Winona
MINNESOTA

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February 20, 2014

Citizen's Environmental Quality Committee
Winona, Minnesota 55987

Dear Committee Members:

The next meeting of the Citizens Environmental Quality Committee meeting will be held on **Tuesday, February 25, 2014 at 4:00 p.m. in the Heritage Room of City Hall**.

1. **Call to Order**

2. **Air Quality Monitoring**

4. **Other Business**

5. **Adjournment**

Sincerely,

Carlos Espinosa
Assistant City Planner

Citizens Environmental Quality Committee

AGENDA ITEM:	2. Air Quality Monitoring
PREPARED BY:	Carlos Espinosa
DATE:	February 25, 2014

The Winona Area Citizens Concerned about Silica Mining (CASM) group has requested to discuss the following questions with the CEQC. Staff has provided additional information about the questions for consideration during discussion:

How we can support the committee on the recommendations it made but that were not supported by the Planning Commission?

The full set of recommendations sent to the Planning Commission is attached. In response to the recommendations, the Planning Commission recommended the MPCA's proposed monitoring program to the City Council. The City Council approved the program by resolution at the end of 2013. Real-time air quality information from the monitoring is available in two places:

http://www.pca.state.mn.us/index.php/air/air-quality-and-pollutants/general-air-quality/air-quality-index/current-condition-details.html

http://www.smogwatch.com/minn/realtimedata.cfm

Additional monitoring along truck routes and at silica sand operations was not recommended by the Planning Commission or approved by the City Council.

How results from the YMCA air monitor will be available to the public in a form understandable to laypeople?

The real-time information on the websites above is given as a PM2.5 Air Quality Index (AQI) number. The index numbers correspond to the following categories:

(0-50) Good: No potential issues.

(51-100) Moderate: Unusually sensitive people should consider limiting prolonged outdoor exposure.

(101-150) Unhealthy for sensitive groups: Active children and adults, and people with respiratory disease, such as asthma, should limit prolonged outdoor exertion.

(151-200) Unhealthy: Active children and adults, and people with respiratory disease, such as asthma, should avoid prolonged outdoor exertion; everyone else, especially children, should limit prolonged outdoor exertion.

(201-300) Very Unhealthy: Active children and adults, and people with respiratory disease, such as asthma, should avoid all outdoor exertion; everyone else, especially children, should limit outdoor exertion.

(301-500) Hazardous: Everyone should avoid all outdoor exertion.

As of 2/19/14, the "Smogwatch" AQI website noted 26 good and 16 moderate air quality days in Winona thus far in 2014. The maximum AQI number (82) occurred on 1/10/2014. It should be noted that this is raw data subject to change. According to the MPCA:

> *[When available], quality assured data will be disseminated by request and posted to the following website where it will be compared to applicable ambient standards and health benchmarks:*
>
> *http://www.pca.state.mn.us/index.php/air/air-quality-and-pollutants/air-pollutants/silica-sand-mining/air-monitoring-data-at-minnesota-frac-sand-facilities.html*
>
> *Data summaries and comparisons to other monitoring sites will be also be completed and distributed to interested parties. Wind rose analyses of episodes or elevated values will also be performed and distributed. Comparing the Winona data to other PM2.5 sites across the state and to sites located near road ways will be valuable.*

In addition to the PM2.5 AQI information, the MPCA is also collecting data on PM4 crystalline silica. The results will be available after the MPCA selects a lab for analysis.

Who will analyze the data from the monitors?

The MPCA will select the lab(s) to analyze the data from the monitors.

How can the CEQC be involved in selecting a lab if a lab other than the Minnesota Department of Health's is involved?

The MPCA is administering the air quality program. Requests related to analysis of the data should go to the Agency.

How can monitoring of crystalline silica be established at fence lines of all frac-sand mines and processing facilities at the expense of the operator as recommended by the MPCA?

The December 13, 2013 draft of "Tools to Assist Local Governments in Planning for and Regulating Silica Sand Projects," recommends the following (*attached - page 23*):

- *All silica sand projects should conduct ambient monitoring prior to startup of the project. The pre-construction monitoring period should continue until at least one year of valid data is collected.*
- *All silica sand projects should conduct ambient monitoring after startup of the project. The post-construction monitoring period should continue until at least three (3) years of valid data are collected.*

It's important to note that this is a draft document and the final recommendations will be considered by the Environmental Quality Board at their meeting on March 19th.

To establish monitoring at the fence lines at existing silica sand facilities either the City or the state must create a regulation that requires this to occur.

To establishing monitoring at a new silica sand facility, the City could require monitoring as an additional condition in the Conditional Use Permit approval process.

How does the Committee communicate with the Planning Commission and City staff and are there any changes the Committee would like to see to help it be more effective?

