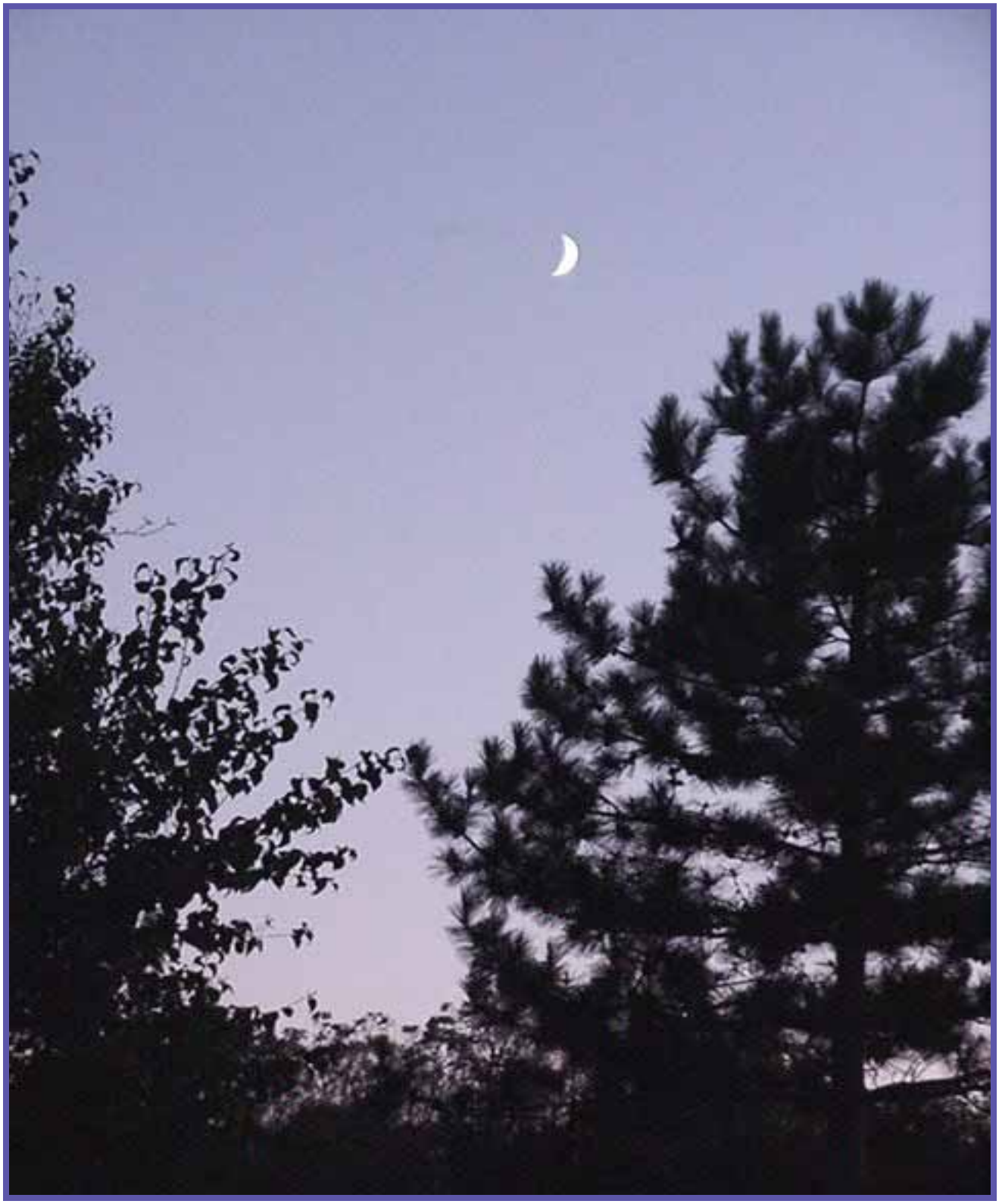
# 2004 Annual Air Quality Report



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Michigan Department of Environmental Quality

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MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY

# MICHIGAN'S 2004 ANNUAL AIR QUALITY REPORT

AIR QUALITY DIVISION
P.O. BOX 30260
LANSING, MI 48909

October 2005

MDEQ homepage: http://www.michigan.gov/deqair

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**Cover Photo:** A clear September night in Michigan (2004). Photo courtesy of Sheila Blais, AQD.

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# EXECUTIVE SUMMARY

The federal Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to the public and the environment. These standards define the maximum permissible concentration of criteria pollutants in the air. Other hazardous air pollutants (HAPs) that can affect human health or the environment are called "air toxics."[1]

One or more NAAQS have been established for the six criteria pollutants that are monitored by the Michigan Department of Environmental Quality's (MDEQ's) Air Quality Division (AQD). These criteria pollutants are carbon monoxide (CO), lead (Pb), nitrogen dioxide ($NO_2$), ozone ($O_3$), particulate matter (PM) less than or equal to ($\leq$) 10 or 2.5 microns in diameter ($PM_{10}$ and $PM_{2.5}$, respectively), and sulfur dioxide ($SO_2$). The purpose of this report is to provide a summary of the 2004 air quality data, along with air quality trends in Michigan.[2] In addition, the intent of this report is to:

- Describe the NAAQS and how compliance is determined,
- Assess the trends of the six criteria pollutants,
- Identify the types of ambient air quality monitoring that are conducted throughout the state,
- Describe the air toxic monitoring program,
- Discuss special projects such as the Air Quality Index (AQI), *Ozone Action!*, and the new Enviroflash program,[3] and
- Provide a modeling and meteorological summary of data.

**Ozone and $PM_{2.5}$:**

In 2004, designations for the newly implemented 8-hour $O_3$ and $PM_{2.5}$ NAAQS took center stage. These designations determine what requirements are necessary to bring any nonattainment area into attainment for a particular criteria pollutant. A nonattainment designation means that an area does not meet the NAAQS for that pollutant or that the area contributes towards the nonattainment designation to a surrounding area, and a timeframe is given to bring that area into attainment. States are then required to develop state implementation plans consisting of legally enforceable measures designed to reduce that criteria pollutant's levels below the NAAQS. In addition, a nonattainment "classification" determines whether certain specific mandatory programs have to be instituted or whether states have the flexibility to look at alternative actions that may provide more cost-effective emission reduction. The states must then provide EPA with an evaluation of a number of potential control measures to be implemented along with an implementation schedule.

The MDEQ's AQD worked diligently in evaluating the monitoring data and providing EPA with designation recommendations for both 8-hour $O_3$ and $PM_{2.5}$ NAAQS. EPA evaluated the information and then made their determinations. Detailed information is provided in the Attainment/Nonattainment Status sections of **Chapter 2.4** (for $O_3$) and **Chapter 2.5** (for $PM_{2.5}$).

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[1] A fact sheet entitled What is an Air Contaminant/Pollutant? is available on the MDEQ's website at http://www.deq.state.mi.us/documents/deq-ead-caap-airconfs.pdf.

[2] On-line information about criteria pollutants and air toxics along with this and previous annual air quality reports are available via the AQD's website at http://www.michigan.gov/deqair under "Spotlight."

[3] AQI readings and real time air monitoring information for $O_3$, $SO_2$, $NO_2$, CO, and $PM_{2.5}$, along with information on the new Enviroflash program are also available on the AQD's website under "Featured Online Services."

## HAPs – Mercury

Another important issue addressed in 2004 was regarding mercury emissions. Mercury has been identified as a significant environmental pollutant for decades and is a persistent, bioaccumulative neurotoxin. While mercury is naturally occurring in the environment, it is also released through a variety of anthropogenic (man-made) sources because of its presence in products and processes utilizing coal and other minerals. Air emissions of mercury contribute to the global cycling of mercury as well as local deposition. A portion of deposited mercury can be converted to methylmercury in aquatic systems. Studies have indicated an increased risk to a developing fetus upon exposure to methylmercury via maternal fish consumption.

For Michigan, the largest industrial source of mercury air emissions is coal-fired power plants. To address this issue, the MDEQ initiated the formation of the Michigan's Mercury Electric Utility Workgroup consisting of MDEQ and Michigan Public Service Commission staff; representative from utilities (potentially impacted by the workgroup recommendations); and representatives from environmental, scientific, and public policy groups. The Workgroup's charge is to look at ways to reduce and phase-out mercury emissions from coal-fired power plants, along with the reduction of nitrogen oxides ($NO_X$ - a precursor to both $PM_{2.5}$ and $O_3$), $SO_2$ (a precursor to the formation of $PM_{2.5}$ and $NO_X$), and carbon dioxide ($CO_2$). The Workgroup's report with recommendations is final.[4] More information on this endeavor is available in **Chapter 3**.

## Federal Rules and Requirements

The EPA proposed a suite of inter-related rules collectively known as the Clean Air Rules of 2004. These rules address $O_3$ and $PM_{2.5}$, non-road diesel emissions, and power plant emissions of $SO_2$, $NO_X$, and mercury.[5] Three of the rules specifically address the transport of pollution across state borders (the Clean Air Interstate Rule [CAIR], Clean Air Mercury Rule [CAMR], and Clean Air Non-road Diesel Rule). Both CAIR and CAMR are also aimed at reducing air pollutant emissions from power plants. Public hearings were held in 2004 to solicit public comment on these proposed rules.

EPA issued the Clean Air Non-road Diesel Rule on May 11, 2004. This rule (part of the Clean Air Rules of 2004) addresses diesel engines used in machines that perform a wide range of activities. Examples include construction and material handling equipment (such as backhoes, front end loaders, heavy forklifts, etc.), agricultural equipment (such as tractors), industrial equipment (airport service vehicles, etc.), and utility equipment (generators, pumps, etc.). Reducing non-road emissions is a critical part of the effort by federal, state, local, and tribal governments to reduce the adverse health impacts of air pollution.

Other new EPA emission requirements that took effect, beginning with the 2004 model year for passenger vehicles, are known as the Tier 2 Vehicle and Gasoline Sulfur Program.[6] These regulations apply equally to all passenger cars, vans, and light trucks, including SUVs, regardless of whether they run on gasoline, diesel fuel, or alternative fuels. At the same time, the Tier 2 Vehicle and Gasoline Sulfur Program also addresses cleaner-burning gasoline that contains 90 percent (%) less sulfur. The Tier 2 program is the first to treat vehicles and the fuels they use as a system, so the cleaner vehicles will have the low-sulfur gasoline they need to run their cleanest. Low emissions and good fuel economy are both important for the environment and by designing cleaner cars that run on cleaner fuels, the result is cleaner air. For the 2004 models,

[4] The Michigan's Mercury Electric Utility Workgroup final report is available on the AQD's website at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-mercury-report.pdf.
[5] Information on these rules are available on the EPA's website at http://www.epa.gov/air/mercuryrule/.
[6] Information on the Tier 2 Vehicle and Gasoline Sulfur Program is available at http://www.epa.gov/tier2 .

manufacturers of cars and the smaller trucks are required to certify 25% of their fleet to meet Tier 2 standards, but up to 35% is expected. The phase-in continues over the next few years and by 2009, 100% of all cars and light trucks must meet the standards.

**Michigan Projects/Grants**

Michigan is involved in several projects to help in the reduction of emissions from the Detroit area (Southeast Michigan). Details on the following can be found in **Chapter 3**:

- The Detroit Air Toxics Initiative (DATI) is a project initiated by the AQD and funded by a grant from the EPA. This project includes two components, one to assess the health risks from exposure to air toxics in the Detroit area, and the other to fund projects to help reduce identified risks. Part of the DATI project is to draft a DATI Risk Assessment Report, the first of its kind in Michigan. The draft DATI Risk Assessment Report is expected to be finaled in the fall of 2005.
- In addition, the AQD is cooperating in an EPA study of air toxics levels in Detroit called the Detroit Exposure Aerosol Research Study (DEARS). DEARS is a three-year field monitoring study that is designed to measure exposure and describe exposure relationships for air toxics, PM components, PM from specific sources, and criteria pollutants in Detroit utilizing monitors at the Allen Park site, indoor monitors, and personal exposure monitors.

**Summary**

For the criteria pollutants CO, Pb, $NO_2$ and $SO_2$, all of Michigan has continued to stay in attainment with levels well below their NAAQS. For $O_3$ and $PM_{2.5}$, Michigan does have some nonattainment areas but for both pollutants, levels have continued to decline.

Meteorological conditions can strongly influence air quality concentrations. The difference in concentrations from one year to the next can be due to changes in emissions, changes in meteorology, or both. For example $O_3$, a summertime pollutant, is created by photochemical reactions involving $NO_X$ and volatile organic compounds (VOCs) influenced by sunlight and/or the number of hot days. In 2003, there were 21 monitoring sites in Michigan that were above the 8-hour $O_3$ NAAQS (three-year average of 2001-2003 monitoring data). During this same time, there were a total of 14 and 25 days (2001 and 2002, respectively) at or above 90°F. Whereas for 2004, there were a total of seven monitoring sites that were above the standard (three-year average of 2002-2004 monitoring data). Part of this decrease is due to considerably less days at or above 90°F in 2003 and 2004 (four and three, respectively). Another result of the considerably cooler temperatures is that only one *Ozone Action!* Day was called in 2004. It is important to mention that $O_3$ is also influenced by transport (prevailing winds). NOTE: All Michigan's violating monitors, in both 2003 and 2004 were located in West and Southeast Michigan and transport was a contributing factor (see **Chapter 2.4** for more information).

This downward trend also continues for $PM_{2.5}$. In 2003, there were eight monitoring sites above the $PM_{2.5}$ NAAQS (three-year average of 2001-2003 monitoring data) with two violating monitors in West Michigan and six in Southeast Michigan. For 2004, there were only five monitoring sites (all located in Southeast Michigan) that had violated the NAAQS (three-year average of 2002-2004) (see **Chapter 2.5** for more information).

The main contributing factors to Michigan's $O_3$ and $PM_{2.5}$ levels are on-road and non-road emission sources ($O_3$--33% and 30%, respectively; $PM_{2.5}$ – 18% and 32%, respectively). In addition, area sources also contribute 37% of $PM_{2.5}$ emissions. Therefore, with the new federal Clean Air Rules for 2004, along with Michigan's continued reduction efforts, both of these criteria pollutants levels should continue to decline.

# CHAPTER 1: Chapter Summaries and Background Information

Included in this chapter is a summary of the information contained in each of the chapters of this report, along with background information about air quality standards and Michigan's ambient air monitoring program.

## Chapter 1.1: Chapter Summaries:

- **Chapter 1** contains background information on the development of the NAAQS and how compliance with these standards is determined; an overview of Michigan's air sampling network (MASN) that shows all the locations where ambient air monitoring was conducted in 2004; a map of the new metropolitan statistical areas (MSAs) and how these areas, along with the national, state, local and special purpose monitoring stations are used when designating attainment/nonattainment areas for NAAQS; and the variety of monitoring techniques and requirements used to ensure quality assurance of the data.
- **Chapter 2** provides an in-depth analysis of air quality trends in Michigan for each of the criteria pollutants for which NAAQS have been established. Provided are brief descriptions of the chemical and physical properties of the six criteria pollutants, as well as their health and environmental effects, common sources, national and Michigan source trends, and NAAQS. Monitoring, attainment status, and long-term trends by location are also given along with the projected impact for Michigan of the $O_3$ and $PM_{2.5}$ NAAQS.
- **Chapter 3** discusses Michigan's air toxics monitoring program. "Air Toxics" include chemicals such as metals and organic pollutants (i.e., mercury). The organic pollutants classification is further divided into sub-categories that include VOCs, carbonyl compounds, semi-volatile organic compounds, along with polycyclic aromatic hydrocarbons (PAHs) / polynuclear aromatic hydrocarbons, pesticides, polychlorinated biphenyls, and polycyclic organic matter. **Chapter 3** also provides the health effects, the importance of monitoring for air toxics, the locations of air toxics monitors, and information on the development of a comprehensive air toxics monitoring strategy.
- **Chapter 4** summarizes special air quality projects and provides their websites. These projects include the Web Monitoring and Mapping, AQI, *Ozone Action!*, the new Enviroflash program, EPA's Ozone Mapping, and real time $PM_{2.5}$ concentrations.
- **Chapter 5** contains information about modeling and meteorology. It includes ambient background determinations for New Source Review applications, a climatological summary, 2004 temperature and precipitation data, and a discussion of meteorological monitoring in Michigan.
- **Chapter 6** lists the references utilized in the creation of this report.

In addition, there are seven appendices that contain the following detailed information:

- **Appendix A** contains Quick Look Reports that provide a statistical summary of the six ambient criteria pollutants monitored in Michigan;
- **Appendix B** provides the assessment summary (Precision and Accuracy Report) on the AQD's network monitors for the criteria air pollutants.
- **Appendix C** provides measured tabular air toxics summaries;
- **Appendix D** shows 1-hour ozone exceedances recorded over the last 10 years;
- **Appendix E** contains a list of acronyms and their meaning;
- **Appendix F** has the AQD district office map; and
- **Appendix G** shows the AQD's organizational chart.

# Chapter 1.2: Background Information:

## NAAQS:

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

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

The EPA revised both the $O_3$ and particulate standards on July 18, 1997. The new 8-hour $O_3$ standard was based on information demonstrating that the 1-hour standard was inadequate for protecting public health. The 8-hour standard for $O_3$ reflects a more realistic measure of people's exposure. $PM_{2.5}$ was introduced in the revised particulate standard. More information on the revised particulate and $O_3$ standards, along with the other current criteria pollutant standards are summarized, by pollutant, in **Chapter 2**.

There are two types of NAAQS, primary and secondary. The primary standard is designed to protect the public health with an adequate margin of safety, including the health of the most susceptible individuals in a population, such as 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 and the size of the sensitive population at risk.

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

The NAAQS have various averaging times to address health impacts. Short averaging times, like the 1-hour maximum level of 35 parts per million (ppm) used for CO, reflect the potential for acute (short-term, immediate) 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 (long-term) effects.

The following **Table 1-1** lists the primary and secondary NAAQS used, averaging time, and concentration level for each criteria pollutant. The concentrations are listed as ppm, microgram per cubic meter ($\mu g/m^3$), and/or milligram per cubic meter ($mg/m^3$).

### Table 1-1: NAAQS in Effect During 2004 for the Criteria Pollutants

| POLLUTANT | Primary (Health Related) | | Secondary (Welfare Related) | |
|---|---|---|---|---|
| | Type of Average | Standard Level Concentration | Type of Average | Standard Level Concentration |
| CO | 8-hour | 9 ppm (10 mg/m$^3$) | No Secondary Standard | |
| | 1-hour | 35 ppm (40 mg/m$^3$) | | |
| Pb | Maximum Quarterly Average | 1.5 μg/m$^3$ | Same as Primary Standard | |
| $NO_2$ | Annual Arithmetic Mean | 0.053 ppm (100 μg/m$^3$) | Same as Primary Standard | |
| $O_3$ | Maximum Daily 1-hour Average | 0.12 ppm (235 μg/m$^3$) | Same as Primary Standard | |
| | 4$^{th}$ Highest 8-Hour Daily Maximum | 0.08 ppm (157 μg/m$^3$) | | |
| $PM_{10}$ | Annual Arithmetic Mean | 50 μg/m$^3$ | Same as Primary Standard | |
| | 24-hour | 150 μg/m$^3$ | | |
| $PM_{2.5}$ | Annual Arithmetic Mean | 15 μg/m$^3$ | Same as Primary Standard | |
| | 98$^{th}$ percentile 24-hour | 65 μg/m$^3$ | | |
| $SO_2$ | Annual Arithmetic Mean | 0.03 ppm (80 μg/m$^3$) | 3-hour | 0.5 ppm (1300 μg/m$^3$) |
| | 24-hour | 0.14 ppm (365 μg/m$^3$) | | |

## Determining Compliance with the NAAQS:

To demonstrate compliance with the NAAQS, EPA has defined specific criteria for each pollutant, which is summarized in **Table 1-2**.

### Table 1-2: Criteria for the Determination of Compliance with the NAAQS

| POLLUTANT | CRITERIA |
|---|---|
| CO | Compliance with the CO standard is met when the 35 ppm 1-hour average standard and/or the 9 ppm 8-hour average standard is not exceeded more than once per year. An 8-hour average is considered valid if at least 75% for the hourly averages are available. In the event that 6 or 7-hourly averages are available, the 8-hour average is estimated on the basis of the average concentration for that time period. |
| Pb | Daily values are collected for three consecutive months (by calendar quarter), averaged, and then compared to the 1.5 μg/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 hourly data that are 75% complete for each calendar quarter. |
| $O_3$ 1-hour | The standard is met when the three-year average of the expected number of days where the 1-hour average of 0.12 ppm is exceeded per calendar year is equal to or less than one. |

### Table 1-2: Criteria for the Determination of Compliance with the NAAQS

| POLLUTANT | CRITERIA |
|---|---|
| **$O_3$ 8-hour** | The primary and secondary standards are met when the three-year average of the 4th highest daily maximum 8-hour average concentration is less than or equal to 0.08 ppm. |
| **$PM_{10}$** | The annual primary and secondary standards are met when the annual arithmetic mean concentration is less than or equal to 50 $\mu g/m^3$. The 24-hour primary and secondary standards are met when the expected number of days per calendar year above 150 $\mu g/m^3$ is equal or less than one. |
| **$PM_{2.5}$** | The annual and secondary standards are met when the annual arithmetic mean concentration is less than or equal to 15 $\mu g/m^3$. The 24-hour primary and secondary standards are met when the three-year average of the 98$^{th}$ percentile 24-hour concentration is less than or equal to 65 $\mu g/m^3$. |
| **$SO_2$** | To determine compliance, the annual average concentration shall not exceed 0.03 ppm, the 24-hour average concentration shall not exceed 0.14 ppm more than once per calendar year, and the three-hour average concentration shall not exceed 0.5 ppm more than once per calendar year. The respective averages shall be based upon hourly data that is at least 75% complete. |

## Michigan Air Sampling Network (MASN):

The MASN is designed to meet the network design set forth by the EPA to measure air quality throughout the state. The network is operated by the MDEQ's AQD, along with local governmental agencies. For instance, the Sault Ste. Marie monitors are managed by the Inter-Tribal Council of MI, Inc.; the $O_3$ monitor in Leelanau County (Peshawbestown) is owned and managed by the Grand Traverse Band of Ottawa and Chippewa Indians; and the Seney Nat'l Wildlife Refuge is operated by the U.S. Fish and Wildlife Service. However, the AQD verifies, analyzes, and collates all the data collected by the MASN[7]

In addition, as part of the EPA's Section 105 grant, the AQD provides an annual review of the MASN monitoring data collected from the previous year and provides recommended changes. These recommendations are based on each monitor's exceedance history, changes in population distribution, and modifications to federal monitoring requirements under the CAA. Any changes made in 2004 due to the 2003 annual review's recommendation will be discussed further, by criteria pollutant, in **Chapter 2**.

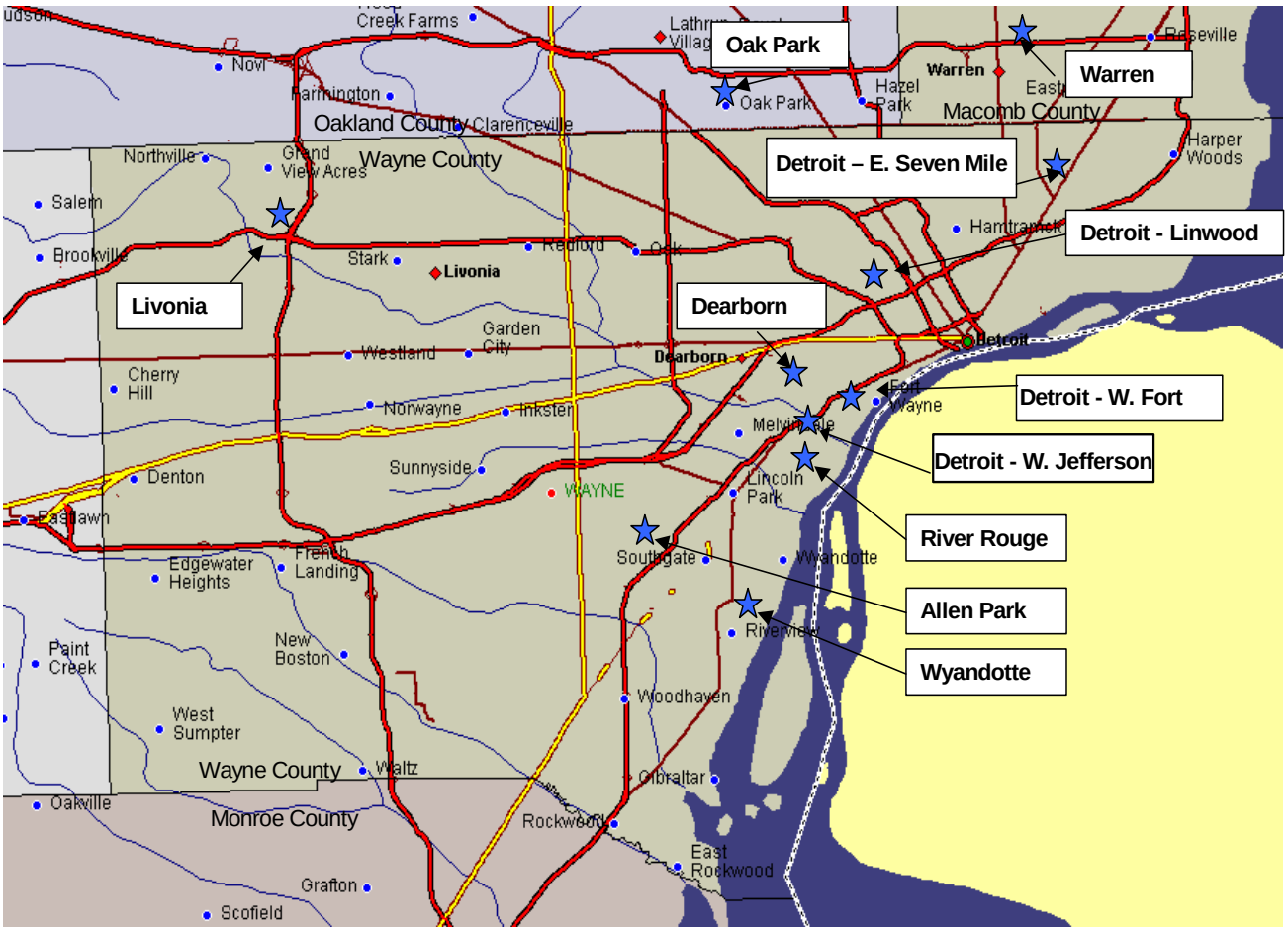
**Figure 1-1** shows all the locations in Michigan where ambient air monitoring was conducted in 2004.

[7] Data collected and reported must meet minimum quality assurance requirements established by the AQD and EPA, as outlined in 40 CFR Part 58 and its appendices. Listing of documents pertaining to 40 CFR Part 58, including siting requirements, attainment determination, methods, and quality assurance/quality control can be viewed on-line at http://www.access.gpo.gov/nara/cfr/waisidx_03/40cfr58_03.html.

# Figure 1-1: 2004 MASN Map

A more detailed map of the Southeast Michigan monitoring sites is shown in **Figure 1-2**.

## Figure 1-2: Southeast MASN Map




In the early years of air monitoring, major monitoring emphasis was placed upon TSP and $SO_2$. However, with the reduction of the levels of those pollutants, increased emphasis has been placed on other criteria pollutants such as $O_3$ and $PM_{2.5}$.

**Table 1-3** identifies the types of monitoring conducted at each monitoring site and the site's Aerometric Information Retrieval System (AIRS) identification number. Since the 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. Addition information on 2004 meteorological conditions is available in **Chapter 5**.

# Table 1-3: MASN Station Locations in 2004

| Site Name | AIRS ID | Carbon Monoxide | Lead | Nitrogen Dioxide | Ozone | Particulate Matter $PM_{10}$ | Particulate Matter $PM_{2.5}$ | Sulfur Dioxide | Volatile Organic Compounds | Carbonyl/ Aldehydes/ Ketone | Trace Metals | Meteorological Parameters |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Holland | 260050003 | | | | √ | | √■* | | | | | √ |
| Bay City | 260170014 | | | | | | √ | | | | | |
| Benzonia | 260190003 | | | | √ | | | | | | | |
| Coloma | 260210014 | | | | √ | | √ | | | | | √ |
| +Cassopolis | 260270003 | | | | √ | | | | | | | |
| ++Sault Ste. Marie-Easterday Ave | 260330901 | | | | | | √■* | | | | | |
| ++Sault Ste. Marie-Marquette Ave | 260330902 | | | | | | √ | | | | | |
| Rose Lake | 260370001 | | | | √ | | | | | | | |
| Flint | 260490021 | | √ | | √ | √ | √■ | √ | | | √ | √ |
| Otisville | 260492001 | √ | | | √ | | | √ | | | | √ |
| Harbor Beach | 260630007 | | | | √ | | | | | | | √ |
| Lansing | 260650012 | | | | √ | | √■ | | | | | √ |
| Kalamazoo | 260770008 | | | | √ | | √■* | | | | | √ |
| Grand Rapids - Wealthy St | 260810007 | | | | | √ | | | | | | |
| Grand Rapids - Monroe St | 260810020 | √ | | √ | √ | √ | √■* | √ | | | | √ |
| Grand Rapids - Randolph | 260810021 | | √ | | | | | | √ | √ | √ | √ |
| Evans | 260810022 | | | | √ | | | | | | | √ |
| +++Peshawbestown | 260890001 | | | | √ | | | | | | | √ |
| Tecumseh | 260910007 | | | | √ | | | | | | | √ |
| New Haven | 260990009 | | | | √ | | √ | | | | | √ |
| Warren | 260991003 | √ | | | √ | | | √ | | | | |
| Scottville | 261050007 | | | | √ | | | | | | | √ |
| Houghton Lake | 261130001 | | √ | | √ | | √■* | | √ | √ | √ | √ |
| Luna Pier | 261150005 | | | | | | √* | | | | | |
| Muskegon - Green Creek Rd | 261210039 | | | | √ | | | | | | | √ |
| Muskegon - Apple Ave | 261210040 | | | | | | √ | | | | | |
| Oak Park | 261250001 | √ | | | √ | | √ | | | | | √ |
| Jenison | 261390005 | | | | √ | | √ | | | | | √ |
| Saginaw | 261450018 | | | | | | √■ | | | | | √ |
| Port Huron | 261470005 | | | | √ | | √■ | √ | | | | √ |
| ++++Seney National Wildlife Refuge | 261530001 | | | | √ | | √■ | | | | | √ |
| Ann Arbor | 261610005 | | | | | | √ | | | | | |
| Ypsilanti | 261610008 | | √ | | √ | | √■* | | √ | √ | √ | √ |
| Allen Park | 261630001 | √ | √ | | √ | √ | √■* | | | | √ | √ |
| River Rouge | 261630005 | | √ | | | | | | | √ | √ | √ |
| Detroit - W. Fort | 261630015 | | √ | | | √ | √ | √ | √ | √ | √ | √ |
| Detroit - Linwood | 261630016 | √ | | √ | √ | | √ | √ | | | | |
| Detroit - E. Seven Mile Rd | 261630019 | | √ | √ | √ | | √ | √ | √ | √ | √ | √ |
| Livonia | 261630025 | √ | | | | | √ | | | | | |
| Detroit – W. Jefferson | 261630027 | | √ | | | | | | √ | | √ | |
| Dearborn | 261630033 | | √ | | | √■ | √■* | | √ | √ | √ | √ |
| Wyandotte | 261630036 | | | | | | √ | | | | | |

√ data collected
* $PM_{2.5}$ chemical speciation monitor
■ TEOM (tapered element oscillating micro-balance) provides hourly concentrations

+Cassopolis monitor is managed by Indiana Dept. of Environmental Management.
++ Sault Ste. Marie monitors are managed by the Inter-Tribal Council of MI, Inc.
+++Peshawbestown monitor in Leelanau County is managed by the Grand Traverse Band of Ottawa & Chippewa Indians
++++Seney Nat'l Wildlife Refuge is operated by the U.S. Fish and Wildlife Service

NOTE: The AQD provides technical support for the Sault Ste. Marie, Peshawbestown, and Seney monitors. Starting in April 2005, the MDEQ will take over operation of the Cassopolis monitor.

## Metropolitan Statistical Areas:

Michigan is divided into geographical planning units called Metropolitan Statistical Areas or MSAs. On June 6, 2003, a bulletin was released from the U.S. Office of Management and Budget (OMB) (http://www.whitehouse.gov/omb/bulletins/b03-04.html) that revised definitions of MSAs, established definitions for Micropolitan Statistical Areas (MiSAs) and Combined Statistical Areas (CSAs), and provided guidance on the uses of the statistical definitions.[8]

The OMB's revised definition for a MSA is that these areas need to have at least one urbanized area of 50,000 or more population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. A MiSA, which is a new set of statistical areas, needs to have at least one urban cluster of at least 10,000 but less than 50,000 population, plus adjacent territory that has a high degree of social and economic integration with the core as measured by commuting ties. Both MSAs and MiSAs are defined in terms of whole counties.

If specified criteria are met, adjacent MSAs and MiSAs, in various combinations, may become the components of a new set of complementary areas called CSAs. CSAs can be characterized as representing larger regions that reflect broader social and economic interactions, such as wholesaling, commodity distribution, and weekend recreation activities, and are likely to be of considerable interest to regional authorities and the private sector.

For Michigan, the new OMB definitions resulted in the listing of four CSAs that are comprised of new MSAs and MiSAs with counties grouped differently than in the last 1990 Census update. Four counties have been newly identified for inclusion in Michigan's MSAs: Barry, Ionia, Newaygo, and Cass.

The two largest CSAs are in West Michigan and Southeast Michigan. For West Michigan, the MSA delineations are especially appropriate for application in the $O_3$ transport impacted counties. The former four-county Grand Rapids MSA consisted of: Kent, Ottawa, Allegan, and Muskegon. Now West Michigan has a new Grand Rapids-Muskegon-Holland CSA that has the following counties separated into three MSAs and one MiSAs as shown in **Table 1-4**:

### Table 1-4: Grand Rapids-Muskegon-Holland CSA

| Grand Rapids-Wyoming MSA | Muskegon-Norton Shores MSA | Holland-Grand Haven MSA | Allegan MiSA |
|---|---|---|---|
| Kent, Barry, Ionia, and Newaygo County | Muskegon County | Ottawa County | Allegan County |

For Southeast Michigan, the former Detroit-Ann Arbor-Flint CMSA (combined MSA) is now called the Detroit-Warren-Flint CSA and still has the original 10 counties but as shown in **Table 1-5**, is now broken down into 4 MSAs:

### Table 1-5: Detroit-Warren-Flint CSA

| Ann Arbor MSA | Detroit-Warren-Livonia MSA | Flint MSA | Monroe MSA |
|---|---|---|---|
| Lenawee and Washtenaw County | Lapeer, Livingston, Macomb, Oakland, St. Clair, and Wayne County | Genesee County | Monroe County |

[8] The Federal Register's final decision, 65 FR 82227-82238, is available at: http://www.whitehouse.gov/omb/fedreg/metroareas122700.pdf.

The last two CSAs and their respective counties in Michigan are shown in **Table 1-6** and **1-7**:

**Table 1-6: Lansing-East Lansing-Owosso CSA**

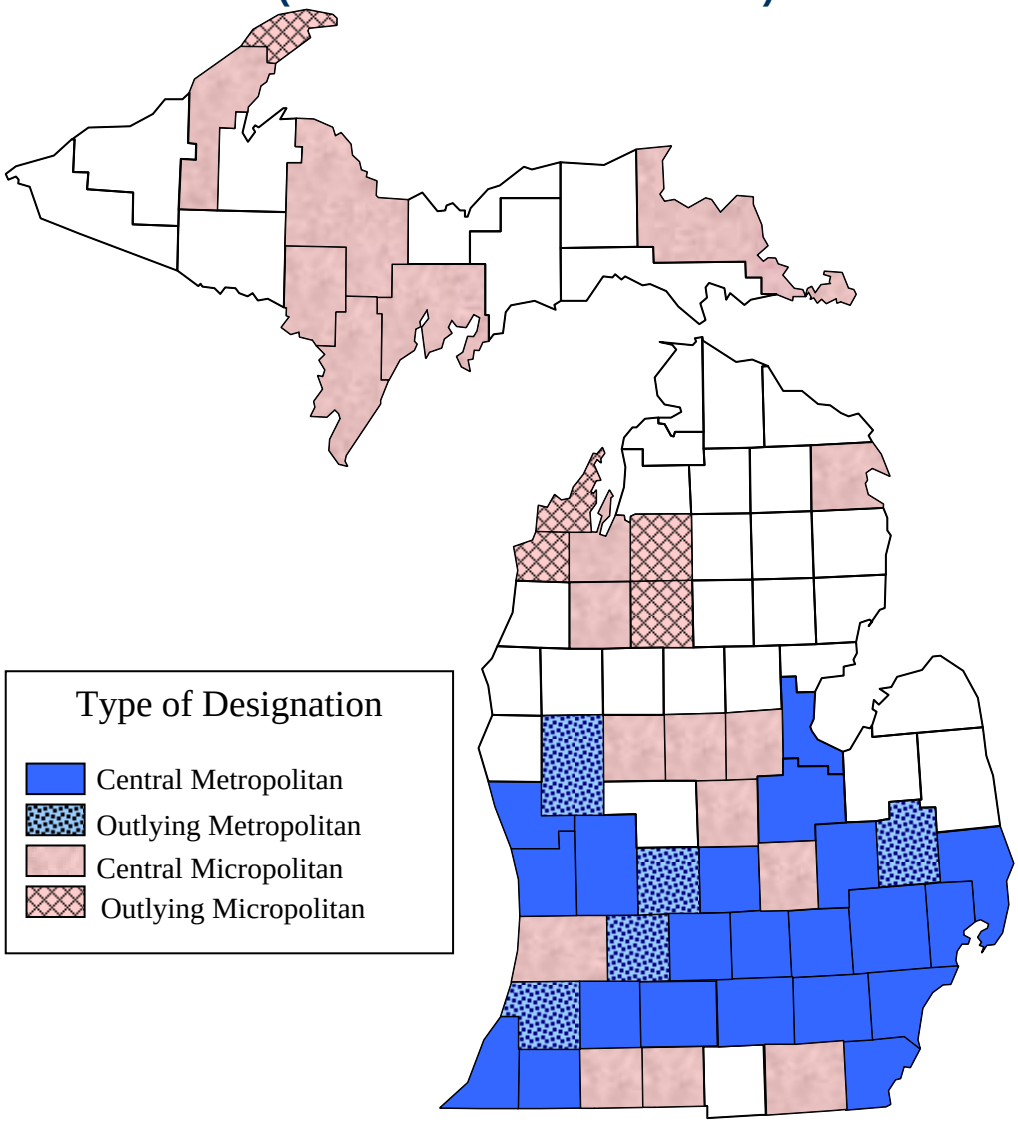
| Lansing-East Lansing MSA | Owosso MiSA |
|---|---|
| Clinton, Eaton, and Ingham County | Shiawassee County |

**Table 1-7: Saginaw-Bay City-Saginaw Twp. North CSA**

| Bay City MSA | Saginaw-Saginaw Twp. North MSA |
|---|---|
| Bay County | Saginaw County |

**Figure 1-3** shows the 2004 MSA/MiSA boundaries for Michigan.[9]

**Figure 1-3: Metropolitan and Micropolitan Areas in Michigan (Based on the 2000 Census)**




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

The EPA has usually relied upon MSA boundaries when designating nonattainment areas for air pollutants relative to NAAQS with the exception of the 8-hour $O_3$ standard. Before implementation of the 8-hour $O_3$ NAAQS, Michigan, along with other states and tribes, sent updated nonattainment and attainment designation recommendations to EPA that included recommendations for appropriate boundaries. Some of Michigan's concerns dealt not only with the regional $O_3$ transport issue for West Michigan, but also with the designation of several counties that were in attainment but were located within a nonattainment MSA. More information on the $O_3$ boundary requests and EPA's response is available in **Chapter 2.4: Ozone Trends** under the heading Attainment/Nonattainment Status.

Another part of the monitoring network that assists in determining nonattainment/attainment status, is the data generated by the establishment of State and Local Air Monitoring Stations (SLAMS), National Air Monitoring Stations (NAMS), and Special Purpose Monitoring (SPM) in Michigan's MSAs.

SLAMS allow state or local government to develop networks tailored for their immediate monitoring needs. Data from SLAMS is used primarily for nonattainment decisions and analyses at specific geographical areas. At least one SLAMS is required for each of the criteria pollutants, except for lead, and must meet monitoring requirements of the CAA.

NAMS were established to ensure a long-term national network for ambient monitoring and to provide a systematic, consistent database for air quality comparisons and trends analysis. The concept is designed to provide data for national policy analyses/trends and for reporting to the public on major metropolitan areas.

The NAMS must be selected from the SLAMS network with emphasis given to urban and multisource areas. Areas to be monitored must be selected based on urbanized population and criteria pollutant concentration levels. Generally, a larger number of NAMS are needed in more polluted urban and multisource areas with larger population totals with the primary objectives to determine maximum pollutant concentration and assess levels in populated areas. For those cases where more than one NAMS is required for an urban area, they are divided into two categories:

- A category "a" NAMS is designed to measure peak concentrations in major downtown urban traffic areas.
- A category "b" NAMS must be located in a highly-populated area to assess population exposure.

The SPM (special purpose monitoring) stations provide special studies needed by the state and local agencies to support their SIPs and other types of monitoring, i.e. industrial, tribal, etc. that are included in the states monitoring network. These SPMs are not permanent and can be moved to accommodate changing needs and priorities. The MDEQ also uses SPM for sites where the siting may not meet specifications, the monitoring methodology may not be the federal reference method, the intent is for a short-term duration, or the data generated is for a special study and not to be used for attainment designations. However, data from SPMs are reported to EPA.

## Monitoring Techniques:

Air pollutants are generally monitored near the breathing zone as specified by a variety of EPA reference or equivalent methods. Gaseous monitors are used for $O_3$, CO, $SO_2$, and $NO_2$; filter based monitors are used for PM (TSP, $PM_{10}$, $PM_{2.5}$) and Pb. The AQD adheres to the quality

assurance requirements of the EPA for gaseous and particulate air pollutant monitors as specified in Title 40 of the CFR, Part 58. The EPA has recently released a new document titled, "List Of Designated Reference and Equivalent Methods."[10] Explanations of these methods are found in 40 CFR Part 58 - Ambient Air Quality Surveillance and are discussed in **Chapter 2**.[11]

The AQD follows a quality system to ensure that the monitoring data that is collected and reported is valid and accurate. In following the quality system, quality assurance project plans are developed and implemented as well as standard operating procedures. Precision (the repeatability of a measurement) and accuracy (the closeness of the measurement to a true value) are the two primary components of the quality system for insuring accurate data. Additional information on the AQD's precision and accuracy procedures along with their 2004 measurement reports are available in **Appendix B**. Additional listings of documents pertaining to 40 CFR Part 58, including siting requirements, attainment determination, laboratory methods for air toxics, and quality assurance/quality control are available on the EPA's website at http://www.epa.gov/ttnamti1/ and http://www.access.gpo.gov/nara/cfr/waisidx_03/40cfr58_03.html.

[10] List Of Designated Reference and Equivalent Methods is at http://www.epa.gov/ttn/amtic/criteria.html.
[11] A complete copy of the 40 CFR Part 58 - Ambient Air Quality Surveillance is available at http://www.epa.gov/ttn/amtic/files/cfr/pt58/40cfr58a.pdf.

# CHAPTER 2: Criteria Pollutants Monitored in Michigan

Each year, air quality trends are plotted using measurements from monitors located across the country. This chapter provides those trends for Michigan's ambient air quality monitors and other information for the criteria pollutants - CO, Pb, $NO_2$, $O_3$, $PM_{10}$ and $PM_{2.5}$, and $SO_2$.

Michigan air quality trends are based on actual statewide monitored readings which are also listed in EPA's Air Quality Subsystem (AQS) Quick Look Report Data for 2004 (see **Appendix A: Criteria Pollutant Summary for 2004**).

This chapter is broken down by sub chapters for each of the criteria pollutants and includes:

- an introduction that describes the pollutant,
- Its health effects,
- national source trends,
- Michigan source trends,
- NAAQS,
- Michigan's monitoring requirements,
- attainment/nonattainment status for Michigan, and
- Michigan's monitoring trends that include figures, broken down by location, of those monitoring sites used in Michigan from 1994-2004.

The EPA also compiles emission estimates. These estimates are based on actual measurements or engineering calculations of the amounts and types of pollutants emitted by vehicles, factories, and other sources. Factors considered include levels of industrial activity, technological developments, fuel consumption, vehicle miles traveled (VMT), and other activities that cause air pollution.

National emission estimates are different from previous estimates. One reason is because EPA is now using updated, peer-reviewed models that estimate VOCs, $NO_X$, CO, and PM emissions from highway vehicles (on-road engines[12]) and non-road engines[13] that better represent real-world conditions, such as more rapid accelerations and faster highway speeds. The emissions estimates generated by the new highway vehicle model are derived from actual tailpipe measurements from thousands of vehicles. As a result of these reporting changes, some national emissions trends have changed significantly. For example, rather than describing no change in the 20-year national emission trend for CO, EPA now estimates a 41% decrease in CO emissions from 1983 to 2002 which is supported by the national trend in CO air quality.

The following is a breakdown of the criteria pollutant subsections:

- **Chapter 2.1**: CO (Carbon Monoxide) Trends
- **Chapter 2.2**: Pb (Lead) Trends
- **Chapter 2.3**: $NO_2$ (Nitrogen Dioxide) Trends
- **Chapter 2.4**: $O_3$ (Ozone) Trends
- **Chapter 2.5**: Particulate Matter ($PM_{10}$, $PM_{2.5}$, and $PM_{2.5}$ Chemical Speciation) Trends
- **Chapter 2.6**: $SO_2$ (Sulfur Dioxide) Trends

[12] Visit EPA's website at http://www.epa.gov/otaq/hwy.htm for on-road engine information.
[13] Non-road engine information is available at http://www.epa.gov/nonroad/.

# Chapter 2.1: Carbon Monoxide Trends

## Introduction:

Carbon monoxide (CO) is a colorless, odorless, and poisonous gas that is created when fuel doesn't burn completely. Although you cannot see or smell CO, this toxic gas is a major air pollutant in many American cities. High concentrations of CO generally occur in areas with heavy traffic congestion. In cities, as much as 95% of all CO emissions may come from automobile exhaust. EPA estimates that motor vehicle exhaust contributes about 60% of all CO emissions nationwide with non-road vehicles accounting for the remaining CO emissions from transportation sources. Other sources of CO emissions include industrial processes, non-transportation fuel combustion, and natural sources such as wildfires (**4**).

Unlike many other air pollutants, CO levels in the outside air typically peak during colder months. One reason is because cars need more fuel to start at cold temperatures, and some emission control devices (such as oxygen sensors and catalytic converters) operate less efficiently when they are cold. Also, during the winter inversion conditions (where air pollutants are trapped near the ground beneath a layer of warm air) are more frequent. Primary sources of CO exposure are the exhaust from idling automobiles, unvented gas or kerosene space heaters, gas ranges with continuous pilot flame ignition, and cigarette smoke. Indoor air CO exposure levels in excess of 50 ppm can occur during startup and idling of motor vehicles in attached residential garages and the use of unvented gas or kerosene space heaters (**4**).

## CO Effects:

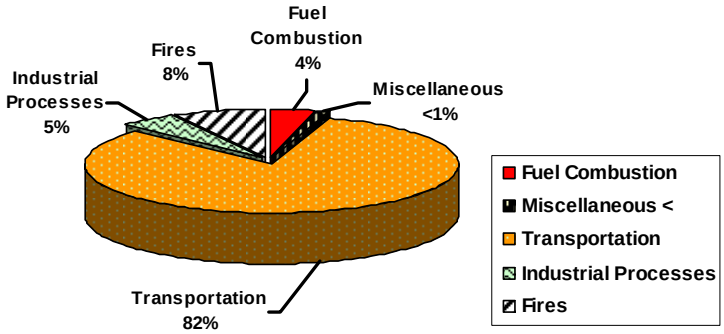
CO enters the bloodstream through the lungs and is harmful because it displaces oxygen delivered to the body's organs and tissues. For those who suffer from cardiovascular (heart and respiratory) disease, especially those with angina and peripheral vascular disease, the health effects are more severe because their circulatory systems are already compromised and less efficient at carrying oxygen. But high CO pollution levels also affect healthy people (**4**).

At elevated levels, CO can cause visual impairment, interfere with mental acuity by reducing learning ability and manual dexterity, and can decrease work performance in completion of complex tasks (**4**). The severity of the reduced mental acuity effect is related to the duration of exposure and the concentration of CO.

## National Source Trends:

According to EPA, as shown in **Figure 2.1-1**, the transportation category, composed of on-road and non-road sources, accounted for 82% of the nation's total CO emissions in 2002.[14] For on-road sources, the focus of CO controls as well as CO monitoring has been on traffic-oriented sites in urban areas where the main source of CO is motor vehicle exhaust. As a result of automotive control programs,

**Figure 2.1-1 EPA's 2002 National CO Emissions by Source Category**




[14] Information is from EPA's Air Trends website at http://www.epa.gov/airtrends/carbon2.html.

CO emissions have decreased 41% the past 20 years (1983 to 2002) and 21% in the past 10 years (1993 to 2002) despite a 155% increase in VMT since 1970. However, emissions from all transportation sources have decreased only 10% over the same period, primarily due to an increase in off-road emissions that has offset the gains realized in reductions of on-road vehicle emissions.

In 2002, EPA addressed non-road engines by finalizing Emission Standards for New Non-road Engines -- Large Industrial Spark-ignition Engines, Recreational Marine Diesel Engines, and Recreational Vehicles (EPA420-F-02-037). According to the EPA, some of these engines emit high levels of CO, which is especially problematic for people who work with or are otherwise active near these engines (i.e. many engines operate in warehouses, ice-skating rinks, or other enclosed areas where personnel who work with or near the equipment can experience increased exposure). The EPA estimates that these standards will reduce CO emissions from these vehicles by about 57% along with the reduction of hydrocarbons (71%) and $NO_X$ (80%).

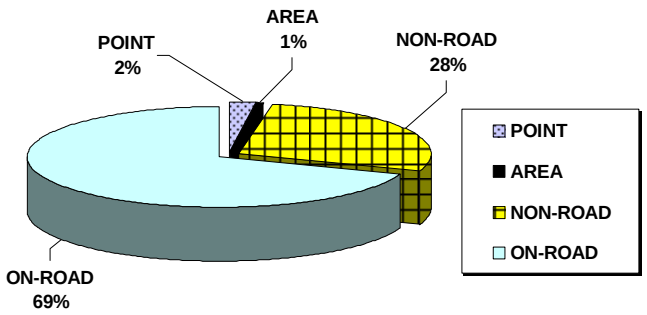
In addition to the tailpipe and non-road emission standards, the EPA finalized a rule for the control of emissions from highway motorcycles on December 23, 2003 that became effective on March 15, 2004.[15] According to the EPA, total annual CO emissions for motorcycles are about the same as current passenger cars and light trucks, even though they have lower VMT (**42**). This is because cars and trucks use closed-loop electronic feedback control fuel systems that allow for near-perfect control of the fuel-air mixture ensuring almost complete combustion, and advanced catalytic converter systems which result in extremely low levels of emissions out the tailpipe. However, when the future car and truck standards and EPA's 1999 Tier 2 Vehicle and Gasoline Sulfur Program take effect, motorcycle emissions will be about two times that of an average passenger vehicle.[16] Emissions contribution of a motorcycle is typically equal to or worse than cars and trucks. The Tier 2 Vehicle and Gasoline Sulfur program is another series of major initiatives that will reduce emissions from all passenger vehicles (including SUVs), highway trucks and buses, and non-road diesel equipment regardless of whether they run on gasoline, diesel fuel, or alternative fuels.[17]

## Michigan Source Trends:

Following the national trend, as shown in **Figure 2.1-2**, Michigan's on-road motor vehicle CO emissions have declined from 72% (1999 EPA Emissions Inventory) to 69% (2002 EPA Emissions Inventory). On-road sources include diesel, heavy and light-duty gas trucks and vehicles, and motorcycles.

Michigan's non-road emissions for CO have increased from 25% (1999 EPA Emissions Inventory) to 28% (2002 EPA Emissions Inventory). These sources include aircraft, marine vessels, non-road two and four stroke engines, railroads, and others.

**Figure 2.1-1: Percentage of CO Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




[15] Additional information is available on the EPA's website at http://www.epa.gov/otaq/roadbike.htm#final.
[16] Detailed information can be viewed on EPA's website at http://www.epa.gov/tier2.
[17] For information on all on-road vehicles and engines go to http://www.epa.gov/otaq/hwy.htm.

CO emissions from Michigan's industries (point sources) have not changed from the 1999 levels and remain at only 2% in 2002. For the Detroit-Ann Arbor area, fossil fuel combustion from electrical utility, industrial, commercial, and residential sources, as well as iron, steel manufacturing, and foundries were the leading stationary sources of CO (**5, 6**).

Michigan's emission totals are estimated to be 20% less than what the emissions were in 1990 and historically, Michigan has had better air quality when compared to nationwide trend site averages.[18]

## NAAQS for CO:

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

An 8-hour standard of 9 ppm (10 mg/m$^3$) and a 1-hour standard of 35 ppm (40 mg/m$^3$) are the two primary standards for CO, which are not to be exceeded more than once each year (**7**). There is no secondary standard for CO. The 8-hour standard is considered to be the more controlling form as there has not been an exceedance of the 1-hour standard in the United States (U.S.) since 1990 (**4**). At present, all Michigan areas are in attainment with both the 1-hour and 8-hour CO standards.

The NAAQS for CO were originally promulgated on April 30, 1971. On August 17, 2000, the EPA National Center for Environmental Assessment announced the final completion of their air quality criteria for CO and recommended no changes be made to the CO NAAQS (**8**). Currently, a review of monitoring network regulations is being conducted by EPA's Office of Air Quality Planning and Standards which may minimize the size of CO networks nationwide.

## CO Monitoring in Michigan:

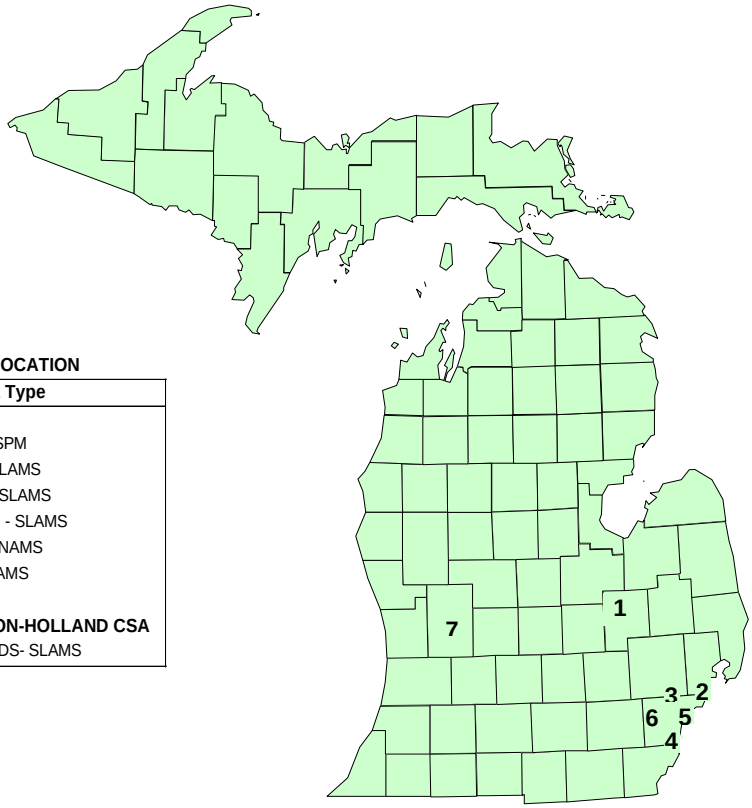
For CO, Detroit is the only urban area having a population greater than 500,000 and is therefore required to operate two CO NAMS, a type "a" and a type "b" (as discussed in **Chapter 1**). However, the type "a" NAMS became inoperable due to the loss of site access and the type "b" monitor located at the Joy Road site was shut down on July 16, 2002. For the "a" NAMS, EPA has allowed a delay in replacing this monitor as they are reviewing eliminating this type of monitoring requirement.[19] In 2003, the EPA approved the AQD's request to designate the Linwood CO monitor as the category "b" CO site. Therefore, there is currently only one CO NAMS in Michigan.

The Detroit MSA also has four CO monitors operating as part of the SLAMS monitoring network (Warren, Oak Park, Allen Park, and Livonia). Data collected at these SLAMS sites exist to assess environmental impact from transportation, to support the new source review (NSR) modeling efforts, and to retain monitors to meet Michigan's state implementation plan (SIP) (**9**). On December 22, 2003 a new SPM monitoring site was established in Otisville (Genesee County) to supply background levels for NSR modeling. This monitor originally came from the Houghton Lake site that was shut down December 13, 2003. A SLAMS monitoring station is also located in Grand Rapids that monitors population exposure to CO.

**Figure 2.1-3** shows the seven CO monitors operating during 2004.

[18] Information on Nationwide Air Quality Trends is available at: http://www.epa.gov/airtrends/carbon.html.
[19] NOTE: EPA is reviewing all of the monitoring regulations which includes the "a" NAMS requirements.

## Figure 2.1-3: Air Quality Monitors for CO Active in 2004




**MONITORS BY LOCATION**

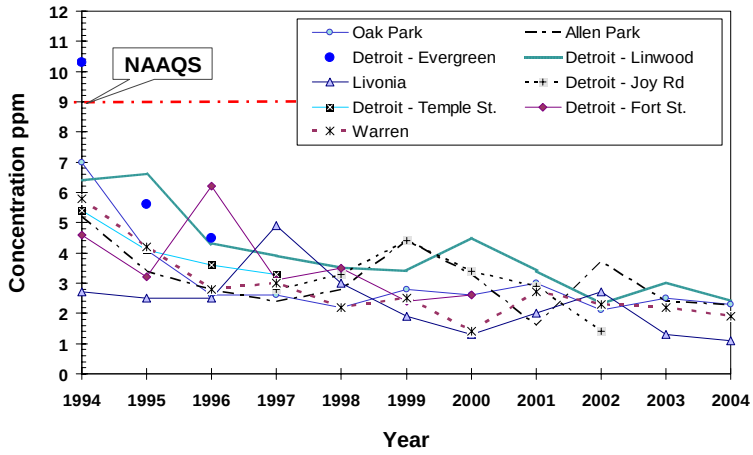
| Monitor ID & Type |
|---|
| **DETROIT CMSA** |
| 1. 260492001 - OTISVILLE - SPM |
| 2. 260991003 - WARREN - SLAMS |
| 3. 261250001 - OAK PARK - SLAMS |
| 4. 261630001 - ALLEN PARK - SLAMS |
| 5. 261630016 - LINWOOD - NAMS |
| 6. 261630025 - LIVONIA - SLAMS |
| **GRAND RAPIDS-MUSKEGON-HOLLAND CSA** |
| 7. 260810020 - GRAND RAPIDS- SLAMS |

## Attainment/Nonattainment Status of CO in Michigan:

As of August 30, 1999, all areas in Michigan are designated as attainment for CO and no monitoring needs to be performed for attainment purposes (**9**).

With the new use requirement of EPA's Mobile6 Emissions Factor Model, effective January 29, 2004, the Southeast Michigan Council of Governments (SEMCOG), MDEQ, and the Interagency Working Group agreed that Southeast Michigan's SIP for CO should be updated to incorporate on-road mobile source budgets derived from Mobile6 emission rates. On December 18, 2003, the AQD submitted to EPA their Revision of Mobile Source Emission Inventories for the Southeast Michigan Carbon Monoxide Maintenance Plan within the SIP. The CO Maintenance Plan encompasses portions of Macomb, Oakland, and Wayne Counties.[20] **Figure 2.1-4** shows only Southeast Michigan's breakdown of the 2nd highest 8-hour maximum CO levels

**Figure 2.1-4: CO Levels by Location For Southeast Michigan from 1994-2004 (2nd highest 8-hour Maximum Values)**




[20] More information on the maintenance plan revisions is available at http://www.michigan.gov/deqair.

from 1994-2004. No excursions of the 8-hour CO standard have occurred since 1994.

## CO Trends by Location:

The following figures list the 1-hour and 8-hour CO trends by location from 1994-2004 for Michigan's entire CO monitoring network.

**Figure 2.1-5**, provides the maximum 2nd highest 1-hour CO levels.

Maximum 1-hour values for the decade ranged between a high of 14.1 ppm (recorded in 1996 at Detroit's Temple Street) to the lowest recorded value of 0.5 ppm at Houghton Lake (in 2003). No exceedances of the 1-hour CO standards have occurred.

**Figure 2.1-6** provides the 2nd highest 8-hour CO maximum values for all CO sites in Michigan. When comparing individual monitoring sites for the decade, the highest annual 8-hour readings ranged from 10.3 ppm in 1994 (Detroit's Evergreen site) to a low of 0.4 ppm in 2003 (Houghton Lake). All sites in Michigan have shown a steady decline with the 2nd highest annual 8-hour CO concentrations less than half of the 10.3 ppm level experienced in 1994.

**Figure 2.1-5: CO Levels by Location for All Areas in Michigan from 1994-2004 (2nd Highest 1-Hour Maximum Values)**

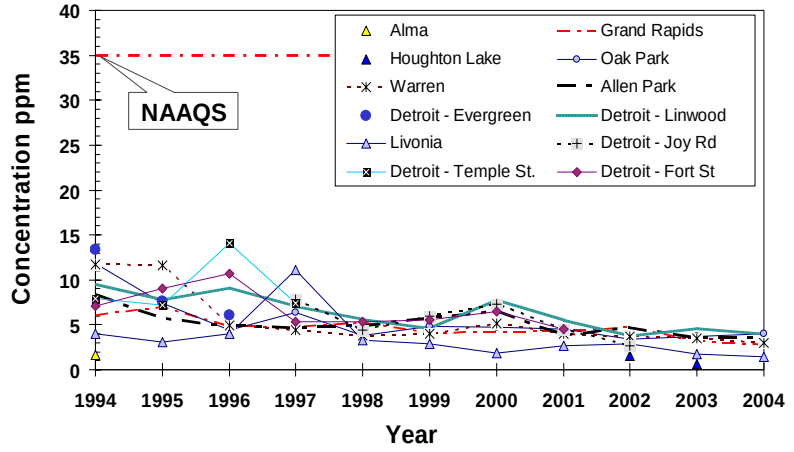
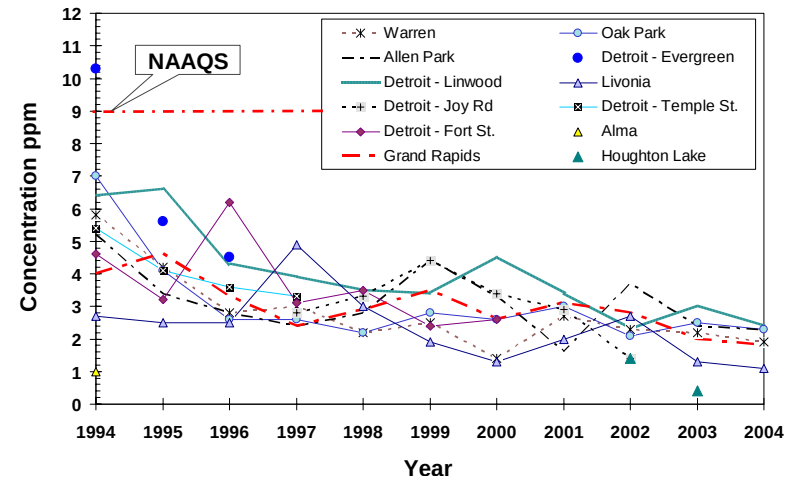



**Figure 2.1-6: CO Levels by Location for All Areas in Michigan from 1994-2004 (2nd Highest 8-Hour Maximum Values)**



# Chapter 2.2: Lead Trends

## Introduction:

In the past, automotive sources were the major contributors of lead (Pb) emissions to the atmosphere. Because of the phase-out of leaded gasoline, Pb emissions and concentrations decreased sharply during the 1980s and early 1990s, and since 1996, motor vehicle gasoline may not exceed 0.05 g (grams) per gallon (**10**). The change in gasoline formulations has had a marked impact on Pb emissions from motor vehicles. The average air quality concentration for Pb currently is 94% lower than in 1983 (**4**).

Industrial and combustion sources are now the dominant Pb emission sources. Industrial processes, primarily metallurgical processes such as smelting/refining of Pb, copper, and zinc, and the production of iron, steel, gray iron, brass, and bronze are the major source of Pb emissions to the atmosphere (**4**). The highest air concentrations of Pb are usually found in the vicinity of smelters and battery manufacturers (Pb acid batteries, Pb oxide/pigments, Pb glass, portland cement, and solder production are also industrial Pb emission sources). For combustion sources, Pb is an impurity found 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.

## Pb Effects:

Exposure to Pb can occur by inhalation or ingestion of lead in food, water, soil, or dust particles. Pb is accumulated in the body, primarily in the blood, bones, and soft tissues. The half-life of Pb stored in bone tissue is 25 years and about 25 to 50 days in soft tissues and blood. Anemia was associated with chronic exposure at blood Pb concentrations of 50-60 micrograms per deciliter ($\mu$g/dl) in adults, and in children at 40-70 $\mu$g/dl (**11**).

Pb can also adversely affect the kidneys, liver, nervous system, and other organs. Recent studies show that neurobehavioral changes may result from Pb exposure during the child's first years of life and that Pb may be a factor in high blood pressure and subsequent heart disease.[21] Excessive Pb exposure has been associated with lower IQ scores and neurological impairment, such as seizures, mental retardation, and behavioral disorders (**4**). Even at low doses, Pb exposure is associated with changes in fundamental enzymatic, metabolic, and homeostatic mechanisms in the human body. Additionally, even low levels of Pb exposure may cause central nervous system damage in fetuses and children.

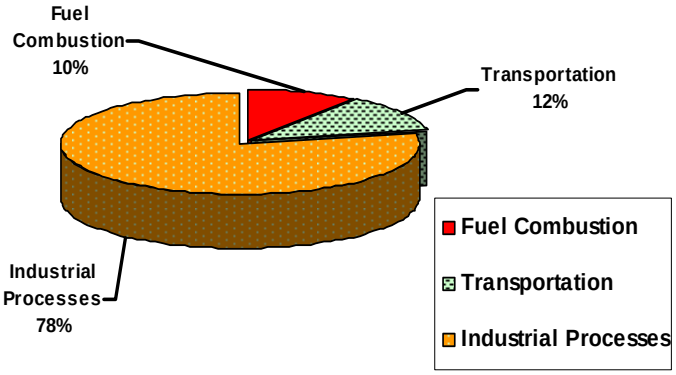
Airborne Pb can also have adverse impacts on the environment. At concentrations of 2-10 $\mu g/m^3$, Pb can inhibit plant growth, effect plant species diversity, and affect the microbial ecology of bacteria and fungi of soils. Reduced decomposition, nitrification, and a reduction in the number of invertebrates have been associated with Pb exposure. Wild and domestic grazing animals may ingest Pb that has deposited on plant or soil surfaces or that has been absorbed by plants through leaves or roots. Animals, however, do not appear to be more susceptible or more sensitive to adverse effects from Pb than are humans. Therefore, the secondary standard for Pb is identical to the primary standard.

[21] Information was obtained from the EPA's Air Trends website at http://www.epa.gov/airtrends/lead2.html.

## National Source Trends:

Nationwide, smelters and battery plants are now the major sources of Pb (**4**). **Figure 2.2-1** shows that national industrial processes account for 78% of Pb emissions (per EPA's 2002 National Pb Emissions by Source Category).[22] Both transportation and fuel combustion make up the remainder of the nations Pb emissions. Monitored ambient Pb air pollution levels along the nation's roadways reflect a 97% decrease (**12**).

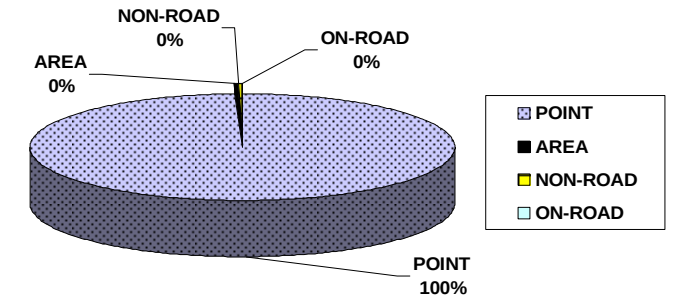
**Figure 2.2-1 EPA's 2002 National Pb Emissions by Source Category**




## Michigan Source Trends:

Michigan Pb emissions have also significantly decreased over the past 25 years. Much of this reduction can be attributed to the removal of alkylated Pb from automotive gasoline. **Figure 2.2-2** shows that non-road and on-road Pb emissions no longer contribute Pb emissions to Michigan. Following the national trend, point sources generated from gasoline additives, non-ferrous smelters, and battery plants now contribute to Michigan's overall Pb emissions (EPA's 1999 Emission Inventory data showed 69% of Michigan's Pb emissions were from point sources). However, there are no large sources of Pb in Michigan and the average ambient Pb levels are less than one tenth of the Pb NAAQS.

**Figure 2.2-2: Percentage of Pb Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




## NAAQS for Pb:

**Primary NAAQS**: Maximum quarterly average not to exceed 1.5 $\mu g/m^3$.

**Secondary NAAQS**: Same as primary standard.

The NAAQS for Pb specifies that the average of all the Pb samples collected during a calendar quarter may not exceed 1.5 $\mu g/m^3$ (**12**). In 1997, with the phase-out of alkylated Pb additives in motor fuels, EPA's ambient air monitoring philosophy changed from a mobile source-oriented to an industrial source-oriented monitoring strategy and therefore the need no longer existed to assess Pb levels near major highways (**4**). No point source-oriented monitoring is being conducted in the state as there are no large sources of Pb in Michigan. Michigan continues to demonstrate concentrations well below the NAAQS.

[22] Additional information is available on EPA's Air Trends website at http://www.epa.gov/airtrends/lead2.html.

