Annual Air Monitoring Network Plan for Minnesota

2015

Minnesota Pollution Control Agency

May 2014

Federal Regulation

40 CFR § 58.10(a) (1) Annual monitoring network plan and periodic network assessment
Beginning July 1, 2007, the State, or where applicable local, agency shall adopt and submit to the Regional Administrator an annual monitoring network plan which shall provide for the establishment and maintenance of an air quality surveillance system that consists of a network of SLAMS monitoring stations including FRM, FEM, and ARM monitors that are part of SLAMS, NCore stations, STN stations, State speciation stations, SPM stations, and/or, in serious, severe and extreme ozone nonattainment areas, PAMS stations, and SPM monitoring stations. The plan shall include a statement of purposes for each monitor and evidence that siting and operation of each monitor meets the requirements of appendices A, C, D, and E of this part, where applicable. The annual monitoring network plan must be made available for public inspection for at least 30 days prior to submission to EPA.

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This report is available in alternative formats upon request, and online at www.pca.state.mn.us/air/monitoringnetwork.html

Document number: aq10-12a

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Acronyms, Abbreviations, and Definitions

AIRMoN – Atmospheric Integrated Research Monitoring Network
Air Toxics – suite of parameters that includes VOCs, carbonyls, and metals
AQI – Air Quality Index
AQS – Air Quality System: EPA's repository of ambient air quality data
BAM – Beta Attenuation Mass
BWCAW – Boundary Waters Canoe Area Wilderness
CAA – Clean Air Act
CAS – Chemical Abstracts Service
CBSA – Core Base Statistical Area
CFR – Code of Federal Regulations
CO – carbon monoxide
Criteria Pollutants – the six pollutants regulated by the 1970 Clean Air Act (particulate matter, ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, and lead)
CSN – Chemical Speciation Network
EPA – Environmental Protection Agency
FEM – Federal Equivalent Method
FRM – Federal Reference Method
GC/MS – Gas Chromatography/Mass Spectrometry
H_2S – hydrogen sulfide
HAP – Hazardous Air Pollutant
Hg – mercury
HPLC – High Pressure Liquid Chromatography
HRV – Health Risk Value
ICP-AES – Inductively Coupled Plasma Atomic Emission Spectrometry: a technique used for metals analysis
IMPROVE – Interagency Monitoring of Protected Visual Environments
IO-3.1 – EPA method for extracting metals from TSP filters
IO-3.4 – EPA method for analyzing metals utilizing ICAP
LADCO – Lake Michigan Air Directors Consortium
MAAQS – Minnesota Ambient Air Quality Standard
MDH – Minnesota Department of Health
MDN – Mercury Deposition Network
MnDOT – Minnesota Department of Transportation
MPCA – Minnesota Pollution Control Agency
MSA – Metropolitan Statistical Area
NAAQS – National Ambient Air Quality Standard
NADP – National Atmospheric Deposition Program
NCore – National Core Monitoring Network
NDDN – National Dry Deposition Network
NH_3 – ammonia
NO – nitric oxide
NO_2 – nitrogen dioxide
NO_x – oxides of nitrogen
NO_y – total reactive nitrogen
NPAP – National Performance Audit Program
NTN – National Trends Network
O_3 – ozone
PAH – Polycyclic Aromatic Hydrocarbon
Pb – lead
PEP – Performance Evaluation Program
PFC – perfluorochemical
PM_4 – particulate matter less than 4 microns in diameter (ultrafine particulate matter)
$PM_{2.5}$ – particulate matter less than 2.5 microns in diameter (fine particulate matter)
$PM_{10-2.5}$ – particulate matter between 2.5 and 10 microns in diameter (coarse particulate matter)
PM_{10} – particulate matter less than 10 microns in diameter
ppb – parts per billion
ppm – parts per million
PQAO – Primary Quality Assurance Organization
QAPP – Quality Assurance Project Plans
QA/QC – Quality Assurance/Quality Control
QMP – Quality Management Plan
SLAMS – State and Local Air Monitoring Stations
SO_2 – sulfur dioxide
SPM – special purpose monitoring
TEOM – Tapered Element Oscillating Microbalance
TMDL – Total Maximum Daily Load
TO-11A – EPA method for analyzing carbonyls utilizing HPLC
TO-15 – EPA method for analyzing VOCs utilizing GC/MS
tpy – tons per year
TRS – total reduced sulfur
TSP – total suspended particulate matter
U of M – University of Minnesota
UFP – ultra fine particles
USDA – United States Department of Agriculture
USG – unhealthy for sensitive groups
USGS – United States Geological Survey
VOC – Volatile Organic Compound

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Introduction

The Minnesota Pollution Control Agency (MPCA) monitors outdoor air quality throughout Minnesota. The data collected by the MPCA helps determine major sources of ambient air pollution in Minnesota and whether we are protecting the public from its harmful health effects. Data are also used to address ways to reduce pollution levels and track concentrations of pollutants over time.

The MPCA's air quality data are used to determine compliance with National Ambient Air Quality Standards (NAAQS) and Minnesota Ambient Air Quality Standards (MAAQS). In 1970, the Clean Air Act (CAA) established NAAQS for six pollutants known to cause harm to human health and the environment. The CAA requires the MPCA to monitor these pollutants, called criteria pollutants, and report the findings to the U. S. Environmental Protection Agency (EPA). The criteria pollutants are particulate matter, lead, ozone, nitrogen dioxide, sulfur dioxide, and carbon monoxide. The MPCA also monitors Minnesota's air for other pollutants called air toxics. Air toxics include a wide range of chemicals that are known or suspected to affect human health. These pollutants do not have federal standards; however, levels found in Minnesota are compared to health benchmarks established by the Minnesota Department of Health (MDH), the EPA, and the State of California.

This Air Monitoring Network Plan is an annual report that is issued by the MPCA. It is a requirement of the Code of Federal Regulations (40 CFR 58) that were established by the EPA on October 17, 2006. The purpose of this report is to provide evidence that current regulations are being met for our air monitoring network, to detail any changes proposed for the 18 months following its publication, and to provide specific information on each of the MPCA's existing and proposed monitoring sites.

In addition to this plan, the EPA requires states to complete a network assessment every five years. Under the direction of the Lake Michigan Air Directors Consortium (LADCO), Minnesota collaborated with other states in our region for the first network assessment which was completed in 2010. The network assessment provides a detailed evaluation of the regional air monitoring network. It contains a network history, a re-evaluation of the types of pollutants monitored, and an evaluation of the network's objectives and costs. It also includes spatial analysis of ambient air monitoring data and a reconsideration of monitor placement based on changes in land use and population. Overall, the report noted that states do not currently have sufficient funding and staffing available to meet all of the new EPA monitoring requirements and suggests a priority order for monitoring objectives. A comprehensive regional monitoring network for $PM_{2.5}$ and ozone remains the highest priority due to potential nonattainment of the $PM_{2.5}$ and ozone standards.

Specifically for Minnesota, the Regional Network Assessment suggested that MPCA may want to review a cluster of “low value” $PM_{2.5}$ sites in Northeast Minnesota including monitors in Virginia, Duluth, and Mille Lacs. These monitors do not show concentrations of $PM_{2.5}$ likely to exceed the standard and may be redundant. The MPCA removed the Mille Lacs $PM_{2.5}$ monitor in 2010. The Virginia monitor remains since it is the closest to Minnesota’s mining industry, while the Duluth $PM_{2.5}$ monitors track concentrations in Minnesota’s largest northern city and port.

The assessment also suggested new investments including establishing an appropriate upwind rural background $PM_{2.5}$ monitor for the Twin Cities. An upwind site would help determine to what extent high $PM_{2.5}$ concentrations in the Twin Cities are the result of regional transport or local emission sources. Wind direction analysis indicates that the most appropriate location would be between the Twin Cities and Rochester. The MPCA is considering establishing such a site; however, an upwind site will not be added in 2015 due to resource limitations and the difficulty in establishing an upwind site for the Twin Cities that would not be unduly influenced by pollutant emissions from Rochester. A final recommendation was to replace the aging filter based federal reference method $PM_{2.5}$ monitors (FRM) with new FRM and semi-continuous federal equivalent method (FEM) monitors. The MPCA completed the replacement of the FRM network in 2010 and the semi-continuous FEM network in 2012.

The 2010 Regional Network Assessment can be found on LADCO’s website at http://www.ladco.org/reports/general/Regional_Network_Assessment/index.html.

The MPCA will once again collaborate with other Region 5 states and LADCO to complete a network assessment in 2015. Results will be discussed in the 2016 Network Plan.

Network overview

The MPCA monitors ambient air quality at 53 sites throughout Minnesota. This includes monitoring at three tribal sites, four Interagency Monitoring of Protected Visual Environments (IMPROVE) sites, three Chemical Speciation Network (CSN) sites, and ten National Acid Deposition Program (NADP) sites. Figure 1 shows all of these sites.

Site location is partly dependent upon population density; therefore, the majority of sites are in the Twin Cities metropolitan area. For the purposes of this report, any sites in the following eight counties are considered the Twin Cities metropolitan area: Hennepin, Ramsey, Wright, Anoka, Washington, Dakota, Scott, and Carver. The area of the state that lies outside the Twin Cities metropolitan area is commonly referred to as Greater Minnesota.

The maps on the following pages show sites labeled according to their MPCA, NADP, or IMPROVE site identification numbers. Figure 1 shows the Greater Minnesota sites and figure 2 shows the Twin Cities metropolitan area sites.

Throughout the report, sites are referred to using the site name or the city where the site is located and the MPCA, NADP, or IMPROVE site identification number.

Site Selection

The selection of air monitoring sites is usually based on at least one of the basic monitoring objectives listed below:

- determine representative concentrations and exposure in areas of high population density;
- determine the highest concentrations of pollutants in an area based on topography and/or wind patterns;
- judge compliance with and/or progress made towards meeting the NAAQS;
- track pollution trends
- determine the highest concentrations of pollutants within the state based on the known atmospheric chemistry of specific pollutants and wind patterns;
- determine the extent of regional pollutant transport to and from populated areas;
- determine how much major sources impact ambient pollution levels;
- validate control strategies designed to prevent or alleviate air pollution;
- provide a data base for research and evaluation of air pollution effects; or
- determine general background concentration levels.

The exact location of a site is most often dependent on the logistics of the area chosen for monitoring, such as site access, security and power availability.

Monitoring objectives

Since it is not possible to monitor everywhere in the state, the concept of spatial scales is used to clarify the link between monitoring objectives and the physical location of the monitor. When designing an air monitoring network one of the following six objectives should be determined:

1. the highest concentrations expected to occur in the area covered by the network;
2. representative concentrations in areas of high population density;
3. the impact of specific sources on ambient pollutant concentrations;
4. general background concentration levels;
5. the extent of regional transport among populated areas and in support of secondary standards; or
6. welfare-related impacts in the more rural and remote areas.

Network scales

The EPA developed a system which specifies an exclusive area or spatial scale that an air monitor represents. The goal in establishing air monitoring sites is to correctly match the spatial scale that is most appropriate for the monitoring objective of the site. Table 1 displays the recommended siting scales for the appropriate monitoring objective. The representative measurement scales are:

- **Micro Scale (10-100) m -** defines the concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters. Measurements on the micro scale typically include concentrations in street canyons, intersections, and in areas next to major emission sources.
- **Middle Scale (100-1,000) m -** defines the concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 to 1,000 meters.
- **Neighborhood Scale (1-4) km -** defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the one to four kilometers range. Generally, these stations represent areas with moderate to high population densities.
- **Urban Scale (4-50) km -** defines the overall, citywide conditions with dimensions on the order of four to 50 kilometers. This scale represents conditions over an entire metropolitan area and is useful in assessing city-wide trends in air quality.
- **Regional Scale/ Background (50-1,000) km -** usually a rural area of reasonably homogeneous geography and extends from tens to hundreds of kilometers.
- **National/Global -** concentrations characterizing the nation and the globe as a whole.

Table 1: Network scales

Monitoring Objective	Appropriate Siting Scales
Highest Concentration	Micro, Middle, Neighborhood (sometimes Urban)
Population Exposure	Neighborhood, Urban
Source Impact	Micro, Middle, Neighborhood
General/Background	Urban, Regional (sometimes Neighborhood)
Regional Transport	Urban, Regional
Welfare – Related	Urban, Regional

Table 2: Site information – Greater Minnesota

MPCA Site ID	City	Site name	AQS Site ID	Address	LAT	LONG	Year Started
MN08*	Hovland	Hovland	(none)	(open field)	47.8472	-89.9625	1996
MN16*	Balsam Lake	Marcell	(none)	Marcell Experimental Forest	47.5311	-93.4686	1978
MN23*	Pillager	Camp Ripley	(none)	(open field)	46.2494	-94.4972	1983
MN27*	Lamberton	Lamberton	(none)	U of M SW Agricultural Research and Outreach Center	44.2369	-95.3010	1979
MN28*	Sandstone	Grindstone Lake	(none)	Audubon Center of the North Woods	46.1208	-93.0042	1996
MN32* VOYA2**	International Falls	Voyageurs	27-137-9000	Voyageurs National Park - Sullivan Bay	48.4128	-92.8292	2000
MN99*	Finland	Wolf Ridge	(none)	6282 Cranberry Rd	47.3875	-91.1958	1996
1300	Virginia	Virginia	27-137-7001	327 First St S	47.5212	-92.5393	1968
2013	Detroit Lakes	Detroit Lakes	27-005-2013	26624 N Tower Rd	46.8499	-95.8463	2004
3051	Mille Lacs	Mille Lacs	27-095-3051	HCR 67 Box 194	46.2052	-93.7594	1997
3052	Saint Cloud	Talahi School	27-145-3052	1321 Michigan Ave SE	45.5497	-94.1335	1998
3204	Brainerd	Brainerd Airport	27-035-3204	16384 Airport Rd	46.3921	-94.1444	2004
4210	Marshall	Marshall Airport	27-083-4210	West Highway 19	44.4559	-95.8363	2004
5008	Rochester	Ben Franklin School	27-109-5008	1801 9th Ave SE	43.9949	-92.4504	1997
5220	Winona	Winona	27-169-5220	207 Winona St	44.0528	-91.6427	2014
5302	Stanton	Stanton Air Field	27-049-5302	1235 Highway 17	44.4719	-93.0126	2003
7001 MN18* BOWA1**	Ely	Fernberg Road	27-075-0005 27-075-9000	Fernberg Rd	47.9466	-91.4956	1977
7416	Cloquet	Cloquet	27-017-7416	175 University Rd	46.7030	-92.5233	2001
7526	Duluth	Torrey Building	27-137-0018	314 W Superior St	46.7834	-92.1027	1976
7545	Duluth	Oneota Street	27-137-0032	37th Ave W & Oneota St	46.7516	-92.1413	1985
7549	Duluth	Michigan Street	27-137-7549	1532 W Michigan St	46.7694	-92.1194	1994
7550	Duluth	WDSE	27-137-7550	1202 East University Circle	46.8182	-92.0894	1998
7554	Duluth	Laura MacArthur School	27-137-7554	720 N Central Ave	46.7437	-92.1660	2012
7555	Duluth	Waseca Road	27-137-7555	Waseca Industrial Rd	46.7306	-92.1634	2001
7810	Grand Portage	Grand Portage	27-031-7810	27 Store Rd	47.9701	-89.6910	2005
BLMO1**	Luverne	Blue Mounds	27-133-9000	1410 161st St	43.7158	-96.1913	2002
GRRI1**	Winona	Great River Bluffs	27-169-9000	43605 Kipp Dr	43.9373	-91.4052	2002

*NADP Site ID
**IMPROVE Site ID

Figure 1: 2014 Air quality monitoring sites in Greater Minnesota

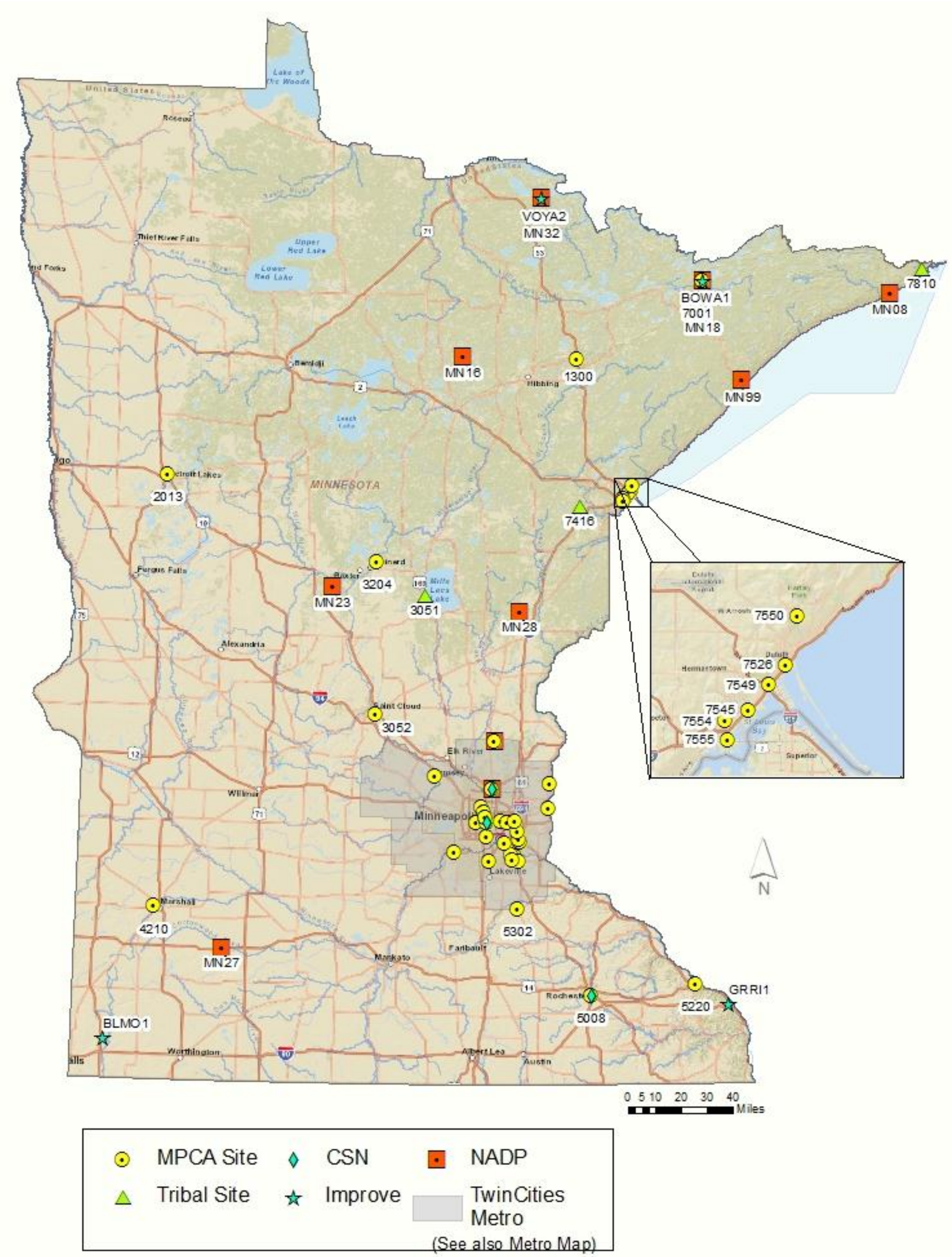
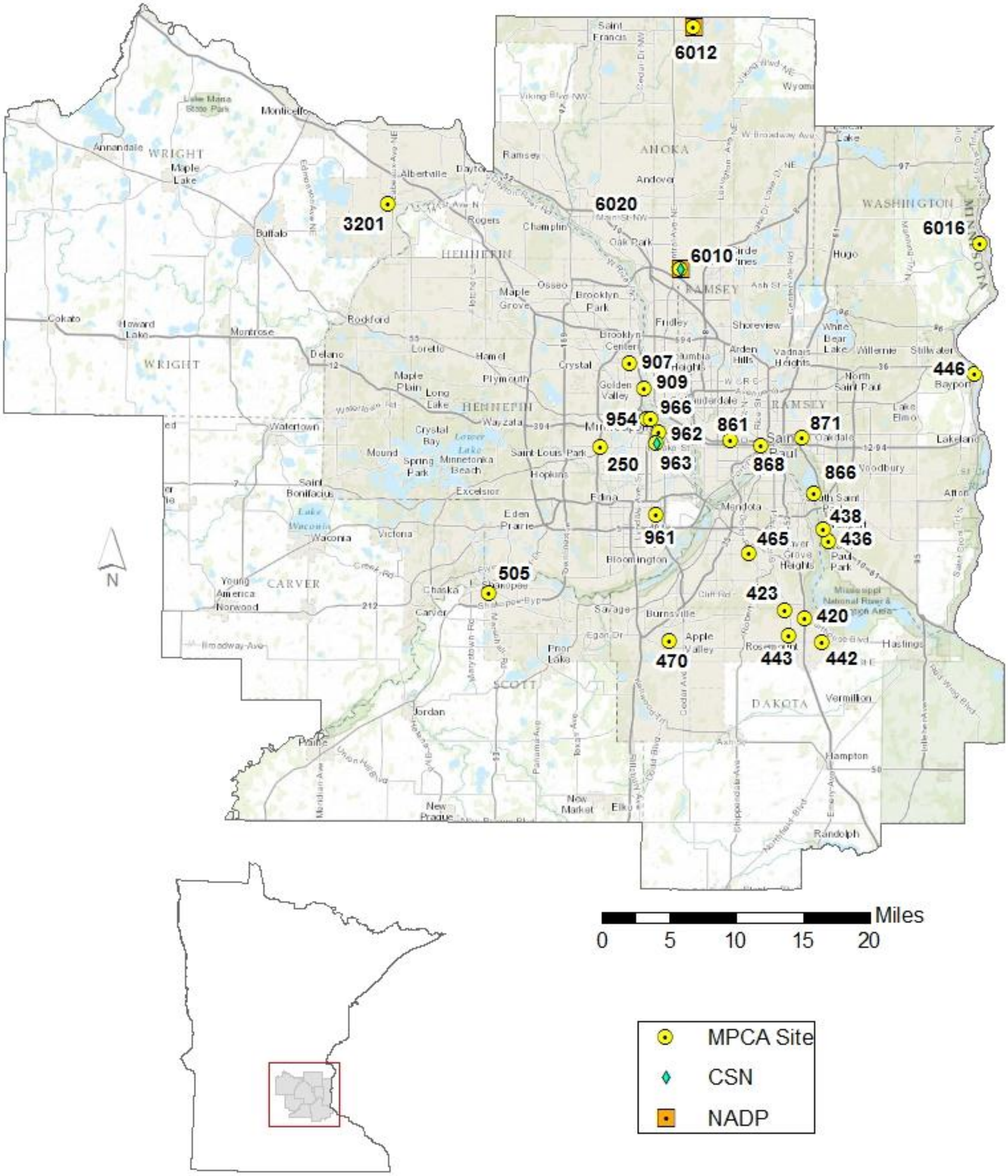


Table 3: Site information – Twin Cities metropolitan area

MPCA Site ID	City	Site name	AQS Site ID	Address	LAT	LONG	Year Started
250	St Louis Park	St. Louis Park	27-053-2006	5005 Minnetonka Blvd	44.9481	-93.3429	1972
420	Rosemount	FHR 420	27-037-0020	12821 Pine Bend Tr	44.7632	-93.0325	1972
423	Rosemount	FHR 423	27-037-0423	2142 120th St E	44.7730	-93.0627	1990
436	St. Paul Park	SPPRC 436	27-163-0436	649 5th St	44.8473	-92.9956	1989
438	Newport	SPPRC 438	27-163-0438	4th Ave & 2nd St	44.8599	-93.0035	1995
442	Rosemount	FHR 442	27-037-0442	County Rd 42	44.7385	-93.0056	2000
443	Rosemount	FHR 443	27-037-0443	14035 Blaine Ave E	44.7457	-93.0554	2008
446	Bayport	Point Road	27-163-0446	22 Point Rd	45.0280	-92.7738	2007
465	Eagan	Gopher Resources	27-037-0465	Hwy 149 & Yankee Doodle Rd	44.8343	-93.1163	2006
470	Apple Valley	Apple Valley	27-037-0470	225 Garden View Dr	44.7387	-93.2373	2000
505	Shakopee	B.F. Pearson School	27-139-0505	917 Dakota St	44.7894	-93.5125	2000
861	St. Paul	Lexington Avenue	27-123-0050	1088 W University Ave	44.9556	-93.1459	1987
866	St. Paul	Red Rock Road	27-123-0866	1450 Red Rock Rd	44.8994	-93.0171	1997
868	St. Paul	Ramsey Health Center	27-123-0868	555 Cedar St	44.9507	-93.0985	1998
871	St. Paul	Harding High School	27-123-0871	1540 East 6th St	44.9593	-93.0359	1998
907	Minneapolis	Humboldt Avenue	27-053-1007	4646 N Humboldt Ave	45.0397	-93.2987	1966
909	Minneapolis	Pacific Street	27-053-0909	3104 Pacific St	45.0121	-93.2767	2013
954	Minneapolis	Arts Center	27-053-0954	528 Hennepin Ave	44.9790	-93.2737	1989
961	Richfield	Richfield Intermediate School	27-053-0961	7020 12th Ave S	44.8756	-93.2588	1999
962	Minneapolis	Near-Road Minneapolis	27-053-0962	1444 18th St E	44.9652	-93.2548	2013
963	Minneapolis	H.C. Andersen School	27-053-0963	2727 10th Ave S	44.9535	-93.2583	2001
966	Minneapolis	City of Lakes	27-053-0966	309 2nd Ave S	44.9793	-93.2611	2002
3201	St. Michael	St. Michael	27-171-3201	101 Central Ave W	45.2092	-93.6690	2003
6010 MN98*	Blaine	Anoka Airport	27-003-1002	2289 CO Rd J	45.1407	-93.2220	1979
6012 MN01*	East Bethel	Cedar Creek	27-003-1001	2660 Fawn Lake Drive NE	45.4018	-93.2031	1979
6016	Marine on St. Croix	Marine on St. Croix	27-163-6016	St. Croix Trail N	45.1680	-92.7651	2012

*NADP Site ID

Figure 2: 2014 Air quality monitoring sites in the Twin Cities metropolitan area



Types of networks

Air monitoring networks are designed to satisfy a variety of purposes including monitoring compliance with the NAAQS, public reporting of the Air Quality Index (AQI), assessing population exposure and risk from air toxics, determining pollution trends, monitoring specific emissions sources, investigating background conditions, and evaluating computer models. Below are descriptions of the existing monitoring networks in operation in Minnesota.

