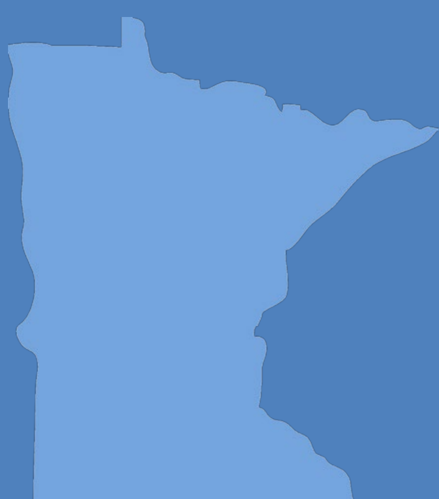
Reference Document for Minnesota Statute § 116.07, Subdivision 4a

Information source for use in complying with statute



Minnesota Pollution Control Agency

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Minnesota Asthma Program – MDH
Minnesota Environmental Public Health Tracking – MDH
Minnesota Center for Health Statistics – MDH
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Contents

Executive summary

The purpose of this document is to provide information for use by air permit applicants whose facility is located within an area described by Minn. Stat. § 116.07, subd. 4a. One area that meets the conditions in the above statute includes the Phillips communities in the southern portion of the city of Minneapolis, and an area within a ½ mile buffer of the Superfund site called the South Minneapolis Residential Arsenic Exposure Site (Figure 1). The process to conduct a Cumulative Levels and Effects Report within the requirements of the above statute are described in a companion document entitled, "Process Document for Minn. Stat. § 116.07, subd. 4a."

In brief, the process to comply with the above statute includes first assessing whether or not the facility is within the area described by Minn. Stat. § 116.07, subd. 4a. An Air Emissions Risk Analysis (AERA) and criteria pollutant modeling are then required to define the extent of the geographic area of study (or Study Area) by the proposed permit. Finally, permit applicants shall analyze potential impacts on human health and the environment from their facility in the context of the data and text within this document. The analysis is then considered by the Minnesota Pollution Control Agency (MPCA) in permitting determinations.

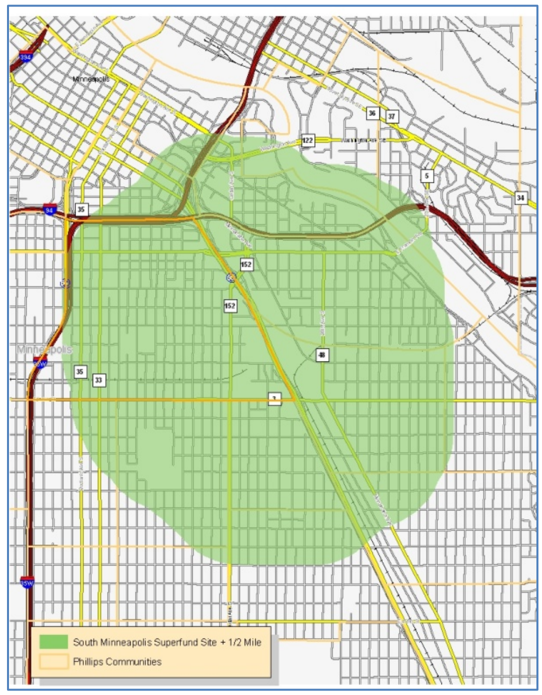

Figure 1: Map including the Phillips communities of Minneapolis and the 1/2 mile around the South Minneapolis Residential Arsenic Contamination Site.

This document is organized to include data groupings for hazard, exposure and health effect indices in a manner similar to the Center for Disease Control (CDC) Environmental Health Tracking programs (http://www.cdc.gov/nceh/tracking/).

The hazard index section of this document is the most data rich, and includes air, water, and land-based information. The air quality section describes modeled and monitored air pollutants, smoking rates as a proxy for environmental tobacco smoke exposures, descriptions and figures describing potential traffic related exposures, Air Quality Index results, and fish tissue ingestion exposure to mercury from atmospheric origin. The water quality section includes information summarizing the city of Minneapolis municipal water report, stormwater and industrial discharge permitted sites, and stream and lake assessment data. The land-based hazard section includes a summary of the South Minneapolis Residential Soil Contamination Site, a U.S. Environmental Protection Agency (EPA) Superfund site. Finally, this section contains brief descriptions and resources for other sites that may be located within a facility's Study Area and may need to be evaluated as part of a facility's cumulative levels and effects analysis.

The exposure indicator section includes only data for which there are biomonitoring results (data on pollutant concentrations in biological tissues). Two biomonitoring data sets were available and have been included: blood lead data by zip code and the Arsenic Biomonitoring Study from the Minnesota Department of Health (MDH) (completed through Minn. Stat. 144.995 – 144.998).

The health indicator section includes available health outcome data sets including asthma related hospitalizations and emergency room visits, hospitalizations coded for ischemic heart disease, socioeconomic indicators including percent below poverty and percent non-white population descriptions, and small for gestational age.

There is a section at the end of the document that includes descriptions of future sources of information that will support continuing efforts to this end as well as a section on limitations of the data and the process.

This document provides information and leads the reader to further information sources about particular topics too complex or geographically specific to cover properly here. The statute implies a type of cumulative risk approach requiring a large scope and multiple sources of diverse data aimed at describing a diverse and mobile population. The permit applicant's analysis based on this document is intended to be a reasonable approach to "*the cumulative levels and effects of past and current environmental pollution from all sources on the environment and residents*[1]" using available data within the context of this specified community. A true quantification of cumulative risk including all pathways, pollutants, exposure routes, etc. would require greater resources and time than are available to the MPCA at this time. Moreover, cumulative risk assessment methods are under development with the exception of certain health endpoints for specific pesticides. Through a benchmarking effort completed by MPCA staff in 2008, it was found that a few states are developing approaches for addressing this issue. The most expansive of these efforts is being conducted by the state of California in a multi-year effort to develop methods to conduct cumulative risk assessments in the context of environmental justice (http://oehha.ca.gov/ej/cipa123110.html)[2]. This effort involved the expertise from academia, government, non-profits, industry, community groups, etc. However, the methodology from this multi-year project is aimed at prioritizing areas for further investigation, where the Statute Area for this methodology has been predefined in the statute language.

Between the years of 2011 and 2013, the EPA held a Cumulative Risk Assessment webinar series. Experts on cumulative impacts and cumulative risk assessment from around the country and internationally spoke on various efforts or recommendations towards writing national guidance on cumulative risk assessment. This effort culminated in a document entitled, "Cumulative Risk Assessment Webinar Series: What We Learned" https://www2.epa.gov/sites/production/files/2015-10/documents/cra-webinar-summary.pdf. This effort was one of the presentations in this series and is discussed in the EPA document.

Within the field of human health risk assessment, human health protective assumptions are made where data gaps exist; this is true for single pollutant single pathway to more complex analyses. For a broad scope cumulative risk assessment, where all factors are integrated into one relative metric, a quantification of risk would necessitate many assumptions with each assumption propagating another layer of uncertainty. The MPCA would require multi-year resources and the ability to draw on other experts outside of the MPCA to compile and acquire higher quality, more spatially and temporally refined data sets, and then ultimately develop quantitative indices to integrate the disparate data for various areas. Initial attempts at this type of analysis are found in current cumulative risk literature such as: Su et al. 2009, Morello-Frosch et al. 2006, etc. Even within these peer reviewed, multi-year, published efforts, not all sources, media and pathways on temporal and spatial resolution implied in the statute were included. For these reasons, the MPCA is recommending both quantitative and qualitative data be analyzed in the Cumulative Levels and Effects Report. Although the processes are relatively new

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[1] Taken from Minn. Stat. § 116.07, subd. 4a

[2] Purpose Statement: "…to create a Cumulative Impacts and Precautionary Approaches (CI/PA) Work Group for the purpose of providing early and ongoing advice on the development of guidance to assess both cumulative impacts from environmental pollutants and precautionary approaches to environmental decision-making**…"**

and quite challenging; community wide cumulative risk assessments are important. This document is expected to be updated as new information and analyses of existing data become available and as the suggested methodology are further developed.

Cumulative risk assessment in the context of environmental equity

Cumulative risk is defined in the EPA Framework for Cumulative Risk Assessment (http://www.epa.gov/risk/framework-cumulative-risk-assessment) as "the combined risks from aggregate exposures to multiple agents or stressors." Stressors may be environmental pollutants, biological agents, non-chemical stressors, allostatic load, etc. The definition within the context of cumulative risk assessments for pesticides (which is the best known methodology in cumulative risk assessment) has a much narrower scope ("The risk of a common toxic effect associated with concurrent exposure by all relevant pathways and routes of exposure to a group of chemicals that share a common mechanism of toxicity").

One component that may not be considered in typical regulatory risk assessments, but is if risk assessments are conducted in a cumulative framework, is the concept of "vulnerability". Vulnerability is described in deFur, et. al, 2007 as how communities or individuals respond to and recover from stressors inadequately or not as well as the average communities or individuals. The National Environmental Justice Advisory Committee discusses the four properties of vulnerability as susceptibility, exposure, preparedness and responsiveness. In both publications, resilience is described somewhat as the opposite of vulnerability, where if two communities are exposed to the same environmental stressors one community may be more resilient or less likely to recover from that exposure. Conditions in a community which may impact health are access to quality healthcare, safety, environmental quality, quality of housing, etc. Communities may have the ability to recover from stressors through resources such as health care access, education, quality employment, etc. The health of a community is dependent on all of these factors, chemical, non-chemical stressors and vulnerabilities.

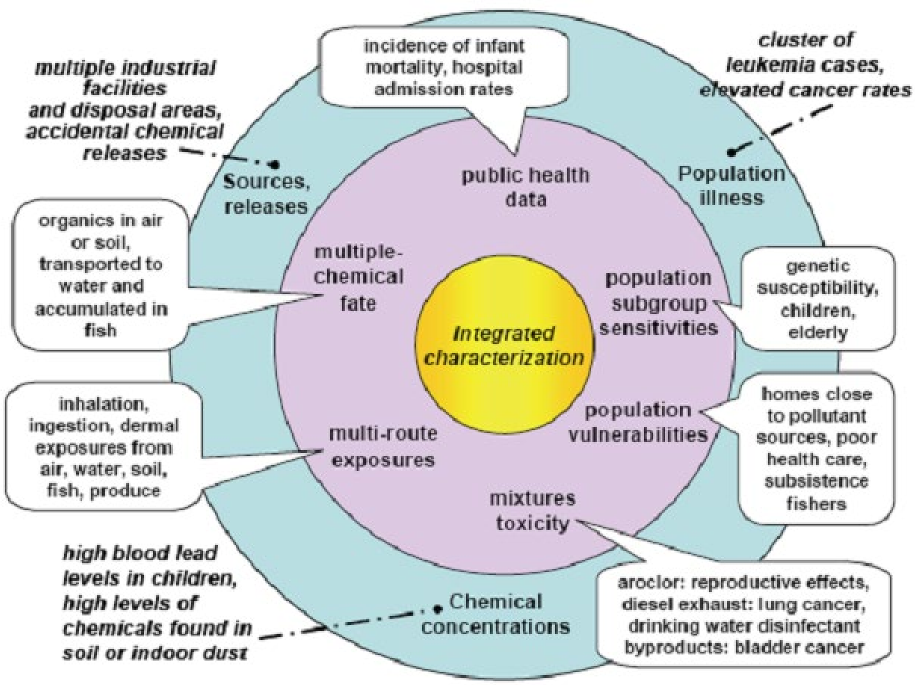


Figure 2: From EPA Cumulative Risk Resource Document: Example Initiating Factors and Data Elements for Cumulative Risk Analyses.

The ultimate goal of a cumulative risk assessment in the context of Minn. Stat. § 116.07, subd. 4a would be to collect, measure, or model all of the described data in the blue and purple circles depicted in Figure 2 (EPA, 2008) and create an integrated assessment that is depicted by the gold center in this circle. The difficulty in a cumulative risk assessment is not the gathering or even mapping of disparate data, but in the integration of those data. The gold circle portion of this analysis is the most technically difficult and will result in the highest level of uncertainty and therefore contention. For example, increased blood lead concentrations in children may not have any physiological association with increases in hospitalizations for asthma. Risks and existing health conditions do not occur in complete isolation (all physiological systems are connected in some manner), however these health conditions may not be completely additive nor multiplicative. So, results such as these cannot be simply summed and reported as a “cumulative risk outcome.” Areas that were developed years ago, tend to have older housing stock, may be proximal to heavily trafficked roads and may also be areas of potential environmental equity concern. Older housing units often tend to have leaded paint that if disturbed may lead to higher percentages of the residents with higher blood lead concentrations. Areas near heavily trafficked roads (prior to removing lead from gasoline) would have a tendency to have higher lead concentrations in soil that also if disturbed may contribute to higher blood lead concentrations. Furthermore, in older homes with poor air filtration, asthmatic episodes may increase due to lack of filtration of indoor air, dust or mold. Thus, two seemingly isolated health effects are related but the association is complex and not well characterized by a one digit value. As a result, the context of the data, or data story, is very important. Additionally, potential risk reduction activities are better elucidated by describing a data story over providing a definitive final quantitative value. Therefore, until methods are more clearly developed, and data become more spatially refined, the integrative portion of this document (the gold circle) is expected to be highly descriptive in nature and may compare the community in question with other areas of the state as the spatial refinement of the data allow. Potential, more quantitative, methods are discussed at the end of this document and will be considered with ongoing efforts relating to Minn. Stat. § 116.07, subd. 4a.

Existing (on line) cumulative mapping tools for the statute area

EPA National Air Toxics Assessment

(http://www.epa.gov/national-air-toxics-assessment)

The EPA National Air Toxics Assessment takes all air emissions in the U.S., incorporates a dispersion model, estimates air concentrations, compares to inhalation health benchmarks, calculates risk, and provides these values in a variety of combinations. This tool allows a user to create maps and data tables at the census tract levels.

EPA EJSCREEN

(http://www2.epa.gov/ejscreen)

Socioeconomic data such as that described above are included in an EPA environmental justice screening tool titled EJSCREEN. This is not a decision making tool, but allows the EPA and other entities to rank locations based on environmental and socioeconomic measures.

Center for Earth Energy and Democracy

(http://www.ceed.org/ejmap)

The Center for Earth Energy and Democracy created an environmental justice mapping tool that includes many environmental and socioeconomic indicators. This tool creates one combined index (Energy Poverty and Vulnerability) that provides information that is unique from other similar tools.

Hazard indicators

"An environmental hazard is an agent or factor in the environment that may adversely affect human health. People can be exposed to physical, chemical, or biologic agents from various environmental sources through air, water, soil, and food." (http://www.cdc.gov/nceh/tracking/biomontrack.htm#hazards). The majority of the data included in this report fall within this category.

Air quality

Data limitations with respect to sources of indoor air and uncertainty in assessing human exposure using outdoor air concentrations

Research conducted within the Phillips communities (Sexton et al. 2004, Adgate et al. 2004, Adgate et al, Pratt et al. 2004, Sexton et al. 2004, Sexton et al. 2007, Ramachandran et al. 2000), elsewhere in the Twin Cities and in other study locations showed that indoor concentrations of many air pollutants are typically higher than outdoor concentrations. Personal exposure measurements of some pollutants in these studies were often higher than both indoor air concentrations and outdoor air concentrations. These studies also showed that personal exposures and indoor air concentrations are much more variable than outdoor air concentrations.

Outdoor air concentrations are often used as a surrogate for personal exposure (and/or human health risks) since exposure measurements are expensive, difficult to conduct, and only done infrequently. Outdoor air pollution penetrates into the indoor environment, but there is typically some removal of pollution during this process (by deposition and/or chemical/physical reactions) resulting in lower concentrations of indoor air pollutant concentrations from outdoor sources. However, in most homes and other indoor environments there are multiple indoor sources of air pollution, including combustion sources (stoves, furnaces, candles, water heaters, dryers, tobacco products, etc.), mechanical sources (vacuuming, sweeping, dusting, grinding, cutting, etc.), pets, consumer products, and personal care products. These indoor sources cause indoor and personal concentrations to be higher than outdoor concentrations. Removing indoor sources and enhanced ventilation will lower impacts from indoor air sources.

Personal exposure is a function of the concentrations in micro-environments and the time spent by an individual in specific microenvironments. A microenvironment is a defined space with its own homogeneous air pollution profile, such as indoors at home, driving in traffic, indoors at work, etc. Variability in housing conditions and personal activity patterns results in complex personal exposure patterns which require large data sets to describe a community properly. Such data sets specific to locations in Minnesota are not available. However, there are general findings, regarding indoor air and personal exposures. For example, surveys of personal activities have shown that people spend more than 90% of their time, on average, indoors. Thus, estimates of exposure and risk from outdoor air pollution often underestimate the risk from air pollution that would otherwise be obtained if community representative indoor air measurements were available. Estimates of the risks from personal exposures or indoor air pollution are less well understood than the risks from outdoor air pollution, and it is often difficult to generalize about the risks in the indoor environment based upon outdoor measurements. The lack of information about indoor air quality is a data gap that prevents a quantitative assessment of the cumulative effects of air pollution. Available data have been used in this section to discuss uncertainties among personal exposures, indoor air concentrations and outdoor air concentrations. Since tobacco smoke is a very strong indicator of personal exposures to many air pollutants, the Survey of the Health of all the Population and the Environment (SHAPE) data have been described in this document.

Traffic related environmental health information (general and South Minneapolis-specific)

Motor vehicles are a significant source of urban air pollutants and greenhouse gases and have been associated with health effects such as cardiovascular impacts and increased asthmatic episodes. Due to growth of the global motor vehicle fleet, as well as increasing urbanization, more people around the world are living and working near major roadways. Motor vehicle emissions, unlike larger "stack-type" or "point source" emissions, tend to result in localized emissions. For this reason, they are one of the main sources of air pollution that have been shown to have high intra-urban variability. Motor vehicle emissions are dispersed almost at street level and depending on meteorology and pollutant exposure zones may disperse to within 50 to 1,500 meters (0.03 to 0.9 miles) from the roadways. The most highly impacted areas, however, tend to be within 300 to 500 meters (0.1 to 0.3 miles) (HEI, 2010, "*Traffic-Related Air Pollution: A Critical Review of the Literature on Emissions, Exposure, and Health Effects*"). Due to the growing body of knowledge associating motor vehicle emissions with human health effects, the state of California and the EPA have written siting guidance for schools, with distance from road being a major factor in siting decisions.

The data in Table 1 are vehicle kilometers traveled divided by the area of the census tract (in square meter units). This is an indicator of traffic density, and is a stronger indicator of potential traffic impacts than vehicle miles traveled data when the areas being compared are different sizes. Some census tracts may have a high number of vehicle miles traveled but also may be quite large, where the converse could also be true. The vehicle miles traveled data have been separated into categories of light vehicles (cars, small trucks) and heavy diesel vehicles (larger diesel trucks).

Table 1: Traffic density indicators: The density of vehicle miles travelled for heavy diesel and light vehicles by census tracts within the area described by the statute, Hennepin County and statewide averages.