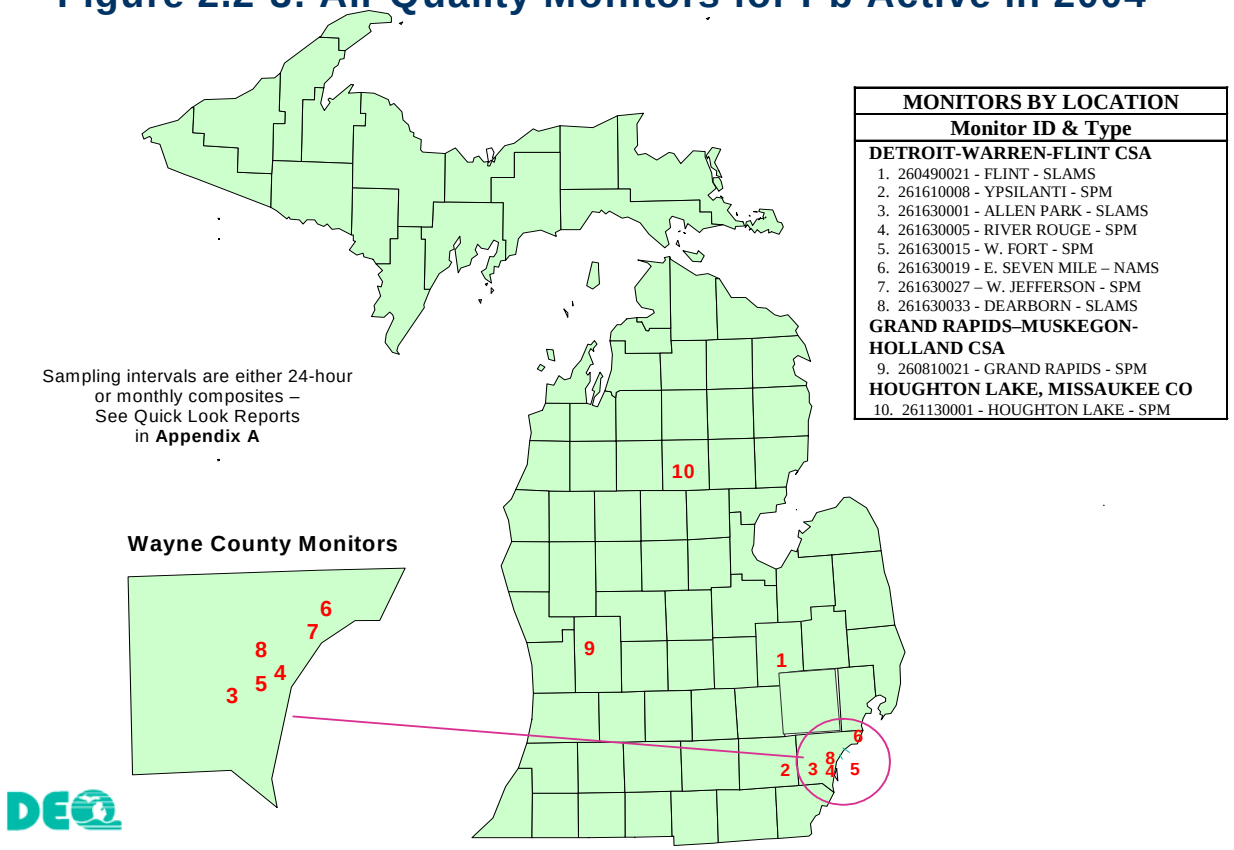
## Pb Monitoring in Michigan:

The January 20, 1999 monitoring requirements for Pb state that a single NAMS site must be located in one of the two cities with the greatest population in each region (**12**). In Region V, the Chicago-Gary-Kenosha CMSA and the Detroit-Warren-Flint CSA have the largest populations with Chicago chosen to house the required NAMS. Due to its larger population, the formal NAMS Pb monitor for the region should remain in Chicago, but the NAMS monitor at Detroit's E. Seven Mile (261630019) has continued its operation as a trace metals site for toxics monitoring.

Although the change in the federal regulations allows the discontinuance of many monitors, Michigan has continued Pb monitoring, along with other trace metals, as part of the Michigan Toxics Air Monitoring Program (MITAMP). The MITAMP sites include Flint, Ypsilanti, Allen Park, River Rouge, Detroit (Fort Street), Grand Rapids, and at the background site in Houghton Lake. These MITAMP sites provide ambient Pb measurements collected for a 24-hour period every six to twelve days. The Dearborn site has been designated as a NATTS and as such, must determine trace metal concentrations from $PM_{10}$ filters (more information on NATTS is available in **Chapter 3: Toxic Air Pollutants in Michigan**). MDEQ is continuing to measure trace metals from TSP (total suspended particles) to maintain continuity with our historical database and to provide a full suite of trace metal measurements by various size fractions ($PM_{2.5}$, $PM_{10}$, TSP) at the NATTS site.

In October 2004, Detroit's W. Jefferson monitoring site (261630027) was reactivated as a result of the Detroit Air Toxics Initiative (DATI). Monitoring is being conducted for TSP, PAH's, mercury, and toxics (see **Chapter 3: Toxic Air Pollutants in Michigan** for more information). **Figure 2.2-3** shows a total of 10 Pb monitoring sites operated in Michigan during 2004.

**Figure 2.2-3: Air Quality Monitors for Pb Active in 2004**



## Attainment/Nonattainment Status of Pb in Michigan:

Michigan is in attainment for Pb. All monitoring locations have met the Pb NAAQS with atmospheric ambient levels remaining consistently low.

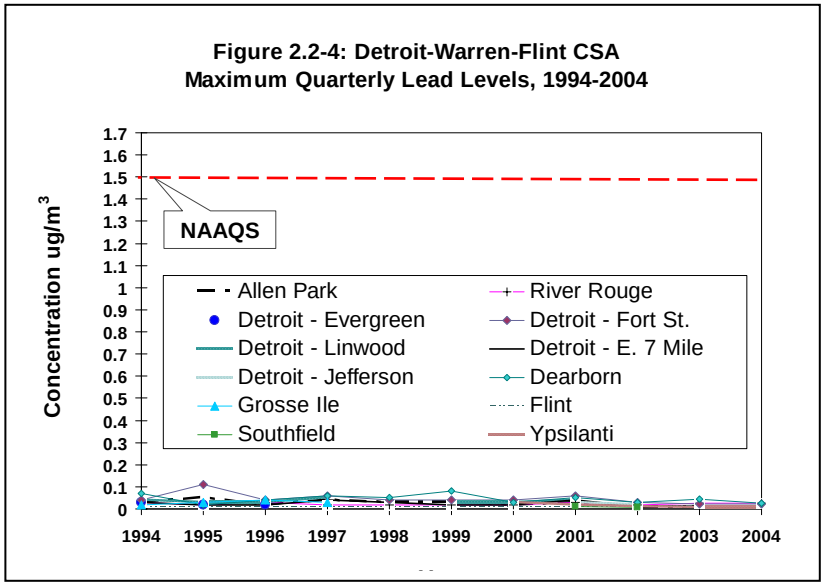
## Pb Trends by Location:

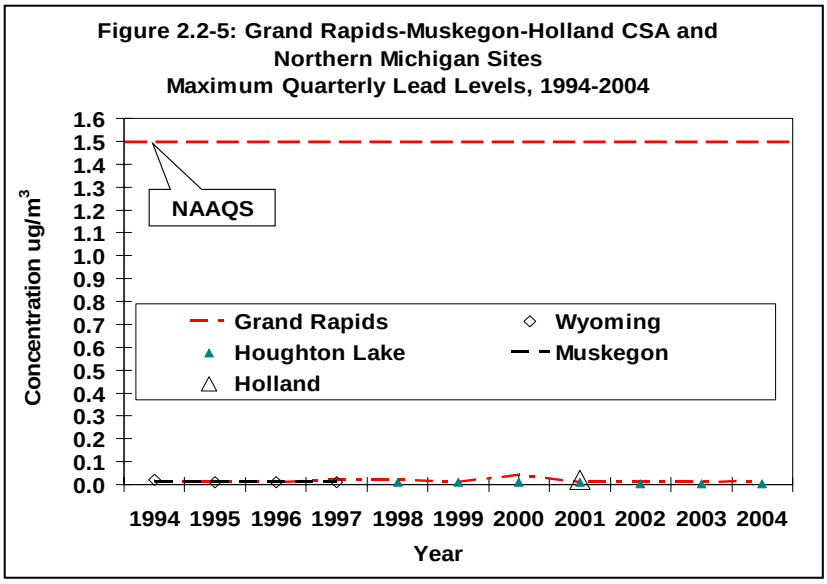
**Figure 2.2-4** and **2.2-5** are broken down by areas of the state. Both figures show that Pb levels in Michigan have remained at less than one-tenth of the NAAQS over the past decade, with a statewide Pb level below 0.02 $\mu g/m^3$. Historically, Michigan's ambient Pb levels have been less than the national average.

**Figure 2.2-4** has those sites located within the Detroit-Warren-Flint CSA. For the past decade, the highest quarterly maximum Pb concentration occurred in 1995 at the Detroit's Fort Street site (0.11 $\mu g/m^3$), which was below the Pb NAAQS of 1.5 $\mu g/m^3$.

**Figure 2.2-5** includes the remainder of Michigan's monitoring sites. These sites are located in the Grand Rapids-Muskegon-Holland CSA and Northern Michigan.

Michigan's lowest quarterly maximum Pb concentration for the decade occurred at the Houghton Lake site in both 2003 and 2004 (0.00395 and 0.00325 $\mu g/m^3$, respectively).



# Chapter 2.3: Nitrogen Dioxide Trends

## Introduction:

Nitrogen dioxide ($NO_2$) is a reddish-brown, highly reactive gas that is formed in the ambient air through the oxidation of nitric oxide (NO). Upon dilution it becomes yellow or invisible. At high concentrations it has a pungent odor and at lower levels its odor is similar to bleach. $NO_2$ and $SO_2$ (sulfur dioxide) can react with other substances in the atmosphere to form acidic products that are deposited in rain (acid rain), fog, snow, or as PM. Nitrate particles and $NO_2$ can block the transmission of light, thus causing visibility impairment in urban areas (**4**).

$NO_2$ is a compound of $NO_X$ and is a matter of public health concern. $NO_X$ is the term used to describe the sum of NO, $NO_2$, and other oxides of nitrogen. A variety of $NO_X$ compounds and their transformation products occur both naturally and as a result of human activities. Natural sources of $NO_X$ are lightning, biological and abiological processes in soil, and stratospheric intrusion. Ammonia and other nitrogen compounds produced naturally are important in the cycling of nitrogen through the ecosystem. Man-made (anthropogenic) emissions of $NO_X$ account for a large majority of all nitrogen inputs to the environment. The major sources of anthropogenic $NO_X$ emissions are high-temperature combustion processes, such as those occurring in automobiles and power plants. According to the EPA, most $NO_X$ from combustion sources (about 95%) are emitted as NO; the remainder are largely $NO_2$. Because NO is readily converted to $NO_2$ in the environment, the estimates reported by EPA assume oxides of nitrogen are emitted in the $NO_2$ form. Home heaters and gas stoves also produce substantial amounts of $NO_2$ in indoor settings (**4**).

## $NO_2$ Effects:

Exposure to $NO_2$ occurs through the respiratory system. $NO_2$ irritates the lungs and asthmatics are more sensitive to its effects than the general population. Short-term $NO_2$ exposures (i.e., less than 3 hours) at or near the ambient $NO_2$ concentrations include cough and increased changes in airway responsiveness and pulmonary function in individuals with preexisting respiratory illnesses, as well as increases in respiratory illnesses in children 5 to 12 years old. Evidence suggests that long-term exposures to $NO_2$ may lead to increased susceptibility to respiratory infection and may cause structural alterations in the lungs. Exercise increases the ventilation rate and hence exposure to $NO_2$ (**4**).

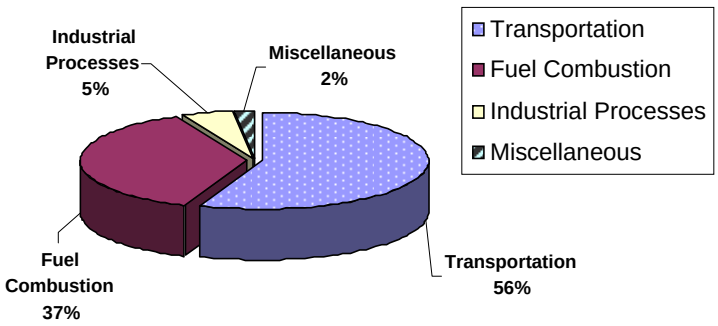
One of the most troubling health effects associated with atmospheric $NO_X$ is that it can lead to the formation of ozone ($O_3$) and nitrogen-bearing particles (e.g., nitrates and nitric acid). As discussed in the $O_3$ and PM chapters, exposure to both PM and $O_3$ is associated with adverse health effects.

Deposition of nitrogen can lead to fertilization, eutrophication, or acidification of terrestrial, wetland, and aquatic systems. These effects can alter competition between existing species, leading to changes in the number and type of species (composition) within a community. For example, eutrophic conditions in aquatic systems can produce explosive algae growth leading to a depletion of oxygen in the water and/or an increase in levels of toxins harmful to fish and other aquatic life (**4**).

## National Source Trends:

Since 1983, national monitored levels of $NO_2$ have decreased 21% and are reflected in all regions of the country. Those areas that once violated the $NO_2$ NAAQS now meet that standard (**4**). EPA's **Figure 2.3-1** shows that transportation (56%) and fuel combustion (37%) make up the majority of the national $NO_2$ emissions.

**Figure 2.3-1: EPA's 2002 National $NO_2$ Emissions by Source Category**



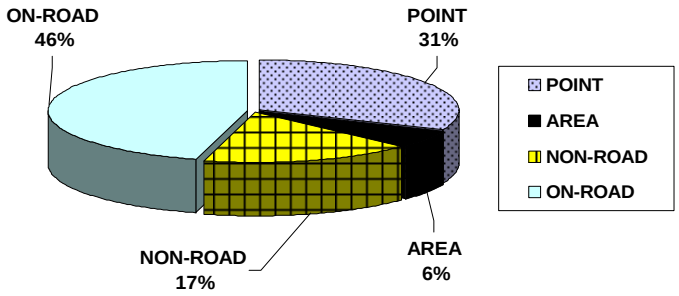

According to the EPA, the highest annual mean $NO_2$ concentrations are typically found in urban areas, with significantly lower annual mean concentrations recorded at rural sites. Interestingly, as the nation has experienced these significant decreases in $NO_2$ concentrations, $NO_X$ emissions are increasing. One possible explanation is that most of the nation's $NO_2$ monitoring sites are mobile-source-oriented sites in urban areas, and the 20-year decline in ambient $NO_2$ levels closely tracks the 19% reduction in emissions from gasoline-powered vehicles over the same time period (**4**).

The EPA has set emissions standards for most non-road engines, including those used in farm and construction equipment, locomotives, commercial marine vessels, and lawnmowers. To help control $NO_X$ emissions from non-road diesel engines, the EPA finalized the Emission Standards for New Non-road Engines -- Large Industrial Spark-ignition Engines, Recreational Marine Diesel Engines, and Recreational Vehicles (EPA420-F-02-037) in 2002 (as discussed in **Chapter 2.1: CO Trends**). Along with the reduction of CO emissions and hydrocarbons, the EPA estimates that this standard will reduce $NO_X$ emissions from these sources by 80% (**4**).

## Michigan Source Trends:

For Michigan, ambient $NO_2$ levels have always been well below the NAAQS (less than half). **Figure 2.3-2** shows that on-road (46%) and point sources (31%) make up most of Michigan's total $NO_X$ emissions (utilizing EPA 2002 Emissions Inventory). Point sources include industrial, commercial, institutional, and residential fossil fuel combustion.

**Figure 2.3-2: Percentage of $NO_X$ Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




## NAAQS for $NO_2$:

**Primary NAAQS**: Annual arithmetic mean not to exceed 0.053 ppm.

**Secondary NAAQS**: Same as primary standard.

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

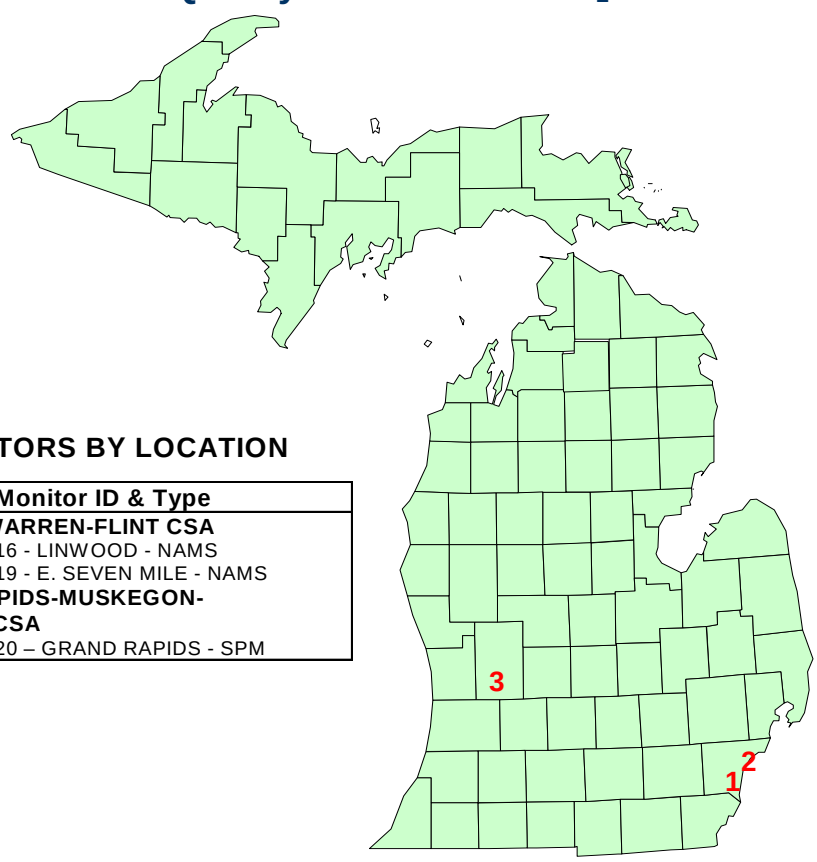
## $NO_2$ Monitoring in Michigan:

$NO_2$ NAMS are required in urban areas with population totals greater than 1,000,000. Previously, Detroit was the only urban area in Michigan meeting this population requirement and two NAMS sites were established. Now, according to the 2000 census, the Grand Rapids-Muskegon-Holland CSA has surpassed the 1,000,000 level. It is likely that the national network redesign efforts will continue to retain this requirement, so a NAMS $NO_2$ monitor may soon be required in the Grand Rapids-Muskegon-Holland CSA. In January 2002, to supplement the AQD's NSR background database, a $NO_2$ monitor became operational at the Grand Rapids site (260810020) but has not been designated as a NAMS site.

For the Detroit CSA there are currently two NAMS sites. The monitor at Linwood measures neighborhood scale air masses to determine the photochemical production of $NO_2$ in an area of the city with the largest emissions of $NO_X$. The E. Seven Mile Road monitor is an urban scale site that measures $NO_2$ produced from the reaction of $O_3$ with $NO_X$ and is downwind of peak $NO_X$ emission sources.

Even though there are no nonattainment areas for $NO_2$ in Michigan and monitoring for attainment purposes is not required, monitors will continue to operate to support photochemical model validation work. The map in **Figure 2.3-3** shows the locations of Michigan's three $NO_2$ monitors operating during 2004. NOTE: Although NOy ($NO_X$ and other nitrogen compounds) measurements are being collected at the Holland site as part of the Photochemical Assessment Monitoring Stations (PAMS) network, this monitor cannot be used to obtain $NO_2$ levels and is not included in **Figure 2.3-3**.

**Figure 2.3-3: Air Quality Monitors for $NO_2$ Active in 2004**




**MONITORS BY LOCATION**

| Monitor ID & Type |
|---|
| **DETROIT-WARREN-FLINT CSA** |
| 1. 261630016 - LINWOOD - NAMS |
| 2. 261630019 - E. SEVEN MILE - NAMS |
| **GRAND RAPIDS-MUSKEGON-HOLLAND CSA** |
| 3. 260810020 – GRAND RAPIDS - SPM |

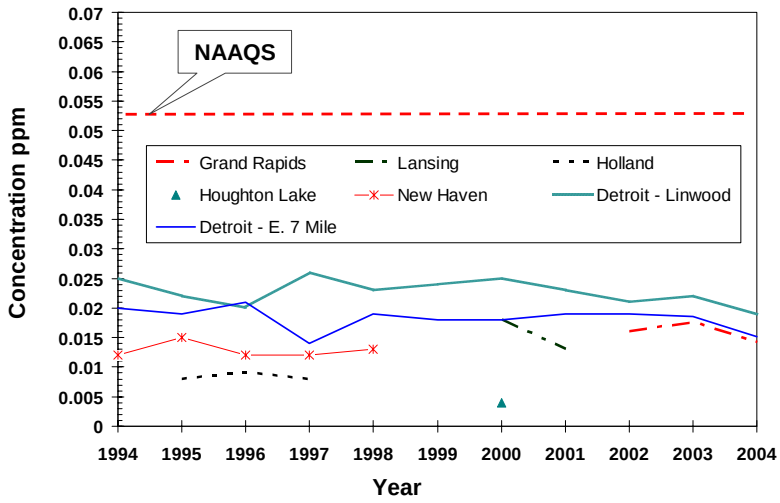
## Attainment/Nonattainment Status of $NO_2$ in Michigan:

Since the NAAQS was established on March 3, 1978, all of the areas in Michigan have been in attainment for $NO_2$.

## $NO_2$ Trends by Location:

As shown in **Figure 2.3-4**, $NO_2$ levels are well below the NAAQS. During the past decade, the largest annual arithmetic mean values measured in Michigan generally occurred at Detroit's Linwood monitoring site. All monitoring sites have shown an annual $NO_2$ concentration at less than half of the 0.053 ppm NAAQS. For 2004, the three Michigan $NO_2$ monitoring sites had concentrations of 0.0189 ppm (Linwood), 0.0152 ppm (E. Seven Mile), and 0.0141 (Grand Rapids), respectively. The highest average $NO_2$ levels observed statewide occurred in 1997 (0.026 ppm) at Detroit's - Linwood monitoring site and the lowest level was at the Houghton Lake site in 2000 (0.004 ppm).

**Figure 2.3-4: $NO_2$ Levels by Location, 1994-2004 (Annual Arithmetic Mean)**




There has never been an exceedance of the $NO_2$ standard in Michigan. Trends show the Detroit's Linwood and E. Seven Mile monitoring sites annual $NO_2$ levels are comparable to the historical nationwide trends.[23]

[23] Information on Nationwide Air Quality Trends is available at http://www.epa.gov/airtrends/nitrogen.html.

# Chapter 2.4: Ozone Trends

## Introduction:

Ozone ($O_3$) has the same chemical structure whether it occurs miles above the earth or at ground level. Therefore, depending on its location in the atmosphere, $O_3$ is considered either good or bad. Good $O_3$ occurs naturally in the stratosphere approximately 10 to 30 miles above the earth's surface and forms a layer that protects life on earth from the sun's harmful rays. The common phrase, "hole in the ozone layer," refers to the $O_3$ in this layer. Various refrigerants contain chlorofluorocarbons or hydrochlorofluorocarbons which, once released, migrate into the upper atmosphere where a complex series of chemical reactions occur destroying $O_3$ molecules and thinning the protective $O_3$ layer.[24]

In the earth's lower atmosphere (also known as the troposphere - the layer of the atmosphere nearest the earth's surface), ground level $O_3$ is considered bad. Ground-level $O_3$ causes human health problems, damages crops and other vegetation, and is a key ingredient of urban smog. Ground level $O_3$ is created by photochemical reactions involving $NO_X$ and VOCs in the presence of sunlight. These reactions usually occur during the hot summer months as ultraviolet radiation from the sun initiates a sequence of photolytical reactions. Major sources of $NO_X$ and VOCs are vehicle and engine exhaust, emissions from industrial facilities, combustion from electric utilities, gasoline vapors, chemical solvents, and biogenic emissions from natural sources (**13**).

Ground level $O_3$ can also be transported hundreds of miles under favorable meteorological conditions. As a result, the long-range transport of air pollutants impacts the air quality of regions downwind from the actual area of formation. For Michigan, transported $O_3$ and $O_3$ precursors from Gary-Chicago-Milwaukee and other upwind source areas affects the monitor levels in Michigan.

## $O_3$ Effects:

Individuals most susceptible to the effects of $O_3$ exposure include individuals with a pre-existing or chronic respiratory disease, children who are active outdoors, and adults who actively exercise or work outdoors (**4**). Human exposure to elevated $O_3$ can irritate a person's airways, reduce lung function, aggravate asthma and chronic lung diseases like emphysema and bronchitis, and inflame and damage the cells lining the lungs. Other effects associated with $O_3$ exposure are increased respiratory related hospital admissions with symptoms such as chest pain, shortness of breath, throat irritation, and cough. Ozone may also reduce the immune system's ability to fight off bacterial infections in the respiratory system, and long-term, repeated exposure may cause permanent lung damage.

$O_3$ also impacts vegetation. Vegetation and forest ecosystem changes that occur include: agricultural crop and forest yield reductions; foliar injury; diminished resistance to pest and pathogens; greater susceptibility of injury from other environmental agents; reduced survivability of tree seedlings; and decreased population number in those species that are sensitive to $O_3$ (**4**).

Additional information about $O_3$ and its effects are available at http://www.epa.gov/airnow and http://www.epa.gov/air/urbanair/ozone/hlth.html. Ambient $O_3$ values in Michigan (including daily maximum values), *Ozone Action!* Day's hourly values, lists of exceedances, and other information are available on the AQD website at http://www.michigan.gov/deqair under "Ozone Action." More information on Michigan's *Ozone Action!* is also discussed in **Chapter 4: Special Projects**.

[24] Detailed explanation of chemical reactions and mechanisms involved in the formation of $O_3$ and other photochemical oxidants can be found on the EPA website at http://www.epa.gov/airtrends/strat.html.

## National Source Trends:

Part of the nation's commitment to clean, healthy air deals with reducing levels of $O_3$. In 1979, a 1-hour standard for $O_3$ was set. Over the past several years, a more restrictive health-based 8-hour $O_3$ standard has been phased in. The new average-based $O_3$ standard (attained when the 3-year average of the 4th highest 8-hour value is below 0.08 ppm) is more representative of the air quality people breathe over an 8-hour period of time.

EPA's The Ozone Report: Measuring Progress through 2003, lays the groundwork for the planning and analysis needed to track progress toward attaining the nation's 8-hour $O_3$ standard and reporting the results to the public.[25] According to EPA, $O_3$ levels across the nation were down substantially in 2003. The improved air quality resulted from favorable weather conditions and continuing reductions in $NO_X$ and VOC emissions (**13**).

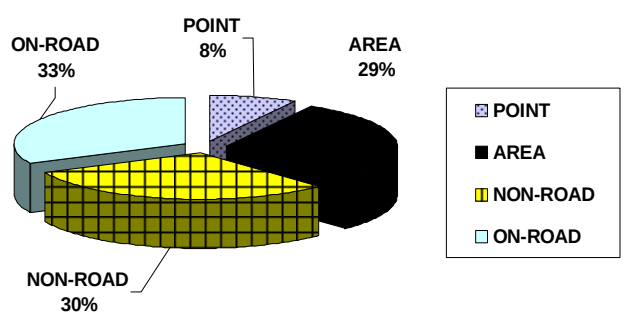
EPA has noted that over the past 20 years, $O_3$ levels (1-hour and 8-hour) have improved considerably nationwide. However, over the past 10 years, the levels have been relatively flat (**4**). Standard statistical tests applied to the 10-year trends for both 1-hour and 8-hour $O_3$ shows that these trends are not statistically significant. Concentrations varied over this 10-year period from year to year but did not change overall (**4**). EPA states that year-to-year changes in ambient $O_3$ trends are influenced by meteorological conditions, population growth, and changes in emissions levels of $O_3$ precursors (i.e. VOCs and $NO_X$) resulting from ongoing control measures (**4, 13**). In addition, it is important to note that there have been changes in network design, siting criteria, spatial coverage, and monitoring instrument calibration procedures during the past two decades (**4**).

National VOC emissions from man-made sources decreased 40% between 1983 and 2002 and 25% over the past 10 years. Nationally, the two major sources of VOC emissions are industrial processes (47%) and transportation sources (45%). $NO_X$ emissions decreased nationwide approximately 15% from 1983 to 2002 and 12% over the past 10 years (**13**).

## Michigan Source Trends:

**Figure 2.4-1** shows by percentage the sources of VOC emissions in Michigan. These source types include: motor vehicles; storage, transport, processing, and marketing of petroleum products; combustions of fuels; and industrial processes such as production/use of organic chemicals, paints, polymers, resins, surface coatings, plastic product manufacturing, coke production/byproducts, and degreasing. VOCs can also include the terpenes and isoprenes naturally emitted from vegetation.

**Figure 2.4-1: Percentage Of VOC Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




For Michigan, on-road and non-road sources still account for a large percentage of VOC emissions. In 2004, EPA began phasing in their very stringent Tier 2 Vehicle and Gasoline Sulfur Program for on-road vehicles and gas-engine cars, trucks, and SUVs that also reduce $NO_X$ emissions. Starting with the 2004 models, manufacturers of cars and light trucks are required to

[25] The 2003 Ozone Report is available on-the EPA website at http://www.epa.gov/airtrends/ozone.html.

certify 25% of their fleet to meet the Tier 2 standards and by 2009, 100% of all cars and lights trucks must meet these standards.

In addition, the EPA's Clean Air Non-Road Diesel Rule, requires the reduction of emissions from non-road diesel engines and would apply to diesel engines used in most kinds of construction, agricultural, and industrial equipment. Because the emission control devices can be damaged by sulfur, EPA also reduced the allowable level of sulfur in non-road diesel fuel. EPA states that after the phase-in, these non-road diesel emission standards will reduce $NO_X$ and PM emissions by more than 90% and are similar to the requirements for engines being implemented for on-road highway trucks and buses.

## NAAQS for $O_3$:

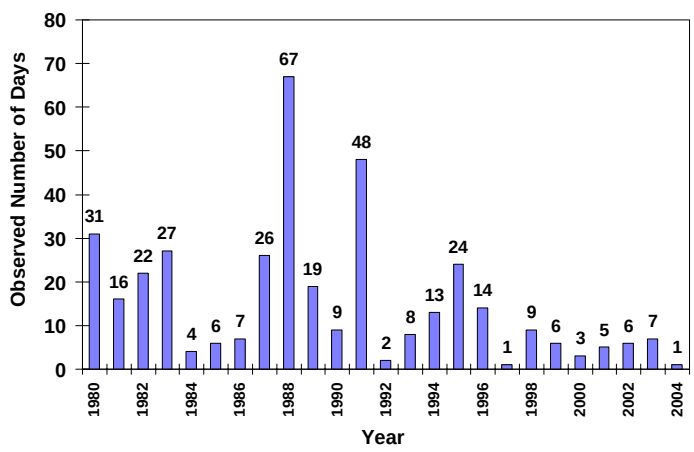
| | |
|---|---|
| **Primary NAAQS (1-hour):** | Maximum daily 1-hour average concentration limit of 0.12 ppm with the average number of expected exceedances per year not to exceed one over a three year period. |
| **Secondary NAAQS (1-hour):** | Same as the primary NAAQS (1 hour). |
| **Primary NAAQS (8-hour):** | 4th highest daily maximum 8-hour average, averaged over three years, not to exceed 0.085 ppm. |
| **Secondary NAAQS (8-hour):** | Same as primary 8-hour standard. |

## Attainment/Nonattainment Status of 1-Hour $O_3$ Standard in Michigan:

All Michigan counties are now designated as attainment for the 1-hour $O_3$ standard. EPA expects to revoke the 1-hour standards one year after an area is designated under the 8-hour standards. Currently, both the 1-hour and 8-hour $O_3$ standards are now in effect (**4, 15, 16**).

For the current 1-hour $O_3$ standard, **Figure 2.4-2** shows Michigan's number of exceedance days from 1980-2004. Exceedance days are measured using the highest 1-hour $O_3$ concentration level (0.125 ppm or higher) reported during a 24-hour period (midnight to midnight). All of the three highest 1-hour $O_3$ concentrations reported in Michigan occurred at the Port Huron site, once in 1996 (0.184 ppm), once in 2002 (0.140 ppm), and then again in 2003 (0.143 ppm). The Port Huron monitor is located downwind of the Detroit urban area and is being influenced by regional $O_3$ transport. **Appendix D** provides a tabular summary of the 1-hour $O_3$ exceedances from 1994 to 2004 for all $O_3$ monitors in Michigan.

**Figure 2.4-2: Observed Number of Exceedance Days of the 1-Hr $O_3$ Standard, 1980-2004**




## Attainment/Nonattainment Status of 8-Hour $O_3$ Standards in Michigan:

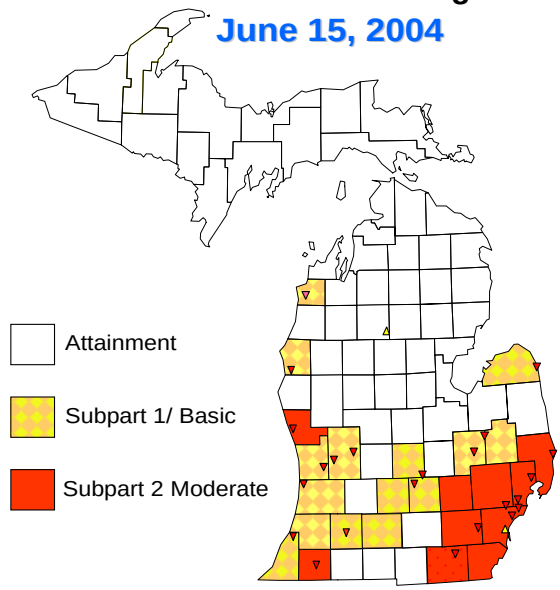
The EPA issued the 8-hour ozone standard in 1997 based on information demonstrating that the 1-hour standard was inadequate for protecting public health. The new average-based 8-hour $O_3$

health standard (attained when the 3-year average of the 4th highest value is below 0.08 ppm) is more representative of the air quality people breathe over an 8-hour period of time, which reflects a more realistic measure of people's exposure and is more protective of public health.

Areas that the EPA believes should be required to reduce emissions to meet the new 8-hour $O_3$ NAAQS were identified in letters sent to states and tribal nations on December 4, 2003 using updated monitoring data (2001-2003). The letters were part of a formal designation process that began in July 2003, when states and tribes sent updated nonattainment and attainment area boundary recommendations to EPA based on the area's 8-hour design value calculated using the most recent three years of data (at that time 2000-2002 monitoring data was used). These designations play an important role in letting the public know whether air quality in a given area is healthy. A nonattainment designation indicates that the area does not meet the national health-based standard, or contributes to violations of the standard in another area.

On April 15, 2004, the EPA made final designations for areas across the country for the 8-hour $O_3$ NAAQS. EPA also issued classifications as to whether these areas are subject to either the requirements of Subpart 1 (basic) or Subpart 2 (marginal, moderate, serious, or severe) of the CAA. This classification, based on severity of pollution, will dictate the deadline for attainment and the regulatory measures that will be required.

**Figure 2.4-3: EPA's 8-Hour $O_3$ Classifications for Michigan**




For Michigan, EPA designated 25 counties as nonattainment for the 8-hour $O_3$ NAAQS with an effective date of June 15, 2004 (**Figure 2.4-3**).[26] Of the 25 counties, 10 counties were classified as moderate with 2010 as the attainment deadline. Under the federal CAA, moderate nonattainment areas are subject to specific requirements, including a mandate to reduce emissions of VOCs by 15% and vehicle testing (if the area's population exceeds 250,000). The remaining 15 counties, called basic nonattainment areas, fall under the more flexible Subpart 1 provisions of the CAA. The EPA expects that these basic nonattainment areas may be able to attain the 8-hour $O_3$ NAAQS through emission reductions resulting from existing regulations. Their attainment deadline is 2009.

On July 15, 2004, using 2002-2004 monitoring data, the MDEQ sent EPA requests for classification adjustments (or bump-downs) from moderate to marginal for the two West Michigan counties and the eight Southeast Michigan counties as the design values for these counties had changed (see **Table 2.4-1**).[27] A marginal classification allows for greater flexibility in choosing measures to reduce emissions and also requires quicker reductions to attain the 8-hour $O_3$ NAAQS by 2007.

**Table 2.4-1** shows Michigan's three year averages of the 4th highest 8-hour $O_3$ values from 1995-2004.

[26] Information on $O_3$ designations is available on the EPA's website at www.epa.gov/ozonedesignations/.
[27] All the MDEQ's submittals are available on the AQD website at http://www.michigan.gov/deqair, "Assessment and Planning," "Attainment/Nonattainment," "Ozone."

## Table 2.4-1: Three-Year Average of the 4th Highest 8-Hr $O_3$ Values From 1995-2004

| AIRS ID Site Name | Values | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260050003-Holland | 4th Highest 8-hr Value ppm | 0.110 | 0.090 | 0.095 | 0.097 | 0.091 | 0.080 | 0.092 | 0.105 | 0.095 | 0.079 |
| | Three-year Average ppm | 0.094 | 0.097 | 0.098 | 0.094 | 0.094 | 0.089 | 0.087 | 0.092 | 0.097 | 0.093 |
| | Rounded to 0.01 ppm | 0.09 | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.10 |
| 260190003–Frankfort/ Benzonia | 4th Highest 8-hr Value ppm | 0.099 | 0.085 | 0.078 | 0.090 | 0.097 | 0.081 | 0.091 | 0.086 | 0.089 | 0.075 |
| | Three-year Average ppm | 0.089 | 0.089 | 0.087 | 0.084 | 0.088 | 0.089 | 0.089 | 0.086 | 0.088 | 0.083 |
| | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.08 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 |
| 260210014-Coloma | 4th Highest 8-hr Value ppm | 0.098 | 0.098 | 0.099 | 0.093 | 0.096 | 0.077 | 0.088 | 0.098 | 0.089 | 0.073 |
| | Three-year Average ppm | 0.087 | 0.094 | 0.098 | 0.096 | 0.096 | 0.088 | 0.087 | 0.087 | 0.091 | 0.086 |
| | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.10 | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| 260270003-Cassopolis | 4th Highest 8-hr Value ppm | 0.099 | 0.095 | 0.090 | 0.091 | 0.095 | 0.079 | 0.088 | 0.103 | 0.089 | 0.077 |
| | Three-year Average ppm | 0.089 | 0.094 | 0.094 | 0.092 | 0.092 | 0.088 | 0.087 | 0.090 | 0.093 | 0.089 |
| | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| 260370001-Rose Lake | 4th Highest 8-hr Value ppm | 0.076 | 0.068 | 0.078 | 0.078 | 0.087 | 0.074 | 0.087 | 0.085 | 0.086 | 0.070 |
| | Three-year Average ppm | 0.077 | 0.074 | 0.074 | 0.074 | 0.081 | 0.079 | 0.082 | 0.082 | 0.086 | 0.080 |
| | Rounded to 0.01 ppm | 0.08 | 0.07 | 0.07 | 0.07 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 |
| 260490021-Flint | 4th Highest 8-hr Value ppm | 0.082 | 0.089 | 0.076 | 0.089 | 0.089 | 0.072 | 0.091 | 0.088 | 0.087 | 0.075 |
| | Three-year Average ppm | 0.076 | 0.082 | 0.082 | 0.084 | 0.084 | 0.083 | 0.084 | 0.083 | 0.088 | 0.083 |
| | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 |
| 260492001-Otisville | 4th Highest 8-hr Value ppm | 0.079 | 0.084 | 0.079 | 0.089 | 0.095 | 0.074 | 0.091 | 0.089 | 0.091 | 0.077 |
| | Three-year Average ppm | 0.074 | 0.078 | 0.080 | 0.084 | 0.087 | 0.086 | 0.086 | 0.084 | 0.090 | 0.085 |
| | Rounded to 0.01 ppm | 0.07 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.08 | 0.09 | 0.09 |
| 260630007-Harbor Beach | 4th Highest 8-hr Value ppm | 0.083 | 0.084 | 0.075 | 0.087 | 0.090 | 0.072 | 0.088 | 0.087 | 0.086 | 0.068 |
| | Three-year Average ppm | 0.080 | 0.083 | 0.080 | 0.082 | 0.084 | 0.083 | 0.083 | 0.082 | 0.087 | 0.080 |
| | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 |
| 260650012-Lansing | 4th Highest 8-hr Value ppm | 0.088 | 0.085 | 0.076 | 0.081 | 0.089 | 0.077 | 0.083 | 0.088 | 0.085 | 0.068 |
| | Three-year Average ppm | 0.082 | 0.084 | 0.083 | 0.080 | 0.082 | 0.082 | 0.083 | 0.082 | 0.085 | 0.080 |
| | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 |
| 260770905-Kalamazoo[1] | 4th Highest 8-hr Value ppm | 0.093 | 0.085 | 0.082 | 0.087 | 0.091 | 0.070 | 0.085 | 0.090 | 0.085 | 0.068 |
| | Three-year Average ppm | 0.084 | 0.085 | 0.086 | 0.084 | 0.086 | 0.082 | 0.082 | 0.081 | 0.086 | 0.081 |
| 260770008-Kalamazoo | Rounded to 0.01 ppm | 0.08 | 0.09 | 0.09 | 0.08 | 0.09 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 |

## Table 2.4-1: Three-Year Average of the 4th Highest 8-Hr $O_3$ Values From 1995-2004 (Continued)

| AIRS ID Site Name | Values | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260810020-Grand Rapids | 4th Highest 8-hr Value ppm | 0.094 | 0.087 | 0.077 | 0.079 | 0.085 | 0.068 | 0.083 | 0.087 | 0.085 | 0.068 |
| | Three-year Average ppm | 0.086 | 0.088 | 0.086 | 0.081 | 0.080 | 0.077 | 0.078 | 0.079 | 0.085 | 0.080 |
| | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 |
| 260812001-Parnell<br>260810022-Evans | 4th Highest 8-hr Value ppm | 0.098 | 0.086 | 0.079 | 0.087 | 0.094 | 0.073 | 0.085 | 0.088 | 0.093 | 0.072 |
| | Three-year Average ppm | 0.086 | 0.089 | 0.087 | 0.084 | 0.086 | 0.084 | 0.084 | 0.082 | 0.088 | 0.084 |
| | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.08 | 0.09 | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 |
| 260890001-Peshawbestown | 4th Highest 8-hr Value ppm | | | | | | | | | 0.079 | 0.070 |
| | Three-year Average ppm | | | | | | | | | | |
| | Rounded to 0.01 ppm | | | | | | | | | | |
| 260910007-Tecumseh | 4th Highest 8-hr Value ppm | 0.089 | 0.085 | 0.076 | 0.086 | 0.083 | 0.082 | 0.086 | 0.089 | 0.088 | 0.074 |
| | Three-year Average ppm | 0.082 | 0.086 | 0.083 | 0.082 | 0.081 | 0.083 | 0.083 | 0.085 | 0.087 | 0.083 |
| | Rounded to 0.01 ppm | 0.08 | 0.09 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.08 |
| 260990009-New Haven | 4th Highest 8-hr Value ppm | 0.092 | 0.091 | 0.090 | 0.098 | 0.096 | 0.075 | 0.095 | 0.095 | 0.102 | 0.081 |
| | Three-year Average ppm | 0.091 | 0.093 | 0.091 | 0.093 | 0.095 | 0.090 | 0.089 | 0.088 | 0.097 | 0.092 |
| | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.09 |
| 260991003-Warren | 4th Highest 8-hr Value ppm | 0.090 | 0.090 | 0.081 | 0.090 | 0.090 | 0.077 | 0.094 | 0.092 | 0.101 | 0.071 |
| | Three-year Average ppm | 0.086 | 0.089 | 0.087 | 0.087 | 0.087 | 0.085 | 0.087 | 0.087 | 0.095 | 0.088 |
| | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.09 |
| 261050006-Ludington[2]<br>261050007-Scottville | 4th Highest 8-hr Value ppm | 0.110 | 0.093 | 0.086 | 0.087 | 0.101 | 0.081 | 0.093 | 0.089 | 0.087 | 0.071 |
| | Three-year Average ppm | 0.095 | 0.096 | 0.096 | 0.088 | 0.091 | 0.089 | 0.091 | 0.087 | 0.089 | 0.082 |
| | Rounded to 0.01 ppm | 0.10 | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 |
| 261130001-Houghton Lake | 4th Highest 8-hr Value ppm | | | | 0.079 | 0.091 | 0.073 | 0.084 | 0.077 | 0.082 | 0.071 |
| | Three-year Average ppm | | | | | | 0.081 | 0.082 | 0.078 | 0.081 | 0.076 |
| | Rounded to 0.01 ppm | | | | | | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| 261210039-Muskegon | 4th Highest 8-hr Value ppm | 0.117 | 0.097 | 0.084 | 0.092 | 0.103 | 0.078 | 0.095 | 0.096 | 0.094 | 0.070 |
| | Three-year Average ppm | 0.096 | 0.101 | 0.099 | 0.091 | 0.093 | 0.091 | 0.092 | 0.089 | 0.095 | 0.086 |
| | Rounded to 0.01 ppm | 0.10 | 0.10 | 0.10 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.10 | 0.09 |
| 261250001-Oak Park | 4th Highest 8-hr Value ppm | 0.084 | 0.074 | 0.076 | 0.089 | 0.088 | 0.075 | 0.090 | 0.093 | 0.090 | 0.075 |
| | Three-year Average ppm | 0.082 | 0.081 | 0.078 | 0.079 | 0.084 | 0.084 | 0.084 | 0.086 | 0.091 | 0.086 |
| | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 |

## Table 2.4-1: Three-Year Average of the 4th Highest 8-Hr $O_3$ Values From 1995-2004 (Continued)

| AIRS ID Site Name | Values | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 261390005-Jenison | 4th Highest 8-hr Value ppm | 0.083 | 0.084 | 0.079 | 0.085 | 0.091 | 0.077 | 0.086 | 0.093 | 0.090 | 0.069 |
| | Three-year Average ppm | | 0.084 | 0.082 | 0.082 | 0.085 | 0.084 | 0.084 | 0.085 | 0.089 | 0.084 |
| | Rounded to 0.01 ppm | | 0.08 | 0.08 | 0.08 | 0.09 | 0.08 | 0.08 | 0.09 | 0.09 | 0.08 |
| 261470005-Port Huron | 4th Highest 8-hr Value ppm | 0.094 | 0.086 | 0.079 | 0.091 | 0.091 | 0.080 | 0.084 | 0.100 | 0.086 | 0.074 |
| | Three-year Average ppm | 0.089 | 0.088 | 0.086 | 0.085 | 0.087 | 0.087 | 0.085 | 0.088 | 0.090 | 0.086 |
| | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 |
| 261530001-Seney | 4th Highest 8-hr Value ppm | | | | | | | | 0.083 | 0.076 | 0.074 |
| | Three-year Average ppm | | | | | | | | | | 0.077 |
| | Rounded to 0.01 ppm | | | | | | | | | | 0.08 |
| 261610005-Ann Arbor<br>261610007-Ann Arbor[3]<br>261610008-Ypsilanti | 4th Highest 8-hr Value ppm | 0.084 | 0.088 | 0.074 | 0.084 | 0.092 | 0.078 | 0.092 | 0.091 | 0.091 | 0.071 |
| | Three-year Average ppm | 0.079 | 0.083 | 0.082 | 0.082 | 0.083 | 0.084 | 0.087 | 0.087 | 0.091 | 0.084 |
| | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.09 | 0.08 |
| 261630001-Allen Park | 4th Highest 8-hr Value ppm | 0.078 | 0.082 | 0.075 | 0.079 | 0.087 | 0.067 | 0.080 | 0.088 | 0.085 | 0.065 |
| | Three-year Average ppm | 0.073 | 0.078 | 0.078 | 0.078 | 0.080 | 0.077 | 0.078 | 0.078 | 0.084 | 0.079 |
| | Rounded to 0.01 ppm | 0.07 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 |
| 261630016-Detroit's Linwood | 4th Highest 8-hr Value ppm | 0.077 | 0.079 | 0.079 | 0.086 | 0.084 | 0.077 | 0.087 | 0.092 | 0.084 | 0.066 |
| | Three-year Average ppm | 0.078 | 0.082 | 0.078 | 0.081 | 0.083 | 0.082 | 0.082 | 0.085 | 0.087 | 0.080 |
| | Rounded to 0.01 ppm | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.08 | 0.09 | 0.09 | 0.08 |
| 261630019-Detroit's E. Seven Mile | 4th Highest 8-hr Value ppm | 0.091 | 0.086 | 0.088 | 0.093 | 0.092 | 0.080 | 0.092 | 0.083 | 0.098 | 0.066 |
| | Three-year Average ppm | 0.089 | 0.090 | 0.088 | 0.089 | 0.091 | 0.088 | 0.088 | 0.085 | 0.091 | 0.082 |
| | Rounded to 0.01 ppm | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.09 | 0.08 |

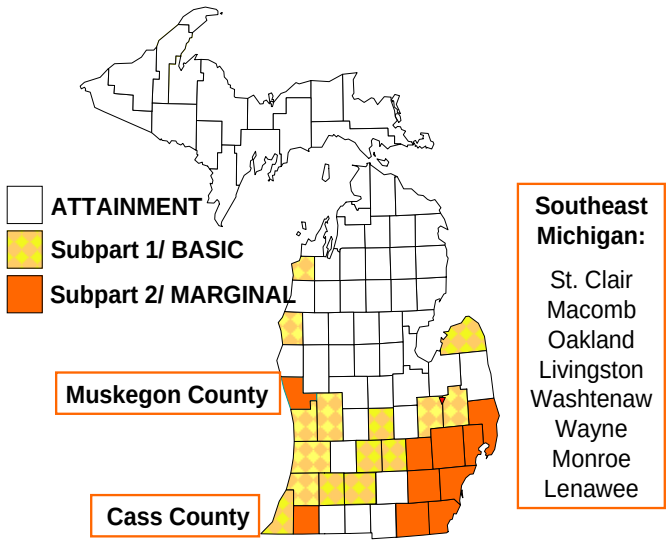
Footnotes:

1. Kalamazoo site monitor operation responsibility was assumed by MDEQ on 10/96, and site ID number changed.
2. Ludington site monitor was closed in 10/97 due to loss of site access, and relocated to Scottville.
3. Ann Arbor site monitor was relocated elsewhere in Ann Arbor and later moved to Ypsilanti due to site access difficulty.

On September 16, 2004, EPA agreed with the MDEQ and reclassified Cass and Muskegon County in West Michigan and the eight Southeast Michigan counties of Wayne, Oakland, Macomb, Livingston, Lenawee, Monroe, St. Clair, and Washtenaw from moderate to marginal with an attainment date of June 2007 (see **Figure 2.4-4**).

For the West Michigan counties, EPA's action was guided in part by recognition that the air quality in the West Michigan communities is greatly influenced by pollution blowing across Lake Michigan. A marginal nonattainment classification will provide these counties with the necessary flexibility to address the transport problem without implementing control programs that fail to target the true causes of the problem.

**Figure 2.4-4: EPA's 8-Hour $O_3$ Reclassifications for Michigan from Moderate to Marginal – September 15, 2004**




EPA's decision for the reclassification of those counties in Southeast Michigan was based on the MDEQ's demonstration that the area will be able to implement emission controls to attain the $O_3$ NAAQS by 2007. The MDEQ provided EPA with a strategy that through a combination of reduction in the vapor pressure of gasoline fuels sold, reduction in VOCs in a series of consumer products, and reduced VOC emissions for cement manufacturing, when combined with other contingency and voluntary measures, are expected to bring Southeast Michigan into compliance with the 8-hour $O_3$ standard. EPA agreed and reclassified those Southeast Michigan counties to marginal. This change means that the areas will have greater flexibility to select control measures that will be most effective in reducing ozone levels in their respective areas. While the action requires early attainment, areas will be subject to fewer mandatory emission reduction programs.

For all of the 25 nonattainment counties in Michigan, new air permits for major sources of VOCs and $NO_X$ must be issued under the nonattainment requirements contained in Michigan's Rule 220.[28] Rule 220 details the NSR requirements for major sources in nonattainment areas and includes the provisions for offsets, Lowest Achievable Emission Rate applicability, and a requirement that all major sources owned by the company seeking the major source permit be in compliance with all local, state, and federal rules The AQD, in response to questions and concerns regarding the NSR permitting requirements and procedures for these nonattainment counties, created the Ozone Nonattainment and NSR Implementation Q&A.[29]

All nonattainment areas are also subject to Transportation Conformity requirements. Transportation projects must conform to air quality improvement plans. New projects must not cause or contribute to a new violation, increase the frequency or severity of any existing violation, or delay timely attainment. If the state fails to develop or implement a plan to improve air quality, EPA can apply sanctions to highway funding.

[28] Michigan's Rule 220 is available in its entirety at http://www.deq.state.mi.us/documents/deq-aqd-air-rules-apc-part2.pdf.

[29] More information on the Ozone Nonattainment and NSR Implementation Q & A is available from the AQD's website at http://www.michigan.gov/deqair under the heading SPOTLIGHT.

It is important to note that air quality improvements will likely result from Michigan's Part 8 Emissions Limitations and Prohibitions--Oxides of Nitrogen revisions ($NO_X$ Rules).[30] The $NO_X$ Rules require that new air pollution control equipment at power plants and large industrial sources reduce $NO_X$ emissions by as much as 85% no later than May 31, 2004. These rules will result in the lowering of $NO_X$ emissions thereby lowering the levels of $O_3$ in Michigan and downwind areas.

In addition, the new federal emission standards for automobiles, trucks, fuels, boats, planes, all terrain vehicles, and construction, farm, and airport vehicles are being phased-in over the next few years and will also help states in their efforts to reduce $O_3$ levels.

## $O_3$ Monitoring in Michigan:

The $O_3$ monitoring season is April 1 through September 30. During 2004, there were a total of 27 $O_3$ monitoring stations in Michigan, with 24 stations operated by state and local agencies; one station (Cassopolis) operated by the State of Indiana,[31] one station in the Seney National Wildlife Refuge (http://www.mwhazecam.net) operated by the U.S. Fish and Wildlife Service, and a site in Leelanau County (Peshawbestown) operated by the Grand Traverse Band of Ottawa and Chippewa Indians.

Monitoring networks often extend beyond the vicinity where most precursor emissions occur because of the time it takes for $O_3$ to form from the reaction of $NO_X$ and VOC emissions. Upwind and background sites are situated according to the predominant morning upwind direction from a metropolitan area (**17**). The monitor near Houghton Lake in Missaukee County is an SPM that provides background concentrations in a remote rural environment. In addition to attainment designation applications, monitoring is also conducted to assess urban air quality, population exposure, and provide real time mapping (WEBMONMAP) and Air Quality Index (AQI) calculations (information on the WEBMONMAP and the AQI is available in **Chapter 4**).

High $O_3$ concentrations in western Michigan shoreline counties are attributed to regional $O_3$ transport. The monitoring sites located at Coloma, Holland, Jenison, Muskegon, Scottville, Peshawbestown, and Benzonia receive regional $O_3$ transport across or along the Lake Michigan shoreline from other major urban areas. These monitoring sites are useful for quantifying the effectiveness of control strategies at upwind sites (**17**).

For eastern Michigan, regional $O_3$ transport is also experienced at the Port Huron monitor located downwind of the Detroit urban area. Further north and downwind of the Port Huron site is the Harbor Beach monitor which provides additional monitoring of regional $O_3$ transport into Michigan's "thumb" area. The Tecumseh monitor measures $O_3$ coming into Ann Arbor and the Detroit metropolitan area. Monitors at E. Seven Mile Road, Linwood, Allen Park, and Ypsilanti are located within Southeast Michigan and provide an indication of population exposure at the neighborhood scale. The Oak Park monitoring site also detects maximum concentrations of $O_3$ contained within urban scale air masses and for estimating population exposure.

$O_3$ is also measured at a neighborhood scale in Flint, Lansing, and Grand Rapids. For urban scale air masses, the maximum $O_3$ concentrations are measured in Otisville, Rose Lake, Evans, Warren, and New Haven as they are situated downwind of urban areas (Flint, Lansing - E. Lansing, Grand Rapids, and Detroit, respectively). The Cassopolis monitor is a downwind site for the South Bend area.

**Figure 2.4-5**, shows the locations and designations of all the 27 $O_3$ air quality monitors active in Michigan during 2004.

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[30] Michigan's $NO_X$ Rules are available at http://www.deq.state.mi.us/documents/deq-aqd-air-rules-apc-part8.pdf.
[31] In April 2005, the MDEQ took over operation of the Cassopolis monitor.

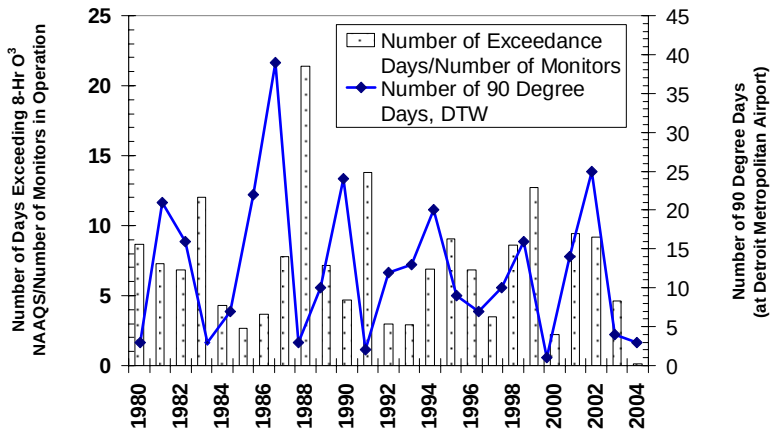
| Monitor ID and Type |
|---|
| ANN ARBOR PMSA |
| 1. 261610008 - YPSILANTI - SLAMS (proposed NAMS) |
| 2. 260910007 - TECUMSEH - SLAMS |
| BENTON HARBOR MSA |
| 3. 260210014 - COLOMA - SLAMS |
| DETROIT-WARREN-LIVONIA MSA |
| 4. 260990009 - NEW HAVEN - SLAMS |
| 5. 260991003 - WARREN - NAMS |
| 6. 261250001 - OAK PARK - SLAMS (proposed NAMS) |
| 7. 261470005 - PORT HURON - SLAMS |
| 8. 261630001 - ALLEN PARK - SLAMS |
| 9. 261630016 - LINWOOD - NAMS |
| 10. 261630019 - E. SEVEN MILE - SLAMS |
| FLINT MSA |
| 11. 260490021 – FLINT - NAMS |
| 12. 260492001 - OTISVILLE - NAMS |
| GRAND RAPIDS-MUSKEGON-HOLLAND CSA |
| 13. 260050003 - HOLLAND - SLAMS |
| 14. 260810020 - GRAND RAPIDS - NAMS |
| 15. 260810022 - EVANS - SLAMS (proposed NAMS) |
| 16. 261210039 - MUSKEGON - SLAMS |
| 17. 261390005 – JENISON - SLAMS |
| KALAMAZOO-BATTLE CREEK MSA |
| 18. 260770008 - KALAMAZOO - SLAMS |
| LANSING-E. LANSING-OWOSSO CSA |
| 19. 260370001 - ROSE LAKE. - NAMS |
| 20. 260650012 - LANSING - NAMS |
| HOUGHTON LAKE, MISSAUKEE CO |
| 21. 261130001 - HOUGHTON LAKE - SPM |
| BENZONIA, BENZIE COUNTY |
| 22. 260190003 – FRANKFORT/BENZONIA - SLAMS |
| CASSOPOLIS, CASS CO |
| 23. 260270003 – CASSOPOLIS - SLAMS |
| HARBOR BEACH, HURON CO |
| 24. 260630007 - HARBOR BEACH - SLAMS |
| PESHAWBESTOWN, LEELANAU CO |
| 25. 26-089-0001 - LEELANAU |
| SCOTTVILLE, MASON CO |
| 26. 261050007 – SCOTTVILLE - SLAMS |
| SENEY NATIONAL WILDLIFE REFUGE, SCHOOLCRAFT CO. |
| 27. 261530001 - SENEY - SLAMS |

## Figure 2.4-5: Air Quality Monitors for $O_3$ Active in 2004

## 8-Hour $O_3$ Trends by Location:

**Figure 2.4-6** compares 8-hour $O_3$ readings ≥ 0.085 ppm with the number of 90°F days (≥ 90°F) measured at the Detroit Metropolitan Airport. The total number of statewide 8-hour readings above 0.085 ppm was divided by the number of monitors that were in operation each year to provide a relative indication of the frequency of elevated 8-hour $O_3$ values.

**Figure 2.4-6: 8-Hr $O_3$ Levels Greater than 0.085 ppm, 1980-2004**

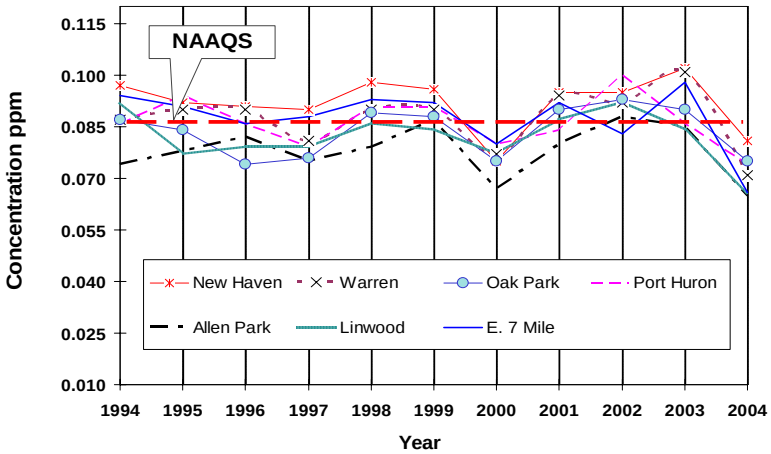



This comparison shows the influence of temperature with respect to elevated $O_3$ levels. Over the past 22 years, a typical summer would have 12 1/2 days with the maximum daily temperature exceeding 90°F. Over the time period from 1980 through 2004, the highest number of 90°F days occurred in 1988 (39 days), while the lowest number occurred in 2000 (one day). For 2004, cooler temperatures prevailed again with only three 90°F days, giving all the monitoring sites, with the exception of three, the lowest readings since 1995. In addition, when the number of 8-hour $O_3$ readings above 0.085 ppm was divided by the number of monitors that were in operation, 2004 had the lowest average (0.15) overall. Also for 2004, when all the sites had their three-year averages calculated, there were only eight (out of 27) sites in Michigan that were above the 8-hour $O_3$ NAAQS. Of these eight sites, four were located in West Michigan - Holland (0.093 ppm), Coloma (0.086 ppm), Cassopolis (0.089 ppm), and Muskegon (0.086 ppm), and four were located in Southeast Michigan - New Haven (0.092 ppm), Warren (0.088 ppm), Oak Park (0.086 ppm), and Port Huron (0.086 ppm). In 2003, there were a total of 21 monitoring sites out of 27 that were above the 8-hour $O_3$ NAAQS.

The following **Figures 2.4-7** through **2.4-10**, show the 4th highest 8-hour $O_3$ value trends for every monitoring site in Michigan over the last ten years (see **Table 2.4-1** for reference). These figures enable readers to view specific parts of Michigan to see how $O_3$ has affected their area of interest.

**Figure 2.4-7** shows the levels for the monitoring sites located in Southeast Michigan. NOTE: For readability purposes, the Flint and Ann Arbor sites are not shown in this figure (see **Figure 2.4-8**).

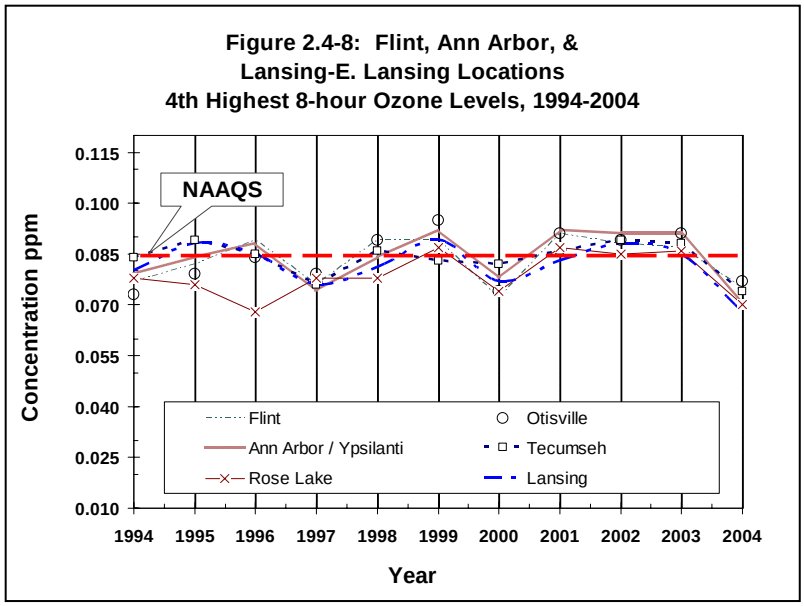
**Figure 2.4-7: Southeast Michigan Locations 4th Highest 8-hour Ozone Levels, 1994-2004**




For 2004, all the monitoring sites in Southeast Michigan's **Figure 2.4-7**, had values at or below 0.085 ppm but when averaged over the 2002-2004 three-year period, only the Linwood (0.080 ppm) and E. Seven Mile (0.082 ppm) sites were below the 8-hour $O_3$ NAAQS. NOTE: The

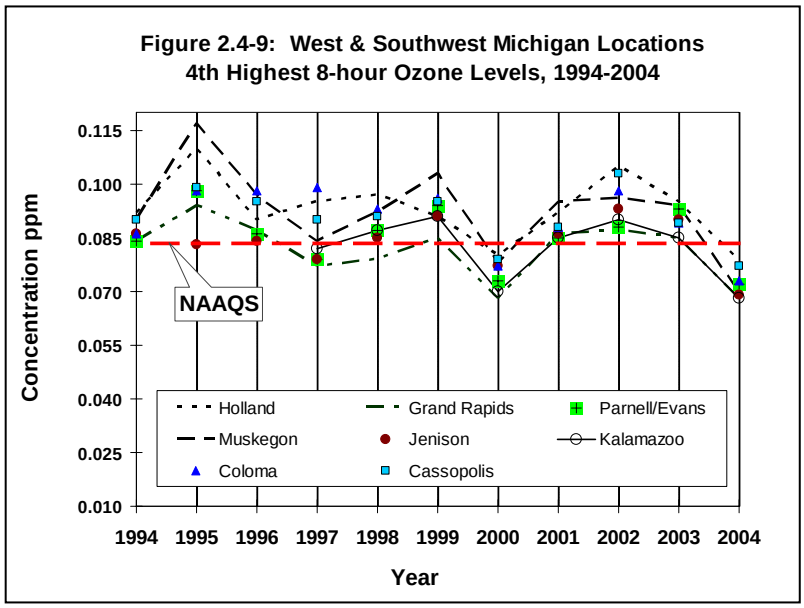
Ann Arbor and Flint sites (shown in **Figure 2.4-8**), which are part of Southeast Michigan, were also below the NAAQS at 0.084 ppm and 0.083 ppm, respectively.

**Figure 2.4-8** shows the levels for the monitoring sites in Central Michigan's Lower Peninsula: Flint, Otisville, Ann Arbor/Ypsilanti, Tecumseh, Rose Lake, and Lansing (although technically considered part of the Detroit CSA, sites in and around Ann Arbor and Flint are shown in this figure to improve legibility of the results).




As shown for 2004, all the sites in Central Michigan had readings below 0.085 ppm. Due to this data, all of these sites, when averaged over the last three years, either met or were below the 8-hour $O_3$ NAAQS. This is quite different from 2003 when all the sites except Lansing (0.085 ppm) were above the 8-hour $O_3$ NAAQS.

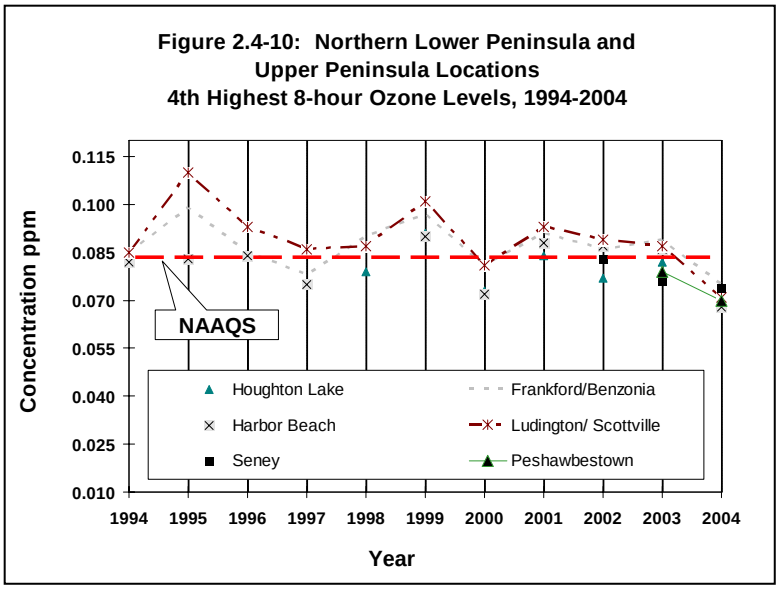
For western Michigan (west and southwest monitors), **Figure 2.4-9** combines those sites located in Holland, Muskegon, Grand Rapids, Kalamazoo, Battle Creek, and Benton Harbor urban areas. Also included is the Cassopolis monitor (a site downwind of South Bend).




For 2004, as was the case with the Central and Southeast Michigan sites, all the West Michigan sites had values below the standard. However, the sites in Holland (0.093 ppm), Coloma (0.086 ppm), Muskegon (0.086 ppm), and Cassopolis (0.089 ppm), when averaged over the 2002-2004 three-year period were the only western Michigan sites above the 8-hour $O_3$ NAAQS.

The following **Figure 2.4-10** contains the following areas located in Michigan's northern Lower and Upper Peninsula: Houghton Lake, Harbor Beach, Seney, Frankfort/Benzonia, Ludington/Scottville, and Peshawbestown.

For 2004, all the northern Lower Peninsula and Upper Peninsula monitoring sites had values below the 8-hour $O^3$ standard. In addition, when these sites were averaged over the 2002-2004 monitoring period, all six sites were below the $O_3$ NAAQS. Whereas, for the 2001-2003 monitoring period, only the Houghton Lake site (0.081 ppm) was below the NAAQS.




In summary when the monitoring data for each of Michigan's $O_3$ monitoring sites were averaged over the 2002-2004 three-year period, there were a total of 18 sites that either met or were below the 8-hour $O_3$ NAAQS.[32] Whereas for the 2001-2003 three-year period, there were only four sites in all of Michigan that either met or were below the 8-hour $O_3$ standard.

