Michigan 2010 Air Quality Report

DEQ

Michigan Department of Environmental Quality

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Cover Photo: Luna Pier Air Monitoring Site 

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2010 Air Quality Report

Introduction

The federal Clean Air Act (CAA) requires the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) for six criteria pollutants considered harmful to the public and the environment. These standards define the maximum permissible concentration of criteria pollutants in the air (see **Table 1.1**).

The six criteria pollutants are monitored by the Department of Environmental Quality (DEQ), Air Quality Division (AQD). These criteria pollutants are:

- Carbon monoxide (CO),
- Lead (Pb),
- Nitrogen dioxide (NO_2),
- Ozone (O_3),
- Particulate matter smaller than 10 and 2.5 microns in diameter (PM_{10} and $PM_{2.5}$, respectively), and
- Sulfur dioxide (SO_2).

Chapters 2 through **7** provide information on each of the six criteria pollutants and include:

- Michigan's monitoring requirements for 2010,
- Attainment/nonattainment status,
- Monitoring site locations (tables show all the monitors active in 2010), and
- Air quality trends from 2005-2010 broken down by location.[1]

The actual 2010 data for each criteria pollutant is available in **Appendix A.**

The AQD also monitors air toxics. "Air toxics" are other hazardous air pollutants that can affect human health and the environment.[2] This data can be found in **Appendix B.**

The purpose of this report is to provide a snapshot of Michigan's 2010 air quality data, air quality trends, overview of the monitoring network (available in much greater detail in the 2010 Network Review)[3], air toxics monitoring program, and other AQD programs, such as MIAir and Emissions Inventory[4].

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[1] The air quality trends are based on actual statewide monitored readings, which are also listed in EPA's Air Quality Subsystem Quick Look Report Data.
[2] A fact sheet entitled What is an Air Contaminant/Pollutant? is available on the DEQ's website at http://www.deq.state.mi.us/documents/deq-ead-caap-airconfs.pdf.
[3] Available on online at http://www.michigan.gov/deq/0,1607,7-135-3310_4195-230649--,00.html
[4] Online 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 "Air Monitoring" and then "Publications".

Chapter 1: Background Information

This chapter provides a summary of the development of the NAAQS and how compliance with these standards is determined. Also included is an overview of Michigan's air sampling network, a description of the metropolitan statistical areas (MSAs) and their use, and the variety of monitoring techniques and requirements used to ensure quality data is obtained.

NAAQS

Under Section 109 of the CAA, the EPA establishes a primary and secondary NAAQS for each pollutant for which air quality criteria have been issued. 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. Factors in selecting the margin of safety for the primary standard include the nature and severity of the health effects involved and the size of the sensitive population at risk. Secondary standards are chosen to protect public welfare (personal comfort and well-being) and the environment by limiting economic damage, visibility and climatic factors, as well as the harmful effects on soil, water, crops, vegetation, wildlife, and buildings.

In addition, the NAAQS have various averaging times to address health impacts. Short averaging times reflect the potential for acute (immediate) effects, whereas long-term averaging times are designed to protect against chronic effects.

NAAQS have been established for CO, Pb, SO_2, NO_2, O_3, and PM. **Table 1.1** lists the primary and secondary NAAQS, averaging time, and concentration level for each criteria pollutant in effect in 2010. The concentrations are listed as parts per million (ppm), micrograms per cubic meter (µg/m^3), and/or milligrams per cubic meter (mg/m^3).

Table 1.1: NAAQS in Effect during 2010 for Criteria Pollutants

Pollutant	Primary (health-related)		Secondary (welfare-related)	
	Level	Averaging Time	Level	Averaging Time
Carbon Monoxide (CO)	9 ppm (10 mg/m^3)	2^{nd} highest 8-hour	None	
	35 ppm (40 mg/m^3)	2^{nd} highest 1-hour		
Lead (Pb)	0.15 µg/m^3	Maximum 3-month average	Same as Primary	
Nitrogen Dioxide (NO_2)	0.053 ppm (100 µg/m^3)	Annual arithmetic mean	Same as Primary	
	0.100 ppm	98^{th} percentile 1-hr averaged over 3-years		
Particulate Matter (PM_{10})	150 µg/m^3	24-hour	Same as Primary	
Particulate Matter ($PM_{2.5}$)	15.0 µg/m^3	Annual arithmetic mean	Same as Primary	
	35 µg/m^3	98^{th} percentile 24-hour averaged over 3 years	Same as Primary	
Ozone (O_3)	0.075 ppm	4^{th} highest 8-hour daily max. averaged over 3 years	Same as Primary	
Sulfur Dioxide (SO_2)	0.03 ppm (80 µg/m^3)	Annual arithmetic mean	0.5 ppm	3-hour
	0.14 ppm (365 µg/m^3)	24-hour		
	0.075 ppm	99^{th} percentile 1-hour averaged over 3 years		

To demonstrate compliance with the NAAQS, the EPA has defined specific criteria for each pollutant, which are summarized in **Table 1.2.**

Table 1.2: Criteria for the Determination of Compliance with the NAAQS

POLLUTANT	CRITERIA FOR COMPLIANCE
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.
Pb	Compliance with the Pb standard is met when daily values collected for 3 consecutive months are averaged and do not exceed the 0.15 μg/m^3 standard.
NO_2	Compliance is met when the annual arithmetic mean concentration does not exceed the 0.053 ppm standard and the 98th percentile averaged over 3-years of the 1 hour concentration does not exceed 100 ppb.
O_3	The 8-hour O_3 primary and secondary standards are met when the 3-year average of the 4th highest daily maximum 8-hr average concentration is less than or equal to 0.075 ppm.
PM	**PM_{10}:** The 24-hour PM_{10} primary and secondary standards are met when the expected number of days per calendar year above 150 μg/m^3 is equal or less than one.
	$PM_{2.5}$: The $PM_{2.5}$ annual and secondary standards are met when the annual arithmetic mean concentration is less than or equal to 15 μg/m^3. The 24-hour $PM_{2.5}$ primary and secondary standards are met when the 3-year average of the 98$_{th}$ percentile 24-hour concentration is less than or equal to 35 μg/m^3.
SO_2	To determine compliance, the annual average concentration shall not exceed 0.03 ppm, the 24hour average concentration shall not exceed 0.14 ppm more than once per calendar year, the 99th percentile of the 1-hour concentration averaged over a three year period does not exceed 0.075 ppm, and the 3-hour average concentration shall not exceed 0.5 ppm more than once per calendar year.

As part of the EPA's grant to the DEQ, the AQD provides an annual review of monitoring data collected from the previous year and recommends any network changes. These recommendations are based on each monitor's exceedance history, changes in population distribution, and modifications to federal monitoring under the CAA. Under the newly amended air monitoring regulations that began in 2007, states are required to solicit public comment on their future air monitoring network design prior to submitting the annual review to the EPA.

Michigan Air Sampling Network

The Michigan Air Sampling Network (MASN) is operated by the DEQ's AQD, along with other governmental agencies. For instance, the O_3 and $PM_{2.5}$ monitors in Manistee County are handled by the Little River Band of Ottawa Indians. **Figure 1.1** shows the 2010 MASN monitoring sites. **Figures 1.2** and **1.3** are pictures of two monitoring stations in Muskegon and Belding, respectively.

Figure 1.1: 2010 MASN Monitoring Sites

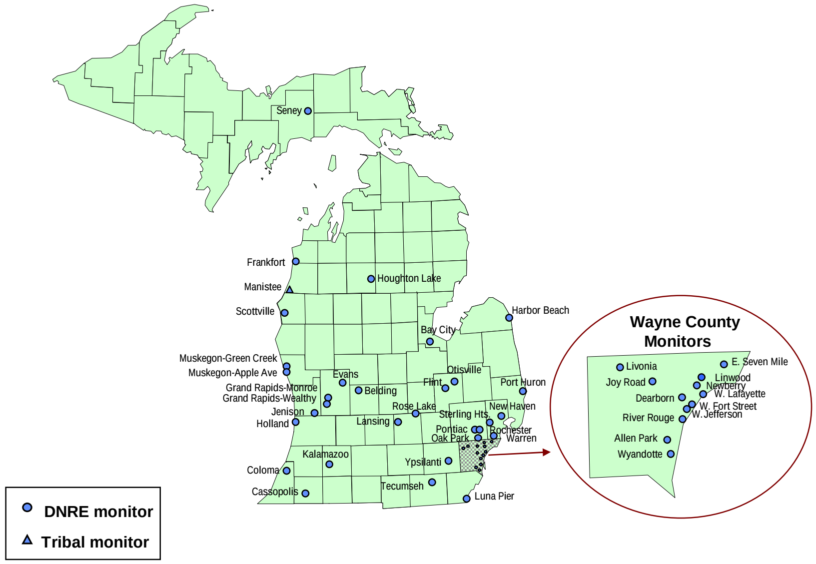
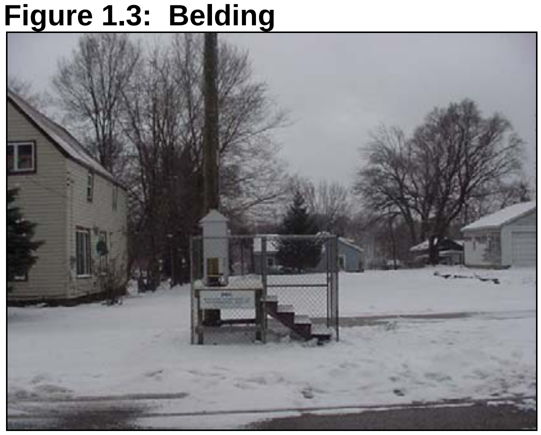


Figure 1.2: Muskegon

Figure 1.3: Belding



The MASN consists of federal reference method (FRM) monitors that enable continuous monitoring for the gaseous pollutants (O_3, CO, NO_2, and SO_2), PM monitors that measure particulate concentrations over a 24-hour period, and high volume samplers for Pb. In addition, continuous $PM_{2.5}$ and PM_{10} monitors are used to provide real-time hourly data, and $PM_{2.5}$ chemical speciation monitors determine the chemical composition of $PM_{2.5}$ and help characterize background levels. The MASN data is also used to provide timely reporting to the DEQ's air quality reporting web page (discussed in **Chapter 9**). The types of monitoring conducted in 2010 and the MASN locations are shown in **Table 1.3.**

Table 1.3 Types of Monitoring Conducted in 2010 and MASN Location

Area	AIRS ID	Site Name	Trace CO	NO_2	Trace NO_y	O_3	PM_{10}	$PM_{2.5}$	$PM_{2.5}$ TEOM	$PM_{2.5}$ Speciation	SO_2	Trace SO_2	VOC	Carbonyls	Trace Metals	Wind Speed & Direction, Temp.	Relative Humidity	Solar Radiation	Barometric Pressure
Detroit-Ann Arbor	260910007	Tecumseh				√		√		√						√			√
	260990009	New Haven				√		√								√	√	√	
	260991003	Warren				√													
	261250001	Oak Park				√		√								√			
	261470005	Port Huron				√		√	√	√						√			
	261610008	Ypsilanti				√		√	√							√			√
	261630001	Allen Park	√		√	√	√	√	√	√		√			√@	√	√		√
	261630005	River Rouge												√	√@	√			
	261630015	Detroit- W Fort S					√	√		√	√		√	√	√@	√	√		√
	261630016	Detroit- Linwood						√											
	261630019	Detroit- E Seven Mile		√		√		√								√	√		√
	261630025	Livonia						√								√	√		√
	261630027	Detroit-W Jefferson													√@				
	261630033	Dearborn					√	√	√	√			√	√	√ + Pb	√	√		√
	261630036	Wyandotte						√											
	261630038	Detroit- Newberry						√	√							√			
	261630039	Detroit W. Lafayette						√	√							√			
Flint	260490021	Flint				√		√	√						√#	√			√
	260492001	Otisville				√										√			
Grand Rapids	261390005	Jenison				√		√								√			
	260810007	Grand Rapids - Wealthy					√	√											
	260810020	Grand Rapids - Monroe	√		√	√	√	√	√	√		√			√@	√			√
	260810022	Evans				√										√			
Lansing/East Lansing	260650012	Lansing				√		√	√							√			√
	260370001	Rose Lake				√													
Monroe Co	261150005	Luna Pier						√		√									
Huron Co	260630007	Harbor Beach				√										√			
Bay Co	260170014	Bay City						√	√							√			
MissaukeeCo	261130001	Houghton Lake				√	√	√	√	√						√			√
Allegan Co	260050003	Holland				√		√								√	√	√	√
Benzie Co	260190003	Frankfort				√													
Berrien Co	260210014	Coloma				√		√								√			
Cass Co	260270003	Cassopolis				√										√			
Kalamazoo Co	260770008	Kalamazoo				√		√	√										
Manistee Co	261010922	Manistee +				√		√								√		√	√
Mason Co	261050007	Scottville				√										√			
Muskegon Co	261210038	Muskegon - Green				√										√			
Muskegon Co	261210040	Muskegon - Apple Ave						√											
Ionia Co	260670002	Belding -Reed St														√			√
Ionia Co	260670003	Belding - Merrick St													Pb				
Schoolcraft Co	261530001	Seney Nat'l Wildlife				√			√							√	√	√	√

√ = Data Collected
\# = Mn Only
@ = Mn, As, Cd, Ni
\+ = Operated by the Little River Band of ottawa Indians

In 2006, the EPA amended its air monitoring requirements to include more collocated monitors. The amended air monitoring requirements also added National Core (NCore) sites that are multi-pollutant in nature, and are enhancing the understanding of how the various forms of air pollution are related and how it is transported. Michigan has two NCore sites, Allen Park and Grand Rapids – Monroe Street. Information on the effects of the 2006 amended monitoring requirements is discussed by criteria pollutant in **Chapters 2 through 7**.

Quality Assurance

The Air Monitoring Unit (AMU) ensures that all of the data collected and reported is of high quality and meets the federal requirements. The AMU has a quality system in place that includes a Quality Assurance Project Plan (QAPP), standard operating procedures, standardized forms and documentation policies, and a robust audit and assessment program.

The monitoring network adheres to the requirements in Title 40 Code of Federal Regulations Parts 50, 53, and 58. This ensures that the monitors are correctly sited, operated in accordance to the federal reference methods, and adhere to the quality assurance requirements.

Quality assurance checks are conducted by the site operators at the frequencies required in the regulations and unit procedures. Independent audits are conducted by the AMU's Quality Assurance (QA) Team, which has a separate reporting line of supervision. The quality assurance checks and audits are reported to the EPA each quarter.

External audits are conducted annually by the EPA. The EPA conducts Performance Evaluation Program (PEP) audits for $PM_{2.5}$ samplers and the National Performance Audit Program (NPAP) for the gaseous monitors. The EPA also conducts program-wide Technical Systems Audits every three to five years to evaluate overall program operations, and assess adequacy of documentation and records retention. External audits are also conducted on the laboratory operations for certain analytical techniques using performance evaluation samples.

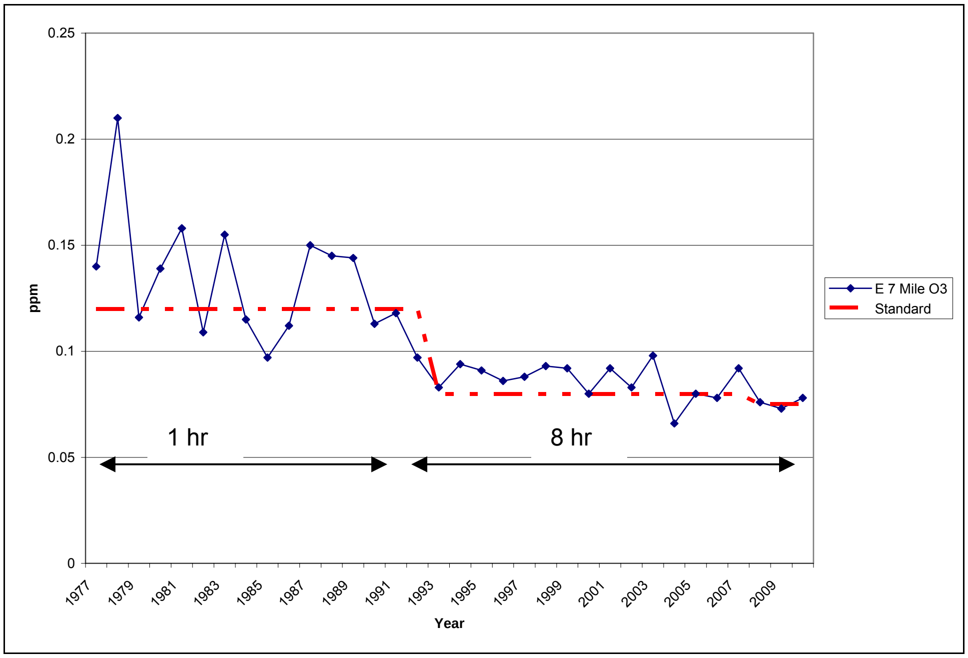
Trends

Congress passed the Clean Air Act in 1970; however, Michigan had a long history of environmental awareness before the Act was established. In 1887 Detroit recorded its first Air Quality Ordinance. It declared that the dense smoke from coal burning was a public nuisance. The following figures show how the air quality has improved in the Detroit Area since the 1970s, when the Clean Air Act was enacted.

The EPA is required to review the criteria pollutant standards every 5 years. As a result, the standards can be lowered based on toxicological data. That is why the State can switch from attainment status to nonattainment status while the overall air quality continues to improve.

The following figures show how the levels of certain pollutants have changed over time and how the standards for those pollutants have changed. Figure 1.4 shows the ozone levels at the Detroit East Seven Mile site. This graph shows how the standard was changed from a one hour average of .120 ppm to a 8-hour average of .08 ppm, in 1997. The standard was again lower to 0.075 ppm in 2008. The graph also shows how the ozone levels have decreased over the years. Because the standard was lowered faster than the ozone levels were decreasing in the southeast Michigan area, the attainment status changed from attainment to nonattainment.

Figure 1.4: Historical Ozone at Detroit East Seven Mile Site



The SO_2 and CO trends are shown in Figures 1.5 and 1.6, respectively. In 2010, the EPA lowered the SO_2 standard and the area is currently in nonattainment. To read more about this, please see Chapter 4. Even though the area has previously been in attainment, the levels of SO_2 and CO have significantly decreased over the years.

Figure 1.5: Historical SO_2 at Detroit – W. Fort Street (SWHS)

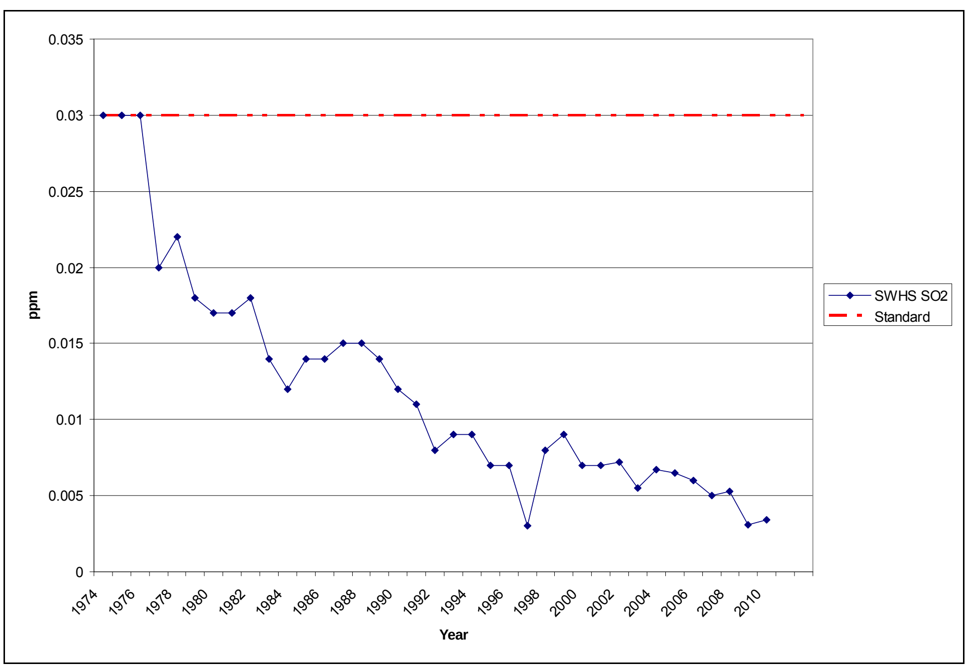
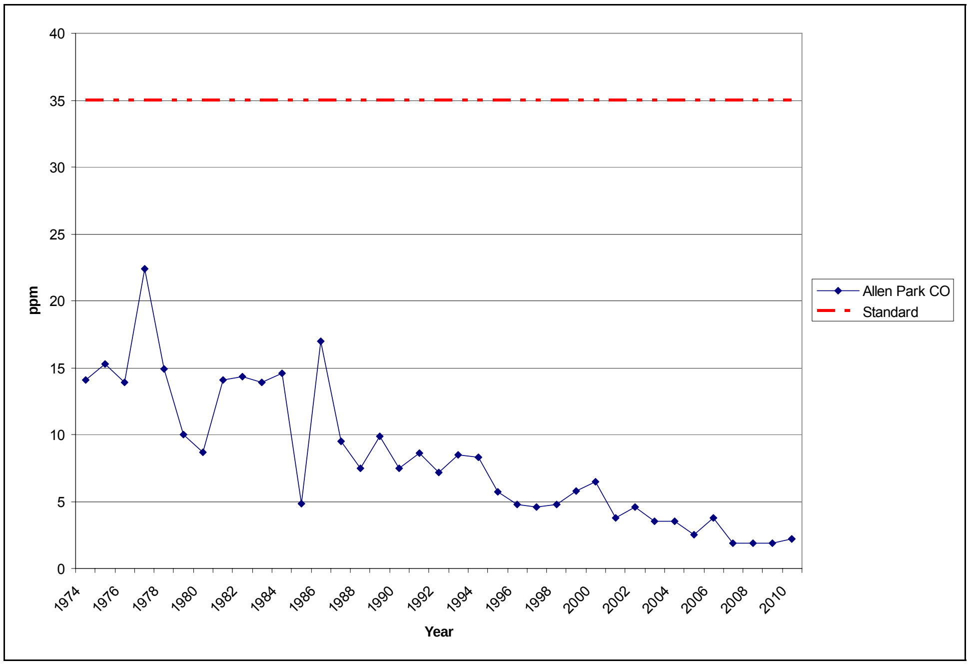
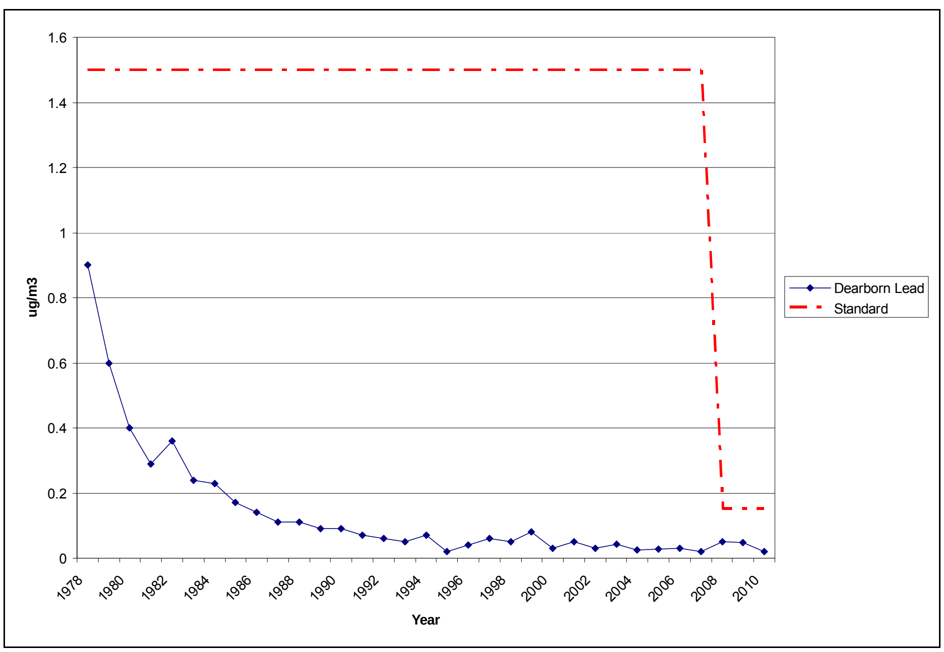


Figure 1.6: Historical CO at Allen Park



The historical lead trend is shown in Figure 1.7. Lead is of interest because it can be harmful to the neurological development of children. This largest decrease in lead in the air is due to the removal of lead in gasoline. In 1975 most newly manufactured vehicles no longer required leaded gasoline and in 1996, the EPA banned the sale of leaded fuel for use in onroad vehicles. As a result there was a dramatic decrease in ambient lead levels. The graph also shows the decrease in the lead standard that occurred in 2008.

Figure 1.7: Historical Lead at Dearborn



Chapter 2: Carbon Monoxide (CO)

Carbon monoxide is a colorless, odorless and poisonous gas formed during incomplete burning of fuel. Levels peak during colder months primarily due to cold temperatures that affect combustion efficiencies of engines. It has a standard of 9 ppm for the 2nd highest 8-hour average and 35 ppm for the 2nd highest 1-hour average. Its sources and effects are as follows:

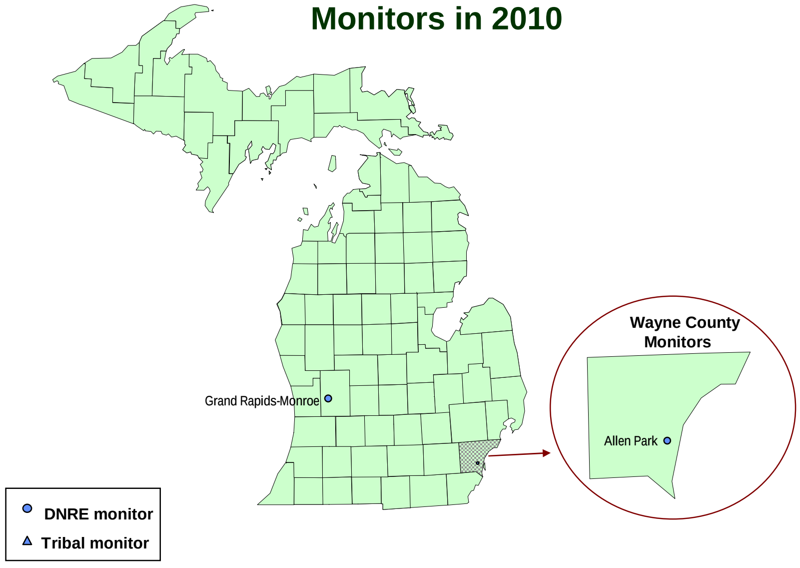
Sources: Outdoor exposure sources are automobile exhaust, industrial processes (metal processing and chemical production), non-vehicle fuel combustion, and natural sources, such as forest fires. Indoor exposure sources are wood stoves, gas ranges with continuous pilot flame ignition, unvented gas or kerosene heaters, and cigarette smoke.

Effects: CO enters the bloodstream through the lungs, where it displaces oxygen delivered to the organs and tissues. Elevated levels can cause visual impairment, interfere with mental acuity by reducing learning ability and manual dexterity, and can decrease work performance in the completion of complex tasks. CO alters atmospheric photochemistry that contributes to the formation of ground-level O_3, which can trigger serious respiratory problems.

Population most at risk: Those who suffer from cardiovascular (heart and respiratory) disease are most at risk for exposure to elevated levels of CO. People with angina and peripheral vascular disease are especially at risk as their circulatory systems are already compromised and less efficient at carrying oxygen. However, elevated CO levels can also affect healthy people.

Figure 2.1 show the two locations in Grand Rapids and Allen Park where trace CO is being monitored for the NCore Network

Figure 2.1: Trace Carbon Monoxide (CO) Monitors in 2010



Figures 2.2 and **2.3** show CO emission sources and CO emissions by county (courtesy of EPA's State and County Emission Summaries).