Census tract	Light vehicle VMT density (vehicle km/m^2)	Heavy diesel VMT density (vehicle km/m^2)
27053005901	0.0324	0.00127
27053008400	0.0923	0.00344
27053008500	0.0238	0.000871
27053009500	0.034	0.00143
27053009600	0.0222	0.000976
27053104800	0.164	0.0059
27053104900	0.1	0.00362
27053105400	0.0978	0.00351
27053106000	0.621	0.022
27053106200	0.39	0.0139
27053106400	0.0218	0.000808
27053107400	0.0122	0.000589
27053107500	0.0366	0.00139
27053107600	0.0167	0.000722
27053108600	0.0203	0.000876
27053108700	0.0651	0.00243
27053108800	0.0369	0.00137
27053108900	0.0215	0.00116
27053109700	0.0899	0.00382
27053110100	0.0224	0.00111
27053110200	0.0331	0.00133
Hennepin County	0.0339	0.0013
Statewide	0.00109	6.31E-05

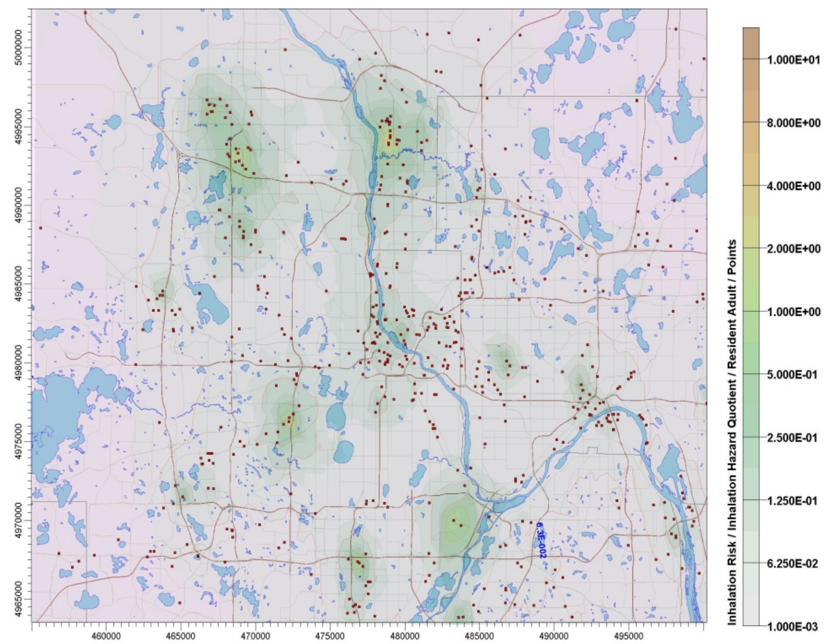


Figure 3: Modeled inhalation risks from point sources in the Twin Cities, MN. Potential impact increases from pink to green to orange, and uses the same scale as the next figure.

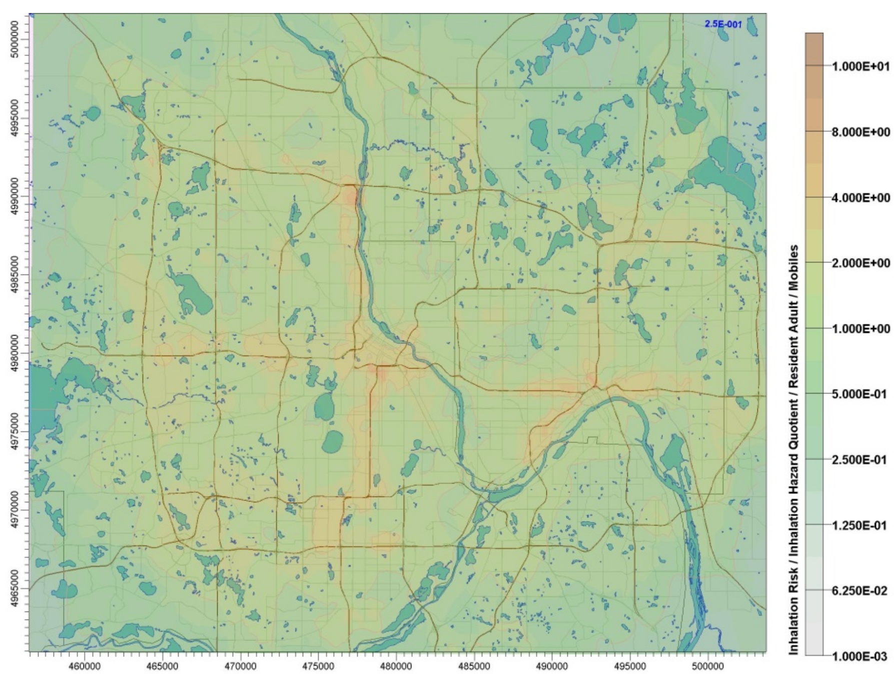


Figure 4: Modeled inhalation risks from mobile sources in the Twin Cities, MN. Potential impact increases from pink to green to orange, and uses the same scale as the previous figure.

There are several data sources used to assess potential human health effects related to motor vehicle emissions. In Figures 3 and 4, air emissions from the Minnesota Emissions Inventory have been modeled using air dispersion modeling, and potential human health risks have been estimated. The human health endpoint depicted in these two figures is chronic (long term) non-cancer effects, with respiratory as the largest end-point within non-cancer impacts. The scales of estimated human health non-cancer hazard index ratios are the same in both Figures 3 and 4. Since Figure 3 includes point sources only, and Figure 4 includes mobile sources only, it becomes apparent that mobile sources are an important contributor to modeled potential human health risks in the Twin Cities.

Another manner of assessing potential human health impacts from exposure to vehicle related emissions is to look directly at daily trips or another similar metric. Figure 5 includes a map of the Phillips communities and the traffic densities surrounding that area of the city of Minneapolis. The darker red portions of the figure are where the traffic densities are the highest, mainly along 35W and 94. Hiawatha Avenue is a bit less heavily traveled than the other two highways.

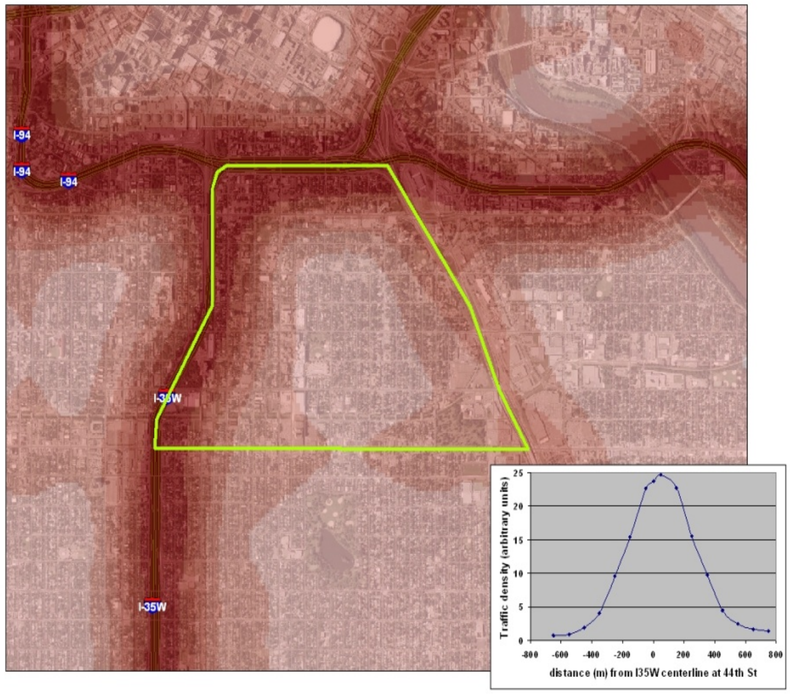


Figure 5: Image depicting traffic density patterns around the Phillips communities. The small inset chart indicates the assumed zone of impact of mobile source emissions in which the impact is greatest at the centerline of the roadway and dissipates with distance following an approximately exponential decay such that the roadway influence is indistinguishable from the urban background after about 300 meters downwind.

Air quality data for pollutants with federal standards (criteria pollutants) and with specific monitoring in the area described by the statute

The Clean Air Act requires the EPA to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants, namely ozone, particulate matter, carbon monoxide, nitrogen oxides, sulfur dioxide and lead. The state of Minnesota is required to measure these air pollutants in order to demonstrate compliance with federal standards. These standards are air concentrations developed to protect human health and the environment with a degree of safety. The actual language is included below. Minnesota is currently in compliance with federal and state standards for criteria pollutants. National and state ambient air standards are reviewed and potentially updated as new scientific evidence is available. There is uncertainty in the accepted standards, and in some cases health effects have been associated with lower ambient air concentrations than are set in rule.

“***Primary standards*** *set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly.* ***Secondary standards*** *set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.”* (http://www.epa.gov/air/criteria.html)

Some of these pollutants are regional in nature and would not vary greatly within the area described by the statute (ozone, $PM_{2.5}$, etc.). Table 2 presents $PM_{2.5}$ concentrations measured within the Phillips communities as an example of measured data along with federal and state regulatory standards.

Table 2: Measured $PM_{2.5}$ ambient air concentrations in the Phillips communities, Air Monitor #963.

Annual seasonally-weighted mean		3-year avg. annual seasonally-weighted mean (12 ug/m3)*		Annual 24-hr 98th percentile value		3-year avg. of annual 24-hr 98th percentile value (35 ug/m3)*	
2001	11.6	2001-2003	10.7	2001	33.4	2001-2003	28
2002	10.2	2002-2004	9.8	2002	26	2002-2004	27
2003	10.2	2003-2005	9.8	2003	25	2003-2005	28
2004	9	2004-2006	9.3	2004	28.6	2004-2006	26
2005	10.3	2005-2007	9.7	2005	30	2005-2007	24
2006	8.6	2006-2008	9.6	2006	19.4	2006-2008	23
2007	10.1	2007-2009	10	2007	23.7	2007-2009	29
2008	10	2008-2010	9.7	2008	25.9	2008-2010	31
2009	10.1	2009-2011	9.5	2009	38.7	2009-2011	30
2010	9.1	2010-2012	9	2010	28.4	2010-2012	25
2011	9.3	2011-2013	8.4	2011	23.3	2011-2013	23
2012	8.5	2012-2014	7.7	2012	22.3	2012-2014	22
2013	7.3			2013	21.9		
2014	7.3			2014	20.7		

*National Ambient Air Quality Standards, NAAQS for $PM_{2.5}$.

Also included within this section are a series of figures depicting measurements of criteria pollutants in relation to other sites around Minnesota. Ambient air monitors are placed to capture potential high impact areas or for other reasons such as special study areas. There is an ambient air monitor in the Phillips communities that is a part of the Ambient Air Monitoring Network for the state of Minnesota. This monitor is located on top of the HC Anderson School shown in Figures 6 and 7 below.

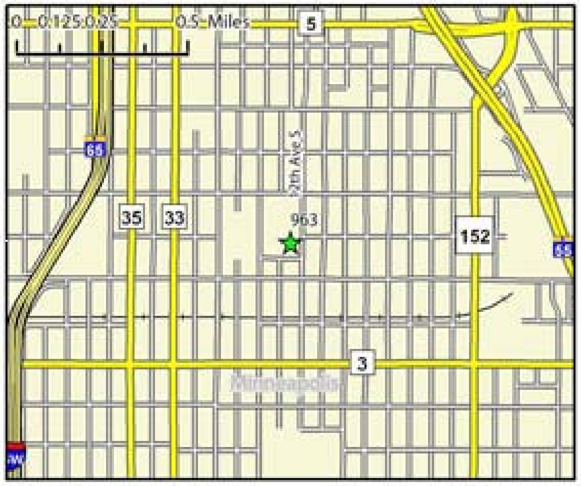


Figure 6: Map of the location of the ambient air monitor in the Phillips communities.

Figure 7: Photograph of the ambient air monitor in the Phillips communities.

Figures 8 and 9 report ambient air concentrations in the Phillips communities in comparison with other site locations for measured criteria pollutants. The data closest to the standard as measured at the Phillips monitor were chosen when there were several time averaging periods.

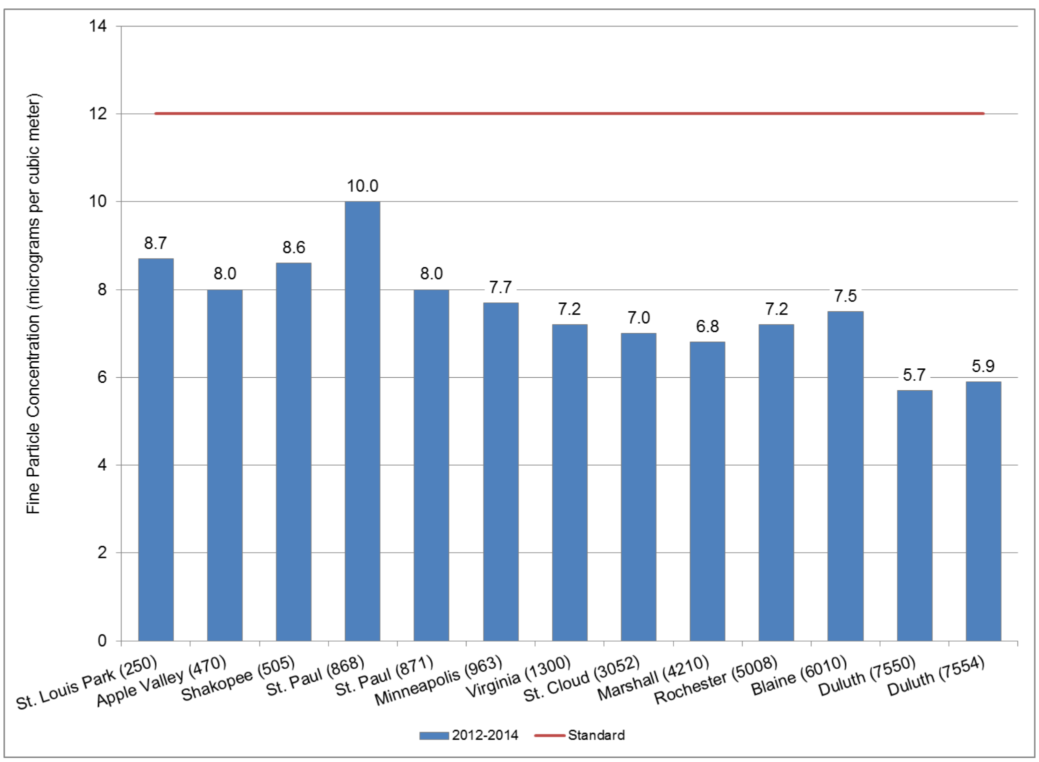


Figure 8: $PM_{2.5}$ concentration in comparison with the 24 hour standard in the Phillips communities. The Phillips monitor is Minneapolis 963.

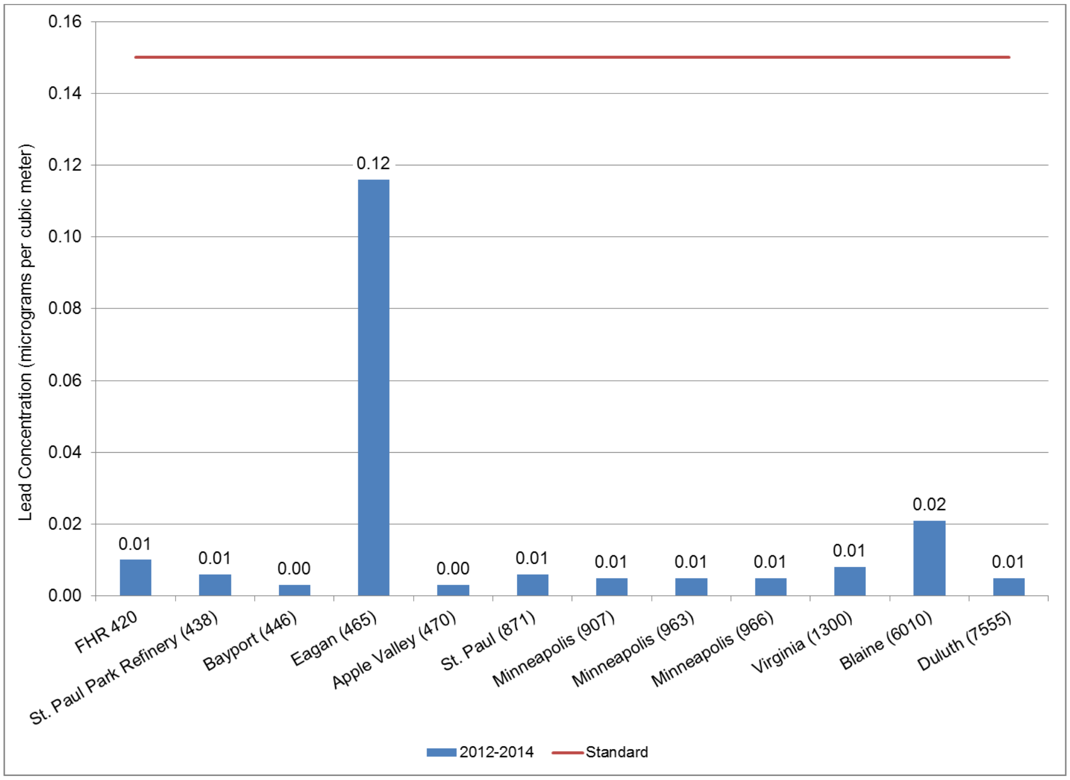


Figure 9: Ambient air data for lead at monitors in Minnesota. The Phillips communities monitor number is Minneapolis 963.

Air quality for "air toxics" (air pollutants without federal ambient air standards) monitored in the Phillips Community

Air toxics are air pollutants that may be carcinogenic or cause other harmful health effects. The language below is taken from the MPCA's AERA guidance, which describes MPCA authority to monitor and model air toxics within the context of permitting or environmental review.

"The Minnesota Pollution Control Agency has authority to gather information that is relevant to pollution or to MPCA rules or statutes….The MPCA also has authority to craft permit conditions to prevent pollution and to protect human health and the environment, even though the requirements do not specifically exist in rule (Minn. Stat.§ 116.07, subd. 4a and Minn. R. 7007.0800, subp. 2). The general permitting rule also authorizes the MPCA to craft permit conditions that protect human health and the environment (Minn. R. 7001.0150, subp. 2). At this time, the AERA process evaluates only the potential for human health impacts, and does not include analysis of potential ecological impacts. Minn. R. 7007.1000, subp.2 also provides the MPCA the authority to deny a permit if there is a potential for adverse effects to human health or the environment." (https://www.pca.state.mn.us/air/why-and-when-aeras-are-completed).

Data collected within the context described above are summarized below as specifically as possible for the area described by the statute. Some of the ambient monitor locations described previously in the criteria pollutant section is also locations where air toxics are measured. Air toxic pollutants are collected in categories of chemical type including: carbonyls, volatile organic chemicals and metals. Criteria pollutants with inhalation health benchmarks are treated as air toxics in risk estimate calculations.

Both “chronic non-cancer” and “cancer” summed health endpoint risks are estimated assuming a lifetime of exposure. These estimations are made using an upper confidence limit of an annual mean from measurements that are taken every six days. These ambient monitoring data are intended to reflect background ambient exposures to air pollutants.

Overall the summed potential human health cancer risks range from 3 to 6 additional cases of cancer in populations of 100,000 people. The summed non-cancer hazard indices were approximately 1, and the summed acute hazard indices range from <0.01 to 1. The summation of risks is an uncertain estimate of cumulative risks, and therefore one significant digit reporting is appropriate.