For both 2003 and 2004, Houghton Lake has maintained the lowest three-year average in all of Michigan.

[32] The readings for the Peshawbestown site were not included in this summarization as it has not been in operation long enough to be averaged.

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

## Introduction:

Particulate matter or PM is a general term used for a mixture of solid particles and liquid droplets found in the air. Some particles are large enough to be seen as dust or dirt (coarse PM) where others are so small they can only be detected with an electron microscope (fine PM) (**4, 19**).

PM can be emitted directly (primary) or form in the atmosphere (secondary). Fine and coarse PM in the atmosphere are further categorized according to size. Generally, coarse PM or $PM_{10}$ (particles less than 10 microns [μm] in diameter which is equal to about 1/7$^{th}$ the diameter of a human hair) is composed largely of primary particles. Primary particles can originate from power plants, various manufacturing processes, wood stoves and fireplaces, agriculture and forestry practices, fugitive dust sources (road dust and wind blown soil), and forest fires. Fine PM or $PM_{2.5}$ (particles less than 5 μm in diameter) can come directly from primary particle emissions or through secondary reactions (**4**). Examples of secondary particulate reactions include sulfates formed from $SO_2$ (sulfur dioxide) emissions from power plants, motor vehicles (especially diesel trucks and buses), and industrial facilities, and nitrates formed from $NO_X$ emissions from power plants, automobiles, and other types of combustion sources (**4**).

Particles with diameters of less than 50 μm are classified as total suspended particulates or TSP. Particles that are greater than 50 μm in diameter do not remain in the atmosphere for appreciable lengths of time and present a smaller health risk because they are too large to be inhaled. Most man-made particulate emissions fall into the size range classified as TSP.

## PM Effects:

Exposure to PM affects breathing, the cellular defenses of the lungs, aggravates existing respiratory and cardiovascular ailments, and has been linked with heart and lung disease. Various health problems have been associated with long-term (e.g., multi-year) exposures as well as daily and shorter term (e.g., 1-hour) exposures to PM. Particles of concern can include both fine and coarse-fraction particles with particle size being the major factor that determines which particles will enter the lungs and how deeply the particles will penetrate. $PM_{2.5}$ have been more clearly linked to the most serious health effects (**4**). People with heart or lung disease, the elderly, and children are at highest risk from exposure to particles.

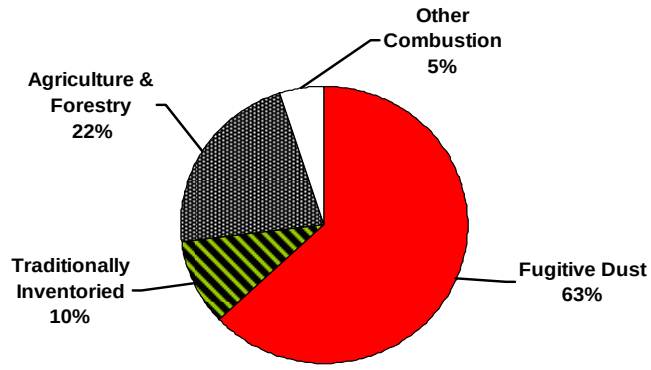
In addition to health problems, PM is the major cause of reduced visibility in many parts of the U.S. with $PM_{2.5}$ considered to be one of the primary visibility-reducing components of urban and regional haze. Airborne particles can also impact vegetation ecosystems and can cause damage to paints, building materials and/or surfaces (**4**). Deposition of acid aerosols and salts may increase corrosion of metals and impact plant tissue by corroding leaf surfaces and interfering with plant metabolism (**4**).[33]

[33] More information about PM and its effects are at: http://www.epa.gov/ttn/oarpg/naaqsfin/pmhealth.html; http://www.epa.gov/air/urbanair/pm/index.html; and http://www.epa.gov/airtrends/pm.html.

## $PM_{10}$ National Source Trends:

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. Incomplete burning of diesel fuel emits particles that are primarily carbon in nature. However, the vast majority of $PM_{10}$ emissions are from area and non-industrial sources (i.e., natural sources) such as agriculture, forestry, wildfires, managed burning, and fugitive dust from paved and unpaved roads (**4**). These $PM_{10}$ emissions can be difficult to quantify compared to the traditionally inventoried sources. The trend in emissions for these categories may fluctuate from year to year as a result (**4**). **Figure 2.5-1** is from the EPA's 2003 National Air Quality and Emissions Trends Report and shows national direct $PM_{10}$ emissions by source category for 2002.[34]

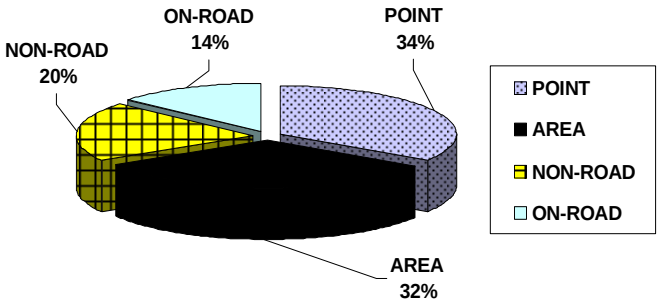
**Figure 2.5-1: EPA's 2002 National Direct $PM_{10}$ Emissions by Source Category**




## Michigan $PM_{10}$ Source Trends:

**Figure 2.5-2** shows that Michigan's emissions data has changed from 1999 to 2002. For instance, while point sources are the leading contributor of $PM_{10}$ emissions in Michigan, the 2002 data shows that point sources contributed 34% versus 43% in 1999.

**Figure 2.5-2: Percentage of $PM_{10}$ Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




There was also a percentage decrease of 11% for Michigan on-road and off-road $PM_{10}$ emissions between 1999 and 2002 (45% and 34%, respectively).

However, for Michigan's area source contributions, there is a substantial increase in percentages from the 2002 emissions inventory (32%) to the 1999 emissions inventory (12%).

**Table 2.5-1** further details the different types of point and area sources that contribute $PM_{10}$ in Michigan.

[34] For more National Air Quality Trends, visit EPA's website at: http://www.epa.gov/airtrends.

## Table 2.5-1: $PM_{10}$ Point and Area Source Types in Michigan

| Point Sources Include | Area Sources Include |
|---|---|
| fossil fuel combustion (i.e., coal burning) | fossil fuel combustion; other combustion (i.e., residential fireplaces/wood stoves); incineration; and open burning |
| chemical and allied product manufacturing | oil and gas production |
| metals processing | agriculture, food, and mineral products |
| petroleum, petroleum products, and related industries | wood, pulp and paper, and publishing products; misc. industrial processes |
| other industrial processes | agriculture and forestry |

On August 25, 2003, the EPA addressed one of Michigan' point source categories (metal processing) when they issued the Final Rule To Reduce Toxic Air Emissions From Taconite Iron Ore Processing Facilities. Michigan's two Taconite Ore Processing facilities separate and concentrate iron ore from taconite and produce taconite pellets, which are approximately 60% iron. This final rule establishes PM emission limits from process stacks of four sources: ore crushing and handling, ore drying, pellet handling, and indurating (hardening) furnaces (emissions from the indurating furnaces account for over 90% of all toxic air pollutants emitted from a taconite iron ore processing facility). The PM emission limits are a surrogate for the air toxic emissions targeted by this rule as PM emissions are easily and accurately measured. EPA developed this rule through participation with representatives from the affected industry and representatives of the states of Minnesota and Michigan.

In addition to the above rule, the EPA also issued a number of other air toxic pollution measures, known as maximum achievable control technology (MACT) standards that help reduce emissions from some of Michigan's other point and area sources for PM.[35]

## $PM_{2.5}$ National Source Trends:

According to the EPA, $PM_{2.5}$ emitted directly from man-made sources decreased 17% between 1993 and 2002. It should be noted that EPA did not account for secondary particles formed when emissions of $NO_X$, $SO_2$, ammonia, and other gases reacted in the atmosphere (**4**).

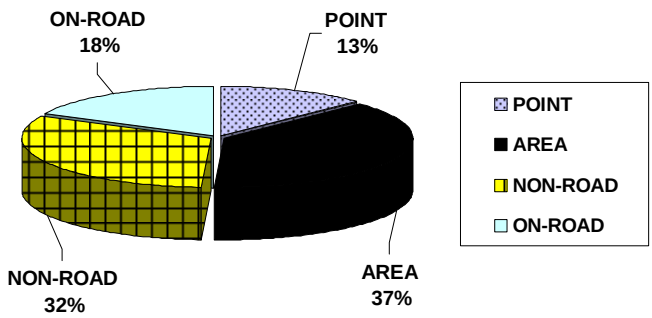
IMPROVE (Interagency Monitoring of Protected Visual Environments) data show that $PM_{2.5}$ levels in rural areas are highest in the eastern U.S. Sulfates and ammonium dominate the East with carbon as the next most prevalent component. Sulfate concentrations in the East are largely the result from $SO_2$ emissions from coal-fired power plants (**4**). It is important to note that EPA's proposed Clean Air Interstate Rule (CAIR) focuses on those states whose $SO_2$ and $NO_X$ emissions significantly contribute to the $PM_{2.5}$ and $O_3$ pollution problems in other downwind states (NOTE: the CAIR rule was finalized in 2005).[36]

[35] More information on these MACTs is available at http://www.epa.gov/ttn/atw/mactfnl.html.
[36] The final CAIR information is available at http://www.epa.gov/air/interstateairquality/.

## Michigan $PM_{2.5}$ Source Trends:

EPA's 2002 emissions inventory data (**Figure 2.5-3)** shows that area sources (37%) followed by non-road sources (32%) produce the majority of $PM_{2.5}$ emissions in Michigan. However, non-road and on-road (18%) sources combined produce 50% of Michigan's $PM_{2.5}$ emissions from vehicle engines. This has changed dramatically from EPA's 1999 emissions inventory data when non-road sources (59%) and on-road sources (39%) accounted for 98% of Michigan's overall $PM_{2.5}$ emissions.

**Figure 2.5-3: Percentage Of $PM_{2.5}$ Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**



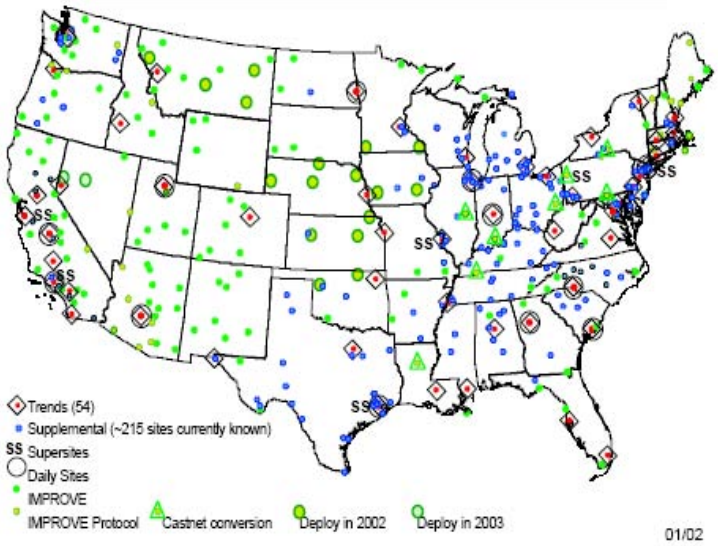

With Michigan's non-road sources producing the majority of $PM_{2.5}$ emissions, it is important to note that the EPA estimates that the Clean Air Non-road Diesel Rule, signed July 7, 2005, decreases exhaust emissions from these types of engines by more than 90%

## $PM_{2.5}$ Chemical Speciation:

To gather data on the chemical makeup of fine particles, EPA established a Speciation Trends Network (STN) (**Figure 2.5-4**) consisting of approximately 54 sites in 43 states (**20, 21, 22**). The STN is intended to complement the other components of the $PM_{2.5}$ network by providing: [37]

- Annual and seasonal spatial characterization of aerosols;
- Air quality trends analysis and tracking the progress of control programs;
- Integration of the chemical speciation data set with the data collected from the IMPROVE network; and
- Development of emission control strategies.

**Figure 2.5-4: Current/Planned $PM_{2.5}$ Speciation Networks**




In July 2001, EPA released the Quality Management Plan for the Fine Particle Speciation Trends Monitoring Program. This quality management plan is in place to assure data of adequate quality are produced by the 54 national trend network sites. These chemical speciation sites are used to determine trends in concentration levels of selected ions, metals, carbon species, and organic compounds in $PM_{2.5}$. The STN samplers will be placed at various NAMS and SLAMS across the

[37] STN data will not be used for attainment or nonattainment decisions.

Nation.[38] Approximately 20 of the monitoring sites have been placed at existing PAMS.[39] The placement of the remaining trends sites was be coordinated by EPA, the Regional Offices, and the state and local agencies with locations primarily in or near larger MSAs (**22**). Future activities include annual and seasonal characterization of aerosols, air quality trends analysis in relation to the development of control programs, evaluation of the monitoring data in the development of emission control strategies, and to investigate spatial distributions (**21**). EPA does not rule out the possibility that objectives, requirements, and methods for speciation sampling may need to be adjusted in the future.[40]

## NAAQS for Particulate Matter:

In 1971, the NAAQS was established for 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 $\mu g/m^3$. Michigan still uses TSP monitoring to determine the concentration of airborne metal particulates.

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

| | |
|---|---|
| **Primary $PM_{10}$ NAAQS**: | Annual arithmetic mean not to exceed 50 $\mu g/m^3$ |
| | 24-hour concentration limit of 150 $\mu g/m^3$. Average number of expected exceedances per year not to exceed one over the most recent three-year period. |
| **Secondary $PM_{10}$ NAAQS**: | Same as primary standard. |

On July 18, 1997, the $PM_{10}$ standard was revised and a new standard was added for $PM_{2.5}$ (**23**).[41] The final form of the $PM_{2.5}$ standard consists of an annual as well as a 24-hour average. Compliance with both the 24-hour and annual standards is based on data averaged over a three-year period.

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

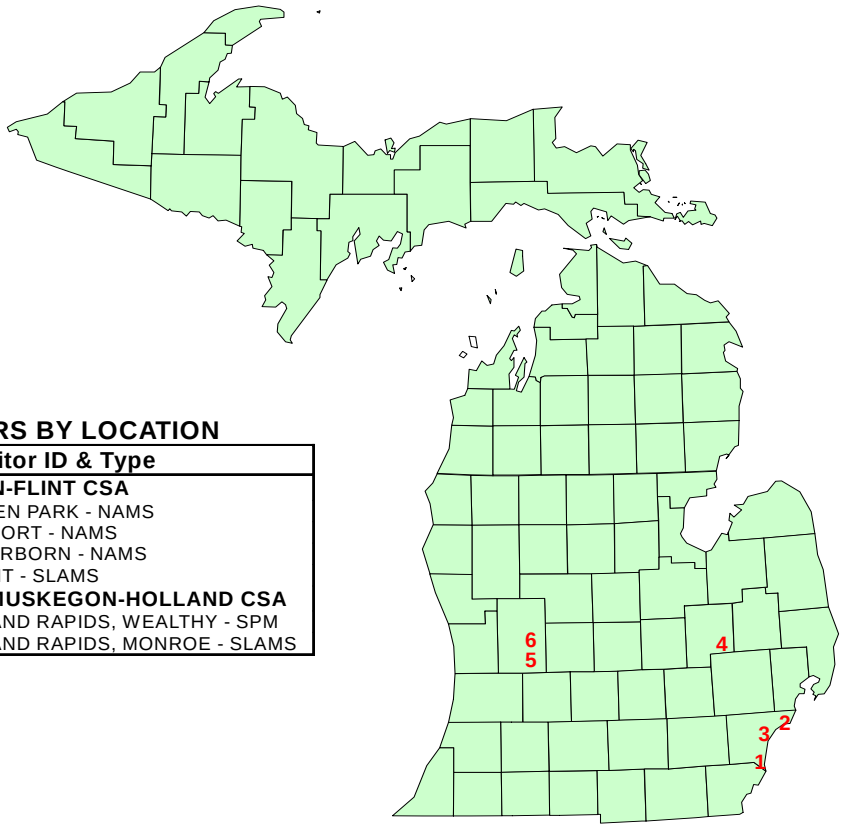
## Monitoring for $PM_{10}$ in Michigan:

Due to the recent focus upon $PM_{2.5}$ and because of the relatively low level of $PM_{10}$ measured over recent years, Michigan's $PM_{10}$ network is maintained at a minimum level. The map in **Figure 2.5-5** identifies the locations of the six $PM_{10}$ monitoring stations that were operating in Michigan during 2004. These monitors are located in Michigan's largest populated urban areas with three in the Detroit area, one in Flint, and two in Grand Rapids. To better characterize the nature of PM in

[38] NAMS and SLAMS requirements are discussed in **Chapter 1**.
[39] PAMS collect and report detailed data for VOCs, $NO_X$, $O_3$ and meteorological parameters. Information on PAMS is available at http://www.epa.gov/oar/oaqps/pams/.
[40] More $PM_{2.5}$ speciation information is available at http://www.epa.gov/ttn/amtic/pmspec.html.
[41] Information on the revised particulate standards are available at: http://www.epa.gov/airlinks/airlinks4.html.

Michigan, many of the existing $PM_{10}$ monitors are co-located with $PM_{2.5}$ monitors in population-oriented areas.

**Figure 2.5-5: Air Quality Monitors for $PM_{10}$ Active in 2004**




**MONITORS BY LOCATION**

| Monitor ID & Type |
|---|
| **DETROIT-WARREN-FLINT CSA** |
| 1. 261630001 - ALLEN PARK - NAMS |
| 2. 261630015 - W. FORT - NAMS |
| 3. 261630033 - DEARBORN - NAMS |
| 4. 260490021 - FLINT - SLAMS |
| **GRAND RAPIDS–MUSKEGON-HOLLAND CSA** |
| 5. 260810007 - GRAND RAPIDS, WEALTHY - SPM |
| 6. 260810020 - GRAND RAPIDS, MONROE - SLAMS |

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

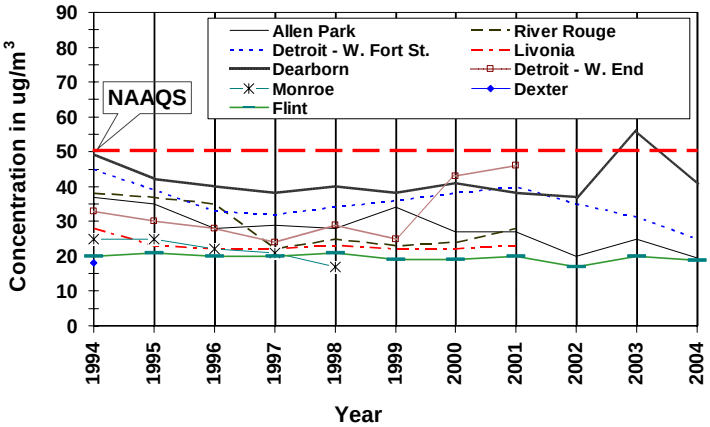
All areas of Michigan are in attainment with the $PM_{10}$ NAAQS since October 4, 1996.

## $PM_{10}$ Trends by Location:

**Figures 2.5-6** through **2.5-8** are broken down by locations and identify the trends in the 24-hour $PM_{10}$ values in Michigan over the past decade.

**Figure 2.5-6** shows the annual arithmetic means for Southeast Michigan (which includes the Detroit-Warren-Livonia MSA, the Ann Arbor MSA, the Flint MSA, and the Monroe MSA). For 2004, all monitoring sites in Southeast Michigan had readings below the $PM_{10}$ standard with the Dearborn site having the highest

**Figure 2.5-6: Southeast Michigan Locations Annual Arithmetic Means for $PM_{10}$**



maximum annual mean at 40.7 µg/m$^3$. Historically, the Dearborn site has had the highest annual $PM_{10}$ levels for the Detroit area, with the levels continuing to decline since 1994 (49 µg/m$^3$). However, in 2003 the construction of a new school began near the monitoring site which produced a maximum annual mean of 56 µg/m$^3$. Even though this was above the NAAQS, this did not meet the summary criteria due to the conditions surrounding the site. In 2004, the Dearborn monitoring site was moved approximately 120 feet to accommodate the school construction. An "exceptional event" occurred in June 2004 due to a storage pile being placed near the monitoring site (see Exceedances discussed below).

For West Michigan, **Figure 2.5-7** shows the annual arithmetic means for the Grand Rapids-Muskegon-Holland CSA. In 2004, there were only two sites monitoring for $PM_{10}$. Both of these sites were in the Grand Rapids-Wyoming MSA and showed annual mean $PM_{10}$ levels well below the $PM_{10}$ NAAQS. The highest annual means for an individual $PM_{10}$ monitoring station in western Michigan was in 1994 at the Grand Rapids-Wealthy Street site (31 µg/m$^3$). For the decade, all the monitoring sites in western Michigan have maintained a level well below the $PM_{10}$ NAAQS.

**Figure 2.5-7: Grand Rapids-Muskegon-Holland CSA Michigan Annual Arithmetic Means for $PM_{10}$**

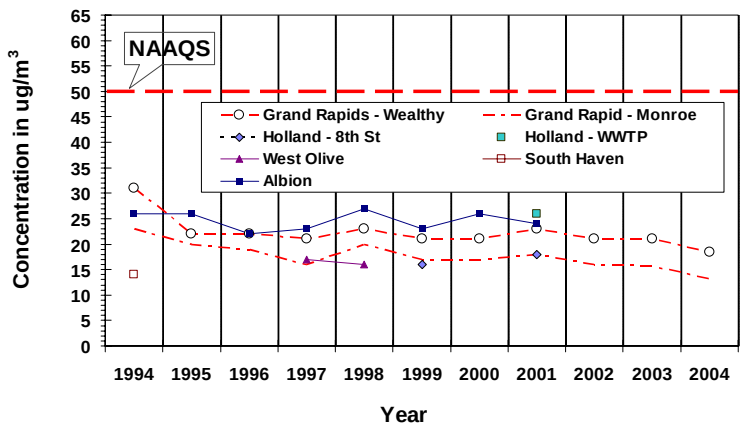
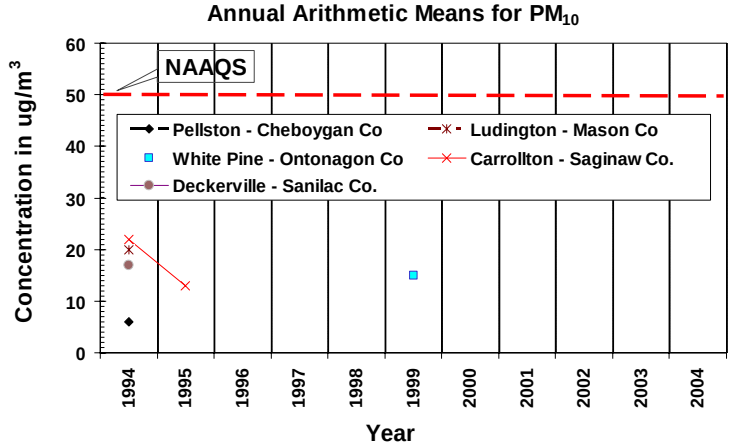



**Figure 2.5-8** contains the annual arithmetic means for $PM_{10}$ in the Saginaw-Bay City-Saginaw Twp. North CSA, and includes three northern Michigan Counties. Monitoring in all these areas concluded in 1999 as the annual mean $PM_{10}$ levels were well below the $PM_{10}$ NAAQS.

**Figure 2.5-8: Saginaw-Bay City-Saginaw Twp. North CSA, Sanilac County, and Northern Michigan Annual Arithmetic Means for $PM_{10}$**




## Exceedances of the $PM_{10}$ Standard

From 1994 to 2005, there were a total of five exceedances of the 24-hour $PM_{10}$ standard. Each occurred at the Dearborn monitoring station. However, three of these events were considered "exceptional events" under federal criteria as they are not representative of ambient air quality. Exceptional events are not included for attainment/nonattainment purposes. The following describes these exceptional events and **Table 2.5-2** lists all the 24-hour $PM_{10}$ exceedances observed over the past decade.

- In 1995, there were two exceedances of the 24-hour $PM_{10}$ standard at the Dearborn site on March 14 and 15 when levels reached 183 µg/m$^3$ and 159 µg/m$^3$, respectively. The rupture of a nearby industrial bag house released excessive particulate emissions over a two-day period.

- On June 8, 2004, there was one exceedance of the 24-hour $PM_{10}$ standard at 242 $\mu g/m^3$ due to construction at the nearby soccer field and running track. During this construction, a large storage pile was placed within 100 feet of the Dearborn monitoring station. These particulate emissions were uncontrolled. Wind gusts reached greater than 28 mph and no precipitation was observed during the period of June 3 through the 8th. On June 9, 2004, a thunderstorm came through the area providing moisture to the pile and created a hard crust, thereby mitigating further particulate emissions.

### Table 2.5-2: Values Exceeding the 24-Hour Standard (150 $\mu g/m^3$) for $PM_{10}$ in Michigan from 1994 to 2004

| Year | Total Number of Exceedances Per Year | Site (s) | Date | 24-Hour Value $\mu g/m^3$ |
|---|---|---|---|---|
| 1994 | 0 | None | | |
| 1995 | 2 | 26-163-0033 | 3/14/95 | 183* |
| | | 26-163-0033 | 3/15/95 | 159* |
| 1996 | 1 | 26-163-0033 | 9/5/96 | 158 |
| 1997 | 0 | None | | |
| 1998 | 0 | None | | |
| 1999 | 1 | 26-163-0033 | 10/25/99 | 156 |
| 2000 | 0 | None | | |
| 2001 | 0 | None | | |
| 2002 | 0 | None | | |
| 2003 | 0 | None | | |
| 2004 | 1 | 26-163-0033 | 6/8/05 | 242** |

* Occurred during industrial baghouse rupture.
** Occurred during construction due to a large storage pile being placed within 100 feet of monitoring station.

## Comprehensive Monitoring for $PM_{2.5}$ in Michigan:

The statewide particulate network consists of many components which together provide a picture of the nature of particulate material within the state. The concentrations of $PM_{2.5}$ measured over a 24-hour time period are determined using the federal reference method (FRM). Short-term measurements of $PM_{2.5}$ or $PM_{10}$ are updated on an hourly basis by sites in the continuous network using R&P Tapered Element Oscillating Microbalance (TEOM) instruments. Chemical composition of fine particles is determined by the speciation network and by limited chemical analysis of the filters generated by the FRM network. Only data generated by FRM monitors should be compared to the NAAQS.

The locations for the Michigan sites were selected using the EPA siting criteria for community-oriented (core monitoring sites located beyond the zone of influence of single sources to provide neighborhood to urban scale representation), regional transport, and regional background sites (**24, 25**). These sites may be located in urban, commercial, and residential areas where people are exposed to $PM_{2.5}$. $PM_{2.5}$ monitors are also located to characterize background or regional fine particulate transport collectively from upwind sources. Siting criteria along with population distribution, emissions from stationary sources, the locations of existing $O_3$ and $PM_{10}$ sites, and Michigan geography determine the final design of the Michigan network.

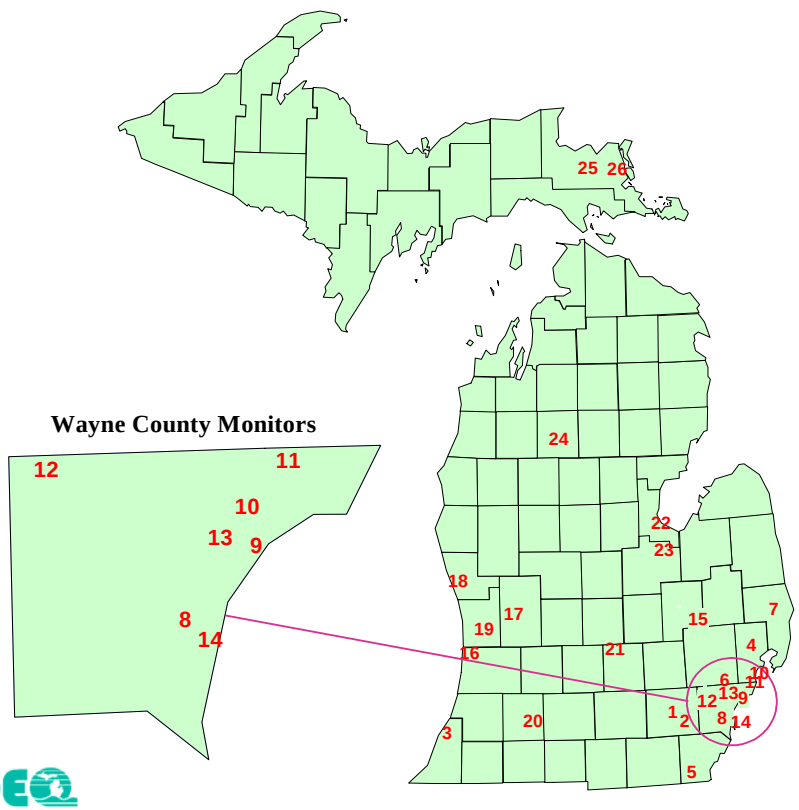
The EPA requires one core $PM_{2.5}$ monitor for MSAs with populations greater than 200,000 and less than 500,000 (**24**) and two core $PM_{2.5}$ monitors for each MSA with populations greater than

500,000 (Detroit-Warren-Flint CSA and Grand Rapids-Muskegon-Holland CSA). There are a total of 13 core $PM_{2.5}$ monitors in Michigan with the Detroit CSA having the largest number of monitors (8), followed by the Grand Rapids-Muskegon-Holland CSA (2). Individual core monitors are also located at the Kalamazoo, Lansing, and Saginaw monitoring sites.

Michigan currently has 26 FRM $PM_{2.5}$ monitoring sites and some are co-located with $PM_{10}$ monitors to allow for fine and coarse particulate comparisons (**24, 26, 27**). Co-located $PM_{10}$ and $PM_{2.5}$ sites include Allen Park, Grand Rapids - Monroe Street, Flint, Dearborn, and Detroit – W. Fort Street. In light of EPA's recent reduction in the $PM_{2.5}$ co-located requirements, the precision monitors at Lansing and Port Huron were shut down in 2004.

**Figure 2.5-9** shows the $PM_{2.5}$ monitoring network in Michigan where 24 sites belong to the MDEQ and the two in Sault Ste. Marie are tribal sites managed by Inter-Tribal Council of Michigan, Inc. with the AQD providing technical support.

**Figure 2.5-9: $PM_{2.5}$ Air Quality Monitors Active in 2004**




**MONITORS BY LOCATION**

| Monitor ID & Type |
|---|
| **ANN ARBOR MSA** |
| 1. 261610005 - ANN ARBOR - SLAMS * |
| 2. 261610008 - YPSILANTI - SLAMS [a] |
| **BENTON HARBOR MSA** |
| 3. 260210014 - COLOMA - SLAMS |
| **DETROIT-WARREN-LIVONIA MSA** |
| 4. 260990009 - NEW HAVEN - SLAMS |
| 5. 261150005 - LUNA PIER - SLAMS |
| 6. 261250001 - OAK PARK - SLAMS* |
| 7. 261470005 - PORT HURON - SLAMS |
| 8. 261630001 - ALLEN PARK - SLAMS* |
| 9. 261630015 - W. FORT - SLAMS |
| 10. 261630016 - LINWOOD - SLAMS* |
| 11. 261630019 - E. SEVEN MILE - SLAMS |
| 12. 261630025 - LIVONIA - SLAMS* |
| 13. 261630033 - DEARBORN - SLAMS |
| 14. 261630036 - WYANDOTTE - SLAMS* |
| **FLINT MSA** |
| 15. 260490021 - FLINT - SLAMS * |
| **GRAND RAPIDS-MUSKEGON-HOLLAND CSA** |
| 16. 260050003 - HOLLAND - SLAMS |
| 17. 260810020 - GRAND RAPIDS - SLAMS* |
| 18. 261210040 - MUSKEGON - SLAMS |
| 19. 261390005 - JENISON - SLAMS |
| **KALAMAZOO-BATTLE CREEK MSA** |
| 20. 260770008 - KALAMAZOO - SLAMS |
| **LANSING–E. LANSING MSA** |
| 21. 260650012 - LANSING - SLAMS * |
| **SAGINAW-BAY CITY-SAGINAW TWP. N CSA** |
| 22. 260170014 - BAY CITY - SLAMS [b] |
| 23. 261450018 - SAGINAW - SLAMS * |
| **HOUGHTON LAKE, MISSAUKEE CO** |
| 24. 261130001 – HOUGHTON LAKE – SLAMS |
| **SAULT STE MARIE, CHIPPEWA CO** |
| 25. 260330901 - TRIBAL, EASTERDAY-SLAMS |
| 26. 260330902 - TRIBAL, MARQUETTE AVE |

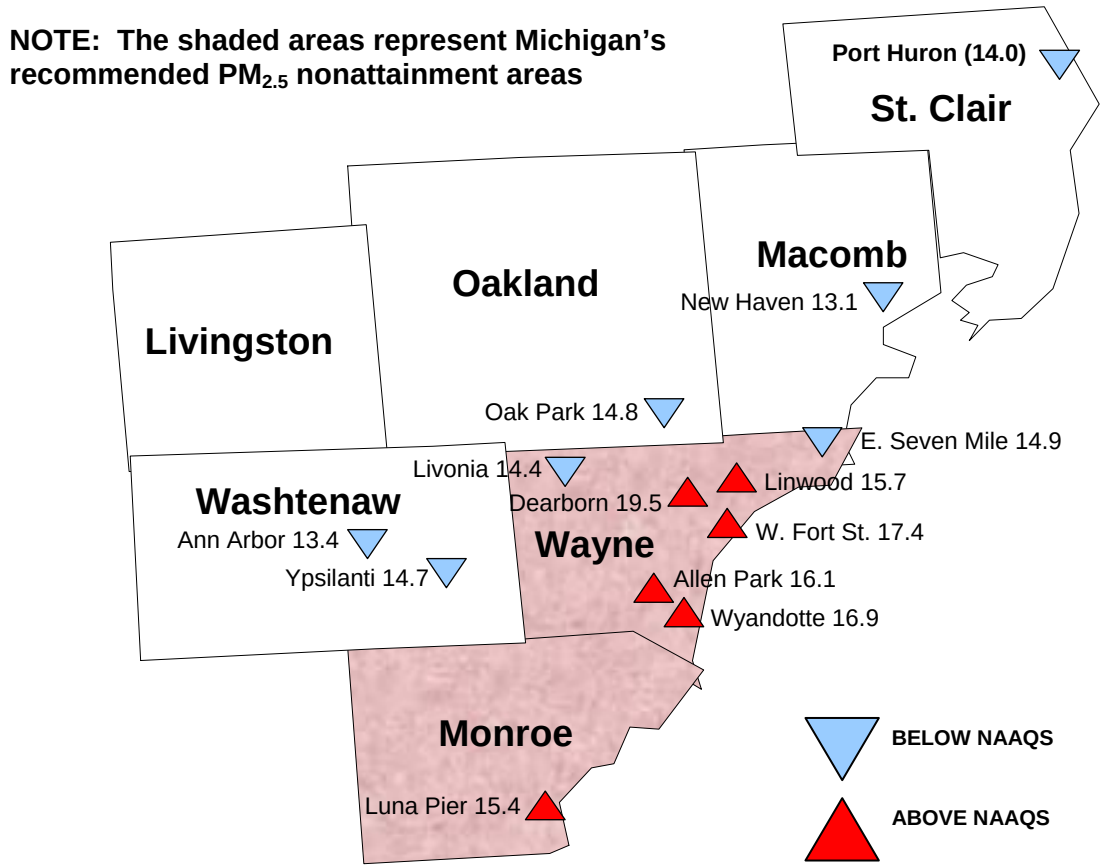
* Pending approval for NAMS designation

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

On July 18, 1997, the EPA promulgated new NAAQS for fine particles ($PM_{2.5}$). Under the federal CAA, EPA is required to seek states' recommendations for initial designations of the attainment/ nonattainment status when a new or revised standard is established. The annual $PM_{2.5}$ standard is met at a monitoring site if data averaged over a three-year period has an annual mean of 15.0 $\mu g/m^3$ or below.

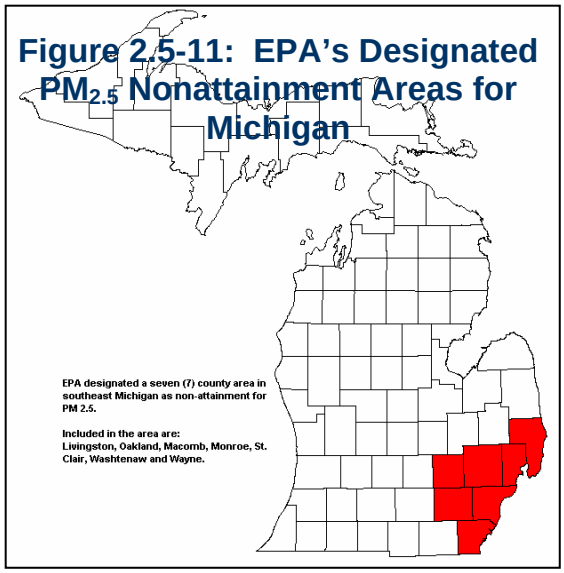
On February 13, 2004, the MDEQ provided EPA with designation recommendations utilizing Michigan's 2001-2003 $PM_{2.5}$ monitoring data. As shown in the following **Figure 2.5-10**, only monitors in the counties of Wayne and Monroe should be designated as nonattainment areas for $PM_{2.5}$, because only monitors in those counties exceeded the standard. NOTE: Two Wayne County monitors are meeting the NAAQS.

**Figure 2.5-10: $PM_{2.5}$ NAAQS for Southeast Michigan**
**(Based on 2001-2003 monitoring data)**




On June 29, 2004, the EPA replied stating their intent to list the seven Michigan counties of Wayne, Oakland, Monroe, Washtenaw, Livingston, Macomb, and St. Clair as nonattainment areas (**Figure 2.5-11**). EPA based this decision on their belief that sources in the surrounding counties are contributing to the violations at the Wayne and Monroe County monitors.

**Figure 2.5-11: EPA's Designated $PM_{2.5}$ Nonattainment Areas for Michigan**



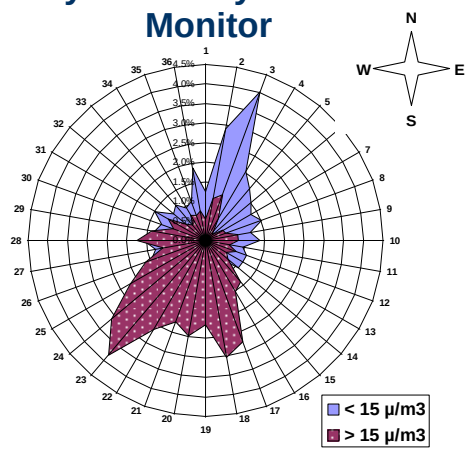

On September 1, 2004, the MDEQ, standing behind their original recommendations, provided EPA with additional technical information and reasoning as to why nonattainment designations should only be made for Wayne and Monroe counties. Additionally, the MDEQ argued that Wayne and Monroe counties should be separate nonattainment areas due to

different emission source influences in the two areas. In support of this, preliminary trends in $PM_{2.5}$ data are highlighted within the MDEQ submittal.[42] The following are a few of the basic facts that were presented.

First, (as shown in the above **Figure 2.5-10**) only monitors in Wayne and Monroe counties have a three-year annual mean above the NAAQS (▲). For Wayne County, $PM_{2.5}$ concentrations are highest in the urban core of Detroit and decrease in areas outward. In fact, Wayne County monitors outside the urban core, such as Livonia and E. Seven Mile, along with all the surrounding counties (with the exception of Luna Pier in Monroe), are attaining the $PM_{2.5}$ NAAQS (▽). Therefore, the MDEQ contends that the most effective local controls would be in those counties with the violating monitors (i.e. Wayne and Monroe County), thereby addressing local impacts from sources suspected of contributing to the area's nonattainment.

Second, the MDEQ provided several pollution roses that show when $PM_{2.5}$ emissions measured higher than the NAAQS (15 µg/m$^3$), winds were predominately from the south to southwest, not from the attaining counties to the north. The pollution rose in **Figure 2.5-12** was generated from data collected at Wayne County's Allen Park monitor and displays $PM_{2.5}$ emissions in relationship to wind direction for the third quarter of 2002. As shown, $PM_{2.5}$ concentrations above NAAQS occur with winds from the south to southwest. With winds coming from west-northwest to the east, $PM_{2.5}$ concentrations were below 15 µg/m$^3$. It is also important to note that each species of particulate shows the same southwest to northeast gradient.

**Figure 2.5-12: Pollution Rose for Wayne County's Allen Park Monitor**




The MDEQ contends that with monitors outside Wayne and Monroe counties measuring attainment, contributions from those outer counties is minimal, making a widespread nonattainment designation inappropriate from a regulatory perspective and misleading from a public health perspective.

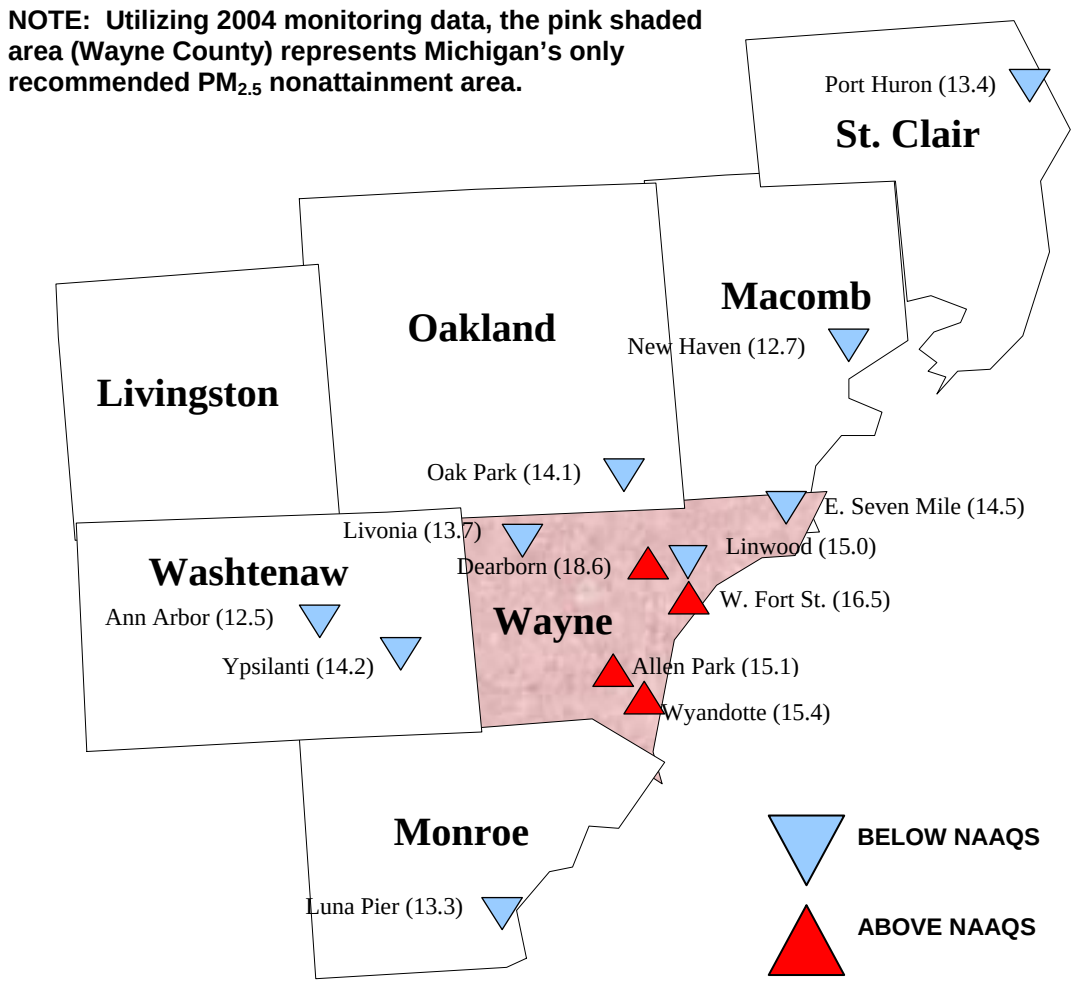
On December 17, 2004, the EPA stood behind their original recommendations and designated the following seven Southeast Michigan counties (Detroit-Warren-Flint CSA) as nonattainment for $PM_{2.5}$: Monroe, Wayne, St. Clair, Oakland, Macomb, Livingston, and Washtenaw. The EPA continues to believe that sources in these counties contribute to violations at monitors in Wayne and Monroe Counties.

It is important to note that in the EPA's January 5, 2005 Federal Register, the final $PM_{2.5}$ designations become effective on April 5, 2005 (90 days following the date of the Federal Register publication).[43] As stated in the notice, States were allowed the opportunity to submit 2004 $PM_{2.5}$ quality-assured monitoring data, calculate the 2002-2004 three-year annual average, and request changes in attainment status if this data and supporting rationale show an area should instead be designated attainment.

[42] All the MDEQ's $PM_{2.5}$ designation recommendations are available at http://www.michigan.gov/deqair.
[43] Information on all of EPA's $PM_{2.5}$ designations is available at: http://www.epa.gov/pmdesignations/.

The MDEQ worked diligently to have the 2004 monitoring data completed, quality assured, and certified within the time frame indicated. As shown in **Figure 2.5-13**, the 2002-2004 monitoring data demonstrates that only those monitors in Wayne County are violating the NAAQS (▲). The counties of Livingston, Oakland, Macomb, St. Clair, Washtenaw, and now Monroe are meeting the $PM_{2.5}$ NAAQS (▼).

**Figure 2.5-13: Revised $PM_{2.5}$ NAAQS for Southeast Michigan**
**(Based on 2002-2004 monitoring data)**




Therefore, on February 22, 2005, the MDEQ submitted the 2002-2004 three-year annual average $PM_{2.5}$ monitoring data to EPA and requested that those six counties meeting NAAQS (Livingston, Macomb, Monroe, Oakland, St. Clair, and Washtenaw) be designated attainment. In addition, to address EPA's stance that the presumptive boundaries for nonattainment areas should be the entire CSA, the MDEQ strongly encouraged the EPA to instead use the county $PM_{2.5}$ monitoring data to designate a county attainment or nonattainment. Using this approach and relying on the recent 2002-2004 data, only one county, Wayne, is in nonattainment. The MDEQ submittal also included information supporting the conclusion that air pollution emissions in the surrounding six counties do not cause the nonattainment levels in Wayne County.

Further bolstering MDEQ's request is the continuing downward trend in $PM_{2.5}$ annual average levels. The monitoring data clearly shows that $PM_{2.5}$ exceedances exist only in the highly industrialized area of Wayne County. This is the same industrial corridor that the MDEQ has been regulating for particulate pollutants for many years so it is not surprising that the $PM_{2.5}$ levels are highest here. It is also not surprising that adjacent counties to the north and west are meeting the NAAQS, since these are not highly industrialized areas. In addition, the wind patterns in Southeast Michigan are indicative of the directional impacts of upwind emissions on the nonattaining monitors in Wayne County.

However, in their April 14, 2005 Federal Register, EPA denied Michigan's request, stating that every county in the Detroit-Warren-Flint CSA had to show monitored levels attaining the $PM_{2.5}$ NAAQS. EPA also concluded each of the counties surrounding Wayne County do contribute to the overall air quality problem within Wayne County.

States with counties designated as nonattainment for $PM_{2.5}$ are required to develop control strategies to bring the areas into attainment by 2010. The state attainment plans and regulations must be submitted to EPA by January 2008. The MDEQ is working with a coalition of stakeholders and others, including the Southeast Michigan Ozone and $PM_{2.5}$ Task Force, and the Lake Michigan Air Director's Consortium, to effectively address $PM_{2.5}$, as well as 8-hour $O_3$ and regional haze. Studies are underway to determine source contributions of the particles and will be essential in developing a strategy for attainment.

It is also important to acknowledge that there are several federal measures that will reduce vehicle emissions nationwide without needing a nonattainment designation as a trigger. Beginning in 2004, requirements that reduce on-road source emissions are being phased-in. This measure, part of several requirements of the Tier 2 Vehicle and Gasoline Sulfur Program, reduces the level of sulfur in gasoline and sets the standards for tailpipe emissions for all on-road passenger vehicles, including SUVs, regardless of whether they run on gasoline, diesel fuel, or alternative fuels.[44]

There are also several federal measures that will help reduce point source emissions of $NO_X$, a source secondary of $PM_{2.5}$. The first is the recently implemented $NO_X$ SIP Call that requires $NO_X$ reductions from power plants in 19 eastern states including Michigan. Other federal measures are included in the EPA's Clean Air Rules of 2004, such as CAIR, finalized in 2005, that requires $NO_X$ reductions from power plants across the region that will also result in lower $PM_{2.5}$ levels. Even though the proposed timing and level of CAIR controls are out of sync with Michigan's attainment deadlines, these federal measures lessen the need for EPA to promulgate widespread nonattainment designations to secure emission reductions.

Because monitoring for $PM_{2.5}$ began in 1999, long-term trend information is unavailable. **Table 2.5-3** provides the 1999-2004 annual mean $PM_{2.5}$ concentrations by individual monitoring stations. Stations labeled #2 are intended to provide an estimate of the precision of the overall measurement and operate on a one in six sampling schedule. All other samplers except for Holland, Grand Rapids #1, Allen Park #1, and Linwood, sample on a one in three day schedule. The differences in the average concentrations and maximum levels are the result from these differences in sampling frequency.

[44] The Tier 2 Vehicle and Gasoline Sulfur Program is available at http://www.epa.gov/tier2/.

## Table 2.5-3: Annual Mean $PM_{2.5}$ Concentrations by Individual Monitoring Station, 1999-2004 (Annual Mean, Rounded)[45]

| AIRS ID | Partial Year 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2002-2004 Mean |
|---|---|---|---|---|---|---|---|
| 260050003 - Holland | 12.1 | 11.7 | 12.8 | 12.4 | 12.38 | 11.21 | 11.9 |
| 260070005 - Alpena | | 7.6 | 9.8 | 9.1 | | | *** |
| 260170014 - Bay City | | 10.1 | 11.5 | 11.3 | 10.89 | 9.85 | 10.6 |
| 260210014 - Coloma | 12.3 | 12.1 | 13.2 | 12.5 | 12.46 | 10.23 | 11.7 |
| 260330901 - Sault Ste. Marie Tribal #1 | | | 8.2 | 7.6 | 8.64 | 7.16 | 7.8 |
| 260330901 - Sault Ste. Marie Tribal #2 | | | 7.9 | 8.2 | 9.45* | 6.28 | 7.9 |
| 260330902 - Sault Ste. Marie Tribal | | | 7.9 | 7.8 | 8.09 | 6.74 | 7.5 |
| 260490021 - Flint | 12.0 | 13.0 | 13.1 | 12.5 | 12.01 | 10.49 | 11.6 |
| 260550003 - Traverse City | | 8.6 | 9.3 | 8.0 | | | *** |
| 260650012 - Lansing #1 | 12.6 | 13.1 | 14.0 | 13.50 | 13.01 | 11.06 | 12.5 |
| 260650012 - Lansing #2 | 12.9 | 13.6 | 13.3 | 12.4 | 14.08* | 6.20* | 10.8 |
| 260770008 - Kalamazoo #1 | 14.9 | 15.1 | 15.6 | 14.8 | 13.92 | 11.33 | 13.3 |
| 260770008 - Kalamazoo #2 | 14.7 | 14.7 | 14.6 | 15.0 | 14.27* | 11.09 | 13.4 |
| 260810020 - Grand Rapids #1 | 13.8 | 13.8 | 14.4 | 13.3 | 13.51 | 12.00 | 12.9 |
| 260810020 - Grand Rapids #2 | 13.9 | 13.8 | 14.2 | 13.2 | 14.00 | 11.26 | 12.8 |
| 260990009 - New Haven | 12.7 | 13.4 | 13.6 | 13.4 | 12.8 | 11.96 | 12.7 |
| 261130001 - Houghton Lake | | | | | 7.89* | 7.29 | ** |
| 261150005 - Luna Pier | | 15.2 | 15.3 | 16.3 | 13.73 | 12.98 | 14.3 |
| 261210040 - Muskegon #1 | 12.2 | 11.9 | 12.6 | 12.4 | 11.87 | 10.16 | 11.4 |
| 261210040 - Muskegon #2 | 14.5 | 11.0 | | | | | *** |
| 261250001 - Oak Park | 14.2 | 15.4 | 14.7 | 15.0 | 14.58 | 12.76 | 14.1 |
| 261250010 - Southfield | | | 17.1 | 17.6 | | | ******* |
| 261390005 - Jenison | 12.9 | 13.2 | 13.8 | 13.6 | 12.69 | 11.33 | 12.5 |
| 261450018 - Saginaw #1 | 9.8 | 10.5 | 11.5 | 10.8 | 10.62 | 9.51 | 10.3 |
| 261450018 - Saginaw #2 | 10.4 | 9.8 | 10.3 | | | | *** |
| 261470005 - Port Huron #1 | 13.2 | 14.4 | 14.0 | 13.8 | 14.16 | 12.10 | 13.3 |
| 261470005 - Port Huron #2 | | | 13.2 | 13.0 | 15.67* | | *** |
| 261530001 - Seney National Wildlife | | | 7.5 | 6.0 | 3.73* | | *** |
| 261610005 - Ann Arbor | 12.8 | 13.2 | 13.5 | 13.6 | 13.06* | 10.67 | 12.4 |
| 261610008 - Ypsilanti #1 | 14.2 | 14.3 | 14.5 | 14.9 | 14.64 | 12.87 | 14.1 |
| 261610008 - Ypsilanti #2 | | | 13.8 | 13.0 | 15.12 | 11.09 | 13.0 |
| 261630001 - Allen Park #1 | 16.7 | 15.6 | 17.3 | 15.9 | 15.2 | 14.24 | **15.1** |
| 261630001 - Allen Park #2 | 19.6 | 16.0 | 16.2 | 13.9 | 17.51* | 12.32 | 14.5 |
| 261630015 - Detroit - W. Fort St. | 17.7 | 18.1 | 18.3 | 17.4 | 16.63 | **15.39** | **16.4** |
| 261630016 - Detroit - Linwood | 17.1 | 15.5 | 15.8 | 15.6 | 15.82 | 13.69 | **15.0** |
| 261630019 - Detroit - E Seven Mile Rd | | 14.5 | 14.5 | 15.6 | 14.63 | 13.23 | 14.4 |
| 261630025 - Livonia | 13.1 | 14.6 | 14.6 | 14.4 | 14.14 | 12.57 | 13.7 |
| 261630033 - Dearborn | 17.0 | 20.1 | 19.6 | 19.8 | 19.11 | **16.83** | **18.5** |
| 261630036 - Wyandotte | 16.3 | 17.6 | 18.2 | 16.3 | 16.26 | 13.66 | **15.4** |

*The mean does not satisfy summary criteria.
**The $PM_{2.5}$ NAAQS (three-year average) cannot be calculated as their is not three years worth of monitoring data.
***Monitoring ended prior to 2004; no 2002-2004 mean is available.

**NOTE**: The annual mean was based on data contained in the EPA AQS (see Federal Reference [FR] 62(138) 62(138), page 99, Part 50, Appendix N and EPA's Guidelines on Data Handling Conventions for the PM NAAQS [EPA-454/R-99-008]).

[45] The annual $PM_{2.5}$ standard is met when the three-year average is less than or equal to 15.0 $\mu g/m^3$. For the purpose of comparing calculated values to the standard, the average annual means is rounded to the nearest 0.1 $\mu g/m^3$.

Of those $PM_{2.5}$ monitoring sites operating in 2004, the Dearborn monitoring site had the highest 24-hour 98th percentile level (39.4 μg/m$^3$) and the highest three-year 24-hour average value (42.6 μg/m$^3$) followed by Detroit's Linwood site (38.3 μg/m$^3$, 42.4 μg/m$^3$, respectively). **Table 2.5-4** provides a detailed assessment of the 24-hour 98$^{TH}$ percentile $PM_{2.5}$ concentrations for 1999-2004 indicating that Michigan's levels are consistently below the 65 μg/m$^3$ standard (three-year average). For yearly annual mean $PM_{2.5}$ trends by location, see **Figures 2.5-14** through **2.5-17**.

## Table 2.5-4: 24-Hour 98th Percentile $PM_{2.5}$ Concentrations by Individual Monitoring Station, 1999-2004 (98th Percentile, Rounded)[46]

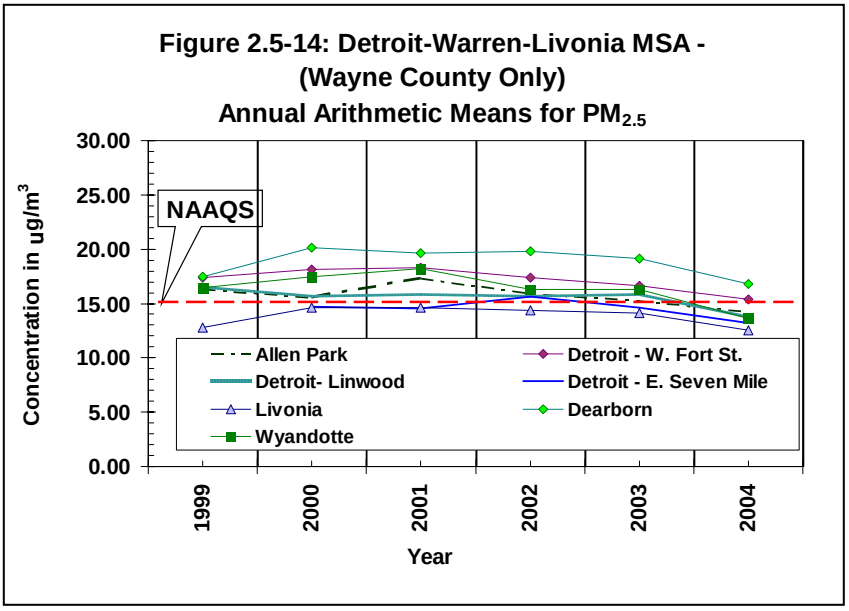
| AIRS ID | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2002-2004 Mean |
|---|---|---|---|---|---|---|---|
| 260050003 - Holland | 36.5 | 35.7 | 42.1 | 36.7 | 35.6 | 30.3 | 34.2 |
| 260070005 - Alpena | | 25.4 | 35.1 | 27.3 | | | ** |
| 260170014 - Bay City | | 27.7 | 34.2 | 32.0 | 26.7 | 28.0 | 28.9 |
| 260210014 - Coloma | 35.4 | 29.7 | 32.3 | 30.6 | 34.1 | 29.0 | 31.2 |
| 260330901 - Sault Ste. Marie #1 | | | 27.9 | 22.1 | 26.3 | 22.3 | 23.5 |
| 260330901 - Sault Ste. Marie #2 | | | 25.4 | 21.4 | 38.3 | 15.4 | 33.5 |
| 260330902 - Sault Ste. Marie | | | 28.0 | 27.0 | 25.4 | 23.2 | 25.2 |
| 260490021 - Flint | 32.8 | 32.2 | 38.0 | 30.8 | 32.2 | 27.9 | 30.3 |
| 260550003 - Traverse City | | 27.2 | 32.7 | 23.3 | | | ** |
| 260650012 - Lansing #1 | 34.6 | 37.2 | 37.2 | 32.8 | 29.0 | 29.4 | 30.4 |
| 260650012 - Lansing #2 | 36.8 | 35.3 | 40.4 | 30.1 | 28.9 | 6.2 | 21.7 |
| 260770008 - Kalamazoo #1 | 38.0 | 35.5 | 40.0 | 32.3 | 36.9 | 27.3 | 32.1 |
| 260770008 - Kalamazoo #2 | 38.7 | 36.5 | 36.0 | 32.0 | 35.7 | 28.9 | 32.2 |
| 260810020 - Grand Rapids #1 | 38.8 | 40.5 | 43.5 | 35.1 | 35.0 | 31.8 | 33.9 |
| 260810020 - Grand Rapids #2 | 39.3 | 28.1 | 39.4 | 32.4 | 29.6 | 30.5 | 30.8 |
| 260990009 - New Haven | 31.9 | 33.2 | 42.0 | 35.6 | 31.8 | 31.9 | 33.1 |
| 261130001 - Houghton Lake | | | | | 23.6 | 21.0 | * |
| 261150005 - Luna Pier | | 37.2 | 39.2 | 42.7 | 34.7 | 35.0 | 37.4 |
| 261210040 - Muskegon #1 | 38.1 | 35.0 | 34.9 | 29.8 | 36.3 | 32.7 | 32.9 |
| 261210040 - Muskegon #2 | 39.1 | 23.5 | | | | | ** |
| 261250001 - Oak Park | 42.8 | 40.7 | 39.4 | 38.4 | 36.6 | 32.5 | 35.8 |
| 261250010 - Southfield | | | 44.2 | 31.4 | | | ** |
| 261390005 - Jenison | 38.7 | 33.7 | 35.0 | 36.8 | 31.0 | 30.9 | 32.9 |
| 261450018 - Saginaw #1 | 31.0 | 27.5 | 34.6 | 26.0 | 26.8 | 27.4 | 26.7 |
| 261450018 - Saginaw #2 | 34.3 | 28.4 | 10.3 | | | | ** |
| 261470005 - Port Huron #1 | 44.5 | 33.1 | 40.5 | 35.3 | 37.2 | 32.2 | 34.9 |
| 261470005 - Port Huron #2 | | | 35.9 | 37.7 | 38.0 | | ** |
| 261530001 - Seney National Wildlife | | | 26.0 | 18.0 | 15.8 | | ** |
| 261610005 - Ann Arbor | 38.2 | 33.1 | 38.5 | 31.3 | 33.3 | 28.4 | 31.0 |
| 261610008 - Ypsilanti #1 | 40.6 | 30.3 | 39.7 | 30.9 | 38.8 | 31.5 | 33.7 |
| 261610008 - Ypsilanti #2 | | | 39.0 | 32.6 | 32.5 | 31.2 | 32.1 |
| 261630001 - Allen Park #1 | 49.0 | 41.8 | 48.3 | 39.6 | 40.5 | 36.9 | 39.0 |
| 261630001 - Allen Park #2 | 44.1 | 34.6 | 40.1 | 30.9 | 39.2 | 33.8 | 34.6 |
| 261630015 - Detroit - W. Fort St. | 50.2 | 44.5 | 42.9 | 38.2 | 33.6 | 36.0 | 35.9 |
| 261630016 - Detroit - Linwood | 51.7 | 44.0 | 46.0 | 42.7 | 46.2 | 38.3 | 42.4 |
| 261630019 - Detroit - E Seven Mile Rd | | 42.0 | 42.0 | 34.4 | 37.1 | 35.0 | 35.5 |
| 261630025 - Livonia | 38.4 | 35.9 | 44.7 | 32.7 | 38.1 | 32.2 | 34.3 |
| 261630033 - Dearborn | 45.1 | 45.1 | 43.2 | 45.7 | 42.8 | 39.4 | 42.6 |
| 261630036 - Wyandotte | 45.0 | 42.7 | 46.6 | 34.1 | 34.8 | 32.3 | 33.7 |

*The monitoring sites do not have three years of data so the $PM_{2.5}$ 24-hr 98th percentile average is not calculated.
**Monitoring ended prior to 2004, so 2002-2004 mean is not available.

[46] The 98$^{TH}$ percentile value was obtained from the EPA AQS. For the purpose of comparing calculated values, the three-year 24-hour average is rounded to the nearest 0.1 μg/m$^3$.

**Figures 2.5-14** through **2.5-17** shows the annual mean $PM_{2.5}$ trend for each monitoring site locations for the years monitoring was conducted. To improve legibility of the data, the Detroit-Warren-Flint CSA was broken down into two figures: **Figure 2.5-14** shows only the sites located in Wayne County, which is part of the Detroit-Warren-Livonia MSA and **Figure 2.5-15** includes the remaining counties (excluding Wayne County) in the Detroit-Warren-Livonia MSA, along with the Ann Arbor MSA, Flint MSA, and Monroe MSA.

**Figure-2.5-14** shows the annual mean trend for each of the monitoring sites in Wayne County. For 2004, only two monitoring sites had readings above the standard (Dearborn and W. Fort Street) with the highest concentration at the Dearborn site (16.83 µg/m$^3$). Historically (since 1999), the Dearborn and W. Fort Street monitoring sites in Wayne County have continually been above the $PM_{2.5}$ NAAQS with the Dearborn site having the highest readings throughout Michigan. However, all the sites in Wayne County have showed decreasing levels with five sites now in attainment for the $PM_{2.5}$ NAAQS.



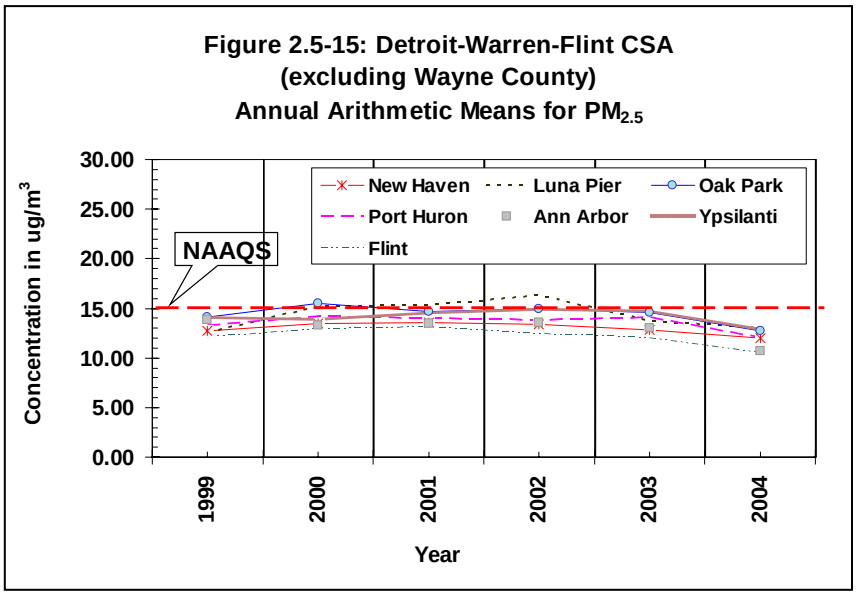
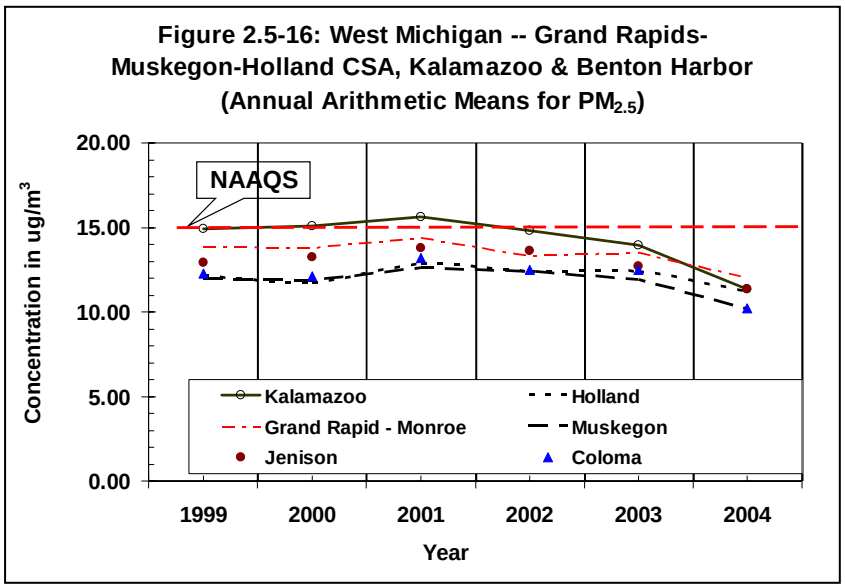




**Figure 2.5-15** shows the remaining sites in Southeast Michigan (excluding Wayne County). For 2004, all these monitoring sites had readings below the standard. In addition, when the latest three-year averages are calculated, each of these sites were below the $PM_{2.5}$ NAAQS.

It is important to note that for the entire Detroit-Warren-Flint CSA (all of Southeast Michigan), only two sites still remain above the NAAQS. All the Southeast Michigan sites show decreasing levels since 1999.

**Figure 2.5-16** combines the $PM_{2.5}$ monitoring sites in the Grand Rapids-Muskegon-Holland CSA, the Kalamazoo area, and the site in Coloma for a view of West Michigan.

All sites in West Michigan have been below the NAAQS since 2002. In 2000 and 2001, the Kalamazoo monitor was the only West Michigan monitor to have readings above the $PM_{2.5}$ standard (at 15.1 $\mu g/m^3$ and 15.6 $\mu g/m^3$, respectively). Since then, West Michigan values have continued to show a steady decline.



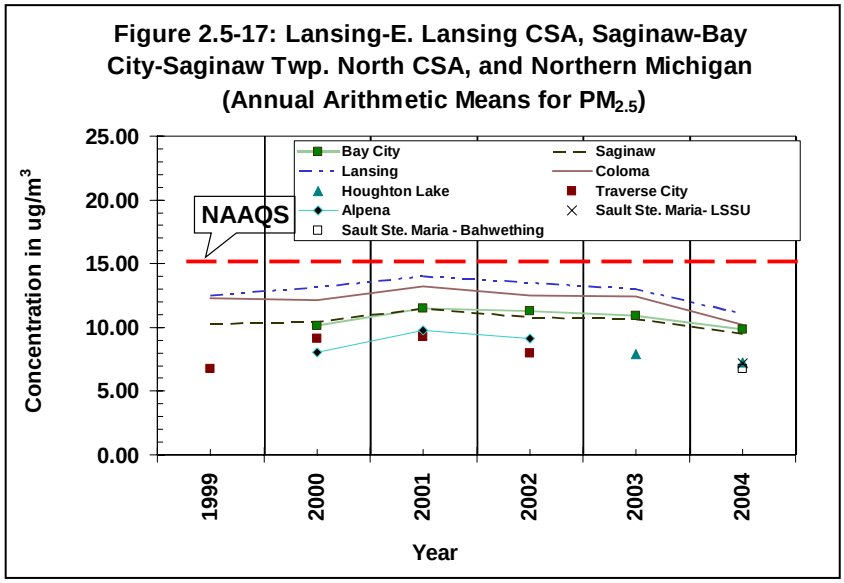




**Figure 2.5-17** shows the remaining monitoring sites in Central and Northern Michigan and include the Lansing - E. Lansing - Owosso CSA, the Saginaw - Bay City - Saginaw Twp. North CSA, and Northern Michigan.

