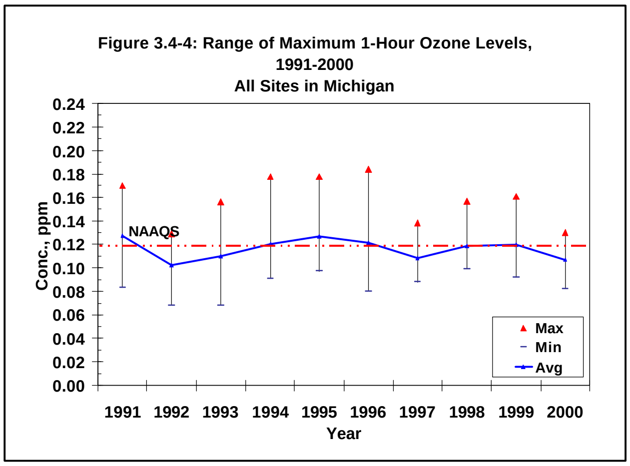
Table 3.4-2: 4th Highest 8-Hr Ozone Values For Years 1994-2000, Averaged at 3-Year Increments

AIRS ID		Year 1994	Year 1995	Year 1996	Year 1997	Year 1998	Year 1999	Year 2000
26005003 Holland	4th Highest 8 hr Value ppm	0.092	0.110	0.090	0.095	0.097	0.091	0.080
	3 Yr Average ppm		0.094	0.097	0.098	0.094	0.094	0.089
	Rounded to 0.01 ppm		0.09	0.10	0.10	0.09	0.09	0.09
26019003 Frankfort/Benzonia	4th Highest 8 hr Value ppm	0.085	0.099	0.085	0.078	0.090	0.097	0.081
	3 Yr Average ppm		0.089	0.089	0.087	0.084	0.088	0.089
	Rounded to 0.01 ppm		0.09	0.09	0.09	0.08	0.09	0.09
260210014 Coloma	4th Highest 8 hr Value ppm	0.086	0.098	0.098	0.099	0.093	0.096	0.077
	3 Yr Average ppm		0.087	0.094	0.098	0.096	0.096	0.088
	Rounded to 0.01 ppm		0.09	0.09	0.10	0.10	0.10	0.09
26027003 Cassopolis	4th Highest 8 hr Value ppm	0.090	0.099	0.095	0.090	0.091	0.095	0.079
	3 Yr Average ppm	0.087	0.089	0.094	0.094	0.092	0.092	0.088
	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	0.078	0.076	0.068	0.078	0.078	0.087	0.074
	3 Yr Average ppm	0.079	0.077	0.074	0.074	0.074	0.081	0.079
	Rounded to 0.01 ppm	0.08	0.08	0.07	0.07	0.07	0.08	0.08
260490021 Flint	4th Highest 8 hr Value ppm	0.077	0.082	0.089	0.076	0.089	0.089	0.072
	3 Yr Average ppm	0.071	0.076	0.082	0.082	0.084	0.084	0.083
	Rounded to 0.01 ppm	0.07	0.08	0.08	0.08	0.08	0.08	0.08
260492001 Otisville	4th Highest 8 hr Value ppm	0.073	0.079	0.084	0.079	0.089	0.095	0.074
	3 Yr Average ppm	0.071	0.074	0.078	0.080	0.084	0.087	0.086
	Rounded to 0.01 ppm	0.07	0.07	0.08	0.08	0.08	0.09	0.09
260550903 Traverse City	4th Highest 8 hr Value ppm					0.081	0.083	
	3 Yr Average ppm							
	Rounded to 0.01 ppm							
260630007 Harbor Beach	4th Highest 8 hr Value ppm	0.082	0.083	0.084	0.075	0.087	0.090	0.072
	3 Yr Average ppm		0.080	0.083	0.080	0.082	0.084	0.083
	Rounded to 0.01 ppm		0.08	0.08	0.08	0.08	0.08	0.08
260650012 Lansing	4th Highest 8 hr Value ppm	0.080	0.088	0.085	0.076	0.081	0.089	0.077
	3 Yr Average ppm	0.079	0.082	0.084	0.083	0.080	0.082	0.082
	Rounded to 0.01 ppm	0.08	0.08	0.08	0.08	0.08	0.08	0.08
260770905 Kalamazoo/ 260770008 Kalamazoo	4th Highest 8 hr Value ppm	0.079	0.093	0.085	0.082	0.087	0.091	0.070
	3 Yr Average ppm		0.084	0.085	0.086	0.084	0.086	0.082
	Rounded to 0.01 ppm		0.08	0.09	0.09	0.08	0.09	0.08
260770906 Kellogs	4th Highest 8 hr Value ppm	0.082	0.090	0.087				
	3 Yr Average ppm			0.086				
	Rounded to 0.01 ppm			0.09				
260810020 Grand Rapids	4th Highest 8 hr Value ppm	0.084	0.094	0.087	0.077	0.079	0.085	0.068
	3 Yr Average ppm		0.086	0.088	0.086	0.081	0.080	0.077
	Rounded to 0.01 ppm		0.09	0.09	0.09	0.08	0.08	0.08
260812001 Parnell. 260810022 Evans	4th Highest 8 hr Value ppm	0.084	0.098	0.086	0.079	0.087	0.094	0.073
	3 Yr Average ppm	0.081	0.086	0.089	0.087	0.084	0.086	0.084
	Rounded to 0.01 ppm	0.08	0.09	0.09	0.09	0.08	0.09	0.08
260910007 Tecumseh	4th Highest 8 hr Value ppm	0.084	0.089	0.085	0.076	0.086	0.083	0.082
	3 Yr Average ppm		0.082	0.086	0.083	0.082	0.081	0.083
	Rounded to 0.01 ppm		0.08	0.09	0.08	0.08	0.08	0.08
260990009 New Haven	4th Highest 8 hr Value ppm	0.097	0.092	0.091	0.090	0.098	0.096	0.075
	3 Yr Average ppm	0.088	0.091	0.093	0.091	0.093	0.094	0.089
	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	0.087	0.090	0.090	0.081	0.090	0.090	0.077
	3 Yr Average ppm	0.083	0.086	0.089	0.087	0.087	0.087	0.085
	Rounded to 0.01 ppm	0.08	0.09	0.09	0.09	0.09	0.09	0.09
261050006 Ludington/ 261050007 Scottville	4th Highest 8 hr Value ppm	0.085	0.110	0.093	0.086	0.087	0.101	0.081
	3 Yr Average ppm		0.095	0.096	0.096	0.088	0.091	0.089
	Rounded to 0.01 ppm		0.10	0.10	0.10	0.09	0.09	0.09
261130001 Houghton Lake	4th Highest 8 hr Value ppm					0.079	0.091	0.073
	3 Yr Average ppm							0.081
	Rounded to 0.01 ppm							0.08
261210039 Muskegon	4th Highest 8 hr Value ppm	0.090	0.117	0.097	0.084	0.092	0.103	0.078
	3 Yr Average ppm	0.086	0.096	0.101	0.099	0.091	0.093	0.091
	Rounded to 0.01 ppm	0.09	0.10	0.10	0.10	0.09	0.09	0.09
261250001 Oak Park	4th Highest 8 hr Value ppm	0.087	0.084	0.074	0.076	0.089	0.088	0.075
	3 Yr Average ppm	0.081	0.082	0.081	0.078	0.079	0.084	0.084
	Rounded to 0.01 ppm		0.08	0.08	0.08	0.08	0.08	0.08
261390005 Jenison	4th Highest 8 hr Value ppm	0.086	0.083	0.084	0.079	0.085	0.091	0.077
	3 Yr Average ppm			0.084	0.082	0.082	0.085	0.084
	Rounded to 0.01 ppm			0.08	0.08	0.08	0.09	0.08
261470005 Port Huron	4th Highest 8 hr Value ppm	0.086	0.094	0.086	0.079	0.091	0.091	0.080
	3 Yr Average ppm	0.082	0.089	0.088	0.086	0.085	0.087	0.087
	Rounded to 0.01 ppm	0.08	0.09	0.09	0.09	0.09	0.09	0.09
261470030 Algonac	4th Highest 8 hr Value ppm	0.095	0.100	0.088	0.087			
	3 Yr Average ppm	0.086	0.093	0.094	0.091			
	Rounded to 0.01 ppm	0.09	0.09	0.09	0.09			
261610005 Ann Arbor	4th Highest 8 hr Value ppm	0.079	0.084	0.088	0.074	0.084	0.092	0.078
261610007 Ann Arbor	3 Yr Average ppm	0.076	0.079	0.083	0.082	0.082	0.083	0.084
261610008 Ypsilanti	Rounded to 0.01 ppm	0.08	0.08	0.08	0.08	0.08	0.08	0.08
261630001 Allen Park	4th Highest 8 hr Value ppm	0.074	0.078	0.082	0.075	0.079	0.087	0.067
	3 Yr Average ppm	0.071	0.073	0.078	0.078	0.078	0.080	0.077
	Rounded to 0.01 ppm	0.07	0.07	0.08	0.08	0.08	0.08	0.08
261630016 Detroit Linwood	4th Highest 8 hr Value ppm	0.092	0.077	0.079	0.079	0.086	0.084	0.077
	3 Yr Average ppm	0.079	0.078	0.082	0.078	0.081	0.083	0.082
	Rounded to 0.01 ppm	0.08	0.08	0.08	0.08	0.08	0.08	0.08
261630019 Detroit E. Seven	4th Highest 8 hr Value ppm	0.094	0.091	0.086	0.088	0.093	0.092	0.080
	3 Yr Average ppm	0.084	0.089	0.090	0.088	0.089	0.091	0.088
	Rounded to 0.01 ppm	0.08	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 then changed
2. Ann Arbor site monitor was later relocated 5 miles NE of the former site location, and later moved to Ypsilanti due to site access.
3. Ludington site monitor was later closed due to loss of site access in 10/97 and relocated to Scottville

Long-Term Trends in Ozone:

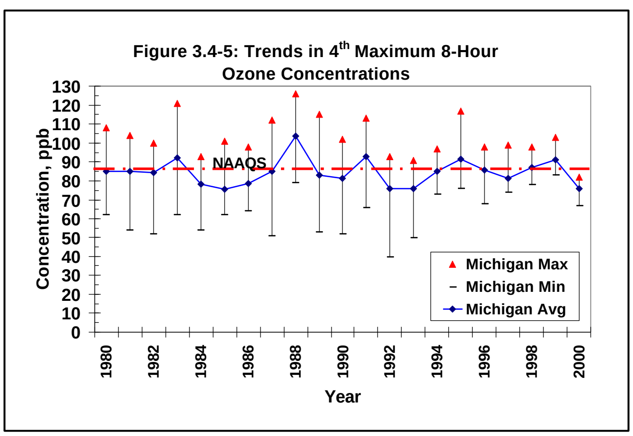
As shown in **Figure 3.4-4**, maximum 1-hour ozone concentrations, over the decade occurred at 4-year time intervals (1991, 1995, and 1999). During these peak years, the statewide average of annual maximum values reached 0.127 ppm (1991 and 1995) and 0.120 ppm (1999). This value is calculated by averaging statewide the maximum seasonal 1-hour ozone level that occurred at each monitoring site. Extremely hot, dry weather typically conducive to ozone formation occurred during the respective years, and contributed to the increased average ozone values, as shown by the upward trends.



In year 2000, the statewide average obtained from the maximum 1-hour ozone concentration dropped to 0.107 ppm. During 1992, the statewide average reached a low for the decade of 0.102 ppm.

The highest year 2000 1-hour ozone concentration occurred at Scottville in Mason County. Over the decade, the highest detected 1-hour ozone concentration (0.184 ppm) occurred on 5/22/96 at the Port Huron site.

Figure 3.4-5 shows the statewide averages of the fourth highest annual 8-hour ozone concentration.



During the time period from 1980 to 2000, peak 8-hour ozone levels have typically occurred at 3-5 year intervals, with the highest values reached in 1988. Recent data for 2000 would show the statewide average is below 85 ppb.

The number of exceedances of the 1-hour standard on a statewide basis is shown in **Figure 3.4-6** for years 1980-2000. In 2000, three exceedances of the 1-hour ozone standard were recorded. A description of the 1-hour ozone exceedances for recent years can be found in Appendix D.

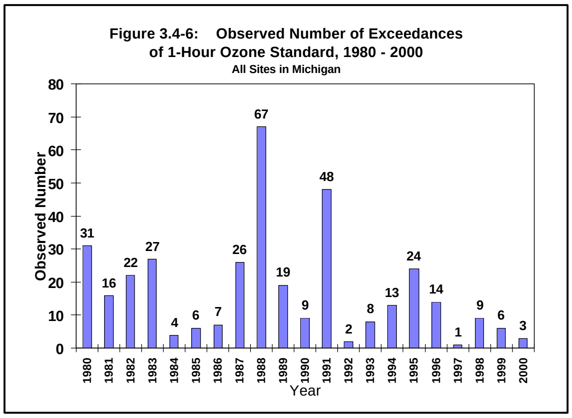


Figure 3.4-6: Observed Number of Exceedances of 1-Hour Ozone Standard, 1980 - 2000

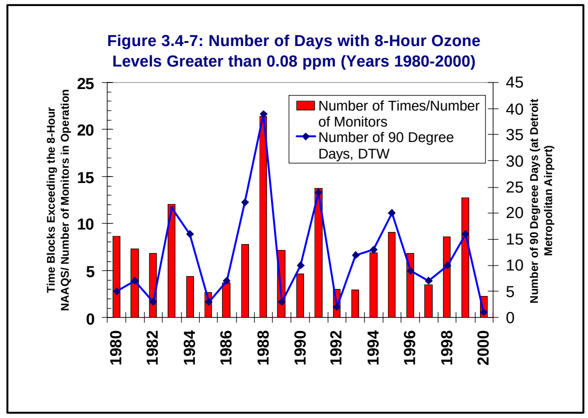


Figure 3.4-7: Number of Days with 8-Hour Ozone Levels Greater than 0.08 ppm (Years 1980-2000)

Figure 3.4-7 compares the number of occasions that an 8-hour ozone reading was greater than or equal to 0.08 ppm with the number of 90°F days (≥ 90°F). The National Weather Service collected 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 ozone values.

This comparison shows the influence of temperature with respect to elevated ozone levels. Over the past 20 years, a typical summer would average 12 days where the temperature would exceed 90°F. Peak occurrences in the number of 90°F days have occurred at 3-5 year time intervals.

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

Trends by MSA & Location:

Maximum hourly ozone values are broken down by MSA in **Figure 3.4-8**.

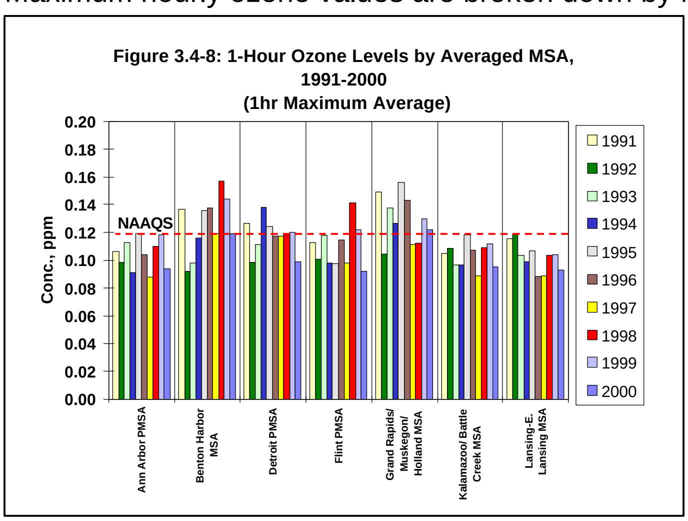


Figure 3.4-8: 1-Hour Ozone Levels by Averaged MSA, 1991-2000 (1hr Maximum Average)

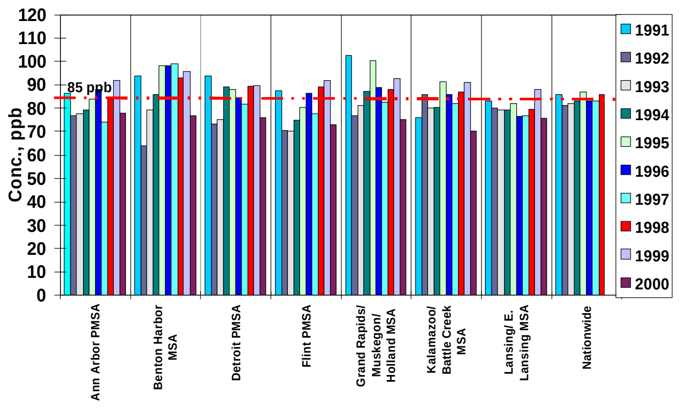
Over the past decade, concentrations above the 0.12 ppm 1-hour standard have been recorded in the Benton Harbor MSA, Detroit PMSA, Flint PMSA, and Grand Rapids-Muskegon-Holland MSA.

Ozone monitors that are not included within a metropolitan area have recorded elevated 1-hour ozone levels above 0.12 ppm.

The Scottville/Mason County and Cassopolis/Cass County sites have recorded elevated concentrations due to sub-regional transport of ozone (see Appendix D).

Figure 3.4-9 shows the fourth highest 8-hour ozone values for each metropolitan area. According to the 8-hour ozone levels graph, all Michigan MSA areas periodically experience 8-hour values greater than 85 ppb.

Figure 3.4-9: Annual 4th Highest 8-Hour Ozone Levels Averaged Across the MSA from 1991-2000

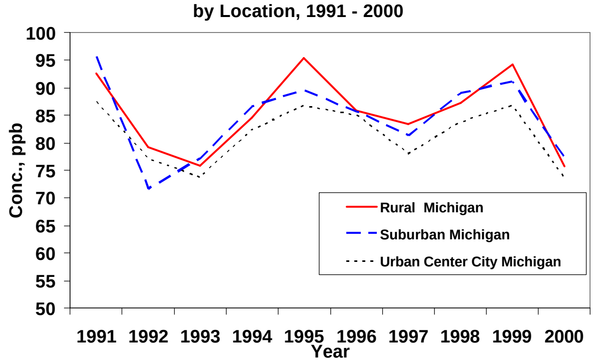


As with the 1-hour ozone data, there are ozone monitors that are not included within an MSA area that have 8-hour ozone values greater than 85 ppb. Ozone monitoring sites at Benzonia/Benzie County, Cassopolis/ Cass County, Harbor Beach/Huron County, Tecumseh/ Lenawee County and Scottville/ Mason County had yearly 8-hour ozone values exceeding 85 ppb (see **Table 3.4-2**).

Ozone is formed downwind of areas that emit the precursor pollutants (VOC and NOx). These precursor pollutants photochemically react in the atmosphere to form ozone at locations other than precursor pollutant origin. This would explain the increase in suburban ozone concentrations when compared to urban center city sites at both a state and national scale.

Higher ozone concentrations are attributed to sub-regional ozone transport into Western Michigan shoreline counties. Monitors located downwind of Detroit also experience sub-regional ozone transport.

Figure 3.4-10: 4th Highest 8-Hour O_3 Levels Averaged by Location, 1991 - 2000



Similar trends are observed for Michigan rural, suburban, and urban center-city areas based on the fourth highest 8-hour ozone level. **Figure 3.4-10** would show that Michigan rural areas periodically detect higher ozone concentrations than urban center-city and suburban monitor sites.

Particulate Matter (PM_{10}, $PM_{2.5}$, $PM_{2.5}$ Chemical Speciation, & TSP)

Introduction:

Particulate matter is a broad classification of material that consists of solid particles, fine liquid droplets, or condensed liquids sorbed onto solid particles. The particles or droplets have many different chemical compositions, depending on their origin. Airborne particulates are not a single pollutant, but rather a mixture of many subclasses of many different air pollutants (**1**). Structural, chemical, physical, and thermodynamic properties determine the chemical reactions that occur in the atmosphere to form new chemical compounds or change the form from gases and liquids into solid particles. Particulate matter can be categorized on the basis of origin and their transformation state. Primary particulates are materials such as wind blown dust, road dust, mechanically generated particles from an industrial process, soot and fly ash from combustion of materials, and condensation of vapors that may have formed during combustion. Primary particulate emission sources that generate particulate emissions include combustion, incineration, construction, mining, metal 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. Sulfur dioxide, nitrogen oxides, and ammonia are gaseous precursor pollutants that react in the atmosphere to form secondary particulate aerosols. Examples of secondary particulates include:

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

Particulate matter in the atmosphere may also be categorized according to size because of different health impacts from particles of different diameters. Particles with diameters of less than 50 µm are classified as Total Suspended Particulates (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. Particulates with a diameter less than 10 µm are defined as PM_{10} - a subset of fine particles within TSP. Particles less than 10 µm present a health risk because they are fine enough to enter the respiratory system and may become lodged in the alveoli. Particles of intermediate size from 2.5 µm to 10 µm in diameter can penetrate into the lungs only through mouth breathing. Particles equal to or less than 2.5 µm in diameter are called $PM_{2.5}$ and they can penetrate into the lungs during normal breathing through the nose.

Most anthropogenic particulate emissions fall into the size range classified as TSP. The PM_{10} sized particles usually are the result of fly ash from power plants, carbon black from automotive industries, various manufacturing processes, from wood stoves and fireplaces, agriculture and forestry practices, and fugitive dust sources. Incomplete burning of diesel fuel emits particles that are primarily made of carbon or are carbonaceous in nature. In the U.S., PM_{10} emissions from fuel combustion, industrial processes, and transportation each contribute about one-third of the traditionally inventoried particulate source categories. These source categories, however, only account for 6% 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.

Fugitive dust is estimated to be responsible for 68% of all PM_{10} emissions, nationwide, followed by agriculture and forestry (**5**). The particle size class ranging from 2.5 μm to 10 μm is mainly due to wind blown dust. The $PM_{2.5}$ material may come directly from emissions (primary) or may be formed through photochemical reactions of gases that occur in the atmosphere (secondary) that are emitted by sources.

Because of the increasing attention given to the relation of precursor pollutants to the formation of fine particulates, in 1999 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 will be 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 monitoring data in the development of emission control strategies (**7**). In addition to the 54 National Ambient Monitoring Stations (NAMS) trends sites, EPA anticipates that 250 State and Local Air Monitoring Stations (SLAMS) chemical speciation sites will later be deployed on a national basis in the future development of State Implementation Plans (**6**).

Additional monitoring efforts have focused on episodic variation in $PM_{2.5}$ concentrations. 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 shall be used to provide temporal resolution of fine particulate concentrations (**9**). In some situations, continuous fine particulate PM analyzers may be used to reduce sampling frequency of federal reference method gravimetric analytical determination (**9**, **10**).

Particulate Matter Effects:

Inhalable particulate matter includes both fine particulates (< 2.5 micrometers in diameter) and coarse particulates (≥ 2.5 and ≤ 10 micrometers diameter) (**11**). Particle size is the major factor that determines which particles will enter the lungs and how deeply the particles will penetrate into the lungs. Fine $PM_{2.5}$ can enter deeply into the lungs, reaching the tracheobronchial region and the alveoli. Respiratory diseases such as asthma are aggravated by exposure to high concentrations of either PM_{10} or $PM_{2.5}$. Lung tissue may become damaged, and changes may occur in the immune system (**2**, **3, 7**). Retention of particulates is dependent on the deposition site, and physical and chemical characteristics of particles (**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. Individuals most sensitive to particulate matter exposure include the elderly, individuals with pre-existing cardiopulmonary diseases such as asthma, and children (**11**).

Particulate matter may also damage building surfaces and 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**).

National Ambient Air Quality Standards for Particulate Matter:

In 1971, the national ambient air quality standards were established for particulate matter less than 50 µm in diameter, called total suspended particulate (TSP). The primary TSP standard was 260 $\mu g/m^3$ over a 24-hour period and 75 $\mu g/m^3$ as the annual geometric mean. A secondary 24-hour standard was established at 150 $\mu g/m^3$. 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.

The particulate standard was revised from TSP to PM_{10} on July 1, 1987 because research demonstrated smaller size particles represent a greater health risk. The PM_{10} standard set a maximum allowable 24-hour level of 150 $\mu g/m^3$ and an annual level of 50 $\mu g/m^3$ averaged over a period of three years.

On July 18, 1997, the EPA promulgated a new standard for particulate material. The new standard added fine particulate matter with a diameter of less than or equal to 2.5 microns. The EPA determined that health concerns with respect to fine particulate warranted adopting a new standard. The final form of the standard consists of an annual as well as 24-hour average. The annual average may not exceed 15 $\mu g/m^3$, and the $\underline{98^{th}}$ percentile of the 24-hour standard must be less than or equal to 65 $\mu g/m^3$ (**12**). Compliance with both the 24-hour and annual standards is based on data averaged over a 3-year period. The PM_{10} standard was retained.

At this time, implementation of the $PM_{2.5}$ standard has been halted by a remand of the federal court. The PM_{10} standard continues to be an applicable particulate standard nationwide. The five-year cycle to review the adequacy of the particulate standard is in process.

Monitoring for Particulate Matter (PM_{10}, $PM_{2.5}$, $PM_{2.5}$ Chemical Speciation, and TSP) in Michigan:

Fifteen PM_{10} monitoring sites operated during 2000 (see **Figure 3.5-2**). The monitoring network is designed to provide neighborhood scale monitoring of maximum PM_{10} concentrations, as well as population-oriented exposure assessment of particulates comprising PM_{10}. A newly developed fine particulate monitoring network of 25 monitoring sites using federal reference method (FRM) design was established during 1998-2000 to assess community-oriented exposure, including maximum pollutant concentrations and regional background/transport levels.

$PM_{2.5}$ 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 MSA areas with populations >200,000 individuals (**9**). The number of "core monitors" is dependent on the population level comprising the MSA area, with the Detroit MSA having the largest number of monitors, while Ann Arbor, Grand Rapids, Flint, Kalamazoo, Lansing, Muskegon, and Saginaw having a reduced number of the "core monitor" sites. Two core $PM_{2.5}$ monitors are required for each MSA with populations greater than 500,000 persons (Detroit and Grand Rapids), with sample collection every day unless exempted by the Regional Administrator. EPA requires one core $PM_{2.5}$ monitor with sampling every third day for MSAs with populations greater than 200,000 persons and less than 500,000 persons (**9**).