The CEQC is a subcommittee to the Planning Commission. Any recommendations made by the Committee go directly to the Planning Commission. The Planning Commission in turn makes recommendations to the City Council. CEQC members may contact City staff at any time and request an item be placed on the next meeting agenda. Staff provides information and resources to the committee members.

Attachments:

1) CEQC Recommendations to the Planning Commission
2) DRAFT – "Tools to Assist Local Governments in Planning for and Regulating Silica Sand Projects," Pages 11-24. December 13, 2013.

Attachment 1

CEQC Air Monitoring Recommendations

1. We recommend monitoring, but defer to the MPCA for protocols, expertise, and resources. A final decision on air quality standards should be determined by the MPCA.
2. The City of Winona should conduct interim monitoring for crystalline silica if action to commence monitoring is not immediately available from the MPCA.
3. Interim monitoring at facilities should commence as soon as possible and use an annual average of 3ug/m^3 PM4 as a limit for ambient crystalline silica exposure.
4. Any firm hired to complete interim monitoring should be selected and hired by the City of Winona in consultation with the MPCA.
5. Any costs associated with monitoring should be paid by the industry.
6. Interim monitoring should also include baseline 2.5 particulate monitoring along truck routes.
7. Baseline data for air quality monitoring along truck routes should start now. The monitoring should be done at 4-5 sites in the city.
8. The City of Winona should make a formal request to the MPCA for an Air Emissions Risk Analysis and a Community Air Improvement Project.
9. In addition to information from truck routes, air quality data from silica sand facilities should be obtained using the annual silica threshold of 3ug/m^3.

II. TOOLS TO ASSIST LOCAL GOVERNMENTS

A. Air Quality

A.1. Air monitoring and Data Requirements

a. Description of Silica Sand Project Concerns

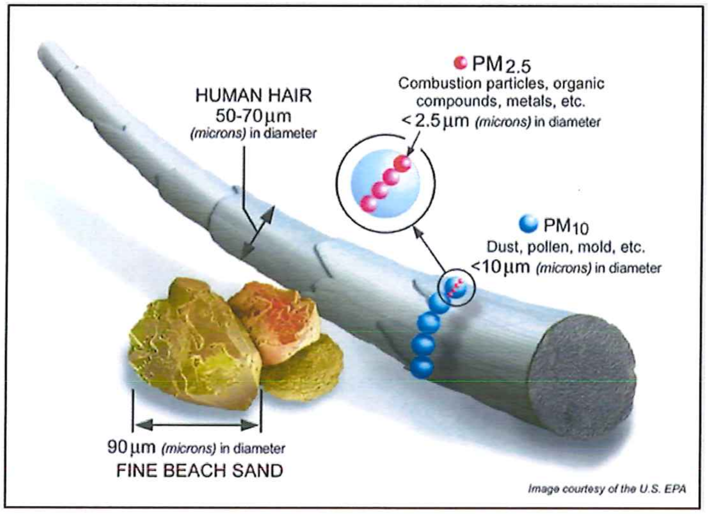
Particle pollution is regulated by particle size. A particle's size has implications for how the particle can enter the body and affect human health. The air pollutants of most concern from silica sand operations include particulates of various size fractions and chemical compositions.

b. Narrative Description, Background Information, Potential Impacts

In response to community concern regarding the potential air quality impacts resulting from increased mining, processing, and transport of silica sand in Minnesota, this section was written to help facilitate air quality assessments in impacted communities. The MPCA routinely collects air monitoring data for broad geographic areas, but also has required some silica sand facilities to collect property line monitoring data. The MPCA has made this air quality monitoring data available on its website.

The air pollutants of most concern from silica sand mining operations and transport include particulates of various size fractions and chemical compositions. This section will address methods for assessing air concentrations of the following air pollutants:

- Total suspended particles (TSP)
- Inhalable particles (PM_{10})
- Fine particles ($PM_{2.5}$)
- Crystalline silica as PM_{10} or PM_4
- Diesel exhaust



Particle pollution is regulated by particle size. A particle's size is determined by measuring the particle's aerodynamic diameter, which has implications for how the particle can enter the body and affect human health.

Human health research has shown that the smallest particles are of greatest concern for public health. Silica sand mining operations have the potential to emit particles across all size ranges including TSP, PM_{10}, PM_4 (not pictured), and $PM_{2.5}$.

Air pollution assessment methods

There are two methods for assessing air pollution concentrations associated with pollutant emissions from silica sand mining operations: ambient air monitoring and air dispersion computer modeling. Ambient air monitoring provides direct measurements of pollutant concentration at a specific location and period of time. Air dispersion modeling estimates air pollution concentrations across a broader area utilizing computer models which incorporate total air emissions from nearby sources and local meteorology. This document will focus primarily on options for conducting ambient air quality monitoring to assess the community level air quality impacts of silica sand mining. It is expected that this document could inform the plan for a site-specific air monitoring study. A silica sand facility or an LGU may initiate the planning and monitoring process. Regardless of who initiates the planning and implementation, the MPCA should be involved early on in the process. The MPCA has, and will continue to do the following: (1) provide technical assistance to LGUs regarding air monitoring issues, (2) review and approve an air monitoring plan, (3) review the data, (4) host the data through its website, and (5) perform audits of monitoring equipment.