All these sites have remained below the $PM_{2.5}$ NAAQS. Historically (since 1999) the Sault Ste. Marie monitoring site, established in 2004, showed the lowest reading for the entire State of Michigan at 6.28 $\mu g/m^3$.

In 2004, there were five $PM_{2.5}$ monitoring sites in Michigan that were above the three-year annual mean $PM_{2.5}$ NAAQS. These sites were all located in Southeast Michigan's Wayne County. This is a decrease from 2003, when there were a total of seven monitoring sites, all in Southeast Michigan, that were above the annual NAAQS with six sites in Wayne County and one in Monroe County (Luna Pier). In 2002 (the first year that a three-year annual mean could be calculated), there were a total of eight monitoring sites above the annual $PM_{2.5}$ NAAQS.

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

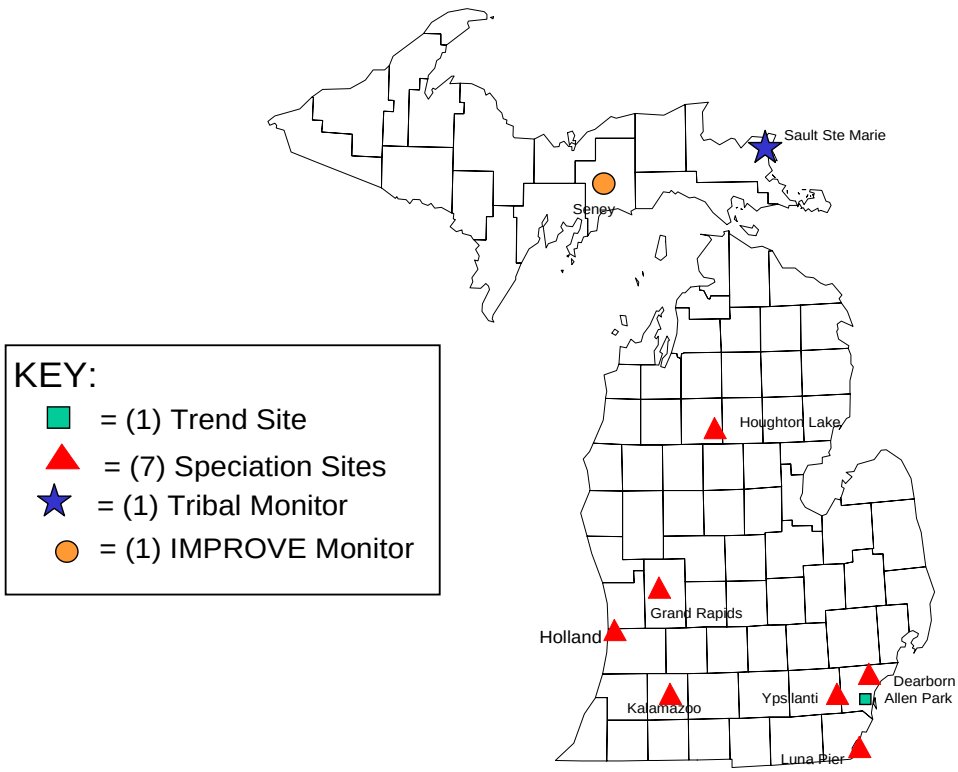
To better understand the chemical composition of fine particulate material and to better characterize background levels, a national speciation network has been deployed in both urban and rural locations. The primary monitoring objectives of Michigan's speciation network are to provide data that will be used to support the development of attainment strategies and determine air quality in population-oriented areas.

Single event Met-One spiral ambient speciation sampler (SASS) are used throughout Michigan's monitoring network **(Figure 2.5-18**). $PM_{2.5}$ chemical speciation samples are collected on filters over a 24-hour period on either a once every three or once every six day schedule. These samplers collect the $PM_{2.5}$ material on three types of filters: teflon, nylon, and quartz. Each filter is analyzed by a different method to determine various components of $PM_{2.5}$. The material collected on teflon filters is weighed to confirm mass, and then analyzed by x-ray fluorescence to determine trace elements from Pb to sodium on the periodic table. The material collected on nylon filters is analyzed using ion chromatography to determine sulfate, nitrate, chloride, and ammonium. The material collected on quartz filters is analyzed by thermal optical analysis to determine organic carbon and elemental carbon. The speciation data will be used to identify sources of $PM_{2.5}$ and to create strategies for control of primary and secondary sources of $PM_{2.5}$.

**Figure 2.5-18: Met-One SASS**

Most of the sites shown in **Figure 2.5-19** are population-oriented stations. A subset of these stations is located in areas designated as nonattainment for $PM_{2.5}$ (excluding the Kalamazoo monitoring site). The speciation data from the monitors in the Detroit CSA (Ypsilanti, Allen Park, Dearborn, and Luna Pier) will be used in the creation of attainment strategies for Southeast Michigan. The Ypsilanti speciation site also provides additional air quality data for Washtenaw County and other researchers in their investigation of the elevated asthma levels in the area.

**Figure 2.5-19: $PM_{2.5}$ Chemical Speciation Network**



For West Michigan, even though the counties were designated as attainment, there are two monitoring sites gathering speciation data; the monitor in Grand Rapids, a large population center, will be valuable in comparing the differences in chemical composition across large metropolitan areas and the Holland site addresses transport and more rural concentrations of speciated $PM_{2.5}$.

Additionally, background information for regional visibility modeling is being conducted at Houghton Lake and speciated $PM_{2.5}$ measurements are being collected by the Inter Tribal Council at the Sault Ste. Marie site for Michigan's Upper Peninsula. In 2004, visibility modeling efforts in the Seney Wildlife Refuge ended and chemical speciation monitoring was removed from this station.

The EPA has also encouraged the use of continuous monitoring instrumentation to provide hourly $PM_{2.5}$ concentrations (**4, 20, 26**). At least one continuous fine particulate analyzer (TEOM) is required at a core monitoring $PM_{2.5}$ site in a metropolitan area with a population greater than one million (Allen Park and Grand Rapids) and is used to provide temporal resolution of fine particulate concentration (**23, 27**).

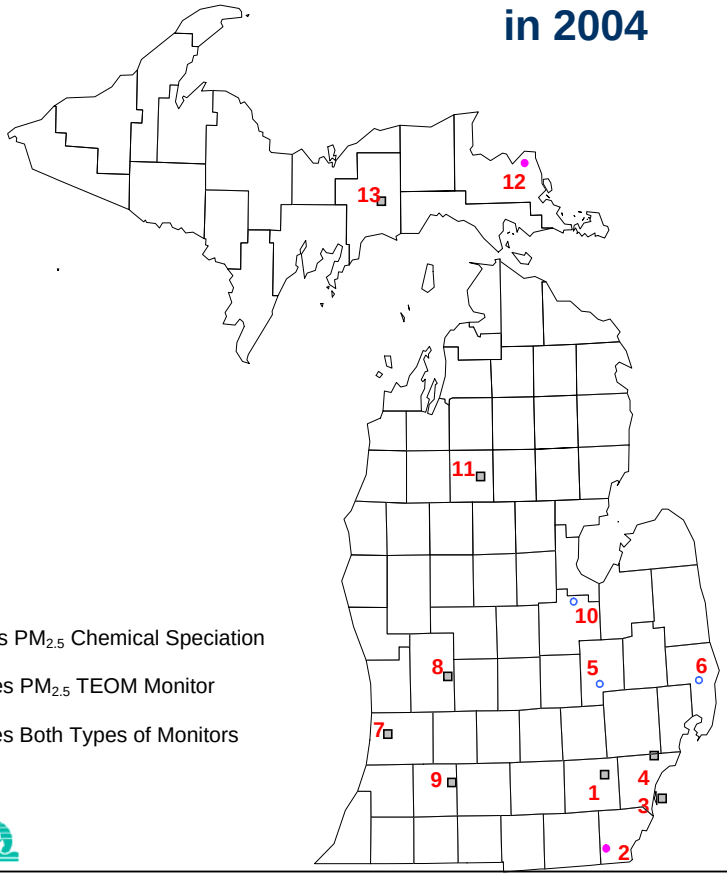
TEOM monitors are beneficial in providing $PM_{2.5}$ concentrations on an hourly basis as they supplement the $PM_{2.5}$ data collected by manual monitors.[47] In 2003, TEOM monitors were added to Houghton Lake, Port Huron, and Dearborn monitoring sites. In 2004, a TEOM monitor was moved from the Lansing site to the Holland monitoring site and TEOM monitoring continued at Flint, Kalamazoo, Grand Rapids, Houghton Lake, Saginaw, Port Huron, Seney, Ypsilanti, Allen Park, and Dearborn monitoring site.

Michigan has also expanded its $PM_{2.5}$ monitoring through the utilization of both continuous TEOM and chemical speciation air monitors. The following are the monitoring site locations where both TEOM and chemical speciation is being conducted: Ypsilanti, Allen Park, Dearborn, Holland, Grand Rapids, Kalamazoo, Houghton Lake, and Seney.

**Figure 2.5-20** shows all of Michigan's site locations where TEOM, chemical speciation, or both were conducted in 2004.

[47] More information regarding the TEOM network is available in **Chapter 4: Special Projects**.

## Figure 2.5-20: $PM_{2.5}$ TEOM & Chemical Speciation Monitors Active in 2004




Denotes $PM_{2.5}$ Chemical Speciation Monitor

Denotes $PM_{2.5}$ TEOM Monitor

Denotes Both Types of Monitors

**MONITORS BY LOCATION**

Monitor ID & Type

**DETROIT-WARREN-FLINT CSA**

1. 261610008 - YPSILANTI – TEOM & CHEM SPECIATION
2. 261150005 - LUNA PIER –CHEM SPECIATION
3. 261630001 - ALLEN PARK - TEOM & CHEM SPECIATION
4. 261630033 - DEARBORN – TEOM & CHEM SPECIATION
5. 260490021 - FLINT – TEOM
6. 261470005 - PORT HURON - TEOM

**GRAND RAPIDS-MUSKEGON-HOLLAND CSA**

7. 260050003 – HOLLAND – TEOM & CHEM SPECIATION
8. 260810020 - GRAND RAPIDS - TEOM & CHEM SPECIATION

**KALAMAZOO-BATTLE CREEK MSA**

9. 260770008 - KALAMAZOO – TEOM & CHEM SPECIATION

**SAGINAW-BAY CITY-SAGINAW TWP. N-CSA**

10. 261450018 - SAGINAW - TEOM

**HOUGHTON LAKE, MISSAUKEE COUNTY**

11. 261130001 - HOUGHTON LAKE – TEOM & CHEM SPECIATION

**SAULT STE MARIE, CHIPPEWA CO.**

12. 260330901 - TRIBAL - CHEM SPECIATION

**SENEY NAT'L WILDLIFE REFUGE, SCHOOLCRAFT CO.**

13. 261530001 - US FISH & WILDLIFE – TEOM & CHEM SPECIATION

# Chapter 2.6: Sulfur Dioxide Trends

## Introduction:

Sulfur dioxide ($SO_2$) is a colorless gas formed by the burning of sulfur-containing material and is odorless at typical ambient concentrations. It can react with other atmospheric chemicals to form sulfuric acid. When a sulfur-bearing fuel is combusted, the sulfur is oxidized to form $SO_2$ and then it reacts with other emissions to form aerosols. In liquid form, it is found in clouds, fog, rain, aerosol particles, and in surface liquid films on these particles. $SO_2$ reacts with ammonia in the atmosphere to form ammonium sulfate, a common fine particulate material ($PM_{2.5}$) found in the Midwest. Other sulfate-containing chemical species prevalent in fine particles include ammonium bisulfate (**20, 28**). Odor thresholds for $SO_2$ range between 0.4 ppm to 8.0 ppm (**29**).

Nationwide, the largest source of $SO_2$ comes from coal-burning power plants. State regulations require that most of the coal burned in Michigan contain low amounts of sulfur. $SO_2$ also is emitted from smelters, petroleum refineries, pulp and paper mills, transportation sources, and steel mills. Other sources include residential, commercial, and industrial space heating

## $SO_2$ Effects:

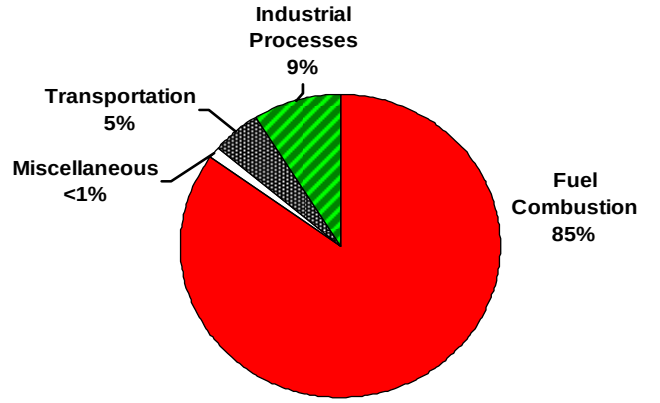
Exposure to elevated levels of $SO_2$ aggravates existing cardiovascular and pulmonary disease. Asthmatics, children, and the elderly are especially sensitive to its effects. Asthmatic individuals receiving short-term exposures during moderate exertion may experience reduced lung function and symptoms such as wheezing, chest tightness, or shortness of breath (**4**). Depending upon the concentration, $SO_2$ may also cause symptoms in people who do not have asthma. Where $SO_2$ is emitted, PM is also often emitted. $SO_2$ and PM may exert a synergistic toxic effect. Together, they may cause respiratory illness, alteration in the body's defense and clearance mechanisms, and aggravation of existing cardiovascular disease (**4**).

$SO_2$ and $NO_X$ together are the major precursors to acid rain, which is associated with the acidification of soils, lakes, and streams and accelerated corrosion of buildings and monuments. $SO_2$ is also a major precursor to $PM_{2.5}$, which is a significant health concern, and a main contributor to poor visibility.

## National Source Trends:

Fuel combustion sources, largely from electricity generation, are the largest man-made sources of $SO_2$ nationwide (EPA's **Figure 2.6-1** is from the EPA's 2003 National Air Quality and Emissions Trends Report and shows national $SO_2$ emissions by source category for 2002). According to the EPA, coal-burning power plants have consistently been the largest contributor for the $SO_2$ emissions and produce about 63% of $SO_2$ emissions and 22% of $NO_X$ emissions (**4**). The highest $SO_2$ emission density is located in the eastern U.S., in large metropolitan areas, and in those areas with coal-burning plants.

**Figure 2.6-1: EPA's 2002 $SO_2$ Emissions by Source Category**
**(from 2003 EPA Trends Report)**



Reductions in $SO_2$ concentrations and emissions since 1990 are due, in large part, to controls implemented under EPA's Acid Rain Program, which began in 1995 (**4**).[48]

Acid rain sources account for only 22% of nationwide nitrogen emissions. Emission trends in other source categories, especially agriculture and mobile sources, also affect air concentrations and deposition of nitrogen. (**4**).

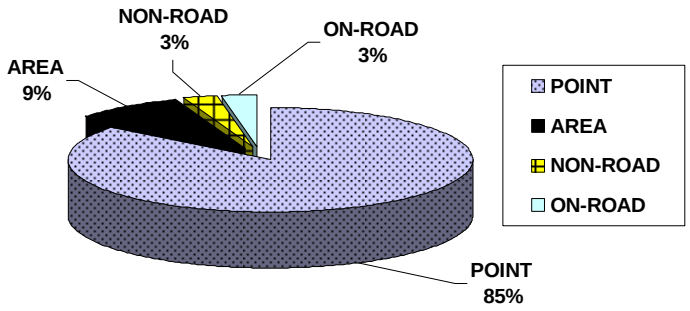
## Michigan Source Trends:

**Figure 2.6-2**, shows that point source emissions contribute 85% of the overall $SO_2$ emissions in Michigan. These point sources include:

- fossil fuel (coal) combustion,
- chemical and allied product manufacturing,
- metals processing,
- petroleum and related industries,
- incineration
- and other industrial processes,

Michigan's $SO_2$ levels have consistently been well below the NAAQS and have remained in attainment for $SO_2$ since 1982.

**Figure 2.6-2: Percentage of $SO_2$ Emissions in Michigan By Source Type (EPA 2002 Emissions Inventory Data)**




## NAAQS for $SO_2$:

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

There are two primary standards for $SO_2$, an annual arithmetic average and a 24-hour average. The annual arithmetic mean average is met if it does not exceed 0.030 ppm (80 $\mu g/m^3$), and the 24-hour average is met if 0.14 ppm (365 $\mu g/m^3$) is not exceeded more than once per year. There is also a secondary standard for $SO_2$ which is met if a 3-hour average does not exceed 0.50 ppm (1300 $\mu g/m^3$) more than once per year (**30, 31**). **Note:** In May of 1996, the EPA made a technical change that expressed the NAAQS for $SO_2$ in terms of ppm rather than $\mu g/m^3$. The actual levels of the standard were not changed.

## $SO_2$ Monitoring in Michigan:

The EPA requires that only two to four NAMS in the Detroit urban area because there is a low probability of exceeding the $SO_2$ NAAQS. Michigan currently has three NAMS in Detroit, measuring for neighborhood scale trends, located at W. Fort Street (situated so that maximum $SO_2$ levels are being monitored), E. Seven Mile Road, and Warren. However, the Warren site may not

[48] Information on the Acid Rain Program is available at: http://www.epa.gov/airmarkets/arp/.

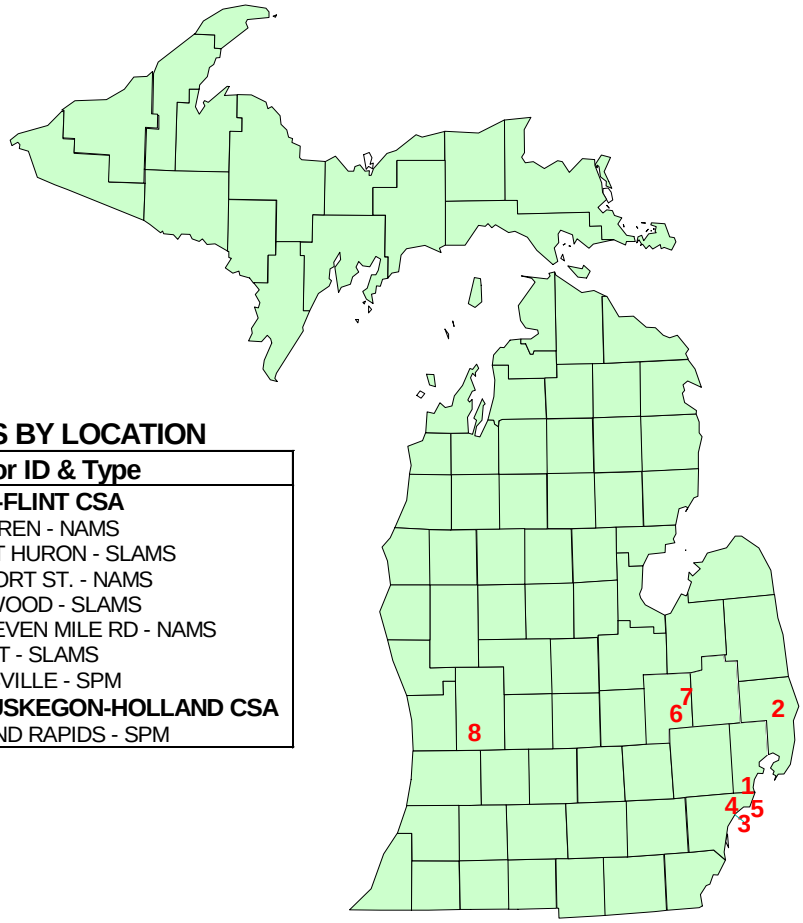
be meeting the siting criteria anymore due to development around the site. This monitor will be moved as soon as a replacement site can be found and a site access agreement is made. In addition, recent drafts of the monitoring regulations may allow a reduction to only a single NAMS $SO_2$ monitor being placed in the Detroit CSA in the future.

An additional monitoring station is located at Port Huron to measure maximum $SO_2$ concentrations of neighborhood or middle scale air parcels. In addition, if the monitoring requirements for $SO_2$ NAMS monitors are changed to require a site in all CSAs with population totals exceeding on million people, the designation of the SPM monitor at Grand Rapids' Monroe Street should be changed to a NAMS description.

There were several changes to the $SO_2$ monitoring network. In December 2003, the Houghton Lake $SO_2$ monitor was moved to Otisville to provide information about background levels for NSR permitting applications.

The map in **Figure 2.6-3** shows the locations of Michigan's eight $SO_2$ monitoring stations that were operational in 2004.

## Figure 2.6-3: Air Quality Monitors for $SO_2$ Active in 2004




**MONITORS BY LOCATION**

| Monitor ID & Type |
|---|
| **DETROIT-WARREN-FLINT CSA** |
| 1. 260991003 - WARREN - NAMS |
| 2. 261470005 - PORT HURON - SLAMS |
| 3. 261630015 - W. FORT ST. - NAMS |
| 4. 261630016 – LINWOOD - SLAMS |
| 5. 261630019 – E. SEVEN MILE RD - NAMS |
| 6. 260490021 – FLINT - SLAMS |
| 7. 260492001 – OTISVILLE - SPM |
| **GRAND RAPIDS-MUSKEGON-HOLLAND CSA** |
| 8. 260810020 - GRAND RAPIDS - SPM |

## Attainment/Nonattainment Status of $SO_2$ in Michigan:

On October 20, 1982, the last remaining $SO_2$ nonattainment area in Michigan was redesignated to attainment. Michigan has continued to maintain attainment status since that date.

## $SO_2$ Trends by Location:

Average $SO_2$ levels monitored in the state have consistently been well below the 0.030 ppm NAAQS as shown in **Figure 2.6-4** (Detroit-Warren-Flint CSA) and **Figure 2.6-5** (the Grand Rapids-Muskegon-Holland CSA and Houghton Lake site in Missaukee County).

The statewide annual $SO_2$ concentrations at MASN sites ranged between 0.002 ppm and 0.009 ppm. Trends for 24-hour maximum levels have followed a pattern similar to that of the annual mean.

**Figure 2.6-4: $SO_2$ Levels for Detroit-Warren-Flint CSA (Annual Arithmetic Mean, 1994-2004)**

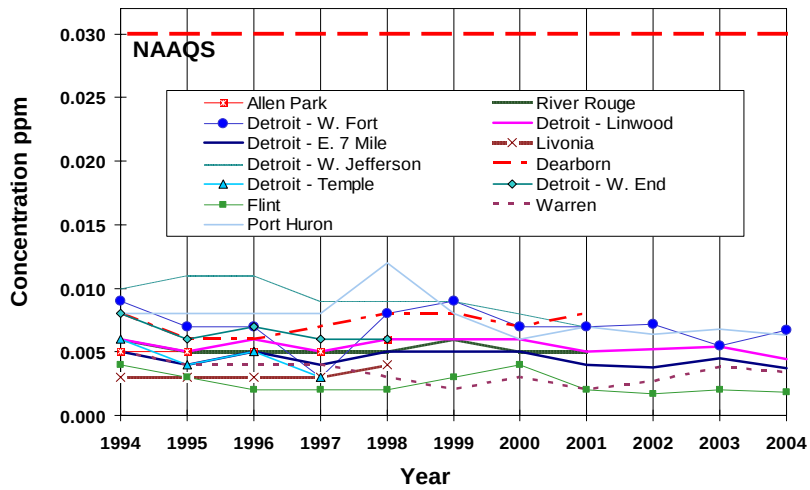
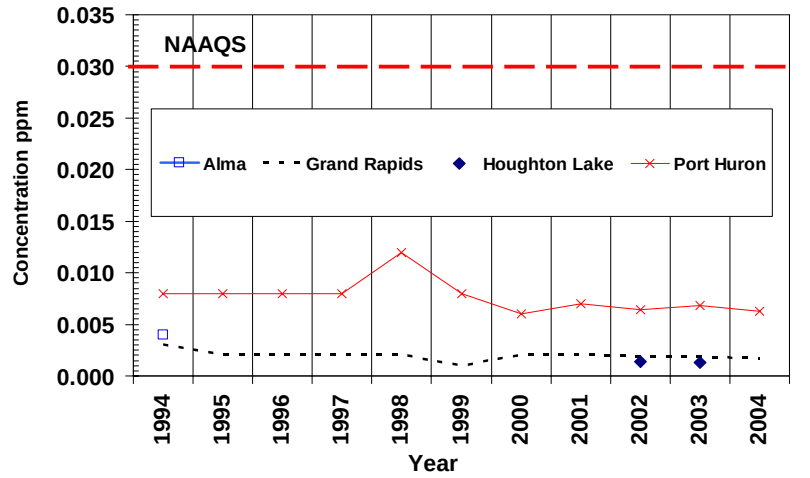



**Figure 2.6-5: $SO_2$ Levels for Grand Rapids-Muskegon-Holland CSA and Houghton Lake Annual Arithmetic Mean, 1994-2004**



# CHAPTER 3: Toxic Air Pollutants in Michigan

## Introduction:

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

In general, air toxics can be categorized as metals, organic substances, and other substances. Examples of metals include aluminum, arsenic, beryllium, barium, cadmium, chromium, cobalt, copper, iron, mercury, manganese, molybdenum, nickel, lead, vanadium, and zinc. The organic toxics classification can be divided into sub-categories that include VOCs, carbonyl compounds (aldehydes and ketones), semi-volatile compounds (SVOCs), PAHs/polynuclear aromatic hydrocarbons (PNAs), pesticides, polychlorinated biphenyls (PCBs), and polycyclic organic matter. The other substances include asbestos, dioxin, 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 in this section), and the EPA has developed an Integrated Urban Air Toxics Strategy with a focus on 33 substances (the Urban HAPs List). The air toxics also pose a challenge due to monitoring and analytical methods that are either unavailable for some compounds or cost prohibitive for others (e.g., dioxins).

The MDEQ's AQD and the EPA made significant efforts to develop monitoring strategies for air toxics, to determine where (and for what substances) future monitoring efforts should be focused to best address data needs and objectives. The AQD drafted The Development of an Air Toxics Monitoring Strategy for Michigan to provide a network characterizing ambient levels of air toxics, including atmospheric deposition.[49]

## Health Effects of Air Toxics:

Air toxics have a wide range of potential health 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 have one "critical" effect, while others may have several. Some effects appear with a short period of exposure, while others may appear after long-term exposure or after a long period of time has passed since the exposure ended; and, most toxic effects are not unique to one substance. For these reasons, it is frequently 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.

[49] The Air Toxics Monitoring Strategy is available at http://www.michigan.gov/deqair, Air Toxics, Information.

The evaluation of the significance of air toxics levels is hindered by several additional factors. Unlike the six criteria pollutants, there are no health-protective NAAQS for the air toxics. Instead, air quality assessments utilize 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. Another problem is that there are 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 these factors make it difficult to accurately assess the potential health concerns of air toxics.

## National Efforts and Data Analysis:

**NATA:** Due to the lack of a comprehensive national air toxics monitoring database and the many challenges of developing one, the EPA conducted a National Air Toxics Assessment (NATA) for air emissions of 33 air pollutants (a subset of 32 air toxics on the CAA's list of 188 air toxics plus diesel particulate matter). In the first assessment, released in August 2000, 1996 emissions inventory data was used as it was the most complete and up-to-date at the time.[50] The NATA includes:

1. Compiling a national emissions inventory of air toxics emissions from outdoor sources including large sources such as waste incinerators and factories, and smaller sources such as dry cleaners, small manufacturers, and wildfires. Also included are emissions from highway and non-road mobile sources, such as cars, trucks and boats.
2. Estimating ambient concentrations of air toxics across the contiguous U.S.
3. Estimating population exposures across the contiguous U.S.
4. Characterizing potential public health risk due to inhalation of air toxics including both cancer and non-cancer effects.

The NATA is intended to provide state, local, tribal agencies, and others with a better understanding of the risks from inhalation exposure to toxic air pollutants from outdoor sources. It will help EPA and states prioritize data and research needs to better assess risk in the future, and will provide a baseline to help measure future trends. The EPA collaborated with state, local, and tribal agencies to develop the information that is contained in the assessment.

**EPA PILOT PROJECTS:** Beginning in 2000, a series of pilot projects were initiated by EPA to generate data about the spatial and temporal variability of air toxics in urban and rural areas, as well as in small cities, and to provide information on sampling and analysis precision, minimal detection levels, and variability of sources (Michigan-specific pilot projects are discussed further in the chapter under the heading **Michigan Monitoring Efforts and Data Analysis**). More extensive monitoring was done for four large urban areas including Detroit, MI; Providence, RI, Tampa, FL and Seattle, WA. For Michigan, this initiative was called the Detroit Air Toxics Pilot Project. The EPA has been utilizing the data from Detroit and other pilot project locations to help design a national air toxics monitoring network.

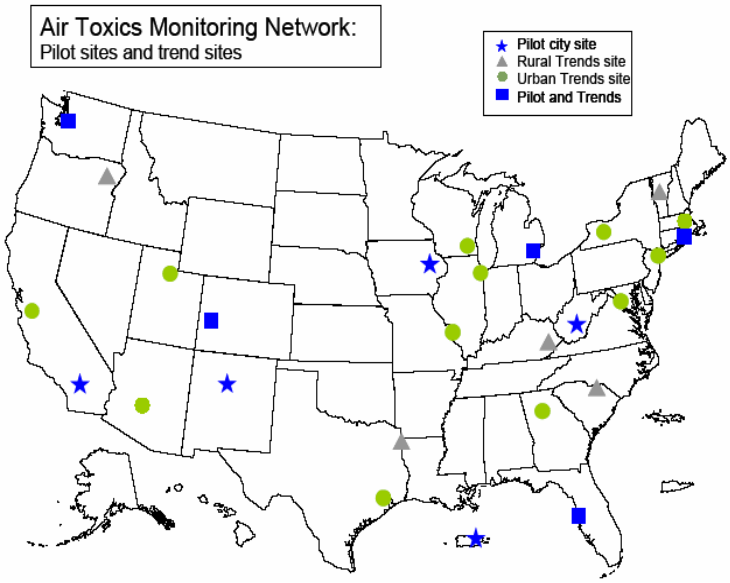
[50] The EPA recognized that the NATA 1996 data does not reflect pollution reductions that have taken effect since 1996, including those from federal, state, and local regulations or from industry initiatives or facility closures. EPA intends to update and repeat that assessment every three years. NATA 1999 is expected to be released by the EPA in late 2005.

**NATTS:** In 2003, using the information generated from the pilot projects along with contractor's network design recommendations, EPA funded 13 National Air Toxics Trend Stations (NATTS) as a preliminary step toward establishing a national air toxics monitoring network.

For 2004, as shown in **Figure 3-1**, the NATTS has been expanded to 22 stations (Tampa is participating with a monitoring site in two counties) including some of the original pilot cities, such as Providence, Detroit, Tampa, Seattle, and Grand Junction (**40**).

The central goal of the NATTS network is to detect trends in high-risk air toxics such as benzene, formaldehyde, acrolein, chromium, and 1,3-butadiene. The EPA requires that the NATTS sites measure VOCs, carbonyls, and trace metals on a once every 6 day sampling schedule (Michigan's Dearborn site also measures trace metals as both TSP and $PM_{2.5}$ along with the required $PM_{10}$ metals).

**Figure 3-1: Map of 22 National Air Toxics Trend Stations**




**Other Studies:** In addition to funding air monitoring projects, EPA also contracted various data analysis activities on a national level. In Michigan, two sets of data analysis activities were completed in 2004 for the Lake Michigan Air Directors Consortium (LADCO). These reports, the Sonoma Technology Inc. (STI) Air Toxics Data Analysis and the Battelle Air Toxics Data Analysis analyzed data from the pilot projects.[51] The following briefly describes these two monitoring projects:

- The STI project consisted of the analysis of air toxics monitoring data and evaluation of air toxics modeling. Both facets of the project build upon previous and ongoing analyses and evaluations. The objectives of the STI project were to provide a comprehensive "look" at all of the existing air toxics data—both the historical archive and the pilot city database. This "look" will provide a broad national assessment of air toxics data, along with guidance and tools that will enable agencies collecting air toxics data to look at and use their data. In addition, the preparation of limited model-to-monitor comparisons with EPA's ongoing modeling work was included.

- The main goal of the Battelle analysis was to apportion and quantify the environmental sources (spatial and temporal) of ambient air toxics monitoring variability, to gain an understanding of how environmental sources of variability influence air toxics concentrations, and to determine specific recommendations for the design of a national air toxics monitoring network. As additional investigations, the effects of below method detection limit (MDL) data on the partitioning of air toxics monitoring variability, and the effects of other explanatory factors (e.g., meteorological variables) on pollutant concentrations were examined.

[51] The STI and Battelle reports are available on the LADCO website at http://www.ladco.org/toxics.html.

## Michigan Monitoring Efforts and Data Analysis:

Data on the ambient levels of air toxics are needed to assess potential exposure levels. For Michigan, air toxics monitoring efforts are separated into three types on the basis of the objectives of the studies:

1. The MITAMP has the purpose of determining the ambient air levels and long-term trends of air toxics in urban areas and a background site.
2. There are special studies of persistent and bioaccumulative toxics (PBTs) with the purpose of characterizing the ambient air levels or deposition rates of these specific substances of concern.
3. 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. (**NOTE**: Source specific monitoring information and data is not provided in this report.)

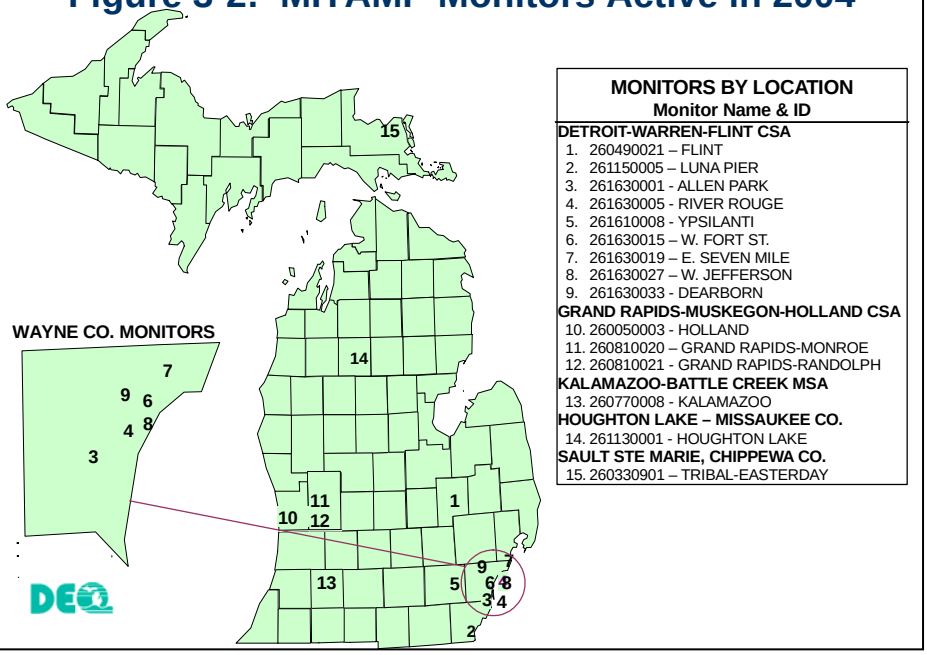
### MITAMP:

The Michigan Toxics Air Monitoring Program or MITAMP was established in January 1990 preceding the 1987-1988 EPA "Urban Toxics Air Monitoring Program." Since the MITAMP's inception, more than 50 toxic organic compounds and up to 15 trace metals have been routinely monitored at various urban locations throughout the state.[52]

Carbonyl sampling (aldehydes and ketones) under the MITAMP began in June 1995 (**32**). To collect MITAMP data, the AQD operates monitors using sampling techniques specifically designed for pollutants of interest. High-volume sampler filters are used to collect metals, evacuated steel canisters are used to sample for VOCs, and carbonyl cartridges are used for aldehydes and ketones. On a non-routine basis, samplers using polyurethane foam and other sorbents are used to collect SVOCs, PCBs, etc.

**Figure 3-2** shows the 15 MITAMP stations where air toxics were measured in 2004. Nine of the MITAMP sites are located in the Detroit-Warren-Flint CSA, with six sites operating in Wayne County. For the Detroit-Warren-Flint CSA, the monitor in Flint collects data for toxic metals; the monitor located on Detroit's W. Fort Street is the MDEQ's long-term trend toxics site; and the Dearborn site (which measures all air toxics monitored in Michigan) is one of the 22 NATTS.

**Figure 3-2: MITAMP Monitors Active in 2004**




[52] Some of the MITAMP sites only measure trace metals and some measure only carbonyls and metals.

For West Michigan, a primarily industrial site located in the Grand Rapids – Randolf Street urban central city area, was moved in 2004 to another Grand Rapids site (Monroe St.) (NOTE: both sites are shown in **Figure 3-2**). Other Michigan sites monitoring for air toxics include Kalamazoo, Ypsilanti, Sault Ste. Marie (tribal monitor) and a "background" site near Houghton Lake. The Houghton Lake site 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.

The following **Table 3-1** shows the type of monitoring conducted at the MITAMP stations.

## Table 3-1: MITAMP Monitors Active in 2004 and Toxics Measured

| AIRS ID - LOCATION | VOCS | CARBONYLS | METALS TSP | METALS $PM_{10}$ | SPECIATED $PM_{2.5}$ |
|---|---|---|---|---|---|
| 260490021 – FLINT | | | X | | |
| 261150005 – LUNA PIER | | | | | X |
| 261630001 - ALLEN PARK | | | X | | X |
| 261630005 - RIVER ROUGE | | X | X | | |
| 261610008 - YPSILANTI | X | X | X | | X |
| 261630015 - W. FORT ST. | X | X | X | | |
| 261630019 - E. SEVEN MILE RD. | | X | X | | |
| 261630027 – W. JEFFERSON | | | X | | |
| 261630033 - DEARBORN | X | X | X | X | X |
| 260050003 - HOLLAND | | | | | X |
| 260810020 – GRAND RAPIDS-MONROE | | | | | X |
| 260810021 - GRAND RAPIDS-RANDOLPH | X | X | X | | |
| 260770008 - KALAMAZOO | | | | | X |
| 261130001 - HOUGHTON LAKE | X | X | X | | X |
| 260330901 – SAULT STE. MARIE | | | | | X |

The summaries of trace metal, VOC, and carbonyl compound analytical results for the MITAMP stations listed above is provided in **Appendix C1**, and **Appendix C2** has the summaries of speciated $PM_{2.5}$ analytical results.

The history of Michigan's air monitoring sites (non-industrial only) operational from 1987 to 2004 and the categories of air toxics monitored at those sites is shown in the following **Table 3-2**.

## Table 3-2: History of Air Monitoring Sites Collecting Toxics Data in Michigan (Non-Industrial Sites Only)

| COUNTY | LOCATION | AIRS ID | YEARS OPERATED | | | | | | | | | | | | | | | | | | EVER MONITORED* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 00 | 01 | 02 | 03 | 04 | VOCs | Carbonyls | Metals-TSP | Metals-$PM_{10}$ | Speciated $PM_{2.5}$ | SVOCs |
| Allegan | South Haven | 260050002 | | | | | | x | x | x | | | | x | x | | | | | | | | | x | | x |
| Allegan | Holland | 260050003 | | | | | | | | x | x | x | x | x | x | x | x | x | x | x | | | | | x | |
| Cheboygan | Pellston | 260310001 | | | | | | x | x | x | | | | | | | | | | | | | | x | | |
| Chippewa | Brimley | 260330033 | | | | | x | | | | | | | | | | | | | | | | x | | | |
| Chippewa | Lake Superior St. Univ. | 260330901 | | | | | | | | | | | | | | | | | x | x | | | | | x | |
| Genesee | Flint | 260490011 | | x | x | x | x | | | | | | | | | | | | | | | | x | | | |
| Genesee | Flint, Whaley Park | 260490021 | | | | | | | | | x | x | x | x | x | x | x | x | x | x | | | x | | | |
| Grand Traverse | Traverse City | 260550002 | | | | | x | | | | | | | | | | | | | | | | x | | | |
| Huron | Bay Port | 260630003 | | | | x | x | | | | | | | | | | | | | | | | x | | | |
| Ingham | Lansing | 260650013 | x | x | | | | | | | | | | | | | | | | | x | | x | | | |
| Ingham | Lansing | 260651001 | | x | x | x | x | | | | | | | | | | | | | | | | x | | | |
| Kalamazoo | Kalamazoo | 260770002 | | x | x | x | x | x | | | | | | | | | | | | | | | x | | | |
| Kalamazoo | Portage | 260770004 | | | | x | x | x | x | | | | | | | | | | | | x | | x | | | |
| Kalamazoo | Fairgrounds | 260770008 | | | | | | | | | | | x | x | | | | | | x | | | | | x | |
| Kent | Grand Rapids | 260810010 | | x | x | x | x | | | x | x | x | x | x | | | | | | | | | x | | | |
| Kent | Grand Rapids | 260810020 | | | | | | | | x | x | x | x | x | x | x | x | x | x | x | | | | | x | |
| Kent | Grand Rapids | 260810021 | | | | | | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | | | |
| Kent | Wyoming | 260812002 | | x | x | x | x | | | | x | x | x | x | | | | | | | | | x | | | |
| Menominee | Menominee | 261090002 | | | | | | | x | | | | | | | | | | | | | | x | | | |
| Midland | Midland | 261110007 | x | x | x | x | x | x | | | | | | | | | | | | | x | | x | | | x |
| Missaukee | Houghton Lake | 261130001 | | | | | | | | | | | | x | x | x | x | x | x | x | x | x | x | | x | |
| Monroe | Luna Pier | 261150005 | | | | | | | | | | | | | | | x | x | x | x | | | | | x | |
| Muskegon | Muskegon | 261210023 | | x | x | x | x | | | | x | x | x | | | | | | | | | | x | | | |
| Oakland | Southfield | 261250010 | | | | | | | | | | | | | | | x | x | | | x | x | x | | x | x |
| Saginaw | Saginaw | 261450002 | | x | x | x | x | | | | | | | | | | | | | | | | x | | | |
| Saint Clair | Port Huron Nat'l Guard | 261470005 | x | x | x | x | x | | | | | | | | | | | | | | x | | x | | | |
| Sanilac | Deckerville | 261510002 | | | | | | x | x | x | | | | | | | | | | | | | | x | | |
| Washtenaw | Ann Arbor | 261610002 | | x | x | x | x | | | | | | | | | | | | | | | | x | | | |
| Washtenaw | Dexter | 261618001 | | | | | | x | x | x | | | | | | | | | | | | | | x | | |
| Washtenaw | Ypsilanti | 261610008 | | | | | | | | | | | | | | x | x | x | x | x | x | x | x | | x | |
| Wayne | Allen Park | 261630001 | | | | | | | | | | | | | | | x | x | x | x | x | x | x | | x | x |
| Wayne | Dearborn | 261630002 | x | x | | | | | | | | | | | | | | | | | x | | x | | | x |
| Wayne | Dearborn, Wyoming St. | 261630033 | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x |
| Wayne | Detroit, Evergreen | 261630014 | | | x | x | x | | | | | | | | | | | | | | | | x | | | |
| Wayne | Detroit, W. Fort | 261630015 | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | | x |
| Wayne | Detroit, W Jefferson | 261630027 | | | | | | | | | | | | | | | 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 Seven Mile | 261630019 | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | | x |
| Wayne | River Rouge | 261630005 | | | | | | | x | x | x | x | x | x | x | x | x | x | x | x | x | x | x | | | x |
| Wayne | Weston Trailer | 261630032 | x | x | | | | | | | | | | | | | | | | | x | | x | | | x |

*Note: Includes all years of operation, not just 2004.

Limited monitoring in Michigan has previously shown that air toxics levels were generally higher in large urban areas, such as Detroit, than in small cities or rural areas. However, these findings were not presented to the public in the form of risk estimates and characterizations. EPA has evaluated the 1996 emissions of air toxics in the U.S., and has estimated the air levels and health risks that they pose. These estimates found that large cities such as Detroit have a relatively high number of emission sources (vehicles and industries) and greater health risks than small cities and urban areas.

The following discuss several Michigan studies that have been conducted to evaluated air toxics in the Detroit area:

**DATI:** The Detroit Air Toxics Initiative (DATI) is a project initiated by the AQD, and funded by a grant from the EPA's Fiscal Year 2003 Community Assistance and Risk Reduction Initiative. This project includes two components, one to assess the health risks from exposure to air toxics in the Detroit area, and the other to fund projects to help reduce identified risks. The risk assessment performed for the DATI has focused primarily on air toxics monitoring data from the Detroit Air Toxics Pilot Project, an intensive one-year study in the Detroit area that ran from April 2001 through April 2002.

A total of 224 air toxics were monitored during 2001-2002 at the following seven sites in the Detroit area: Allen Park, Dearborn, W. Jefferson, W. Fort Street, Southfield, River Rouge, and E. Seven Mile. In addition, monitoring was also done at Ypsilanti and Houghton Lake (background site) for comparison. The VOC data from these sites was plotted for various compounds. These graphs revealed that the concentrations of certain VOCs were considerably higher at the Houghton Lake and Ypsilanti sites. As a result of these findings, the AQD staff inspected the manifold pumps on these two samplers in March 2005 and discovered that both were inoperable. Since the pump was not exhausting the manifold, the secondary pump that was pulling air from the manifold and into the canister, was contaminated with indoor air. A review of the data was conducted and based on the concentrations observed at the Houghton Lake and Ypsilanti sites, it appears that the pumps failed in 2001. The pump failure and subsequent indoor air contamination seriously compromised the quality of the data at Houghton Lake and Ypsilanti. Therefore, all VOC data will be deleted from April 23, 2001 through March 25, 2005 for the Houghton Lake site and from October 8, 2001 through March 25, 2005 for the Ypsilanti site. Corrective actions have been identified and implemented to prevent this type of incident in the future.

The AQD finalized the DATI Risk Assessment Report, along with a Technical Summary and Public Summary of that report in 2005.[53] Potential risk reduction efforts are being evaluated, with the assistance from the DATI Stakeholder Group. In addition, the AQD is continuing to monitor air toxics in the Detroit area in response to the DATI findings. This monitoring will determine whether the levels of air toxics have changed since the DATI monitoring in 2001 and 2002 or remain at levels of concern.

**DEARS:** In 2004, the AQD and EPA's National Exposure Research Laboratory and National Health and Environmental Effects Research Laboratory began conducting the Detroit Exposure Aerosol Research Study (DEARS). DEARS is a three-year field monitoring study that is designed to measure exposure and describe exposure relationships for air toxics, PM components, PM from specific sources, and criteria pollutants in Detroit. The study includes monitors at the Allen Park site, indoor monitors, and personal exposure monitors.

[53] The DATI reports are available on the MDEQ AQD's website at http://www.michigan.gov/deqair.

Some of the DEARS objectives are to:

- Determine the associations between concentrations measured at central site monitors and outdoor residential and indoor residential and personal exposures.
- Identify the human activity factors that influence personal exposures to selected pollutants.
- Investigate and apply source apportionment models to evaluate the contribution of specific ambient sources to residential concentrations and personal exposures to PM constituents and air toxics.
- Determine the associations between ambient concentrations of criteria gases ($O_3$, $NO_2$, and $SO_2$) and personal exposures for these gases.

The DEARS monitoring was conducted at 120 residences from seven geographical areas in Detroit, representing various mobile and point source categories. Measurements were collected from each home for five consecutive days during both the summer and winter of 2004; totaling 10 days during the one-year period. In order to evaluate expected variations in industrial source emissions, traffic volumes, and personal activities, a combination of both weekday and weekend sampling was conducted.

## 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 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 (**33, 34, 35**). 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 PM that are deposited on water and land surfaces in the absence of precipitation.

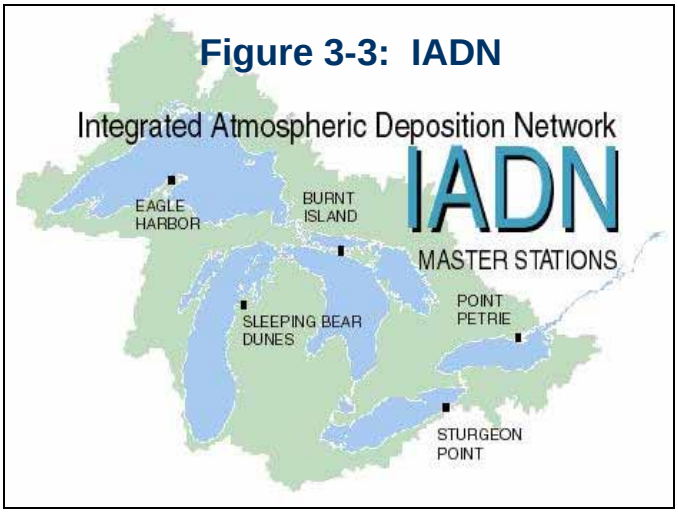
*Gas Absorption or Exchange* refers to pollutants in a gaseous state that cross the air-water interface, and are absorbed in the water column by gas transfer.

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, crops, and meat/dairy products. The following discusses EPA's Integrated Atmospheric Deposition Network (IADN) within the Great Lakes Basin.

**IADN:** The EPA and Canada have established a limited monitoring network within the Great Lakes Basin in response to the 1990 CAA and the 1987 amended Great Lakes Water

Quality Agreement - Annex 15. The IADN (**Figure 3-3**) was mandated to assess the extent of atmospheric deposition of HAPs to the Great Lakes. Two sites were established in Michigan as part of this network with one located in Sleeping Bear Dunes on the Lake Michigan shoreline and the other is at Eagle Harbor on the Lake Superior shoreline in the Keweenaw Peninsula.

**Figure 3-3: IADN**




At the IADN sites, precipitation and air samples are collected and analyzed for trace metals including Pb, arsenic and cadmium, as well as PCBs, PAHs, and pesticides including lindane, dieldrin, dichlorodiphenyltrichloroethane (DDT), and endosulfan. This data has been summarized in several published articles (**36, 37**).

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

Although MDEQ does not have funding to support an extensive monitoring network for PBTs, a few short-term studies have been conducted to better understand the levels of PBTs, specifically addressing mercury in the atmosphere and to assess loadings. The following is a brief summary of these on-going studies:

- For Michigan, the largest industrial source of mercury air emissions is coal-fired power plants. The MDEQ was directed from Governor Granholm to pursue the reduction and phase-out of mercury emissions from coal-fired power plants, along with reductions of $NO_X$ (a precursor to both $PM_{2.5}$ and $O_3$), $SO_2$ (a precursor to the formation of $PM_{2.5}$ and $NO_X$), and carbon dioxide ($CO_2$).

  The AQD initiated the creation of the Michigan Mercury Electric Utility Workgroup for Mercury Emissions from Coal-Fired Power Plants in 2003. This workgroup consisted of MDEQ and Michigan Public Service Commission staff; representative from utilities potentially impacted by the workgroup recommendations; and representatives from environmental, scientific, and public policy groups. The workgroup's report along with their recommendations was finaled on June 21, 2005.[54] This report also includes detailed information on:

  - background, sources, and uses of mercury;
  - its impacts to health, environment, and recreation;
  - Michigan's monitoring efforts and regulatory programs;
  - mercury emissions, deposition and modeling, including a mercury emissions inventory;

[54] The Michigan's Mercury Electric Utility Workgroup Final Report on Mercury Emissions from Coal-Fired Power Plants is available at http://www.deq.state.mi.us/documents/deq-aqd-air-aqe-mercury-report.pdf.

- federal and other states/regional regulations;[55]
- energy choices and policy development;
- along with controls, costs, methodologies and other issues associated with mercury reduction programs from coal-fired utilities.

- In 2000, the MDEQ, the Minnesota Pollution Control Agency, and the Wisconsin Department of Natural Resources applied for and received a grant from EPA's Great Lakes National Geographic Initiative to identify and quantify under-appreciated sources of mercury to the atmosphere within the three Great Lakes' states. MDEQ's AQD was responsible for administering the funds which included the design and building of a mobile mercury laboratory, housed in a climate-controlled trailer, complete with a generator, two Tekran 2537A mercury vapor analyzers, meteorological monitoring equipment, data loggers, and a computer for data compilation and analysis (**38**). This "Tekran" trailer was then shared and continues to be shared on a rotation basis among the tri-states for quantifying mercury emissions from:

  - manufacturing facilities (thermometers, chlor-alkali),
  - mercury recyclers (fluorescent bulbs, smelters, and other materials),
  - scrap metal yards and shredders,
  - solid waste processing facilities,
  - medical waste autoclaves,
  - land-applied wastes (sewage sludge, wood ash, coal ash),
  - taconite tailings basins,
  - control soils, and
  - parking lots.

  In addition, the funding also allowed the purchase and sharing of two portable Lumex RA 915+ mercury vapor analyzers. The three states assist local health departments in providing use of the Lumex to facilitate quantification of mercury concentrations in homes or businesses where mercury was spilled. The final grant report titled, Identification of Atmospheric Mercury Sources in the Great Lakes States Through an Ambient Monitoring Program was finalized in November 2003.[56]

- The AQD, partnering with the University of Michigan, were awarded grants from the Michigan Great Lakes Protection Fund and the EPA's Great Lake Atmospheric Deposition Program to develop a mercury monitoring network. The project began in the fall of 2001. Because Michigan lacks long-term mercury data from urban areas, sites were established in three urban areas of Grand Rapids, Flint, and Detroit. In addition, the recording of long-term event-based mercury deposition continued at three rural sites in Michigan (Dexter, Pellston, and Eagle Harbor) (**39**).

  Preliminary data demonstrated the influence of local sources emitting mercury and the importance of speciated mercury monitoring to assess man-made source contributions to wet (e.g., rain) deposition of mercury. To allow trend analysis, the AQD and University of Michigan received additional funding to extend this project through the fall of 2005.

[55] In 2004, EPA addressed mercury emissions with the Clean Air Mercury Rule (CAMR). CAMR, to be finaled in 2005, proposes to permanently cap and reduce mercury emissions from coal-fired power plants.

[56] The final grant report is available on the AQD's website at http://www.deq.state.mi.us/documents/deq-aqd-toxics-Hgfinalreport.pdf.

While 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.

# CHAPTER 4: Special Projects

## AQD's Web Monitoring and Mapping:

The WEBMONMAP (Web Monitoring and Mapping) is a web-based program designed to report raw hourly air pollution data collected at MDEQ air monitoring sites and displays it graphically over the U.S. Census Bureau TIGER base maps in an array of time series plots. The air pollution data is downloaded directly from the air monitoring stations.[57] The WEBMONMAP program then performs a series of calculations to create images that display the pollutant concentrations recorded over the past hour and updates every hour. In the case of 8-hour $O_3$ and 24-hour $PM_{2.5}$, it shows the maximum 8-hour and 24-hour concentration values recorded during that day. WEBMONMAP software also displays levels for $SO_2$ and CO, with plans in 2005 to display meteorological data.

The time of the actual graphical data upload, referenced in Eastern Standard Time, will be printed on each map. Please note that the raw data utilized in WEBMONMAP's graphical displays has not been fully quality assured. The data is provided as a public service and should not be used for trends analysis or official reporting.

## Air Quality Index:

The AQI is a tool that is used by the MDEQ and the EPA to report daily air quality data. The tool for displaying the AQI is AQD's WEBMONMAP that uses a relative scale of 0 to 500 to provide a measure of air quality. The higher the AQI value, the greater the level of air pollution and potential for health concerns, in terms of acute health effects over time periods of 24 hours or less.

In **Table 4-1**, each air pollutant concentration is related to an index value and the AQI is the highest of the corresponding index values for the monitored air pollutants. The AQI index has limitations in that it does not provide an indication of chronic air pollution exposure over months or years, nor does it reflect additive, synergistic, or antagonistic health effects that may result from exposure from two or more air pollutants.

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

| | | POLLUTANT CONCENTRATION | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **AQI Value** | **AQI Descriptor** | **$PM_{2.5}$ (24 hr) $\mu g/m^3$** | **$PM_{10}$ (24 hr) $\mu g/m^3$** | **$SO_2$ (24 hr) ppm** | **$O_3$ (8 hr) ppm** | **$O_3$ (1 hr) ppm** | **CO (8 hr) ppm** | **$NO_2$ (1 hr) ppm** |
| 500 | | 500.4 | 604 | 1.004 | | 0.604 | 50 | 2.04 |
| 400 | Hazardous (AQI > 301) | 350.4 | 504 | 0.804 | | 0.504 | 40 | 1.64 |
| 300 | Very Unhealthy (AQI 201-300) | 250.4 | 424 | 0.604 | 0.374 | 0.404 | 30 | 1.24 |
| 200 | Unhealthy (AQI 151-200) | 150.4 | 354 | 0.304 | 0.124 | 0.204 | 15 | 0.64 |
| 150 | Unhealthy for sensitive groups (AQI 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 | |

[57] Air pollution data uploads could be delayed if a telephone line or modem is disabled at one of the stations.

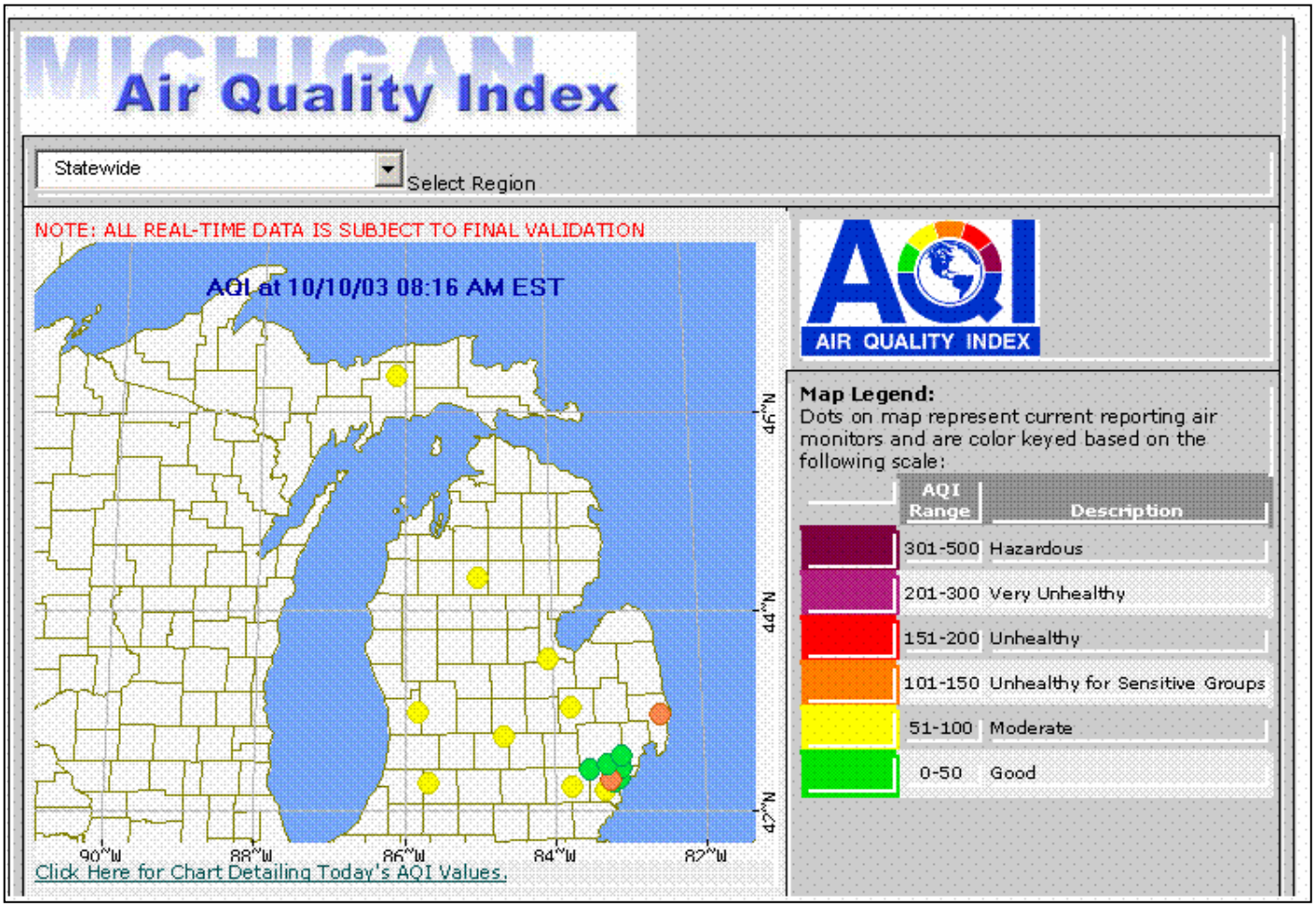
The EPA has assigned a specific color to each AQI category. **Table 4-2** identifies the AQI colors and the associated health statements by individual air pollutant. These color codes are used to display AQI values and level of health concern.

## Table 4-2: The AQI Colors and Health Statements

| AQI COLOR, CATEGORY & VALUE | PARTICULATE MATTER | OZONE | CARBON MONOXIDE | SULFUR DIOXIDE | NITROGEN DIOXIDE |
|---|---|---|---|---|---|
| | ($\mu g/m^3$) 24-Hour | (ppm) 8-Hour / 1-Hour | (ppm) 8-hour | (ppm) 24-hour | (ppm) 1-hour |
| **GREEN:** Good 1-50 | **None** | **None** | **None** | **None** | **None** |
| **YELLOW**: Moderate 51-100 | Unusually sensitive people should consider reducing prolonged or heavy exertion | Unusually sensitive people should consider reducing prolonged or heavy exertion | **None** | **None** | **None** |
| **ORANGE**: Unhealthy For Sensitive Groups 101-150 | People with heart or lung disease, older adults, and children should reduce prolonged or heavy exertion. | Active children and adults, and people with lung disease such as asthma, should reduce prolonged or heavy 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** |
| **RED**: Unhealthy 151-200 | People with heart or lung disease, older adults, and children should avoid prolonged or heavy exertion. Everyone else should limit prolonged exertion. | Active children and adults, and people with lung disease such as asthma, should avoid prolonged or heavy exertion. Everyone else, especially children, should reduce prolonged outdoor exertion. | People with cardiovascular disease, such as angina, should limit moderate exertion and avoid sources of CO, such as heavy traffic. | Children, asthmatics, and people with heart or lung disease should limit outdoor exertion. | **None** |
| **PURPLE**: Very Unhealthy 201-300 | People with heart or lung disease, older adults, and children should avoid all physical activity outdoors. Everyone else should avoid prolonged or heavy 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 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. |
| **MAROON**: Hazardous 301-500 | Everyone should avoid any outdoor exertion; people with heart or lung disease, older adults, and children should remain indoors. | Everyone should avoid all outdoor exertion. | 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. |

The following **Figure 4-1** provides an example map displaying AQI values as color-coded dots for each monitor site throughout the state.

## Figure 4-1: Air Quality Index



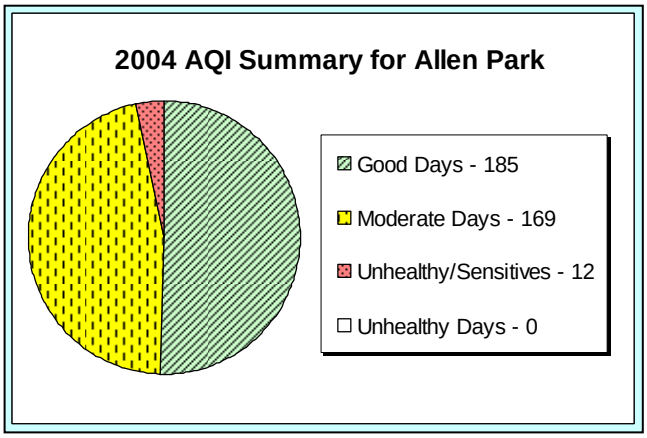

Air quality in Michigan generally falls in the "good" or "moderate" range. Rarely does the state record unhealthy air quality. Occasionally, an area will fall into the "unhealthy for sensitive groups" range. AQI values are made available to the public and local news agencies (newspapers, television, and radio) on a daily basis and are also updated daily on the MDEQ's website at http://www.michigan.gov/deqair, under "Air Quality Index." AQI values are presented in tabular form and plotted on a state map with color-coded dots that signify the AQI value.

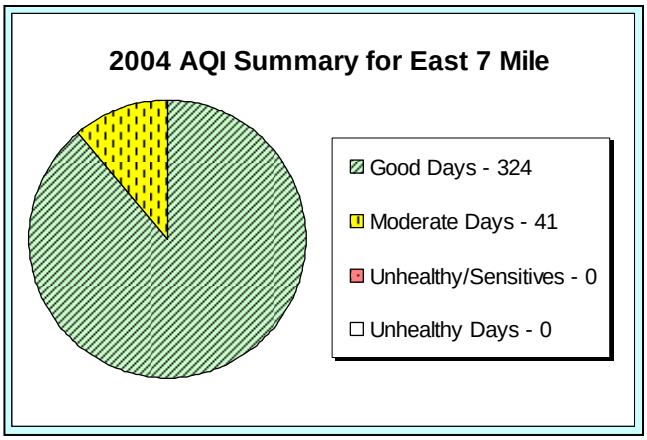
Not all parameters are measured at each site. In fact, some sites only obtain AQI measurements for that portion of the year corresponding to the $O_3$ season, therefore, the number of days for each site may not be equivalent to 365 days per year.