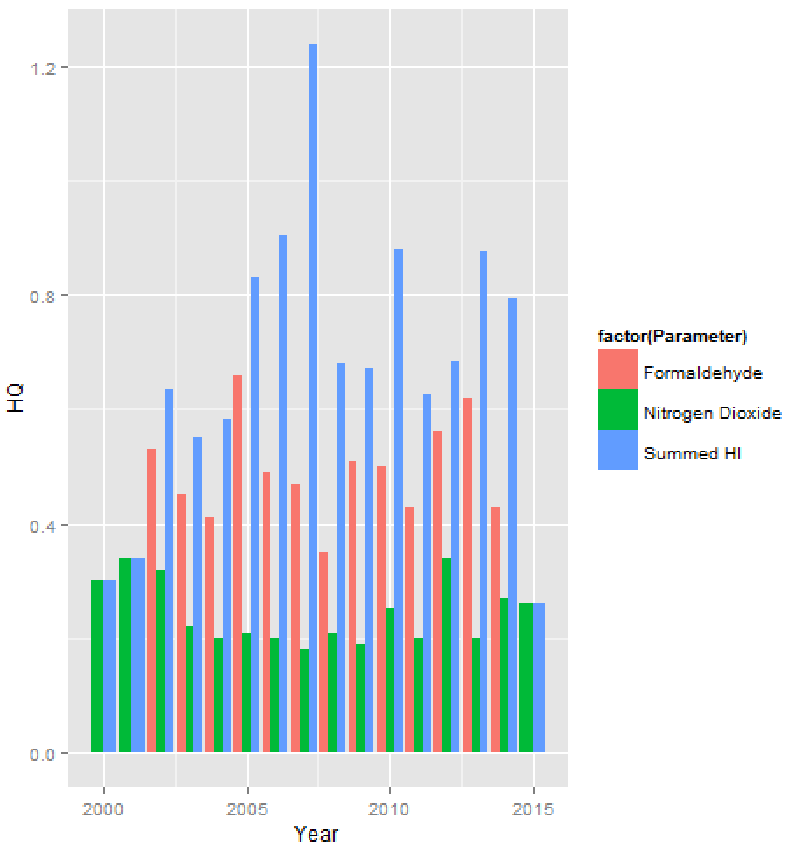


Figure 10: Estimated acute hazard quotients and summed hazard indices for measured air pollutants at HC Anderson School with the highest concentrations in comparison to acute non-cancer inhalation health benchmarks.

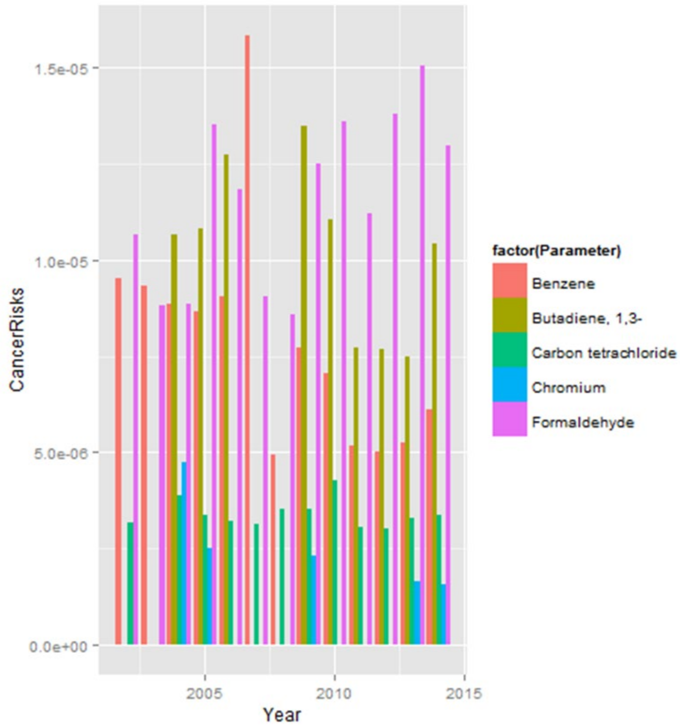


Figure 11: Estimated cancer risks for measured air pollutants at HC Anderson School with the highest concentrations in comparison to cancer inhalation health benchmarks.

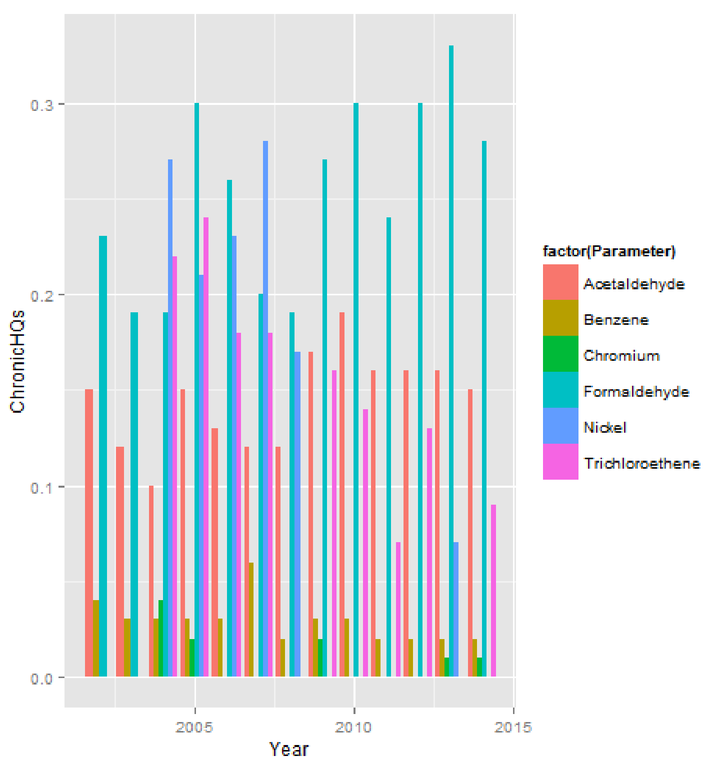


Figure 12: Estimated chronic hazard quotients for measured air pollutants at HC Anderson School with the highest concentrations in comparison to chronic non-cancer inhalation health benchmarks.

The second manner in which the ambient monitoring data are summarized is by population density. Since not all pollutants are measured at each site, site by site cumulative risk estimates are not feasible at all monitoring sites. In Figures 13-15, the ambient monitoring data were updated and averaged (based on 95^{th} upper confidence limits for the arithmetic means) for the years 2012 through 2014. Then all pollutant concentrations are divided by an inhalation health benchmark, and these single pollutant ratios are summed to represent a cumulative index of air pollutant concentrations with respect to their inhalation health benchmarks. These cumulative indices are called hazard indices for non-cancer health effects and cancer risks for cancer based health effects.

In these representations, one may notice the difference between urban, rural and suburban sites. These definitions are based on population density within the context of the MPCA cumulative risk guidance ((https://www.pca.state.mn.us/air/aera-guide-section-5-cumulative-air-emission-risk-analysis). Population densities below 500 people per square mile are considered rural. Population densities between 500 and 3,000 people per square mile are considered intermediate (or suburban), and population densities above 3,000 people per square mile are considered urban. Risks of additional cancer cases per a population of 100,000 range from three to six in more urban population densities, and from two to three in more rural locations. Similar population based differences are found for the non-cancer chronic and acute estimates.

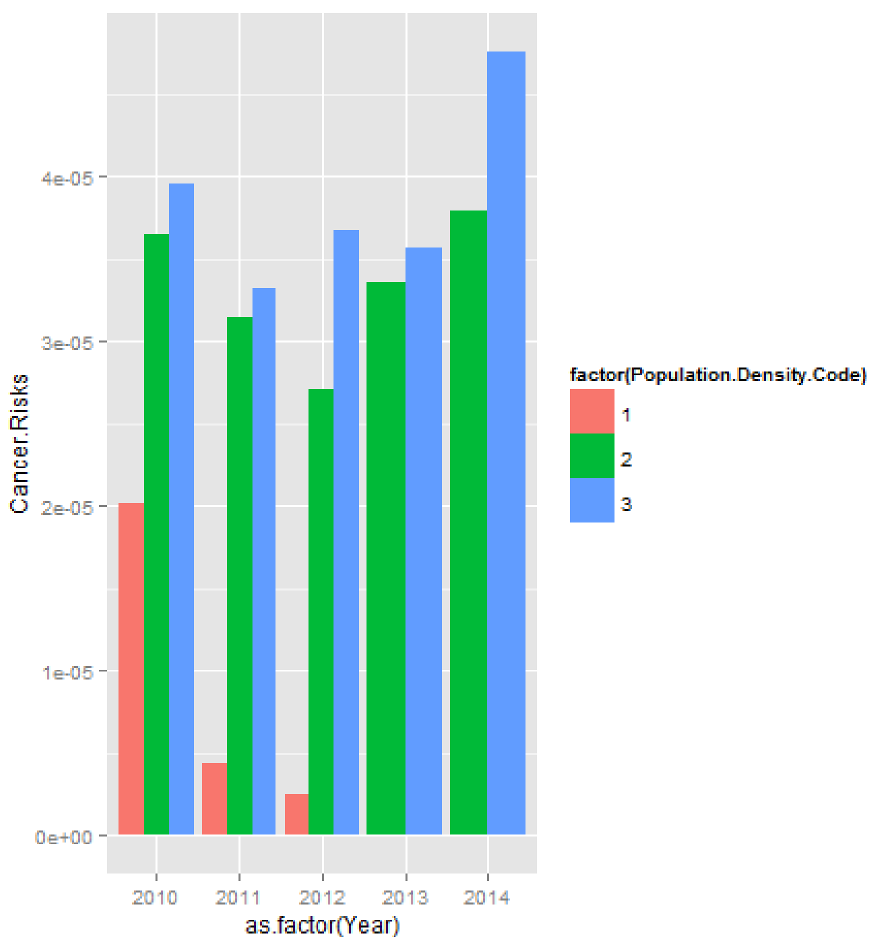


Figure 13: Estimated cancer risks, by population density.

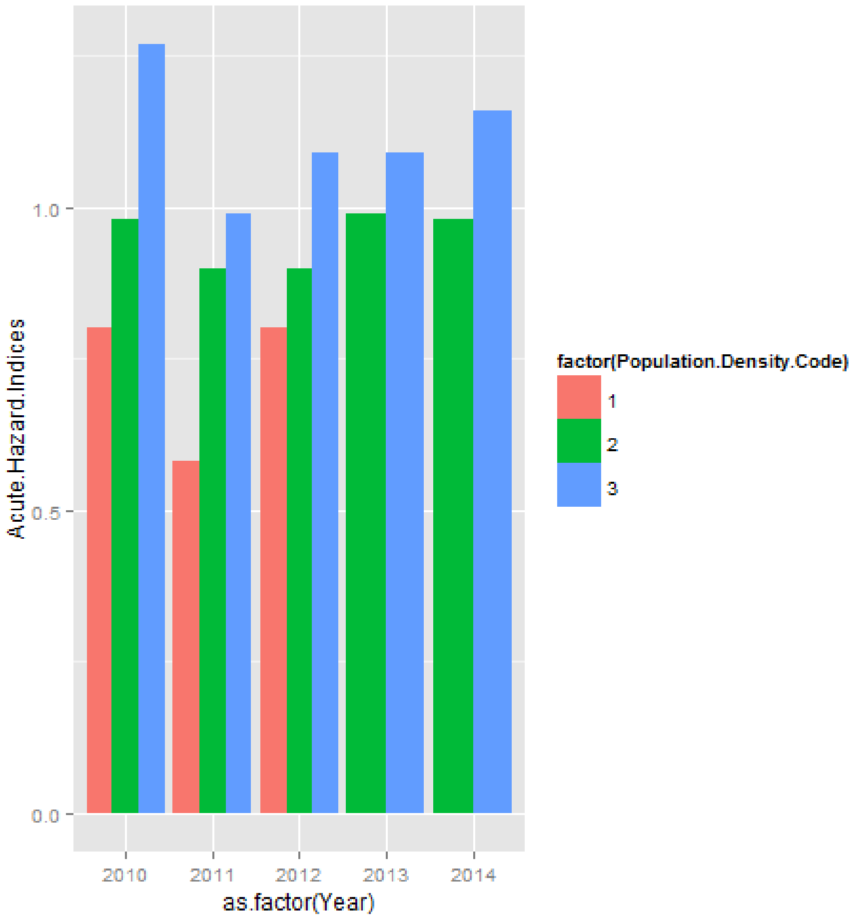


Figure 14: Estimated acute hazard indices (non-cancer) by population density.

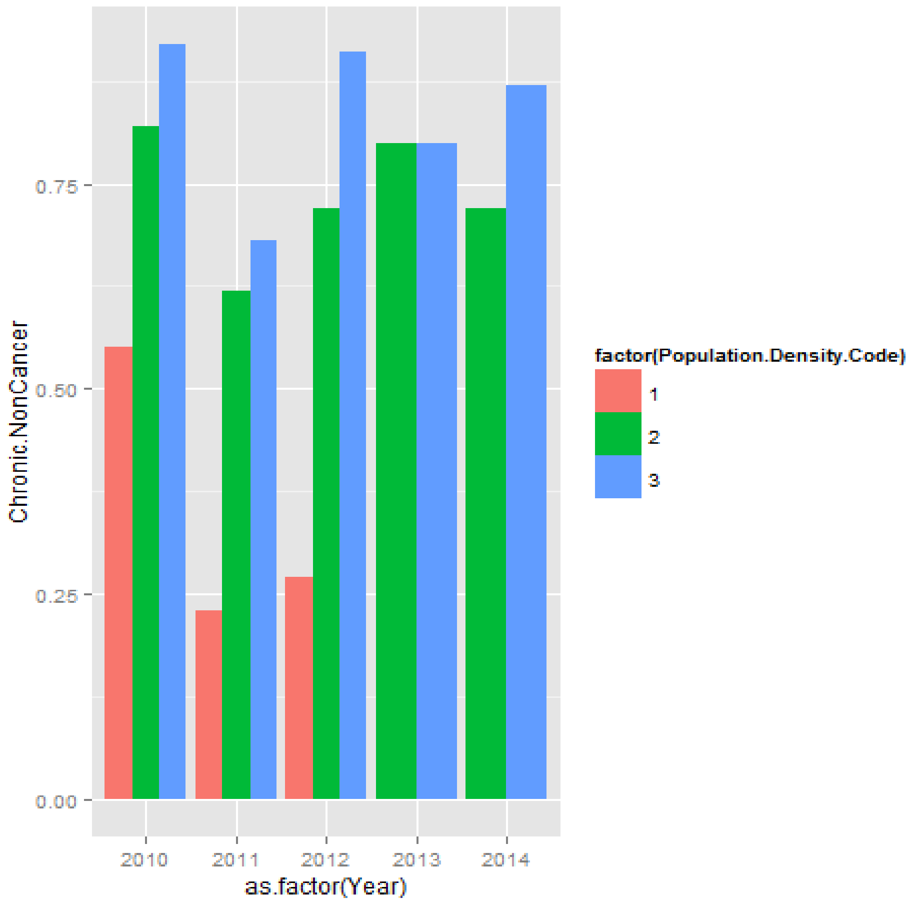
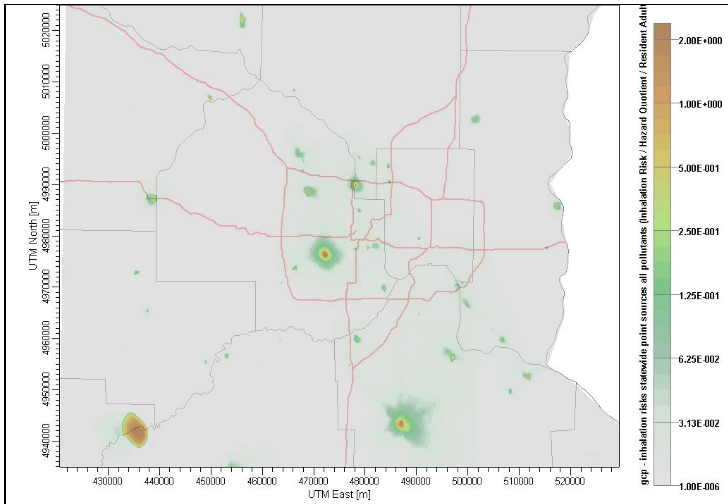


Figure 15: Estimated chronic hazard indices (non-cancer) by population density.

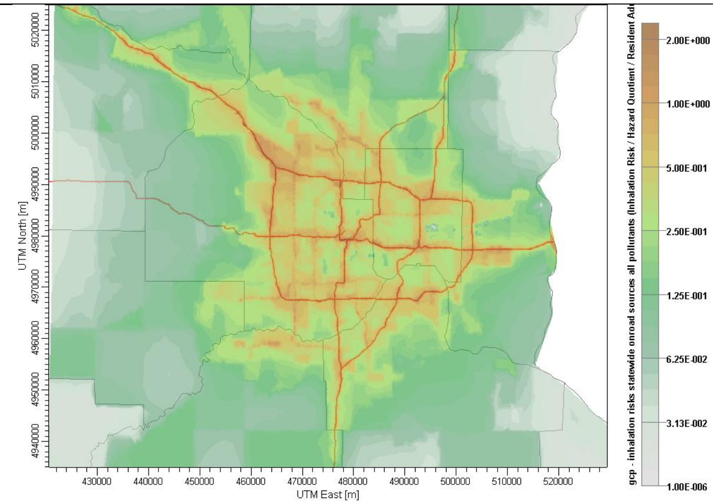
Air quality for air toxics modeled in one area described by the statute

Although the monitored air toxics data may be used to compare between population densities or over a range of time where measurements were made, they do not provide information on the major source contributions. The state of Minnesota has developed a risk screening tool, identified as "MNRiskS" to provide further information about air pollutant sources and estimated impacts. Minnesota Risks Screening Tool (MNRiskS) is a computer software program that incorporates all available air emissions data (2011 Emissions Inventory) for Minnesota including area, mobile, non-road and point sources. MNriskS includes air dispersion models to calculate air concentrations and human health databases to estimate potential human health risks.

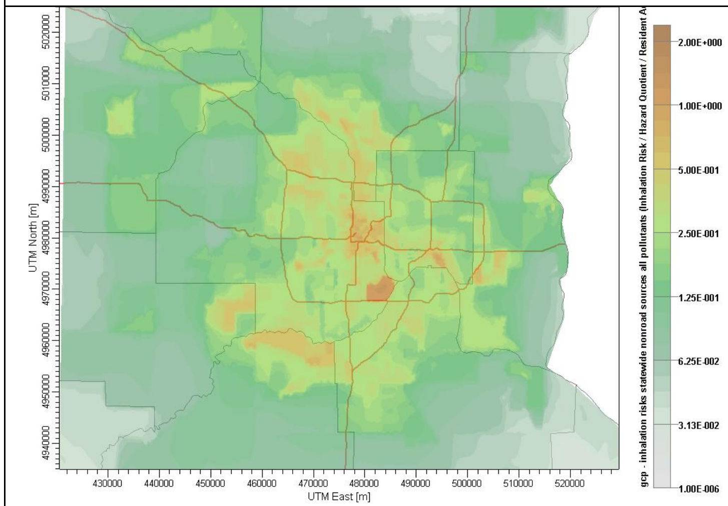
Figure 16 presents a series of images depicting modeled air toxics (air pollutants without federal ambient air quality standards) concentrations in the Twin Cities Metro Area. These modeled concentrations have used the "resident" human exposures scenario. The assumptions under this exposure scenario include the resident breathing outdoor air, eating home grown produce and having some indirect ingestion of soil (through dust from track in, etc.). These data have been provided in the following charts for source types (on-road, non-road, area, point and all sources) and for both cancer and non-cancer endpoints. Following the source contribution discussion will be a discussion of risk driver pollutants as estimated by MNRiskS modeling. One must remember that not all modeled pollutants are measured in the Twin Cities Metro Area or on a statewide basis in Minnesota.