Figure 2.2

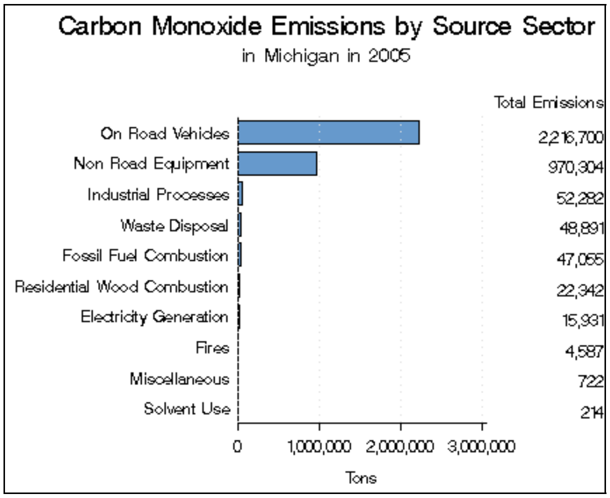


Figure 2.3

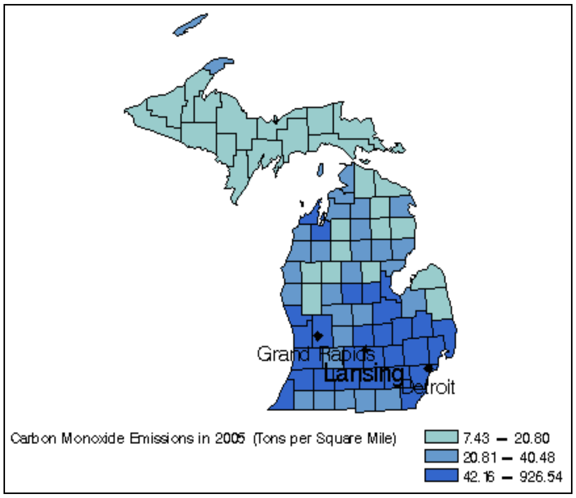
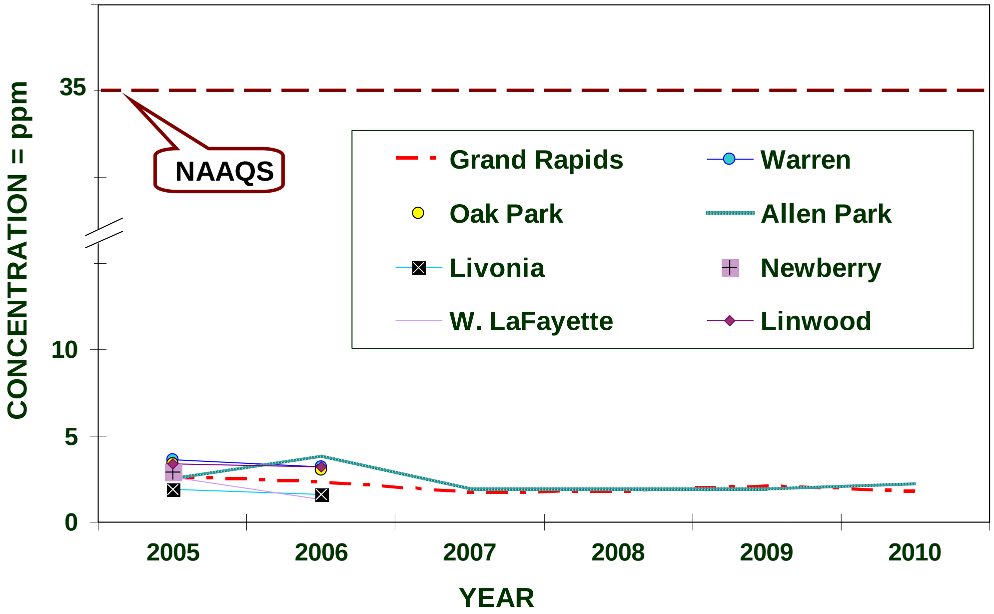


Figure 2.4 provides the maximum second highest 1-hour CO level trends for Michigan from 2005-2010, which demonstrates that there have not been any exceedances of the 1-hour CO NAAQS.

Figure 2.4: CO Levels in MI from 2005-2010
(2nd Highest 1-Hr Maximum Values)



Chapter 3: Lead (Pb)

Lead is a highly toxic metal found in coal, oil, and other fuels. It is also found in municipal solid waste and sewage sludge incineration and may be released to the atmosphere during their combustion. Its sources and effects are as follows:

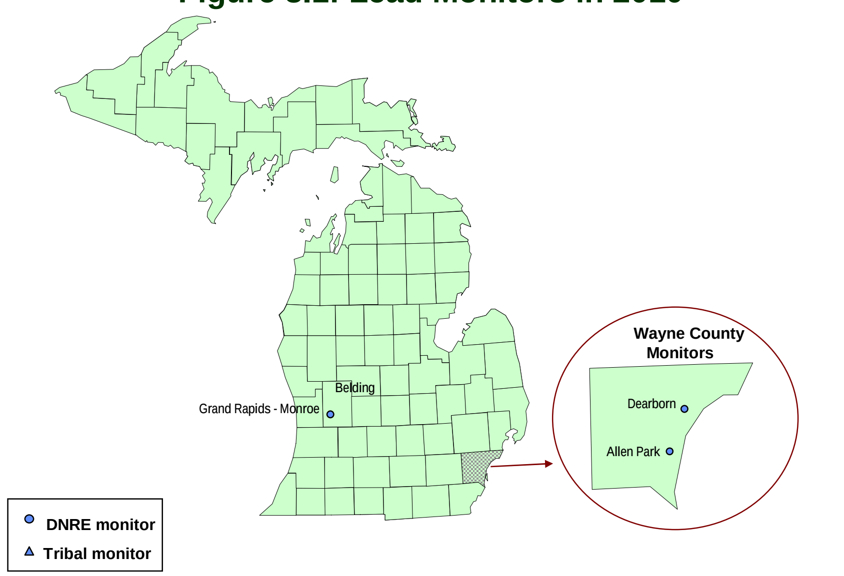
Sources: With the phase-out of leaded gas in the 1970s, the major sources of Pb emissions are industrial and combustion sources. The highest air concentrations of Pb are found near smelters and battery manufacturers (Pb acid batteries, Pb oxide/ pigments). Other industrial sources include Pb glass, Portland cement, and solder production.

Effects: Exposure occurs through the inhalation or ingestion of Pb in food, water, soil, or dust particles. Pb primarily accumulates in the body's blood, bones, and soft tissues, and adversely affects the kidneys, liver, nervous system, and other organs.

Population most at risk: Fetuses and children are most at risk as low levels of Pb may cause central nervous system damage. Excessive Pb exposure during the early years of life is associated with lower IQ scores and neurological impairment (seizures, mental retardation, and behavioral disorders). Even at low doses, Pb exposure is associated with changes in fundamental enzymatic, metabolic, and homeostatic mechanisms in the body, and Pb may be a factor in high blood pressure and subsequent heart disease.

Figure 3.1 shows the location of the Pb monitors in the MASN.

Figure 3.1: Lead Monitors in 2010



Figures 3.2 and **3.3** show Pb emission sources and Pb emissions by county (courtesy of EPA's State and County Emission Summaries).

Figure 3.2

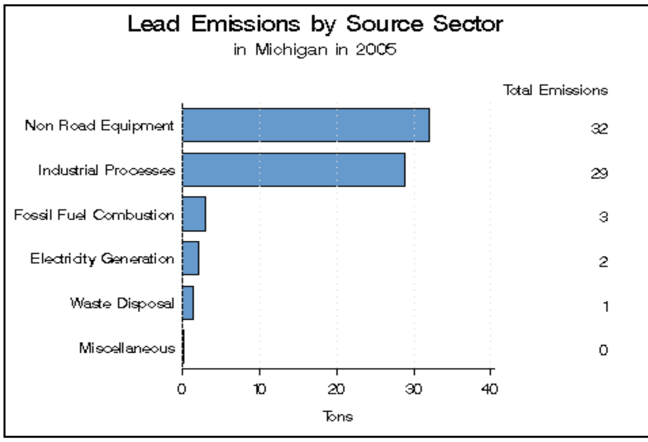
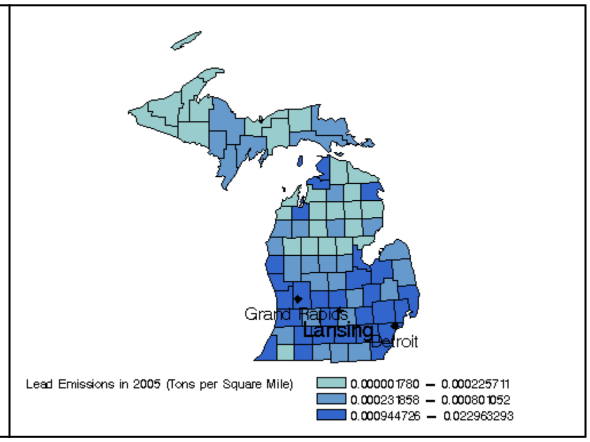
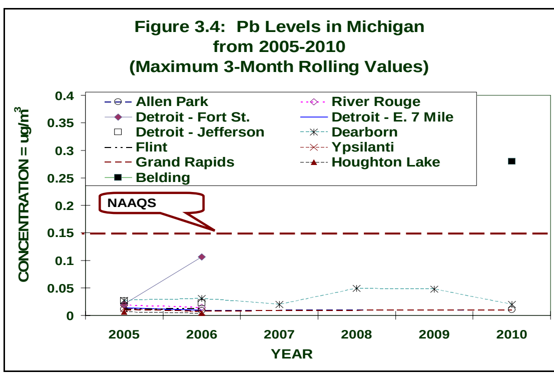


Figure 3.3



On November 12, 2008, the EPA modified the Pb NAAQS by reducing the level of the standard from a maximum quarterly average of 1.5 µg/m^3 to a 3-month rolling average of 0.15 µg/m^3. The monitoring network design has been modified to consist of source-oriented monitors as well as population-oriented monitors. For details of the new Pb network that was begun in 2010, see Michigan's 2010 Annual Ambient Air Monitoring Network Review.

As part of the new standard, the DEQ was required to monitor near stationary lead sources emitting more than 1 ton per year. One of these sources is located in Belding. Monitoring in Belding began in January of 2010. As a result of this effort, the DEQ recorded a violation of the new health standard in Belding in 2010, as shown in **Figure 3.4a.**



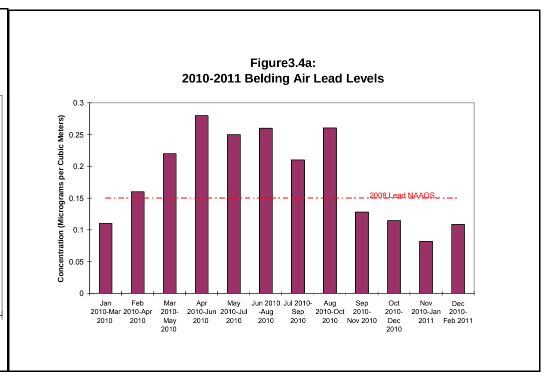


Figure 3.4 provides the maximum quarterly Pb level values for the years 2005 to 2009. Then starting in 2010, it is the maximum three-month rolling average.

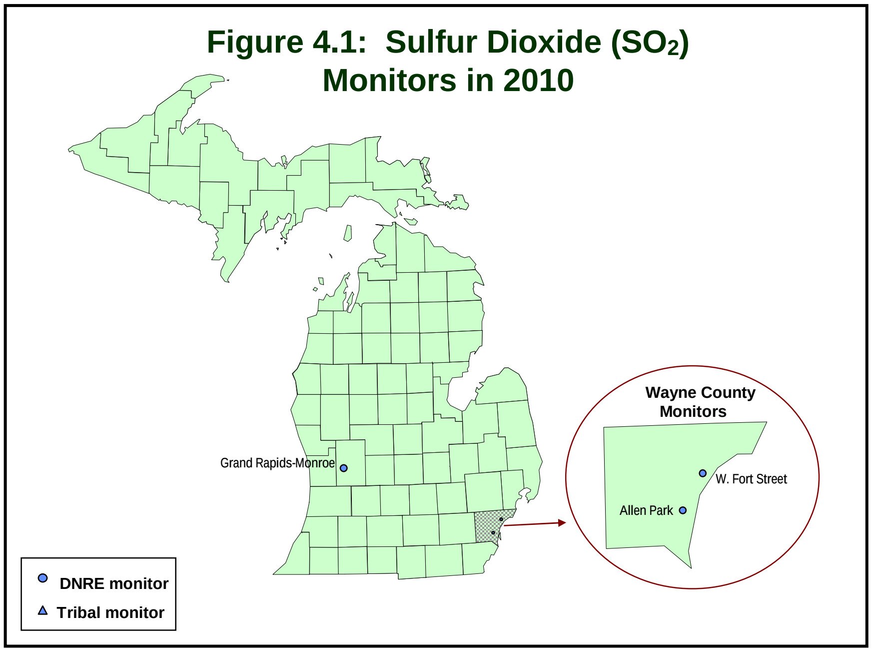
All other Pb sites in Michigan are well below the standard. The Dearborn site is part of the National Air Toxics Trend Sites (NATTS) program and monitors Pb and other trace metals, both as total suspended particulate (TSP) and PM_{10}. Pb measurements as $PM_{2.5}$ are made throughout the $PM_{2.5}$ speciation network.

Chapter 4: Sulfur Dioxide (SO_2)

Sulfur dioxide is a colorless gas formed by the burning of sulfur-containing material. Odorless at typical ambient concentrations, SO_2 can react with other atmospheric chemicals to form sulfuric acid. When sulfur-bearing fuel is burned, the sulfur is oxidized to form SO_2, which then reacts with other pollutants to form aerosols. In liquid form, it is found in clouds, fog, rain, aerosol particles, and in surface films on these particles. It is a major precursor to $PM_{2.5}$. The primary standard for SO_2 is an annual mean of 0.03 ppm,0.14 ppm for the 2^{nd} highest 24-hour average and 0.075 ppm for the 99^{th} percentile of 1 hour concentrations averaged for a three year period. The secondary standard is a 3-hour average of 0.5 ppm. Its sources and effects are as follows:

- **Sources:** Coal-burning power plants are the largest source of SO_2 emissions. SO_2 is also 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 and PM are often emitted together.
- **Effects:** Exposure to elevated levels aggravates existing cardiovascular and pulmonary disease. SO_2 and PM together may cause respiratory illness, alteration of the body's defense and clearance mechanisms, and aggravation of existing cardiovascular disease. SO_2 and NO_X together are the major precursors to acid rain, associated with the acidification of soils, lakes, and streams and accelerated corrosion of buildings and monuments.
- **Population most at risk:** Asthmatics, children, and the elderly are especially sensitive to SO_2 exposure. Asthmatics receiving short-term exposures during moderate exertion may experience reduced lung function and symptoms, such as wheezing, chest tightness, or shortness of breath. Depending on the concentration, SO_2 may also cause symptoms in people who do not have asthma.

Figure 4.1 shows the location of each SO_2 monitor.



Figures 4.2 and **4.3** show SO_2 emission sources and SO_2 emissions by county (courtesy of the EPA's State and County Emission Summaries).

Figure 4.2

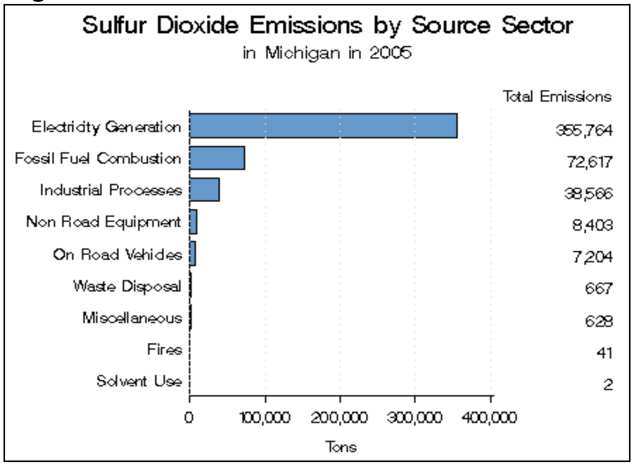
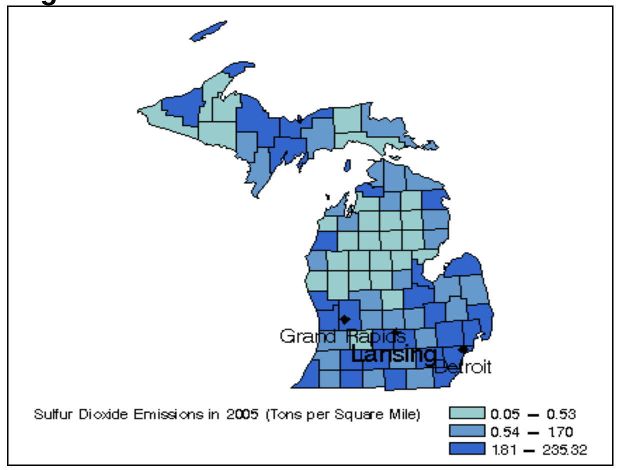
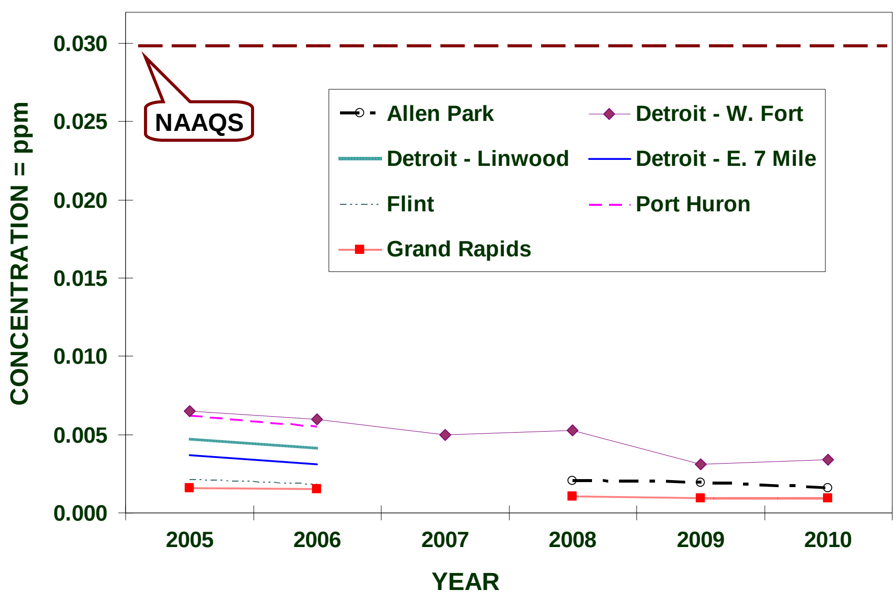


Figure 4.3



Michigan had been in attainment for SO_2 since 1982 with levels consistently well below the SO_2 NAAQS. The SO_2 monitor at W. Fort Street (Southwestern High School [SWHS]) in Detroit does not meet the new 1-hour NAAQS. The monitor at SWHS has been active for more than 32 years. For the NCore network, trace SO_2 is monitored at the Grand Rapids and Allen Park NCore sites. For trend purposes, W. Fort Street is also added with Allen Park and Grand Rapids SO_2 monitors shown in **Figure 4.4.**

Figure 4.4: SO_2 Levels in Michigan from 2005-2010
(Annual Arithmetic Mean)



Chapter 5: Nitrogen Dioxide (NO_2)

Nitrogen Dioxide is a reddish-brown, highly reactive gas formed through oxidation of nitric oxide (NO). Upon dilution, it becomes yellow or invisible. High concentrations produce a pungent odor and lower levels have an odor similar to bleach. NO_X is the term used to describe the sum of NO, NO_2, and other nitrogen oxides. NO_X can lead to the formation of O_3 and NO_2, and can react with other substances in the atmosphere to form acidic products that are deposited in rain (acid rain), fog, snow, or as PM. The standard for NO_2 is an annual mean of 0.053 ppm. On January 22, 2010, the EPA added a 1-hour NO_2 standard. This standard is 100 ppb, taking the form of the 98th percentile averaged over three years. Its sources and effects are as follows:

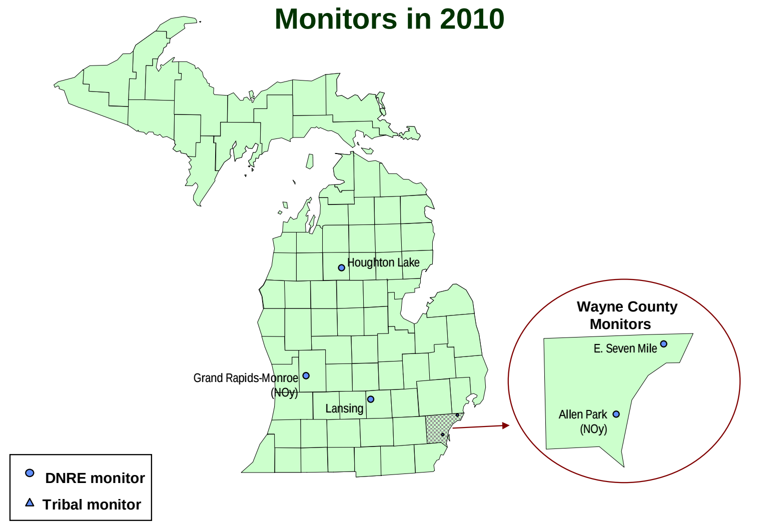
Sources: NO_X compounds and their transformation products occur both naturally and as a result of human activities. Natural sources of NO_X are lightning, biological and abiological processes in soil, and stratospheric intrusion. Ammonia and other nitrogen compounds produced naturally are important in the cycling of nitrogen through the ecosystem. The major sources of man-made (anthropogenic) NO_X emissions, which account for a large majority of all nitrogen inputs to the environment, come from high-temperature combustion processes (such as those occurring in automobiles and power plants). Home heaters and gas stoves produce substantial amounts of NO_2 in indoor settings.

Effects: Exposure to NO_2 occurs through the respiratory system, irritating the lungs. Short-term NO_2 exposures (i.e., less than 3 hours) can produce coughing and changes in airway responsiveness and pulmonary function. 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. Nitrate particles and NO_2 can block the transmission of light, thus causing visibility impairment. Deposition of nitrogen can lead to fertilization, eutrophication, or acidification of terrestrial, wetland, and aquatic systems.

Population most at risk: Individuals with pre-existing respiratory illnesses and asthmatics are more sensitive to the effects of NO_2 than the general population. Short-term NO_2 exposure can increase respiratory illnesses in children.

Figure 5.1 shows the location of each NO_2 monitor.

Figure 5.1: Nitrogen Dioxide (NO_2) / Trace NO_y Monitors in 2010



The E 7 Mile monitor in Detroit is a downwind urban scale site that measures NO_2. The Grand Rapids and Allen Park sites monitor trace NO_Y, which began in early January 2008 as part of the NCore program (however, only NO_2 monitors can be used for attainment/nonattainment purposes). In addition, in 2010, the AQD added NO_2 monitors at Lansing and Houghton Lake to provide background information for modeling applications.

New roadway monitoring regulations were also included in the January 22, 2010 rulemaking. As a result, DEQ will need to deploy new NO_2 sites. These sites are require to be operational in 2013. Please see the 2012 Annual Network Review document for more details.

Figures 5.2 and **5.3** show NO_2 emission sources and NO_2 emissions by county (courtesy of the EPA's State and County Emission Summaries).

Figure 5.2

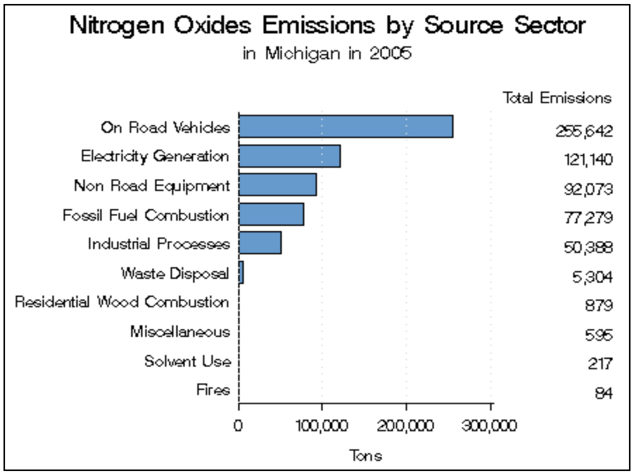
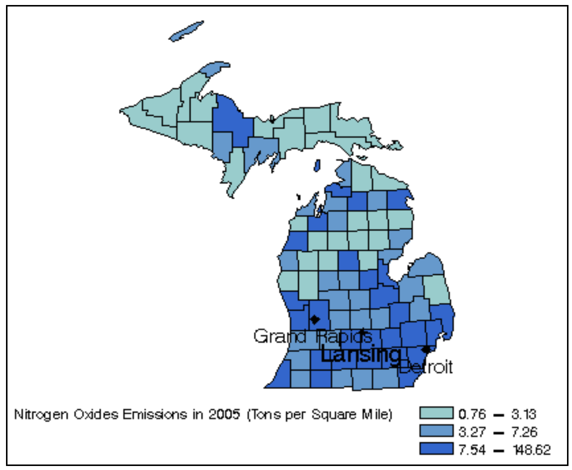
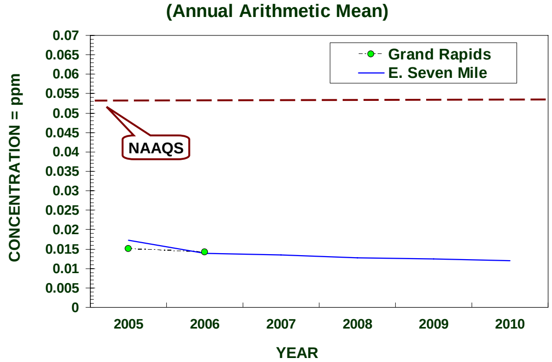


Figure 5.3



Michigan ambient NO_2 levels have always been well below the NAAQS. Since March 3, 1978, all areas in Michigan have been in attainment for NO_2. As shown in **Figure 5.4**, all monitoring sites have had an annual NO_2 concentration at less than half of the 0.053 ppm NAAQS. As such, the DEQ requested a designation of nonclassifiable/attainment for the entire state.

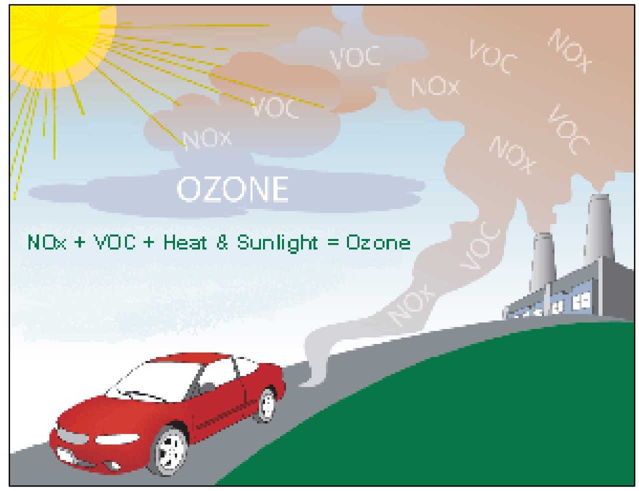
Figure 5.4: NO_2 Levels in MI from 2005-2010 (Annual Arithmetic Mean)



Even though there are no nonattainment areas for NO_2 in Michigan and monitoring for attainment purposes is not required, monitors continue to operate to support photochemical model validation work.

Chapter 6: Ozone (O_3)

Ground-level O_3 is created by photochemical reactions involving nitrogen oxides (NOx) and volatile organic compounds (VOCs), or hydrocarbons, in the presence of sunlight as the illustration to the right depicts (image courtesy of EPA). These reactions usually occur during the hot summer months as ultraviolet radiation from the sun initiates a sequence of photochemical reactions. O_3 is also a key ingredient of urban smog. In Earth's lower atmosphere (also known as the troposphere), ozone is an air pollutant. Ground level ozone can also be transported hundreds of miles under favorable meteorological conditions. Ozone levels are often higher in rural areas than in cities due to transport to regions downwind from the actual emissions of ozone forming air pollutants. Shoreline monitors along Lake Michigan often measure high ozone concentrations due to transport from upwind states. Its sources and effects are as follows:



Sources: Major sources of NO_X and VOCs are engine exhaust, emissions from industrial facilities, combustion from power plants, gasoline vapors, chemical solvents, and biogenic emissions from natural sources. 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.

