Minnesota Pollution Control Agency

Annual Pollution Report to the Legislature

A summary of Minnesota's air emissions and water discharges

April 2011

Legislative Charge

Minn. Statutes § 116.011 Annual Pollution Report
A goal of the Pollution Control Agency is to reduce the amount of pollution that is emitted in the state. By April 1 of each year, the MPCA shall report the best estimate of the agency of the total volume of water and air pollution that was emitted in the state the previous calendar year for which data are available. The agency shall report its findings for both water and air pollution, etc, etc.
HIST: 1995 c 247 art 1 s 36; 2001 c 187 s 3

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Foreword

The *Annual Pollution Report* statute requires the Minnesota Pollution Control Agency (MPCA) to estimate the total amounts of air and water pollution emitted in the state during the most recent calendar year for which data are available. The statute further directs the MPCA to estimate the percentage increase or decrease over the previous calendar year, and to estimate the relative contributions of the various sources of these emissions and discharges to the environment.

The Annual Pollution Report, prepared each year since 1996, has evolved to include new kinds of information, such as discharges of toxic air pollutants, greenhouse gas emissions, and emerging issues of concern as these kinds of data have become available. Observations of some advantages and limitations of this kind of report are presented below to add context for interested parties.

Advantages of the inventory approach

- The Annual Pollution Report is the only MPCA report that specifically asks for an accounting of emissions and discharges. Such inventories are inherently important, as understanding emission amounts and sources is fundamental in protecting the environment and human health.
- The report attempts to track trends year to year, which is valuable if data are reliable.
- The report covers both air and water pollutants in one document, instead of separate reports, reminding readers of the potential for cross-media impacts.
- The report shows relative contributions of various pollution sources to the total.

> *Minn. Statutes 116.011 Annual Pollution Report.* A goal of the Pollution Control Agency is to reduce the amount of pollution that is emitted in the state. By April 1 of each year, the MPCA shall report the best estimate of the agency of the total volume of water and air pollution that was emitted in the state in the previous calendar year for which data are available. The agency shall report its findings for both water and air pollution:
>
> (1) in gross amounts, including the percentage increase or decrease over the previous calendar year; and
> (2) in a manner which will demonstrate the magnitude of the various sources of water and air pollution.
>
> HIST: 1995 c 247 art 1 s 36; 2001 c 187 s 3
>
>

Challenges of the inventory report approach

- There is currently no completely reliable way to quantify the volumes of water pollutants released by nonpoint sources in the form of polluted runoff, such as city streets, construction sites and farm fields. This is a major gap in inventorying pollutants discharged. However, local watershed managers reporting to statewide data management systems like eLINK have enabled better estimates of pollutant loads from nonpoint sources. Reasonable estimates of benefits from preventing soil loss and reducing phosphorus from implementation of best management practices (BMPs) may now be made statewide and are discussed in this report. New monitoring approaches such as the MPCA’s Major Load Monitoring Network, which is designed to monitor statewide water quality on a watershed scale, will also help aid understanding of the relative contribution of pollutants from various sources and waters.

Challenges cont.

- Aggregating data into total volumes lacks the important context of relative risk. Pollutants emitted in smaller volumes can have a greater impact than some emitted in tremendously larger volumes. Volume figures are not able to indicate whether such emissions and discharges are acceptable or unacceptable from a risk assessment perspective.

- The most current pollutant emissions and discharge data are usually at least two years behind real time, sometimes more, depending on the type of pollutants. Air emission estimates are frequently revised as industrial output models and factors used to estimate emissions are refined. Also, the number of facilities included varies from year to year. Year-to-year comparisons are not always reliable, as emissions inventory methodologies are evolving.

Outlook

Several important national, regional and state actions affecting pollutant emissions and discharges now and in the future were enacted recently and are worth mentioning:

- **Agency Focus on Watershed Approach:** The MPCA is employing a watershed approach to coordinate surface water quality management efforts throughout the agency. This means the state's 81 major watersheds provide a framework for analysis and decision making. This coordinated effort will help reduce discharges from both point and nonpoint source pollutants and better engage local partners. Activities that will be coordinated as a system under this approach include:
    - monitoring and assessment
    - watershed protection and restoration strategies
    - permitting, compliance and enforcement (e.g. wastewater, stormwater, feedlots)
    - prevention and assistance activities, including financial and technical assistance
    - certification and licensing
    - training and educational activities
- **Progress on Total Maximum Daily Load (TMDL) Studies:** The federal Clean Water Act (CWA) requires states to adopt water-quality standards to protect waters from pollution. These standards define how much of a pollutant can be in the water and still allow it to meet designated uses, such as drinking water, fishing and swimming. The standards are set on a wide range of pollutants, including bacteria, nutrients, turbidity and mercury. Based on the federal CWA, lakes and streams that do not meet water quality standards are "impaired" and a Total Maximum Daily Load (TMDL) study is required. By following the TMDL process, states can establish water quality-based controls for waters to reduce point and nonpoint sources of pollution to restore and maintain the quality of water resources. Once a TMDL study has been approved by the U.S. Environmental Protection Agency (EPA) an Implementation Plan is developed. The Implementation Plan is designed to ensure that the management actions identified by the TMDL will be carried out. The MPCA's 2008 inventory showed 2,575 total river, lake and wetland impairments, which included 1,090 impaired by conventional pollutants and 1,476 by toxic pollutants including mercury, polychlorinated biphenyls (PCBs) and others. Some program highlights include:

- For conventional impairments, 212 approved TMDLs are in implementation and 650 are under development. For toxic impairments, 1,093 approved TMDLs are in implementation. Many of these are included in the statewide mercury TMDL.
- Fifty-four TMDL studies addressing the impairments listed above were approved by the EPA as of February 2011. Implementation plans have been approved or are being developed for these TMDL Studies.
- Waters restored to attain water quality standards: 14 impairments (two lakes and 12 river segments). Other waters are showing improvement but have not yet achieved standards.

- **Statewide Nitrogen Study:** The MPCA is leading a study to characterize total nitrogen loading to Minnesota's surface waters. The study will help provide a scientific foundation of information that will be used to develop and evaluate nitrogen reduction strategies for two separate purposes. First, this work will assist in developing implementation strategies for Minnesota's nitrate toxicity-based standard (currently in draft). The MPCA was directed by the Minnesota Legislature to establish water quality standards for nitrate-nitrogen and total nitrogen (2010 Session Laws, Chapter 361, Article 2, Section 4, Subdivision 1). Additionally, by assessing where and why nitrate and nitrogen loading is occurring in Minnesota streams, the study will assist in developing a better strategy to address Minnesota's total nitrogen contributions to the Gulf of Mexico. Nitrogen and phosphorus coming from the Mississippi River are contributing to algae blooms in the Gulf of Mexico, leading to large areas of oxygen deprivation known as "hypoxia."

- **Consolidated Emissions Inventory:** A combination of federal and state funding in 2009 allowed the MPCA to begin development of a new air emissions inventory system called the Consolidated Emissions Data Repository. The new system will consolidate the air toxics, criteria pollutant, and greenhouse gas inventories into a single database. It will also feature web-based electronic reporting for facilities. The electronic reporting feature along with other system improvements will reduce the inventory completion time, improve data quality, and reduce the burden on staff at reporting facilities and the agency. In February of 2011, electronic reporting was made available for more than 400 facilities. The completion of the entire system is scheduled for the fall of 2011. For more information on web-based reporting, see http://www.pca.state.mn.us/index.php/air/air-monitoring-and-reporting/air-emissions-and-monitoring/air-emissions-inventory-redesign-project-cedr-consolidated-emissions-data-repository.html

- **Proposed Federal Transport Rule:** The Clean Air Act contains a requirement, known as the "good neighbor" provision, meant to prevent air emissions from one state from contributing to another state not meeting the National Ambient Air Quality Standards (NAAQS). In 2010, the EPA proposed the Federal Transport Rule to address this interstate transport of air pollutants. It creates a market-based cap-and-trade program for SO_2 and NO_x. The Transport Rule covers power plants in 31 Eastern States. Minnesota is included due to its impact on non-attainment of the $PM_{2.5}$ NAAQS in the Chicago and Milwaukee areas, and interference with maintenance of the $PM_{2.5}$ NAAQS in Wisconsin and Iowa. Minnesota would be required to reduce its emissions of SO_2 and NO_x to levels specified in pollutant budgets set forth by EPA. Unlimited trading would be allowed within Minnesota, along with limited trading with other states. The Transport Rule replaces the Clean Air Interstate Rule. The final version is expected in 2011.

- **Greenhouse Gas Regulatory Update**
  - <u>EPA Mandatory Reporting</u>
    In 2009, EPA published a final rule to require reporting of greenhouse gas emissions. Most facilities which must now report belong to a sector listed in the rule and also have actual

emissions of 25,000 tons per year (tpy) or more of carbon dioxide equivalents (CO_2e). Facilities will report directly to EPA using electronic reporting. For more information, see http://www.epa.gov/climatechange/emissions/ghgrulemaking.html

- Greenhouse gas permitting
  On May 13, 2010, EPA issued a final rule to establish permit thresholds for GHG emissions. The new permit threshold for GHGs is a potential to emit (PTE) of 100,000 tpy of CO_2e for both construction and operating permits. Effective dates are January 2, 2011 for certain new or modifying sources and July 1, 2011 for all facilities. The MPCA is revising relevant sections of Minnesota's rules to comply with this new permit requirement.

  For more information on greenhouse gas permitting, see the following websites.
  EPA Tailoring rule website:
  http://www.epa.gov/NSR/actions.html#may10http://www.epa.gov/climatechange/emissions/ghgrulemaking.html

  MPCA rulemaking website: http://www.pca.state.mn.us/index.php/air/air-permits-and-rules/air-rulemaking/air-quality-rules-possible-rule-to-adopt-federal-air-permit-thresholds-for-greenhouse-gases.html

- **Transportation Initiatives:** The MPCA has little direct control over transportation sources. However, several programs are underway to decrease diesel emissions and promote the use of electric vehicles.

  - The MPCA has partnered with and provided state and federal grants to Clean Air Minnesota (CAM), a nonprofit organization that has focused on retrofitting school buses with emission reduction equipment. MPCA's $2.4 million in funding from the Minnesota Legislature and $300,000 in federal funding helped retrofit 1,800 school buses with emission controls across Minnesota through our partnership with CAM's Project Green Fleet Program.

  - MPCA has used $1.55 million in federal American Recovery and Reinvestment Act grants to reduce heavy-duty diesel emissions from nearly 250 vehicles in large and small private trucking fleets, a few construction companies, a river tour boat, a municipality fleet and one tribal community fleet.

  - MPCA has also provided loans using state small-business and federal grant funding for idle reduction devices on 111 long haul trucks.

  - MPCA utilized the federal Congestion Mitigation and Air Quality grant for emission control retrofits on 352 public, heavy-duty vehicles in the Twin Cities, including snowplows, dump trucks, garbage trucks and fire trucks.

  - The MPCA is leading the Drive Electric Minnesota partnership which includes representatives from metro-area cities, counties, state agencies, interested non-profits, and Minnesota's largest utility. This coalition is working toward the installation of publicly available plug-in charging stations and early procurement of electric vehicles by local government fleets. Installation of 30 on-street, parking ramp and flat-lot charging stations are planned for 2011. An additional four solar powered stations are planned for the Energy Innovation Corridor adjacent to the light rail corridor between St. Paul and Minneapolis.

Introduction and Summary

The Minnesota Pollution Control Agency (MPCA) is required to submit to the Legislature an annual report of the volume of pollution emitted or discharged to the state's air and water resources. The basis of the MPCA's 2011 Annual Pollution Report is the 2008 MPCA Greenhouse Gas Inventory, the 2005 and 2009 Minnesota Criteria Pollutant Emission Inventories, the 2005 Air Toxics Emission Inventory and the 2009 Water Quality National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Reports.

Annual emission and discharge estimates are one important component of tracking progress on air and water pollution, and for tracking performance and relative contributions of pollution sources. The MPCA also regularly prepares reports on the physical, chemical and biological conditions measured in the environment, and on pollutants of special concern to human health and the environment. These reports and others are available on the Internet and are referenced throughout this document for readers who would like additional context and information.

The MPCA provides public access to ambient air and water quality monitoring data, surface water discharge monitoring data, and air emissions data. These data are available for viewing and download online at the Environmental Data Access on the following website:

http://www.pca.state.mn.us/eda

About Emission Inventories

Completing air pollutant emission inventories is a time-intensive process. For example, to develop the point source part of the Criteria Pollutant Emission Inventory for the year 2009, facilities with MPCA permits had until April 1, 2010 to submit their 2009 emissions estimates to the MPCA. Agency staff then compiled these emission estimates into a draft Criteria Pollutant Emission Inventory, which was sent back to the facilities for review in October 2010. Facilities completed their review by November, 2010. MPCA staff then reviewed the changes and completed the inventory for 2009 in January 2011.

The Minnesota Air Toxics Emission Inventory and the area and mobile source components of the Criteria Pollutant Emission Inventory are completed once every three years to coincide with the three-year cycle of the EPA's National Emission Inventory. MPCA staff develops emissions estimates for the Air Toxics Emission Inventory based upon the completed Criteria Pollutant Emission Inventory, the assistance of permittees, and available information from other state and federal agencies.

Air Emissions

In this report, the MPCA reports on emissions of major air pollutants including greenhouse gases, criteria air pollutants (pollutants with national ambient air quality standards), and air toxics.

The MPCA reports data from the Minnesota Criteria Pollutant Emission Inventory. The major air pollutants summarized in this report include particulate matter, ammonia, sulfur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOCs), carbon monoxide and lead. Emissions of criteria pollutants from large facilities are estimated every year with data from 2009 currently available. However, emissions from smaller sources are estimated every three years with 2005 estimates the most recent available.

In past reports, the MPCA has reported carbon dioxide (CO_2) emissions. Starting this year, emissions for six greenhouse gases (CO_2, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride) are reported in terms of CO_2 equivalents (CO_2e). The most recent emissions inventory completed for greenhouse gases in Minnesota is from 2008.

The Minnesota Air Toxics Emission Inventory estimates emissions of individual air toxics including compounds such as benzene, formaldehyde, acrolein, mercury and polycyclic organic matter. There is some overlap between the Minnesota Air Toxics Emission Inventory and the estimates for VOCs and particulate matter because many air toxics are components of these broader categories. The most recent inventory of air toxics emissions is from 2005.

Table 1 lists the total statewide emissions of the major air pollutants from 2005 to 2009. The percent change from 2008 to 2009 is given in the final column. It is possible to look at emission trends between these years; however, it is important not to place undue emphasis on a yearly change since emission estimates fluctuate as a result of changes and improvements in the inventory and other factors such as the economy and weather.

Table 1: Minnesota Air Pollution Emission Estimates, 2005-2009*
(thousand tons)

Pollutant	2005	2006	2007	2008	2009	2008-2009 % Change
Greenhouse gases**	161,300	160,000	161,800	159,400		-1.5%
Particulate matter (PM_{10})***	778	776	777	776	769	-0.9%
Sulfur dioxide (SO_2)	159	148	138	129	101	-28%
Nitrogen oxides (NO_x)	422	409	408	391	353	-11%
Volatile organic compounds (VOCs)	349	347	347	345	342	-0.9%
Carbon monoxide (CO)	1,771	1,771	1,773	1,771	1,769	-0.1%
Total Criteria Pollutants (not including CO_2)	3,480	3,451	3,443	3,413	3,333	-2.4%

*2005 mobile and nonpoint emission estimates were used in the 2005-2009 emission estimates. The only changes are from point sources. 2008 emission estimates should be available for the 2012 report.

**Greenhouse gas emission estimates include net imported electricity. Data is not available for 2009, so percent change is for 2007-2008.

***PM_{10} emissions represent only primary formation; secondary formation is not included.

The biggest changes in emission estimates between 2008 and 2009 were the 28 percent decrease in SO_2 and the 11 percent decrease in NO_x. These decreases were mainly due to emissions reductions in the electric utilities and mining sectors.

Xcel Energy's Allen S. King coal-fired power plant in Oak Park Heights was renovated with state-of-the-art pollution controls while St. Paul's High Bridge power plant and Minneapolis' Riverside power plant were converted from coal to cleaner-burning natural gas. Minnesota Power also installed modern air pollution controls at its Boswell coal-fired power plant in Cohasset in 2009.

The Riverside plant completed its conversion in 2009 resulting in a decrease in emissions of more than 10,000 tons of SO_2 and nearly 10,000 tons of NO_x. The Boswell plant reduced its emissions by 8,000 tons of SO_2 and more than 4,000 tons of NO_x due to decreased burning of coal during renovation and air pollution control modernization. In addition, Xcel's Sherburne facility decreased its NO_x emissions by nearly 4,000 tons due to improved pollution control equipment. Additional reductions came from facilities such as Minnesota Power's Taconite Harbor power plant and Rochester Public Utilities Silver Lake burning less coal in 2009.

Mining emissions were also significantly lower in 2009. Mining emissions vary annually depending on the demand for taconite pellets. There was a significant reduction in taconite production in 2009 at many facilities resulting in more than 3,000 fewer tons of SO_2 emissions and a reduction of more than 16,000 tons of NO_x.

There may be differences in the total emission figures for a given year discussed in this report versus past MPCA emission reports because data may be updated in MPCA's emission inventory due to corrections or changes in methodology.

It should also be noted that despite the importance of the secondary formation of particulate matter, estimated air emissions data in this report are only based on direct releases from sources into the atmosphere. Secondary formation occurs when emissions of volatile gases combine and form fine particles downwind of the emission source.

Fine particulate matter ($PM_{2.5}$) and ammonia are not included in Table 1 since estimated values are only available for 2002 and 2005. However, $PM_{2.5}$ emissions are a subset of PM_{10} emissions, so $PM_{2.5}$ mass emissions are included within the PM_{10} estimate. Estimated $PM_{2.5}$ and ammonia emissions are provided in the body of the report.

Lead and mercury are pollutants which can be toxic at very low concentrations. In 2008, 16 tons of lead was estimated to have been emitted in Minnesota and 2,763 pounds of mercury was estimated to have been emitted in 2008.

Water Discharges

Owners or operators of any disposal system or point source are required by Minnesota Statutes, Chapter 115.03(7) to maintain records and make reports of any discharges to waters of the state. These self-monitoring reports submitted to MPCA are commonly referred to as Discharge Monitoring Reports (DMRs). Data in the DMRs are compiled in DELTA, a compliance tracking system maintained by MPCA data specialists. The 2011 Annual Pollution Report examines the most recent five-year period for which DMR data are available.

The MPCA's water quality program continues to evolve from a predominantly concentration-based, facility-by-facility regulatory approach to one that emphasizes managing total pollution discharges to Minnesota's watersheds. The current report represents a continuing effort to improve the agency's capacity to accurately perform loading analyses. Due to the multi-year life of permit requirements, however, many of our permits do not yet contain monitoring and reporting requirements that enable efficient, computerized calculations of total annual pollutant loadings. As the agency reissues permits and conducts ongoing review of data, it will continue to build capability in this area and the assessment of pollutant trends over multiple years will become more reliable.

This year's report looks at water discharge data from major municipal and industrial point sources for five commonly measured water pollutants covering the years 2005-2009 (Table 2). Major municipal and industrial dischargers are defined as facilities that discharge more than one million gallons per day to waters of the state. The 2009 figures represent the combined loading from 95 major municipal and industrial dischargers. These major facilities represent approximately 85 percentage of the total volume of discharge to waters of the state from point sources. The remaining 15 percent comes from smaller municipal and industrial facilities. Although discharges from these facilities are small, they can have significant impacts on individual lakes and stream segments.

Data from 2010 will be incorporated into the 2012 Annual Pollution Report. Adjustments were made to include such data as late reports, and parameters added to permit requirements as a result of permit reissuance. The reader may therefore notice some differences in yearly pollutant loads reported in the current report compared with previous editions of the Annual Pollution Report.

In addition to the specific sources of variance highlighted above, a number of additional sources of variation, both up and down, can potentially impact year-by-year comparisons:

- Approximately 11,000 individually reported values have been incorporated into the yearly totals. These reported values are derived from an even larger set of raw data that has been summarized and interpreted by permittees before submission to MPCA, generally in ways that are optimized for concentration-based compliance determination.

- The loading calculations incorporate a number of data interpretation decisions that can legitimately be made in a variety of ways.

- Reporting requirements can vary with each permit issuance, resulting in variation in parameters, limit types, and reporting periods, making year-by-year comparisons difficult. Additionally, when a facility does not monitor a pollutant in a month that it discharges, the concentration for that month is presumed to be the average annual concentration.

- Wastewater treatment facilities regularly experience variations in influent strength, influent flow and facility performance that may not be fully reflected in the data used to generate this report.

This report discusses five common chemical parameters found in wastewater treatment plant effluent including total suspended solids (TSS), biochemical oxygen demand (BOD), total phosphorus (TP), ammonia (NH_3) and nitrate (NO_3). Table 2 shows the water pollution discharge estimate from major point sources by pollutant for 2005-2009. In 2009, the total statewide loading from major dischargers was about nine percent lower that the total loading in 2007, suggesting that recent improvements to treatment plant technology and operation continue to have a measurable positive effect on Minnesota's water resources, at least as far as point source discharges are concerned.

Table 2: Minnesota Water Pollution Discharge Estimates from Major Point Sources, 2005-2009 (thousand kilograms)

Pollutant	2005	2006	2007	2008	2009	2008-2009 % Change
Total suspended solids	4,500	3,600	4,200	3,800	3,400	-11%
Biochemical oxygen demand	2,700	2,100	2,500	2,700	2,200	-19%
Total phosphorus	770	710	670	700	540	-23%
Ammonia	650	500	550	650	770	18%
Nitrate	3,600	3,900	4,000	3,800	3,600	-5%
Total	12,200	10,900	12,000	11,700	10,600	-9%

Each pollutant is discussed in more detail beginning on page 48.

Chapter 1: Air Pollutant Emissions Overview

Thousands of chemicals are emitted into the air. Many of these are air pollutants that can directly or indirectly affect human health, reduce visibility, cause property damage and harm the environment. For these reasons, the MPCA attempts to reduce the amount of pollutants released into the air. In order to understand the sources of air pollution and to track the success of reduction strategies, the MPCA estimates the emissions of certain air pollutants released in Minnesota.

Criteria pollutants—The 1970 Clean Air Act identified six major air pollutants that were present in high concentrations throughout the United States called "criteria pollutants." These air pollutants are particulate matter ($PM_{2.5}$ and PM_{10}), sulfur dioxide (SO_2), nitrogen oxides (NO_x), ozone (O_3), carbon monoxide (CO) and lead (Pb). The Minnesota Criteria Pollutant Emission Inventory estimates emissions of five criteria pollutants (PM_{10}, SO_2, NO_x, CO and Pb). Ozone is not directly emitted, so a group of ozone precursors called volatile organic compounds (VOCs) is included instead. Emissions estimates for large facilities are available for 2009. Mobile and nonpoint source emissions are available for 2005.

$PM_{2.5}$ and ammonia (which contributes to $PM_{2.5}$ formation) emissions are estimated every three years with estimates available for 2002 and 2005. The Criteria Pollutant Emissions section also includes a summary of the MPCA's Air Quality Index (AQI) data for 2010.

Greenhouse gases—Increases in ambient levels of greenhouse gases can lead to global climate change. MPCA tracks greenhouse gas emissions in Minnesota. In the past, MPCA has reported carbon dioxide (CO_2) emissions in this report. Starting this year, 2008 emissions for six greenhouse gases (CO_2, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride) are reported in terms of CO_2 equivalents (CO_2e). CO_2e compares the warming potential of different gases to the impact of CO_2. More information is available on climate change and greenhouse gases at the following link: http://www.pca.state.mn.us/index.php/topics/climate-change/regulatory-initiatives-programs-and-policies/climate-change-publications-reports-and-fact-sheets.html

Air toxics—Many other chemicals are released in smaller amounts than most of the criteria pollutants, but are still toxic. The EPA refers to chemicals that can cause serious health and environmental hazards as hazardous air pollutants or air toxics. Air toxics include chemicals such as benzene, formaldehyde, acrolein, mercury and polycyclic organic matter. Minnesota data come from the 2005 Minnesota Air Toxics Emission Inventory.

This report is limited to a summary and discussion of emissions of various air pollutants in Minnesota. However, the MPCA has prepared other reports that discuss air pollution trends and emissions in more detail. Please reference the following reports for more information.

Air Quality in Minnesota: 2011 Report to the Legislature
http://www.pca.state.mn.us/index.php/about-mpca/legislative-issues/legislative-reports/air-quality-in-minnesota-2011-report-to-the-legislature.html

Annual Air Monitoring Network Plan for the State of Minnesota, 2011
http://www.pca.state.mn.us/index.php/air/air-monitoring-and-reporting/air-emissions-and-monitoring/air-monitoring-network-plan.html

Criteria Air Pollutant Emissions

Minnesota's Emission Inventory Rule requires all facilities in Minnesota that have an air emissions permit to submit an annual emission inventory report to the MPCA. The report quantifies emissions of the following regulated pollutants:

- particulate matter less than 10 microns in diameter (PM_{10})
- sulfur dioxide (SO_2)
- nitrogen oxides (NO_x)
- volatile organic compounds (VOCs)
- carbon monoxide (CO)
- lead (Pb)

The emission inventory is used to track the estimated pollutant emissions of each facility and to determine the type and quantity of pollutants being emitted into the atmosphere. Ozone is a criteria pollutant that is not directly emitted, so a group of ozone precursors called VOCs is included instead. The data are then used to calculate an annual emission fee for each facility. Starting in 2002, MPCA also began estimating $PM_{2.5}$ and ammonia emissions every three years. Estimates are currently available for $PM_{2.5}$ and ammonia for 2002 and 2005.

The Minnesota Criteria Pollutant Emission Inventory estimates emissions from permitted facilities every year in order to fulfill Minnesota rules. In addition, federal rules require the MPCA to estimate emissions every three years from two other principal source categories: nonpoint sources and mobile sources. Overall, the Minnesota Criteria Pollution Emission Inventory includes emissions from three principal source categories.

1. **Point sources:** Typically large, stationary sources with relatively high emissions, such as electric power plants and refineries. A "major" source emits a threshold amount (or more) of at least one criteria pollutant, and must be inventoried and reported.

2. **Nonpoint sources**: Typically stationary sources, but generally smaller sources of emissions than point sources. Examples include dry cleaners, gasoline service stations and residential wood combustion. Nonpoint sources may also include a diffuse stationary source, such as wildfires or agricultural tilling. These sources do not individually produce sufficient emissions to qualify as point sources. For example, a single gas station typically will not qualify as a point source, but collectively the emissions from many gas stations may be significant.

3. **Mobile sources:** Mobile sources are broken up into two categories; on-road vehicles and non-road sources. On-road vehicles include vehicles operated on highways, streets and roads. Non-road sources are off-road vehicles and portable equipment powered by internal combustion engines. Lawn and garden equipment, construction equipment, aircraft and locomotives are examples of non-road sources.

The Minnesota Criteria Pollutant Emission Inventory is complete for point sources through 2009. Emission estimates are available for nonpoint and mobile sources for 2005. When 2009 summary data are given, they include nonpoint and mobile data from 2005 and point source data from 2009. This report presents trend data for point sources from 2005-2009.

With each new inventory, improvements are made in terms of pollutants covered, source categories included, and the accuracy of emission estimates. Therefore, changes in the way emissions are calculated may affect trends, even if there was no real increase or decrease in emissions.

The reader may note differences in the total emission figures for a given year discussed in this report, versus previous emission reports the MPCA has published, because data may be updated in past emission inventories due to corrections or changes in methodology.

In addition, despite the importance of secondary formation for some pollutants (e.g., $PM_{2.5}$), estimated air emission data in this report are based on direct releases from sources into the atmosphere. Secondary formation of pollutants is not included in the estimates because there is currently no reliable way to estimate their quantity. Models to predict secondary formation of particles are under development.