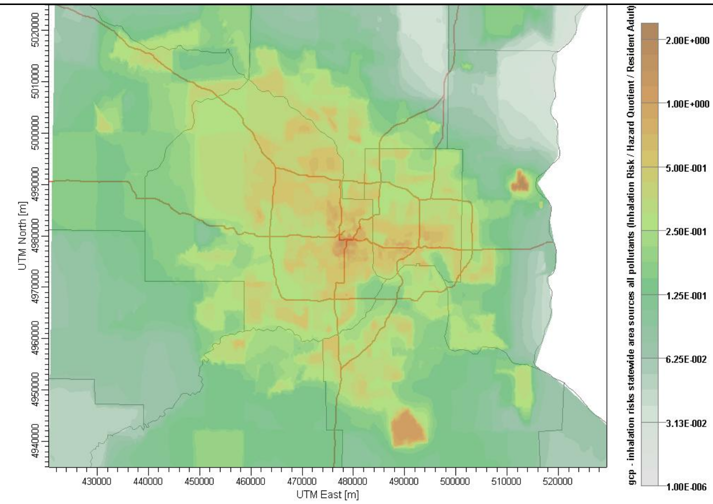
Estimated non-cancer chronic hazard indices from point sources



Estimated inhalation non-cancer risks from on-road mobile sources



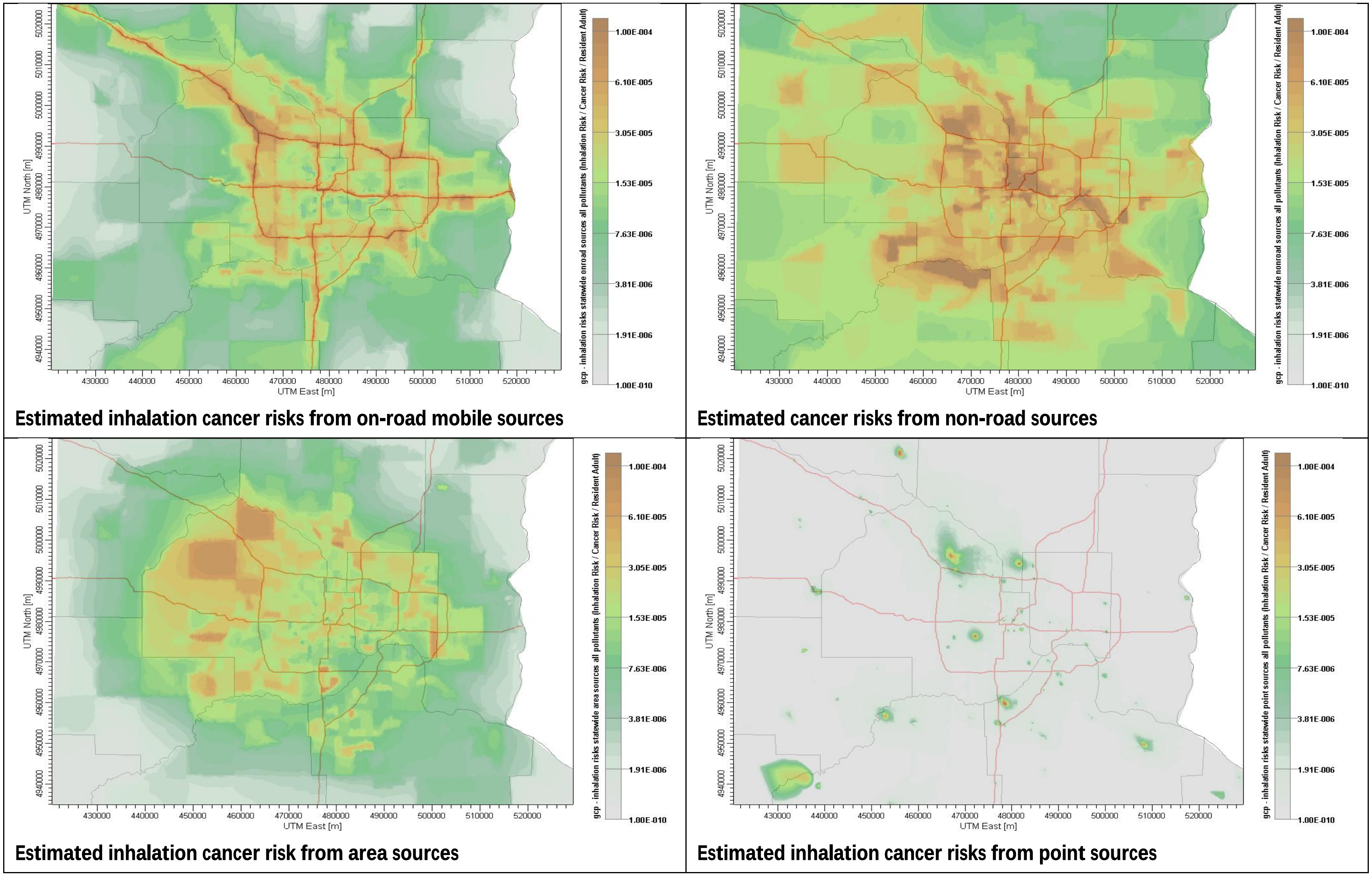
Estimated non-cancer chronic hazard indices from non-road mobile sources



Estimated inhalation non-cancer risks from area sources

As can been seen in Figure 16, mobile and area sources contribute a large portion of the estimated non-cancer chronic Hazard Indices. Mobile sources include on-road and off-road vehicles including cars, trucks, buses and construction vehicles. Area sources include gas stations, airports, etc. Much of the area source variation is dependent on population density (e.g. where there are more people, there tend to be more gas stations, larger airports, etc.). The next series of images, Figure 17, present the inhalation cancer endpoint. These images show similar source contributions as non-cancer estimates. The scale is the same in each image. Area, mobile and non-road sources of emissions have greater estimated impacts than point sources in the Twin Cities.

Figure 16: Series of images depicting inhalation non-cancer risks from different source types. All non-cancer hazard indices are represented by the same color scale in each figure. The higher estimated non-cancer inhalation hazard indices are orange, and the lower are green.



Estimated inhalation cancer risks from on-road mobile sources

Estimated cancer risks from non-road sources

Estimated inhalation cancer risk from area sources

Estimated inhalation cancer risks from point sources

Figure 17: Series of images depicting inhalation cancer risks from different source types. All cancer risks are represented by the same color scale in each figure. Higher estimated inhalation cancer risks are orange, and the lower are green.

Risk driver pollutants specific to the area described by Minn. Stat. § 116.07, subd. 4a were found using the MNRiskS software program. First, all of the air emissions sources within Hennepin County and Ramsey County were modeled for the resident exposure scenario. The residential exposure scenario assumes consumption of home grown vegetables, inhalation of outdoor air, and some incidental ingestion of soil. Next, all of these results were pared down to include only the area within approximately 1.5 miles from the center of the South Minneapolis Residential Soil Exposure Site. A value of 1.6 miles was used as the radius to include all potential receptors within 0.5 miles of the outer perimeter of the sampling area used in the South Minneapolis Residential Soil Exposure Site. Next the results were pared down further to include only those pollutants that were modeled above risk driver levels (an estimated risk of 1 additional cancer case in a population of a million and a hazard quotient of 0.1). These risk driver pollutants are identified in the Table 3.

Table 3: Risk driver pollutants as modeled by MNRiskS for an area described by the statute. Risk drivers are defined in this context as an estimated risk that is 10% of a facility risk guideline (one in 100,000 for cancer and one for hazard indices).

Non-cancer risk drivers for the area described by Minn. Stat. § 116.07, subd. 4a *(Endpoint is included parenthetically)*		**Cancer risk drivers for the area described by Minn. Stat. § 116.07, subd. 4a *(Cancer is included as a summation, and is not broken into endpoints)***
1,3 Butadiene	(reproductive system)	1,3 Butadiene
Acrolein	(respiratory)	Benzene
Diesel Particulate Matter*	(respiratory)	Lead
Formaldehyde	(respiratory)	Nickel
Nickel	(respiratory, hemapoetic)	Chromium, hexavalent
Benzene	(decreased lymphocyte count)	Diesel Particulate Matter*
Chromium, hexavalent	(respiratory)	Formaldehyde
		Naphthalene

*As modeled from primary $PM_{2.5}$ emissions

The data that are reported above are depicted in data Tables 4 and 5 below. The summed inhalation hazard indices and cancer risks presented in these tables were averaged by census tract, Hennepin County, and statewide. Two models are compared side by side in these tables; the MNRiskS tool and the National Air Toxics Assessment (NATA) (http://www.epa.gov/ttn/atw/natamain/). The data from these models represent the 2011 emissions inventory. A major difference in the outcomes of the two models is the inclusion of a cancer unit risk for diesel particulate matter in MNRiskS, where there was no inclusion of this assessment in the NATA. Diesel particulate matter tends to be a risk driver (i.e. higher than 10% of a general risk guideline reference point of one for cancer and non-cancer) when this unit risk factor is used, although the value is very uncertain and not widely agreed upon. There are different modeling, emissions estimations and toxicity values used so these data convey an estimate of risk as well as communicate the level of uncertainty that is inherent in such estimates. Estimated cancer risks are reported as the risk of additional cases of cancer in a population of 100,000, divided by 100,000. Therefore, a cancer risk of one as reported in Table 4 and 5 would suggest a risk of one additional cancer in a population of 100,000. Hazard indices are a sum of multiple hazard quotients for multiple substances with the same or similar toxic endpoints. Each hazard quotient is the ratio of a single substance's exposure level to an inhalation health benchmark.

Table 4: Estimated inhalation cancer risks from modeled air pollutants. Cancer risks are presented as the risk of an additional cancer in a population of 100,000. Both the MNRiskS and the NATA data represent the emissions inventory from 2011. The following MNRiskS data are subject to update once MNRiskS 2011 is final.

Geographic_area	Area		NonRoad		OnRoad		Point		Total	
	MNRiskS	NATA	MNRiskS	NATA	MNRiskS	NATA	MNRiskS	NATA	MNRiskS	NATA
27053005901	2E-04	1E-05	2E-04	7E-06	4E-04	4E-05	8E-06	3E-06	8E-04	9E-05
27053005902	2E-04	1E-05	2E-04	6E-06	3E-04	3E-05	7E-06	3E-06	8E-04	7E-05
27053007801	4E-04	1E-05	2E-04	5E-06	3E-04	2E-05	2E-05	1E-05	8E-04	7E-05
27053008300	3E-04	1E-05	1E-04	4E-06	3E-04	2E-05	1E-05	6E-06	7E-04	7E-05
27053008400	1E-04	1E-05	1E-04	4E-06	2E-04	2E-05	8E-06	4E-06	5E-04	6E-05
27053008500	1E-04	1E-05	1E-04	4E-06	2E-04	2E-05	6E-06	2E-06	4E-04	6E-05
27053009500	1E-04	1E-05	1E-04	4E-06	2E-04	2E-05	5E-06	2E-06	4E-04	6E-05
27053009600	1E-04	1E-05	1E-04	4E-06	1E-04	1E-05	5E-06	2E-06	4E-04	5E-05
27053104800	2E-04	1E-05	2E-04	7E-06	3E-04	2E-05	7E-06	3E-06	7E-04	7E-05
27053104900	2E-04	1E-05	2E-04	6E-06	2E-04	2E-05	7E-06	2E-06	6E-04	6E-05
27053105400	2E-04	1E-05	2E-04	1E-05	3E-04	3E-05	9E-06	3E-06	7E-04	8E-05
27053105700	3E-04	1E-05	2E-04	7E-06	4E-04	3E-05	7E-06	3E-06	9E-04	8E-05
27053106000	2E-04	1E-05	1E-04	5E-06	3E-04	2E-05	7E-06	2E-06	7E-04	7E-05
27053106200	2E-04	1E-05	2E-04	5E-06	3E-04	2E-05	6E-06	2E-06	7E-04	6E-05
27053106400	1E-04	1E-05	1E-04	4E-06	2E-04	2E-05	6E-06	2E-06	5E-04	6E-05
27053106900	3E-04	1E-05	2E-04	7E-06	3E-04	2E-05	8E-06	4E-06	7E-04	7E-05
27053107400	9E-05	1E-05	1E-04	5E-06	1E-04	1E-05	5E-06	2E-06	4E-04	5E-05
27053107500	1E-04	1E-05	1E-04	5E-06	2E-04	2E-05	5E-06	2E-06	4E-04	6E-05
27053107600	8E-05	1E-05	1E-04	4E-06	1E-04	1E-05	6E-06	1E-06	3E-04	5E-05
27053108600	2E-04	1E-05	1E-04	4E-06	2E-04	2E-05	5E-06	2E-06	5E-04	6E-05
27053108700	4E-04	1E-05	1E-04	4E-06	2E-04	1E-05	5E-06	2E-06	7E-04	5E-05
27053108800	1E-04	1E-05	1E-04	4E-06	1E-04	2E-05	5E-06	1E-06	4E-04	5E-05
27053108900	8E-05	1E-05	1E-04	4E-06	1E-04	1E-05	5E-06	1E-06	3E-04	5E-05
27053109700	3E-04	1E-05	1E-04	4E-06	1E-04	1E-05	5E-06	2E-06	6E-04	5E-05
27053110100	1E-04	1E-05	1E-04	4E-06	1E-04	1E-05	5E-06	1E-06	4E-04	5E-05
27053110200	2E-04	1E-05	1E-04	4E-06	1E-04	1E-05	5E-06	1E-06	4E-04	5E-05
27053125600	2E-04	1E-05	2E-04	5E-06	2E-04	2E-05	5E-06	2E-06	5E-04	5E-05
27053125800	2E-04	1E-05	2E-04	6E-06	2E-04	2E-05	8E-06	2E-06	5E-04	6E-05
27053125900	1E-04	1E-05	1E-04	5E-06	2E-04	2E-05	6E-06	2E-06	5E-04	6E-05
27053126000	2E-04	1E-05	2E-04	6E-06	3E-04	2E-05	1E-05	5E-06	6E-04	7E-05
27053126100	1E-04	2E-05	2E-04	1E-05	3E-04	4E-05	8E-06	3E-06	6E-04	9E-05
Hennepin County	4E-05	1E-05	1E-04	4E-06	1E-04	1E-05	4E-06	1E-06	3E-04	5E-05
Statewide	1E-05	8E-06	4E-05	2E-06	4E-05	8E-06	9E-05	8E-07	2E-04	4E-05

Table 5: Estimated inhalation non-cancer hazard indices from modeled air pollutants.

Geographic_area	Area		NonRoad		OnRoad		Point		Total	
	MNRiskS	NATA	MNRiskS	NATA	MNRiskS	NATA	MNRiskS	NATA	MNRiskS	NATA
27053005901	3	2	0.4	0.6	1	4	0.8	0.10	6	8
27053005902	3	2	0.4	0.6	1	2	0.9	0.10	6	6
27053007801	5	2	0.4	0.5	0.8	2	4	0.25	10	5
27053008300	4	2	0.4	0.5	1	2	2	0.15	8	5
27053008400	2	2	0.4	0.5	0.9	1	2	0.12	5	4
27053008500	2	2	0.4	0.5	0.6	1	0.8	0.10	4	4
27053009500	2	2	0.4	0.5	0.7	1	0.6	0.09	4	4
27053009600	2	2	0.4	0.5	0.5	1	0.6	0.09	3	4
27053104800	3	2	0.4	0.6	1	2	0.7	0.11	5	6
27053104900	2	2	0.5	0.5	0.7	2	0.8	0.12	5	5
27053105400	3	3	0.4	0.8	1	3	0.8	0.11	5	7
27053105700	4	2	0.5	0.7	1	3	0.8	0.10	7	6
27053106000	3	2	0.4	0.5	1	2	0.8	0.10	5	5
27053106200	3	2	0.4	0.5	0.9	2	0.6	0.10	5	5
27053106400	2	2	0.3	0.5	0.8	2	0.5	0.10	4	5
27053106900	4	2	0.4	0.6	0.8	2	1	0.12	7	5
27053107400	1	2	0.3	0.5	0.5	1	0.4	0.10	3	4
27053107500	2	2	0.3	0.5	0.6	1	0.5	0.10	3	5
27053107600	1	2	0.3	0.5	0.5	1	0.3	0.10	3	4
27053108600	3	2	0.4	0.5	0.7	1	0.5	0.09	5	4
27053108700	5	2	0.3	0.5	0.7	1	0.4	0.10	7	4
27053108800	2	2	0.3	0.5	0.6	1	0.4	0.11	3	4
27053108900	1	2	0.3	0.5	0.4	1	0.3	0.10	3	4
27053109700	4	2	0.4	0.5	0.5	1	0.6	0.09	6	4
27053110100	2	2	0.4	0.6	0.5	1	0.4	0.09	3	4
27053110200	2	2	0.4	0.6	0.5	1	0.4	0.10	4	4
27053125600	2	2	0.4	0.5	0.6	1	0.6	0.11	4	5
27053125800	2	2	0.4	0.6	0.7	1	0.8	0.10	4	4
27053125900	2	2	0.3	0.6	0.9	1	0.7	0.10	4	5
27053126000	2	2	0.4	0.7	0.8	2	2	0.13	6	5
27053126100	2	3	0.4	0.9	1	3	0.8	0.11	5	8
Hennepin County	0.7	2	0.3	0.4	0.4	1	0.3	0.09	2	4
Statewide	0.3	0.9	0.1	0.2	0.2	0.7	0.2	0.07	0.9	2

Air quality alert days in the Twin Cities

The method for estimating the air quality index (AQI), and the ranges (break points) that are used to determine air quality alert days, is based on a summary of measured air concentrations in relation to federal and state standards. Although the air quality alert days are based on regulatory standards, they are not in and of themselves required by or developed under state or federal rules. The methods used to estimate the AQI changes over time depending on new information, new methods of measurements, or new guidelines or rules proposed through the EPA. In looking at the number of air quality alert days in Figure 18, some of the changes may be based on increases or decreases in emissions, but many times major changes in the number of alert days depend on methodological or meteorological changes such as stagnation of ambient air.