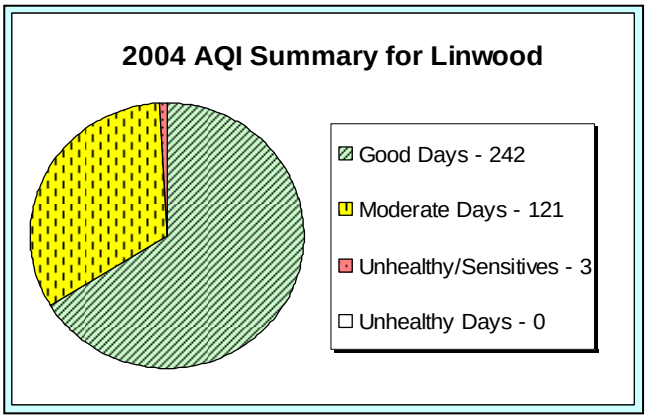
Michigan has never recorded an AQI above 300. The following pie charts are grouped within various areas of Michigan and show the 2004 AQI value for each monitoring site location within that area:

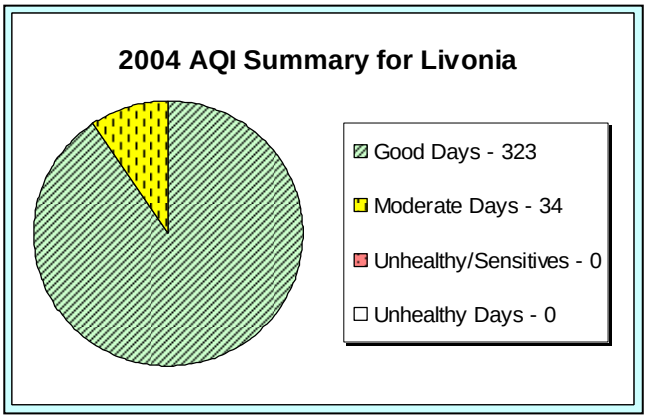
- **Figure 4-2** - Detroit Area AQI Summaries
- **Figure 4-3** - Flint, Ann Arbor, and Saginaw AQI Summaries
- **Figure 4-4** - Lansing/East Lansing AQI Summaries
- **Figure 4-5** - West Michigan AQI Summaries
- **Figure 4-6** - Northern Michigan AQI Summaries

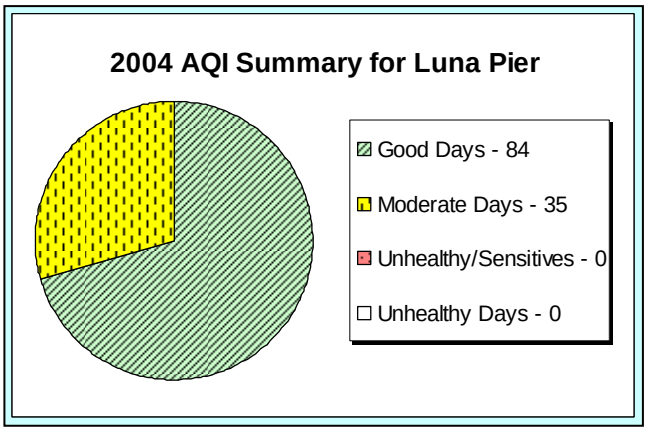
# Figure 4-2: Detroit Area AQI Summaries

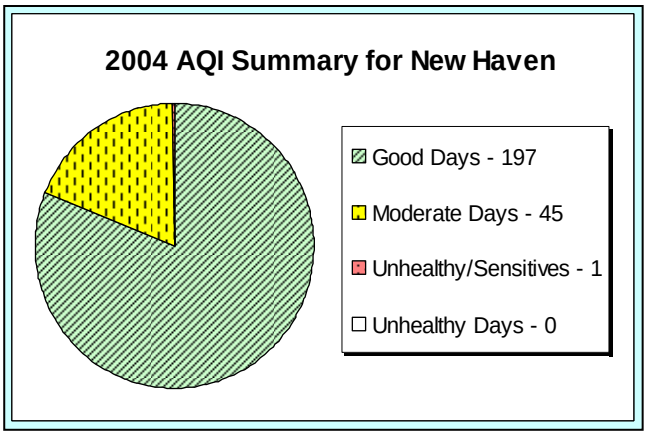


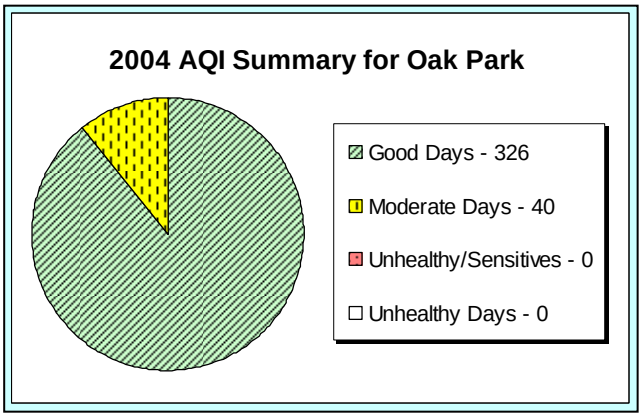



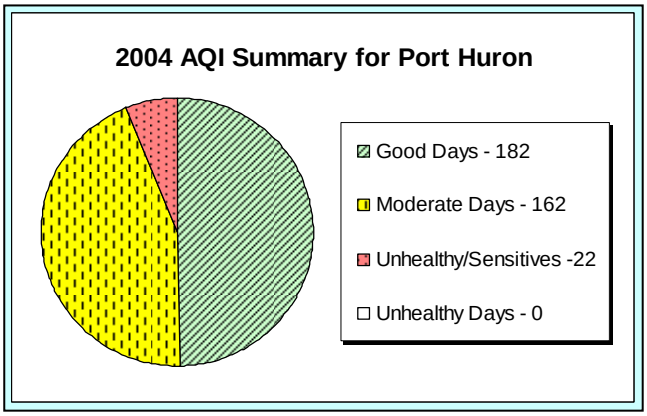



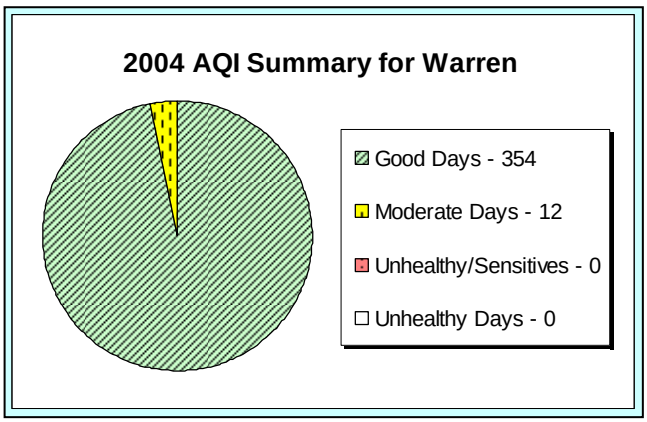



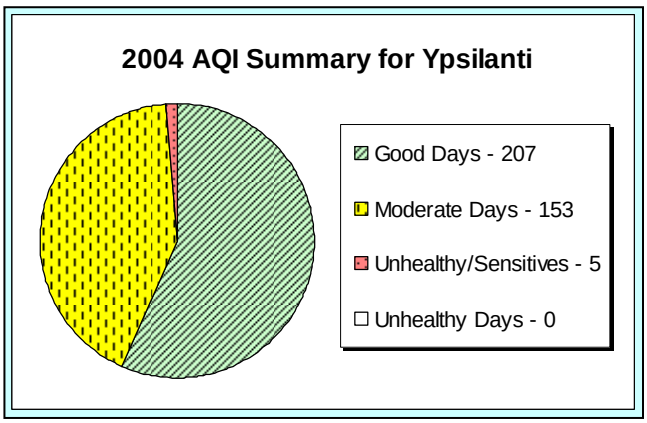



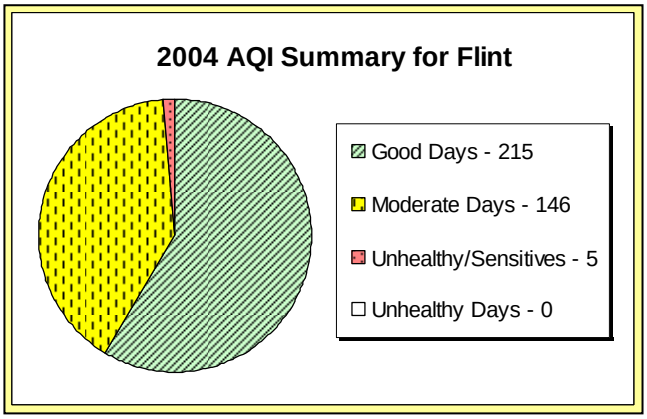



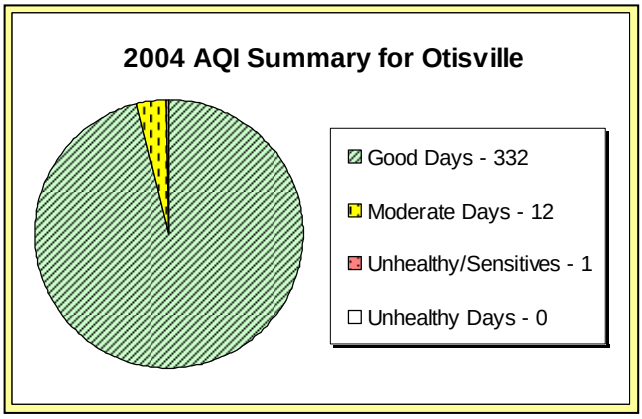
## Figure 4-2: Detroit Area AQI Summaries (Continued)

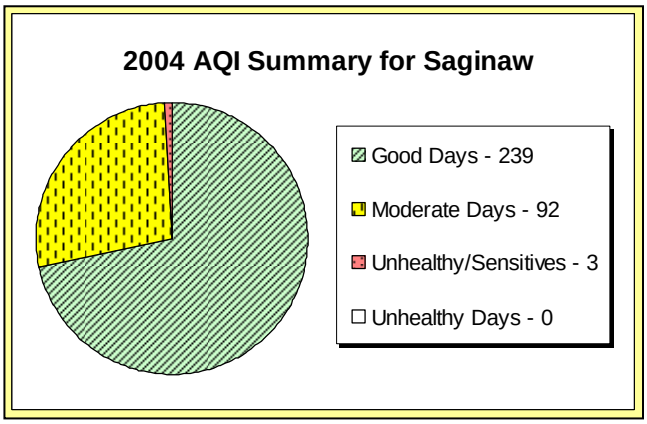


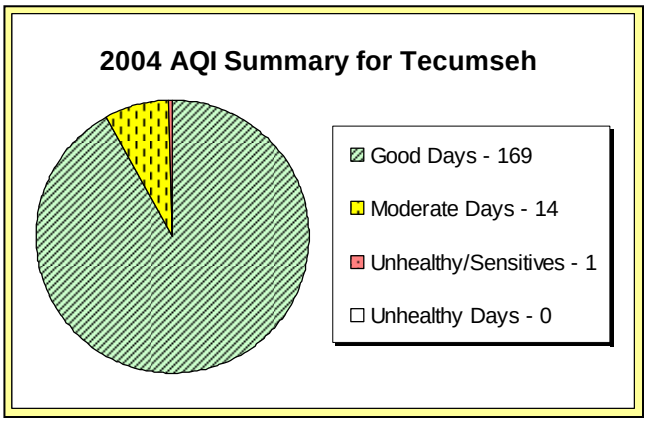




## Figure 4-3: Flint, Ann Arbor, Saginaw AQI Summaries

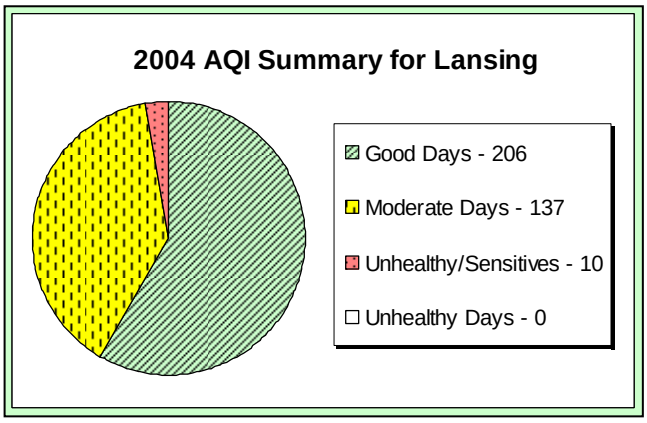


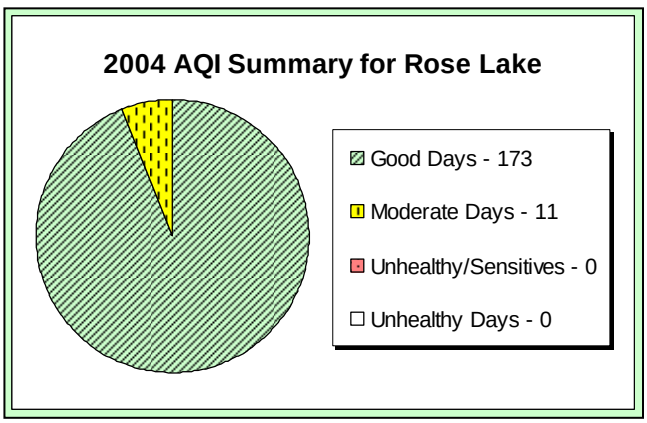



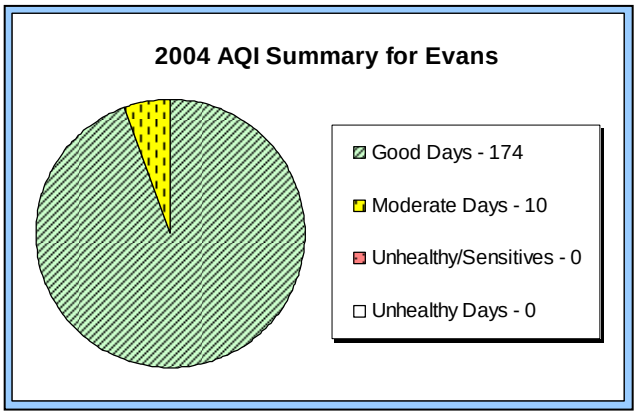

## Figure 4-4: Lansing-East Lansing AQI Summaries

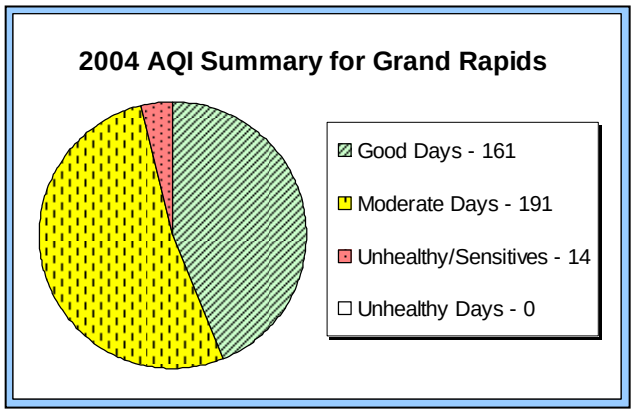


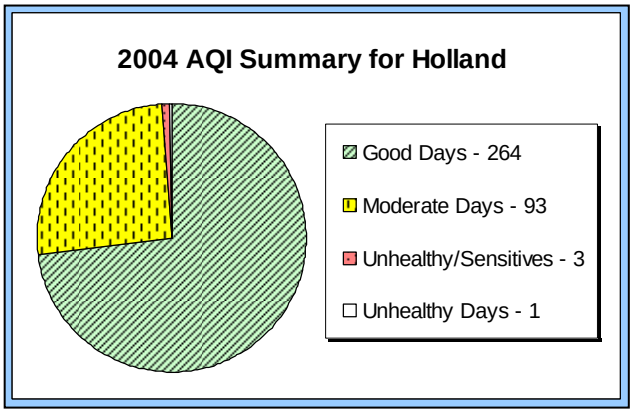



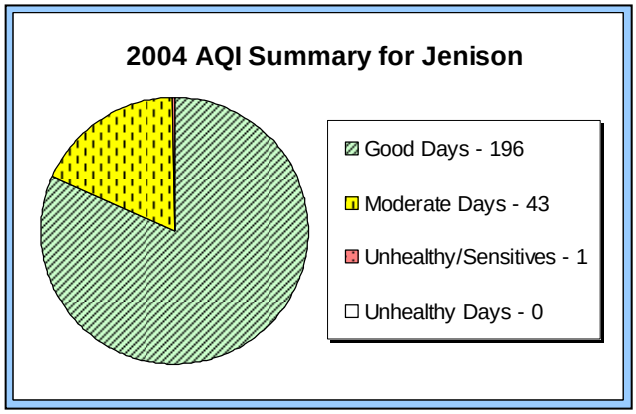
# Figure 4-5: West Michigan AQI Summaries

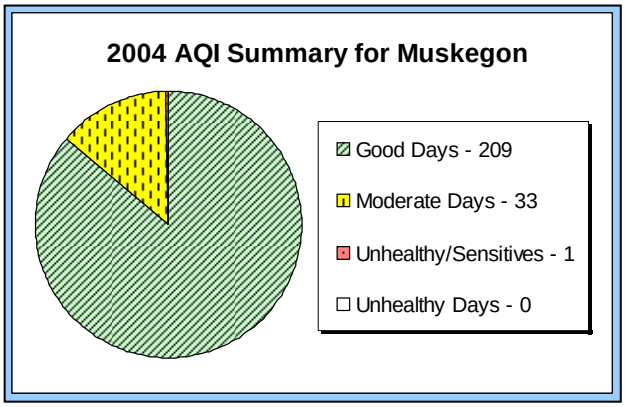
## Grand Rapids-Muskegon-Holland



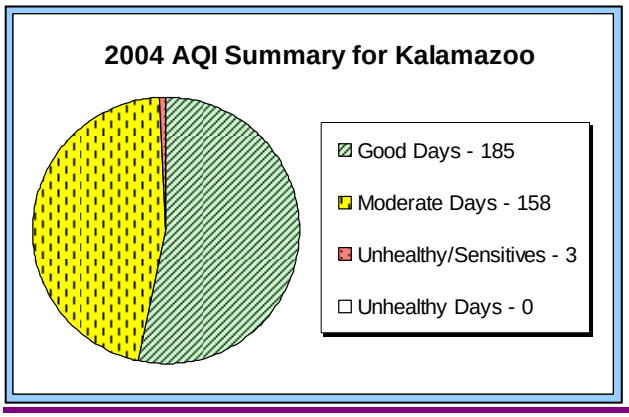



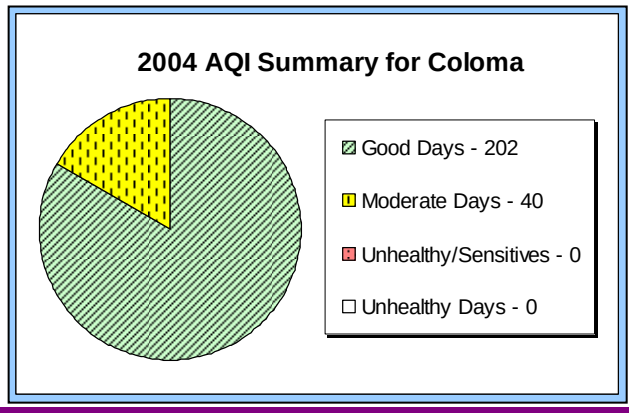



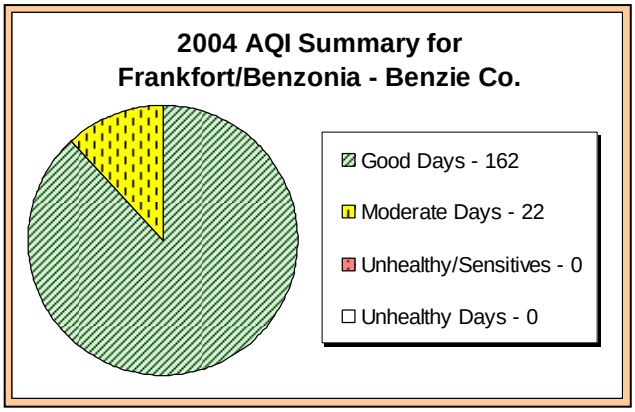



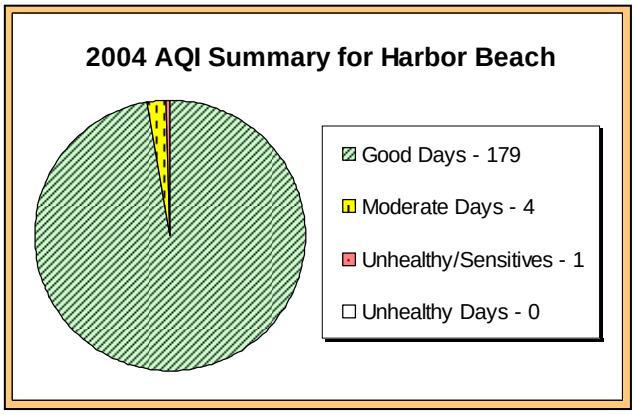

## Kalamazoo-Benton Harbor

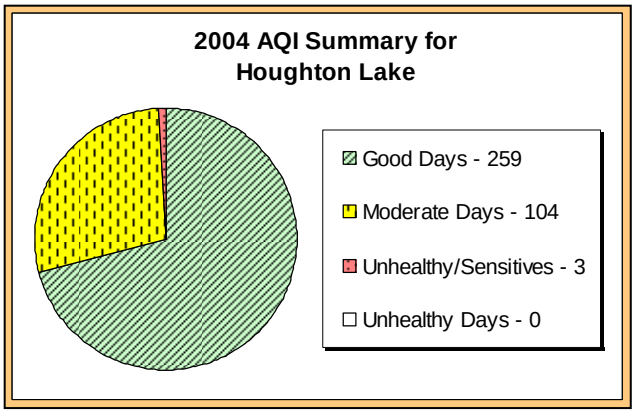


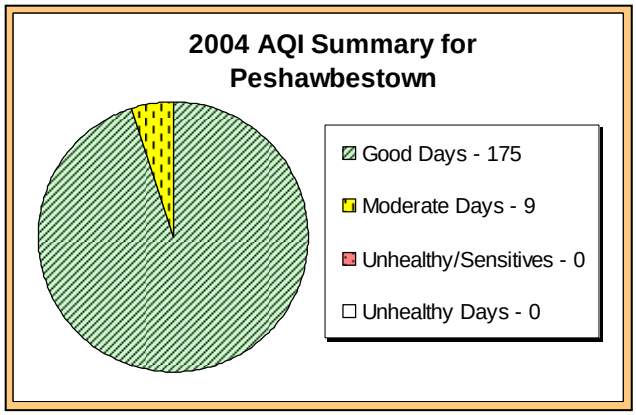



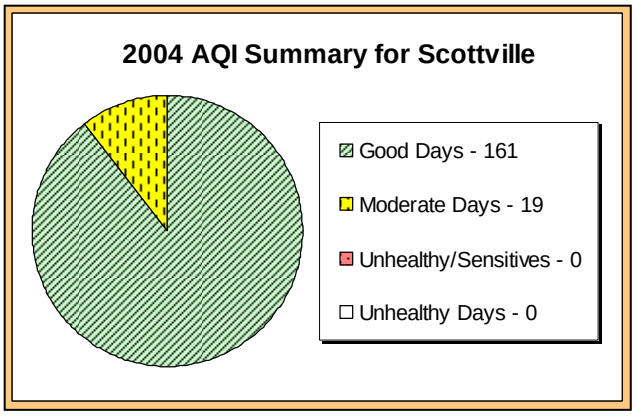
# Figure 4-6: Northern Michigan AQI Summaries

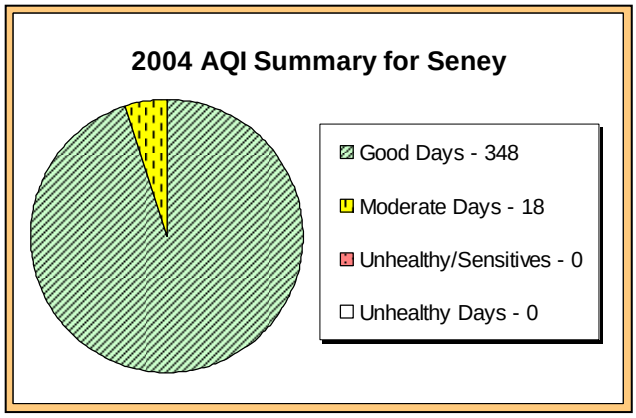


## Michigan's Ozone Action!:

*Ozone Action!* days are declared in southeast and west Michigan when meteorological conditions are conducive for elevated ground-level $O_3$ to occur. When 8-hour $O_3$ levels are expected to exceed 0.085 ppm, the AQI health indicator, an *Ozone Action!* day may be called. On *Ozone Action!* days, business, industry, government, and the public are encouraged to take voluntary action to reduce emissions that lead to the formation of $O_3$. Clean air choices include:

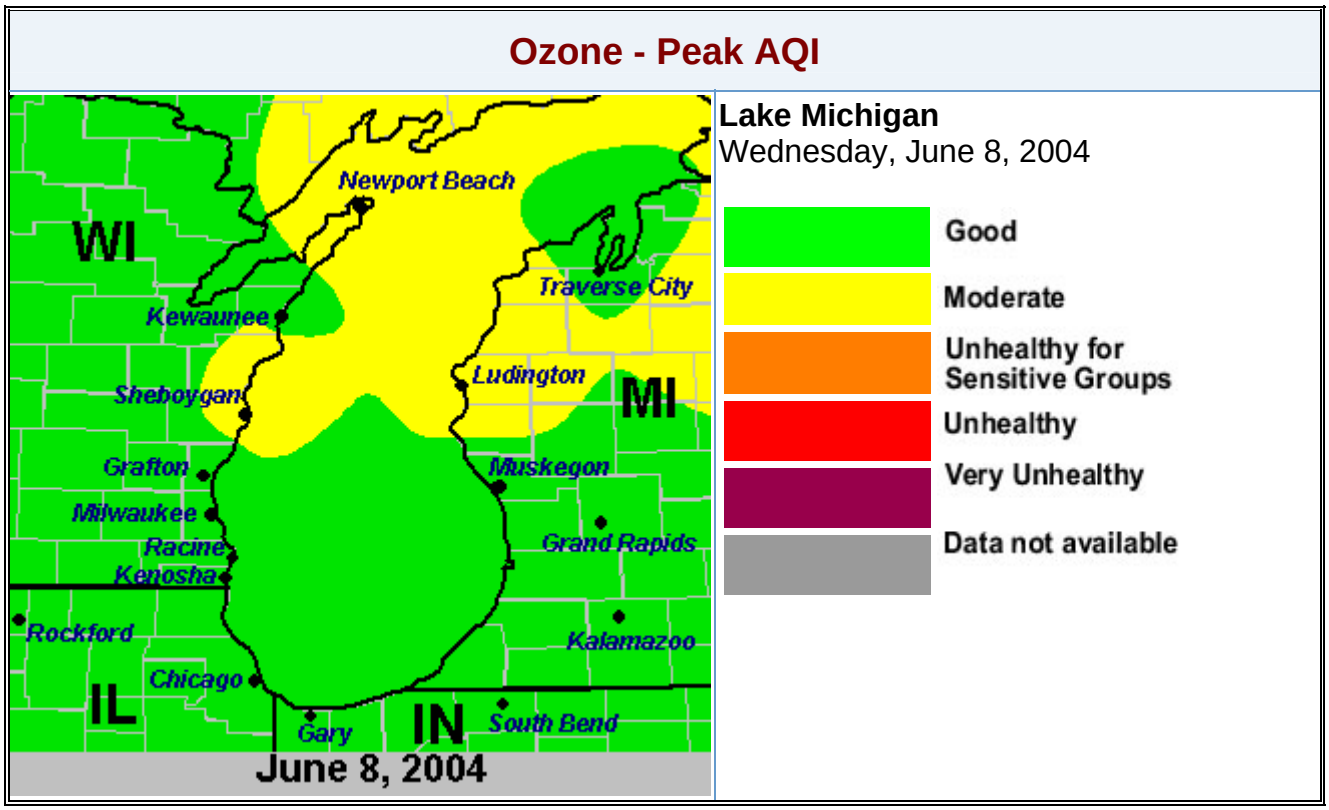
- avoiding the refueling of vehicles or choosing to refuel during the evening hours;
- omitting unnecessary travel;
- selecting alternative transportation options such as carpools, taking the bus, walking or biking;
- deferring the use of gasoline-powered lawn and recreation equipment (particularly inefficient two-stroke engines);
- reducing energy use; and
- modifying use of household solvents and cleaners.

**Table 4-3** shows that during 2004, only one *Ozone Action!* Day was called for both Southeast and West Michigan. **Figure 4-7** displays Lake Michigan's Peak AQI map for that day.

### Table 4-3: 2004 *Ozone Action!* Day Information

| MONTH | SEMCOG (Southeast Michigan) | WMCAC (West Michigan) |
|---|---|---|
| JUNE | Tuesday, 8th | Tuesday, 8th |
| TOTAL: | 1 | 1 |

### Figure 4-7: Lake Michigan's Ozone Peak AQI Map for June 8, 2004

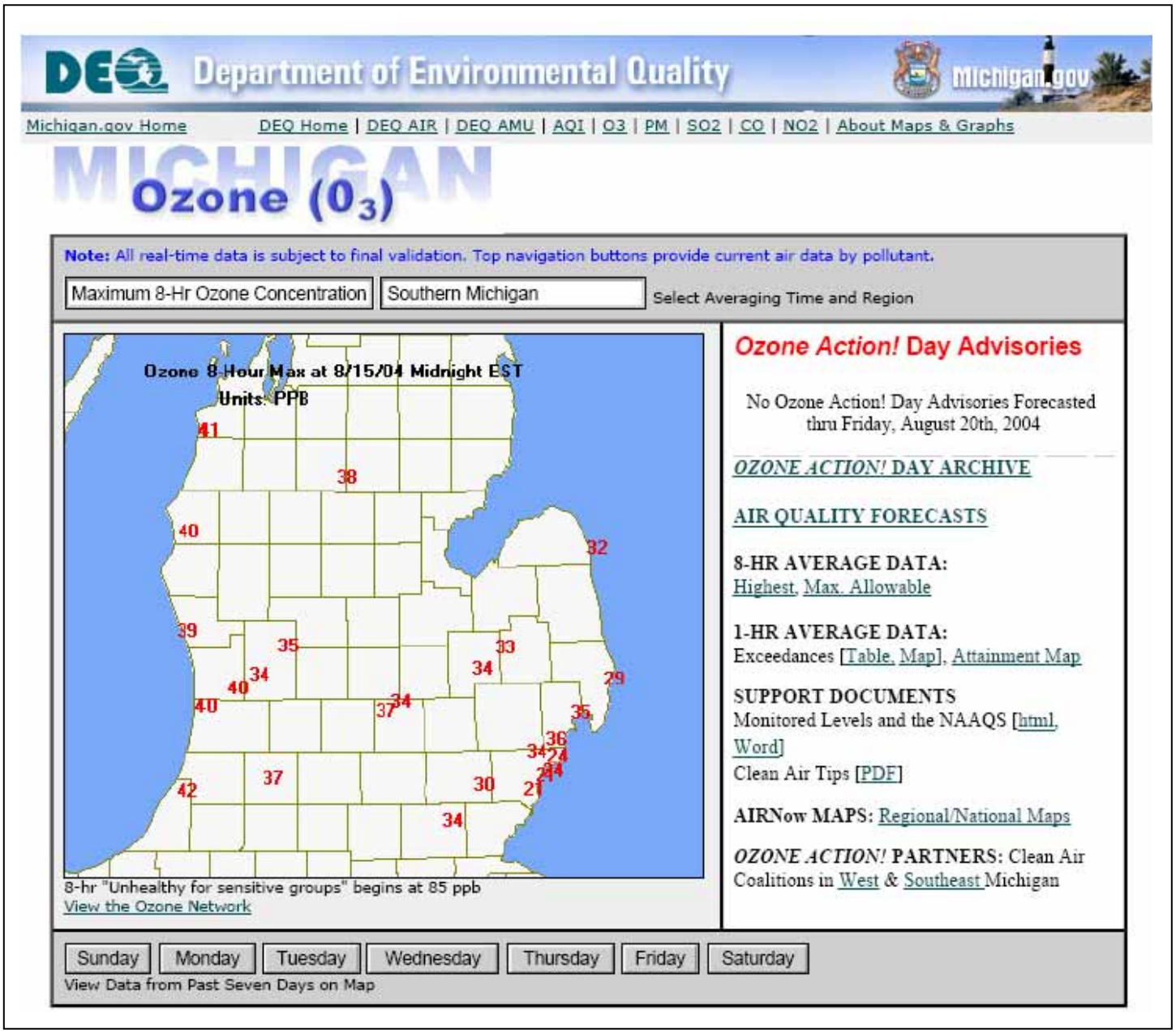


As part of the notification and education process for Michigan's *Ozone Action!* days, the AQD's website lists *Ozone Action!* day information and provides current and extended forecasts, as well as a historical summaries of *Ozone Action!* days for western and southeastern Michigan, and is displayed in **Figure 4-8**. Maximum daily $O_3$ concentrations are displayed as both 1-hour and 8-hour values by geographical location on a near real time basis. $O_3$ values for both averaging times are also available for the previous week along with web links that provide:

- Exceedances of the 1-hour $O_3$ standard,
- Highest 8-hour $O_3$ values by year,
- Three-year average of the 4$^{TH}$ highest 8-hour $O_3$ values,
- Attainment maps,
- Monitor locations by pollutant.

Additional *Ozone Action!* Information is available at http://www.michigan.gov/deqair, under "*Ozone Action!*" and includes the website links to its *Ozone Action!* Partners.

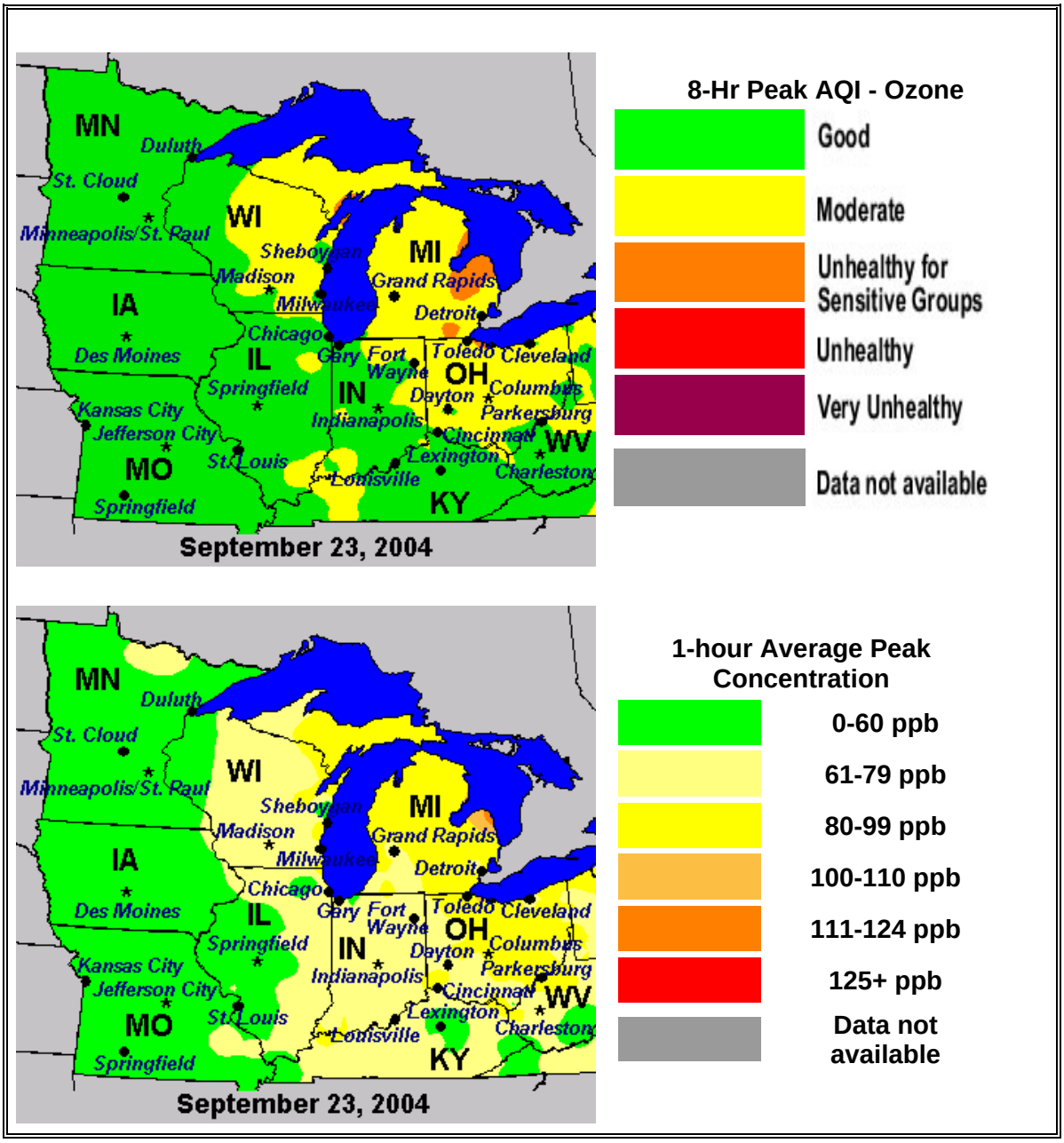
## Figure 4-8: AQD's *Ozone Action*! Website



## EPA's $O_3$ Mapping:

Michigan supplies data to EPA as part of a cooperative effort between EPA, states, and local air pollution control agencies to provide near real time information on ground level $O_3$ concentrations. EPA uses this $O_3$ data to produce maps that display $O_3$ concentrations covering the Midwest, New England, Mid-Atlantic, Southeastern, South Central, and Pacific Coastal regions of the country. In addition, Information can be obtained of current and previous day's $O_3$ animation showing $O_3$ formation and transport with time. There are also web links that provide the previous and/or historical 1-hour and 8-hour peak $O_3$ values as shown in **Figure 4-9**. The EPA AIRNOW website is different from the AQD daily $O_3$ concentration website in that the geographical scale is much broader and data maps are generated over a less frequent time interval basis. EPA's AIRNOW website is available at: http://www.epa.gov/airnow/.

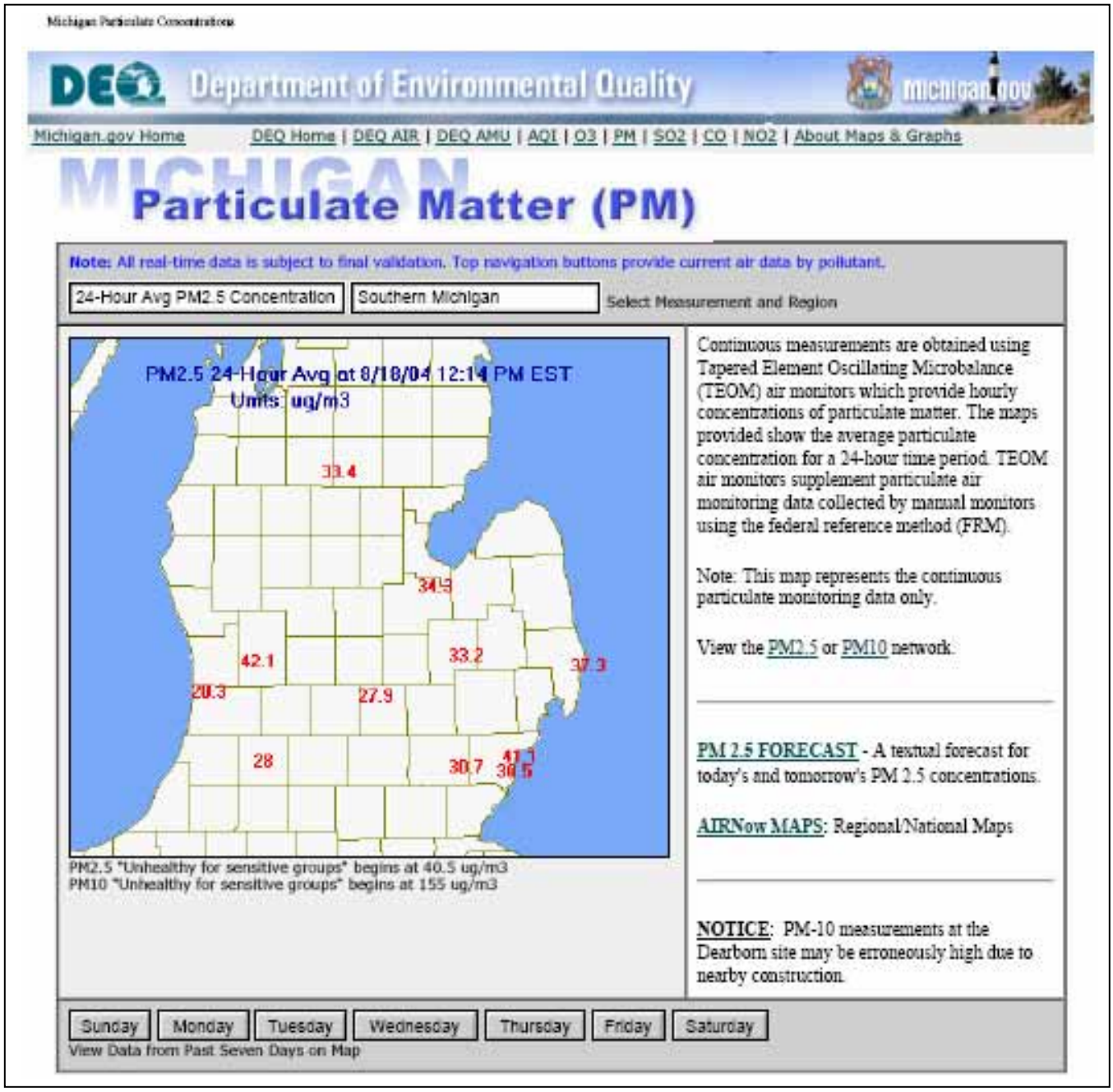
### Figure 4-9: AIRNOW Midwest 8-Hr and 1-Hr Ozone Maps



## AQD's Daily Fine Particulate $PM_{2.5}$ Concentrations Website:

**Figure 4-10** shows the AQD's hourly $PM_{2.5}$ concentrations that are obtained from TEOM air monitors located in Grand Rapids, Holland, Kalamazoo, Saginaw, Flint, Port Huron, Detroit's Allen Park, Dearborn, Ypsilanti, Houghton Lake, and Seney. These continuous monitors supplement the $PM_{2.5}$ data that is currently being collected from the FRM, manual air monitoring equipment. This information is available on the AQD's website at: http://www.deq.state.mi.us/aqi/pm.asp.

### Figure 4-10: $PM_{2.5}$ Daily Concentrations Website



In 2004, the Detroit metropolitan area (Southeast Michigan) was one of five pilot cities selected to participate in a new EPA pilot project called **EnviroFlash**. This pilot project is designed to transmit air quality information electronically, via computer e-mail or mobile text messaging, on $PM_{2.5}$ and $O_3$ ground level pollution in select cities across the nation. EPA's ultimate goal is to develop a nationwide notification system that provides current local environmental information. Other pilot cities selected included Cincinnati-Ohio; Nashville-Tennessee; Oklahoma City-Oklahoma; and Winston/Salem-North Carolina.

Currently air quality forecasts and "near" real-time AQI data are available for the public when they access the AQD website and via EPA's AIRNow. **EnviroFlash** is an additional service that notifies the subscriber about air quality forecasts (at self-selected health levels) and about "Ozone Action!" days. People with small children, family members with asthma (or other health problems), or even those that will have increased deep respiration due to working or exercising strenuously may want to be notified when the air is predicted to be "unhealthy for sensitive groups." This "heads-up" information allows them the ability to adjust their daily activities when poor air conditions are anticipated. People enrolled in **EnviroFlash** get only the information they choose to receive sent directly to their computer e-mail or mobile phone with text messaging.

In 2005, **EnviroFlash** will be expanded to over 100 cities across the nation and will allow the MDEQ to provide real-time air quality forecasts and/or *Ozone Action*! notifications electronically to people living or working in Detroit, Ann Arbor, Flint Saginaw, Kalamazoo, Grand Rapids, Muskegon, Holland, Lansing, and Traverse City (see **Figure 4-11**). Providing this information will help residents make informed decisions on planning their daily activities and in making those clean air choices that improve where we all live, work, and play. Clean air choices include taking "*Action!*" to reduce air pollution levels by driving less, using energy efficient products, and by opting not to burn as combustion generates air pollution.

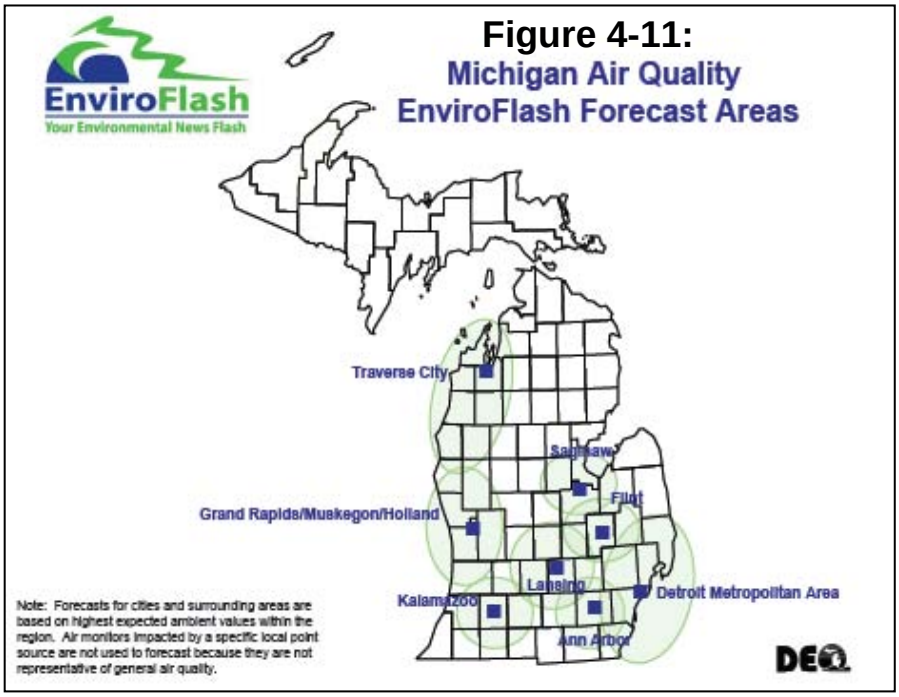



**Figure 4-11: Michigan Air Quality EnviroFlash Forecast Areas**

Future plans hope to include a feature to communicate emergency air issues as well as information on other environmental topics (such as water quality or beach closings).

To sign-up for **EnviroFlash** notices and to view more details about this program visit the AQD's website at: www.michigan.gov/deqair.

# CHAPTER 5: Modeling and Meteorological Information

## Ambient Background Determinations:

Ambient background estimates are needed in order to carry out modeling NSR analyses in NSR applications. These backgrounds are added with modeled impacts to demonstrate that new and modified facilities will not cause a violation of the NAAQS. **Table 5-1** lists default ambient background values by Air Quality Control Region (AQCR) for the latest available years of data.

### Table 5-1: Default Ambient Background Values by AQCR (µg/m$^3$)

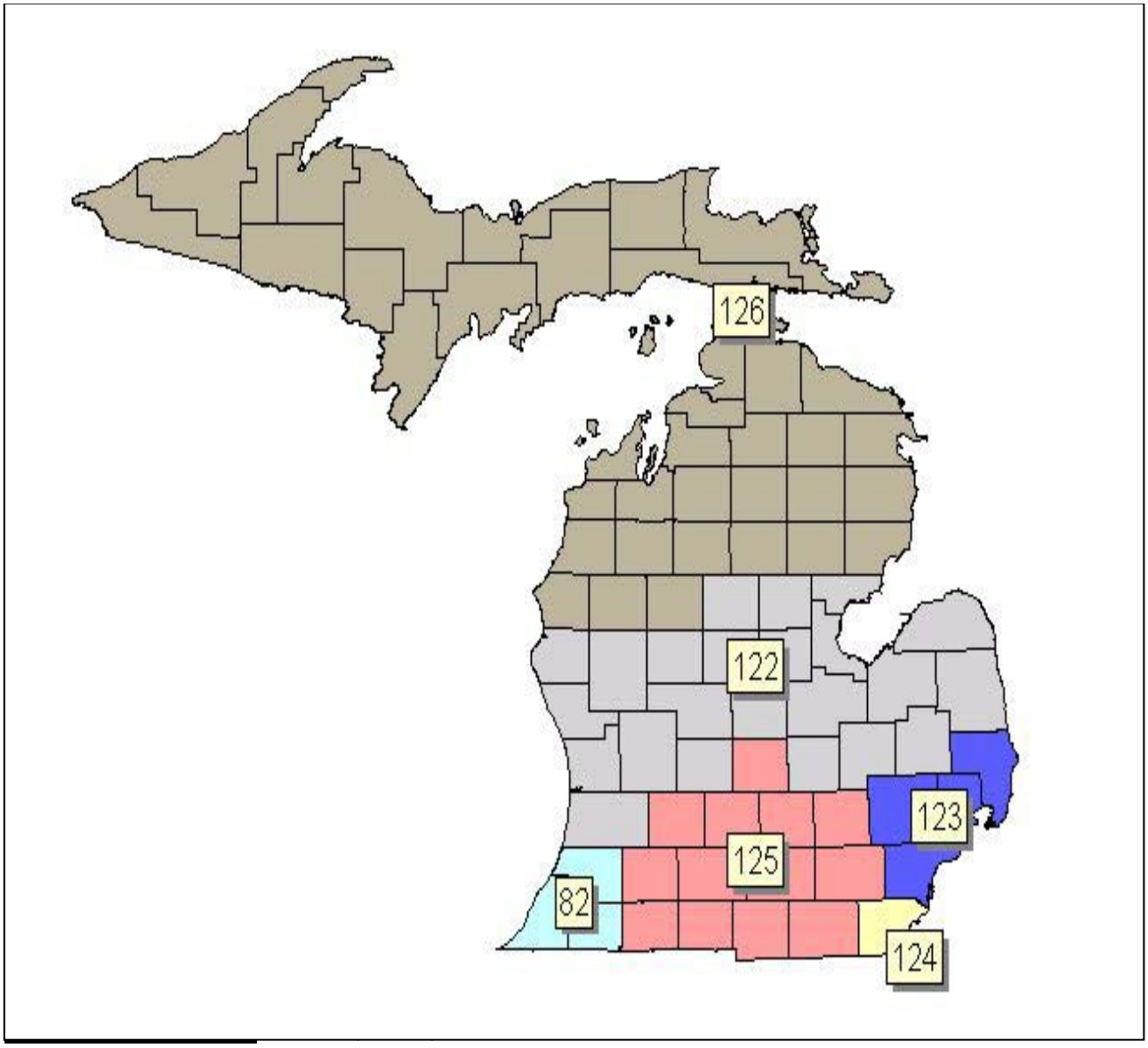
| POLLUTANT | AVERAGING TIME | REGION 82 | REGION 122 | REGION 123 | REGION 124 | REGION 125 | REGION 126 |
|---|---|---|---|---|---|---|---|
| $SO_2$ | 3 Hour (1) | 85 | 67 | 468 | 162 | 67 | 69 |
| | 24 Hour (1) | 40 | 37 | 144 | 51 | 37 | 19 |
| | Annual (2) | 11 | 5 | 19 | 16 | 5 | 5 |
| $PM_{10}$ | 24 Hour (3) | 38 | 53 | 187 | 74 | 52 | 10 |
| | Annual (2) | 19 | 23 | 45 | 23 | 26 | 27 |
| CO | 1 Hour (1) | 5452 | 5452 | 8468 | 4524 | 5452 | 1740 |
| | 8 Hour (1) | 3596 | 3596 | 5104 | 3712 | 3596 | 1624 |
| NO2 | Annual (2) | 29 | 34 | 44 | 36 | 25 | 8 |
| Pb | Quarterly (4) | 0.02 | 0.02 | 0.08 | 0.27 | 0.02 | 0.01 |

Footnotes:

(1) High second high values observed.
(2) Highest of the three highest annual concentrations observed.
(3) Fourth highest 24-hour concentration observed.
(4) Highest quarterly concentration observed.

**Figure 5-1** shows the locations of the AQCRs with the counties within each region specified below. Please note that these background values are generalized and that certain NSR applications may demand more site specific values. If more site specific information is desired, please contact the AQD's Strategy Development Unit at 517-373-7023.

## Figure 5-1: AQCR and Counties For NSR Ambient Backgrounds




**Region 122 Counties:** Allegan, Arenac, Bay, Clare, Genesee, Gladwin, Gratiot, Huron, Ionia, Isabella, Kent, Lapeer, Mecosta, Midland, Montcalm, Muskegon, Newaygo, Oceana, Ottawa, Saginaw, Sanilac, Shiawassee, Tuscola

**Region 123 Counties:** Macomb, Oakland, St. Clair, Wayne

**Region 124 County:** Monroe

**Region 125 Counties:** Barry, Branch, Calhoun, Clinton, Eaton, Hillsdale, Ingham, Jackson, Kalamazoo, Lenawee, Livingston, St. Joseph, Washtenaw

**Region 126 Counties:** Alcona, Alger, Alpena, Antrim, Baraga, Benzie, Charlevoix, Cheboygan, Chippewa, Crawford, Delta, Dickinson, Emmet, Gogebic, Grand Traverse, Houghton, Iosco, Iron, Kalkaska, Keweenaw, Lake, Leelanau, Luce, Mackinac, Manistee, Marquette, Mason, Menominee, Missaukee, Montmorency, Ogemaw, Ontonagon, Osceola, Oscoda, Otsego, Presque Isle, Roscommon, Schoolcraft, Wexford

## Climatological Information:

Michigan owes much of its climate to its mid-latitude location. Stretching from about 41.5 degrees ($^o$) to 47.5$^o$ north latitude, Michigan's weather varies dramatically depending upon the seasonal position of the polar jet stream. In the winter, the polar jet passes to the south of Michigan, exposing the state to cold arctic air masses. In the summer, when the polar jet is to the north of the state, Michigan experiences warm weather thanks to air masses originating in the Gulf of Mexico. However, the Great Lakes also have a profound impact upon Michigan's weather. "Lake-effects" are usually greatest within approximately thirty miles of the lakeshore, but can extend further inland. In the summer, air above the Great Lakes is transported onshore as a cool breeze. In the fall these waters, cooling slower than the surrounding land, can help warm the lakeshore, increasing the number of frost-free growing days. As winter's first cold winds blow across the warm, open lakes, clouds often form to produce intense, localized snowfalls. In the spring, when moisture-laden air passes over a cold lake surface, it may cool enough to cause broad fog banks to form along shoreline areas.

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

## 2004 Temperature and Precipitation Data for Michigan:

**Figures 5-2** through **5-4** (average daily temperatures) and **Figures 5-5** through **5-7** (total monthly precipitation amounts) show total amounts as compared to their climatic norms for sites in the Upper Peninsula, and the northern and southern Lower Peninsula. These figures were constructed by averaging data from several National Weather Service (NWS) stations and therefore are not meant to be representative of any one single location in Michigan. Instead, they are intended to depict the regional trends that occurred during the year 2004.

**Figure 5-2: Southern Lower Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures**

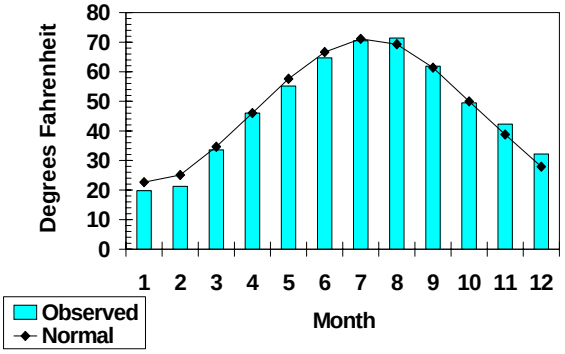



**Figure 5-3: Northern Lower Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures**

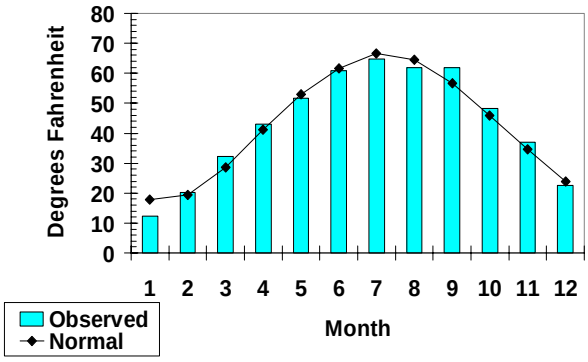



**Figure 5-4: Upper Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures**

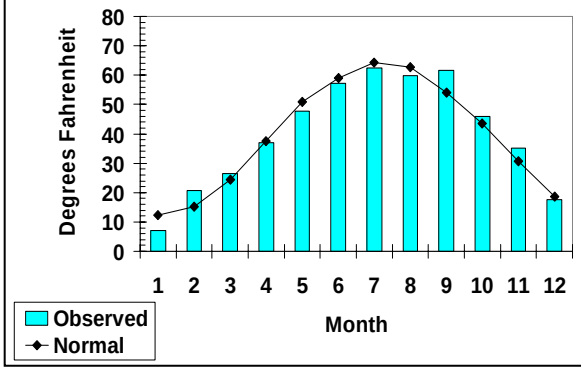



**Figure 5-5: Southern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation**

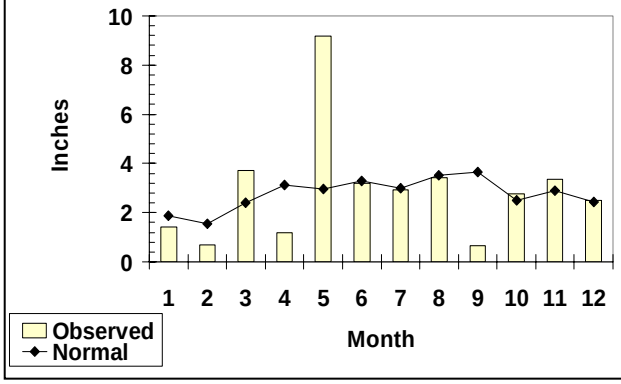



**Figure 5-6: Northern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation**

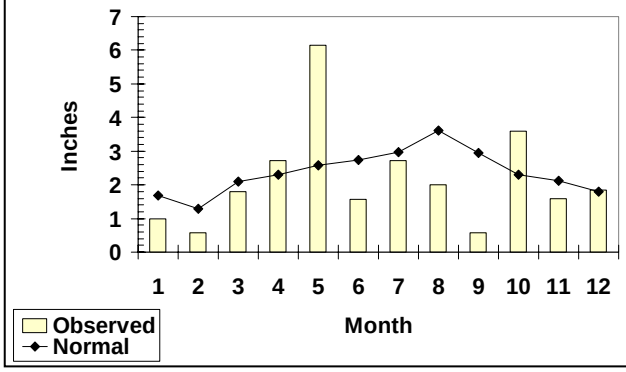
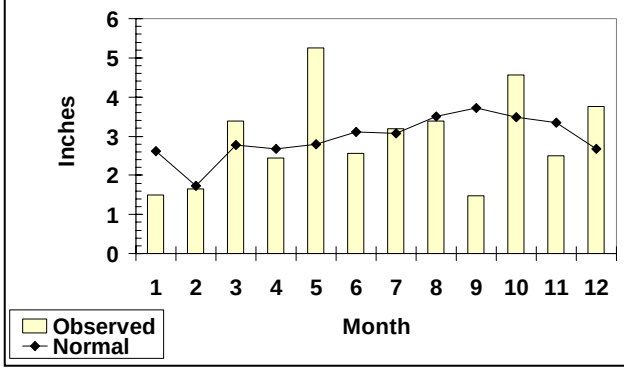



**Figure 5-7: Upper Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation**



## Meteorological Monitoring in Michigan:

**Figure 5-8** and **Table 5-2** show the locations of MDEQ monitoring stations and the type of meteorological data collected at these sites. Wind speed and wind direction data collected at these sites represent a vector sum average over the entire hour. **Figure 5-8** also shows the locations where the NWS collects meteorological data. The wind speed and wind direction data collected at the NWS sites are three- to five-minute readings that represents the whole hour.

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 EPA. On-line precipitation data information for these NADP monitoring sites is available at: http://nadp.sws.uiuc.edu/nadpdata/state.asp?state=MI.

As part of the IADN, meteorological information is collected at Sleeping Bear Dunes and Eagle Harbor. Wind roses for the Great Lakes IADN sites are periodically published and made available on-line at: http://www.epa.gov/grtlakes/air.

Meteorological data and extended forecasts for Michigan's Ozone Action! Days are available at: http://www.deq.state.mi.us/aqi/o3.asp.

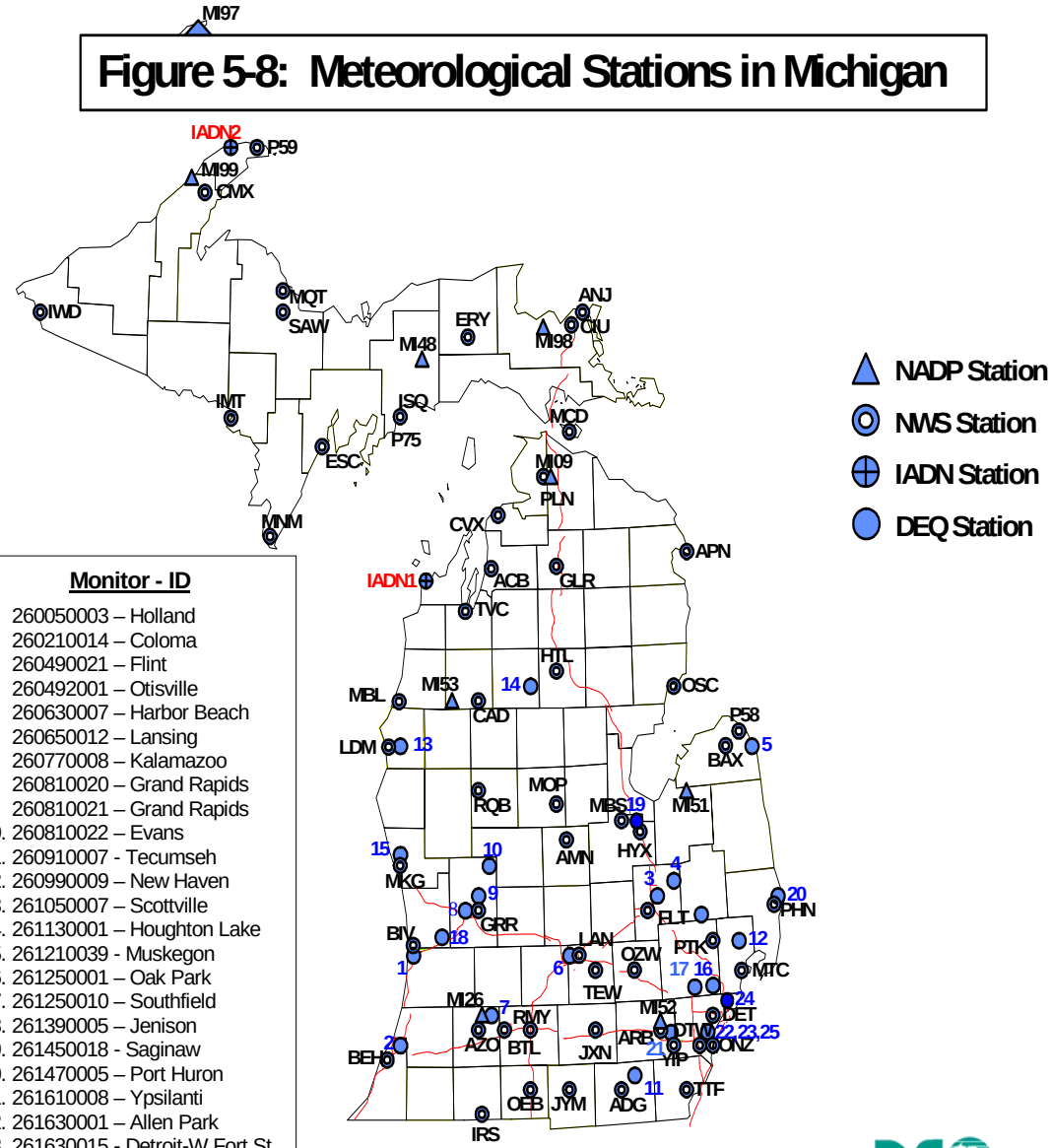
More meteorological information can be obtained from the NWS at http://www.nws.noaa.gov/.

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

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

## Figure 5-8: Meteorological Stations in Michigan




**Monitor - ID**

1. 260050003 – Holland
2. 260210014 – Coloma
3. 260490021 – Flint
4. 260492001 – Otisville
5. 260630007 – Harbor Beach
6. 260650012 – Lansing
7. 260770008 – Kalamazoo
8. 260810020 – Grand Rapids
9. 260810021 – Grand Rapids
10. 260810022 – Evans
11. 260910007 - Tecumseh
12. 260990009 – New Haven
13. 261050007 – Scottville
14. 261130001 – Houghton Lake
15. 261210039 - Muskegon
16. 261250001 – Oak Park
17. 261250010 – Southfield
18. 261390005 – Jenison
19. 261450018 - Saginaw
20. 261470005 – Port Huron
21. 261610008 – Ypsilanti
22. 261630001 – Allen Park
23. 261630015 - Detroit-W Fort St
24. 261630019 - Detroit-E 7 Mile
25. 261630033 - Dearborn

## Table 5-2: Meteorological Data Collected in Michigan During 2004

| Site ID Station | Wind Speed | Wind Direction | Resultant Speed | Resultant Direction | Temp | Relative Humidity | Solar Radiation | Barometric Pressure |
|---|---|---|---|---|---|---|---|---|
| 260050003 Holland | | | √ | √ | √ | √ | √ | √ |
| 260210014 Coloma | | | √ | √ | √ | | | |
| 260490021 Flint | | | √ | √ | √ | | | √ |
| 260492001 Otisville | | | √ | √ | √ | | | |
| 260630007 Harbor Beach | | | √ | √ | √ | | | |
| 260650012 Lansing | | | √ | √ | √ | | | √ |
| 260770008 Kalamazoo | | | √ | √ | √ | | | |
| 260810020 Grand Rapids | | | √ | √ | √ | | | √ |
| 260810021 Grand Rapids | | | √ | √ | √ | | | |
| 260810022 Evans | | | √ | √ | √ | | | |
| 260890001 Peshawbestown | | | √ | √ | √ | | | |
| 260910007 Tecumseh | | | √ | √ | √ | | | √ |
| 260990009 New Haven | | | √ | √ | √ | √ | √ | |
| 261050007 Scottville | | | √ | √ | √ | | | |
| 261130001 Houghton Lake | | | √ | √ | √ | | | √ |
| 261210039 Muskegon | | | √ | √ | √ | | | |
| 261250001 Oak Park | | | √ | √ | √ | | | √ |
| 261250010 Southfield | √ | √ | | | √ | | | |
| 261390005 Jenison | | | √ | √ | √ | | | |
| 261450018 Saginaw | | | √ | √ | √ | | | √ |
| 261470005 Port Huron | | | √ | √ | √ | | | |
| 261530001 Seney | √ | √ | | | √ | √ | √ | √ |
| 261610008 Ypsilanti | | | √ | √ | √ | | | √ |
| 261630001 Allen Park | √ | √ | | | √ | √ | | √ |
| 261630015 Detroit W Fort | √ | √ | | | √ | √ | | √ |
| 261630019 Detroit E 7 Mile | √ | √ | | | √ | √ | | √ |
| 261630033 Dearborn | √ | √ | | | √ | √ | | √ |

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# Appendix A: Criteria Pollutant Summary for 2004

**Appendix A** utilizes EPA's 2004 AQS Quick Look Report Data to present a summary of ambient air quality data collected for the criteria pollutants at monitoring locations throughout Michigan. Concentrations of non-gaseous pollutants are generally given in $\mu g/m^3$ at 25°C (Celsius) and one atmosphere pressure, and in ppm for gaseous pollutants. The following define some of the terms listed in the **Appendix A** reports.

**Site I.D.**: The AQS site ID is the EPA's code number for these sites and has replaced the MASN number. Prior to 1989, each site was labeled with a five-digit MASN code number.

**POC**: The Parameter Occurrence Code or POC is used to assist in distinguishing different uses of monitors, i.e. under Pb, $NO_2$, and $SO_2$, POC #1-5 are used to help differentiate between monitoring data received. For PM, the POC #'s are used more for the type of monitoring, such as:

- 1 - federal reference method (FRM);
- 2 - co-located FRM;
- 3 - TEOM hourly $PM_{10}$ and $PM_{2.5}$ measurements; and
- 5 - $PM_{2.5}$ speciation monitors (SASS - spiral aerosol speciation sampler shown at right).

MET ONE Spiral Aerosol Speciation Sampler (SASS™)

**# OBS**: For Pb, TSP, $PM_{2.5}$, and $PM_{10}$, the # OBS (number of observations) refers to the number of valid 24-hour values gathered and are measured in $\mu g/m^3$.

For continuous monitors (CO, $NO_2$, $O_3$, $PM_{2.5}$ TEOM, and $SO_2$,), # OBS refers to the total valid hourly averages obtained from the analyzer and are measured in ppm.

**Values**: The value is listed for each criteria pollutant per its NAAQS (primary and secondary). The number of excursions per site for the primary and secondary standards utilize running averages for continuous monitors, except for $O_3$, and does not include averages considered invalid due to limited sampling times. For example, a particulate-mean based only on six months could not be considered as violating the annual standard. As noted, each site is allowed one short-term standard excursion before a violation is determined.

**>:** The "greater than" symbol (>) heads the column reporting values or observations above the corresponding primary or secondary standards.