Find more information on the Minnesota Criteria Pollutant Emission Inventory:
http://www.pca.state.mn.us/air/criteria-emissioninventory.html

See the MPCA Environmental Data Access web site to download MPCA emission estimates for criteria pollutants and air toxics including county level emissions for 2005:
http://www.pca.state.mn.us/data/edaAir/emissions.cfm

Find more information on criteria air pollutants in the following EPA website:
http://www.epa.gov/air/urbanair/index.html

See the EPA's AIR*Data* website to download EPA criteria pollutant emission estimates:
http://www.epa.gov/air/data/index.html

Air Quality Index (AQI)

The Air Quality Index (AQI) was developed by the EPA to provide a simple, uniform way to report daily air quality conditions.

In Minnesota, four criteria pollutants are used to calculate the AQI: ground-level ozone, sulfur dioxide, carbon monoxide and fine particles ($PM_{2.5}$). High AQI days in Minnesota are usually the result of elevated levels of ozone or $PM_{2.5}$. The AQI is currently calculated for the Brainerd area, Detroit Lakes, Duluth area, Ely, Grand Portage, Marshall, Rochester, St. Cloud, and the Twin Cities. Not all pollutants are monitored at each location.

The AQI translates each pollutant measurement to a common index, with a value of 100 reflecting when health effects might be expected in sensitive populations. The pollutant with the highest index value is used to determine the overall AQI. The table below shows the different AQI categories along with the corresponding index range.

AQI Color Legend

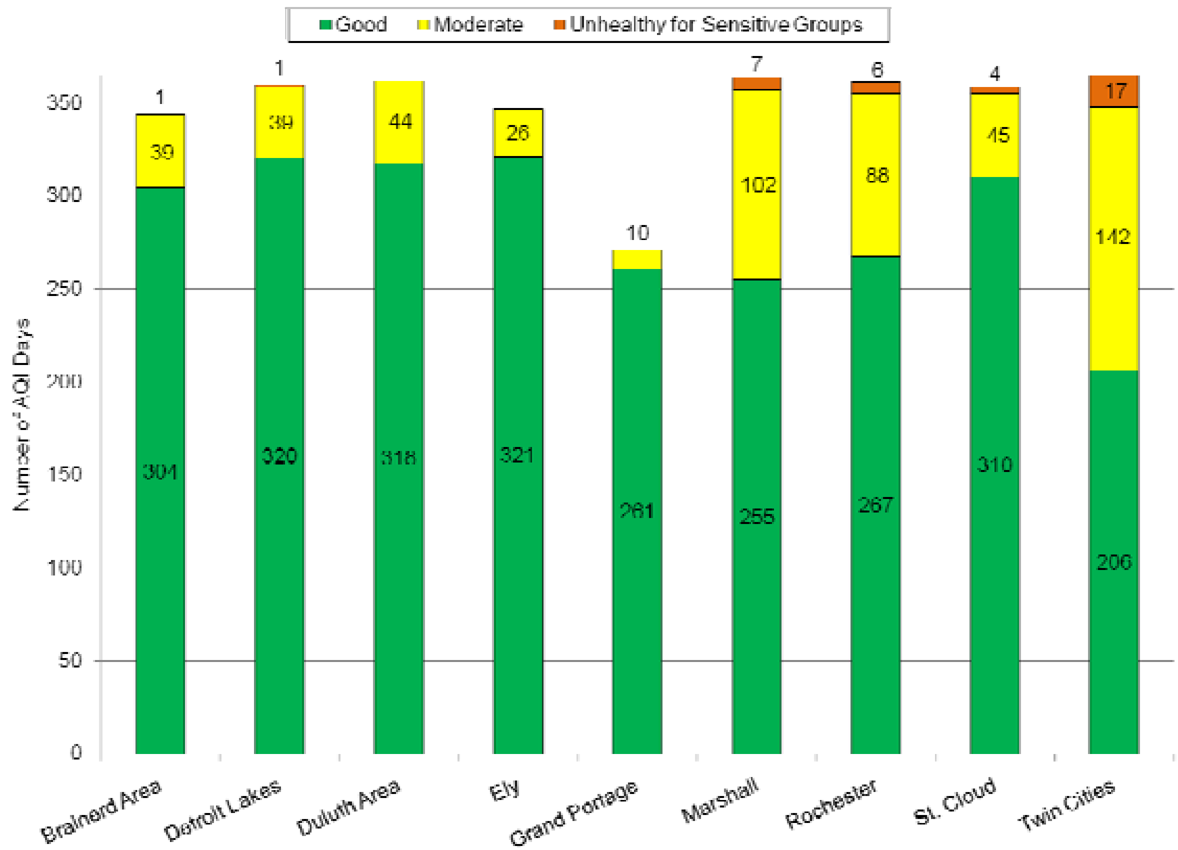
Beginning in May 2008, the pollutant concentration breakpoints for the AQI categories (i.e. Good, Moderate, Unhealthy for Sensitive Groups, etc.) were adjusted to reflect revisions to the National Ambient Air Quality Standards (NAAQS) for ozone and fine particles. As a result of these changes, $PM_{2.5}$ concentrations which were previously associated with an AQI of 90 and ozone concentrations previously associated with an AQI of 79 are now equal to an AQI of 101, the threshold for issuing an air pollution health alert.

The chart on the next page displays the number of Good, Moderate, Unhealthy for Sensitive Groups, and Unhealthy days for all monitored regions in 2010. The EPA may report slightly different AQI summary totals for Minnesota because the MPCA and EPA use different methods to calculate the AQI. The MPCA AQI summary totals will show a higher number of Moderate and Unhealthy for Sensitive Group days than EPA summary totals due to the calculation method for the $PM_{2.5}$ AQI.

Yearly variations in weather patterns can affect air quality. This was particularly evident in 2010, as persistently calm and stagnant weather conditions from November 2009 – March 2010, contributed to 24 air quality alert days. Sixteen of the 17 air quality alert days in 2010 occurred in the January-March time period.

All of the Unhealthy for Sensitive Groups AQI days in the Twin Cities were the result of elevated $PM_{2.5}$ concentrations. The Twin Cities AQI monitoring network measures hourly $PM_{2.5}$ concentrations at five locations including: St. Paul, Minneapolis, Apple Valley, Blaine, and St. Michael. Across these sites the number of Unhealthy for Sensitive Group days ranged from 14 days in St. Paul, less than 10 days for Minneapolis and Apple Valley, and four days for Blaine and St. Michael. While fine particle concentrations tend to rise and fall uniformly across broad geographic regions, local meteorological conditions, geographical features, and emissions activities will impact the peak pollutant concentrations at each monitor.

2010 Air Quality Index Days by Category and Reporting Region



References/web links

For more information on the AQI, see the following websites:

http://aqi.pca.state.mn.us/hourly/

http://www.epa.gov/airnow/

http://www.epa.gov/airnow/aqibroch/

Particulate Matter

Particulate matter is a broad class of chemically and physically diverse substances that exist as discrete particles (liquid droplets or solids) over a wide range of sizes. Some particles are seen as soot or smoke while others are so small they can only be detected with an electron microscope.

EPA currently has National Ambient Air Quality Standards (NAAQS) for particulate matter in two size classes, $PM_{2.5}$ and PM_{10}. $PM_{2.5}$, also known as fine particulate matter, includes particles with diameters less than or equal to 2.5 microns. PM_{10}, which is also known as inhalable particulate matter, includes particulate matter smaller than or equal to 10 microns. $PM_{2.5}$ and PM_{10} are associated with numerous adverse health effects, which are briefly described in the following sections. Health researchers have identified adverse health effects from a range of different sizes of particulate matter. Over time, federal particulate matter regulations have shifted to focus on smaller-sized particles.

Particulate matter also causes adverse impacts to the environment. Fine particles are the major cause of reduced visibility in parts of the United States. In addition, when particles containing nitrogen and sulfur deposit onto land or waters, they may affect nutrient balances and acidity. This can result in the depletion of nutrients in the soil, damage to sensitive forests and farm crops, and diversity changes in ecosystems. Particulate matter also causes soiling and erosion damage to materials and buildings. Finally, different types of particulate matter, for example black carbon (soot) and sulfate particles, play a role in climate change by altering cloud formation and precipitation and depending on the type of particle and location, contributing to global warming or cooling.

$PM_{2.5}$

Fine particles are an aerosol including solid particles and liquid droplets in the air that vary in size, composition and origin. Fine particles contain sulfate, nitrate, ammonium, elemental carbon, organic carbon-containing chemicals, minerals, trace elements and water.

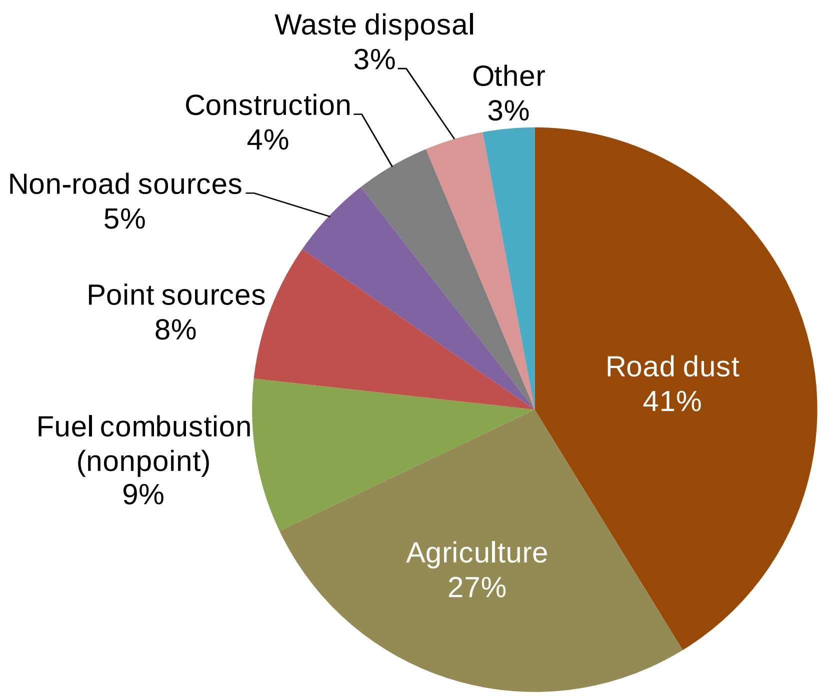
Studies have shown that ambient $PM_{2.5}$ concentrations are linked with increased hospital admissions and deaths from cardiovascular and respiratory problems. Elevated $PM_{2.5}$ concentrations are also associated with a number of adverse effects including heart attacks; atherosclerosis; acute and chronic bronchitis; asthma attacks; respiratory symptoms; and reduced lung function growth and increased respiratory illness in children.

Emissions data and sources

$PM_{2.5}$ concentrations in the air are the result of many manmade and natural sources of emissions. $PM_{2.5}$ can be directly emitted to the air in the form of small particles. Examples of these “directly” emitted $PM_{2.5}$ particles include the smallest particles created from mechanical, grinding or abrasion processes, blowing dust and the soot from combustion processes such as diesel engines and wood burning. MPCA estimates these types of emissions in the direct $PM_{2.5}$ emission inventory.

The MPCA estimate for statewide primary emissions of $PM_{2.5}$ in 2005 is 166,000 tons. This includes the $PM_{2.5}$ directly emitted from sources included in the MPCA emission inventory; however, it does not include secondarily formed or natural sources of $PM_{2.5}$, which can comprise at least half of the $PM_{2.5}$ found in the air.

Sources of Direct Fine Particulate ($PM_{2.5}$) Emissions in Minnesota, 2005*



*Does not include secondarily formed or natural sources

More than 40 percent of the estimated mass of primary, manmade $PM_{2.5}$ emissions comes from fugitive dust from unpaved and paved roads. A quarter of the emissions come from suspended soils released from agricultural tilling. Almost 10 percent come from industrial, commercial and residential fuel combustion. The remainder comes from a variety of large facilities such as electric utilities and the paper and mining industries; combustion of fuels in non-road sources; construction; and waste disposal.

Although this inventory suggests that most of the estimated $PM_{2.5}$ emissions are related to the soils found in the earth's crust, such as from agricultural tilling and road dust, in reality, only a small fraction of the $PM_{2.5}$ concentrations measured in typical air result from these "crustal" emission sources. Much of Minnesota's $PM_{2.5}$ air pollution results from secondary sources in Minnesota and other states that release "precursor" gases such as sulfur dioxide, nitrogen oxides, ammonia, or carbon-containing chemicals to the atmosphere. Depending on the weather conditions, these precursor gases will undergo chemical reactions in the air to form "secondary" $PM_{2.5}$.

At least half of the ambient fine particles measured in the Twin Cities and Rochester, and a proportionally larger fraction of the ambient $PM_{2.5}$ measured in rural areas, were found to result from $PM_{2.5}$ "precursor" gases. The following table describes the sources associated with the most common fine particle components, and whether they are the result of direct emissions or secondary formation.

Table 3: Major Sources of PM $_{2.5}$ Components

Component	Major Sources	Present in the air because…
Sulfate (SO_4)	Coal combustion	Secondary formation
Nitrate (NO_3)	Coal combustion, mobile sources and gas heating	Secondary formation
Ammonia (NH_4)	Agriculture	Secondary formation
Elemental Carbon	Mobile sources and biomass burning	Primary emissions
Organic Carbon	Biogenic emissions (i.e. natural decay), mobile sources, and biomass burning	Primary emissions and secondary formation
Crustal material	Fugitive dust	Primary emissions
Metals	Combustion and fugitive dust	Primary emissions

Trends

Statewide $PM_{2.5}$ emissions are estimated every three years. $PM_{2.5}$ emissions were estimated for the first time in 2002 and 2005 estimates are now available. Total estimated $PM_{2.5}$ emissions were 169,000 tons in 2002 and 166,000 tons in 2005. Estimating $PM_{2.5}$ emissions is challenging and the methodology is expected to improve over time. Given the uncertainty in the emission estimates, and the ongoing improvements in the estimation methods, it is difficult to interpret whether there has been a decrease in actual emissions**.**

References/web links

For more information on $PM_{2.5}$, see the following websites:

http://www.epa.gov/oar/particlepollution/

http://www.epa.gov/airtrends/pm.html

PM_{10}

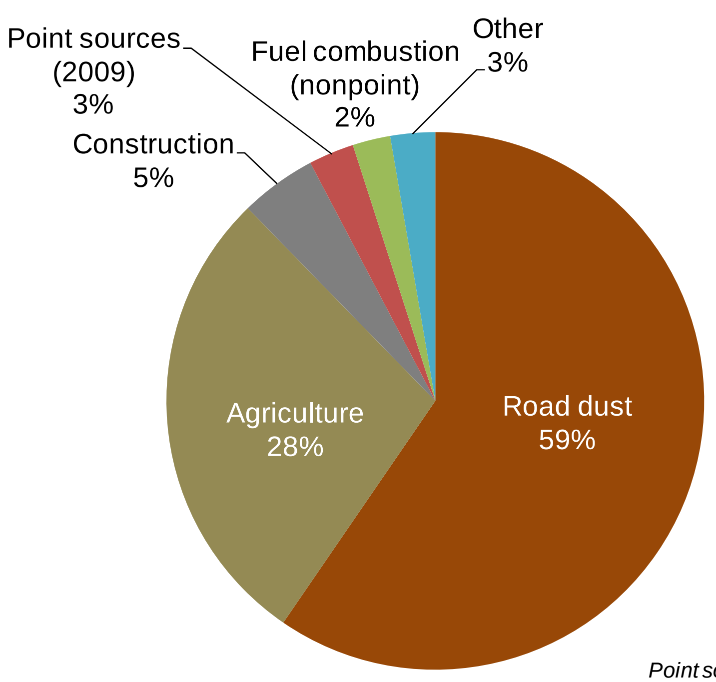
PM_{10} includes all particles with aerodynamic diameters less than 10 microns. $PM_{2.5}$ is a subset of PM_{10} emissions. Based on monitoring data, roughly half of the mass of Minnesota's ambient PM_{10} particles are of particles within the $PM_{2.5}$ size and so the direct and secondary formation and the health effects discussed for $PM_{2.5}$ have relevance for PM_{10}. However, ambient PM_{10} includes a much higher fraction of crustal materials. PM_{10} has been linked to cardiovascular and respiratory health effects, but the studies of PM_{10} indicate a weaker association with cardiovascular effects than for $PM_{2.5}$.

PM_{10} particles are generally emitted from sources such as vehicles traveling on unpaved roads; agricultural tilling; materials handling; crushing and grinding operations, and windblown dust. The larger of these particles can settle from the atmosphere within hours. Their spatial impact is typically more limited (compared to $PM_{2.5}$) because they tend to fall out of the air near where they were emitted.

Emissions data and sources

The MPCA estimate for statewide primary emissions of PM_{10} in 2009 is 768,930 tons. This includes the PM_{10} directly emitted from sources included in the MPCA emission inventory; however, it does not include secondarily formed PM_{10}.

Sources of Direct PM_{10} Emissions in Minnesota, 2005 and 2009



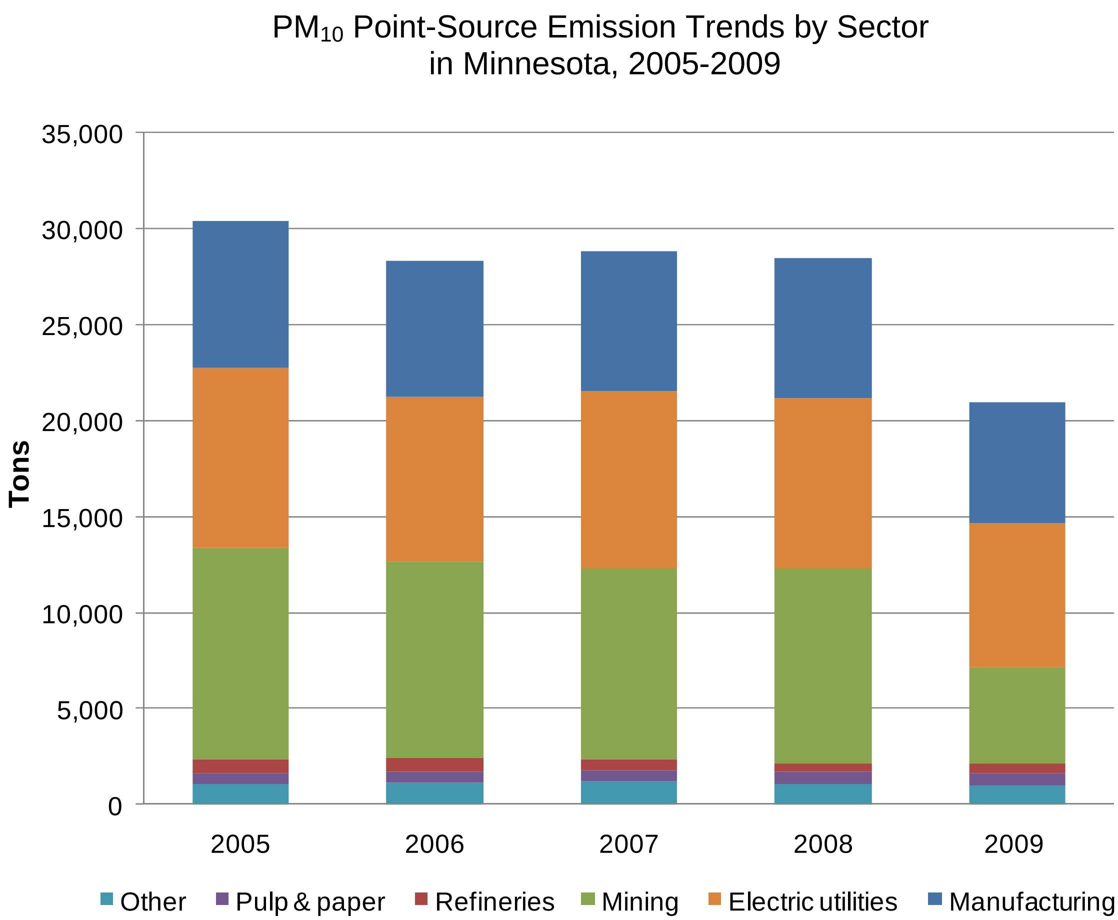
Point source data are from the 2009 Emissions Inventory. All other data are from the 2005 Emissions Inventory.

Almost 60 percent of the mass of direct primary PM_{10} emissions come from fugitive dust from unpaved and paved roads. Over a quarter of emissions come from agricultural tilling. Five percent is emitted from construction. The remainder comes from a variety of large facilities such as electric utilities and the paper and mining industries, and fuel combustion from smaller sources.

PM_{10} particles formed secondarily in the atmosphere from chemical reactions involving gaseous pollutants are not accounted for in these pie charts and graphs.

Trends

In 2009, point sources contributed three percent to the total state PM_{10} emissions. PM_{10} emissions have decreased since 2005. Between 2008 and 2009 there was a large reduction in PM_{10} emissions from the mining sector due to production decreases at taconite facilities in Northern Minnesota. In addition, there was also a reduction in coal burned at electric utilities such as Minnesota Power's Boswell facility in Cohasset.



References/web links

For more information on PM_{10}, see the following website:

http://www.epa.gov/oar/particlepollution

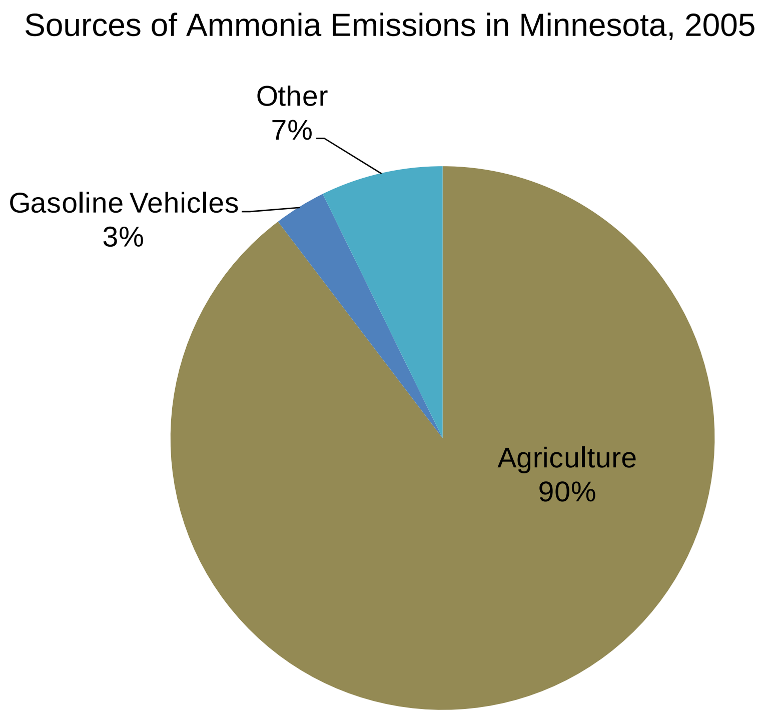
Ammonia

Ammonia is a colorless gas with a distinctive odor. The main source of ammonia gas in the air is livestock waste and fertilizer application. It can be smelled at a concentration near 50 ppm, but human health effects are not expected at that level. Exposure to high concentrations of ammonia may irritate the skin, eyes, throat and lungs and cause coughing and burns.

Federal rules direct the MPCA to track emissions of ammonia because it is a major component of fine particles ($PM_{2.5}$). Ammonia combines with sulfur dioxide and nitrogen oxides to form ammonium sulfate and ammonium nitrate particles. These particles make up half of fine particle mass in urban areas in Minnesota and at least three quarters of fine particle mass in rural areas.

Emissions data and sources

The MPCA estimate for statewide emissions of ammonia in 2005 is 180,000 tons. The majority of ammonia emissions were from agricultural production, mainly livestock waste and fertilizer application.



Trends

Statewide ammonia emissions are estimated every three years. Ammonia emissions were included in the emissions inventory for the first time in 2002 when total Minnesota ammonia emissions were estimated at 179,000 tons. In 2005, Minnesota ammonia emissions were estimated at 180,000 tons. Due to inherent uncertainties of the emissions estimating process, there was essentially no change in ammonia emissions between 2002 and 2005.

References/web links

For more information on how ammonia affects fine particle formation see the section on $PM_{2.5}$.

Sulfur Dioxide

Sulfur dioxide (SO_2) belongs to the family of sulfur oxide gases. Sulfur oxide gases are formed when fuel containing sulfur (mainly coal and oil) is burned and during gasoline production and metal smelting.

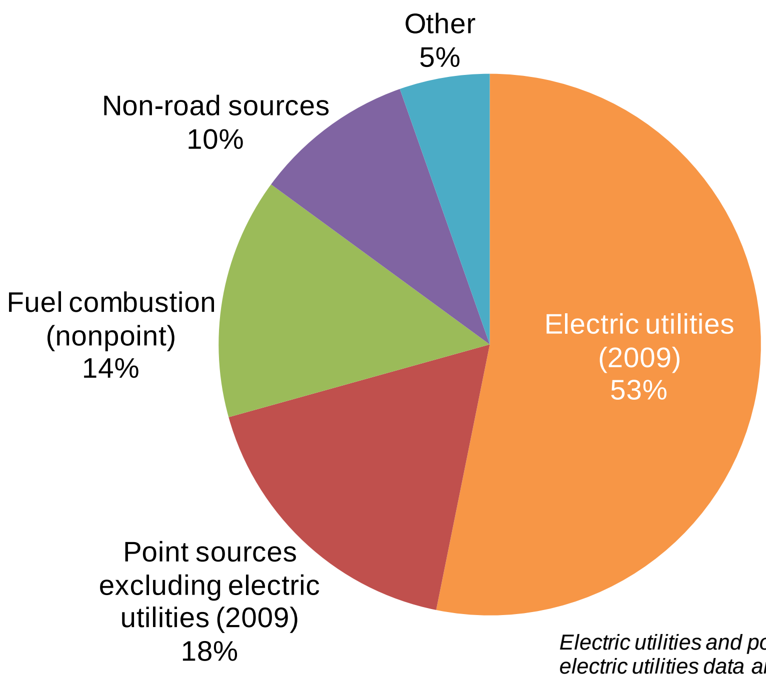
Current scientific evidence links short-term exposures to SO_2 with adverse respiratory effects including bronchoconstriction and increased asthma symptoms. Studies show a connection between exposure to SO_2 and increased visits to emergency departments and hospital admissions for respiratory illness. Children, asthmatics and the elderly may be particularly sensitive. SO_2 also reacts with other chemicals in the air to form tiny sulfate particles.

SO_2 also causes significant environmental damage. SO_2 reacts with other substances in the air to form acids, which fall to earth as rain, fog, snow, or dry particles. Acid rain damages forests and crops, changes the makeup of soil, and makes lakes and streams acidic and unsuitable for fish. In addition, SO_2 accelerates the decay of buildings and monuments and is a major cause of reduced visibility due to haze in Minnesota.

Emissions data and sources

The MPCA estimate for statewide emissions of SO_2 in 2009 is 101,000 tons. The figure below shows sources of 2005 and 2009 SO_2 emissions.