Planning an air monitoring study

In choosing locations for an air monitoring site, particular attention should be paid to the goals of the air monitoring study. A community interested in assessing the air quality impacts of silica sand mining operations should consider the following monitoring objectives:

Source-oriented monitoring: An air monitoring site is located at the property line of an air pollution emissions source in the area of expected maximum pollution concentration. An upwind (non-impacted) and downwind (impacted) monitoring site may be established to measure the air quality impact of the emissions source.

Hot-spot monitoring: Similar to source-oriented monitoring, air pollution hot-spot monitors are located in the area of expected maximum pollution concentration. An air pollution hot-spot may be the result of a single emission source, or multiple emission sources concentrated in a small area, such as a heavily trafficked roadway.

Area background monitoring: Area background monitors are located to measure "typical" air pollution concentrations in a community. These monitors are located in areas that are not directly impacted by distinct emission sources; rather they are sited to measure the cumulative impact of air pollution emissions in a community. Area background monitoring provides a baseline for air pollution concentrations in a community, which can be used to measure the relative air pollution impact of air pollution sources assessed through source-oriented or hot spot monitors.

In addition to meeting the objectives of the air monitoring study, an air monitoring site should meet all siting criteria established by the U.S. Environmental Protection Agency (EPA) which are described in 40 Code of Federal Regulations Part 58 Appendix E. Important factors to consider when establishing an ambient monitoring site include:

Measuring ambient air: To compare air monitoring results with air quality standards, the air monitoring site must be measuring ambient air. According to 40 CFR 50.1 (e), ambient air is defined as the portion of the atmosphere, external to buildings, to which the general public has access. Air monitoring sites located within a facility's property line are not considered ambient if a fence or other physical obstruction prevents public access. However, if no such obstruction exists, air quality monitors located within a facility's property boundary may be considered ambient.

Horizontal and vertical placement: The objectives of the monitoring study will determine the criteria for placement of air monitoring probes or sample inlets. In most cases, air monitoring probes and inlets must be located between 2 and 7 meters above ground level. As a result, monitoring sites located at ground level typically require the installation of an elevated platform or shelter. Air monitoring sites may also be located on the roof of a building which is no higher than two-stories.

Spacing from emission sources: The proximity of the air monitor to air pollution emission sources is dependent on the objectives of the monitoring study. For source-oriented or hot-spot monitoring, air monitors should be located as close to the area of expected maximum air pollution concentration as safely possible. If the monitoring objective is to assess air pollution concentrations representative of a wider area, such as the average air pollution concentration across a community, air monitors should be located further away from emission sources.

Spacing from obstructions: Buildings and other obstacles can impact air monitoring results by scavenging pollutants and restricting airflow to the monitor, resulting in inaccurate air concentration measurements. In general, if an obstruction is located near an air monitoring site, the distance of the air monitor from the obstruction must be twotimes the height of the obstruction.

Cost of establishing an air monitoring site

The costs associated with establishing an air monitoring site will vary depending on the physical characteristics of the chosen monitoring location, the type of monitoring platform chosen (e.g. ground-level platform, shelter/trailer, rooftop), pollutants measured and existing infrastructure. The following section will describe the estimated costs associated with establishing a new air monitoring site in 2013. These cost estimates have been developed assuming all site infrastructure and equipment will be purchased and may not reflect the costs associated with establishing a temporary air monitoring site through a contractor.

Site Infrastructure

Capital costs for site infrastructure at ground-level sites - $10,000

- Land clearing and grading to access the site and meet siting criteria Utility drop and electrical connections to power instrument platforms
- Building permits
- Materials to construct elevated monitoring platforms
- Security fence and gate to enclose the monitoring site -

Capital cost considerations for alternative site configurations
- Ground level shelter/trailer and associated infrastructure -$32,000
- Rooftop installation and associated infrastructure - $6,000

Supporting Equipment (equipment needs will depend on pollutants measured at the site)