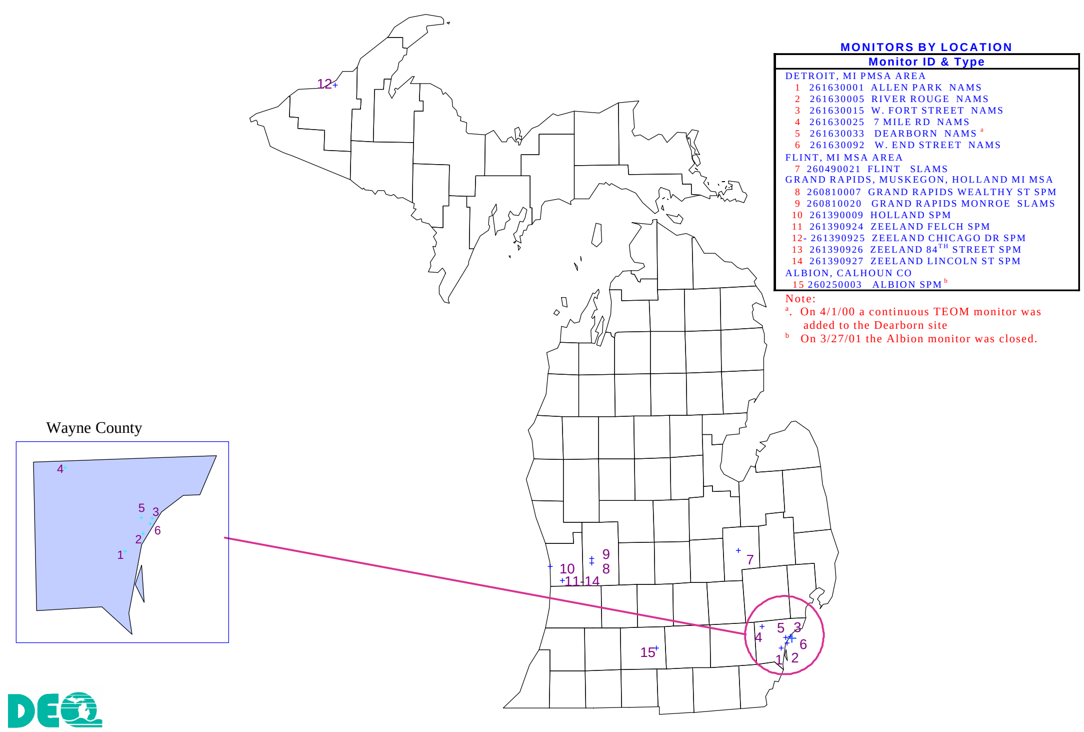
Of Michigan's 25 $PM_{2.5}$ monitoring sites, five are co-located at PM_{10} monitoring sites to allow for fine and coarse particulate comparisons to be made with respect to fractional size. Co-located PM_{10} and $PM_{2.5}$ sites include Flint, Grand Rapids-Monroe and the Detroit PMSA monitoring sites at W. Fort, E. Seven Mile Road and Dearborn.

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. Three new $PM_{2.5}$ chemical speciation monitor sites were established at Allen Park, Southfield, and at Detroit - E. Seven Mile in December 2000. Allen Park is a NAMS trend chemical speciation monitor site, while the Southfield and Detroit – E. Seven Mile are special purpose chemical speciation monitors. The Southfield monitor site is located north of the I-696 freeway, and will be used to chemically speciate fine particulate matter of motor vehicle emissions. The Detroit – E. Seven Mile chemical speciation monitor is co-located with a gas chromatograph. These special purpose chemical speciation monitors will operate for the duration of the Detroit Air Toxics Pilot Project.

The map in **Figure 3.5-1** identifies the locations of the 15 PM_{10} monitoring stations that were operated in Michigan during 2000. The majority of these monitors are located in Michigan's largest populated urban areas. Of the 15 PM_{10} sites, six are located in the Detroit PMSA area within Wayne County, one is in Flint PMSA, and seven are located in the Grand Rapids, Muskegon, Holland MSA. Six special purpose monitors (SPM) were used to monitor fugitive dust levels at Holland and Zeeland in Ottawa County and Albion in Calhoun County. In response to public concerns in Holland, PM_{10} monitoring was conducted as a special study to assess fugitive dust levels associated with scrap metal recycling, aggregate processing and other industrial sources (**12**). Another special study was conducted in Zeeland to monitor industrial source contribution from Zeeland Farm Services, a soybean processor. Four PM_{10} monitors were established in Zeeland. The purpose of the monitoring was to assess fugitive emissions from truck traffic and loading operations.

Population exposure to neighborhood scale PM_{10} air masses is performed at Allen Park, Livonia at E. Seven Mile Rd., Flint at Whaley Park, and Grand Rapids at Monroe. Additional neighborhood scale monitoring is performed to determine maximum PM_{10} concentrations at Grand Rapids at Wealthy Street, River Rouge at Genesee, W. Fort Street in Detroit, Dearborn at Wyoming, and W. End Street in Detroit (**13**).

Figure 3.5-1: Air Quality Monitors for PM_{10} Active in 2000

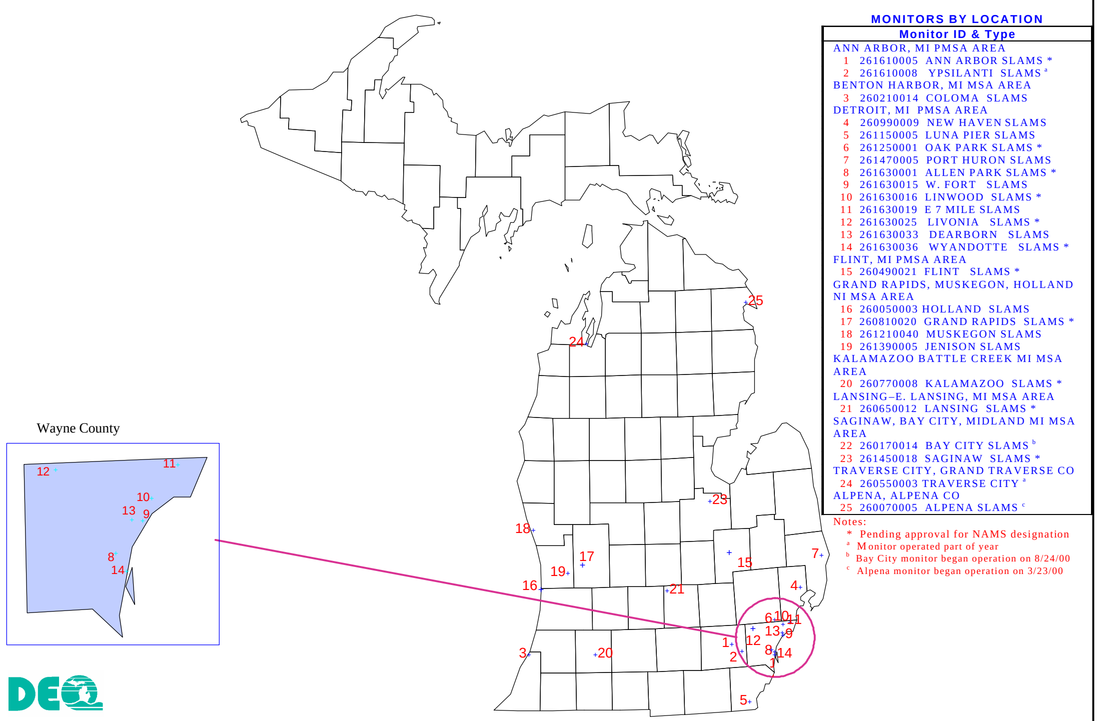


Samples are generally collected every sixth day, with the exception of the Holland site, where sampling was conducted every third day. On April 1,2000, a co-located continuous PM_{10} monitor (TEOM) was established at the Dearborn site and monitoring frequency using the federal reference method was reduced from daily to every six days.

Figure 3.5-2 identifies the locations of the newly established $PM_{2.5}$ monitoring network in Michigan. Of these 25 monitoring sites, 11 were located in the Detroit PMSA area, 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, Lansing-E. Lansing MSA, Traverse City, and Alpena. 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 (**9, 14**). Siting criteria along with population distribution, emissions from stationary sources, the locations of existing ozone and PM_{10} sites, and Michigan geography determined on the final design of the Michigan network.

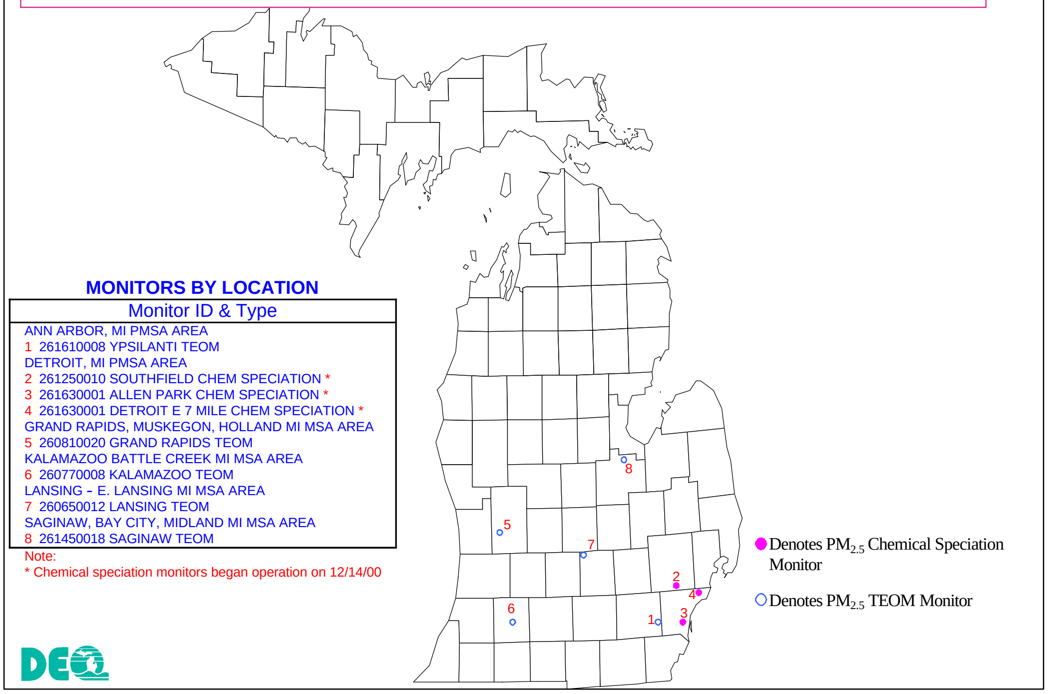
Figure 3.5-2: Air Quality Monitors for $PM_{2.5}$ Active in 2000



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

Michigan expanded its $PM_{2.5}$ monitoring through the utilization of Tapered Element Oscillating Microbalance (TEOM) and chemical speciation air monitors. **Figure 3.5-3** shows the monitoring 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 year 2000, TEOM monitors operated in Grand Rapids, Lansing, Kalamazoo, Ypsilanti, and Saginaw. More recently, a TEOM was located in Allen Park. For more information regarding the TEOM network, please see the ***Special Projects*** section of this report.

Figure 3.5-3: $PM_{2.5}$ TEOM & $PM_{2.5}$ Chemical Speciation Particulate Monitors Active in 2000



Attainment/Nonattainment Status of Particulate Matter as PM_{10} and $PM_{2.5}$ in Michigan:

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

Long-Term Trends in Particulate Matter:

Since 1991, the average arithmetic mean PM_{10} levels across the state decreased by 10% (see **Figure 3.5-4)**. Statewide annual mean PM_{10} levels have remained near the 25 µg/m^3, (half of the 50 µg/m3 NAAQS, while maximum annual mean PM_{10} levels peaked around 40 µg/m^3. The highest annual mean for an individual PM_{10} monitoring station in Michigan during 2000 was detected at the Detroit W. End Street monitoring site in Wayne County. **Figure 3.5-5** identifies the trend in the 24-hour PM_{10} values in Michigan over the past decade.

Figure 3.5-4: Range of Annual Arithmetic Means for PM_{10} Levels, 1991-2000

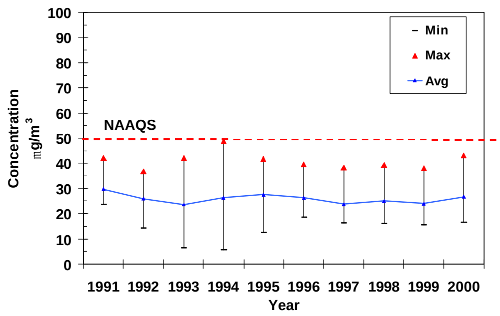
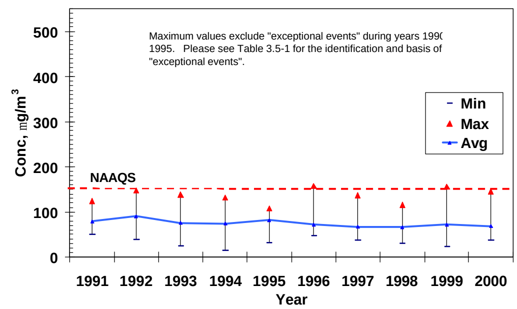


Figure 3.5-5: Range of Maximum 24-Hour PM_{10} Levels, 1991-2000



Average 24-hour levels have been relatively constant at about 70 µg/m^3. Maximum values measured during excessive wind conditions are considered “exceptional events” under federal criteria and have not been included in this figure.

On 10/25/99, a 24-hour value was measured at 156 µg/m^3 from the Dearborn site, which, while above the 24-hour NAAQS standard, is not a violation. Another high reading occurred at the Dearborn site on 9/5/96 when the 24-hour reached 158 µg/m^3. High values were reached again at this site on 3/14/95 and 3/15/95 at 183 µg/m^3 and 159 µg/m^3 respectively. However, these 1995 events were associated with particulate control equipment malfunctions at a stationary source near the monitor site, and are considered exceptional events.

Excessive wind conditions occurred on 6/17/92 at the Dearborn site and at a Bay City site, and are considered exceptional events. On 12/25/92, high wind conditions at Bay City were again responsible for a 24-hour measurement at 286 µg/m^3 and is considered an exceptional event.

Because deployment of monitoring for fine pariculates $PM_{2.5}$ did not start until 1999, long-term trend information is unavailable. The statewide annual arithmetic mean $PM_{2.5}$ concentration of the four calendar quarters for 2000 was 13.7 µg/m^3. The highest 4-quarter annual mean of individual monitoring sites for 2000 occurred at the Dearborn in Wayne County at 20.1 µg/m^3. The partial two years of monitoring data indicate that the 15.0 µg/m^3 annual mean standard will be the limiting standard in future nonattainment area designations. **Table 3.5-1** provides the annual mean PM2.5 concentrations by individual monitoring station for years 1999-2000.

In year 2000, the statewide average of the 24-hour 98th percentile $PM_{2.5}$ level of monitoring sites was 35 µg/m^3. The highest 24-hour 98th percentile $PM_{2.5}$ level during 2000 of all monitoring sites (45.1 µg/m^3) occurred at the Dearborn monitor in Wayne County. **Table 3.5-2** provides a more detailed assessment of the 24-hour 98th percentile $PM_{2.5}$ concentrations for the years 1999 and 2000. Although three years of monitoring data would be required for future nonattainment area designations, available monitoring data would indicate that Michigan ambient air quality levels are less than the 65 µg/m^3 standard.

Table 3.5-1: Annual Mean $PM_{2.5}$ Concentrations by Individual Monitoring Station for Years 1999-2000 – Annual Mean, Rounded to Nearest 0.1 µg/m^3

AIRS ID	Partial Year 1999	Year 2000	Mean
260050003 Holland	12.1	11.7	11.9
260070005 Alpena		7.6	7.6
260170014 Bay City		10.1	10.1
260210014 Coloma	12.3	12.1	12.2
260490021 Flint	12.0	12.9	12.5
260550003 Traverse City		8.6	8.6
260650012 Lansing	12.6	13.1	12.8
260650012 Lansing	12.9	13.6	13.2
260770008 Kalamazoo	14.9	15.1	15.0
260770008 Kalamazoo	14.7	14.7	14.7
260810020 Grand Rapids	13.8	13.8	13.8
260810020 Grand Rapids	13.9	13.8	13.9
260990009 New Haven	12.7	13.4	13.1
261150005 Luna Pier		15.2	**15.2**
261210040 Muskegon	12.2	11.9	12.0
261210040 Muskegon	14.5	11.0	12.8
261250001 Oak Park	14.2	15.4	14.8
261390005 Jenison	12.9	13.2	13.1
261450018 Saginaw	9.8	10.5	10.2
261450018 Saginaw	10.4	9.8	10.10
261470005 Port Huron	13.2	14.4	13.8
261610005 Ann Arbor	12.8	13.2	13.0
261610008 Ypsilanti	14.2	14.3	14.2
261630001 Allen Park	16.7	15.6	**16.1**
261630001 Allen Park	19.6	15.1	**17.4**
261630015 Detroit – W. Fort	17.7	18.1	**17.9**
261630016 Detroit – Linwood	17.1	15.5	**16.3**
261630019 Detroit – E Seven Mile		14.5	14.5
261630025 Livonia	13.1	14.6	13.8
261630033 Dearborn	17.0	20.1	**18.6**
261630036 Wyandotte	16.3	17.6	**17.0**

Note: The annual $PM_{2.5}$ standard is met when the 3-year average is less than or equal to 15.0 µg/m^3. For the purpose of comparing calculated values to the standard the average annual means shall be rounded to the nearest 0.1 µg/m3. Because $PM_{2.5}$ monitoring had begun in 1999, three years of complete monitoring data is not available. Therefore any designation of nonattainment areas would occur upon having sufficient monitoring data for making such determination. The annual mean was determined by averaging the quarterly means as provided from AIRS AMP260 report. For more information, please see Federal Register 62(138) 62(138), page 99 Part 50, Appendix N and EPA *Guidelines on Data Handling Conventions for the PM NAAQS* (EPA-454/R-99-008).

Table 3.5-2: 24 Hour 98th Percentile $PM_{2.5}$ Concentrations by Individual Monitoring Station for Years 1999-2000 – 98th Percentile, Rounded to Nearest 1 μg/m^3

AIRS ID	Year 1999	Year 2000	Mean
260050003 Holland	35	32	33
260070005 Alpena		25	25
260170014 Bay City		28	28
260210014 Coloma	35	30	33
260490021 Flint	33	32	33
260550003 Traverse City		27	27
260650012 Lansing	35	37	36
260650012 Lansing	37	35	36
260770008 Kalamazoo	38	36	37
260770008 Kalamazoo	39	37	38
260810020 Grand Rapids	37	35	36
260810020 Grand Rapids	39	28	34
260990009 New Haven	32	33	33
261150005 Luna Pier		37	37
261210040 Muskegon	38	35	37
261210040 Muskegon	39	24	31
261250001 Oak Park	43	41	42
261390005 Jenison	39	34	36
261450018 Saginaw	31	28	29
261450018 Saginaw	34	28	31
261470005 Port Huron	44	33	39
261610005 Ann Arbor	38	33	36
261610008 Ypsilanti	41	30	35
261630001 Allen Park	44	39	41
261630001 Allen Park	44	35	39
261630015 Detroit – W. Fort	50	45	47
261630016 Detroit – Linwood	45	40	42
261630019 Detroit – E Seven Mile		42	42
261630025 Livonia	38	36	37
261630033 Dearborn	45	45	45
261630036 Wyandotte	45	43	44

Note: The 24-hour $PM_{2.5}$ standard is met when the 3-year average is less than or equal to 65.0 μg/m3. For the purpose of comparing calculated values to the standard the 3-year average of the 98TH percentile values shall be rounded to the nearest 1.0 μg/m3. Because $PM_{2.5}$ monitoring had begun in 1999, three years of complete monitoring data is not available. Therefore any designation of nonattainment areas would occur upon having complete monitoring data for making such determination. The 98TH percentile value was determined using the procedures as presented in EPA *Guidelines on Data Handling Conventions for the PM NAAQS* (EPA-454/R-99-008).

Trends by MSA & Location:

Figure 3.5-6 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 $\mu g/m^3$). In year 2000, Detroit's annual average PM_{10} level (year 2000) was 32 $\mu g/m^3$. For the Grand Rapids – Muskegon - Holland MSA, which comprises four counties, the annual average peaked during 1992 at 30 $\mu g/m^3$. In more recent years, this MSA area experienced a significant reduction with an annual average level at 18 $\mu g/m^3$ in 2000.

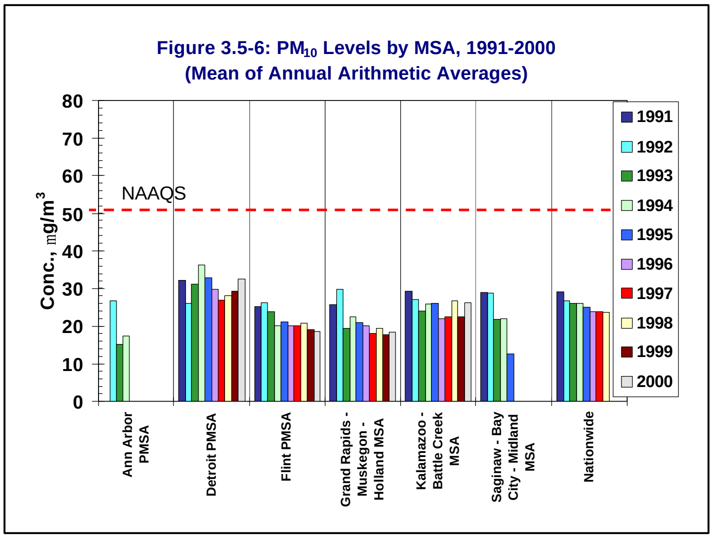


Figure 3.5-6: PM_{10} Levels by MSA, 1991-2000 (Mean of Annual Arithmetic Averages)

When comparing Michigan MSAs to national averages, most Michigan areas demonstrate better air quality than their national counter-parts. The exception is the Detroit, a highly urbanized PMSA, where PM_{10} annual averages over the decade have consistently remained above national annual averages.

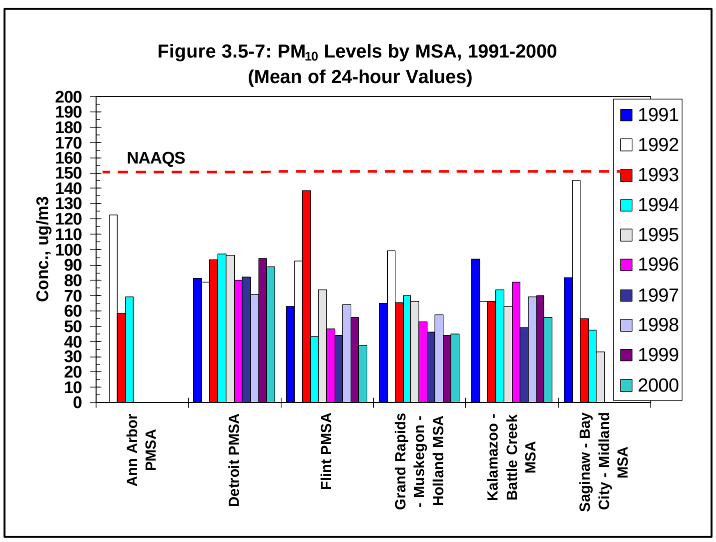


Figure 3.5-7: PM_{10} Levels by MSA, 1991-2000 (Mean of 24-hour Values)

Average 24-hour PM_{10} levels were calculated for all MSAs, as shown in **Figure 3.5-7**. The highest average 24-hour PM_{10} levels over the decade occurred during the early 1990s. Maximum values measured during excessive wind conditions are considered "exceptional events" under federal criteria and have not been included.

Table 3.5-3 lists the 24-hour exceedances that have been 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 and 159 $\mu g/m^3$, respectively. It is believed a nearby industrial bag house ruptured, releasing excessive particulate emissions over a two-day period. Weather conditions were extremely windy on June 17, 1992 and contributed to two exceedances in Bay City and Detroit (Dearborn). The State requested that these be considered exceptional events. Region V concurred and determined the information submitted to support the request was adequate to meet the exceptional event criteria.

Table 3.5-3: Values Exceeding the 24-Hour Standard (150 mg/m^3) for PM_{10} in Michigan from 1991 to 2000

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

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

Year	Total Number of Exceedances/ Yr.	Site (s)	Date	24-Hour Value, mg/m^3
1991	0	None		
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		

Because fine particulate $PM_{2.5}$ monitoring has just begun throughout the State, historical long-term $PM_{2.5}$ trends for the decade are unavailable. **Figure 3.5-8** shows the annual mean (considering an average of the four calendar quarters) for years 1999 and 2000. Based upon this limited data of only two years, the highest concentration of $PM_{2.5}$ was observed in the Detroit PMSA.

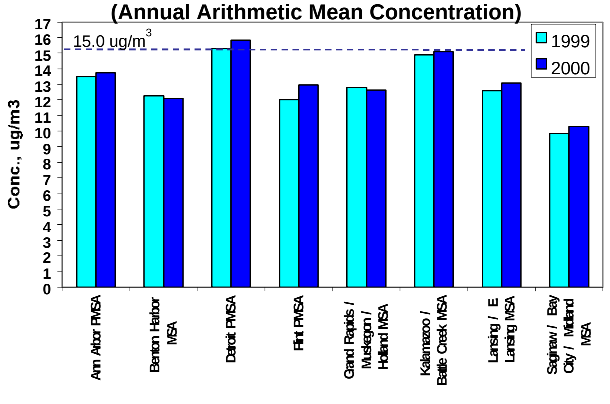


Figure 3.5-8: $PM_{2.5}$ Levels by MSA, 1999-2000 (Annual Arithmetic Mean Concentration)

The Kalamazoo – Battle Creek MSA had the second highest MSA average. For all remaining MSA areas, annual mean $PM_{2.5}$ levels were generally between 10 to 14 µg/m^3.

Sulfur Dioxide

Introduction:

Sulfur dioxide (SO_2) is a colorless gas. At typical ambient concentrations, it is odorless. Odor thresholds for SO_2 range between 0.4 ppm to 8.0 ppm (**1**). When a sulfur-bearing fuel is combusted, the sulfur is oxidized to form sulfur dioxide. Sulfur dioxide and its oxidized forms can react 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. The designation SO_x refers to either SO_2 or H_2SO_4 (**2**). Both sulfur dioxide and nitrogen dioxide are precursors to acidic deposition in the formation of acid rain (**3**). Because of subsequent atmospheric oxidative reactions, it is also a precursor in the formation of water soluble fine particulates (**3, 4, 5**). SO_2 reacts with ammonia in the atmosphere to form ammonium sulfate $(NH_4)_2SO_4$, which is 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 sulfuric acid (H_2SO_4) and ammonium bisulfate (NH_4HSO_4) (**4, 5**).

Fuel combustion sources such as coal-fired power plants are the largest anthropogenic sources of sulfur dioxide nationwide (**6**). Electrical utility plants produce approximately 64 percent of annual SO_2 emissions (**3**). Sulfur dioxide 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**).

Sulfur Dioxide Effects:

Exposure to sulfur dioxide 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 concentration, SO_2 may cause wheezing, chest tightness, and shortness of breath 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), and reduced species diversity and population number (**6**). Sulfuric acid is a component of acid rain, which can cause acidification of soils and water, and erosion of building surfaces. Sulfuric acid and its reaction products with ammonia account for most of the air pollution related to visibility degradation (**2**).

National Ambient Air Quality Standards for Sulfur Dioxide:

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 $\mu g/m^3$), and the 24-hour average 0.14 ppm (365 $\mu g/m^3$) 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 $\mu g/m^3$) more than once per year (10). Note: in May 1996, the EPA made a technical change that expressed the NAAQS for SO_2 in terms of parts per million (ppm) rather than micrograms per cubic meter ($\mu g/m^3$). The actual levels of the standard were not changed.

The EPA is considering a voluntary state-level intervention program that would protect sensitive populations from 5-minute spikes of elevated SO_2 concentrations. The proposal sets a concern level at 0.6 ppm and would require source-oriented monitoring for industry based on various source evaluation, population exposure and impact area assessment criteria (**8**). Final action on the establishment of a sulfur dioxide intervention level program is expected after the summer of 2001.