Effects: Elevated O_3 exposure 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 include increased respiratory related hospital admissions with symptoms such as chest pain, shortness of breath, throat irritation, and cough. O_3 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 and the forest ecosystem, including agricultural crop and forest yield reductions, diminished resistance to pest and pathogens, and reduced survivability of tree seedlings.

Population most at risk: Individuals most susceptible to the effects of O_3 exposure include those with a pre-existing or chronic respiratory disease, children who are active outdoors, and adults who actively exercise or work outdoors.

Figure 6.1 shows the location of each O_3 monitor.

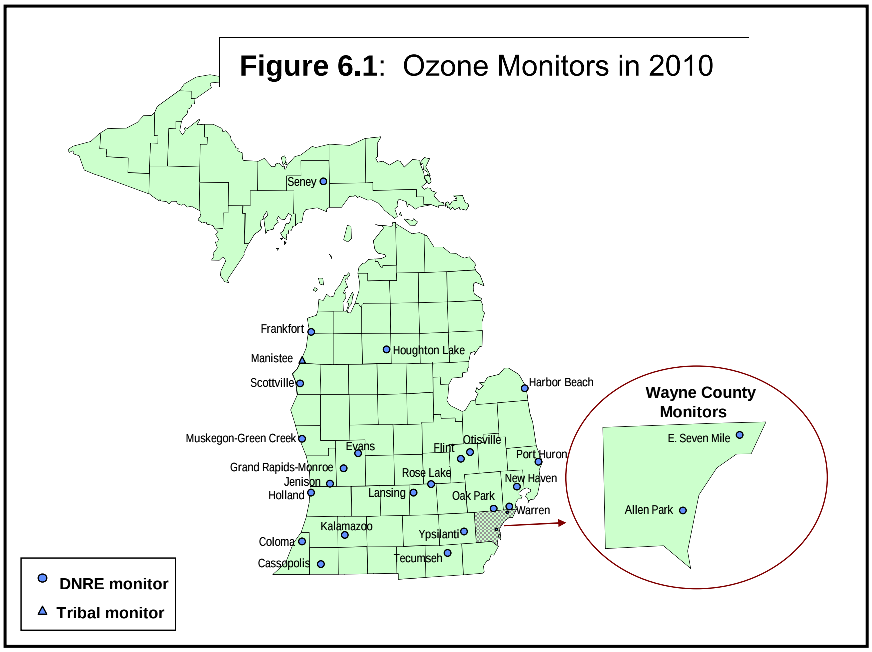


Figure 6.1: Ozone Monitors in 2010

Figures 6.2 and **6.3** show VOC emission sources and VOC emissions by county (courtesy of EPA's State and County Emission Summaries).

Figure 6.2

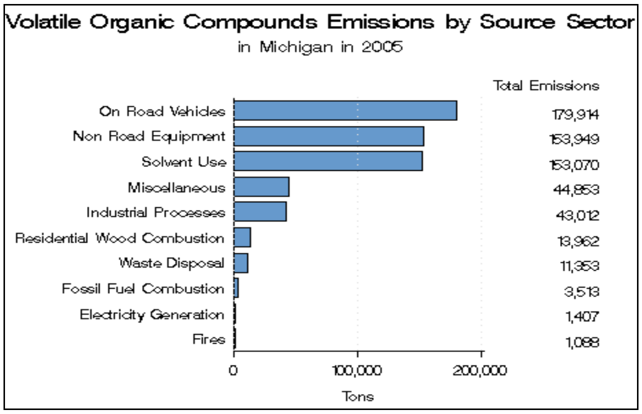
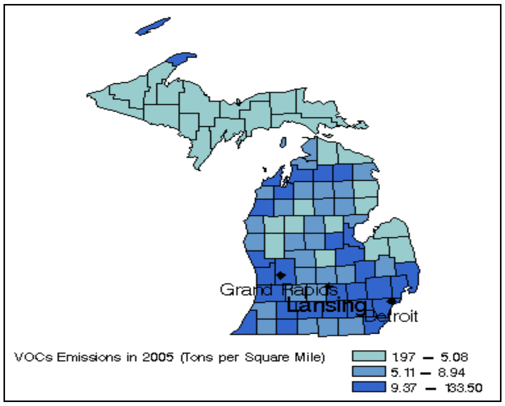


Figure 6.3



The ozone NAAQS was revised by the EPA on March 12, 2008 to 0.075 ppm and became effective on May 27, 2008. To attain the 2008 standard, the 3-year average of the 4th highest daily maximum 8-hour average concentration within an area must not exceed 0.075ppm.

Nonattainment designations are assigned to areas that exceed the NAAQS, or contribute to exceedances in a nearby area. The EPA planned to make attainment and nonattainment designations for this standard no later than March 12, 2010; however, the EPA decided to re-evaluate the standard instead. Attainment and nonattainment designations for the 0.08 ppm standard were made in 2004. Twenty-five counties in Michigan were originally designated as nonattainment. However, the ozone levels has since dropped dramatically. The last county in Michigan, Allegan County, was approved for attainment on September 24, 2010.

The O_3 monitoring season in Michigan is from April 1 through September 30, during which time O_3 monitoring data is available for the public via the AQD's website (discussed in **Chapter 9**). This data helps in attainment designation applications, to assess urban air quality, and population exposure.

Table 1.3 from **Chapter 1** shows all 26 O_3 air quality monitors active in Michigan at the beginning of 2010. It is important to note that under the 2006 amended air monitoring regulations, MSA boundaries have been modified and population totals tied to measurements of ambient air quality have increased. Basically, the amended regulations state that any monitors with a design value, using the most recent three years of data greater than or equal to 85% of the O_3 NAAQS, have a higher probability of violating the standard. Therefore, more monitors could be required in these MSAs.[5]

Table 6.1 shows the three-year average of the 4th highest 8-hour ozone values from 2008-2010.

Areas	County	Monitor Sites	2006-2008	2007-2009	2008-2010
Detroit-Ann Arbor MI	Lenawee	Tecumseh	0.076	0.073	0.068
	Macomb	New Haven	0.081	0.079	0.074
		Warren	0.080	0.078	0.073
	Oakland	Oak Park	0.077	0.077	0.073
	St. Clair	Port Huron	0.078	0.075	0.071
	Washtenaw	Ypsilanti	0.074	0.070	0.066
	Wayne	Allen Park	0.071	0.069	0.066
		E 7 Mile	0.082	0.080	0.075
Flint MI	Genesee	Flint	0.074	0.072	0.068
		Otisville	0.076	0.074	0.068
Grand Rapids, MI	Ottawa	Jenison	0.079	0.075	0.069
	Kent	Grand Rapids	0.077	0.072	0.067
		Evans	0.078	0.075	0.069
Muskegon Co MI	Muskegon	Muskegon	0.083	0.077	0.074
Allegan Co MI	Allegan	Holland	0.086	0.081	0.074
Huron Co MI	Huron	Harbor Beach	0.074	0.072	0.067
Kalamazoo- Battle Creek MI	Kalamazoo	Kalamazoo	0.073	0.074	0.069
Lansing East Lansing MI	Ingham	Lansing	0.074	0.073	0.068
	Clinton	Rose Lake	0.073	0.071	0.065
Benton Harbor MI	Berrien	Coloma	0.078	0.076	0.071
Benzie Co MI	Benzie	Frankfort	0.076	0.072	0.069
Cass Co MI	Cass	Cassopolis	0.076	0.075	0.070
Mason Co MI	Mason	Scottville	0.076	0.073	0.068
Missaukee Co MI	Missaukee	Houghton Lake	0.072	0.069	0.065
Manistee Co MI	Manistee	Manistee	0.077	0.072	0.067
Schoolcraft Co MI	Schoolcraft	Seney	0.075	0.070	0.067

Tables 6.2 and **6.3** highlight the number of days when two or more monitors exceeded 0.075 ppm. They also specify in which month they occurred and the temperature range.

[5] Additional information is available in Michigan's 2010 Ambient Air Monitoring Network Review Final Report at http://www.michigan.gov/documents/deq/deq-aqd-air-aqe-2010-Monitoring-Network-Review-final-6-09_284564_7.pdf

Table 6.2

Daily High Temperature Range	2010 WEST MICHIGAN OZONE SEASON											
	April		May		June		July		August		September	
	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days
≥ 95	0		0		0		0		0		0	
90 ≥ 94	0		1		0		4	1	4		0	
85 ≥ 89	0		7		2		13	1	14		2	1
80 ≥ 84	4		2		13		12		7		2	
75 ≥ 79	1		4		9		2		6		5	
70 ≥ 74	3		1		4		0		0		10	
65 ≥ 69	12		7		2		0		0		7	
60 ≥ 64	4		3		0		0		0		2	
55 ≥ 59	2		2		0		0		0		2	
50 ≥ 54	2		2		0		0		0		0	
49 ≥	2		2		0		0		0		0	
Totals	**30**	**0**	**31**	**0**	**30**	**0**	**31**	**2**	**31**	**0**	**30**	**1**

Days: Number of days during month when the daily high temperature falls within the specified temperature range.
O_3 Days: Number of days, during specified temperature range, when two or more area monitors exceeded 75 ppb.

Table 6.3

Daily High Temperature Range	2010 SOUTHEAST MICHIGAN OZONE SEASON											
	April		May		June		July		August		September	
	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days	Days	O_3 Days
≥ 95	0		0		0		0		0		0	
90 ≥ 94	0		0		0		10	2	5	2	2	
85 ≥ 89	0		6	1	7		7	1	11		2	
80 ≥ 84	5		5		8		11		11		3	
75 ≥ 79	2		4		10		3		4		5	
70 ≥ 74	3		3		3		0		0		9	
65 ≥ 69	6		6		2		0		0		5	
60 ≥ 64	7		1		0		0		0		3	
55 ≥ 59	3		3		0		0		0		1	
50 ≥ 54	2		2		0		0		0		0	
49 ≥	2		1		0		0		0		0	
Totals	**30**	**0**	**31**	**1**	**30**	**0**	**31**	**3**	**31**	**2**	**30**	**0**

Days: Number of days during month when the daily high temperature falls within the specified temperature range.
O_3 Days: Number of days, during specified temperature range, when two or more area monitors exceeded 75 ppb.

There were two days in July and one day in September where ozone exceeded 0.075 ppm at two or more monitors in west Michigan. The respective temperatures for those days were between 85^0F – 94^0F. There was one day in May, three days in July, and two days in August where ozone exceeded 0.075 ppm at two or more monitors in southeast Michigan. The respective temperatures for those days were between 85^0F – 94^0F. **Table 6.4** gives a breakdown of those days and the specific monitors that went over the standard in the western, central/upper, and eastern portions of the state.

Table 6.4: Eight-hour Exceedance Days (>75 ppb) and Locations

Date	Monitors			Total
	Western Michigan	Central/Upper Michigan	Eastern Michigan	
04-15-10	Kalamazoo		E 7 Mile	2
05-26-10	Coloma		E 7 Mile, Oak Park, Warren	4
05-30-10		Seney		1
07-03-10	Manistee, Muskegon, Scottville	Seney	E 7 Mile, Port Huron	6
07-04-10			New Haven, Port Huron	2
07-06-10	Holland, Muskegon		E 7 Mile, Port Huron	4
07-07-10			New Haven	1
07-15-10			E 7 Mile	1
08-02-10	Muskegon		Port Huron	2
08-12-10			E 7 Mile	1
08-29-10		Seney	E 7 Mile, Harbor Beach, New Haven, Warren	5
08-30-10			New Haven	1
08-31-10			New Haven, Port Huron	2
09-21-10	Evans, Holland, Jenison, Muskegon			4
			TOTAL	36

July 3, 2010 had the most number of monitor readings exceeding the standard. Three out of six of these monitors were in the western portion of Michigan. The E 7 mile monitor exceeded the level of the standard most at seven times, compared to five times each for New Haven and Port Huron, four times for Muskegon, and three times for Seney.

NOTE: Even though several monitors exceeded the standard on particular days, the following graphs show that the 3-year average for ozone did not exceed the NAAQS.

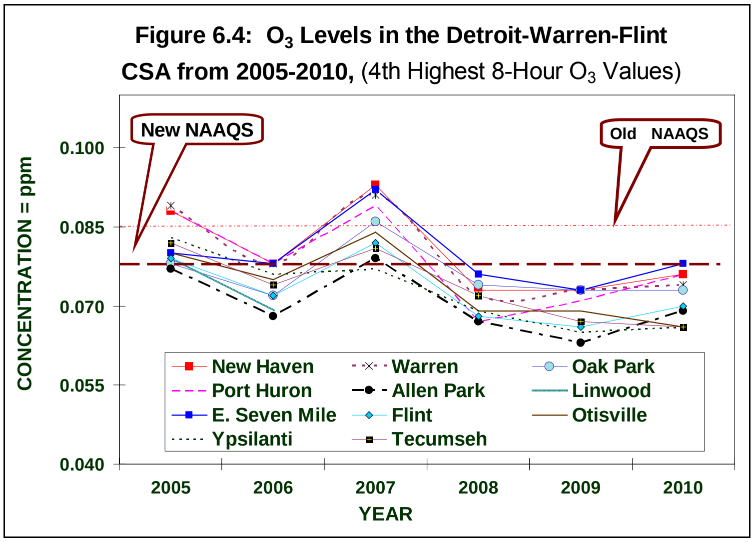
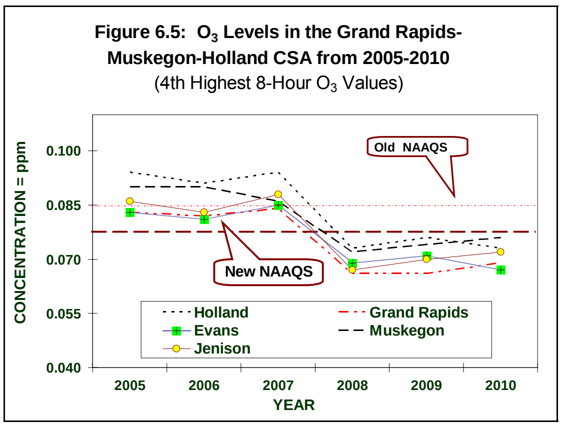
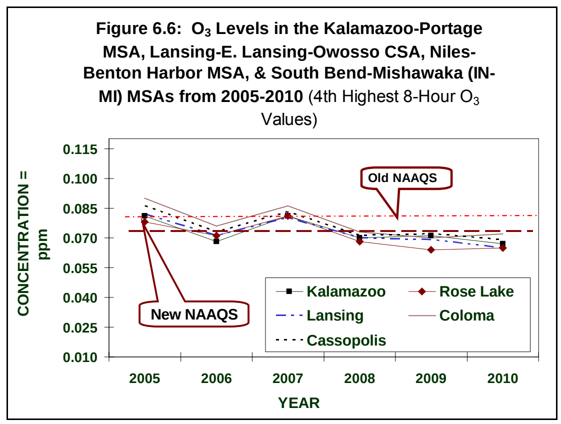
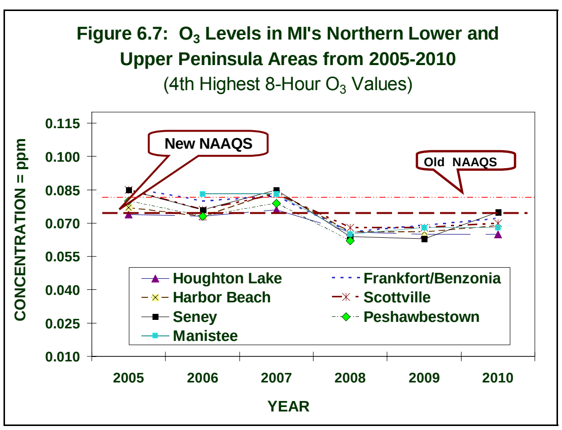


Figure 6.4 shows the 4th highest 8-hour O_3 values for all of Michigan's monitoring sites in southeast Michigan from 2005-2010. During the 2010 monitoring season, only the 4th highest value at E. 7 Mile reached 0.075 ppm.

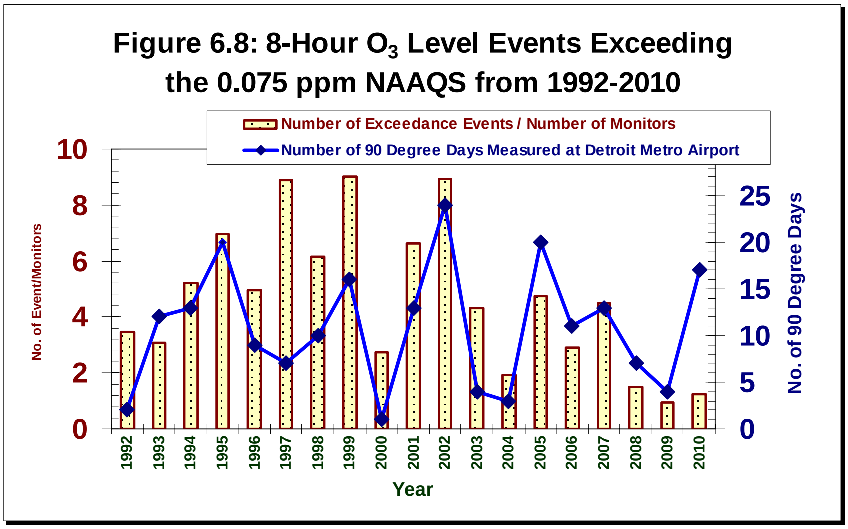






Figures 6.5, 6.6 and **6.7** show the 4th highest 8-hour O_3value trends for the other monitoring sites in Michigan over the last five years (see **Table 6.1** for reference).

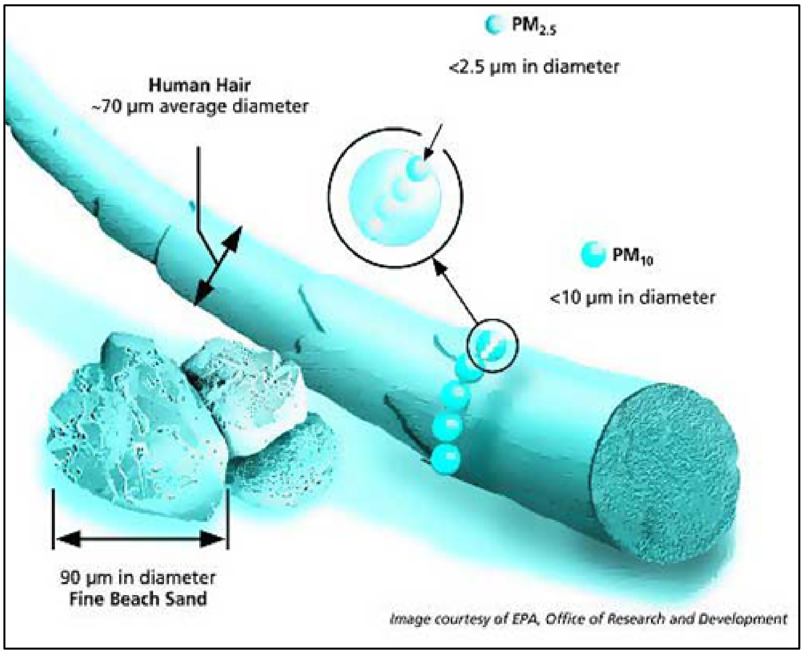
Figure 6.8 shows 8-hour O_3 readings ≥ 0.075 ppm with the number of 90°F days (≥ 90°F) measured at the Detroit Metropolitan Airport. The total number of southeastern Michigan-area 8-hour readings above 0.075 ppm were divided by the number of monitors that were in operation each year to provide a relative indication of the frequency of elevated 8-hour O_3 values.



This comparison in southeast Michigan shows the influence of temperature with respect to elevated O_3 levels. Over the past 19 years, a typical summer would have an average of 11 days with the maximum daily temperature exceeding 90°F. Over the time period from 1992 through 2010, the highest number of 90°F days occurred in 2002 (24 days), while the lowest number occurred in 2000 (one day). For 2010, there were 17 days greater than 90°F.

Chapter 7: Particulate Matter (PM_{10}, $PM_{2.5}$, $PM_{2.5}$ Chemical Speciation and TSP)

Particulate matter is a general term used for a mixture of solid particles and liquid droplets found in the air, which is further categorized according to size. Large particles with diameters of less than 50 micrometers (μm) are classified as total suspended particulates (TSP). PM_{10} are "coarse particles" less than 10 μm in diameter (about one-seventh the diameter of a human hair) and $PM_{2.5}$ are much smaller "fine particles" equal to or less than 2.5 μm in diameter. PM_{10} has a 24-hour average standard of 150 μg/m^3. $PM_{2.5}$ has an annual average standard of 15 μg/m^3, and a 98th percentile 24-hour average of 35 μg/m^3 over three years. Its sources and effects are as follows:



Sources: PM can be emitted directly (primary) or may form in the atmosphere (secondary). Most man-made particulate emissions are classified as TSP. PM_{10} consists of primary particles that 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. $PM_{2.5}$ can come directly from primary particle emissions or through secondary reactions that include VOCs, SO_2, and NO_X emissions originating from power plants, motor vehicles (especially diesel trucks and buses), industrial facilities, and other types of combustion sources.

Effects: Exposure to PM affects breathing and the cellular defenses of the lungs, aggravates existing respiratory and cardiovascular ailments, and has been linked with heart and lung disease. Particle size is the major factor that determines which particles will enter the lungs and how deeply the particles will penetrate. PM is the major cause of reduced visibility in many parts of the U.S. $PM_{2.5}$ is considered a primary visibility-reducing component of urban and regional haze. Airborne particles impact vegetation ecosystems and damage paints, building materials and surfaces. Deposition of acid aerosols and salts increases corrosion of metals and impacts plant tissue.

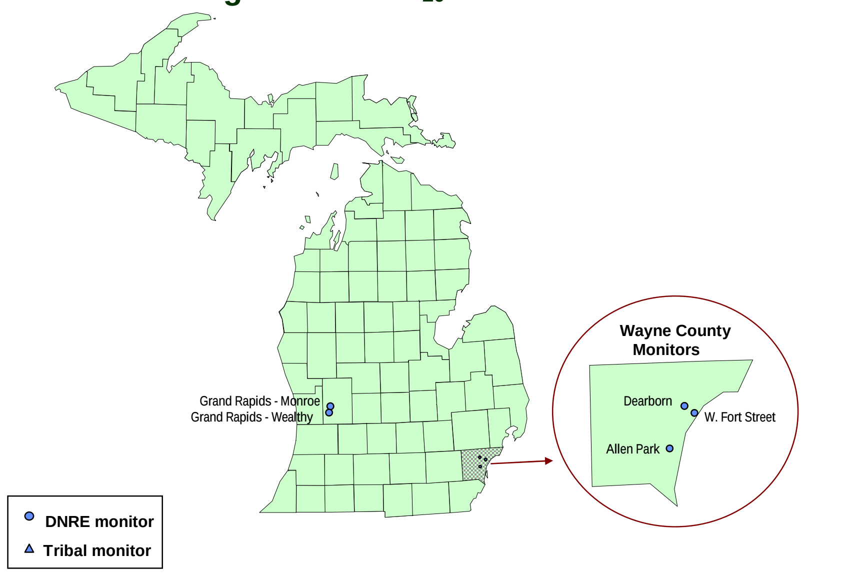
Population most at risk: $PM_{2.5}$ has been linked to the most serious health effects. People with heart or lung disease, the elderly, and children are at highest risk from exposure to PM.

PM_{10}

Since October 4, 1996, all areas in Michigan have been in attainment with the PM_{10} NAAQS. Due to the recent focus upon $PM_{2.5}$ and because of the relatively low concentrations of PM_{10} measured in recent years, Michigan's PM_{10} network has been reduced to a minimum level. **Table 1-3** identifies the locations of PM_{10} monitoring stations that were operating in Michigan during 2009. These monitors are located in the state's largest populated urban areas - three in the Detroit area and two in Grand Rapids. To better characterize the nature of PM in Michigan, many of the existing PM_{10} monitors are co-located with $PM_{2.5}$ monitors in population-oriented areas.

Figure 7.1 shows the location of each PM_{10} monitor.

Figure 7.1: PM_{10} Monitors in 2010



Figures 7.2 and **7.3** show PM_{10} emission sources and PM_{10} emissions by county (courtesy of EPA's State and County Emission Summaries).

Figure 7.2

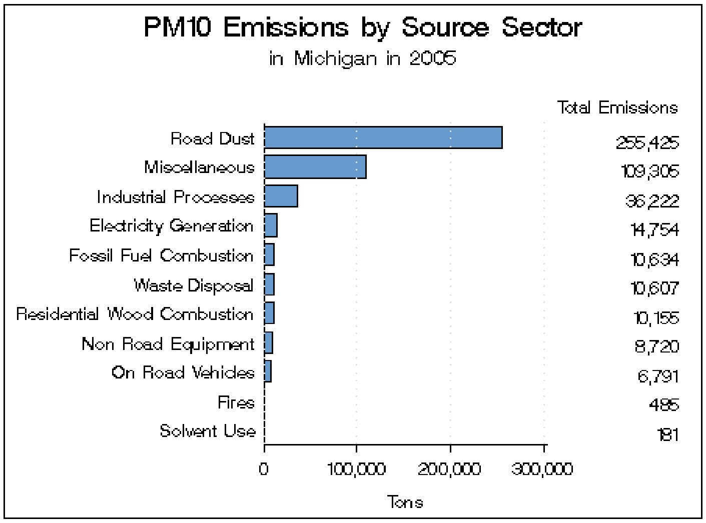


Figure 7.3

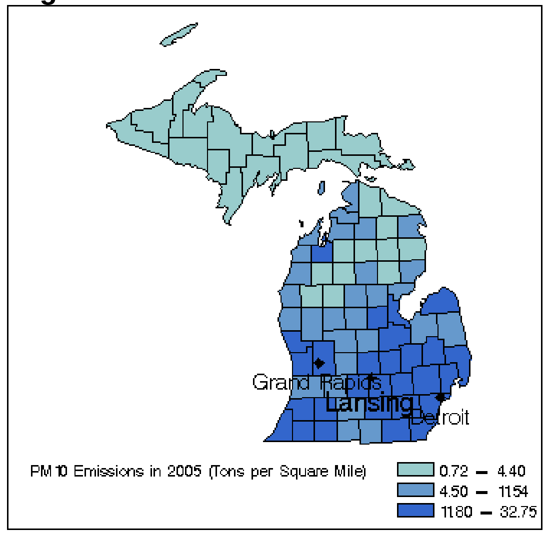
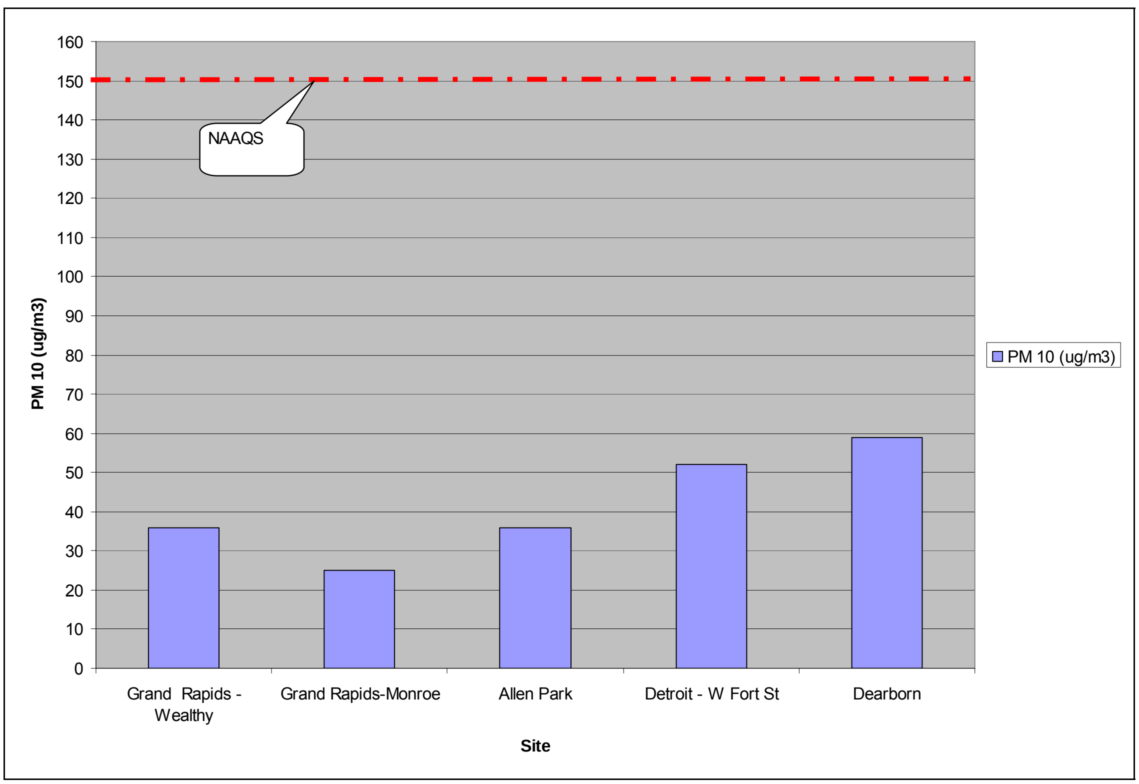


Figure 7.4 shows the PM_{10} levels in Michigan compared to the 24-hour average of 150 µg/m^3. This standard must not be exceeded more than once per year over a 3-year period. The design value is the 4th highest value over a three year period. The PM_{10} levels at all sites in Michigan are well below the national standard.