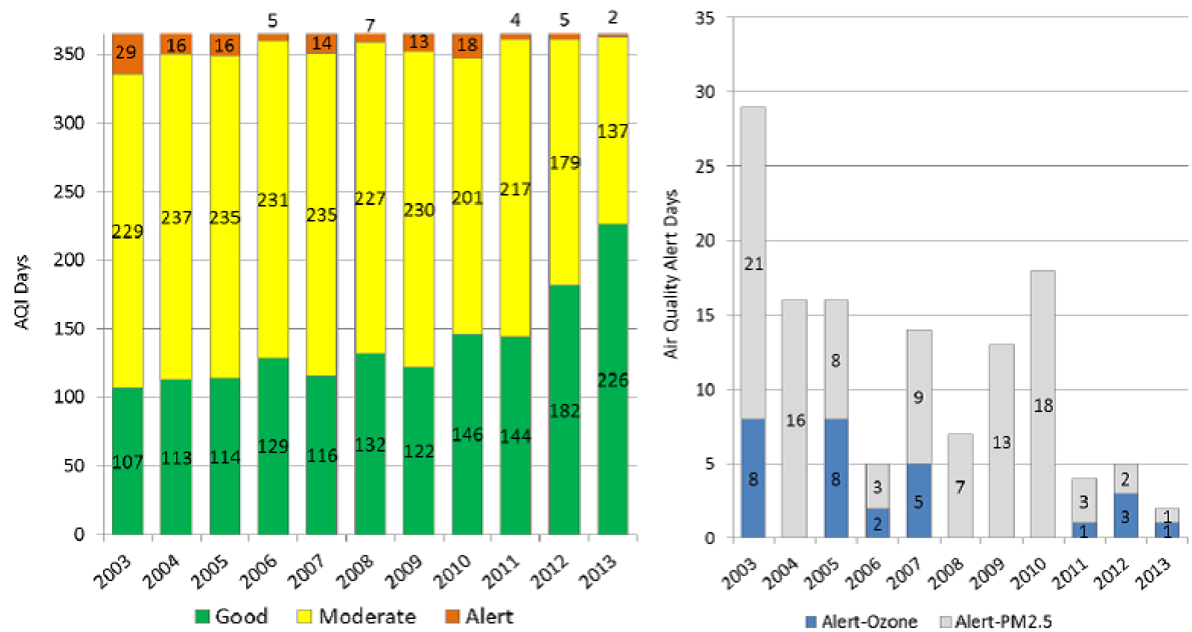
Monitors used to provide measurements for determining air quality alert days are strategically placed in order to capture regional air quality information and are therefore of limited use for site specific analyses (map of air monitoring locations: http://www.pca.state.mn.us/3y8k8q3). Air quality alert days are summarized for the Twin Cities Metro Area, and cannot be defined for smaller areas due to limitations in the placement and number of ambient air monitors. Generally the values used to estimate an AQI are not expected to have a large spatial variation within an urban area due to the characteristics of some measured pollutants (e.g. $PM_{2.5}$ and ozone tend to be regional and are formed in the air and are not always emitted directly). An AQI is reported in a scale from 0 to 300. Gradations of these values communicate various risk levels for the air quality of the day along with recommendations for various susceptible populations. In Minnesota, the color legend for AQI days are shown in Table 6 and described as follows: an AQI value from 0 to 50 is good quality, 51 to 100 is moderate quality, 101-150 is unhealthy for sensitive groups, 151-200 is unhealthy, and 201-300 is very unhealthy. These break points changed in April of 2008, potentially resulting in more air quality alert days due to the more stringent break points.

Table 6: Scale used for air quality alert days.

Good	0-50
Moderate	51-100
Unhealthy for Sensitive Groups	101-150
Unhealthy	151-200
Very Unhealthy	201-300

Air quality alert days are reported statewide and for the Twin Cities, Figures 18 and 19. Some of the major sources of these measures of air quality (fine particles, ground-level ozone, sulfur dioxide and carbon monoxide) are associated with mobile sources (cars and trucks) and therefore would be more prevalent in more populated areas such as the Twin Cities.

AQI and air quality alert days in the Twin Cities



Trend in statewide AQI days

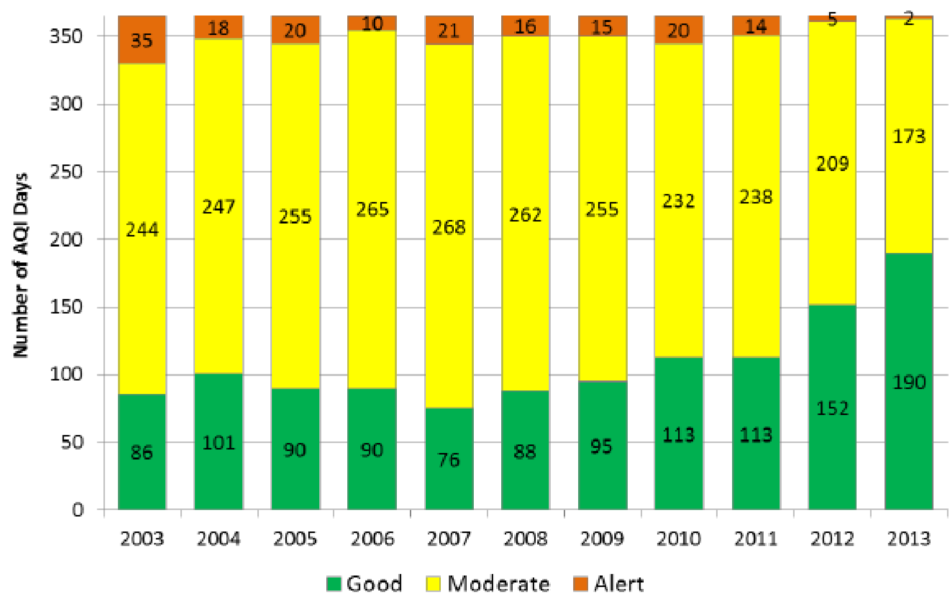


Figure 18: Air Quality Index results for the Twin Cities and statewide.

Surface water assessments

There are two waterbodies identified in the area described by the statute: the Mississippi River and Powderhorn Lake. Data and reports regarding surface water assessments may be found at http://cf.pca.state.mn.us/water/watershedweb/wdip/index.cfm for both lakes and streams.

Available fish tissue data for Minneapolis

Although the data in Table 7 describe an ingestion related exposure route, the majority of mercury is from atmospheric origin. Moreover, the majority of atmospheric mercury in Minnesota originates from outside of the state. Fish tissue data are available for polychlorinated biphenyls and mercury for the following fishable waterbodies in Minneapolis: Harriet, Mississippi River, Nokomis, Hiawatha, Lake of the Isles, Cedar, and Calhoun. The 95th percentile upper confidence limit of the arithmetic mean was calculated using EPA ProUCL software. The table below presents the data and the estimated risks from intake of fish from lakes in Minneapolis using various exposure scenarios.

Table 7: Estimated non-cancer hazard quotients for two generic exposure scenarios.

	95th% upper confidence limit of the mean (mg/g)	Subsistence Fisher Non Cancer Hazard Index (approximately 2 pounds a week for approximately 30 years)	Recreational Fisher Non Cancer Hazard Index (approximately one half pound a week for approximately 30 years)
Mercury	0.43	9	2
Polychlorinated Biphenyls	0.72	< risk driver levels**	< risk driver levels
Cadmium*	0.007	< risk driver levels	

*There was only one detected level of cadmium in this data set, no average or summary was made of this one data point. Cadmium was detected in one out of 32 total samples in Lake Harriet.

**A risk driver is defined as an estimate of risk for a single pollutant that is 10% of a general risk guideline. These risk guidelines used in Minnesota are the risks of 1 additional case of cancer in a population of a million people (1 in 1,000,000) or a ratio between the exposure concentration and a known level at which effects have not been seen of 0.1 for non-cancer endpoints.

The data and estimated risks in the table above are not significantly different for the city of Minneapolis and the rest of the state.

Statewide Safe Eating Guidelines for fish were developed to limit human exposures to mercury and PCBs. These guidelines are found on the MDH website (http://www.health.state.mn.us/divs/eh/fish/eating/safeeating.html) and are separated by the type and size of fish. Smaller Minnesota-caught fish such as sunfish, crappie, yellow perch, etc. should be limited to one meal per week. Medium sized Minnesota-caught fish such as bass, catfish, and walleye shorter than 20 inches should be limited to one meal per month. Larger Minnesota-caught fish should not be eaten (e.g. walleye longer than 20 inches or northern pike longer than 30 inches, etc.).

Fish tissue concentration data, similar to the fish tissue concentration data in Table 7, are used to develop safe eating guidelines. The data can also be used to estimate human health risks based on an assumed level of consumption, or to calculate a safe consumption level based on an acceptable level of risk. The assumptions used in both of these calculations are intended to be health protective since there are no specific fish consumption rate data for the area described by the statue (e.g. Powderhorn Lake, Mississippi River, etc.)

Drinking water quality

Residents of the area described by the state have drinking water available to them through the city of Minneapolis, unless they drink bottled water. Annual drinking water quality reports are available through the city at the following URL (http://www.ci.minneapolis.mn.us/water/). The 2014 data are used to generate the 2015 Drinking Water Quality Report which is shown in Figure 19.

Minneapolis 2014 Monitoring Results

Contaminant (units)	MCLG	MCL	Level Found Range (2014)	Average Result	Typical Source of Contaminant	Meets Standard
Fluoride (ppm)	4	4	.95 - 1	.97	State of Minnesota requires all municipal water systems to add fluoride to the drinking water to promote strong teeth; Erosion of natural deposits; Discharge from fertilizer and aluminum factories.	✓
Haloacetic Acids (HAA5) (ppb)	0	60	1.3 - 52	24.85	By-product of drinking water disinfection.	✓
Nitrate (as Nitrogen) (ppm)	10.4	10.4	N/A	.19	Runoff from fertilizer use; Leaching from septic tanks, sewage; Erosion of natural deposits.	✓
TTHM (Total Trihalomethanes) (ppb)	0	80	7.9 - 61.2	26.03	By-product of drinking water disinfection	✓
Total Coliform Bacteria	0 present	>5% present	N/A	1%*	Naturally present in the environment.	✓
Turbidity (NTU)	N/A	TT	100% for the lowest % of compliance	0.19 NTU Highest Measurement	Soil runoff	✓
Chlorine (ppm)	4 MRDLG	4 MRDL	0.5 - 3.9 Lowest and Highest Individual Result	3.4 Highest Running Annual Average	Water additive used to control microbes.	✓
Total Organic Carbon	25% - 30% Removal Required		Quarters below removal rate=0	43.5-60.0% Removal Achieved	Naturally present in the environment.	✓
Copper (ppm) (7/26/12)	1.3	1.3 AL	90% Level .07	0 out of 50 sites over AL	Corrosion of household plumbing systems; Erosion of natural deposits.	✓
Lead (ppb) (7/26/12)	0	15 AL	90% Level 3.2	1 out of 50 sites over AL	Corrosion of household plumbing systems; Erosion of natural deposits.	✓

TURBIDITY *is a measure of the water clarity. We monitor it because it is a good indicator of the effectiveness of our filtration system.*

*** 5 OUT OF 2180 SAMPLES** *were positive for total coliforms. Follow-up sampling showed no contamination present.*

Figure 19: Taken directly from the city of Minneapolis Drinking Water Quality Report from 2015.

The city of Minneapolis monitors drinking water quality that is delivered to homes, but cannot guarantee that there is not additional lead burden from plumbing or other potential contaminants. To minimize potential for lead exposures, and other exposures that may originate from the path water takes once inside a residence (e.g. plumbing) residents are told to run tap water for 30 seconds to 2 minutes before using drinking water for cooking or drinking.

Land-based hazard indicators

The South Minneapolis Residential Arsenic Exposure Site

The cumulative levels and effects analysis required by Minn. Stat. § 116.07, subd. 4a should include information pertaining to Superfund sites and potential risks from those sites. The largest site, and only federal Superfund site, in this area of Minneapolis is the Residential Arsenic Exposure Site (formerly the CMC Heartland Partners Lite Yard Site). This site has been subject to multiple studies and a large remediation effort by the EPA. The remediation process incorporating assumptions for acute and chronic exposures was completed during the summer of 2011. The pre-remediation soil contamination levels are depicted in Figure 20. An investigation of background concentrations of arsenic was conducted for this area, and background arsenic soil concentrations were determined to be approximately 16 parts per million (ppm). The value of 16 ppm of arsenic in soil has an estimated potential cancer risk of 6 additional cases of cancer in a population of 100,000 people (http://www3.epa.gov/region5/superfund/npl/sas_sites/minnesota/MNN000509136.html). Arsenic levels higher than 25 ppm in soil were determined to be subject to clean up with clean replacement fill, since 25 ppm (estimated potential cancer risk: one additional cancer in a population of 10,000 people) would be approximately equal to background concentrations (16 ppm). The remediation status as of summer of 2011 is depicted in Figure 21, where blue sites are completed construction sites.

Figure 20: Initial arsenic surface sampling results.

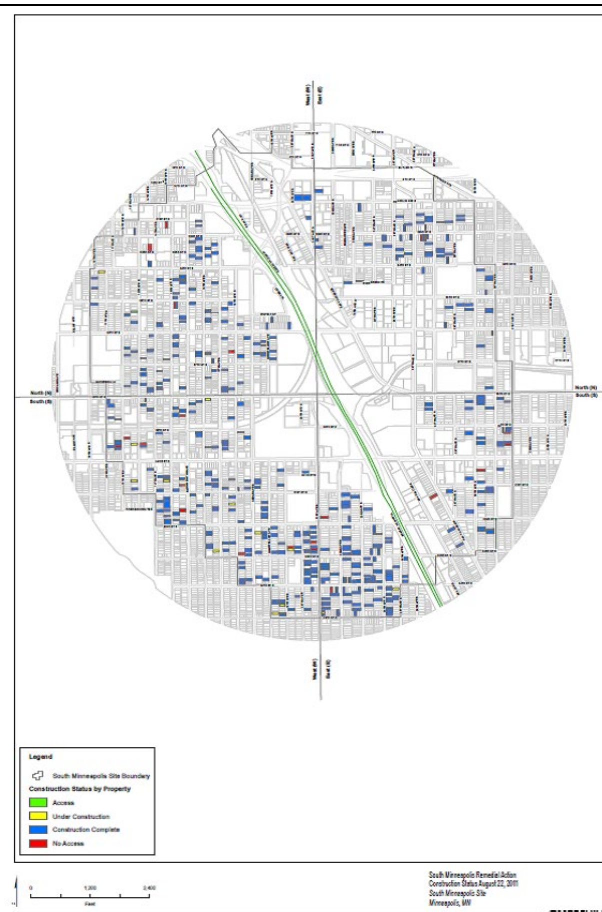


Figure 21: Remediation status as of August 22, 2011.

Other sites in the area described by Minn. Stat. § 116.07, subd. 4a

There are several categories and classifications used by the MPCA to describe or define active sites that may impact the health of the population and the environment in the area described by the Minn. Stat. § 116.07, subd. 4a. In addition to the federal superfund site within the area described by the Minn. Stat. § 116.07, subd. 4a, there are also state superfund sites; Voluntary Investigation and Cleanup (VIC) sites; leak sites and other remediation sites. Others are small sites that may produce hazardous wastes such as paints or ink cartridges that are then shipped off site. All of these sites are included in the MPCA's database called "What's In My Neighborhood" (https://www.pca.state.mn.us/data/whats-my-neighborhood). A brief description of the types of sites located in the area described by Minn. Stat. § 116.07, subd. 4a follows.

Once a permit applicant has identified their facility's Study Area, the MPCA's "What's in My Neighborhood" may be used to determine potential sites to discuss in the Cumulative Levels and Effects Analysis. MPCA's "What's In My Neighborhood" contains information and points to resources for further inquiry of known sources of past and current environmental pollution. Other tools may be used to identify sites located within a facility's area of study, including a spreadsheet that is included with the Minn. Stat. § 116.07, subd. 4a materials supplied by MPCA staff. Sites regulated under the following programs are found within the area described by the statute.

Sites with potential for groundwater pollution should be discussed only if there is a potential for inhalation exposure through vapor intrusion. The assumption can be made that residents within the area described by the Minn. Stat. § 116.07, subd. 4a drink municipal city of Minneapolis water.

Air emissions facilities

Sites that are identified and permitted by the MPCA as air emissions facilities, have been modeled in the MNRiskS and generally do not need to be independently analyzed and considered for this cumulative levels and effect analysis. MPCA staff may be contacted if specific sites are in question as to their inclusion or exclusion in MNRiskS.

Hazardous waste generators

In Minnesota, commercial entities that produce any amount of hazardous waste are regulated as hazardous waste "generators" with requirements that depend upon the amount of waste they produce. These requirements are part of the federal Resource Conservation and Recovery Act (RCRA) and Minnesota Hazardous Waste rules. These rules are designed to protect residents and the environment from the effects of improper management of hazardous wastes from commercial sources. It is unlikely there would be environmental and/or residential exposure due to properly managed hazardous waste. (For more information, please see: https://www.pca.state.mn.us/waste/hazardous-waste).

Hazardous Waste Generators in Minneapolis are regulated through Hennepin County. Information on Hennepin County's program may be found at http://www.hennepin.us/business/recycling-hazardous-waste/hazardous-waste-licensing-renewal.

MPCA provides a fact sheet on Basic Requirements for Businesses: https://www.pca.state.mn.us/sites/default/files/w-hw1-00.pdf.

Water

These sites would be analyzed in relation to their potential impact on the environment. In consideration of human health, the residents of the area described by the Minn. Stat. § 116.07, subd. 4a drinking water exposures are from municipal drinking water only. Their drinking water is supplied and monitored by the city of Minneapolis, and this has been discussed previously (section Drinking Water Quality).

There are several stormwater sites in the area described by Minn. Stat. § 116.07, subd. 4a. These sites are regulated under the construction, industrial and municipal stormwater programs. More information about these programs can be found at: http://www.pca.state.mn.us/water/stormwater/index.html.

Industrial stormwater

This program is the regulatory mechanism to reduce, minimize, or eliminate contaminated stormwater discharge so that water quality standards are met. This is accomplished through the facility's implementation of stormwater control measures, and through benchmark monitoring and effluent limit monitoring of the stormwater discharges for pollutants that are specific to each of the twenty-nine different industrial sectors. Stormwater discharge monitoring results compared against specified benchmark monitoring results are used to guide adaptive management of the facility's stormwater control measures. As a result, there is assurance that if a facility has effective stormwater control measures and benchmark values are met, the facility's stormwater discharges will not cause or contribute to an exceedance of water quality standards.

Construction stormwater

When stormwater drains off a construction site, it carries sediment and other pollutants that harm lakes, streams and wetlands. According to the 1996 National Water Quality Inventory, stormwater runoff is a leading source of water pollution. The EPA estimates that 20 to 150 tons of soil per acre is lost every year to stormwater runoff from construction sites. To keep Minnesota's valuable water resources clean the MPCA issues permits to construction site owners and their operators to prevent stormwater pollution during and after construction.

Stormwater program for Municipal Separate Storm Sewer Systems (MS4)

Stormwater program for MS4s is designed to reduce the amount of sediment and pollution that enters surface and groundwater from storm sewer systems to the maximum extent practicable. Stormwater discharges associated with MS4s are regulated through the use of National Pollutant Discharge Elimination System (NPDES) permits.

Tank sites

Above-ground storage tanks (ASTs) in the area described by the Minn. Stat. § 116.07, subd. 4a are regulated by MPCA to prevent spills and leaks by providing storage tank owners with various safeguard options. These options include safeguards such as: secondary containment to minimize the impact of a release, corrosion protection and overfill prevention to prevent releases, and tank monitoring for leak detection. The level of protection needed depends on the type of product stored, the size of the tank, and the date that the tank was installed. Aboveground tank link: https://www.pca.state.mn.us/waste/aboveground-storage-tank-systems.

Underground storage tanks (USTs) are in use in the area described by Minn. Stat. § 116.07, subd. 4a. The UST program was created to help prevent contamination caused by leaking tanks. Design and operating rules for regulated USTs include tank and piping corrosion protection; overfill prevention, dispenser and pump containment, cathodic protection system testing, release detection, and other requirements. A brief summary of the requirements and links to forms and fact sheets can be found at the following website: http://www.pca.state.mn.us/cleanup/ust.html.