Sources of Sulfur Dioxide Emissions in Minnesota, 2005 and 2009



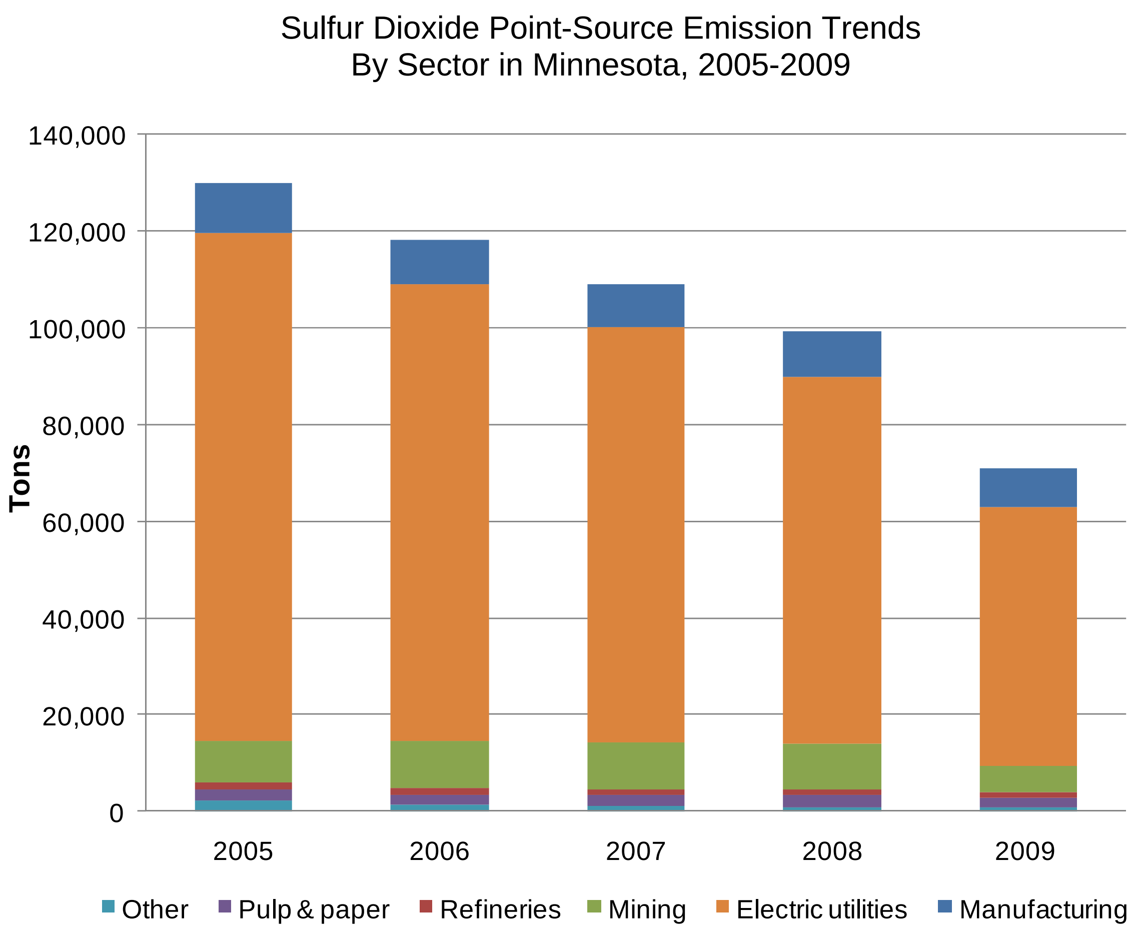
Electric utilities and point sources excluding electric utilities data are from the 2009 Emissions Inventory. All other data are from the 2005 Emissions Inventory.

The majority (53 percent) of SO_2 emissions come from coal-burning electric utilities. Eighteen percent comes from industrial point sources while 14 percent are the result of smaller industrial burning of coal, distillate oil and prescribed burning. Non-road agricultural, railroad and construction equipment burning distillate oil make up the bulk of remaining SO_2 emissions.

Trends

Point sources contribute 71 percent to the total state SO_2 emissions with coal-burning electric utilities the greatest emitters. Emissions from point sources have been decreasing since 2005 due mainly to reductions in emissions from electric utilities. Xcel Energy's Allen S. King coal-fired power plant in Oak Park Heights was renovated with state-of-the-art pollution controls while St. Paul's High Bridge power plant and Minneapolis' Riverside power plant were converted from coal to cleaner-burning natural gas. Minnesota Power also installed modern air pollution controls at its Boswell coal-fired power plant in Cohasset in 2009.

As a result of these changes, the Allen S. King plant burned more coal in 2008 than it did in 2004, but decreased its emissions of SO_2 by over 26,000 tons. The High Bridge plant completed its conversion to natural gas in February 2008. Its emissions of SO_2 dropped from a high of nearly 4,000 tons in 2004, to just over one ton in 2008. In addition, the Riverside plant completed its conversion in 2009 resulting in a decrease in emissions of over 10,000 tons. The Boswell plant reduced its emissions by over 8,000 tons due to decreased burning of coal during renovation and air pollution control modernization.



References/web links

For more information on sulfur dioxide, see the following websites:

http://www.epa.gov/air/sulfurdioxide/

http://www.epa.gov/air/airtrends/sulfur.html

Nitrogen Oxides

Nitrogen oxides (NO_x) is the generic term for a group of highly reactive gases, all of which contain nitrogen and oxygen. The two primary constituents are nitric oxide (NO) and nitrogen dioxide (NO_2). NO is a colorless, odorless gas that is readily oxidized in the atmosphere to NO_2. NO_2 exists as a brown gas that gives photochemical smog its reddish-brown color. NO_x is reported because NO and NO_2 continuously cycle between the two species. NO_x form when fuel is burned at high temperatures.

Current scientific evidence links short-term NO_2 exposures with adverse respiratory effects including increased asthma symptoms and an increase in other respiratory illnesses. Studies also show a connection between exposure to NO_2 and increased visits to emergency departments and hospital admissions for respiratory illnesses, particularly for children, the elderly, and asthmatics.

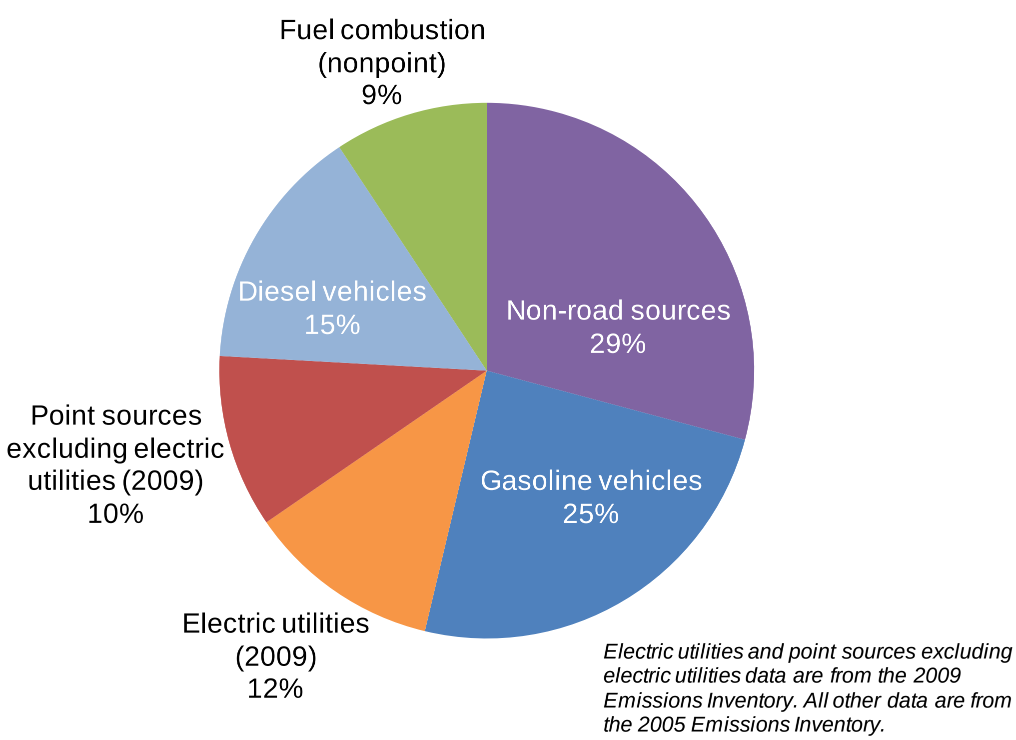
NO_x are a major precursor both to ozone and to fine particulate matter ($PM_{2.5}$). As discussed in the ozone and $PM_{2.5}$ sections of this report, exposure to these pollutants is associated with serious adverse health effects.

High NO_x concentrations also have environmental impacts. Deposition of nitrogen can lead to fertilization, eutrophication, and acidification of terrestrial, wetland and aquatic systems resulting in changes in species number and composition such as the reduction of fish and shellfish populations. Nitrate particles and nitrogen dioxide also increase visibility impairment in areas such as the Boundary Waters Canoe Area Wilderness and Voyagers National Park and urban areas such as Minneapolis and St. Paul. In addition, nitrous oxide (N_2O), another component of NO_x, is a greenhouse gas that contributes to global climate change.

Emissions data and sources

The MPCA estimate for statewide emissions of NO_x in 2009 is 353,000 tons. The figure below shows sources of 2005 and 2009 NO_x emissions.

Sources of Nitrogen Oxide Emissions in Minnesota, 2005 and 2009



More than a quarter of NO_x emissions come from non-road sources such as railroads and agricultural, construction and recreational equipment. Another 25 percent comes from on-road gasoline vehicles. Electric utilities contribute 12 percent of NO_x emissions. Combustion from other large point sources emits 10 percent while diesel vehicles emit an additional 15 percent. Fuel combustion from smaller sources contributes most of the remainder of NO_x emissions in Minnesota.

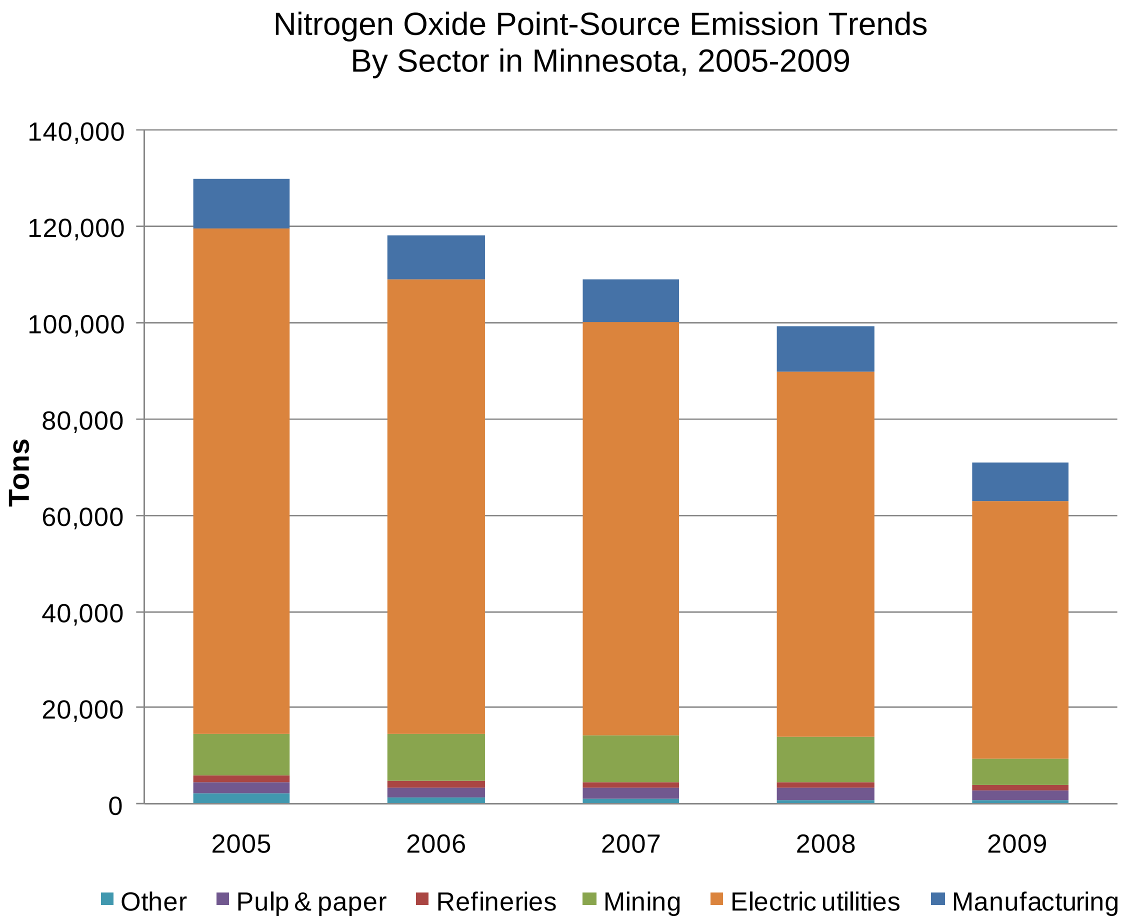
Trends

Point sources contribute 22 percent of the NO_x emissions in Minnesota. There was a pronounced decrease in NO_x emissions in 2006, 2008 and 2009 due to emission reductions in the electric utilities and mining sectors.

Xcel Energy's Allen S. King coal-fired power plant in Oak Park Heights was renovated with state-of-the-art pollution controls while St. Paul's High Bridge power plant and Minneapolis' Riverside power plant were converted from coal to cleaner-burning natural gas. Minnesota Power also installed modern air pollution controls at its Boswell coal-fired power plant in Cohasset in 2009.

As a result of these changes, in 2008, the Allen S. King plant burned more coal than it did in 2004, but decreased its emissions of NO_x by more than 11,000 tons. The High Bridge plant completed its conversion to natural gas in February 2008. Its emissions of NO_x dropped from a high of more than 6,000 tons in 2004, to less than 30 tons in 2008. In addition, the Riverside plant completed its conversion in 2009 resulting in a decrease in emissions of nearly 10,000 tons. The Boswell plant reduced its emissions by over 4,000 tons due to decreased burning of coal during renovation and air pollution control modernization.

Mining emissions have also been lower since 2005. Mining emissions vary annually depending on the demand for taconite pellets. The kilns that bake the pellets burn natural gas, which results in NO_x emissions. There was a significant reduction in taconite production in 2009 at many facilities.



References/web links

For more information on nitrogen oxides, see the following websites:

http://www.epa.gov/air/nitrogenoxides/

http://www.epa.gov/airtrends/nitrogen.html

Ozone

Ozone is a colorless gas composed of three atoms of oxygen. Naturally occurring ozone in the upper atmosphere helps protect the earth's surface from ultraviolet radiation. However, ground-level ozone at elevated concentrations can trigger a variety of health problems.

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 also has been associated with increased susceptibility to respiratory infections, medication use, doctor visits, and emergency department visits and hospital admissions for individuals with lung disease. Ozone exposure also increases the risk of premature death from heart or lung disease. Children are at particular risk from ozone because their lungs are still developing and they are more likely to have increased exposure since they are often active outdoors.

Scientific evidence shows that repeated exposure to ground-level ozone also has detrimental effects on plants and ecosystems including interfering with plants' ability to produce and store food, damaging the leaves of trees and other plants, and reducing forest growth and crop yields. 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.

Emissions data and sources

Emissions of ozone are not reported because ozone is not normally emitted directly into the air. Instead, it is created when precursor gases such as nitrogen oxides (NO_x) and volatile organic compounds (VOCs) react in a hot stagnant atmosphere. Since heat and sunlight are needed for ozone to be produced, elevated levels of ozone in Minnesota are normally seen on very hot summer afternoons. Both urban and rural areas may have high levels of ozone since wind carries ozone and its precursors far from the original sources.

Ozone precursors come from a variety of sources. NO_x can form when fuels are burned at high temperatures. The major NO_x sources are combustion processes from highway vehicles and power plants. VOCs are emitted from a variety of sources, including industrial sources, motor vehicles and consumer products. NO_x and VOCs are also emitted by naturally occurring sources such as soil and vegetation. See the nitrogen oxides and volatile organic compounds sections of this report for more information regarding 2009 emissions of ozone precursors.

References/web links

For more information on ozone, see the following websites:

http://www.epa.gov/air/ozonepollution/index.html

http://www.epa.gov/airtrends/ozone.html

Volatile Organic Compounds

Volatile organic compounds (VOCs) are compounds containing the elements carbon and hydrogen that exist in the atmosphere primarily as gases because of their low vapor pressure. VOCs are defined in federal rules as chemicals that participate in forming ozone. Therefore, only gaseous hydrocarbons that are photochemically reactive and participate in the chemical and physical atmospheric reactions that form ozone and other photochemical oxidants are considered VOCs.

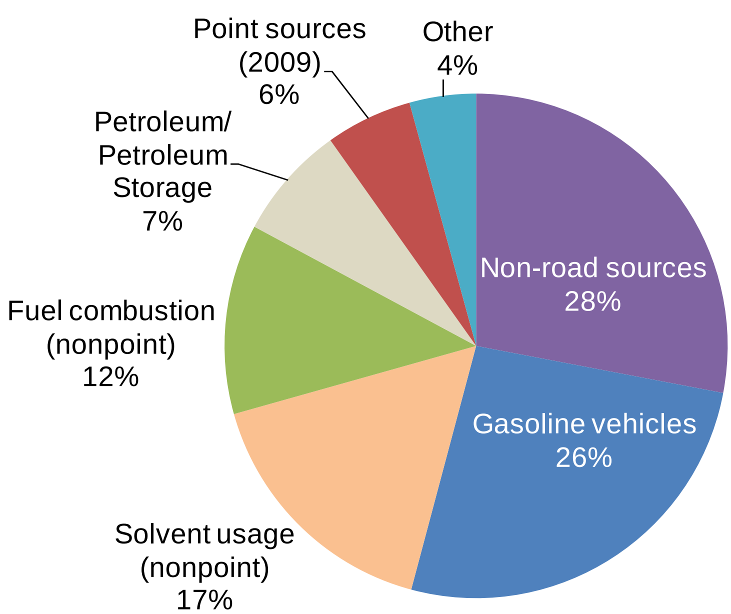
Many VOCs are also air toxics and can have harmful effects on human health and the environment. However, VOCs are regulated as a criteria pollutant because they are precursors to ozone. See the sections on ozone and air toxics for related human health and environmental effects.

Emissions data and sources

The MPCA estimate for statewide emissions of VOCs in 2009 is 342,000 tons.

VOCs are emitted from a variety of sources including industrial facilities, motor vehicles, consumer products, and natural sources such as soils and vegetation. The figure below shows only manmade Minnesota sources of VOCs in 2009.

Sources of Volatile Organic Compound Emissions in Minnesota, 2005 and 2009

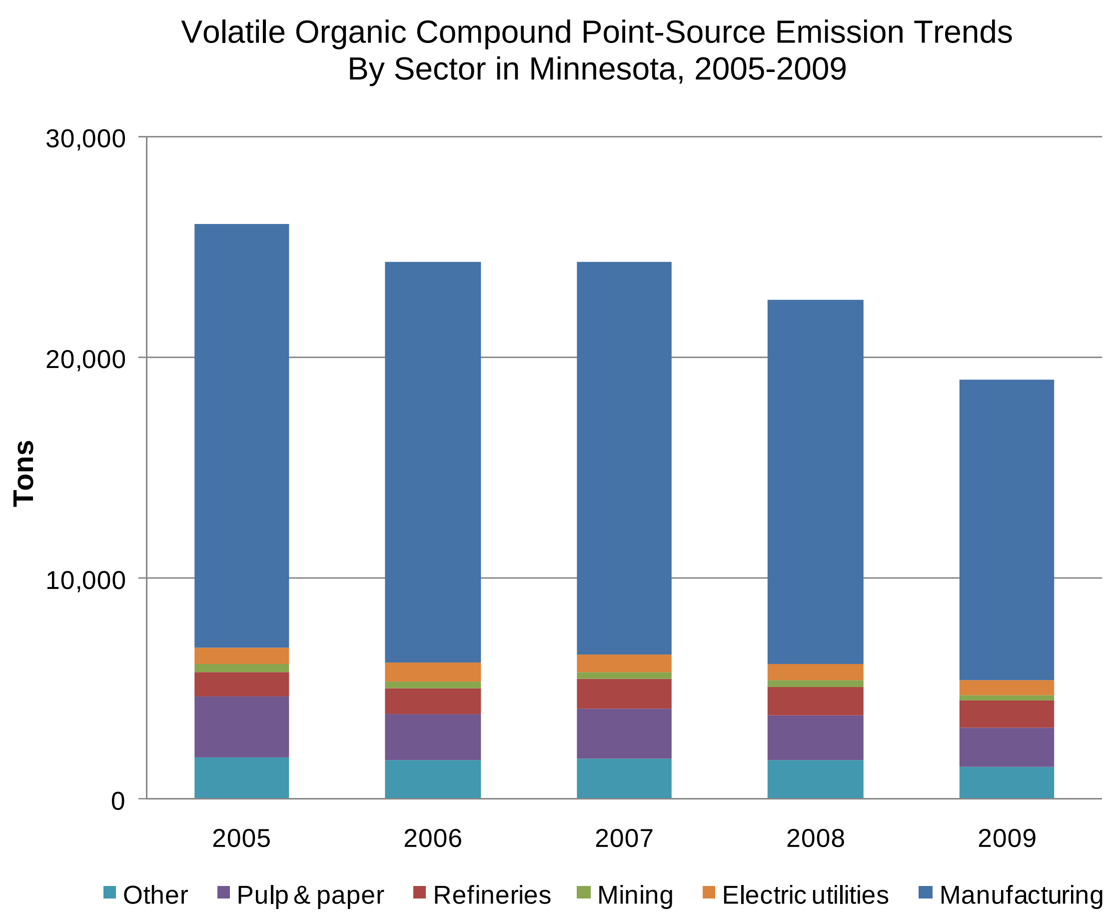


Point source data are from the 2009 Emissions Inventory. All other data are from the 2005 Emissions Inventory.

Almost 30 percent of VOC emissions are from non-road sources, in particular recreational vehicles such as snowmobiles, boats, ATVs and motorcycles burning gasoline. Some additional non-road sources of VOCs include agricultural, construction and lawn and garden equipment. On-road gasoline vehicles emit another quarter of VOC emissions. Solvent usage from smaller sources emits 17 percent. Twelve percent of VOC emissions are from residential burning of wood in fireplaces and woodstoves. The storage and transport of gasoline, solvent usage and other emissions from larger facilities make up the bulk of the remaining VOC emissions.

Trends

Point sources contribute six percent of the VOC emissions in the state. Emissions have been gradually decreasing since 2004 due mainly to decreases in the manufacturing sector. In 2009, there were significant decreases across all sectors.



References/web links

For more information on volatile organic compounds, see the sections on ozone and air toxics.

Carbon Monoxide

Carbon monoxide (CO) is a colorless and odorless toxic gas formed when carbon in fuels is not burned completely. A major source of CO is motor vehicle exhaust. Higher levels of CO generally occur in areas with heavy traffic congestion and during the colder months of the year.

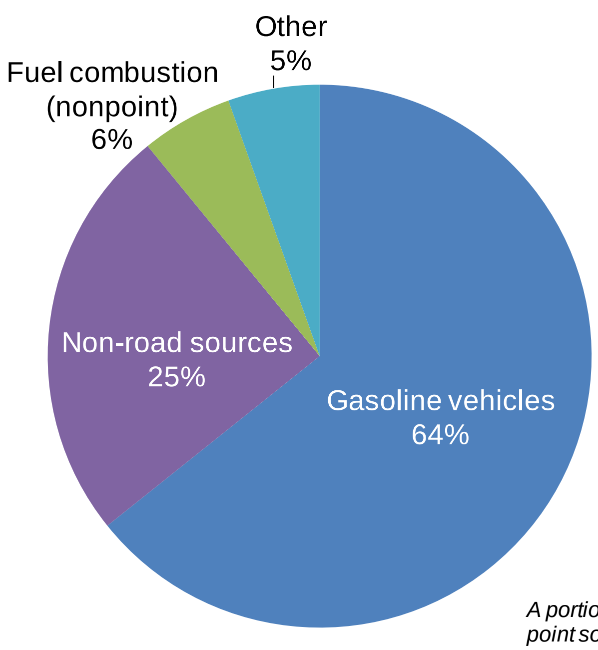
CO enters the bloodstream and reduces the delivery of oxygen to the body's organs and tissues. The health threat from CO is most serious for those who suffer from cardiovascular disease. At higher concentrations it also affects healthy individuals. Exposure to elevated CO levels is associated with impaired visual perception, work capacity, manual dexterity, learning ability and performance of complex tasks. Prolonged exposure to high levels can lead to death.

At concentrations commonly found in the ambient air, CO does not appear to have adverse effects on plants, wildlife or materials. However, CO is oxidized to form carbon dioxide (CO_2), a major greenhouse gas and contributor to global climate change. CO also contributes to the formation of ground-level ozone.

Emissions data and sources

The MPCA estimate for statewide emissions of CO in 2009 is 1,769,000 tons. The figure below shows sources of 2009 CO emissions.

Sources of Carbon Monoxide Emissions in Minnesota, 2005 and 2009

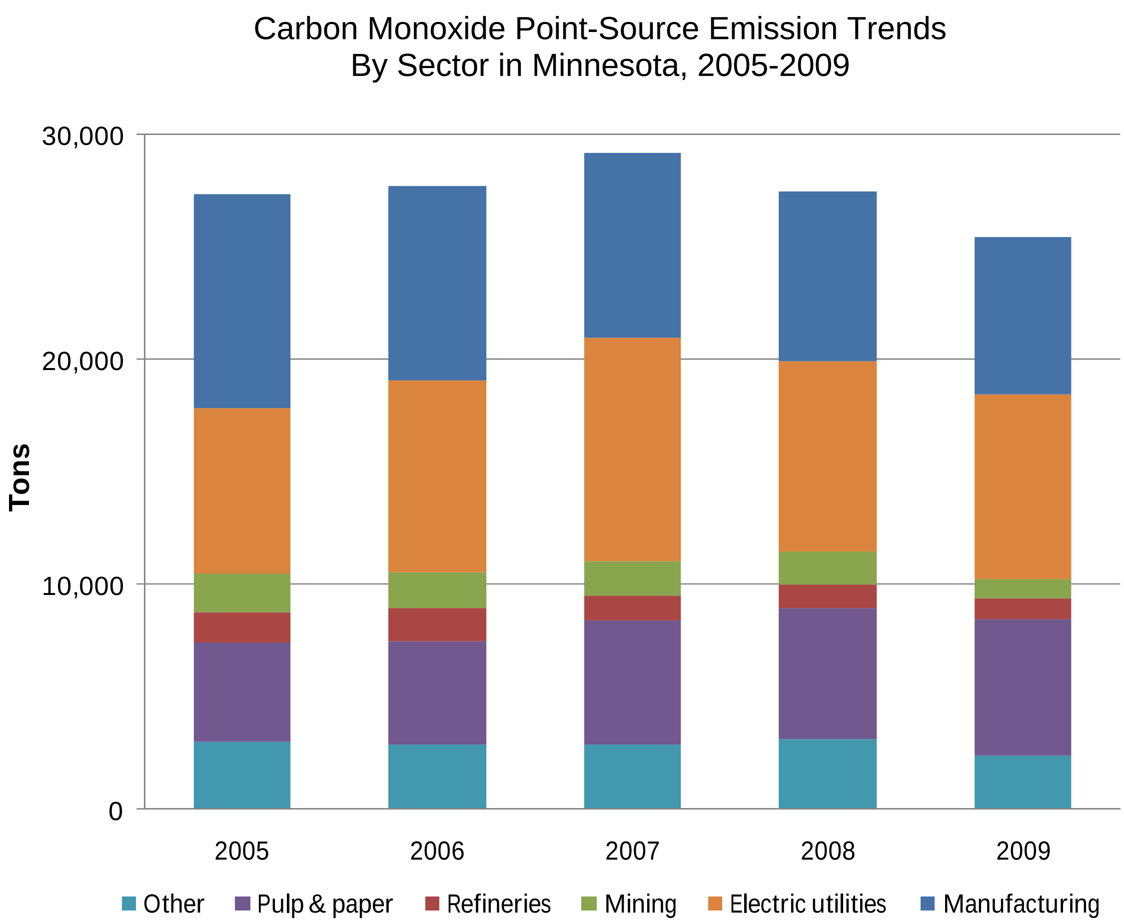


A portion of the other category includes point source data from the 2009 Emissions Inventory. All other data are from the 2005 Emissions Inventory.