Figure 7.4: PM_{10} Design Value, 2008-2010



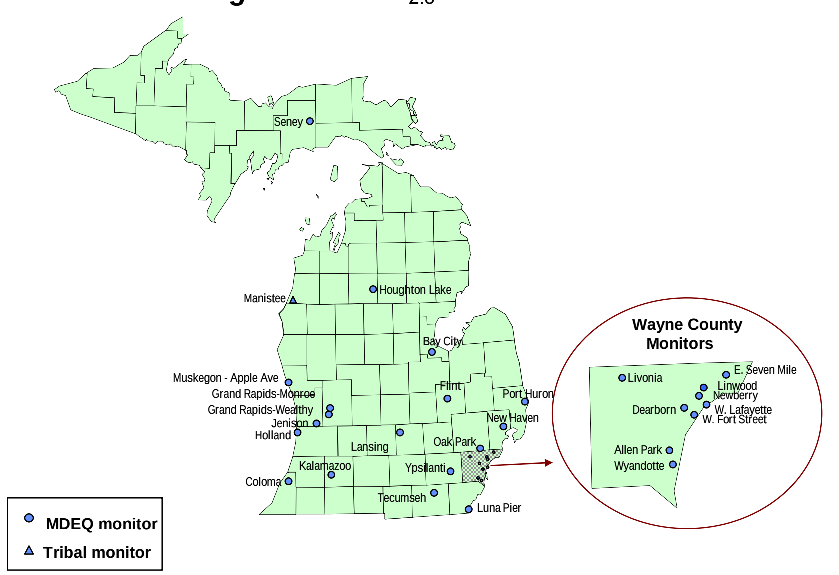
$PM_{2.5}$

On August 18, 2008, the EPA proposed the 7-county southeast Michigan area as nonattainment based on 2005-2007 data. The 2007-2010 data shows that the 7-county southeast Michigan area to be in attainment for $PM_{2.5}$. The AQD is currently working with the EPA to get the area redesignated to attainment. The $PM_{2.5}$ particulate network consists of the following components, which together provide a picture of the nature of PM within the state.

- **$PM_{2.5}$ FRM monitoring.** The concentrations of $PM_{2.5}$ measured over a 24-hour time period are determined using the gravimetric FRM. Only data generated by FRM monitors are used for comparisons to the NAAQS. The sites are located in urban, commercial, and residential areas where people are exposed to $PM_{2.5}$.
- **Continuous $PM_{2.5}$ monitoring (*Tapered Element Oscillating Microbalance [TEOM]*).** Continuous monitoring is beneficial as it provides real-time hourly data that supplements the $PM_{2.5}$ data collected by FRM monitors.
- **Chemical Speciation monitoring.** Speciated monitoring provides a better understanding of the chemical composition of $PM_{2.5}$ material and better characterizes background levels.

Figure 7.5 shows the location of each $PM_{2.5}$ monitor.

Figure 7.5: $PM_{2.5}$ Monitors in 2010



$PM_{2.5}$ FRM Monitoring Network: $PM_{2.5}$ FRM monitors are deployed at all of Michigan's 26 $PM_{2.5}$ monitoring sites to characterize background or regional $PM_{2.5}$ transport collectively from upwind sources. The two of the monitoring sites in Detroit, W. Lafayette and Newberry, measure PM levels in an area that is heavily impacted by mobile source emissions. In addition, five $PM_{2.5}$ FRM monitoring sites are co-located with PM_{10} monitors to allow for $PM_{2.5}$ and PM_{10} comparisons[6]. Co-located PM_{10} and $PM_{2.5}$ sites include Grand Rapids (Monroe and Wealthy), Dearborn, Allen Park, and Detroit's W. Fort Street (SWHS) station.

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[6] Requirements for $PM_{2.5}$ FRM sites are obtained from the Revised Requirements for Designation of Reference and Equivalent Methods for $PM_{2.5}$ and Ambient Air Quality Surveillance for PM [62 FR 38763]; Guidance for Using

Continuous $PM_{2.5}$ Network: Short-term measurements of $PM_{2.5}$ or PM_{10} are updated on an hourly basis using TEOM instruments. At least one continuous TEOM is required at a core monitoring $PM_{2.5}$ site in a metropolitan area with a population greater than one million. Both Detroit (Allen Park) and Grand Rapids (Monroe) meet this requirement[7]. Under the revised 2006 air monitoring regulations, 50% of the FRM monitoring sites are now required to have a continuous $PM_{2.5}$ monitor. For Michigan, there are 26 FRM monitoring sites, 13 of which also have TEOMS. The DEQ initially operated all TEOM units with an inlet temperature of 50ºC, but this high inlet temperature was volatilizing nitrate levels during the winter months. Therefore, the DEQ began operating TEOMs with a 30°C inlet temperature October through March and a 50°C inlet temperature between April and September.

Chemical Speciation Monitoring: Single event Met-One speciation air sampling system (SASS) monitors are used throughout Michigan's speciation network and are placed in population-oriented stations in both urban and rural locations. $PM_{2.5}$ chemical speciation samples are collected on three types of filters – Teflon, nylon, and quartz – over a 24-hour period. Each filter is analyzed by a different method to determine various components of $PM_{2.5}$. In 2008, the EPA changed the protocol for the SASS monitors by removing the quartz carbon channel and replacing it with an URG 3000 N sampler. The Dearborn and the Ypsilanti sites were changed over in 2008. The remaining sites were changed over in 2009. There are eight SASS monitors operating in Michigan; see **Table 1.3.**

The primary objectives of the chemical speciation monitoring sites are to provide data that will be used to determine the sources of poor air quality and to support the development of attainment strategies. Historical speciation data for Michigan indicates that $PM_{2.5}$ is made up of 30% nitrate compounds, 30% sulfate compounds, 30% organic carbon[8], and 10% unidentified or trace elements.

Continuous $PM_{2.5}$ Speciation Monitoring (EC/OC and Aethalometer): To determine diurnal changes in $PM_{2.5}$ composition, the DEQ operated two aethalometers and three elemental carbon/organic carbon (EC/OC) monitors in 2010.

- Aethalometers measure carbon black, a combustion by-product typical of transportation sources, by concentrating particulate on a filter tape and measuring changes in optical transmissivity and absorption. In 2010, the DEQ's aethalometers were located at Dearborn and Allen Park.
- The EC/OC instruments measure elemental carbon, using pyroloysis coupled with a nondispersive infrared detector to separate the elemental and organic carbon fractions. These instruments are located at Dearborn, Allen Park and Tecumseh.

It is important to note that the 2006 amended air monitoring regulations specify speciation monitoring but did not provide much detail except that measurements of PM_{10}-$PM_{2.5}$ will need to be added to the NCore sites[9]. The DEQ began PM_{10}-$PM_{2.5}$ monitoring in 2010 at Allen Park and Grand Rapids – Monroe Street.

Continuous Monitors in $PM_{2.5}$ Monitoring Networks [EPA-454/R-98-012, May 1998]; and Appendix N to Part 50 - Interpretation of the National Ambient Air Quality Standards for PM [40 CFR Part 50, July 1, 1998].

[7] Under the Guidance for Using Continuous Monitors in $PM_{2.5}$ Monitoring Networks [EPA-454/R-98-012, May 1998].

[8] To better understand the chemical composition of the organic carbon fraction, a number of studies have been conducted in Southeast Michigan to further investigate organic carbon. Information can be found in the Michigan 2006 Ambient Air Monitoring Network Review, available at http://www.michigan.gov/deqair.

[9] Current information on both proposals can be found at http://www.epa.gov/air/particles/actions.html.

Table 1.3 shows all of Michigan's 26 $PM_{2.5}$ FRM monitoring stations operating in 2010 and denotes which sites also have TEOM and/or SASS monitors in operation.

Figures 7.6 and **7.7** show $PM_{2.5}$ emission sources and $PM_{2.5}$ emissions by county (from the EPA's State and County Emission Summaries).

Figure 7.6

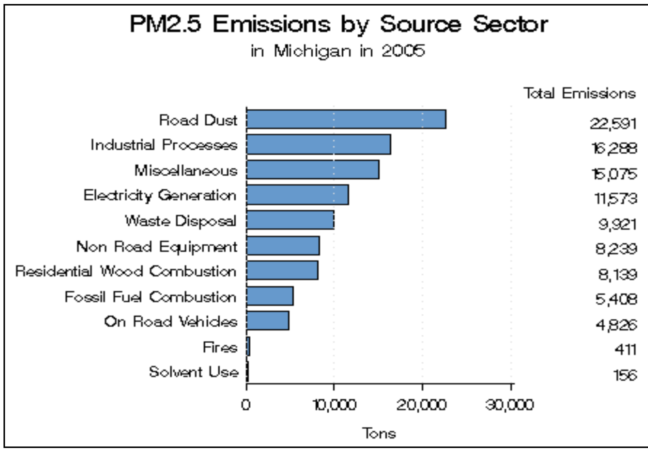


Figure 7.7

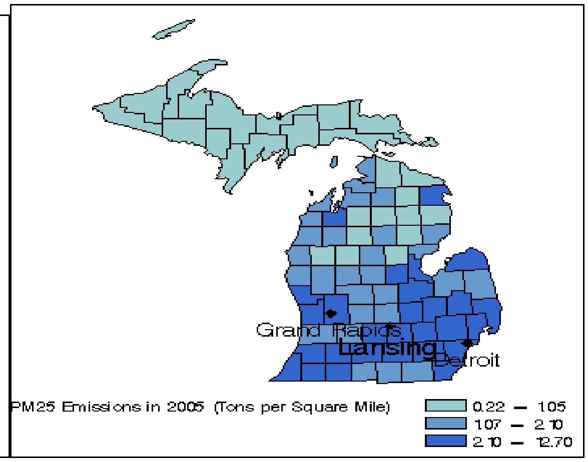


Table 7.1 provides the 2008-2010 annual mean $PM_{2.5}$ concentrations by individual monitoring stations[10]. Stations labeled #2 provide a precision estimate of the overall measurement and operate on a one in six sampling schedule. All other monitors sampled on a one in three day schedule except for Allen Park #1, which samples daily. The Allen Park #2 was moved to Dearborn #2 in January 2010.

Table 7.1: Three-Year Average of the Annual Mean PM2.5 Concentrations

Areas	County	Monitoring Sites	2008	2009	2010	2008-2010 Mean
Detroit-Ann Arbor MI	Lenawee	Tecumseh	7.28	9.74	8.9	8.6
	Macomb	New Haven	10.66	9.49	8.9	9.7
	Oakland	Oak Park	10.86	10.03	9.1	10.0
	St. Clair	Port Huron	11.08	9.74	8.9	10.0
	Washtenaw	Ypsilanti #1	10.91	9.94	10.9	10.6
		Ypsilanti #2	12.99	9.80	9.4	10.7
	Wayne	Allen Park #1	11.83	11.06	10.2	11.0
		Allen Park #2	13.92	11.32	*	
		Detroit- Linwood	11.94	10.36	9.9	10.7
		Detroit - E 7 Mile	11.33	10.54	9.9	10.6
		Detroit - W Fort	12.85	11.12	10.7	11.5
		Detroit - Newberry	11.81	10.17	10.0	10.7
		Detroit - W. Lafayette	12.23	10.70	10.1	11.0
		Wyandotte	10.94	10.36	9.4	10.2
		Dearborn #1	13.34	12.07	11.3	12.2
		Dearborn #2			12.3	
		Livonia	11.01	9.88	9.2	10.0
Flint MI	Genesee	Flint	9.77	8.73	8.9	9.1
Grand Rapids, MI	Ottawa	Jenison	10.82	9.19	9.2	9.7
	Kent	Grand Rapids-Wealthy	11.15	9.88	9.6	10.2
		Grand Rapids #1	10.67	9.42	9.6	9.9
		Grand Rapids #2	10.66	9.67	10.0	10.1
Muskegon Co MI	Muskegon	Muskegon	9.64	8.75	8.3	8.9
Allegan Co MI	Allegan	Holland	9.68	8.57	8.5	8.9
Monroe Co MI	Monroe	Luna Pier	11.36	10.33	9.4	10.4
Kalamazoo- Battle Creek MI	Kalamazoo	Kalamazoo #1	11.19	10.02	9.3	10.2
		Kalamazoo #2	11.08	9.92	9.2	10.1
Lansing East Lansing MI	Ingham	Lansing	9.85	9.06	9.0	9.3
Benton Harbor MI	Berrien	Coloma	9.78	9.04	8.74	9.2
Bay Co MI	Bay	Bay City	8.89	8.19	8.16	8.4
Missaukee Co MI	Missaukee	Houghton Lake	6.48	5.91	5.9	6.1
Manistee Co MI	Manistee	Manistee	7.62	6.14	6.6	6.8

* moved to Dearborn

[10] For comparison to the standard, the average annual means is rounded to the nearest 0.1 µg/m^3.

Table 7.2 is a detailed assessment of the 24-hour 98th percentile $PM_{2.5}$ concentrations for 2008-2010 showing Michigan's levels are below the 35 µg/m^3 standard (3-year average)[11].

Table 7.2: 98th Percentile PM2.5 Values Averaged over 3 Years						
Areas	County	Monitoring Sites	2008	2009	2010	2008-2010 Mean
Detroit-Ann Arbor MI	Lenawee	Tecumseh	23.4	29.9	22.3	25.2
	Macomb	New Haven	28.9	26.2	25.5	26.9
	Oakland	Oak Park	30.4	30.1	27.1	29.2
	St. Clair	Port Huron	31.0	29.9	25.8	28.9
	Washtenaw	Ypsilanti #1	28.2	28.2	23.3	26.6
		Ypsilanti #2	31.3	29.4	22.4	27.7
	Wayne	Allen Park #1	30.3	29.2	27.8	29.1
		Allen Park #2	32.3	32.4	*	
		Detroit- Linwood	30.0	31.0	27.9	29.6
		Detroit - E 7 Mile	31.9	29.2	28.6	29.9
		Detroit - W Fort	34.3	30.9	26.6	30.6
		Detroit - Newberry	31.5	25.9	30.4	29.3
		Detroit - W. Lafayette	31.7	31.7	27.7	30.4
		Wyandotte	26.3	26.9	24.4	25.9
		Dearborn #1	31.7	35.7	28.6	32.0
		Dearborn #2			31.5	
		Livonia	28.3	29.3	25.3	27.6
Flint MI	Genesee	Flint	25.8	26.2	24.7	25.6
Grand Rapids, MI	Ottawa	Jenison	27.1	26.5	22.7	25.4
	Kent	Grand Rapids-Wealthy	26.8	28.8	22.4	26.0
		Grand Rapids #1	24.9	30.0	24.3	26.4
		Grand Rapids #2	22.5	31.4	24.3	26.1
Muskegon Co MI	Muskegon	Muskegon	26.3	27.3	23.4	25.7
Allegan Co MI	Allegan	Holland	24.5	25.4	24.6	24.8
Monroe Co MI	Monroe	Luna Pier	28.6	23.6	26.3	26.2
Kalamazoo- Battle Creek MI	Kalamazoo	Kalamazoo #1	26.0	29.0	21.5	25.5
		Kalamazoo #2	24.1	36.4	20.8	27.1
Lansing East Lansing MI	Ingham	Lansing	24.0	27.1	23.7	24.9
Benton Harbor MI	Berrien	Coloma	24.8	22.2	23.3	23.4
Bay Co MI	Bay	Bay City	23.6	23.3	31.1	26.0
Missaukee Co MI	Missaukee	Houghton Lake	21.1	17.5	17.6	18.7
Manistee Co MI	Manistee	Manistee	21.2	19.8	21.9	21.0

*moved to Dearborn

[11] The 98th percentile value was obtained from the EPA AQS. For the purpose of comparing calculated values, the 3-year 24-hour average is rounded to the nearest 1 µg/m^3.

Figures 7.8 through **7.11** show the current annual mean $PM_{2.5}$ trend for each monitoring site in Michigan for the years monitoring was conducted. For clarity, the monitoring sites within the Detroit-Warren-Flint CSA, which are currently designated as nonattainment for the $PM_{2.5}$ NAAQS, have been broken down into two graphs. **Figure 7.8** shows those sites in Wayne County and **Figure 7.9** shows the remaining counties within the CSA.

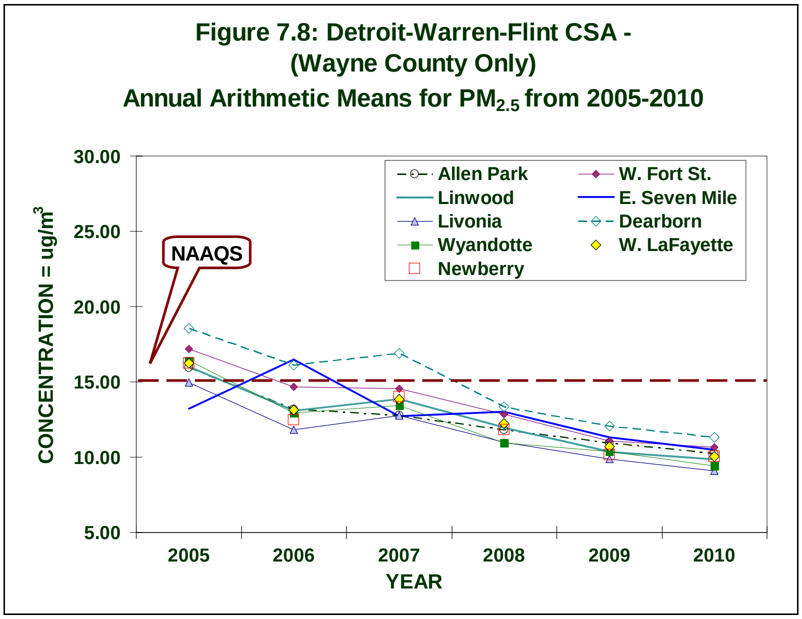


Figure 7.8 shows that 2010 levels in Wayne County have remained below the standard. For the first time, the Dearborn site has met the standard. Historically, Dearborn has had the highest readings in the state.

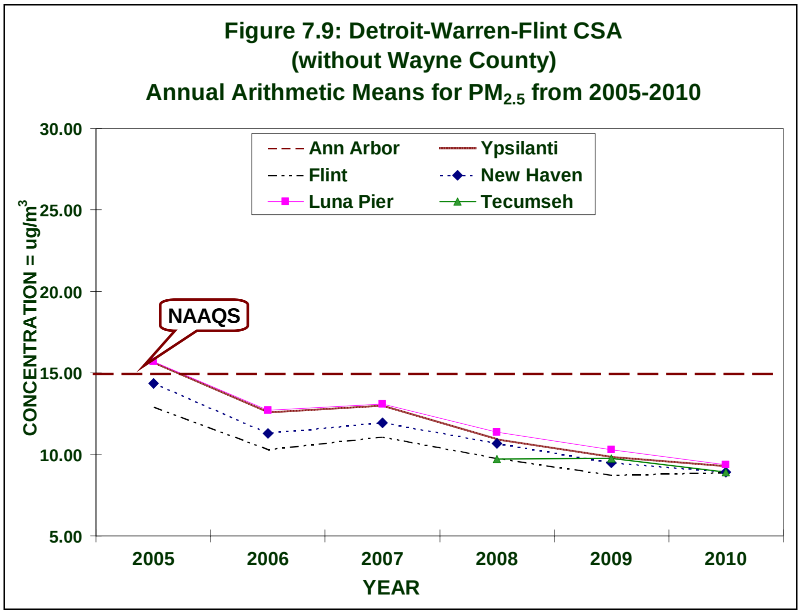


Figure 7.9 contains the remainder of those sites in the Detroit-Warren-Flint CSA that are outside of Wayne County. These sites show readings in 2010 below the $PM_{2.5}$ standard and after the 3-year annual mean is averaged, they remain below the current $PM_{2.5}$ NAAQS.

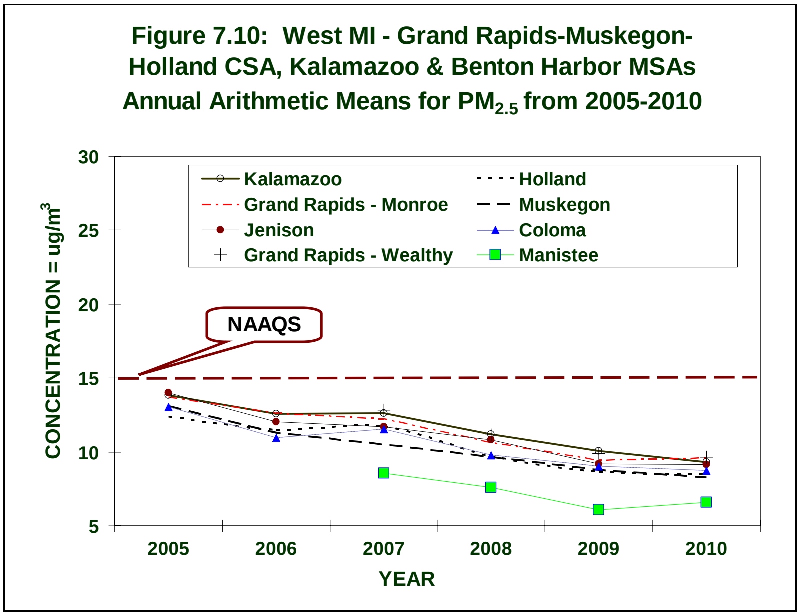


Figure 7.10 combines the $PM_{2.5}$ monitoring sites located in west Michigan. As shown, all sites in west Michigan have been below the annual $PM_{2.5}$ NAAQS since 2004.

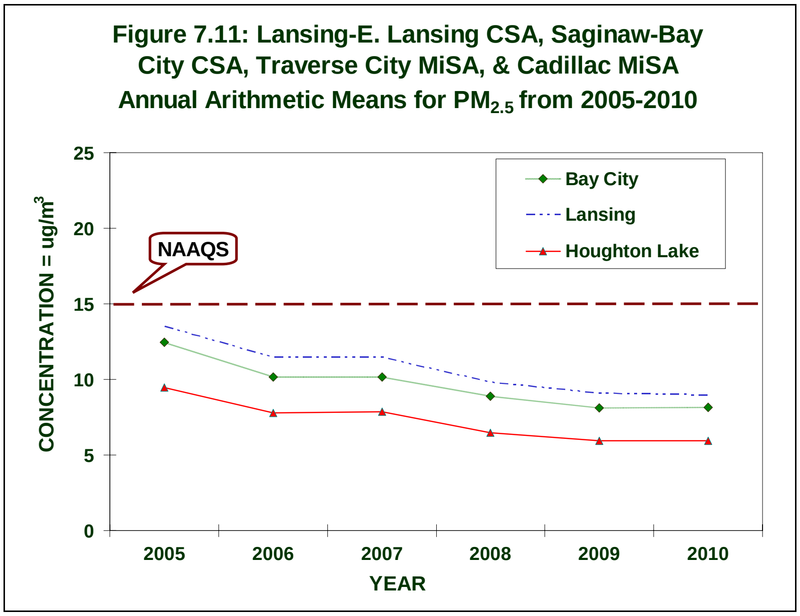


Figure 7.11 displays the remaining monitoring sites in Michigan's Lower Peninsula. All these sites have 2010 levels below the standard and their 3-year averages also remain below the annual $PM_{2.5}$ NAAQS.

Chapter 8: Toxic Air Pollutants

In addition to the six criteria pollutants discussed in the previous chapter, the AQD monitors a wide variety of substances classified as toxic air pollutants , and/or Hazardous Air Pollutants (HAPs). The list of compounds and substances included in this category are determined by state and federal regulations that address these materials. Under the Clean Air Act (CAA), the EPA specifically addresses a group of 188 HAPs. Under Michigan'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 lists 41 substances that are not TACs, indicating that all others are TACs.

Sources: Air toxics come from a variety of mobile, stationary, indoor, and outdoor natural sources. Mobile sources include motor vehicles, stationary sources include industrial factories and power plants, indoor sources include household cleaners, and natural sources include forest fires and eruptions from volcanoes.

Effects: Once air toxics enter the body, there is a wide range of potential health effects. They include cancer, the aggravation of asthma; irritation to the eyes, nose, and throat; carcinogenicity; developmental toxicity (birth defects); nervous system effects and various other effects on internal organs. Some effects appear after a shorter period of exposure, while others may appear after long-term exposure or after a long period of time has passed since the exposure ended. Most toxic effects are not unique to one substance, and some effects may be of concern only after the substance has deposited to the ground or to a water body (e.g., mercury, dioxin), followed by exposure through an oral pathway such as the eating of fish or produce. This further complicates the assessment of air toxics concerns due to the broad range of susceptibility that various people may have.

Population most at risk: People with asthma, children, and the elderly**.**

Air Toxics can be categorized as:

- *Metals:* Examples include aluminum, arsenic, beryllium, barium, cadmium, chromium, cobalt, copper, iron, mercury, manganese, molybdenum, nickel, lead, vanadium, and zinc.
- *Organic Substances*: Further divided into sub-categories that include -
    - o VOCs, include benzene (found in gasoline), perchlorethylene (emitted from some dry cleaning facilities), and methylene chloride (a solvent and paint stripper used by industry);
    - o carbonyl compounds (aldehydes and ketones);
    - o semi-volatile compounds (SVOCs);
    - o polycyclic aromatic hydrocarbons (PAHs)/polynuclear aromatic hydrocarbons (PNAs);
    - o pesticides;
    - o polychlorinated biphenyls (PCBs); and
    - o polycyclic organic matter.
- *Other substances*: Asbestos, dioxin, and radionuclides such as radon.

Because air toxics are such a large and diverse group of substances, regulatory agencies sometimes further refine these classifications to address specific concerns.

For example:

- Some initiatives have targeted those substances that are *persistent, bioaccumulative and toxic* (PBT), such as mercury, which accumulates in body tissues.
- The EPA has developed an Integrated *Urban Air Toxics Strategy* with a focus on 33 substances (the Urban HAPs List).[12]

The evaluation of air toxics levels is hindered due to several factors.

- There are no health-protective NAAQS. Instead, air quality assessments utilize various short- and long-term screening levels and health benchmark levels estimated to be safe considering the critical effects of concern for specific substances.
- There is incomplete 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.
- Data gaps are present regarding the potential for interactive toxic effects for co-exposure to multiple substances present in emissions and in ambient air. 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).

These factors make it difficult to accurately assess the potential health concerns of all air toxics. Nevertheless, it is feasible and important to characterize the potential health hazards and risks associated with many air toxics.

Table 8.1 shows the monitoring stations and what was monitored at each station in 2010 (this table can also be found in **Appendix B** with the Air Toxics Monitoring Summary).