Sulfur Dioxide Monitoring in Michigan:

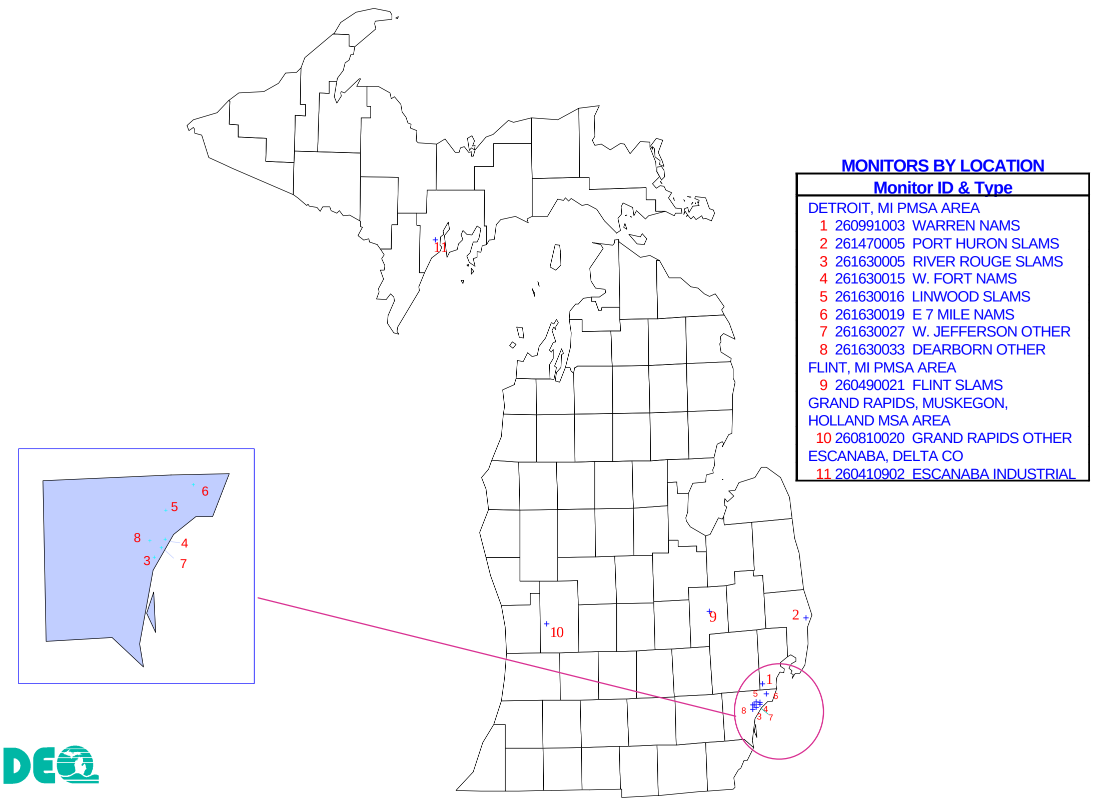
The map in **Figure 3.6-1** shows the locations of Michigan sulfur dioxide monitoring stations that operated during year 2000. In total, there were 11 SO_2 monitors. One is an industrial site in Escanaba, eight are located within the Detroit PMSA, one in the Grand Rapids – Muskegon - Holland MSA, and one in the Flint PMSA. Three NAMS sites (W. Fort Street, E. Seven Mile, and Warren) in the Detroit PMSA area 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 at Port Huron, River Rouge, W. Jefferson, Dearborn within the Detroit PMSA have been located to measure maximum SO_2 concentrations of neighborhood or middle scale air parcels.

To provide an indication of population exposure to SO_2, sampling of air masses is performed on a neighborhood scale. These include Flint, Grand Rapids, Warren NAMS, and Detroit stations at Linwood, and the NAMS at E. Seven Mile.

Attainment/Nonattainment Status of Sulfur Dioxide in Michigan:

On October 20, 1982, the last remaining SO_2 nonattainment area in Michigan was redesignated to attainment (**9**). The state has continued to maintain attainment status since that date. 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**).

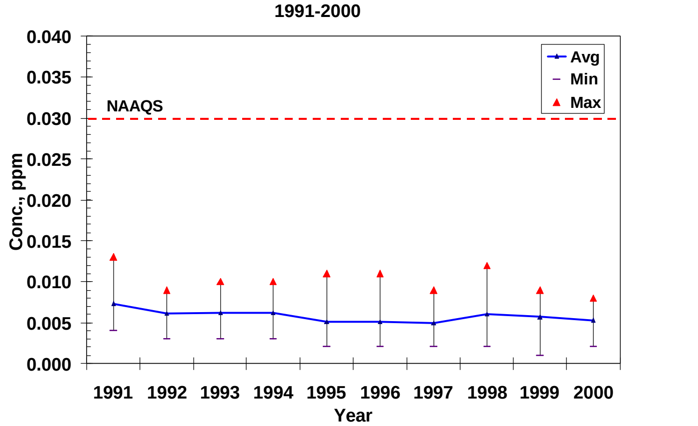
Figure 3.6-1: Air Quality Monitors for SO_2 Active in 2000



Long-Term Trends in Sulfur Dioxide:

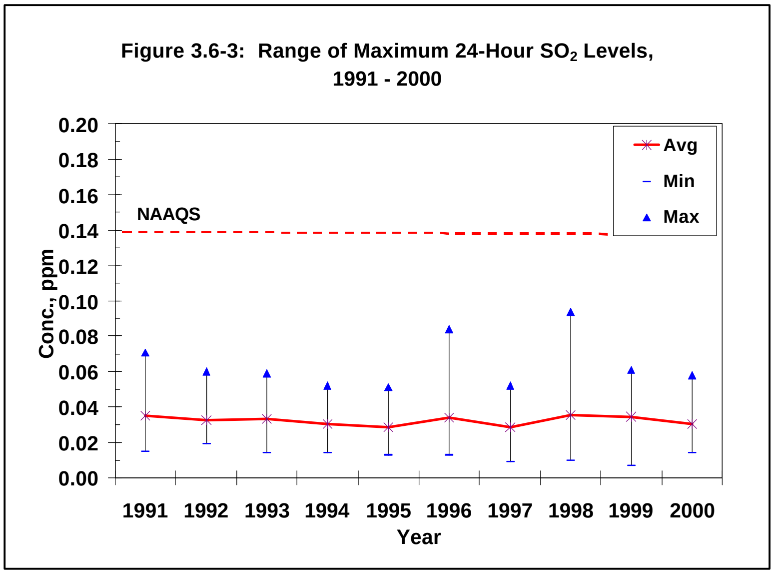
Average SO_2 levels monitored in the state have consistently been below the 0.03 ppm air quality standard (see **Figure 3.6-2**). Over the past decade, the statewide annual mean SO_2 concentration of Michigan air sampling network sites ranged between 0.005 to 0.007 ppm.

Figure 3.6-2: Range of SO_2 Annual Arithmetic Means, 1991-2000



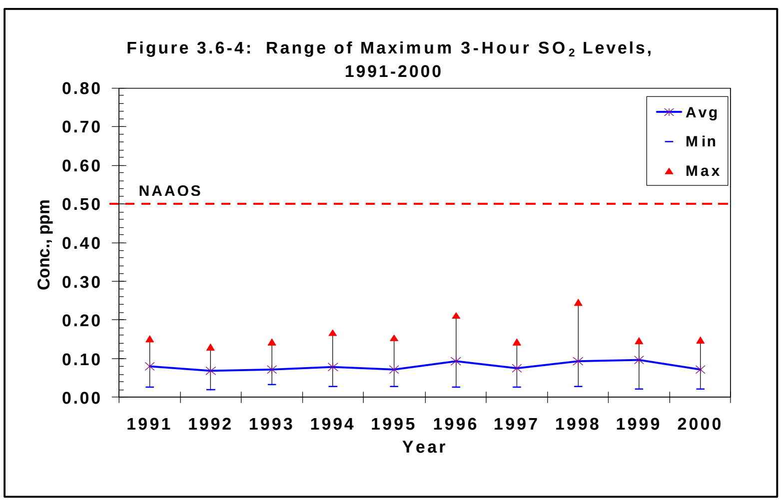
Annual averages over the ten-year period (1991-2000) decreased by nearly 1/4th. The highest annual mean concentration during 2000 occurred at the Detroit W. Jefferson site recording 0.008 ppm.

Trends for 24-hour maximum levels have followed an air quality trend pattern similar to that of the annual mean. As shown in **Figure 3.6-3**, the 24-hour statewide average of Michigan air sampling network sites has remained at the 0.03 ppm level, which is significantly less than the 24-hour NAAQS of 0.14 ppm.



During year 2000, the highest monitored 24-hour SO_2 concentration of 0.058 ppm occurred at the Detroit – W. Fort monitoring site.

As shown in **Figure 3.6-4,** no exceedances of the 3-hour secondary standard for SO_2 have occurred at Michigan SO_2 sites during the decade.

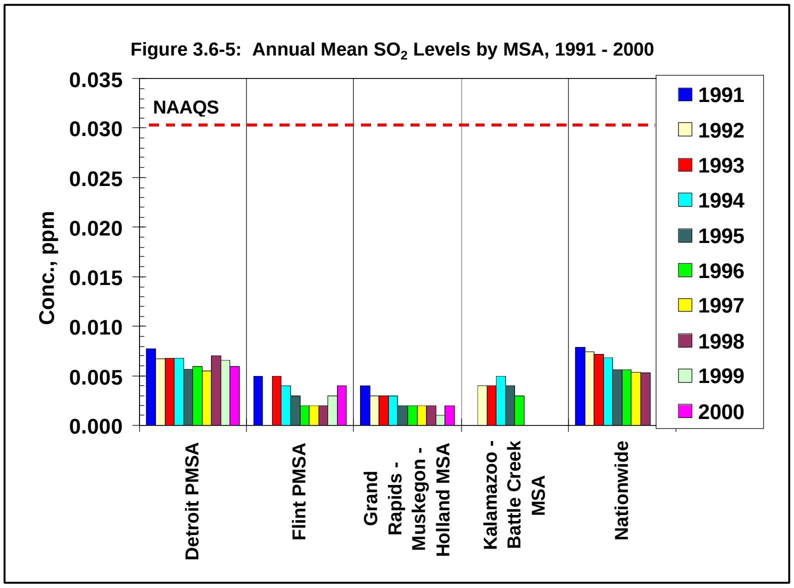


When 3-hour maximum values are averaged, SO_2 levels ranged between 0.06 to nearly 0.10 ppm. These values are significantly less than the 0.5 ppm secondary NAAQS. At this shorter 3-hour averaging time, the Port Huron and Detroit – W. Jefferson had the highest detected SO_2 levels during year 2000.

Trends by MSA & Location:

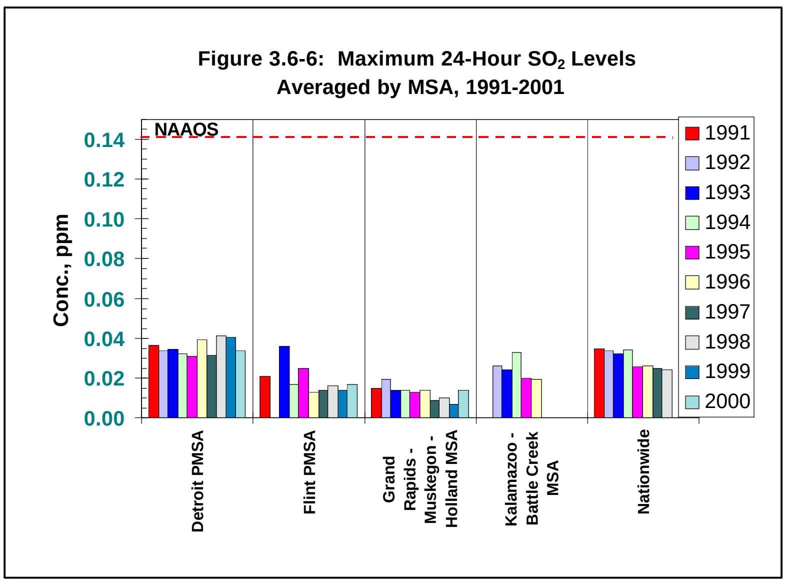
Figure 3.6-5 compares the mean of the annual average sulfur dioxide levels for MSAs that monitored for SO_2 in Michigan over the past decade. SO_2 levels have generally decreased in all Michigan MSAs. Monitored SO_2 levels of the Detroit PMSA were comparable to the national average, while Flint PMSA, Grand Rapids – Muskegon – Holland MSA, and Kalamazoo – Battle Creek MSA monitor sites were less than the national average.

Year 2000 annual mean values were 0.006 ppm for the Detroit PMSA, 0.004 ppm at the Flint PMSA, and 0.002 ppm for the Grand Rapids – Muskegon - Holland MSA.



During the last year of monitoring (1996), the Kalamazoo – Battle Creek MSA annual mean was 0.003 ppm. Monitoring in the Lansing - East Lansing MSA and Saginaw – Bay City – Midland MSAs was discontinued in the 1980s since the MSAs were in attainment and monitoring was no longer required.

Figure 3.6-6 provides the SO_2 concentrations for each MSA in terms of the 24-hour average. As shown in the Figure, the 24-hour average SO_2 levels for all MSAs are well below the 24-hour average NAAQS of 0.14 ppm.



At the shorter 24-hour time period, the Detroit PMSA area had experienced higher SO_2 levels in recent years than their national counterparts, while other Michigan MSAs generally experiencing better air quality than the national average.

The Clean Air Act-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 1980 levels. Electric utility emissions would be capped at 8.95 million tons per year (**11**).

CHAPTER 4: Toxic Pollutants in Michigan

Introduction:

The previous chapters of this report addressed the six air pollutants that have National Ambient Air Quality Standards (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 Clean Air Act, 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 sub-categorized as toxic metals, organic substances, and other substances. The metals include 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 volatile organic compounds (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 Federal Register 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 2000, the MDEQ-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 in order to best address data needs and objectives. Those strategies are still under development and revision. The MDEQ-AQD monitoring strategy will provide a fairly comprehensive plan describing a monitoring network to characterize 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 this (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.

Unlike the six criteria pollutants, there are no health-protective national ambient air quality standards 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 deposited to 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." Finally, 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 above in the Introduction. Currently, MDEQ-AQD is conducting a relatively intensive "Pilot Project" study of air toxics in Wayne County, supported by a grant from EPA. 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 is developing a National-Scale Air Toxics Assessment (NATA). The NATA project is currently focusing on the 1996 emissions inventory and dispersion modeling to estimate potential ambient air concentrations and the public's exposure levels. EPA intends to update and repeat that assessment every three years.

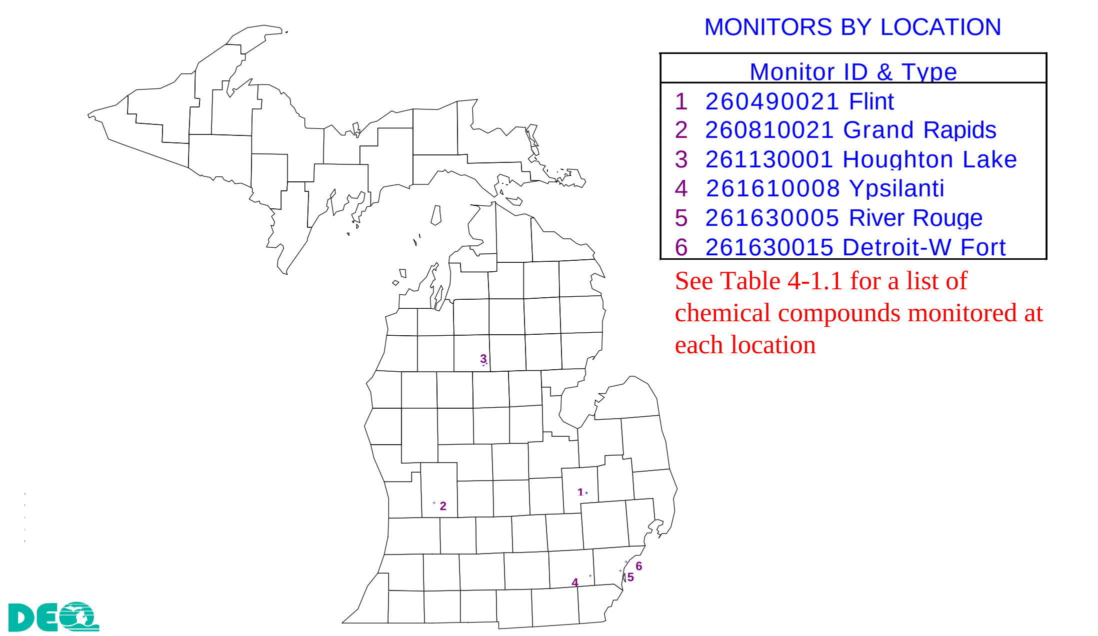
Air toxics monitoring efforts in the year 2000 can be separated into three types on the basis of the objectives of the studies. First, the Michigan Toxic Air Monitoring Program (MITAMP) has the purpose of determining the ambient air levels of air toxics primarily in urban areas. Secondly, source specific 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. Finally, 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. These efforts are further described in the following sections.

The Michigan Toxic Air Monitoring Program (MITAMP)

The Michigan Toxic Air Monitoring Program (MITAMP) was established in January 1990. Since the program's inception, over 50 toxic organic compounds and 13 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 Air Quality Division 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 Department 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, it should not be used for comparison or analytical purposes. Data collected and analyzed after 1993 is considered valid, however some errors occurred in converting the data for publication in the earlier Air Quality Reports. **Figure 4.1-1** shows the locations of the five MITAMP stations where air toxics were measured in 2000. The list of parameters monitored is in **Table 4.1-1**. **Table 4.1-2** presents the MITAMP non-industrial monitoring sites operational from 1987 to 2000, and the categories of air toxics monitored at those sites.

Two MITAMP sites operated in the Detroit area during 2000. The monitor, located at 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. The second Detroit-area toxics site is located in River Rouge. Another site is located in Grand Rapids; this site's data collection began 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, in Missaukee County, 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 at Whaley Park. And, beginning in 2000, data were collected at a new MITAMP site located in Ypsilanti. Sampling data collected at the MITAMP monitoring sites in 2000 are presented in **Appendix C**.

Figure 4.1-1: MITAMP Monitors Active in 2000



Source Specific Monitoring of Ambient Air Toxics

The primary purpose of source specific monitoring is to determine the ambient levels of air toxics near certain facilities with significant air emissions. The source specific air monitoring is required by either the Michigan Hazardous Waste Management Act (Part 111 of Act 451 of 1994 and associated administrative rules established environmental monitoring requirements under R299.9611), as part of the company's permit to operate, or due to community and MDEQ staff concerns with emissions. A typical industrial network consists of a monitor in the prevailing upwind direction to assess the ambient background concentration, and one or more monitors spacially distributed to measure source emission impact. Some sites were established as a single monitor to evaluate community air quality and to assess facility impacts in conjunction with the recorded wind direction data.

Table 4.1-1: Chemical Compounds Monitored At MITAMP Sites During 2000

Chemical Compound	Flint	Grand Rapids	Houghton Lake	Ypsilanti	River Rouge	Detroit – W Fort St
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-Dichlorobenzene		√	√	√	√	√
1,4-Dichlorobenzene		√	√	√	√	√
2,5-Dimethylbenzaldehyde		√	√		√	√
Acetalaldehyde		√	√		√	√
Acetone		√	√		√	√
Acrolein		√	√		√	√
Arsenic	√	√	√	√	√	√
Barium	√	√	√	√	√	√
Benzaldehyde		√	√		√	√
Benzene		√	√	√	√	√
Beryllium	√	√	√	√	√	√
Bromomethane (Methyl Bromide)		√	√	√	√	√
Cadmium	√	√	√	√	√	√
Carbon Tetrachloride		√	√	√	√	√
Chlorobenzene		√	√	√	√	√
Chloroethane		√	√	√	√	√
Chloroform		√	√	√	√	√
Chloromoethane		√	√	√	√	√
Chromium	√	√	√	√	√	√
cis-1,3-Dichloropropene		√	√	√	√	√
Cobalt	√	√	√	√	√	√
Copper	√	√	√	√	√	√
Crotonaldehyde		√	√		√	√
Dichlorodifluoromethane		√	√	√	√	√
Ethylbenzene		√	√	√	√	√
Formaldehyde		√	√		√	√
Halocarbon 113		√	√	√	√	√
Halocarbon 114		√	√	√	√	√
Hexachloro-1,3-Butadiene		√	√	√	√	√
Hexanaldehyde		√	√		√	√
Iron	√	√	√	√	√	√
Isovaleraldehyde		√	√		√	√
Lead	√	√	√	√	√	√
m,p-Tolualdehyde		√	√		√	√
m/p-Xylene		√	√	√	√	√
Manganese	√	√	√	√	√	√
Methylene Chloride		√	√	√	√	√
Molybdenum	√	√	√	√	√	√
n-Butyraldehyde		√	√		√	√
Nickel	√	√	√	√	√	√
o-Tolualdehyde		√	√		√	√
o-Xylene		√	√	√	√	√
Propionaldehyde		√	√		√	√
Styrene		√	√	√	√	√
Tetrachloroethene		√	√	√	√	√
Toluene		√	√	√	√	√
trans-1,3-Dichloropropene		√	√	√	√	√
Trichloroethene		√	√	√	√	√
Trichlorofluoromethane		√	√	√	√	√
Valeraldehyde		√	√		√	√
Vanadium	√	√	√	√	√	√
Vinyl Chloride		√	√	√	√	√
Zinc	√	√	√	√	√	√

Note: Summaries of volatile organic compound and trace metal analysis results can be found in Appendix C.

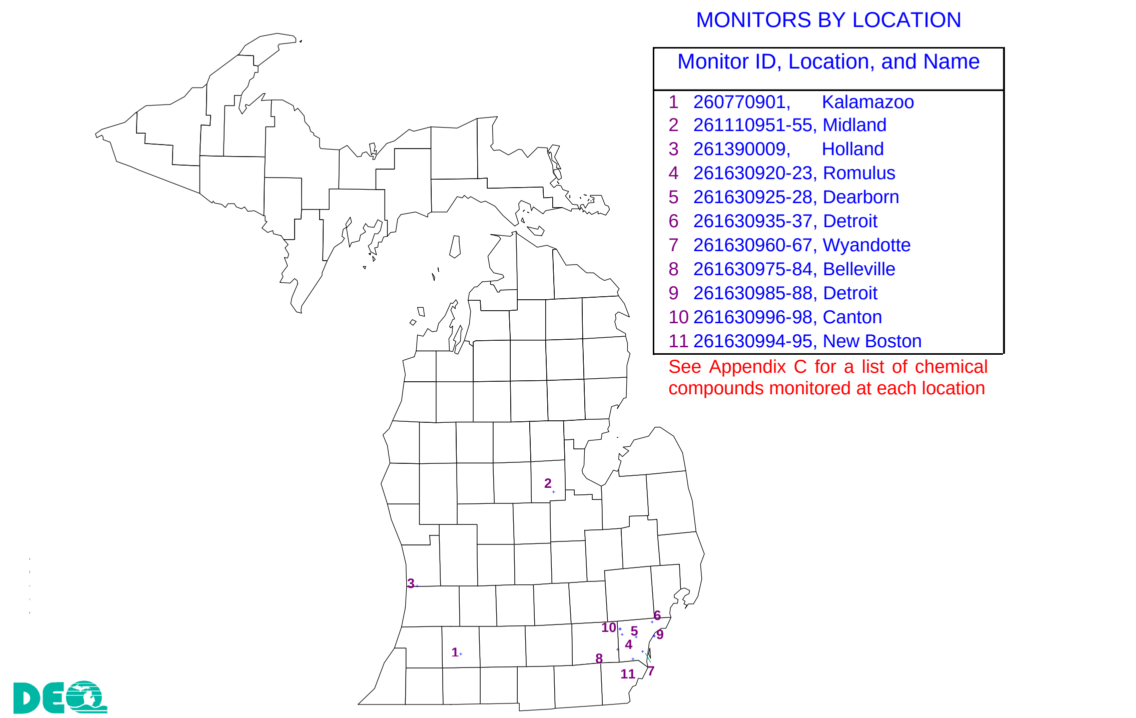
Table 4.1-2: Non-Industrial Sites Collecting Air Toxics Data in Michigan. (Not all parameters were collected during all years.)

County	Location	AIRS ID	Years Operated 87	88	89	90	91	92	93	94	95	96	97	98	99	00	VOC's	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	260490021									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, College	260810010		x	x	x	x			x	x	x	x	x				x		
Kent	Grand Rapids, Randolph	260810021									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		
Muskegon	Muskegon	261210023		x	x	x	x				x	x	x					x		
Saginaw	Saginaw	261450002		x	x	x	x											x		
Saint Clair	Pt. 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	
Wayne	Dearborn	261630002	x	x													x	x		x
Wayne	River Rouge	261630005							x	x	x	x	x	x	x	x	x	x		
Wayne	Detroit, Evergreen	261630014			x	x	x											x		
Wayne	Detroit, W. Fort Street	261630015				x	x	x	x	x	x	x	x	x	x	x	x	x		
Wayne	Detroit, Linwood	261630016			x	x	x	x	x	x	x	x	x	x	x	x		x		
Wayne	Detroit, E. 7 Mile	261630019			x	x	x	x	x	x	x	x	x	x	x	x		x		
Wayne	Wayne Co:Weston Trailer	261630032	x	x													x	x		x
Wayne	Dearborn	261630033				x	x	x	x	x	x	x	x	x	x	x		x		

Figure 4.1-2 shows the locations of the source specific monitoring sites for 2000. **Appendix C** identifies the specific parameters monitored at these sites, and the levels measured in 2000.

The data presented in **Appendix C** do not indicate the location of the monitor(s) in relation to the facility being evaluated. The parameters monitored are relatively few in number, reflecting a focus on the facility-specific emissions of interest. The results are used to assess the acceptability of the ambient air impacts for public health and environmental protection. Further information on these data can be obtained by contacting the MDEQ-AQD.

Figure 4.1-2: Industrial Source Monitors Active in 2000



Persistent Bioaccumulative Toxics (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 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 State resource constraints. However, the Environmental Protection Agency and Canada have established a limited monitoring network within the Great Lakes Basin in response to the 1990 Clean Air Act 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 hazardous air pollutants to the Great Lakes. Two sites were established in Michigan as part of this network, located on the Lake Michigan shoreline and on the Lake Superior shoreline on 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. This data has been summarized in published articles **(9, 10).**

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 mercury 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 mercury emissions to the atmosphere and the impact in both dry and wet deposition to Lake Superior. The first phase of the study will be completed by the end of 2001.

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 mercury, cadmium, and PCBs in urban runoff and in mercury deposition for a nine-month period **(11)**. This limited data set collected in Detroit indicated that dry deposition of mercury bound to particulate matter significantly contributed to the total atmospheric deposition in the city and to levels of mercury in urban runoff**.** The goal, however, was to determine if atmospheric deposition of mercury, PCBs, and cadmium to the Detroit Wastewater Treatment Plant'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 of an issue.

The MDEQ-AQD received funding from EPA's Great Lakes National Program Office (GLNPO) 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 is expected to be completed in 2001.

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

The MDEQ-AQD, partnering with the University of Michigan, was awarded a grant for $400,000 from the Michigan Great Lakes Protection Fund to develop a mercury monitoring network. The project is expected to begin summer of 2001. Sites will be established in urban areas because currently Michigan lacks long-term mercury data from urban areas. This proposal would also continue the long-term event-based mercury 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. MDEQ-AQD is currently designing a comprehensive ambient and atmospheric deposition network that outlines MDEQ-AQD's long-term goals for air toxics monitoring, including PBTs.

CHAPTER 5: Special Projects

Air Quality Index Homepage:

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 danger, in terms of acute health effects over short time periods of 24 hours or less. Each air pollutant concentration is related to an index value (see Table 5.1-1), 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.

Intermediate AQI levels of 200, 300, and 400 are respectively associated with alert, warning, and emergency episode level notifications used for the mitigation of air quality impacts during times of extreme pollutant levels (**1**).