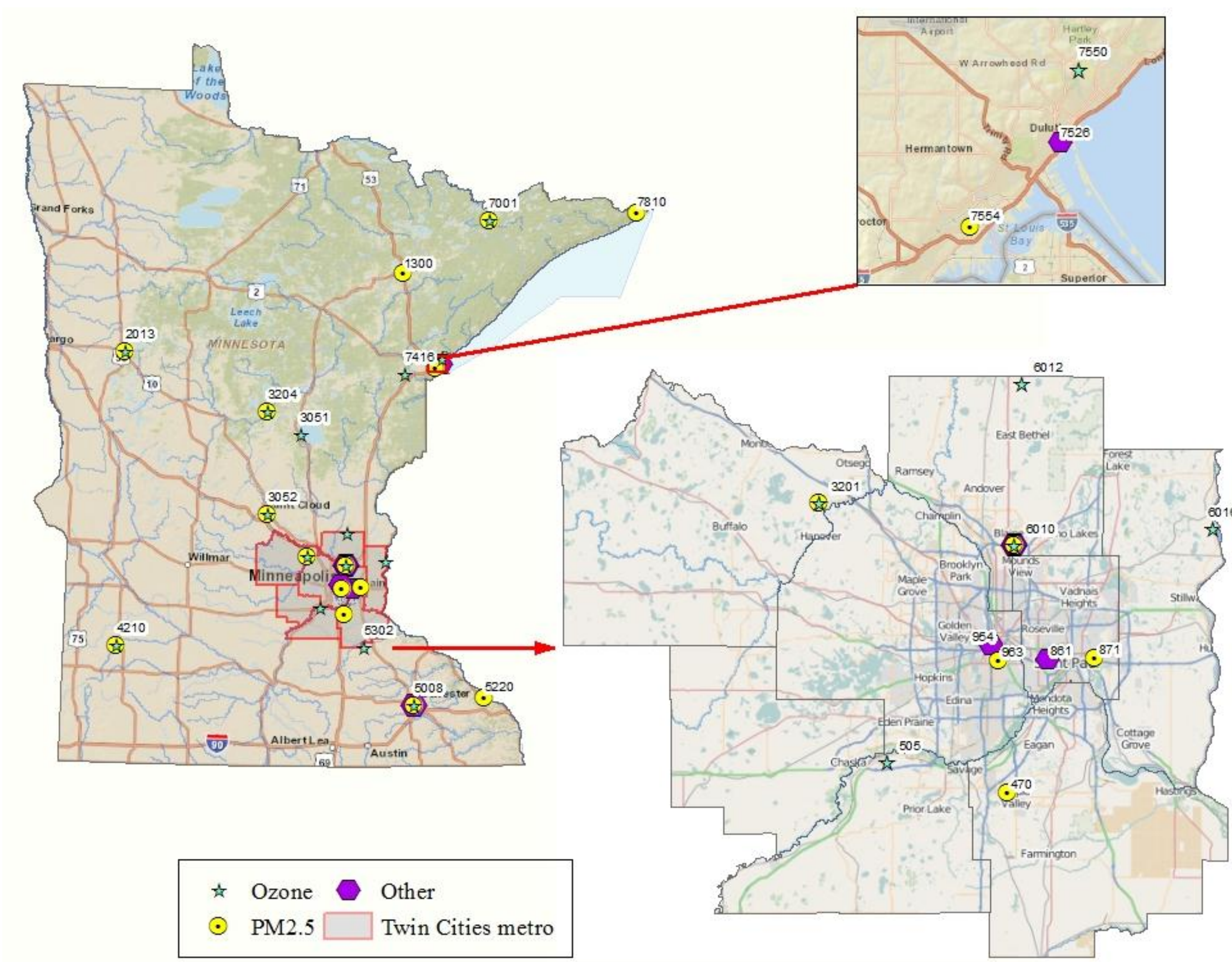
State and Local Air Monitoring Stations (SLAMS)

This network consists of about 3,500 monitoring sites across the United States. The size and distribution of the sites are largely determined by the needs of state and local air pollution control agencies to meet their respective State Implementation Plan (SIP) requirements and monitoring objectives. Most Minnesota monitoring sites are part of the SLAMS network. Sites in the SLAMS network may also belong to monitoring networks described below.

Air Quality Index (AQI)

The AQI was developed by the EPA to provide a simple, uniform way to report daily air quality conditions. Minnesota AQI numbers are determined by hourly measurements of five pollutants: $PM_{2.5}$, ground-level ozone, SO_2, NO_2, and CO. The pollutant with the highest value determines the AQI for that hour. The most common pollutants to drive the AQI are $PM_{2.5}$ and ozone. AQI values are updated hourly and posted on the MPCA's web site at www.pca.state.mn.us/aqi. There are 24 sites in the AQI network in Minnesota (figure 3).

Figure 3: 2014 AQI Sites

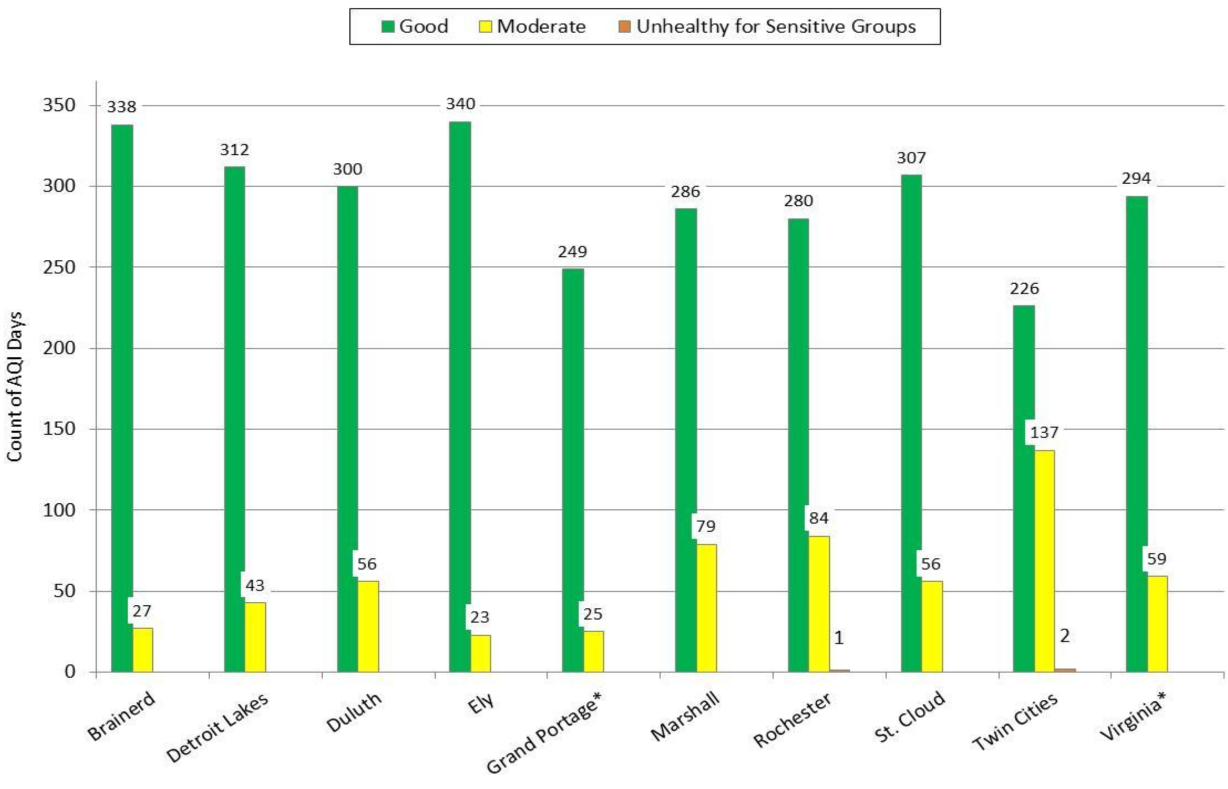


Air quality is ranked as good, moderate, unhealthy for sensitive groups (USG), unhealthy, or very unhealthy (figure 4). If it is suspected through forecasting or monitoring that one of the four pollutants may be unhealthy for sensitive groups or higher, the MPCA issues an Air Pollution Health Alert to the media and to individuals who have signed up to receive e-mail alerts. Alerts allow the public to be proactive about protecting their health and reducing their own contributions to emissions and exposure to pollution. To receive e-mail alerts and air quality forecasts, sign up at http://mn.enviroflash.info

Figure 4: AQI categories

Figure 5 shows the number of good, moderate, and USG days at sites in Minnesota in 2013. Regions may not show a total of 365 days because of monitoring problems or non-operational days. In 2013, the cleanest air was in Ely with 340 good air days and 23 moderate days. The Twin Cities metropolitan area had the lowest number of good air quality days (226 days), experiencing 137 moderate days, and 2 days considered unhealthy for sensitive groups. There were no unhealthy or very unhealthy days in Minnesota in 2013.

Figure 5: 2013 AQI days in Minnesota cities



*The AQI in Grand Portage and Virginia only includes $PM_{2.5}$

Table 4 summarizes the days the AQI exceeded 100 in 2013. In 2013, across Minnesota, the AQI reached a level considered unhealthy for sensitive groups on two days, which is the lowest number of air quality alert days in over a decade. On February 26, 2013, fine particle concentrations reached unhealthy for sensitive group levels in the Twin Cities and in Rochester. The elevated fine particle concentrations measured on February 26 were the result of heavy fog and stagnant weather conditions that promoted the production and build-up of fine particle pollution across much of Minnesota and Iowa. On July 27, 2013, ozone concentrations reached unhealthy for sensitive group levels in the Twin Cities. The elevated ozone concentrations measured on July 27 were the result of increased ozone production due to high daytime temperatures (greater than 90° F), sunny-skies, low-wind speeds, and the presence of wildfire smoke transported to Minnesota from fires burning in central Canada and the western United States.

Table 4: 2013 days with AQI greater than 100

	Brainerd	Detroit Lakes	Duluth	Ely	Grand Portage	Marshall	Rochester	Saint Cloud	Twin Cities
2/26/2013							112		107
7/7/2013									106
Total	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**2**

Ozone	Fine Particles

National Core Monitoring (NCore)

In October 2006, the United States Environmental Protection Agency (EPA) established the National Core (NCore) multi-pollutant monitoring network in its final amendments to the ambient air monitoring regulations for criteria pollutants (codified in 40 CFR parts 53 and 58). EPA requires each state to have at least one NCore site. Nationwide, there will be approximately 75 sites, mostly in urban areas.

At a minimum NCore monitoring sites must measure the parameters listed in Table 5.

Table 5: NCore parameters

Parameter	Comments
$PM_{2.5}$ speciation	Organic and elemental carbon, major ions and trace metals (24 hour average every 3rd day)
$PM_{2.5}$ FRM mass	24 hour average every third day
continuous $PM_{2.5}$ mass	one hour reporting interval
continuous $PM_{(10-2.5)}$ mass	in anticipation of a $PM_{(10-2.5)}$ standard
lead (Pb)	24 hour sample every sixth day
ozone (O_3)	continuous monitor consistent with other O_3 sites
carbon monoxide (CO) trace level	continuous monitor capable of trace levels (low ppb and below)
sulfur dioxide (SO_2) trace level	continuous monitor capable of trace levels (low ppb and below)
total reactive nitrogen (NO/NO_y)	continuous monitor capable of trace levels (low ppb and below)
surface meteorology	wind speed and direction, temperature, barometric pressure, and relative humidity

The NCore monitoring network addresses the following monitoring objectives which are equally valued at each site:

- timely reporting of data to the public through AIRNow, air quality forecasting, and other public reporting mechanisms;
- support development of emission strategies through air quality model evaluation and other observational methods;
- accountability of emission strategy progress through tracking long-term trends of criteria and non-criteria pollutants and their precursors;
- compliance through establishing nonattainment/attainment areas by comparison with the NAAQS;
- support of scientific studies ranging across technological, health, and atmospheric process disciplines; support long-term health assessments that contribute to ongoing reviews of the National Ambient Air Quality Standards (NAAQS); and
- support of ecosystem assessments, recognizing that national air quality networks benefit ecosystem assessments and, in turn, benefit from data specifically designed to address ecosystem analysis.

In 2011, the MPCA began operating the full suite of NCore parameters at the Anoka County Airport in Blaine (6010). The Anoka County Airport monitoring station is located approximately 11 miles north of downtown Minneapolis and approximately 15 miles northwest of downtown St. Paul. A detailed report about Minnesota's NCore site in Blaine can be found on the MPCA website at www.pca.state.mn.us/air/monitoringnetwork.html. It is Appendix B of the 2010 Annual Air Monitoring Network Plan for the State of Minnesota.

Minnesota's NCore site focuses on providing multi-pollutant monitoring data. Numerous chemical and physical interactions between pollutants underlie the formation of particulates and ozone and the presence of other pollutants. In addition, emission sources tend to release multiple pollutants or their precursors simultaneously. Multi-pollutant monitoring will benefit health studies, long-term epidemiological studies, source apportionment studies, and air quality models.

Another focus of the NCore site in Blaine is trace level monitoring of carbon monoxide, sulfur dioxide, oxides of nitrogen, and total reactive nitrogen. These pollutants are dominant inorganic combustion products, as well as the most abundant inorganic elements in the atmosphere. Emissions reductions have reduced the concentrations of these pollutants in most urban and rural areas; however, they are precursor gases that continue to play an important role in the formation of ozone, particulate matter, and air toxics on both local and regional scales. The trace level data that this site provides will help us understand the role of these pollutants in the environment at levels far below the NAAQS. Trace level monitors have been at the NCore site in Blaine (6010) since 2009; however, due to performance issues with the monitoring equipment, trace level monitoring results have been unreliable. The MPCA replaced the trace level monitoring instruments in late 2013.

Near-road Monitoring

In February of 2010, The U.S. Environmental Protection Agency (EPA) finalized new minimum monitoring requirements for the nitrogen dioxide (NO_2) monitoring network in support of a 1-hour NO_2 National Ambient Air Quality Standard (NAAQS). In the new monitoring requirements, state and local air monitoring agencies are required to install near-road NO_2 monitoring stations at locations where peak hourly NO_2 concentrations are expected to occur within the near-road environment in large urban areas. In August of 2011 and December of 2012, the EPA extended the near-road monitoring requirements to the national carbon monoxide (CO) and fine particle ($PM_{2.5}$) monitoring networks, respectively.

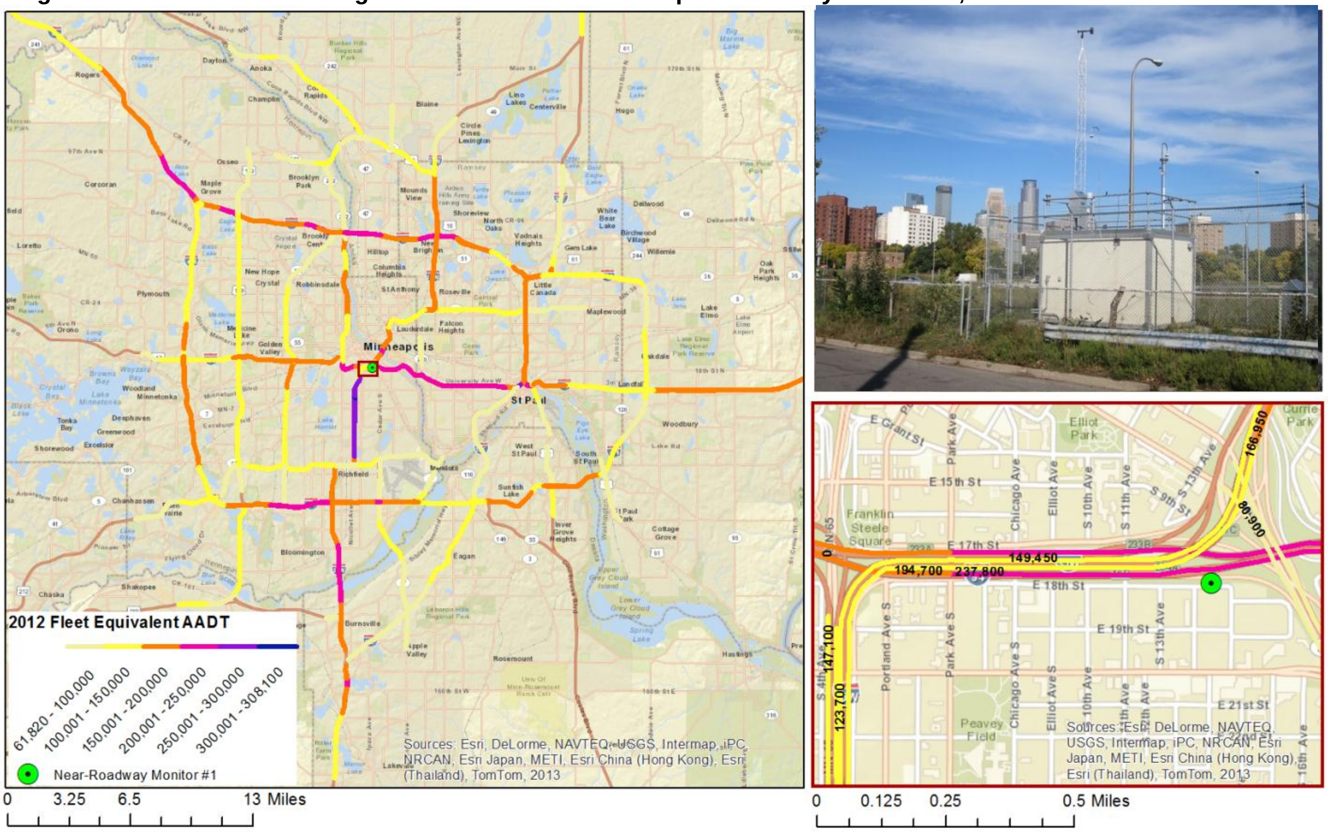
According to 40 CFR Part 58 Appendix D, state and local air agencies are required to operate one near-road monitoring site in each Core Based Statistical Area (CBSA) with a population of 500,000 or more people. In addition, CBSAs with 2,500,000 or more people, or those CBSAs with one or more roadway segments carrying traffic volumes of 250,000 or more vehicles per day are required to operate two near-road monitoring sites. The Minneapolis-St. Paul- Bloomington CBSA is the only CBSA in Minnesota that requires near-road monitoring. The 2013 population estimate for the Minneapolis-St. Paul-Bloomington CBSA is 3,459,146 people, triggering the requirement for a second near-road monitoring site within the CBSA. The location of the second near-road monitoring site is still being finalized, but is planned to begin operations in January 2015. Table 6 lists the parameters at each of the near-road sites.

Table 6: Near-road parameters

MPCA Site ID	City Name	Site Name	$PM_{2.5}$ FEM	TSP and Metals	Ozone	Oxides of Nitrogen	Carbon Monoxide	VOCs	Carbonyls	Other Parameters
962	Minneapolis	Near-road Minneapolis	X	X	X	X	X	X	X	Meteorological Data, Ultrafine Particle Counter, Black Carbon, PAHs
TBD	TBD	Near-road TBD	X			X	X			Meteorological Data

The first near-road air monitoring site in the Twin Cities metropolitan area is located along I-94 & I-35W freeway commons in Downtown Minneapolis (figure 6). This site is located along the traffic segment with the highest ranked Fleet Equivalent Annual Average Daily Traffic (FE-AADT) count. The FE-AADT ranks traffic segments based on total daily vehicle traffic, with extra weight given for traffic segments with more heavy duty truck traffic. More information on the site selection process for the first near-road monitoring site is available in the following PDF report, http://www.pca.state.mn.us/index.php/view-document.html?gid=17857.

Figure 6: Near-road monitoring site #1: Downtown Minneapolis Freeway Commons, I-94 & I-35W



The second near-road air monitoring site in the Twin Cities metropolitan area is required to begin operations in January 2015. The MPCA is currently working with the Minnesota Department of Transportation (MnDOT) to finalize the location of the second near-road air monitoring site. Based on 2012 traffic data provided by MnDOT, candidate road segments were chosen from the traffic segments with the higest ranked FE-AADT counts.

The EPA requires state and local air agencies to site near-road monitoring stations in locations where peak 1-hour NO_2, CO, and $PM_{2.5}$ concentrations are expected to be the highest in the near-road environment. To identify these locations, the EPA recommends that state and local air agencies utilize the most recent traffic counts to identify the most trafficked road segments. Factors such as fleet mix, roadway design, traffic congestion patterns, terrain or topography, and meteorology of candidate road segments can also be considered in identifying road segments for monitoring. To identify final candidates for the second near-roadway monitoring site, the MPCA also considered the feasibility of locating an air monitoring site along the traffic segment and the proximity of the traffic segment to the first near-road monitoring site near Downtown Minneapolis. Table 7 lists candidate road segments, traffic statistics, and notes.

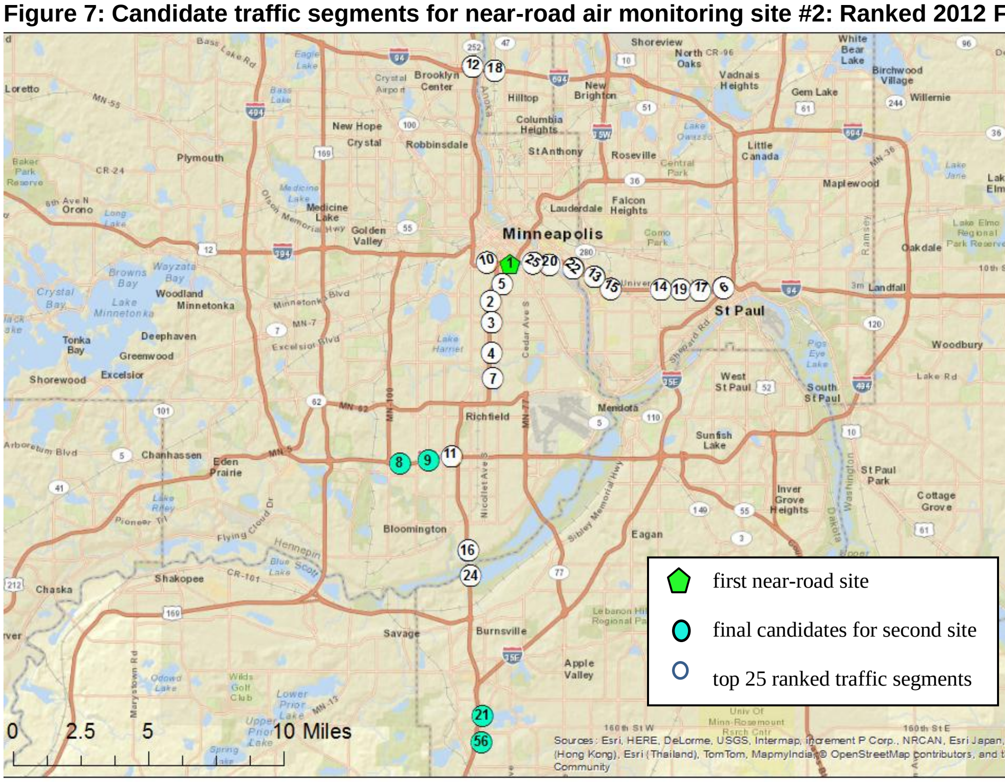
Based on the decision criteria described above, the MPCA has identified a final list of four traffic segments that are being evaluated for air monitor siting feasibility (blue circles in figure 7). The final four candidate traffic road segments are located in the south-metro, along I-494 in Bloomington (segments 8 and 9), and I-35 in the Burnsville/Lakeville area (segments 21 and 56). The traffic segment in Lakeville (segment 56) was added to the list of finalists due to its proximity to traffic segment 21 and the opportunity to leverage existing MnDOT infrastructure along the road segment when building the monitoring site. While these final four traffic segments do not have the highest overall FE-AADT ranks, these traffic segments do carry a higher percentage of heavy duty truck traffic compared to the higher ranked traffic segments located in the Twin Cities urban core. As shown in the figure 7, the majority of highly ranked traffic segments are located along the same traffic route as the first near-road monitoring site. The location of the second near-road air monitoring site will be identifed by June 30, 2014 and will be described in the final version of this network plan.