Table 8.1

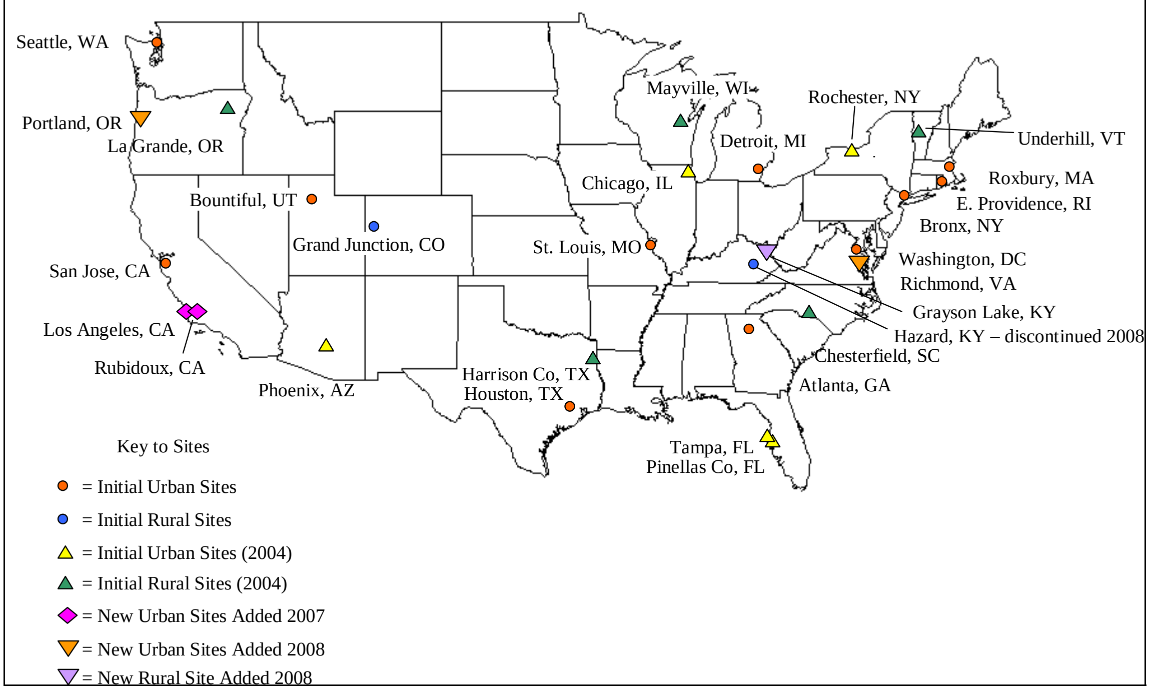
SITE NAME	VOC	Carbonyl	PAHs	Metals TSP	Metals PM_{10}	Hex Chrome	Speciated $PM_{2.5}$
Allen Park				x	x		x
Dearborn	x	x	x	x	x	x	x
Detroit W. Fort St	x	x		x	Mn		x
Detroit W. Jefferson				x			
Detroit Heidt St				x			
Flint				Mn			
Grand Rapids				x			x
Belding				x			
Houghton Lake							x
Luna Pier							x
Port Huron, Nat'l Guard Arm.							x
River Rouge		x		x	Mn		
Tecumseh							x

[12] EPA's Air Toxics Website – Urban Strategy is located at http://www.epa.gov/ttn/atw/urban/urbanpg.html.

National Monitoring Efforts and Data Analysis

The EPA administers national programs that identify air toxics levels, detect trends, and prioritize air toxics research. The DEQ participates in these programs. In addition, the AQD operates a site in Dearborn that is part of EPA's National Air Toxics Trend Stations (NATTS). The purpose of the NATTS network is to detect trends in high-risk air toxics such as benzene, formaldehyde, chromium, and 1,3-butadiene and to measure the progress of air toxics regulatory programs at the national level. Currently, the NATTS network contains 25 stations, 18 urban and 7 rural (see **Figure 8.1**). The EPA requires that the NATTS sites measure VOCs, carbonyls, PAHs, hexavalent chromium, and trace metals on a once every six day sampling schedule. The Dearborn measures trace metals as TSP, $PM_{10,}$ and $PM_{2.5}$.

Figure 8.1: National Air Toxics Trends Sites



Chapter 9: MIair – Air Quality Information in Real-Time

MIair is the internet tool that provides real-time air quality information via DEQ's webpage. The www.deqmiair.org hotlink opens to the current Air Quality Index (AQI) map and displays air quality forecasts for "today" and "tomorrow." **MIair** also hosts Enviroflash, the automated air quality notification system.

Air Quality Index

The Air Quality Index (AQI) is a simple tool developed to communicate current air quality information to the public. The current day's color-coded AQI values, ranging from Good to Hazardous, are displayed in a forecast table and as dots on a Michigan map.

As can be seen from the annual summaries in **Appendix C**, air quality in Michigan generally falls in the Good or Moderate range. An area will occasionally fall into the Unhealthy for Sensitive Groups range, but rarely reaches Unhealthy levels.

Air Quality Forecasts

Air Quality Division meteorologists provide air pollution forecasts to alert the public when air pollution levels may become elevated. *Action!* Days are declared when levels are expected to reach or exceed the Unhealthy for Sensitive Groups AQI health indicator. On *Action!* Days, businesses, industry, government and the public are encouraged to reduce air pollution levels by limiting vehicle use, refueling only after 6 PM, carpooling, walking, biking or taking public transit, deferring the use of gasoline-powered lawn and recreation equipment, limiting the use of volatile chemicals and curtailing all burning. More information on voluntary air pollution control measures can be found under the *Action!* Day tab on **MIair**.

Air Quality Notification

EnviroFlash is a free service that sends automated air quality and UV (ultraviolet) forecasts to subscribers. Those enrolled receive computer e-mails or text messages to their mobile phones. To receive notices and learn more about this program, select the 'Air Quality Notification' tab in **MIair** when logged onto www.michigan.gov/air. Michigan's EnviroFlash network has the potential to reach up to 98% of the state's population.

AIRNow

The DEQ supplies Michigan air monitoring data to AIRNow, the EPA's nation-wide air quality mapping system. Information about AIRNow is available at www.epa.gov/airnow or you can select the AIRNow hot link at the bottom of each **MIair** webpage.

Table 9.1: AQI Colors and Health Statements

AQI COLOR, CATEGORY & VALUE	PARTICULATE MATTER ($\mu g/m^3$) 24-Hour	OZONE (ppm) 8-Hour / 1-Hour	CARBON MONOXIDE (ppm) 8-hour	SULFUR DIOXIDE (ppm) 24-hour	NITROGEN DIOXIDE (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 pro-longed 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. Every-one else should avoid outdoor exertion.	Children and people with respiratory disease, such as asthma, should limit moderate or heavy outdoor exertion.

Chapter 10: Meteorological Information

The following **Figures 10.1** through **10.3** (average daily temperatures) and **Figures 10.4** through **10.6** (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 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 2010.

Figure 10.1: Southern Lower Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

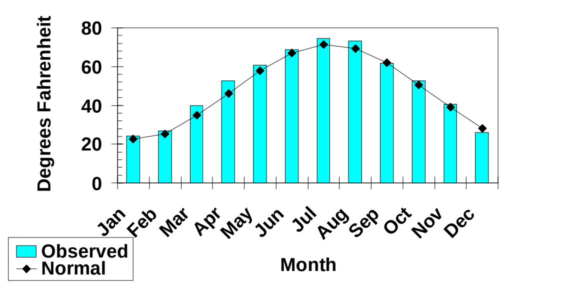


Figure 10.2: Northern Lower Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

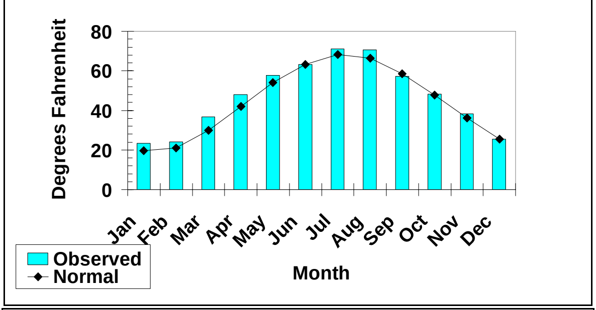


Figure 10.3: Upper Peninsula Observed Average Daily Temperatures vs. Normal Average Daily Temperatures

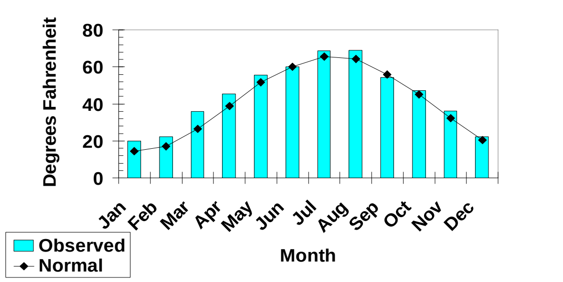


Figure 10.4: Southern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

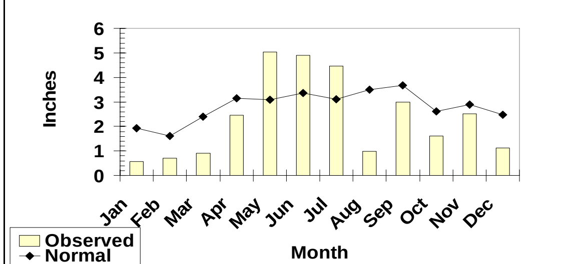


Figure 10.5: Northern Lower Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation

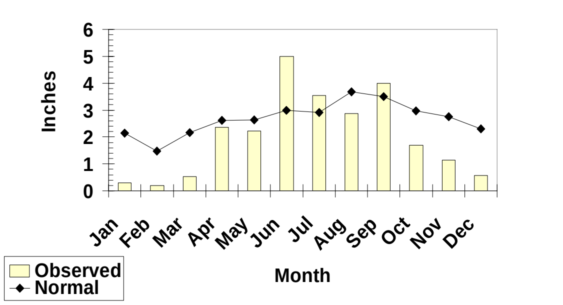
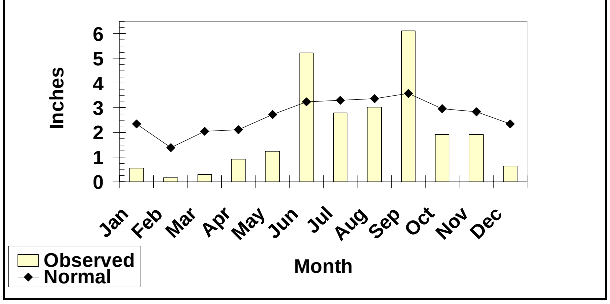


Figure 10.6: Upper Peninsula Observed Monthly Precipitation vs. Normal Monthly Precipitation



The weather plays a significant role in air quality, and can either help increase or decrease the amount of pollution in the air. *Action!* Days are declared when levels are expected to reach or exceed the Unhealthy for Sensitive Groups AQI health indicator – specifically, when meteorological conditions are conducive for the formation of elevated ground-level O_3 or $PM_{2.5}$ concentrations.

Table 10.1 Shows that there were four *Action!* Days declared during the summer of 2010. Five of the six locations exceeded the standard on August 30th and 31st.

Table 10.1

Location	Year	Number	Dates
Ann Arbor	2010	2	8/13, 8/14
Benton Harbor	2010	4	7/4, 8/13, 8/29,8/30
Detroit	2010	5	7/7 8/13, 8/14,8/30,8/31
Flint	2010	2	8/30,8/31
Grand Rapids	2010	5	7/4, 8/13, 8/29,8/30,8/31
Ludington	2010	4	7/4, 8/29, 8/30,8/31

Figure 10.7: Surface Map of Weather Conditions on August 30, 2010

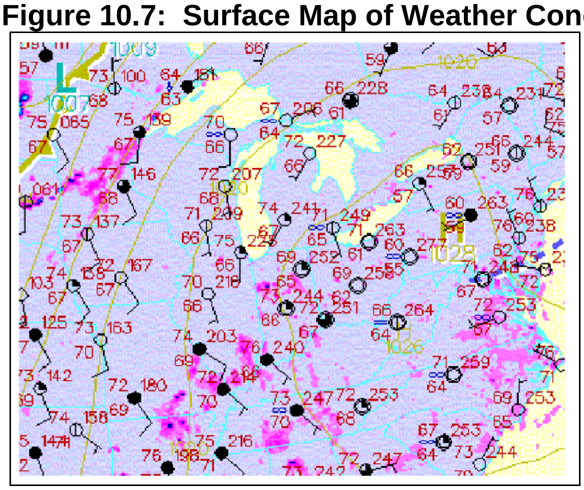


Figure 10.7 shows a surface map (courtesy of Unisys Weather: http://weather.unisys.com/) of the weather conditions on the morning of August 30.

From **Figure 10.7**, one can see that Michigan was to the west of the center of a high pressure system located over Pennsylvania and east of a low pressure front hovering over Minnesota and Manitoba. The weather conditions in southeast Michigan were hazy with scattered clouds and winds from the southeast. This caused photochemical reactions to occur which aided in ozone formation. Temperatures were in the upper 60s lower 70s during the morning hours, but reached the upper 80s to lower 90s in the late afternoon/early evening. Humidity levels were also high.

APPENDIX A: CRITERIA POLLUTANT SUMMARY FOR 2010

Appendix A utilizes EPA's 2010 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 $\mu g/m^3$ 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 (shown at right is a Met One SASS - spiral aerosol speciation sampler).

 # 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.

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.

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 2010

Trace 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
260810020	1	Grand Rapids	Kent	2010	8650	2.0	1.8	0	1.4	1.3	0
261630001	1	Allen Park	Wayne	2010	7748	2.2	2.2	0	1.4	1.2	0

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

Site ID	POC	City	County	Year	# OBS	Highest rolling 3-month Arith Mean	2nd Highest rolling 3-month Arith Mean	3rd Highest rolling 3-month Arith Mean	4th Highest rolling 3-month Arith Mean	# 3-month Means > .15	Highest Value (24 hr)	2nd Highest Value (24hr)
260670003	1	Belding	Ionia	2010	59	0.28	0.26	0.26	0.24	7	1.219	1.159
260810020	1	Grand Rapids	Kent	2010	55	0.01	0.01	0.01	0.01	0	0.015	0.011
261630001	1	Allen Park	Wayne	2010	60	0.01	0.01	0.01	0.01	0	0.013	0.013
261630033	1	Dearborn	Wayne	2010	60	0.02	0.01	0.01	0.01	0	0.052	0.050

NO_2 Measured in ppb

Site ID	POC	City	County	Year	# OBS	1-Hr Highest Value	1-Hr 2nd Highest Value	Annual Arith Mean
260650012	1	Lansing	Ingham	2010	4289	41.0	38.0	7.88*
261130001	1	Houghton Lake	Missaukee	2010	3303	9.0	8.0	.65*
261630019	2	Detroit - E. Seven Mile	Wayne	2010	8289	74.0	59.0	11.96

*Indicates the mean does not satisfy summary criteria

NO_Y Measured in ppb

Site ID	POC	City	County	Year	# OBS	1-Hr Highest Value	1-Hr 2nd Highest Value	Annual Arith Mean
260810020	1	Grand Rapids	Kent	2010	8228	271.0	254.0	17.37
261630001	1	Allen Park	Wayne	2010	6916	200.4	200.4	25.19

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	2010	183	183	.089	.084	.084	.084	0	0.0	0
260190003	1	Benzonia	Benzie	2010	183	183	.084	.082	.079	.078	0	0.0	0
260210014	1	Coloma	Berrien	2010	182	183	.091	.089	.086	.081	0	0.0	1

O_3 (1-Hour) Measured in ppm (continued)

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
260270003	2	Cassopolis	Cass	2010	181	183	.089	.079	.077	.076	0	0.0	2
260370001	2	Rose Lake	Clinton	2010	183	183	.080	.079	.073	.070	0	0.0	0
260490021	1	Flint	Genesee	2010	183	183	.088	.081	.082	.079	0	0.0	0
260492001	1	Otisville	Genesee	2010	183	183	.080	.079	.078	.077	0	0.0	0
260630007	1	Harbor Beach	Huron	2010	183	183	.084	.082	.081	.078	0	0.0	0
260650012	2	Lansing	Ingham	2010	183	183	.080	.079	.072	.071	0	0.0	0
260770008	1	Kalamazoo	Kalamazoo	2010	183	183	.081	.080	.077	.076	0	0.0	0
260810020	1	Grand Rapids	Kent	2010	183	183	.083	.082	.079	.076	0	0.0	0
260810022	1	Evans	Kent	2010	183	183	.085	.081	.072	.072	0	0.0	0
260910007	1	Tecumseh	Lenawee	2010	140	183	.075	.073	.072	.070	0	0.0	0
260990009	1	New Haven	Macomb	2010	181	183	.105	.101	.101	.097	0	0.0	0
260991003	1	Warren	Macomb	2010	183	183	.094	.085	.084	.083	0	0.0	0
261010933	1	Manistee	Manistee	2010	175	183	.084	.082	.081	.076	0	0.0	0
261050007	1	Scottville	Mason	2010	183	183	.095	.080	.077	.077	0	0.0	0
261130001	1	Houghton Lake	Missaukee	2010	181	183	.074	.074	.069	.069	0	0.0	2
261210039	1	Muskegon	Muskegon	2010	183	183	.096	.088	.088	.086	0	0.0	0
261250001	2	Oak Park	Oakland	2010	183	183	.093	.084	.083	.080	0	0.0	0
261390005	1	Jenison	Ottawa	2010	183	183	.086	.080	.078	.077	0	0.0	0
261470005	1	Port Huron	St .Clair	2010	183	183	.092	.091	.089	.086	0	0.0	0
261530001	1	Seney	Schoolcraft	2010	183	183	.101	.089	.087	.085	0	0.0	0
261610008	1	Ypsilanti	Washtenaw	2010	182	183	.078	.076	.075	.074	0	0.0	1
261630001	2	Allen Park	Wayne	2010	179	183	.087	.082	.080	.080	0	0.0	0
261630019	2	Detroit - E. Seven Mile	Wayne	2010	170	183	.096	.095	.095	.093	0	0.0	0

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 > 0.075
260050003	1	Holland	Allegan	2010	100	183	.077	.076	.075	.073	2
260190003	1	Benzonia	Benzie	2010	100	183	.074	.074	.073	.072	0
260210014	1	Coloma	Berrien	2010	99	181	.079	.074	.074	.072	1
260270003	2	Cassopolis	Cass	2010	98	179	.073	.071	.071	.069	0
260370001	2	Rose Lake	Clinton	2010	57	183	.075	.068	.066	.065	0
260490021	1	Flint	Genesee	2010	100	183	.074	.074	.072	.070	0
260492001	1	Otisville	Genesee	2010	100	183	.075	.068	.067	.066	0
260630007	1	Harbor Beach	Huron	2010	100	183	.078	.073	.069	.069	1
260650012	2	Lansing	Ingham	2010	100	183	.074	.067	.067	.065	0
260770008	1	Kalamazoo	Kalamazoo	2010	99	181	.076	.069	.069	.067	1
260810020	1	Grand Rapids	Kent	2010	99	181	.073	.072	.072	.069	0

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 > 0.075
260810022	1	Evans	Kent	2010	98	180	.076	.074	.070	.067	1
260910007	1	Tecumseh	Lenawee	2010	75	138	.067	.067	.067	.066	0
260990009	1	New Haven	Macomb	2010	99	181	.089	.086	.077	.076	5
260991003	1	Warren	Macomb	2010	100	183	.081	.076	.074	.074	2
261010922	1	Manistee	Manistee	2010	95	173	.077	.073	.071	.068	1
261050007	1	Scottville	Mason	2010	100	183	.078	.072	.070	.070	1
261130001	1	Houghton Lake	Missaukee	2010	99	181	.069	.069	.065	.065	0
261210039	1	Muskegon	Muskegon	2010	100	183	.079	.077	.077	.076	4
261250001	2	Oak Park	Oakland	2010	99	181	.082	.075	.075	.073	1
261390005	1	Jenison	Ottawa	2010	99	182	.076	.073	.073	.072	1
261470005	1	Port Huron	St .Clair	2010	100	183	.085	.082	.077	.076	5
261530001	1	Seney	Schoolcraft	2010	100	183	.091	.079	.078	.075	3
261610008	1	Ypsilanti	Washtenaw	2010	99	182	.074	.070	.067	.066	0
261630001	2	Allen Park	Wayne	2010	98	179	.071	.071	.069	.069	0
261630019	2	Detroit - E. Seven Mile	Wayne	2010	92	169	.082	.082	.078	.078	7

$PM_{2.5}$ (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	2010	121	32.2	25.2	24.6	22.6	24.6	8.50
260170014	1	FRM	Bay City	Bay	2010	121	36.3	33.3	31.1	28.3	31.1	8.16
260210014	1	FRM	Coloma	Berrien	2010	112	26.5	25.0	23.3	23.0	23.3	8.74
260490021	1	FRM	Flint	Genesee	2010	122	30.3	27.8	24.7	24.5	24.7	8.88
260650012	1	FRM	Lansing	Ingham	2010	112	33.6	24.7	23.7	22.0	23.7	8.98
260770008	1	FRM	Kalamazoo	Kalamazoo	2010	117	33.9	22.4	21.5	21.3	21.5	9.31
260770008	2	FRM	Kalamazoo	Kalamazoo	2010	52	33.1	20.8	20.4	19.8	20.8	9.19*
260810007	1	FRM	Grand Rapids - Wealthy	Kent	2010	115	40.0	22.9	22.4	22.4	22.4	9.63
260810020	1	FRM	Grand Rapids - Monroe	Kent	2010	121	41.1	25.0	24.3	24.2	24.3	9.62
260810020	2	FRM	Grand Rapids - Monroe	Kent	2010	59	41.4	24.3	22.5	21.8	24.3	10.04
260910007	1	FRM	Tecumseh	Lenawee	2010	117	32.7	24.0	22.3	22.2	22.3	8.91
260990009	1	FRM	New Haven	Macomb	2010	122	31.6	27.5	25.5	25.4	25.5	8.92
261010922	1	FRM	Manistee	Manistee	2010	118	23.7	23.1	21.9	19.9	21.9	6.61
261130001	1	FRM	Houghton Lake	Missaukee	2010	111	23.4	18.4	17.6	17.2	17.6	5.94
261150005	1	FRM	Luna Pier	Monroe	2010	119	38.0	27.5	26.3	25.0	26.3	9.36
261210040	1	FRM	Muskegon	Muskegon	2010	120	30.8	24.5	23.4	22.8	23.4	8.26
261250001	1	FRM	Oak Park	Oakland	2010	118	28.9	27.1	24.9	27.1	30.1	9.12

$PM_{2.5}$ (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
261390005	1	FRM	Jenison	Ottawa	2010	120	33.5	24.0	22.7	22.6	22.7	9.15
261470005	1	FRM	Port Huron	St. Clair	2010	119	37.8	30.3	25.8	24.1	25.8	8.94
261610008	1	FRM	Ypsilanti	Washtenaw	2010	118	27.7	27.0	23.3	23.2	23.3	9.24
261610008	2	FRM	Ypsilanti	Washtenaw	2010	59	28.2	22.4	19.9	19.6	22.4	9.40
261630001	1	FRM	Allen Park	Wayne	2010	334	34.8	31.5	30.6	28.7	27.8	10.23
261630001	2	FRM	Allen Park	Wayne	2010	1	3.2				3.2	3.20
261630015	1	FRM	Detroit - W. Fort	Wayne	2010	120	34.6	30.0	26.6	25.9	26.6	10.67
261630016	1	FRM	Detroit - Linwood	Wayne	2010	115	35.2	28.0	27.9	27.8	27.9	9.85
261630019	1	FRM	Detroit - E. Seven Mile	Wayne	2010	108	32.5	31.3	28.6	26.2	28.6	9.89
261630025	1	FRM	Livonia	Wayne	2010	114	27.0	26.8	25.3	25.0	25.3	9.10
261630033	1	FRM	Dearborn	Wayne	2010	118	38.0	29.0	28.6	28.2	28.6	11.33
261630036	1	FRM	Wyandotte	Wayne	2010	113	32.7	24.9	24.4	24.3	24.4	9.44*
261630038	1	FRM	Detroit - Newberry.	Wayne	2010	118	36.1	34.7	30.4	25.6	30.4	10.04
261630039	1	FRM	Detroit – W. Lafayette	Wayne	2010	332	39.6	32.9	31.8	30.7	27.7	10.04

*Indicates the mean does not satisfy summary criteria

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

Site ID	POC	Monitor (with FDMS)	City	County	Year	# OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd. Arith. Mean
260170014	3	TEOM	Bay City	Bay	2010	7927	47.0	41.0	40.0	39.0	8.87
260490021	3	TEOM	Flint	Genesee	2010	8153	116.0	80.0	54.0	48.0	9.17
260650012	5	TEOM	Lansing	Ingham	2010	8551	76.0	69.0	42.0	41.0	9.33
260770008	3	TEOM	Kalamazoo	Kalamazoo	2010	7774	56.0	54.0	52.0	50.0	10.97
260810020	3	TEOM	Grand Rapids	Kent	2010	8661	57.0	48.0	46.0	45.0	9.33
260910007	3	TEOM	Tecumseh	Lenawee	2010	8673	90.0	51.0	50.0	48.0	9.37
261130001	3	TEOM	Houghton Lake	Missaukee	2010	7086	56.0	48.0	44.0	38.0	7.04
261470005	3	TEOM	Port Huron	St. Clair	2010	8625	68.0	59.0	56.0	53.0	9.75
261530001	3	TEOM	Seney	Schoolcraft	2010	8488	223.0	128.0	109.0	101.0	5.86
261610008	3	TEOM	Ypsilanti	Washtenaw	2010	8711	55.0	53.0	50.0	48.0	10.06
261630001	3	TEOM	Allen Park	Wayne	2010	8605	82.0	74.0	67.0	59.0	10.76
261630033	3	TEOM	Dearborn	Wayne	2010	8673	122.0	117.0	100.0	98.0	11.58
261630038	3	TEOM	Detroit – 29th Street	Wayne	2010	8559	100.0	99.0	99.0	97.0	10.92
261630039	3	TEOM	Detroit – W. Lafayette	Wayne	2010	8313	132.0	85.0	63.0	58.0	10.68

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

Site ID	POC	Monitor	City	County	Year	# OBS	# Req.	Valid Days	% OBS	Highest Value	2nd Highest Value	3rd Highest Value	4th Highest Value	Wtd Arith Mean
260810007	1	GRAV	Grand Rapids - Wealthy	Kent	2010	60	61	60	98	39	37	32	32	14.0
260810020	1	GRAV	Grand Rapids - Monroe	Kent	2010	44	61	44	72	28	27	24	23	12.9*
261630001	1	GRAV	Allen Park	Wayne	2010	59	61	59	97	38	32	30	28	14.7
261630005	1	GRAV	River Rouge	Wayne	2010	59	61	56	92	65	46	43	41	20.1
261630015	1	GRAV	Detroit - W. Fort	Wayne	2010	59	61	58	95	63	49	46	44	20.6
261630033	1	GRAV	Dearborn	Wayne	2010	61	61	60	98	66	52	49	41	20.9

*Indicates the mean does not satisfy summary 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	2010	8167	321	239	237	237	21.5

SO_2 Measured in ppb

Site ID	POC	City	County	Year	# OBS	24-hr Highest Value	24-hr 2nd Highest Value	99th %ile 1-hr	OBS > 0.5	1-hr Highest Value	1-hr 2nd Highest Value	Arith Mean
261630015	1	Detroit - W. Fort	Wayne	2010	8723	68.4	48.8	107.0	0	160.0	125.0	3.39
260810020	2	Grand Rapids	Kent	2010	8194	6.2	4.5	17.8	0	45.9	25.2	.96
261630001	1	Allen Park	Wayne	2010	8217	14.2	11.3	57.2	0	67.1	65.1	1.56

APPENDIX B: 2009 AIR TOXICS MONITORING SUMMARY FOR METALS, VOCS, CARBONYL COMPOUNDS, PAHS, HEXAVALENT CHROMIUM & SPECIATED $PM_{2.5}$

Appendix B provides summary statistics of ambient air concentrations of various substances monitored in Michigan during 2010. At each monitoring site, air samples were taken over a 24-hour period (midnight to midnight). These air samples represent the average air concentration during that 24-hour period. The frequency of air samples collected is typically done once every 6 or 12 days. Sometimes the sampled air concentration is lower than the laboratory's analytical method detection level (MDL). When the concentration is lower than the MDL, two options are used to estimate the air concentration. The calculation of the minimum average ("Average (ND=0)") uses 0.0 μg/m³ for a value less than the MDL. In the calculation of the maximum average ("Average (ND=MDL/2)") the MDL divided by 2 (i.e., ½ the MDL) is substituted for air concentrations less than the MDL.