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 and are available on the Internet through the Air Quality Division's Air Monitoring page as a table, and are plotted on a state map with color-coded dots that signify the AQI value (**http://www.deq.state.mi.us/aqd/** and click on "Air Monitoring – AQI").

Table 5.1-1: The Air Quality Index (Effective 10/4/99)

		Pollutant Concentration						
AQI Value	AQI Descriptor	$PM_{2.5}$ (24 hr) µg/m^3	PM_{10} (24 hr) µg/m^3	SO_2 (24 hr) ppm	Ozone (8 hr) ppm	Ozone (1 hr) ppm	CO (8 hr) ppm	NO_2 (1 hr) ppm
500	Hazardous (AQI > 301)	500.4	604	1.004		0.604	50	2.04
400		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	

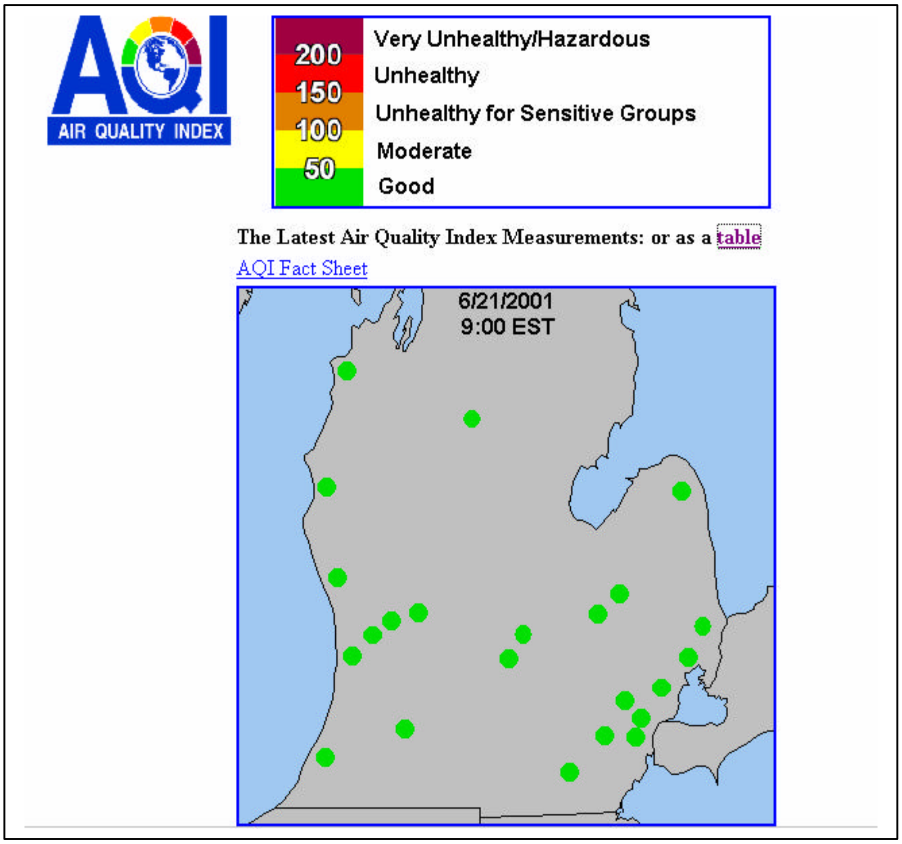
The EPA has assigned a specific color to each AQI category. **Table 5.1-2** identifies the AQI colors and the associated health statements by individual air pollutant. These color codes are used to display AQI values and level of health concern on the Internet through the Air Quality Division's Air Monitoring page.

Table 5.1-2: The AQI Colors and Health Statements

AQI CATEGORY & VALUE	OZONE (ppm)	OZONE (ppm)	PARTICULATE MATTER PM2.5 (µg/m3)	PARTICULATE MATTER PM10 (µg/m3)	CARBON MONOXIDE (ppm)	SULFUR DIOXIDE (ppm)	NITROGEN DIOXIDE (ppm)
	8-hour	1-hour	24-hour	24-hour	8-hour	24-hour	1-hour
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 outdor 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: Air Quality Index (AQI)



Ozone Action! Homepage:

Ozone Action! days are declared in southeast and west Michigan when meteorological conditions forecast the formation of excessive ground-level ozone. When ozone levels are expected to exceed 0.08 ppm on 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. Everyone is encouraged to take voluntary action to reduce hydrocarbon emissions that lead to the formation of ozone. Clean air choices include: avoiding vehicle refueling 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 Air Quality Division has developed an Internet homepage that can be accessed through **http://www.deq.state.mi.us/aqd/** and clicking on the Ozone Action! forecast link.

This web site lists Ozone Action! day information and provides current and extended forecasts for both western and southeastern Michigan. Links are given at 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.

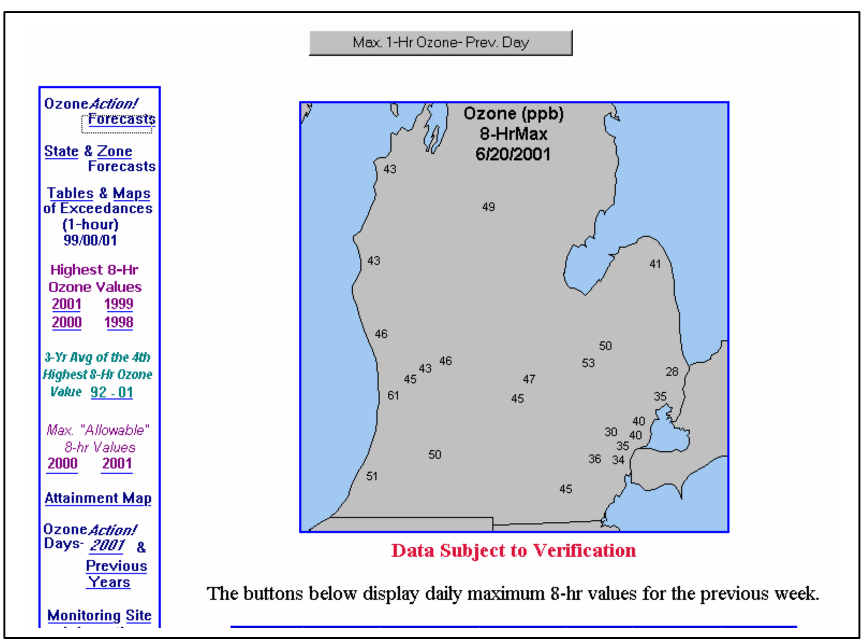
Maximum daily ozone concentrations are displayed as both 1-hour and 8-hour values by geographical location for the state of Michigan (see **Figure 5.1-2**). During the ozone season, both the 1-hour and 8-hour ozone values are updated on a near real time basis. Ozone values expressed in both forms are available for the previous week, too. Web links are available that also provide:

- Exceedances of the 1-hour ozone standard,
- Highest 8-hour ozone values by year,
- 3-year average of the 4[TH] highest 8-hour ozone values,
- Attainment maps, and
- Monitoring site information showing monitor locations by pollutant.

Ozone Mapping:

Michigan supplies daily ozone data to EPA for ozone mapping activities. It is a cooperative effort involving EPA, states, and local air pollution control agencies in the development of a coordinated effort to provide daily information on ground level ozone concentrations. EPA uses ozone data supplied by state and local governmental agencies to produce maps that display ozone contours covering the Midwest, New England, Mid-Atlantic, southeastern, south central, and Pacific coastal regions of the country. Color-coded, animated concentration gradient ozone maps are created that show daily ozone formation and transport at various spatial scales (national, Midwest, and Lake Michigan basin).

Figure 5.1-2: Ozone Action! Web Homepage

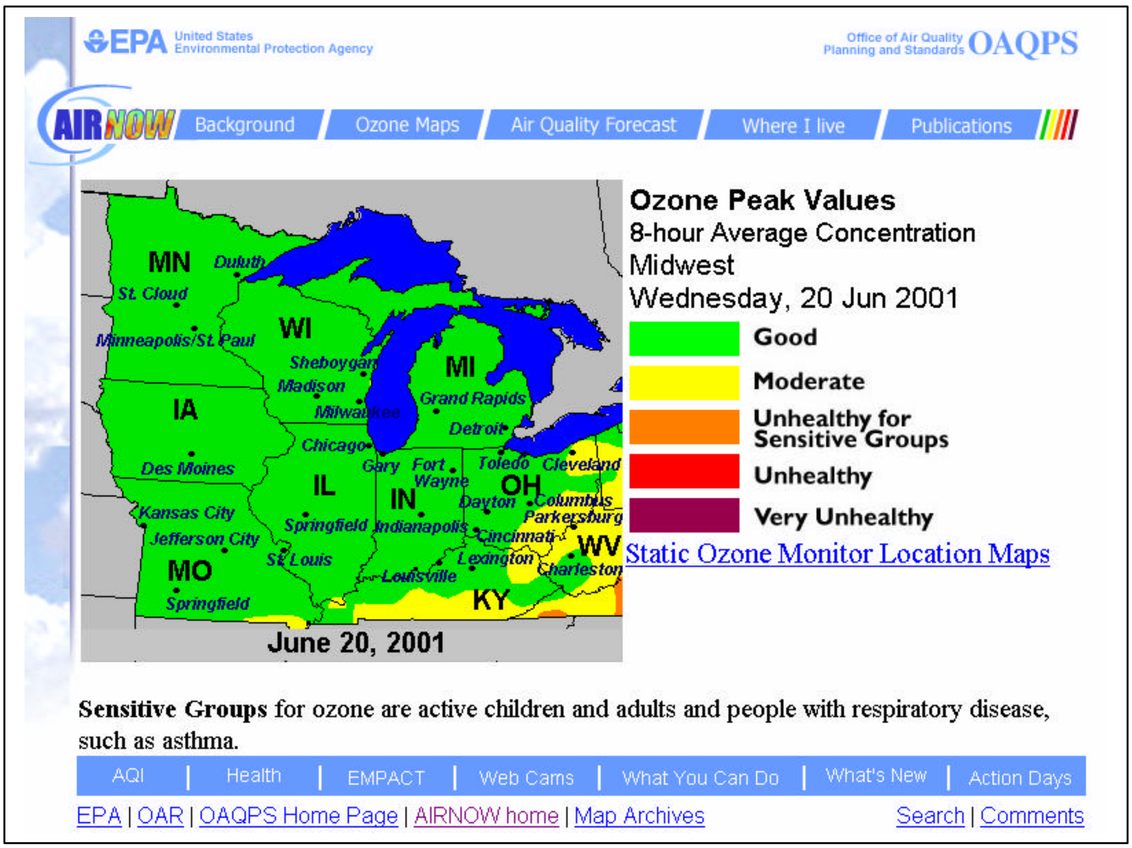


This information is available on the EPA's AIRNOW web site at: **http://www.epa.gov/airnow.** Information can be obtained of current and previous day's ozone animation showing ozone formation and transport with time. There are also web links that provide the previous day's 1-hour and 8-hour peak ozone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

Daily Fine Particulate $PM_{2.5}$ Concentrations Web Site:

Real time fine particulate $PM_{2.5}$ concentrations are made available to the general public from Tapered Element Oscillating Microbalance (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 DEQ web site at: **http://www.deq.state.mi.us/aqd/eval/amu/pm25data.html**. These monitors will supplement the fine particulate $PM_{2.5}$ data that is currently being collected from federal reference method (FRM), manual air monitoring equipment.

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



CHAPTER 6: Meteorological Summary

Climatological Summary:

Michigan owes much of its climate to its mid-latitude location. Stretching from about 41.5^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 lake breeze. In the fall, the slower cooling waters can help warm the lakeshore and increase 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 to reduce air pollution in Michigan by raising atmospheric humidity. First, the moisture that the Lakes add to the air condenses on small pollutant particles to form cloud droplets. The cloud drops 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 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.

2000 Temperature and Precipitation Data for Michigan

Figures 6.1.1 to 6.1.6 show average daily temperature and total monthly precipitation amounts for sites in the Upper Peninsula, the northern Lower Peninsula and the southern Lower Peninsula as compared to their climatic norms. These figures were constructed by averaging data from several National Weather Service 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 2000.

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

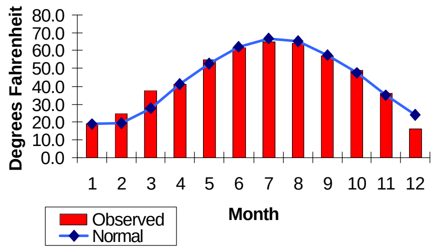


Figure 6.1-2: Northern Lower Peninsula Observed Monthly Precipitation vs. Normal Average Monthly Precipitation

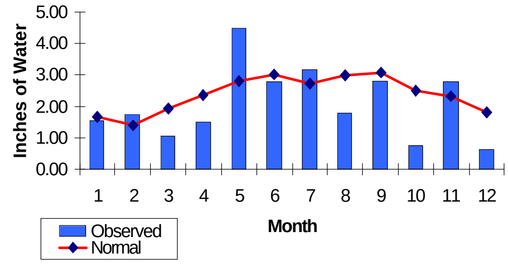


Figure 6.1-3: Southern Lower Peninsula Observed Average Daily Temperatures vs. Normal Daily Average Temperatures

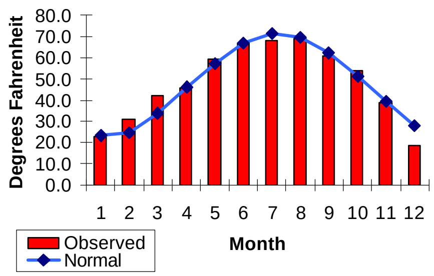


Figure 6.1-4: Southern Lower Peninsula Observed Monthly Precipitation vs. Normal Average Monthly Precipitation

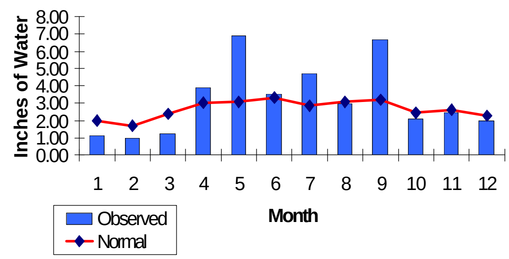


Figure 6.1-5: Upper Peninsula Observed Average Daily Temperatures vs. Normal Daily Average Temperatures

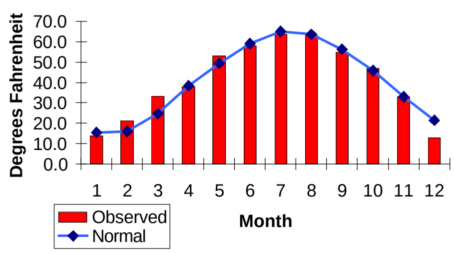
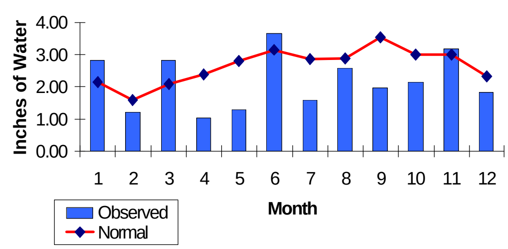


Figure 6.1-6: Upper Peninsula Observed Monthly Precipitation vs. Normal Average Monthly Precipitation



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 ***National Weather Service*** collects meteorological data. The wind speed and wind direction data are a 3 to 5 minute reading that represents the whole hour. As part of the ***Great Lakes Integrated Atmospheric Deposition Network (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 U.S. Forest Service and the U.S. Environmental Protection Agency.

MDEQ Meteorological Stations					
ID	Monitor Description		ID	Monitor Description	
1	Holland	260050003	14	Tecumseh	260910007
2	Alpena	260070005	15	New Haven	260990009
3	Benzonia	260190003	16	Scottville	261050007
4	Coloma	260210014	17	Houghton Lake	261130001
5	Flint	260490021	18	Muskegon	261210039
6	Otisville	260492001	19	Oak Park	261250001
7	Harbor Beach	260630007	20	Jenison	261390005
8	Lansing	260650012	21	Saginaw	261450018
9	Kalamazoo	260770008	22	Port Huron	261470005
10	Kalamazoo	260770901	23	Ypsilanti	261610008
11	Grand Rapids	260810020	24	Allen Park	261630001
12	Grand Rapids	260810021	25	Detroit	261630019
13	Evans	260810022	26	Dearborn	261630033

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 Isl
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

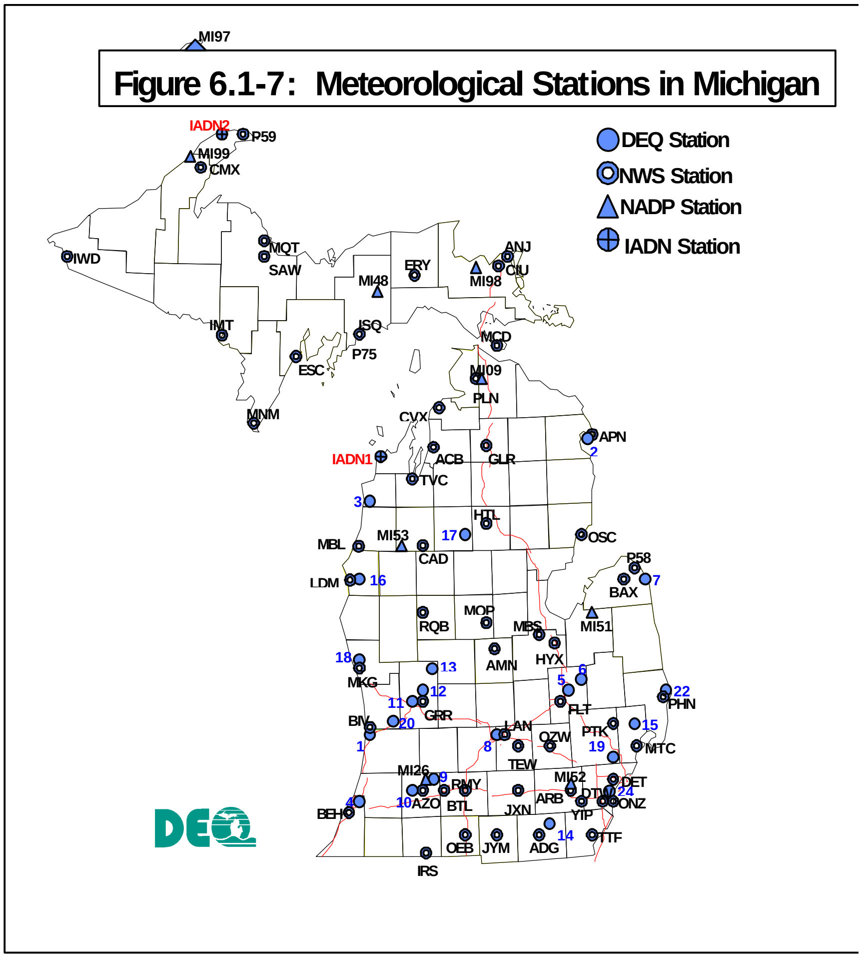


Figure 6.1-7: Meteorological Stations in Michigan

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

2000 Wind Roses for Selected Sites in Michigan:

The windroses shown in **Figures 6.1-8** to **6.1-24** were generated using WRPLOT. They reflect yearly trends in wind speed and direction.

Table 6-1-1: Meteorological Data Collected in Michigan During Year 2000

Site ID Station	Wind Speed	Wind Direction	Resultant Speed	Resultant Direction	Temp	Temp Difference	Relative Humidity	Solar Radiation	Barometric Pressure
260050003 Holland			Ö	Ö	Ö		Ö	Ö	Ö
260070005 Alpena			Ö	Ö	Ö				
260190003 Benzonia			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	Ö	Ö	Ö	Ö	Ö	Ö		Ö	
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
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
261630019 Detroit	Ö	Ö			Ö		Ö		Ö
261630033 Dearborn	Ö	Ö			Ö		Ö		Ö

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On-line References:

1. Ambient ozone values in Michigan (includes daily maximum values and on Ozone Action! days- hourly values), lists of exceedances and more on the DEQ OzoneAction! Homepage, accessed through **http://www.deq.state.mi.us/aqd/**

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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

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4. *National Air Pollutant Emission Trends, 1900 - 1993*. EPA-454/R-94-027. October 1994. EPA, Office of Air Quality Planning and Standards, Research Triangle Park, NC, 27711.

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At: http://www.epa.gov/air/oaqps/greenbk/pnsum.html

On-Line References:

1. 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

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

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   http://www.deq.state.mi.us/ead/pub/factsheet/airconfs.pdf

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   http://www.epa.gov/glnpo/
   http://www.epa.gov/ngispgm3/iris/index.html
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2. MDEQ, AQD's Ozone Action! Day Page:
http://www.deq.state.mi.us/aqd/

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

4. Southeast Michigan Council of Governments (SEMCOG) Ozone Action web page provides educational and teacher's resource information on ozone, and voluntary efforts for prevention and reduction of air pollutant emissions: **http://www.semcog.org/ozoneaction/**

References: Chapter 6.0 – Meteorological Summary

On-Line References:

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http://www.deq.state.mi.us/aqd/eval/amu/o34cast.html

2. Wind roses for the Great Lakes Integrated Atmospheric Deposition Network (IADN) sites is periodically published and made available at:
http://www.epa.gov/grtlakes/air/

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

4. Other interesting meteorological sites include:
- The O.S.U. Atmospheric Science Homepage:
  http://asp1.sbs.ohio-state.edu/
- National Weather Service Welcome Page:
  http://www.nws.noaa.gov/

Appendices to the

2000 Annual Air Quality Report

Appendix A: Criteria Pollutant Summary for 2000

Appendix B: Precision Accuracy Report for 2000

Appendix C: 2000 Data Summary for Volatile Organic Compounds & Trace Metals

Appendix D: Ozone Exceedances 1991 to 2000

Appendix E: AQD Organizational Structure and District Phone Numbers

Appendix A: Criteria Pollutant Summary for 2000

Appendix A presents a summary of the ambient air quality data collected for the criteria pollutants at monitoring locations throughout Michigan during 2000. In annual reports prior to 1989, each site was labeled with a five-digit MASN code number. The AIRS (Aerometric Information Retrieval System) number is the U.S. EPA code number for the sites. The AIRS site number has replaced the MASN number on the following appendices.

In appendices, please note that REP ORG refers to the reporting organization in the Michigan Network. The number for the DEQ Air Quality Division is 001 while 002 represents the Wayne County Department of Environment, Air Quality Management Division. Other numbers refer to federal, state, or other local agencies.

For total suspended particulates, lead, PM_{10} and $PM_{2.5}$ appendices, #OBS refers to the number of valid 24-hour values gathered. For continuous monitors (sulfur dioxide, nitrogen dioxide, carbon monoxide, and ozone), #OBS refers to the total valid hourly averages obtained from the analyzer. Notation is provided for those monitors that operated part of year 2000.

The "greater than" operator (>) heads the column reporting values or observations above the corresponding primary or secondary standards. METH refers to the method of analysis for each pollutant listed. Notation is also made for the identification of Tapered Element Oscillating Microbalance (TEOM) hourly PM10 and PM2.5 measurements. Concentrations of non-gaseous pollutants are generally given in micrograms per cubic meter at 25°C and 1 atmosphere pressure, and in parts per million for gaseous pollutants.

The column listing the number of excursions per site for the primary and secondary standards utilizes running averages for continuous monitors, except for ozone, 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.

EPA AEROMETRIC INFORMATION RETRIEVAL SYSTEM (AIRS)
AIR QUALITY SUBSYSTEM
QUICK LOOK REPORT FOR STATE OF MICHIGAN

POLLUTANT: LEAD UNITS: 001 µG/CU METER (25 C)

SITE ID	POC	MT	CITY	COUNTY	YR	REP ORG	#OBS	QUARTERLY ARITH MEANS 1ST	2ND	3RD	4TH	MEAN >1.5	MAX VALUES 1ST	2ND	METH
26-049-0021	4	2	FLINT	GENESEE	00	001	57	0.01	0.01	0.01	0.01	0	0.06	0.03	090
26-081-0021	4	3	GRAND RAPIDS	KENT	00	001	26	0.01?	0.04?	0.01?	0.01?	0	0.15	0.03	090
26-113-0001	1	3		MISSAUKEE	00	001	25	0.01?	0.01?	0.01?	0.01?	0	0.01	0.01	090
26-161-0008	1	3	YPSILANTI	WASHTENAW	00	001	16*		0.01	0.03?	0.01?	0	0.14	0.01	0.90
26-163-0001	1	2	ALLEN PARK	WAYNE	00	002	12	0.01 [1]	0.02 [1]	0.01 [1]	0.02 [1]	0	0.02 [1]	0.02 [1]	092
26-163-0005	1	3	RIVER ROUGE	WAYNE	00	001	27	0.02?	0.02?	0.02?	0.01?	0	0.05	0.05	090
26-163-0015	2	2	DETROIT – W. FORT	WAYNE	00	002	12	0.03 [1]	0.04 [1]	0.04 [1]	0.03 [1]	0	0.05 [1]	0.05 [1]	092
26-163-0015	4	3	DETROIT – W. FORT	WAYNE	00	001	25	0.03?	0.03?	0.03?	0.02?	0	0.06	0.05	090
26-163-0016	1	2	DETROIT – LINWOOD	WAYNE	00	002	12	0.02 [1]	0.02 [1]	0.02 [1]	0.03 [1]	0	0.03 [1]	0.03 [1]	092
26-163-0019	1	1	DETROIT E. 7 MILE	WAYNE	00	002	8*		0.02 [1]	0.01 [1]	0.02 [1]	0	0.03 [1]	0.02 [1]	092
26-163-0033	1	2	DEARBORN	WAYNE	00	002	12	0.02 [1]	0.03 [1]	0.03 [1]	0.03 [1]	0	0.05 [1]	0.04 [1]	092

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA
* INDICATES THAT MONITOR ONLY OPERATED PART OF YEAR 2000
[1] INDICATES RESULTS BASED ON MONTHLY COMPOSITE OF 24-HOUR SAMPLES

POLLUTANT: NITROGEN DIOXIDE UNITS: 007 PPM

SITE ID	POC	MT	CITY	COUNTY	YR	REP ORG	#OBS	MAX 1 HR 1ST	2ND	ARITH MEAN	METH
26-065-0012	1	2	LANSING	INGHAM	00	001	276*	0.042	0.039	0.018?	035
26-113-0001	1	3		MISSAUKEE	00	001	8372	0.039	0.039	0.004	035
26-163-0016	1	1	DETROIT	WAYNE	00	002	7883	0.128	0.123	0.025	089
26-163-0019	2	1	DETROIT	WAYNE	00	002	5907*	0.100	0.082	0.018?	089