Table 7: Candidate traffic segments for near-road monitoring site #2

City	Route	2012 AADT	2012 HCAADT	2012 FE-AADT	FE-AADT Rank	AADT Rank	HCAADT Rank	%HCAADT	Notes
Minneapolis	I-94 & I-35W	277,000	12,250	387,250	1	1	3	4.4	Near-road site #1
Bloomington	I-494	160,000	8,900	240,100	8	9	31	5.6	Candidate segment for monitor #2
Bloomington	I-494	159,000	8,800	238,200	9	10	34	5.5	
Burnsville	I-35	106,000	12,500	218,500	21	97	2	11.8	
Lakeville	I-35	87,000	11,800	193,200	56	169	8	13.6	
Minneapolis	I-35W	210,000	10,900	308,100	2	2	10	5.2	Same route as monitor #1
Minneapolis	I-35W	194,000	10,400	287,600	3	3	14	5.4	
Minneapolis	I-35W	185,000	10,400	278,600	4	4	14	5.6	
Minneapolis	I-35W	180,000	9,500	265,500	5	7	19	5.3	
Saint Paul	I-35E	182,000	9,000	263,000	6	5	30	4.9	
Minneapolis	I-35W	172,000	9,500	257,500	7	8	19	5.5	
Minneapolis	I-94	181,000	6,300	237,700	10	6	114	3.5	
Bloomington	I-494	157,000	8,800	236,200	11	12	34	5.6	Cannot meet monitor siting criteria
Fridley	I-694	150,000	9,400	234,600	12	20	22	6.3	
Saint Paul	I-94	158,000	8,000	230,000	13	11	49	5.1	Same route as monitor #1
Saint Paul	I-94	157,000	8,000	229,000	14	12	49	5.1	
Saint Paul	I-94	156,000	7,900	227,100	15	14	53	5.1	
Bloomington	I-35W	117,000	12,200	226,800	16	66	4	10.4	Cannot meet monitor siting criteria
Saint Paul	I-94	155,000	7,900	226,100	17	16	53	5.1	Same route as monitor #1
Fridley	I-694	144,000	9,100	225,900	18	28	26	6.3	Cannot meet monitor siting criteria
Saint Paul	I-94	152,000	7,800	222,200	19	18	57	5.1	Same route as monitor #1
Minneapolis	I-94	151,000	7,700	220,300	20	19	59	5.1	
Minneapolis	I-94	149,000	7,700	218,300	22	21	59	5.2	
Minneapolis	I-94	149,000	7,700	218,300	22	21	59	5.2	
Burnsville	I-35W	109,000	12,100	217,900	24	84	5	11.1	Cannot meet monitor siting criteria
Minneapolis	I-94	148,000	7,600	216,400	25	23	66	5.1	Same route as monitor #1

**The location of these traffic segments can be identified by the segment's FE-AADT rank in the map below.*

Figure 7: Candidate traffic segments for near-road air monitoring site #2: Ranked 2012 FE-AADT



Interagency Monitoring of Protected Visual Environments (IMPROVE)

The IMPROVE Aerosol Network is a cooperative air quality monitoring effort between federal land managers; regional, state, and tribal air agencies; and the EPA. This program was established in 1985 in response to the 1977 Clean Air Act Amendments to aid in developing Federal and State implementation plans for the protection of visibility in Class I areas. Class I areas are National Parks and other wilderness areas that are designated by the United States Department of Agriculture (USDA). The IMPROVE network presently comprises 175 monitoring sites nationally.

The objectives of the IMPROVE network are:

- to establish current visibility and aerosol conditions in Class I areas;
- to identify chemical species and emission sources responsible for existing man-made visibility impairment;
- to document long-term trends for assessing progress towards the national visibility goal; and
- with the enactment of the Regional Haze Rule, to provide regional haze monitoring representing all visibility-protected federal class I areas where practical.

The IMPROVE sites also provide $PM_{2.5}$ speciation data; therefore, they are a key component of the EPA's national fine particle monitoring and are critical to tracking progress related to the Regional Haze Regulations. Minnesota has four IMPROVE Aerosol Network sites. They are located at Voyageurs National Park (VOYA2), near the Boundary Waters Canoe Area Wilderness at Ely (BOWA1), Blue Mounds State Park (BLMO1), and Great River Bluffs State Park (GRRI1). Figure 1 shows the locations of these sites.

Chemical Speciation Network (CSN)

The CSN is an EPA effort to gather data on the chemical composition of $PM_{2.5}$ and to provide a basic, long-term record of the concentration levels of selected ions, metals, carbon species, and organic compounds found in $PM_{2.5}$. EPA has established a chemical speciation network consisting of approximately 300 monitoring sites. The chemical speciation data provides data for assessing trends and developing mitigation strategies to reduce emissions and ambient concentrations.

The programmatic objectives of the CSN are:

- temporal and spatial characterization of aerosols;
- air quality trends analysis and tracking the progress of control programs;
- comparison of the chemical speciation data set to the data collected from the IMPROVE network; and development of emission control strategies.

There are currently three CSN sites in Minnesota. They are located in Minneapolis at the H.C. Andersen School (963), at the NCore site in Blaine (6010), and in Rochester (5008). Figure 1 shows the locations of these sites.

The EPA has been conducting an assessment of the (CSN in an effort to optimize the network and create a network that is financially sustainable going forward. As a result of this assessment, EPA is recommending defunding a number of monitoring sites, eliminating the CSN $PM_{2.5}$ mass measurement at all CSN sites, reducing the frequency of carbon blanks, and reducing the number of icepacks in shipment during the cooler months of the year. The CSN $PM_{2.5}$ mass measurement is recommended for elimination in July 2014 and all other changes are recommended to take place in January 2015. Should these recommendations become final; all funded CSN sites in Minnesota will be affected. In addition, the site in Rochester (5008) is recommended for defunding and will be shut down at the end of 2014. The MPCA is currently soliciting feedback regarding the EPA recommendations. Final changes to the CSN network in Minnesota will be reflected in the final 2015 Annual Air Monitoring Network Plan.

National Atmospheric Deposition Program (NADP)

Atmospheric deposition is monitored through the NADP. It has two active sub-networks in Minnesota: the National Trends Network (NTN) and the Mercury Deposition Network (MDN). There are currently over 250 sites in the NADP spanning the continental United States, Alaska, Puerto Rico, and the Virgin Islands. More information can be found at http://nadp.sws.uiuc.edu/.

NTN collects weekly precipitation samples for pH, sulfate, nitrate, ammonium, chloride, and base cations (such as calcium and magnesium). NTN provides long-term, high-quality data for determining spatial and temporal trends in the chemical composition of precipitation.

MDN collects precipitation samples for analysis of total mercury and methylmercury concentrations. Its objective is to develop a national database of the weekly concentrations of total mercury in precipitation and the seasonal and annual flux of total mercury in wet deposition. Samples are collected weekly and sent to Frontier Geosciences, Inc. for analysis.

Minnesota has ten NADP sites; figure 1 shows the locations of these sites.

Industrial Networks

In Minnesota, air quality (AQ) permits are required to legally operate certain existing facilities and to begin construction on new facilities or modifications to existing facilities. Air quality permits contain state and federal requirements to minimize the environmental impact of air emissions from these facilities. Some federal programs involve performance standards for specific types of units or processes within a facility. Others address the impact of newly constructed facilities, or modifications to existing facilities, on ambient air quality.

Facilities that are required to monitor ambient air quality near their facility get assistance from MPCA with siting evaluations, instrument performance audits, and submitting data to the EPA's Air Quality System (AQS) database. The facilities are responsible for their own data validation and for other QA/QC activities.

The MPCA is currently assisting the following facilities:

- American Crystal Sugar Company in Moorhead, Crookston, and East Grand Forks
- Andersen Corporation in Bayport, MN
- Boise White Paper, L.L.C. in International Falls, MN
- Jordan Sands, LLC in Mankato, MN
- Northshore Mining Company in Silver Bay, MN
- Southern Minnesota Beet Sugar Cooperative in Renville, MN
- Shakopee Sands in Jordan, MN
- Tiller North Branch in North Branch, MN

Clean Air Status and Trends Network (CASTNET)

The Clean Air Status and Trends Network (CASTNET) is a national air quality monitoring network designed to provide data to assess trends in air quality, atmospheric deposition, and ecological effects due to changes in air pollutant emissions. CASTNET began collecting measurements in 1991 with the incorporation of 50 sites from the National Dry Deposition Network (NDDN), which had been in operation since 1987. CASTNET provides long-term monitoring of air quality in rural areas to determine trends in regional atmospheric nitrogen, sulfur, and ozone concentrations and deposition fluxes of sulfur and nitrogen pollutants in order to evaluate the effectiveness of national and regional air pollution control programs. CASTNET operates more than 80 regional sites throughout the contiguous United States, Alaska, and Canada. Sites are located in areas where urban influences are minimal. More information can be found at http://epa.gov/castnet.

There is one CASTNET site in Minnesota, located at Voyageurs National Park. This site is operated by the National Park Service. The MPCA does not have any role in this monitoring.

Quality Assurance/Quality Control (QA/QC) Program

The purpose of the QA/QC program is to assure the quality of data obtained from the MPCA air monitoring networks. The MPCA meets or exceeds the QA requirements defined in 40 CFR 58 and all applicable appendices.

The QA/QC program includes but is not limited to the following activities:

- instrument performance audits,
- monitor siting evaluations,
- precision and span checks,
- bias determinations,
- flow rate audits,
- leak checks, and
- data validation.

For independent quality assurance activities, the MPCA participates in the National Performance Audit Program and the Performance Evaluation Program for criteria pollutant monitoring and performance. Additional inter-laboratory comparisons are performed quarterly for air toxics monitoring.

As the Primary Quality Assurance Organization (PQAO) for ambient air monitoring activities in Minnesota, the MPCA operates under an EPA approved Quality Management Plan (QMP) and utilizes Quality Assurance Project Plans (QAPP) for each statewide monitoring network. The primary purpose of the QAPP is to provide an overview of the project, describe the need for the measurements, and define QA/QC activities to be applied to the project. All other ambient air monitoring initiatives including state, tribal, and industrial projects must have an MPCA approved monitoring plan for each specific project.

Parameter Networks

The MPCA monitors different types of measurable properties called parameters. The group of sites where a parameter is monitored is referred to as a parameter network. Generally, parameters are pollutants such as fine particles or air toxics. However, parameters also include non-concentration data such as wind speed and temperature.

The MPCA monitors the six criteria pollutants established by the 1970 Clean Air Act to show compliance with the NAAQS. The criteria pollutants are particulate matter ($PM_{2.5}$ and PM_{10}), lead, ozone, nitrogen dioxide, sulfur dioxide, and carbon monoxide.

Other types of particulate matter are also collected in Minnesota. Total suspended particulate matter (TSP) is monitored to show compliance with Minnesota Ambient Air Quality Standards (MAAQS). Chemical speciation of $PM_{2.5}$ is monitored at seven sites in Minnesota through the IMPROVE network and CSN. Speciation data are used for trends analysis and to better understand the sources of fine particles. In 2014, the MPCA began monitoring ultrafine particles (UFP) at the near-road monitoring site in Minneapolis.

The MPCA also monitors pollutants that pose a potential risk to human health and the environment, but are not regulated by standards including air toxics, acid rain, and mercury. Air toxics include volatile organic compounds (VOCs), carbonyls, and metals. Acid rain and mercury are monitored through the NADP across Minnesota.

Compounds containing sulfur are also monitored since they may cause irritation to the eyes, nose, and throat. Hydrogen sulfide (H_2S) is monitored to show compliance with the MAAQS. Total reduced sulfur (TRS) contains H_2S; it is monitored around industrial sources and used as conservative measure to compare to the H_2S MAAQS.

Temperature, wind speed and direction, barometric pressure, and relative humidity strongly influence the concentrations and transport of pollutants. Meteorological data are collected at five sites in the Twin Cities metropolitan area. Meteorological data from other sources near air monitoring stations can also be used to interpret air quality monitoring data.

Generally, parameters are monitored continuously or as integrated data. Continuous data gives readings on a real time basis, in short increments such as every five or 15 minutes or every hour. Integrated samples are usually 24-hour averages. Integrated samples are collected daily, once every three days or once every six days. Continuous data are collected and analyzed at the site. For integrated data, samples are collected at sites and then transported to the lab for further analysis.

Tables 8 and 9 list all of the air quality monitoring sites in Minnesota and the parameters monitored at each. Table 10 lists the types of parameters monitored by the MPCA along with the methods and equipment used.

Table 8: 2014 Site parameters - Greater Minnesota

MPCA Site ID	City Name	Site Name	$PM_{2.5}$ FRM	$PM_{2.5}$ FEM	$PM_{2.5}$ pre-FEM	$PM_{2.5}$ Speciation	PM_{10}	TSP and Metals	Ozone	Oxides of Nitrogen	Sulfur Dioxide	Carbon Monoxide	VOCs	Carbonyls	Other Parameters
MN08*	Hovland	Hovland													Acid Deposition
MN16*	Balsam Lake	Marcell													Acid and Hg Deposition
MN23*	Pillager	Camp Ripley													Acid and Hg Deposition
MN27*	Lamberton	Lamberton													Acid and Hg Deposition
MN28*	Sandstone	Grindstone Lake													Acid Deposition
MN32* VOYA1**	International Falls	Voyageurs				IMP			X						Acid Deposition
MN99*	Finland	Wolf Ridge													Acid Deposition
1300	Virginia	Virginia		X			X	X							
2013	Detroit Lakes	Detroit Lakes		X					X						
3051	Mille Lacs	Mille Lacs							X						PAHs
3052	Saint Cloud	Talahi School		X					X						
3204	Brainerd	Brainerd Airport		X					X						
4210	Marshall	Marshall Airport		X					X						
5008	Rochester	Ben Franklin School	X	X		CSN			X		X				
5220	Winona	Winona	X												Meteorological data and PM_4 silica
5302	Stanton	Stanton Air Field							X						PM_4 silica
7001 MN18* BOWA1**	Ely	Fernberg Road		X		IMP			X						Acid and Hg Deposition
7416	Cloquet	Cloquet							X						
7526	Duluth	Torrey Building										X			
7545	Duluth	Oneota Street					X								Collocated PM_{10}
7549	Duluth	Michigan Street											X	X	
7550	Duluth	WDSE	X						X						Collocated $PM_{2.5}$ FRM
7554	Duluth	Laura MacArthur School	X	X											
7555	Duluth	Waseca Road						X							Collocated TSP and metals
7810	Grand Portage	Grand Portage			X										
BLMO1**	Luverne	Blue Mounds				IMP									
GRRI1**	Winona	Great River Bluffs				IMP									

*NADP Site ID (no MPCA site ID exists)

**IMPROVE Site ID (no MPCA site ID exists and not an NADP site)

Table 9: 2014 Site parameters - Twin Cities metropolitan area

MPCA Site ID	City Name	Site Name	$PM_{2.5}$ FRM	$PM_{2.5}$ FEM	$PM_{2.5}$ Speciation	PM_{10}	TSP and Metals	Ozone	Oxides of Nitrogen	Sulfur Dioxide	Carbon Monoxide	VOCs	Carbonyls	Other Parameters
250	St. Louis Park	St. Louis Park	X									X	X	
420	Rosemount	FHR 420					X		X	X	X	X	X	TRS, Meteorological Data
423	Rosemount	FHR 423							X	X	X	X	X	TRS, Meteorological Data
436	St. Paul Park	SPPRC 436								X		X	X	TRS, Collocated VOCs and Carbonyls
438	Newport	SPPRC 438					X					X	X	
442	Rosemount	FHR 442								X		X	X	
443	Rosemount	FHR 443								X		X	X	
446	Bayport	Point Road					X					X	X	
465	Eagan	Gopher Resources					X^{L}							Collocated TSP and Metals
470	Apple Valley	Apple Valley	X	X			X					X	X	
505	Shakopee	Shakopee	X					X						
861	St. Paul	Lexington Avenue									X			
866	St. Paul	Red Rock Road				X								Collocated PM_{10}
868	St. Paul	Ramsey Health Center	X			X^{C}						X	X	$^{C}PM_{10}$ Continuous, Fibers
871	St. Paul	Harding High School	X	X			X					X	X	Collocated $PM_{2.5}$ FRM and $PM_{2.5}$ FEM
907	Minneapolis	Humboldt Avenue					X					X	X	
909	Minneapolis	Pacific Street		X										Meteorological Data
954	Minneapolis	Arts Center								X	X			
961	Richfield	Richfield Intermediate School										X	X	
962	Minneapolis	Near-road Minneapolis		X			X	X	X		X	X	X	Meteorological Data, Ultrafine Particle Counter, Black Carbon, PAHs
963	Minneapolis	H.C. Andersen School	X	X	CSN		X					X	X	PAHs
966	Minneapolis	City of Lakes				X	X					X	X	Collocated VOCs and Carbonyls
3201	Saint Michael	Saint Michael		X				X						
6010	Blaine	Anoka Airport	X	X	CSN	X^{C}	X^{PL}	X	X^{T}	X^{T}	X^{T}	X	X	$^{C}PM_{10}$ Continuous, ^{T}NCore trace level gases, Hg Deposition, $PM_{10-2.5}$, and Meteorological Data
6012	East Bethel	Cedar Creek						X						Acid Deposition
6016	Marine on St. Croix	Marine on St. Croix						X						

^{L}Source-oriented Lead
^{PL}Population-oriented Lead

Table 10: Methods and equipment

Monitoring parameter	Methods and equipment	Analyzing agency
Acid Deposition	Wet-only precipitation collection, Chromatography analysis	NADP
Black Carbon	Teledyne API Model 633	MPCA
Carbonyls	Liquid Chromatography – ATEC Model 2200 sampler	MPCA
CO	Infrared Absorption – Teledyne API Models 300E/T300, Dasibi 3008	MPCA
CO trace level	Infrared Absorption – Teledyne API Model T300U	MPCA
Fibers	MDH Method 852 – TE-2000 TSP sampler	MDH
H_2S	Honeywell Analytics MDA Model SPM Chemcassette	MPCA
Mercury Deposition	Wet-only precipitation collection, Inductively Coupled Argon Plasma analysis	NADP
Metals	Inductively Coupled Argon Plasma (ICP-OES) from TSP filters	MPCA
Meteorological Data	Various meteorological sensors	MPCA
NO/NO_y trace level	Chemiluminescence – Teledyne API Model T200U	MPCA
NO_X	Chemiluminescence – Teledyne API Models 200A/T200	MPCA
Ozone	Ultraviolet Absorption – Teledyne API Models 400E/ T400	MPCA
Particle sizer/counter	TSI Model 3031 Ultrafine Particle Monitor	MPCA
PM_{10}	Gravimetric – Andersen Hi-Vol samplers	MPCA
PM_{10} Continuous	Beta Attenuation – MetOne Instruments BAM-1020	MPCA
$PM_{10-2.5}$	Beta Attenuation – MetOne Instruments BAM-1020	MPCA
$PM_{2.5}$ Continuous	Beta Attenuation – MetOne Instruments BAM-1020	MPCA
$PM_{2.5}$ FEM	Beta Attenuation – MetOne Instruments BAM-1020 FEM	MPCA
$PM_{2.5}$ FRM	Gravimetric – Thermo Partisol-Plus Model 2025 $PM_{2.5}$ Sequential Air Sampler	MPCA
$PM_{2.5}$ Speciation - CSN	Gravimetric, GC/MS, Ion Chromatography – MetOne Instruments SAAS Speciation Sampler; URG3000N Carbon Samplers	US EPA
$PM_{2.5}$ Speciation - IMPROVE	Gravimetric, GC/MS, Ion Chromatography – IMPROVE Speciation Sampler	IMPROVE
PM_4 Silica	BGI Model PQ100 sampler	TBD
SO_2	Pulsed Fluorescence – Teledyne API Models 100E/T100	MPCA
SO_2 trace level	Pulsed Fluorescence – Teledyne API Model T100U	MPCA
TRS	SO_2 analyzer (pulsed fluorescence) with thermal oxidizer	MPCA
TSP	Gravimetric – Andersen Hi-Volume samplers	MPCA
VOCs	Gas Chromatography and Mass Spectrometry – ATEC Model 2200 sampler	MPCA

Criteria pollutants

In 1970, the Clean Air Act (CAA) established standards for six pollutants known to cause harm to human health and the environment. The CAA requires the MPCA to monitor these pollutants, called criteria pollutants, and report the findings to the EPA. The criteria pollutants are particulate matter, lead, ozone, nitrogen dioxide, sulfur dioxide, and carbon monoxide. For each of these pollutants the EPA has developed primary and secondary National Ambient Air Quality Standards (NAAQS). Primary standards are set to protect public health, while the secondary standard is set to protect the environment and public welfare (i.e. visibility, crops, animals, vegetation, and buildings).

The CAA requires the EPA to review the scientific basis of these standards every five years to ensure they are protective of public health and the environment. Table 11, found on the EPA website at http://epa.gov/air/criteria.html, describes the NAAQS (as of December 2012).

Table 11: National Ambient Air Quality Standards (NAAQS)

Pollutant [final rule cite]		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]		primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$ (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]		primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	$PM_{2.5}$	primary	Annual	12 $\mu g/m^3$	annual mean, averaged over 3 years
		secondary	Annual	15 $\mu g/m^3$	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 µg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

Particulate matter

The MPCA monitors five different particle fractions: ultrafine particulate matter (UFP) which has an aerodynamic diameter of less than 0.1 microns, fine particulate matter ($PM_{2.5}$) which has an aerodynamic diameter of less than 2.5 microns, coarse particulate matter ($PM_{10-2.5}$) which has an aerodynamic diameter ranging from 2.5 to 10 microns, PM_{10} which has an aerodynamic diameter of less than 10 microns, and total suspended particulate matter (TSP) which includes the total mass of particles found in a sample of ambient air. $PM_{2.5}$ and PM_{10} are regulated by the NAAQS and TSP is regulated by the MAAQS. There are currently no air quality standards for UFP or $PM_{10-2.5}$.

Ultrafine particulate matter (UFP)

Ultrafine particles are particulate matter with an aerodynamic diameter less than 0.1 microns. Ultrafines are released directly into the air through combustion and are also formed in the environment when other pollutant gases react in the air. Motor vehicles are a significant source of ultrafine particles. As a result, the highest levels of ultrafines are found along roadways. Similar to fine particles ($PM_{2.5}$), ultrafines can be inhaled deeply into the lungs and may enter the blood stream, impacting respiratory and cardiovascular health. Due to their small size and unique physical characteristics, emerging health research suggests that exposure to ultrafine particles may be a more significant driver of health effects than exposure to fine particles. However, to date, the EPA has found insufficient health evidence to support the creation of a distinct ultrafine particle standard.

In 2014, the MPCA installed an ultrafine particle sizer and counter at the near-road monitoring site (Site 962) along I-94 and I-35W in Downtown Minneapolis. In contrast to particulate monitors for $PM_{2.5}$, $PM_{10-2.5}$, PM_{10}, and TSP, which measure the total mass of particles in a sample of air, the ultrafine particle monitor measures the number of particles contained in the sample across six distinct size fractions (20–30 nm, 30–50 nm, 50–70 nm, 70–100 nm, 100–200 nm, and 200-1000 nm).

The addition of an ultrafine particle monitor in Minnesota's particulate monitoring network will support research activities ranging across technological, health, and atmospheric process disciplines and will help inform future long-term health assessments that contribute to ongoing reviews of the National Ambient Air Quality Standards (NAAQS).

Fine particulate matter ($PM_{2.5}$)

$PM_{2.5}$ is a chemically and physically diverse mixture of different sizes of very small particles most of which are smaller than 2.5 microns in diameter. It contains a complex mixture of chemicals including ammonium sulfate, ammonium nitrate, particle-bound water, elemental carbon, hundreds or thousands of organic compounds, and inorganic material including soil and metals.

$PM_{2.5}$ can be inhaled deeply into the lungs. Elevated concentrations of $PM_{2.5}$ are associated with a rise in heart attacks, acute and chronic bronchitis, asthma attacks, and respiratory symptoms. In children, reduced lung function growth and increased respiratory illness are also associated with elevated $PM_{2.5}$ concentrations.