The majority of CO emissions come from the combustion of gasoline in on-road vehicles. A quarter of emissions come from the combustion of fuels in non-road recreational vehicles such as snowmobiles, boats, golf carts, and ATVs as well as lawn and garden equipment. Fuel combustion, particularly residential wood combustion, contributes an additional six percent of CO emissions. A variety of sources, including emissions from fuel combustion and metals processing in large facilities, burning waste, and emissions from diesel vehicles comprise the remaining emissions from CO.

Trends

Point sources contributed fewer than two percent of the total Minnesota CO emissions in 2009. The CO values had been gradually increasing since 2005, but decreased in 2008 and 2009. The increase in 2007 was mainly due to increased throughput at a few electric utility facilities and increases in the pulp and paper sector. In 2008, the utility emissions returned to 2006 levels, while the pulp and paper sector continued to increase. Mining saw the largest reductions due to production decreases at taconite facilities in 2009. All other sectors decreased except for pulp and paper, which increased emissions of CO slightly.



References/web links

For more information on carbon monoxide, see the following websites:

http://www.epa.gov/airquality/carbonmonoxide/

http://www.epa.gov/air/airtrends/carbon.html

http://www.health.state.mn.us/divs/eh/indoorair/co/index.html

Lead

Lead is a metal found naturally in the environment as well as in manufactured products. In the past, the major sources of lead emissions were motor vehicles and industrial sources. Since lead in gasoline was phased out, air emissions and ambient air concentrations have decreased dramatically. Currently, metals processing (lead and other metals smelters) and aircraft using leaded fuel are the primary sources of lead emissions.

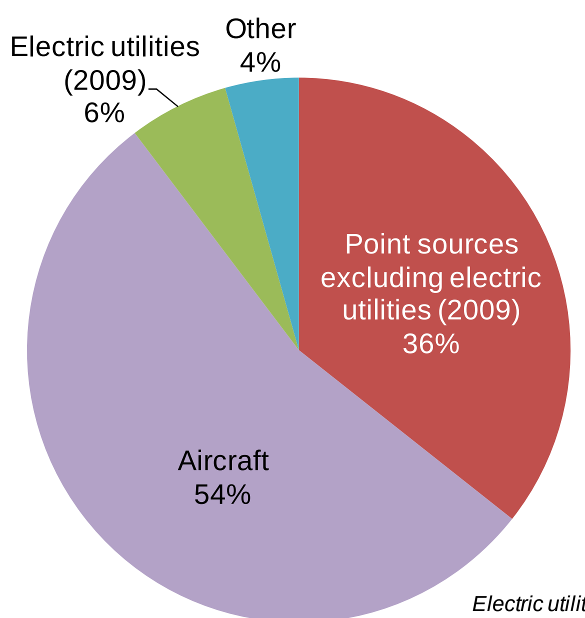
Scientific evidence about the health effects of lead has expanded significantly in the last 30 years. Exposures to low levels of lead early in life have been linked to effects on IQ, learning, memory and behavior. There is no known safe level of lead in the body.

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.

Emissions data and sources

The MPCA estimate for statewide emissions of lead in 2009 is 16 tons. The total mass of lead emitted is much less than the other criteria pollutants. However, it takes only a small amount of lead to cause serious and permanent health problems. Therefore, even relatively low lead emissions are a concern. The figure below shows sources of 2009 lead emissions.

Sources of Lead Emissions in Minnesota, 2005 and 2009



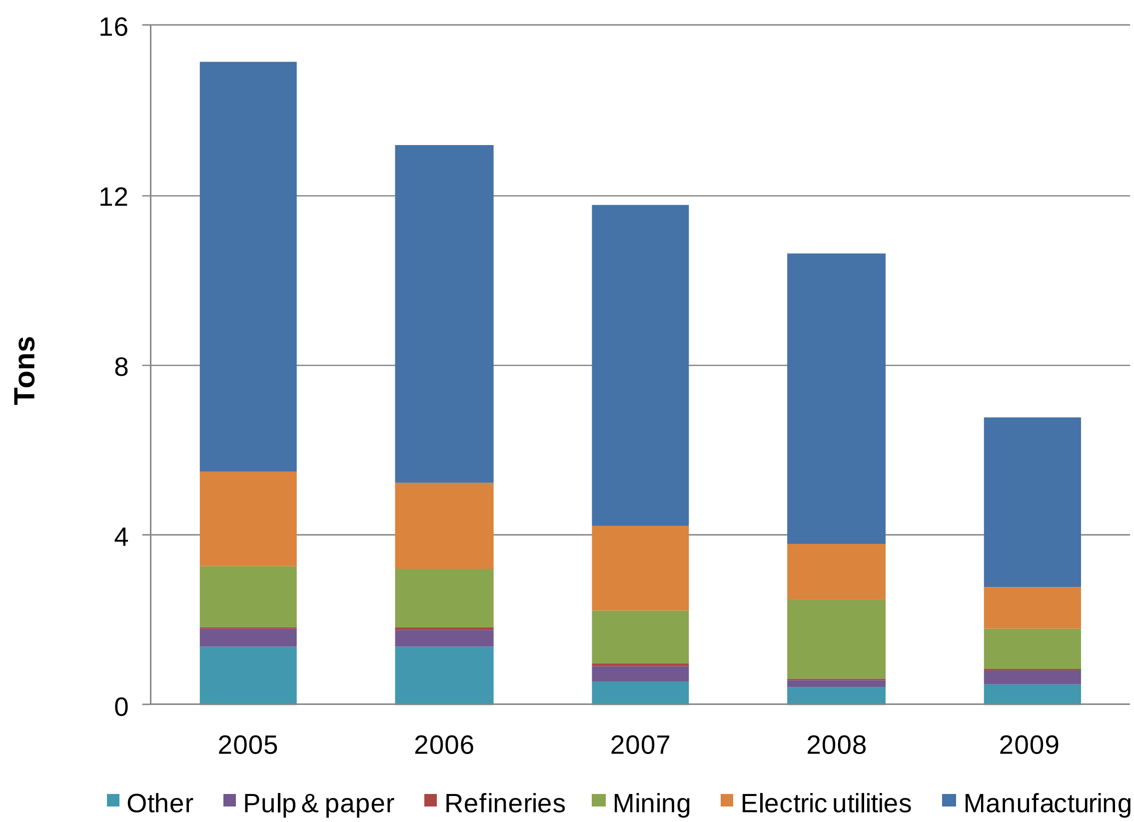
Electric utilities and point sources excluding electric utilities data are from the 2009 Emissions Inventory. All other data are from the 2005 Emissions Inventory.

Point sources excluding electric utilities contribute 36 percent of Minnesota's lead emissions. These point sources include metal processing, and some combustion of waste and coal. General aviation aircraft emit 54 percent of lead emissions from burning leaded fuel. Coal-burning power plants add an additional six percent of lead to the environment while other small sources contribute the final four percent.

Trends

Point sources (including electric utilities) contribute 42 percent of the state's lead emissions. In Minnesota, the estimated lead emissions from point sources have been decreasing from most sectors. In 2009, taconite mining facilities and foundries reduced production, resulting in lead emission reductions. One foundry also completed a stack test, resulting in a lower emission factor for lead. Electric utilities emit lead when burning coal. Utilities burnt less coal in 2009 due to conversions to natural gas and other factors.

Lead Point-Source Emission Trends By Sector in Minnesota, 2005-2009



References/web links

For more information on lead, see the following websites:

http://www.epa.gov/air/lead/index.html

http://www.epa.gov/air/airtrends/lead.html

http://www.pca.state.mn.us/air/lead.html

http://www.health.state.mn.us/divs/eh/lead/index.html

Mercury

Mercury is a neurotoxin, a substance that damages the central nervous system of people and other animals. For most Minnesotans, eating fish contaminated with too much mercury poses the greatest risk of exposure. While fish provide a healthy source of protein, and consumption is generally encouraged, citizens are advised to restrict their consumption of larger predatory fish, which are more contaminated.

The vast majority of mercury in Minnesota's environment comes from air pollution. Minnesota's land and water become contaminated with mercury when it falls in rain and snow or as "dry deposition." Because mercury vapor can be transported long distances by the atmosphere, most of the mercury in Minnesota originates outside of the state and most of Minnesota's emissions are deposited in other states and countries.

MPCA scientists calculate that mercury pollution sources need to be reduced by about 93 percent from 1990 levels in order to safely eat larger predatory fish such as walleye and northern pike. Accordingly, under the federally mandated Total Maximum Daily Load (TMDL) provisions of the Clean Water Act, the MPCA established a goal of reducing air emissions of mercury to no more than 789 pounds per year by the year 2025. In 2009, with substantial stakeholder input, the MPCA developed a TMDL implementation plan to achieve these reductions.

The largest emission sources in the state are the burning of coal and the processing of taconite iron ore. In addition, the use and disposal of a variety of mercury-added products contributes significantly to emissions. The MPCA estimates that in 2008, emissions of mercury from all sources in the state totaled 2,763 pounds, a level that is compatible with reaching the reduction goal by 2025.

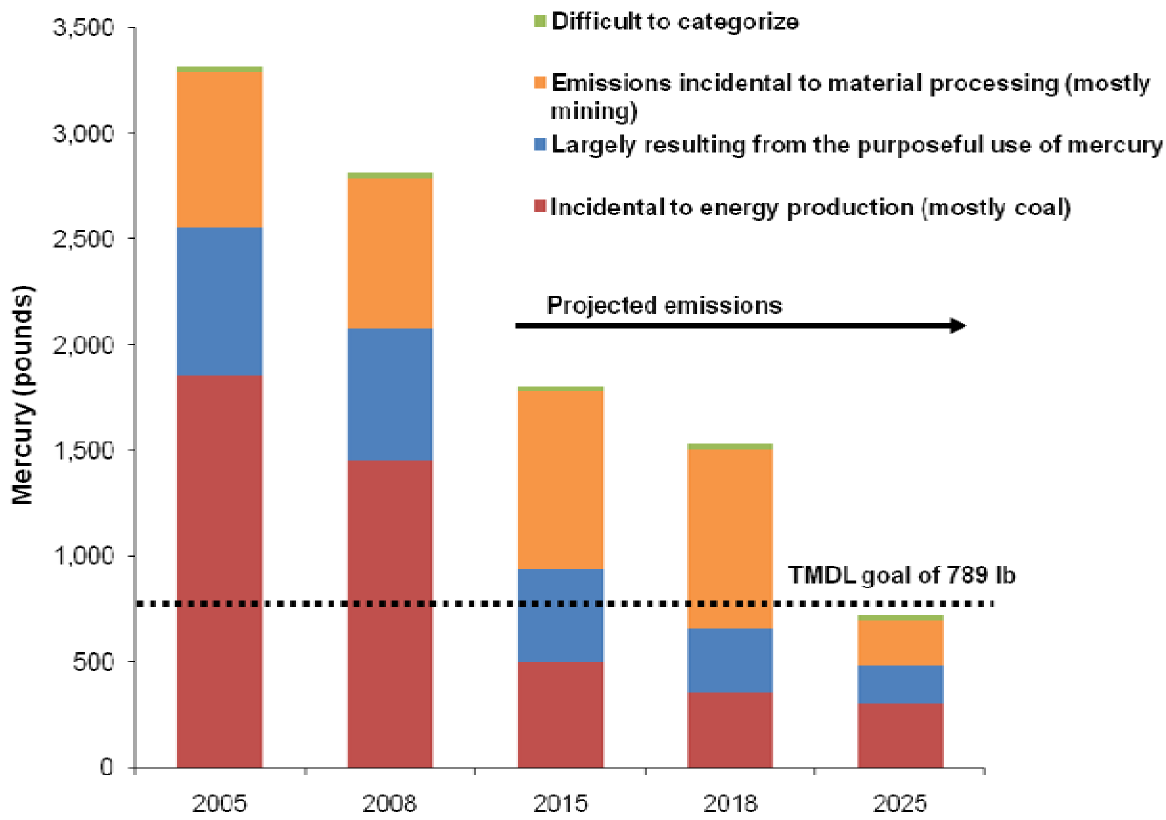
Producers and retailers of electricity are required by Minnesota's Mercury Emissions Consumer Information Act of 1997 to report the amount of mercury emitted through the generation of electricity. This law also requires the MPCA to summarize this information in its biennial air toxics report to the Legislature. In 2008 and 2009, facilities in Minnesota reported the emission of 1250 and 1,090 pounds of mercury, respectively, in the production of electricity within the state. Electricity imported into Minnesota from outside the state resulted in an additional 1,892 and 1,926 pounds of mercury emissions in those two years. Appendix A provides a more detailed summary of mercury emissions associated with electricity production for 2008 and 2009.

Reductions called for in the Minnesota Legislature's Mercury Emission Reduction Act of 2006 will contribute significantly to achieving the state's reduction goal. This law calls for reductions at the state's three largest coal-burning power plants by the end of 2014. The first phase of this reduction was completed in 2010 at Minnesota Power's Boswell Plant in Cohasset and Xcel Energy's Sherco Plant in Becker. Minnesota Power has completed an air pollution control retrofit of Boswell Unit 3, and is expecting to achieve 90 percent control of mercury from this coal-fired generating unit. Xcel Energy has installed mercury control equipment on Sherco Unit 3, and is expecting similar results. Data demonstrating mercury capture will be finalized in early 2011.

Minnesota's taconite-processing industry, soon to be the largest mercury emission source in the state due to decreases in the coal-fired energy sector, is working to identify and prove pollution control technologies suited to their unique industry. Promising initial research findings will be expanded with the aid of a federal grant awarded to the Minnesota Department of Natural Resources in 2010.

More information on strategies for meeting these targets can be found on the MPCA web site at http://www.pca.state.mn.us/air/mercury-reductionplan.html

Actual and Projected Mercury Emissions 2005-2025
(based on stakeholder recommended strategies)



Mercury concentrations in Minnesota fish

A recent analysis of a 25-year record of mercury in northern pike and walleye from Minnesota lakes has found a recent unexpected rise. After declining by 37 percent from 1982 to 1992, average mercury concentrations in these fish started to increase in the mid-1990s. During the last decade of the analysis, 1996-2006, the average mercury concentrations increased 15 percent. This is surprising because during this same period, emissions in Minnesota and the United States declined sharply. MPCA scientists believe that the most likely cause of this increase is either increased global mercury emissions by sources outside of the United States, or factors associated with global climate change, or both. This increase underscores the need to reduce global mercury emissions and address climate change.

References/web links

For more information on mercury, see the following websites:

http://www.pca.state.mn.us/air/mercury.html

http://www.epa.gov/mercury/

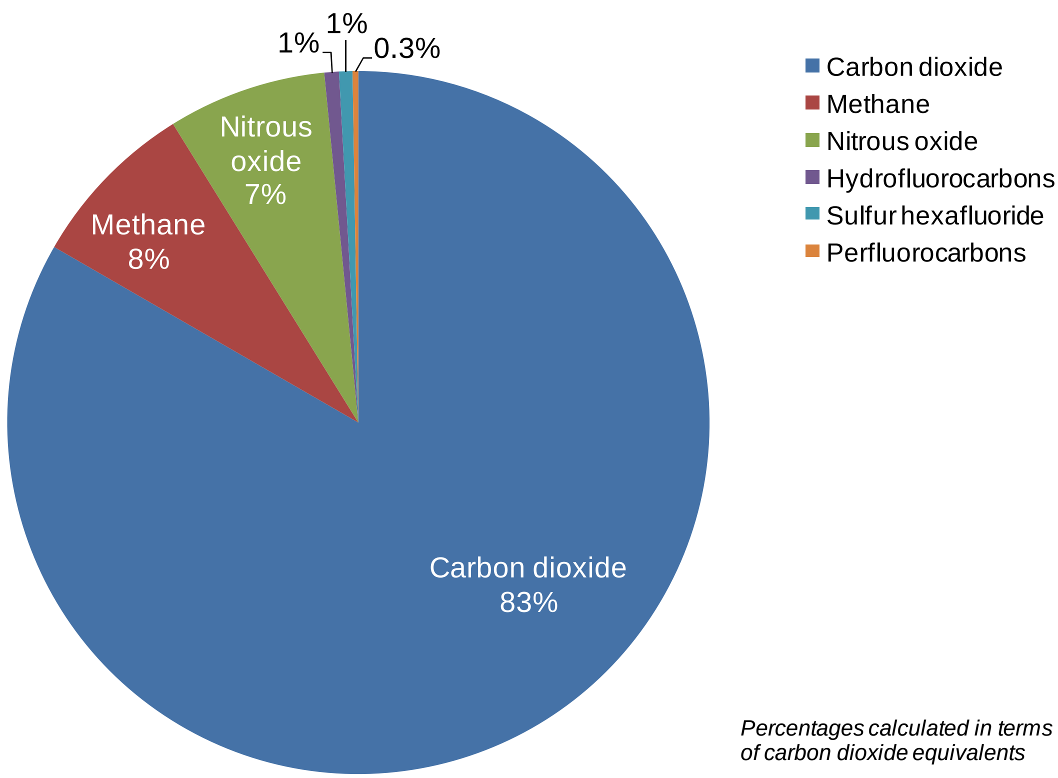
Greenhouse Gases

Climate change results from the buildup of a group of compounds, collectively called greenhouse gases. The most important greenhouse gas, carbon dioxide (CO_2), is mainly formed from the combustion of fossil fuels such as oil, gas and coal. Many greenhouse gases occur naturally, but fossil fuel burning and other human activities are adding gases to the natural mix at an accelerated rate.

Emissions data and sources

In the past, MPCA has reported carbon dioxide (CO_2) emissions in this report. Starting this year, 2008 emissions for six greenhouse gases (CO_2, nitrous oxide, methane, hydrofluorocarbons, perfluorocarbons and sulfur hexafluoride) are reported in terms of CO_2 equivalents (CO_2e). CO_2e compares the warming potential of different gases to the impact of CO_2. In 2008, emissions of CO_2 accounted for about 83 percent of Minnesota warming potential.

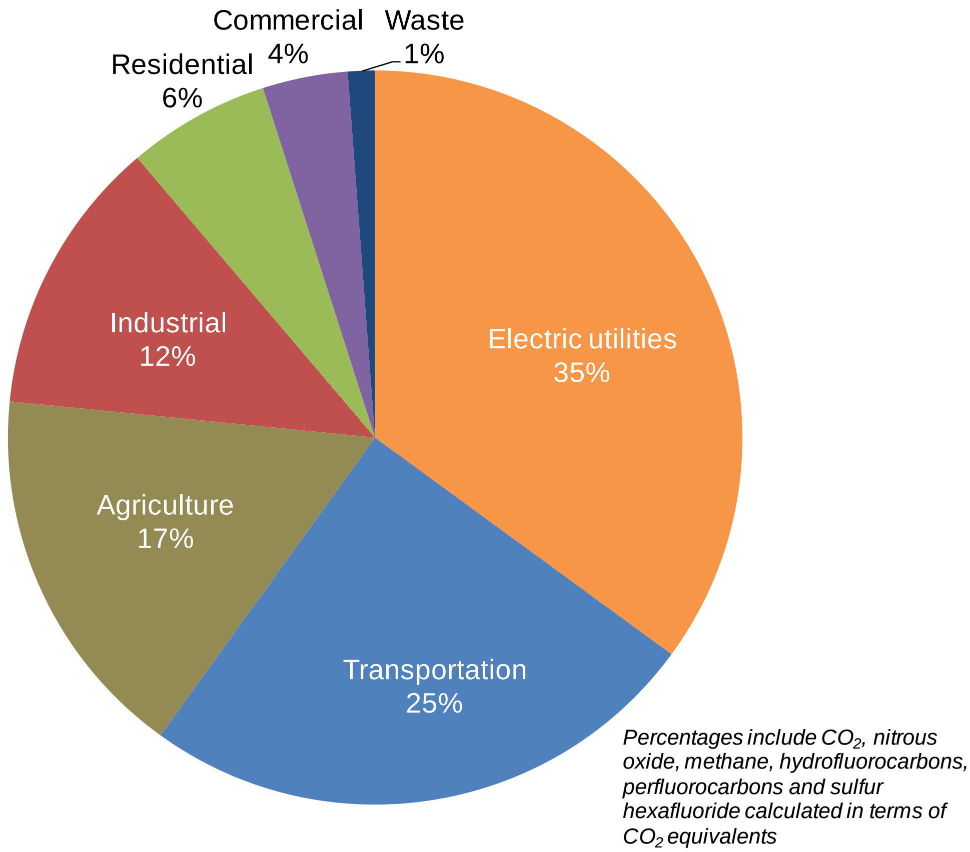
Contribution of Six Greenhouse Gases to Minnesota Warming Potential, 2008



Percentages calculated in terms of carbon dioxide equivalents

The most recent estimate for statewide emissions of greenhouse gases in 2008 is 159 million tons. Roughly 85 percent of greenhouse gas emissions are associated with energy consumption or the production and transportation of fuels. The following pie chart shows greenhouse gas emissions by sector. The largest source of emissions is from electric power generation (35 percent). Included in the estimates from electric power generation are emissions associated with the net import of power from outside of Minnesota to meet domestic electric demand. Transportation contributes 25 percent, agriculture 17 percent and industrial sources 12 percent, to estimated greenhouse gas emissions. The remaining emissions are from residential and commercial sources and waste disposal.

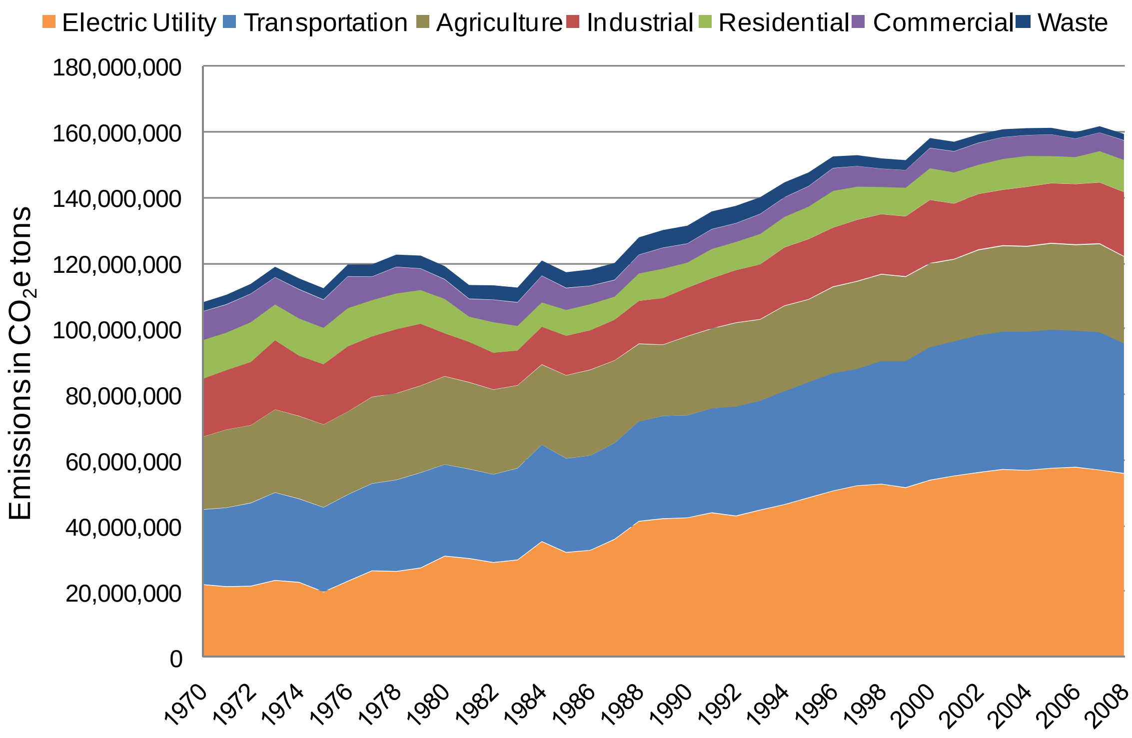
Sources of Greenhouse Gas Emissions in Minnesota, 2008
(Estimates include Net Imported Electricity in Minnesota)



Trends

Emission estimates of these six priority greenhouse gases are available from 1970-2008. They are reported as CO_2 equivalents. Between 1970 and 2008, the majority of the growth in estimated statewide greenhouse gas emissions occurred in two sectors, electric utilities and transportation. In 1970, emissions from these sectors comprised roughly 40 percent of all Minnesota greenhouse gas emissions; however, by 2008 they accounted for 60 percent of emissions.

Trends in Greenhouse Gas Emissions in Minnesota by Economic Sectors, 1970-2008
(Estimates include Net Imported Electricity in Minnesota)



References/web links

For more information on climate change and greenhouse gas emissions, see the following websites:

http://www.pca.state.mn.us/index.php/topics/climate-change/regulatory-initiatives-programs-and-policies/climate-change-publications-reports-and-fact-sheets.html

Air Toxics

The EPA defines air toxics as pollutants that cause or may cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental and ecological effects.

The Minnesota Air Toxics Emission Inventory estimates emissions of air toxics. Federal rules require air toxic emission inventories be completed every three years. The most recent completed inventory for Minnesota is for 2005. The inventory includes three principal source categories: point, nonpoint, and mobile sources.

Point Sources: Typically large, stationary sources with relatively high emissions, such as electric power plants and refineries.

Nonpoint Sources: Typically stationary sources, but generally smaller sources of emissions than point sources. Examples include dry cleaners, gasoline service stations and residential wood combustion. Nonpoint sources may also include a diffuse stationary source, such as wildfires or agricultural tilling. These sources do not individually produce sufficient emissions to qualify as point sources. For example, a single gasoline station typically will not qualify as a point source, but collectively the emissions from many gas stations may be significant.

Mobile Sources: Mobile sources are broken up into two categories; on-road vehicles and non-road sources. On-road vehicles include vehicles operated on highways, streets and roads. Non-road sources are off-road vehicles and portable equipment powered by internal combustion engines. Lawn and garden equipment, construction equipment, aircraft and locomotives are examples of non-road sources.

MPCA staff compiled the emissions estimates for point and the majority of nonpoint sources in the 2005 inventory. However, emissions for wildfires and prescribed burning were obtained from EPA. The results for aircraft (including ground support equipment), and locomotives were also estimated by the MPCA. The estimates for commercial marine vessels were estimated from the 2002 emissions, which were prepared by the Central States Regional Air Partnership (CENRAP) using state-specific data. For all non-road equipment and on-road vehicles, MPCA used estimates from EPA's national inventory.

Table 4 provides a summary of air toxics emissions from principal source categories taken from the 2005 Minnesota Air Toxics Emission Inventory. Values in the table reflect all updates since last year's report until February 2010. The table gives total statewide emissions of each chemical, along with the percent from point, nonpoint, on-road, and non-road mobile sources. The inventory includes 167 chemicals: 16 polycyclic aromatic hydrocarbon compounds (PAHs), 13 metal compounds and 138 non-metal compounds.