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* INDICATES THAT MONITOR ONLY OPERATED PART OF YEAR 2000

EPA AEROMETRIC INFORMATION RETRIEVAL SYSTEM (AIRS)
AIR QUALITY SUBSYSTEM
QUICK LOOK REPORT FOR STATE OF MICHIGAN

POLLUTANT: OZONE UNITS: 007 PPM
OZONE SEASON: APR 01 TO SEPT 30

									VALID DAILY 1-HR MAXIMUM						MISS DAYS	
						REP	NUM	NUM	MAXIMA				VALS> 0.125		ASSUMED <	
SITE ID	POC	MT	CITY	COUNTY	YR	ORG	MEAS	REQ	1ST	2ND	3RD	4TH	MEAS	EST	STANDARD	METH
26-005-0003	1	2	HOLLAND	ALLEGAN	00	001	180	183	0.126	0.123	0.102	0.096	1	1.0	1	019
26-019-0003	1	2	BENZONIA	BENZIE	00	001	183	183	0.119	0.093	0.087	0.085	0	0.0	0	019
26-021-0014	1	2	COLOMA	BERRIEN	00	001	181	183	0.119	0.107	0.106	0.092	0	0.0	0	019
26-027-0003	1	2		CASS	00	087	168	183	0.123	0.098	0.092	0.087	0	0.0	5	047
26-037-0001	2	1	BATH TOWNSHIP	CLINTON	00	001	182	183	0.092	0.090	0.086	0.080	0	0.0	1	019
26-049-0021	1	1	FLINT	GENESEE	00	001	183	183	0.089	0.086	0.084	0.082	0	0.0	0	019
26-049-2001	1	1	OTISVILLE	GENESEE	00	001	183	183	0.095	0.094	0.090	0.080	0	0.0	0	019
26-063-0007	1	2		HURON	00	001	181	183	0.104	0.093	0.091	0.085	0	0.0	1	019
26-065-0012	2	1	LANSING	INGHAM	00	001	183	183	0.094	0.091	0.090	0.088	0	0.0	0	019
26-077-0008	1	2	KALAMAZOO	KALAMAZOO	00	001	183	183	0.095	0.090	0.084	0.079	0	0.0	0	019
26-081-0020	1	1	GRAND RAPIDS	KENT	00	001	183	183	0.112	0.097	0.093	0.077	0	0.0	0	019
26-081-0022	1	2		KENT	00	001	176	183	0.121	0.114	0.105	0.080	0	0.0	1	019
26-091-0007	1	2	TECUMSEH	LENAWEE	00	001	183	183	0.100	0.094	0.094	0.087	0	0.0	0	019
26-099-0009	1	2	NEW HAVEN	MACOMB	00	001	180	183	0.111	0.093	0.091	0.089	0	0.0	0	019
26-099-1003	1	1	WARREN	MACOMB	00	001	178	183	0.100	0.093	0.091	0.087	0	0.0	0	019
26-105-0007	1	2	SCOTTVILLE	MASON	00	001	183	183	0.130	0.116	0.095	0.093	1	1.0	0	019
26-113-0001	1	3	HOUGHTON LAKE	MISSAUKEE	00	001	182	183	0.117	0.084	0.081	0.081	0	0.0	1	019
26-121-0039	1	2	MUSKEGON	MUSKEGON	00	001	183	183	0.129	0.123	0.099	0.090	1	1.0	0	019
26-125-0001	2	2	OAK PARK	OAKLAND	00	001	181	183	0.090	0.088	0.086	0.081	0	0.0	0	019
26-139-0005	1	2		OTTAWA	00	001	183	183	0.123	0.106	0.090	0.089	0	0.0	0	019
26-147-0005	1	2	PORT HURON	ST CLAIR	00	001	178	183	0.115	0.102	0.086	0.085	0	0.0	2	019
26-161-0008	1	2	YPSILANTI	WASHTENAW	00	001	182	183	0.094	0.091	0.089	0.089	0	0.0	1	019
26-163-0001	2	2	ALLEN PARK	WAYNE	00	002	182	183	0.082	0.081	0.080	0.079	0	0.0	1	019
26-163-0016	1	1	DETROIT – LINWOOD	WAYNE	00	002	181	183	0.092	0.088	0.087	0.084	0	0.0	2	019
26-163-0019	2	2	DETROIT – E. 7 MILE	WAYNE	00	002	175	183	0.103	0.099	0.088	0.086	0	0.0	1	019

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EPA AEROMETRIC INFORMATION RETRIEVAL SYSTEM (AIRS)
AIR QUALITY SUBSYSTEM
QUICK LOOK REPORT FOR STATE OF MICHIGAN

POLLUTANT: SULFUR DIOXIDE UNITS: 007 PPM

SITE ID	POC	MT	CITY	COUNTY	YR	REP ORG	#OBS	MAX 24-HR 1ST	MAX 24-HR 2ND	OBS > STD	MAX 3-HR 1ST	MAX 3-HR 2ND	OBS > STD	MAX 1-HR 1ST	MAX 1-HR 2ND	ARITH MEAN	METH
26-041-0902	1	4	ESCANABA	DELTA	00	915	8308	0.010	0.010	0	0.020	0.020	0	0.050	0.040	0.002	039
26-049-0021	1	2	FLINT	GENESEE	00	001	8542	0.017	0.015	0	0.030	0.027	0	0.033	0.032	0.004	039
26-081-0020	1	3	GRAND RAPIDS	KENT	00	001	8710	0.014	0.010	0	0.021	0.021	0	0.030	0.029	0.002	039
26-099-1003	1	1	WARREN	MACOMB	00	001	8169	0.017	0.014	0	0.058	0.044	0	0.078	0.071	0.003	039
26-147-0005	1	2	PORT HURON	ST CLAIR	00	001	8628	0.041	0.039	0	0.147	0.147	0	0.216	0.209	0.006	039
26-163-0005	1	2	RIVER ROUGE	WAYNE	00	002	8699	0.019	0.018	0	0.050	0.046	0	0.094	0.086	0.005	061
26-163-0015	1	1	DETROIT – W. FORT	WAYNE	00	002	8688	0.058	0.042	0	0.088	0.085	0	0.126	0.125	0.007	061
26-163-0016	2	2	DETROIT – LINWOOD	WAYNE	00	002	8701	0.030	0.029	0	0.098	0.087	0	0.149	0.132	0.006	061
26-163-0019	1	1	DETROIT – E. 7 MILE	WAYNE	00	002	5193*	0.018	0.016	0	0.052	0.045	0	0.083	0.063	0.005?	039
26-163-0027	1	3	DETROIT – JEFFERSON	WAYNE	00	002	7128*	0.046	0.043	0	0.103	0.091	0	0.163	0.144	0.008	061
26-163-0033	1	3	DEARBORN	WAYNE	00	002	7958	0.041	0.034	0	0.078	0.070	0	0.118	0.109	0.007	061

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* INDICATES THAT MONITOR ONLY OPERATED PART OF YEAR 2000

POLLUTANT: CARBON MONOXIDE UNITS: 007 PPM

SITE ID	POC	MT	CITY	COUNTY	YR	REP ORG	#OBS	MAX 1-HR 1ST	2ND	OBS > 35	MAX 8-HR 1ST	2ND	OBS >9	METH
26-081-0020	1	2	GRAND RAPIDS	KENT	00	001	8724	5.0	4.2	0	2.8	2.6	0	054
26-099-1003	1	2	WARREN	MACOMB	00	001	8243	5.1	5.1	0	1.8	1.4	0	051
26-125-0001	1	2	OAK PARK	OAKLAND	00	001	8399	9.8	4.7	0	3.6	2.6	0	051
26-163-0001	1	2	ALLEN PARK	WAYNE	00	002	8631	6.6	6.5	0	5.1	3.3	0	000
26-163-0016	1	2	DETROIT – LINWOOD	WAYNE	00	002	8189	8.2	7.7	0	4.7	4.5	0	051
26-163-0025	1	2	LIVONIA	WAYNE	00	002	8528	2.5	1.9	0	1.4	1.3	0	051
26-163-0026	1	2	DETROIT – JOY ROAD	WAYNE	00	002	8302	7.5	7.3	0	3.6	3.4	0	051
26-163-0083	1	1	DETROIT - GRISWOLD	WAYNE	00	002	5262*	7.2	6.5	0	4.1	2.6	0	051

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* INDICATES THAT MONITOR ONLY OPERATED PART OF YEAR 2000

EPA AEROMETRIC INFORMATION RETRIEVAL SYSTEM (AIRS)
AIR QUALITY SUBSYSTEM
QUICK LOOK REPORT FOR STATE OF MICHIGAN

POLLUTANT: PM_{10} TOTAL 0-10 mM UNITS: 001 µG/CU METER (25 C)

SITE ID	POC	MT	CITY	COUNTY	YR	REP ORG	NUM OBS	NUM OBS	% OBS	NUM REQ	MAXIMUM VALUES 1ST	2ND	3RD	4TH	VALS > 150 MEAS	EST	WTD ARITH MEAN	METH
26-025-0003	1	3	ALBION	CALHOUN	00	001	40*	40	83	48	56	55	52	49	0	0.00	26?	064
26-049-0021	1	2	FLINT	GENESEE	00	001	58	58	91	64	37	36	36	36	0	0.00	19	064
26-081-0007	1	3	GRAND RAPIDS – WEALTHY	KENT	00	001	57	57	89	64	53	49	37	35	0	0.00	21	064
26-081-0020	1	2	GRAND RAPIDS – MONROE	KENT	00	001	52	52	81	64	41	37	34	29	0	0.00	17?	064
26-139-0009	1	3	HOLLAND	OTTAWA	00	001	117	61	95	366	41	40	40	39	0	0.00	18?	064
26-139-0924	1	3	ZEELAND – FELCH	OTTAWA	00	001	39*	39	63	32	18	15	15	15	0	0.00	12?	064
26-139-0925	1	3	ZEELAND – CHICAGO DR	OTTAWA	00	001	39*	39	63	32	19	19	18	17	0	0.00	13?	064
26-139-0926	1	3	ZEELAND – 84TH	OTTAWA	00	001	39*	39	63	32	20	19	18	18	0	0.00	15?	064
26-139-0927	1	3	ZEELAND - LINCOLN	OTTAWA	00	001	39*	39	63	32	15	13	13	12	0	0.00	8?	064
26-163-0001	1	1	ALLEN PARK	WAYNE	00	002	59	59	92	64	70	51	48	47	0	0.00	27	064
26-163-0005	1	1	RIVER ROUGE	WAYNE	00	002	56	56	88	64	45	41	40	40	0	0.00	24?	064
26-163-0015	1	1	DETROIT – W. FORT	WAYNE	00	002	61	61	95	64	108	75	71	69	0	0.00	38	063
26-163-0025	1	1	LIVONIA	WAYNE	00	002	61	60	94	64	49	40	38	38	0	0.00	22	064
26-163-0033	1	1	DEARBORN	WAYNE	00	002	146	127	91	366	115	113	101	96	0	0.00	41?	064
26-163-0033	3	2	DEARBORN	WAYNE	00	002	265*	265	96	275	112	98	91	89	0	0.00	35?	079 [1]
26-163-0092	2	1	DETROIT – W. END	WAYNE	00	002	57	57	89	64	146	101	78	78	0	0.00	43	062

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA
* INDICATES THAT MONITOR ONLY OPERATED PART OF YEAR 2000
[1] INDICATES TEOM MONITOR

EPA AEROMETRIC INFORMATION RETRIEVAL SYSTEM (AIRS)
AIR QUALITY SUBSYSTEM
QUICK LOOK REPORT FOR STATE OF MICHIGAN

POLLUTANT: $PM_{2.5}$ AT LOCAL CONDITIONS UNITS: 105 µG/CU METER (LOCAL CONDITIONS)

SITE ID	POC	MT	CITY	COUNTY	YR	REP ORG	NUM OBS	MAXIMUM VALUES 1ST	2ND	3RD	4TH	ARITH MEAN	METH	UNITS	INT
26-005-0003	1	2	HOLLAND	ALLEGAN	00	001	348	42.7	36.7	35.7	35.2	11.75	118	105	7
26-007-0005	1	2	ALPENA	ALPENA	00	001	78*	25.6	25.4	24.9	22.0	8.05?	118	105	7
26-017-0014	1	2	BAY CITY	BAY	00	001	39*	27.7	26.6	26.3	23.3	10.12	118	105	7
26-021-0014	1	2	COLOMA	BERRIEN	00	001	122	31.8	30.8	29.7	28.2	12.12	118	105	7
26-049-0021	1	2	FLINT	GENESEE	00	001	111	41.2	39.3	32.2	31.7	12.90	118	105	7
26-055-0003	1	2	TRAVERSE CITY	GRAND TRAVERSE	00	001	83*	31.5	27.2	26.6	22.1	9.11?	118	105	7
26-065-0012	1	2	LANSING	INGHAM	00	001	105	38.2	37.8	37.2	32.4	13.14	118	105	7
26-065-0012	2	2	LANSING	INGHAM	00	001	102	38.4	38.0	35.3	31.1	13.52	118	105	7
26-065-0012	5	2	LANSING	INGHAM	00	001	8611	473.0	262.0	127.0	72.0	13.01	701 [1]	105	1
26-077-0008	1	2	KALAMAZOO	KALAMAZOO	00	001	111	38.9	35.9	35.5	34.8	14.96	118	105	7
26-077-0008	2	2	KALAMAZOO	KALAMAZOO	00	001	115	38.4	36.7	36.5	35.1	14.65	118	105	7
26-077-0008	3	2	KALAMAZOO	KALAMAZOO	00	001	3267	86.0	59.0	59.0	57.0	11.53?	701 [1]	105	1
26-081-0020	1	2	GRAND RAPIDS	KENT	00	001	353	41.8	41.8	40.5	40.1	13.80	118	105	7
26-081-0020	2	2	GRAND RAPIDS	KENT	00	001	57	35.1	28.1	27.7	27.1	13.89	118	105	7
26-081-0020	3	2	GRAND RAPIDS	KENT	00	001	8219	79.0	73.0	48.0	45.0	9.02	701 [1]	105	1
26-099-0009	1	2	NEW HAVEN	MACOMB	00	001	113	38.8	38.1	33.2	32.2	13.45	118	105	7
26-115-0005	1	2		MONROE	00	001	117	39.9	39.3	37.2	33.4	15.20	118	105	7
26-121-0040	1	2	MUSKEGON	MUSKEGON	00	001	117	35.3	35.1	35.0	31.7	11.86	118	105	7
26-121-0040	2	2	MUSKEGON	MUSKEGON	00	001	59	36.5	23.5	23.0	21.1	11.12	118	105	7
26-125-0001	1	2	OAK PARK	OAKLAND	00	001	90	43.7	40.7	37.7	36.3	15.55	118	105	7
26-139-0005	1	2		OTTAWA	00	001	119	40.3	34.3	33.7	33.5	13.22	118	105	7
26-145-0018	1	2	SAGINAW	SAGINAW	00	001	95	32.2	27.5	27.4	26.7	10.43	118	105	7
26-145-0018	2	2	SAGINAW	SAGINAW	00	001	76*	29.1	28.4	26.5	24.5	9.76?	118	105	7
26-145-0018	3	2	SAGINAW	SAGINAW	00	001	8557	119.0	70.0	67.0	56.0	8.53	701 [1]	105	1
26-147-0005	1	3	PORT HURON	ST. CLAIR	00	001	102	47.3	39.5	33.1	31.1	14.17	118	105	7
26-161-0005	1	2	ANN ARBOR	WASHTENAW	00	001	96	40.4	33.1	30.7	28.6	13.31	118	105	7
26-161-0008	1	2	YPSILANTI	WASHTENAW	00	001	102*	37.9	34.1	30.3	29.1	13.85	118	105	7
26-161-0008	3	2	YPSILANTI	WASHTENAW	00	001	7023	500.0	495.0	426.0	314.0	13.10	701 [1]	105	1
26-163-0001	1	2	ALLEN PARK	WAYNE	00	001	339	46.4	45.2	41.8	41.7	15.53	118	105	7
26-163-0001	2	2	ALLEN PARK	WAYNE	00	001	54	35.8	34.6	30.4	29.0	16.13	118	105	7
26-163-0001	5	T	ALLEN PARK	WAYNE	00	001	1*	52.9				52.90	810	105	7
26-163-0015	1	2	DETROIT – W. FORT	WAYNE	00	001	119	47.5	44.7	44.5	41.1	18.10	118	105	7
26-163-0016	1	2	DETROIT – LINWOOD	WAYNE	00	001	325	54.8	49.7	44.0	42.7	15.60	118	105	7
26-163-0019	1	2	DETROIT – E. 7 MILE	WAYNE	00	001	70*	42.2	42.0	40.6	30.3	14.68?	118	105	7
26-163-0019	5	2	DETROIT – E. 7 MILE	WAYNE	00	822	1*	35.2				35.20?	810	105	7
26-163-0025	1	2	LIVONIA	WAYNE	00	001	113	42.4	38.5	35.9	31.8	14.60	118	105	7
26-163-0033	1	2	DEARBORN	WAYNE	00	001	108	49.8	47.3	45.1	43.3	20.17	118	105	7
26-163-0036	1	2	WYANDOTTE	WAYNE	00	001	103	45.8	45.5	42.7	42.0	17.45	118	105	7

? INDICATES THAT THE MEAN DOES NOT SATISFY SUMMARY CRITERIA
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Appendix B: Precision & Accuracy Report

Appendix B is a quality assurance data assessment report for the criteria pollutants. All quality assurance is performed in accordance with U.S. EPA requirements.

APPENDIX B
MICHIGAN AIR SAMPLING NETWORK
2000 DATA ASSESSMENT SUMMARY FOR CRITERIA AIR POLLUTANTS

PM-10:

	PRECISION						ACCURACY		
YR-QTR	# of Co-located Samples	#Co-located Sites	# Samples < Limit	95 Per Cent Probability Limits Lower	Upper	No. of Valid Colocated Data Pairs	# Audits	Probability Lower	Upper
2000	39	1	14	-16	+6	25	6	-6	+4
1st	0	1	0	*	*	0	2	-5	-2
2nd	15	1	4	-22	+6	11	1	1	*
3rd	9	1	3	-8	+4	6	1	-2	*
4th	15	1	7	-10	+5	8	2	-2	+5

* insufficient number of checks to calculate accuracy.

LEAD:

	PRECISION						ACCURACY			LAB ACCURACY				
YR-Q	# of Co-loc Samples	# of Co-loc Sites	# of Samples < Limit	Probability Limits Lower	Upper	# Valid Co-loc DataPair	# Audits	Level 2 Lower	Upper	#Audits	Level 1 Lower	Upper	Level 2 Lower	Upper
2000	26	1	29	-17	-6	2	5	-8	+4	24	-13	+3	-12	+2
1st	8	1	6	-17	-6	2	1	-2	-2	6	-9	+6	-11	+3
2nd	5	1	5	*	*	0	1	-4	-4	6	-10	-3	-12	+0
3rd	6	1	6	*	*	0	3	-9	+6	6	-17	+2	-17	+6
4th	7	1	7	*	*	0	0	*	*	6	-12	+1	-12	+1

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

SULFUR DIOXIDE:

	PRECISION				ACCURACY						
YR-QTR	#Analyzer	# Checks	Probability Limits Lower	Upper	# Audits	Level 1 Lower	Upper	Level 2 Lower	Upper	Level 3 Lower	Upper
2000	4	114	-8	+7	7	-8	+5	-7	+4	-7	+6
1st	4	30	-8	+9	2	-3	-3	-4	+0	-7	+2
2nd	4	28	-7	+7	3	-12	+14	-15	+15	-15	+16
3rd	4	26	-6	+5	2	-10	+5	-7	+3	-6	+5
4th	4	30	-7	+2	0	*	*	*	*	*	*

* insufficient number of checks to calculate accuracy.

APPENDIX B
MICHIGAN AIR SAMPLING NETWORK
2000 DATA ASSESSMENT SUMMARY FOR CRITERIA AIR POLLUTANTS

CARBON MONOXIDE:

	PRECISION				ACCURACY						
			Probability Limits			Level 1		Level 2		Level 3	
YR-QTR	#Analyzer	# Checks	Lower	Upper	# Audits	Lower	Upper	Lower	Upper	Lower	Upper
2000	3	86	-7	+8	6	-6	+7	-6	+9	-5	+10
1st	2	25	-8	+7	1	-0	*	+1	*	+2	*
2nd	3	20	-3	+6	2	-8	+10	-3	+8	-4	+10
3rd	3	19	-5	+5	1	+5	*	+7	*	+8	*
4th	3	22	-5	+7	2	-4	-0	-5	+1	-2	-0

* insufficient number of analyzers to calculate accuracy.

PM-2.5:

	PRECISION						ACCURACY		
	# of			95 Per Cent		No. of Valid			
	Co-located	#Co-located	# Samples	Probability Limits		Colocated		Probability	
YR-QTR	Samples	Sites	< Limit	Lower	Upper	Data Pairs	# Audits	Lower	Upper
2000	421	6	4	-8	+10	417	93	-3	+3
1st	103	6	0	-8	+8	103	12	-5	+4
2nd	106	6	1	-9	+9	105	20	-3	+4
3rd	117	6	3	-9	+10	114	30	-3	+4
4th	95	6	0	-5	+10	95	31	-5	+5

OZONE:

	PRECISION				ACCURACY						
			Probability Limits			Level 1		Level 2		Level 3	
YR-QTR	#Analyzer	# Checks	Lower	Upper	# Audits	Lower	Upper	Lower	Upper	Lower	Upper
2000	21	310	-6	+6	32	-9	+3	-9	+3	-9	+1
1st	No data due to ozone season										
2nd	21	153	-6	+6	17	-9	+1	-8	+0	-8	+0
3rd	21	157	-5	+4	15	-13	+9	-10	+9	-10	+4
4th	No data due to ozone season										

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

Appendix C: 2000 Data Summary for Volatile Organic Compounds & Trace Metals

Appendix C is a summary of Volatile Organic Compounds (VOCs), carbonyl compounds (including aldehydes and ketones if measured), and trace metals from special-purpose monitors and industrial monitors located at Part 111 facilities. The data were converted from ppbv to ? g/m^3, assuming standard temperature and pressure (25 °C and 1 atmosphere pressure) for DEQ sites (26-163-0005, 26-163-0015, 26-081-0021, 26-113-0001, 26-161-0008), The Dow Chemical Co, and Pharmacia & Upjohn. No conversion is necessary for data collected by Environmental Waste Control, Michigan Recovery Systems, Chem-Met Services, Wayne Disposal, and Saulk Trail Hills Landfill because these sites report in ? g/m^3. Some values are lower than the detection limit because improved instrumental sensitivity by some laboratories. The cited method detection limits (MDLs) represent the detection limits that are routinely attained. In the calculation of the minimum and maximum averages, zero or the MDL, respectively, is substituted for non-detected levels.

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.

"Chemical Name" = Commonly accepted name of air pollutant analyzed
"MDL = Analytical Method Detection Limit
"Num Obs" = Number of Observations, same as the number of 24-hr air samples taken during the year.
"Num > MDL" = Number of samples that were above the method detection limit
"Max1" = The first highest air concentration during the year.
"Max2" = The second highest air concentration during the year.
"Max3" = The third highest air concentration during the year.
"Min Mean" = The annual mean air concentration assuming that the samples below the MDL are equal to 0.
"Max Mean" = The annual mean air concentration assuming that the samples below the MDL are equal to the MDL.

Location: Belleville | **Site ID: 261630984** | **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1	59	0	0	0	0	0.0000	1.0000
Benzene	0.14	59	28	2.1	1.1	0.7	0.1305	0.2041
Cadmium	0.005	60	4	0.002	0.001	0.001	0.0001	0.0047
Carbon Tetrachloride	0.04	59	2	0.2	0.2	0	0.0068	0.0454
Chloroform	0.02	59	0	0	0	0	0.0000	0.0200
Chromium	0.009	60	47	0.009	0.009	0.007	0.0025	0.0044
Ethylbenzene	1	59	34	3	1	1	0.1797	0.6034
Lead	0.025	60	27	0.04	0.02	0.02	0.0053	0.0191
Methylene Chloride	1	59	0	0	0	0	0.0000	1.0000
Tetrachloroethene	0.06	59	1	0.1	0	0	0.0017	0.0607
Toluene	1	59	39	3.4	2.4	1.6	0.3797	0.7186
Trichloroethene	0.18	59	4	1.7	1.7	0.4	0.0661	0.2339
Xylene	1	59	43	3.7	2.7	2.3	0.6237	0.8949

Location: Belleville - Site 5 | **Site ID: 261630975** | **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1	58	2	0.4	0.1	0	0.0086	0.9741
Benzene	0.14	58	32	2.5	2.5	2	0.3345	0.3972
Cadmium	0.005	60	1	0.001	0	0	0.0000	0.0049
Carbon Tetrachloride	0.04	58	2	0.7	0.2	0	0.0155	0.0541
Chloroform	0.02	58	2	0.2	0.1	0	0.0052	0.0245
Chromium	0.009	60	40	0.007	0.006	0.006	0.0022	0.0052
Ethylbenzene	1	58	39	3	2.6	1	0.3155	0.6431
Lead	0.025	60	20	0.05	0.04	0.03	0.0050	0.0217
Methylene Chloride	1	58	2	1	0.1	0	0.0190	0.9845
Tetrachloroethene	0.06	58	19	6.7	2	0.7	0.2103	0.2507
Toluene	1	58	43	19	8.5	3.8	1.4362	1.6948
Trichloroethene	0.18	58	11	8.4	1.1	0.6	0.2138	0.3597
Xylene	1	58	40	10.1	4.3	3.9	1.3397	

Location: Belleville - Site 6 | **Site ID: 261630981** | **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1	59	2	0.1	0.1	0	0.0034	0.9695
Benzene	0.14	59	19	8.2	2.4	2	0.2847	0.3797
Cadmium	0.005	60	0	0	0	0	0.0000	0.0050
Carbon Tetrachloride	0.04	59	2	0.2	0.2	0	0.0068	0.0454
Chloroform	0.02	59	1	0.1	0	0	0.0017	0.0214
Chromium	0.009	60	45	0.006	0.006	0.005	0.0020	0.0042
Ethylbenzene	1	59	29	0.8	0.8	0.7	0.1492	0.6576
Lead	0.025	60	22	0.07	0.04	0.03	0.0057	0.0215
Methylene Chloride	1	59	2	0.6	0.2	0	0.0136	0.9797
Tetrachloroethene	0.06	59	16	3.1	0.5	0.4	0.0983	0.1420
Toluene	1	59	29	3.8	3.1	2.9	0.5831	1.0915
Trichloroethene	0.18	59	6	1.6	0.3	0.1	0.0390	0.2007
Xylene	1	59	31	16.1	2.9	2.8	0.9220	

Location: Belleville - Site 7 | **Site ID: 261630977** | **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1	59	0	0	0	0	0.0000	1.0000
Benzene	0.14	59	23	1.7	1.6	1	0.1881	0.2736
Cadmium	0.005	60	2	0.002	0.001	0	0.0001	0.0049
Carbon Tetrachloride	0.04	59	1	0.1	0	0	0.0017	0.0410
Chloroform	0.02	59	2	0.9	0.2	0	0.0186	0.0380
Chromium	0.009	60	44	0.009	0.009	0.009	0.0027	0.0051
Ethylbenzene	1	59	32	1.8	1.2	1.1	0.2424	0.7000
Lead	0.025	60	38	0.05	0.04	0.03	0.0087	0.0178
Methylene Chloride	1	59	0	0	0	0	0.0000	1.0000
Tetrachloroethene	0.06	59	15	1.7	0.4	0.3	0.0678	0.1125
Toluene	1	59	31	6.2	5.8	5.8	0.9780	1.4525
Trichloroethene	0.18	59	13	5.6	1.9	0.9	0.1915	0.3319
Xylene	1	59	31	5.3	4.7	3.8	0.8915	