Table B shows the monitoring stations and what types of air toxics were monitored at each station in 2010. The following terms and acronyms are used in **Appendix B-1** and **B-2** data tables:

- Num Obs: Number of Observations (number of daily air samples taken during the year)
- Obs>MDL: Number of daily samples above the MDL
- Average (ND=0): average air concentration in 2010, assuming daily samples below MDL were equal to 0.0 μg/m³.
- Average (ND=MDL/2): average air concentration in 2010, assuming daily samples below MDL were equal to one half MDL.
- MDL: Analytical MDL in units of μg/m³
- Max1: Highest daily air concentration during 2009
- Max2: Second highest daily air concentration during 2009
- Max3: Third highest daily air concentration during 2009
- μg/m³: Micrograms per cubic meter (1,000,000 μg = 1 g)

Table B: Monitoring Stations and Types of Air Samples Collected

	Appendix B-1						Appendix B-2
Site Name	**VOC**	**Carbonyl**	**PAHs**	**Metals TSP**	**Metals PM_{10}**	**Hex Chrome**	**Speciated PM2.5**
Allen Park				x	x		x
Dearborn	x	x	x	x	x	x	x
Detroit, W. Fort	x	x		x	Mn		x
Detroit, W. Jefferson				x			
Detroit, Heidt St				x			
Flint				Mn			
Grand Rapids				x			x
Belding				x			
Houghton Lake							x
Luna Pier							x
Port Huron							x
River Rouge		x		x	Mn		
Tecumseh							x

VOC = volatile organic compound; SVOC = semi-volatile organic compound; TSP = total suspended particulate; PM_{10} = particulate matter with aerodynamic diameter less than 10 μm; Hex Chrome = hexavalent chromium (Cr+6)

APPENDIX B-1

Allen Park (261630001) Concentrations in micrograms per cubic meter (µg/m^3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (PM-10)	59	59	0.00124	0.00124	0.0000672	0.00696	0.00449	0.00367
Arsenic (TSP)	60	60	0.00149	0.00149	0.0000488	0.00844	0.00443	0.00436
Cadmium (PM-10)	59	59	0.00032	0.000317	0.0000286	0.00285	0.000867	0.000733
Cadmium (TSP)	60	60	0.00020	0.000197	0.0000406	0.000495	0.000455	0.000432
Chromium (PM-10)	58	58	0.00275	0.00275	0.000271	0.00427	0.00405	0.0037
Lead (PM-10)	59	59	0.00406	0.00406	0.0000357	0.0121	0.0113	0.00874
Lead (TSP)	60	60	0.00514	0.00514	0.0000286	0.0134	0.0132	0.0115
Manganese (PM-10)	59	59	0.00899	0.00899	0.000317	0.0299	0.025	0.022
Manganese (TSP)	60	60	0.0214	0.0214	0.000255	0.0739	0.06	0.0522
Nickel (PM-10)	59	59	0.00072	0.000718	0.000161	0.00174	0.00164	0.00146
Nickel (TSP)	60	60	0.00114	0.00114	0.000129	0.00263	0.00226	0.00226

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m^3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
1,1,1-Trichloroethane	67	52	0.0498	0.0620	0.109	0.338	0.0818	0.0818
1,1,2,2-Tetrachloroethane	67	0	0	0.0378	0.0755	0	0	0
1,1,2-Trichloroethane	67	0	0	0.0491	0.0982	0	0	0
1,1-Dichloroethane	67	0	0	0.0344	0.0688	0	0	0
1,2,4-Trichlorobenzene	67	0	0.00000	0.0680	0.134			
1,2,4-Trimethylbenzene	67	67	0.706	0.706	0.0541	2.85	2.76	2.55
1,2-Dibromoethane	67	0	0	0.0461	0.0922	0	0	0
1,2-Dichlorobenzene	67	1	0.00135	0.0369	0.0721	0.0902	0	0
1,2-Dichloroethane	67	13	0.0146	0.0390	0.0607	0.105	0.089	0.085
1,2-Dichloropropane	67	0	0	0.0578	0.116	0	0	0
1,3,5-Trimethylbenzene	67	64	0.234	0.235	0.0492	0.944	0.919	0.895
1,3-Butadiene	67	66	0.0873	0.0874	0.0221	0.372	0.288	0.197
1,3-Dichlorobenzene	67	1	0.00188	0.0315	0.0601	0.126	0	0
1,4-Dichlorobenzene	67	31	0.0319	0.0481	0.0601	0.18	0.168	0.15
2,5-dimethylbenzaldehyde	64	0	0	0.00256	0.00513	0	0	0
2-Chloro-1,3-Butadiene	67	0	0	0.0253	0.0507	0	0	0
Acenapthene	65	65	0.0137	0.0137	0.0000678	0.175	0.121	0.0551
Acenapthylene	65	41	0.0006326	0.000641	0.0000452	0.00264	0.00233	0.00226
Acetaldehyde	64	64	1.53	1.53	0.00898	3.46	2.96	2.83
Acetone	64	64	2.93	2.93	0.0142	14.7	6.39	5.77
Acetonitrile	67	67	0.619	0.619	0.0269	1.25	1.15	1.15
Acetylene	67	67	1.07	1.07	0.0266	4.21	2.76	2.53
Acrylonitrile	67	3	0.00233	0.0303	0.0586	0.0868	0.0478	0.0217
Anthracene	65	57	0.0007323	0.000736	0.0000500	0.00642	0.00361	0.0031
Arsenic (PM-10)	115	114	0.0018299	0.00183	0.0000856	0.0165	0.0164	0.0068
Arsenic (TSP)	114	114	0.00163	0.00163	0.0000497	0.00813	0.00716	0.00618

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m^3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Barium (PM-10)	115	115	0.0157	0.0157	0.00140	0.183	0.178	0.0362
Barium (TSP)	114	114	0.0262	0.0262	0.00108	0.0576	0.0574	0.0496
Benzaldehyde	63	63	0.119	0.119	0.00703	0.243	0.239	0.221
Benzene	67	67	0.925	0.924	0.0607	2.56	2.23	1.92
Benzo[a]anthracene	65	45	0.0001521	0.000161	0.0000504	0.00106	0.000811	0.000799
Benzo[a]pyrene	65	59	0.0001751	0.000177	0.0000467	0.00103	0.000741	0.000591
Benzo[b]fluoranthene	65	65	0.0004794	0.000479	0.0000671	0.00227	0.00191	0.00181
Benzo[g,h,i]perylene	65	65	0.0002368	0.000237	0.0000334	0.000968	0.00087	0.00083
Benzo[k]fluoranthene	65	58	0.0001254	0.000128	0.0000458	0.000604	0.00055	0.000502
Beryllium (PM-10)	115	108	0.0003013	0.000301	0.0000447	0.0166	0.0154	.0000816
Beryllium (TSP)	114	114	0.0000770	0.0000771	0.0000731	0.000238	0.000226	0.000222
Bromochloromethane	67	0	0	0.0476	0.0953	0	0	0
Bromodichloromethane	67	0	0	0.0704	0.141	0	0	0
Bromoform	67	0	0	0.0569	0.114	0	0	0
Bromomethane (Methyl Bromide)	67	53	0.0335	0.0388	0.0505	0.0699	0.0544	0.0544
Cadmium (PM-10)	115	114	0.0006933	0.000693	0.0000467	0.0169	0.0169	0.00227
Cadmium (TSP)	114	113	0.0004112	0.000411	0.0000415	0.00219	0.0021	0.00169
Carbon Disulfide	67	67	0.156	0.156	0.0343	0.529	0.495	0.38
Carbon Tetrachloride	67	67	0.694	0.694	0.151	1.08	0.931	0.925
Chlorobenzene	67	0	0	0.0322	0.0645	0	0	0
Chloroethane	67	27	0.0211	0.0305	0.0317	0.116	0.0765	0.0739
Chloroform	67	67	0.608	0.608	0.083	1.77	1.71	1.36
Chloromethane	67	67	1.37	1.37	0.033	1.77	1.75	1.67
Chloromethyl Benzene	67	0	0	0.0440	0.088	0	0	0
Chromium (PM-10)	115	115	0.00371	0.00371	0.000273	0.022	0.021	0.0209
Chromium (TSP)	114	114	0.00493	0.00493	0.00022	0.0138	0.0131	0.0116
Chromium VI (TSP)	64	57	0.0000447	0.0000450	0.000003	0.000158	0.00015	0.000138
Chrysene	65	65	0.000454	0.000454	0.0000395	0.0022	0.0017	0.00155
cis-1,2-Dichloroethene	67	1	0.00888	0.0792	0.143	0.595	0	0
cis-1,3-Dichloropropene	67	0	0	0.0340	0.0681	0	0	0
Cobalt (PM-10)	115	114	0.000644	0.000643	0.0000415	0.0186	0.0174	0.00957
Cobalt (TSP)	114	114	0.000236	0.000236	0.0000393	0.000868	0.000765	0.000674
Copper (PM-10)	115	114	0.0559	0.0559	0.000801	0.351	0.342	0.199
Copper (TSP)	114	114	0.190	0.190	0.000635	2	1.1	0.448
Dibeno[a,h]anthracene	65	19	0.0000194	0.0000335	0.0000391	0.000184	0.000165	0.000162
Dibromochloromethane	67	0	0	0.0469	0.0937	0	0	0
Dichlorodiflouromethane	67	67	2.85	2.85	0.0593	3.79	3.48	3.46
Ethyl Acrylate	67	0	0	0.0225	0.045	0	0	0
Ethyl Tert-Butyl Ether	67	0	0	0.0188	0.0376	0	0	0
Ethylbenzene	67	67	0.503	0.503	0.0521	2.51	1.39	1.35
Fluoranthene	65	65	0.00478	0.00478	0.0000413	0.0232	0.0187	0.0142
Fluorene	65	65	0.0125	0.0125	0.0000495	0.152	0.114	0.0448
Formaldehyde	64	64	2.77	2.77	0.00387	8.2	5.91	5.04

Dearborn (261630033) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Halocarbon 114	67	67	0.124	0.124	0.0839	0.147	0.147	0.147
Hexachloro-1,3-Butadiene	67	0	0	0.0640	0.128	0	0	0
Hexanaldehyde	64	64	0.107	0.107	0.00409	0.275	0.213	0.209
Indeno[1,2,3-Cd]pyrene	65	64	0.000222	0.000222	0.0000317	0.000863	0.00085	0.000819
Iron (PM-10)	115	115	0.635	0.635	0.000002	4.39	2.29	2.28
Iron (TSP)	114	114	1.20	1.20	0.0000020	3.65	3.26	3.24
Isovaleraldehyde	64	2	0.00264	0.00603	0.00699	0.0916	0.0775	0
Lead (PM-10)	115	114	0.0107	0.0107	0.0000618	0.0602	0.055	0.0504
Lead (TSP)	114	114	0.0118	0.0118	0.0000553	0.0602	0.0536	0.0523
m/p -Xylene	67	67	1.47	1.47	0.0608	8.6	4.78	4.39
Manganese (PM-10)	115	115	0.0451	0.0451	0.000315	0.412	0.393	0.302
Manganese (TSP)	114	114	0.0867	0.0867	0.000256	0.43	0.278	0.259
Methyl Ethyl Ketone	67	66	0.882	0.882	0.0767	2.41	2.34	2
Methyl Isobutyl Ketone	67	66	0.242	0.242	0.041	0.754	0.635	0.594
Methyl Methacrylate	67	1	0.00306	0.0434	0.0819	0.205	0	0
Methyl Tert-Butyl Ether	67	1	0.000269	0.0163	0.0325	0.018	0	0
Methylene Chloride	67	67	1.33	1.33	0.0799	4.76	4.2	3.23
Molybdenum (PM-10)	114	113	0.00209	0.00209	0.0000645	0.0787	0.0174	0.0173
Molybdenum (TSP)	114	114	0.00111	0.00111	0.0000558	0.00914	0.00725	0.00483
Naphthalene	65	65	0.135	0.135	0.00136	0.411	0.36	0.336
Nickel (PM-10)	115	114	0.0118	0.0118	0.000161	0.806	0.271	0.0537
Nickel (TSP)	114	114	0.00256	0.00256	0.000129	0.0386	0.0187	0.00668
n-Octane	67	53	0.173	0.179	0.0561	1.85	0.981	0.481
o-xylene	67	67	0.413	0.413	0.0434	1.35	1.17	1.01
Phenanthrene	65	65	0.0200	0.0200	0.000128	0.146	0.112	0.0799
Propionaldehyde	64	64	0.282	0.282	0.00479	0.651	0.594	0.53
Propylene	67	67	0.742	0.742	0.0482	2.34	1.53	1.47
Pyrene	65	65	0.00252	0.00252	0.0000406	0.00995	0.00814	0.00664
Styrene	67	43	0.0547	0.0624	0.0426	0.213	0.204	0.196
Tetrachloroethene	67	60	0.204	0.208	0.0746	1.09	0.821	0.61
Tolualdehydes	57	57	0.148	0.148	0.0109	0.369	0.359	0.339
Toluene	67	67	1.66	1.66	0.049	5.35	4.67	4.6
trans-1,2-Dichloroethene	67	0	0	0.0278	0.0555	0	0	0
trans-1,3-Dichloropropene	67	0	0	0.0363	0.0726	0	0	0
Trichloroethene	67	17	0.0261	0.0602	0.0913	0.36	0.333	0.204
Trichloroflouromethane	67	67	1.68	1.68	0.0674	3.25	2.96	2.32
Valeraldehyde	64	64	0.0843	0.0843	0.00705	0.19	0.183	0.176
Vanadium (PM-10)	112	112	0.00228	0.00228	0.0000695	0.0239	0.019	0.00683
Vanadium (TSP)	114	114	0.00344	0.00344	0.0000640	0.0106	0.0102	0.00981
Vinyl Chloride	67	7	0.00233	0.0172	0.0332	0.0562	0.0256	0.0179
Zinc (PM-10)	115	115	0.0758	0.0758	0.000874	0.385	0.345	0.32
Zinc (TSP)	114	114	0.110	0.110	0.000674	0.462	0.438	0.326

Detroit, Fort Street (N. Delray-SWHS) (261630015) Concentrations in micrograms per cubic meter (µg/m^3)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
1,1,1-Trichloroethane	30	0	0	0.276	0.552	0	0	0
1,1,2,2-Tetrachloroethane	30	0	0	0.382	0.764	0	0	0
1,1,2-Trichloroethane	30	0	0	0.497	0.994	0	0	0
1,1-Dichloroethane	30	0	0	0.139	0.277	0	0	0
1,1-Dichloroethene	30	0	0	0.135	0.271	0	0	0
1,2,4-Trichlorobenzene	30	0	0	0.8	1.6			
1,2,4-Trichlorobenzene	30	0	0	0.8	1.6	0	0	0
1,2,4-Trimethylbenzene	30	11	0.441	0.648	0.655	2.3	1.9	1.4
1,2-Dibromoethane	30	0	0	0.6	1.2	0	0	0
1,2-Dichlorobenzene	30	0	0	0.357	0.714	0	0	0
1,2-Dichlorobenzene	30	0	0	0.357	0.714			
1,2-Dichloroethane	30	0	0	0.208	0.416	0	0	0
1,2-Dichloropropane	30	0	0	0.266	0.532	0	0	0
1,3,5-Trimethylbenzene	30	1	0.0217	0.329	0.635	0.65	0	0
1,3-Butadiene	30	0	0	0.267	0.534	0	0	0
1,3-Dichlorobenzene	30	0	0	0.379	0.757			
1,3-Dichlorobenzene	30	0	0	0.379	0.757	0	0	0
1,4-Dichlorobenzene	30	0	0	0.339	0.678	0	0	0
1,4-Dichlorobenzene	30	0	0	0.339	0.678			
2,2,4-Trimethylpentane	30	10	0.290	0.425	0.404	1.6	1.3	1.2
2,5-dimethylbenzaldehyde	29	0	0	0.0275	0.0549	0	0	0
2-Chloro-1,3-Butadiene	30	0	0	0.124	0.247	0	0	0
Acetaldehyde	29	29	2.016	2.02	0.0242	3.83	3.34	2.98
Acetone	29	29	3.439	3.44	0.0783	8.19	7.57	6.05
Acetonitrile	30	4	0.177	0.653	1.1	1.6	1.4	1.2
Acrylonitrile	30	0	0	0.0722	0.144	0	0	0
Arsenic (TSP)	59	59	0.00159	0.00159	0.00005	0.00406	0.00384	0.00357
Barium (TSP)	3	3	0.0297	0.0297	0.00134	0.0321	0.0292	0.0277
Benzaldehyde	29	1	0.0284	0.0392	0.0223	0.825	0	0
Benzene	30	28	1.16	1.16	0.219	4.6	2.7	2.2
Beryllium (TSP)	3	3	0.000168	0.000168	0.0001066	0.000399	5.57E-05	5.03E-05
Bromodichloromethane	30	0	0	0.55	1.1	0	0	0
Bromoform	30	0	0	0.85	1.7	0	0	0
Bromomethane (Methyl Bromide)	30	0	0	0.5	1	0	0	0
Cadmium (TSP)	59	59	0.000377	0.000377	0.00004	0.00109	0.00109	0.00103
Carbon Tetrachloride	30	13	0.357	0.542	0.650	0.94	0.94	0.9
Chlorobenzene	30	1	0.0467	0.399	0.730	1.4	0	0
Chloroethane	30	0	0	0.368	0.735	0	0	0
Chloroform	30	29	1.14	1.15	0.512	2.1	2	1.8
Chloromethane	30	30	1.52	1.52	0.599	2.7	2.6	2.5
Chloromethyl Benzene	30	1	0.0323	0.415	0.791	0.97	0	0
Chromium (TSP)	3	3	0.00390	0.00390	0.000226	0.00443	0.00393	0.00335
cis-1,2-Dichloroethene	30	0	0	0.108	0.215	0	0	0

Detroit, Fort Street (N. Delray-SWHS) (261630015) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
cis-1,3-Dichloropropene	30	0	0	0.313	0.625	0	0	0
Cobalt (TSP)	3	3	0.00025	0.000250	0.00001	0.000299	0.000235	0.000216
Copper (TSP)	3	3	0.293	0.293	0.000704	0.39	0.297	0.193
Crotonaldehyde (trans)	29	1	0.0151	0.0214	0.0130	0.439	0	0
Dibromochloromethane	30	0	0	0.742	1.48	0	0	0
Dichlorodiflouromethane	30	30	3.19	3.19	0.634	5.1	4.6	4.5
Ethylbenzene	30	3	0.109	0.43	0.714	1.3	1	0.96
Formaldehyde	29	29	2.47	2.47	0.0261	5.91	4.68	3.96
Halocarbon 113	30	20	0.559	0.664	0.626	1.2	1.1	1.1
Halocarbon 114	30	0	0	0.853	1.71	0	0	0
Hexachloro-1,3-Butadiene	30	0	0	0.8	1.6	0	0	0
Hexanaldehyde	29	0	0	0.0215	0.0429	0	0	0
Iron (TSP)	3	3	1.19	1.19	0	1.64	1.04	0.895
Isovaleraldehyde	29	0	0	0.0135	0.0271	0	0	0
Lead (TSP)	3	3	0.0120	0.0120	0.0000297	0.0185	0.01	0.00735
m,p-Tolualdehyde	29	2	0.0786	0.0975	0.0410	1.2	1.08	0
m/p -Xylene	30	17	0.935	1.09	0.735	4.4	3.1	2.6
Manganese (PM-10)	59	59	0.0342	0.0342	0.000319	0.393	0.264	0.0733
Manganese (TSP)	59	59	0.0595	0.0595	0.000251	0.247	0.175	0.151
Methyl Ethyl Ketone	30	30	1.98	1.98	0.12	4.4	3.4	3.2
Methyl Isobutyl Ketone	30	25	1.007	1.05	0.51	6.1	2.5	2.3
Methyl Tert-Butyl Ether	30	0	0	0.103	0.206	0	0	0
Methylene Chloride	30	26	0.612	0.628	0.243	5.2	0.92	0.78
Molybdenum (TSP)	3	3	0.000873	0.000872	0.0000416	0.00113	0.000769	0.000719
n-Butyraldehyde	29	10	0.215	0.220	0.0140	1.5	0.858	0.77
n-Hexane	30	29	1.76	1.76	0.230	12	5.6	4.2
Nickel (TSP)	59	59	0.00544	0.00544	0.000128	0.147	0.0184	0.00837
o-Tolualdehyde	29	0	0	0.0173	0.0345	0	0	0
o-xylene	30	5	0.164	0.445	0.675	1.1	1.1	1.1
Propionaldehyde	29	26	0.826	0.828	0.0401	6.38	4.28	0.87
Styrene	30	0	0	0.252	0.504	0	0	0
Tetrachloroethene	30	0	0	0.54	1.08	0	0	0
Toluene	30	30	2.53	2.53	0.462	7	5.9	5.1
trans-1,2-Dichloroethene	30	0	0	0.144	0.287	0	0	0
trans-1,3-Dichloropropene	30	0	0	0.317	0.633	0	0	0
Trichloroethene	30	0	0	0.257	0.514	0	0	0
Trichloroflouromethane	30	30	1.76	1.76	0.506	2.9	2.7	2.3
Valeraldehyde	29	0	0	0.0205	0.0410	0	0	0
Vanadium (TSP)	3	3	0.00619	0.00619	0.0000416	0.0138	0.00258	0.00218
Vinyl Chloride	30	0	0	0.302	0.604	0	0	0
Zinc (TSP)	3	3	0.0534	0.0534	0.000838	0.0691	0.0495	0.0416

Detroit, W. Jefferson, South Delray (261630027) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (TSP)	57	57	0.00212	0.00212	0.00005	0.00738	0.00726	0.00575
Barium (TSP)	3	3	0.06027	0.06024	0.00136	0.068	0.0615	0.0513
Beryllium (TSP)	3	3	0.00056	0.00056	0.00011	0.00073	0.00054	0.00041
Cadmium (TSP)	57	57	0.00058	0.00058	0.00004	0.00333	0.00178	0.00127
Chromium (TSP)	3	3	0.01064	0.01063	0.00023	0.0118	0.0112	0.00893
Cobalt (TSP)	3	3	0.00075	0.00075	0.00001	0.00077	0.00075	0.00074
Copper (TSP)	3	3	0.17900	0.17892	0.00072	0.206	0.192	0.139
Iron (TSP)	3	3	3.47	3.47353	0.000002	4.07	3.31	3.04
Lead (TSP)	3	3	0.0193	0.01926	0.00003	0.0241	0.0203	0.0134
Manganese (TSP)	57	57	0.142	0.14176	0.00026	0.696	0.519	0.50200
Molybdenum (TSP)	3	3	0.00144	0.00144	0.00004	0.0016	0.00149	0.001
Nickel (TSP)	57	57	0.00292	0.00292	0.00013	0.00885	0.00768	0.00705
Vanadium (TSP)	3	3	0.0118	0.01185	0.00004	0.0198	0.0084	0.00733
Zinc (TSP)	3	3	0.0916	0.09146	0.00085	0.108	0.0926	0.0741

Detroit, Heidt St (261630046) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (TSP)	3	3	0.00281	0.00281	0.00003	0.00489	0.00247	0.00108
Barium (TSP)	3	3	0.02543	0.02541	0.00133	0.03000	0.02640	0.01990
Beryllium (TSP)	3	3	0.00009	0.00009	0.00011	0.00018	0.00006	0.00004
Cadmium (TSP)	3	3	0.00028	0.00028	0.00002	0.00036	0.00030	0.00019
Chromium (TSP)	3	3	0.00543	0.00543	0.00022	0.00857	0.00398	0.00373
Cobalt (TSP)	3	3	0.00024	0.00024	0.00001	0.00029	0.00025	0.00019
Copper (TSP)	3	3	0.58033	0.58019	0.00070	0.69200	0.66300	0.38600
Iron (TSP)	3	3	1.17733	1.17906	0.000002	1.95000	0.98100	0.60100
Lead (TSP)	3	3	0.01073	0.01074	0.00003	0.01450	0.00913	0.00856
Manganese (TSP)	3	3	0.09763	0.09764	0.00025	0.20200	0.04980	0.04110
Molybdenum (TSP)	3	3	0.00071	0.00071	0.00004	0.00077	0.00071	0.00065
Nickel (TSP)	3	3	0.00245	0.00245	0.00013	0.00295	0.00231	0.00210
Vanadium (TSP)	3	3	0.00537	0.00537	0.00004	0.00687	0.00640	0.00285
Zinc (TSP)	3	3	0.06083	0.06082	0.00083	0.07270	0.05540	0.05440

River Rouge (261630005) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
2,5-dimethylbenzaldehyde	58	0	0.0000	0.0256	0.05119	0	0	0
Acetaldehyde	58	58	1.9502	1.9500	0.02258	4.09	3.55	3.54
Acetone	58	58	2.9407	2.9406	0.07292	7.76	5.99	5.7
Arsenic (TSP)	60	60	0.0017	0.0017	0.00005	0.00417	0.00407	0.00407
Barium (TSP)	3	3	0.0213	0.0213	0.00133	0.0237	0.0216	0.0187
Benzaldehyde	58	3	0.0420	0.0519	0.02086	0.894	0.881	0.66
Beryllium (TSP)	3	3	0.0000	0.0000	0.00010	0.00006	0.00004	0.00003

River Rouge (261630005) Concentrations in micrograms per cubic meter ($\mu g/m^3$)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Cadmium (TSP)	60	60	0.0005	0.0005	0.00004	0.00338	0.00159	0.00143
Chromium (TSP)	3	3	0.0042	0.0042	0.00023	0.00458	0.00413	0.00401
Cobalt (TSP)	3	3	0.0002	0.0002	0.00001	0.000262	0.000206	0.000157
Copper (TSP)	3	3	0.5070	0.5070	0.00070	0.749	0.571	0.201
Crotonaldehyde (trans)	58	7	0.0579	0.0633	0.01212	0.771	0.456	0.45
Formaldehyde	58	58	2.8579	2.8586	0.02432	6.82	5.41	4.85
Hexanaldehyde	58	4	0.0512	0.0698	0.03999	0.992	0.721	0.635
Iron (TSP)	3	3	0.8663	0.8665	0.00008	0.971	0.868	0.76
Isovaleraldehyde	58	0	0.0000	0.0126	0.02520	0	0	0
Lead (TSP)	3	3	0.0111	0.0111	0.00003	0.0134	0.0105	0.00951
m,p-Tolualdehyde	58	0	0.0000	0.0191	0.03820	0	0	0
Manganese (PM-10)	59	59	0.0305	0.0305	0.00032	0.223	0.197	0.136
Manganese (TSP)	60	60	0.0689	0.0689	0.00025	0.242	0.215	0.194
Molybdenum (TSP)	3	3	0.0007	0.0007	0.00004	0.000981	0.00054	0.000532
n-Butyraldehyde	58	14	0.1369	0.1419	0.01306	0.802	0.752	0.649
Nickel (TSP)	60	60	0.0063	0.0063	0.00012	0.257	0.00573	0.00572
o-Tolualdehyde	58	0	0.0000	0.0161	0.03213	0	0	0
Propionaldehyde	58	41	0.6846	0.6899	0.03738	6.44	5.11	3.19
Valeraldehyde	58	2	0.0246	0.0431	0.03826	0.842	0.585	0
Vanadium (TSP)	3	3	0.0043	0.0043	0.00004	0.00641	0.00332	0.00318
Zinc (TSP)	3	3	0.0618	0.0618	0.00083	0.0916	0.0506	0.0433

Flint (260490021) Concentrations in micrograms per cubic meter ($\mu g/m^3$)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Manganese (TSP)	60	60	0.00867	0.00867	0.000257	0.0233	0.0227	0.0222