Table 4: 2005 Minnesota Air Toxics Emissions Inventory Statewide Summary

Pollutant Name	Total (short tons)	Point sources (%)	Nonpoint sources (%)	On-road mobile (%)	Non-road mobile (%)
PAHs					
Acenaphthene	8.7	56	31	4	9
Acenaphthylene	58.2	<1	93	3	3
Anthracene	6.1	7	79	7	7
Benz[a]Anthracene	6.6	<1	96	2	2
Benzo[a]Pyrene	1.9	4	88	3	4
Benzo[b]Fluoranthene	2.2	<1	93	3	3
Benzo[g,h,i,]Perylene	2.9	<1	85	4	10
Benzo[k]Fluoranthene	1.3	<1	89	6	5
Chrysene	4.7	<1	96	1	2
Dibenzo[a,h]Anthracene	0.1	10	88	<1	2
Fluoranthene	8.4	<1	83	5	11
Fluorene	9.6	5	72	8	16
Indeno[1,2,3-c,d]Pyrene	2.0	34	60	2	4
Naphthalene	323.1	5	69	16	9
Phenanthrene	27.7	2	83	4	10
Pyrene	10.4	1	83	6	10
PAHs (non-specified)	5.9	27	73	<1	<1
PAH Total	479.7	5	74	12	8
Metal Compounds					
Antimony	1.2	95	4		<1
Arsenic	7.9	92	2	2	4
Beryllium	0.3	79	12		9
Cadmium	1.1	79	19		2
Chromium	7.7	93	4	3	<1
Chromium VI	1.0	92	2	5	1
Cobalt	2.6	96	3		<1
Copper	8.0	98	2		<1
Lead	27.2	66	1		33
Manganese	46.1	99	<1	<1	<1
Mercury	1.8	81	19	<1	<1
Nickel	18.6	92	6	1	<1
Selenium	3.9	88	12		<1
Metal Total	127.4	89	3	<1	7
Non-Metal Compounds (Excluding PAHs)					
Acetaldehyde	1,854	9	13	46	32
Acetamide	0.0		100		
Acetone	914.0	57	40		3
Acetonitrile	2.5	100	<1		
Acetophenone	0.3	61	39		
Acrolein	246.8	23	34	23	20
Acrylamide	0.3	100			
Acrylic Acid	12.6	100	<1		
Acrylonitrile	4.8	38	62		
Aldehydes	42.5	100			
Allyl Chloride	0.006	89	11		
Aniline	0.00005	100			

Table 4: 2005 Minnesota Air Toxics Emissions Inventory Statewide Summary

Pollutant Name	**Total (short tons)**	**Point sources (%)**	**Nonpoint sources (%)**	**On-road mobile (%)**	**Non-road mobile (%)**
Atrazine	96.8		100		
Benzaldehyde	70.3	2	80		19
Benzene	6,146	2	24	51	23
Benzyl Chloride	2.0	91	9		
Biphenyl	1.6	69	31		
Dichloroethyl Ether (Bis[2-Chloroethyl]Ether)	<1	100			
Bromoform	0.4	98	2		
Methyl Bromide (Bromomethane)	532	1	99		
1,3-Butadiene	807	<1	12	41	46
Butyraldehyde	13.6	6			94
Carbon Disulfide	2.0	71	29		
Carbon Tetrachloride	8.3	99	<1		
Carbonyl Sulfide	6.7	95	5		
Catechol	0.5	100			
Trichlorofluoromethane (CFC-11, R-11)	1.6	43	57		
Trichlorotrifluoromethane (CFC-113, R-113)	95.9	<1	100		
Chlorine	44.5	24	76		
Chloroacetic Acid	0.2	100			
Chlorobenzene	170	<1	100		
Ethyl Chloride	3.2	72	28		
Chloroform	202	3	97		
2-Chloroacetophenone	0.1	98	2		
Cresol/Cresylic Acid (Mixed Isomers)	1.1	100	<1		
m-Cresol	0.0	100			
o-Cresol	2.6	98	2		
p-Cresol	0.6	77	23		
Crotonaldehyde	13.5	1			99
Cumene	21.3	43	57		
Cyanide Compounds	224	<1	2	21	78
2,4-D (2,4-Dichlorophenoxyacetic Acid)	21.7		100		
Dibenzofuran	1.0	16	84		
Ethylene Dibromide (Dibromoethane)	1.0	99	1		
Dibutyl Phthalate	3.6	94	6		
Ethylene Dichloride (1,2-Dichloroethane)	7.1	87	13		
Dichlorvos	0.1	100			
1,4-Dichlorobenzene	195	<1	99		
M-Dichlorobenzene	1.2	1	99		
O-Dichlorobenzene	0.6	28	72		
Dichlorobenzenes	0.1	29	71		
Ethylidene Dichloride (1,1-Dichloroethane)	1.6	45	55		
Cis-1,2-Dichloroethylene	0.2	100			
Cis-1,3-Dichloropropene	0.1	100			
1,3-Dichloropropene	376	<1	100		
Diethyl Sulfate	0.0	100			
Diethanolamine	1.4	34	66		
Dimethyl Phthalate	5.6	99	1		
Dimethyl Sulfate	0.5	98	2		
N,N-Dimethylformamide	21.1	100	<1		
Dimethylaniline(N,N-Dimethylaniline)	0.1	82	18		

Table 4: 2005 Minnesota Air Toxics Emissions Inventory Statewide Summary

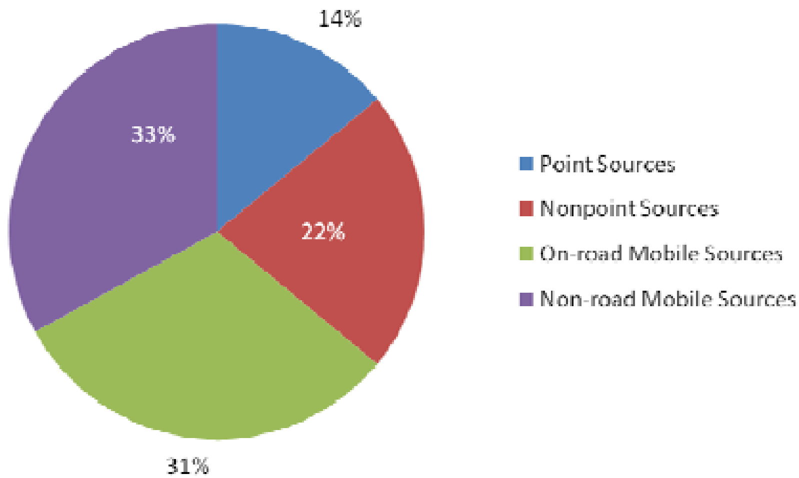
Pollutant Name	Total (short tons)	Point sources (%)	Nonpoint sources (%)	On-road mobile (%)	Non-road mobile (%)
4,6-Dinitro-o-Cresol (Including Salts)	0.0001	100			
2,4-Dinitrophenol	0.01	100			
2,4-Dinitrotoluene	0.1	98	2		
Bis(2-Ethylhexyl)Phthalate (Dehp)	2.7	91	9		
Di-N-Octylphthalate	0.1	100			
p-Dioxane	2.1	52	48		
Epichlorohydrin	0.01	98	2		
1,2-Epoxybutane	0.02	100			
Ethyl Acrylate	0.5	100	<1		
Ethyl Carbamate (Urethane) Chloride (Chloroeth	0.1	100			
Ethylbenzene	2,043	5	6	55	33
Ethylene Glycol	469	14	86		
Ethylene Oxide	15.8	2	98		
Formaldehyde	3,487	14	18	33	35
Glycol Ethers	530	33	67		
Hydrochloric Acid (Hydrogen Chloride Gas)	3,504	88	12		
Hexachlorocyclopentadiene	0.0	69	31		
Hexamethylene Diisocyanate	1.0	100			
Hexane	3,941	38	22	21	20
Hexachloroethane	0.0	100			
Hexachlorobutadiene	0.1	100	<1		
Hexachlorobenzene	0.0	1	99		
Hydrogen Fluoride (Hydrofluoric Acid)	581	94	6		
Hydroquinone	1.6	100			
Isophorone	17.8	85	15		
Maleic Anhydride	0.3	100			
Methyl Ethyl Ketone (2-Butanone)	695	37	63		
Methylhydrazine	1.8	98	2		
Methyl Iodide (Iodomethane)	0.0	100			
Methyl Isobutyl Ketone (Hexone)	177.2	59	41		
Methyl Isocyanate	0.0	100			
Methyl Methacrylate	45	98	2		
Methyl Tert-Butyl Ether	0.8	92	8	<1	
Methanol	2,449	24	76		
4,4'-Methylenediphenyl Diisocyanate (MDI)	4.0	75	25		
Methyl Chloride (Chloromethane)	65.2	9	91		
Methylene Chloride (Dichloromethane)	206.6	30	70		
Nitrobenzene	0.0	99	<1		
4-Nitrophenol	0.2	12	88		
2-Nitropropane	0.01		100		
N-Nitrosodimethylamine	0.004	100			
Parathion	0.1	100			
Polychlorinated Biphenyls (Aroclors)	0.6	<1	100		
Polychlorinated Dibenzodioxins, Total	0.02	98	2	<1	<1
Polychlorinated Dibenzo-P-Dioxins and Furans, Total	0.001	100			
Polychlorinated Dibenzofurans, Total	0.001	78	20	1	<1
Pentachlorophenol	0.3	96	4		
Tetrachloroethylene (Perchloroethylene)	245	38	62		

Table 4: 2005 Minnesota Air Toxics Emissions Inventory Statewide Summary

Pollutant Name	**Total (short tons)**	**Point sources (%)**	**Nonpoint sources (%)**	**On-road mobile (%)**	**Non-road mobile (%)**
Phenol	131	67	33		<1
Phosphine	1.0	58	42		
Phosphorus	2.0	95	4		<1
Phthalic Anhydride	0.1	100			
Polycyclic Organic Matter	25.3	34	66		<1
1,2-Propylenimine (2-Methylaziridine)	0.01	100			
Propionaldehyde	240	2	19	27	51
Propoxur	0.01	100			
Propylene Dichloride (1,2-Dichloropropane)	0.6	71	29		
Propylene Oxide	0.8	97	3		
Quinoline	0.001	100			
Quinone (p-Benzoquinone)	1.0	100			
Styrene	1,135	55	15	21	9
2,3,7,8-Tetrachlorodibenzo-p-Dioxin	0.000002	26	49	17	9
2,3,7,8-Tetrachlorodibenzofuran	0.00002	37	58	3	2
Dioxin and Furans (2,3,7,8-TCDD Equivalents)	0.000002	100	<1		
Methyl Chloroform (1,1,1-Trichloroethane)	989.4	<1	100		<1
1,1,2,2-Tetrachloroethane	3.0	69	31		
Toluene	20,072	3	11	38	47
2,4-Toluene Diisocyanate	1.0	86	14		
o-Toluidine	0.00009	32	68		
Trichloroethylene	145	97	3		
1,2,4-Trichlorobenzene	9.1	100	<1		
1,1,2-Trichloroethane	0.5	100	<1		
2,4,5-Trichlorophenol	0.0001	100			
2,4,6-Trichlorophenol	0.0003	100			
Triethylamine	4.6	26	74		
Trifluralin	6.0		100		
2,2,4-Trimethylpentane	7,699	<1	3	40	57
1,2,4-Trimethylbenzene	73.1	90	10		
1,3,5-Trimethylbenzene	2.0	100			
Trimethylbenzene	8.4	14	86		
Vinylidene Chloride (1,1-Dichloroethylene)	1.1	8	92		
Vinyl Acetate	24.9	97	3		
Vinyl Chloride	3.9	53	47		
m-Xylene	6.9	60	40		
p-Xylene	2.0	100			
Xylenes (Mixed Isomers)	10,554	5	10	41	44
Non-Metal Total	71,903	12	18	30	40
Grand Total	72,510	12	18	30	40

The following chart summarizes air toxics pollutant emissions in Minnesota from 2005. On-road and non-road mobile sources account for 64 percent of the emissions. Nonpoint sources contributed 22 percent of total emissions and point sources contributed 14 percent of emissions.

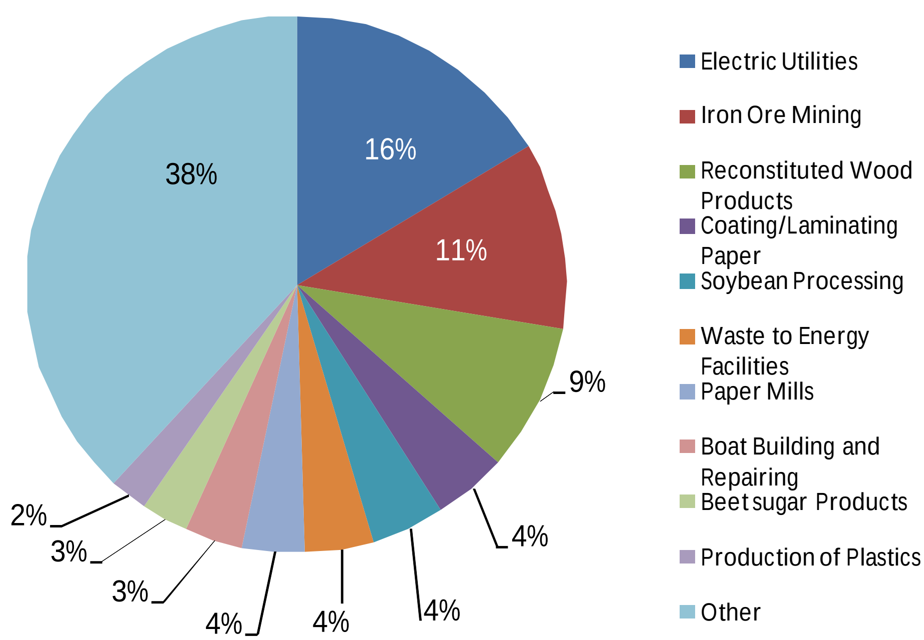
Contribution of Principal Source Categories to 2005 Air Toxics Emissions in Minnesota



Total air toxics emissions in 2005: 72,500 tons

A more detailed breakdown of emissions for each principal source category is shown in the following four pie charts. For point sources, no one source category dominates the air toxics emissions. The largest source category is electric utilities, which accounts for 16 percent of point source emissions.

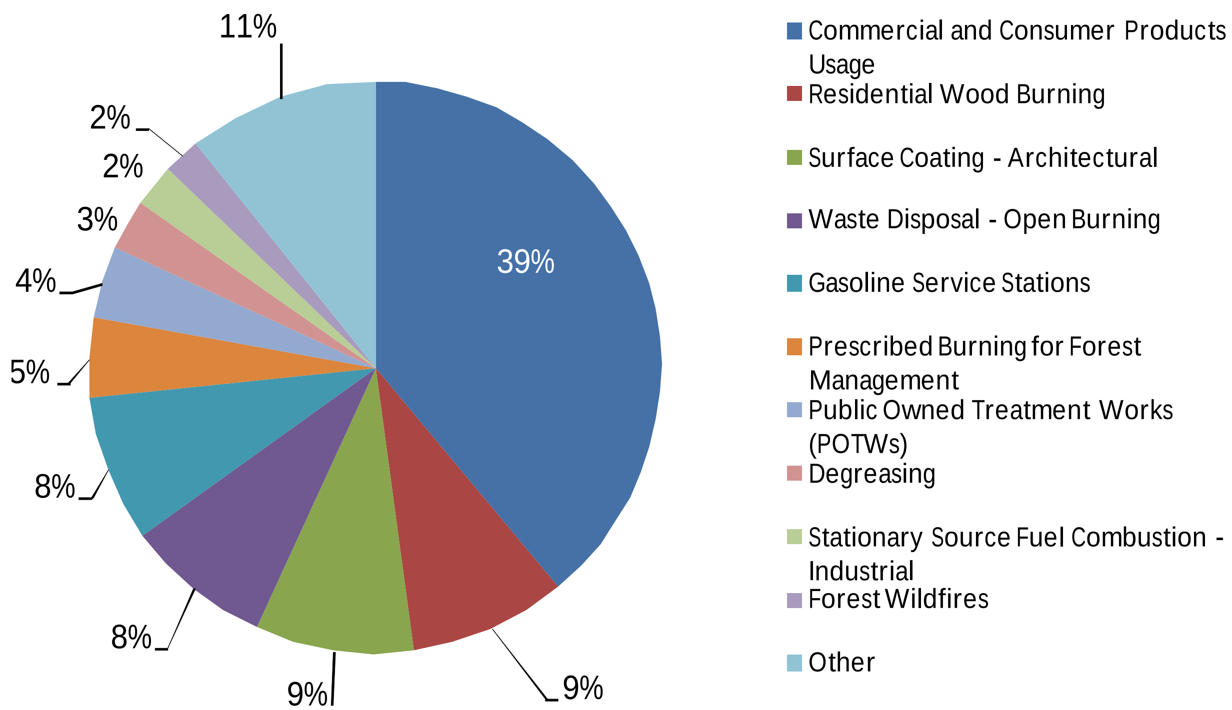
Contribution of Major Categories to 2005 Point Source Air Toxic Emissions in Minnesota



Total air toxics point source emissions in 2005: 11,700 tons

For nonpoint sources, the major contributors of emissions are industrial surface coating, commercial and consumer products usage and residential wood burning. Approximately 57 percent of the nonpoint source emissions are attributed to these three categories.

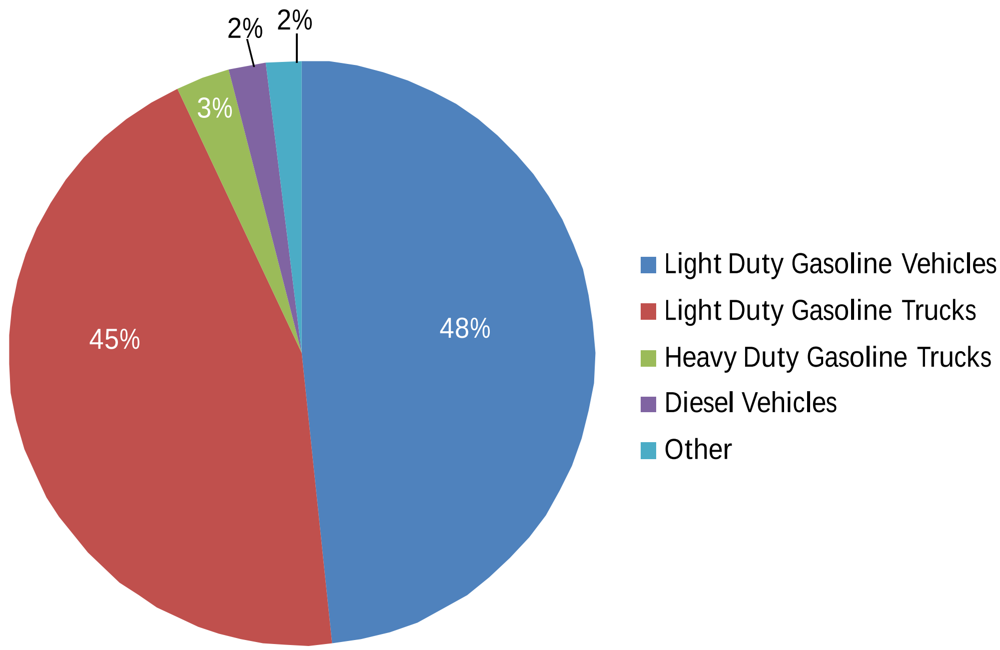
Contribution of Major Categories to 2005 Nonpoint Source Air Toxics Emissions in Minnesota



Total air toxics nonpoint source emissions in 2005: 16,100 tons

For on-road mobile sources, the largest emission contributor is light duty gasoline vehicles, which accounted for 48 percent of total mobile source emissions in 2005. The second largest contributor of on-road mobile source emissions is light duty gasoline trucks, which accounts for another 45 percent of mobile source air toxics emissions.

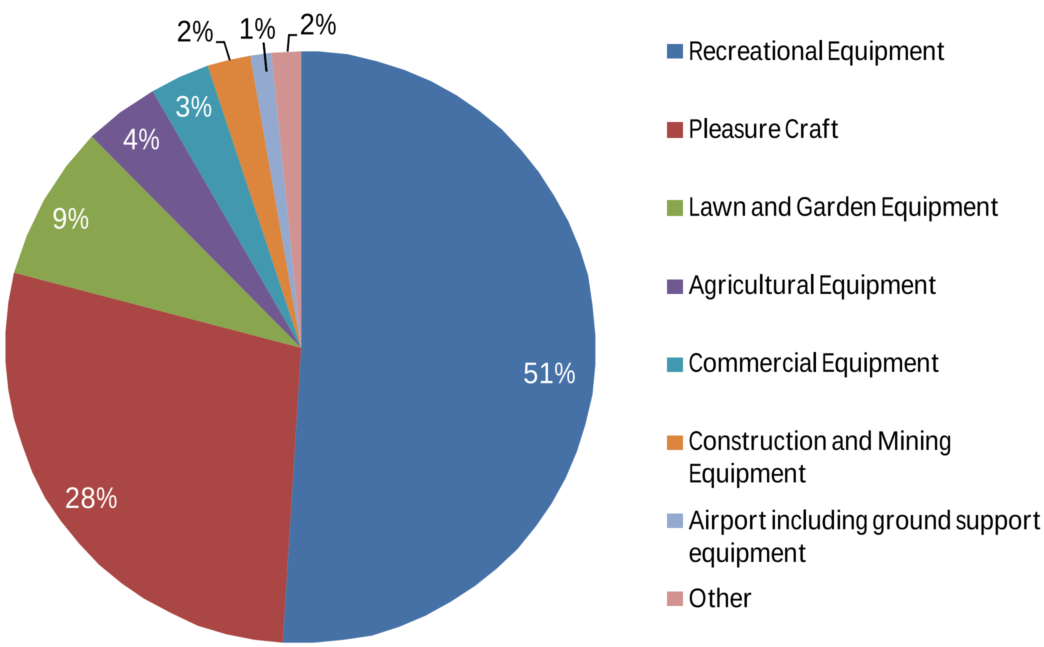
Contribution of Major Categories to 2005 On-road Mobile Source Air Toxics Emissions in Minnesota



Total air toxics on-road mobile source emissions in 2005: 22,700 tons

For non-road mobile sources, the largest emission contributor is recreational equipment (all-terrain vehicles, snowmobiles, etc.), which accounted for approximately half of all of the emissions. The second largest contributor is pleasure craft (boats, jet skis, etc,), which accounted for another 28 percent of the emissions.

Contribution of Major Categories to 2005 Non-road Mobile Source Air Toxics Emissions in Minnesota



Total non-road mobile source emissions in 2005: 24,200 tons

For more information on air toxics, the Minnesota Air Toxics Emission Inventory and the Great Lakes Air Emissions Inventory, see the following websites:

http://www.pca.state.mn.us/air/airtoxics.html

http://www.pca.state.mn.us/air/toxics/toxicsinventory.html

http://www.epa.gov/ttn/atw/index.html

http://www.glc.org/air/

Chapter 2: Water Pollutant Discharges Overview

Minnesota's rivers, streams and lakes provide great natural beauty, and supply the water necessary for recreation, industry, agriculture and aquatic life. The major goal of the MPCA's water quality program is to enable Minnesotans to protect and improve the state's rivers, lakes, wetlands and groundwater so that they support healthy aquatic communities and designated public uses such as fishing, swimming and drinking water. The key strategies for accomplishing this goal include regulating point source discharges, controlling nonpoint sources of pollution, and assessing water quality to provide data and information to make sound environmental management decisions.

Point sources consist mainly of municipal and industrial wastewater discharges. Point sources have the greatest potential to impact the environment during periods of low precipitation and stream flow. Nonpoint sources include runoff from agricultural fields, feedlots, urban areas, and on-site sewage treatment (septic) systems. Nonpoint sources are most significant during periods of high precipitation and stream flow.

Minnesota has been successful in controlling end-of-pipe discharges from wastewater treatment plants and industries to our state's waters. But at the same time, the challenges posed by nonpoint sources of pollution are increasing as land use changes and population expands. The federal Clean Water Act requires states to adopt water quality standards to protect the nation's waters. These standards define how much of a pollutant can be in a surface or groundwater supply while still allowing it to meet its designated uses, such as for drinking water, fishing, swimming, irrigation or industrial purposes.

For each pollutant that causes a water to fail to meet state water quality standards, the federal Clean Water Act requires the MPCA to conduct a Total Maximum Daily Load (TMDL) study. A TMDL study identifies both point and nonpoint sources of each pollutant that fails to meet water quality standards. While rivers and streams may have several TMDLs, each one determining the limit for a different pollutant, the state is moving toward a watershed approach that addresses multiple pollutants and sites within a watershed to efficiently complete TMDLs. Many of Minnesota's water resources cannot currently meet their designated uses because of pollution from a combination of point and nonpoint sources.

At the state level, the Clean Water Legacy Act of 2006 provides for accelerated testing of Minnesota's surface and ground water; provides resources to develop specific plans to clean up Minnesota's contaminated waters including those in TMDL studies, and to protect clean waters; and designates funding to existing state and local programs to improve water quality.

The Clean Water, Land and Legacy Amendment to the state constitution increased the state sales tax by three-eighths of a percent beginning July 1, 2009. According to the law, 33 percent of the money raised is to be allocated to a clean water fund. Money deposited into the fund may be spent only to protect, enhance and restore water quality in lakes, rivers and streams, and to protect groundwater from degradation. The 2009 Legislature provided the MPCA with $51.16 million specifically for monitoring and assessment, TMDL development, protection and restoration of waters of the state, and for groundwater and drinking water assessment. For more information on the Clean Water Fund, please see the following web site: http://www.pca.state.mn.us/index.php/water/water-types-and-programs/clean-water-fund/clean-water-fund.html

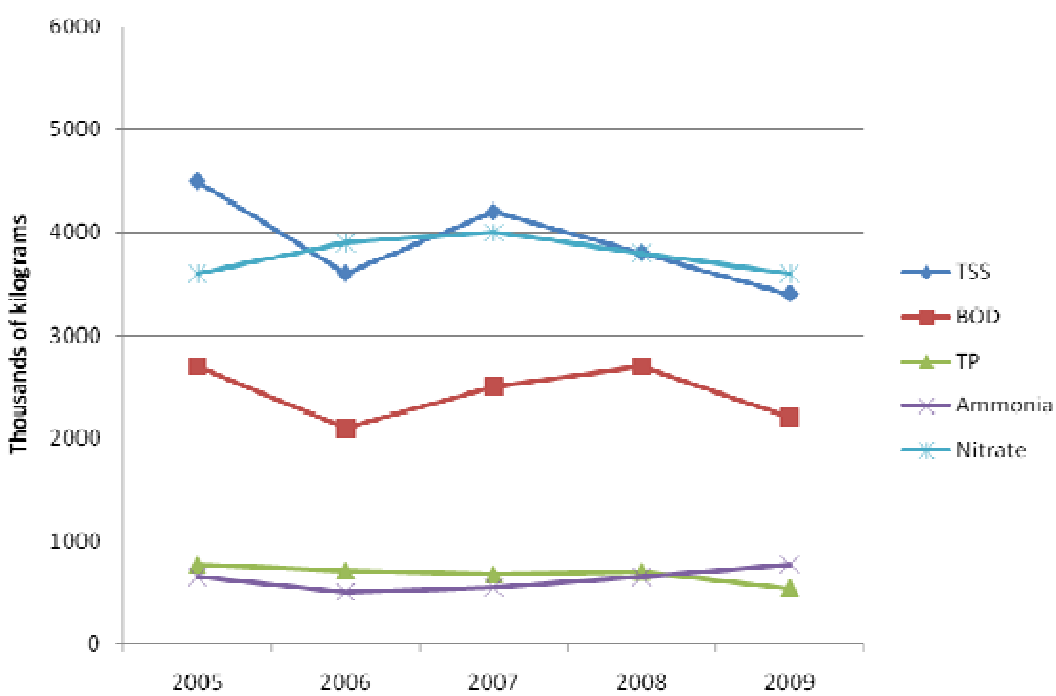
Major Water Discharge Parameters, Flow and Trends

This section presents trends in total loading and flow from the major municipal and industrial facilities as well as discharge information for the following pollutants that are released from major facilities into Minnesota waters: total suspended solids (TSS); biochemical oxygen demand (BOD); total phosphorus (TP); and ammonia (NH_3). Major facilities are defined as municipal and industrial facilities that discharge more than one million gallons per day to waters of the state. These major facilities represent approximately 85 percent of the total volume of discharge to waters of the state from point sources. The remaining 15 percent comes from smaller municipal and industrial facilities. Note that the number of facilities that are required to report discharge information varies by pollutant.