Location: Belleville - Site 8 **Site ID: 261630982** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1	59	3	0.4	0.3	0.2	0.0153	0.9644
Benzene	0.14	59	38	3.5	0.8	0.8	0.3085	0.3583
Cadmium	0.005	59	2	0.001	0.001	0	0.0000	0.0049
Carbon Tetrachloride	0.04	59	3	0.9	0.6	0.4	0.0322	0.0702
Chloroform	0.02	59	2	0.3	0.1	0	0.0068	0.0261
Chromium	0.009	59	48	0.009	0.009	0.009	0.0026	0.0043
Ethylbenzene	1	59	37	2.6	2.2	2.2	0.5373	0.9102
Lead	0.025	59	30	0.04	0.04	0.03	0.0081	0.0204
Methylene Chloride	1	59	0	0	0	0	0.0000	1.0000
Tetrachloroethene	0.06	59	23	1.5	0.8	0.6	0.1220	0.1586
Toluene	1	59	42	9.4	5.8	5.8	1.3610	1.6492
Trichloroethene	0.18	59	22	2.7	0.8	0.6	0.1322	0.2451
Xylene	1	59	40	4	4	2.7	1.1220	

Location: Belleville - Site 9 **Site ID: 261630983** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1	59	2	0.2	0.1	0	0.0051	0.9712
Benzene	0.14	59	39	1.9	1.1	1	0.2203	0.2678
Cadmium	0.005	60	0	0	0	0	0.0000	0.0050
Carbon Tetrachloride	0.04	59	3	0.6	0.6	0.1	0.0220	0.0600
Chloroform	0.02	59	1	0.2	0	0	0.0034	0.0231
Chromium	0.009	60	45	0.009	0.008	0.007	0.0020	0.0043
Ethylbenzene	1	59	46	2	1.2	1.2	0.2678	0.4881
Lead	0.025	60	26	0.03	0.03	0.02	0.0052	0.0193
Methylene Chloride	1	59	2	0.4	0.1	0	0.0085	0.9746
Tetrachloroethene	0.06	59	17	1.5	1.3	0.7	0.1136	0.1563
Toluene	1	59	44	6.9	6.6	5.4	0.9000	1.1542
Trichloroethene	0.18	59	12	3	1.8	0.4	0.1102	0.2536
Xylene	1	59	45	6.2	5.8	3.3	0.8525	

Location: Canton, Landfill #1 **Site ID: 261630996** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1-Dichloroethane	1	61	0	0	0	0	0.0000	1.0000
1,2-Dichloropropane	1	61	0	0	0	0	0.0000	1.0000
1,3-Dichloropropene	1	61	0	0	0	0	0.0000	1.0000
1,4-Dichlorobenzene	1	61	0	0	0	0	0.0000	1.0000
Benzene	0.14	61	57	10.4	3.7	3.5	1.4180	1.4272
Chlorobenzene	1	61	1	0.3	0	0	0.0049	0.9885
Chloroform	0.02	61	10	0.1	0.1	0.1	0.0164	0.0331
Methylene Chloride	1	61	17	10.3	8.8	5.3	0.7984	1.5197
Tetrachloroethene	0.06	61	40	1.9	1.1	0.8	0.1918	0.2125
Toluene	1	61	56	31.4	24.1	16	4.3426	4.4246
Trichloroethene	0.18	61	42	8	1.5	1.5	0.3311	0.3872
Vinyl Chloride	0.4	61	0	0	0	0	0.0000	0.4000
Xylene	1	61	51	8.6	8.2	7.8	2.6689	2.8328

Location: Canton, Landfill #2 **Site ID: 261630997** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1-Dichloroethane	1	60	0	0	0	0	0.0000	1.0000
1,2-Dichloropropane	1	60	0	0	0	0	0.0000	1.0000
1,3-Dichloropropene	1	60	1	1.1	0	0	0.0183	1.0017
1,4-Dichlorobenzene	1	60	0	0	0	0	0.0000	1.0000
Benzene	0.14	60	47	3.1	2	1.5	0.5800	0.6103
Chlorobenzene	1	60	1	0.3	0	0	0.0050	0.9883
Chloroform	0.02	60	1	0.7	0	0	0.0117	0.0313
Methylene Chloride	1	60	23	10.1	3.5	2.8	0.7850	1.4017
Tetrachloroethene	0.06	60	38	2.6	1.4	1	0.2667	0.2887
Toluene	1	60	46	59.8	18.5	16.5	4.4333	4.6667
Trichloroethene	0.18	60	34	1.7	1.7	0.8	0.2033	0.2813
Vinyl Chloride	0.4	60	0	0	0	0	0.0000	0.4000
Xylene	1	60	43	64.9	24.9	11.7	4.1167	4.4000

Location: Canton, Landfill #3 **Site ID: 261630998** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1-Dichloroethane	1	57	0	0	0	0	0.0000	1.0000
1,2-Dichloropropane	1	57	0	0	0	0	0.0000	1.0000
1,3-Dichloropropene	1	57	0	0	0	0	0.0000	1.0000
1,4-Dichlorobenzene	1	57	1	0.4	0	0	0.0070	0.9895
Benzene	0.14	56	41	7.9	5.4	3.8	1.2750	1.3125
Chlorobenzene	1	57	0	0	0	0	0.0000	1.0000
Chloroform	0.02	57	6	2.1	0.1	0.1	0.0456	0.0635
Methylene Chloride	1	55	30	13.5	12.9	8.4	2.0509	2.5055
Tetrachloroethene	0.06	57	40	11.8	5.8	5.6	1.0439	1.0618
Toluene	1	57	45	80.4	50.7	48.2	13.0439	13.2544
Trichloroethene	0.18	57	37	6.4	4.8	3.6	0.8298	0.8930
Vinyl Chloride	0.4	57	1	2.8	0	0	0.0491	0.4421
Xylene	1	56	44	65.4	48.2	24.6	8.7036	8.9179

Location: Dearborn, Site #1 **Site ID: 261630925** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic	0.01	56	54	0.0036	0.0027	0.0026	0.0010	
Cadmium	0.01	56	37	0.002	0.0019	0.0016	0.0004	0.0038
Chromium	0.01	56	51	0.009	0.008	0.008	0.0036	0.0045
Lead	0.5	56	10	0.02	0.01	0.01	0.0020	0.4127
Mercury (TSP)	0.01	56	5	0.0005	0.0005	0.0001	0.0000	
Nickel	0.01	54	35	0.009	0.004	0.002	0.0010	0.0046

Location: Dearborn, Site #2 **Site ID: 261630926** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic	0.01	57	52	0.0037	0.0028	0.0021	0.0010	
Cadmium	0.01	57	37	0.0017	0.0013	0.0013	0.0003	0.0038
Chromium	0.01	58	48	0.009	0.008	0.008	0.0036	0.0053
Lead	0.5	58	12	0.06	0.03	0.03	0.0036	0.4002
Mercury (TSP)	0.01	55	5	0.0009	0.0004	0.0002	0.0000	
Nickel	0.01	55	32	0.022	0.003	0.002	0.0012	0.0053

Location: Dearborn, Site #3 **Site ID: 261630927** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic	0.01	59	54	0.0045	0.0026	0.0025	0.0012	
Cadmium	0.01	57	41	0.004	0.002	0.0012	0.0005	0.0033
Chromium	0.01	57	50	0.011	0.008	0.008	0.0039	0.0051
Lead	0.5	57	19	0.19	0.04	0.03	0.0081	0.3414
Mercury (TSP)	0.01	55	6	0.0005	0.0004	0.0001	0.0000	
Nickel	0.01	55	40	0.014	0.009	0.005	0.0016	0.0043

Location: Dearborn, Site #4 **Site ID: 261630928** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic	0.01	58	53	0.0053	0.003	0.0025	0.0012	
Cadmium	0.01	58	42	0.0053	0.0018	0.0018	0.0005	0.0033
Chromium	0.01	58	49	0.012	0.008	0.008	0.0036	0.0052
Lead	0.5	58	24	0.21	0.03	0.03	0.0091	0.3022
Mercury (TSP)	0.01	56	7	0.0002	0.0001	0.0001	0.0000	
Nickel	0.01	58	44	0.026	0.021	0.015	0.0024	0.0048

Location: Detroit - Site 1 **Site ID: 261630935** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic	0.3	59	14	0.055	0.045	0.045	0.0044	0.2332
Chromium	1	59	51	0.107	0.032	0.022	0.0104	0.1460
Lead	1	59	42	0.36	0.12	0.1	0.0285	0.3166

Location: Detroit - Site 2 **Site ID : 261630936** **Units : µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic	0.3	60	10	0.068	0.063	0.055	0.0050	0.2550
Chromium	1	60	54	0.062	0.042	0.019	0.0092	0.1092
Lead	1	60	42	0.1	0.07	0.07	0.0208	0.3208

Location: Detroit - Site 3 **Site ID: 261630937** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic	0.3	60	12	0.089	0.071	0.052	0.0054	0.2454
Chromium	1	60	51	0.08	0.034	0.016	0.0084	0.1584
Lead	1	60	40	0.13	0.06	0.06	0.0180	0.3513

Location: Flint, Whaley Park **Site ID: 260490021** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Arsenic	3	57	4	0.0044	0.0037	0.0033	0.0003	2.7897
Barium	0.001	57	57	0.18	0.109	0.08	0.0530	0.0530
Beryllium	1E-04	57	0	0	0	0	0.0000	0.0001
Cadmium	0.001	57	0	0	0	0	0.0000	0.0010
Chromium	0.005	57	1	0.0022	0	0	0.0000	0.0050
Cobalt	0.003	57	0	0	0	0	0.0000	0.0025
Copper	0.001	57	57	0.112	0.108	0.097	0.0534	0.0534
Iron	0.003	57	57	0.99	0.7	0.55	0.2875	0.2875
Lead	0.003	57	54	0.064	0.032	0.015	0.0082	0.0084
Manganese	0.001	57	57	0.059	0.03	0.023	0.0112	0.0112
Molybdenum	0.003	57	0	0	0	0	0.0000	0.0030
Nickel	0.005	57	1	0.0033	0	0	0.0001	0.0050
Vanadium	0.001	57	0	0	0	0	0.0000	0.0010
Zinc	0.001	57	57	0.08	0.067	0.066	0.0376	0.0376

Location: Kalamazoo **Site ID: 260770901** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	0.245	28	3	0.22	0.22	0.11	0.0196	0.2384
1,2,3-Trimethybenzene	0.383	28	4	1.18	0.59	0.59	0.1018	0.4301
1,2,4-Trimethylbenzene	0.491	28	13	2.8	1.52	1.08	0.4714	0.7345
1,2-Dichlorobenzene	1.602	28	0	0	0	0	0.0000	1.6020
1,2-Dichloroethane	0.202	28	0	0	0	0	0.0000	0.2020
1,3,5-Trimethylbenzene	0.383	28	1	0.78	0	0	0.0279	0.3972
1,3-Dichlorobenzene	6	28	0	0	0	0	0.0000	6.0000
1,4-Dichlorobenzene	6	28	0	0	0	0	0.0000	6.0000
Benzene	1.116	28	26	1.59	1.59	1.4	0.7386	0.8183
Carbon Tetrachloride	0.188	28	15	0.5	0.19	0.19	0.0936	0.1809
Chlorobenzene	0.726	28	0	0	0	0	0.0000	0.7260
Chloroform	0.195	28	2	0.19	0.1	0	0.0104	0.1914
Ethylbenzene	0.542	28	24	1.91	0.69	0.69	0.3161	0.3935
m/p –Xylene	0.815	28	26	6.37	2.51	1.78	1.0564	1.1146
Methylene Chloride	0.243	28	21	29.95	18.96	16.95	5.4214	5.4822
n-heptane	0.528	28	20	0.82	0.61	0.61	0.1975	0.3484
n-Hexane	0.915	28	15	0.6	0.39	0.32	0.1154	0.5402
o-xylene	0.433	28	26	1.99	0.91	0.61	0.3589	0.3899
Tetrachloroethene	7	28	21	0.41	0.34	0.34	0.1261	1.8761
Toluene	0.639	28	27	20.95	11.96	8.5	3.5914	3.6143

Location: Midland **Site ID: 261110954** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,2-Dichloroethane	0.8	60	0	0	0	0	0.0000	0.8000
1,3-Butadiene	0.4	60	1	1.24	0	0	0.0207	0.4140
Acrylonitrile	0.4	59	1	7.5	0	0	0.1271	0.5203
Arsenic	0.001	54	53	0.005	0.0037	0.0023	0.0012	0.0012
Benzene	0.6	56	29	7.65	3.32	3.06	0.7005	0.9898
Cadmium	0.001	54	48	0.0012	0.0007	0.0006	0.0002	0.0003
Carbon Tetrachloride	1.3	59	0	0	0	0	0.0000	1.3000
Chloroform	1	57	0	0	0	0	0.0000	1.0000
Chloromethane	0.4	55	55	1.61	1.5	1.44	1.0584	1.0584
Chromium	0.001	54	50	0.0016	0.0015	0.0014	0.0005	0.0005
Methylene Chloride	0.7	60	1	2.5	0	0	0.0417	0.7300
Styrene	0.9	55	1	0.93	0	0	0.0169	0.9005
Tetrachloroethene	1.4	57	0	0	0	0	0.0000	1.4000
Vinyl Chloride	0.6	60	0	0	0	0	0.0000	

Location: Midland **Site ID: 261110951** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,2-Dichloroethane	0.8	61	1	1.5	0	0	0.0246	0.8115
1,3-Butadiene	0.4	61	9	7.97	1.35	1.28	0.2572	0.5982
Acrylonitrile	0.4	60	11	4.23	2.97	1.84	0.2353	0.5620
Arsenic	0.001	54	53	0.0029	0.0023	0.0021	0.0010	0.0010
Benzene	0.6	57	41	2.93	2.87	1.53	0.7486	0.9170
Cadmium	0.001	54	46	0.0013	0.0004	0.0004	0.0002	0.0003
Carbon Tetrachloride	1.3	60	0	0	0	0	0.0000	1.3000
Chloroform	1	58	0	0	0	0	0.0000	1.0000
Chloromethane	0.4	55	55	44.11	25.97	25.97	6.4342	6.4342
Chromium	0.001	53	51	0.0019	0.0018	0.0017	0.0007	0.0007
Methylene Chloride	0.7	58	27	7.55	6.13	3.15	0.8217	1.1959
Styrene	0.9	56	14	3.57	3.14	2.55	0.4611	1.1361
Tetrachloroethene	1.4	58	2	3.59	1.49	0	0.0876	1.4393
Vinyl Chloride	0.6	61	2	2.6	1.79	0	0.0720	

Location: Midland **Site ID: 261110953** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,2-Dichloroethane	0.8	61	0	0	0	0	0.0000	0.8000
1,3-Butadiene	0.4	61	3	1.17	0.75	0.66	0.0423	0.4226
Acrylonitrile	0.4	55	5	3.62	2.54	2.17	0.2007	0.5644
Arsenic	0.001	54	54	0.003	0.0023	0.002	0.0009	0.0009
Benzene	0.6	57	38	2.77	2.77	2.49	0.8042	1.0042
Cadmium	0.001	54	51	0.001	0.0005	0.0005	0.0002	0.0003
Carbon Tetrachloride	1.3	60	1	1.63	0	0	0.0272	1.3055
Chloroform	1	57	11	4.87	3.02	2.29	0.3905	1.1975
Chloromethane	0.4	57	57	44.32	22.26	17.54	3.6719	3.6719
Chromium	0.001	54	54	0.0022	0.0022	0.002	0.0010	0.0010
Methylene Chloride	0.7	61	25	11.16	7.03	4.78	0.9103	1.3234
Styrene	0.9	56	10	8.84	5.18	2.97	0.4836	1.2229
Tetrachloroethene	1.4	58	5	1.83	1.69	1.62	0.1376	1.4169
Vinyl Chloride	0.6	61	1	0.61	0	0	0.0100	

Location: Midland **Site ID: 261110955** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,2-Dichloroethane	0.8	60	7	3.68	1.98	1.62	0.1887	0.8953
1,3-Butadiene	0.4	60	4	1.41	0.97	0.73	0.0607	0.4340
Acrylonitrile	0.4	59	10	3.49	1.99	1.21	0.1834	0.5156
Arsenic	0.001	53	52	0.0039	0.0032	0.0029	0.0010	0.0010
Benzene	0.6	56	46	6.82	2.96	2.68	1.1582	1.2654
Cadmium	0.001	53	50	0.0006	0.0005	0.0004	0.0002	0.0002
Carbon Tetrachloride	1.3	60	0	0	0	0	0.0000	1.3000
Chloroform	1	57	25	13.84	13.6	9.26	1.6375	2.1989
Chloromethane	0.4	57	57	8.93	8.9	7.94	2.6375	2.6375
Chromium	0.001	53	52	0.0036	0.0025	0.0023	0.0009	0.0009
Methylene Chloride	0.7	56	37	36.04	20.9	16.15	3.6086	3.8461
Styrene	0.9	56	10	1.91	1.4	1.32	0.2095	0.9488
Tetrachloroethene	1.4	56	16	10.83	10.76	4.26	1.0479	2.0479
Vinyl Chloride	0.6	61	4	8.27	3.88	3.04	0.2603	

Location: New Boston **Site ID: 261630994** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Cadmium	0.3	16	0	0	0	0	0.0000	0.3000
Lead	1	16	15	0.05	0.05	0.05	0.0238	0.0862
Mercury (TSP)	0.01	16	0	0	0	0	0.0000	0.0100

Location: New Boston **Site ID: 261630995** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
Cadmium	0.3	15	0	0	0	0	0.0000	0.3000
Lead	1	15	13	0.07	0.05	0.05	0.0253	0.1587
Mercury (TSP)	0.01	15	0	0	0	0	0.0000	0.0100

Location: Detroit **Site ID: 261630985** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1.5	69	36	16.6	3.5	3.4	0.8609	1.5783
Benzene	0.05	73	67	30.3	12	6.6	3.4041	3.4082
Carbon Tetrachloride	0.01	70	62	16.6	6.4	3.9	1.2643	1.2654
Chloroform	0.01	69	16	6.8	3.4	1.4	0.3261	0.3338
Methylene Chloride	0.03	71	46	1200	580	450	101.7845	101.7950
Tetrachloroethene	0.05	71	67	37	21	16	3.9451	3.9479
Toluene	1	72	68	530	380	310	90.6583	90.7139
Trichloroethene	0.02	69	51	60.6	31	26	3.7174	3.7226
Vinyl Chloride	0.01	69	1	13.5	0	0	0.1957	0.2055
Xylene	1	73	69	150	130	130	36.1890	36.2438

Location: Detroit **Site ID: 261630986** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1.5	74	53	7.2	5.3	3.8	0.9986	1.4243
Benzene	0.05	75	70	27	25.8	8.4	3.6213	3.6247
Carbon Tetrachloride	0.01	74	65	80	8.1	7.7	2.2514	2.2526
Chloroform	0.01	73	21	46	11	3.6	1.0452	1.0523
Methylene Chloride	0.03	74	45	870	483.6	480	58.6932	58.7050
Tetrachloroethene	0.05	75	69	76	67	24	6.9893	6.9933
Toluene	1	75	71	1800	350	340	102.7120	102.7653
Trichloroethene	0.02	75	62	56	41	39	6.4960	6.4995
Vinyl Chloride	0.01	72	0	0	0	0	0.0000	0.0100
Xylene	1	75	72	360	200	153.5	45.7880	45.8280

Location: Detroit **Site ID: 261630987** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1.5	72	48	16	6.7	4	1.2153	1.7153
Benzene	0.05	72	68	100	25	13	5.1056	5.1083
Carbon Tetrachloride	0.01	72	60	6.8	4.8	3.8	0.9792	0.9808
Chloroform	0.01	71	29	30	11	4.5	1.1775	1.1834
Methylene Chloride	0.03	70	55	900	750	730	150.3571	150.3635
Tetrachloroethene	0.05	72	67	33	18	16	4.7500	4.7535
Toluene	1	73	72	500	380	370	152.0137	152.0274
Trichloroethene	0.02	72	56	38	15	14	3.7069	3.7114
Vinyl Chloride	0.01	69	0	0	0	0	0.0000	0.0100
Xylene	1	72	72	580	510	310	89.7528	89.7528

Location: Detroit **Site ID: 261630988** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1.5	74	39	6.1	3.3	3.1	0.6203	1.3297
Benzene	0.05	74	66	158.8	11	7.6	4.9024	4.9078
Carbon Tetrachloride	0.01	74	60	5.1	3.2	2.4	0.7824	0.7843
Chloroform	0.01	73	10	3.4	3	2.4	0.1918	0.2004
Methylene Chloride	0.03	74	37	1400	1200	670	79.4960	79.5109
Tetrachloroethene	0.05	74	72	140	29	27.6	8.4473	8.4486
Toluene	1	74	68	2700	590	290	101.4608	101.5419
Trichloroethene	0.02	73	39	39.9	21	9.8	2.0164	2.0258
Vinyl Chloride	0.01	73	0	0	0	0	0.0000	0.0100
Xylene	1	74	70	270	212.1	170	33.1243	33.1784

Location: Romulus - Site 1 **Site ID: 261630921** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,2,2-Tetrachloroethane	0.1	60	0	0	0	0	0.0000	0.1000
1,1,2-Trichloroethane	0.1	60	0	0	0	0	0.0000	0.1000
Benzene	0.04	60	41	4.7	4.6	2.7	0.5917	0.6043
Cadmium	0.005	60	3	0.001	0.001	0.001	0.0001	0.0048
Carbon Tetrachloride	0.25	60	2	0.7	0.2	0	0.0150	0.2567
Chloroform	0.05	60	0	0	0	0	0.0000	0.0500
Ethylbenzene	1	60	49	15.8	13.4	11	2.9583	3.1417
Lead	0.5	60	33	0.05	0.02	0.02	0.0072	0.2322
Methylene Chloride	1	60	0	0	0	0	0.0000	1.0000
Tetrachloroethene	0.1	60	26	1.3	1.3	1.1	0.1583	0.2150
Toluene	1	60	47	17.6	10.2	9.6	2.2900	2.5067
Trichloroethene	0.1	60	18	1.7	0.9	0.5	0.0983	0.1683
Xylene	1	60	48	35.1	19.6	16.8	4.3683	4.5683

Location: Romulus - Site 2 **Site ID: 261630922** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,2,2-Tetrachloroethane	0.1	60	0	0	0	0	0.0000	0.1000
1,1,2-Trichloroethane	0.1	60	0	0	0	0	0.0000	0.1000
Benzene	0.04	60	31	1.9	1.2	0.9	0.2250	0.2443
Cadmium	0.005	60	4	0.003	0.001	0.001	0.0001	0.0048
Carbon Tetrachloride	0.25	60	1	0.4	0	0	0.0067	0.2525
Chloroform	0.05	60	0	0	0	0	0.0000	0.0500
Ethylbenzene	1	60	33	5.5	5.5	4.3	0.9983	1.4483
Lead	0.5	60	28	0.02	0.02	0.02	0.0052	0.2718
Methylene Chloride	1	60	0	0	0	0	0.0000	1.0000
Tetrachloroethene	0.1	60	26	1.5	1.5	1.4	0.2767	0.3333
Toluene	1	60	40	3.2	3.2	3.1	0.6883	1.0217
Trichloroethene	0.1	60	8	3.1	0.8	0.6	0.0833	0.1700
Xylene	1	60	39	19.5	6.2	5	1.3733	1.7233

Location: Romulus - Site 3 **Site ID: 261630923** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,2,2-Tetrachloroethane	0.1	60	0	0	0	0	0.0000	0.1000
1,1,2-Trichloroethane	0.1	60	0	0	0	0	0.0000	0.1000
Benzene	0.04	60	27	2.2	2	2	0.3550	0.3770
Cadmium	0.005	59	0	0	0	0	0.0000	0.0050
Carbon Tetrachloride	0.25	60	5	8.5	1.8	1.5	0.2117	0.4408
Chloroform	0.05	60	0	0	0	0	0.0000	0.0500
Ethylbenzene	1	60	39	9.2	6.6	5.9	1.2517	1.6017
Lead	0.5	59	26	0.5	0.3	0.2	0.0627	0.3424
Methylene Chloride	1	60	6	20.7	4.5	3.6	0.4983	1.3983
Tetrachloroethene	0.1	60	23	1.5	1.4	0.9	0.1933	0.2550
Toluene	1	60	45	8.6	8	7.6	1.8367	2.0867
Trichloroethene	0.1	60	17	70.2	15.7	7.2	1.6367	1.7083
Xylene	1	60	45	86.2	24.8	19	5.2350	5.4850

Location: Romulus - Site 4 **Site ID: 261630920** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,2,2-Tetrachloroethane	0.1	60	0	0	0	0	0.0000	0.1000
1,1,2-Trichloroethane	0.1	60	0	0	0	0	0.0000	0.1000
Benzene	0.04	60	24	9.1	4.3	3.8	0.6017	0.6257
Cadmium	0.005	60	2	0.001	0.001	0	0.0000	0.0049
Carbon Tetrachloride	0.25	60	1	0.5	0	0	0.0083	0.2542
Chloroform	0.05	60	0	0	0	0	0.0000	0.0500
Ethylbenzene	1	60	36	56.7	20.7	19.2	3.7267	4.1267
Lead	0.5	60	37	0.04	0.02	0.02	0.0075	0.1992
Methylene Chloride	1	60	0	0	0	0	0.0000	1.0000
Tetrachloroethene	0.1	60	13	9.8	8.2	2.5	0.4650	0.5433
Toluene	1	60	38	50.7	39.3	15.2	3.7783	4.1450
Trichloroethene	0.1	60	12	2	1.2	0.9	0.1233	0.2033
Xylene	1	60	39	92.6	72.5	54.2	10.4933	10.8433

Location: Wyandotte - Site 1 **Site ID: 261630960** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1	53	1	1.23	0	0	0.0232	1.0043
1,1,2,2-Tetrachloroethane	0.01	53	0	0	0	0	0.0000	0.0100
1,1,2-Trichloroethane	0.01	53	1	0.13	0	0	0.0025	0.0123
Benzene	0.01	53	46	4.03	4.03	4.02	1.2596	1.2609
Carbon Tetrachloride	0.01	53	47	1.5	1.45	1.41	0.6594	0.6606
Chlorobenzene	0.1	53	0	0	0	0	0.0000	0.1000
Chloroform	0.01	53	0	0	0	0	0.0000	0.0100
Ethylbenzene	1	53	19	9.7	5.29	4.54	0.8645	1.5060
Methylene Chloride	0.01	53	7	3.34	2.68	1.61	0.2360	0.2447
Styrene	1	53	0	0	0	0	0.0000	1.0000
Tetrachloroethene	0.01	53	31	2.47	2.09	1.56	0.3794	0.3836
Toluene	1	53	40	22.39	17.11	15.87	4.1389	4.3842
Trichloroethene	0.01	53	25	4.05	2.47	2.24	0.4564	0.4617
Xylene	1	53	23	20.62	18.93	9.92	2.7030	3.2691

Location: Wyandotte - Site 4 **Site ID: 261630963** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1	51	0	0	0	0	0.0000	1.0000
1,1,2,2-Tetrachloroethane	0.01	51	0	0	0	0	0.0000	0.0100
1,1,2-Trichloroethane	0.01	51	0	0	0	0	0.0000	0.0100
Benzene	0.01	51	47	5.33	4.42	4	1.4710	1.4718
Carbon Tetrachloride	0.01	51	38	1.9	1.9	1.7	0.5563	0.5588
Chlorobenzene	0.1	52	0	0	0	0	0.0000	0.1000
Chloroform	0.01	51	0	0	0	0	0.0000	0.0100
Ethylbenzene	1	51	21	6.22	5.09	4.04	0.8002	1.3884
Methylene Chloride	0.01	51	11	37.38	29.38	15.2	2.0606	2.0684
Styrene	1	51	1	0.31	0	0	0.0061	0.9865
Tetrachloroethene	0.01	51	38	3.42	3.33	2.12	0.4278	0.4304
Toluene	1	51	50	22.04	21.33	14.77	5.2961	5.3157
Trichloroethene	0.01	51	31	2.76	1.71	1.69	0.3122	0.3161
Xylene	1	51	31	18.72	18.27	11.3	3.3825	3.7747