There are currently 22 $PM_{2.5}$ sites in Minnesota, eight of which are in the Twin Cities metropolitan area. Figure 3 shows the locations of the sites in Minnesota. Five types of $PM_{2.5}$ monitors run in Minnesota: Federal Reference Method (FRM), Federal Equivalent Method (FEM), continuous, CSN, and IMPROVE. Monitors classified as FRM or FEM are regulatory grade monitors and can be used to demonstrate compliance with the $PM_{2.5}$ NAAQS. Monitors in the continuous, CSN, and IMPROVE networks are not eligible for regulatory comparisons.

The FRM monitors collect a 24-hour mass sample of $PM_{2.5}$ on Teflon filters. All FRM sites in Minnesota run once every three days. $PM_{2.5}$ data collected using this method are compared to the NAAQS to demonstrate compliance.

The FEM and continuous $PM_{2.5}$ monitors are MetOne Instruments BAM-1020 (BAM) continuous mass monitors that collect and report hourly $PM_{2.5}$ concentrations. With the exception of the BAM monitor operated by the Grand Portage Band of Lake Superior Chippewa, all BAM monitors operating in Minnesota are designated as FEM and can be used to demonstrate compliance with the $PM_{2.5}$ NAAQS. Hourly $PM_{2.5}$ data are also used to calculate the AQI and develop AQI forecasts for Minnesota. Continuous data are reported to the MPCA's AQI website (www.pca.state.mn.us/aqi) and the EPA's AIRNow website (http://airnow.gov/) as well as the Air Quality System (AQS).

CSN and IMPROVE monitors collect 24-hour samples once every three or six days that are analyzed for chemical composition. Data from the $PM_{2.5}$ speciation networks are used for trends analysis and to better understand sources and health effects of fine particles.

$PM_{2.5}$ regulatory network

The $PM_{2.5}$ regulatory network includes FRM and FEM monitors. Currently the MPCA is operating ten FRM sites and 14 FEM sites. Long term, the MPCA intends to use continuous $PM_{2.5}$ FEM monitors across the network and minimize, to the extent possible, the use of $PM_{2.5}$ FRM monitors.

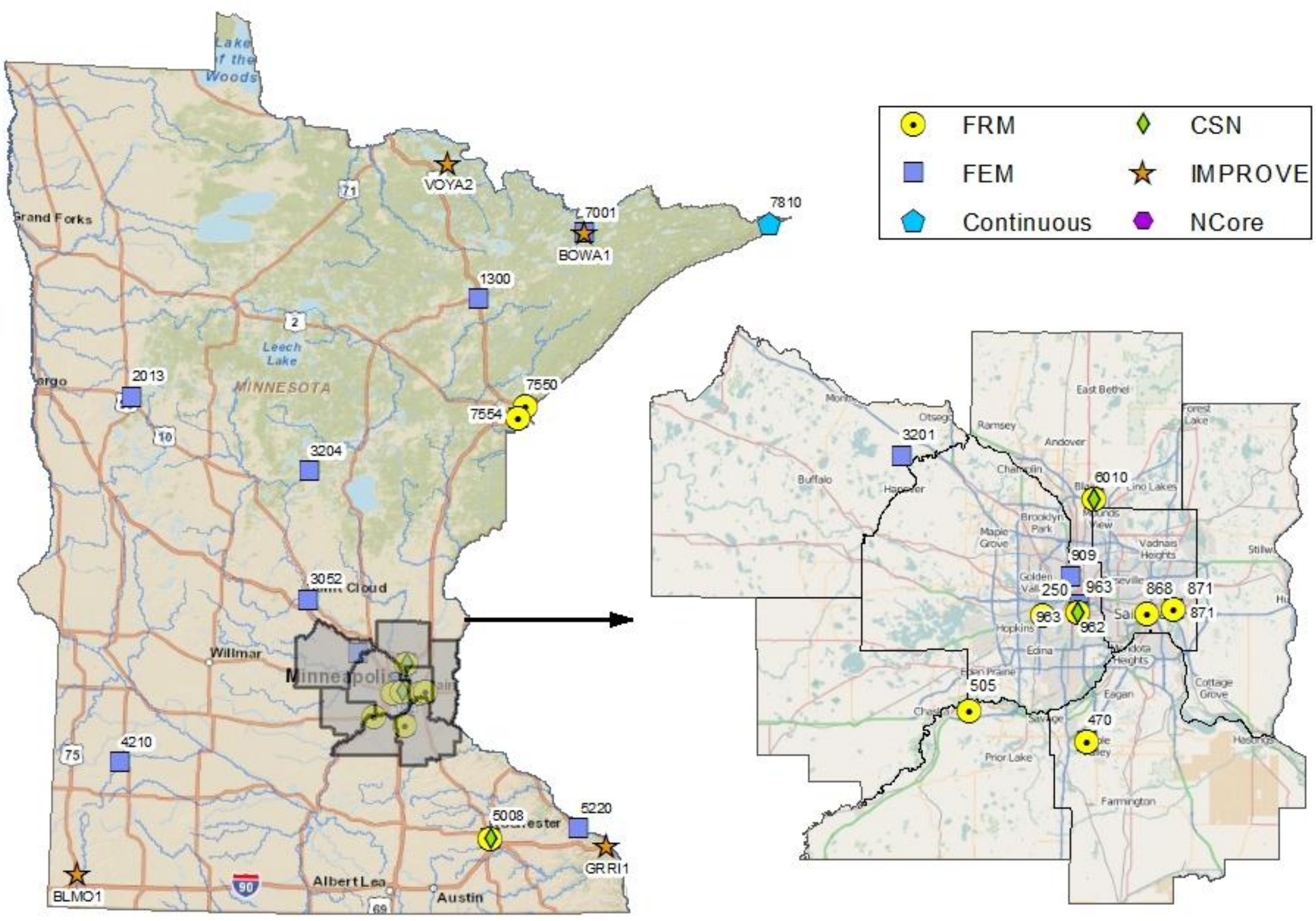
As part of the most recent revisions to the PM NAAQS, the EPA introduced new near-road $PM_{2.5}$ monitoring requirements. In 2014, a FEM $PM_{2.5}$ monitor was added to the near-road monitoring site along I-94 and I-35W in Minneapolis (Site 962). In 2015, a FEM $PM_{2.5}$ monitor will be added to the second near-road monitoring station in the Minneapolis-St. Paul-Bloomington CBSA. The location of this monitoring site is currently being finalized.

Two $PM_{2.5}$ FEM monitors will close in 2015. The special purpose monitor at site 909 in Minneapolis will close upon completion of two years of monitoring. More information on this project can be found on the project website (http://www.pca.state.mn.us/rx6ffwu). In addition, the special purpose monitor at site 5220 in Winona will close upon completion of one year of monitoring. More information on this project can be found on the project website (http://www.pca.state.mn.us/6f6dhkf).

In 2015 special purpose $PM_{2.5}$ monitors will also be added to short term (3 month) sites as part of the Community Air Monitoring Project; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).

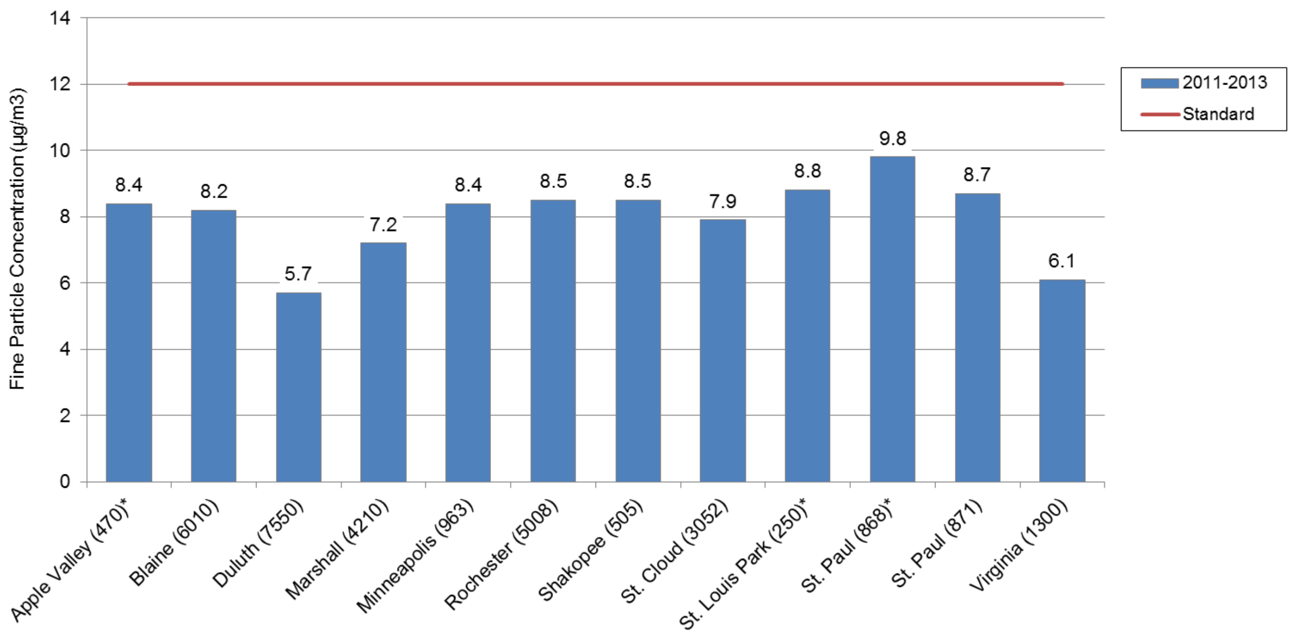
If a $PM_{2.5}$ FRM monitoring site were lost due to circumstances beyond the MPCA's control, a replacement site would be established if the lost site exceeded the NAAQS or if it is the "design value site" for a particular metropolitan statistical area (MSA). In this case, all possible efforts would be made to find a new site that is physically close to the lost site and has a similar scale and monitoring objective. However, if the "design value site" for that MSA is still operational, the MPCA would not establish a replacement site because the "design value site" would be used to determine compliance with the $PM_{2.5}$ NAAQS.

Figure 8: 2014 $PM_{2.5}$ monitoring sites in Minnesota



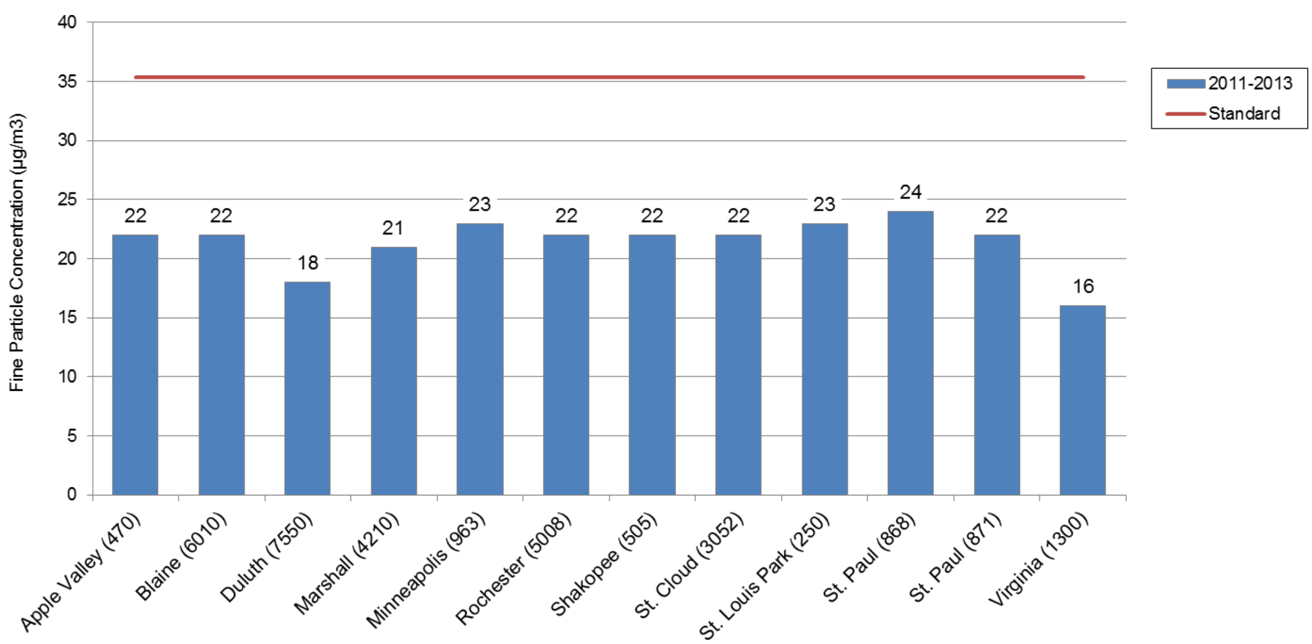
A monitoring site meets the annual $PM_{2.5}$ NAAQS if the three-year average of the annual average $PM_{2.5}$ concentration is less than or equal to 12 μg/m^3. Figure 9 shows the average of the 2011 through 2013 annual average $PM_{2.5}$ concentrations at Minnesota sites and compares them to the standard. Minnesota averages ranged from 5.7 μg/m^3 in Duluth (7550) to 9.8 μg/m^3 in St. Paul (868); therefore, all sites were below the annual standard.

Figure 9: Annual $PM_{2.5}$ concentrations compared to the NAAQS



A site meets the 24-hour standard if the 98th percentile of the 24-hour $PM_{2.5}$ concentrations in a year, averaged over three years, is less than or equal to 35 μg/m^3. Figure 10 shows the average of 2011 through 2013 98th percentile of the daily $PM_{2.5}$ averages at Minnesota sites and compares them to the standard. Minnesota averages ranged from 16 μg/m^3 in Virginia (1300) to 24 μg/m^3 in St. Paul (868); therefore, all sites were below the 24-hour standard.

Figure 10: 24-hour $PM_{2.5}$ concentrations compared to the NAAQS



$PM_{2.5}$ continuous network

The MPCA currently operates 14 FEM $PM_{2.5}$ sites in Minnesota. All FEM sites became operational in 2011 and 2012. There is also a pre-FEM $PM_{2.5}$ monitor at Grand Portage (7810) which is owned and operated by the Grand Portage Band of Lake Superior Chippewa. As discussed in the $PM_{2.5}$ regulatory network, two $PM_{2.5}$ FEM monitors will close at the end of 2014. Short term sites will be added as part of the Community Scale Monitoring project in 2014 and 2015. The Red Lake Band of Chippewa plans to establish a new tribal FEM $PM_{2.5}$ monitoring site in Red Lake in 2014. The MPCA will provide technical support and quality assurance for the operation of the site. The AQI data will be published on the MPCA website and the hourly values will be reported to the AQS upon validation.

The $PM_{2.5}$ continuous data provides two key types of information that are not available from the FRM network. Continuous data capture high concentration days that might be missed in the one in three day FRM sampling schedule. Daily monitoring also allows for temporal comparisons between sites on an ongoing basis, providing better comparisons. In addition, continuous $PM_{2.5}$ monitoring provides hourly data that assists in understanding how concentrations vary throughout the day. Understanding these daily fluctuations helps determine sources of $PM_{2.5}$ and when health risks from fine particles are greatest. This increased understanding of concentrations and risks aids in prioritizing emission reduction efforts.

Figure 11 shows daily $PM_{2.5}$ concentrations from eight FEM monitors across Minnesota. This chart illustrates how continuous data show the variability between sites. $PM_{2.5}$ is a regional pollutant with some addition from local sources; therefore, concentrations tend to rise and fall in unison across the state. The differences in concentrations between sites tend to be driven by local sources and closer proximity to large $PM_{2.5}$ sources to the south. The difference between urban and rural areas demonstrates the affect of man-made sources on fine particulate concentrations.

Figure 11: $PM_{2.5}$ daily concentrations in August 2013

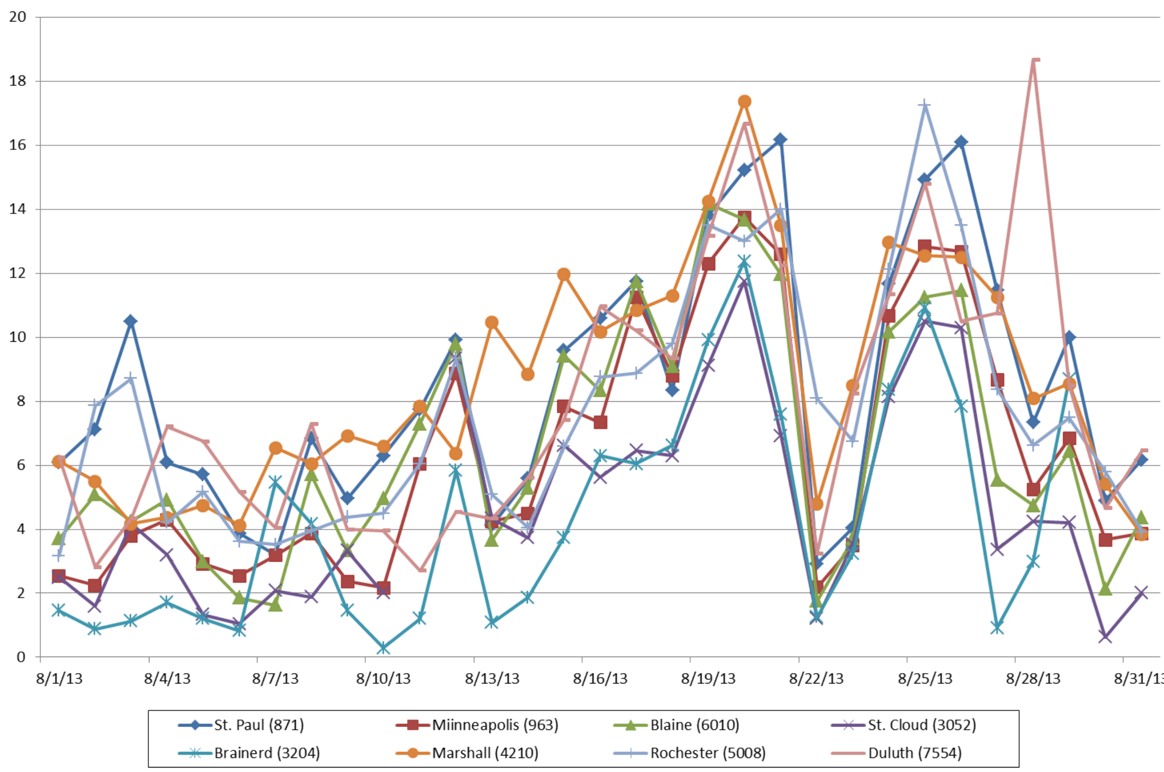
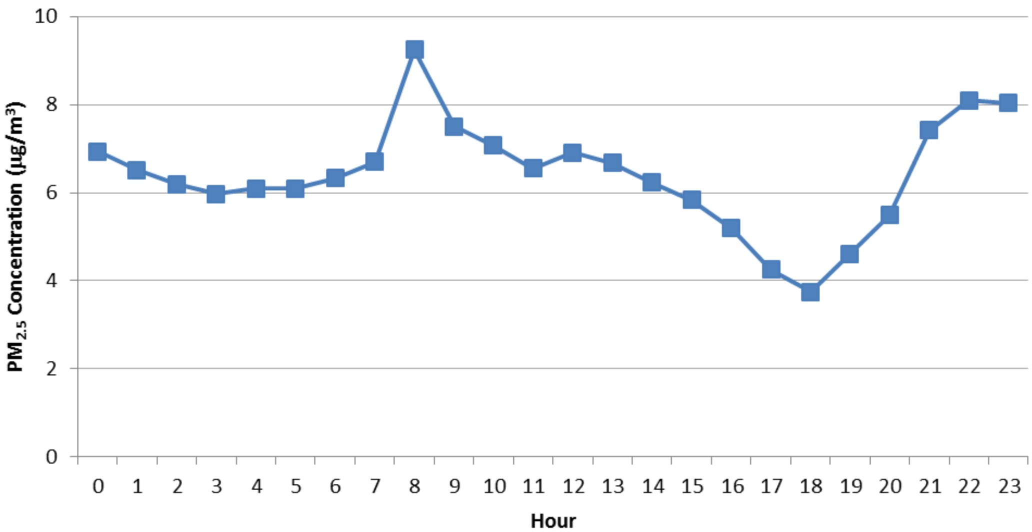


Figure 12 shows the average hourly concentrations in August 2013 in Minneapolis (site 963). It shows a classic traffic pattern in an urban area. The peak concentration around 8:00 a.m. results from rush hour traffic. As temperatures rise in the day, the atmospheric mixing height increases. This allows for dilution of fine particle concentrations and lowered concentrations in the afternoon. Temperatures fall in the evening, lowering the mixing height and trapping the particles, including those emitted during evening rush hour. This results in elevated concentrations throughout the night.

Figure 12: $PM_{2.5}$ average hourly concentrations at Andersen School (963) in August 2013



$PM_{2.5}$ Speciation

Currently, seven monitors measure $PM_{2.5}$ chemical speciation in Minnesota. Figure 1 shows the locations of the sites in Minnesota. The monitors in Minneapolis (963), Blaine (6010), and Rochester (5008) are part of the EPA's Chemical Speciation Network (CSN) (http://www.epa.gov/ttn/amtic/speciepg.html) which focuses on urban locations. The monitors at Voyageurs (VOYA2), Ely (BOWA1), Blue Mounds (BLMO1), and Great River Bluffs (GRRI1) are part of the IMPROVE network (http://vista.cira.colostate.edu/IMPROVE/) which focuses on visibility issues primarily in rural locations. Sampling frequency for these sites is once every three days except Rochester (5008) where sampling is done once every six days. Samples are analyzed at contract labs selected by the EPA and the IMPROVE program.

The particulate monitoring portion of the IMPROVE program measures $PM_{2.5}$ for mass, optical absorption, major and trace elements, organic and elemental carbon, and nitrate. CSN monitoring is similar except that it also includes analysis for ammonium and does not include optical absorption. In order to make the CSN data more comparable to the IMPROVE data, URG3000N carbon samplers were added to the CSN network over the last few years. Minneapolis (963) started sampling with a URG3000N carbon sampler on May 3, 2007 and Rochester (5008) started on October 4, 2009. On January 1, 2011 a CSN speciation monitor was added to the NCore site in Blaine (6010).

The EPA has been conducting an assessment of the CSN in an effort to optimize the network and create a network that is financially sustainable going forward. As a result of this assessment, EPA is recommending defunding a number of monitoring sites, eliminating the CSN $PM_{2.5}$ mass measurement, reducing the frequency of carbon blanks, and reducing the number of icepacks in shipment during the cooler months of the year. The CSN $PM_{2.5}$ mass measurement is recommended for elimination in July 2014 and all other changes are recommended to take place in January 2015. Should these recommendations become final; all funded CSN sites in Minnesota will be affected. In addition, the site in Rochester (5008) is recommended for defunding and will be shut down at the end of 2014. The MPCA is currently soliciting feedback regarding the EPA recommendations. Final changes to the CSN network in Minnesota will be reflected in the final 2015 Annual Air Monitoring Network Plan.

Coarse Particulate Matter ($PM_{10-2.5}$)

The 2006 Ambient Air Monitoring Regulations contain a requirement for $PM_{10-2.5}$ mass and speciation monitoring to be conducted at NCore multipollutant monitoring sites. The collocation of both $PM_{10-2.5}$ and $PM_{2.5}$ speciation monitoring at NCore sites is consistent with the multipollutant objectives of the NCore network and will support further research in understanding the chemical composition and sources of PM_{10}, $PM_{10-2.5}$, and $PM_{2.5}$ at a variety of urban and rural locations. This additional data will inform future regulation, providing more targeted protection from the health effects associated with coarse particles.

The MPCA started monitoring $PM_{10-2.5}$ at the NCore site in Blaine (6010) in the beginning of 2011. No additional sites are expected at this time.

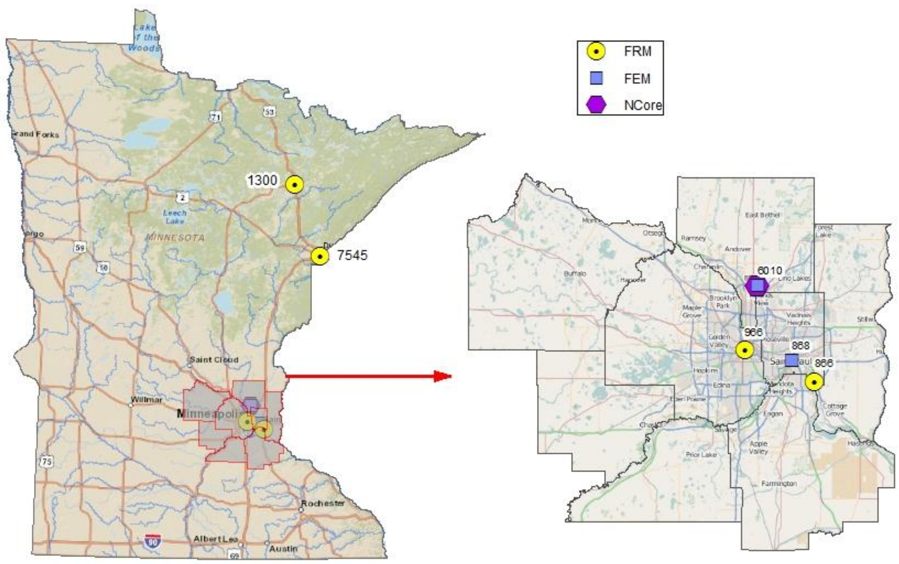
PM_{10}

PM_{10} includes all particles with an aerodynamic diameter less than 10 microns. Short-term exposure to PM_{10} is linked to hospitalization and even premature death in people with heart or lung disease. Decreased lung function and increased respiratory symptoms in children are also associated with PM_{10} exposure.