Since the MPCA is now trying to address water management using a holistic, watershed approach, the discharge summaries are presented by major watershed, rather than on a county-by-county basis starting on page 48. By plotting individual discharge points rather than aggregating the data, it is hoped that the reader gets a clearer picture of how discharges from major treatment facilities impact watersheds statewide. A table of the data for each parameter from 2005-2009 (the five most recent years for which data are available) is found on page 4 of this report.

A graph of the pollution discharge loading trends for major facilities is shown below. The total statewide annual pollutant load from major treatment facilities to Minnesota waters for 2009 showed a decrease to 10.6 million kilograms from the 11.7 million kilograms reported in 2008.

Minnesota Water Pollution Discharge Loading Trends from Major Point Sources, 2005-2009, in thousand kilograms



Improvements intended to increase biological nutrient removal at wastewater treatment plants across the state are beginning to have an effect in improving the overall quality of discharges to Minnesota's surface waters. The general trend in total loading of all pollutants examined has been downward during the five most recent years of record, 2005-2009. This is encouraging for the status of Minnesota's surface waters.

As a specific example, phosphorus data at the Metropolitan Council Environmental Services (MCES) Metropolitan Wastewater Treatment Facility, the largest treatment plant in Minnesota, show that biological phosphorus removal has significantly improved the plant's overall performance. Due to the large volume of waste treated by the MCES Metropolitan Wastewater Treatment Facility, improvements like this have contributed to verifiable reductions in reported water pollutant loadings over the past several years. During the period 2005-2009, phosphorus loading from this facility was reduced by 57 percent and total loading was reduced by six percent.

In addition to pollutant loads, the volume of flow through a wastewater treatment plant is also important in assessing statewide data. For example, in 2009 the MCES Metropolitan Wastewater Treatment Facility contributed nearly 45 percent of the total load of the five parameters examined as compared with major industrial and other major municipal dischargers. However, when relative contributions to flow are examined, the MCES Metropolitan Wastewater Treatment Facility contributed only about 20 percent of the total.

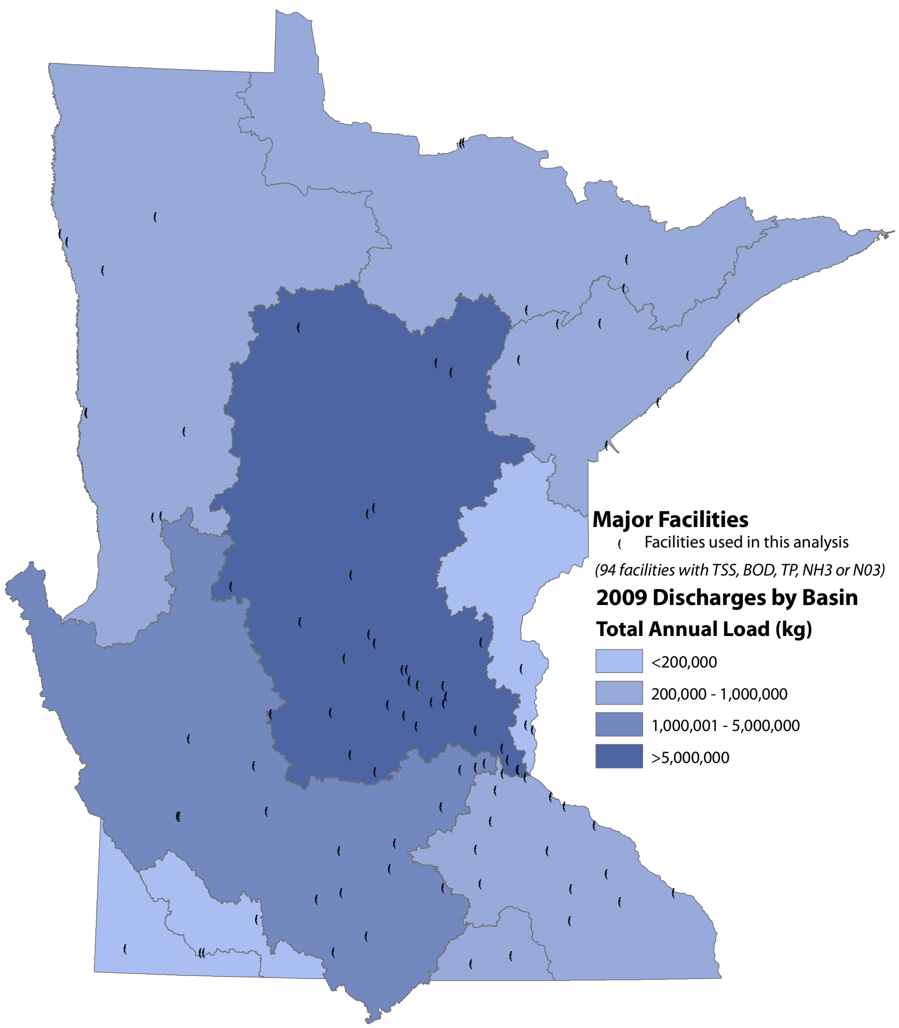
Point source contributions of nitrate and phosphorus to waters of the state are still small in many watersheds compared to nonpoint contributions of these pollutants from sources such as agriculture and urban runoff. Point sources tend to have the greatest impact on receiving waters during periods of low precipitation and stream flow, while nonpoint sources are most significant during periods of high precipitation and stream flow. However, it is difficult to measure directly the effects of nonpoint pollution on Minnesota's lakes, rivers and groundwater.

Total Annual Pollutant Load by Drainage Basin

The total statewide annual pollutant load from major treatment facilities to Minnesota waters for 2009 showed a decrease to 10.6 million kilograms from the 11.7 million kilograms reported in 2008.

The figure below shows the statewide distribution of pollutant loading by major river basin for 2009. The Upper Mississippi River Basin contributed about 6.35 million kilograms (down from about 6.95 million kilograms in 2008), while the Minnesota River Basin contributed 1.05 million kilograms (down slightly from 1.16 million kilograms in 2008). Together, these two river basins account for more than two-thirds of pollutants discharged from major wastewater treatment plants in the state. Following is a discussion of the statewide loadings of several individual pollutants that contribute to total loading and trends in discharge for those parameters noted in recent years.

Total Annual Pollutant Load by Basin from
Major Wastewater Treatment Facilities, 2009

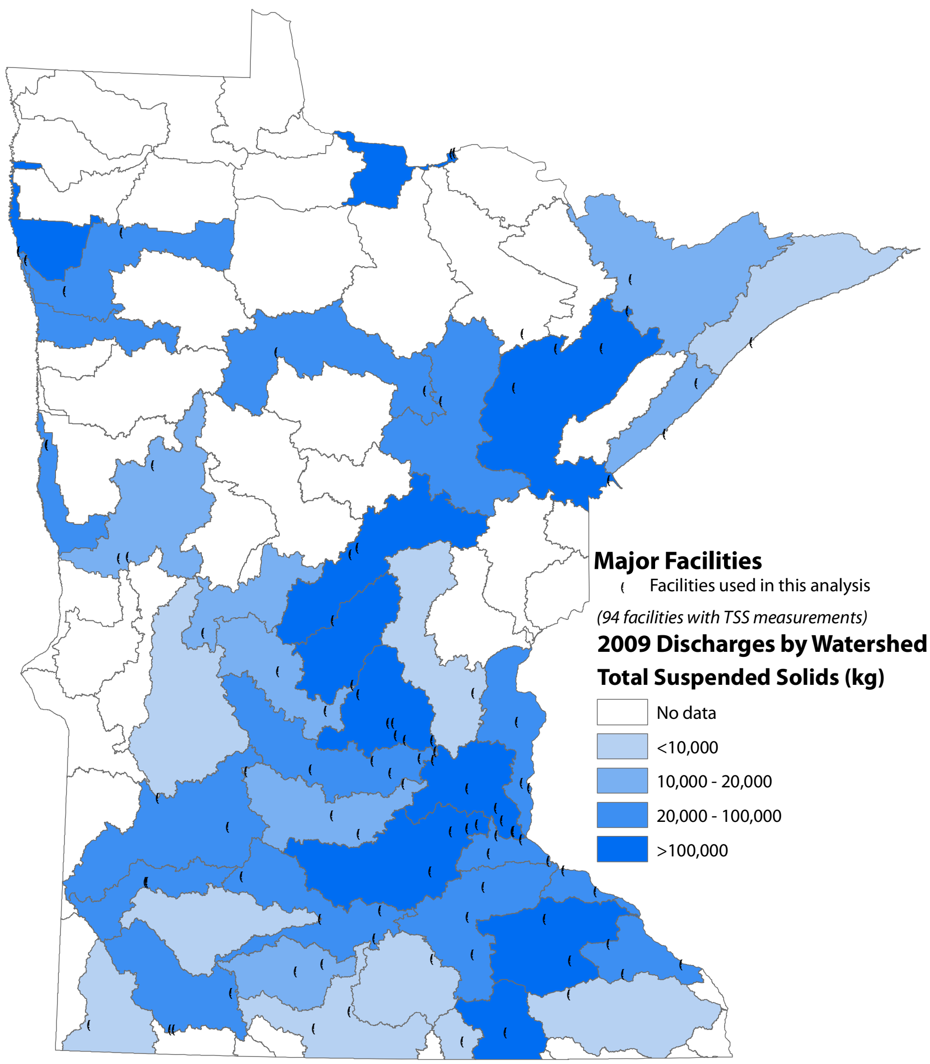


Total Suspended Solids

Total suspended solids (TSS) is a measure of the material suspended in water or wastewater. TSS causes interference with light penetration, buildup of sediment and potential degradation of aquatic habitat. Suspended solids also carry nutrients that cause algal blooms that are harmful to fish and other aquatic organisms.

Based on results of Discharge Monitoring Reports for 94 major treatment facilities, the estimated discharge of TSS to waters of the state for 2009 was approximately 3,400,000 kilograms, a decrease of 11percent from that reported in 2008. The map below shows the 2009 TSS discharges to surface waters by major point sources of water pollution by watershed.

Total Suspended Solids Discharges from
Major Point Sources by Major Watershed, 2009

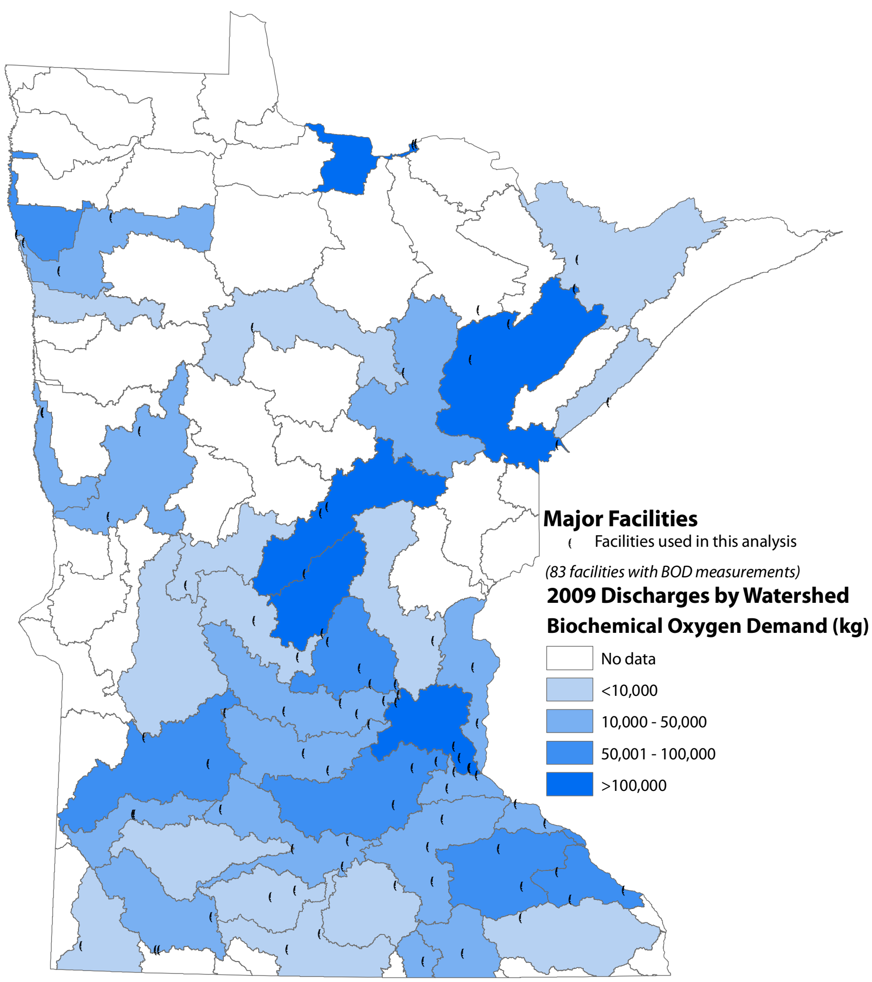


Biochemical Oxygen Demand (BOD)

When organic wastes are introduced into water, they require oxygen to break down. High concentrations of organic materials characterize untreated domestic wastes and many industrial wastes. The amount of oxygen required for decomposition of organic wastes by microorganisms is known as the biochemical oxygen demand (BOD), while carbonaceous biochemical oxygen demand (CBOD) is the amount of oxygen required for microorganisms to decompose waste carbonaceous materials. Both BOD and CBOD are indicators of the strength of waste effluent and effectiveness of treatment. For purposes of this report, BOD data were used wherever available; CBOD data were used only if BOD was not reported. A high demand for oxygen causes reduction in the concentration of oxygen in the receiving waters. Depletion of oxygen deteriorates water quality and impacts aquatic life, including fish and other organisms.

Based on results of Discharge Monitoring Reports for 83 major treatment facilities, the estimated discharge of BOD to waters of the state for 2009 was approximately 2,200,000 kilograms, a decrease of 19 percent from 2008. The map below shows the 2009 BOD discharges to surface waters by major point sources of water pollution by watershed.

Biochemical Oxygen Demand Discharges
from Major Point Sources, 2009

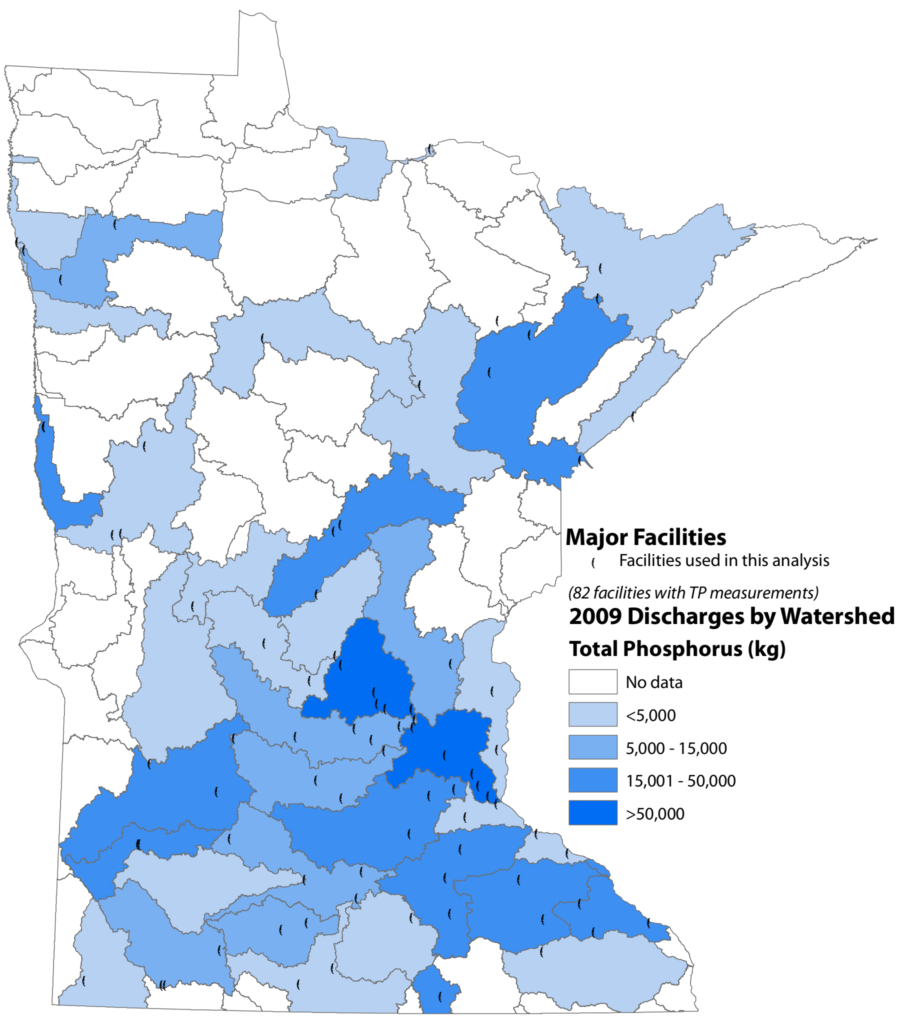


Total Phosphorus

Total phosphorus (TP) is the primary pollutant associated with eutrophication of surface water from anthropogenic sources (sources that result from human activities). Excess phosphorus causes algae blooms and reduced water transparency, making water unsuitable for swimming and other activities. Phosphorus is released from both point and nonpoint sources of pollution. Minnesota has had point source effluent limitations for phosphorus since the early 1970s.

Based on the results of Discharge Monitoring Reports for 82 major treatment facilities, the estimated discharge of TP to waters of the state for 2009 was approximately 540,000 kilograms, a decrease of 23 percent from 2008. Many treatment plants are now using advanced methods for phosphorus removal. It is encouraging when TP discharges decrease because, as a headwaters state, Minnesota seeks to do its share to reduce its contribution from phosphorus to national problems, like the hypoxic zone in the Gulf of Mexico. Since 2005, TP discharges have decreased 30 percent. The map below shows the 2009 TP discharges to surface waters by major point sources of water pollutants by watershed.

Total Phosphorus Discharges
from Major Point Sources, 2009

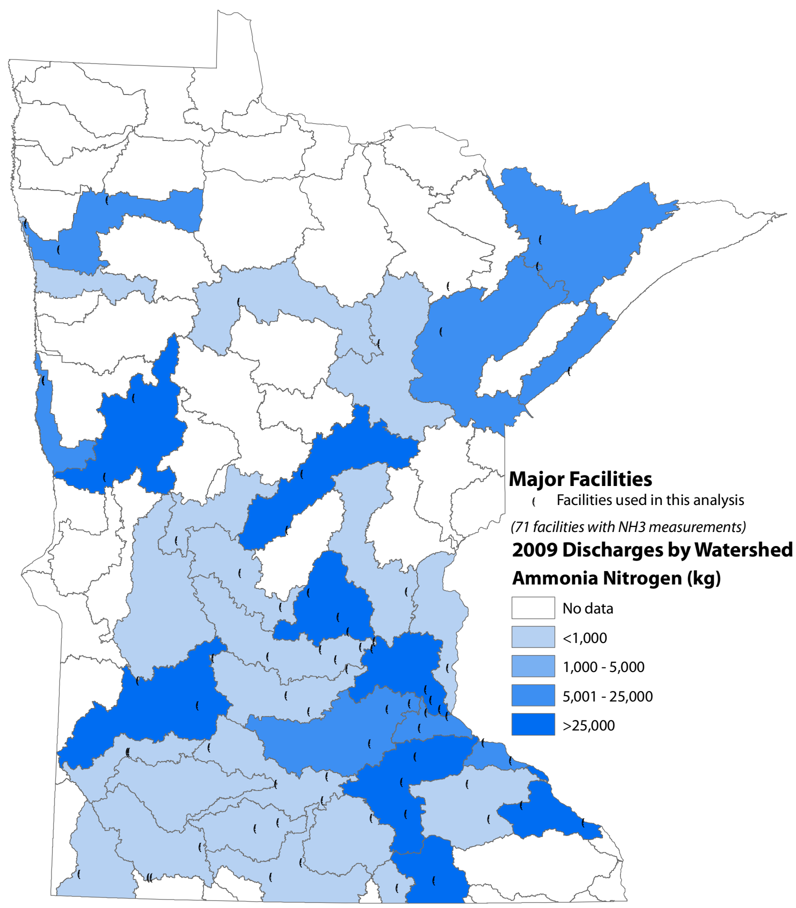


Nitrogen

Nitrogen, generally occurring as either nitrate or ammonia is present in a wide variety of effluents including sewage (wastewater treatment plants and on-site septic systems), food processing wastes, mining effluents, landfill leachate, and agricultural and urban runoff. Nitrate and/or ammonia concentrations in most of these sources are monitored under permit requirements. Nitrogen as ammonia can be toxic to aquatic life and nitrogen in the form of nitrate can be a significant problem in ground water supplies. Nonpoint sources of nitrogen from agricultural and urban runoff are an important source of loading to waters of the state, although very little of this contribution is captured through Discharge Monitoring Reports required by permit.

Based on the results of Discharge Monitoring Reports for 71 major treatment facilities, the estimated discharges for 2009 were 770,000 kilograms of ammonia, an increase of 18 percent from 2008. A review of the results from individual treatment facilities showed that the MCES Metropolitan Wastewater Treatment Facility had an ammonia increase of approximately 95,000 kilograms from 2008-2009. The ammonia discharges at the Metropolitan Wastewater Treatment Facility are consistently below the water quality-based effluent limits assigned to the facility. Based on conversations with MCES staff, the increase in ammonia discharged from the Metropolitan Wastewater Treatment Facility may be a result of the facility working to optimize phosphorus treatment and reduce energy consumption at the wastewater facility, resulting in changes in the ammonia removal efficiencies.

Ammonia Discharges from Major Point Sources, 2009



Nonpoint Source Pollution

As previously discussed, Minnesota has made significant progress in cleaning up point sources of water pollution as measured by discharges of pollutants in municipal and industrial wastewater. An indicator of this success is shown by the fact that 94 major treatment facilities discharging more than one million gallons per day of treated effluent have cut their total amount of pollutants discharged to waters of the state by approximately 1,600 thousand kilograms in the period 2005-2009, despite year-to-year variation in levels of individual pollutants due to factors such as climate variability, change in flow conditions, and even fluctuations in the economy.

It is the nonpoint sources of pollution from rainfall or snowmelt moving over or through the ground carrying natural and human-made pollutants into lakes, rivers, wetlands and groundwater that now pose the greater challenge for prevention and cleanup. Both point and nonpoint sources of pollution must be controlled to reach the Clean Water Act goal of fishable, swimmable waters statewide. Despite significant improvements in recent years, too much phosphorus and nitrogen continue to reach many of our waters, carried in soil erosion and runoff from roads, yards, farms and septic systems.

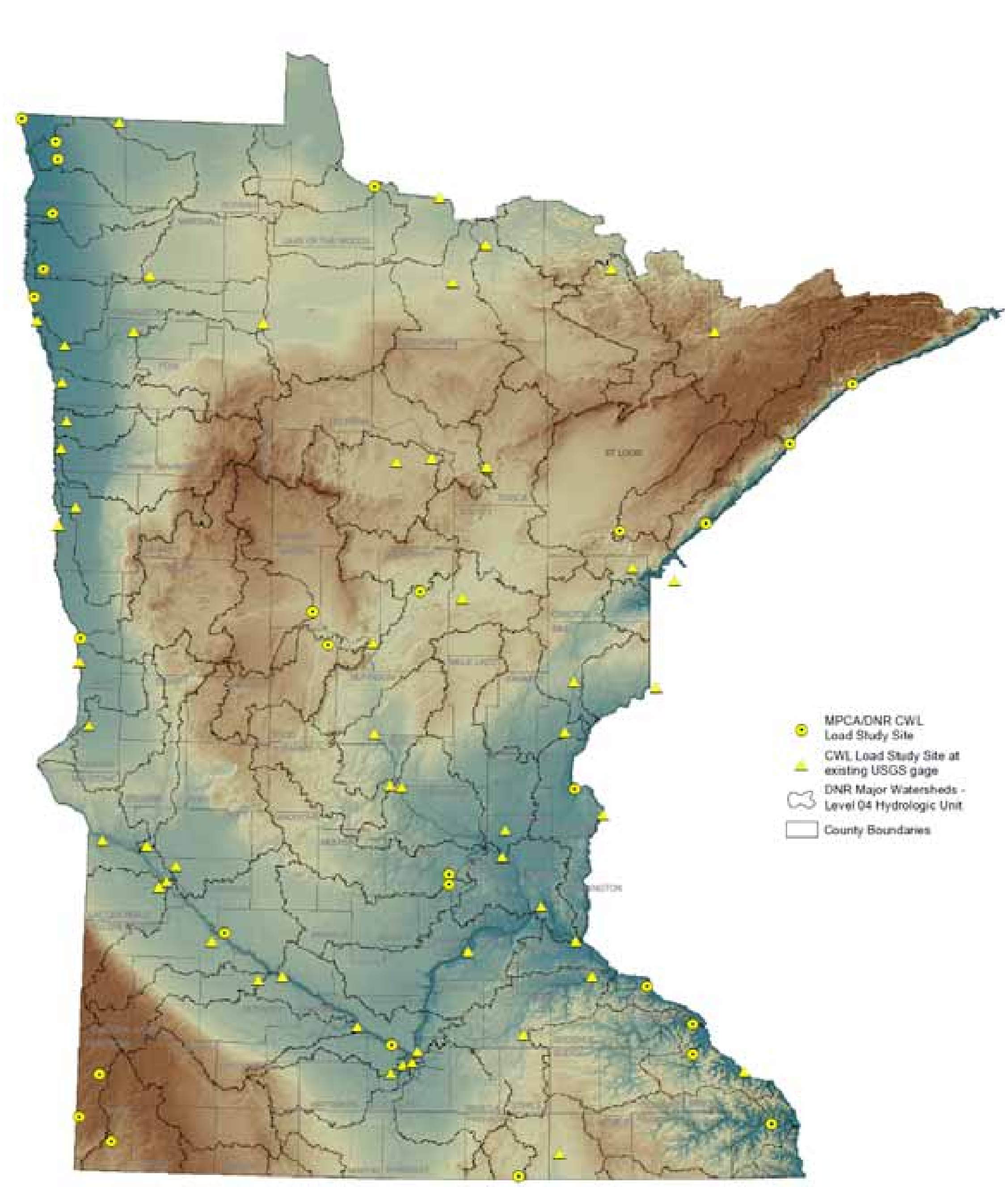
Over the past few years, more regulatory controls for such sources as feedlots, septic systems and stormwater have been implemented, but other sources of nonpoint pollution can be diffuse and difficult to assess and manage. Much of the work to control unregulated nonpoint sources of pollution thus far has used financial incentives to encourage voluntary adoption of best management practices (BMPs). As described below, the Board of Water and Soil Resources (BWSR) reports the amount of nonpoint source pollutants (nitrogen, phosphorus and sediment) avoided by use of BMPs.

Many of the stresses from nonpoint sources of pollution that affect Minnesota's surface and groundwater resources are the result of choices that individuals make everyday such as lawn care practices, watercraft operation and waste disposal. The daily decisions that homeowners, developers, farmers and businesses make regarding land use are crucial to protecting water resources from the effects of nonpoint source pollution. Once a water resource declines in quality, recovery is costly and can take many years. Clearly, prevention is the key when it comes to nonpoint source pollution. What happens to Minnesota's water resources in the next 10 years will help determine the quality of those resources for the next 100 years.