Remediation sites

There are several sites identified with soil and/or groundwater contamination in the area described by Minn. Stat. § 116.07, subd. 4a. These sites are regulated through the following programs. The MPCA has developed guidance outlining a risk-based approach to decision making during site investigation and remedy selection under the state's VIC and Superfund programs. This guidance is available athttps://www.pca.state.mn.us/waste/cleanup-guidance.

EPA Superfund sites

One EPA Superfund site has been identified in the area to date and is discussed above. The CMC Heartland Lite Yard site (plant site) was located on five acres at the northwest corner of the intersection of Hiawatha Avenue and 28th Street. Several companies produced pesticides at the plant from 1938 to 1968. In the Superfund program, the site is called the South Minneapolis Residential Soil Contamination Site http://cumulis.epa.gov/supercpad/cursites/csitinfo.cfm?id=0509136.

State Superfund sites (PLPs)

The Superfund program identifies, investigates, and determines appropriate cleanup plans for abandoned or uncontrolled hazardous waste sites where a release or potential release of a hazardous substance poses a risk to human health or the environment. Sites are placed on the state Superfund list, also known as Permanent List of Priorities (PLPs) users of the Superfund program are industries that generated or transported, and then disposed of or arranged for disposal of hazardous substances. Owners/operators of facilities where a release of hazardous materials occurred also are brought into the program. Information on the state Superfund Program may be found at https://www.pca.state.mn.us/waste/superfund-program.

At this time, no active state Superfund sites were identified in the area described by the statute.

Brownfields

Brownfields are abandoned, idled, or underused industrial and commercial properties where expansion or redevelopment is complicated by actual or suspected environmental contamination.

Assessment and cleanup of brownfield sites are generally overseen through the MPCA VIC Program, the MPCA Voluntary Petroleum Brownfields Program, or under the RCRA Corrective Action Program.

The EPA also operates a Brownfield site program.

Resource Conservation and Recovery Act

For RCRA cleanup sites, go to https://www.pca.state.mn.us/waste/resource-conservation-and-recovery-act-rcra-corrective-action.

Leak sites

Information on petroleum remediation and brownfield sites can be found at https://www.pca.state.mn.us/waste/tank-compliance-and-assistance-program. Contact project managers as needed for more information.

Information on other types of leak sites can also be searched at http://www.pca.state.mn.us/enzq88e. Contact project managers as needed for more detailed information.

Voluntary Investigation and Cleanup sites

The VIC Program site information can be found at https://www.pca.state.mn.us/waste/brownfields. Remediation site specific and information can be found in the Remediation sites with institutional controls Excel spreadsheet found near the end of the above URL. Contact project managers as needed for more detailed information.

Noise exposure (non-chemical stressor)

Noise is a non-chemical stressor that is associated with increased levels of stress and health effects such as elevation of blood pressure. State noise standards (shown in Table 8, L equals percent of an hour) are regulated by the MPCA. They are based on sleep disturbance, speech disturbance and general annoyance. At noise levels above state standards there is a potential for these effects. Noise emissions are somewhat similar to air emissions in that they can be described as point sources or line sources. The presence of buildings, walls, vegetation, etc. will result in the attenuation of perceived sound. For example, noise walls along a highway must reduce noise by at least 5 decibels in order to be approved by the Minnesota Department of Transportation (MnDOT). To put this into context, perceived loudness doubles when there is an increase in 10 decibels; where 5 decibels is defined by MNDOT as “quite noticeable”.

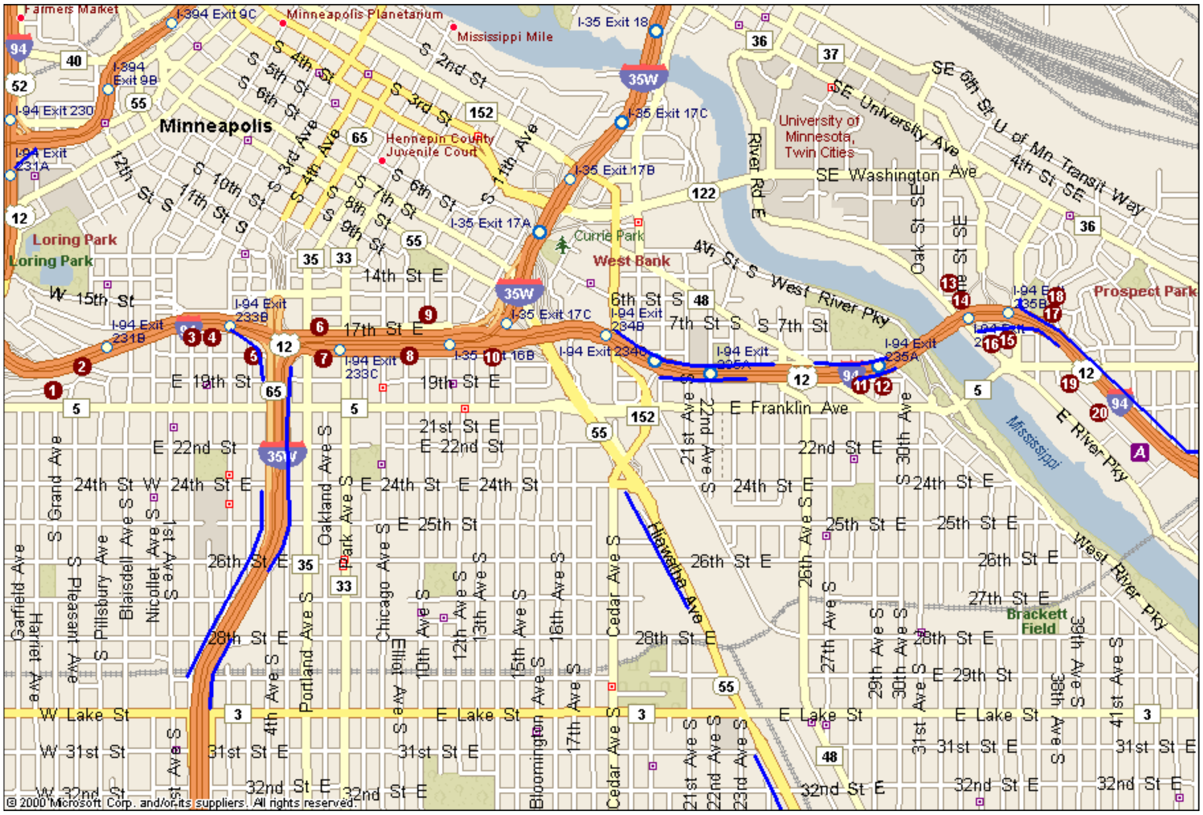
Table 8: Minnesota noise standards.

MPCA state noise standards

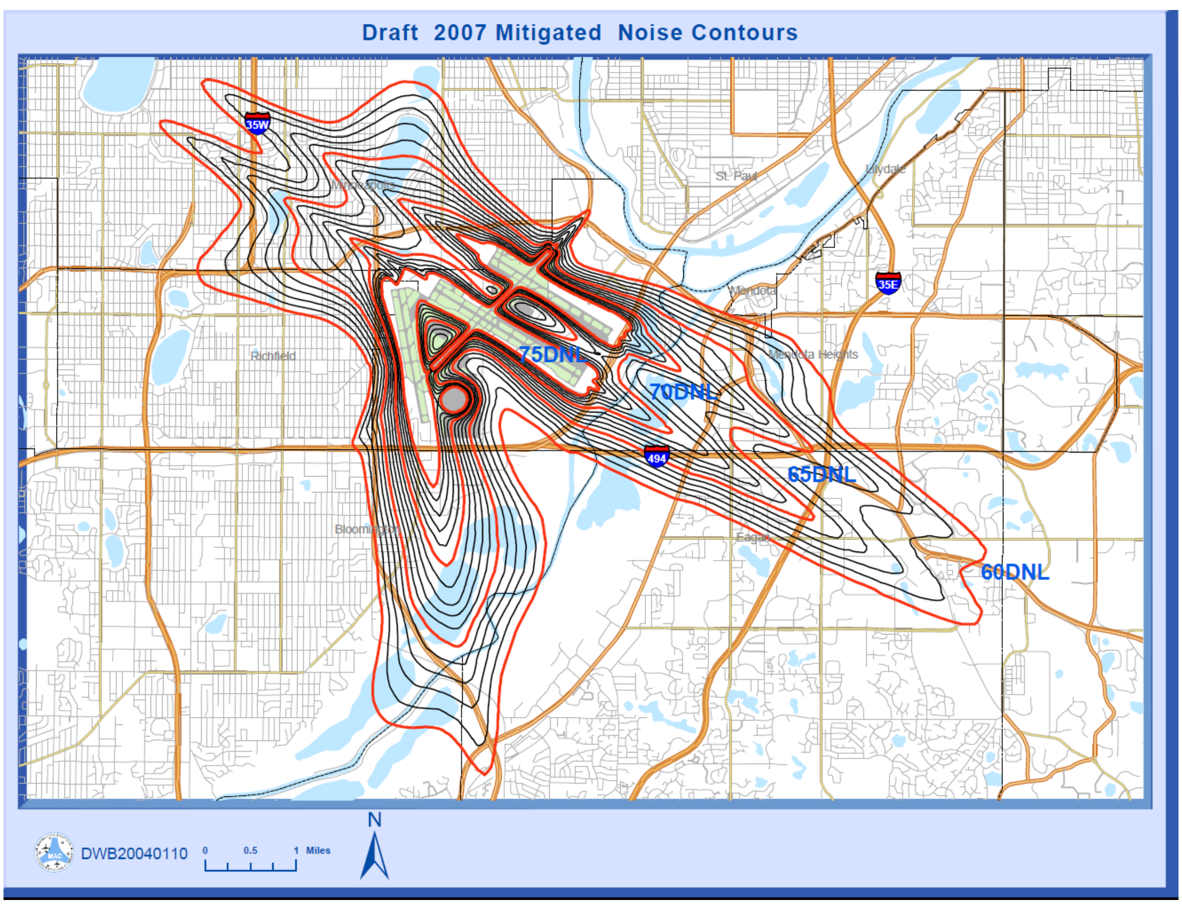
Land use	Code	Day (7:00 a.m. - 10:00 p.m.) dBA		Night (10:00 p.m. - 7:00 a.m.) dBA	
Residential	NAC-1	L10 of 65	L50 of 60	L10 of 55	L50 of 50
Commercial	NAC-2	L10 of 70	L50 of 65	L10 of 70	L50 of 65
Industrial	NAC-3	L10 of 80	L50 of 75	L10 of 80	L50 of 75

The two main sources of noise, and therefore information about noise, are from the Metropolitan Airport Commission noise programs, MNDOT noise monitors, and modeled noise exposures from roadways. The figure below includes averaged noise contours within the Metropolitan Airport Commission Settlement Area. These noise contours will vary dependent on wind direction and speed. Generally, in the Twin Cities Metro Area, airplanes tend to depart south and arrive over Minneapolis. Airplane noise is generally more localized during arrivals (ie arrivals are low to the ground, but slow and not as noisy). Airplane take offs are more dispersed but are louder. The Federal Highway Administration has a guideline for major highways of 70 decibels no more than 10% of the time (L10).

The information readily available to MPCA staff that could serve as a potential hazard indicator for noise are specific noise complaints received and documented by the MPCA.



Blue areas are noise walls. Maroon dots are noise monitoring locations.



Exposure indicators

The exposure indicators section includes data that would be considered an exposure indicator by the CDC environmental health tracking program. This is partially due to the increasing availability of various environmental health data through various environmental health tracking programs including the program in the state of Minnesota. Under this definition, exposure indicators include biomonitoring data, or the assessment of exposure through direct measurement of environmental chemicals or their metabolites in biological specimens such as blood or urine. (http://www.cdc.gov/nceh/tracking/)

Blood lead data for children

Table 8 contains zip code level summaries for blood lead data for children with test results above 5 ug/dl. Each of the zip codes in the area described by Minn. Stat. § 116.07, subd. 4a are represented. Since not all children are tested, the percentage data is a comparison of children tested and not a comparison of the whole population. The percentage data may not be compared between zip codes since the populations tested were not randomly selected. For example, one may not discuss with any statistical certainty that a value of 3.8% is higher that a value of 1.8%.

A blood lead level (BLL) above 5 ug/dl level is the CDC action level. Public health action is advised if a child has two venous test results above this concentration of lead in blood. Public health action may involve the following case management actions: visit the child's residence (and other sites where the child spends significant amounts of time) a minimum of two times, assess factors that may impact the child's BLL (including sources of lead, nutrition, access to services, family interaction, and caregiver understanding), oversee the activities of the case management team, develop a written plan for intervention, coordinate the implementation of the plan and/or evaluate compliance with the plan and the success of the plan.

Table 8: Elevated blood lead data (2014) for tested children under the age of 6 years of age for zip codes included in the area described by Minn. Stat. § 116.07, subd. 4a, Minneapolis, St. Paul and the State (from MDH).

Zip code	Total children tested (< 6 years of age)	Total elevated blood lead levels (≥5 mcg/dL)	Percent elevated blood lead levels (≥5 mcg/dL)
55404	928	35	3.8%
55406	848	15	1.8%
55407	1,338	44	3.3%
55408	695	23	3.3%
55414	241	<5	<2.1%
55454	252	<5	<2.0%
55455	<5	0	0.0%
Minneapolis	9,823	273	2.8%
St. Paul	7,933	257	3.2%
State total	17,756	530	3.0%

Arsenic biomonitoring study

In 2007, the Minnesota legislature directed the MDH to conduct a biomonitoring study of the area surrounding the South Minneapolis Residential Soil Exposure Site through Minn. Stat. §144.995 – 144.998. Hundreds of participants from the area were solicited for involvement in this study, and the final count of participants totaled 65 children. Participants' urine arsenic was measured during two consecutive first morning voids. Urine concentrations higher than 15 $\mu g\text{-}g^{-1}$ (creatinine corrected) were speciated to further elucidate potential sources of exposure.

The highest levels of arsenic in this study were associated with dietary exposure, as the main species were organic in nature. No correlations were found between arsenic levels in urine and contamination levels in the soil. The MDH made it clear, however, that this finding should not be interpreted to indicate that arsenic contamination in soil is not of potential harm to children. Arsenic is not stored for long periods of time in the body; rather it is fairly quickly metabolized and excreted. Arsenic concentrations in urine tend to reflect recent exposure, and therefore are generally highly correlated with recent dietary intake (e.g. seafood). Other pollutants such as lead are stored in the body and then eliminated more slowly over time. A pollutant with a longer half-life in the human body would have had a higher potential to result in correlations between contaminant levels and biomarker concentrations such as urine.

Health indicators

"Health effects are chronic or acute health conditions that affect the wellbeing of an individual or community. Effects are measured in terms of illness and death and understood in terms of environmental, psychological, physiological, or genetic factors and conditions that predispose an individual to the development of a disease or health condition." (http://www.cdc.gov/nceh/tracking/)

Asthma health indicators

The MDH collects and reports asthma data including information on hospitalizations and emergency department visits due to asthma complications or episodes. Table 9 is a comparison of zip code data in the area described by the statute, city, and statewide results for various asthma indices. According to the data in Table 9 there are disproportionate hospitalizations and emergency room visits due to asthma in the zip codes encompassing the area described by Minn. Stat. § 116.07, subd. 4a. Many factors are associated with increased emergency room visits and hospitalizations for asthmatic episodes including access to routine health care visits, air pollution episodes, emotional stressor, temperature fluctuations, and dust or mold in the indoor environment. The air pollutants that have been associated with asthmatic episodes in health studies include: ozone, sulfur dioxide, particulate matter, nitrogen oxides.

The MDH published a large Epidemiology Report on Asthma in Minnesota in 2012, which can be found here: http://www.health.state.mn.us/asthma/documents/asthmaepireport2012.pdf. Some key findings discussed in this document are that age-adjusted hospitalization rates in Minnesota are decreasing, and Twin Cities Metro Area children tend to have higher rates of asthma than other Minnesotan children.

Zip code asthma hospitalization rate data are available for the Twin Cities Metro Area on the Minnesota Public Health Access data portal. Follow these steps to pull tables or maps of this data set: navigate to this URL: https://apps.health.state.mn.us/mndata/, select asthma under "All Data Topics", Select "Explore Data", and finally select "More maps", select "Table", scroll down to the bottom of the table and select "Click to download data". The data in Table 9 are five year composite values for 2009-2013. Data on this website will be updated annually and could be used in the place of Table 9 information if it is more recent. Maps under the other tabs may be copied and pasted into reports by right-clicking.

Asthma health indicator data are also available from the SHAPE information originally from Hennepin County, at this URL: http://www.hennepin.us/your-government/research-data/shape-surveys. Current SHAPE work is collaborative between Hennepin and Ramsey County, and should be reviewed prior to using the information below. Past years reported data on various parts of Hennepin County. In the year 2006, the area described by the Minn. Stat. § 116.07, subd. 4a was averaged with the Longfellow neighborhood and the Central neighborhoods and called the "Central Communities." These asthma data are discussed as a proxy for data specific to the area described by the Minn. Stat. § 116.07, subd. 4a. In the time of that that report, there were disproportionate emergency room visits and hospitalizations of adults and children with asthma compared to other locations. Hospitalizations and emergency room visits is a general marker of the ability of a person or population to manage their asthmatic condition. Managing asthma necessitates access to healthcare services, the ability to purchase prescription drugs, access to education about asthma triggers and healthy lifestyle choices that might lower the risk of asthmatic episodes. The Central Communities had the lowest percentage of survey respondents reporting private health insurance in Hennepin County and the highest percentage reporting no insurance. This was true for both adults and children.

In addition to the SHAPE survey and the MDH asthma tracking program, the Asthma and Allergy Foundation of America conducts a national study of comparative quality of life for persons living with asthma (Asthma Capitals: http://www.aafa.org/page/asthma-capitals.aspx). Minneapolis ranked 87th out of 100 cities surveyed as the worst places to live in the country with asthma (one being the worst). This survey is developed through a ranking system of various life quality indices for those with asthma including: annual pollen score*, air quality*, 100% public smoke-free laws*, poverty rate, uninsured rate*, school inhaler access laws, use of quick relief medication, use of controller medications and number of asthma specialists.

Table 9: Asthma related hospitalizations and emergency department visits (MDH).