The MPCA currently operates four PM_{10} Federal Reference Method (FRM) monitors. This method collects mass samples of PM_{10} over a 24-hour period once every six days. There are also continuous FEM PM_{10} monitors in St. Paul (868) and Blaine (6010). Figure 13 shows the locations of the PM_{10} monitors in Minnesota in 2014. The majority of the PM_{10} monitors are located in the Twin Cities metropolitan area with additional monitors in Duluth (7545) and Virginia (1300). No changes are expected in 2015.

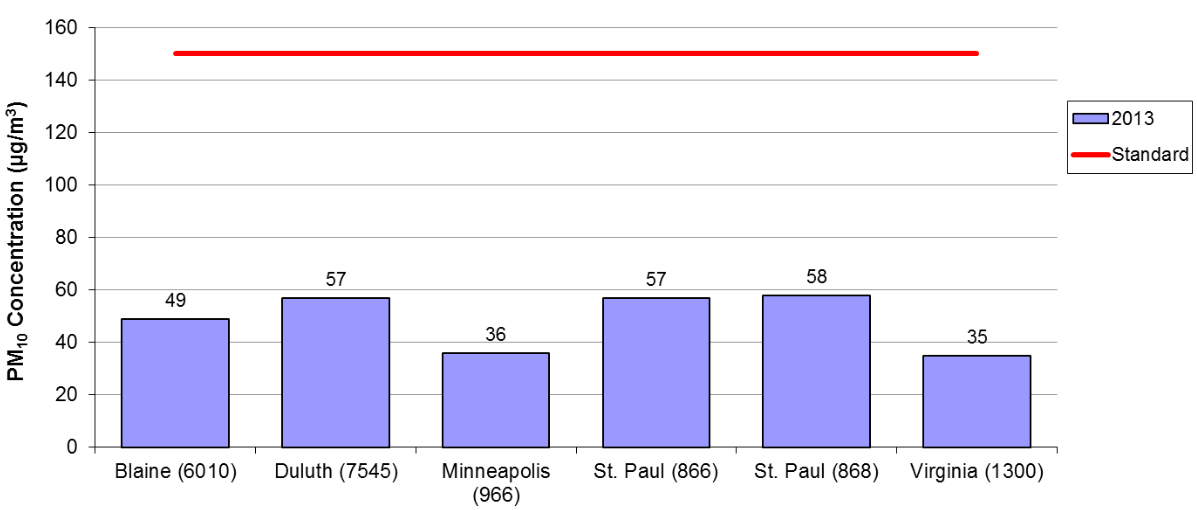
The long-term goal is to use continuous PM_{10} FEM monitors across the entire network and eliminate, to the extent possible, the use of the filter based PM_{10} FRM monitors. Continuous monitors capture more data and reduce operational costs associated with weighing, deploying, and recovering filters from the network.

Figure 13: 2014 PM_{10} monitoring sites in Minnesota



Minnesota currently meets applicable NAAQS for PM_{10} at all sites. A monitoring site meets the 24-hour PM_{10} NAAQS when the level of 150 $\mu g/m^3$ is not exceeded more than once per year. Figure 14 shows the 2013 second highest daily maximums at Minnesota sites and compares them to the standard. The Minnesota values ranged from 35 $\mu g/m^3$ in Virginia (1300) to 58 $\mu g/m^3$ in St. Paul (868); therefore, all sites were below the 24-hour standard in 2012. There is no annual standard for PM_{10}.

Figure 14: 24-hour PM_{10} concentrations compared to the NAAQS



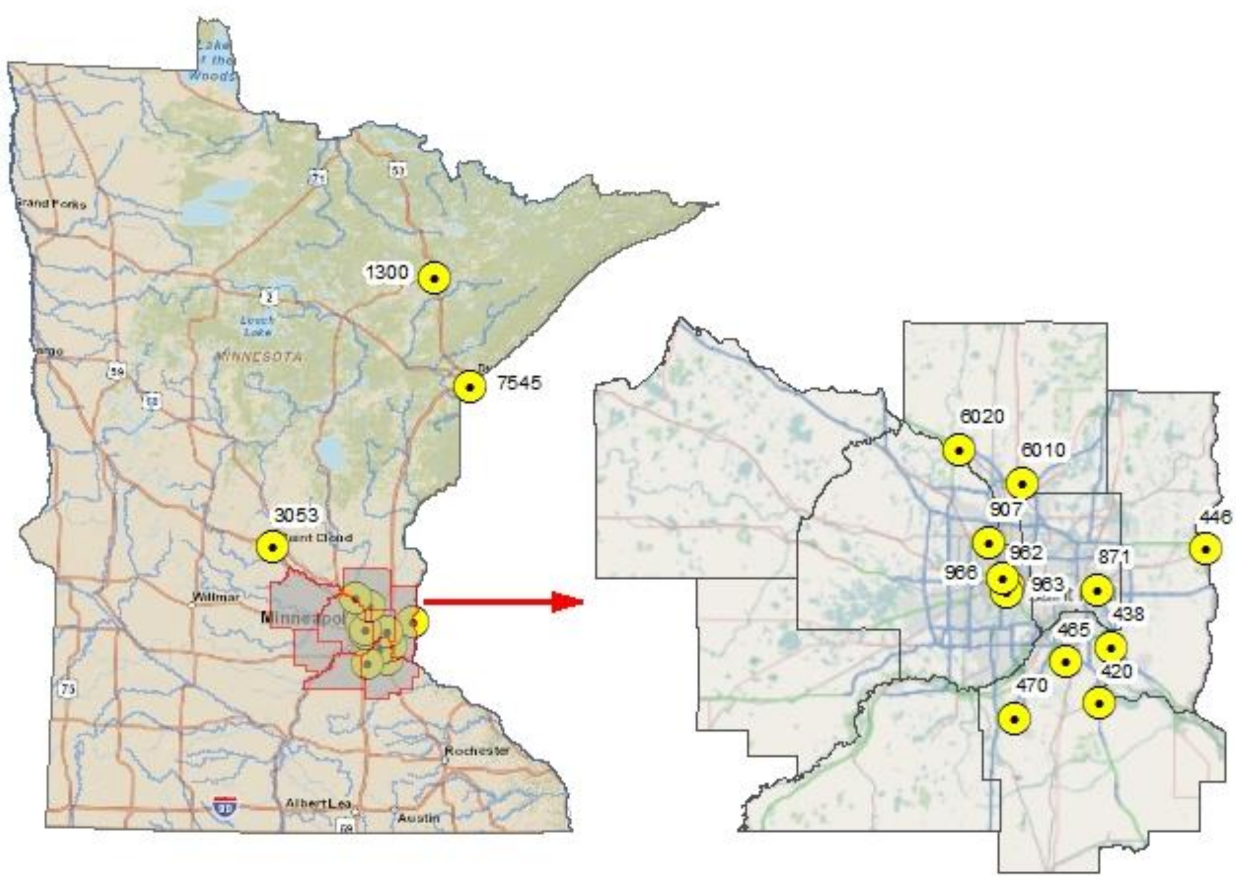
Total Suspended Particulate Matter (TSP)

TSP includes the total number of particles of solid or liquid matter - such as soot, dust, aerosols, fumes, and mist - found in a sample of ambient air. TSP was one of the original NAAQS; however, it was replaced in 1987 by the PM_{10} standard at the national level. Generally, more health effects are expected from smaller particles such as PM_{10} and $PM_{2.5}$. Today, TSP levels are regulated by the MAAQS in Minnesota.

The MPCA currently operates 14 TSP monitoring sites. Figure 15 shows the location of the existing sites in Minnesota. Mass samples of TSP are collected over a 24 hour period once every six days. TSP filters are also analyzed using Inductively Coupled Argon Plasma (ICAP) for metals as part of the air toxics program. Metals are discussed further in the air toxics section of this report.

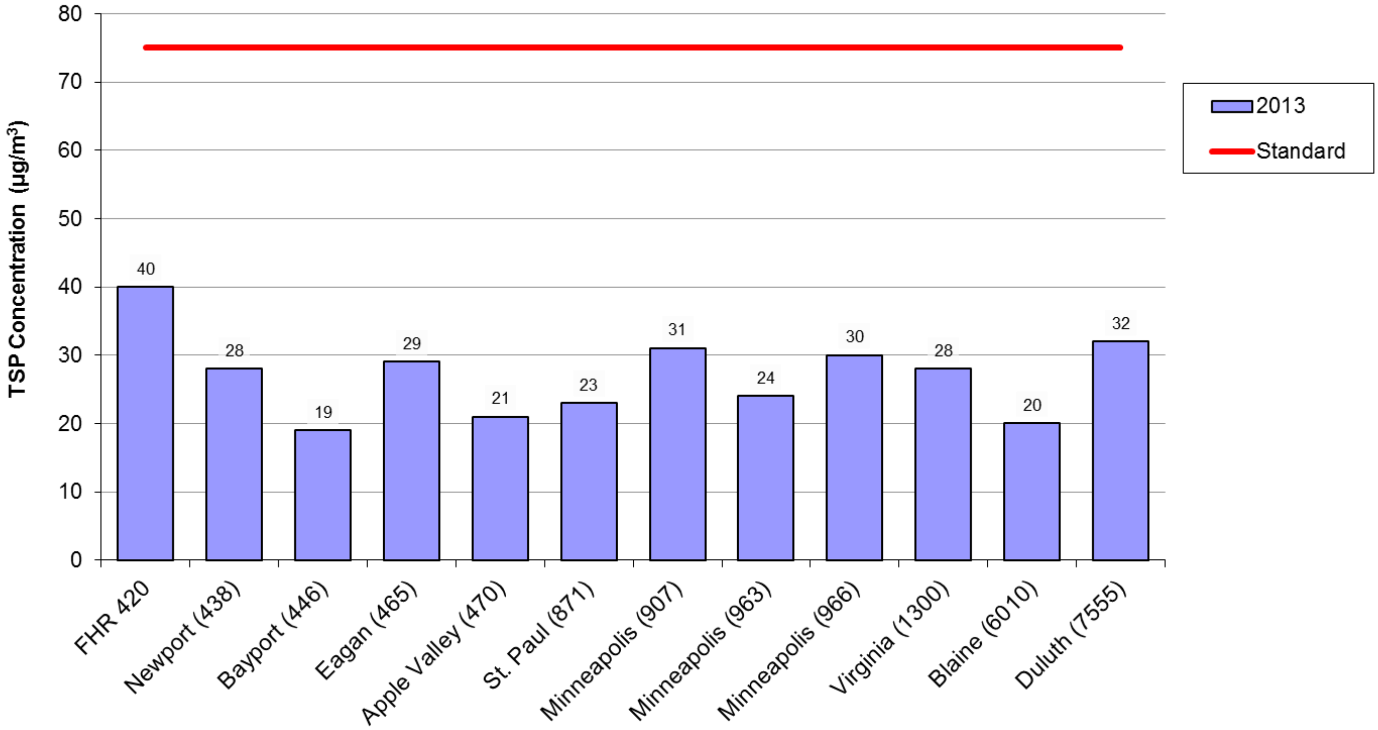
In 2014 and 2015 $PM_{2.5}$ monitors will be added to short term (3 month) sites as part of the Community Air Monitoring Project; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).

Figure 15: 2014 TSP monitoring sites in Minnesota



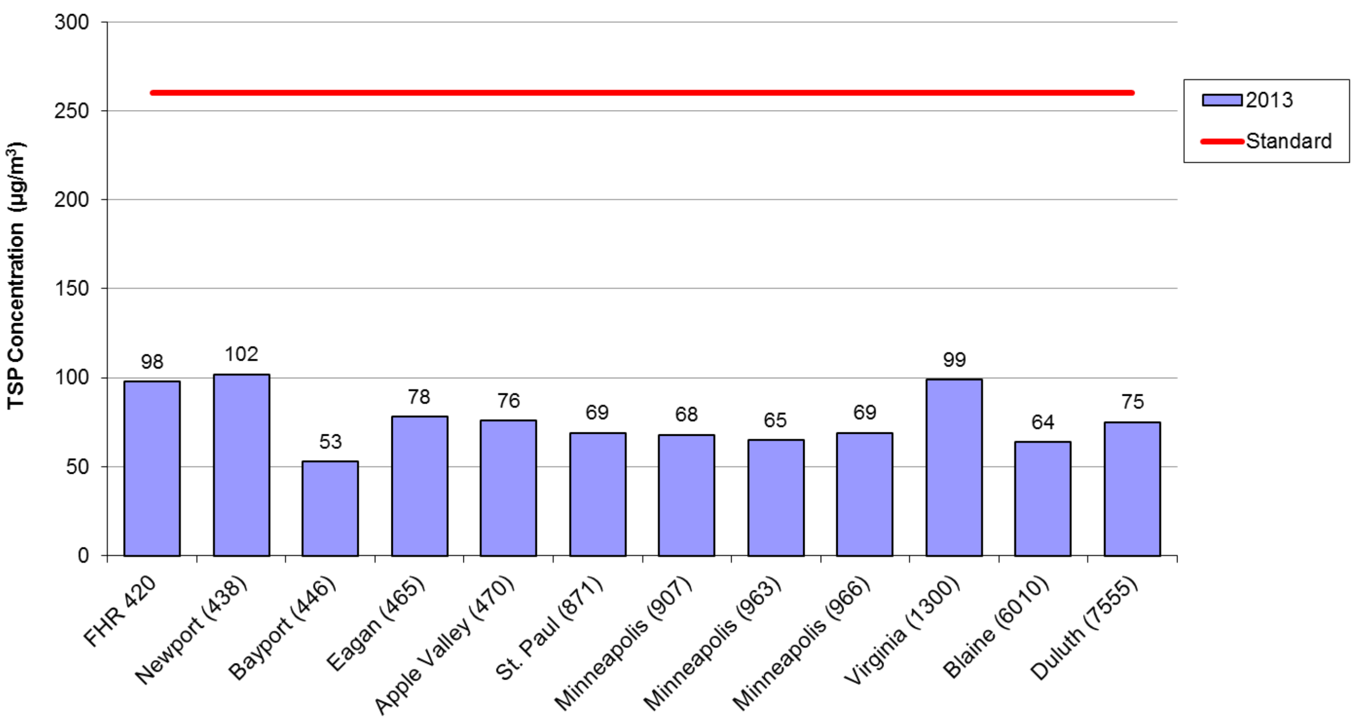
Minnesota currently meets applicable MAAQS for TSP. A monitoring site meets the annual TSP standard if the annual geometric average is less than or equal to 75 µg/m³. Figure 16 shows the 2013 annual averages at Minnesota sites and compares them to the standard. Minnesota averages ranged from 19 µg/m³ in Bayport (446) to 40 µg/m³ at FHR420; therefore, all sites were below the annual standard in 2013.

Figure 16: Annual average TSP concentrations compared to the MAAQS



A monitoring site meets the 24-hour standard when the level of 260 µg/m^3 is not exceeded more than once per year. Figure 17 shows the 2013 second highest daily maximums at Minnesota sites and compares them to the standard. Minnesota values ranged from 53 µg/m^3 in Bayport (446) to 102 µg/m^3 in Newport; therefore, all sites were below the 24-hour standard in 2013.

Figure 17: 24-hour TSP concentrations compared to the MAAQS



Lead (Pb)

Lead is a metal found naturally in the environment as well as in manufactured products. Since lead was phased out of gasoline, air emissions and ambient air concentrations have decreased dramatically. Currently, metals processing facilities (lead and other metals smelters) and leaded aviation fuel are the primary sources of lead emissions.

Lead emitted into the air can be inhaled directly or ingested after it settles onto surfaces or soils. Scientific evidence about the health effects of lead has expanded significantly in the last 30 years. Exposures to low levels of lead early in life have been linked to effects on IQ, learning, memory, and behavior. There is no known safe level of lead in the body.

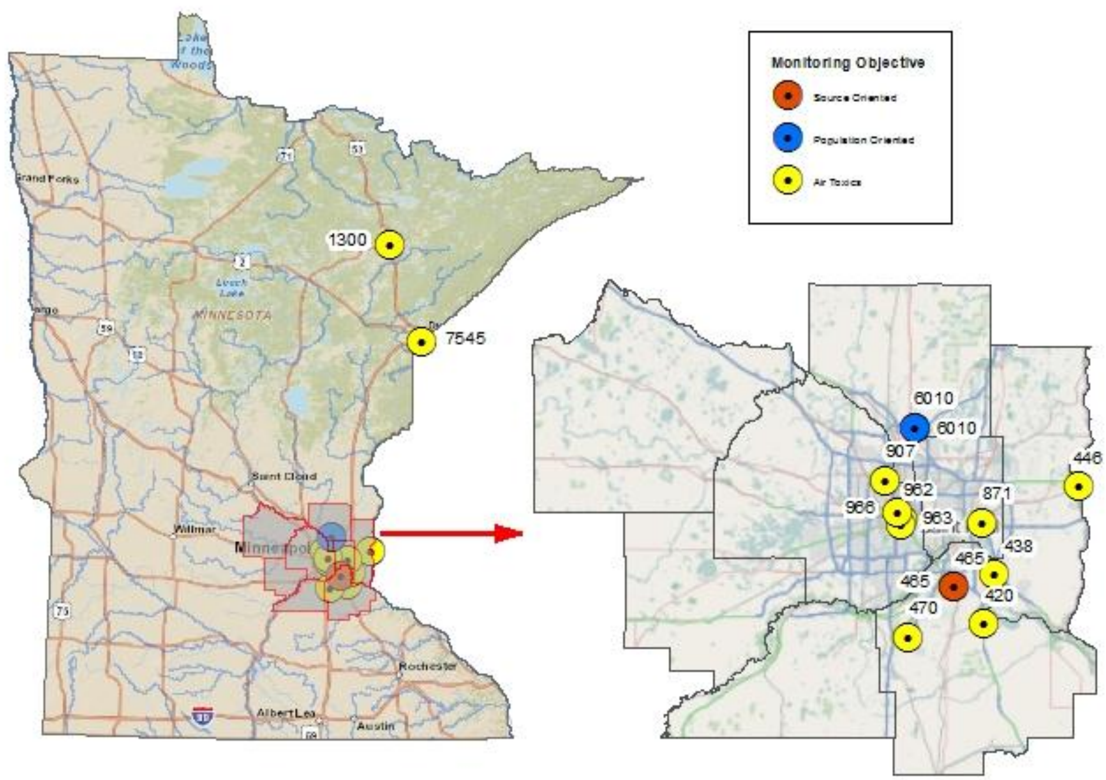
Elevated lead levels are also detrimental to animals and to the environment. Ecosystems near sources of lead show many adverse effects including losses in biodiversity, changes in community composition, decreased growth and reproductive rates in plants and animals, and neurological effects in animals.

The MPCA monitors lead at 12 sites across the state; including the one source-oriented monitoring sites in Eagan (465), one population-oriented site at NCore in Blaine (6010), and all sites where TSP is collected as part of the Air Toxics Program metals analysis. Figure 18 shows the locations where lead is monitored in 2014.

As part of the 2008 NAAQS revision for lead, the EPA expanded the existing lead monitoring network. On December 14, 2010 the EPA finalized revisions to the lead monitoring requirements, requiring monitoring near sources with lead emissions equal to or greater than 0.5 tons per year (tpy), and requiring that all urban NCore sites include lead monitoring. In 2010, The MPCA began operations of a new source-oriented lead monitoring network, which includes an existing lead site at Gopher Resources in Eagan (465), and new sites in Anoka (6020) and St. Cloud (3053). Based on monitoring data collected from 2010 through 2012, lead concentrations measured at the source-oriented monitoring sites in Anoka and St. Cloud were found to be less than 50 percent of the lead NAAQS. As a result, following EPA approval, these monitoring sites were closed in June 2013.

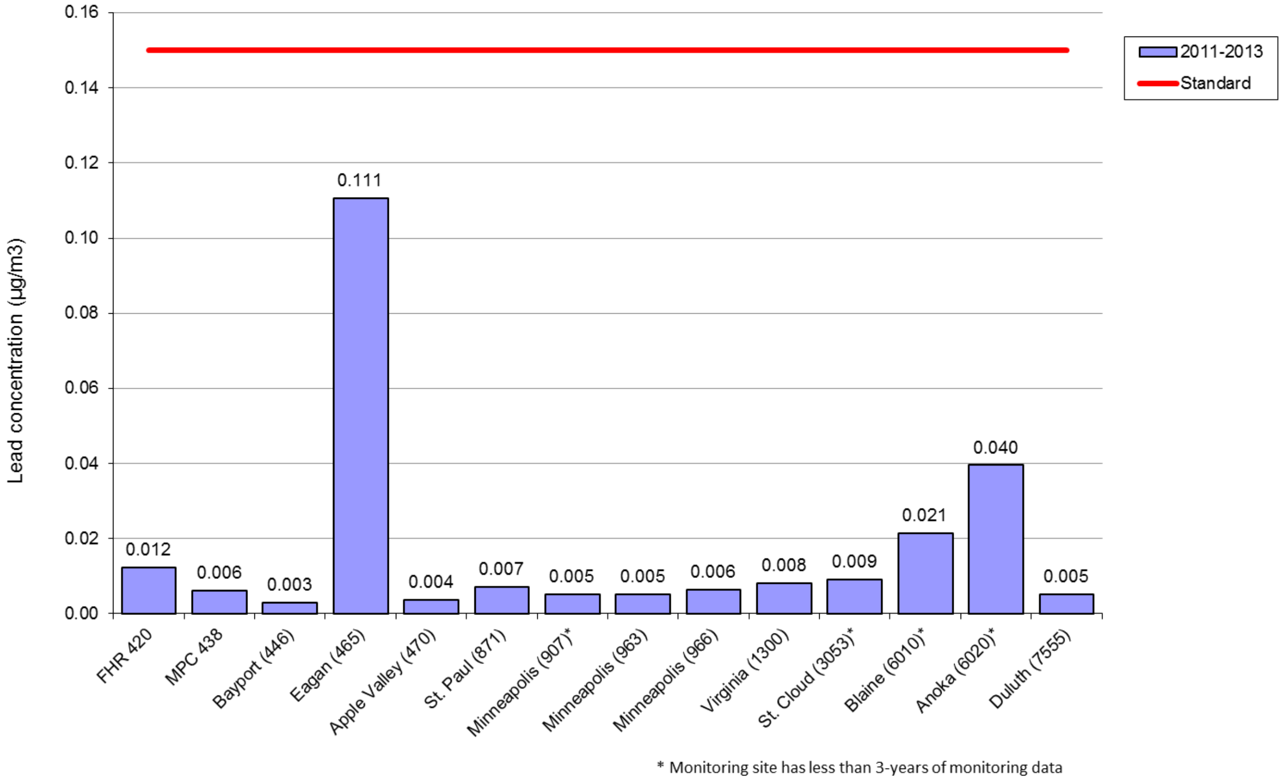
As discussed in the TSP section, TSP monitors will be added to short term (3 month) sites as part of the Community Air Monitoring Project in 2014 and 2015; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).

Figure 18: 2014 Lead monitoring sites in Minnesota



All lead monitoring sites in Minnesota meet the 2008 lead NAAQS of 0.15 µg/m^3. Figure 19 shows the 3-year maximum rolling quarter average concentration at monitored sites from 2011-2013. Minnesota values range from 0.003 µg/m^3 in Bayport (446) to 0.111 µg/m^3 in Eagan (465) with the majority of sites below 0.02 µg/m^3.

Figure 19: Lead concentrations compared to the NAAQS



Ozone (O_3)

Ozone is an odorless, colorless gas composed of three atoms of oxygen. Ground-level ozone is not emitted directly into the air, but is created through a reaction of nitrogen oxides and volatile organic compounds in the presence of sunlight.