Major Watershed Load Monitoring Network

The passage of the Clean Water Land and Legacy Act and subsequent appropriations by the Legislature from the Clean Water Fund is enhancing monitoring of Minnesota waters, and our understanding of the relative contributions of pollutants from various sources and waters. One example of this monitoring is the MPCA's Major Watershed Load Monitoring network. Established in 2008, the network is designed to monitor statewide water quality at the watershed scale. In partnership with the Minnesota Department of Natural Resources (DNR), the United States Geological Survey (USGS), and Metropolitan Council Environmental Services (MCES), 79 permanent stream flow gaging stations have been established at the outlets of all of Minnesota's major watersheds. The MPCA's Major Watershed Load Monitoring Program (MWLMP) will help measure and compare regional water quality differences and long-term trends in water quality along Minnesota's major rivers and from the outlets of major tributaries draining to these rivers. The program's multi-agency approach combines site specific stream flow data from the USGS and DNR with water quality data collected by the MPCA, MCES, and local monitoring organizations to compute annual nutrient and sediment pollutant loads. Monitoring occurs at the outlets of most of Minnesota's eight-digit HUC watersheds (average drainage area of 1400 square miles) and at various locations along Minnesota's major rivers including the Red, Minnesota, Mississippi, and Rainy. Intensive water quality sampling is conducted year round at all 79 MWLM sites. Thirty to 35 mid-stream grab samples are collected per site per year with sampling frequency greatest during periods of moderate to high flow. Water quality samples are analyzed for common nutrients and sediment and coupled with site related discharge data to compute annual pollutant loads. In addition to providing statewide comparative and trend information, data will also be used in developing watershed protection and restoration plans and assisting with watershed modeling efforts. March 2011 will mark the first annual publication of statewide contaminant load calculations for all 79 sites. That information will be included in future years of this report.

Minnesota Major Watershed Load Monitoring Sites



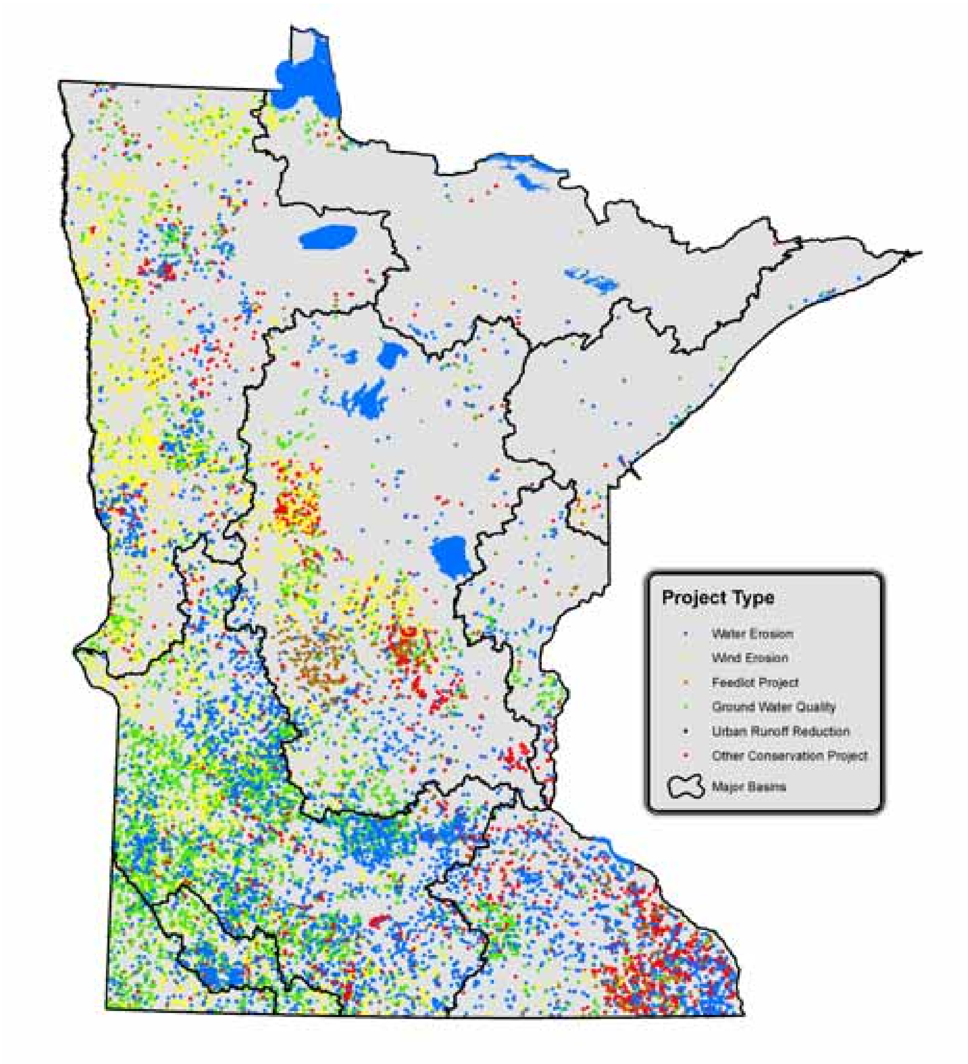
For more information on the Major Watershed Load Monitoring Network, see http://www.pca.state.mn.us/index.php/view-document.html?gid=10227

Soil Loss Reduction in Minnesota

Many conservation projects and best management practices prevent thousands of tons of soil, sediment and other pollutants from leaving fields and becoming airborne or flowing into rivers and lakes. Soil erosion means not only the loss of valuable topsoil, decreases in land productivity and higher fertilizer requirements, but also damage to surface water in the form of silt that chokes off rivers, lakes and wetlands, and possible groundwater contamination from over-application of fertilizer.

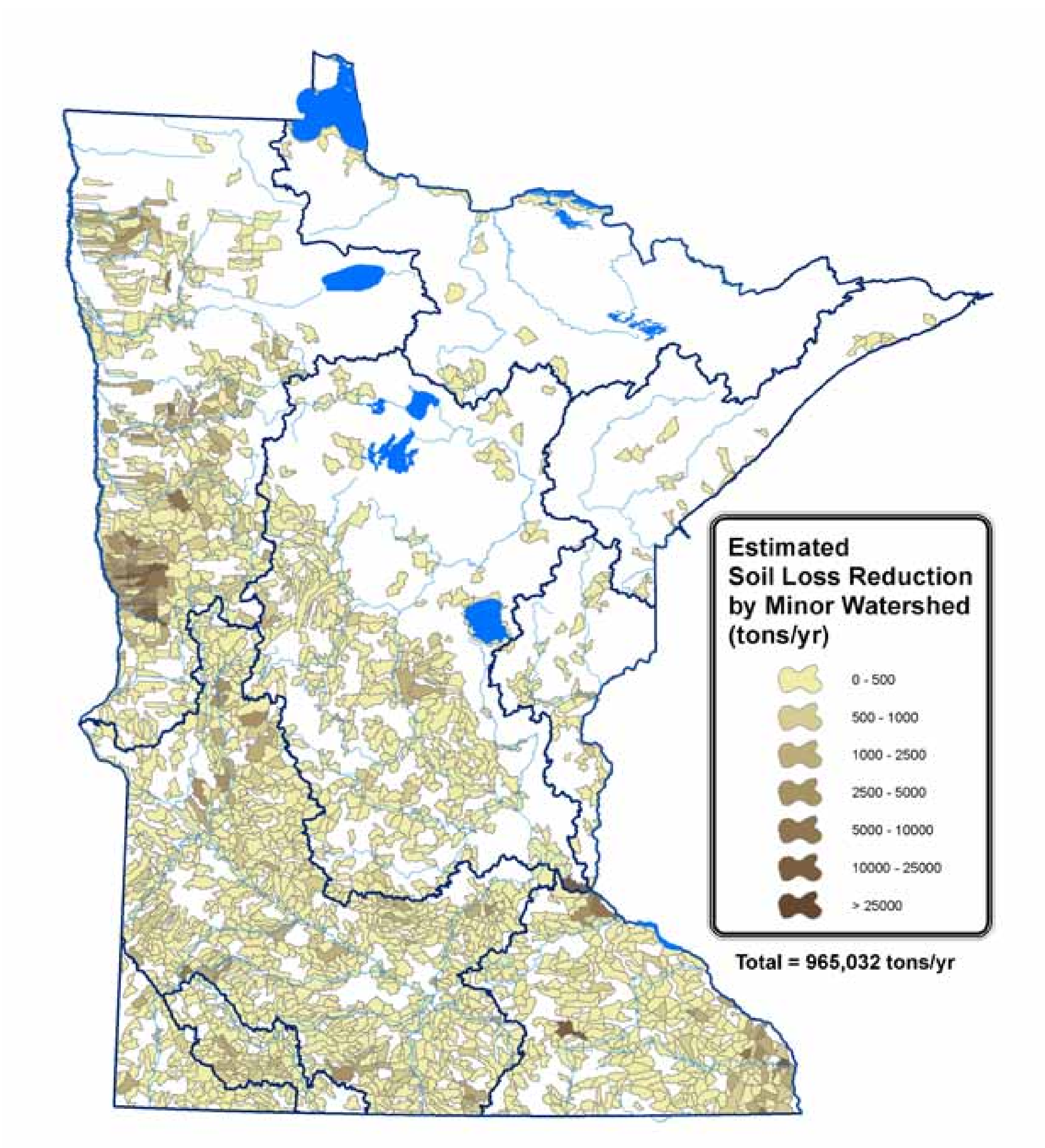
BWSR tracks soil loss and BMPs to reduce pollution from soil loss and sedimentation using the eLINK database (http://www.bwsr.state.mn.us/outreach/eLINK/). The figure below shows the locations of projects tracked by eLINK as reported by county soil conservation offices and local officials for the eight-year period 2003-2010. Sites are classified as preventive measures for wind erosion, water erosion, animal feedlot construction and operation, ground water quality, urban runoff reduction and other conservation measures.

Location of Conservation and Best Management Projects
Reported by e-LINK (2003-2010)



From 2003-2010, soil loss reduction statewide attributed to pollutant reduction measures was estimated to average about 965,000 tons per year. Common pollution-reduction BMPs include gully stabilization; sheet and rill erosion control; stream and ditch stabilization; filter strips to trap sediment; and wind erosion control. Even at the minor watershed level, some areas of west-central Minnesota showed soil loss reductions of more than 25,000 tons/year. The map below shows soil loss reduction benefits from conservation and management practices by watershed during the period 2003-2010.

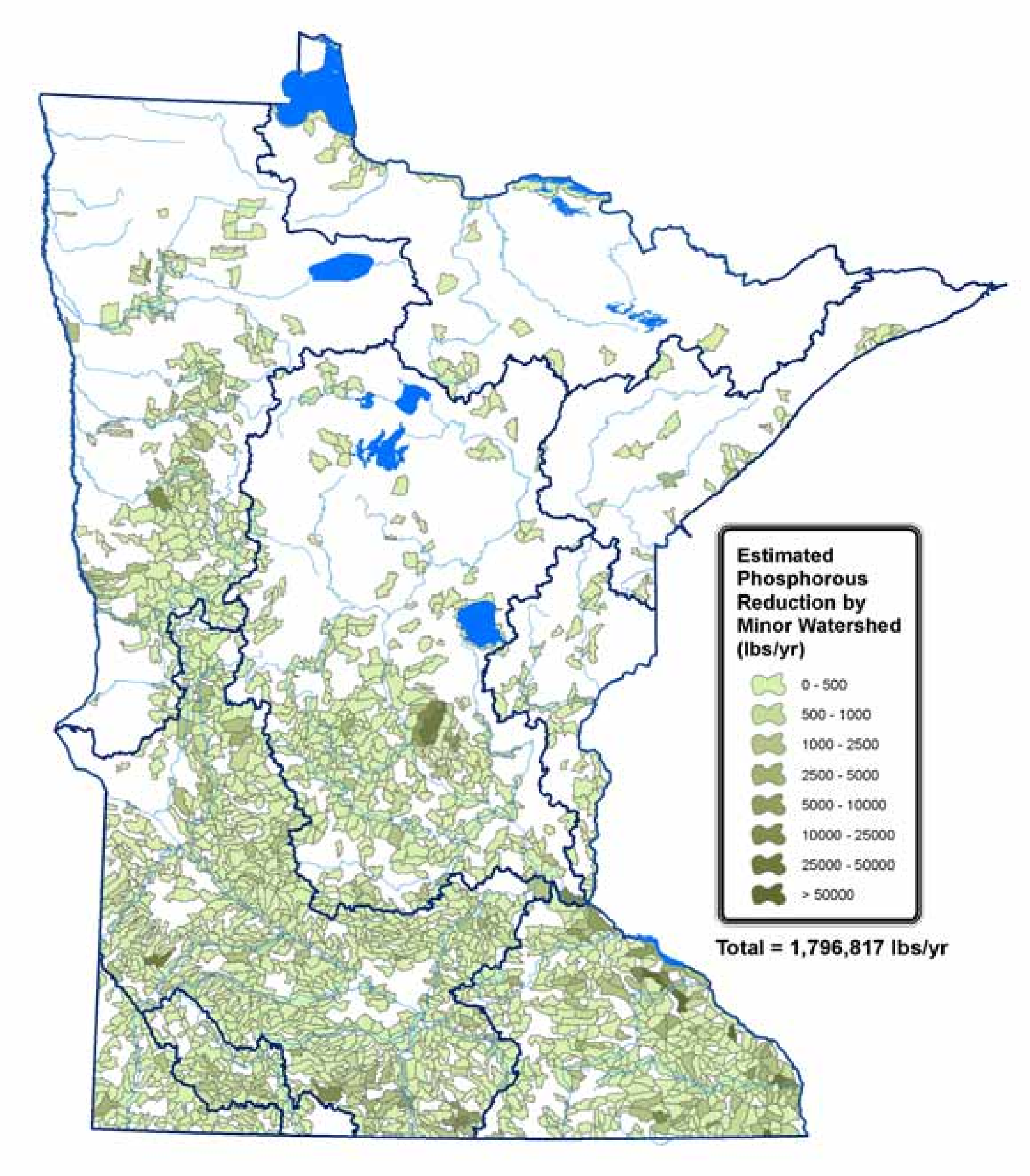
Soil Loss Reduction Benefits from Conservation and Management Practices
Reported Via eLINK (2003-2010)



Not only can sediment cause silting problems, but it can also carry chemicals attached to it into the water. One of these chemicals is phosphorus, a common element of fertilizer, which can create problems in surface water such as algae blooms. The proliferation of algae and other aquatic vegetation takes oxygen from the water, suffocating fish, discouraging wildlife and making lakes and waterways unsuitable for recreational use.

From 2003-2010, phosphorus reductions statewide were estimated at about 1.80 million pounds/year. The map below shows phosphorus reduction benefits from conservation and management practices during the period 2003-2010.

Phosphorus Reduction Benefits from Conservation and Management Practices Reported by eLINK (2003-2010)



Emerging Issues of Concern in Minnesota's Environment

There are a number of newly recognized environmental contaminants and other issues that are not fully understood, but which have the potential to cause known or suspected adverse ecological and/or human health effects. "Emerging issues" are new areas of environmental concern that are not currently incorporated into regular environmental protection activities in Minnesota or elsewhere.

Chemical contaminants, for example, can enter the environment through consumer products, solid waste disposal, agricultural and urban runoff, residential and industrial wastewater, and long-range atmospheric transport. The release of these substances to the environment may have occurred long ago, but remained unrecognized because analytical methods to detect them at low concentrations did not exist. In other cases, the synthesis of new chemicals or changes in use and disposal of existing chemicals can create new sources of contamination. Several studies have demonstrated that some contaminants cause adverse effects on fish and wildlife, such as the feminization of male fish.

However, the risks posed to humans from exposure to these contaminants at low concentrations are not well understood. While monitoring and analytical lab advances make it possible to detect these compounds at tiny concentrations, such as parts per trillion, there are very few established environmental standards or benchmarks for comparison and risk characterization. Much research is underway around the world to better understand how these compounds behave in the environment and in the human body.

The MPCA is attempting to stay abreast of newly recognized environmental contaminants and other issues that have the potential to cause known or suspected adverse ecological or human health effects in order to help inform lawmakers, regulators, the public and industry. The Legislature approved funding for some of these efforts in recent biennial budgets. Partnering with other scientists at universities, state agencies and federal agencies, the MPCA is conducting specific investigations of several key emerging issues of importance to Minnesota. Examples include:

- Pharmaceuticals, household and industrial-use products
- Endocrine disrupting compounds
- Perfluorinated chemicals (PFCs)

Pharmaceuticals, household and industrial-use products

In 2002, the U.S. Geological Survey (USGS) published results of the first nationwide survey of pharmaceuticals, hormones, and household and industrial products in surface waters. The compounds analyzed in the study encompassed a wide variety of compounds including: antibiotics, over-the-counter pharmaceuticals, hormones, detergents, disinfectants, plasticizers, fire retardants, insecticides and musks used in the production of fragrances. The USGS included certain compounds in their survey because they are biologically active, such as pharmaceuticals or chemicals that are suspected endocrine disruptors. These products are widely used in consumer and industrial products and are continuously released into the environment through human activities. Sources of these chemicals can include wastewater discharge, manure from confined animal feedlots, landfill leachate, and urban runoff.

In Minnesota, the MPCA has been collaborating with researchers from the local and national USGS offices since 2000 and St. Cloud State University since 2004 to further monitor and define health effects associated with this suite of compounds in Minnesota's waters. The first state reconnaissance study by USGS, the MPCA and the Minnesota Department of Health showed that industrial and household-use compounds and pharmaceuticals are present in streams, groundwater, wastewater and landfill effluents. Steroids, nonprescription drugs and insect repellents were the chemical groups most frequently detected, with detergent degradates and plasticizers measured in the highest concentrations. The complete report may be found at: http://water.usgs.gov/pubs/sir/2004/5138/.

In 2010, as part of a larger streams study funded by the U.S. Environmental Protection Agency (EPA), the MPCA sampled 150 stream locations for about 25 pharmaceuticals and personal care product related compounds. Analysis of these samples (which have been extracted and frozen) will be performed by the Minnesota Department of Health laboratory in spring or summer of 2011.

Also in 2010, the MPCA contracted with the USGS using funds made available by EPA through the NARS National Coastal Survey to conduct monitoring of chemicals of concern in the Duluth/Superior Harbor, which is part of the St. Louis River Area of Concern (AOC). The St. Louis River is the largest U.S. tributary to Lake Superior, and the AOC portion is adjacent to the largest urban area on Lake Superior. The Duluth/Superior Harbor is heavily impacted by historical industrial pollution, but little is known about the persistence and fate of chemicals of emerging concern (pharmaceuticals, antibiotics, hormones, organic wastewater compounds, and perfluorinated compounds) in this complex hydrological setting.

Using a combination of a stratified sampling design and a sampling protocol that follows hydrologic gradients, the USGS collected surface water and sediment samples from 30 locations in Minnesota's portion of the AOC in August 2010. Twenty-five sites were chosen at random, and 5 sites were pre-selected as suspected sources of contamination. The USGS contributed an additional $41,000 to the project budget, and worked with the Wisconsin DNR to sample three additional sites in Wisconsin's portion of the Duluth/Superior Harbor, thereby improving the scope of the project. The USGS is scheduled to provide a draft report of this work to the MPCA by December 31, 2011.

The MPCA has also worked since 2002 with several partner organizations to improve environmental compliance and pollution prevention in healthcare facilities throughout Minnesota. Multimedia regulatory inspections of health care facilities revealed widespread mismanagement of complex hazardous wastes such as pharmaceuticals, laboratory solvents and reagents, and mercury-containing wastes. As a result of collaboration with a number of agencies and associations, health care facilities are using more environmentally preferable waste management methods. Fiscal year 2008 resulted in out-state hospitals properly managing 677,000 pounds of pharmaceuticals and 618,000 pounds of laboratory wastes as hazardous waste. During the four-year period from calendar year 2005 to 2008, 37.8 million pounds of additional waste were properly managed by outstate hospitals compared to the previous four-year period (calendar year 2001 to 2004). Thirty-two hazardous waste compliance training events were presented throughout the state in fiscal year 2010 with over 1500 healthcare professionals in attendance. More information on these efforts can be found at: http://www.pca.state.mn.us/industry/healthcare.html.

Endocrine disrupting chemicals

Endocrine disruption is a broad term referring to both natural and synthetic compounds that cause adverse effects in humans, fish, or wildlife by mimicking or altering the endocrine or hormone systems. Scientists are increasingly adopting the term "endocrine active chemicals" (EACs)" over the term "endocrine disrupting chemicals" (EDCs) as a more accurate description for chemicals affecting the endocrine system. Originally, studies of EACs focused on those chemicals affecting the estrogenic, androgenic (testosterone), or thyroid systems of humans and wildlife. However, the scope of interest has expanded to include other signaling chemicals in humans and wildlife, such as neurochemicals. Because endocrine disruption encompasses numerous sources, exposures, and organisms, scientists are addressing endocrine disruption in the context of environmental protection through a multidisciplinary and collaborative approach. MPCA has been supporting Minnesota-based EAC studies and researchers that build on national studies and perspectives.

Building on the results of the 2002 USGS survey of pharmaceuticals, household and industrial products in the aquatic environment, scientists from the USGS, St. Cloud State University (SCSU), the University of

Minnesota, the University of St. Thomas, and the MPCA continue to investigate the significance, sources, and occurrence of EACs in Minnesota's waste streams and waters. This multidisciplinary team of experts has designed a phased approach from laboratory to field studies to discover what effects these compounds have on aquatic organisms.

In January 2008, the MPCA completed a report to the Minnesota Legislature titled *Endocrine Disrupting Compounds*. This report summarized what is understood about the range of these compounds and their effects on humans, fish, and wildlife, as well as reviewing possibilities for preventing their release to the environment and the options for treatment at waste water treatment plants. The report is available at: http://www.pca.state.mn.us/publications/reports/lrp-ei-1sy08.pdf.

In cooperation with USGS and SCSU, the MPCA completed the Statewide EDC Study in June, 2009, which included the analysis of surface water and sediment in 12 Minnesota lakes and four rivers and streams. This study also included an analysis of effects in fish collected from the same locations. The results of this study can be found at http://www.pca.state.mn.us/water/edc.html.

MPCA is currently pursuing three projects focused on EACs and organic wastewater compounds in the environment. The first study is a survey of 25 wastewater treatment plants across Minnesota, which includes chemical analysis of surface water and sediment as well as limited study of fish at those locations. The final report was completed in March 2011 and is available at the following website: http://www.pca.state.mn.us/index.php/view-document.html?gid=15610

The second study continues the 2007-2009 Statewide EDC Study and will examine in more detail the presence and effects of EACs on a single Minnesota lake from a variety of point and non-point sources. Results of this study will be reported in June, 2011.

Finally, the MPCA is undertaking a survey of EACs in groundwater. In 2010, the first year of the survey, 38 wells from the MPCA's ambient groundwater monitoring network and five monitoring wells located downgradient of landfills were sampled. The primary objective of the first year of the survey is to determine the magnitude of any of the targeted chemicals in groundwater; consequently, the sampling focused on areas with a high relative potential for groundwater contamination. Wells from the MPCA's ambient monitoring network were selected to represent urban land uses including sewered residential and residential areas with septic systems. The results from the first year of monitoring will be used to inform the design of the groundwater EAC survey in 2011.

Perfluorinated chemicals (PFCs)

Perfluorinated chemicals (PFCs) such as perfluorooctanesulfonic acid (PFOS), perfluorooctanic acid, (PFOA), perfluorobutyric acid (PFBA) and others, are manmade chemicals used to manufacture products that are heat and stain resistant and repel water. PFCs used in emulsifier and surfactant applications are found in fabric, carpet and paper coatings, floor polish, shampoos, fire-fighting foam and certain insecticides. PFCs are used to make fluoropolymers, which then are used in the production of many personal care products, textiles, non-stick surfaces and fire-fighting foam. PFCs are widespread and persistent in the environment and they have been found in animals and people all over the globe.

In Minnesota, 3M manufactured PFOS and PFOA from approximately 1950 until they were phased out in 2002. During that time, large volumes of PFCs were released into the Mississippi River in effluent from the 3M Cottage Grove wastewater treatment plant. In addition, four sites in Washington County were identified where 3M disposed of PFC wastes prior to the advent of modern solid and hazardous waste laws and regulations aimed at protecting groundwater.

In 2007, the MPCA and 3M entered into a Consent Order regarding the release and discharge of PFCs from certain sites. The consent decree sets forth specific remediation steps that 3M is required to take regarding PFC releases. A copy of the consent decree is available at:

http://www.pca.state.mn.us/index.php/view-document.html?gid=2860

MPCA investigations have detected PFOS at elevated concentrations in fish taken from Pool 2 of the Mississippi River and downstream, as well as in metro area lakes with no known connection to 3M's manufacturing or waste disposal. Mississippi River Pool 2, which received 3M Cottage Grove effluent during the years of PFOS and PFOA manufacturing, is listed as impaired water, due to PFOS. This is based on fish tissue PFOS concentrations that prompted the MDH to issue a one-meal per month consumption advisory for certain species in that pool. Preliminary work in advance of a PFOS TMDL for Pool 2 also is underway, and TMDLs will be needed for the PFOS-impaired lakes.

The Consent Order also provided 3M funds for the MPCA to investigate the broader presence of PFCs in the ambient environment and numerous studies are underway to do that. In addition to fish tissue, PFCs have been found in some shallow groundwater wells, in the influent, effluent and sludge of wastewater treatment plants, in ambient air, in blood of bald eagles, and in landfill leachate and gas. Several findings of elevated PFOS concentrations have been traced to chrome platers using PFOS-containing products in plating or for chrome mist suppression. The MPCA and the MDH continue to examine potential sources of exposure to PFCs. An extensive description of all MPCA and MDH activities, and links to many PFC-related reports and studies is available on the following websites:
www.pca.state.mn.us/cleanup/pfc/index.html and
www.health.state.mn.us/divs/eh/hazardous/topics/pfcshealth.html

Much remains to be learned about the origins, fate and mechanisms of PFC contamination in the environment. However, the results of investigations to date have begun to move PFCs beyond the realm of the emerging issue of concern and into the MPCA's prevention and regulatory work. Some examples include PFC effluent limits for wastewater treatment plants, monitoring at solid waste landfills, and development of TMDLs (total maximum daily loads) for impaired waters.

Toxics in products

In addition to the examples noted above, the Legislature directed the MPCA and the MDH to examine questions surrounding toxic chemicals in consumer products, especially those used by children. MDH also was directed to publish a list of chemicals of high concern by July 1, 2010 and to identify a subset of these as priority chemicals by February 1, 2011.

The MPCA and MDH jointly published a report on December 15, 2010 that fulfills the Legislature's directive. In the report, the MPCA made a number of recommendations regarding actions the Legislature may consider to address existing data, safety and technology gaps in current chemical policy, and additionally, to promote and provide incentives for green chemistry and product design in Minnesota. The report is available here: http://www.pca.state.mn.us/index.php/view-document.html?gid=15319.

On January 31, 2011, the MDH published a list of nine priority chemicals in the State Register: more information about the priority chemicals is available here:
http://www.health.state.mn.us/divs/eh/hazardous/topics/toxfreekids/priority.html

Appendix A: Mercury Emissions Associated with Electricity Production, 2008-2009

Introduction

In accordance with Minnesota Statute §116.925, this appendix reports mercury emissions associated with electricity production. In addition to electricity, mercury emissions are associated with other energy production activities, taconite processing and releases from the use of mercury in products. Based on stakeholder recommendations the Minnesota Pollution Control Agency (MPCA) adopted a plan to reduce emissions by about 75 percent from all sources by the year 2025. More information about Minnesota's mercury emissions and reduction strategies can be found at http://www.pca.state.mn.us/air/mercury.html.

Mercury Emissions from Electricity Generation

Minnesota Statutes §116.925 requires producers and retailers of electricity to report the amount of mercury emitted through the generation of electricity. Emissions from 2008 and 2009 are summarized in Table A1 (emissions of mercury from electricity generation in Minnesota) and Table A2 (emissions of mercury associated with the generation of electricity imported to Minnesota). Minnesota law exempts certain electric-generation facilities from reporting mercury emissions: (1) those that operate less than 240 hours per year, (2) combustion units smaller than 150 British thermal units (Btu) per hour, (3) generation units with a maximum output of 15 megawatts or less, and (4) combustion facilities that emit less than three pounds of mercury in a given year. Therefore, generation facilities that do not emit any mercury, such as nuclear, wind, and hydro, are not reported here.