Asthma-related hospitalizations and emergency department (ED) visits, 2009-2013

	Asthma emergency department visits				Asthma hospitalizations			
	Children (0-17 years)		Adults		Children (0-17 years)		Adults	
Zip code	Age-adjusted rate per 10,000	95% CI	Age-adjusted rate per 10,000	95% CI	Age-adjusted rate per 10,000	95% CI	Age-adjusted rate per 10,000	95% CI
55404	352.8	(300.5 - 405.1)	118.8	(108.1 - 129.5)	30.6	(23.3 - 39.4)	26.1	(22.1 - 30.1)
55406	138.0	(119.1 - 156.8)	35.0	(31.0 - 38.9)	16.3*	(11.9 - 21.8)	7.7	(6.2 - 9.5)
55407	259.3	(235.4 - 283.2)	68.7	(62.7 - 74.6)	27.1	(22.2 - 31.9)	13.8	(11.5 - 16.2)
55408	256.2	(219.7 - 292.8)	55.2	(49.2 - 61.2)	21.9	(16.3 - 28.9)	14.7	(11.7 - 17.6)
55414	221.5	(151.9 - 291.2)	31.0	(24.4 - 37.5)	17.0*	(8.6 - 30.0)	6.8*	(4.3 - 10.2)
55415	768.8	(249.1 - 1796.2)	98.6	(73.7 - 123.5)	100.0*	(21.7 - 285.5)	19.4*	(11.5 - 30.7)
55454	541.7	(224.7 - 858.6)	105.4	(74.2 - 136.6)	22.3*	(8.2 - 48.5)	25.3*	(16.1 - 37.8)
55455	#	-	#	-	#	-	#	-
Minneapolis	197.0	(187.9-206.1)	57.2	(54.6-59.8)	21.0	(18.1-24.0)	12.1	(10.8-13.3)
St Paul	142.0	(133.9-150.2)	48.9	(46.0-51.8)	13.1	(10.6-15.6)	9.6	(8.3-10.9)
Minnesota	68.2	(66.8-69.7)	30.0	(29.5-30.6)	8.6	(8.0-9.0)	5.8	(5.6-6.0)
Healthy People 2020 objective	95.6 (ages 0-4) 49.7 (ages 5-64)		49.7 (ages 5-64) 13.8 (age 65 and older)		18.1 (ages 0-4) 8.6 (ages 5-64)		8.6 (ages 5-64) 20.3 (age 65 and older)	

#Rates based on 1-5 hospitalizations/ED visits are suppressed

*Rates based on 6-20 hospitalizations/ED visits are unstable and should be interpreted with caution

Data sources: Minnesota Hospital Association, American Community Survey

Notes:

- Asthma hospitalizations/ED visits are defined as those for which asthma was the primary diagnosis.
- Zip code is that of the patient's residence.
- These data include hospitalizations for Minnesota residents seeking care at hospitals in MN, ND, SD and IA, and ED visits for Minnesota residents seeking care at hospitals in MN and ND.
- Data from federal and sovereign hospitals (e.g., Veteran's Administration and Indian Health Service) are not included.
- Because MDH does not receive information that would allow for the identification of patients, these rates are based on the number of hospitalizations/ED visits, not the number of people who were hospitalized/went to the ED (i.e., it is not possible to identify repeat hospitalizations/ED visits).
- Rates based on asthma hospitalization/ED visit counts of 1-5 are suppressed.
- Rates based on counts of 6-20 or with a relative standard error greater than or equal to 30% are unstable and should be interpreted with caution because the rate can change dramatically with the addition or subtraction of a single case.

Minnesota Department of Health Asthma Program, 12/14/15

Chronic Obstructive Pulmonary Disease

Chronic obstructive pulmonary disease (COPD) is a group of diseases that make breathing difficult, and include symptoms of shortness of breath and wheezing. This disease is mostly found in older adults, and its primary cause is smoking. Those with COPD can prevent exacerbations by quitting smoking, avoiding environmental tobacco smoke (ETS), workplace, and air pollution exposures, and managing respiratory infections. Data related to COPD rates is available on the MDH Public Health Data Access portal. The data in Table 10 were pulled from this site and reflect 2011-2013 reporting. More recent data may be pulled by following these directions: navigate to this URL: https://apps.health.state.mn.us/mndata/, select Chronic Obstructive Pulmonary Disease under "All Data Topics" select "Explore Data" and finally select "Interactive map"; on the right select "ZIP code"; at the top select "tools" and then "download data" and then save the zip code data file to your computer. Data on this website will be updated annually and could be used in the place of Table 10 information if it is more recent. Maps under the other tabs may be copied and pasted into reports by right-clicking.

Region	Age adjusted rate	ACI	Total count	Average annual population	Unstable	Suppressed
Minnesota	30.8	(30.5 - 31.2)	31602	2158413		
7-County Metro Area	26	(25.6 - 26.5)	12538	1100943		
55404	65.8	(53.8 - 77.8)	234	7,615		
55406	33.8	(27.1 - 40.5)	162	12,802		
55407	41.3	(32.8 - 49.7)	163	10,382		
55408	44.8	(35.0 - 54.6)	138	7,066		
55414	19.7	(12.7 - 29.0)	36	3,795		
55415	20	(6.7 - 45.8)	8	907	**Unstable**	
55454	17.6	(7.0 - 36.7)	13	1,488	**Unstable**	
55455				0		**Suppressed**

Unstable rates, means there were too few values to be meaningful. These rates have less certainty than stable rates. Data are **suppressed** for privacy reasons. It is possible that the privacy of individuals could be compromised if counts are below a certain number of people. For this reason, these data are not reported.

Socioeconomic status description of an area described by the statute

Socioeconomic data are used as a general indicator of a community's vulnerability, or ability, to access and achieve healthy living conditions. Three socioeconomic indicators are reported below from the 2010 U.S. Census.

Table 10: Census tracts within the area described by the statute, Hennepin County, Minnesota state percentages for young persons, older populations, low-income and non-white populations.

Geography	Median household income	Percent non-white population	% population below 185x poverty level	% population under 10 years	% population over 65
27053005901	17683	57	68	8	20
27053008400	46984	73	44	20	3
27053008500	41125	62	56	15	3
27053009500	47742	68	55	18	3
27053009600	50530	46	41	17	7
27053104800	17704	58	77	6	19
27053104900	20353	29	86	2	3
27053105400	38315	39	51	4	4
27053106000	20422	84	63	14	6
27053106200	30219	53	60	9	8
27053106400	36045	46	54	7	10
27053107400	43504	43	45	18	6
27053107500	51563	21	27	13	9
27053107600	71997	16	15	11	9
27053108600	39630	57	61	23	4
27053108700	61737	40	30	12	10
27053108800	42004	44	42	17	10
27053108900	62962	19	14	12	8
27053109700	50195	46	40	21	6
27053110100	46526	34	31	15	7
27053110200	63667	25	21	12	11
Statewide	61271	17	26	13	14
Hennepin County	69877	28	26	12	12

The two maps in Figures 22 and 23 are representations of these two socioeconomic indicators, projected by census tract, for the area described the statute. Included in the figures are larger roadways for location identification, the Phillips communities and the ½ mile buffer around the South Minneapolis Residential Soil Exposure Site.

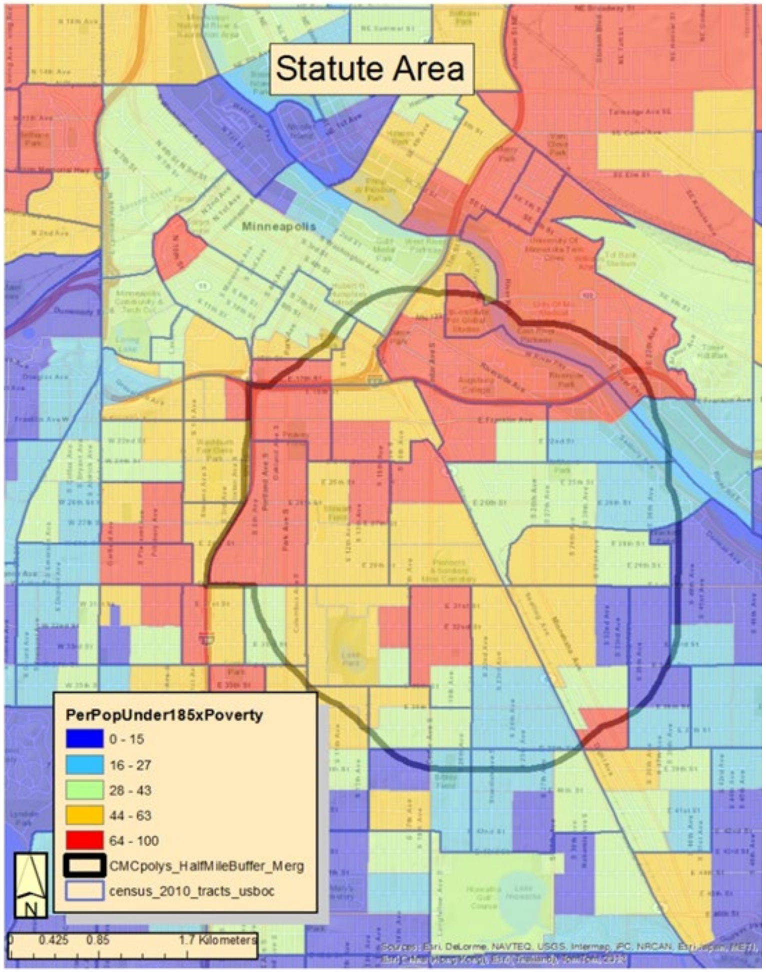


Figure 22: Map of the area described by the statute identifying % population below poverty level.

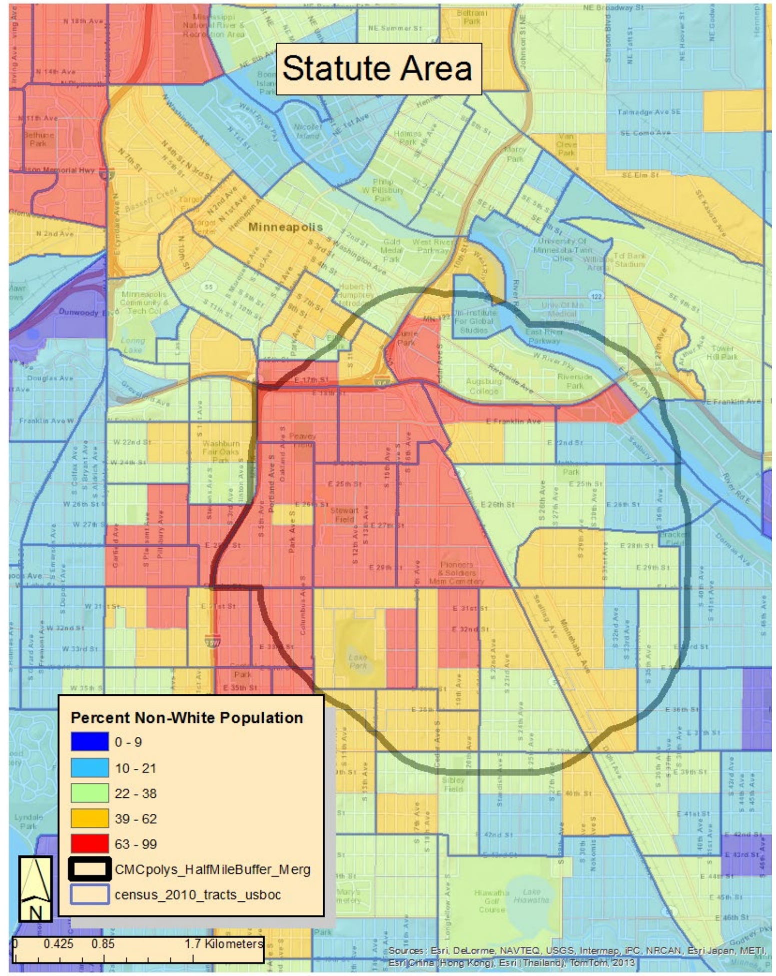


Figure 23: Map of the area described by the statute identifying % non-white population.

Housing value

Housing value can be used as a surrogate of income, or a surrogate for a community's ability to achieve and access a healthy living environment. The table below reports average housing values by geographic areas for comparison.

Geography	Home value ($)
27053005901	189500
27053008400	207800
27053008500	212900
27053009500	219700
27053009600	216050
27053104800	110900
27053104900	322050
27053105400	350000
27053106000	186133
27053106200	237000
27053106400	208750
27053107400	182300
27053107500	232850
27053107600	242100
27053108600	186733
27053108700	175733
27053108800	196900
27053108900	191367
27053109700	188967
27053110100	193000
27053110200	196400
Statewide	208945
Hennepin County	275639

Small for gestation age natality indicators

Recent publications in environmental health literature have reported associations between exposure to poor air quality and poor perinatal outcomes (Lee et al. 2003, Rogers and Dunlap 2006, Parker et al. 2005, Brauer et al. 2008, Le et al. 2012, Vinikoor-Imler et al. 2014). Generally these studies have tested potential associations between various criteria pollutant air concentrations (e.g. $PM_{2.5}$, CO, sulfur dioxide, etc.) with multiple manners of assessing low birth weight (e.g. small for gestational age of preterm infants, intrauterine growth retardation, birth weight for full term infants, etc.). There are potential confounders in these data sets due to seasonality and varying gestational windows of importance. The resulting associations between the air pollution concentrations and birth outcome data have been both positive and negative and within the positive associations, these have been of varying strengths. The data, therefore, should be discussed with the appropriate qualifiers.

Table 11: Small for gestational age natality data by zip code, Hennepin County and statewide.

Zip code 55455 is in the statute area, but has too few births to report.

Small for gestational age (count)									
Year	55404	55407	55408	55454	55406	55415	55414	Hennepin County	Statewide
2004	35	25	18	6	20	3	7	567	2167
2005	19	30	13	2	16	1	9	539	2110
2006	18	40	23	7	15	2	4	582	2179
2007	25	24	11	1	17	2	7	530	2195
2008	25	28	16	6	12	4	5	566	2296
2009	14	45	17	7	15	1	6	530	2137
2010	18	26	23	5	9	3	9	526	2177
2011	18	27	10	2	12	4	1	609	2321
2012	33	32	29	5	17	4	5	753	2652
2013	37	27	25	5	19	3	8	756	2606
2014	33	33	16	6	22	1	1	699	2615
Small for gestational age (percent)									
	55404	55407	55408	55454	55406	55415	55414	Hennepin County	Statewide
2004	7.2	3	4.3	4.7	4.4	9.4	4.2	3.8	3.4
2005	4.5	4.1	3.2	1.5	3.4	4.8	5.2	3.8	3.4
2006	4	5.3	5.7	6.2	3.2	8.7	2.7	4	3.4
2007	6	3.3	2.7	0.8	3.7	7.4	5.4	3.8	3.5
2008	5.9	4	4.1	5.9	2.8	13.8	4.1	4.2	3.6
2009	3.3	5.8	4.4	7.1	3.4	4	4.5	3.8	3.4
2010	4.5	3.7	6.2	4.5	2	7.1	6.1	3.7	3.5
2011	4.9	4.3	2.5	2.4	2.7	10.3	0.7	4.4	3.8
2012	7.3	4.6	7.1	4.9	3.8	8	3.1	4.8	4.1
2013	7.6	4	6.4	4	3.9	9.4	5.5	4.7	4
2014	7.1	5.1	4.5	5.2	4	4.8	0.6	4.3	4

Cardiovascular health indicators

In 2009, the EPA drafted the Integrated Science Assessment for Particulate Matter (EPA, 2009_DRAFT) for public review. Causality determination for short-term exposure to $PM_{2.5}$ includes a causal relationship with cardiovascular morbidity. Cardiovascular health effect indicators are complex and range in severity from subtle changes in heart rate variability to hospitalizations due to cardiovascular irregularities. Results from epidemiological studies, human clinical studies, and toxicological studies have reported associations between ischemic heart disease and short-term exposures to fine particulate matter.

The MDH collects, analyzes, and reports on heart disease (Table 12) and mortality data for the state of Minnesota. Although heart disease outcomes have been found to have a causal relationship with elevated levels of $PM_{2.5}$, there are many risk factors that also cause and/or exacerbate heart disease such as diet, smoking status, activity levels, genetics, etc. Similar to other environmental health data, these data should be discussed with appropriate qualifications.

One of the reports published by the MDH is the Burden Report on Heart Disease and Stroke in Minnesota. Within this report, disparities are discussed by ethnic, socioeconomic and regional groups of people. American Indians have higher rates of heart disease compared to white counterparts, and Black men and women have a higher rate of stroke compared to white counterparts. A recent report from Wilder Research and the Blue Cross and Blue Shield Foundation of Minnesota found significant disparities in life expectancy across Twin Cities zip codes, all of which was highly correlated with race, ethnicity, income, and education attainment.

2009-2013	**AMI hospitalizations**	**Stroke hospitalizations**
counts	**Ages 35+**	**Ages 35+**
55404	144	210
55406	177	278
55407	174	242
55408	97	134
55414	54	86
55415	<10	<10
55454	18	32
55455	<10	<10
Hennepin	6,947	10,148
Ramsey	3,392	5,234
Minnesota	43,274	53,011
Age-adjusted annual rate per 10,000*	**AMI hospitalizations (95% CI)**	**Stroke hospitalizations (95% CI)**
55404	25.8 *(21.6-30.0)*	42.3 *(36.5-48.0)*
55406	21.0 *(17.9-24.1)*	36.0 *(31.7-40.2)*
55407	26.1 *(22.2-30.0)*	37.0 *(32.3-41.6)*
55408	20.4 *(16.4-24.5)*	29.0 *(24.1-33.9)*
55414	20.8 *(15.2-26.3)*	35.3 *(27.8-42.7)*
55415	-	-
55454	16.4 *(8.8-23.9)*	27.9 *(18.2-37.6)*
55455	-	-
Hennepin	22.4 *(21.9-22.9)*	33.4 *(32.8-34.1)*
Ramsey	24.5 *(23.7-25.3)*	38.4 *(37.3-39.4)*
Minnesota	28.3 *(28.1-28.6)*	35.2 *(34.9-35.5)*

= unstable rate: based on count <20

*Age-adjusted to 2000 U.S. standard

Source: Minnesota Hospital Association; U.S. Census

Notes: Acute myocardial infarction and stroke hospitalization visit rates are calculated by dividing the number of hospitalizations visits in a particular year by the number of residents for that year (based on population estimates from the U.S. Census) and multiplying by 10,000 to get rates per 10,000 residents. AMI and stroke hospitalizations are defined as those for which AMI or stroke was the principal diagnosis. Zip code is that of the patient's residence. Minnesota hospitals report data on inpatient and outpatient visits on a voluntary basis to the Minnesota Hospital Association. Currently over 95% of hospitalizations/ED visits are reported; however this does not include data from federal and sovereign hospitals (e.g., Veteran's Administration and Indian Health Service). Because MDH does not receive information that would allow us to identify individuals, these rates are based on the number of hospitalizations visits in a particular year, not the number of people who were hospitalized in that year (i.e., we cannot identify repeat hospitalizations).

Minnesota Department of Health Cardiovascular Health Unit, 1/29/2016

Cancer registry in Minnesota

Cancer is not a single disease. It is a descriptor of many diseases that all involve uncontrolled growth and spread of abnormal cells. It is believed that the first step in increasing potential for a future detectable cancer is damage to a cell which can lead to an event or sequence of events that may prevent cell repair and growth from functioning normally. Cancer is a latent disease, therefore something impacting potential cancer status may not be observed (via cell mutation or detectable cancer) for 10 or more years after exposure. The factor(s) leading to this event or chain of events can be internal or external. External factors are discussed in this document in the context of environmental data such as air quality, water quality, etc. However, many other external factors have stronger associations with cancers such as diet and smoking status. Therefore, cancer counts are not a sensitive indicator of environmental quality for a small area such as that described by the statute.

Another complicating factor in a discussion of cancer is the mobility of populations. Mobility rates for the area described by the statute are high. Zip code 55454 includes a large student and renter population, and therefore the census data are likely incorrect. For this reason, the data from that zip code have not been included below. The data in Table 12 are summarized from the Minnesota Cancer Registry. All cancers in Minnesota are logged and stored in the cancer registry and these data are summarized and published in reports by MDH.

Table 12: Cancer cases in the zip codes described by the Minn. Stat. § 116.07, subd. 4a.