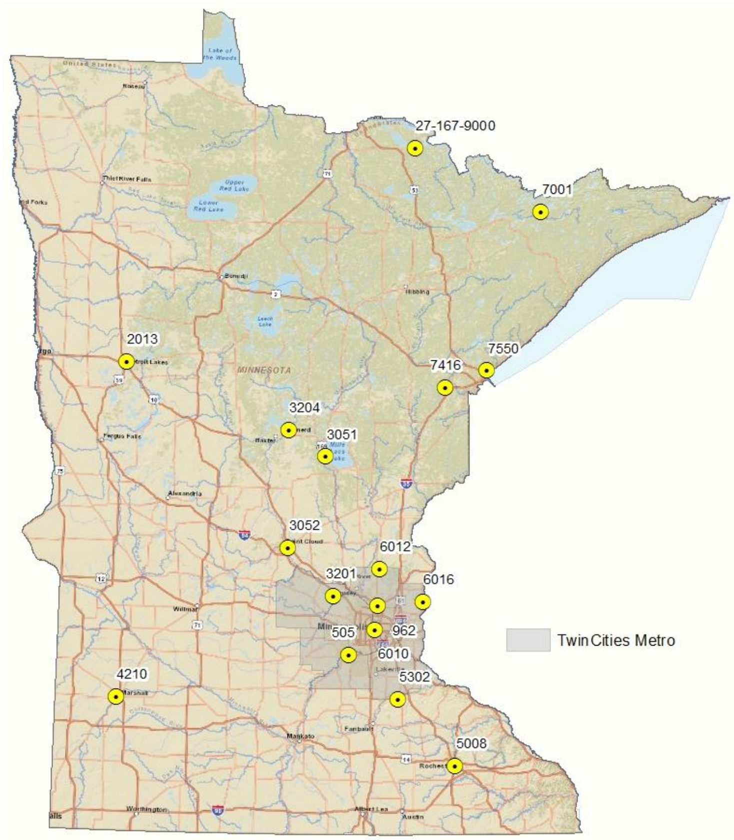
Breathing air containing ozone can reduce lung function and inflame airways, which can increase respiratory symptoms and aggravate asthma or other lung diseases. Ozone exposure has also been associated with increased susceptibility to respiratory infections, medication use, doctor and emergency department visits and hospital admissions for individuals with lung disease. Ozone exposure also increases the risk of premature death from heart and lung disease. Children are at increased risk from ozone because their lungs are still developing and they are more likely to have increased exposure since they are often active outdoors.

In addition, cumulative ozone exposure can lead to reduced tree growth; visibly injured leaves and increased susceptibility to disease, damage from insects and harsh weather. These effects can have adverse impacts on ecosystems, including loss of species and changes to habitat quality, and water and nutrient cycles.

Ozone is monitored on a continuous basis at 16 monitoring sites and is reported in hourly increments. Because ozone formation requires high temperatures and sunny conditions, the EPA only requires Minnesota to monitor for ozone from April 1 – October 31 each year. The majority of ozone sites in Minnesota follow this monitoring season; however, ozone is measured year round at the NCore site in Blaine (6010). The data collected from these ozone monitors are used to determine compliance with the NAAQS and are reported as part of the AQI. Figure 20 shows the monitoring locations for ozone (2014) in Minnesota. An additional ozone monitor, located at Voyageurs National Park (AQS site 27-167-9000), is operated by the National Park Service. Since the MPCA does not have any role in this monitor, it is not included in our SLAMS or AQI monitoring networks.

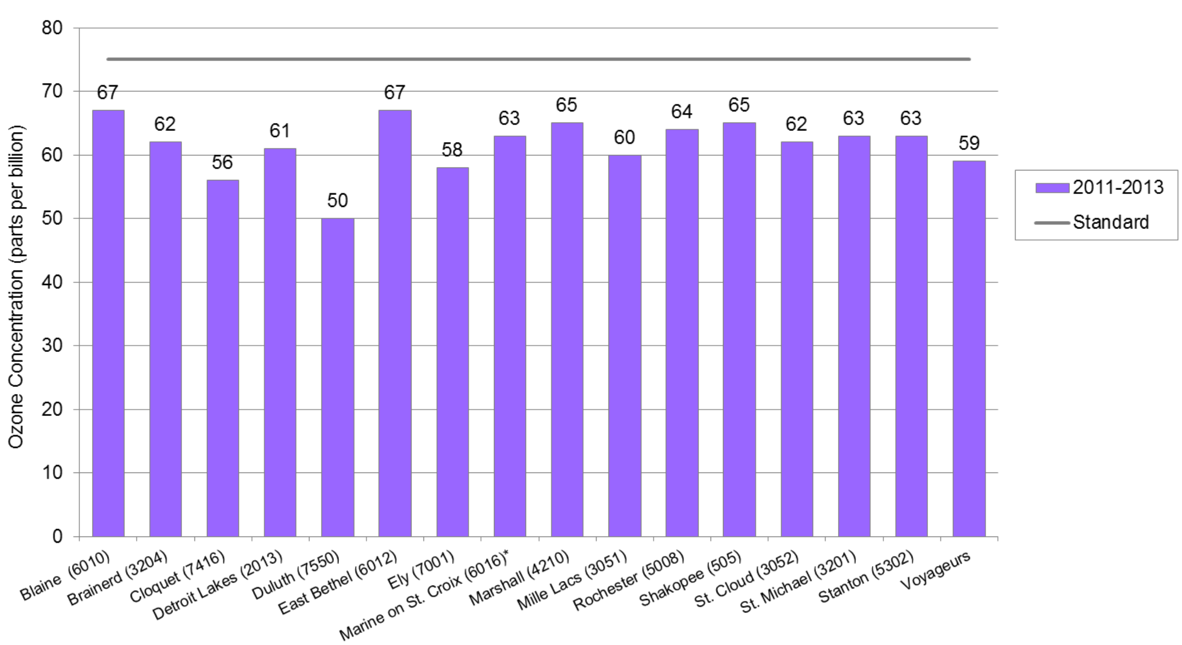
No changes are expected in ozone monitoring in 2015.

Figure 20: 2014 Ozone monitoring sites in Minnesota



A monitoring site meets the primary ozone NAAQS if the three year average of the fourth highest daily maximum 8-hour concentration is less than or equal to 75 ppb. Figure 21 shows the 2011 through 2013 8-hour averages at Minnesota sites and compares them to the standard. Minnesota averages ranged from 50 ppb in Duluth (7550) to 67 ppb in Blaine (6010) and East Bethel (6012); therefore, all sites were below the 8-hour standard.

Figure 21: 8-hour average ozone concentrations compared to the NAAQS



* less than 3-years of complete data

Oxides of nitrogen (NO_X)

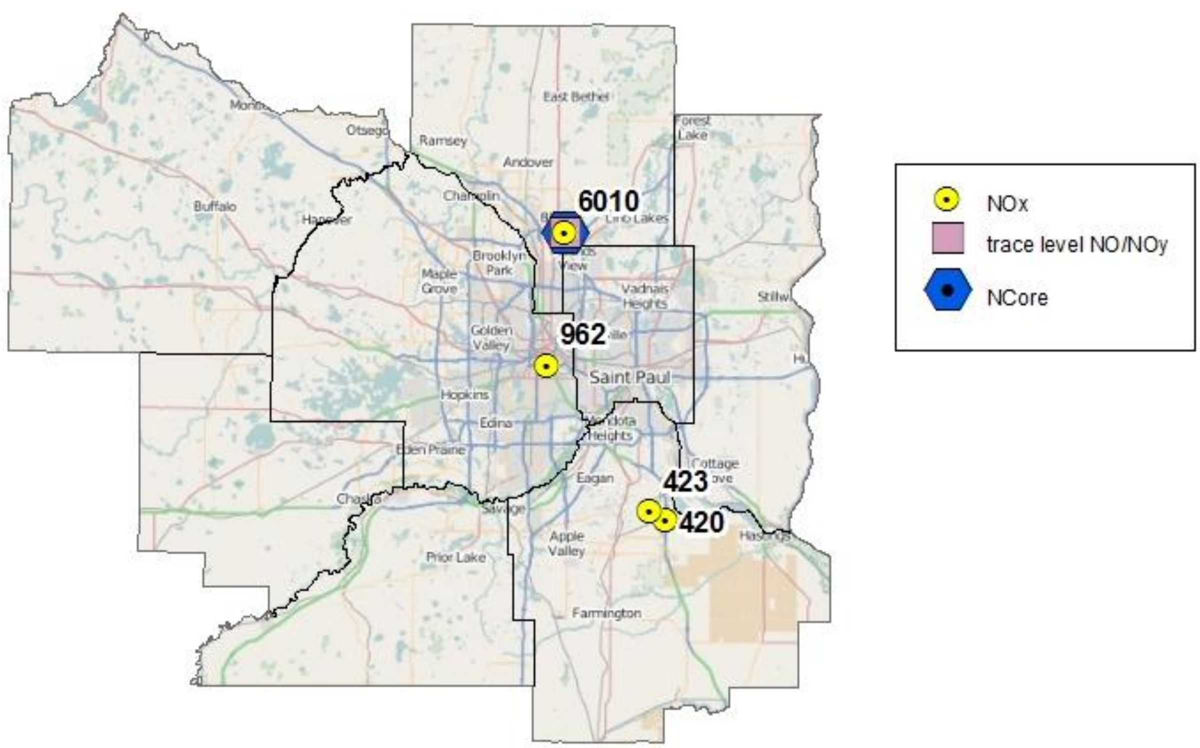
NO_X is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen in varying amounts. The two primary components are nitric oxide (NO) and nitrogen dioxide (NO_2). NO_2 is the regulated pollutant; it can often be seen as a reddish-brown layer in urban areas.

NO_X contribute to a wide range of health and environmental effects. NO_2 itself can irritate the lungs and lower resistance to respiratory infections. More importantly, nitrogen oxides react to form ground–level ozone, $PM_{2.5}$, acid rain and other toxic chemicals. They also can lead to visibility and water quality impairment due to increased nitrogen loading in water bodies. In addition, nitrous oxide, another component of NO_x, is a greenhouse gas that contributes to climate change.

Currently, the MPCA monitors NO_2 and NO at four sites in the Twin Cities metropolitan area (figure 22). Trace level NO/NO_y has been at the NCore site in Blaine (6010) since 2009. This trace level data will help us understand the role of these pollutants at levels far below the NAAQS; however, due to performance issues with the monitoring equipment, trace level monitoring results have been unreliable. The trace-level NO/NOy analyzer at the NCore site in Blaine (6010) was replaced and tested in early 2014; valid data collection has resumed as of May 1, 2014.

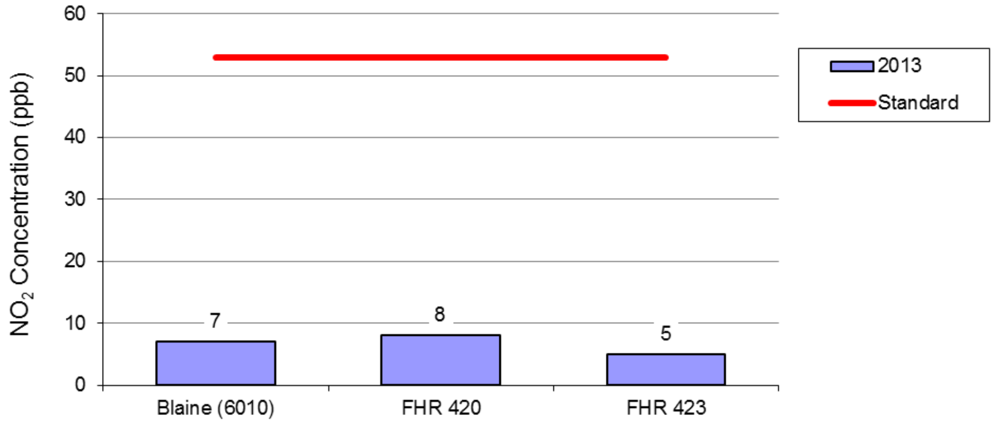
In February of 2010, The U.S. Environmental Protection Agency (EPA) finalized new minimum monitoring requirements for the nitrogen dioxide (NO_2) monitoring network in support of a 1-hour NO_2 National Ambient Air Quality Standard (NAAQS). In the new monitoring requirements, state and local air monitoring agencies are required to install near-road NO_2 monitoring stations at locations where peak hourly NO_2 concentrations are expected to occur within the near-road environment in large urban areas. Based on population, The Minneapolis-St. Paul-Bloomington CBSA is the only CBSA in Minnesota that requires near-road monitoring, with two-monitoring stations required by January 2015. The first near-road monitoring site (site 962), which is located along I-94 and I-35W in downtown Minneapolis, began operations in January 2013. The location of the second near-road monitoring site is still being finalized, but is planned to begin operations in January 2015.

Figure 22: 2014 NO_X monitoring sites in the Twin Cities metropolitan area



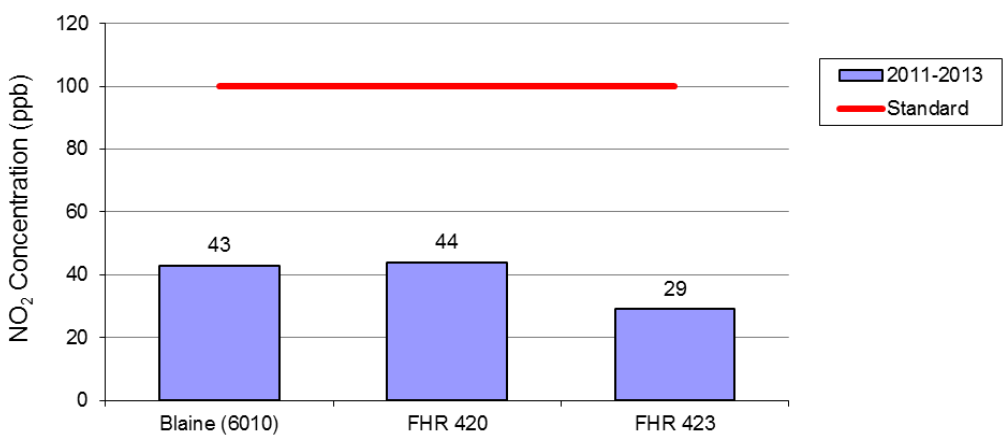
A monitoring site meets the annual NAAQS for NO_2 if the annual average is less than or equal to 53 ppb. Figure 23 shows the 2013 averages at Minnesota sites and compares them to the standard. Minnesota averages ranged from 5 ppb at FHR 423 to 8 ppb at FHR 420; therefore, Minnesota currently meets the annual NAAQS for NO_2.

Figure 23: Annual average NO_2 concentrations compared to the NAAQS



On January 22, 2010 the EPA finalized revisions to the NO_2 NAAQS. As part of the standard review process, the EPA retained the existing annual NO_2 NAAQS, but also created a new 1-hour standard. This new 1-hour NAAQS will protect against adverse health effects associated with short term exposures to elevated NO_2. To meet this standard, the three-year average of the annual 98^{th} percentile daily maximum 1-hour NO_2 concentration must not exceed 100 ppb. Figure 24 shows the 2011-2013 average of the annual 98^{th} percentile daily maximum 1-hour NO_2 concentrations at Minnesota sites and compares them to the 1-hour standard. Minnesota averages ranged from 29 ppb at FHR 423 to 44 ppb at FHR 420; therefore, all Minnesota sites currently meet the1-hour NAAQS for NO_2.

Figure 24: 1-hour NO_2 concentrations compared to the NAAQS

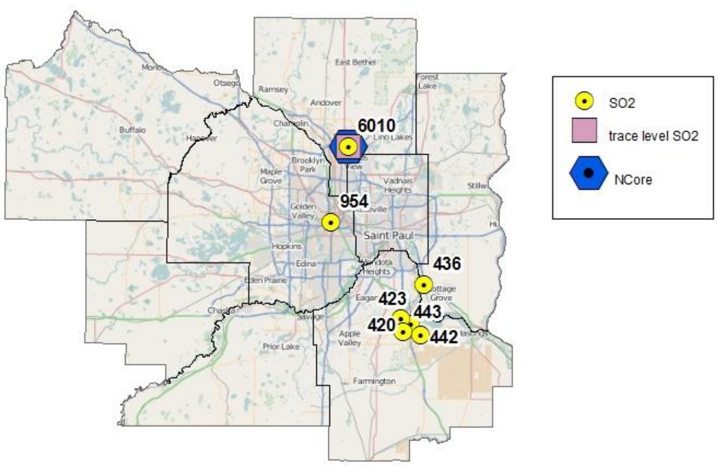


Sulfur dioxide (SO_2)

SO_2 belongs to the family of sulfur oxide gases. SO_2 reacts with other chemicals in the air to form sulfate particles. Exposures to SO_2, sulfate aerosols, and fine particles contribute to respiratory illness, and aggravate existing heart and lung diseases. High levels of SO_2 emitted over a short period, such as a day, can be particularly problematic for people with asthma. SO_2 also contributes to the formation of $PM_{2.5}$, visibility impairment, and acid rain. SO_2 is monitored on a continuous basis and reported in hourly increments. Data are used to determine compliance with the NAAQS and are reported as part of the AQI. Minnesota currently meets all applicable NAAQS for SO_2; however, continued reductions are sought due to its role in forming fine particles.

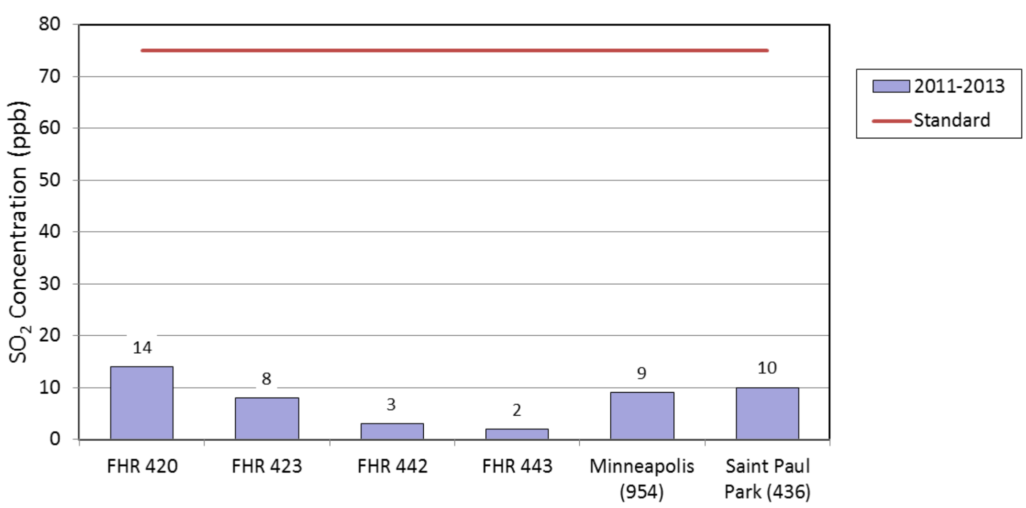
The MPCA monitors SO_2 at eight sites in the Twin Cities metropolitan area shown in Figure 25. In 2014, a SO2 monitor was added to Rochester (5008); monitoring will continue for three years so data can be used for model verification. Trace level SO_2 has been at the NCore site in Blaine (6010) since 2009. This trace level data will help us understand the role of SO_2 at levels far below the NAAQS; however, due to performance issues with the monitoring equipment, trace level monitoring results have been unreliable. The trace-level SO_2 analyzer at the NCore site in Blaine (6010) was replaced in early 2014; valid data collection has resumed as of May 1, 2014

Figure 25: 2014 SO_2 monitoring sites in the Twin Cities metropolitan area



On June 2, 2010, the EPA finalized revisions to the primary SO_2 NAAQS. EPA established a new 1-hour standard which is met if the three-year average of the annual 99th percentile daily maximum 1-hour SO_2 concentration is less than 75 ppb. In addition to creating the new 1-hour standard, the EPA revoked the existing 24-hour and annual standards. Figure 26 describes the 2011 -2013 average 99th percentile 1-hour SO_2 concentration and compares them to the 1-hour standard. Minnesota averages ranged from 2 ppb at FHR 443 to 14 ppb at FHR 420; therefore, all Minnesota sites currently meet the1-hour NAAQS for SO_2.

Figure 26: 1-hour SO_2 concentrations compared to the NAAQS*



Carbon monoxide (CO)

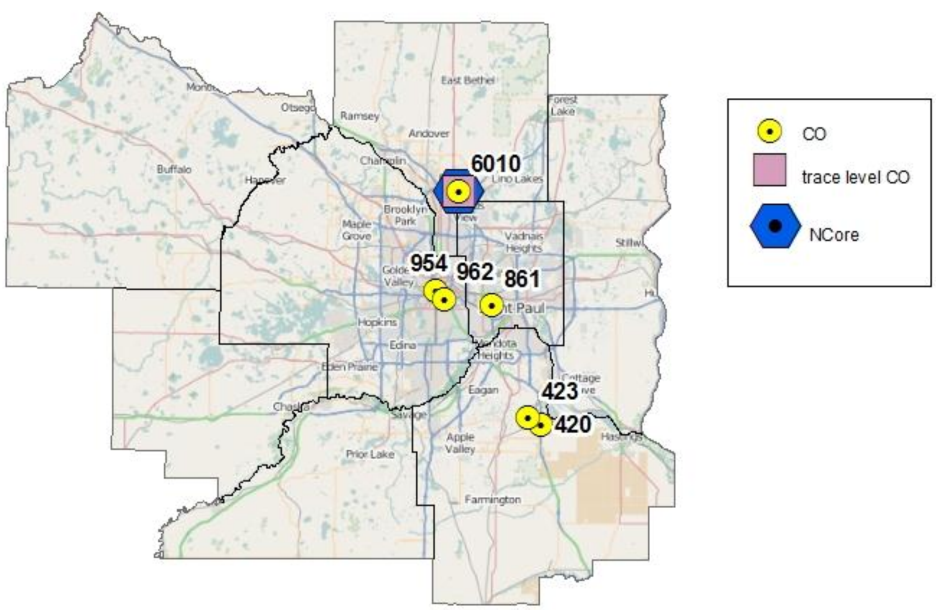
CO is a colorless and odorless toxic gas formed when carbon in fuels is not burned completely. CO enters the bloodstream and reduces the delivery of oxygen to the body's organs and tissues. Exposure to elevated CO concentrations is associated with vision problems, reduced ability to work or learn reduced manual dexterity, and difficulty performing complex tasks. Prolonged exposure to high levels can lead to death. Carbon monoxide is also oxidized to form carbon dioxide (CO_2) which contributes to climate change and the formation of ground-level ozone.

CO is monitored on a continuous basis and reported in hourly increments. Data is used to determine compliance with the NAAQS and reported as part of the AQI.

The MPCA monitors for CO at seven sites in Minnesota including six sites in the Twin Cities metropolitan area (figure 27) and one site in Duluth (7526). The Duluth site will close on June 30, 2014. In 2015, CO monitoring will be added to the second near-road monitoring station in the Minneapolis-St. Paul-Bloomington CBSA. The location of this monitoring site is currently being finalized.

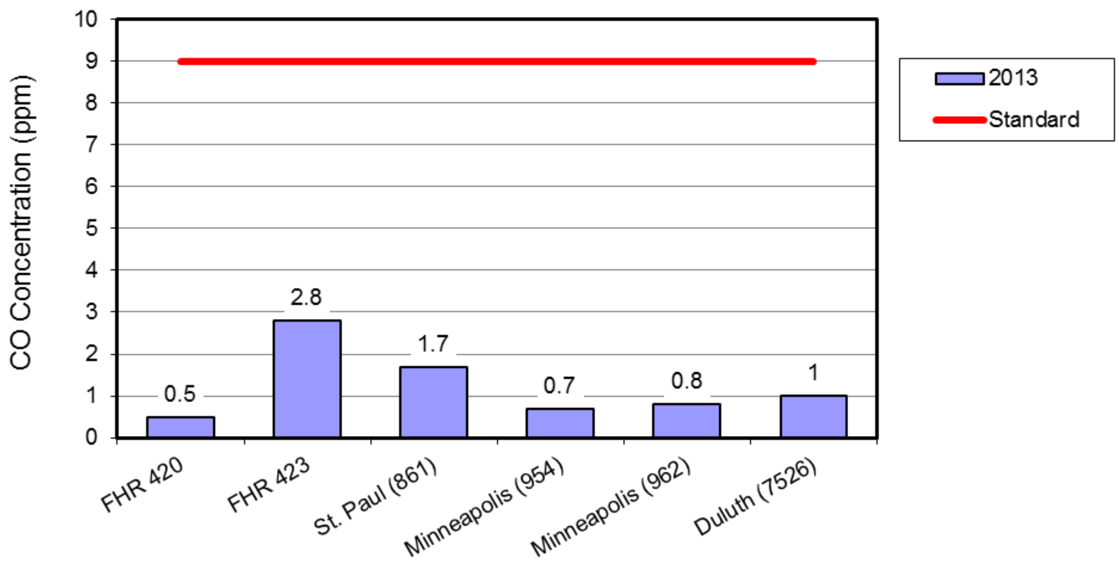
Trace level CO was added to the NCore site in Blaine (6010) in 2008. This trace level data will help us understand the role of CO at levels far below the NAAQS; however, due to performance issues with the monitoring equipment, trace level monitoring results have been unreliable. The trace-level CO analyzer at the NCore site in Blaine (6010) was replaced in early 2014; valid data collection has resumed as of May 1, 2014. The CO site in Duluth (7526) will close in 2014.