# CRITERIA POLLUTANT SUMMARY FOR 2004

## CO Measured in ppm

| Site ID | POC | City | County | Year | # OBS | 1-hr Highest Value | 1-hr 2nd Highest Value | # > 35 | 8-hr Highest Value | 8-hr 2nd Highest Value | # > 9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260492001 | 1 | Otisville | Genesee | 2004 | 8096 | 1.1 | 1.0 | 0 | 0.6 | 0.6 | 0 |
| 260810020 | 1 | Grand Rapids | Kent | 2004 | 8680 | 3.0 | 2.8 | 0 | 2.2 | 1.8 | 0 |
| 260991003 | 1 | Warren | Macomb | 2004 | 8739 | 3.3 | 3.0 | 0 | 2.1 | 1.9 | 0 |
| 261250001 | 1 | Oak Park | Oakland | 2004 | 8741 | 4.1 | 4.0 | 0 | 2.4 | 2.3 | 0 |
| 261630001 | 1 | Allen Park | Wayne | 2004 | 8316 | 3.6 | 3.5 | 0 | 3.1 | 2.3 | 0 |
| 261630016 | 1 | Detroit - Linwood | Wayne | 2004 | 8636 | 4.1 | 3.9 | 0 | 2.6 | 2.4 | 0 |
| 261630025 | 1 | Livonia | Wayne | 2004 | 8038 | 1.4 | 1.4 | 0 | 1.2 | 1.1 | 0 |

## Pb (24-Hour) Measured in $\mu g/m^3$

| Site ID | POC | City | County | Year | # OBS | Qtr 1 Arith Mean | Qtr 2 Arith Mean | Qtr 3 Arith Mean | Qtr 4 Arith Mean | # Means > 1.5 | Highest Value | 2nd Highest Value |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260490021 | 4 | Flint | Genesee | 2004 | 59 | .00746 | .00802 | .01213 | .00661 | 0 | .02258 | .02228 |
| 260810021 | 4 | Grand Rapids | Kent | 2004 | 30 | .00825* | .00864* | .01213* | .00747* | 0 | .01833 | .01774 |
| 261130001 | 1 | Houghton Lake | Missaukee | 2004 | 54 | .00272 | .00226 | .00325 | .00274 | 0 | .00677 | .00648 |
| 261610008 | 1 | Ypsilanti | Washtenaw | 2004 | 28 | .00706* | .00755* | .00661* | .00693* | 0 | .01339 | .01276 |
| 261630001 | 2 | Allen Park | Wayne | 2004 | 59 | .00698 | .00872 | .01006 | .00831 | 0 | .02283 | .02178 |
| 261630005 | 1 | River Rouge | Wayne | 2004 | 55 | .01152* | .01359 | .02593 | .01290 | 0 | .06778 | .04889 |
| 261630015 | 4 | Detroit - W. Fort | Wayne | 2004 | 58 | .01147 | .01905 | .02521 | .01533 | 0 | .05847 | .04689 |
| 261630019 | 1 | Detroit - E. Seven Mile | Wayne | 2004 | 59 | .00702 | .01079 | .01042 | .00871 | 0 | .02618 | .01884 |
| 261630027 | 1 | Detroit – W. Jefferson | Wayne | 2004 | 11 | | | | .01732* | 0 | .03716 | .02856 |
| 261630033 | 2 | Dearborn | Wayne | 2004 | 54 | .01446 | .02574* | .01875 | .02616 | 0 | .09870 | .09478 |

*Indicates the mean does not satisfy summary criteria

## $NO_2$ Measured in ppm

| Site ID | POC | City | County | Year | # OBS | 1-Hour Highest Value | 1-Hour 2nd Highest Value | Annual Arith Mean |
|---|---|---|---|---|---|---|---|---|
| 260810020 | 1 | Grand Rapids | Kent | 2004 | 8016 | .062 | .058 | .0141 |
| 261630016 | 1 | Detroit - Linwood | Wayne | 2004 | 6783 | .063 | .063 | .0189 |
| 261630019 | 2 | Detroit - E. Seven Mile | Wayne | 2004 | 7996 | .078 | .078 | .0152 |

## $O_3$ (1-Hour) Measured in ppm

| Site ID | POC | City | County | Year | Num Meas | Num Req | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | Day Max >/= 0.125 Measured | Values >/= 0.125 Estimated | Missed Days < 0.125 Standard |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260050003 | 1 | Holland | Allegan | 2004 | 183 | 183 | .127 | .096 | .092 | .091 | 1 | 1.0 | 0 |
| 260190003 | 1 | Benzonia | Benzie | 2004 | 183 | 183 | .087 | .086 | .085 | .084 | 0 | 0.0 | 0 |
| 260210014 | 1 | Coloma | Berrien | 2004 | 181 | 183 | .089 | .089 | .087 | .084 | 0 | 0.0 | 2 |
| 260270003 | 1 | Cassopolis | Cass | 2004 | 172 | 183 | .096 | .091 | .086 | .083 | 0 | 0.0 | 3 |
| 260370001 | 2 | Rose Lake | Clinton | 2004 | 183 | 183 | .089 | .083 | .079 | .077 | 0 | 0.0 | 0 |
| 260490021 | 1 | Flint | Genesee | 2004 | 183 | 183 | .092 | .087 | .084 | .082 | 0 | 0.0 | 0 |
| 260492001 | 1 | Otisville | Genesee | 2004 | 183 | 183 | .097 | .096 | .087 | .081 | 0 | 0.0 | 0 |
| 260630007 | 1 | Harbor Beach | Huron | 2004 | 183 | 183 | .106 | .093 | .080 | .082 | 0 | 0.0 | 0 |
| 260650012 | 2 | Lansing | Ingham | 2004 | 183 | 183 | .089 | .083 | .080 | .076 | 0 | 0.0 | 0 |
| 260770008 | 1 | Kalamazoo | Kalamazoo | 2004 | 183 | 183 | .080 | .080 | .077 | .076 | 0 | 0.0 | 0 |
| 260810020 | 1 | Grand Rapids | Kent | 2004 | 182 | 183 | .084 | .078 | .077 | .075 | 0 | 0.0 | 1 |
| 260810022 | 1 | Evans | Kent | 2004 | 183 | 183 | .094 | .087 | .080 | .077 | 0 | 0.0 | 0 |
| 260890001 | 1 | Peshawbestown | Leelanau | 2004 | 175 | 183 | .092 | .088 | .082 | .079 | 0 | 0.0 | 6 |
| 260910007 | 1 | Tecumseh | Lenawee | 2004 | 183 | 183 | .090 | .084 | .083 | .079 | 0 | 0.0 | 0 |
| 260990009 | 1 | New Haven | Macomb | 2004 | 180 | 183 | .115 | .101 | .091 | .091 | 3 | 0.0 | 0 |
| 260991003 | 1 | Warren | Macomb | 2004 | 183 | 183 | .092 | .091 | .089 | .084 | 1 | 0.0 | 0 |
| 261050007 | 1 | Scottville | Mason | 2004 | 178 | 183 | .087 | .086 | .085 | .084 | 0 | 0.0 | 0 |
| 261130001 | 1 | Houghton Lake | Missaukee | 2004 | 180 | 183 | .087 | .079 | .077 | .075 | 0 | 0.0 | 3 |
| 261210039 | 1 | Muskegon | Muskegon | 2004 | 182 | 183 | .103 | .086 | .083 | .079 | 0 | 0.0 | 1 |
| 261250001 | 2 | Oak Park | Oakland | 2004 | 183 | 183 | .094 | .092 | .085 | .083 | 0 | 0.0 | 0 |
| 261390005 | 1 | Jenison | Ottawa | 2004 | 182 | 183 | .089 | .081 | .079 | .079 | 0 | 0.0 | 1 |
| 261470005 | 1 | Port Huron | St .Clair | 2004 | 180 | 183 | .101 | .092 | .090 | .088 | 2 | 0.0 | 1 |
| 261530001 | 1 | Seney | Schoolcraft | 2004 | 179 | 183 | .089 | .089 | .082 | .081 | 1 | 0.0 | 0 |
| 261610008 | 1 | Ypsilanti | Washtenaw | 2004 | 181 | 183 | .091 | .086 | .085 | .084 | 0 | 0.0 | 0 |
| 261630001 | 2 | Allen Park | Wayne | 2004 | 181 | 183 | .085 | .084 | .083 | .077 | 0 | 0.0 | 2 |
| 261630016 | 1 | Detroit -Linwood | Wayne | 2004 | 174 | 183 | .083 | .082 | .080 | .079 | 0 | 0.0 | 2 |
| 261630019 | 2 | Detroit - E. Seven Mile | Wayne | 2004 | 173 | 183 | .081 | .080 | .079 | .073 | 0 | 0.0 | 2 |

## $O_3$ (8-Hour) Measured in ppm

| Site ID | POC | City | County | Year | % OBS | Valid Days Measured | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | Day Max >/= 0.085 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260050003 | 1 | Holland | Allegan | 2004 | 100 | 183 | .107 | .084 | .081 | .079 | 1 |
| 260190003 | 1 | Benzonia | Benzie | 2004 | 100 | 183 | .081 | .080 | .078 | .075 | 0 |
| 260210014 | 1 | Coloma | Berrien | 2004 | 98 | 180 | .078 | .075 | .074 | .073 | 0 |
| 260270003 | 1 | Cassopolis | Cass | 2004 | 92 | 169 | .083 | .083 | .078 | .077 | 0 |
| 260370001 | 2 | Rose Lake | Clinton | 2004 | 100 | 183 | .079 | .075 | .073 | .070 | 0 |
| 260490021 | 1 | Flint | Genesee | 2004 | 100 | 183 | .083 | .077 | .076 | .075 | 0 |
| 260492001 | 1 | Otisville | Genesee | 2004 | 100 | 183 | .086 | .081 | .078 | .077 | 1 |
| 260630007 | 1 | Harbor Beach | Huron | 2004 | 100 | 183 | .088 | .076 | .073 | .068 | 1 |

## $O_3$ (8-Hour) Measured in ppm (Continued)

| Site ID | POC | City | County | Year | % OBS | Valid Days Measured | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | Day Max >/= 0.085 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260650012 | 2 | Lansing | Ingham | 2004 | 100 | 183 | .077 | .074 | .072 | .068 | 0 |
| 260770008 | 1 | Kalamazoo | Kalamazoo | 2004 | 100 | 183 | .071 | .070 | .069 | .068 | 0 |
| 260810020 | 1 | Grand Rapids | Kent | 2004 | 98 | 180 | .072 | .070 | .070 | .068 | 0 |
| 260810022 | 1 | Evans | Kent | 2004 | 99 | 182 | .082 | .076 | .072 | .072 | 0 |
| 260890001 | 1 | Peshawbestown | Leelanau | 2004 | 96 | 175 | .081 | .074 | .070 | .070 | 0 |
| 260910007 | 1 | Tecumseh | Lenawee | 2004 | 100 | 183 | .085 | .076 | .076 | .074 | 1 |
| 260990009 | 1 | New Haven | Macomb | 2004 | 98 | 179 | .082 | .082 | .082 | .081 | 0 |
| 260991003 | 1 | Warren | Macomb | 2004 | 100 | 183 | .083 | .080 | .077 | .071 | 0 |
| 261050007 | 1 | Scottville | Mason | 2004 | 96 | 176 | .081 | .079 | .076 | .071 | 0 |
| 261130001 | 1 | Houghton Lake | Missaukee | 2004 | 98 | 180 | .084 | .076 | .074 | .071 | 0 |
| 261210039 | 1 | Muskegon | Muskegon | 2004 | 99 | 182 | .079 | .074 | .073 | .070 | 0 |
| 261250001 | 2 | Oak Park | Oakland | 2004 | 100 | 183 | .079 | .078 | .075 | .075 | 0 |
| 261390005 | 1 | Jenison | Ottawa | 2004 | 98 | 180 | .074 | .070 | .069 | .069 | 0 |
| 261470005 | 1 | Port Huron | St .Clair | 2004 | 98 | 179 | .079 | .078 | .076 | .074 | 0 |
| 261530001 | 1 | Seney | Schoolcraft | 2004 | 98 | 179 | .081 | .080 | .075 | .074 | 0 |
| 261610008 | 1 | Ypsilanti | Washtenaw | 2004 | 98 | 180 | .077 | .077 | .075 | .071 | 0 |
| 261630001 | 2 | Allen Park | Wayne | 2004 | 99 | 181 | .077 | .072 | .072 | .065 | 0 |
| 261630016 | 1 | Detroit - Linwood | Wayne | 2004 | 95 | 174 | .072 | .070 | .068 | .066 | 0 |
| 261630019 | 2 | Detroit - E. Seven Mile | Wayne | 2004 | 94 | 172 | .074 | .071 | .068 | .066 | 0 |

## $PM_{2.5}$ (24-Hour) Measured in $\mu g/m^3$ at Local Conditions

| Site ID | POC | Monitor | City | County | Year | # OBS | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | 98% | Wtd. Arith. Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260050003 | 1 | FRM | Holland | Allegan | 2004 | 350 | 44.0 | 43.9 | 39.0 | 33.1 | 30.3 | 11.21 |
| 260050003 | 5 | SASS | Holland | Allegan | 2004 | 57 | 34.0 | 27.1 | 26.6 | 25.2 | 27.1 | 10.15 |
| 260170014 | 1 | FRM | Bay City | Bay | 2004 | 120 | 33.8 | 33.6 | 28.0 | 28.0 | 28.0 | 9.85 |
| 260210014 | 1 | FRM | Coloma | Berrien | 2004 | 116 | 34.2 | 30.8 | 29.0 | 25.5 | 29.0 | 10.23 |
| 260330901 | 1 | FRM | Sault Ste. Marie | Chippewa | 2004 | 114 | 31.5 | 25.5 | 22.3 | 21.8 | 22.3 | 7.16 |
| 260330901 | 2[a] | FRM | Sault Ste. Marie | Chippewa | 2004 | 58 | 18.2 | 15.4 | 15.4 | 15.2 | 15.4 | 6.28 |
| 260330901 | 5[b] | SASS | Sault Ste. Marie | Chippewa | 2004 | 112 | 29.3 | 24.6 | 23.4 | 22.3 | 24.6 | 7.52 |
| 260330902 | 1 | FRM | Sault Ste. Marie | Chippewa | 2004 | 114 | 32.4 | 25.1 | 23.2 | 21.3 | 23.2 | 6.74 |
| 260490021 | 1 | FRM | Flint | Genesee | 2004 | 113 | 33.7 | 29.2 | 27.9 | 27.2 | 27.9 | 10.49 |
| 260650012 | 1 | FRM | Lansing | Ingham | 2004 | 116 | 33.0 | 31.9 | 29.4 | 28.3 | 29.4 | 11.06 |
| 260650012 | 2[a] | FRM | Lansing | Ingham | 2004 | 1 | 6.2 | | | | 6.2 | 6.2* |
| 260770008 | 1 | FRM | Kalamazoo | Kalamazoo | 2004 | 114 | 31.8 | 28.2 | 27.3 | 24.5 | 27.3 | 11.33 |
| 260770008 | 2[a] | FRM | Kalamazoo | Kalamazoo | 2004 | 56 | 36.5 | 28.9 | 27.8 | 25.1 | 28.9 | 11.09 |
| 260770008 | 5[b] | SASS | Kalamazoo | Kalamazoo | 2004 | 57 | 32.1 | 30.5 | 30.4 | 28.2 | 30.5 | 12.98 |
| 260810020 | 1 | FRM | Grand Rapids | Kent | 2004 | 344 | 45.8 | 45.3 | 42.3 | 33.7 | 31.8 | 12.00 |

*Indicates the mean does not satisfy summary criteria

[a] POC 2 FRM: - Federal reference monitors used primarily for precision purposes.

[b] POC 5: SASS - Speciation monitors used primarily for determining particulate species.

## $PM_{2.5}$ (24-Hour) Measured in $\mu g/m^3$ at Local Conditions (Continued)

| Site ID | POC | Monitor | City | County | Year | # OBS | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | 98% | Wtd. Arith. Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260810020 | 2[a] | FRM | Grand Rapids | Kent | 2004 | 59 | 46.6 | 30.5 | 28.4 | 27.5 | 30.5 | 11.26 |
| 260810020 | *5 | SASS | Grand Rapids | Kent | 2004 | 52 | 34.2 | 33.7 | 28.6 | 25.4 | 33.7 | 11.46* |
| 260990009 | 1 | FRM | New Haven | Macomb | 2004 | 121 | 40.6 | 37.3 | 31.9 | 30.0 | 31.9 | 11.96 |
| 261130001 | 1 | FRM | Houghton Lake | Missaukee | 2004 | 111 | 26.4 | 21.8 | 21.0 | 21.0 | 21.0 | 7.29 |
| 261130001 | 5[b] | SASS | Houghton Lake | Missaukee | 2004 | 51 | 26.5 | 26.3 | 20.0 | 17.3 | 26.3 | 7.44* |
| 261150005 | 1 | FRM | Luna Pier | Monroe | 2004 | 116 | 38.8 | 37.0 | 35.0 | 33.0 | 35.0 | 12.98 |
| 261150005 | 5[b] | SASS | Luna Pier | Monroe | 2004 | 46 | 33.5 | 32.7 | 30.9 | 28.1 | 33.5 | 12.24* |
| 261210040 | 1 | FRM | Muskegon | Muskegon | 2004 | 119 | 42.8 | 34.5 | 32.7 | 24.7 | 32.7 | 10.16 |
| 261250001 | 1 | FRM | Oak Park | Oakland | 2004 | 117 | 37.7 | 33.0 | 32.5 | 32.0 | 32.5 | 12.76 |
| 261390005 | 1 | FRM | Jenison | Ottawa | 2004 | 117 | 45.5 | 33.0 | 30.9 | 30.0 | 30.9 | 11.33 |
| 261450018 | 1 | FRM | Saginaw | Saginaw | 2004 | 118 | 32.3 | 31.6 | 27.4 | 27.0 | 27.4 | 9.51 |
| 261470005 | 1 | FRM | Port Huron | St. Clair | 2004 | 112 | 36.7 | 33.9 | 32.2 | 30.4 | 32.2 | 12.10 |
| 261610005 | 1 | FRM | Ann Arbor | Washtenaw | 2004 | 114 | 31.8 | 31.2 | 28.4 | 27.4 | 28.4 | 10.67 |
| 261610008 | 1 | FRM | Ypsilanti | Washtenaw | 2004 | 118 | 37.2 | 32.4 | 31.5 | 30.9 | 31.5 | 12.87 |
| 261610008 | 2[a] | FRM | Ypsilanti | Washtenaw | 2004 | 59 | 31.5 | 31.2 | 27.1 | 26.9 | 31.2 | 11.09 |
| 261610008 | 5[b] | SASS | Ypsilanti | Washtenaw | 2004 | 58 | 34.6 | 30.2 | 29.7 | 28.4 | 30.2 | 11.87 |
| 261630001 | 1 | FRM | Allen Park | Wayne | 2004 | 331 | 46.4 | 40.4 | 39.5 | 38.4 | 36.9 | 14.24 |
| 261630001 | 2[a] | FRM | Allen Park | Wayne | 2004 | 58 | 35.4 | 33.8 | 28.8 | 28.8 | 33.8 | 12.32 |
| 261630001 | 5[b] | SASS | Allen Park | Wayne | 2004 | 112 | 39.2 | 34.8 | 34.4 | 33.9 | 34.4 | 14.29 |
| 261630015 | 1 | FRM | Detroit - W. Fort | Wayne | 2004 | 115 | 40.1 | 39.0 | 36.0 | 35.7 | 36.0 | 15.39 |
| 261630016 | 1 | FRM | Detroit - Linwood | Wayne | 2004 | 324 | 49.8 | 41.3 | 41.1 | 39.5 | 38.3 | 13.69 |
| 261630019 | 1 | FRM | Detroit - E. Seven Mile | Wayne | 2004 | 119 | 40.2 | 37.2 | 35.0 | 32.9 | 35.0 | 13.23 |
| 261630025 | 1 | FRM | Livonia | Wayne | 2004 | 112 | 39.0 | 35.7 | 32.2 | 30.8 | 32.2 | 12.57 |
| 261630033 | 1 | FRM | Dearborn | Wayne | 2004 | 107 | 41.7 | 39.9 | 39.4 | 35.1 | 39.4 | 16.83 |
| 261630033 | 5[b] | SASS | Dearborn | Wayne | 2004 | 54 | 56.0 | 47.6 | 43.5 | 42.7 | 47.6 | 18.67* |
| 261630036 | 1 | FRM | Wyandotte | Wayne | 2004 | 113 | 33.9 | 33.8 | 32.3 | 31.5 | 32.3 | 13.66 |

*Indicates the mean does not satisfy summary criteria

[a] POC 2 FRM: - Federal reference monitors used primarily for precision purposes.
[b] POC 5: SASS - Speciation monitors used primarily for determining particulate species.

## $PM_{10}$ (24-Hour) Measured in $\mu g/m^3$

| Site ID | POC | Monitor | City | County | Year | # OBS | # Req. | % OBS | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | Wtd Arith Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260490021 | 1 | GRAV | Flint | Genesee | 2004 | 57 | 61 | 93 | 61 | 52 | 46 | 43 | 18.8 |
| 260810007 | 1 | GRAV | Grand Rapids | Kent | 2004 | 56 | 61 | 92 | 42 | 41 | 34 | 33 | 18.5 |
| 260810020 | 1 | GRAV | Grand Rapids | Kent | 2004 | 57 | 61 | 93 | 33 | 30 | 30 | 26 | 13.2 |
| 261630001 | 1 | GRAV | Allen Park | Wayne | 2004 | 57 | 61 | 93 | 51 | 47 | 45 | 41 | 19.4 |
| 261630015 | 1 | GRAV | Detroit - W. Fort | Wayne | 2004 | 60 | 61 | 98 | 116 | 67 | 55 | 54 | 25.0 |
| 261630033 | 1 | GRAV | Dearborn | Wayne | 2004 | 53 | 61 | 87 | 242 | 139 | 101 | 66 | 40.7 |

*Indicates the mean does not satisfy summary criteria

## $PM_{2.5}$ TEOM (1-Hour) Measured in $\mu g/m^3$

| Site ID | POC | Monitor | City | County | Year | # OBS | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | Wtd. Arith. Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 260050003 | 3 | TEOM | Holland | Allegan | 2004 | 6235 | 55 | 54 | 52 | 52 | 9.87 |
| 260490021 | 3 | TEOM | Flint | Genesee | 2004 | 8675 | 67 | 66 | 66 | 65 | 15.30 |
| 260650012 | 3 | TEOM | Lansing | Ingham | 2004 | 8130 | 172 | 136 | 126 | 82 | 16.78 |
| 260770008 | 3 | TEOM | Kalamazoo | Kalamazoo | 2004 | 7361 | 156 | 78 | 77 | 76 | 17.55 |
| 260810020 | 3 | TEOM | Grand Rapids | Kent | 2004 | 8467 | 90 | 73 | 69 | 69 | 18.89 |
| 261130001 | 3 | TEOM | Houghton Lake | Missaukee | 2004 | 8560 | 84 | 57 | 55 | 55 | 13.36 |
| 261450018 | 3 | TEOM | Saginaw | Saginaw | 2004 | 7623 | 60 | 60 | 59 | 59 | 12.92 |
| 261470005 | 3 | TEOM | Port Huron | St. Clair | 2004 | 8723 | 85 | 78 | 77 | 75 | 18.38 |
| 261530001 | 3 | TEOM | Seney | Schoolcraft | 2004 | 8568 | 96 | 62 | 53 | 48 | 6.35 |
| 261610008 | 3 | TEOM | Ypsilanti | Washtenaw | 2004 | 8691 | 63 | 60 | 60 | 60 | 15.39 |
| 261630001 | 3 | TEOM | Allen Park | Wayne | 2004 | 8657 | 68 | 65 | 63 | 62 | 16.77 |
| 261630033 | 3 | TEOM | Dearborn | Wayne | 2004 | 2421 | 95 | 94 | 93 | 93 | 22.32 |

*Indicates the mean does not satisfy the criteria

## $PM_{10}$ TEOM (1-Hour) Measured in $\mu g/m^3$

| Site ID | POC | Monitor | City | County | Year | # OBS | Highest Value | 2nd Highest Value | 3rd Highest Value | 4th Highest Value | Wtd. Arith. Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 261630033 | 3 | TEOM | Dearborn | Wayne | 2004 | 8554 | 211 | 182 | 136 | 125 | 36.7 |

## $SO_2$ Measured in ppm

| Site ID | POC | City | County | Year | # OBS | 24-hr Highest Value | 24-hr 2nd Highest Value | OBS > 0.14 | 3-hr Highest Value | 3-hr 2nd Highest Value | OBS > 0.5 | 1-hr Highest Value | 1-hr 2nd Highest Value | Arith Mean |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 260410902 | 1 | Escanaba | Delta | 2004 | 2084 | .004 | .004 | 0 | .017 | .013 | 0 | .030 | .020 | .0013 |
| 260490021 | 1 | Flint | Genesee | 2004 | 8738 | .012 | .010 | 0 | .023 | .022 | 0 | .033 | .029 | .0018 |
| 260492001 | 1 | Otisville | Genesee | 2004 | 8216 | .011 | .009 | 0 | .022 | .022 | 0 | .043 | .029 | .0018 |
| 260810020 | 1 | Grand Rapids | Kent | 2004 | 8532 | .013 | .011 | 0 | .031 | .021 | 0 | .032 | .032 | .0016 |
| 260991003 | 1 | Warren | Macomb | 2004 | 8738 | .021 | .015 | 0 | .059 | .050 | 0 | .080 | .080 | .0034 |
| 261470005 | 1 | Port Huron | St Clair | 2004 | 8662 | .063 | .043 | 0 | .113 | .112 | 0 | .164 | .151 | .0063 |
| 261630015 | 1 | Detroit - W. Fort | Wayne | 2004 | 8502 | .056 | .048 | 0 | .118 | .113 | 0 | .156 | .140 | .0067 |
| 261630016 | 2 | Detroit - Linwood | Wayne | 2004 | 8656 | .026 | .026 | 0 | .088 | .085 | 0 | .098 | .098 | .0044 |
| 261630019 | 1 | Detroit - E. Seven Mile | Wayne | 2004 | 8662 | .017 | .015 | 0 | .040 | .039 | 0 | .067 | .061 | .0037 |

# Appendix B: Precision and Accuracy Report for 2004

**Appendix B** provides the quality assurance assessment summary for precision and accuracy of the AQD's Air Monitoring Unit (AMU) network monitors for the criteria air pollutants. Gaseous monitors are used for $O_3$, CO, $SO_2$, and $NO_2$; particulate monitors are used for PM (TSP, $PM_{10}$, $PM_{2.5}$); and Pb is collected using a High Volume sampler (Hi-Vol).

The AMU also follows a quality system to ensure that the monitoring data that is collected and reported is accurate and defendable. In following the quality system, quality assurance project plans are developed and implemented as well as standard operating procedures. Precision (the repeatability of a measurement) and accuracy (the closeness of the measurement to a true value) are the two primary components of the quality system for insuring accurate data[58].

The AMU adheres to the quality assurance requirements of the EPA for gaseous and particulate air pollutant monitors as specified in Title 40 of the CFR, Part 58. To insure the accuracy of AMU's monitoring equipment, all flow measurement devises, flow orifices, thermometers, and met equipment (measuring wind speed and wind direction at the sites) are recertified once a year using a certified standard. In addition, once a year the EPA laboratory certifies two of AMU's ozone generators. These two ozone generators are then used as Reference Method instruments for AMU staff to certify the remaining ozone generators and monitors. Each ozone generator is recertified every 90 days. Each ozone monitor is independently audited at least once a year. The other gaseous pollutant monitors are calibrated every four weeks using EPA certified Protocol 1 cylinder gases for calibration and are independently audited once a year.

### Precision Measurements

Gaseous monitors: Title 40 CFR 58 specifies the concentration levels of calibration gas to be used for gaseous monitor precision and span checks. These precision and span checks are conducted on the criteria pollutant monitors by the site operators every two weeks. The precision checks are performed by challenging the monitor with a level of gas that is closest to the expected ambient level. The span check is conducted by challenging the monitor with a higher level of gas that is at the upper end of the monitor's calibration range.

Particulate monitors: The particulate monitors also have precision criteria in Title 40 CFR 58, but the evaluation of precision is achieved through co-located sampling. Co-located sampling is conducted by placing two monitors in the same location, sampling for the same duration, and on the same day. The closeness of the measurements to each other is how precision is evaluated.

### Accuracy Measurements

Gaseous monitors: Accuracy is evaluated for gaseous monitors by the site operator conducting the two week calibration checks and the quarterly multi-point calibration gas checks. Accuracy for gaseous monitors is also evaluated by a yearly independent audit (as specified in 40 CFR Part 58) where three levels of audit gas are used to challenge the gaseous monitors. Quality Assurance Team Members conduct audits using dedicated audit equipment and gases. The assessment summary in this appendix reports the results of the accuracy calculations for Level 1, 2, and 3 of the calibration gas.

[58] Audits for precision and accuracy were also conducted at the two tribal sites in Sault Ste. Marie and at the federal IMPROVE site in Seney, but that information is not included in this report.)

**Accuracy Measurements (continued)**

Particulate monitors: The site operator evaluates the accuracy on the particulate monitors by conducting quarterly flow checks on the $PM_{10}$ and High Vol samplers, four-week checks on the $PM_{2.5}$ (Federal Reference Method), and two-week checks on the continuous $PM_{2.5}$ TEOMs[59]. The accuracy of the flow rates on the $PM_{10}$, Hi-Vol, and TEOMs are audited at least once a year and the $PM_{2.5}$ flow rates are audited each quarter. Quality Assurance Team members conduct these independent flow audits using dedicated audit equipment.

The MDEQ's Environmental Laboratory also conducts internal quality control tests for Pb and other metals. For the multi-metals ambient air sampling that is conducted, the MDEQ Lab analyzes several levels of metals standards. The accuracy calculations for Pb in this appendix are indicated by Level 1 and Level 2.

Any questions or concerns about the AQD's quality assurance program can be directed to the AMU's Quality Assurance Coordinator at 517-373-1279.

[59] TEOM data is not addressed in this appendix because it is not used by EPA for agency precision and accuracy calculations

# 2004 DATA ASSESSMENT SUMMARY FOR THE FOLLOWING CRITERIA AIR POLLUTANTS

## CO:

| YEAR | PRECISION | | | | ACCURACY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quarter | # of Analyzers | # of Checks | Probability Limits Lower | Probability Limits Upper | # of Audits | Level 1 Lower | Level 1 Upper | Level 2 Lower | Level 2 Upper | Level 3 Lower | Level 3 Upper |
| **2004** | **7** | **180** | **-6** | **+6** | **7** | **-13** | **+10** | **-12** | **+11** | **-11** | **+12** |
| 1st | 7 | 47 | -5 | +7 | 2 | -5 | +7 | -3 | +6 | -1 | +3 |
| 2nd | 7 | 46 | -8 | +5 | 2 | -3 | +1 | -9 | +12 | -7 | +14 |
| 3rd | 7 | 41 | -5 | +4 | 3 | -22 | +13 | -20 | +15 | -18 | +14 |
| 4th | 7 | 46 | -7 | +7 | 0 | * | * | * | * | * | * |

* insufficient number of analyzers to calculate accuracy.

## Pb:

| YEAR | PRECISION | | | | | | ACCURACY | | | LAB ACCURACY | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quarter | # of Co-located Samples | # of Co-located Sites | # of Samples < Limit | Probability Limits Lower | Probability Limits Upper | # of Valid Co-located Data Pair | # of Audits | Level 2 Lower | Level 2 Upper | # of Audits | Level 1 Lower | Level 1 Upper | Level 2 Lower | Level 2 Upper |
| **2004** | **77** | **2** | **77** | ***** | ***** | **0** | **15** | **-7** | **+7** | **24** | **-3** | **+10** | **-10** | **+15** |
| 1st | 17 | 2 | 17 | * | * | 0 | 4 | -11 | +9 | 6 | -6 | +14 | -12 | +9 |
| 2nd | 19 | 2 | 19 | * | * | 0 | 3 | -3 | +7 | 6 | -5 | +12 | -9 | +8 |
| 3rd | 21 | 2 | 21 | * | * | 0 | 4 | -3 | +3 | 6 | -2 | +8 | -1 | +11 |
| 4th | 20 | 2 | 20 | * | * | 0 | 4 | -10 | +8 | 6 | -1 | +8 | -9 | +22 |

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

## $NO_2$:

| YEAR | PRECISION | | | | ACCURACY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quarter | # of Analyzers | # of Checks | Probability Limits Lower | Probability Limits Upper | # of Audits | Level 1 Lower | Level 1 Upper | Level 2 Lower | Level 2 Upper | Level 3 Lower | Level 3 Upper |
| **2004** | **3** | **71** | **-6** | **+8** | **4** | **-19** | **+1** | **-16** | **+3** | **-13** | **+3** |
| 1st | 3 | 18 | -8 | +6 | 1 | * | * | * | * | * | * |
| 2nd | 3 | 19 | -8 | +9 | 1 | * | * | * | * | * | * |
| 3rd | 3 | 17 | -6 | +9 | 1 | * | * | * | * | * | * |
| 4th | 3 | 17 | -1 | +5 | 1 | * | * | * | * | * | * |

* insufficient number of checks to calculate accuracy.

## $O_3$:

| YEAR Quarter | PRECISION | | | | ACCURACY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | # of Analyzers | # of Checks | Probability Limits Lower | Upper | # of Audits | Level 1 Lower | Upper | Level 2 Lower | Upper | Level 3 Lower | Upper |
| **2004** | **26** | **363** | **-4** | **+4** | **27** | **-3** | **+5** | **-4** | **+4** | **-3** | **+4** |
| 1st | No data due to ozone season | | | | | | | | | | |
| 2nd | 26 | 177 | -4 | +4 | 14 | -3 | +5 | -4 | +4 | -4 | +4 |
| 3rd | 26 | 186 | -4 | +4 | 13 | -4 | +5 | -3 | +4 | -3 | +4 |
| 4th | No data due to ozone season | | | | | | | | | | |

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

## $PM_{10}$:

| YEAR Quarter | PRECISION | | | | | | ACCURACY | | |
|---|---|---|---|---|---|---|---|---|---|
| | # of Co-located Samples | # of Co-located Sites | # of Samples < Limit | 95% Probability Limits Lower | Upper | # of Valid Co-located Data Pairs | # of Audits | Probability Lower | Upper |
| **2004** | **100** | **2** | **47** | **-13** | **+9** | **53** | **11** | **-6** | **+8** |
| 1st | 25 | 2 | 14 | -3 | +9 | 11 | 3 | -5 | +8 |
| 2nd | 24 | 2 | 10 | -18 | +14 | 14 | 2 | -2 | +7 |
| 3rd | 26 | 2 | 10 | -14 | +7 | 16 | 3 | -7 | +6 |
| 4th | 25 | 2 | 13 | -15 | +6 | 12 | 3 | -10 | +12 |

* insufficient number of checks to calculate accuracy.

## $PM_{2.5}$:

| YEAR Quarter | PRECISION | | | | | | ACCURACY | | |
|---|---|---|---|---|---|---|---|---|---|
| | # of Co-located Samples | # of Co-located Sites | # of Samples < Limit | 95% Probability Limits Lower | Upper | # of Valid Co-located Data Pairs | # of Audits | Probability Lower | Upper |
| **2004** | **268** | **5** | **94** | **-7** | **+8** | **174** | **123** | **-3** | **+3** |
| 1st | 58 | 5 | 20 | -6 | +8 | 38 | 30 | -3 | +3 |
| 2nd | 64 | 5 | 26 | -5 | +6 | 38 | 31 | -3 | +3 |
| 3rd | 76 | 5 | 19 | -8 | +9 | 57 | 31 | -2 | +3 |
| 4th | 70 | 5 | 29 | -7 | +8 | 41 | 31 | -3 | +2 |

**$SO_2$:**

| YEAR | PRECISION | | | | ACCURACY | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quarter | # of Analyzers | # of Checks | Probability Limits Lower | Probability Limits Upper | # of Audits | Level 1 Lower | Level 1 Upper | Level 2 Lower | Level 2 Upper | Level 3 Lower | Level 3 Upper |
| **2004** | **8** | **205** | **-4** | **+6** | **9** | **-12** | **+10** | **-8** | **+6** | **-7** | **+5** |
| 1st | 8 | 48 | -5 | +7 | 2 | -4 | -0 | -3 | +2 | -1 | +3 |
| 2nd | 8 | 52 | -4 | +7 | 2 | -7 | +21 | -4 | +11 | -6 | +11 |
| 3rd | 8 | 52 | -4 | +6 | 2 | -8 | -3 | -4 | -3 | -6 | -1 |
| 4th | 8 | 53 | -4 | +5 | 3 | -10 | +5 | -5 | -3 | -6 | -1 |

* insufficient number of checks to calculate accuracy.

# Appendix C: 2004 Air Toxics Monitoring Summary for Metals, VOCs, Carbonyl Compounds, and Speciated $PM_{2.5}$

**Appendix C** provides summary statistics of ambient air concentrations of various substances monitored in Michigan during 2004. At each monitoring site, air samples were taken over a 24-hour period (midnight to midnight); a calendar day. These air samples are called "observations" and represent the average air concentration during that 24-hour period. The frequency of observation varies by site and chemical substance, but was typically done once every 6 or 12 days. For some substances the sampled air concentration was lower than the laboratory's analytical MDL. Air concentrations that are lower than the MDL are given the value of "non-detect." Each substance analyzed has its own MDL, which varies from laboratory to laboratory and from year to year. The cited MDLs represent the detection limits that are routinely attained. In the calculation of the minimum and maximum annual averages (also called "means"), zero (0.0 $\mu g/m^3$) or the MDL, respectively, are substituted for non-detected air contaminant levels.

The data in this appendix are divided into two sections:

**Appendix C1** summarizes the air concentrations of various metals (total suspended particulate or TSP), VOCs, and carbonyls for January through December 2004. **Appendix C2** summarizes the air concentrations of various metals found in Speciated $PM_{2.5}$ sampled from January through December 2004. Table C-1 shows the monitoring locations and what was monitored.

**Table C-1: Monitoring Location and Type of Monitoring Conducted**

| LOCATION | Appendix C1 | | | | Appendix C2 |
|---|---|---|---|---|---|
| | VOC | Carbonyl | Metals TSP | Metals $PM_{10}$ | Speciated $PM_{2.5}$ |
| Allen Park (261630001) | | | x | | x |
| Dearborn (261630033) | x | x | x | x | x |
| Detroit E. 7 Mile Rd. (261630019) | x | x | x | | |
| Detroit, W. Fort (261630015) | x | x | x | | |
| Detroit, W. Jefferson (261630027) | x | | x | | |
| Flint, (260490021) | | | x | | |
| Grand Rapids, Monroe St., NW (260810020) | | | | | x |
| Grand Rapids, Randolph (260810021) | x | x | x | | |
| Holland (260050003) | | | | | x |
| Houghton Lake (261130001) | x | x | x | | x |
| Kalamazoo (260770008) | | | | | x |
| Sault Ste. Marie (260330901) | | | | | x |
| Luna Pier (261150005) | | | | | x |
| River Rouge (261630005) | | x | x | | |
| Ypsilanti, (261610008) | x | x | x | | x |

Terms and Acronyms used in **Appendix C** data tables:

| | |
|---|---|
| **Chemical Name:** | Commonly accepted name of air pollutant analyzed |
| **MDL:** | Analytical Method Detection Limit in units of $\mu g/m^3$ |
| **Num Obs:** | Number of Observations (the number of daily air samples taken during the year) |
| **Num > MDL:** | Number of daily samples that were above the method detection limit |
| **Max1:** | The highest daily air concentration during the year |
| **Max2:** | The second highest daily air concentration during the year |
| **Max3:** | The third highest daily air concentration during the year |
| **Min Mean:** | The average air concentration for the year, assuming that the daily samples below the MDL were equal to 0.0 $\mu g/m^3$. |
| **Max Mean:** | The average air concentration for the year, assuming that the daily samples below the MDL were equal to the MDL. |
| **AIRS ID:** | Aerometric Information Retrieval System identification number. EPA and MDEQ use this number to identify each monitoring site. |

# APPENDIX C1: AIR TOXICS MONITORING SUMMARY FOR METALS, VOCS, AND CARBONYL COMPOUNDS

| ALLEN PARK | AIRS ID: 261630001 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Arsenic (TSP) | 59 | 59 | 0.00000265 | 0.00751 | 0.00504 | 0.00483 | 0.00171 | 0.00171 |
| Beryllium (TSP) | 59 | 55 | 0.000021 | 0.0001 | 0.00005 | 0.00005 | 0.0000212 | 0.0000227 |
| Barium (TSP) | 59 | 59 | 0.000542 | 0.184 | 0.18 | 0.179 | 0.131 | 0.131 |
| Cadmium (TSP) | 59 | 59 | 0.00000696 | 0.00131 | 0.00089 | 0.00073 | 0.000345 | 0.000345 |
| Chromium (TSP) | 59 | 59 | 0.0000789 | 0.0874 | 0.0744 | 0.0105 | 0.00892 | 0.00892 |
| Cobalt (TSP) | 59 | 59 | 0.0000084 | 0.00102 | 0.00096 | 0.00061 | 0.000268 | 0.000268 |
| Copper (TSP) | 59 | 59 | 0.000978 | 0.386 | 0.315 | 0.315 | 0.187 | 0.187 |
| Iron (TSP) | 59 | 59 | 0.000475 | 2.09 | 1.73 | 1.6 | 0.657 | 0.657 |
| Lead (TSP) | 59 | 59 | 0.0000307 | 0.0228 | 0.0218 | 0.018 | 0.00854 | 0.00854 |
| Manganese (TSP) | 59 | 59 | 0.000151 | 0.18 | 0.109 | 0.098 | 0.0334 | 0.0334 |
| Molybdenum (TSP) | 59 | 59 | 0.0000084 | 0.00249 | 0.00218 | 0.00216 | 0.00112 | 0.00112 |
| Nickel (TSP) | 59 | 59 | 0.000246 | 0.0788 | 0.0674 | 0.0121 | 0.00467 | 0.00467 |
| Vanadium (TSP) | 59 | 58 | 0.0000129 | 0.0387 | 0.0102 | 0.00884 | 0.00312 | 0.00312 |
| Zinc (TSP) | 59 | 59 | 0.000264 | 0.195 | 0.173 | 0.167 | 0.0803 | 0.0803 |

| DEARBORN | AIRS ID: 261630033 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Arsenic (TSP) | 54 | 54 | 0.00000255 | 0.0543 | 0.00802 | 0.00477 | 0.0031 | 0.0031 |
| Beryllium (TSP) | 55 | 55 | 0.0000201 | 0.00066 | 0.000252 | 0.00022 | 0.0000983 | 0.0000983 |
| Barium (TSP) | 55 | 55 | 0.000518 | 0.193 | 0.17 | 0.16 | 0.112 | 0.112 |
| Cadmium (TSP) | 54 | 54 | 0.00000611 | 0.00197 | 0.00174 | 0.00153 | 0.000759 | 0.000759 |
| Chromium (TSP) | 54 | 54 | 0.0000749 | 0.0161 | 0.0159 | 0.0134 | 0.00833 | 0.00833 |
| Cobalt (TSP) | 54 | 54 | 0.0000082 | 0.00308 | 0.00266 | 0.00231 | 0.000496 | 0.000496 |
| Copper (TSP) | 55 | 55 | 0.000936 | 0.667 | 0.653 | 0.502 | 0.234 | 0.234 |
| Iron (TSP) | 55 | 55 | 0.000455 | 14.4 | 11.6 | 5.62 | 1.98 | 1.98 |
| Lead (TSP) | 54 | 54 | 0.0000308 | 0.0987 | 0.0948 | 0.0515 | 0.0211 | 0.0211 |
| Manganese (TSP) | 55 | 55 | 0.000144 | 0.677 | 0.618 | 0.367 | 0.139 | 0.139 |
| Molybdenum (TSP) | 54 | 54 | 0.0000082 | 0.00304 | 0.00264 | 0.00228 | 0.00126 | 0.00126 |
| Nickel (TSP) | 54 | 54 | 0.000236 | 0.00989 | 0.00951 | 0.0085 | 0.00366 | 0.00366 |
| Vanadium (TSP) | 54 | 54 | 0.0000123 | 0.0206 | 0.02 | 0.0144 | 0.00533 | 0.00533 |
| Zinc (TSP) | 55 | 55 | 0.000252 | 2.09 | 0.995 | 0.798 | 0.261 | 0.261 |
| 1,1,1-Trichloroethane | 23 | 0 | 1.54 | 0 | 0 | 0 | 0 | 1.54 |
| 1,1,2,2-Tetrachloroethane | 23 | 0 | 1.93 | 0 | 0 | 0 | 0 | 1.93 |
| 1,1,2-Trichloroethane | 23 | 0 | 1.55 | 0 | 0 | 0 | 0 | 1.55 |
| 1,1-Dichloroethane | 23 | 0 | 1.16 | 0 | 0 | 0 | 0 | 1.16 |
| 1,1-Dichloroethene | 23 | 0 | 1.15 | 0 | 0 | 0 | 0 | 1.15 |
| 1,2,4-Trichlorobenzene | 23 | 0 | 2.15 | 0 | 0 | 0 | 0 | 2.15 |
| 1,2,4-Trimethylbenzene | 23 | 17 | 1.39 | 3.1 | 1.6 | 1.4 | 0.707 | 1.04 |
| 1,2-Dibromoethane | 23 | 0 | 2.22 | 0 | 0 | 0 | 0 | 2.22 |
| 1,2-Dichlorobenzene | 23 | 0 | 1.73 | 0 | 0 | 0 | 0 | 1.73 |
| 1,2-Dichloroethane | 23 | 0 | 1.16 | 0 | 0 | 0 | 0 | 1.16 |
| 1,2-Dichloropropane | 23 | 0 | 1.32 | 0 | 0 | 0 | 0 | 1.32 |
| 1,3,5-Trimethylbenzene | 23 | 6 | 1.39 | 0.92 | 0.43 | 0.38 | 0.119 | 1.13 |

| DEARBORN | AIRS ID: 261630033 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| 1,3-Butadiene | 23 | 13 | 0.625 | 0.55 | 0.37 | 0.31 | 0.121 | 0.379 |
| 1,3-Dichlorobenzene | 23 | 0 | 1.73 | 0 | 0 | 0 | 0 | 1.73 |
| 1,4-Dichlorobenzene | 23 | 0 | 1.73 | 0 | 0 | 0 | 0 | 1.73 |
| 2,2,4-Trimethylpentane | 23 | 20 | 1.34 | 1.8 | 1 | 1 | 0.536 | 0.718 |
| 2,5-dimethylbenzaldehyde | 26 | 0 | 0.0538 | 0 | 0 | 0 | 0 | 0.0538 |
| 2-Chloro-1,3-Butadiene | 23 | 0 | 1.08 | 0 | 0 | 0 | 0 | 1.08 |
| Acetaldehyde | 26 | 26 | 0.0238 | 3.73 | 2.71 | 2.69 | 1.91 | 1.91 |
| Acetone | 26 | 26 | 0.0768 | 6.4 | 5.49 | 5.44 | 3.54 | 3.54 |
| Acetonitrile | 23 | 2 | 1.63 | 2.2 | 1.4 | 0 | 0.157 | 1.64 |
| Acrylonitrile | 23 | 0 | 1.06 | 0 | 0 | 0 | 0 | 1.06 |
| Benzaldehyde | 26 | 1 | 0.022 | 1.07 | 0 | 0 | 0.0412 | 0.0623 |
| Benzene | 23 | 22 | 0.904 | 3.2 | 2.2 | 2.2 | 1.23 | 1.27 |
| Bromodichloromethane | 23 | 0 | 1.93 | 0 | 0 | 0 | 0 | 1.93 |
| Bromoform | 23 | 0 | 3.05 | 0 | 0 | 0 | 0 | 3.05 |
| Bromomethane (Methyl Bromide) | 22 | 0 | 1.07 | 0 | 0 | 0 | 0 | 1.07 |
| Carbon Tetrachloride | 23 | 0 | 1.84 | 0 | 0 | 0 | 0 | 1.84 |
| Chlorobenzene | 23 | 0 | 1.34 | 0 | 0 | 0 | 0 | 1.34 |
| Chloroethane | 23 | 0 | 0.747 | 0 | 0 | 0 | 0 | 0.747 |
| Chloroform | 23 | 0 | 1.35 | 0 | 0 | 0 | 0 | 1.35 |
| Chloromethane | 23 | 22 | 0.587 | 1.3 | 1.2 | 1.2 | 0.995 | 1.02 |
| Chloromethyl Benzene | 23 | 0 | 1.47 | 0 | 0 | 0 | 0 | 1.47 |
| cis-1,2-Dichloroethene | 18 | 0 | 1.1 | 0 | 0 | 0 | 0 | 1.1 |
| cis-1,3-Dichloropropene | 23 | 0 | 1.26 | 0 | 0 | 0 | 0 | 1.26 |
| Crotonaldehyde | 26 | 0 | 0.0128 | 0 | 0 | 0 | 0 | 0.0128 |
| Dibromochloromethane | 23 | 0 | 2.43 | 0 | 0 | 0 | 0 | 2.43 |
| Dichlorodifluoromethane | 23 | 22 | 1.42 | 3 | 2.8 | 2.8 | 2.39 | 2.46 |
| Ethylbenzene | 23 | 15 | 1.25 | 1.5 | 0.76 | 0.75 | 0.354 | 0.759 |
| Formaldehyde | 26 | 26 | 0.0256 | 4.98 | 4.87 | 3.78 | 2.82 | 2.82 |
| Halocarbon 113 | 23 | 14 | 2.2 | 0.76 | 0.71 | 0.7 | 0.354 | 1.25 |
| Halocarbon 114 | 23 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| Hexachloro-1,3-Butadiene | 23 | 0 | 3.07 | 0 | 0 | 0 | 0 | 3.07 |
| Hexanaldehyde | 26 | 1 | 0.0421 | 2.99 | 0 | 0 | 0.115 | 0.155 |
| Isovaleraldehyde | 26 | 1 | 0.0265 | 1.5 | 0 | 0 | 0.0577 | 0.0832 |
| m,p-Tolualdehyde | 26 | 0 | 0.0403 | 0 | 0 | 0 | 0 | 0.0403 |
| m/p -Xylene | 23 | 18 | 1.26 | 4.1 | 2.2 | 2 | 1.04 | 1.29 |
| Methyl Ethyl Ketone | 23 | 20 | 13.8 | 2.3 | 1.7 | 1.6 | 0.913 | 2.83 |
| Methyl Isobutyl Ketone | 23 | 0 | 3.86 | 0 | 0 | 0 | 0 | 3.86 |
| Methyl Tert-Butyl Ether | 23 | 0 | 1.73 | 0 | 0 | 0 | 0 | 1.73 |
| Methylene Chloride | 22 | 2 | 0.994 | 0.89 | 0.86 | 0 | 0.0795 | 0.989 |
| n-Butyraldehyde | 26 | 17 | 0.0138 | 1.95 | 1.3 | 0.737 | 0.438 | 0.443 |
| n-Hexane | 23 | 22 | 3.33 | 2.6 | 2.5 | 2 | 0.949 | 1.1 |
| o-Tolualdehyde | 26 | 0 | 0.0339 | 0 | 0 | 0 | 0 | 0.0339 |
| o-xylene | 23 | 16 | 1.25 | 1.8 | 0.86 | 0.84 | 0.406 | 0.754 |
| Propionaldehyde | 26 | 22 | 0.0394 | 0.998 | 0.867 | 0.734 | 0.457 | 0.463 |
| Styrene | 23 | 2 | 1.24 | 0.27 | 0.27 | 0 | 0.0235 | 1.15 |
| Tetrachloroethene | 23 | 7 | 1.95 | 37 | 29 | 22 | 4.47 | 5.81 |
| Toluene | 23 | 22 | 1.06 | 11 | 5.6 | 5.4 | 2.93 | 2.98 |
| trans-1,2-Dichloroethene | 22 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| trans-1,3-Dichloropropene | 23 | 0 | 1.26 | 0 | 0 | 0 | 0 | 1.26 |
| Trichloroethene | 23 | 0 | 1.55 | 0 | 0 | 0 | 0 | 1.55 |
| Trichloroflouromethane | 23 | 22 | 1.61 | 2.9 | 2.3 | 2.2 | 1.56 | 1.64 |

| DEARBORN | AIRS ID: 261630033 | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Valeraldehyde | 26 | 1 | 0.0403 | 1.14 | 0 | 0 | 0.0438 | 0.0825 |
| Vinyl Chloride | 23 | 0 | 0.723 | 0 | 0 | 0 | 0 | 0.723 |
| Arsenic ($PM_{10}$) | 106 | 106 | 0.00000298 | 0.0455 | 0.0373 | 0.00542 | 0.00296 | 0.00296 |
| Beryllium ($PM_{10}$) | 106 | 99 | 0.0000239 | 0.000146 | 0.000129 | 0.000127 | 0.0000414 | 0.0000429 |
| Barium ($PM_{10}$) | 106 | 106 | 0.000615 | 0.053 | 0.053 | 0.052 | 0.0257 | 0.0257 |
| Cadmium ($PM_{10}$) | 106 | 106 | 0.0000078 | 0.007 | 0.00276 | 0.00228 | 0.000943 | 0.000943 |
| Chromium ($PM_{10}$) | 106 | 106 | 0.0000889 | 0.00878 | 0.00865 | 0.00686 | 0.00413 | 0.00413 |
| Cobalt ($PM_{10}$) | 106 | 106 | 0.00000857 | 0.00231 | 0.00226 | 0.00174 | 0.000398 | 0.000398 |
| Copper ($PM_{10}$) | 106 | 106 | 0.00111 | 0.149 | 0.122 | 0.109 | 0.0444 | 0.0444 |
| Iron ($PM_{10}$) | 106 | 106 | 0.00054 | 6.12 | 6.04 | 3.62 | 1.18 | 1.18 |
| Lead ($PM_{10}$) | 106 | 106 | 0.0000364 | 0.094 | 0.0912 | 0.0427 | 0.0181 | 0.0181 |
| Manganese ($PM_{10}$) | 106 | 106 | 0.000172 | 0.412 | 0.411 | 0.27 | 0.0846 | 0.0846 |
| Molybdenum ($PM_{10}$) | 106 | 106 | 0.00000857 | 0.00246 | 0.00226 | 0.00214 | 0.00107 | 0.00107 |
| Nickel ($PM_{10}$) | 106 | 106 | 0.00028 | 0.00807 | 0.00742 | 0.00732 | 0.00325 | 0.00325 |
| Vanadium ($PM_{10}$) | 106 | 106 | 0.0000174 | 0.0228 | 0.0208 | 0.0166 | 0.00391 | 0.00391 |
| Zinc ($PM_{10}$) | 106 | 106 | 0.0003 | 1.89 | 1.77 | 0.97 | 0.247 | 0.247 |

| DETROIT - E. Seven Mile Rd. | AIRS ID: 261630019 | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Arsenic (TSP) | 59 | 59 | 0.00000274 | 0.00407 | 0.004 | 0.00336 | 0.00153 | 0.00153 |
| Beryllium (TSP) | 59 | 55 | 0.0000218 | 0.000113 | 0.0001 | 0.000071 | 0.000028 | 0.0000293 |
| Barium (TSP) | 59 | 59 | 0.000562 | 0.181 | 0.18 | 0.18 | 0.121 | 0.121 |
| Cadmium (TSP) | 59 | 59 | 0.00000743 | 0.00127 | 0.00093 | 0.00069 | 0.000324 | 0.000324 |
| Chromium (TSP) | 59 | 59 | 0.0000817 | 0.0141 | 0.00954 | 0.00941 | 0.00632 | 0.00632 |
| Cobalt (TSP) | 59 | 59 | 0.00000848 | 0.00131 | 0.0011 | 0.00085 | 0.000315 | 0.000315 |
| Copper (TSP) | 59 | 59 | 0.00102 | 0.378 | 0.289 | 0.252 | 0.114 | 0.114 |
| Iron (TSP) | 59 | 59 | 0.000494 | 1.61 | 1.35 | 1.25 | 0.587 | 0.587 |
| Lead (TSP) | 59 | 59 | 0.0000318 | 0.0262 | 0.0188 | 0.0188 | 0.00927 | 0.00927 |
| Manganese (TSP) | 59 | 59 | 0.000157 | 0.241 | 0.241 | 0.115 | 0.0353 | 0.0353 |
| Molybdenum (TSP) | 59 | 59 | 0.00000848 | 0.00806 | 0.00375 | 0.00276 | 0.00124 | 0.00124 |
| Nickel (TSP) | 59 | 59 | 0.000255 | 0.0115 | 0.0107 | 0.00544 | 0.00277 | 0.00277 |
| Vanadium (TSP) | 59 | 59 | 0.0000147 | 0.0383 | 0.0157 | 0.0125 | 0.00366 | 0.00366 |
| Zinc (TSP) | 59 | 59 | 0.000273 | 0.617 | 0.463 | 0.4 | 0.11 | 0.11 |
| 2,5-dimethylbenzaldehyde | 15 | 0 | 0.0431 | 0 | 0 | 0 | 0 | 0.0431 |
| Acetaldehyde | 15 | 15 | 0.0191 | 4.09 | 3.8 | 3.65 | 2.8 | 2.8 |
| Acetone | 15 | 15 | 0.0615 | 5.02 | 4.79 | 4.6 | 3.31 | 3.31 |
| Benzaldehyde | 15 | 5 | 0.0176 | 0.907 | 0.781 | 0.638 | 0.227 | 0.239 |
| Crotonaldehyde | 15 | 0 | 0.0102 | 0 | 0 | 0 | 0 | 0.0102 |
| Formaldehyde | 15 | 15 | 0.0205 | 4.6 | 4.52 | 4.02 | 3.05 | 3.05 |
| Hexanaldehyde | 15 | 13 | 0.0338 | 2.76 | 2.66 | 2.12 | 1.55 | 1.56 |
| Isovaleraldehyde | 15 | 0 | 0.0213 | 0 | 0 | 0 | 0 | 0.0213 |
| m,p-Tolualdehyde | 15 | 0 | 0.0323 | 0 | 0 | 0 | 0 | 0.0323 |
| n-Butyraldehyde | 15 | 15 | 0.011 | 1.31 | 1.13 | 1.11 | 0.806 | 0.806 |
| o-Tolualdehyde | 15 | 0 | 0.0271 | 0 | 0 | 0 | 0 | 0.0271 |
| Propionaldehyde | 15 | 15 | 0.0315 | 1.29 | 1.03 | 1.03 | 0.841 | 0.841 |
| Valeraldehyde | 15 | 13 | 0.0322 | 1.25 | 1.04 | 0.948 | 0.689 | 0.693 |

**DETROIT - W. Fort St.** **AIRS ID: 261630015** **Units: µg/m³**

| Parameter Name | Num Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
|---|---|---|---|---|---|---|---|---|
| Arsenic (TSP) | 58 | 58 | 0.00000273 | 0.0068 | 0.00574 | 0.00539 | 0.00231 | 0.00231 |
| Beryllium (TSP) | 57 | 57 | 0.0000218 | 0.000263 | 0.00024 | 0.000176 | 0.0000709 | 0.0000709 |
| Barium (TSP) | 57 | 57 | 0.000562 | 0.175 | 0.169 | 0.168 | 0.13 | 0.13 |
| Cadmium (TSP) | 58 | 58 | 0.0000072 | 0.00481 | 0.00454 | 0.00379 | 0.00111 | 0.00111 |
| Chromium (TSP) | 58 | 58 | 0.0000807 | 0.0889 | 0.0613 | 0.0443 | 0.0125 | 0.0125 |
| Cobalt (TSP) | 58 | 58 | 0.00000847 | 0.00208 | 0.00203 | 0.00165 | 0.000532 | 0.000532 |
| Copper (TSP) | 57 | 57 | 0.00102 | 0.501 | 0.473 | 0.452 | 0.184 | 0.184 |
| Iron (TSP) | 57 | 57 | 0.000494 | 10.6 | 6.63 | 6.12 | 2.12 | 2.12 |
| Lead (TSP) | 58 | 58 | 0.0000328 | 0.0585 | 0.0469 | 0.0395 | 0.0179 | 0.0179 |
| Manganese (TSP) | 57 | 57 | 0.000156 | 0.554 | 0.288 | 0.226 | 0.098 | 0.098 |
| Molybdenum (TSP) | 58 | 58 | 0.00000847 | 0.00581 | 0.0045 | 0.00288 | 0.00165 | 0.00165 |
| Nickel (TSP) | 58 | 58 | 0.000257 | 0.0957 | 0.0815 | 0.0395 | 0.00853 | 0.00853 |
| Vanadium (TSP) | 58 | 58 | 0.0000152 | 0.0388 | 0.0201 | 0.0116 | 0.00504 | 0.00504 |
| Zinc (TSP) | 57 | 57 | 0.000273 | 0.345 | 0.333 | 0.313 | 0.128 | 0.128 |
| 1,1,1-Trichloroethane | 30 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,1,2,2-Tetrachloroethane | 30 | 0 | 2.01 | 0 | 0 | 0 | 0 | 2.01 |
| 1,1,2-Trichloroethane | 30 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,1-Dichloroethane | 30 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,1-Dichloroethene | 30 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2,4-Trichlorobenzene | 30 | 0 | 2.21 | 0 | 0 | 0 | 0 | 2.21 |
| 1,2,4-Trimethylbenzene | 30 | 25 | 1.44 | 2.9 | 1.3 | 1.2 | 0.587 | 0.83 |
| 1,2-Dibromoethane | 30 | 0 | 2.29 | 0 | 0 | 0 | 0 | 2.29 |
| 1,2-Dichlorobenzene | 30 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| 1,2-Dichloroethane | 30 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2-Dichloropropane | 30 | 0 | 1.39 | 0 | 0 | 0 | 0 | 1.39 |
| 1,3,5-Trimethylbenzene | 30 | 3 | 1.44 | 0.84 | 0.38 | 0.33 | 0.0517 | 1.34 |
| 1,3-Butadiene | 30 | 21 | 0.652 | 0.6 | 0.43 | 0.38 | 0.12 | 0.316 |
| 1,3-Dichlorobenzene | 30 | 1 | 1.8 | 0.34 | 0 | 0 | 0.0113 | 1.75 |
| 1,4-Dichlorobenzene | 30 | 1 | 1.8 | 0.46 | 0 | 0 | 0.0153 | 1.75 |
| 2,2,4-Trimethylpentane | 30 | 28 | 1.4 | 2.1 | 1.2 | 0.84 | 0.47 | 0.564 |
| 2,5-dimethylbenzaldehyde | 30 | 0 | 0.177 | 0 | 0 | 0 | 0 | 0.177 |
| 2-Chloro-1,3-Butadiene | 30 | 0 | 1.1 | 0 | 0 | 0 | 0 | 1.1 |
| Acetaldehyde | 30 | 30 | 0.0782 | 10.6 | 9.85 | 6.75 | 2.69 | 2.69 |
| Acetone | 30 | 30 | 0.252 | 31.9 | 22.9 | 22.1 | 6.6 | 6.6 |
| Acetonitrile | 30 | 20 | 1.64 | 13 | 11 | 4.8 | 2.32 | 2.87 |
| Acrylonitrile | 30 | 7 | 1.1 | 0.62 | 0.43 | 0.38 | 0.092 | 0.935 |
| Benzaldehyde | 30 | 0 | 0.0721 | 0 | 0 | 0 | 0 | 0.0721 |
| Benzene | 30 | 30 | 0.943 | 11 | 5.9 | 5.5 | 2.31 | 2.31 |
| Bromodichloromethane | 30 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| Bromoform | 30 | 0 | 3.04 | 0 | 0 | 0 | 0 | 3.04 |
| Bromomethane (Methyl Bromide) | 30 | 1 | 1.12 | 1.2 | 0 | 0 | 0.04 | 1.12 |
| Carbon Tetrachloride | 30 | 0 | 1.86 | 0 | 0 | 0 | 0 | 1.86 |
| Chlorobenzene | 30 | 0 | 1.38 | 0 | 0 | 0 | 0 | 1.38 |
| Chloroethane | 30 | 1 | 0.779 | 0.12 | 0 | 0 | 0.004 | 0.757 |
| Chloroform | 30 | 0 | 1.41 | 0 | 0 | 0 | 0 | 1.41 |
| Chloromethane | 30 | 30 | 0.61 | 1.4 | 1.4 | 1.3 | 1.14 | 1.14 |
| Chloromethyl Benzene | 30 | 0 | 1.5 | 0 | 0 | 0 | 0 | 1.5 |

**DETROIT - W. Fort St. AIRS ID: 261630015 Units: µg/m³**

| Parameter Name | Num Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
|---|---|---|---|---|---|---|---|---|
| cis-1,2-Dichloroethene | 25 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| cis-1,3-Dichloropropene | 30 | 1 | 1.31 | 0.44 | 0 | 0 | 0.0147 | 1.28 |
| Crotonaldehyde | 30 | 0 | 0.0421 | 0 | 0 | 0 | 0 | 0.0421 |
| Dibromochloromethane | 30 | 0 | 2.51 | 0 | 0 | 0 | 0 | 2.51 |
| Dichlorodiflouromethane | 30 | 30 | 1.48 | 3.3 | 3.1 | 3 | 2.54 | 2.54 |
| Ethylbenzene | 30 | 24 | 1.3 | 1.4 | 0.71 | 0.7 | 0.343 | 0.603 |
| Formaldehyde | 30 | 30 | 0.0841 | 15.5 | 14.8 | 12.9 | 3.82 | 3.82 |
| Halocarbon 113 | 30 | 24 | 2.27 | 1.7 | 1.3 | 1.1 | 0.701 | 1.16 |
| Halocarbon 114 | 30 | 1 | 2.08 | 0.16 | 0 | 0 | 0.00533 | 2.02 |
| Hexachloro-1,3-Butadiene | 30 | 0 | 3.14 | 0 | 0 | 0 | 0 | 3.14 |
| Hexanaldehyde | 30 | 1 | 0.138 | 1.63 | 0 | 0 | 0.0543 | 0.191 |
| Isovaleraldehyde | 30 | 0 | 0.0872 | 0 | 0 | 0 | 0 | 0.0872 |
| m,p-Tolualdehyde | 30 | 0 | 0.132 | 0 | 0 | 0 | 0 | 0.132 |
| m/p -Xylene | 30 | 25 | 1.3 | 3.9 | 2.1 | 1.9 | 0.904 | 1.12 |
| Methyl Ethyl Ketone | 30 | 29 | 14.4 | 2.9 | 2.7 | 2.6 | 1.45 | 1.95 |
| Methyl Isobutyl Ketone | 30 | 0 | 4.02 | 0 | 0 | 0 | 0 | 4.02 |
| Methyl Tert-Butyl Ether | 30 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| Methylene Chloride | 30 | 4 | 1 | 1.3 | 1.2 | 0.96 | 0.146 | 1.02 |
| n-Butyraldehyde | 30 | 0 | 0.0451 | 0 | 0 | 0 | 0 | 0.0451 |
| n-Hexane | 30 | 30 | 3.47 | 7.5 | 6.2 | 3.4 | 1.43 | 1.43 |
| o-Tolualdehyde | 30 | 0 | 0.111 | 0 | 0 | 0 | 0 | 0.111 |
| o-xylene | 30 | 23 | 1.3 | 1.8 | 0.83 | 0.8 | 0.374 | 0.678 |
| Propionaldehyde | 30 | 3 | 0.129 | 3.65 | 0.884 | 0.796 | 0.178 | 0.299 |
| Styrene | 30 | 4 | 1.27 | 0.7 | 0.59 | 0.52 | 0.0703 | 1.18 |
| Tetrachloroethene | 30 | 2 | 2.01 | 1.7 | 1.3 | 0 | 0.1 | 1.97 |
| Toluene | 30 | 30 | 1.1 | 12 | 6.4 | 6.3 | 3.18 | 3.18 |
| trans-1,2-Dichloroethene | 30 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| trans-1,3-Dichloropropene | 30 | 1 | 1.31 | 0.3 | 0 | 0 | 0.01 | 1.27 |
| Trichloroethene | 30 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| Trichloroflouromethane | 30 | 30 | 1.67 | 3.4 | 3.3 | 2.5 | 1.93 | 1.93 |
| Valeraldehyde | 30 | 0 | 0.132 | 0 | 0 | 0 | 0 | 0.132 |
| Vinyl Chloride | 30 | 0 | 0.754 | 0 | 0 | 0 | 0 | 0.754 |

**FLINT AIRS ID: 260490021 Units: µg/m³**

| Parameter Name | Num Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
|---|---|---|---|---|---|---|---|---|
| Arsenic (TSP) | 59 | 59 | 0.00000268 | 0.00552 | 0.00499 | 0.00437 | 0.0016 | 0.0016 |
| Beryllium (TSP) | 59 | 44 | 0.0000205 | 0.00005 | 0.00004 | 0.0000226 | 0.00000908 | 0.000014 |
| Barium (TSP) | 59 | 59 | 0.000528 | 0.145 | 0.13 | 0.13 | 0.103 | 0.103 |
| Cadmium (TSP) | 59 | 59 | 0.0000073 | 0.00116 | 0.00089 | 0.0006 | 0.000258 | 0.000258 |
| Chromium (TSP) | 59 | 59 | 0.0000768 | 0.00731 | 0.00702 | 0.00672 | 0.00508 | 0.00508 |
| Cobalt (TSP) | 59 | 59 | 0.00000815 | 0.00051 | 0.00046 | 0.0004 | 0.000188 | 0.000188 |
| Copper (TSP) | 59 | 59 | 0.000955 | 0.713 | 0.494 | 0.468 | 0.194 | 0.194 |
| Iron (TSP) | 59 | 59 | 0.000464 | 1.24 | 0.984 | 0.949 | 0.399 | 0.399 |
| Lead (TSP) | 59 | 59 | 0.0000302 | 0.0226 | 0.0223 | 0.0222 | 0.00863 | 0.00863 |
| Manganese (TSP) | 59 | 59 | 0.000147 | 0.051 | 0.051 | 0.038 | 0.0126 | 0.0126 |

| FLINT | AIRS ID: 260490021 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Molybdenum (TSP) | 59 | 59 | 0.00000815 | 0.00177 | 0.0013 | 0.00126 | 0.000769 | 0.000769 |
| Nickel (TSP) | 59 | 59 | 0.000241 | 0.00402 | 0.00319 | 0.00306 | 0.00171 | 0.00171 |
| Vanadium (TSP) | 59 | 59 | 0.0000129 | 0.00816 | 0.00504 | 0.0045 | 0.00105 | 0.00105 |
| Zinc (TSP) | 59 | 59 | 0.000257 | 0.166 | 0.088 | 0.083 | 0.0468 | 0.0468 |

| GRAND RAPIDS - Randolph | AIRS ID: 260810021 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Arsenic (TSP) | 30 | 30 | 0.00000205 | 0.00701 | 0.00485 | 0.00268 | 0.0015 | 0.0015 |
| Beryllium (TSP) | 30 | 28 | 0.0000163 | 0.00006 | 0.00004 | 0.00004 | 0.0000184 | 0.0000193 |
| Barium (TSP) | 30 | 30 | 0.00042 | 0.159 | 0.139 | 0.136 | 0.0987 | 0.0987 |
| Cadmium (TSP) | 30 | 30 | 0.00000423 | 0.00067 | 0.00049 | 0.00047 | 0.000273 | 0.000273 |
| Chromium (TSP) | 30 | 30 | 0.0000609 | 0.0193 | 0.0141 | 0.0109 | 0.00721 | 0.00721 |
| Cobalt (TSP) | 30 | 30 | 0.00000596 | 0.00125 | 0.00093 | 0.00067 | 0.000361 | 0.000361 |
| Copper (TSP) | 30 | 30 | 0.000759 | 0.616 | 0.249 | 0.219 | 0.112 | 0.112 |
| Iron (TSP) | 30 | 30 | 0.00037 | 1.42 | 1.38 | 1.31 | 0.656 | 0.656 |
| Lead (TSP) | 30 | 30 | 0.0000239 | 0.0183 | 0.0177 | 0.0177 | 0.00945 | 0.00945 |
| Manganese (TSP) | 30 | 30 | 0.000117 | 0.055 | 0.054 | 0.052 | 0.0296 | 0.0296 |
| Molybdenum (TSP) | 30 | 30 | 0.00000596 | 0.00199 | 0.00198 | 0.00169 | 0.000997 | 0.000997 |
| Nickel (TSP) | 30 | 30 | 0.000192 | 0.0434 | 0.0417 | 0.017 | 0.00789 | 0.00789 |
| Vanadium (TSP) | 30 | 30 | 0.0000104 | 0.00318 | 0.00209 | 0.00193 | 0.000932 | 0.000932 |
| Zinc (TSP) | 30 | 30 | 0.000204 | 0.196 | 0.177 | 0.168 | 0.0952 | 0.0952 |
| 1,1,1-Trichloroethane | 24 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,1,2,2-Tetrachloroethane | 24 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| 1,1,2-Trichloroethane | 24 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,1-Dichloroethane | 24 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,1-Dichloroethene | 24 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2,4-Trichlorobenzene | 24 | 0 | 2.2 | 0 | 0 | 0 | 0 | 2.2 |
| 1,2,4-Trimethylbenzene | 24 | 18 | 1.42 | 2.8 | 1.4 | 1.4 | 0.718 | 1.08 |
| 1,2-Dibromoethane | 24 | 0 | 2.29 | 0 | 0 | 0 | 0 | 2.29 |
| 1,2-Dichlorobenzene | 24 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| 1,2-Dichloroethane | 24 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2-Dichloropropane | 24 | 0 | 1.38 | 0 | 0 | 0 | 0 | 1.38 |
| 1,3,5-Trimethylbenzene | 24 | 5 | 1.42 | 0.89 | 0.62 | 0.41 | 0.112 | 1.24 |
| 1,3-Butadiene | 24 | 10 | 0.651 | 0.91 | 0.32 | 0.25 | 0.102 | 0.481 |
| 1,3-Dichlorobenzene | 24 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| 1,4-Dichlorobenzene | 24 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| 2,2,4-Trimethylpentane | 24 | 22 | 1.4 | 2.1 | 1.1 | 1 | 0.54 | 0.657 |
| 2,5-dimethylbenzaldehyde | 30 | 0 | 0.0505 | 0 | 0 | 0 | 0 | 0.0505 |
| 2-Chloro-1,3-Butadiene | 24 | 0 | 1.1 | 0 | 0 | 0 | 0 | 1.1 |
| Acetaldehyde | 30 | 30 | 0.0223 | 3.08 | 2.81 | 2.71 | 1.62 | 1.62 |
| Acetone | 30 | 30 | 0.0719 | 10 | 8.95 | 8.85 | 4.01 | 4.01 |
| Acetonitrile | 24 | 3 | 1.63 | 2 | 0.61 | 0.45 | 0.128 | 1.55 |
| Acrylonitrile | 24 | 20 | 1.1 | 1.9 | 1.9 | 1.7 | 0.669 | 0.852 |

| GRAND RAPIDS - Randolph | AIRS ID: 260810021 | Units: µg/m³ |
|---|---|---|

| Parameter Name | Num Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
|---|---|---|---|---|---|---|---|---|
| Benzaldehyde | 30 | 2 | 0.0206 | 0.781 | 0.716 | 0 | 0.0499 | 0.0691 |
| Benzene | 24 | 24 | 0.94 | 3.2 | 1.8 | 1.6 | 1.09 | 1.09 |
| Bromodichloromethane | 24 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| Bromoform | 24 | 0 | 3.02 | 0 | 0 | 0 | 0 | 3.02 |
| Bromomethane (Methyl Bromide) | 24 | 0 | 1.11 | 0 | 0 | 0 | 0 | 1.11 |
| Carbon Tetrachloride | 24 | 0 | 1.85 | 0 | 0 | 0 | 0 | 1.85 |
| Chlorobenzene | 24 | 0 | 1.38 | 0 | 0 | 0 | 0 | 1.38 |
| Chloroethane | 24 | 0 | 0.777 | 0 | 0 | 0 | 0 | 0.777 |
| Chloroform | 24 | 1 | 1.4 | 0.52 | 0 | 0 | 0.0217 | 1.37 |
| Chloromethane | 24 | 24 | 0.609 | 1.5 | 1.5 | 1.4 | 1.16 | 1.16 |
| Chloromethyl Benzene | 24 | 0 | 1.5 | 0 | 0 | 0 | 0 | 1.5 |
| cis-1,2-Dichloroethene | 22 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| cis-1,3-Dichloropropene | 24 | 0 | 1.3 | 0 | 0 | 0 | 0 | 1.3 |
| Crotonaldehyde | 30 | 1 | 0.012 | 0.464 | 0 | 0 | 0.0155 | 0.027 |
| Dibromochloromethane | 24 | 0 | 2.5 | 0 | 0 | 0 | 0 | 2.5 |
| Dichlorodiflouromethane | 24 | 24 | 1.34 | 3.1 | 3.1 | 2.8 | 2.57 | 2.57 |
| Ethylbenzene | 24 | 20 | 1.3 | 2.4 | 1.1 | 1 | 0.609 | 0.825 |
| Formaldehyde | 30 | 29 | 0.024 | 5.06 | 4.45 | 4.43 | 2.59 | 2.59 |
| Halocarbon 113 | 24 | 19 | 2.27 | 1.2 | 0.77 | 0.75 | 0.509 | 0.988 |
| Halocarbon 114 | 24 | 0 | 2.08 | 0 | 0 | 0 | 0 | 2.08 |
| Hexachloro-1,3-Butadiene | 24 | 0 | 3.12 | 0 | 0 | 0 | 0 | 3.12 |
| Hexanaldehyde | 30 | 3 | 0.0394 | 0.828 | 0.701 | 0.639 | 0.0723 | 0.108 |
| Isovaleraldehyde | 30 | 1 | 0.0249 | 0.701 | 0 | 0 | 0.0234 | 0.0474 |
| m,p-Tolualdehyde | 30 | 1 | 0.0376 | 0.978 | 0 | 0 | 0.0326 | 0.069 |
| m/p -Xylene | 24 | 22 | 1.3 | 5.9 | 2.9 | 2.6 | 1.6 | 1.71 |
| Methyl Ethyl Ketone | 24 | 21 | 14.3 | 3.3 | 2.3 | 2.2 | 1.27 | 3.06 |
| Methyl Isobutyl Ketone | 24 | 3 | 4 | 1.2 | 1.1 | 0.71 | 0.125 | 3.63 |
| Methyl Tert-Butyl Ether | 24 | 0 | 1.8 | 0 | 0 | 0 | 0 | 1.8 |
| Methylene Chloride | 24 | 12 | 1 | 3.2 | 2 | 1.7 | 0.743 | 1.24 |
| n-Butyraldehyde | 30 | 8 | 0.0129 | 1.25 | 0.767 | 0.675 | 0.167 | 0.176 |
| n-Hexane | 24 | 22 | 3.46 | 2.8 | 1.3 | 1.3 | 0.82 | 1.11 |
| o-Tolualdehyde | 30 | 0 | 0.0317 | 0 | 0 | 0 | 0 | 0.0317 |
| o-xylene | 24 | 20 | 1.3 | 2.7 | 1 | 1 | 0.628 | 0.845 |
| Propionaldehyde | 30 | 21 | 0.0368 | 1.65 | 1.17 | 1.05 | 0.442 | 0.452 |
| Styrene | 24 | 1 | 1.27 | 0.36 | 0 | 0 | 0.015 | 1.23 |
| Tetrachloroethene | 24 | 1 | 2 | 38 | 0 | 0 | 1.58 | 3.5 |
| Toluene | 24 | 24 | 1.1 | 14 | 6.1 | 5.4 | 3.4 | 3.4 |
| trans-1,2-Dichloroethene | 24 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| trans-1,3-Dichloropropene | 24 | 0 | 1.3 | 0 | 0 | 0 | 0 | 1.3 |
| Trichloroethene | 24 | 5 | 1.6 | 4.4 | 1.2 | 0.88 | 0.321 | 1.59 |
| Trichloroflouromethane | 24 | 24 | 1.52 | 2.7 | 2.4 | 2.1 | 1.55 | 1.55 |
| Valeraldehyde | 30 | 2 | 0.0377 | 0.652 | 0.578 | 0 | 0.041 | 0.0762 |
| Vinyl Chloride | 23 | 0 | 0.752 | 0 | 0 | 0 | 0 | 0.752 |