Grand Rapids - Monroe St (260810020) Concentrations in micrograms per cubic meter ($\mu g/m^3$)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (TSP)	42	42	0.00128	0.00128	0.00003	0.0037	0.00266	0.00228
Cadmium (TSP)	42	42	0.00022	0.00022	0.00002	0.00151	0.000511	0.000338
Chromium (TSP)	42	42	0.00239	0.00239	0.00020	0.00814	0.00514	0.00447
Lead (TSP)	42	42	0.00612	0.00612	0.00003	0.0158	0.0108	0.00982
Manganese (TSP)	42	42	0.0263	0.0263	0.00025	0.24	0.117	0.0575
Nickel (TSP)	42	42	0.00165	0.00165	0.00013	0.007	0.00653	0.00591

Belding (260670003) Concentrations in micrograms per cubic meter (µg/m³)								
Chemical Name	Num Obs	Obs > MDL	Average (ND=0)	Average (ND=MDL/2)	MDL	Max 1	Max 2	Max 3
Arsenic (TSP)	59	59	0.0013	0.00126	0.000031	0.0161	0.0039	0.00295
Cadmium (TSP)	59	59	0.0016	0.00164	0.000023	0.0148	0.0105	0.00929
Chromium (TSP)	59	59	0.0014	0.00138	0.000217	0.00279	0.00254	0.00207
Lead (TSP)	59	59	0.1767	0.1767	0.000029	1.25	1.15	1.05
Manganese (TSP)	59	59	0.0116	0.0116	0.000240	0.0312	0.0297	0.0293
Nickel (TSP)	59	59	0.0009	0.00086	0.000129	0.00336	0.00208	0.00157

APPENDIX B-2

Dearborn (261630033), Speciated $PM_{2.5}$ (units = µg/m^3)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Antimony Pm2.5 Lc	55	13	0.0043	0.0193	0.0502	0.0338	0.0280
Arsenic Pm2.5 Lc	55	28	0.0009	0.0014	0.0076	0.0053	0.0036
Aluminum Pm2.5 Lc	55	45	0.0316	0.0332	0.2890	0.1250	0.1200
Barium Pm2.5 Lc	55	19	0.0010	0.0047	0.0188	0.0060	0.0053
Bromine Pm2.5 Lc	55	55	0.0045	0.0045	0.0184	0.0173	0.0134
Cadmium Pm2.5 Lc	55	13	0.0026	0.0092	0.0338	0.0171	0.0152
Calcium Pm2.5 Lc	55	55	0.1064	0.1064	1.0300	0.2480	0.2300
Chromium Pm2.5 Lc	55	39	0.0016	0.0019	0.0118	0.0074	0.0068
Cobalt Pm2.5 Lc	55	38	0.0010	0.0012	0.0050	0.0049	0.0046
Copper Pm2.5 Lc	55	55	0.0195	0.0195	0.1350	0.0649	0.0630
Chlorine Pm2.5 Lc	55	53	0.1044	0.1046	1.4500	1.0500	0.5190
Cerium Pm2.5 Lc	55	5	0.0001	0.0045	0.0053	0.0009	0.0006
Cesium Pm2.5 Lc	55	6	0.0002	0.0057	0.0050	0.0018	0.0016
Iron Pm2.5 Lc	55	55	0.3341	0.3341	1.3600	1.1400	1.0300
Lead Pm2.5 Lc	55	42	0.0051	0.0055	0.0360	0.0247	0.0196
Indium Pm2.5 Lc	55	12	0.0020	0.0099	0.0233	0.0216	0.0141
Manganese Pm2.5 Lc	55	54	0.0087	0.0088	0.0341	0.0314	0.0240
Nickel Pm2.5 Lc	55	44	0.0012	0.0014	0.0064	0.0051	0.0049
Magnesium Pm2.5 Lc	55	34	0.0186	0.0215	0.1160	0.0652	0.0648
Phosphorus Pm2.5 Lc	55	1	0.0001	0.0059	0.0058	0.0000	0.0000
Selenium Pm2.5 Lc	55	42	0.0010	0.0013	0.0049	0.0046	0.0037
Tin Pm2.5 Lc	55	10	0.0017	0.0119	0.0338	0.0175	0.0095
Titanium Pm2.5 Lc	55	30	0.0025	0.0036	0.0279	0.0187	0.0141
Vanadium Pm2.5 Lc	55	29	0.0010	0.0018	0.0083	0.0048	0.0043
Silicon Pm2.5 Lc	55	55	0.0863	0.0863	0.6160	0.3980	0.2680
Silver Pm2.5 Lc	55	13	0.0019	0.0093	0.0211	0.0172	0.0134
Zinc Pm2.5 Lc	55	55	0.0474	0.0474	0.3850	0.2100	0.1750
Strontium Pm2.5 Lc	55	20	0.0004	0.0012	0.0032	0.0023	0.0022
Sulfur Pm2.5 Lc	55	55	0.8036	0.8036	2.8900	2.6700	2.5400
Rubidium Pm2.5 Lc	55	23	0.0003	0.0009	0.0025	0.0021	0.0020
Potassium Pm2.5 Lc	55	55	0.0709	0.0709	0.3020	0.1670	0.1640
Sodium Pm2.5 Lc	55	46	0.0687	0.0720	0.2570	0.2560	0.2300
Zirconium Pm2.5 Lc	55	12	0.0007	0.0040	0.0101	0.0070	0.0035
Ammonium Ion Pm2.5 Lc	56	56	1.1077	1.1077	5.8200	3.2600	2.8700
Sodium Ion Pm2.5 Lc	56	53	0.0734	0.0742	0.2560	0.2190	0.2090
Potassium Ion Pm2.5 Lc	56	36	0.0501	0.0528	0.2640	0.1940	0.1520
Total Nitrate Pm2.5 Lc	56	56	1.7173	1.7173	12.4000	7.3100	6.3500

Dearborn (261630033), Speciated $PM_{2.5}$ (units = µg/m³)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	2.7974	2.7974	8.7000	7.2000	5.2700
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	0.5439	0.5439	1.3600	1.2500	1.1600
Sulfate Pm2.5 Lc	56	56	2.0647	2.0647	8.0600	6.2200	6.2200

W Fort Street (SWHS) (261630015), Speciated $PM_{2.5}$ (units = µg/m³)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Antimony Pm2.5 Lc	58	16	0.0078	0.0216	0.0605	0.0547	0.0408
Arsenic Pm2.5 Lc	58	30	0.0008	0.0012	0.0042	0.0042	0.0041
Aluminum Pm2.5 Lc	58	51	0.0284	0.0294	0.1030	0.0842	0.0838
Barium Pm2.5 Lc	58	10	0.0004	0.0057	0.0060	0.0049	0.0036
Bromine Pm2.5 Lc	58	55	0.0040	0.0040	0.0138	0.0104	0.0092
Cadmium Pm2.5 Lc	58	14	0.0018	0.0080	0.0221	0.0158	0.0120
Calcium Pm2.5 Lc	58	58	0.0790	0.0790	0.3040	0.2790	0.2080
Chromium Pm2.5 Lc	58	45	0.0011	0.0013	0.0036	0.0032	0.0031
Cobalt Pm2.5 Lc	58	43	0.0011	0.0013	0.0054	0.0044	0.0037
Copper Pm2.5 Lc	58	57	0.0091	0.0091	0.0291	0.0266	0.0244
Chlorine Pm2.5 Lc	58	55	0.0488	0.0490	0.5380	0.3410	0.2740
Cerium Pm2.5 Lc	58	9	0.0001	0.0035	0.0018	0.0013	0.0011
Cesium Pm2.5 Lc	58	12	0.0006	0.0055	0.0061	0.0047	0.0042
Iron Pm2.5 Lc	58	58	0.2634	0.2634	0.8910	0.8790	0.8430
Lead Pm2.5 Lc	58	50	0.0068	0.0070	0.0386	0.0309	0.0226
Indium Pm2.5 Lc	58	13	0.0021	0.0102	0.0168	0.0140	0.0128
Manganese Pm2.5 Lc	58	56	0.0063	0.0064	0.0380	0.0369	0.0162
Nickel Pm2.5 Lc	58	40	0.0006	0.0008	0.0029	0.0025	0.0025
Magnesium Pm2.5 Lc	58	34	0.0112	0.0145	0.1070	0.0637	0.0561
Phosphorus Pm2.5 Lc	58	0	0.0000	0.0055	0.0000	0.0000	0.0000
Selenium Pm2.5 Lc	58	36	0.0016	0.0020	0.0136	0.0100	0.0072
Tin Pm2.5 Lc	58	20	0.0040	0.0125	0.0315	0.0257	0.0245
Titanium Pm2.5 Lc	58	31	0.0017	0.0028	0.0109	0.0103	0.0090
Vanadium Pm2.5 Lc	58	31	0.0010	0.0018	0.0093	0.0044	0.0036
Silicon Pm2.5 Lc	58	57	0.0818	0.0819	0.3930	0.2970	0.2590
Silver Pm2.5 Lc	58	10	0.0009	0.0088	0.0114	0.0110	0.0070
Zinc Pm2.5 Lc	58	57	0.0403	0.0403	0.7080	0.1010	0.0995
Strontium Pm2.5 Lc	58	21	0.0007	0.0014	0.0167	0.0022	0.0022
Sulfur Pm2.5 Lc	58	58	0.9133	0.9133	3.4600	2.7400	2.6500
Rubidium Pm2.5 Lc	58	24	0.0004	0.0010	0.0051	0.0027	0.0023
Potassium Pm2.5 Lc	58	58	0.0855	0.0855	0.5810	0.2740	0.2720

W Fort Street (SWHS) (261630015), Speciated $PM_{2.5}$ (units = µg/m³)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Sodium Pm2.5 Lc	58	46	0.0588	0.0637	0.4670	0.1950	0.1810
Zirconium Pm2.5 Lc	58	11	0.0008	0.0042	0.0151	0.0070	0.0070
Ammonium Ion Pm2.5 Lc	58	58	1.4076	1.4076	5.5000	5.1800	4.5100
Sodium Ion Pm2.5 Lc	58	56	0.0649	0.0654	0.2260	0.2040	0.1980
Potassium Ion Pm2.5 Lc	58	37	0.0684	0.0709	0.4640	0.2440	0.2250
Total Nitrate Pm2.5 Lc	58	58	2.1595	2.1595	12.8000	10.5000	9.1200
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	61	61	2.7406	2.7406	8.9800	6.3100	5.9900
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	61	61	0.5890	0.5890	1.8000	1.5400	1.4200
Sulfate Pm2.5 Lc	58	58	2.7087	2.7087	10.3000	8.5100	7.7600

Allen Park, (261630001), Speciated $PM_{2.5}$ (units = µg/m³)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Antimony Pm2.5 Lc	120	43	0.0070	0.0188	0.0828	0.0701	0.0548
Arsenic Pm2.5 Lc	120	59	0.0006	0.0011	0.0056	0.0050	0.0035
Aluminum Pm2.5 Lc	120	87	0.0210	0.0232	0.1270	0.1050	0.1010
Barium Pm2.5 Lc	120	45	0.0026	0.0059	0.1200	0.0168	0.0129
Bromine Pm2.5 Lc	120	115	0.0029	0.0029	0.0098	0.0098	0.0079
Cadmium Pm2.5 Lc	120	39	0.0029	0.0083	0.0202	0.0199	0.0187
Calcium Pm2.5 Lc	120	120	0.0428	0.0428	0.1420	0.1400	0.1350
Chromium Pm2.5 Lc	120	89	0.0023	0.0026	0.0665	0.0126	0.0124
Cobalt Pm2.5 Lc	120	71	0.0006	0.0009	0.0034	0.0029	0.0026
Copper Pm2.5 Lc	120	111	0.0080	0.0081	0.0471	0.0414	0.0379
Chlorine Pm2.5 Lc	120	101	0.0183	0.0190	0.2180	0.2070	0.1790
Cerium Pm2.5 Lc	120	15	0.0001	0.0049	0.0022	0.0020	0.0018
Cesium Pm2.5 Lc	120	22	0.0006	0.0055	0.0075	0.0071	0.0060
Iron Pm2.5 Lc	120	120	0.0956	0.0956	0.2930	0.2750	0.2600
Lead Pm2.5 Lc	120	86	0.0025	0.0031	0.0225	0.0119	0.0100
Indium Pm2.5 Lc	120	30	0.0027	0.0104	0.0234	0.0222	0.0205
Manganese Pm2.5 Lc	120	108	0.0025	0.0026	0.0221	0.0088	0.0071
Nickel Pm2.5 Lc	120	95	0.0009	0.0010	0.0132	0.0064	0.0040
Magnesium Pm2.5 Lc	120	52	0.0058	0.0098	0.1760	0.0454	0.0275
Phosphorus Pm2.5 Lc	120	4	0.0000	0.0054	0.0025	0.0014	0.0006
Selenium Pm2.5 Lc	120	79	0.0008	0.0011	0.0061	0.0038	0.0032
Tin Pm2.5 Lc	120	42	0.0038	0.0121	0.0467	0.0245	0.0222
Titanium Pm2.5 Lc	120	59	0.0013	0.0025	0.0091	0.0074	0.0069
Vanadium Pm2.5 Lc	120	48	0.0004	0.0014	0.0034	0.0025	0.0025
Silicon Pm2.5 Lc	120	119	0.0551	0.0552	0.3030	0.2340	0.1990
Silver Pm2.5 Lc	120	29	0.0018	0.0087	0.0168	0.0167	0.0167

Allen Park, (261630001), Speciated $PM_{2.5}$ (units = µg/m[3])							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Zinc Pm2.5 Lc	120	120	0.0141	0.0141	0.1050	0.0553	0.0536
Strontium Pm2.5 Lc	120	53	0.0012	0.0019	0.0434	0.0116	0.0069
Sulfur Pm2.5 Lc	120	120	0.7550	0.7550	3.3500	3.3400	2.5500
Rubidium Pm2.5 Lc	120	49	0.0003	0.0009	0.0026	0.0023	0.0018
Potassium Pm2.5 Lc	120	120	0.0692	0.0692	2.0400	0.2850	0.1510
Sodium Pm2.5 Lc	120	91	0.0309	0.0357	0.1850	0.1660	0.1590
Zirconium Pm2.5 Lc	120	26	0.0009	0.0041	0.0175	0.0141	0.0105
Ammonium Ion Pm2.5 Lc	121	121	1.2118	1.2118	5.6500	5.0200	4.8300
Sodium Ion Pm2.5 Lc	121	111	0.0498	0.0510	0.2230	0.2030	0.1610
Potassium Ion Pm2.5 Lc	121	71	0.0567	0.0597	2.1600	0.2460	0.1620
Oc Csn Unadjusted Pm2.5 Lc Tot	30	30	2.9430	2.9430	7.0200	5.5100	4.4600
Total Nitrate Pm2.5 Lc	121	121	1.9349	1.9349	12.0000	11.2000	11.0000
Ec Csn Pm2.5 Lc Tot	30	30	0.8486	0.8486	1.7900	1.7400	1.6900
Oc1 Csn Unadjusted Pm2.5 Lc Tot	30	30	0.6802	0.6802	1.8000	1.3800	1.2600
Oc2 Csn Unadjusted Pm2.5 Lc Tot	30	30	1.1549	1.1549	1.8500	1.8300	1.7600
Oc3 Csn Unadjusted Pm2.5 Lc Tot	30	30	0.7200	0.7200	1.4100	1.4000	1.2600
Oc4 Csn Unadjusted Pm2.5 Lc Tot	30	29	0.7985	0.8025	2.0600	2.0500	2.0100
Op Csn Pm2.5 Lc Tot	30	0	0.0000	0.1200	0.0000	0.0000	0.0000
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	121	121	2.4651	2.4651	8.7900	7.0800	5.3700
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	121	121	0.4956	0.4956	1.4700	1.4100	1.2400
Sulfate Pm2.5 Lc	121	121	2.2532	2.2532	10.3000	8.9700	8.5100

Port Huron, Nat'l Guard Arm. (261470005), Speciated $PM_{2.5}$ (units = µg/m[3])							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Antimony Pm2.5 Lc	61	19	0.0039	0.0167	0.0408	0.0246	0.0221
Arsenic Pm2.5 Lc	61	29	0.0007	0.0012	0.0041	0.0041	0.0035
Aluminum Pm2.5 Lc	61	45	0.0196	0.0218	0.1000	0.0985	0.0820
Barium Pm2.5 Lc	61	10	0.0005	0.0054	0.0068	0.0049	0.0043
Bromine Pm2.5 Lc	61	56	0.0032	0.0033	0.0158	0.0108	0.0097
Cadmium Pm2.5 Lc	61	17	0.0024	0.0084	0.0215	0.0170	0.0165

Port Huron, Nat'l Guard Arm. (261470005), Speciated $PM_{2.5}$ (units = $\mu g/m^3$)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Calcium Pm2.5 Lc	61	60	0.0389	0.0389	0.2080	0.1510	0.1100
Chromium Pm2.5 Lc	61	36	0.0010	0.0014	0.0300	0.0036	0.0021
Cobalt Pm2.5 Lc	61	36	0.0004	0.0007	0.0023	0.0018	0.0016
Copper Pm2.5 Lc	61	43	0.0015	0.0018	0.0074	0.0072	0.0058
Chlorine Pm2.5 Lc	61	49	0.0232	0.0239	0.5890	0.0919	0.0774
Cerium Pm2.5 Lc	61	7	0.0001	0.0049	0.0016	0.0014	0.0012
Cesium Pm2.5 Lc	61	5	0.0002	0.0056	0.0048	0.0048	0.0020
Iron Pm2.5 Lc	61	60	0.0455	0.0455	0.1320	0.1320	0.1230
Lead Pm2.5 Lc	61	41	0.0032	0.0037	0.0290	0.0164	0.0157
Indium Pm2.5 Lc	61	15	0.0022	0.0096	0.0210	0.0187	0.0163
Manganese Pm2.5 Lc	61	43	0.0011	0.0014	0.0041	0.0040	0.0031
Nickel Pm2.5 Lc	61	43	0.0011	0.0013	0.0120	0.0067	0.0043
Magnesium Pm2.5 Lc	61	22	0.0054	0.0100	0.0717	0.0390	0.0252
Phosphorus Pm2.5 Lc	61	1	0.0000	0.0056	0.0012	0.0000	0.0000
Selenium Pm2.5 Lc	61	36	0.0008	0.0012	0.0057	0.0051	0.0038
Tin Pm2.5 Lc	61	15	0.0029	0.0124	0.0314	0.0303	0.0175
Titanium Pm2.5 Lc	61	26	0.0013	0.0027	0.0104	0.0093	0.0076
Vanadium Pm2.5 Lc	61	37	0.0014	0.0021	0.0171	0.0094	0.0058
Silicon Pm2.5 Lc	61	60	0.0540	0.0541	0.2730	0.2360	0.1980
Silver Pm2.5 Lc	61	13	0.0020	0.0092	0.0198	0.0175	0.0140
Zinc Pm2.5 Lc	61	60	0.0194	0.0194	0.1420	0.1320	0.0829
Strontium Pm2.5 Lc	61	27	0.0006	0.0014	0.0077	0.0055	0.0033
Sulfur Pm2.5 Lc	61	60	0.6914	0.6915	2.9800	2.9700	2.1100
Rubidium Pm2.5 Lc	61	31	0.0004	0.0009	0.0024	0.0023	0.0016
Potassium Pm2.5 Lc	61	61	0.0552	0.0552	0.2570	0.1520	0.1510
Sodium Pm2.5 Lc	61	41	0.0294	0.0361	0.3320	0.1120	0.1020
Zirconium Pm2.5 Lc	61	9	0.0006	0.0040	0.0186	0.0070	0.0052
Ammonium Ion Pm2.5 Lc	61	59	0.9906	0.9909	5.5300	5.3700	3.3600
Sodium Ion Pm2.5 Lc	61	58	0.0575	0.0582	0.4320	0.1580	0.1420
Potassium Ion Pm2.5 Lc	61	38	0.0467	0.0495	0.2380	0.1550	0.1500
Total Nitrate Pm2.5 Lc	61	60	1.5741	1.5741	13.0000	12.8000	6.4100
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	60	60	2.2853	2.2853	7.4600	4.7800	4.7500
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	60	60	0.2342	0.2342	0.5790	0.5190	0.5130
Sulfate Pm2.5 Lc	61	61	1.9985	1.9985	9.5700	8.7200	6.0400

Luna Pier (261150005), Speciated $PM_{2.5}$ (units = µg/m[3])							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Antimony Pm2.5 Lc	60	16	0.0050	0.0202	0.0617	0.0338	0.0245
Arsenic Pm2.5 Lc	60	27	0.0006	0.0012	0.0062	0.0037	0.0028
Aluminum Pm2.5 Lc	60	49	0.0326	0.0342	0.4270	0.1660	0.1500
Barium Pm2.5 Lc	60	7	0.0005	0.0059	0.0083	0.0063	0.0057
Bromine Pm2.5 Lc	60	59	0.0035	0.0035	0.0096	0.0090	0.0090
Cadmium Pm2.5 Lc	60	10	0.0012	0.0087	0.0184	0.0101	0.0092
Calcium Pm2.5 Lc	60	60	0.0373	0.0373	0.1800	0.1470	0.1140
Chromium Pm2.5 Lc	60	48	0.0013	0.0015	0.0099	0.0096	0.0045
Cobalt Pm2.5 Lc	60	33	0.0003	0.0006	0.0018	0.0017	0.0014
Copper Pm2.5 Lc	60	53	0.0020	0.0021	0.0078	0.0065	0.0063
Chlorine Pm2.5 Lc	60	45	0.0187	0.0197	0.1950	0.1450	0.1060
Cerium Pm2.5 Lc	60	7	0.0001	0.0035	0.0015	0.0012	0.0008
Cesium Pm2.5 Lc	60	7	0.0003	0.0056	0.0050	0.0039	0.0039
Iron Pm2.5 Lc	60	60	0.0591	0.0591	0.2540	0.1780	0.1670
Lead Pm2.5 Lc	60	40	0.0024	0.0030	0.0090	0.0081	0.0070
Indium Pm2.5 Lc	60	6	0.0010	0.0110	0.0175	0.0119	0.0112
Manganese Pm2.5 Lc	60	50	0.0014	0.0016	0.0053	0.0049	0.0049
Nickel Pm2.5 Lc	60	38	0.0005	0.0007	0.0034	0.0024	0.0020
Magnesium Pm2.5 Lc	60	25	0.0054	0.0092	0.0332	0.0330	0.0313
Phosphorus Pm2.5 Lc	60	1	0.0000	0.0056	0.0001	0.0000	0.0000
Selenium Pm2.5 Lc	60	41	0.0017	0.0020	0.0176	0.0133	0.0090
Tin Pm2.5 Lc	60	13	0.0023	0.0129	0.0280	0.0252	0.0151
Titanium Pm2.5 Lc	60	32	0.0013	0.0024	0.0175	0.0048	0.0047
Vanadium Pm2.5 Lc	60	20	0.0004	0.0015	0.0023	0.0022	0.0022
Silicon Pm2.5 Lc	60	59	0.0577	0.0578	0.4360	0.3800	0.1960
Silver Pm2.5 Lc	60	8	0.0012	0.0108	0.0210	0.0158	0.0105
Zinc Pm2.5 Lc	60	59	0.0113	0.0113	0.0434	0.0383	0.0325
Strontium Pm2.5 Lc	60	23	0.0004	0.0012	0.0028	0.0028	0.0023
Sulfur Pm2.5 Lc	60	60	0.8082	0.8082	3.1100	2.5800	2.5000
Rubidium Pm2.5 Lc	60	28	0.0003	0.0009	0.0022	0.0014	0.0013
Potassium Pm2.5 Lc	60	60	0.0580	0.0580	0.1980	0.1510	0.1490
Sodium Pm2.5 Lc	60	48	0.0421	0.0455	0.2040	0.1470	0.1450
Zirconium Pm2.5 Lc	60	15	0.0009	0.0041	0.0106	0.0079	0.0057
Ammonium Ion Pm2.5 Lc	60	60	1.3283	1.3283	7.4500	4.5400	4.3500
Sodium Ion Pm2.5 Lc	60	58	0.0775	0.0780	0.4610	0.3220	0.2910
Potassium Ion Pm2.5 Lc	60	43	0.0565	0.0585	0.1960	0.1550	0.1410
Total Nitrate Pm2.5 Lc	60	60	2.1951	2.1951	14.7000	12.2000	11.2000
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	2.3302	2.3302	8.9600	5.9200	5.1200
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	0.3231	0.3231	1.0400	0.8860	0.7550

Luna Pier (261150005), Speciated $PM_{2.5}$ (units = µg/m^3)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Sulfate Pm2.5 Lc	60	60	2.3421	2.3421	9.6200	7.7400	6.4300

Houghton Lake (261130001), Speciated $PM_{2.5}$ (units = µg/m^3)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Antimony Pm2.5 Lc	56	18	0.0076	0.0218	0.0840	0.0641	0.0362
Arsenic Pm2.5 Lc	56	17	0.0003	0.0010	0.0035	0.0020	0.0019
Aluminum Pm2.5 Lc	56	31	0.0111	0.0152	0.1270	0.0895	0.0686
Barium Pm2.5 Lc	56	5	0.0004	0.0051	0.0063	0.0055	0.0044
Bromine Pm2.5 Lc	56	48	0.0019	0.0020	0.0054	0.0053	0.0048
Cadmium Pm2.5 Lc	56	14	0.0018	0.0086	0.0229	0.0128	0.0117
Calcium Pm2.5 Lc	56	52	0.0125	0.0127	0.1110	0.0551	0.0466
Chromium Pm2.5 Lc	56	34	0.0006	0.0011	0.0059	0.0033	0.0020
Cobalt Pm2.5 Lc	56	24	0.0003	0.0007	0.0025	0.0018	0.0015
Copper Pm2.5 Lc	56	35	0.0007	0.0010	0.0053	0.0035	0.0027
Chlorine Pm2.5 Lc	56	34	0.0066	0.0081	0.2320	0.0118	0.0102
Cerium Pm2.5 Lc	56	5	0.0001	0.0035	0.0013	0.0012	0.0011
Cesium Pm2.5 Lc	56	6	0.0002	0.0053	0.0033	0.0025	0.0024
Iron Pm2.5 Lc	56	56	0.0185	0.0185	0.0994	0.0743	0.0697
Lead Pm2.5 Lc	56	24	0.0006	0.0016	0.0030	0.0025	0.0025
Indium Pm2.5 Lc	56	11	0.0018	0.0109	0.0177	0.0156	0.0129
Manganese Pm2.5 Lc	56	28	0.0005	0.0010	0.0042	0.0027	0.0018
Nickel Pm2.5 Lc	56	31	0.0003	0.0006	0.0019	0.0016	0.0015
Magnesium Pm2.5 Lc	56	18	0.0031	0.0077	0.0324	0.0185	0.0169
Phosphorus Pm2.5 Lc	56	1	0.0000	0.0056	0.0021	0.0000	0.0000
Selenium Pm2.5 Lc	56	16	0.0002	0.0009	0.0016	0.0012	0.0011
Tin Pm2.5 Lc	56	15	0.0033	0.0134	0.0432	0.0280	0.0187
Titanium Pm2.5 Lc	56	16	0.0012	0.0029	0.0169	0.0164	0.0098
Vanadium Pm2.5 Lc	56	14	0.0002	0.0014	0.0015	0.0012	0.0011
Silicon Pm2.5 Lc	56	53	0.0343	0.0347	0.2920	0.2200	0.1700
Silver Pm2.5 Lc	56	10	0.0012	0.0105	0.0215	0.0117	0.0105
Zinc Pm2.5 Lc	56	51	0.0040	0.0041	0.0241	0.0101	0.0100
Strontium Pm2.5 Lc	56	19	0.0004	0.0013	0.0061	0.0050	0.0018
Sulfur Pm2.5 Lc	56	56	0.4743	0.4743	1.9400	1.8000	1.5400
Rubidium Pm2.5 Lc	56	22	0.0003	0.0010	0.0027	0.0017	0.0016
Potassium Pm2.5 Lc	56	56	0.0323	0.0323	0.1510	0.1030	0.1020
Sodium Pm2.5 Lc	56	35	0.0123	0.0193	0.0620	0.0502	0.0466
Zirconium Pm2.5 Lc	56	11	0.0005	0.0050	0.0105	0.0047	0.0035
Ammonium Ion Pm2.5 Lc	56	55	0.5036	0.5038	2.9900	2.3600	1.8100