Figure 27: 2014 CO monitoring sites in the Twin Cities metropolitan area



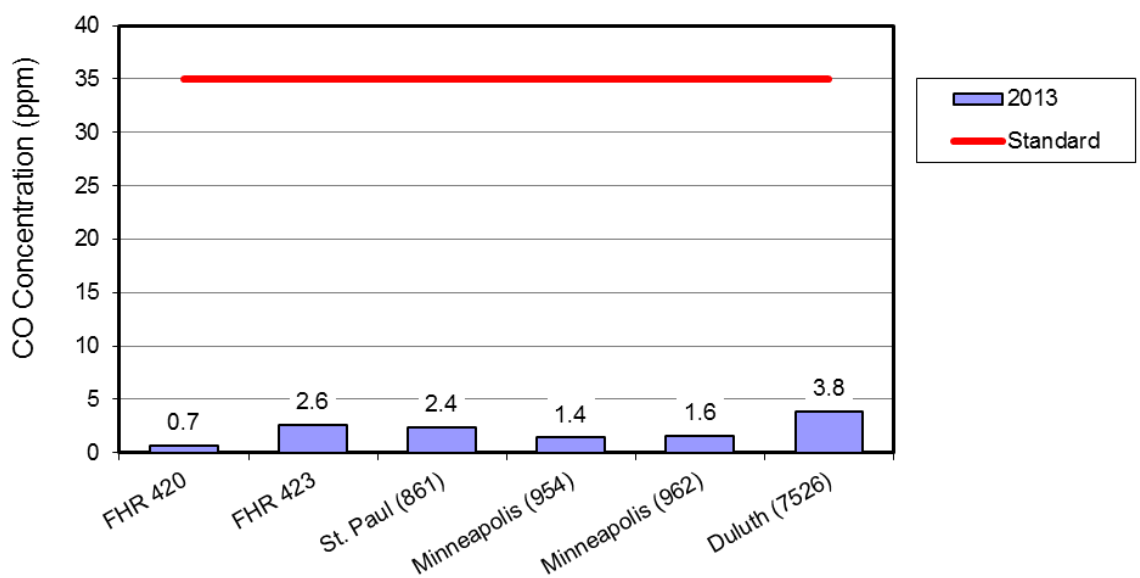
Minnesota currently meets applicable NAAQS for CO. A monitoring site meets the 8-hour CO NAAQS when the level of 9 ppm is not exceeded more than once per year. Figure 28 shows the second highest 8-hour average at Minnesota sites in 2013 and compares them to the standard. Minnesota values range from 0.5 ppm at FHR 420 to 2.8 ppm at FHR 423.

Figure 28: 8-hour average CO concentrations compared to the NAAQS*



The 1-hour CO NAAQS is met when the level of 35 ppm is not exceeded more than once per year. Figure 29 shows the second highest 1-hour average at Minnesota sites in 2013 and compares them to the standard. Minnesota values range from 0.7 ppm at FHR 420 to 3.8 ppm in Duluth (7526).

Figure 29: 1-hour average CO concentrations compared to the NAAQS*



Air toxics

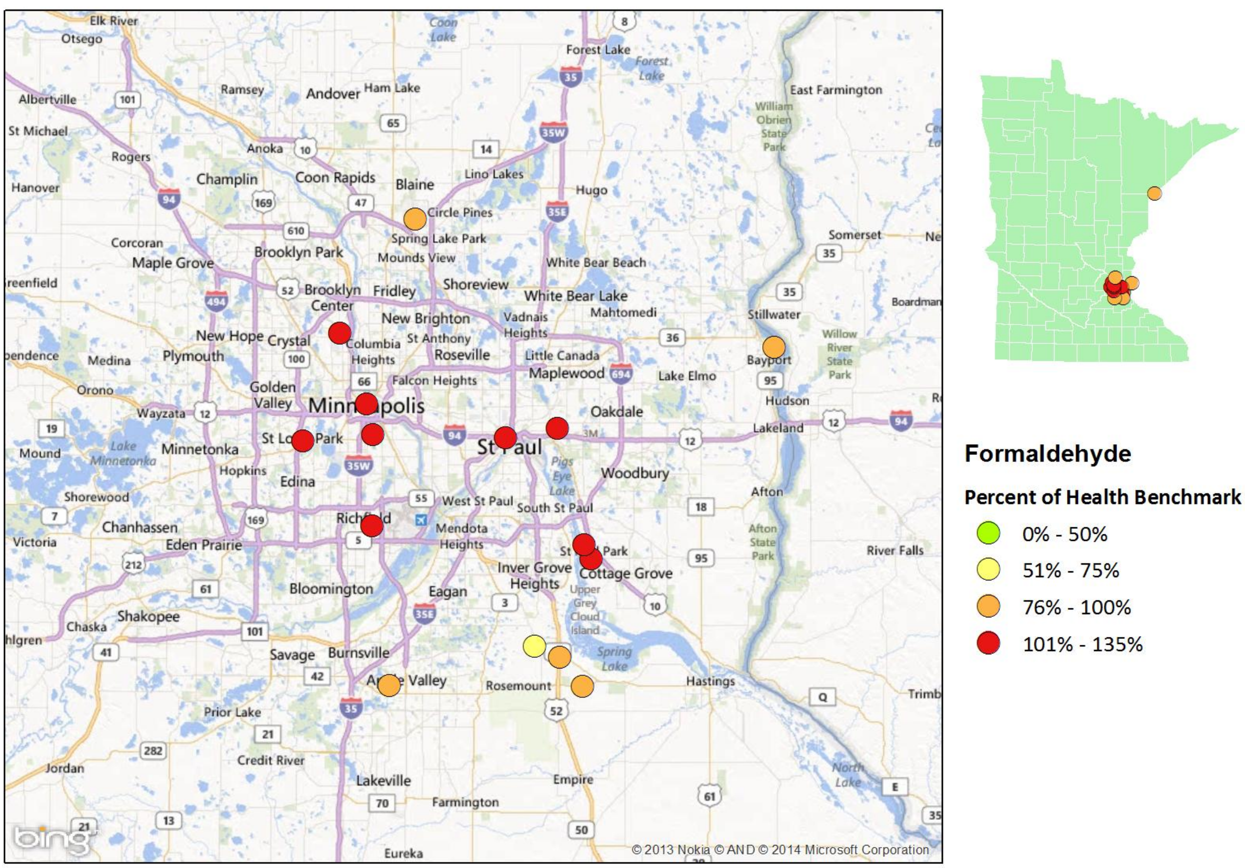
The EPA defines air toxics as those pollutants that cause or may cause cancer or other serious health effects (such as reproductive or birth defects), or adverse environmental and ecological effects. Air toxics include, but are not limited to, the 188 Hazardous Air Pollutants (HAPs) specified in the 1990 Clean Air Act Amendments (see http://www.epa.gov/ttn/atw/orig189.html for a list of HAPs). There are no federal requirements for air toxics monitoring in Minnesota, but the MPCA monitors for a variety of compounds in order to understand the risk to Minnesota citizens and to track reductions in emissions and concentrations of potentially hazardous compounds.

Air toxics do not have standards. Instead, the MPCA uses guidelines called health benchmarks. These benchmarks come from a variety of sources including the Minnesota Department of Health's Health Risk Values (HRVs) found at http://www.health.state.mn.us/divs/eh/risk/guidance/air/table.html, the EPA's Integrated Risk Information System (IRIS) found at http://www.epa.gov/iris/, and California's Office of Health Hazard Assessment (OEHHA) found at http://www.oehha.ca.gov/air.html.

Figure 30 is an example of how the MPCA uses health benchmarks to evaluate air toxics monitoring results. Exposure to elevated levels of formaldehyde, which is a colorless gas with a pungent odor, can contribute to respiratory issues, eye, nose, and throat irritation. Long-term formaldehyde exposure has also been linked to lung and nasal cancers and has been classified by EPA as a probable carcinogen.

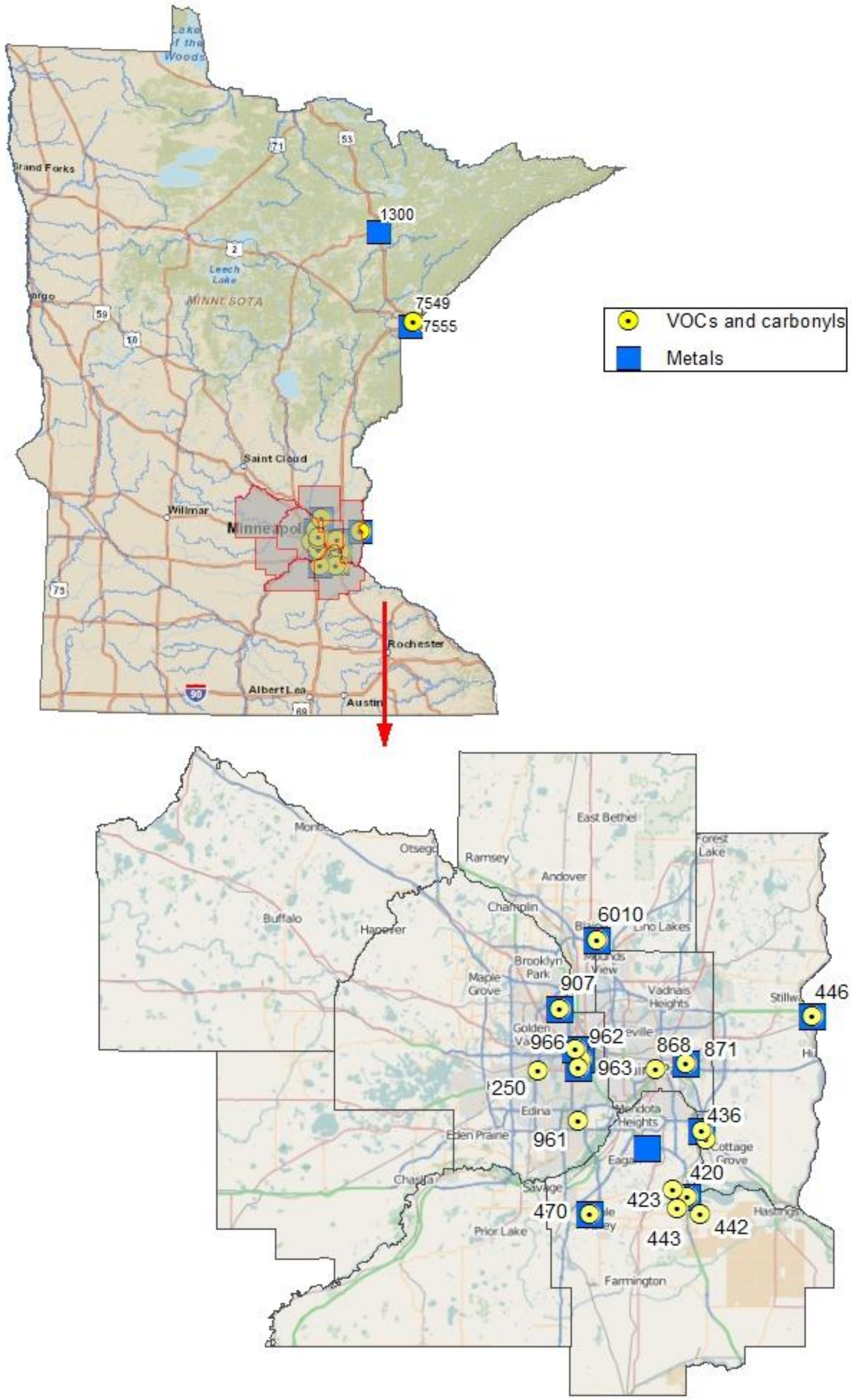
For cancer related health effects, the health benchmarks are chosen so the additional lifetime risk of developing cancer is less than or equal to 1 additional chance in 100,000 if an individual is continuously exposed to the health benchmark concentration for a lifetime. Figure 30's map below describes the 2013 annual average formaldehyde concentration as a percentage of the chronic-cancer health benchmark. Locations with results greater than 100% (red circles), have annual concentration results greater than the chronic-cancer health benchmark, and may be contributing to health risks greater than the MPCA air toxic risk goal of 1 in 100,000.

Figure 30: Annual average formaldehyde concentrations as a percent of chronic health benchmark, 2013



The MPCA monitors three types of air toxics: 59 volatile organic compounds (VOCs), seven Carbonyls, and 15 metals. For information on concentrations of and risks from air toxics in Minnesota, visit the MPCA website at http://www.pca.state.mn.us/air/airtoxics.html. Samples are collected once every six days over a 24-hour period; the resulting concentration is a 24-hour average. Between October 2012 and March 2013, air toxics samples were collected once every twelve days due to resource issues. Sampling returned to a one in six day schedule on April 1, 2013.

Figure 31: 2014 Air toxics monitoring sites in Minnesota



Volatile organic compounds (VOCs) and carbonyls

The MPCA analyzes samples for 57 VOCs and 7 Carbonyls. Table 12 lists the Carbonyls and table 13 lists the VOCs monitored by the MPCA. Samples are analyzed using EPA Compendium Methods TO-15 for VOCs and TO-11A for carbonyls.

The MPCA monitors VOCs and Carbonyls at 19 sites in Minnesota. These sites are primarily located in the Twin Cities metropolitan area, with an additional site for VOCs and Carbonyls in Duluth (7549). Figure 31 shows the locations of the sites.

Air toxics monitors are being added to short term (3 month) sites as part of the Community Air Monitoring Project in 2014 and 2015; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).

Table 12: Carbonyls monitored by MPCA in 2014

Parameter	CAS #	EPA Parameter Code
Acetaldehyde	75-07-0	43503
Acetone	67-64-1	43551
Benzaldehyde	100-52-7	45501
Butryaldehyde	123-72-8	43510
Trans-Crotonaldehyde	123-73-9	43516
Formaldehyde	50-00-0	43502
Propionaldehyde	123-38-6	43504

Table 13: VOCs monitored by MPCA in 2014

Parameter	CAS #	EPA Parameter Code
1,1,2,2-tetrachloroethane	79-34-5	43818
1,1,2,3,4,4-Hexachloro-1,3-butadiene	87-68-3	43844
1,1,2-Trichloroethane	79-00-5	43820
1,1-Dichloroethane	75-34-3	43813
1,1-diChloroEthene	75-35-4	43826
1,2,4-Trichlorobenzene	120-82-1	45810
1,2,4-Trimethylbenzene	95-63-6	45208
1,2-Dichloropropane	78-87-5	43829
1,3,5-Trimethylbenzene	108-67-8	45207
1,3-Butadiene	106-99-0	43218
4-Ethyltoluene	622-96-8	45228
Benzene	71-43-2	45201
Benzyl chloride	100-44-7	45809
Bromodichloromethane	75-27-4	43828
Carbon disulfide	75-15-0	42153
Carbon tetrachloride	56-23-5	43804
Chlorobenzene	108-90-7	45801
Chloroform	67-66-3	43803
cis-1,2-Dichloroethene	156-59-2	43839
cis-1,3-Dichloropropene	10061-01-5	43831
Cyclohexane	110-82-7	43248
Dibromochloromethane	124-48-1	43832
Dichlorobenzene (m)	541-73-1	45806
Dichlorobenzene (o)	95-50-1	45805
Dichlorobenzene (p)	106-46-7	45807
Dichlorodifluoromethane (Freon 12)	75-71-8	43823
Dichloromethane	75-09-2	43802
Dichlorotetrafluoroethane (Freon 114)	76-14-2	43208
Ethyl Chloride	75-00-3	43812
Ethylbenzene	100-41-4	45203
Ethylene chloride	107-06-2	43815
Ethylene dibromide	106-93-4	43843
Heptane	142-82-5	43232
Hexane	110-54-3	43231
Methyl bromide	74-83-9	43819
Methyl butyl ketone	591-78-6	43559
Methyl chloride	74-87-3	43801
Methyl chloroform	71-55-6	43814
Methyl ethyl ketone	78-93-3	43552
Methyl methacrylate	91-20-3	43441
Methyl tert-butyl ether	1634-04-4	43372
Naphthalene	80-62-6	17141
Propylene	115-07-1	43205
Styrene	100-42-5	45220
Tetrachloroethene	127-18-4	43817
Tetrahydrofuran	109-99-9	46401
Toluene	108-88-3	45202
trans-1,2-Dichloroethene	156-60-5	43838
trans-1,3-Dichloropropene	10061-02-6	43830
Tribromomethane	75-25-2	43806
Trichloroethene	79-01-6	43824
Trichlorofluoromethane (Freon 11)	75-69-4	43811
Trichlorotrifluoroethane	76-13-1	43207
Vinyl acetate	108-05-4	43447
Vinyl chloride	75-01-4	43860
Xylene (m&p)	108-38-3	45109
Xylene (o)	95-47-6	45204

Metals

Metals are extracted from TSP filters and analyzed using ICP-AES following an EPA FEM method for lead determination (EQL-0311-196). Table 14 lists the metals analyzed by the MPCA.

The MPCA monitors metals at 14 sites in Minnesota. These sites are primarily located in the Twin Cities metropolitan area with additional sites in Virginia (1300) and Duluth (7555). Figure 31 shows the locations of the sites.

Metals are being added to short term (3 month) sites as part of the Community Air Monitoring Project in 2014 and 2015; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).

Table 14: Metals monitored by MPCA in 2014

Parameter	CAS #	EPA Parameter Code
Antimony	7440-36-0	12102
Arsenic	7440-38-2	12103
Barium	7440-39-3	12107
Beryllium	7440-41-7	12105
Cadmium	7440-43-9	12110
Chromium	16065-83-1	12112
Cobalt	7440-48-4	12113
Iron	15438-31-0	12126
Lead	7439-92-1	14129
Manganese	7439-96-5	12132
Nickel	7440-02-0	12136
Selenium	7782-49-2	12154
Zinc	7440-66-6	12167

Atmospheric deposition

Atmospheric deposition is monitored through the NADP. The NADP has two active sub-networks in Minnesota: the National Trends Network (NTN) and the Mercury Deposition Network (MDN).

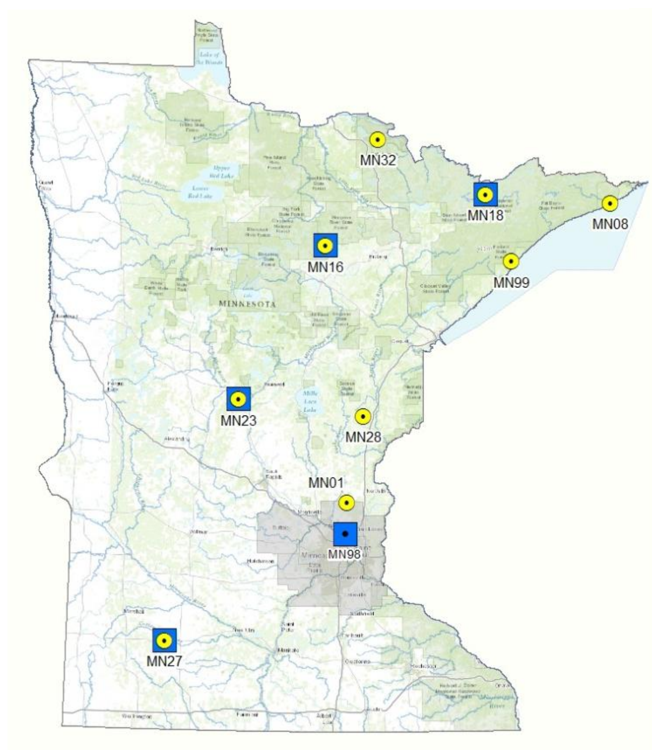
NTN collects weekly precipitation samples for pH, sulfate, nitrate, ammonium, chloride, and base cations (such as calcium and magnesium). NTN provides long-term, high-quality data for determining spatial and temporal trends in the chemical composition of precipitation. MDN collects weekly precipitation samples for analysis of total mercury and methylmercury concentrations. It supports a regional database of the weekly concentrations of mercury in precipitation and the seasonal and annual flux of total mercury in wet deposition.

Acid deposition

Acid deposition, or acid rain, is monitored as part of the NTN. Acid deposition begins with the burning of fossil fuels (such as coal, gas, or oil) for energy. The resulting air pollution contains SO_2 and NO_X. These gases react in the atmosphere to form various acidic compounds. These compounds may be deposited on the Earth by dry deposition, a process where acidic particles or gases settle on, or are absorbed by, plants, land, water, or building materials. The acidic compounds may also be deposited through rain, snow, and cloud water. These pathways are known as wet deposition.

The MPCA sponsors several sites that are part of the NADP (http://nadp.sws.uiuc.edu/) to monitor acid rain and mercury. The purpose of the network is to collect data on the chemistry of precipitation for monitoring of geographical and long-term trends. The precipitation at each station is collected weekly. It is then sent to a national contract laboratory where it is analyzed for hydrogen (acidity as pH), sulfate, nitrate, ammonium, chloride, and cations (such as calcium, magnesium, potassium, and sodium). Minnesota has nine monitoring sites for wet deposition. These sites are highlighted in figure 32. These sites are subject to changes in 2014 depending on funding.

Figure 32: Atmospheric Deposition sites in



Mercury (Hg) deposition

Mercury contamination of fish is a well-documented problem in Minnesota. Because of wide-spread mercury contamination, the Minnesota Department of Health (MDH) advises people to restrict their consumption of large sport fish from all lakes and rivers. More than 95 percent of the mercury in Minnesota surface water comes from the atmosphere. In 2007, the EPA accepted Minnesota's mercury Total Maximum Daily Load (TMDL) plan that concludes that atmospheric mercury deposition must be reduced by 76 percent to achieve compliance with aquatic mercury standards.

Mercury is monitored in wet deposition in Minnesota as part of the NADP through the Mercury Deposition Network (MDN), which began in 1996 and now consists of over 85 sites. The MDN website can be found at http://nadp.sws.uiuc.edu/mdn/. The MDN collects weekly samples of precipitation, which are analyzed for total mercury. The objective of the MDN is to provide a nationally consistent survey of mercury in precipitation so that atmospheric loading to surface water can be quantified and long-term changes can be detected.

Minnesota was on the leading edge of mercury monitoring, establishing four sites as part of the MDN network in 1996, which are still operating. They include Marcell (MN16), Fernberg Road (MN18), Camp Ripley (MN23), and Lamberton (MN27). A site at Mille Lacs (MN22) operated from April 2002 to April 2007. A new urban site opened in Blaine (MN98) in February 2008. Figure 32 shows the locations of these sites. These sites are subject to changes in 2015 depending on funding.

In addition to quantifying total mercury, the MPCA also cooperates with the MDN network to measure methylmercury in four-week composites of the precipitation samples. Only a minority of the sites participate in the methylmercury analysis.

The MPCA also cooperates with the states of Michigan and Wisconsin to share the use of a trailer equipped with atmospheric mercury monitoring equipment. The equipment includes two Tekran 2537 mercury vapor analyzers, a generator, and a meteorological tower that can record wind speed and direction. The trailer is used to identify local sources of mercury vapor.

Hydrogen sulfide (H_2S)

H_2S is a flammable, colorless gas that smells like rotten eggs even at low levels. It occurs naturally in sources such as crude petroleum and natural gas. It also results from bacterial breakdown of organic matter and is produced by human and animal wastes. Industrial activities such as food processing, coke ovens, kraft paper mills, petroleum refineries, and confined animal feed lots also emit H_2S.

Exposure to low concentrations of H_2S may cause irritation to the eyes, nose, and throat. It may also cause difficulty in breathing for some asthmatics.

Minnesota's state standard for H_2S is a 30-minute average of 30 ppb not to be exceeded more than twice in five days, or a 30-minute average of 50 ppb not to be exceeded more than twice per year. H_2S is primarily a concern in the summer, when biological activity is at a peak. Each summer, MPCA monitors several confined animal feedlots based on complaints due to odor and health effects from H_2S created from animal waste. H_2S can also be a concern from beet sugar facilities, as wastewater lagoons may release H_2S. Therefore, in addition to confined animal feedlot monitoring, the MPCA oversees industrial monitoring at the Southern Minnesota Beet Sugar Cooperative processing plant in Renville, and the American Crystal Sugar processing plants in Moorhead, Crookston, and East Grand Forks.

Total reduced sulfur (TRS)

TRS consists of the total sulfur from various compounds, including hydrogen sulfide, methyl mercaptan, dimethyl sulfide, and dimethyl disulfide. Sulfur dioxide is not included. Since the majority of TRS is H_2S and the other components are considered to be less toxic than H_2S, TRS can be used as a conservative measure and compared to the H_2S standard. No standard for TRS is available. The MPCA measures TRS at sites 420 and 423 near the Flint Hills Refinery in Rosemount and at site 436 near the St. Paul ParkRefinery Company in St. Paul Park. BoiseWhite Paper, L.L.C. in International Falls also monitors TRS near its facility as a requirement of their operating permit. No changes are planned for 2014.