All cancer counts and rates for Minneapolis zip codes
(55404, 55406, 55407, 55408, 55414, 55415, 55454, 55455)
2003-2012

Observed and expected counts

Zip	Sex	Observed	Expected	Obs/Exp*	p value**
55404	F	381	391	0.97	0.63
55404	M	481	540	0.89	0.01
55406	F	810	763	1.06	0.09
55406	M	713	756	0.94	0.12
55407	F	586	607	0.96	0.40
55407	M	612	605	1.01	0.77
55408	F	369	406	0.91	0.07
55408	M	407	457	0.89	0.02
55414	F	212	242	0.88	0.05
55414	M	259	307	0.84	0.01
55415	F	30	24	1.23	0.31
55415	M	31	44	0.71	0.06
55454	F	68	123	0.55	<.0001
55454	M	64	124	0.52	<.0001
55455	F	2	2	1.08	1.00
55455	M	2	2	1.26	0.94

Age adjusted rates / 100,000 for all cancers 2003-2012

Sex	Original 3 zip codes	8 zip code area	Hennepin	7 county Metro	Minnesota
Female	413.0	417.8	422.3	426.1	418.1
Male	498.6	492.0	531.3	543.1	539.5

Expected counts obtained using the seven county Twin Cities as a reference
*This is the ratio of observed to expected (Less than one indicates count was lower than expected counts)
** P value associated with the ratio (<0.05 is considered significant)
2010 U.S. census was the data source for the population numbers

The most current information, 2011 Minnesota Cancer Facts and Figures, is located at the following URL: http://www.health.state.mn.us/divs/hpcd/cdee/mcss/documents/mncancerfactsfigures2011033011.pdfThis document contains information on new cancer cases and disproportionate cancer types.

General description of data and potential additional data sources

Census and American Community Survey data

The socioeconomic data was pulled for consideration from the 2010 census. The American Community Survey (formerly the long form) is an extensive data source and can be mined for information specific to a certain type of facility.

SHAPE data

The Survey of the Health of All the Population and the Environment (SHAPE) is a rich source of health data for Hennepin County including asthma, tobacco use, poverty levels, etc. In 2002, the Phillips communities were specifically described in the SHAPE data books. In 2006, due to budget shortfalls, the Central, Phillips and Powderhorn communities were averaged together. This averaging over communities is a loss in Phillips specific data, but did allow for a specific description of all of these health data for children in these communities. The differences in these three averaged communities were not great based on 2002 SHAPE summaries, therefore the Central Communities averaged 2006 adult and child data are summarized below. If more data are required for an analysis the URL for these two data sets are as follows: http://www.hennepin.us/~/media/hennepinus/residents/health-medical/documents/adult-data-book-final and http://www.hennepin.us/~/media/hennepinus/residents/health-medical/documents/shape-2006-child-data-book.pdf?la=en. The 2014 SHAPE report will be published in December of 2015 and all related SHAPE information will be updated to the extent possible at that time.

Tobacco use from SHAPE data 2006

As summarized in the 2009 "Minnesota Cancer Facts and Figures" (Minnesota Cancer Alliance), approximately 90% of lung cancer cases are associated with tobacco smoke exposures and approximately 30% all cancer cases are lung cancers. Tobacco use is also associated with 30% of cancer deaths in the United States. Environmental tobacco smoke (second hand smoke or ETS) is the indirect exposure by non-smokers to tobacco smoke from smokers in their home or their environment. Smoking rates in the city of Minneapolis are depicted in Figures 24 and 25 as a proxy to potential environmental tobacco smoke exposures.

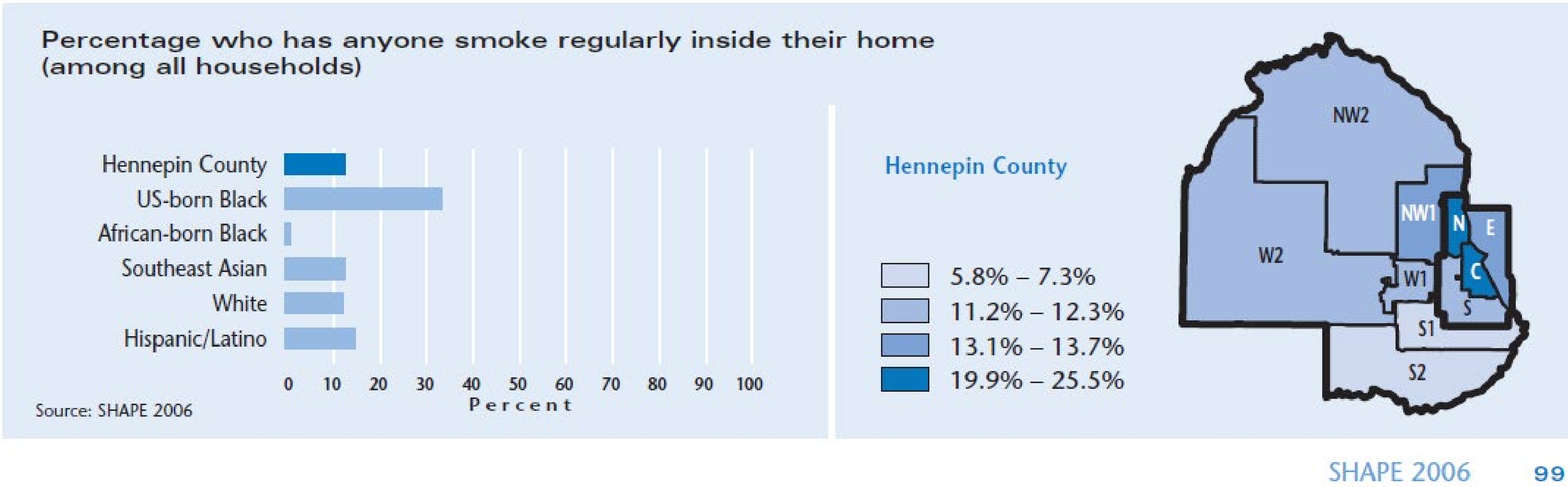


Figure 25

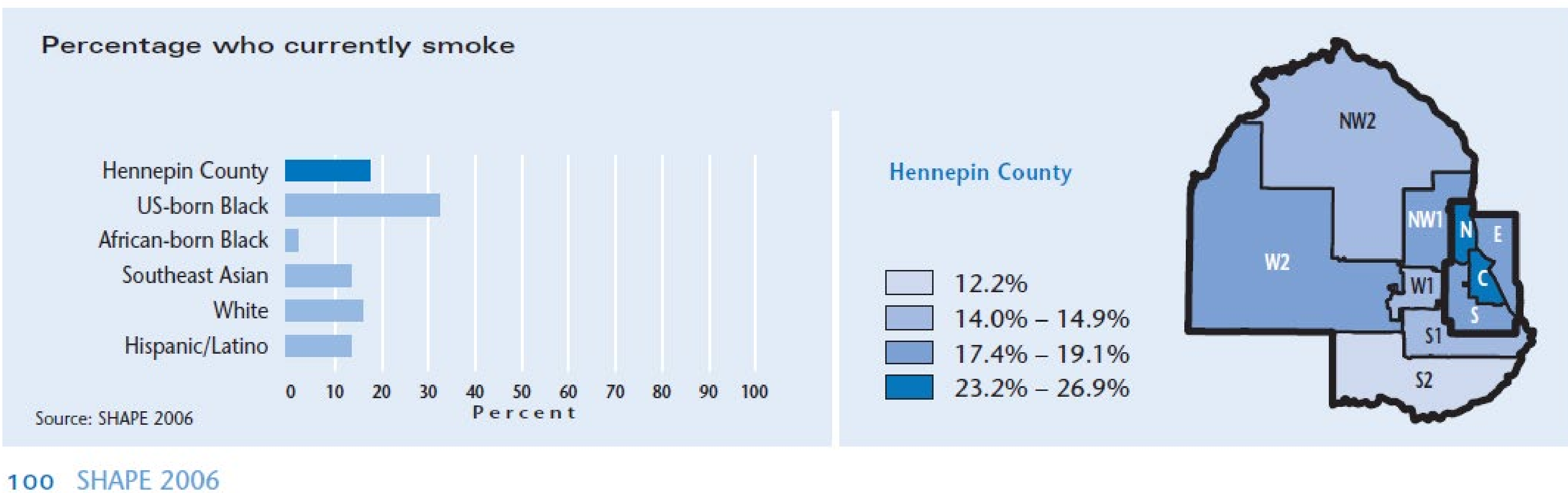


Figure 26

Figures 25 and 26 are taken from the Survey of the Health of All the People and the Environment in Hennepin County (SHAPE) from 2006. Residents in one area described by the statute are described by the category "Central Communities." With the assumption that those who smoke, also smoke in or near their residence, these data above are used to describe potential exposure of populations to ETS or second-hand smoke.

Nationwide, ETS is responsible for at least 3,000 lung cancer deaths and 46,000 coronary heart disease deaths each year (http://oehha.ca.gov/air/environmental_tobacco/2005etsfinal.html, Anderson and Arias 2003). Environmental tobacco smoke is a trigger to asthmatic episodes and hospitalizations and is associated with Sudden Infant Death Syndrome (http://www.surgeongeneral.gov/library/secondhandsmoke/, Hjern et al, 1999, Weitzman et al. 1990, Lewis and Bosque 1995, etc.). According to the data obtained by Hennepin County, residents in the area described by the Statute are likely exposed disproportionately to ETS.

Please note, that there were several other questions in the SHAPE 2006 related to ETS where responses did not imply elevated exposures in comparison with other areas of Hennepin County. These questions included the percentage of people who smoke more than 21 cigarettes a day, percentage of the population who stopped smoking for one day or longer in the 12 months prior to the interview and percentage of population who had quit smoking in the year prior to the interview.

SHAPE 2010 has been modified somewhat due to continuing economic constraints for the study. In SHAPE 2010, maps such as Figure 24 and Figure 25 are no longer included in the SHAPE data books. Furthermore, the question pertaining to smoking in households is no longer asked. However, the Central Communities does continue to have a higher population who are everyday or some-day smokers than the Hennepin County average. Therefore, there remains potential for elevated exposures to environmental tobacco smoke in the Statute Area. The SHAPE 2010 children's data book is segregated geographically only by the city of Minneapolis and suburban areas, and is therefore not spatially refined enough to provide conclusions on potential disproportionate exposures to the Statute Area, nor specific Study Areas for permit application reviews.

Allina Hospitals and Clinics: Backyard Initiative Assessment Report

Allina Hospitals and Clinics' Center for Innovation have completed a report on the characteristics, or personality, of the "Backyard" of their Hospitals. The neighborhoods included are Ventura, East Phillips, Midtown Phillips, Phillips West, Central, Powderhorn Park and Corcoran. These reports are updated each year to include the level of community engagement, and activities associated with the Backyard Initiative project. Information on stresses, access to care, availability of healthy foods, ability to exercise, parental support, etc. were sought through group discussions and walk-around interviews. Persons within the community were hired to support these studies. Current work is focused on linking neighborhood wellness resources (e.g. exercise classes, community gardens, insurance enrollment support) with the needs identified in the earlier community performed interviews. http://www.allinahealth.org/About-Us/Community-involvement/Initiatives-and-programs/The-Backyard-Initiative/

Radon data and information

Since people spend the majority of their time indoors, indoor air exposures are an important addition to the discussion in this report. Environmental tobacco smoke was discussed earlier in this section, because there were data fairly specific to the area described by the statute. For radon, there aren't as spatially specific data sources, since radon concentrations in a home vary from home to home. There are, however, programs and information found through the MDH. Minnesota is a state in which it is advised to test for radon inside a residence. Information on how to test, what the results mean, costs, and other information can be found at http://www.health.state.mn.us/divs/eh/indoorair/radon/index.html. If radon problems exist in a home, they can be fixed.

Birth defects registry

The state of Minnesota, through MDH, has formed a work group to develop a program for monitoring birth defects. Although approximately 20% of birth defects are caused by genetics, 10% are caused by environmental factors (drug abuse, infections, exposure to medications or other chemicals) the remaining 70% have largely unknown causes. Work towards developing this monitoring program can be found on http://www.health.state.mn.us/divs/cfh/program/cyshn/bdmaintro.cfm.

Environmental public health tracking and biomonitoring website

The MDH has developed the Minnesota Public Health Data Access portal, which provides zip code (Metro area) and county level health and environmental data. There are multiple important categories of data in this tool, and many means of displaying and comparing the data. A future goal for this report is to incorporate this data portal as more zip code data become available. When Minnesota Public Health Data Access holds data useful for a Cumulative Levels and Effects Analysis, directions will be included in how to find and download that data. Environmental health tracking is a program funded through the CDC and is defined as ongoing collection, integration, analysis, interpretation and dissemination of environmental hazard monitoring, human exposure surveillance and health effects surveillance. This portal is available at this URL: https:/apps.health.state.mn.us/mndata/.

Data limitations, data gaps and intended future work or improvements

- Increase the use of the Minnesota Public Health Data Portal.
- The evaluation of criteria pollutants in comparison with state and federal standards does not evaluate health effects or estimate risk. There are potential health effects that have been shown to be associated with criteria pollutant levels lower than the standard.
- Indoor air sources are not counted.
- Historical predictions of exposure are not included.
- 100% infiltration of outdoor air pollutants is assumed.
- Modeled risk estimations are for pollutants in the Minnesota air emissions inventory or those measured at ambient air toxics monitors. Pollutants not included in these two data sources were not included in the estimated risk sums.
- The MPCA is currently conducting a summary for statewide sediment data; these could be incorporated for eco risk or “environmental effects.”
- Given enough resources and time, relative indices could be developed using all available data and summarized. These indices could be compared to statewide averages for the data available. This would be a multi-year effort that would require intensive staff and funding resources.

References

Adgate JL, Church TR, Ryan AD, Ramachandran G, Fredrickson AL, Stock TH, Morandi MT and Sexton K. "Outdoor, Indoor and Personal Exposure to VOCs in Children." Environmental Health Perspectives vol. 112. No. 14. Pps. 1386 – 1392. 2004.

Adgate JL, Ramachandran G, Pratt GC, Waller LA, Sexton K. "Spatial and Temporal Variability in Outdoor, Indoor and Personal PM2.5 Exposure." Atmospheric Environment. Vol. 36. Pps. 3255 – 3265. 2002.

Allina Hospitals and Clinics, The Center for Healthcare Innovation. Project Manager: Paula Fynboh. "Community at the Core: Backyard Initiative Assessment Report". 2010. http://www.allinahealth.org/About-Us/Community-involvement/Initiatives-and-programs/The-Backyard-Initiative/

Amherst H. Wilder Foundation, St. Paul, MN. "The unequal distribution of health in the Twin Cities." October 2010.

Brauer M, Lencar L, Tamburic L, Koehoorn M, Demers P, Karr C. "A Cohort of traffic Related Air pollution Impacts on Birth Outcomes." Environmental Health Perspectives. Vol. 116. No. 5. Pps. 680 – 686. 2008.

deFur PL, Evans GW, Cohen Hubal EA, Kyle AD, Morello-Frosch RA, Williams DR. "Vulnerability as a Function of Individual and Group Resources in Cumulative Risk Assessment. Environmental Health Perspectives. 115:817-824. 2007.

Hennepin County Human Services and Public Health Department. SHAPE 2010 Adult Data Book, Survey of the Health of All the Population and the Environment, Minneapolis, Minnesota, March 2011.

Le HQ, Batterman SA, Wirth JJ, Wahl RL, Hoggatt KJ, Sadeghnejad A, Hultin ML, Depa M. "Air pollutant exposure and preterm and term small-for-gestational-age births in Detroit, Michigan: long-term trends and associations." Environ Int. 2012 Sep;44:7-17. doi: 10.1016/j.envint.2012.01.003. Epub 2012 Feb 6.
Lee BE, Ha EH, Park HS, Kim YJ, Hong YC, Kim H, Lee JT. "Exposure to Air Pollution During Different Gestational Phases Contributes to Risks of Low Birth Weight." Human Reproduction. Vol. 18. No. 3. Pps. 638-643. 2003.

Minnesota Department of Health, St. Paul, MN. Heart Disease and Stroke in Minnesota: 2007 Burden Report. September 2007.

Minnesota Department of Health. "Healthy People 2010 Asthma Objectives. December 2009 Update." http://www.health.state.mn.us/asthma/documents/hp2010.pdf.

National Academy of Sciences, Committee on Improving Risk Analysis Approaches Used by the U.S. EPA, National Research Council. "Sciences and Decisions: Advancing Risk Assessment." 2009.

National Environmental Justice Advisory Council. "Ensuring Risk Reduction in Communities with Multiple Stressors: Environmental justice and Cumulative Risks/Impacts. Washington DC. U.S. Environmental Protection Agency. 2004.

Parker JD, Woodruff TJ, Basu R. Schoendorf, KC. "Air Pollution and Birth Weight Among Term Infants in California. Pediatrics. Vol. 115. No. 1. Pps. 121-128. 2005.

Pratt GC, Wu CY, Bock D, Adgate JL, Ramachandran G, Stock TH, Morandi M, Sexton K. "Comparing Air Dispersion Model Predictions with Measured Concentrations of VOCs in Urban Communities." Environmental Science and Technology. Vol. 38. Pps. 1949 – 1959. 2004.

Ramachandran G, Adgate JL, Hill N, Sexton K, Pratt GC, Bock D. "Comparison of Short-term Variations (15-Minute Averages) in Outdoor and Indoor PM2.5 Concentrations." Journal of the Air and Waste Management Association. Vol. 50. Pps. 1157-1166. 2000.

Rogers JF, Dunlop AL. "Air Pollution and Very Low Birth Weight Infants: A Target Population." Pediatrics. Vol. 118. Pps. 156 – 164. 2006.

Sexton K, Mongin SJ, Adgate JL, Pratt GC, Ramachandran G, Stock TH, Morandi MT. "Estimating Volatile Organic Compound Concentrations in Selected Microenvironments Using Time-Activity and personal Exposure Data." Journal of Toxicology and Environmental health, part A. Vol. 70. Pps. 465 – 476. 2007.

Sexton K, Adgate JL, Mongin SJ, Pratt GC, Ramachandran G, Stock, TH, Morandi MT. "Evaluating Differences between Measured Personal Exposures to Volatile Organic Compounds and Concentrations in Outdoor and Indoor Air." Environmental Science and Technology. Vol. 38. Pps. 2593 – 2602. 2004

Sexton K, Adgate JL, Ramachandran G, Pratt GC, Mongin SJ, Stock TH, Morandi MT. "Comparison of Personal, Indoor and Outdoor Exposures to Hazardous Air Pollutants in Three Urban Communities." Environmental Science and Technology. Vol. 38. Pps. 423 – 430. 2004.

U.S. Department of Health and Human Services. Office of Disease Prevention and Health Promotion. Healthy People 2010. www.healthypeople.gov.

U.S. EPA: 630P02001F. Office of Research and Development. National Center for Environmental Assessment. "Framework for Cumulative Risk Assessment." 2003.

U.S. EPA. Concepts, Methods, and Data Sources for Cumulative Health Risk Assessment of Multiple Chemicals, Exposures and Effects: A Resource Document (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-06/013F, 2007.

U.S. EPA. Integrated Science Assessment for Particulate Matter (Final Report). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-08/139F, 2009.

Vinikoor-Imler LC, Davis JA, Meyer RE, Messer LC, Luben TJ. "Associations between prenatal exposure to air pollution, small for gestational age, and term low birthweight in a state-wide birth cohort." Environ Res. 2014 Jul;132:132-9. doi: 10.1016/j.envres.2014.03.040. Epub 2014 Apr 25.