**HOUGHTON LAKE** **AIRS ID: 261130001** **Units: µg/m³**

| Parameter Name | Num Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
|---|---|---|---|---|---|---|---|---|
| Arsenic (TSP) | 54 | 54 | 0.00000236 | 0.00184 | 0.0015 | 0.00129 | 0.000554 | 0.000554 |
| Beryllium (TSP) | 54 | 34 | 0.0000196 | 0.000027 | 0.000017 | 0.000017 | 0.0000065 | 0.0000138 |
| Barium (TSP) | 54 | 54 | 0.000505 | 0.145 | 0.144 | 0.144 | 0.103 | 0.103 |
| Cadmium (TSP) | 54 | 54 | 0.00000585 | 0.00108 | 0.00049 | 0.00045 | 0.000152 | 0.000152 |
| Chromium (TSP) | 54 | 54 | 0.0000725 | 0.046 | 0.0371 | 0.00805 | 0.00559 | 0.00559 |
| Cobalt (TSP) | 54 | 54 | 0.00000799 | 0.00051 | 0.00039 | 0.00021 | 0.0000887 | 0.0000887 |
| Copper (TSP) | 54 | 54 | 0.000912 | 1.59 | 1.43 | 1.41 | 0.338 | 0.338 |
| Iron (TSP) | 54 | 54 | 0.000444 | 0.525 | 0.501 | 0.349 | 0.117 | 0.117 |
| Lead (TSP) | 54 | 54 | 0.0000296 | 0.00677 | 0.00648 | 0.00579 | 0.0028 | 0.0028 |
| Manganese (TSP) | 54 | 54 | 0.000141 | 0.111 | 0.08 | 0.08 | 0.0115 | 0.0115 |
| Molybdenum (TSP) | 54 | 54 | 0.00000799 | 0.00098 | 0.00076 | 0.00075 | 0.000411 | 0.000411 |
| Nickel (TSP) | 54 | 54 | 0.00023 | 0.0432 | 0.0332 | 0.00175 | 0.00227 | 0.00227 |
| Vanadium (TSP) | 54 | 52 | 0.0000115 | 0.00211 | 0.00133 | 0.00123 | 0.000338 | 0.000338 |
| Zinc (TSP) | 54 | 54 | 0.000246 | 0.173 | 0.173 | 0.086 | 0.0352 | 0.0352 |
| 1,1,1-Trichloroethane | 54 | 0 | 1.55 | 0 | 0 | 0 | 0 | 1.55 |
| 1,1,2,2-Tetrachloroethane | 54 | 0 | 1.94 | 0 | 0 | 0 | 0 | 1.94 |
| 1,1,2-Trichloroethane | 54 | 0 | 1.55 | 0 | 0 | 0 | 0 | 1.55 |
| 1,1-Dichloroethane | 54 | 0 | 1.16 | 0 | 0 | 0 | 0 | 1.16 |
| 1,1-Dichloroethene | 54 | 0 | 1.16 | 0 | 0 | 0 | 0 | 1.16 |
| 1,2,4-Trichlorobenzene | 54 | 0 | 2.16 | 0 | 0 | 0 | 0 | 2.16 |
| 1,2,4-Trimethylbenzene | 54 | 4 | 1.39 | 0.53 | 0.41 | 0.36 | 0.0306 | 1.31 |
| 1,2-Dibromoethane | 54 | 0 | 2.24 | 0 | 0 | 0 | 0 | 2.24 |
| 1,2-Dichlorobenzene | 54 | 0 | 1.74 | 0 | 0 | 0 | 0 | 1.74 |
| 1,2-Dichloroethane | 54 | 0 | 1.17 | 0 | 0 | 0 | 0 | 1.17 |
| 1,2-Dichloropropane | 54 | 0 | 1.35 | 0 | 0 | 0 | 0 | 1.35 |
| 1,3,5-Trimethylbenzene | 54 | 0 | 1.39 | 0 | 0 | 0 | 0 | 1.39 |
| 1,3-Butadiene | 54 | 0 | 0.628 | 0 | 0 | 0 | 0 | 0.628 |
| 1,3-Dichlorobenzene | 54 | 0 | 1.74 | 0 | 0 | 0 | 0 | 1.74 |
| 1,4-Dichlorobenzene | 54 | 0 | 1.75 | 0 | 0 | 0 | 0 | 1.75 |
| 2,2,4-Trimethylpentane | 54 | 19 | 1.35 | 0.4 | 0.21 | 0.2 | 0.0507 | 0.958 |
| 2,5-dimethylbenzaldehyde | 30 | 0 | 0.0519 | 0 | 0 | 0 | 0 | 0.0519 |
| 2-Chloro-1,3-Butadiene | 54 | 0 | 1.08 | 0 | 0 | 0 | 0 | 1.08 |
| Acetaldehyde | 30 | 30 | 0.0229 | 1.57 | 1.4 | 1.36 | 0.762 | 0.762 |
| Acetone | 30 | 30 | 0.0739 | 3.88 | 3.72 | 2.96 | 1.78 | 1.78 |
| Acetonitrile | 53 | 49 | 2.36 | 150 | 149 | 100 | 32.5 | 32.6 |
| Acrylonitrile | 54 | 10 | 1.07 | 0.82 | 0.63 | 0.48 | 0.077 | 0.942 |
| Benzaldehyde | 30 | 0 | 0.0211 | 0 | 0 | 0 | 0 | 0.0211 |
| Benzene | 54 | 54 | 0.91 | 0.79 | 0.7 | 0.55 | 0.37 | 0.37 |
| Bromodichloromethane | 54 | 0 | 1.94 | 0 | 0 | 0 | 0 | 1.94 |
| Bromoform | 54 | 0 | 3.04 | 0 | 0 | 0 | 0 | 3.04 |
| Bromomethane (Methyl Bromide) | 54 | 2 | 1.08 | 0.75 | 0.56 | 0 | 0.0243 | 1.06 |
| Carbon Tetrachloride | 53 | 0 | 1.83 | 0 | 0 | 0 | 0 | 1.83 |
| Chlorobenzene | 54 | 0 | 1.35 | 0 | 0 | 0 | 0 | 1.35 |
| Chloroethane | 53 | 0 | 0.751 | 0 | 0 | 0 | 0 | 0.751 |
| Chloroform | 54 | 36 | 1.36 | 0.74 | 0.7 | 0.64 | 0.291 | 0.758 |
| Chloromethane | 54 | 54 | 0.59 | 1.8 | 1.7 | 1.4 | 1.22 | 1.22 |
| Chloromethyl Benzene | 54 | 0 | 1.48 | 0 | 0 | 0 | 0 | 1.48 |
| cis-1,2-Dichloroethene | 47 | 0 | 1.16 | 0 | 0 | 0 | 0 | 1.16 |

| HOUGHTON LAKE | AIRS ID: 261130001 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| cis-1,3-Dichloropropene | 54 | 1 | 1.26 | 0.34 | 0 | 0 | 0.0063 | 1.25 |
| Crotonaldehyde | 30 | 0 | 0.0123 | 0 | 0 | 0 | 0 | 0.0123 |
| Dibromochloromethane | 54 | 0 | 2.44 | 0 | 0 | 0 | 0 | 2.44 |
| Dichlorodiflouromethane | 54 | 54 | 1.43 | 3 | 2.8 | 2.7 | 2.43 | 2.43 |
| Ethylbenzene | 54 | 6 | 1.26 | 0.39 | 0.29 | 0.24 | 0.0289 | 1.14 |
| Formaldehyde | 30 | 30 | 0.0246 | 3.67 | 3.22 | 2.99 | 1.27 | 1.27 |
| Halocarbon 113 | 54 | 37 | 2.21 | 0.87 | 0.81 | 0.79 | 0.437 | 1.15 |
| Halocarbon 114 | 54 | 0 | 2.01 | 0 | 0 | 0 | 0 | 2.01 |
| Hexachloro-1,3-Butadiene | 54 | 0 | 3.06 | 0 | 0 | 0 | 0 | 3.06 |
| Hexanaldehyde | 30 | 1 | 0.0405 | 1.7 | 0 | 0 | 0.0567 | 0.0957 |
| Isovaleraldehyde | 30 | 0 | 0.0255 | 0 | 0 | 0 | 0 | 0.0255 |
| m,p-Tolualdehyde | 30 | 0 | 0.0387 | 0 | 0 | 0 | 0 | 0.0387 |
| m/p -Xylene | 54 | 6 | 1.27 | 1 | 0.62 | 0.56 | 0.0665 | 1.19 |
| Methyl Ethyl Ketone | 53 | 52 | 13.8 | 3.3 | 3.3 | 3.1 | 1.61 | 1.9 |
| Methyl Isobutyl Ketone | 54 | 4 | 3.88 | 0.83 | 0.75 | 0.74 | 0.0565 | 3.64 |
| Methyl Tert-Butyl Ether | 54 | 0 | 1.74 | 0 | 0 | 0 | 0 | 1.74 |
| Methylene Chloride | 54 | 9 | 0.994 | 1.6 | 1.6 | 1.2 | 0.189 | 1.02 |
| n-Butyraldehyde | 30 | 0 | 0.0132 | 0 | 0 | 0 | 0 | 0.0132 |
| n-Hexane | 54 | 9 | 3.35 | 1.7 | 0.74 | 0.68 | 0.101 | 2.87 |
| o-Tolualdehyde | 30 | 0 | 0.0326 | 0 | 0 | 0 | 0 | 0.0326 |
| o-xylene | 54 | 7 | 1.26 | 0.45 | 0.34 | 0.25 | 0.0367 | 1.13 |
| Propionaldehyde | 30 | 3 | 0.0379 | 0.487 | 0.463 | 0.371 | 0.044 | 0.0781 |
| Styrene | 54 | 13 | 1.24 | 0.4 | 0.33 | 0.33 | 0.0733 | 1 |
| Tetrachloroethene | 54 | 51 | 1.95 | 49 | 46 | 38 | 13.4 | 13.6 |
| Toluene | 54 | 54 | 1.07 | 1.6 | 1.5 | 1.4 | 0.723 | 0.723 |
| trans-1,2-Dichloroethene | 53 | 0 | 1.19 | 0 | 0 | 0 | 0 | 1.19 |
| trans-1,3-Dichloropropene | 54 | 0 | 1.26 | 0 | 0 | 0 | 0 | 1.26 |
| Trichloroethene | 54 | 0 | 1.56 | 0 | 0 | 0 | 0 | 1.56 |
| Trichloroflouromethane | 54 | 54 | 1.61 | 5.2 | 4.5 | 4.4 | 2.72 | 2.72 |
| Valeraldehyde | 30 | 0 | 0.0387 | 0 | 0 | 0 | 0 | 0.0387 |
| Vinyl Chloride | 54 | 0 | 0.726 | 0 | 0 | 0 | 0 | 0.726 |

| RIVER ROUGE | AIRS ID: 261630005 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Arsenic (TSP) | 55 | 55 | 0.00000268 | 0.00531 | 0.0048 | 0.00403 | 0.002 | 0.002 |
| Beryllium (TSP) | 56 | 56 | 0.0000216 | 0.00013 | 0.000115 | 0.000111 | 0.0000463 | 0.0000463 |
| Barium (TSP) | 56 | 56 | 0.000557 | 0.173 | 0.167 | 0.165 | 0.121 | 0.121 |
| Cadmium (TSP) | 55 | 55 | 0.00000701 | 0.00373 | 0.00355 | 0.00355 | 0.000933 | 0.000933 |
| Chromium (TSP) | 55 | 55 | 0.0000809 | 0.0236 | 0.0169 | 0.0159 | 0.00849 | 0.00849 |
| Cobalt (TSP) | 55 | 55 | 0.00000866 | 0.00147 | 0.00091 | 0.00078 | 0.00035 | 0.00035 |
| Copper (TSP) | 56 | 56 | 0.00101 | 0.968 | 0.911 | 0.9 | 0.482 | 0.482 |
| Iron (TSP) | 56 | 56 | 0.000489 | 3.78 | 3.01 | 2.73 | 1.21 | 1.21 |
| Lead (TSP) | 55 | 55 | 0.0000324 | 0.0678 | 0.0489 | 0.0463 | 0.016 | 0.016 |
| Manganese (TSP) | 56 | 56 | 0.000156 | 0.288 | 0.252 | 0.157 | 0.0728 | 0.0728 |

| RIVER ROUGE | AIRS ID: 261630005 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Molybdenum (TSP) | 55 | 55 | 0.00000866 | 0.0028 | 0.00257 | 0.00246 | 0.00119 | 0.00119 |
| Nickel (TSP) | 55 | 55 | 0.000255 | 0.0112 | 0.00757 | 0.0075 | 0.00321 | 0.00321 |
| Vanadium (TSP) | 55 | 55 | 0.0000143 | 0.0326 | 0.0214 | 0.0188 | 0.00567 | 0.00567 |
| Zinc (TSP) | 56 | 56 | 0.000271 | 0.429 | 0.346 | 0.333 | 0.131 | 0.131 |
| 2,5-dimethylbenzaldehyde | 40 | 0 | 0.0668 | 0 | 0 | 0 | 0 | 0.0668 |
| Acetaldehyde | 40 | 40 | 0.0293 | 15.1 | 2.65 | 2.63 | 1.87 | 1.87 |
| Acetone | 40 | 39 | 0.0946 | 18.8 | 5.11 | 4.3 | 2.68 | 2.68 |
| Benzaldehyde | 40 | 1 | 0.0272 | 2.67 | 0 | 0 | 0.0668 | 0.0934 |
| Crotonaldehyde | 40 | 0 | 0.016 | 0 | 0 | 0 | 0 | 0.016 |
| Formaldehyde | 40 | 40 | 0.0315 | 65.2 | 32.5 | 6.28 | 4.82 | 4.82 |
| Hexanaldehyde | 40 | 3 | 0.0527 | 5.14 | 1.77 | 0.803 | 0.193 | 0.242 |
| Isovaleraldehyde | 40 | 1 | 0.0326 | 1.05 | 0 | 0 | 0.0262 | 0.0582 |
| m,p-Tolualdehyde | 40 | 0 | 0.0503 | 0 | 0 | 0 | 0 | 0.0503 |
| n-Butyraldehyde | 40 | 4 | 0.0172 | 1.65 | 0.49 | 0.46 | 0.0761 | 0.0919 |
| o-Tolualdehyde | 40 | 0 | 0.0423 | 0 | 0 | 0 | 0 | 0.0423 |
| Propionaldehyde | 40 | 23 | 0.0497 | 5.13 | 1.07 | 0.848 | 0.461 | 0.479 |
| Valeraldehyde | 40 | 1 | 0.0508 | 2.64 | 0 | 0 | 0.066 | 0.116 |

| YPSILANTI | AIRS ID: 261610008 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Arsenic (TSP) | 28 | 28 | 0.00000263 | 0.0148 | 0.00458 | 0.00422 | 0.00206 | 0.00206 |
| Beryllium (TSP) | 28 | 24 | 0.0000206 | 0.00005 | 0.00003 | 0.0000292 | 0.0000131 | 0.000016 |
| Barium (TSP) | 28 | 28 | 0.000533 | 0.193 | 0.157 | 0.155 | 0.121 | 0.121 |
| Cadmium (TSP) | 28 | 28 | 0.00000669 | 0.00185 | 0.00052 | 0.00045 | 0.000288 | 0.000288 |
| Chromium (TSP) | 28 | 28 | 0.0000771 | 0.00751 | 0.00747 | 0.00736 | 0.00557 | 0.00557 |
| Cobalt (TSP) | 28 | 28 | 0.00000842 | 0.00051 | 0.00046 | 0.00044 | 0.000231 | 0.000231 |
| Copper (TSP) | 28 | 28 | 0.000962 | 1.13 | 1.03 | 0.937 | 0.354 | 0.354 |
| Iron (TSP) | 28 | 28 | 0.000468 | 1.13 | 0.992 | 0.886 | 0.405 | 0.405 |
| Lead (TSP) | 28 | 28 | 0.0000306 | 0.0134 | 0.0128 | 0.0116 | 0.00703 | 0.00703 |
| Manganese (TSP) | 28 | 28 | 0.000149 | 0.337 | 0.05 | 0.044 | 0.0297 | 0.0297 |
| Molybdenum (TSP) | 28 | 28 | 0.00000842 | 0.00211 | 0.0021 | 0.00201 | 0.00102 | 0.00102 |
| Nickel (TSP) | 28 | 28 | 0.000243 | 0.00585 | 0.00493 | 0.00347 | 0.0019 | 0.0019 |
| Vanadium (TSP) | 28 | 28 | 0.0000118 | 0.0156 | 0.0115 | 0.00509 | 0.00219 | 0.00219 |
| Zinc (TSP) | 28 | 28 | 0.000259 | 0.124 | 0.121 | 0.109 | 0.0575 | 0.0575 |
| Halocarbon 113 | 28 | 21 | 2.27 | 0.75 | 0.74 | 0.72 | 0.443 | 1.01 |
| Halocarbon 114 | 28 | 0 | 2.08 | 0 | 0 | 0 | 0 | 2.08 |
| 1,3-Butadiene | 28 | 11 | 0.651 | 0.28 | 0.25 | 0.2 | 0.0614 | 0.456 |
| n-Hexane | 28 | 26 | 3.47 | 1.5 | 1.2 | 1.1 | 0.554 | 0.804 |
| 2,2,4-Trimethylpentane | 28 | 26 | 1.4 | 1.2 | 0.74 | 0.72 | 0.371 | 0.471 |
| Methyl Tert-Butyl Ether | 28 | 0 | 1.79 | 0 | 0 | 0 | 0 | 1.79 |
| Formaldehyde | 29 | 29 | 0.0282 | 4.2 | 3.8 | 3.2 | 2.18 | 2.18 |
| Acetaldehyde | 29 | 29 | 0.0262 | 2.84 | 2.42 | 2.34 | 1.44 | 1.44 |
| Propionaldehyde | 29 | 14 | 0.0433 | 10.9 | 1.07 | 0.841 | 0.628 | 0.651 |
| n-Butyraldehyde | 29 | 4 | 0.0151 | 0.814 | 0.566 | 0.543 | 0.0803 | 0.0935 |

| YPSILANTI | AIRS ID: 261610008 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Isovaleraldehyde | 29 | 0 | 0.0292 | 0 | 0 | 0 | 0 | 0.0292 |
| Crotonaldehyde | 29 | 0 | 0.0141 | 0 | 0 | 0 | 0 | 0.0141 |
| Hexanaldehyde | 29 | 1 | 0.0464 | 1.06 | 0 | 0 | 0.0366 | 0.0813 |
| Valeraldehyde | 29 | 3 | 0.0443 | 0.874 | 0.761 | 0.638 | 0.0784 | 0.118 |
| Acetone | 29 | 29 | 0.0845 | 5.33 | 4.91 | 4.9 | 2.75 | 2.75 |
| Methyl Ethyl Ketone | 28 | 28 | 14.4 | 2.1 | 2 | 1.9 | 1.02 | 1.02 |
| Methyl Isobutyl Ketone | 28 | 0 | 4.01 | 0 | 0 | 0 | 0 | 4.01 |
| Acetonitrile | 28 | 3 | 2.35 | 91 | 57 | 47 | 6.96 | 8.43 |
| Acrylonitrile | 28 | 2 | 1.1 | 0.77 | 0.38 | 0 | 0.0411 | 1.06 |
| Chloromethane | 28 | 28 | 0.609 | 1.5 | 1.4 | 1.4 | 1.18 | 1.18 |
| Methylene Chloride | 28 | 5 | 1 | 1.2 | 1.2 | 1 | 0.191 | 1.01 |
| Chloroform | 28 | 28 | 1.41 | 2.9 | 2.7 | 2.4 | 1.58 | 1.58 |
| Carbon Tetrachloride | 28 | 0 | 1.86 | 0 | 0 | 0 | 0 | 1.86 |
| Bromoform | 28 | 0 | 3.04 | 0 | 0 | 0 | 0 | 3.04 |
| Trichloroflouromethane | 28 | 28 | 1.67 | 1.6 | 1.6 | 1.6 | 1.41 | 1.41 |
| Chloroethane | 28 | 0 | 0.777 | 0 | 0 | 0 | 0 | 0.777 |
| 1,1-Dichloroethane | 28 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,1,1-Trichloroethane | 28 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,2-Dichloroethane | 28 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| Tetrachloroethene | 28 | 1 | 2 | 2.3 | 0 | 0 | 0.0821 | 2.01 |
| 1,1,2,2-Tetrachloroethane | 28 | 0 | 2 | 0 | 0 | 0 | 0 | 2 |
| Bromomethane (Methyl Bromide) | 28 | 0 | 1.11 | 0 | 0 | 0 | 0 | 1.11 |
| 1,1,2-Trichloroethane | 28 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| Dichlorodiflouromethane | 28 | 28 | 1.48 | 2.8 | 2.7 | 2.7 | 2.47 | 2.47 |
| Trichloroethene | 28 | 0 | 1.6 | 0 | 0 | 0 | 0 | 1.6 |
| 1,1-Dichloroethene | 28 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| Bromodichloromethane | 28 | 0 | 1.99 | 0 | 0 | 0 | 0 | 1.99 |
| 1,2-Dichloropropane | 28 | 0 | 1.39 | 0 | 0 | 0 | 0 | 1.39 |
| trans-1,3-Dichloropropene | 28 | 0 | 1.3 | 0 | 0 | 0 | 0 | 1.3 |
| cis-1,3-Dichloropropene | 28 | 1 | 1.3 | 0.42 | 0 | 0 | 0.015 | 1.27 |
| Dibromochloromethane | 28 | 0 | 2.5 | 0 | 0 | 0 | 0 | 2.5 |
| 2-Chloro-1,3-Butadiene | 28 | 0 | 1.1 | 0 | 0 | 0 | 0 | 1.1 |
| trans-1,2-Dichloroethene | 28 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| cis-1,2-Dichloroethene | 23 | 0 | 1.2 | 0 | 0 | 0 | 0 | 1.2 |
| 1,2-Dibromoethane | 28 | 0 | 2.29 | 0 | 0 | 0 | 0 | 2.29 |
| Hexachloro-1,3-Butadiene | 28 | 0 | 3.13 | 0 | 0 | 0 | 0 | 3.13 |
| Vinyl Chloride | 28 | 0 | 0.752 | 0 | 0 | 0 | 0 | 0.752 |
| m/p -Xylene | 28 | 19 | 1.3 | 2 | 1.3 | 1.2 | 0.523 | 0.94 |
| Benzene | 28 | 28 | 0.941 | 2.1 | 1.7 | 1.7 | 0.951 | 0.951 |
| Toluene | 28 | 28 | 1.1 | 6.1 | 4.5 | 4.4 | 2.1 | 2.1 |
| Ethylbenzene | 28 | 14 | 1.3 | 0.75 | 0.52 | 0.48 | 0.179 | 0.829 |
| o-xylene | 28 | 16 | 1.3 | 0.87 | 0.57 | 0.55 | 0.222 | 0.779 |
| 1,3,5-Trimethylbenzene | 28 | 1 | 1.44 | 0.36 | 0 | 0 | 0.0129 | 1.4 |
| 1,2,4-Trimethylbenzene | 28 | 21 | 1.44 | 1.3 | 0.88 | 0.83 | 0.411 | 0.776 |
| Styrene | 28 | 7 | 1.27 | 1.2 | 1.2 | 0.54 | 0.154 | 1.11 |
| Benzaldehyde | 29 | 0 | 0.0241 | 0 | 0 | 0 | 0 | 0.0241 |
| 2,5-dimethylbenzaldehyde | 29 | 0 | 0.0593 | 0 | 0 | 0 | 0 | 0.0593 |

| YPSILANTI | AIRS ID: 261610008 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| o-Tolualdehyde | 29 | 0 | 0.0372 | 0 | 0 | 0 | 0 | 0.0372 |
| m,p-Tolualdehyde | 29 | 0 | 0.0443 | 0 | 0 | 0 | 0 | 0.0443 |
| Chlorobenzene | 28 | 0 | 1.38 | 0 | 0 | 0 | 0 | 1.38 |
| 1,2-Dichlorobenzene | 28 | 0 | 1.79 | 0 | 0 | 0 | 0 | 1.79 |
| 1,3-Dichlorobenzene | 28 | 0 | 1.79 | 0 | 0 | 0 | 0 | 1.79 |
| 1,4-Dichlorobenzene | 28 | 0 | 1.79 | 0 | 0 | 0 | 0 | 1.79 |
| Chloromethyl Benzene | 28 | 0 | 1.5 | 0 | 0 | 0 | 0 | 1.5 |
| 1,2,4-Trichlorobenzene | 28 | 0 | 2.2 | 0 | 0 | 0 | 0 | 2.2 |

# APPENDIX C2: AIR TOXICS MONITORING SUMMARY FOR SPECIATED $PM_{2.5}$

| ALLEN PARK | AIRS ID: 261630001 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ Local conditions (LC) | 501 | 501 | 0.74 | 46.4 | 40.4 | 39.5 | 14 | 14 |
| Aluminum $PM_{2.5}$ LC | 113 | 57 | 0.0202 | 0.498 | 0.13 | 0.0941 | 0.021 | 0.0322 |
| Ammonium Ion $PM_{2.5}$ LC | 113 | 110 | 0.0166 | 7.04 | 6.71 | 5.82 | 1.85 | 1.85 |
| Antimony $PM_{2.5}$ LC | 113 | 42 | 0.0242 | 0.0759 | 0.0642 | 0.0619 | 0.00551 | 0.0209 |
| Arsenic $PM_{2.5}$ LC | 113 | 85 | 0.00247 | 0.00933 | 0.00827 | 0.00689 | 0.00186 | 0.00253 |
| Barium $PM_{2.5}$ LC | 113 | 63 | 0.0387 | 0.078 | 0.0661 | 0.0651 | 0.0122 | 0.0313 |
| Bromine $PM_{2.5}$ LC | 113 | 106 | 0.00196 | 0.0091 | 0.00776 | 0.00701 | 0.00252 | 0.00266 |
| Cadmium $PM_{2.5}$ LC | 113 | 45 | 0.0114 | 0.0308 | 0.0224 | 0.0191 | 0.0022 | 0.00909 |
| Calcium $PM_{2.5}$ LC | 113 | 112 | 0.00632 | 0.264 | 0.188 | 0.149 | 0.0584 | 0.0584 |
| Cerium $PM_{2.5}$ LC | 113 | 44 | 0.0577 | 0.0508 | 0.0433 | 0.04 | 0.00418 | 0.0477 |
| Cesium $PM_{2.5}$ LC | 113 | 34 | 0.0276 | 0.051 | 0.0373 | 0.0352 | 0.00404 | 0.0236 |
| Chlorine $PM_{2.5}$ LC | 113 | 69 | 0.00937 | 0.376 | 0.203 | 0.147 | 0.0244 | 0.0284 |
| Chromium $PM_{2.5}$ LC | 113 | 79 | 0.00207 | 0.0767 | 0.0158 | 0.0116 | 0.00257 | 0.00319 |
| Cobalt $PM_{2.5}$ LC | 113 | 24 | 0.00165 | 0.0014 | 0.00128 | 0.00116 | 0.000103 | 0.00142 |
| Copper $PM_{2.5}$ LC | 113 | 100 | 0.00228 | 0.027 | 0.0254 | 0.0242 | 0.00669 | 0.00696 |
| Elemental Carbon $PM_{2.5}$ LC | 112 | 111 | 0.24 | 2.02 | 1.87 | 1.62 | 0.726 | 0.728 |
| Europium $PM_{2.5}$ LC | 113 | 26 | 0.00786 | 0.0204 | 0.0198 | 0.0167 | 0.00153 | 0.00813 |
| Gallium $PM_{2.5}$ LC | 113 | 29 | 0.00412 | 0.00142 | 0.00141 | 0.00124 | 0.000161 | 0.00351 |
| Gold $PM_{2.5}$ LC | 113 | 53 | 0.00647 | 0.0111 | 0.00842 | 0.00653 | 0.00132 | 0.00424 |
| Hafnium $PM_{2.5}$ LC | 113 | 52 | 0.0277 | 0.0265 | 0.0226 | 0.0208 | 0.00218 | 0.0169 |
| Indium $PM_{2.5}$ LC | 113 | 34 | 0.0141 | 0.0282 | 0.0226 | 0.0192 | 0.0021 | 0.0119 |
| Iridium $PM_{2.5}$ LC | 113 | 41 | 0.00774 | 0.0103 | 0.0063 | 0.00595 | 0.000896 | 0.00579 |
| Iron $PM_{2.5}$ LC | 113 | 110 | 0.00237 | 0.469 | 0.403 | 0.364 | 0.121 | 0.121 |
| Lanthanium $PM_{2.5}$ LC | 113 | 62 | 0.0447 | 0.0599 | 0.0431 | 0.0421 | 0.00837 | 0.0304 |
| Magnesium $PM_{2.5}$ LC | 113 | 37 | 0.0252 | 0.256 | 0.0849 | 0.04 | 0.00893 | 0.0252 |
| Manganese $PM_{2.5}$ LC | 113 | 96 | 0.00224 | 0.0149 | 0.0142 | 0.0111 | 0.00303 | 0.00333 |
| Mercury $PM_{2.5}$ LC | 113 | 48 | 0.00478 | 0.00804 | 0.00735 | 0.00726 | 0.00136 | 0.00416 |
| Molybdenum $PM_{2.5}$ LC | 113 | 26 | 0.00817 | 0.00988 | 0.00896 | 0.00806 | 0.000721 | 0.00703 |
| Nickel $PM_{2.5}$ LC | 113 | 92 | 0.00173 | 0.0282 | 0.00958 | 0.00507 | 0.00158 | 0.00189 |
| Niobium $PM_{2.5}$ LC | 113 | 17 | 0.00475 | 0.00523 | 0.00386 | 0.00291 | 0.000251 | 0.00416 |
| Organic Carbon Peak1 $PM_{2.5}$ LC | 112 | 112 | 0.24 | 3.89 | 2.56 | 2.28 | 1.01 | 1.01 |
| Organic Carbon Peak2 $PM_{2.5}$ LC | 112 | 112 | 0.24 | 2.55 | 2.5 | 2.32 | 1.09 | 1.09 |
| Organic Carbon Peak3 $PM_{2.5}$ LC | 112 | 112 | 0.24 | 1.7 | 1.63 | 1.5 | 0.702 | 0.702 |
| Organic Carbon Peak4 $PM_{2.5}$ LC | 112 | 112 | 0.24 | 2.82 | 2.41 | 2.19 | 0.908 | 0.908 |
| Organic Carbon $PM_{2.5}$ LC | 112 | 112 | 0.24 | 12.8 | 9.01 | 8.83 | 3.77 | 3.77 |
| Organic Carbon Pyrolytic $PM_{2.5}$ LC | 112 | 20 | 0.24 | 3.09 | 1.85 | 0.89 | 0.0604 | 0.258 |
| Phosphorus $PM_{2.5}$ LC | 113 | 38 | 0.00947 | 0.041 | 0.0284 | 0.0258 | 0.00263 | 0.00882 |
| Potassium Ion $PM_{2.5}$ LC | 113 | 41 | 0.014 | 0.312 | 0.2 | 0.189 | 0.0328 | 0.0418 |
| Potassium $PM_{2.5}$ LC | 113 | 111 | 0.0087 | 0.364 | 0.233 | 0.211 | 0.0596 | 0.0598 |
| Rubidium $PM_{2.5}$ LC | 113 | 48 | 0.00218 | 0.00269 | 0.0021 | 0.00204 | 0.000334 | 0.00165 |

| ALLEN PARK | AIRS ID: 261630001 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Samarium $PM_{2.5}$ LC | 113 | 30 | 0.006 | 0.00995 | 0.00747 | 0.00599 | 0.000725 | 0.00537 |
| Scandium $PM_{2.5}$ LC | 113 | 26 | 0.0196 | 0.00245 | 0.00163 | 0.0014 | 0.000151 | 0.0138 |
| Selenium $PM_{2.5}$ LC | 113 | 82 | 0.0029 | 0.00572 | 0.00491 | 0.00478 | 0.00118 | 0.00198 |
| Silicon $PM_{2.5}$ LC | 113 | 102 | 0.0148 | 0.974 | 0.262 | 0.223 | 0.0728 | 0.0745 |
| Silver $PM_{2.5}$ LC | 113 | 48 | 0.0104 | 0.0197 | 0.0183 | 0.0162 | 0.00225 | 0.00817 |
| Sodium Ion $PM_{2.5}$ LC | 113 | 106 | 0.03 | 0.359 | 0.268 | 0.253 | 0.0771 | 0.079 |
| Sodium $PM_{2.5}$ LC | 113 | 51 | 0.0799 | 0.448 | 0.313 | 0.266 | 0.0384 | 0.0824 |
| Strantium $PM_{2.5}$ LC | 113 | 72 | 0.00259 | 0.00823 | 0.00689 | 0.00437 | 0.00109 | 0.00218 |
| Sulfate $PM_{2.5}$ LC | 113 | 113 | 0.012 | 15.7 | 15.3 | 13.7 | 3.36 | 3.36 |
| Sulfur $PM_{2.5}$ LC | 113 | 110 | 0.0114 | 4.41 | 4.35 | 4.22 | 1.07 | 1.07 |
| Tantalum $PM_{2.5}$ LC | 113 | 51 | 0.0163 | 0.0215 | 0.0162 | 0.0117 | 0.00181 | 0.00927 |
| Terbium $PM_{2.5}$ LC | 113 | 15 | 0.00658 | 0.0409 | 0.0177 | 0.0166 | 0.00113 | 0.00702 |
| Tin $PM_{2.5}$ LC | 113 | 41 | 0.0205 | 0.0421 | 0.0419 | 0.037 | 0.00349 | 0.0166 |
| Titatium $PM_{2.5}$ LC | 113 | 90 | 0.00425 | 0.0414 | 0.0124 | 0.0118 | 0.00374 | 0.00474 |
| Total Nitrate $PM_{2.5}$ LC | 113 | 111 | 0.00869 | 17.2 | 11.8 | 11.3 | 2.76 | 2.76 |
| Tungsten $PM_{2.5}$ LC | 113 | 56 | 0.0126 | 0.0178 | 0.0141 | 0.0137 | 0.00232 | 0.00857 |
| Vanadium $PM_{2.5}$ LC | 113 | 82 | 0.00275 | 0.0139 | 0.0128 | 0.0127 | 0.00189 | 0.0026 |
| Yttrium $PM_{2.5}$ LC | 113 | 45 | 0.00322 | 0.00355 | 0.00275 | 0.00269 | 0.000469 | 0.00252 |
| Zinc $PM_{2.5}$ LC | 113 | 111 | 0.00233 | 0.0929 | 0.0842 | 0.0816 | 0.0221 | 0.0221 |
| Zirconium $PM_{2.5}$ LC | 113 | 31 | 0.00394 | 0.00766 | 0.00736 | 0.00606 | 0.00072 | 0.00345 |

| DEARBORN | AIRS ID: 261630033 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ Local conditions (LC) | 161 | 161 | 0.74 | 56 | 47.6 | 43.5 | 17.5 | 17.5 |
| Aluminum $PM_{2.5}$ LC | 54 | 33 | 0.0197 | 0.734 | 0.474 | 0.223 | 0.0571 | 0.0658 |
| Ammonium Ion $PM_{2.5}$ LC | 53 | 51 | 0.0163 | 6.07 | 5.62 | 5.57 | 1.74 | 1.74 |
| Antimony $PM_{2.5}$ LC | 54 | 18 | 0.0237 | 0.0165 | 0.0165 | 0.013 | 0.00201 | 0.018 |
| Arsenic $PM_{2.5}$ LC | 54 | 44 | 0.00262 | 0.0077 | 0.0066 | 0.00607 | 0.00243 | 0.00288 |
| Barium $PM_{2.5}$ LC | 54 | 25 | 0.0436 | 0.171 | 0.0874 | 0.0641 | 0.0143 | 0.0364 |
| Bromine $PM_{2.5}$ LC | 54 | 46 | 0.00209 | 0.00911 | 0.00885 | 0.00885 | 0.00335 | 0.00373 |
| Cadmium $PM_{2.5}$ LC | 54 | 17 | 0.0117 | 0.0107 | 0.01 | 0.00958 | 0.00168 | 0.00982 |
| Calcium $PM_{2.5}$ LC | 54 | 53 | 0.00616 | 1.65 | 1.1 | 0.918 | 0.24 | 0.24 |
| Cerium $PM_{2.5}$ LC | 54 | 27 | 0.0652 | 0.063 | 0.0481 | 0.0478 | 0.00941 | 0.0417 |
| Cesium $PM_{2.5}$ LC | 54 | 22 | 0.0305 | 0.151 | 0.0267 | 0.0198 | 0.0063 | 0.0207 |
| Chlorine $PM_{2.5}$ LC | 54 | 36 | 0.00945 | 0.924 | 0.44 | 0.317 | 0.0775 | 0.0809 |
| Chromium $PM_{2.5}$ LC | 54 | 36 | 0.00209 | 0.0233 | 0.0124 | 0.0124 | 0.00217 | 0.00285 |
| Cobalt $PM_{2.5}$ LC | 54 | 10 | 0.00169 | 0.00233 | 0.00163 | 0.00116 | 0.000152 | 0.00154 |
| Copper $PM_{2.5}$ LC | 54 | 52 | 0.00225 | 0.0205 | 0.0197 | 0.0193 | 0.00875 | 0.00883 |
| Elemental Carbon $PM_{2.5}$ LC | 53 | 53 | 0.24 | 2.69 | 2.09 | 1.98 | 0.958 | 0.958 |

| DEARBORN | AIRS ID: 261630033 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| Chemical Name | Num Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
| Europium $PM_{2.5}$ LC | 54 | 13 | 0.00866 | 0.156 | 0.118 | 0.0593 | 0.00817 | 0.0155 |
| Gallium $PM_{2.5}$ LC | 54 | 12 | 0.00429 | 0.00105 | 0.00099 | 0.00076 | 0.000121 | 0.00369 |
| Gold $PM_{2.5}$ LC | 54 | 22 | 0.00676 | 0.00989 | 0.00943 | 0.00805 | 0.00147 | 0.00501 |
| Hafnium $PM_{2.5}$ LC | 54 | 24 | 0.028 | 0.0225 | 0.0126 | 0.012 | 0.00256 | 0.0173 |
| Indium $PM_{2.5}$ LC | 54 | 17 | 0.0143 | 0.0157 | 0.0114 | 0.0101 | 0.00145 | 0.0112 |
| Iridium $PM_{2.5}$ LC | 54 | 24 | 0.00814 | 0.0115 | 0.0109 | 0.0078 | 0.00176 | 0.00628 |
| Iron $PM_{2.5}$ LC | 54 | 52 | 0.00242 | 6.3 | 2.25 | 1.88 | 0.636 | 0.636 |
| Lanthanium $PM_{2.5}$ LC | 54 | 24 | 0.0507 | 0.061 | 0.0582 | 0.0508 | 0.0097 | 0.0332 |
| Magnesium $PM_{2.5}$ LC | 54 | 29 | 0.026 | 0.711 | 0.39 | 0.382 | 0.0562 | 0.067 |
| Manganese $PM_{2.5}$ LC | 54 | 50 | 0.00236 | 0.226 | 0.17 | 0.113 | 0.0302 | 0.0303 |
| Mercury $PM_{2.5}$ LC | 54 | 25 | 0.00499 | 0.0108 | 0.00675 | 0.00651 | 0.00152 | 0.00422 |
| Molybdenum $PM_{2.5}$ LC | 54 | 20 | 0.0081 | 0.0104 | 0.00623 | 0.00582 | 0.00112 | 0.00633 |
| Nickel $PM_{2.5}$ LC | 54 | 45 | 0.00174 | 0.00596 | 0.00477 | 0.00395 | 0.00121 | 0.0015 |
| Niobium $PM_{2.5}$ LC | 54 | 12 | 0.00495 | 0.00536 | 0.00326 | 0.00291 | 0.000429 | 0.00414 |
| Organic Carbon Peak1 $PM_{2.5}$ LC | 53 | 53 | 0.24 | 4.57 | 4.26 | 3.5 | 1.8 | 1.8 |
| Organic Carbon Peak2 $PM_{2.5}$ LC | 53 | 53 | 0.24 | 2.47 | 1.78 | 1.72 | 1.17 | 1.17 |
| Organic Carbon Peak3 $PM_{2.5}$ LC | 53 | 53 | 0.24 | 1.94 | 1.4 | 1.29 | 0.775 | 0.775 |
| Organic Carbon Peak4 $PM_{2.5}$ LC | 53 | 53 | 0.24 | 3.59 | 3.07 | 2.37 | 1.03 | 1.03 |
| Organic Carbon $PM_{2.5}$ LC | 53 | 53 | 0.24 | 11 | 9.24 | 7.44 | 4.78 | 4.78 |
| Organic Carbon Pyrolytic $PM_{2.5}$ LC | 53 | 9 | 0.24 | 0.244 | 0.164 | 0.0455 | 0.0106 | 0.21 |
| Phosphorus $PM_{2.5}$ LC | 54 | 10 | 0.00901 | 0.0362 | 0.0314 | 0.0217 | 0.00238 | 0.00972 |
| Potassium Ion $PM_{2.5}$ LC | 53 | 29 | 0.014 | 0.928 | 0.732 | 0.57 | 0.133 | 0.14 |
| Potassium $PM_{2.5}$ LC | 54 | 54 | 0.00832 | 0.978 | 0.717 | 0.587 | 0.168 | 0.168 |
| Rubidium $PM_{2.5}$ LC | 54 | 35 | 0.0023 | 0.00709 | 0.00698 | 0.00517 | 0.00127 | 0.0022 |
| Samarium $PM_{2.5}$ LC | 54 | 11 | 0.0063 | 0.085 | 0.0321 | 0.0293 | 0.00344 | 0.00858 |
| Scandium $PM_{2.5}$ LC | 54 | 5 | 0.0176 | 0.00358 | 0.00244 | 0.0014 | 0.000153 | 0.0162 |
| Selenium $PM_{2.5}$ LC | 54 | 38 | 0.00293 | 0.00718 | 0.00617 | 0.00584 | 0.00175 | 0.00265 |
| Silicon $PM_{2.5}$ LC | 54 | 51 | 0.0143 | 1.73 | 1.48 | 0.837 | 0.228 | 0.229 |
| Silver $PM_{2.5}$ LC | 54 | 24 | 0.0109 | 0.00893 | 0.00779 | 0.00761 | 0.00155 | 0.00756 |
| Sodium Ion $PM_{2.5}$ LC | 53 | 49 | 0.0301 | 1.37 | 0.458 | 0.434 | 0.122 | 0.125 |
| Sodium $PM_{2.5}$ LC | 54 | 24 | 0.0823 | 0.787 | 0.329 | 0.295 | 0.06 | 0.104 |
| Strantium $PM_{2.5}$ LC | 54 | 38 | 0.0027 | 0.0103 | 0.00678 | 0.00547 | 0.00179 | 0.0027 |
| Sulfate $PM_{2.5}$ LC | 53 | 53 | 0.012 | 16.5 | 15.5 | 11.7 | 3.85 | 3.85 |
| Sulfur $PM_{2.5}$ LC | 54 | 54 | 0.0116 | 4.73 | 4.71 | 4.14 | 1.22 | 1.22 |
| Tantalum $PM_{2.5}$ LC | 54 | 27 | 0.0177 | 0.0275 | 0.0152 | 0.0132 | 0.00266 | 0.011 |
| Terbium $PM_{2.5}$ LC | 54 | 8 | 0.00699 | 0.101 | 0.00525 | 0.00512 | 0.00225 | 0.00823 |
| Tin $PM_{2.5}$ LC | 54 | 21 | 0.0209 | 0.0308 | 0.0306 | 0.0294 | 0.00417 | 0.0167 |
| Titatium $PM_{2.5}$ LC | 54 | 50 | 0.00413 | 0.0529 | 0.0514 | 0.0338 | 0.00862 | 0.00899 |
| Total Nitrate $PM_{2.5}$ LC | 53 | 52 | 0.00868 | 13.7 | 12.3 | 8.31 | 2.46 | 2.46 |
| Tungsten $PM_{2.5}$ LC | 54 | 22 | 0.0135 | 0.0176 | 0.0175 | 0.0174 | 0.00248 | 0.0108 |
| Vanadium $PM_{2.5}$ LC | 54 | 32 | 0.00268 | 0.0171 | 0.0101 | 0.00967 | 0.00196 | 0.00308 |
| Yttrium $PM_{2.5}$ LC | 54 | 27 | 0.00337 | 0.00385 | 0.00376 | 0.00335 | 0.000649 | 0.00249 |

| DEARBORN | AIRS ID: 261630033 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Zinc $PM_{2.5}$ LC | 54 | 54 | 0.00229 | 1.08 | 0.624 | 0.427 | 0.123 | 0.123 |
| Zirconium $PM_{2.5}$ LC | 54 | 22 | 0.0041 | 0.00969 | 0.00489 | 0.00407 | 0.000969 | 0.00326 |

| GRAND RAPIDS - Monroe St. | AIRS ID: 260810020 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ Local conditions (LC) | 455 | 455 | 0.74 | 46.6 | 45.8 | 45.3 | 11.9 | 11.9 |
| Aluminum $PM_{2.5}$ LC | 52 | 27 | 0.0201 | 0.182 | 0.0784 | 0.0728 | 0.0147 | 0.0256 |
| Ammonium Ion $PM_{2.5}$ LC | 53 | 53 | 0.0164 | 5.68 | 5.23 | 3.9 | 1.43 | 1.43 |
| Antimony $PM_{2.5}$ LC | 52 | 18 | 0.0235 | 0.0946 | 0.063 | 0.0393 | 0.00632 | 0.0216 |
| Arsenic $PM_{2.5}$ LC | 52 | 35 | 0.00254 | 0.00678 | 0.00559 | 0.00448 | 0.00148 | 0.00236 |
| Barium $PM_{2.5}$ LC | 52 | 31 | 0.0385 | 0.0531 | 0.0449 | 0.0403 | 0.0107 | 0.0257 |
| Bromine $PM_{2.5}$ LC | 52 | 45 | 0.00203 | 0.00664 | 0.00548 | 0.00544 | 0.00224 | 0.00258 |
| Cadmium $PM_{2.5}$ LC | 52 | 17 | 0.011 | 0.0255 | 0.0136 | 0.0124 | 0.0024 | 0.00979 |
| Calcium $PM_{2.5}$ LC | 52 | 52 | 0.0062 | 0.109 | 0.0856 | 0.0849 | 0.036 | 0.036 |
| Cerium $PM_{2.5}$ LC | 52 | 22 | 0.0594 | 0.0804 | 0.062 | 0.0386 | 0.00636 | 0.0437 |
| Cesium $PM_{2.5}$ LC | 52 | 20 | 0.0279 | 0.0328 | 0.0302 | 0.0143 | 0.00334 | 0.0207 |
| Chlorine $PM_{2.5}$ LC | 52 | 26 | 0.00989 | 0.119 | 0.0448 | 0.0242 | 0.00717 | 0.0126 |
| Chromium $PM_{2.5}$ LC | 52 | 43 | 0.00205 | 0.00932 | 0.00653 | 0.00559 | 0.00145 | 0.0018 |
| Cobalt $PM_{2.5}$ LC | 52 | 11 | 0.00164 | 0.0014 | 0.0014 | 0.00093 | 0.000129 | 0.00142 |
| Copper $PM_{2.5}$ LC | 52 | 50 | 0.00227 | 0.0415 | 0.033 | 0.0228 | 0.00658 | 0.00667 |
| Elemental Carbon $PM_{2.5}$ LC | 53 | 53 | 0.24 | 1.45 | 1.11 | 1.1 | 0.552 | 0.552 |
| Europium $PM_{2.5}$ LC | 52 | 15 | 0.00744 | 0.00961 | 0.0095 | 0.00571 | 0.00104 | 0.00687 |
| Gallium $PM_{2.5}$ LC | 52 | 13 | 0.00441 | 0.00093 | 0.0007 | 0.00058 | 0.0000946 | 0.00347 |
| Gold $PM_{2.5}$ LC | 52 | 31 | 0.00709 | 0.0126 | 0.00788 | 0.0071 | 0.00185 | 0.00445 |
| Hafnium $PM_{2.5}$ LC | 52 | 19 | 0.0259 | 0.0415 | 0.0209 | 0.0105 | 0.00252 | 0.0184 |
| Indium $PM_{2.5}$ LC | 52 | 15 | 0.0137 | 0.0132 | 0.00875 | 0.00653 | 0.000974 | 0.0105 |
| Iridium $PM_{2.5}$ LC | 52 | 24 | 0.00864 | 0.00841 | 0.00781 | 0.00732 | 0.00168 | 0.00602 |
| Iron $PM_{2.5}$ LC | 52 | 52 | 0.00235 | 0.282 | 0.232 | 0.182 | 0.0784 | 0.0784 |
| Lanthanium $PM_{2.5}$ LC | 52 | 28 | 0.0456 | 0.0504 | 0.0497 | 0.0407 | 0.00763 | 0.0324 |
| Magnesium $PM_{2.5}$ LC | 52 | 14 | 0.0271 | 0.299 | 0.106 | 0.0853 | 0.0152 | 0.0337 |
| Manganese $PM_{2.5}$ LC | 52 | 47 | 0.00223 | 0.0239 | 0.0213 | 0.0183 | 0.00441 | 0.00459 |
| Mercury $PM_{2.5}$ LC | 52 | 22 | 0.00489 | 0.00991 | 0.00654 | 0.00571 | 0.00148 | 0.00425 |
| Molybdenum $PM_{2.5}$ LC | 52 | 16 | 0.00829 | 0.0163 | 0.0126 | 0.00773 | 0.0017 | 0.00743 |
| Nickel $PM_{2.5}$ LC | 52 | 39 | 0.00171 | 0.00396 | 0.00304 | 0.0028 | 0.000867 | 0.00128 |
| Niobium $PM_{2.5}$ LC | 52 | 16 | 0.00489 | 0.00388 | 0.00356 | 0.00315 | 0.000532 | 0.00379 |
| Organic Carbon Peak1 $PM_{2.5}$ LC | 53 | 53 | 0.24 | 1.95 | 1.73 | 1.69 | 0.988 | 0.988 |
| Organic Carbon Peak2 $PM_{2.5}$ LC | 53 | 53 | 0.24 | 2.27 | 1.68 | 1.62 | 1.05 | 1.05 |
| Organic Carbon Peak3 $PM_{2.5}$ LC | 53 | 53 | 0.24 | 1.88 | 1.28 | 1.23 | 0.66 | 0.66 |
| Organic Carbon Peak4 $PM_{2.5}$ LC | 53 | 53 | 0.24 | 2.72 | 1.6 | 1.54 | 0.775 | 0.775 |

| GRAND RAPIDS - Monroe St. | AIRS ID: 260810020 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Organic Carbon $PM_{2.5}$ LC | 53 | 53 | 0.24 | 8.6 | 6.11 | 5.24 | 3.51 | 3.51 |
| Organic Carbon Pyrolytic $PM_{2.5}$ LC | 53 | 11 | 0.24 | 0.582 | 0.538 | 0.295 | 0.0303 | 0.22 |
| Phosphorus $PM_{2.5}$ LC | 52 | 11 | 0.00905 | 0.01 | 0.00841 | 0.00736 | 0.000756 | 0.00801 |
| Potassium Ion $PM_{2.5}$ LC | 53 | 16 | 0.014 | 0.146 | 0.133 | 0.126 | 0.0257 | 0.0354 |
| Potassium $PM_{2.5}$ LC | 52 | 52 | 0.00866 | 0.116 | 0.105 | 0.0994 | 0.0485 | 0.0485 |
| Rubidium $PM_{2.5}$ LC | 52 | 21 | 0.00223 | 0.00234 | 0.00176 | 0.00145 | 0.000304 | 0.0018 |
| Samarium $PM_{2.5}$ LC | 52 | 17 | 0.00593 | 0.0101 | 0.00455 | 0.0035 | 0.000866 | 0.00508 |
| Scandium $PM_{2.5}$ LC | 52 | 12 | 0.0192 | 0.00209 | 0.00198 | 0.00117 | 0.00016 | 0.0166 |
| Selenium $PM_{2.5}$ LC | 52 | 34 | 0.00293 | 0.00559 | 0.00443 | 0.0029 | 0.000951 | 0.002 |
| Silicon $PM_{2.5}$ LC | 52 | 46 | 0.0145 | 0.262 | 0.24 | 0.236 | 0.0572 | 0.0593 |
| Silver $PM_{2.5}$ LC | 52 | 20 | 0.01 | 0.0189 | 0.01 | 0.00897 | 0.00165 | 0.00806 |
| Sodium Ion $PM_{2.5}$ LC | 53 | 44 | 0.03 | 0.389 | 0.214 | 0.211 | 0.0587 | 0.0638 |
| Sodium $PM_{2.5}$ LC | 52 | 14 | 0.0884 | 0.525 | 0.171 | 0.161 | 0.0289 | 0.0933 |
| Strantium $PM_{2.5}$ LC | 52 | 22 | 0.00264 | 0.00436 | 0.00327 | 0.00301 | 0.000704 | 0.00247 |
| Sulfate $PM_{2.5}$ LC | 53 | 53 | 0.012 | 14.2 | 9.23 | 8.07 | 2.74 | 2.74 |
| Sulfur $PM_{2.5}$ LC | 52 | 52 | 0.0125 | 4.54 | 3.26 | 2.68 | 0.881 | 0.881 |
| Tantalum $PM_{2.5}$ LC | 52 | 28 | 0.0167 | 0.0231 | 0.0154 | 0.0147 | 0.00329 | 0.0103 |
| Terbium $PM_{2.5}$ LC | 52 | 13 | 0.00644 | 0.00571 | 0.00499 | 0.00374 | 0.000577 | 0.00523 |
| Tin $PM_{2.5}$ LC | 52 | 25 | 0.0195 | 0.0287 | 0.0236 | 0.0229 | 0.00519 | 0.0151 |
| Titatium $PM_{2.5}$ LC | 52 | 42 | 0.00424 | 0.00968 | 0.00743 | 0.00735 | 0.00285 | 0.00379 |
| Total Nitrate $PM_{2.5}$ LC | 53 | 53 | 0.00869 | 12 | 7.06 | 6.99 | 2.05 | 2.05 |
| Tungsten $PM_{2.5}$ LC | 52 | 35 | 0.013 | 0.02 | 0.0147 | 0.0122 | 0.00362 | 0.00733 |
| Vanadium $PM_{2.5}$ LC | 52 | 29 | 0.00271 | 0.00337 | 0.00315 | 0.00314 | 0.00075 | 0.00198 |
| Yttrium $PM_{2.5}$ LC | 52 | 21 | 0.00329 | 0.00272 | 0.00258 | 0.00221 | 0.000444 | 0.00262 |
| Zinc $PM_{2.5}$ LC | 52 | 52 | 0.00227 | 0.0416 | 0.0352 | 0.035 | 0.0163 | 0.0163 |
| Zirconium $PM_{2.5}$ LC | 52 | 16 | 0.00402 | 0.00432 | 0.00364 | 0.00309 | 0.000548 | 0.0032 |

| HOLLAND | AIRS ID: 260050003 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ Local conditions (LC) | 407 | 407 | 0.74 | 44 | 43.9 | 39 | 11.1 | 11.1 |
| Aluminum $PM_{2.5}$ LC | 57 | 24 | 0.0199 | 0.125 | 0.07 | 0.0483 | 0.0102 | 0.0229 |
| Ammonium Ion $PM_{2.5}$ LC | 57 | 57 | 0.0167 | 4.9 | 4.49 | 3.78 | 1.32 | 1.32 |
| Antimony $PM_{2.5}$ LC | 57 | 25 | 0.0236 | 0.0566 | 0.0525 | 0.0367 | 0.00582 | 0.0194 |
| Arsenic $PM_{2.5}$ LC | 57 | 40 | 0.00257 | 0.00792 | 0.00541 | 0.00537 | 0.00153 | 0.00241 |
| Barium $PM_{2.5}$ LC | 57 | 37 | 0.0401 | 0.0545 | 0.0356 | 0.033 | 0.00811 | 0.0217 |
| Bromine $PM_{2.5}$ LC | 57 | 48 | 0.00205 | 0.00725 | 0.00524 | 0.00478 | 0.00178 | 0.00223 |
| Cadmium $PM_{2.5}$ LC | 57 | 26 | 0.0112 | 0.0275 | 0.0271 | 0.0166 | 0.0035 | 0.00974 |
| Calcium $PM_{2.5}$ LC | 57 | 57 | 0.00619 | 0.123 | 0.116 | 0.0698 | 0.0259 | 0.0259 |
| Cerium $PM_{2.5}$ LC | 57 | 21 | 0.0606 | 0.0866 | 0.0496 | 0.0403 | 0.00715 | 0.0476 |

| HOLLAND | AIRS ID: 260050003 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Cesium $PM_{2.5}$ LC | 57 | 18 | 0.0287 | 0.0334 | 0.0294 | 0.0268 | 0.00395 | 0.0217 |
| Chlorine $PM_{2.5}$ LC | 57 | 21 | 0.00976 | 0.0676 | 0.0288 | 0.0256 | 0.00407 | 0.0107 |
| Chromium $PM_{2.5}$ LC | 57 | 32 | 0.00206 | 0.00386 | 0.0035 | 0.00233 | 0.000691 | 0.00159 |
| Cobalt $PM_{2.5}$ LC | 57 | 20 | 0.00165 | 0.00204 | 0.00163 | 0.00147 | 0.00024 | 0.00134 |
| Copper $PM_{2.5}$ LC | 57 | 45 | 0.00226 | 0.00957 | 0.00582 | 0.00512 | 0.00147 | 0.00195 |
| Elemental Carbon $PM_{2.5}$ LC | 57 | 56 | 0.24 | 0.971 | 0.879 | 0.778 | 0.302 | 0.306 |
| Europium $PM_{2.5}$ LC | 57 | 11 | 0.00782 | 0.0132 | 0.0111 | 0.00526 | 0.000692 | 0.00744 |
| Gallium $PM_{2.5}$ LC | 57 | 19 | 0.00438 | 0.0014 | 0.00112 | 0.00105 | 0.000156 | 0.00307 |
| Gold $PM_{2.5}$ LC | 57 | 33 | 0.007 | 0.0085 | 0.00793 | 0.00572 | 0.00162 | 0.00432 |
| Hafnium $PM_{2.5}$ LC | 57 | 19 | 0.0266 | 0.0538 | 0.0297 | 0.0117 | 0.00273 | 0.0197 |
| Indium $PM_{2.5}$ LC | 57 | 18 | 0.0138 | 0.034 | 0.0253 | 0.0179 | 0.00269 | 0.0121 |
| Iridium $PM_{2.5}$ LC | 57 | 28 | 0.00849 | 0.01 | 0.00652 | 0.0056 | 0.00135 | 0.00597 |
| Iron $PM_{2.5}$ LC | 57 | 57 | 0.00237 | 0.228 | 0.221 | 0.138 | 0.0469 | 0.0469 |
| Lanthanium $PM_{2.5}$ LC | 57 | 24 | 0.0472 | 0.0371 | 0.0348 | 0.0312 | 0.00593 | 0.0363 |
| Magnesium $PM_{2.5}$ LC | 57 | 20 | 0.0267 | 0.0481 | 0.0262 | 0.026 | 0.00601 | 0.022 |
| Manganese $PM_{2.5}$ LC | 57 | 51 | 0.00227 | 0.0054 | 0.00455 | 0.00442 | 0.00165 | 0.00191 |
| Mercury $PM_{2.5}$ LC | 57 | 33 | 0.00492 | 0.00865 | 0.00594 | 0.00513 | 0.00122 | 0.00344 |
| Molybdenum $PM_{2.5}$ LC | 57 | 13 | 0.00823 | 0.0118 | 0.00724 | 0.0064 | 0.000809 | 0.00714 |
| Nickel $PM_{2.5}$ LC | 57 | 38 | 0.00172 | 0.00257 | 0.00246 | 0.00219 | 0.000514 | 0.00107 |
| Niobium $PM_{2.5}$ LC | 57 | 8 | 0.00492 | 0.00361 | 0.0035 | 0.00315 | 0.000307 | 0.00444 |
| Organic Carbon Peak1 $PM_{2.5}$ LC | 57 | 57 | 0.24 | 1.43 | 1.14 | 1.12 | 0.587 | 0.587 |
| Organic Carbon Peak2 $PM_{2.5}$ LC | 57 | 57 | 0.24 | 2.58 | 2.25 | 1.5 | 0.917 | 0.917 |
| Organic Carbon Peak3 $PM_{2.5}$ LC | 57 | 57 | 0.24 | 1.81 | 1.16 | 1.02 | 0.555 | 0.555 |
| Organic Carbon Peak4 $PM_{2.5}$ LC | 57 | 57 | 0.24 | 3.02 | 1.62 | 1.46 | 0.628 | 0.628 |
| Organic Carbon $PM_{2.5}$ LC | 57 | 57 | 0.24 | 8.5 | 4.55 | 4.44 | 2.69 | 2.69 |
| Organic Carbon Pyrolytic $PM_{2.5}$ LC | 57 | 10 | 0.24 | 0.0223 | 0.0216 | 0.0164 | 0.00192 | 0.2 |
| Phosphorus $PM_{2.5}$ LC | 57 | 17 | 0.009 | 0.0341 | 0.00734 | 0.00723 | 0.00164 | 0.00809 |
| Potassium Ion $PM_{2.5}$ LC | 57 | 14 | 0.014 | 0.197 | 0.139 | 0.124 | 0.0203 | 0.0308 |
| Potassium $PM_{2.5}$ LC | 57 | 57 | 0.00855 | 0.212 | 0.157 | 0.0862 | 0.0459 | 0.0459 |
| Rubidium $PM_{2.5}$ LC | 57 | 26 | 0.00225 | 0.00315 | 0.00222 | 0.00201 | 0.000439 | 0.00167 |
| Samarium $PM_{2.5}$ LC | 57 | 16 | 0.00604 | 0.00774 | 0.00711 | 0.00617 | 0.00104 | 0.00564 |
| Scandium $PM_{2.5}$ LC | 57 | 12 | 0.0185 | 0.00244 | 0.00187 | 0.00117 | 0.00018 | 0.0157 |
| Selenium $PM_{2.5}$ LC | 57 | 39 | 0.00294 | 0.0038 | 0.00324 | 0.00269 | 0.000816 | 0.00179 |
| Silicon $PM_{2.5}$ LC | 57 | 48 | 0.0144 | 0.604 | 0.221 | 0.172 | 0.0449 | 0.0477 |
| Silver $PM_{2.5}$ LC | 57 | 28 | 0.0103 | 0.0167 | 0.014 | 0.014 | 0.00261 | 0.00832 |
| Sodium Ion $PM_{2.5}$ LC | 57 | 51 | 0.03 | 0.335 | 0.295 | 0.194 | 0.0605 | 0.0636 |
| Sodium $PM_{2.5}$ LC | 57 | 22 | 0.0865 | 0.206 | 0.133 | 0.128 | 0.0235 | 0.0735 |
| Strantium $PM_{2.5}$ LC | 57 | 27 | 0.00266 | 0.00428 | 0.00296 | 0.00293 | 0.000683 | 0.00229 |
| Sulfate $PM_{2.5}$ LC | 57 | 57 | 0.012 | 13.4 | 10.9 | 9.96 | 2.76 | 2.76 |
| Sulfur $PM_{2.5}$ LC | 57 | 57 | 0.0122 | 4.63 | 3.53 | 3.16 | 0.894 | 0.894 |
| Tantalum $PM_{2.5}$ LC | 57 | 22 | 0.017 | 0.0264 | 0.0159 | 0.0146 | 0.00214 | 0.0114 |
| Terbium $PM_{2.5}$ LC | 57 | 10 | 0.00661 | 0.0035 | 0.00291 | 0.00217 | 0.000277 | 0.00565 |

| HOLLAND | AIRS ID: 260050003 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Tin $PM_{2.5}$ LC | 57 | 23 | 0.0199 | 0.0409 | 0.0349 | 0.0317 | 0.0048 | 0.0165 |
| Titatium $PM_{2.5}$ LC | 57 | 40 | 0.00421 | 0.0238 | 0.00899 | 0.00763 | 0.00204 | 0.00339 |
| Total Nitrate $PM_{2.5}$ LC | 57 | 57 | 0.00869 | 12.5 | 7.61 | 5.9 | 1.79 | 1.79 |
| Tungsten $PM_{2.5}$ LC | 57 | 36 | 0.0132 | 0.0162 | 0.012 | 0.00958 | 0.00246 | 0.00706 |
| Vanadium $PM_{2.5}$ LC | 57 | 29 | 0.0027 | 0.00338 | 0.00327 | 0.00322 | 0.000627 | 0.00193 |
| Yttrium $PM_{2.5}$ LC | 57 | 18 | 0.00331 | 0.00273 | 0.00255 | 0.00244 | 0.000388 | 0.00276 |
| Zinc $PM_{2.5}$ LC | 57 | 52 | 0.00228 | 0.0533 | 0.0268 | 0.023 | 0.00912 | 0.00931 |
| Zirconium $PM_{2.5}$ LC | 57 | 10 | 0.00405 | 0.00563 | 0.00408 | 0.00291 | 0.00035 | 0.00354 |