Location: Wyandotte - Site 5 **Site ID: 261630965** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1	18	0	0	0	0	0.0000	1.0000
1,1,2,2-Tetrachloroethane	0.01	18	0	0	0	0	0.0000	0.0100
1,1,2-Trichloroethane	0.01	18	0	0	0	0	0.0000	0.0100
Benzene	0.01	18	18	4.88	3.09	2.71	1.8650	1.8650
Carbon Tetrachloride	0.01	18	18	0.94	0.83	0.8	0.6856	0.6856
Chlorobenzene	0.1	18	0	0	0	0	0.0000	0.1000
Chloroform	0.01	18	0	0	0	0	0.0000	0.0100
Ethylbenzene	1	18	3	1.42	1.16	1.07	0.2028	1.0361
Methylene Chloride	0.01	18	3	9.85	2.37	1.43	0.7583	0.7667
Styrene	1	18	0	0	0	0	0.0000	1.0000
Tetrachloroethene	0.01	18	17	0.76	0.41	0.4	0.2211	0.2217
Toluene	1	18	18	8.22	5.42	5.39	3.6061	3.6061
Trichloroethene	0.01	18	11	0.28	0.25	0.21	0.0939	0.0978
Xylene	1	18	10	6.89	5.11	4.53	2.3250	2.7694

Location: Wyandotte - Site 7 **Site ID: 261630967** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1	52	0	0	0	0	0.0000	1.0000
1,1,2,2-Tetrachloroethane	0.01	52	0	0	0	0	0.0000	0.0100
1,1,2-Trichloroethane	0.01	52	1	0.42	0	0	0.0081	0.0179
Benzene	0.01	51	43	4.41	4.08	3.87	1.1516	1.1531
Carbon Tetrachloride	0.01	52	43	2.07	1.83	1.71	0.6600	0.6617
Chlorobenzene	0.1	51	0	0	0	0	0.0000	0.1000
Chloroform	0.01	52	3	3.25	1.45	1.15	0.1125	0.1219
Ethylbenzene	1	51	15	3.66	3.25	2.83	0.5476	1.2535
Methylene Chloride	0.01	52	12	38.78	23.74	13.87	1.9517	1.9594
Styrene	1	52	0	0	0	0	0.0000	1.0000
Tetrachloroethene	0.01	52	28	4.78	1.91	1.37	0.3335	0.3381
Toluene	1	51	34	16.63	12.56	10.57	3.2382	3.5716
Trichloroethene	0.01	52	24	5.2	4.27	3.06	0.4479	0.4533
Xylene	1	51	23	12.56	8.99	8.62	2.2427	2.7918

Location: Detroit, W. Fort St. **Site ID: 261630015** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1.1	23	0	0	0	0	0.0000	1.1000
1,1,2,2-Tetrachloroethane	1.4	23	0	0	0	0	0.0000	1.4000
1,1,2-Trichloroethane	1.1	23	0	0	0	0	0.0000	1.1000
1,1-Dichloroethane	0.8	23	0	0	0	0	0.0000	0.8000
1,1-Dichloroethene	0.8	23	0	0	0	0	0.0000	0.8000
1,2,4-Trichlorobenzene	1.5	23	0	0	0	0	0.0000	1.5000
1,2,4-Trimethylbenzene	1	23	1	2.75	0	0	0.1196	1.0761
1,2-Dibromoethane	1.5	23	0	0	0	0	0.0000	1.5000
1,2-Dichlorobenzene	1.2	23	0	0	0	0	0.0000	1.2000
1,2-Dichloroethane	0.8	23	0	0	0	0	0.0000	0.8000
1,2-Dichloroethene	0.8	23	0	0	0	0	0.0000	0.8000
1,2-Dichloropropane	0.9	23	0	0	0	0	0.0000	0.9000
1,3,5-Trimethylbenzene	1	23	0	0	0	0	0.0000	1.0000
1,3-Dichlorobenzene	1.2	23	0	0	0	0	0.0000	1.2000
1,4-Dichlorobenzene	1.2	23	0	0	0	0	0.0000	1.2000
2,5-dimethylbenzaldehyde	0.3	23	0	0	0	0	0.0000	0.3000
Acetaldehyde	0.3	23	23	4.68	4.41	3.69	2.3996	2.3996
Acetone	0.3	23	23	7.61	6.85	4.64	3.1204	3.1204
Acrolein	0.3	23	0	0	0	0	0.0000	0.3000
Arsenic	3	25	5	0.0093	0.0046	0.0035	0.0010	2.4010
Barium	0.001	25	25	0.13	0.127	0.097	0.0658	0.0658
Benzaldehyde	0.3	23	1	0.48	0	0	0.0209	0.3078
Benzene	0.6	23	23	7.78	6.73	5.93	2.9487	2.9487
Beryllium	1E-04	25	5	0.0002	0.0001	0.0001	0.0000	0.0001
Bromomethane (Methyl Bromide)	0.8	23	0	0	0	0	0.0000	0.8000
Cadmium	0.001	25	3	0.0017	0.0013	0.0011	0.0002	0.0010
Carbon Tetrachloride	1.3	23	0	0	0	0	0.0000	1.3000
Chlorobenzene	0.9	23	0	0	0	0	0.0000	0.9000
Chloroethane	0.5	23	0	0	0	0	0.0000	0.5000
Chloroform	1	23	0	0	0	0	0.0000	1.0000
Chloromethane	0.4	23	23	2.47	2.12	2.04	1.6787	1.6787
Chromium	0.005	25	21	0.0113	0.0069	0.0057	0.0037	0.0045
cis-1,3-Dichloropropene	0.9	23	0	0	0	0	0.0000	0.9000
Cobalt	0.003	25	2	0.001	0.001	0	0.0001	0.0024
Copper	0.001	25	25	0.358	0.28	0.226	0.1356	0.1356
Crontonaldehyde	0.3	23	0	0	0	0	0.0000	0.3000
Dichlorodiflouromethane	1	23	23	4.79	4.05	4	3.2400	3.2400
Ethylbenzene	0.9	23	9	1.56	1.47	1.13	0.4561	1.0039
Formaldehyde	0.3	23	23	9.6	6.88	5.6	3.7400	3.7400
Halocarbon 113	1.5	23	21	5.43	4.74	4.59	2.9061	3.0365
Halocarbon 114	1.4	23	0	0	0	0	0.0000	1.4000
Hexachloro-1,3-Butadiene	2.1	23	0	0	0	0	0.0000	2.1000
Hexanaldehyde	0.3	23	3	1.72	1.31	0.45	0.1513	0.4122
Iron	0.003	25	25	2.89	2.44	2.1	1.0959	1.0959
Isovaleraldehyde	0.3	23	6	0.56	0.49	0.32	0.1013	0.3230
Lead	0.003	25	25	0.058	0.052	0.05	0.0252	0.0252
m,p-Tolualdehyde	0.3	23	1	0.39	0	0	0.0170	0.3039
m/p -Xylene	1.7	23	15	4.16	3.99	3.77	1.8148	2.4061
Manganese	0.001	25	25	0.15	0.122	0.118	0.0646	0.0646
Methylene Chloride	0.7	23	17	1.56	1.18	1.14	0.4474	0.6300
Molybdenum	0.003	25	5	0.0038	0.003	0.0027	0.0005	0.0029
n-Butyraldehyde	0.3	23	13	1.21	0.85	0.59	0.2757	0.4061
Nickel	0.005	25	11	0.0151	0.0059	0.0055	0.0023	0.0051
o-Tolualdehyde	0.3	23	0	0	0	0	0.0000	0.3000
o-xylene	0.9	23	10	1.82	1.56	1.52	0.5596	1.0683
Propionaldehyde	0.3	23	20	2.7	1.16	1.09	0.5752	0.6143
Styrene	0.9	23	0	0	0	0	0.0000	0.9000
Tetrachloroethene	1.4	23	7	9.14	1.56	1.56	0.8043	1.7783
Toluene	0.8	23	23	19.22	7.56	7.37	4.9230	4.9230
trans-1,3-Dichloropropene	0.9	23	0	0	0	0	0.0000	0.9000
Trichloroethene	1.1	23	7	1.13	1.13	1.13	0.3439	1.1091
Trichloroflouromethane	1.1	23	23	11.27	10.48	8.58	6.6274	6.6274
Valeraldehyde	0.3	23	12	0.98	0.77	0.6	0.2435	0.3870
Vanadium	0.001	25	1	0.0096	0	0	0.0004	0.0013
Vinyl Chloride	0.5	23	0	0	0	0	0.0000	0.5000
Zinc	0.001	25	25	0.34	0.31	0.27	0.1590	0.1590

Location: River Rouge **Site ID: 261630005** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1.1	26	0	0	0	0	0.0000	1.1000
1,1,2,2-Tetrachloroethane	1.4	26	0	0	0	0	0.0000	1.4000
1,1,2-Trichloroethane	1.1	26	0	0	0	0	0.0000	1.1000
1,1-Dichloroethane	0.8	26	0	0	0	0	0.0000	0.8000
1,1-Dichloroethene	0.8	26	0	0	0	0	0.0000	0.8000
1,2,4-Trichlorobenzene	1.5	26	0	0	0	0	0.0000	1.5000
1,2,4-Trimethylbenzene	1	26	0	0	0	0	0.0000	1.0000
1,2-Dibromoethane	1.5	26	0	0	0	0	0.0000	1.5000
1,2-Dichlorobenzene	1.2	26	0	0	0	0	0.0000	1.2000
1,2-Dichloroethane	0.8	26	0	0	0	0	0.0000	0.8000
1,2-Dichloroethene	0.8	26	0	0	0	0	0.0000	0.8000
1,2-Dichloropropane	0.9	26	0	0	0	0	0.0000	0.9000
1,3,5-Trimethylbenzene	1	26	0	0	0	0	0.0000	1.0000
1,3-Dichlorobenzene	1.2	26	0	0	0	0	0.0000	1.2000
1,4-Dichlorobenzene	1.2	26	0	0	0	0	0.0000	1.2000
2,5-dimethylbenzaldehyde	0.3	23	0	0	0	0	0.0000	0.3000
Acetaldehyde	0.3	23	23	3.87	3.06	3.04	2.2339	2.2339
Acetone	0.3	23	23	4.6	3.65	3.29	2.4465	2.4465
Acrolein	0.3	23	0	0	0	0	0.0000	0.3000
Arsenic	3	27	2	0.0034	0.003	0	0.0002	2.7780
Barium	0.001	27	27	0.188	0.12	0.066	0.0545	0.0545
Benzaldehyde	0.3	23	1	0.43	0	0	0.0187	0.3057
Benzene	0.6	26	26	4.43	4.11	3.86	2.1315	2.1315
Beryllium	1E-04	27	0	0	0	0	0.0000	0.0001
Bromomethane (Methyl Bromide)	0.8	26	1	1.05	0	0	0.0404	0.8096
Cadmium	0.001	27	3	0.0021	0.0013	0.0011	0.0002	0.0011
Carbon Tetrachloride	1.3	26	0	0	0	0	0.0000	1.3000
Chlorobenzene	0.9	26	0	0	0	0	0.0000	0.9000
Chloroethane	0.5	26	7	2.66	2.42	2.24	0.5896	0.9550
Chloroform	1	26	0	0	0	0	0.0000	1.0000
Chloromethane	0.4	26	26	2.08	1.92	1.9	1.4462	1.4462
Chromium	0.005	27	17	0.0066	0.0066	0.0065	0.0024	0.0043
cis-1,3-Dichloropropene	0.9	26	0	0	0	0	0.0000	0.9000
Cobalt	0.003	27	0	0	0	0	0.0000	0.0025
Copper	0.001	27	27	0.07	0.067	0.065	0.0462	0.0462
Crontonaldehyde	0.3	23	4	0.57	0.4	0.31	0.0657	0.3135
Dichlorodiflouromethane	1	26	26	4.54	3.85	3.7	3.1788	3.1788
Ethylbenzene	0.9	26	10	1.17	1.13	1.08	0.3919	0.9458
Formaldehyde	0.3	23	23	12.51	9.13	7.55	4.9348	4.9348
Halocarbon 113	1.5	26	1	2.29	0	0	0.0881	1.5304
Halocarbon 114	1.4	26	0	0	0	0	0.0000	1.4000
Hexachloro-1,3-Butadiene	2.1	26	0	0	0	0	0.0000	2.1000
Hexanaldehyde	0.3	23	3	0.61	0.37	0.37	0.0587	0.3196
Iron	0.003	27	27	1.935	1.9	1.88	0.8052	0.8052
Isovaleraldehyde	0.3	23	3	0.46	0.35	0.32	0.0491	0.3100
Lead	0.003	27	27	0.05	0.047	0.032	0.0167	0.0167
m,p-Tolualdehyde	0.3	23	0	0	0	0	0.0000	0.3000
m/p -Xylene	1.7	26	19	3.81	3.6	3.6	1.9296	2.3873
Manganese	0.001	27	27	0.185	0.155	0.135	0.0599	0.0599
Methylene Chloride	0.7	26	16	1.56	1.25	1.11	0.3046	0.5738
Molybdenum	0.003	27	1	0.0035	0	0	0.0001	0.0030
n-Butyraldehyde	0.3	23	16	0.59	0.53	0.5	0.2839	0.3752
Nickel	0.005	27	3	0.005	0.0033	0.0032	0.0004	0.0049
o-Tolualdehyde	0.3	23	0	0	0	0	0.0000	0.3000
o-xylene	0.9	26	13	1.3	1.21	1.21	0.5400	0.9900
Propionaldehyde	0.3	23	19	4.84	4.27	2.51	0.8530	0.9052
Styrene	0.9	26	0	0	0	0	0.0000	0.9000
Tetrachloroethene	1.4	26	0	0	0	0	0.0000	1.4000
Toluene	0.8	26	26	5.98	5.87	5.79	3.9619	3.9619
trans-1,3-Dichloropropene	0.9	26	0	0	0	0	0.0000	0.9000
Trichloroethene	1.1	26	0	0	0	0	0.0000	1.1000
Trichloroflouromethane	1.1	26	18	2.19	2.07	1.79	1.1923	1.5308
Valeraldehyde	0.3	23	9	0.53	0.49	0.49	0.1665	0.3491
Vanadium	0.001	27	0	0	0	0	0.0000	0.0010
Vinyl Chloride	0.5	26	0	0	0	0	0.0000	0.5000
Zinc	0.001	27	27	0.75	0.365	0.33	0.1410	0.1410

Location: Ypsilanti **Site ID: 261610008** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1.1	22	0	0	0	0	0.0000	1.1000
1,1,2,2-Tetrachloroethane	1.4	22	0	0	0	0	0.0000	1.4000
1,1,2-Trichloroethane	1.1	22	0	0	0	0	0.0000	1.1000
1,1-Dichloroethane	0.8	22	0	0	0	0	0.0000	0.8000
1,1-Dichloroethene	0.8	22	0	0	0	0	0.0000	0.8000
1,2,4-Trichlorobenzene	1.5	22	0	0	0	0	0.0000	1.5000
1,2,4-Trimethylbenzene	1	22	1	2.89	0	0	0.1314	1.0859
1,2-Dibromoethane	1.5	22	0	0	0	0	0.0000	1.5000
1,2-Dichlorobenzene	1.2	22	0	0	0	0	0.0000	1.2000
1,2-Dichloroethane	0.8	22	0	0	0	0	0.0000	0.8000
1,2-Dichloroethene	0.8	22	0	0	0	0	0.0000	0.8000
1,2-Dichloropropane	0.9	22	0	0	0	0	0.0000	0.9000
1,3,5-Trimethylbenzene	1	22	0	0	0	0	0.0000	1.0000
1,3-Dichlorobenzene	1.2	22	0	0	0	0	0.0000	1.2000
1,4-Dichlorobenzene	1.2	22	0	0	0	0	0.0000	1.2000
Arsenic	3	16	2	0.0078	0.0035	0	0.0007	2.6257
Barium	0.001	16	16	0.338	0.067	0.059	0.0686	0.0686
Benzene	0.6	22	22	3.44	2.58	2.1	1.4759	1.4759
Beryllium	1E-04	16	0	0	0	0	0.0000	0.0001
Bromomethane (Methyl Bromide)	0.8	22	3	0.89	0.89	0.89	0.1214	0.8123
Cadmium	0.001	16	0	0	0	0	0.0000	0.0010
Carbon Tetrachloride	1.3	22	0	0	0	0	0.0000	1.3000
Chlorobenzene	0.9	22	0	0	0	0	0.0000	0.9000
Chloroethane	0.5	22	0	0	0	0	0.0000	0.5000
Chloroform	1	22	0	0	0	0	0.0000	1.0000
Chloromethane	0.4	22	22	1.98	1.67	1.53	1.3441	1.3441
Chromium	0.005	16	0	0	0	0	0.0000	0.0050
cis-1,3-Dichloropropene	0.9	22	0	0	0	0	0.0000	0.9000
Cobalt	0.003	16	0	0	0	0	0.0000	0.0025
Copper	0.001	16	16	0.143	0.078	0.078	0.0546	0.0546
Dichlorodiflouromethane	1	22	22	5.18	4.19	3.65	3.2736	3.2736
Ethylbenzene	0.9	22	3	2.17	1.17	0.91	0.1932	0.9705
Halocarbon 113	1.5	22	0	0	0	0	0.0000	1.5000
Halocarbon 114	1.4	22	0	0	0	0	0.0000	1.4000
Hexachloro-1,3-Butadiene	2.1	22	0	0	0	0	0.0000	2.1000
Iron	0.003	16	16	0.59	0.48	0.3	0.2541	0.2541
Lead	0.003	16	15	0.144	0.014	0.01	0.0157	0.0159
m/p -Xylene	1.7	22	15	5.33	3.12	3.12	1.8341	2.3750
Manganese	0.001	16	16	0.026	0.025	0.017	0.0112	0.0112
Methylene Chloride	0.7	22	19	8.25	2.18	1.91	0.9314	1.0268
Molybdenum	0.003	16	0	0	0	0	0.0000	0.0030
Nickel	0.005	16	0	0	0	0	0.0000	0.0050
o-xylene	0.9	22	6	2.38	1.39	1.17	0.3505	1.0050
Styrene	0.9	22	2	3.57	2.59	0	0.2800	1.0982
Tetrachloroethene	1.4	22	7	32.28	7.24	3.99	2.3532	3.3077
Toluene	0.8	22	22	12.49	7.11	5.64	3.8377	3.8377
trans-1,3-Dichloropropene	0.9	22	0	0	0	0	0.0000	0.9000
Trichloroethene	1.1	22	0	0	0	0	0.0000	1.1000
Trichloroflouromethane	1.1	22	13	2.3	1.96	1.96	1.0518	1.5018
Vanadium	0.001	16	0	0	0	0	0.0000	0.0010
Vinyl Chloride	0.5	22	0	0	0	0	0.0000	0.5000
Zinc	0.001	16	16	0.124	0.09	0.07	0.0526	0.0526

Location: Grand Rapids **Site ID: 260810021** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1.1	27	0	0	0	0	0.0000	1.1000
1,1,2,2-Tetrachloroethane	1.4	27	0	0	0	0	0.0000	1.4000
1,1,2-Trichloroethane	1.1	27	0	0	0	0	0.0000	1.1000
1,1-Dichloroethane	0.8	27	0	0	0	0	0.0000	0.8000
1,1-Dichloroethene	0.8	27	0	0	0	0	0.0000	0.8000
1,2,4-Trichlorobenzene	1.5	27	0	0	0	0	0.0000	1.5000
1,2,4-Trimethylbenzene	1	27	5	4.61	4.42	4.42	0.6489	1.4637
1,2-Dibromoethane	1.5	27	0	0	0	0	0.0000	1.5000
1,2-Dichlorobenzene	1.2	27	0	0	0	0	0.0000	1.2000
1,2-Dichloroethane	0.8	27	0	0	0	0	0.0000	0.8000
1,2-Dichloroethene	0.8	27	0	0	0	0	0.0000	0.8000
1,2-Dichloropropane	0.9	27	0	0	0	0	0.0000	0.9000
1,3,5-Trimethylbenzene	1	27	3	1.42	1.37	1.37	0.1541	1.0430
1,3-Dichlorobenzene	1.2	27	0	0	0	0	0.0000	1.2000
1,4-Dichlorobenzene	1.2	27	0	0	0	0	0.0000	1.2000
2,5-dimethylbenzaldehyde	0.3	27	0	0	0	0	0.0000	0.3000
Acetaldehyde	0.3	27	26	4.46	3.2	2.91	1.8441	1.8552
Acetone	0.3	27	26	18.05	9.43	8.39	4.5448	4.5559
Acrolein	0.3	27	0	0	0	0	0.0000	0.3000
Arsenic	3	26	4	0.0038	0.0034	0.0033	0.0005	2.5390
Barium	0.001	26	26	0.087	0.07	0.069	0.0537	0.0537
Benzaldehyde	0.3	27	2	0.43	0.35	0	0.0289	0.3067
Benzene	0.6	27	26	2.55	2.01	1.91	1.3844	1.4067
Beryllium	1E-04	26	0	0	0	0	0.0000	0.0001
Bromomethane (Methyl Bromide)	0.8	27	0	0	0	0	0.0000	0.8000
Cadmium	0.001	26	0	0	0	0	0.0000	0.0010
Carbon Tetrachloride	1.3	27	0	0	0	0	0.0000	1.3000
Chlorobenzene	0.9	27	0	0	0	0	0.0000	0.9000
Chloroethane	0.5	27	1	0.84	0	0	0.0311	0.5126
Chloroform	1	27	0	0	0	0	0.0000	1.0000
Chloromethane	0.4	27	27	2.41	2.08	1.92	1.4585	1.4585
Chromium	0.005	26	15	0.0099	0.007	0.0067	0.0026	0.0048
cis-1,3-Dichloropropene	0.9	27	0	0	0	0	0.0000	0.9000
Cobalt	0.003	26	3	0.0023	0.0019	0.0011	0.0002	0.0024
Copper	0.001	26	26	0.17	0.16	0.148	0.0963	0.0963
Crontonaldehyde	0.3	27	0	0	0	0	0.0000	0.3000
Dichlorodiflouromethane	1	27	27	4.84	4.1	3.55	3.1789	3.1789
Ethylbenzene	0.9	27	17	3.9	2.95	2.47	1.1981	1.5315
Formaldehyde	0.3	27	27	9.32	8.37	7.77	4.6741	4.6741
Halocarbon 113	1.5	27	1	1.84	0	0	0.0681	1.5126
Halocarbon 114	1.4	27	0	0	0	0	0.0000	1.4000
Hexachloro-1,3-Butadiene	2.1	27	0	0	0	0	0.0000	2.1000
Hexanaldehyde	0.3	27	9	0.61	0.53	0.49	0.1544	0.3544
Iron	0.003	26	26	0.88	0.87	0.8	0.4143	0.4143
Isovaleraldehyde	0.3	27	4	0.42	0.39	0.39	0.0574	0.3130
Lead	0.003	26	26	0.148	0.028	0.022	0.0163	0.0163
m,p-Tolualdehyde	0.3	27	0	0	0	0	0.0000	0.3000
m/p -Xylene	1.7	27	19	12.13	10.62	7.93	3.5852	4.0889
Manganese	0.001	26	26	0.072	0.066	0.056	0.0279	0.0279
Methylene Chloride	0.7	27	22	11.65	6.21	5.1	1.7978	1.9274
Molybdenum	0.003	26	0	0	0	0	0.0000	0.0030
n-Butyraldehyde	0.3	27	14	1	0.97	0.85	0.2944	0.4389
Nickel	0.005	26	15	0.022	0.0184	0.0183	0.0055	0.0076
o-Tolualdehyde	0.3	27	0	0	0	0	0.0000	0.3000
o-xylene	0.9	27	17	3.03	2.51	2.43	1.1022	1.4356
Propionaldehyde	0.3	27	21	2.63	2.51	2.16	0.6081	0.6748
Styrene	0.9	27	0	0	0	0	0.0000	0.9000
Tetrachloroethene	1.4	27	1	1.49	0	0	0.0552	1.4033
Toluene	0.8	27	27	12.94	10.49	8.61	4.9044	4.9044
trans-1,3-Dichloropropene	0.9	27	0	0	0	0	0.0000	0.9000
Trichloroethene	1.1	27	1	2.31	0	0	0.0856	1.1448
Trichloroflouromethane	1.1	27	16	2.47	1.91	1.79	0.9989	1.4470
Valeraldehyde	0.3	27	3	0.39	0.35	0.35	0.0404	0.3070
Vanadium	0.001	26	0	0	0	0	0.0000	0.0010
Vinyl Chloride	0.5	27	0	0	0	0	0.0000	0.5000
Zinc	0.001	26	26	0.347	0.206	0.2	0.0981	0.0981

Location: Houghton Lake **Site ID: 261130001** **Units: µg/m³**

Chemical Name	MDL	Num Obs	Num > MDL	Max1	Max2	Max3	Min Mean	Max Mean
1,1,1-Trichloroethane	1.1	18	0	0	0	0	0.0000	1.1000
1,1,2,2-Tetrachloroethane	1.4	18	0	0	0	0	0.0000	1.4000
1,1,2-Trichloroethane	1.1	18	0	0	0	0	0.0000	1.1000
1,1-Dichloroethane	0.8	18	0	0	0	0	0.0000	0.8000
1,1-Dichloroethene	0.8	18	0	0	0	0	0.0000	0.8000
1,2,4-Trichlorobenzene	1.5	18	1	7.11	0	0	0.3950	1.8117
1,2,4-Trimethylbenzene	1	18	0	0	0	0	0.0000	1.0000
1,2-Dibromoethane	1.5	18	0	0	0	0	0.0000	1.5000
1,2-Dichlorobenzene	1.2	18	0	0	0	0	0.0000	1.2000
1,2-Dichloroethane	0.8	18	0	0	0	0	0.0000	0.8000
1,2-Dichloroethene	0.8	18	0	0	0	0	0.0000	0.8000
1,2-Dichloropropane	0.9	18	0	0	0	0	0.0000	0.9000
1,3,5-Trimethylbenzene	1	18	0	0	0	0	0.0000	1.0000
1,3-Dichlorobenzene	1.2	18	0	0	0	0	0.0000	1.2000
1,4-Dichlorobenzene	1.2	18	0	0	0	0	0.0000	1.2000
2,5-dimethylbenzaldehyde	0.3	23	0	0	0	0	0.0000	0.3000
Acetaldehyde	0.3	23	20	4.1	3.22	2.45	1.3491	1.3883
Acetone	0.3	23	20	5.17	4.9	4.48	2.0748	2.1139
Acrolein	0.3	23	0	0	0	0	0.0000	0.3000
Arsenic	3	25	0	0	0	0	0.0000	3.0000
Barium	0.001	25	25	0.07	0.05	0.05	0.0430	0.0430
Benzaldehyde	0.3	23	6	1.34	0.95	0.65	0.1939	0.4157
Benzene	0.6	18	6	1.47	1.05	0.99	0.3089	0.7089
Beryllium	1E-04	25	0	0	0	0	0.0000	0.0001
Bromomethane (Methyl Bromide)	0.8	18	0	0	0	0	0.0000	0.8000
Cadmium	0.001	25	0	0	0	0	0.0000	0.0010
Carbon Tetrachloride	1.3	18	0	0	0	0	0.0000	1.3000
Chlorobenzene	0.9	18	0	0	0	0	0.0000	0.9000
Chloroethane	0.5	18	0	0	0	0	0.0000	0.5000
Chloroform	1	18	0	0	0	0	0.0000	1.0000
Chloromethane	0.4	18	17	2	1.75	1.71	1.3039	1.3261
Chromium	0.005	25	1	0.0023	0	0	0.0001	0.0049
cis-1,3-Dichloropropene	0.9	18	0	0	0	0	0.0000	0.9000
Cobalt	0.003	25	0	0	0	0	0.0000	0.0025
Copper	0.001	25	25	0.177	0.14	0.139	0.0886	0.0886
Crontonaldehyde	0.3	23	0	0	0	0	0.0000	0.3000
Dichlorodiflouromethane	1	18	17	4	3.6	3.41	2.8772	2.9328
Ethylbenzene	0.9	18	0	0	0	0	0.0000	0.9000
Formaldehyde	0.3	23	21	68.8	57.82	36.35	12.4544	12.4804
Halocarbon 113	1.5	18	0	0	0	0	0.0000	1.5000
Halocarbon 114	1.4	18	0	0	0	0	0.0000	1.4000
Hexachloro-1,3-Butadiene	2.1	18	1	5.96	0	0	0.3311	2.3144
Hexanaldehyde	0.3	23	8	4.95	2.86	2.17	0.7517	0.9474
Iron	0.003	25	25	0.249	0.24	0.2	0.0826	0.0826
Isovaleraldehyde	0.3	23	7	0.81	0.56	0.49	0.1439	0.3526
Lead	0.003	25	8	0.009	0.007	0.006	0.0018	0.0038
m,p-Tolualdehyde	0.3	23	0	0	0	0	0.0000	0.3000
m/p -Xylene	1.7	18	0	0	0	0	0.0000	1.7000
Manganese	0.001	25	25	0.018	0.014	0.011	0.0048	0.0048
Methylene Chloride	0.7	18	4	0.94	0.9	0.52	0.1428	0.6872
Molybdenum	0.003	25	0	0	0	0	0.0000	0.0030
n-Butyraldehyde	0.3	23	6	0.68	0.65	0.5	0.1239	0.3457
Nickel	0.005	25	0	0	0	0	0.0000	0.0050
o-Tolualdehyde	0.3	23	0	0	0	0	0.0000	0.3000
o-xylene	0.9	18	0	0	0	0	0.0000	0.9000
Propionaldehyde	0.3	23	12	1.52	0.74	0.69	0.2722	0.4157
Styrene	0.9	18	1	3.66	0	0	0.2033	1.0533
Tetrachloroethene	1.4	18	0	0	0	0	0.0000	1.4000
Toluene	0.8	18	5	1.77	1.32	1.2	0.3533	0.9311
trans-1,3-Dichloropropene	0.9	18	0	0	0	0	0.0000	0.9000
Trichloroethene	1.1	18	1	3.06	0	0	0.1700	1.2089
Trichloroflouromethane	1.1	18	12	2.92	2.58	2.58	1.3706	1.7372
Valeraldehyde	0.3	23	8	1.55	0.84	0.7	0.2378	0.4335
Vanadium	0.001	25	0	0	0	0	0.0000	0.0010
Vinyl Chloride	0.5	18	0	0	0	0	0.0000	0.5000
Zinc	0.001	25	25	0.04	0.04	0.04	0.0200	0.0200

Appendix D: Ozone Exceedances 1991 to 2000

Appendix D is a tabulation of Ozone Exceedances from 1991 to 2000. Exceedances are measured as an 1-hour ozone averaged concentration level of 0.125 ppm or higher during a 24-hour (midnight to midnight) period, with the highest 1-hour ozone level being reported.