Although not required to annually report to the MPCA, Tables A1 and A2 include some combustion facilities that emit less than three pounds per year because of excellent pollution control or because they use a low-mercury fuel such as natural gas. In addition, because of variation in operating conditions, some facilities may emit more than three pounds one year and less than three pounds in another. When emissions are less than three pounds, the actual emissions are either given or listed as exempt, depending on the wishes of the facility's management.

Submissions from 77 generation units in Minnesota are summarized in Table A1. The major fuel for most units was coal, although some facilities depend on municipal solid waste, oil or natural gas for fuel.

For 2008, facilities in Minnesota reported the emission of 1,250 pounds of mercury in the production of 37,843,553 megawatt-hours (MWh) of electricity, with a median release rate of 18 milligrams per megawatt-hour mg/MWh. For 2009, reported emissions decreased to 1,090 pounds in the production of 38,746,771 MWh of electricity, with a median release rate of 14 mg/MWh.

The law also requires Minnesota retailers and wholesalers of electricity produced outside the state to report mercury emissions associated with production. This information is summarized in Table A2.

Included in Table A2 are Minnesota distribution cooperatives that distribute electricity to consumers but do not generate any electricity. All retailers of electricity are required to report mercury emissions associated with the generation of the electricity they distribute. In the case of Minnesota's distribution cooperatives, most of their electricity was generated in North Dakota, South Dakota and Wisconsin. The information is provided to the distribution cooperatives by their suppliers: Great River Energy, Dairyland Power Cooperative, Minnkota Power Cooperative, and East River Electric Power Cooperative. The calculated mercury emissions from each supplier may vary because of varying amounts of electricity purchased from the grid and because of the varying amounts of hydroelectric power used by each distribution cooperative.

Reports of electricity imported into Minnesota in 2008, but produced outside the state, totaled 35,935,299 MWh associated with mercury-emitting facilities. These facilities emitted 1,892 pounds of mercury.

Reports for 2009 totaled 34,777,987 MWh and 1,926 pounds of mercury emitted. The median release rate was 28 mg/MWh in both years.

Summing Tables A1 and A2 yields estimates of mercury emissions associated with electricity production. In 2008, 3,142 pounds of mercury were reported as emitted in the production of 73,778,852 MWh of electricity. In 2009, 3,016 pounds of mercury were reported as emitted in the production of 73,778,852 MWh.

Table A1. Reported 2008 and 2009 emissions of mercury from electricity generation in Minnesota.

Company	Generating Facility	Major Fuel Type(s)	2009 Electricity Produced (MWh)	2009 Mercury Emissions (lb)	2009 Mercury Emissions per Megawatt-hour (mg/MWh)	2008 Electricity Produced (MWh)	2008 Mercury Emissions (lb)	2008 Mercury Emissions per Megawatt-hour (mg/MWh)
Austin NE Power Plant	Unit 1	coal, gas	-	0.00		-	2.25	
Covanta Hennepin Energy Resource Co	Unit 1[c]	MSW[a]	106,141	0.00	0	128,325	4.20	15
Covanta Hennepin Energy Resource Co	Unit 2[c]	MSW[a]	112,631	0.00	0	123,589	2.95	11
Fairbault Energy Park	FEP 13100071	oil, gas	174,378	0.04	0	282,614	0.03	0
Fairbault Energy Park	MRS-01900059	oil, gas	577	0.00	0	744	0.00	
Great River Energy	Arrowhead Station	oil	122	0.00		25	0.00	
Great River Energy	Cambridge Station[c,d]	oil	38,138	0.00		67,711	0.00	
Great River Energy	Elk River Station[c]	oil, gas, MSW[a]	157,446	6.70	19	193,973	7.50	18
Great River Energy	Lakefield Station [c,d]	oil, gas	55,196	0.00		115,853	0.00	
Great River Energy	Maple Lake Station[c,d]	oil	300	0.00		201	0.00	
Great River Energy	Pleasant Valley Station[c,d]	oil, gas	60,113	0.00		65,999	0.00	
Great River Energy	Rock Lake Station[c,d]	oil	268	0.00		156	0.00	
Great River Energy	St. Bonifacius Station[c]	oil	3,751	0.00		1,394	0.00	
Hibbing Public Utilities	Unit 1A[h,c]	coal,oil	45,320	3.75	38		2.55	
Hibbing Public Utilities	Unit 2A[h,c]	coal,oil	47,369	3.92	38		2.56	
Hibbing Public Utilities	Unit 7A[h,c]	wood	-	0.00				
Hibbing Public Utilities	Unit 4A	wood, oil	87,394	3.28	17		2.40	
Hibbing Public Utilities	Unit 3A[h]	coal,oil	47,657	3.95	38		3.61	
Hibbing Public Utilities	Total for all units (2008)	wood, coal, oil				176,729		
Interstate Power and Light Company, Sherburn, MN	Fox lake Power Station #3[f]	oil, gas	13,140					
Marshall Municipal Utilities	GE Turbine	oil	158 0.00		0	210		
Minnesota Power(Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 1	coal, oil	373,063	16.26	20	373,063	16.27	20
Minnesota Power(Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 2	coal, oil	320,900	6.30	9	320,900	6.30	9
Minnesota Power(Taconite Harbor Energy Center)	Taconite Harbor Energy Center Unit 3	coal, oil	364,300	14.57	18	364,300	14.57	18
Minnesota Power	Boswell Unit 1	coal, oil	373,830	3.81	5	507,696	5.30	5
Minnesota Power	Boswell Unit 2	coal, oil	436,727	4.38	5	475,539	4.82	5
Minnesota Power	Boswell unit 3	coal, oil	1,563,601	62.94	18	5,602,570	121.41	10
Minnesota Power	Boswell Unit 4[e]	coal, oil	3,777,495	155.10	19	3,482,829	151.02	20
Minnesota Power	Hibbard 3-4	coal, gas	40,704	1.13	13	61,635	4.84	36
Minnesota Power	Laskin Unit 1 & 2	coal, oil	510,505	16.71	15	659,429	20.40	14
Minnesota Power (Rapids Energy Center)	Rapids Energy Center 5-6[c]	coal, wood	122,779	0.81	3	106,171	2.66	11
Northshore Mining Company	Silver Bay Power Plant PB 1[c]	coal, oil, gas				320,057	16.57	23
Northshore Mining Company	Silver Bay Power Plant PB 2[c]	coal, gas				518,171	16.75	15
Xcel Energy	AS King 1	coal, gas, petroleum	3,759,090	50.00	6	3,456,590	45.20	6
Xcel Energy	Black Dog 3	coal, gas	569,980	33.00	26	475,300	27.70	26
Xcel Energy	Black Dog 4	coal, gas	NA	45.80		1,102,600	61.80	25
Xcel Energy	Black Dog 5[c,d]	gas	475,430	0.00		347,427		
Xcel Energy	Blue Lake 1-3[c]	oil, gas	1,143	0.00		952		
Xcel Energy	Blue Lake 4	oil	377	0.00				
Xcel Energy	Blue Lake 7-8[c,d]	gas	17,705	0.00		20,388		
Xcel Energy	Granite City 1-4[c,d]	oil, gas	351	0.00		144		
Xcel Energy	High Bridge 5	coal, gas				-		
Xcel Energy	High Bridge 6	coal, gas				-		
Xcel Energy	High Bridge 7-8					422,329		
Xcel Energy	High Bridge 13-16	natural gas	735,798	0.00				
Xcel Energy	Inver Hills 1-6[c]	oil, gas	14,193	0.00		25,371		

Company	Generating Facility	Major Fuel Type(s)	2009 Electricity Produced (MWh)	2009 Mercury Emissions (lb)	2009 Mercury Emissions per Megawatt-hour (mg/MWh)	2008 Electricity Produced (MWh)	2008 Mercury Emissions (lb)	2008 Mercury Emissions per Megawatt-hour (mg/MWh)
Xcel Energy	Key City 4-7	gas	248			4		
Xcel Energy	Minnesota Valley 4[c,d]	coal, oil, gas	-	0.00		-		
Xcel Energy	Red Wing 1 Waste-to-Energy	gas, RDF[b]	55,448	1.30	11	56,050	2.20	18
Xcel Energy	Red Wing 2 Waste-to-Energy	gas, RDF[b]	58,925	1.80	14	60,649	3.40	25
Xcel Energy	Riverside 6/7	coal, oil, gas				508,663	23.30	21
Xcel Energy	Riverside 3	coal, oil, coke	-	0.20				
Xcel Energy	Riverside 15-16	natural gas	313,094	0.00				
Xcel Energy	Riverside 8	coal, oil, coke				1,184,492	48.90	19
Xcel Energy	Sherburne 1	coal, oil	5,055,150	221.90	20	5,086,790	221.70	20
Xcel Energy	Sherburne 2	coal, oil	4,922,090	219.30	20	4,867,970	213.40	20
Xcel Energy	Sherburne 3 (Xcel owned portion)	coal, oil	13,052,789	182.90	6	5,410,592	155.80	13
Xcel Energy	Wilmarth 1 Waste-to-Energy[c]	RDFb, gas	53,443	2.00	17	64,641	3.20	22
Xcel Energy	Wilmarth 2 Waste-to-Energy[c]	RDFb, gas	54,794	1.40	12	46,344	1.20	12
Otter Tail Power	Hoot Lake #2 & 3	coal, oil	599,138	18.99	14	396,253	15.74	18
Rochester Public Utilities	Silver Lake 1	coal, gas	561	0.01	6	2,918	0.08	13
Rochester Public Utilities	Silver Lake 2	coal, gas	7,657	0.59	35	23,239	0.40	8
Rochester Public Utilities	Silver Lake 3	coal, gas	2,618	0.12	20	52,379	1.88	16
Rochester Public Utilities	Silver Lake 4	coal, gas	41,488	0.00		135,545	1.58	5
Rochester Public Utilities	Cascade Creek Station 1	oil, gas	771	0.00	1	101		
Rochester Public Utilities	Cascade Creek Station 2-3	oil, gas	11,430	0.00		25,744		
Sappi-Cloquet	Power Boiler 7[h]	oil, gas, wood	N/A	0.90		N/A	0.98	
Sappi-Cloquet	Power Boiler 8[h]	gas	N/A	0.00		N/A		
Sappi-Cloquet	Power Boiler 9[h]	oil, gas, wood	N/A	2.65		N/A	2.91	
Sappi-Cloquet	Power Boiler 10[h]	gas	N/A	0.97		N/A	0.99	
Sappi-Cloquet	Lime Kiln	natural gas	N/A	0.00		N/A		
Southern Minnesota Municipal Power Agency	Faribault Energy Park	oil, gas						
Southern Minnesota Municipal Power Agency	Sherburne 3 (SMMPA owned portion)	coal, oil						
Southern Minnesota Municipal Power Agency	Minnesota River Station Combustion Turbine[d]	oil, gas						
Verso Paper- Sartell	BBC Turbine/Boiler	coal, oil, wood, sludge	75,935	0.16	1	76,645	5.44	32
Willmar Municipal Utilities	Boiler 3	coal, natural gas	33,029	2.63	36	43,476	3.00	31
Willmar Municipal Utilities	Boiler 2	natural gas	92	0.00		75	0.00	
		Summary of Reports	**38,746,771**	**1,090**	**14**	**37,843,553**	**1,250**	**18**
			Total Reported 2009 Electricity Produced (MWh)	Total Reported 2009 Mercury Emissions (lb)	Median Reported 2009 Mercury Emissions per Megawatt-hour (mg/MWh)	Total Reported 2008 Electricity Produced (MWh)	Total Reported 2008 Mercury Emissions (lb)	Median Reported 2008 Mercury Emissions per Megawatt-hour (mg/MWh)

Notes

[a]MSW is Municipal Solid Waste.

[b]RDF is Refuse-Derived Fuel, which is sorted and processed municipal solid waste.

[c]Facility has agreed to include for reporting mercury emissions of less than 3 pounds.

[d]Mercury emissions round to less than 0.00 pounds mercury for one or both years.

[g]Exempt from reporting. (Facilities emitting under 3 pounds of mercury or less than 240 hours of operation per year.)

[h]Due to common steam headers, calculation of mercury per electrical generation is not possible, electrical generation is from each individual turbine not from each boiler

Table A2. Reported 2008 and 2009 emissions of mercury associated with the generation of electricity imported into Minnesota.

Company	Electrical Supplier, if not generated by the Reporting Company	Generating Facility	Major Fuel Type(s)	2009 Electricity Imported Into Minnesota (MWh)	2009 Mercury Emissions (lb)	2009 Mercury Emissions per Megawatt-hour (mg/MWh)	2008 Electricity Imported Into Minnesota (MWh)	2008 Mercury Emissions (lb)	2008 Mercury Emissions per Megawatt-hour (mg/MWh)
Interstate Power and Light Company, Dubuque, IA (Alliant Energy)		Dubuque 1, Dubuque IA	coal, nat gas	78,830	2.40	14	138,541	4.00	13
Interstate Power and Light Company, Dubuque, IA (Alliant Energy)		Dubuque 5, Dubuque IA	coal, nat gas	58,142	3.00	23	137,928	6.50	21
Interstate Power and Light Company, Dubuque, IA (Alliant Energy)		Dubuque 6, Dubuque IA	coal, nat gas						
Interstate Power and Light Company, Lansing, IA (Alliant Energy)		Lansing 3, Lansing IA	coal, oil	17,674	0.20	5	148,734	1.70	5
Interstate Power and Light Company, Lansing, IA (Alliant Energy)		Lansing 4, Lansing IA	coal, oil	1,249,932	166.90	61	1,604,513	219.80	62
Interstate Power and Light Company, Clinton, IA (Alliant Energy)		ML Kapp 2, Clinton IA	coal, gas	776,580	60.30	35	700,682	86.00	56
Interstate Power and Light Company, Louisa County, IA (Alliant Energy)		Louisa 1/Louisa Co. IA	coal, gas	4,728,795	12.40	1	4,919,163	12.50	1
Interstate Power and Light Company, Sioux City, IA (Alliant Energy)		Neal 3, Sioux City IA	coal, gas	3,605,713	55.10	7	3,303,588	52.10	7
Interstate Power and Light Company, Sioux City, IA (Alliant Energy)		Neal 4, Sioux City IA	coal, oil	3,972,915	57.80	7	4,421,780	63.50	7
Interstate Power and Light Company, Burlington, IA (Alliant Energy)		Burlington Station #1	coal, nat gas	1,211,841	132.10	49	1,188,428	128.90	49
Interstate Power and Light Company, Ottumwa, IA (Alliant Energy)		Ottumwa Station #1	coal, oil	1,907,757	162.60	39	2,105,307	175.70	38
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Prairie Creek Station #1a-2	coal, gas	30,468	3.00	45	27,011	2.80	47
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Prairie Creek Station #3	coal, oil, gas	17,344	0.40	10	40,336	0.60	7
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Prairie Creek Station #4	coal, gas	32,726	1.50	21	273,988	12.40	21
Interstate Power and Light Company, Marshalltown, IA (Alliant Energy)		Sutherland Station #1	coal, gas	163,111	7.20	20	183,055	7.90	20
Interstate Power and Light Company, Marshalltown, IA (Alliant Energy)		Sutherland Station #2	coal, gas	76,240	3.60	21	195,662	9.20	21
Interstate Power and Light Company, Marshalltown, IA (Alliant Energy)		Sutherland Station #3	coal, gas	235,003	3.10	6	340,084	4.50	6
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #2	coal, oil, gas	-	-				
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #3-4	coal, gas	-	-		-	1.30	
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #5-6	coal, gas	-	-		3,438	2.20	
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #7-8	coal, gas	-	-		30,870	1.60	24
Interstate Power and Light Company, Cedar Rapids, IA (Alliant Energy)		Sixth Street Station #9-10	coal, gas	-	-		-	8.80	
Minnesota Power	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	1,403,802	226.61	73			
Marshall Municipal Utilities	Heartland Power		sub coal	-	-				
Marshall Municipal Utilities	Missouri River Energy		sub coal	-	-				
Northern Municipal Power Agency, Thief River Falls	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal				133,501	17.60	60
Northern Municipal Power Agency, Thief River Falls	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal				111,102	14.60	60
Northern Municipal Power Agency, Thief River Falls	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal	257,820	28.15	50	64,154	8.20	58
People's Cooperative Services	Dairyland Power Cooperative	Alma 1-5	Bit/Sub Coal	19,382	0.44	10	32,332	0.58	8
People's Cooperative Services	Dairyland Power Cooperative	JP Madgett	Sub bituminous coal	110,028	2.74	11	95,622	1.38	7
People's Cooperative Services	Dairyland Power Cooperative	Genoa	Bit/Sub Coal	39,664	0.85	10	87,887	0.55	3
People's Cooperative Services	Dairyland Power Cooperative, Great River Energy/G3	Great River Energy/G3	Bit/Sub Coal	513	0.01	9	609	See Genoa 3	
People's Cooperative Services	Dairyland Power Cooperative,	Seven Mile Creek	Landfill gas	774	-	0	535	-	
People's Cooperative Services	Dairyland Power Cooperative,	Grid Purchases	Coal	17,960	0.39	10	486	-	
People's Cooperative Services	Dairyland Power Cooperative,	Weston 4	Sub-Coal	42,757	0.66	7	14,100	0.19	6

Company	Electrical Supplier, if not generated by the Reporting Company	Generating Facility	Major Fuel Type(s)	2009 Electricity Imported Into Minnesota (MWh)	2009 Mercury Emissions (lb)	2009 Mercury Emissions per Megawatt-hour (mg/MWh)	2008 Electricity Imported Into Minnesota (MWh)	2008 Mercury Emissions (lb)	2008 Mercury Emissions per Megawatt-hour (mg/MWh)
Tri-County Electric Cooperative	Dairyland Power Cooperative	Alma 1-5	Sub Coal	27,165	0.61	10	45,927	0.82	8
Tri-County Electric Cooperative	Dairyland Power Cooperative	JP Madgett	Bit/Sub coal	154,209	3.84	11	135,828	1.96	7
Tri-County Electric Cooperative	Dairyland Power Cooperative	Genoa	Bit/Sub Coal	55,591	1.19	10	124,841	0.78	3
Tri-County Electric Cooperative	Dairyland Power Cooperative	Great River Energy/G3	Bit/Sub Coal	719	0.02	13	865	See Genoa 3	
Tri-County Electric Cooperative	Dairyland Power Cooperative	Seven Mile Creek	Landfill gas	1,085	-	0	760	-	0
Tri-County Electric Cooperative	Dairyland Power Cooperative	Weston 4	Sub-Coal	59,925	0.93	7	20,029	0.27	6
Tri-County Electric Cooperative	Dairyland Power Cooperative	Xcel Schedule 4	Coal	396	0.01	11	931	0.01	5
Tri-County Electric Cooperative	Dairyland Power Cooperative	Grid Purchases	Coal	25,172	0.55	10	14,295	0.17	5
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Alma 1-5	Bit/Sub Coal	16,251	0.37	10	27,148	0.49	8
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	JP Madgett	Sub bituminous coal	92,252	2.30	11	80,291	1.16	7
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Genoa 3	Bit/Sub Coal	33,256	0.71	10	73,796	0.46	3
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Great River Energy/G3	Bit/Sub Coal	430	0.01	11	512	See Genoa 3	
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Seven Mile Creek	Landfill gas	649	-	0	449	-	0
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Weston 4	Sub Coal	35,849	0.56	7	11,840	0.16	6
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Xcel Schedule 4	Coal	237	0.01	19	551	0.01	8
Freeborn-Mower Cooperative Services	Dairyland Power Cooperative	Grid Purchases	Coal	15,058	0.33	10	8,450	0.10	5
Agralite Electric Cooperative	Great River Energy		lignite coal	166,818	10.35	28	171,435	10.43	28
Arrowhead Electric Cooperative	Great River Energy		lignite coal	69,944	4.34	28	72,692	4.42	28
Benco Electric Cooperative	Great River Energy		lignite coal	273,960	17.00	28	274,888	16.72	28
Brown County Rural Electrical Ass'n	Great River Energy		lignite coal	118,517	7.36	28	120,557	7.33	28
Connexus Energy	Great River Energy		lignite coal	2,240,516	139.07	28	2,349,856	142.91	28
Cooperative Light and Power	Great River Energy		lignite coal	94,470	5.86	28	100,956	6.14	28
Crow Wing Power	Great River Energy		lignite coal	597,221	37.07	28	604,388	36.76	28
Dakota Electric Ass'n	Great River Energy		lignite coal	1,882,111	116.82	28	1,922,768	116.94	28
East Central Energy	Great River Energy		lignite coal	881,210	54.70	28	936,783	56.97	28
Federated Rural Electric	Great River Energy		lignite coal	163,529	10.15	28			
Goodhue County Cooperative Electric Ass'n	Great River Energy		lignite coal	93,127	5.78	28	93,976	5.72	28
Itasca-Mantrap Co-op. Electrical Ass'n	Great River Energy		lignite coal	194,048	12.04	28	199,260	12.12	28
Kandiyohi Power Cooperative	Great River Energy		lignite coal	131,339	8.15	28	134,035	8.15	28
Lake Country Power	Great River Energy		lignite coal	684,746	42.50	28	703,438	42.78	28
Lake Region Electric Cooperative	Great River Energy		lignite coal	381,422	23.68	28	376,894	22.92	28
McLeod Cooperative Power Ass'n	Great River Energy		lignite coal	187,287	11.63	28	186,343	11.33	28
Meeker Cooperative Light & Power Ass'n	Great River Energy		lignite coal	153,688	9.54	28	158,453	9.64	28
Mille Lacs Electric Cooperative	Great River Energy		lignite coal	205,072	12.73	28	207,033	12.59	28
Minnesota Valley Electric Cooperative	Great River Energy		lignite coal	609,330	37.82	28	614,821	37.39	28
Nobles Electric Cooperative	Great River Energy		lignite coal	108,592	6.74	28	110,162	6.70	28
North Itasca Electric Cooperative, Inc.	Great River Energy		lignite coal	57,786	3.08	24	59,420	3.13	24
Redwood Electric Cooperative	Great River Energy		lignite coal	32,705	2.03	28	33,473	2.04	28
Runestone Electric Ass'n	Great River Energy		lignite coal	188,891	11.72	28	190,682	11.60	28
South Central Electric Ass'n	Great River Energy		lignite coal	148,255	9.20	28	152,045	9.25	28
Stearns Electric Ass'n	Great River Energy		lignite coal	440,320	27.33	28	437,882	26.63	28
Steele-Waseca Cooperative Electric	Great River Energy		lignite coal	243,069	15.09	28	247,027	15.02	28
Todd-Wadena Electric Cooperative	Great River Energy		lignite coal	137,098	8.51	28	143,246	8.71	28
Wright-Hennepin Cooperative Electric Ass'n	Great River Energy		lignite coal	813,578	50.50	28	821,983	49.99	28
Clearwater-Polk Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	24,855	3.30	60	28,422	3.70	59
Clearwater-Polk Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	25,878	3.50	61	23,653	3.10	59
Clearwater-Polk Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal				13,658	1.70	56
North Star Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	37,114	4.90	60	43,003	5.70	60
North Star Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	38,641	5.20	61	35,788	4.70	60
North Star Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal				20,665	2.60	57
PKM Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	41,426	5.50	60	36,079	4.70	59
PKM Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	43,131	5.80	61	30,026	4.00	60
PKM Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal				17,338	2.20	58
Red Lake Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	41,426	5.50	60	46,841	6.20	60
Red Lake Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	43,131	5.80	61	38,982	5.10	59
Red Lake Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal				22,509	2.90	58

Company	Electrical Supplier, if not generated by the Reporting Company	Generating Facility	Major Fuel Type(s)	2009 Electricity Imported Into Minnesota (MWh)	2009 Mercury Emissions (lb)	2009 Mercury Emissions per Megawatt-hour (mg/MWh)	2008 Electricity Imported Into Minnesota (MWh)	2008 Mercury Emissions (lb)	2008 Mercury Emissions per Megawatt-hour (mg/MWh)
Red River Valley Cooperative Power Ass'n	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	43,755	5.80	60	46,610	6.10	59
Red River Valley Cooperative Power Ass'n	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	45,555	6.10	61	38,789	5.10	60
Red River Valley Cooperative Power Ass'n	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal				22,398	2.90	59
Roseau Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	50,197	6.60	60	59,174	7.80	60
Roseau Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	52,262	7.00	61	49,246	6.50	60
Roseau Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal				28,436	3.60	57
Wild Rice Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	86,107	11.40	60	94,160	12.40	60
Wild Rice Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	89,650	12.00	61	78,362	10.30	60
Wild Rice Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal				45,248	5.80	58
Beltrami Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #1, Center, ND	lignite coal	144,567	19.10	60	168,936	22.20	60
Beltrami Electric Cooperative	Minnkota Power Cooperative	Milton R. Young #2, Center, ND	lignite coal	150,517	20.10	61	140,592	18.50	60
Beltrami Electric Cooperative	Minnkota Power Cooperative	Coyote Station, Beulah, ND	lignite coal				81,182	10.40	58
Sioux Valley-Southwestern Electric Coop[a]	L & O Electric (Puchases from Basin Elec.)	Grid Purchases	coal	114,496	5.03	20	112,854	5.68	23
Crow Wing Power	Basin Electric		lignite coal	5,318	0.34	29	29,000	NA	
Federated Rural Electric	Basin Electric		lignite coal	126,343	1.65	6			
Minnesota Valley Electric Cooperative	Basin Electric		sub-bitumnious, lignite	89,920	5.28	27			
Minnesota Valley Coop. Light & Power Ass'n	Basin Electric	Antelope Valley	lignite coal	151,105	9.67	29	150,186	10.66	32
Traverse Electric Cooperative	Basin Electric		lignite coal	47,625	2.16	21	45,079	2.33	23
Wright-Hennepin Cooperative Electric Ass'n	Basin Electric		lignite coal	92,082	5.40	27	105,542	7.49	32
Agralite Electric Cooperative	East River		lignite coal	11,025	0.71		28,791	NA	
South Central Electric Ass'n	East River Electric Power Co-op		lignite	5,823	0.30	23			
Redwood Electric Cooperative	East River Electric Power Cooperative		lignite	15,440	0.98	29			
Meeker Cooperative Light & Power Ass'n	East River Electric Power Cooperative		lignite	4,040	0.24	27			
Renville Sibley Cooperative Ass'n	East River Electric Power Cooperative		lignite coal	132,503	7.78	27	127,132	8.66	31
Lyon-Lincoln Electric Cooperative	East River Electric Power Cooperative		lignite coal	68,265	4.37	29	69,440	4.93	32
Minnesota Valley Electric Cooperative	Utilities Plus		lignite, sub coal				82,847	5.88	32
Stearns Electric Association	Utilities Plus		sub coal, lignite						
Wright-Hennepin Cooperative Electric Ass'n	Utilities Plus		lignite, sub coal						
Willmar Municipal Utilities	Great River Energy, Coal Creek, ND		sub coal	221,484	13.75	28	219,251	14.04	29
Otter Tail Power		Big Stone Power, Big Stone, SD	coal, oil	502,833	49.79	45	954,934	59.66	28
Otter Tail Power		Coyote Station, Beulah, ND	coal, oil	358,810	47.08	60	525,700	68.56	59
			Summary of Reports	**34,777,987**	**1,926**	**28**	**35,935,299**	**1,892**	**28**
				Total Reported 2009 Electricity Imported Into Minnesota Associated with Mercury Emissions (MWh)	Total Reported 2009 Mercury Emissions (lb)	Median Reported 2009 Mercury Emissions per Megawatt-hour (mg/MWh)	Total Reported 2008 Electricity Imported Into Minnesota Associated with Mercury Emissions (MWh)	Total Reported 2008 Mercury Emissions (lb)	Median Reported 2008 Mercury Emissions per Megawatt-hour (mg/MWh)

Notes

NA indicates data was either not available or not submitted to MPCA

[a]used Basin Electric lb Hg/MWh emission factor to calculate estimated emissions