| HOUGHTON LAKE | AIRS ID: 261130001 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ Local conditions (LC) | 162 | 162 | 0.74 | 26.5 | 26.4 | 26.3 | 7.36 | 7.36 |
| Aluminum $PM_{2.5}$ LC | 51 | 21 | 0.0207 | 0.204 | 0.117 | 0.0751 | 0.012 | 0.0252 |
| Ammonium Ion $PM_{2.5}$ LC | 50 | 49 | 0.0167 | 3.55 | 2.4 | 2.34 | 0.776 | 0.777 |
| Antimony $PM_{2.5}$ LC | 51 | 21 | 0.025 | 0.0564 | 0.0539 | 0.0431 | 0.00787 | 0.0227 |
| Arsenic $PM_{2.5}$ LC | 51 | 31 | 0.00229 | 0.00513 | 0.00279 | 0.00222 | 0.000797 | 0.00165 |
| Barium $PM_{2.5}$ LC | 51 | 26 | 0.0339 | 0.0856 | 0.0357 | 0.0191 | 0.00572 | 0.0234 |
| Bromine $PM_{2.5}$ LC | 51 | 42 | 0.0018 | 0.00477 | 0.00456 | 0.00404 | 0.00137 | 0.00176 |
| Cadmium $PM_{2.5}$ LC | 51 | 15 | 0.0113 | 0.024 | 0.0175 | 0.0174 | 0.00248 | 0.0102 |
| Calcium $PM_{2.5}$ LC | 51 | 50 | 0.00654 | 0.0881 | 0.0734 | 0.0573 | 0.0173 | 0.0175 |
| Cerium $PM_{2.5}$ LC | 51 | 22 | 0.0486 | 0.0548 | 0.0486 | 0.0299 | 0.00594 | 0.0269 |
| Cesium $PM_{2.5}$ LC | 51 | 8 | 0.0245 | 0.0855 | 0.0255 | 0.0111 | 0.00292 | 0.0234 |
| Chlorine $PM_{2.5}$ LC | 51 | 19 | 0.00902 | 0.0302 | 0.0295 | 0.0187 | 0.00336 | 0.00935 |
| Chromium $PM_{2.5}$ LC | 51 | 33 | 0.00206 | 0.00413 | 0.00308 | 0.0028 | 0.000774 | 0.00149 |
| Cobalt $PM_{2.5}$ LC | 51 | 21 | 0.00161 | 0.00141 | 0.0014 | 0.00126 | 0.000247 | 0.00122 |
| Copper $PM_{2.5}$ LC | 51 | 45 | 0.00232 | 0.00755 | 0.00643 | 0.00605 | 0.00166 | 0.00191 |
| Elemental Carbon $PM_{2.5}$ LC | 52 | 48 | 0.24 | 0.447 | 0.443 | 0.432 | 0.174 | 0.193 |
| Europium $PM_{2.5}$ LC | 51 | 15 | 0.00725 | 0.00437 | 0.00413 | 0.00373 | 0.000531 | 0.00631 |
| Gallium $PM_{2.5}$ LC C | 51 | 13 | 0.00381 | 0.00147 | 0.00139 | 0.00128 | 0.000162 | 0.0031 |
| Gold $PM_{2.5}$ LC | 51 | 28 | 0.00586 | 0.0146 | 0.0103 | 0.00722 | 0.00172 | 0.0038 |
| Hafnium $PM_{2.5}$ LC | 51 | 29 | 0.028 | 0.0129 | 0.0081 | 0.0077 | 0.00161 | 0.0134 |
| Indium $PM_{2.5}$ LC | 51 | 18 | 0.0142 | 0.029 | 0.0175 | 0.0169 | 0.00314 | 0.0123 |
| Iridium $PM_{2.5}$ LC | 51 | 28 | 0.00689 | 0.00805 | 0.00689 | 0.00672 | 0.0013 | 0.00454 |
| Iron $PM_{2.5}$ LC | 51 | 49 | 0.00233 | 0.186 | 0.0585 | 0.046 | 0.0205 | 0.0206 |
| Lanthanium $PM_{2.5}$ LC | 51 | 24 | 0.0384 | 0.0645 | 0.0492 | 0.031 | 0.00686 | 0.0265 |
| Magnesium $PM_{2.5}$ LC | 51 | 13 | 0.0235 | 0.0918 | 0.0595 | 0.0581 | 0.00606 | 0.0239 |
| Manganese $PM_{2.5}$ LC | 51 | 35 | 0.00214 | 0.00525 | 0.0042 | 0.00326 | 0.00103 | 0.00169 |
| Mercury $PM_{2.5}$ LC | 51 | 27 | 0.00452 | 0.012 | 0.007 | 0.00618 | 0.00159 | 0.00362 |
| Molybdenum $PM_{2.5}$ LC | 51 | 17 | 0.00817 | 0.00943 | 0.00832 | 0.00745 | 0.00118 | 0.00671 |

| HOUGHTON LAKE | AIRS ID: 261130001 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Nickel $PM_{2.5}$ LC | 51 | 37 | 0.00173 | 0.0028 | 0.00269 | 0.00193 | 0.000537 | 0.00101 |
| Niobium $PM_{2.5}$ LC | 51 | 14 | 0.00449 | 0.00241 | 0.00176 | 0.00163 | 0.000297 | 0.00323 |
| Organic Carbon Peak1 $PM_{2.5}$ LC | 52 | 52 | 0.24 | 1.28 | 1.26 | 0.797 | 0.414 | 0.414 |
| Organic Carbon Peak2 $PM_{2.5}$ LC | 52 | 52 | 0.24 | 2.91 | 2.57 | 2.2 | 0.892 | 0.892 |
| Organic Carbon Peak3 $PM_{2.5}$ LC | 52 | 52 | 0.24 | 1.88 | 1.54 | 1.09 | 0.535 | 0.535 |
| Organic Carbon Peak4 $PM_{2.5}$ LC | 52 | 52 | 0.24 | 1.7 | 1.64 | 1.03 | 0.431 | 0.431 |
| Organic Carbon $PM_{2.5}$ LC | 52 | 52 | 0.24 | 7.53 | 6.68 | 4.26 | 2.28 | 2.28 |
| Organic Carbon Pyrolytic $PM_{2.5}$ LC | 52 | 10 | 0.24 | 0.094 | 0.0538 | 0.0433 | 0.00479 | 0.199 |
| Phosphorus $PM_{2.5}$ LC | 51 | 10 | 0.00974 | 0.0478 | 0.0226 | 0.0128 | 0.00188 | 0.00966 |
| Potassium Ion $PM_{2.5}$ LC | 50 | 4 | 0.014 | 0.549 | 0.108 | 0.104 | 0.0164 | 0.0293 |
| Potassium $PM_{2.5}$ LC | 51 | 50 | 0.0091 | 0.148 | 0.0714 | 0.0526 | 0.0281 | 0.0283 |
| Rubidium $PM_{2.5}$ LC | 51 | 18 | 0.00204 | 0.00303 | 0.00245 | 0.00198 | 0.000402 | 0.0017 |
| Samarium $PM_{2.5}$ LC | 51 | 14 | 0.00573 | 0.00303 | 0.00292 | 0.00233 | 0.000391 | 0.00483 |
| Scandium $PM_{2.5}$ LC | 51 | 6 | 0.0227 | 0.0021 | 0.00168 | 0.00163 | 0.000114 | 0.0199 |
| Selenium $PM_{2.5}$ LC | 51 | 31 | 0.00284 | 0.00326 | 0.00278 | 0.00268 | 0.000675 | 0.00178 |
| Silicon $PM_{2.5}$ LC | 51 | 38 | 0.0154 | 0.495 | 0.222 | 0.124 | 0.0379 | 0.0423 |
| Silver $PM_{2.5}$ LC | 51 | 21 | 0.0102 | 0.0177 | 0.0142 | 0.0126 | 0.0021 | 0.00788 |
| Sodium Ion $PM_{2.5}$ LC | 50 | 41 | 0.03 | 0.214 | 0.135 | 0.132 | 0.0422 | 0.0476 |
| Sodium $PM_{2.5}$ LC | 51 | 17 | 0.0733 | 0.249 | 0.168 | 0.164 | 0.0229 | 0.0744 |
| Strantium $PM_{2.5}$ LC | 51 | 26 | 0.00242 | 0.0052 | 0.00454 | 0.00285 | 0.000759 | 0.00207 |
| Sulfate $PM_{2.5}$ LC | 50 | 50 | 0.012 | 9.59 | 8.23 | 6.04 | 2.03 | 2.03 |
| Sulfur $PM_{2.5}$ LC | 51 | 51 | 0.0107 | 4.49 | 2.91 | 2.82 | 0.744 | 0.744 |
| Tantalum $PM_{2.5}$ LC | 51 | 24 | 0.0148 | 0.0125 | 0.0111 | 0.00828 | 0.00176 | 0.00787 |
| Terbium $PM_{2.5}$ LC | 51 | 13 | 0.00625 | 0.00408 | 0.00396 | 0.00315 | 0.000453 | 0.00546 |
| Tin $PM_{2.5}$ LC | 51 | 22 | 0.0207 | 0.0384 | 0.031 | 0.0223 | 0.00423 | 0.0158 |
| Titatium $PM_{2.5}$ LC | 51 | 25 | 0.00438 | 0.0203 | 0.011 | 0.00491 | 0.0014 | 0.00354 |
| Total Nitrate $PM_{2.5}$ LC | 50 | 50 | 0.00869 | 4.93 | 4.84 | 3.38 | 0.803 | 0.803 |
| Tungsten $PM_{2.5}$ LC | 51 | 25 | 0.0114 | 0.0251 | 0.0193 | 0.00665 | 0.00199 | 0.00773 |
| Vanadium $PM_{2.5}$ LC | 51 | 29 | 0.00283 | 0.00618 | 0.00457 | 0.00427 | 0.000792 | 0.00194 |
| Yttrium $PM_{2.5}$ LC | 51 | 18 | 0.00303 | 0.00336 | 0.00291 | 0.00166 | 0.000384 | 0.00245 |
| Zinc $PM_{2.5}$ LC | 51 | 39 | 0.00239 | 0.0142 | 0.0122 | 0.0121 | 0.0036 | 0.00413 |
| Zirconium $PM_{2.5}$ LC | 51 | 8 | 0.00372 | 0.0028 | 0.00245 | 0.0023 | 0.000253 | 0.00328 |

| KALAMAZOO | AIRS ID: 260770008 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ Local conditions (LC) | 227 | 227 | 0.74 | 36.5 | 32.1 | 31.8 | 11.8 | 11.8 |
| Aluminum $PM_{2.5}$ LC | 57 | 30 | 0.0201 | 0.534 | 0.2 | 0.133 | 0.0338 | 0.0445 |
| Ammonium Ion $PM_{2.5}$ LC | 57 | 57 | 0.0168 | 4.59 | 4.17 | 3.44 | 1.28 | 1.28 |
| Antimony $PM_{2.5}$ LC | 57 | 17 | 0.0244 | 0.0287 | 0.0233 | 0.0192 | 0.00271 | 0.0204 |

| KALAMAZOO | AIRS ID: 260770008 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Arsenic $PM_{2.5}$ LC | 57 | 52 | 0.00248 | 0.0103 | 0.00883 | 0.00503 | 0.00202 | 0.00227 |
| Barium $PM_{2.5}$ LC | 57 | 33 | 0.0401 | 0.0867 | 0.0852 | 0.0622 | 0.0127 | 0.0279 |
| Bromine $PM_{2.5}$ LC | 57 | 54 | 0.00197 | 0.00827 | 0.00714 | 0.00615 | 0.00261 | 0.00277 |
| Cadmium $PM_{2.5}$ LC | 57 | 20 | 0.0117 | 0.0265 | 0.0145 | 0.0114 | 0.00202 | 0.00977 |
| Calcium $PM_{2.5}$ LC | 57 | 57 | 0.00634 | 0.64 | 0.399 | 0.36 | 0.0988 | 0.0988 |
| Cerium $PM_{2.5}$ LC | 57 | 27 | 0.0588 | 0.0777 | 0.0576 | 0.0558 | 0.00734 | 0.0363 |
| Cesium $PM_{2.5}$ LC | 57 | 24 | 0.0282 | 0.0329 | 0.0248 | 0.0156 | 0.00331 | 0.0188 |
| Chlorine $PM_{2.5}$ LC | 57 | 26 | 0.00918 | 0.225 | 0.0473 | 0.0353 | 0.0104 | 0.0157 |
| Chromium $PM_{2.5}$ LC | 57 | 40 | 0.00209 | 0.00514 | 0.00485 | 0.00429 | 0.00113 | 0.00174 |
| Cobalt $PM_{2.5}$ LC | 57 | 17 | 0.00166 | 0.00163 | 0.00133 | 0.00123 | 0.000235 | 0.00144 |
| Copper $PM_{2.5}$ LC | 57 | 54 | 0.00228 | 0.0129 | 0.00944 | 0.00941 | 0.00309 | 0.0032 |
| Elemental Carbon $PM_{2.5}$ LC | 57 | 57 | 0.24 | 1.53 | 1.23 | 1.22 | 0.521 | 0.521 |
| Europium $PM_{2.5}$ LC | 57 | 15 | 0.00823 | 0.0226 | 0.0193 | 0.0135 | 0.00186 | 0.0087 |
| Gallium $PM_{2.5}$ LC | 57 | 10 | 0.00405 | 0.00268 | 0.00118 | 0.00079 | 0.000151 | 0.00364 |
| Gold $PM_{2.5}$ LC | 57 | 22 | 0.00629 | 0.00991 | 0.00678 | 0.00615 | 0.00131 | 0.00488 |
| Hafnium $PM_{2.5}$ LC | 57 | 21 | 0.0285 | 0.0324 | 0.0066 | 0.00561 | 0.00164 | 0.019 |
| Indium $PM_{2.5}$ LC | 57 | 27 | 0.0144 | 0.0213 | 0.0143 | 0.0119 | 0.00196 | 0.00966 |
| Iridium $PM_{2.5}$ LC | 57 | 21 | 0.00746 | 0.0107 | 0.00829 | 0.00723 | 0.00101 | 0.00587 |
| Iron $PM_{2.5}$ LC | 57 | 57 | 0.00239 | 0.592 | 0.416 | 0.342 | 0.118 | 0.118 |
| Lanthanium $PM_{2.5}$ LC | 57 | 22 | 0.0459 | 0.051 | 0.0506 | 0.0326 | 0.0059 | 0.0378 |
| Magnesium $PM_{2.5}$ LC | 57 | 20 | 0.0246 | 0.256 | 0.242 | 0.077 | 0.0169 | 0.0318 |
| Manganese $PM_{2.5}$ LC | 57 | 50 | 0.00228 | 0.019 | 0.0113 | 0.00697 | 0.00251 | 0.00271 |
| Mercury $PM_{2.5}$ LC | 57 | 26 | 0.00479 | 0.00559 | 0.00491 | 0.00489 | 0.00122 | 0.00374 |
| Molybdenum $PM_{2.5}$ LC | 57 | 12 | 0.00811 | 0.0136 | 0.00919 | 0.0068 | 0.000892 | 0.00732 |
| Nickel $PM_{2.5}$ LC | 57 | 41 | 0.00174 | 0.00268 | 0.00257 | 0.00257 | 0.000678 | 0.00116 |
| Niobium $PM_{2.5}$ LC | 57 | 12 | 0.00474 | 0.00385 | 0.00338 | 0.00315 | 0.000391 | 0.00416 |
| Organic Carbon Peak1 $PM_{2.5}$ LC | 57 | 57 | 0.24 | 2.53 | 1.95 | 1.67 | 0.87 | 0.87 |
| Organic Carbon Peak2 $PM_{2.5}$ LC | 57 | 57 | 0.24 | 2.27 | 1.78 | 1.68 | 1.03 | 1.03 |
| Organic Carbon Peak3 $PM_{2.5}$ LC | 57 | 57 | 0.24 | 1.62 | 1.52 | 1.28 | 0.653 | 0.653 |
| Organic Carbon Peak4 $PM_{2.5}$ LC | 57 | 57 | 0.24 | 2.72 | 1.74 | 1.62 | 0.758 | 0.758 |
| Organic Carbon $PM_{2.5}$ LC | 57 | 57 | 0.24 | 9.13 | 6.09 | 5.57 | 3.32 | 3.32 |
| Organic Carbon Pyrolytic $PM_{2.5}$ LC | 57 | 10 | 0.24 | 0.0432 | 0.039 | 0.0354 | 0.00404 | 0.202 |
| Phosphorus $PM_{2.5}$ LC | 57 | 15 | 0.0094 | 0.0396 | 0.0352 | 0.0181 | 0.00278 | 0.00971 |
| Potassium Ion $PM_{2.5}$ LC | 57 | 15 | 0.014 | 0.438 | 0.165 | 0.147 | 0.026 | 0.0363 |
| Potassium $PM_{2.5}$ LC | 57 | 57 | 0.00862 | 0.512 | 0.235 | 0.172 | 0.072 | 0.072 |
| Rubidium $PM_{2.5}$ LC | 57 | 23 | 0.00219 | 0.00223 | 0.00176 | 0.00158 | 0.000391 | 0.0018 |
| Samarium $PM_{2.5}$ LC | 57 | 13 | 0.00611 | 0.0138 | 0.0131 | 0.0125 | 0.00123 | 0.00613 |
| Scandium $PM_{2.5}$ LC | 57 | 11 | 0.0197 | 0.00175 | 0.00105 | 0.00093 | 0.000132 | 0.0169 |
| Selenium $PM_{2.5}$ LC | 57 | 40 | 0.0029 | 0.00431 | 0.00395 | 0.0034 | 0.00105 | 0.00193 |
| Silicon $PM_{2.5}$ LC | 57 | 55 | 0.0148 | 1.28 | 0.772 | 0.418 | 0.151 | 0.152 |
| Silver $PM_{2.5}$ LC | 57 | 24 | 0.0107 | 0.0221 | 0.0204 | 0.0126 | 0.00286 | 0.00942 |

| KALAMAZOO | AIRS ID: 260770008 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Sodium Ion $PM_{2.5}$ LC | 57 | 51 | 0.03 | 0.203 | 0.199 | 0.193 | 0.0586 | 0.0617 |
| Sodium $PM_{2.5}$ LC | 57 | 18 | 0.077 | 0.416 | 0.415 | 0.27 | 0.0393 | 0.0883 |
| Strantium $PM_{2.5}$ LC | 57 | 31 | 0.0026 | 0.00691 | 0.00533 | 0.00429 | 0.000982 | 0.00236 |
| Sulfate $PM_{2.5}$ LC | 57 | 57 | 0.012 | 13.9 | 8.9 | 8.04 | 2.89 | 2.89 |
| Sulfur $PM_{2.5}$ LC | 57 | 57 | 0.011 | 4.91 | 3.22 | 3.17 | 0.994 | 0.994 |
| Tantalum $PM_{2.5}$ LC | 57 | 24 | 0.0166 | 0.016 | 0.0111 | 0.011 | 0.00211 | 0.0109 |
| Terbium $PM_{2.5}$ LC | 57 | 5 | 0.00675 | 0.00501 | 0.00233 | 0.00163 | 0.000182 | 0.00632 |
| Tin $PM_{2.5}$ LC | 57 | 30 | 0.021 | 0.0628 | 0.0326 | 0.0318 | 0.00591 | 0.0154 |
| Titatium $PM_{2.5}$ LC | 57 | 42 | 0.00423 | 0.04 | 0.0218 | 0.0172 | 0.00487 | 0.00605 |
| Total Nitrate $PM_{2.5}$ LC | 57 | 57 | 0.0087 | 10.5 | 8.11 | 7.04 | 1.94 | 1.94 |
| Tungsten $PM_{2.5}$ LC | 57 | 25 | 0.0127 | 0.0188 | 0.0144 | 0.012 | 0.00247 | 0.0101 |
| Vanadium $PM_{2.5}$ LC | 57 | 33 | 0.00275 | 0.00553 | 0.00338 | 0.00303 | 0.000812 | 0.00193 |
| Yttrium $PM_{2.5}$ LC | 57 | 20 | 0.00323 | 0.00329 | 0.00225 | 0.00166 | 0.000375 | 0.00262 |
| Zinc $PM_{2.5}$ LC | 57 | 55 | 0.00235 | 0.0354 | 0.0334 | 0.0291 | 0.0133 | 0.0133 |
| Zirconium $PM_{2.5}$ LC | 57 | 11 | 0.00394 | 0.0092 | 0.00513 | 0.00477 | 0.000554 | 0.00358 |

| SAULT STE. MARIE - TRIBAL | AIRS ID: 260330901 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ Local conditions (LC) | 284 | 284 | 0.74 | 31.5 | 29.3 | 25.5 | 7.19 | 7.19 |
| Aluminum $PM_{2.5}$ LC | 113 | 52 | 0.02 | 0.209 | 0.197 | 0.135 | 0.0152 | 0.027 |
| Ammonium Ion $PM_{2.5}$ LC | 114 | 112 | 0.0161 | 4.74 | 3.81 | 3.36 | 0.698 | 0.699 |
| Antimony $PM_{2.5}$ LC | 113 | 51 | 0.0234 | 0.043 | 0.0407 | 0.0384 | 0.00525 | 0.0182 |
| Arsenic $PM_{2.5}$ LC | 113 | 72 | 0.00254 | 0.00605 | 0.00424 | 0.00384 | 0.000853 | 0.00188 |
| Barium $PM_{2.5}$ LC | 113 | 52 | 0.0395 | 0.063 | 0.0601 | 0.0374 | 0.00744 | 0.03 |
| Bromine $PM_{2.5}$ LC | 113 | 88 | 0.00202 | 0.0155 | 0.0104 | 0.00647 | 0.00169 | 0.00227 |
| Cadmium $PM_{2.5}$ LC | 113 | 45 | 0.0113 | 0.0183 | 0.0178 | 0.0174 | 0.00194 | 0.00888 |
| Calcium $PM_{2.5}$ LC | 113 | 113 | 0.00619 | 0.119 | 0.102 | 0.101 | 0.0318 | 0.0318 |
| Cerium $PM_{2.5}$ LC | 113 | 52 | 0.0595 | 0.067 | 0.0572 | 0.0538 | 0.00705 | 0.0428 |
| Cesium $PM_{2.5}$ LC | 113 | 37 | 0.0283 | 0.0457 | 0.0428 | 0.0273 | 0.00374 | 0.0217 |
| Chlorine $PM_{2.5}$ LC | 113 | 54 | 0.00962 | 1.14 | 0.358 | 0.206 | 0.0293 | 0.0348 |
| Chromium $PM_{2.5}$ LC | 113 | 81 | 0.00207 | 0.046 | 0.00736 | 0.00711 | 0.00171 | 0.00229 |
| Cobalt $PM_{2.5}$ LC | 113 | 25 | 0.00165 | 0.00151 | 0.00128 | 0.0011 | 0.000111 | 0.00142 |
| Copper $PM_{2.5}$ LC | 113 | 80 | 0.00227 | 0.0113 | 0.00482 | 0.00454 | 0.00121 | 0.00186 |
| Elemental Carbon $PM_{2.5}$ LC | 112 | 111 | 0.24 | 0.841 | 0.788 | 0.653 | 0.285 | 0.288 |
| Europium $PM_{2.5}$ LC | 113 | 27 | 0.00784 | 0.0287 | 0.00829 | 0.00561 | 0.000874 | 0.00737 |
| Gallium $PM_{2.5}$ LC | 113 | 41 | 0.00429 | 0.00314 | 0.00267 | 0.00151 | 0.000206 | 0.00307 |
| Gold $PM_{2.5}$ LC | 113 | 53 | 0.0068 | 0.0147 | 0.012 | 0.00954 | 0.00148 | 0.00445 |
| Hafnium $PM_{2.5}$ LC | 113 | 46 | 0.0265 | 0.0129 | 0.0113 | 0.00733 | 0.00131 | 0.0161 |
| Indium $PM_{2.5}$ LC | 113 | 37 | 0.0139 | 0.0244 | 0.0209 | 0.0186 | 0.0026 | 0.0119 |

| SAULT STE. MARIE - TRIBAL | AIRS ID: 260330901 | Units: µg/m³ |
|---|---|---|

| Chemical Name | Num Obs | Obs > MDL | MDL | Max1 | Max2 | Max3 | Min Mean | Max Mean |
|---|---|---|---|---|---|---|---|---|
| Iridium $PM_{2.5}$ LC | 113 | 51 | 0.00822 | 0.00929 | 0.00813 | 0.00651 | 0.00124 | 0.00563 |
| Iron $PM_{2.5}$ LC | 113 | 110 | 0.00237 | 0.501 | 0.431 | 0.268 | 0.0663 | 0.0663 |
| Lanthanium $PM_{2.5}$ LC | 113 | 51 | 0.0464 | 0.0499 | 0.0474 | 0.0431 | 0.00594 | 0.0335 |
| Magnesium $PM_{2.5}$ LC | 113 | 30 | 0.0262 | 0.351 | 0.176 | 0.124 | 0.01 | 0.0287 |
| Manganese $PM_{2.5}$ LC | 113 | 92 | 0.00226 | 0.0455 | 0.0227 | 0.0131 | 0.00305 | 0.00349 |
| Mercury $PM_{2.5}$ LC | 113 | 56 | 0.00487 | 0.00885 | 0.00756 | 0.00733 | 0.00142 | 0.0039 |
| Molybdenum $PM_{2.5}$ LC | 113 | 32 | 0.00819 | 0.0148 | 0.00742 | 0.00735 | 0.000812 | 0.00667 |
| Nickel $PM_{2.5}$ LC | 113 | 81 | 0.00172 | 0.0145 | 0.0043 | 0.0038 | 0.000987 | 0.00147 |
| Niobium $PM_{2.5}$ LC | 113 | 21 | 0.00486 | 0.00395 | 0.00363 | 0.00335 | 0.000302 | 0.00407 |
| Organic Carbon Peak1 $PM_{2.5}$ LC | 112 | 112 | 0.24 | 2.98 | 1.45 | 1.33 | 0.56 | 0.56 |
| Organic Carbon Peak2 $PM_{2.5}$ LC | 112 | 112 | 0.24 | 2.74 | 2.35 | 2.24 | 0.944 | 0.944 |
| Organic Carbon Peak3 $PM_{2.5}$ LC | 112 | 112 | 0.24 | 2.19 | 1.62 | 1.44 | 0.588 | 0.588 |
| Organic Carbon Peak4 $PM_{2.5}$ LC | 112 | 112 | 0.24 | 2.78 | 2.53 | 2.39 | 0.559 | 0.559 |
| Organic Carbon $PM_{2.5}$ LC | 112 | 112 | 0.24 | 10.7 | 7.34 | 6.56 | 2.66 | 2.66 |
| Organic Carbon Pyrolytic $PM_{2.5}$ LC | 112 | 27 | 0.24 | 0.156 | 0.0735 | 0.0631 | 0.00443 | 0.187 |
| Phosphorus $PM_{2.5}$ LC | 113 | 34 | 0.00887 | 0.0309 | 0.0152 | 0.0115 | 0.00126 | 0.00757 |
| Potassium Ion $PM_{2.5}$ LC | 114 | 43 | 0.014 | 0.342 | 0.316 | 0.263 | 0.0431 | 0.0519 |
| Potassium $PM_{2.5}$ LC | 113 | 113 | 0.0086 | 0.387 | 0.324 | 0.305 | 0.0687 | 0.0687 |
| Rubidium $PM_{2.5}$ LC | 113 | 46 | 0.00223 | 0.00303 | 0.00302 | 0.00267 | 0.000375 | 0.00171 |
| Samarium $PM_{2.5}$ LC | 113 | 34 | 0.00602 | 0.0148 | 0.00792 | 0.00732 | 0.000986 | 0.00545 |
| Scandium $PM_{2.5}$ LC | 113 | 21 | 0.019 | 0.00279 | 0.00175 | 0.00163 | 0.000128 | 0.015 |
| Selenium $PM_{2.5}$ LC | 113 | 63 | 0.00291 | 0.00373 | 0.00302 | 0.0029 | 0.000615 | 0.00193 |
| Silicon $PM_{2.5}$ LC | 113 | 85 | 0.0145 | 0.387 | 0.257 | 0.209 | 0.0367 | 0.041 |
| Silver $PM_{2.5}$ LC | 113 | 52 | 0.0103 | 0.0241 | 0.0184 | 0.0171 | 0.0024 | 0.00821 |
| Sodium Ion $PM_{2.5}$ LC | 114 | 97 | 0.03 | 0.882 | 0.555 | 0.378 | 0.0662 | 0.0707 |
| Sodium $PM_{2.5}$ LC | 113 | 50 | 0.0842 | 0.562 | 0.494 | 0.318 | 0.0419 | 0.0884 |
| Strantium $PM_{2.5}$ LC | 113 | 45 | 0.00262 | 0.00421 | 0.00215 | 0.00198 | 0.000404 | 0.00215 |
| Sulfate $PM_{2.5}$ LC | 114 | 114 | 0.012 | 13.1 | 9.85 | 7.58 | 1.89 | 1.89 |
| Sulfur $PM_{2.5}$ LC | 113 | 113 | 0.0119 | 4.24 | 3.18 | 2.77 | 0.619 | 0.619 |
| Tantalum $PM_{2.5}$ LC | 113 | 48 | 0.0167 | 0.0237 | 0.0205 | 0.0152 | 0.00221 | 0.00997 |
| Terbium $PM_{2.5}$ LC | 113 | 16 | 0.00658 | 0.0407 | 0.0085 | 0.00677 | 0.000745 | 0.00662 |
| Tin $PM_{2.5}$ LC | 113 | 54 | 0.0199 | 0.0284 | 0.0263 | 0.0213 | 0.00432 | 0.0141 |
| Titatium $PM_{2.5}$ LC | 113 | 73 | 0.00422 | 0.0125 | 0.0102 | 0.00736 | 0.00159 | 0.00319 |
| Total Nitrate $PM_{2.5}$ LC | 114 | 113 | 0.00862 | 9.33 | 7.34 | 5.82 | 0.713 | 0.713 |
| Tungsten $PM_{2.5}$ LC | 113 | 57 | 0.0129 | 0.0256 | 0.0248 | 0.0152 | 0.0026 | 0.00825 |
| Vanadium $PM_{2.5}$ LC | 113 | 77 | 0.00272 | 0.00708 | 0.00683 | 0.00546 | 0.00142 | 0.00224 |
| Yttrium $PM_{2.5}$ LC | 113 | 39 | 0.00326 | 0.00516 | 0.00507 | 0.00337 | 0.000506 | 0.00279 |
| Zinc $PM_{2.5}$ LC | 113 | 105 | 0.00228 | 0.0539 | 0.0349 | 0.0334 | 0.00803 | 0.00816 |
| Zirconium $PM_{2.5}$ LC | 113 | 31 | 0.00399 | 0.00768 | 0.00523 | 0.005 | 0.000743 | 0.00358 |

| LUNA PIER | AIRS ID: 261150005 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ Local conditions (LC) | 162 | 162 | 0.74 | 38.8 | 37 | 35 | 12.8 | 12.8 |
| Aluminum $PM_{2.5}$LC | 46 | 23 | 0.0199 | 0.182 | 0.179 | 0.0944 | 0.0222 | 0.0332 |
| Ammonium Ion $PM_{2.5}$LC | 46 | 46 | 0.0166 | 6.19 | 5.01 | 4.95 | 1.56 | 1.56 |
| Antimony $PM_{2.5}$LC | 46 | 18 | 0.0234 | 0.048 | 0.0455 | 0.0292 | 0.0058 | 0.0201 |
| Arsenic $PM_{2.5}$LC | 46 | 29 | 0.00258 | 0.00943 | 0.00548 | 0.00498 | 0.00151 | 0.00256 |
| Barium $PM_{2.5}$LC | 46 | 17 | 0.04 | 0.0482 | 0.0432 | 0.0296 | 0.00721 | 0.0356 |
| Bromine $PM_{2.5}$LC | 46 | 44 | 0.00207 | 0.00781 | 0.0062 | 0.00617 | 0.00249 | 0.00263 |
| Cadmium $PM_{2.5}$LC | 46 | 18 | 0.0111 | 0.0148 | 0.00914 | 0.00816 | 0.00187 | 0.00857 |
| Calcium $PM_{2.5}$LC | 46 | 46 | 0.00617 | 0.192 | 0.0974 | 0.075 | 0.0406 | 0.0406 |
| Cerium $PM_{2.5}$LC | 46 | 17 | 0.0621 | 0.066 | 0.0547 | 0.0425 | 0.00676 | 0.0444 |
| Cesium $PM_{2.5}$LC | 46 | 14 | 0.0287 | 0.0275 | 0.0256 | 0.025 | 0.00364 | 0.0258 |
| Chlorine $PM_{2.5}$LC | 46 | 18 | 0.00987 | 0.232 | 0.109 | 0.0372 | 0.0113 | 0.018 |
| Chromium $PM_{2.5}$LC | 46 | 37 | 0.00206 | 0.0146 | 0.0101 | 0.01 | 0.00192 | 0.00232 |
| Cobalt $PM_{2.5}$LC | 46 | 17 | 0.00165 | 0.0021 | 0.00159 | 0.00105 | 0.00025 | 0.00133 |
| Copper $PM_{2.5}$LC | 46 | 38 | 0.00226 | 0.0411 | 0.00818 | 0.00752 | 0.00285 | 0.00326 |
| Elemental Carbon $PM_{2.5}$LC | 46 | 46 | 0.24 | 1.92 | 1.41 | 1.37 | 0.513 | 0.513 |
| Europium $PM_{2.5}$LC | 46 | 11 | 0.00774 | 0.0113 | 0.0109 | 0.00545 | 0.00094 | 0.00746 |
| Gallium $PM_{2.5}$LC | 46 | 15 | 0.00444 | 0.00149 | 0.00141 | 0.00128 | 0.000225 | 0.00339 |
| Gold $PM_{2.5}$LC | 46 | 18 | 0.00712 | 0.0096 | 0.0072 | 0.0063 | 0.00141 | 0.00569 |
| Hafnium $PM_{2.5}$LC | 46 | 18 | 0.0262 | 0.00576 | 0.00503 | 0.00443 | 0.000975 | 0.0153 |
| Indium $PM_{2.5}$LC | 46 | 16 | 0.0137 | 0.0244 | 0.0165 | 0.0136 | 0.00203 | 0.0108 |
| Iridium $PM_{2.5}$LC | 46 | 17 | 0.00868 | 0.00607 | 0.00574 | 0.00573 | 0.00117 | 0.0067 |
| Iron $PM_{2.5}$LC | 46 | 45 | 0.00237 | 0.304 | 0.131 | 0.124 | 0.0619 | 0.0619 |
| Lanthanium $PM_{2.5}$LC | 46 | 15 | 0.0472 | 0.0376 | 0.0293 | 0.0276 | 0.00454 | 0.0326 |
| Magnesium $PM_{2.5}$LC | 46 | 14 | 0.0271 | 0.332 | 0.0808 | 0.0318 | 0.0129 | 0.0308 |
| Manganese $PM_{2.5}$LC | 46 | 41 | 0.00226 | 0.00641 | 0.00525 | 0.00501 | 0.00184 | 0.00206 |
| Mercury $PM_{2.5}$LC | 46 | 21 | 0.00494 | 0.00655 | 0.0048 | 0.00456 | 0.00113 | 0.00388 |
| Molybdenum $PM_{2.5}$LC | 46 | 14 | 0.00826 | 0.00984 | 0.00693 | 0.00641 | 0.00105 | 0.00686 |
| Nickel $PM_{2.5}$LC | 46 | 34 | 0.00171 | 0.00463 | 0.00454 | 0.00367 | 0.00107 | 0.00151 |
| Niobium $PM_{2.5}$LC | 46 | 8 | 0.00495 | 0.00327 | 0.0027 | 0.00247 | 0.000382 | 0.00448 |
| Organic Carbon Peak1 $PM_{2.5}$LC | 46 | 46 | 0.24 | 1.92 | 1.58 | 1.47 | 0.785 | 0.785 |
| Organic Carbon Peak2 $PM_{2.5}$LC | 46 | 46 | 0.24 | 2.42 | 1.85 | 1.52 | 0.916 | 0.916 |
| Organic Carbon Peak3 $PM_{2.5}$LC | 46 | 46 | 0.24 | 1.8 | 1.28 | 1.04 | 0.586 | 0.586 |
| Organic Carbon Peak4 $PM_{2.5}$LC | 46 | 46 | 0.24 | 2.29 | 2.23 | 1.52 | 0.711 | 0.711 |
| Organic Carbon $PM_{2.5}$LC | 46 | 46 | 0.24 | 8.43 | 6.53 | 5.06 | 3.01 | 3.01 |
| Organic Carbon Pyrolytic $PM_{2.5}$LC | 46 | 9 | 0.24 | 0.189 | 0.0569 | 0.0367 | 0.00776 | 0.201 |
| Phosphorus $PM_{2.5}$LC | 46 | 9 | 0.00914 | 0.0306 | 0.0228 | 0.0158 | 0.00208 | 0.00954 |
| Potassium Ion $PM_{2.5}$LC | 46 | 14 | 0.014 | 0.138 | 0.124 | 0.0987 | 0.0222 | 0.0319 |
| Potassium $PM_{2.5}$LC | 46 | 46 | 0.00857 | 0.115 | 0.114 | 0.0834 | 0.0464 | 0.0464 |
| Rubidium $PM_{2.5}$LC | 46 | 19 | 0.00226 | 0.00281 | 0.00233 | 0.00222 | 0.000487 | 0.00178 |
| Samarium $PM_{2.5}$LC | 46 | 15 | 0.00602 | 0.00961 | 0.00595 | 0.0042 | 0.00097 | 0.00524 |
| Scandium $PM_{2.5}$LC | 46 | 11 | 0.0179 | 0.00198 | 0.00117 | 0.0007 | 0.000135 | 0.0137 |

| LUNA PIER | AIRS ID: 261150005 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Selenium $PM_{2.5}$LC | 46 | 35 | 0.00294 | 0.022 | 0.00958 | 0.00477 | 0.00181 | 0.00254 |
| Silicon $PM_{2.5}$LC | 46 | 43 | 0.0144 | 0.279 | 0.239 | 0.221 | 0.0582 | 0.0594 |
| Silver $PM_{2.5}$LC | 46 | 18 | 0.0102 | 0.0131 | 0.0106 | 0.00886 | 0.00153 | 0.00812 |
| Sodium Ion $PM_{2.5}$LC | 46 | 43 | 0.03 | 0.277 | 0.239 | 0.231 | 0.0721 | 0.0741 |
| Sodium $PM_{2.5}$LC | 46 | 24 | 0.0883 | 0.55 | 0.542 | 0.34 | 0.0545 | 0.0971 |
| Strantium $PM_{2.5}$LC | 46 | 30 | 0.00268 | 0.00397 | 0.00365 | 0.00324 | 0.000857 | 0.00189 |
| Sulfate $PM_{2.5}$LC | 46 | 46 | 0.012 | 15.5 | 12.9 | 9.42 | 3.07 | 3.07 |
| Sulfur $PM_{2.5}$LC | 46 | 46 | 0.0125 | 4.21 | 3.76 | 3.35 | 1.01 | 1.01 |
| Tantalum $PM_{2.5}$LC | 46 | 22 | 0.017 | 0.0156 | 0.0148 | 0.0125 | 0.00184 | 0.0102 |
| Terbium $PM_{2.5}$LC | 46 | 8 | 0.00657 | 0.0148 | 0.00841 | 0.00385 | 0.000716 | 0.00616 |
| Tin $PM_{2.5}$LC | 46 | 19 | 0.0197 | 0.0212 | 0.0118 | 0.0118 | 0.00245 | 0.0138 |
| Titatium $PM_{2.5}$LC | 46 | 35 | 0.0042 | 0.0152 | 0.00918 | 0.00864 | 0.00236 | 0.00348 |
| Total Nitrate $PM_{2.5}$LC | 46 | 46 | 0.00868 | 10.9 | 10.4 | 7.07 | 2.35 | 2.35 |
| Tungsten $PM_{2.5}$LC | 46 | 22 | 0.0133 | 0.0152 | 0.0145 | 0.0104 | 0.00244 | 0.0089 |
| Vanadium $PM_{2.5}$LC | 46 | 33 | 0.00269 | 0.0103 | 0.00432 | 0.00327 | 0.00113 | 0.00188 |
| Yttrium $PM_{2.5}$LC | 46 | 19 | 0.00333 | 0.00457 | 0.004 | 0.00337 | 0.00075 | 0.00296 |
| Zinc $PM_{2.5}$LC | 46 | 46 | 0.00227 | 0.0552 | 0.0423 | 0.0386 | 0.0131 | 0.0131 |
| Zirconium $PM_{2.5}$LC | 46 | 14 | 0.00408 | 0.0516 | 0.00622 | 0.00619 | 0.00183 | 0.00454 |

| YPSILANTI | AIRS ID: 261610008 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| $PM_{2.5}$ Local conditions (LC) | 235 | 235 | 0.74 | 37.2 | 34.6 | 32.4 | 12.2 | 12.2 |
| Aluminum $PM_{2.5}$LC | 58 | 26 | 0.0201 | 0.266 | 0.0793 | 0.0573 | 0.0132 | 0.0253 |
| Ammonium Ion $PM_{2.5}$LC | 58 | 58 | 0.0167 | 5.67 | 5.16 | 4.9 | 1.58 | 1.58 |
| Antimony $PM_{2.5}$LC | 58 | 20 | 0.0237 | 0.101 | 0.0315 | 0.0243 | 0.00489 | 0.0209 |
| Arsenic $PM_{2.5}$LC | 58 | 49 | 0.00251 | 0.00693 | 0.00594 | 0.00547 | 0.00178 | 0.00228 |
| Barium $PM_{2.5}$LC | 58 | 26 | 0.0382 | 0.148 | 0.0589 | 0.0459 | 0.00993 | 0.0343 |
| Bromine $PM_{2.5}$LC | 58 | 52 | 0.002 | 0.00722 | 0.00711 | 0.00696 | 0.00218 | 0.00246 |
| Cadmium $PM_{2.5}$LC | 58 | 24 | 0.0111 | 0.0177 | 0.0117 | 0.0111 | 0.00242 | 0.00888 |
| Calcium $PM_{2.5}$LC | 58 | 58 | 0.00625 | 0.101 | 0.0998 | 0.0926 | 0.0367 | 0.0367 |
| Cerium $PM_{2.5}$LC | 58 | 22 | 0.0583 | 0.0882 | 0.038 | 0.0241 | 0.00448 | 0.0464 |
| Cesium $PM_{2.5}$LC | 58 | 20 | 0.0276 | 0.0274 | 0.0177 | 0.0142 | 0.00256 | 0.0186 |
| Chlorine $PM_{2.5}$LC | 58 | 25 | 0.00972 | 0.219 | 0.11 | 0.11 | 0.013 | 0.019 |
| Chromium $PM_{2.5}$LC | 58 | 34 | 0.00206 | 0.00602 | 0.0048 | 0.00466 | 0.00108 | 0.00194 |
| Cobalt $PM_{2.5}$LC | 58 | 19 | 0.00164 | 0.00233 | 0.00141 | 0.00118 | 0.000256 | 0.00138 |
| Copper $PM_{2.5}$LC | 58 | 53 | 0.00228 | 0.0241 | 0.0178 | 0.0174 | 0.004 | 0.00419 |
| Elemental Carbon $PM_{2.5}$LC | 57 | 57 | 0.24 | 1.05 | 1 | 0.974 | 0.49 | 0.49 |
| Europium $PM_{2.5}$LC | 58 | 13 | 0.00752 | 0.00894 | 0.00562 | 0.00372 | 0.000588 | 0.00702 |
| Gallium $PM_{2.5}$LC | 58 | 12 | 0.00431 | 0.0014 | 0.00117 | 0.00104 | 0.000134 | 0.00369 |

| YPSILANTI | AIRS ID: 261610008 | | | | | Units: µg/m³ | | |
|---|---|---|---|---|---|---|---|---|
| **Chemical Name** | **Num Obs** | **Obs > MDL** | **MDL** | **Max1** | **Max2** | **Max3** | **Min Mean** | **Max Mean** |
| Gold $PM_{2.5}LC$ | 58 | 25 | 0.00688 | 0.00865 | 0.00746 | 0.00623 | 0.00153 | 0.00512 |
| Hafnium $PM_{2.5}LC$ | 58 | 23 | 0.0263 | 0.0183 | 0.0125 | 0.0113 | 0.00188 | 0.0179 |
| Indium $PM_{2.5}LC$ | 58 | 22 | 0.0138 | 0.0185 | 0.0183 | 0.0136 | 0.00256 | 0.0112 |
| Iridium $PM_{2.5}LC$ | 58 | 26 | 0.00833 | 0.0106 | 0.00827 | 0.0077 | 0.00131 | 0.0054 |
| Iron $PM_{2.5}LC$ | 58 | 58 | 0.00236 | 0.256 | 0.166 | 0.152 | 0.055 | 0.055 |
| Lanthanium $PM_{2.5}LC$ | 58 | 23 | 0.0449 | 0.0557 | 0.0233 | 0.023 | 0.0046 | 0.0385 |
| Magnesium $PM_{2.5}LC$ | 58 | 18 | 0.0264 | 0.0448 | 0.039 | 0.0381 | 0.00599 | 0.0228 |
| Manganese $PM_{2.5}LC$ | 58 | 50 | 0.00223 | 0.0103 | 0.00747 | 0.00582 | 0.00223 | 0.00251 |
| Mercury $PM_{2.5}LC$ | 58 | 28 | 0.00484 | 0.00934 | 0.00549 | 0.00534 | 0.00135 | 0.00405 |
| Molybdenum $PM_{2.5}LC$ | 58 | 14 | 0.00826 | 0.00962 | 0.00886 | 0.00841 | 0.001 | 0.00725 |
| Nickel $PM_{2.5}LC$ | 58 | 39 | 0.00171 | 0.00456 | 0.00244 | 0.00234 | 0.000702 | 0.00126 |
| Niobium $PM_{2.5}LC$ | 58 | 17 | 0.00484 | 0.00455 | 0.00351 | 0.00281 | 0.000455 | 0.0037 |
| Organic Carbon Peak1 $PM_{2.5}LC$ | 57 | 57 | 0.24 | 1.99 | 1.65 | 1.51 | 0.882 | 0.882 |
| Organic Carbon Peak2 $PM_{2.5}LC$ | 57 | 57 | 0.24 | 2.39 | 1.9 | 1.59 | 1.02 | 1.02 |
| Organic Carbon Peak3 $PM_{2.5}LC$ | 57 | 57 | 0.24 | 2.7 | 1.98 | 1.14 | 0.67 | 0.67 |
| Organic Carbon Peak4 $PM_{2.5}LC$ | 57 | 57 | 0.24 | 2.81 | 2.26 | 1.74 | 0.783 | 0.783 |
| Organic Carbon $PM_{2.5}LC$ | 57 | 57 | 0.24 | 8.84 | 6 | 5.88 | 3.37 | 3.37 |
| Organic Carbon Pyrolytic $PM_{2.5}LC$ | 57 | 10 | 0.24 | 0.427 | 0.215 | 0.0261 | 0.0133 | 0.211 |
| Phosphorus $PM_{2.5}LC$ | 58 | 10 | 0.00918 | 0.00944 | 0.00409 | 0.00396 | 0.000446 | 0.00817 |
| Potassium Ion $PM_{2.5}LC$ | 58 | 11 | 0.014 | 0.231 | 0.215 | 0.117 | 0.0188 | 0.0302 |
| Potassium $PM_{2.5}LC$ | 58 | 58 | 0.0087 | 0.256 | 0.251 | 0.121 | 0.0496 | 0.0496 |
| Rubidium $PM_{2.5}LC$ | 58 | 25 | 0.00221 | 0.0028 | 0.00167 | 0.00163 | 0.000349 | 0.0017 |
| Samarium $PM_{2.5}LC$ | 58 | 21 | 0.00593 | 0.00602 | 0.00455 | 0.00427 | 0.000913 | 0.00483 |
| Scandium $PM_{2.5}LC$ | 58 | 12 | 0.0194 | 0.0007 | 0.00058 | 0.00058 | 0.0000826 | 0.016 |
| Selenium $PM_{2.5}LC$ | 58 | 38 | 0.00292 | 0.00472 | 0.00398 | 0.00331 | 0.000983 | 0.00199 |
| Silicon $PM_{2.5}LC$ | 58 | 50 | 0.0146 | 0.577 | 0.261 | 0.233 | 0.0585 | 0.061 |
| Silver $PM_{2.5}LC$ | 58 | 31 | 0.0101 | 0.0156 | 0.0128 | 0.0106 | 0.00248 | 0.00767 |
| Sodium Ion $PM_{2.5}LC$ | 58 | 52 | 0.03 | 0.242 | 0.133 | 0.127 | 0.0523 | 0.0554 |
| Sodium $PM_{2.5}LC$ | 58 | 24 | 0.0856 | 0.264 | 0.191 | 0.145 | 0.0251 | 0.0715 |
| Strantium $PM_{2.5}LC$ | 58 | 28 | 0.00261 | 0.00508 | 0.00426 | 0.0038 | 0.000713 | 0.00212 |
| Sulfate $PM_{2.5}LC$ | 58 | 58 | 0.012 | 11.3 | 11 | 10.7 | 3.04 | 3.04 |
| Sulfur $PM_{2.5}LC$ | 58 | 58 | 0.0121 | 3.93 | 3.83 | 3.32 | 0.982 | 0.982 |
| Tantalum $PM_{2.5}LC$ | 58 | 28 | 0.0165 | 0.0171 | 0.0156 | 0.0146 | 0.00225 | 0.0106 |
| Terbium $PM_{2.5}LC$ | 58 | 12 | 0.00645 | 0.00785 | 0.00257 | 0.00256 | 0.000431 | 0.0057 |
| Tin $PM_{2.5}LC$ | 58 | 21 | 0.0198 | 0.0298 | 0.0241 | 0.0212 | 0.00266 | 0.0149 |
| Titatium $PM_{2.5}LC$ | 58 | 40 | 0.00425 | 0.0258 | 0.0138 | 0.0124 | 0.00251 | 0.00397 |
| Total Nitrate $PM_{2.5}LC$ | 58 | 58 | 0.00869 | 12.6 | 11.4 | 9.64 | 2.15 | 2.15 |
| Tungsten $PM_{2.5}LC$ | 58 | 25 | 0.0128 | 0.0141 | 0.013 | 0.0105 | 0.00236 | 0.00917 |
| Vanadium $PM_{2.5}LC$ | 58 | 31 | 0.00273 | 0.0063 | 0.00455 | 0.0042 | 0.0012 | 0.00245 |
| Yttrium $PM_{2.5}LC$ | 58 | 22 | 0.00326 | 0.00362 | 0.00299 | 0.00245 | 0.000491 | 0.00275 |
| Zinc $PM_{2.5}LC$ | 58 | 54 | 0.00229 | 0.0426 | 0.0391 | 0.0362 | 0.0124 | 0.0125 |
| Zirconium $PM_{2.5}LC$ | 58 | 12 | 0.00398 | 0.0063 | 0.00488 | 0.00431 | 0.000624 | 0.0037 |

# Appendix D: 1-Hour Ozone Exceedances from 1994-2004

**Appendix D** is a tabulation of 1-hour $O_3$ Exceedances from 1994 to 2004. This information is provided by **Site Location**.

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

Historical $O_3$ exceedances for years prior to 1993 can be found in earlier Annual Air Quality Reports.

# 1-HOUR $O_3$ EXCEEDANCES FROM 1994 TO 2004 - Sorted By SITE LOCATION

(Units in ppm)

| 26-147-0030 ALGONAC | 26-163-0001 ALLEN PARK | 26-161-0005 ANN ARBOR | 26-161-0007 ANN ARBOR | 26-037-0001 ROSE LAKE | 26-019-0003 BENZONIA | 26-027-0003 CASSOPOLIS, (I.D.E.M.) | 26-021-0014 COLOMA | 26-163-0016 DETROIT, (Linwood) | 26-163-0019 DETROIT, (E. Seven Mile) |
|---|---|---|---|---|---|---|---|---|---|
| Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc |
| 6-16-94 0.133 | 6-18-94 0.126 | Monitoring for $O_3$ ended in 1996 | Monitor started in 1997; moved in 2000 to Ypsilanti site (26-161-0008) | | 6-28-96 0.144 | 7-14-95 0.150 | 8-12-95 0.136 | | 6-18-94 0.131 |
| 6-18-94 0.129 | | | | | | 5-19-98 0.137 | 6-13-96 0.125 | | 8-18-94 0.129 |
| 7-14-95 0.135 | | | | | | 6-24-02 0.128 | 6-28-96 0.138 | | 8-26-95 0.126 |
| 7-31-95 0.137 | | | | | | 7-3-02 0.127 | 5-19-98 0.136 | | |
| Monitoring for $O_3$ ended in 1999 | | | | | | | 9-6-98 0.157 | | |
| | | | | | | | 7-30-99 0.144 | | |
| | | | | | | | 8-8-01 0.126 | | |

| 26-161-8001 DEXTER, (EPA) | 26-041-0912 ESCANABA | 26-081-0020 EVANS | 26-133-0901 EVART | 26-049-0011 FLINT (Old) | 26-049-0021 FLINT (New) | 26-139-0005 GEORGETOWN TWP | 26-081-0020 GRAND RAPIDS | 26-081-2001 GRATTAN TWP | 26-063-0006 HARBOR BEACH |
|---|---|---|---|---|---|---|---|---|---|
| Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc |
| Monitoring for $O_3$ ended in 1992 | Monitoring for $O_3$ ended in 1993 | 1999 - Monitor moved from former Grattan Twp/Parnell site (26-081-2001) | Only in service during 1996 | Monitoring for $O_3$ ended in 1992 | 5-15-98 0.130 | 7-13-95 0.133 | 6-17-94 0.149 | 7-13-95 0.134 | Monitor site used for SEMOS study in 1993. Moved to another site in Harbor Beach (26-063-007) |
| | | | | | | 6-28-96 0.140 | 7-13-95 0.163 | 6-28-96 0.128 | |
| | | | | | | | 6-28-96 0.135 | 6-29-96 0.125 | |
| | | | | | | | 6-29-96 0.127 | Monitoring moved in 1999 to Evans (26-081-0020) | |

| 26-063-0007 HARBOR BEACH | 26-005-0003 HOLLAND | 26-113-0001 HOUGHTON LAKE (Background Site) | 26-143-0901 HOUGHTON LAKE | 26-077-0008 KALAMAZOO | 26-077-0905 KALAMAZOO | 26-077-0906 KALAMAZOO | 26-125-0902 LAKE ORION | 26-121-0039 LAKETON TWP |
|---|---|---|---|---|---|---|---|---|
| Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc |
| 6-15-94 0.159 | 6-17-95 0.137 | | Only in service during 1996 | Monitor put in service 1997 | 7-14-95 0.125 | Monitoring for $O_3$ ended in 1996 | Only in service in 1993 for SEMOS study | 7-6-94 0.146 |
| 6-14-01 .0153 | 7-13-95 0.178 | | | | Monitor replaced in 1997 with 26-077-0008 | | | 6-17-95 0.142 |
| | 7-14-95 0.145 | | | | | | | 7-13-95 0.171 |
| | 8-13-95 0.135 | | | | | | | 7-14-95 0.130 |
| | 6-28-96 0.154 | | | | | | | 7-31-95 0.136 |
| | 9-6-98 0.130 | | | | | | | 6-28-96 0.158 |
| | 7-30-99 0.154 | | | | | | | 7-30-99 0.154 |
| | 6-9-00 0.126 | | | | | | | 6-9-00 0.129 |
| | 6-23-02 0.129 | | | | | | | 6-22-02 0.130 |
| | 7-20-04 0.107 | | | | | | | 6-23-02 0.128 |

# 1-HOUR $O_3$ EXCEEDANCES FROM 1994 TO 2004 - Sorted By SITE LOCATION (Continued)

(Units in ppm)

| 26-065-0012 LANSING | 26-159-0901 LAWTON | 26-163-0025 LIVONIA, (Seven Mile Rd) | 26-163-2002 LIVONIA, (Schoolcraft Rd) | 26-105-0006 LUDINGTON | 26-101-8001 MANISTEE NAT'L FOREST (EPA) | 26-115-0037 MAYBEE | 26-099-0009 NEW HAVEN |
|---|---|---|---|---|---|---|---|
| Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc | Date Conc |
| | Monitoring for $O_3$ ended in 1992 | Monitoring for $O_3$ ended in 1993 | Monitoring for $O_3$ ended in 1993 | Monitor started in 1993 | Monitoring for $O_3$ ended in 1992 | Only in service in 1993, Site relocated to Tecumseh site (26-091-0007) | 5-22-94 0.137 |
| | | | | 6-17-95 0.125 | | | 6-16-94 0.142 |
| | | | | 7-13-95 0.127 | | | 6-17-95 0.129 |
| | | | | 6-27-96 0.128 | | | 7-31-95 0.140 |
| | | | | 6-28-96 0.160 | | | 7-12-97 0.138 |
| | | | | 7-30-99 0.161 | | | 7-15-98 0.129 |
| | | | | 6-9-00 0.130 | | | 8-21-98 0.126 |
| | | | | 8-1-01 0.125 | | | 6-12-99 0.147 |
| | | | | | | | 6-27-01 0.127 |
| | | | | | | | 6-24-03 0.135 |
| | | | | | | | 6-25-03 0.131 |
| | | | | | | | 7-3-03 0.131 |

| 26-125-0001 OAK PARK | 26-049-2001 OTISVILLE | 26-147-0005 PORT HURON, (New) | 26-043-0901 QUINNESSEC #1 | 26-043-0902 QUINNESSEC #2 | 26-161-1001 SALINE | 26-153-0001 SENEY | 26-091-0007 TECUMSEH | 26-055-0903 TRAVERSE CITY |
|---|---|---|---|---|---|---|---|---|
| Date Conc | Date Conc | Date Conc | -Date Conc | Date Conc | Monitoring for $O_3$ ended in 1993 | Date Conc | Date Conc | Date Conc |
| 8-3-94 0.127 | 5-15-98 0.152 | 6-18-94 0.178 | Monitoring for $O_3$ ended in 1993 | Monitoring for $O_3$ ended in 1993 | | | Monitor started in 1993 | Monitor started in 1998 |
| 7-14-95 0.138 | 6-11-99 0.131 | 7-13-95 0.126 | | | | | | |
| 7-15-95 0.125 | | 5-22-96 0.184 | | | | | | |
| | | 5-19-98 0.128 | | | | | | |
| | | 6-29-01 0.126 | | | | | | |
| | | 6-25-02 0.140 | | | | | | |
| | | 6-24-03 0.132 | | | | | | |
| | | 6-25-03 0.143 | | | | | | |

| 26-157-8001 UNIONVILLE, TUSCOLA CO (EPA) | 26-099-1003 WARREN | 26-103-0930 WITCH LAKE | 26-161-0008 YPSILANTI |
|---|---|---|---|
| Date Conc | Date Conc | Date Conc | Date Conc |
| Monitoring for $O_3$ ended in 1992 | 6-16-94 0.145 | Only in service during 1993. SPM for LMOS Industrial study | In 2000, Monitor relocated from former Ann Arbor site (26-161-0007) |
| | 7-6-96 0.125 | | |
| | 6-25-03 0.125 | | |

# Appendix E: AQD Acronyms and Definitions

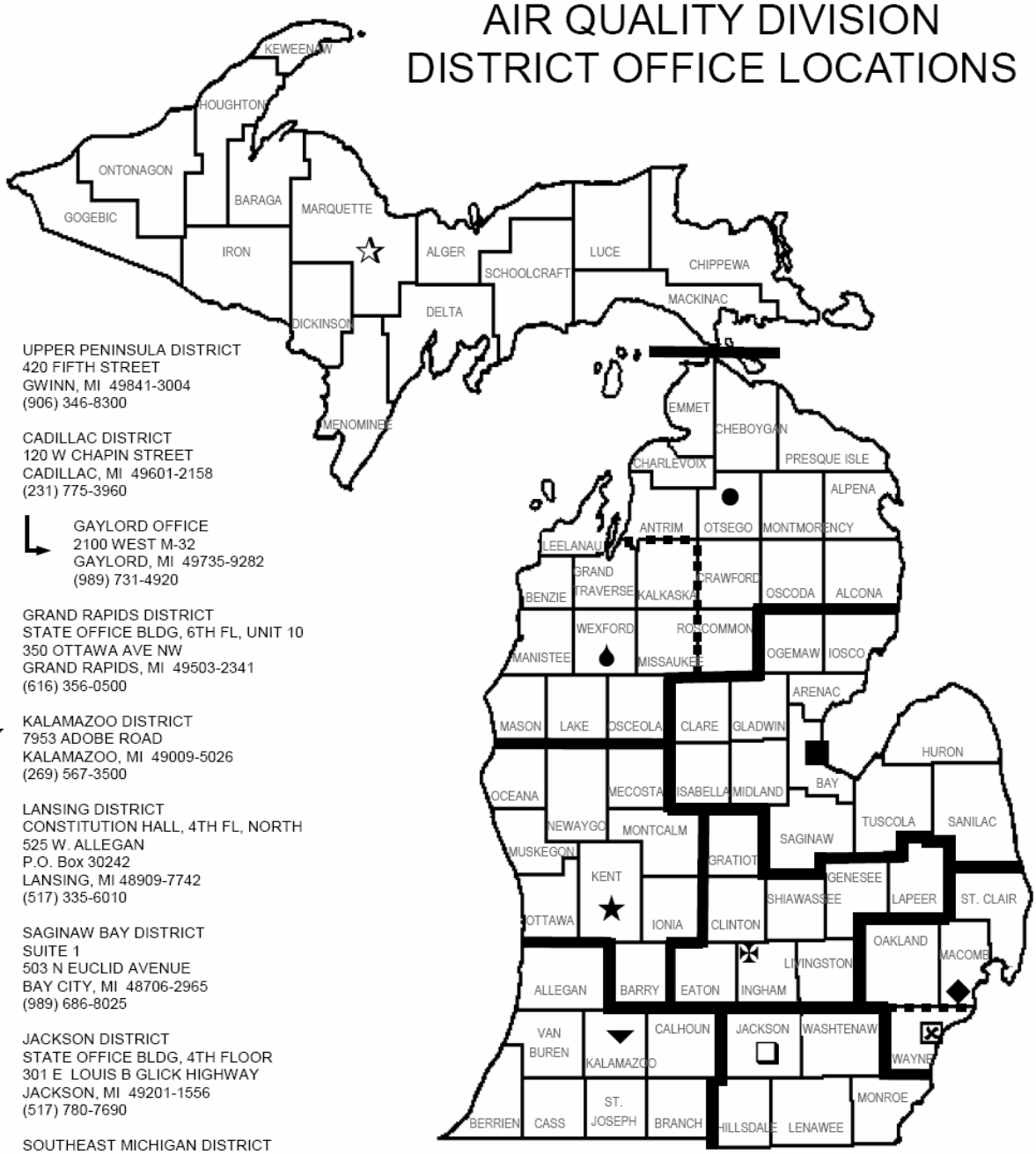
| AQD ACRONYM | DEFINITION |
|---|---|
| < | less than |
| > | greater than |
| ≥ | greater than or equal to |
| º | degree |
| % | percent |
| AIRS | Aerometric Information Retrieval System |
| AMU | Air Monitoring Unit (AQD) |
| AQA | Air Quality Analysis |
| AQCR | Air Quality Control Region |
| AQD | Air Quality Division |
| AQES | Air Quality Evaluation Section |
| AQI | Air Quality Index |
| AQS | Air Quality Subsystem |
| Btu | British thermal units |
| C | Celsius |
| CAA | Clean Air Act |
| CFR | Code of Federal Regulations |
| CMSA | Consolidated Metropolitan Statistical Area |
| CO | carbon monoxide |
| CSA | Combined Statistical Area |
| DATI | Detroit Air Toxics Initiative |
| DDE | a DDT degradation product |
| DDT | dichlorodiphenyltrichloroethane |
| EGBE | ethylene glycol monobutyl ether |
| EMSL | Environmental Monitoring and Support Laboratory |
| EPA | United States Environmental Protection Agency |
| FR | Federal Register |
| FRM | Federal Reference Method |
| g | grams |
| GLPF | Great Lakes Protection Fund |
| HAP | Hazardous Air Pollutant |
| IADN | Integrated Atmospheric Deposition Network |
| IMPROVE | Interagency Monitoring of Protected Visual Environments |
| LADCO | Lake Michigan Air Director's Consortium |
| LMOS | Lake Michigan Ozone Study |
| MACT | Maximum Achievable Control Technology |
| MASN | Michigan Air Sampling Network |
| MDEQ | Michigan Department of Environmental Quality |
| MDNR | Michigan Department of Natural Resources |
| MESB | Michigan Environmental Science Board |
| $mg/m^3$ | milligrams per cubic meter |
| MI | Michigan |
| MiSA | Micropolitan Statistical Area |
| MITAMP | Michigan Toxics Air Monitoring Program |
| MSA | Metropolitan Statistical Area |
| NAAQS | National Ambient Air Quality Standards |

| AQD ACRONYM | DEFINITION |
|---|---|
| NADP | National Atmospheric Deposition Program |
| NAMS | National Air Monitoring Stations |
| NASA | National Aeronautics and Space Administration |
| NATA | National Air Toxics Assessment |
| NATIS | National Air Toxics Trend Site |
| $NO_2$ | nitrogen dioxide |
| $NO_X$ | oxides of nitrogen |
| NSR | New Source Review |
| NWS | National Weather Service |
| $O_3$ | ozone |
| OAQPS | Office of Air Quality Planning and Standards (EPA) |
| OAR | Office of Air and Radiation (EPA) |
| OBS | Observations |
| OMB | U.S. Office of Management and Budget |
| ORD | Office of Research and Development (EPA) |
| OTAG | Ozone Transport Assessment Group |
| PAHs | polycyclic aromatic hydrocarbons |
| PAMS | Photochemical Assessment Monitoring Station |
| Pb | lead |
| PBT | Persistent, Bioaccumulative Toxics |
| PCB | polychlorinated biphenyls |
| PM | Particulate Matter |
| $PM_{10}$ | PM with an aerodynamic diameter $\geq$ 10 microns in diameter |
| $PM_{2.5}$ | PM with an aerodynamic diameter $\geq$ 2.5 microns in diameter |
| PNAs | polynuclear aromatic hydrocarbons |
| ppb | parts per billion |
| ppm | parts per million |
| RTP | Research Triangle Park |
| SASS | Spiral aerosol speciation sampler |
| SEMCOG | Southeast Michigan Council of Governments |
| SIP | State Implementation Plan |
| SLAMS | State and Local Air Monitoring Stations |
| $SO_2$ | sulfur dioxide |
| SPM | Special Purpose Monitoring |
| SPOTS | Spatially Plotted Ozone Tracking System |
| STN | Speciation Trends Network |
| SVOC | Semi-volatile compounds |
| TACs | Toxic Air Contaminants |
| TEOM | Tapered Element Oscillating Microbalance |
| TOMS | Total Ozone Mapping Spectrometer (NASA) |
| TSP | Total Suspended Particulates |
| $\mu$g/dl | micrograms per deciliter |
| $\mu g/m^3$ | micrograms per cubic meter |
| $\mu$m | micrometers |
| U.S. | United States |
| VOC | Volatile Organic Compounds |
| VMT | vehicle miles traveled |
| WEBMONMAP | Web Monitoring and Mapping |

# Appendix F: AQD District Office Locations

MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY
AIR QUALITY DIVISION

## AIR QUALITY DIVISION DISTRICT OFFICE LOCATIONS




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

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

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

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

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

LANSING DISTRICT
CONSTITUTION HALL, 4TH FL, NORTH
525 W. ALLEGAN
P.O. Box 30242
LANSING, MI 48909-7742
(517) 335-6010

SAGINAW BAY DISTRICT
SUITE 1
503 N EUCLID AVENUE
BAY CITY, MI 48706-2965
(989) 686-8025

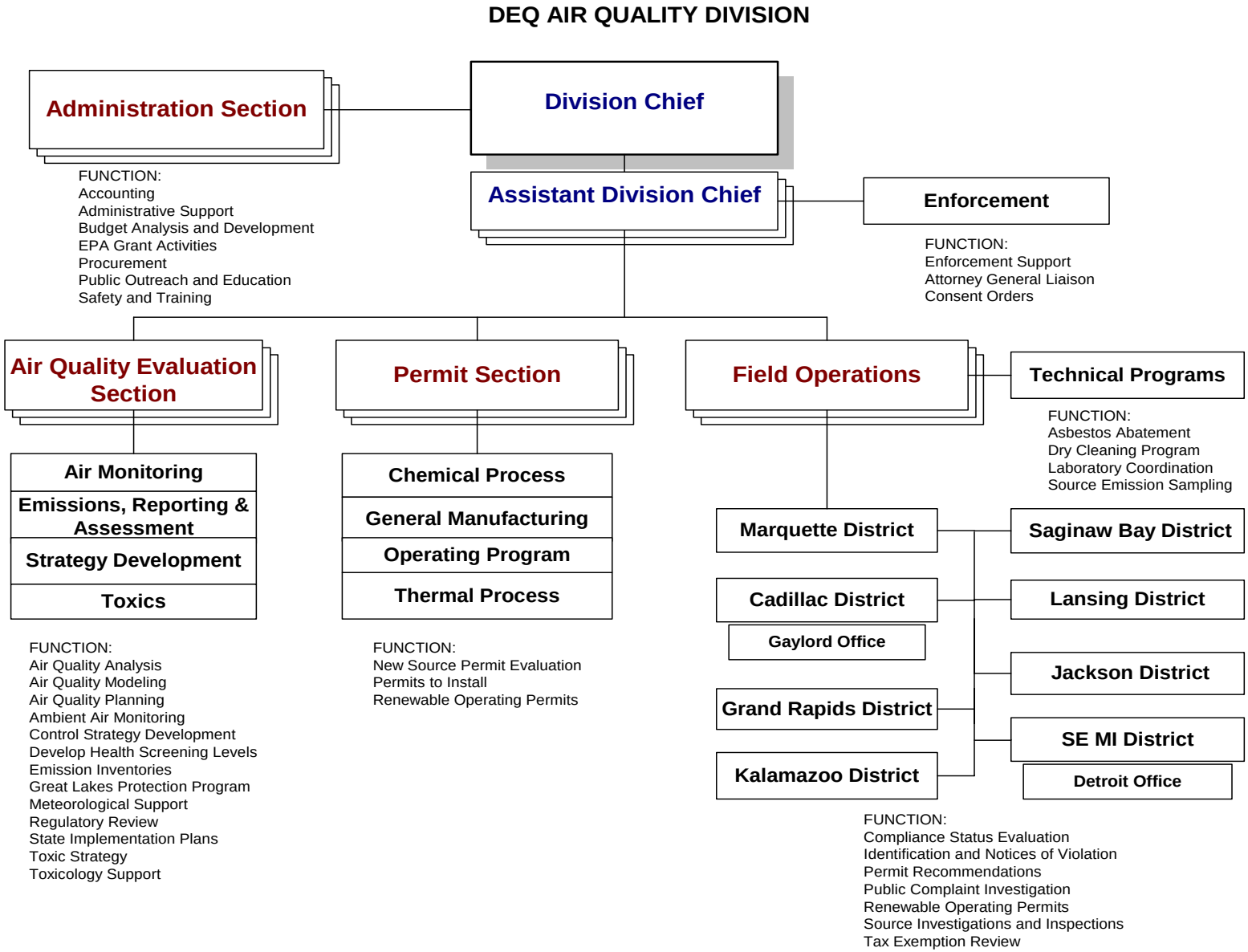
JACKSON DISTRICT
STATE OFFICE BLDG, 4TH FLOOR
301 E LOUIS B GLICK HIGHWAY
JACKSON, MI 49201-1556
(517) 780-7690

SOUTHEAST MICHIGAN DISTRICT
27700 DONALD COURT
WARREN, MI 48092-2793
(586) 753-3700

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

**AIR QUALITY INTERNET ADDRESS:**

**www.michigan.gov/deqair**

10-12-05

# Appendix G: AQD Organizational Chart