Historical ozone exceedances for years prior to 1990 can be found in the ***1998 Annual Air Quality Report.***

1991 OZONE EXCEEDANCES

(Units in ppm)

26-005-0002 * SOUTH HAVEN		26-019-0002 * BENZIE COUNTY		26-021-0013 * BENTON HARBOR		26-027-0003 CASSOPOLIS (I.D.E.M.)		26-037-0001 BATH TWP		26-041-0009 * DELTA COUNTY		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
7-17-91	0.132	6-29-91	0.131	7-17-91	0.137					6-26-91	0.128				
7-18-91	0.153	7-6-91	0.138							8-26-91	0.130				
7-19-91	0.128	7-19-91	0.170												

26-049-0011 FLINT (Old)		26-049-2001 OTISVILLE		26-065-0012 LANSING		26-077-0906 KALAMAZOO		26-081-0020 GRAND RAPIDS (Monroe St)		26-081-2001 GRATTAN TWP (Parnell)		26-099-0009 NEW HAVEN		26-099-1003 WARREN	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
								7-18-91	0.142			6-9-91	0.128	8-28-91	0.127
								7-19-91	0.126			7-19-91	0.136	9-8-91	0.137

26-105-0005 LUDINGTON		26-117-0002 * GREENVILLE (Montcalm Co)		26-121-0006 MUSKEGON		26-121-0039 LAKETON TWP		26-125-0001 OAK PARK		26-127-0001 * OCEANA CO		26-139-0005 GEORGETOWN TWP (Jenison)		26-139-0006 * HOLLAND	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
6-29-91	0.125			5-29-91	0.139	5-29-91	0.147			5-29-91	0.140	7-18-91	0.154	7-18-91	0.170
7-6-91	0.146			6-28-91	0.129	7-6-91	0.125			6-29-91	0.130	7-19-91	0.136	7-19-91	0.146
7-19-91	0.155			7-6-91	0.125	7-18-91	0.148			7-6-91	0.132			7-22-91	0.128
7-20-91	0.125			7-18-91	0.145	7-19-91	0.156			7-19-91	0.153				
				7-19-91	0.139										

26-139-0007 * HOLLAND		26-147-0005 PORT HURON (New)		26-147-0030 ALGONAC		26-159-0901 LAWTON		26-161-0005 ANN ARBOR		26-161-1001 SALINE		26-163-0001 ALLEN PARK		26-163-0016 DETROIT (Linwood)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
6-9-91	0.125	5-23-91	0.125	7-2-91	0.126							6-20-91	0.143		
6-28-91	0.138	7-19-91	0.136	7-18-91	0.131										
7-18-91	0.161			7-19-91	0.133										
7-19-91	0.143														
7-22-91	0.139														

26-163-0019 DETROIT (East 7 Mile)		26-163-2002 LIVONIA (Schoolcraft Rd)		26-061-0101 ISLE ROYALE NP (EPA)		26-101-8001 MANISTEE NAT'L FOREST (EPA)		26-157-8001 UNIONVILLE TUSCOLA CO EPA		26-161-8001 DEXTER (EPA)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc

- = Lake Michigan Ozone Study (LMOS) Sites

1992 OZONE EXCEEDANCES

(Units in ppm)

26-005-0003 HOLLAND		26-019-0003 BENZONIA		26-021-0014 COLOMA (Benton Harbor)		26-037-0001 BATH TWP		26-041-0912 ESCANABA		26-043-0901 QUINNESSEC #1		26-043-0902 QUINNESSEC #2		26-049-0011 FLINT (Old)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
						7-1-92	0.125								

26-049-0021 FLINT (New)		26-049-2001 OTISVILLE (Lakeville)		26-065-0012 LANSING		26-077-0905 KALAMAZOO		26-077-0906 KALAMAZOO		26-081-0020 GRAND RAPIDS (Monroe St)		26-081-2001 GRATTAN TWP (Parnell)		26-099-0009 NEW HAVEN	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc

26-099-1003 WARREN		26-121-0039 LAKETON TWP		26-125-0001 OAK PARK		26-139-0005 GEORGETOWN TWP (Jenison)		26-147-0005 PORT HURON (New)		26-147-0030 ALGONAC (Clay Twp)		26-159-0901 LAWTON		26-161-0005 ANN ARBOR	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
		5-22-92	0.129												

26-161-1001 SALINE		26-163-0001 ALLEN PARK		26-163-0016 DETROIT (Linwood)		26-163-0019 DETROIT (East 7 Mile)		26-163-0025 LIVONIA (7 Mile Rd)		26-163-2002 LIVONIA (Schoolcraft Rd)		26-027-0003 CASSOPOLIS (I.D.E.M.)		26-101-8001 MANISTEE NAT'L FOREST (EPA)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc

26-157-8001 UNIONVILLE TUSCOLA CO EPA		26-161-8001 DEXTER (EPA)	
Date	Conc	Date	Conc
		5-21-92	0.126

1993 OZONE EXCEEDANCES
(Units in ppm)

26-005-0003 HOLLAND		26-019-0003 BENZONIA		26-021-0014 COLOMA (Benton Harbor)		26-037-0001 BATH TWP		26-041-0912 ESCANABA		26-043-0901 QUINNESSEC #1		26-043-0902 QUINNESSEC #2		26-049-0021 FLINT (New)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
8-26-93	0.133														

26-049-2001 OTISVILLE		26-063-0006 HARBOR BEACH		26-065-0012 LANSING		26-077-0905 KALAMAZOO		26-077-0906 KALAMAZOO		26-081-0020 GRAND RAPIDS (Monroe St)		26-081-2001 GRATTAN TWP (Parnell)		26-091-0007 TECUMSEH	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
6-24-93	0.129									8-26-93	0.156				

26-099-0009 NEW HAVEN		26-099-1003 WARREN		26-103-0930 WITCH LAKE		26-105-0006 LUDINGTON (Scottville)		26-115-0037 MAYBEE		26-121-0039 LAKETON TWP		26-125-0001 OAK PARK		26-125-0902 LAKE ORION	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
		8-14-93	0.128			8-27-93	0.129			8-26-93	0.141				
						8-30-93	0.125								

26-147-0005 PORT HURON (New)		26-147-0030 ALGONAC (Clay Twp)		26-161-0005 ANN ARBOR		26-161-1001 SALINE		26-163-0001 ALLEN PARK		26-163-0016 DETROIT (Linwood)		26-163-0019 DETROIT (East 7 Mile)		26-163-0025 LIVONIA (7 Mile Rd)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
8-14-93	0.147														

26-163-0062 DETROIT (Temple St)		26-163-2002 LIVONIA (Schoolcraft Rd)		26-027-0003 CASSOPOLIS (I.D.E.M)	
Date	Conc	Date	Conc	Date	Conc

1994 OZONE EXCEEDANCES
(Units in ppm)

26-005-0003 HOLLAND	26-019-0003 BENZONIA	26-021-0014 COLOMA (Benton Harbor)	26-037-0001 BATH TWP	26-049-0021 FLINT (New)	26-049-2001 OTISVILLE	26-063-0007 HARBOR BEACH	26-065-0012 LANSING
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc
						6-15-94 0.159	

26-077-0905 KALAMAZOO	26-077-0906 KALAMAZOO	26-081-0020 GRAND RAPIDS (Monroe St)	26-081-2001 GRATTAN TWP (Parnell)	26-091-0007 TECUMSEH	26-099-0009 NEW HAVEN	26-099-1003 WARREN	26-105-0006 LUDINGTON (Scottville)
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc
		6-17-94 0.149			5-22-94 0.137	6-16-94 0.145	
					6-16-94 0.142		

26-121-0039 LAKETON TWP	26-125-0001 OAK PARK	26-139-0005 GEORGETOWN TWP (Jenison)	26-147-0005 PORT HURON (New)	26-147-0030 ALGONAC (Clay Twp)	26-161-0005 ANN ARBOR	26-163-0001 ALLEN PARK	26-163-0016 DETROIT (Linwood)
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc
7-6-94 0.146	8-3-94 0.127		6-18-94 0.178	6-16-94 0.133		6-18-94 0.126	
				6-18-94 0.129			

26-163-0019 DETROIT (East 7 Mile)	26-027-0003 CASSOPOLIS (I.D.E.M.)
Date Conc	Date Conc
6/18/94 0.131	
8/18/94 0.129	

1995 OZONE EXCEEDANCES

(Units in ppm)

26-005-0003 HOLLAND	26-019-0003 BENZONIA	26-021-0014 COLOMA (Benton Harbor)	26-037-0001 BATH TWP	26-049-0021 FLINT (New)	26-049-2001 OTISVILLE	26-063-0007 HARBOR BEACH	26-065-0012 LANSING
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc
6-17-95 0.137		8-12-95 0.136					
7-13-95 0.178							
7-14-95 0.145							
8-13-95 0.135							

26-077-0905 KALAMAZOO	26-077-0906 KALAMAZOO	26-081-0020 GRAND RAPIDS (Monroe St)	26-081-2001 GRATTAN TWP (Parnell)	26-091-0007 TECUMSEH	26-099-0009 NEW HAVEN	26-099-1003 WARREN	26-105-0006 LUDINGTON (Scottville)
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc
7-14-95 0.125		7-13-95 0.163	7-13-95 0.134		6-17-95 0.129		6-17-95 0.125
					7-31-95 0.140		7-13-95 0.127

26-121-0039 LAKETON TWP	26-125-0001 OAK PARK	26-139-0005 GEORGETOWN TWP (Jenison)	26-147-0005 PORT HURON (New)	26-147-0030 ALGONAC (Clay Twp)	26-161-0005 ANN ARBOR	26-163-0001 ALLEN PARK	26-163-0016 DETROIT (Linwood)
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc	Date Conc
6-17-95 0.142	7-14-95 0.138	7-13-95 0.133	7-13-95 0.126	7-14-95 0.135			
7-13-95 0.171	7-15-95 0.125			7-31-95 0.137			
7-14-95 0.130							
7-31-95 0.136							

26-163-0019 DETROIT (East 7 Mile)	26-027-0003 CASSOPOLIS (I.D.E.M.)
Date Conc	Date Conc
8-26-95 0.126	7-14-95 0.150

1996 OZONE EXCEEDANCES

(Units in ppm)

26-005-0003 HOLLAND		26-019-0003 BENZONIA		26-021-0014 COLOMA (Benton Harbor)		26-037-0001 BATH TWP		26-049-0021 FLINT (New)		26-049-2001 OTISVILLE		26-063-0007 HARBOR BEACH		26-065-0012 LANSING	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
6-28-96	0.154	6-28-96	0.144	6-13-96	0.125										
				6-28-96	0.138										

26-077-0905 KALAMAZOO		26-077-0906 KALAMAZOO		26-081-0020 GRAND RAPIDS (Monroe St)		26-081-2001 GRATTAN TWP (Parnell)		26-091-0007 TECUMSEH		26-099-0009 NEW HAVEN		26-099-1003 WARREN		26-105-0006 LUDINGTON (Scottville)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
				6-28-96	0.135	6-28-96	0.128					7-6-96	0.125	6-27-96	0.128
				6-29-96	0.127	6-29-96	0.125							6-28-96	0.160

26-121-0039 LAKETON TWP		26-125-0001 OAK PARK		26-139-0005 GEORGETOWN TWP (Jenison)		26-147-0005 PORT HURON (New)		26-147-0030 ALGONAC (Clay Twp)		26-161-0005 ANN ARBOR		26-163-0001 ALLEN PARK		26-163-0016 DETROIT (Linwood)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
6-28-96	0.158			6-28-96	0.140	5-22-96	0.184								

26-163-0019 DETROIT (East 7 Mile)		26-027-0003 CASSOPOLIS (I.D.E.M.)		26-133-0901 EVART (Paris)		26-143-0901 HOUGHTON LAKE	
Date	Conc	Date	Conc	Date	Conc	Date	Conc

1997 OZONE EXCEEDANCES

(Units in ppm)

26-005-0003 HOLLAND		26-019-0003 BENZONIA		26-021-0014 COLOMA (Benton Harbor)		26-037-0001 BATH TWP		26-049-0021 FLINT (New)		26-049-2001 OTISVILLE		26-063-0007 HARBOR BEACH		26-065-0012 LANSING	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc

26-077-0008 KALAMAZOO		26-081-0020 GRAND RAPIDS (Monroe St)		26-081-2001 GRATTAN TWP (Parnell)		26-091-0007 TECUMSEH		26-099-0009 NEW HAVEN		26-099-1003 WARREN		26-105-0006 LUDINGTON (Scottville)		26-027-0003 CASSOPOLIS (I.D.E.M.)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
								7/12/97	0.138						

26-121-0039 LAKETON TWP		26-125-0001 OAK PARK		26-139-0005 GEORGETOWN TWP (Jenison)		26-147-0005 PORT HURON (New)		26-147-0030 ALGONAC (Clay Twp)		26-161-0007 ANN ARBOR		26-163-0001 ALLEN PARK		26-163-0016 DETROIT (Linwood)	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc

26-163-0019 DETROIT (East 7 Mile)	
Date	Conc

1998 OZONE EXCEEDANCES

(Units in ppm)

26-005-0003 HOLLAND		26-019-0003 BENZONIA		26-021-0014 COLOMA (Benton Harbor)		26-027-0003 CASSOPOLIS (I.D.E.M.)I		26-037-0001 BATH TWP		26-049-0021 FLINT		26-049-2001 OTISVILLE		26-055-0903 TRAVERSE CITY	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
9/06/98	0.130			5/19/98	0.136	5/19/98	0.137			5/15/98	0.130	5/15/98	0.152		
				9/06/98	0.157										

26-063-0007 HARBOR BEACH		26-065-0012 LANSING		26-077-0008 KALAMAZOO		26-081-0020 GRAND RAPIDS (Monroe St)		26-081-2001 GRATTAN TWP (Parnell)		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	Date	Conc
												7/15/98	0.129		
												8/21/98	0.126		

26-105-0007 LUDINGTON (Scottville)		26-113-0001 Houghton Lake (Background Ozone Site)		26-121-0039 LAKETON TWP		26-125-0001 OAK PARK		26-139-0005 GEORGETOWN TWP (Jenison)		26-147-0005 PORT HURON (New)		26-147-0030 ALGONAC (Clay Twp)		26-161-0007 ANN ARBOR	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
										5/19/98	0.128				

26-163-0001 ALLEN PARK		26-163-0016 DETROIT (Linwood)		26-163-0019 DETROIT (East 7 Mile)	
Date	Conc	Date	Conc	Date	Conc

1999 OZONE EXCEEDANCES

(Units in ppm)

26-005-0003 HOLLAND	26-019-0003 BENZONIA	26-021-0014 COLOMA (Benton Harbor)	26-027-0003 CASSOPOLIS (I.D.E.M.)I	26-037-0001 BATH TWP	26-049-0021 FLINT	26-049-2001 OTISVILLE	26-055-0903 TRAVERSE CITY
Date Conc 7/30/99 0.154	Date Conc	Date Conc 7/30/99 0.144	Date Conc	Date Conc	Date Conc	Date Conc 6/11/99 0.131	Date Conc

26-063-0007 HARBOR BEACH	26-065-0012 LANSING	26-077-0008 KALAMAZOO	26-081-0020 GRAND RAPIDS (Monroe St)	26-081-0020 EVANS	26-091-0007 TECUMSEH	26-099-0009 NEW HAVEN	26-099-1003 WARREN
Date Conc	Date Conc	Date Conc	Date Conc	Date Conc Monitor relocated from former Grattan Township/ Parnell site 26-081-2001	Date Conc	Date Conc 6/12/99 0.147	Date Conc

26-105-0007 SCOTTVILLE/ (LUDINGTON)	26-113-0001 HOUGHTON LAKE (Background Ozone Site Missaukee Cty)	26-121-0039 LAKETON TWP	26-125-0001 OAK PARK	26-139-0005 GEORGETOWN TWP (Jenison)	26-147-0005 PORT HURON (New)	26-147-0030 ALGONAC (Clay Twp)	26-161-0007 ANN ARBOR
Date Conc 7/30/99 0.161	Date Conc	Date Conc 7/30/99 0.154	Date Conc	Date Conc	Date Conc	Date Conc Closed Monitor	Date Conc

26-163-0001 ALLEN PARK	26-163-0016 DETROIT (Linwood)	26-163-0019 DETROIT (East 7 Mile)
Date Conc	Date Conc	Date Conc

2000 OZONE EXCEEDANCES

(Units in ppm)

26-005-0003 HOLLAND		26-019-0003 BENZONIA		26-021-0014 COLOMA (Benton Harbor)		26-027-0003 CASSOPOLIS (I.D.E.M.)I		26-037-0001 BATH TWP		26-049-0021 FLINT		26-049-2001 OTISVILLE		26-055-0903 TRAVERSE CITY	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
6/9/00	0.126														

26-063-0007 HARBOR BEACH		26-065-0012 LANSING		26-077-0008 KALAMAZOO		26-081-0020 GRAND RAPIDS (Monroe St)		26-081-0020 EVANS		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	Date	Conc

26-105-0007 SCOTTVILLE/ (LUDINGTON)		26-113-0001 HOUGHTON LAKE (Background Ozone Site Missuakee Cty)		26-121-0039 LAKETON TWP		26-125-0001 OAK PARK		26-139-0005 GEORGETOWN TWP (Jenison)		26-147-0005 PORT HURON (New)		26-161-0007 ANN ARBOR		26-161-0008 YPSILANTI	
Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc	Date	Conc
6/9/00	0.130			6/9/00	0.129							Closed Monitor		Monitor relocated from former Ann Arbor site 26-161-0007	

26-163-0001 ALLEN PARK		26-163-0016 DETROIT (Linwood)		26-163-0019 DETROIT (East 7 Mile)	
Date	Conc	Date	Conc	Date	Conc

Appendix E: AQD Organizational Structure & District Phone Numbers

Appendix E provides an organization chart of Michigan Department of Environmental Quality Division, and identifies division functions and telephone numbers.

Organization and Function Chart for the Air Quality Division

Department of Environmental Quality

Air Quality Division

Administrative Support

Telephone Number:
(517) 373-7023

Functions:

- Budget Analysis & Development
- Administrative Support
- Accounting
- Procurement
- Information Processing
- Computer Systems and Technical Assistance
- Internet Support
- Computer Programming and Contracts
- EPA Grant Activities
- Safety & Training
- Public Outreach

Air Quality Evaluation

Telephone Number:
(517) 373-7063

Functions:

- Ambient Air Monitoring
- Air Quality Analysis
- Meteorological Support
- Air Quality Modeling
- Emission Inventories
- Air Quality Planning
- Regulatory Review
- Control Strategy Development
- State Implementation Plans

Permits

Telephone Number:
(517) 373-7074

Functions:

- New Source Permit Evaluation
- Permits to Install
- Renewable Operating Permits

Enforcement

Telephone Number:
(517) 241-7621

Functions:

- Enforcement Support
- Attorney General Liaison
- Consent Orders

Toxics and Compliance Support

Telephone Numbers:
Toxics: (517) 335-6989
Comp.Suprt: (517) 241-7621

Functions:

- Toxicology support
- Develop Health Screening Levels
- Toxics Strategy
- Great Lakes Protection Program
- Source Emission Sampling
- Laboratory Coordination

Field Operations and District Offices

Telephone Numbers:
(See District Offices)

Functions:

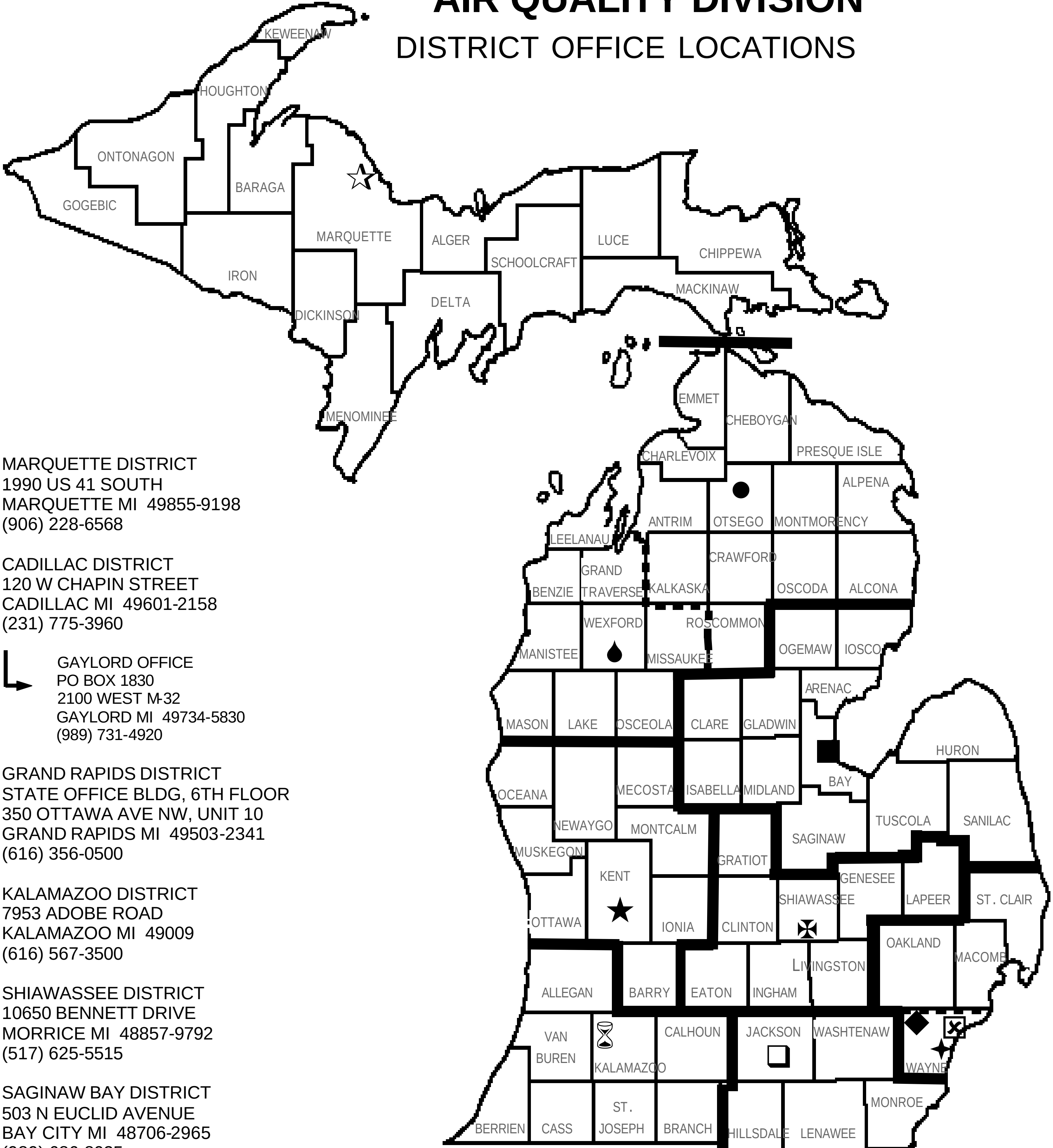
- Public Complaint Investigation
- Source Investigations and Inspections
- Compliance Status Evaluation
- Permit Recommendations
- Renewable Operating Permit Evaluation
- Tax Exemption Review
- Identification and notices of violation

DEQ /2003

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

AIR QUALITY DIVISION

DISTRICT OFFICE LOCATIONS



MARQUETTE DISTRICT
1990 US 41 SOUTH
MARQUETTE MI 49855-9198
(906) 228-6568

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

GAYLORD OFFICE
PO BOX 1830
2100 WEST M-32
GAYLORD MI 49734-5830
(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
(616) 567-3500

SHIAWASSEE DISTRICT
10650 BENNETT DRIVE
MORRICE MI 48857-9792
(517) 625-5515

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
(313) 392-6480

WAYNE CO. DEPT. OF ENVIRONMENT
AIR QUALITY MANAGEMENT DIVISION
640 TEMPLE, SUITE 700
DETROIT MI 48201-2500
(313) 833-7030