Meteorological data

Air pollution concentrations are strongly influenced by atmospheric conditions. Meteorological data can be an important tool for understanding and interpreting concentration data. The MPCA collects hourly wind speed, and wind direction data at sites 420 and 423 in Rosemount near the Flint Hills Resources refinery, at the NCore site in Blaine (6010), and at most H_2S monitoring sites. In Blaine, temperature, relative humidity, and barometric pressure are also measured. Meteorological parameters were added to a new site in Winona (5520) in 2014.

Site 909 in Minneapolis will close in December 2014 upon completion of two years of monitoring. More information on this project can be found on the project website (http://www.pca.state.mn.us/rx6ffwu).

Special studies

Black carbon

Black carbon (or soot) is a component of fine particulate. It is correlated with elemental carbon which is monitored as part of the $PM_{2.5}$ speciation networks. Elemental carbon particles are emitted into the air from virtually all combustion activity, but are especially prevalent in diesel exhaust and smoke from the burning of wood, other biomass, and wastes. Black carbon is sometimes used as a surrogate for diesel smoke. Black carbon can be continuously monitored using an aethalometer, while elemental carbon is only available in Minnesota as a 24-hour average every three days. MPCA began monitoring black carbon at the near-road site in Minneapolis (962) in 2014.

Community air monitoring project

In keeping with the agency's commitment to ensure environmental justice and with funding from the 2013 Minnesota Legislature, the MPCA has initiated an air quality monitoring project to assess whether low-income or communities of color are disproportionately impacted by air pollution emissions from highways, air traffic, or industrial sources.

Communities to be monitored will be chosen based on the criteria identified in the funding legislation. Within the community, actual monitoring locations will be selected based on community input and ability to meet monitor siting requirements. Identified communities will be monitored for three months, after which the monitoring equipment moves to the next site.

Project objectives are to:

- sample ambient air at seven locations, giving priority to criteria listed in legislation;
- analyze and compare results to data from the agency's existing air monitoring network;
- determine if there are significant differences between the community monitor locations and MPCA's existing stationary monitors; and
- share results with legislators, neighborhood groups, and the general public.

Three months of air quality data in seven neighborhoods will be collected over the course of two years. Monitored pollutants include fine particles ($PM_{2.5}$) and air toxics which include metals, volatile organic compounds (VOCs), and Carbonyls. Monitoring began on October 1, 2013 and will continue through June 30, 2015.

As sites are selected, their community information, their monitoring status and available monitoring results will be posted to the Community Air Monitoring Project website (http://www.pca.state.mn.us/9xc4ahc).

Fibers

As a requirement of its air permit Northshore Mining Company in Silver Bay monitors for fibers, which are defined as chrysotile and amphibole mineral particles with 3-to-1 or greater aspect ratio. The permit requires that the ambient air in Silver Bay contain no more fibers than that level ordinarily found in the ambient air of a control city. The MPCA chose the city of St. Paul as a control city and is presently monitoring mineral fibers in air at the Ramsey Health Center (868). The fiber levels in Silver Bay are being monitored by the Northshore Mining Company; the fiber levels in St. Paul are being monitored by the MPCA. The MDH is responsible for the analysis of all fiber samples collected by both parties.

Figure 33 shows the locations of the fiber monitors in Minnesota. No changes are planned for 2014.

Figure 33: 2013 Fiber monitoring sites in Minnesota

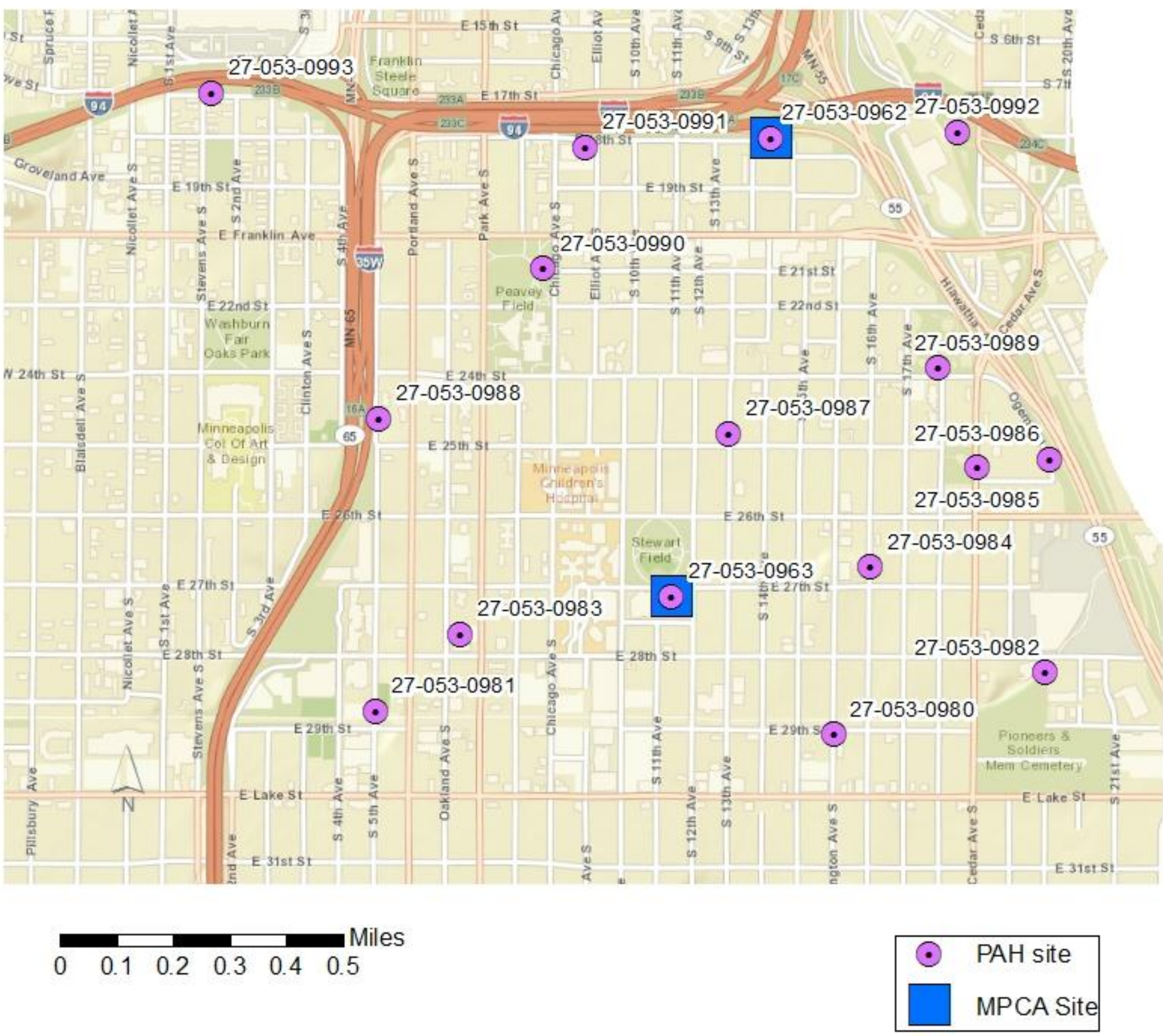
Polycyclic aromatic hydrocarbons (PAHs)

Polycyclic aromatic hydrocarbons (PAHs) can occur naturally in the environment but they are also created during burning (examples include motor vehicles burning fuel, home heating, diesel trucks, tobacco smoke, etc.). PAHs are a priority to environmental health agencies because they stay in the environment for long periods of time and exposure to high levels of PAHs are associated with health effects such as cancer and respiratory irritation.

The MPCA received an EPA Community Scale Air Toxics Grant to study PAH levels in the air in South Minneapolis and Mille Lacs. The MPCA, the Minnesota Department of Health (MDH) and the Mille Lacs Band of Ojibwe Department of Natural Resources and Environment (DNRE) are monitoring PAHs using passive and active techniques during the two year study.

Approximately 30 PAH compounds are chemically analyzed, which is an extension of the EPA list of 16 priority PAHs. The monitoring includes four fixed-site active samplers; including two collocated at the near-road site (962), one at the H.C. Andersen School (963), and one at the Mille Lacs site (3051). The 20 passive samplers include two collocated at the near-road site (962), one at the H.C. Andersen School (963), two at Mille Lacs (3051), and the remaining samplers located around South Minneapolis centered in the Phillips communities neighborhood. Figure 34 is a map of the monitoring sites in Minneapolis with AQS site identification numbers. The monitoring started in June 2013. Monitored concentrations of PAHs will be compared to health values to estimate risks. These measured air concentrations risk results will also be compared to model results from Minnesota State Risk Screening tool (MNRiskS).

Figure 34: PAH monitoring sites in Minneapolis



Silica sand mining and facility related monitoring

In 2010 the MPCA began receiving public inquiries about projects to mine silica sand for use in hydraulic fracturing, or "fracking," a drilling method used for natural gas and oil wells. Southeastern and south central Minnesota and southwestern Wisconsin have extensive deposits of sand that meets the specifications required for fracking. Mining of certain types of these deposits has been occurring in the region for many years; however, there are new issues based on the quantity, type and depth of mining.

There are no federal or state standards for silica in ambient air. The MPCA uses a health based value developed by the Minnesota Department of Health for respirable crystalline silica with a particle size of 4 microns and smaller to assess the potential for human health effects. No generally accepted ambient monitoring method exists for this size. There are state standards for TSP and state and federal air quality standards for PM_{10} and for $PM_{2.5}$.

Ambient air monitors were placed at two sites at the Shakopee Sands facility (Jordan, MN) in 2012, and have been collecting TSP, PM_{10}, and respirable crystalline silica (measured as PM_{10}) data since the third quarter of 2012. Ambient air data are also being collected at the Tiller North Branch Facility (North Branch, MN) for PM_{10}, $PM_{2.5}$ and PM_4 silica. Jordan Sands, LLC in Mankato, MN will begin monitoring for TSP, PM_{10}, $PM_{2.5}$ and PM_4 silica at their industrial sand mining and processing facility in 2014. One year of data are required for comparison to the TSP standards and the respirable crystalline silica health benchmark and three years of data are required for comparison to the PM_{10} and $PM_{2.5}$ standards.

Preliminary data from this monitoring and more information about frac sand mining are available on the MPCA's website (http://www.pca.state.mn.us/6f6dhkf).

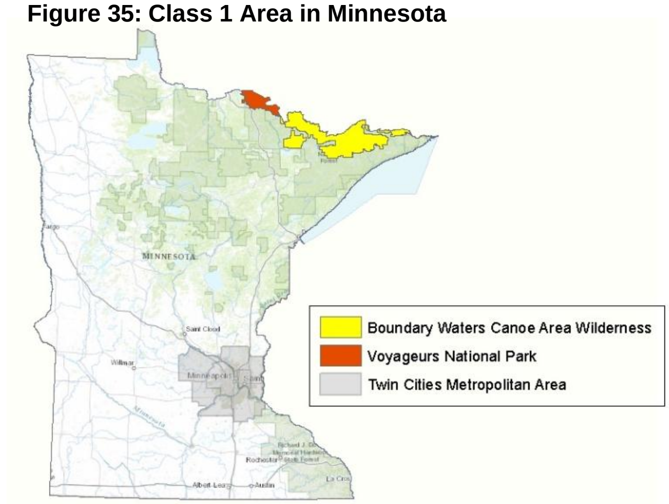
The MPCA is also conducting community based monitoring at two sites. A new site was created in Winona (5520) where PM_4 silica, $PM_{2.5}$ FEM, and meteorological parameters are being monitored. In addition, PM_4 silica was added to the existing ozone site in Stanton (5302). This monitoring started in January 2014 and will close in December 2014 upon the completion of one year of monitoring.

The MPCA air monitoring program will continue to provide technical support to local units of government, permitted facilities, and to a Technical Advisory Team being formed by the Environmental Quality Board.

Visibility

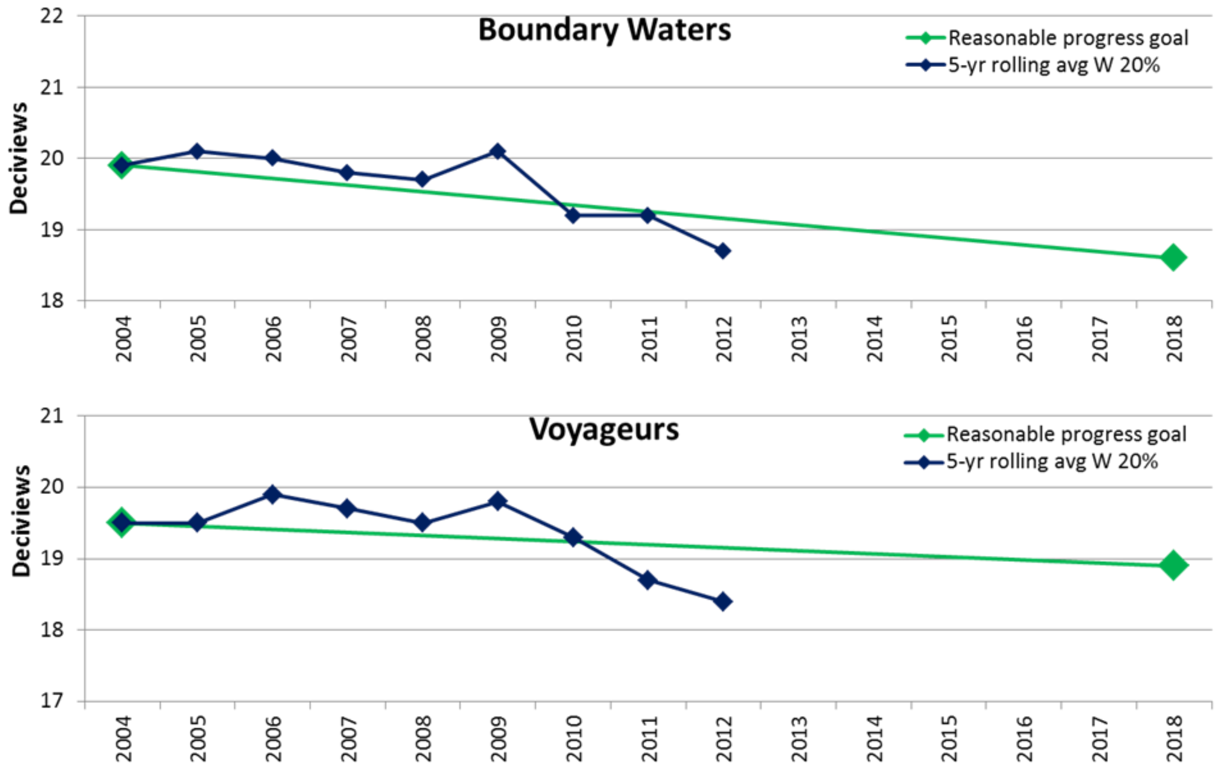
Air pollution that reduces visibility is called haze. Haze is caused when sunlight encounters fine particles in the air which absorb and scatter light. This haze can affect visibility in some of the most pristine and remote parts of Minnesota. In 1999, EPA issued new rules to implement the national goal in the Clean Air Act to prevent any future and remedy any ongoing impairment of visibility in Class I areas. The requirements of the Regional Haze rules are directed at achieving natural visibility conditions in the Class I areas by 2064, with interim progress goals every 10 years. The first interim progress goal is established for 2018. Minnesota has two Class I areas – the BWCAW and Voyageurs National Park, shown in Figure 35.

Figure 35: Class 1 Area in Minnesota



Visibility is measured through the IMPROVE Aerosol Network (http://vista.cira.colostate.edu/IMPROVE/). As discussed in the $PM_{2.5}$ section of this report, the IMPROVE network measures $PM_{2.5}$ speciation as well as employing transmissometers and nephelometers to measure light extinction and light scattering. Minnesota has an IMPROVE site in each of the two Class I areas (BWCAW and Voyageurs). There are also additional sites in two southern Minnesota state parks, Blue Mounds and Great River Bluffs, to help better understand the regional transport of pollutants that impair visibility. Figure 36 shows that both BWCAW and Voyageurs National Park are achieving the 2018 progress goal toward natural visibility conditions.

Figure 36: Progress toward visibility goals in Minnesota



In addition, cameras are used to capture images that show haze. One camera is located in Grand Portage and points toward Isle Royale National Park in Lake Superior. The MPCA operates another camera in St. Paul which captures the downtown St. Paul skyline. On good visibility days, the downtown Minneapolis skyline is also visible. Images from Grand Portage and St. Paul can be viewed at http://www.mwhazecam.net. The US Forest Service also has a haze camera at Ely (7001); these images can be viewed on the US Forest Service website at http://www.fsvisimages.com/fstemplate.aspx?site=BOWA1. All haze camera images are updated every 15 minutes.

No changes are expected with respect to visibility monitoring in 2015.

2014 network changes

Changes to the MPCA Air Monitoring Network are intended to improve the effectiveness of monitoring efforts and to ensure compliance with the EPA National Ambient Air Monitoring Strategy. Table 15 lists the sites that were affected by changes in 2014 and details those changes. Following the table, the changes are summarized according to parameter network.

Table 15: 2014 Network Changes

MPCA Site ID	City Name	Site Name	Site Status	$PM_{2.5}$ Continuous FEM	TSP and Metals	Oxides of Nitrogen	Sulfur Dioxide	Carbon Monoxide	VOCs	Carbonyls	Meteorological Data	UFP and Black Carbon	PM_4 Silica
Various	Twin Cities metro area	Community Project	A	A	A				A	A			
962	Minneapolis	Near-road Minneapolis										A	
5008	Rochester	Rochester					A						
5220	Winona	Winona	A	A							A		A
5302	Stanton	Stanton Air Field											A
7526	Duluth	Torrey Building	T					T					
TBD	Red Lake	Red Lake	A	A									

A = added
T = terminated

Fine particulate matter ($PM_{2.5}$)

- In 2014 $PM_{2.5}$ monitors were added to short term (3 month) sites as part of the Community Air Monitoring Project; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).
- The Red Lake Band of Chippewa will deploy a $PM_{2.5}$ continuous FEM monitor to a site in Red Lake in summer 2014.

$PM_{2.5}$ speciation

- EPA has been conducting an assessment of the Chemical Speciation Network (CSN) in an effort to optimize the network and create a network that is financially sustainable going forward. As a result of this assessment, USEPA is recommending defunding a number of monitoring sites, eliminating the CSN $PM_{2.5}$ mass measurement, reducing the frequency of carbon blanks, and reducing the number of icepacks in shipment during the cooler months of the year. The CSN $PM_{2.5}$ mass measurement is recommended for elimination in July 2014 and all other changes are recommended to take place in January 2015. Should these recommendations become final; all funded CSN sites in Minnesota will be affected. In addition, the site in Rochester (5008) is recommended for defunding and will be shut down at the end of 2014. The MPCA is currently soliciting feedback regarding the EPA recommendations. Final changes to the CSN network in Minnesota will be reflected in the final 2015 Annual Air Monitoring Network Plan.

Total suspended particulate matter (TSP) and metals

- In 2014 TSP monitors were added to short term (3 month) sites as part of the Community Air Monitoring Project; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).

Oxides of nitrogen (NO_X)

- The MPCA will build a second near-road NO_X monitoring site in 2014 and begin monitoring in January 2015. The exact location of the second near-road site is currently under consideration. The near-road network section of this report on pages 11 and 12 has a discussion of the selection process. For details on how the location of the Minneapolis near-road monitoring site was chosen, see the Near-Road Air Monitoring in Minnesota Plan.
- The trace-level NO/NO_y analyzer at the NCore site in Blaine (6010) was replaced and tested in early 2014. Valid data collection has resumed as of May 1, 2014.

Sulfur dioxide (SO_2)

- In 2014, an SO_2 monitor was added to Rochester (5008); monitoring will continue for three years so data can be used for model verification.
- The trace-level SO_2 analyzer at the NCore site in Blaine (6010) was replaced in early 2014. Valid data collection has resumed as of May 1, 2014

Carbon monoxide

- Carbon monoxide monitoring at the Torrey Building in Duluth will end on June 30, 2014.
- The trace-level CO analyzer at the NCore site in Blaine (6010) was replaced in early 2014. Valid data collection has resumed as of May 1, 2014.

Air toxics – VOCs and carbonyls

- In 2014 air toxics monitors were added to short term (3 month) sites as part of the Community Air Monitoring Project; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).

Meteorological data

- Site 909 in Minneapolis will close in December 2014 upon completion of two years of monitoring. More information on this project can be found on the project website (http://www.pca.state.mn.us/rx6ffwu)
- Meteorological parameters were added to a new site in Winona (5520) in 2014.

Black carbon

- The MPCA began monitoring black carbon at the near-road site (962) in Minneapolis in April 2014.

Ultrafine particles

- The MPCA began monitoring ultrafine particles at the near-road site (962) in Minneapolis in March 2014.

PM_4 silica

- The MPCA started monitoring PM_4 silica in Winona (5520) and Stanton (5302) in 2014.

2015 Proposed Changes

The changes that are proposed for 2015 are summarized in Table 16. Following the table, the proposed changes are summarized according to parameter network.

Table 16: 2015 Proposed Changes

MPCA Site ID	**City Name**	**Site Name**	**Site Status**	**$PM_{2.5}$ Continuous FEM**	**TSP and Metals**	**Oxides of Nitrogen**	**Carbon Monoxide**	**VOCs**	**Carbonyls**	**Meteorological Data**	**Poly Aromatic Hydrocarbons (PAHs)**	**$PM_{2.5}$ Chemical Speciation**	**PM_4 Silica**
909	Minneapolis	Pacific Street	T	T									
TBD	TBD	Near-road TBD	A			A	A			A			
TBD	Twin Cities metropolitan area	TBD	A	A	A			A	A				
Various	Minneapolis and Mille Lacs	Various	T								T		
5008	Rochester	Ben Franklin										T	
5220	Winona	Winona	T	T									T
5302	Stanton	Stanton Air Field											T

A = proposed to add
T = proposed to terminate

Fine particulate matter ($PM_{2.5}$)

- In 2015 $PM_{2.5}$ monitors will be added to short term (3 month) sites as part of the Community Air Monitoring Project; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).
- The $PM_{2.5}$ monitor at site 909 in Minneapolis will close in December 2014 upon completion of two years of monitoring. More information on this project can be found on the project website (http://www.pca.state.mn.us/rx6ffwu).
- A $PM_{2.5}$ monitor at site 5220 in Winona will close in December 2014 upon completion of one year of monitoring. More information on this project can be found on the project website (http://www.pca.state.mn.us/6f6dhkf).
- A semi-continuous FEM $PM_{2.5}$ monitor will be added to the new near-road site to begin monitoring in January 2015.

$PM_{2.5}$ speciation

- EPA has been conducting an assessment of the Chemical Speciation Network (CSN) in an effort to optimize the network and create a network that is financially sustainable going forward. As a result of this assessment, USEPA is recommending defunding a number of monitoring sites, eliminating the CSN $PM_{2.5}$ mass measurement, reducing the frequency of carbon blanks, and reducing the number of icepacks in shipment during the cooler months of the year. The CSN $PM_{2.5}$ mass measurement is recommended for elimination in July 2014 and all other changes are recommended to take place in January 2015. Should these recommendations become final; all funded CSN sites in Minnesota will be affected. In addition, the site in Rochester (5008) is recommended for defunding and will be shut down at the end of 2014. The MPCA is currently soliciting feedback regarding the EPA recommendations. Final changes to the CSN network in Minnesota will be reflected in the final 2015 Annual Air Monitoring Network Plan.

Oxides of nitrogen (NO_X)

- The MPCA will build a second near-road NO_X monitoring site in 2014 and begin monitoring in January 2015. The exact location of the second near-road site is currently under consideration. The near-road network section of this report on pages 11 and 12 has a discussion of the selection process. For details on how the location of the Minneapolis near-road monitoring site was chosen, see the Near-Road Air Monitoring in Minnesota Plan.

Carbon monoxide

- Carbon monoxide will be added to the new near-road site to begin monitoring in January 2015.

Meteorological data

- Meteorological parameters will be collected at the new near-road site to begin monitoring in January 2015.

Total suspended particulate matter (TSP) and metals

- In 2015 $PM_{2.5}$ monitors will be added to short term (3 month) sites as part of the Community Air Monitoring Project; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).

Air toxics – VOCs and carbonyls

- In 2015 $PM_{2.5}$ monitors will be added to short term (3 month) sites as part of the Community Air Monitoring Project; more information can be found on the project website (http://www.pca.state.mn.us/9xc4ahc).

Poly aromatic hydrocarbons (PAHs)

- The community scale air toxics study to monitor PAHs in south Minneapolis and Mille Lacs will conclude in June 2015.

PM_4 silica

- The PM_4 silica monitors in Winona (5220) and Stanton (5302) will close in December 2014 upon the completion of one year of monitoring. More information on this project can be found on the project website (http://www.pca.state.mn.us/6f6dhkf).

Summary of the public comment period

This draft report is available for public comment from June 2, 2014 through July1, 2014. Any comments received during that time period will be summarized in this section of the final report.