Houghton Lake (261130001), Speciated $PM_{2.5}$ (units = µg/m³)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Sodium Ion Pm2.5 Lc	56	47	0.0407	0.0431	0.2490	0.2300	0.1690
Potassium Ion Pm2.5 Lc	56	19	0.0223	0.0273	0.1330	0.1270	0.1110
Total Nitrate Pm2.5 Lc	56	56	0.6858	0.6858	6.0500	4.7500	4.4000
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	57	57	1.4649	1.4649	7.3300	3.0900	3.0800
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	57	57	0.0800	0.0800	0.3030	0.2960	0.2270
Sulfate Pm2.5 Lc	56	56	1.3683	1.3683	5.8400	5.3000	4.4000

Tecumseh (260910007), Speciated $PM_{2.5}$ (units= µg/m³)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Antimony Pm2.5 Lc	60	23	0.0068	0.0183	0.0583	0.0396	0.0372
Arsenic Pm2.5 Lc	60	24	0.0003	0.0009	0.0027	0.0016	0.0013
Aluminum Pm2.5 Lc	60	41	0.0182	0.0212	0.1520	0.1060	0.0720
Barium Pm2.5 Lc	60	8	0.0004	0.0054	0.0081	0.0049	0.0039
Bromine Pm2.5 Lc	60	57	0.0030	0.0030	0.0085	0.0075	0.0070
Cadmium Pm2.5 Lc	60	25	0.0042	0.0092	0.0230	0.0222	0.0211
Calcium Pm2.5 Lc	60	60	0.0301	0.0301	0.1510	0.1220	0.0972
Chromium Pm2.5 Lc	60	44	0.0017	0.0020	0.0289	0.0100	0.0097
Cobalt Pm2.5 Lc	60	34	0.0003	0.0006	0.0020	0.0019	0.0014
Copper Pm2.5 Lc	60	44	0.0015	0.0018	0.0093	0.0067	0.0039
Chlorine Pm2.5 Lc	60	47	0.0107	0.0116	0.1070	0.0671	0.0604
Cerium Pm2.5 Lc	60	6	0.0001	0.0037	0.0021	0.0018	0.0011
Cesium Pm2.5 Lc	60	11	0.0003	0.0044	0.0057	0.0026	0.0023
Iron Pm2.5 Lc	60	60	0.0424	0.0424	0.1870	0.1270	0.1140
Lead Pm2.5 Lc	60	42	0.0021	0.0025	0.0076	0.0072	0.0070
Indium Pm2.5 Lc	60	12	0.0020	0.0102	0.0193	0.0174	0.0163
Manganese Pm2.5 Lc	60	46	0.0017	0.0019	0.0088	0.0070	0.0059
Nickel Pm2.5 Lc	60	35	0.0005	0.0008	0.0086	0.0039	0.0027
Magnesium Pm2.5 Lc	60	26	0.0053	0.0093	0.0446	0.0325	0.0320
Phosphorus Pm2.5 Lc	60	0	0.0000	0.0058	0.0000	0.0000	0.0000
Selenium Pm2.5 Lc	60	37	0.0007	0.0011	0.0042	0.0029	0.0024
Tin Pm2.5 Lc	60	14	0.0025	0.0119	0.0361	0.0191	0.0175
Titanium Pm2.5 Lc	60	27	0.0011	0.0025	0.0145	0.0089	0.0071
Vanadium Pm2.5 Lc	60	17	0.0002	0.0014	0.0035	0.0016	0.0014
Silicon Pm2.5 Lc	60	60	0.0570	0.0570	0.4420	0.2960	0.2590
Silver Pm2.5 Lc	60	13	0.0019	0.0094	0.0264	0.0128	0.0117

Tecumseh (260910007), Speciated $PM_{2.5}$ (units= µg/m[3])							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Zinc Pm2.5 Lc	60	59	0.0086	0.0087	0.0298	0.0288	0.0207
Strontium Pm2.5 Lc	60	20	0.0004	0.0012	0.0055	0.0019	0.0019
Sulfur Pm2.5 Lc	60	60	0.7684	0.7684	2.3600	2.3400	2.3300
Rubidium Pm2.5 Lc	60	24	0.0002	0.0008	0.0012	0.0011	0.0011
Potassium Pm2.5 Lc	60	60	0.0575	0.0575	0.1840	0.1410	0.1350
Sodium Pm2.5 Lc	60	40	0.0284	0.0351	0.2930	0.1670	0.1560
Zirconium Pm2.5 Lc	60	14	0.0010	0.0042	0.0136	0.0093	0.0058
Ammonium Ion Pm2.5 Lc	59	59	1.1779	1.1779	5.4700	4.4600	3.8100
Sodium Ion Pm2.5 Lc	59	55	0.0651	0.0662	0.4570	0.2720	0.2690
Potassium Ion Pm2.5 Lc	59	42	0.0580	0.0600	0.2290	0.1780	0.1490
Total Nitrate Pm2.5 Lc	59	59	1.9531	1.9531	10.9000	10.6000	8.1300
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	2.1202	2.1202	7.6500	4.8800	4.7200
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	58	58	0.1962	0.1962	0.4990	0.4750	0.4690
Sulfate Pm2.5 Lc	59	59	2.1123	2.1123	6.4600	6.4400	6.3800

Grand Rapids (260810020), Speciated $PM_{2.5}$ (units=µg/m[3])							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Antimony Pm2.5 Lc	59	16	0.0059	0.0207	0.0595	0.0513	0.0327
Arsenic Pm2.5 Lc	59	30	0.0006	0.0010	0.0036	0.0025	0.0025
Aluminum Pm2.5 Lc	59	46	0.0222	0.0244	0.1490	0.1380	0.0963
Barium Pm2.5 Lc	59	17	0.0015	0.0057	0.0125	0.0118	0.0118
Bromine Pm2.5 Lc	59	58	0.0033	0.0033	0.0094	0.0085	0.0073
Cadmium Pm2.5 Lc	59	14	0.0021	0.0087	0.0315	0.0207	0.0105
Calcium Pm2.5 Lc	59	59	0.0512	0.0512	0.4080	0.3040	0.2800
Chromium Pm2.5 Lc	59	47	0.0010	0.0012	0.0044	0.0031	0.0028
Cobalt Pm2.5 Lc	59	39	0.0004	0.0007	0.0016	0.0015	0.0014
Copper Pm2.5 Lc	59	53	0.0045	0.0046	0.0127	0.0111	0.0106
Chlorine Pm2.5 Lc	59	52	0.0263	0.0268	0.3400	0.2380	0.1600
Cerium Pm2.5 Lc	59	6	0.0001	0.0036	0.0014	0.0014	0.0007
Cesium Pm2.5 Lc	59	6	0.0003	0.0050	0.0047	0.0035	0.0026
Iron Pm2.5 Lc	59	59	0.0782	0.0782	0.2970	0.2670	0.1900
Lead Pm2.5 Lc	59	47	0.0027	0.0030	0.0171	0.0099	0.0083
Indium Pm2.5 Lc	59	9	0.0017	0.0108	0.0236	0.0187	0.0187
Manganese Pm2.5 Lc	59	52	0.0050	0.0051	0.0359	0.0313	0.0306
Nickel Pm2.5 Lc	59	32	0.0003	0.0007	0.0016	0.0014	0.0013

Grand Rapids (260810020), Speciated $PM_{2.5}$ (units=µg/m^3)							
Chemical Name	Num Obs	Obs> MDL	Average (ND=0)	Average (ND=MDL/2)	MAX1	MAX2	MAX3
Magnesium Pm2.5 Lc	59	28	0.0109	0.0148	0.1640	0.0742	0.0527
Phosphorus Pm2.5 Lc	59	0	0.0000	0.0057	0.0000	0.0000	0.0000
Selenium Pm2.5 Lc	59	30	0.0005	0.0010	0.0032	0.0021	0.0020
Tin Pm2.5 Lc	59	12	0.0014	0.0121	0.0207	0.0178	0.0112
Titanium Pm2.5 Lc	59	35	0.0023	0.0032	0.0116	0.0115	0.0111
Vanadium Pm2.5 Lc	59	22	0.0004	0.0014	0.0039	0.0026	0.0023
Silicon Pm2.5 Lc	59	59	0.0726	0.0726	0.4310	0.4060	0.3900
Silver Pm2.5 Lc	59	8	0.0014	0.0106	0.0172	0.0163	0.0128
Zinc Pm2.5 Lc	59	59	0.0135	0.0135	0.1050	0.0339	0.0308
Strontium Pm2.5 Lc	59	20	0.0003	0.0012	0.0020	0.0018	0.0016
Sulfur Pm2.5 Lc	59	59	0.6911	0.6911	2.5700	2.5400	2.0700
Rubidium Pm2.5 Lc	59	23	0.0003	0.0009	0.0030	0.0018	0.0017
Potassium Pm2.5 Lc	59	59	0.0560	0.0560	0.1630	0.1450	0.1420
Sodium Pm2.5 Lc	59	46	0.0261	0.0300	0.1510	0.1210	0.1120
Zirconium Pm2.5 Lc	59	14	0.0009	0.0045	0.0106	0.0075	0.0070
Ammonium Ion Pm2.5 Lc	58	58	1.2413	1.2413	7.5400	4.2500	3.8300
Sodium Ion Pm2.5 Lc	58	54	0.0509	0.0517	0.1700	0.1680	0.1620
Potassium Ion Pm2.5 Lc	58	34	0.0416	0.0448	0.1700	0.1610	0.1470
Total Nitrate Pm2.5 Lc	58	58	2.1823	2.1823	15.6000	10.0000	9.9600
Oc Csn_Rev Unadjusted Pm2.5 Lc Tot	60	60	2.5260	2.5260	7.9300	6.9600	6.8500
Ec Csn_Rev Unadjusted Pm2.5 Lc Tot	60	59	0.3442	0.3500	0.8780	0.8580	0.8510
Sulfate Pm2.5 Lc	58	58	1.9407	1.9407	7.2300	7.1600	5.7100

Appendix C: 2010 AQI Pie Charts

Appendix C contains pie charts that were created to show the AQI values for each of Michigan's 2010 monitoring sites and includes the total number of days measurements were taken, along with the pollutant distribution of the AQI values for those measurements. It is important to note that not all pollutants are measured at each site. In fact, some sites only obtain AQI measurements for that portion of the year corresponding to the O3 season; therefore, the number of days for each site may not be equivalent to 365 days per year. **Figures C.1** through **C.4** are grouped by CSA. **Figures C.5** and **C.6** show the remaining sites (not part of a CSA) located in Michigan's Upper and Lower Peninsulas.

Figure C.1: AQI Summaries for Detroit-Warren-Flint CSA

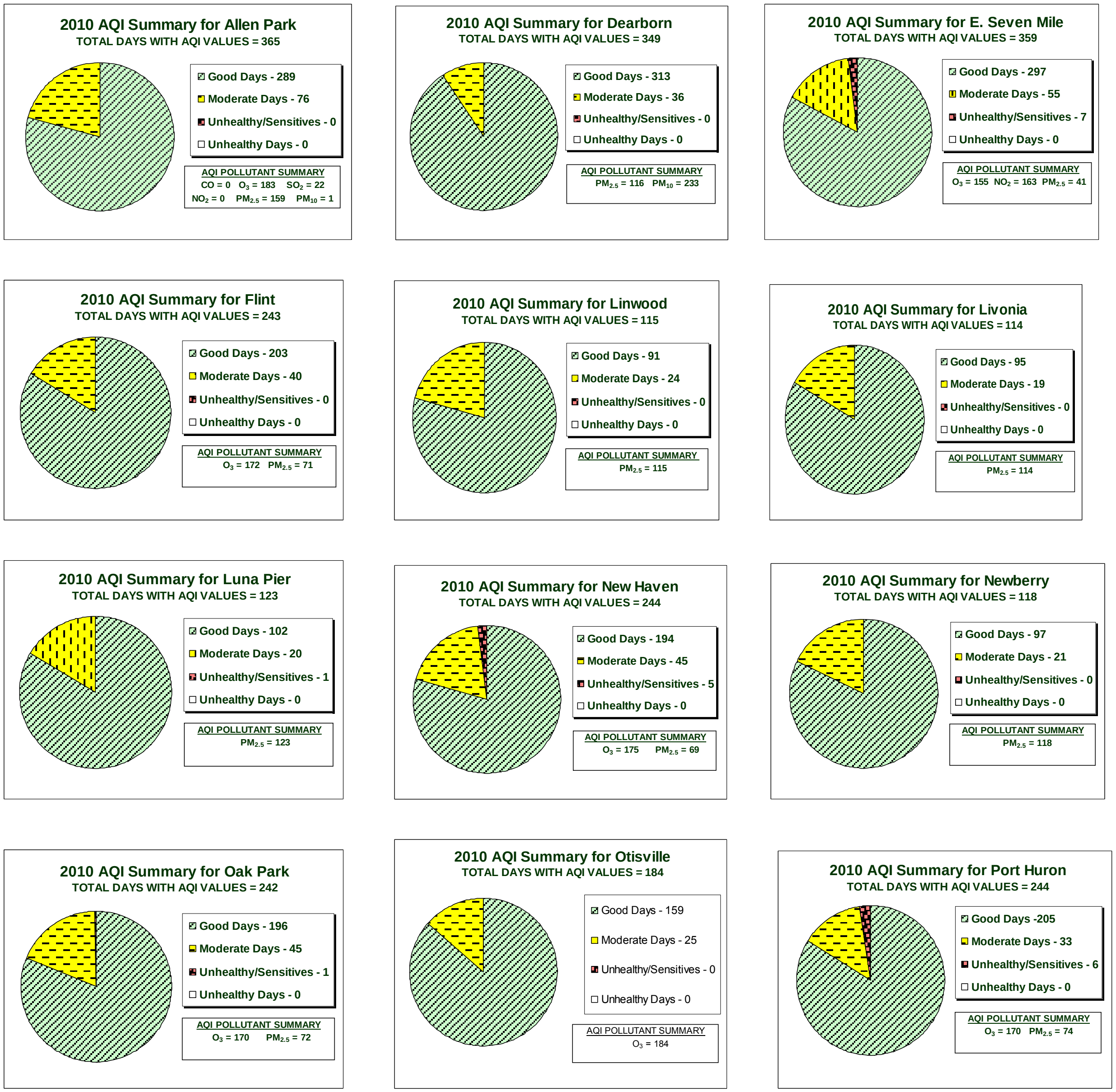
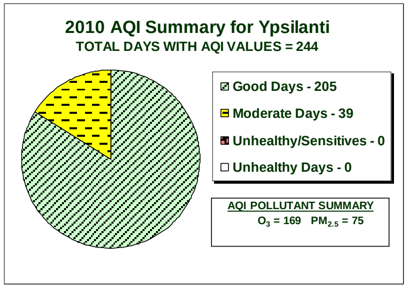
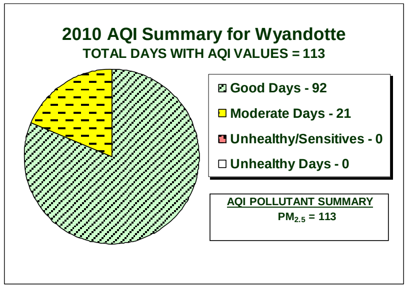
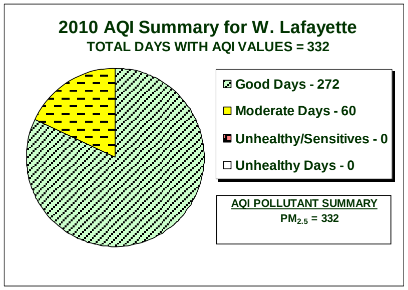
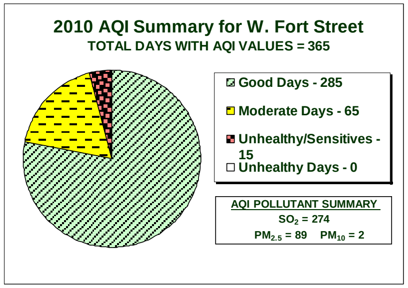


Figure C1, continued: AQI Summaries for Detroit-Warren-Flint-CSA









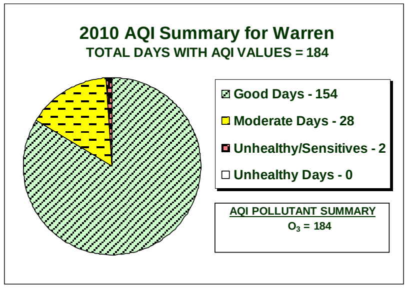
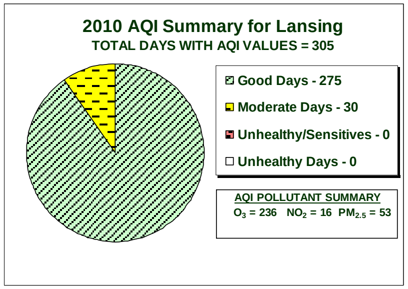


Figure C2: AQI Summaries for Lansing-East Lansing-Owosso CSA



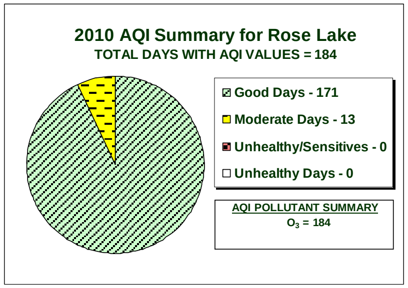


Figure C3: AQI Summary for Saginaw-Bay City-Saginaw Twp North CSA

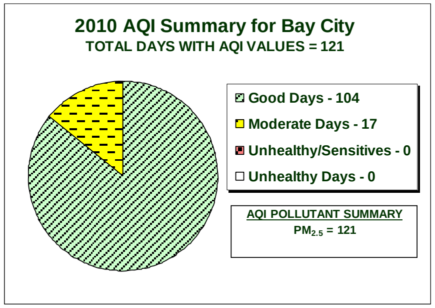
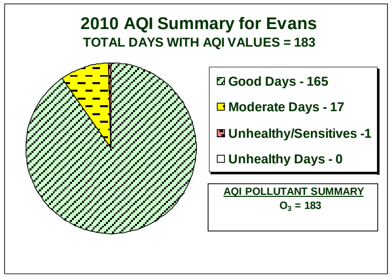
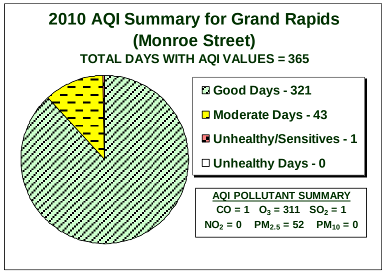
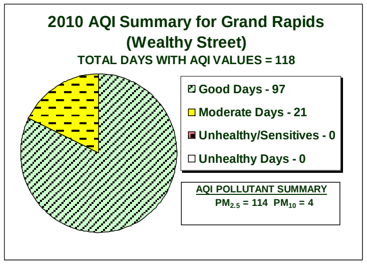
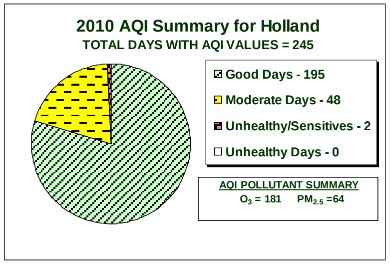


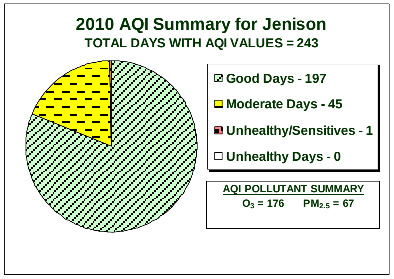
Figure C4: AQI Summaries for Grand Rapids-Muskegon-Holland CSA

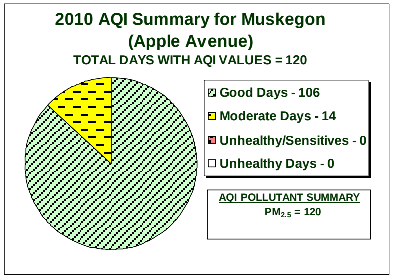












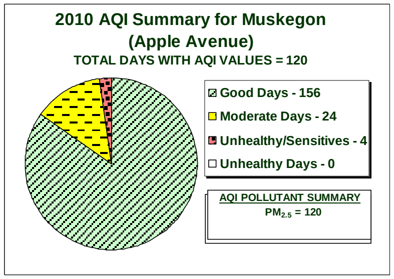


Figure C5: AQI Summary for Upper Peninsula

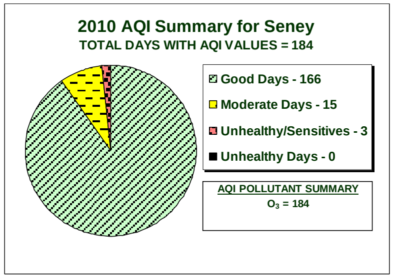
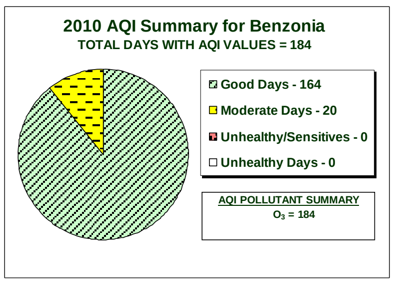
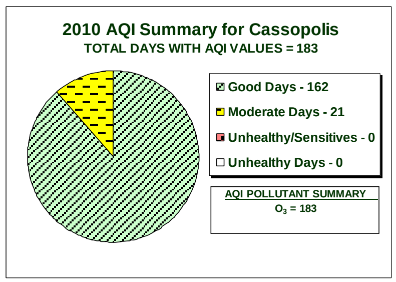
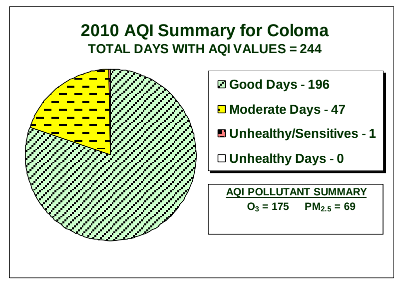
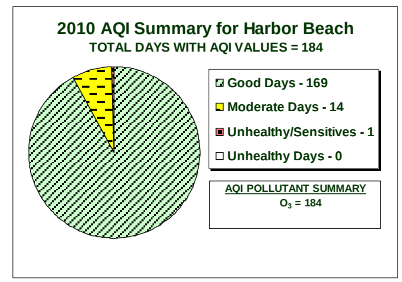


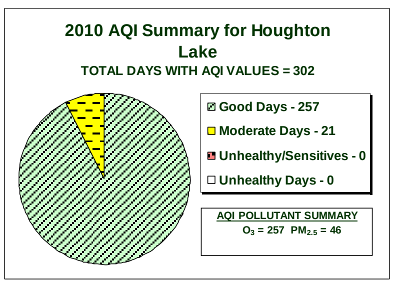
Figure C6: AQI Summaries for Michigan's Other Lower Peninsula Area

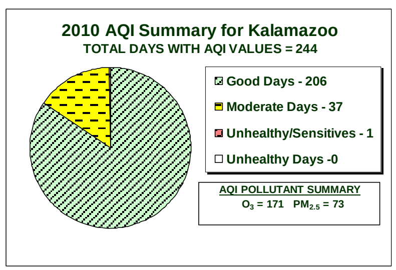


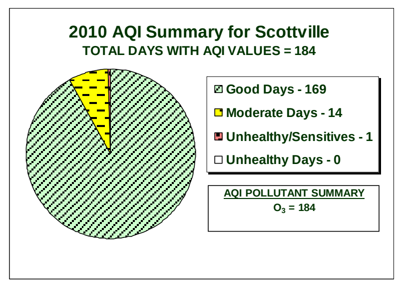


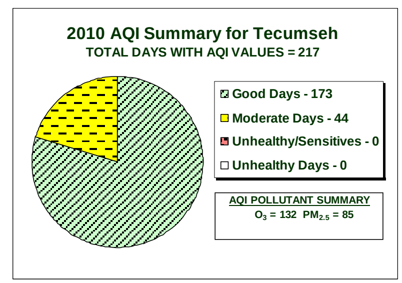


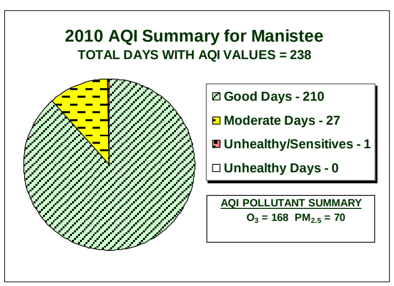












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AIR QUALITY DIVISION

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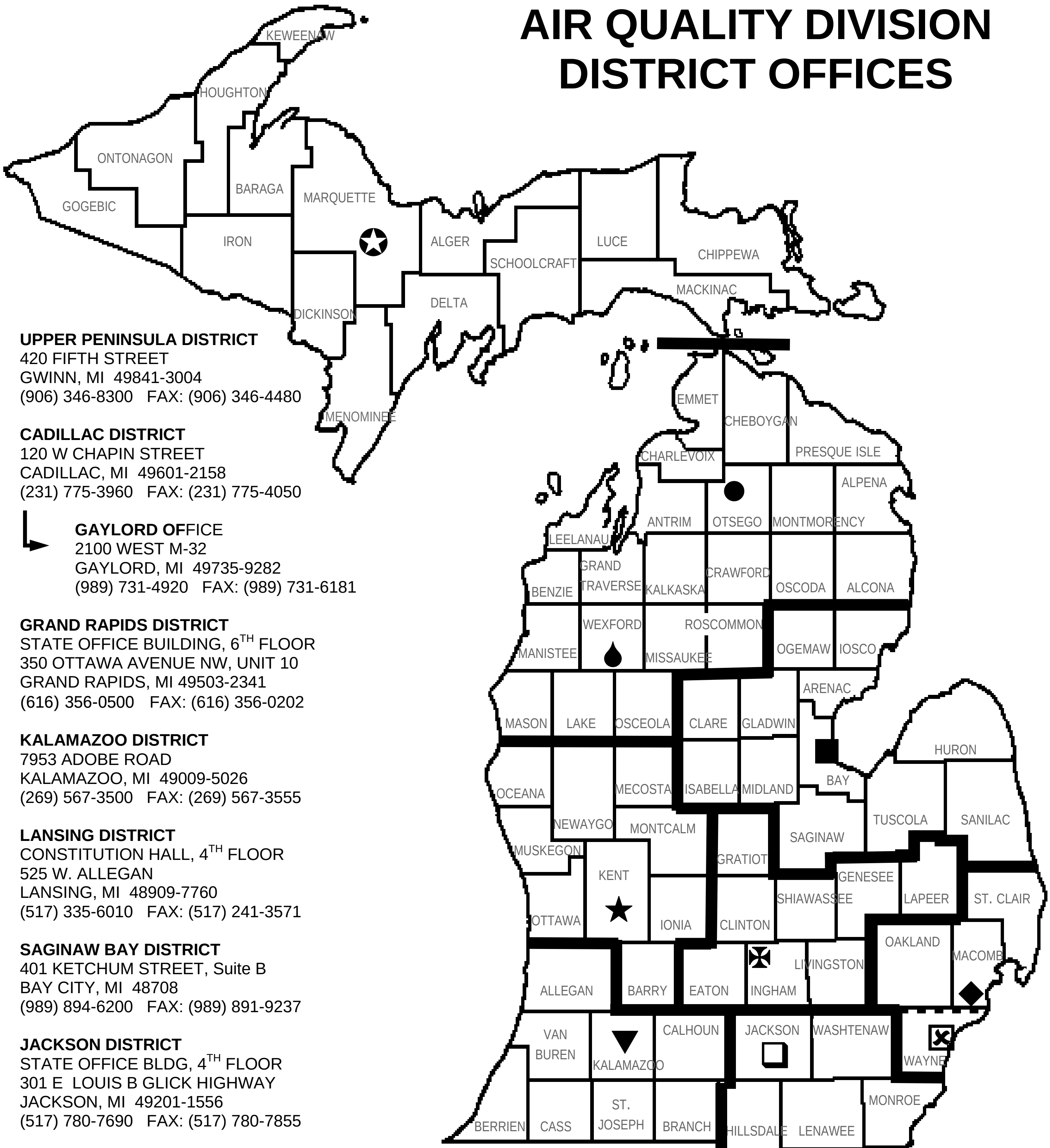

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