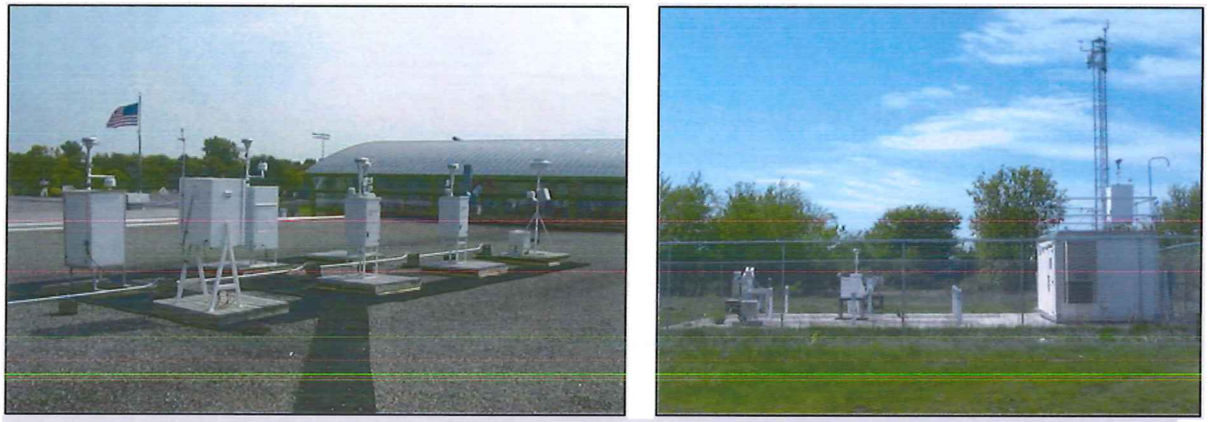
- Data logger and wireless telemetry for continuous monitoring instruments - $9,000
- Meteorological equipment and tripod - $3,500
- Laptop and uninterruptable power supply - $4,500
- Certified meters and devices to calibrate and perform quality control checks- $2,500
- Dynamic Dilution Calibrator with gas phase titration chamber (GPT) - $21,000
- NO2 Calibration gas cylinder and regulators - $1,000

Recurring annual site operation costs - $31,000

- Weekly site operation and maintenance - $20,000
- Project administration, contract management, site construction, procurement, QA/QC audits, data management, analysis and reporting - $10,000

- Consumable field supplies and miscellaneous hardware - $1,000

The following sections provide additional information about the pollutants of concern from silica sand mining operations including information on health effects, relevant air quality standards, and available air monitoring equipment and associated costs.



Example air monitoring sites: rooftop monitoring (left); ground-level monitoring including a shelter (right).

Total suspended particles (TSP)

Total suspended particles (TSP) are small airborne particles or aerosols that are less than 100 micrometers in diameter. Common components of TSP include soot, dust, fumes, and sea mist. In contrast to smaller size particulates (such as fine particles), the human body effectively blocks TSP, reducing the adverse health effects associated with exposure. Nearly all inhaled TSP is either directly exhaled or trapped in the upper areas of the respiratory system and expelled. If TSP enters the windpipe or lungs, it becomes trapped in protective mucous and is removed through coughing. While TSP pollutants are not expected to cause serious health effects in humans, high levels of TSP can be a nuisance, cause property damage, and reduce visibility.

In Minnesota, TSP is regulated by two Minnesota Ambient Air Quality Standards (MAAQS), including a daily (24-hour) and annual standard. To meet the daily standard, the 2nd maximum 24-hour average TSP concentration in an area must not exceed 150 micrograms per cubic meter ($\mu g/m^3$). An area meets the annual standard if the annual average TSP concentration does not exceed 60 $\mu g/m^3$.

Total suspended particulate monitoring is conducted by collecting a 24-hour mass sample on a glass fiber filter. The fiber filter is weighed in a laboratory pre and post sample collection. The mass difference is used to calculate the total TSP concentration in a volume of air. The standard annual operating schedule for TSP monitoring is a midnight to midnight 24-hour mass sample collected once every six days.

Total suspended particulate monitors should be sited to meet the goals of the specific monitoring project. To measure TSP concentrations associated with silica sand mining, TSP monitors should be located directly downwind of the TSP emission source of concern. When establishing a TSP monitoring site additional factors which must be considered include, maintaining unobstructed airflow in all directions of the air monitor, placing the sample inlet between 2-15 meters above ground level, and removing public access to the monitor through fencing or locating the monitor on the roof of a building.

On average, the cost of an EPA certified TSP monitor is $8,000. For regulatory comparisons with ambient air quality standards, all TSP monitoring networks must meet applicable quality assurance and quality control requirements, including a 10% monitor collocation requirement. For community level monitoring projects, the collocation requirement means that at least one monitoring site must have two TSP monitors operating at the same time. An additional collocated monitor is required for every 10 monitoring sites.


High-volume TSP Sampler

Operational costs associated with TSP monitoring include sample media purchase, preparation, and post sample analysis; weekly visits by a site operator and quarterly visits by a QA officer; motor replacement and/or brush repair; and power.

TSP Summary Information	**Regulatory Standards**
Equipment Cost: $8,000/monitor **O&M Cost**: $5,000/monitor	**Daily MAAQS:** Annual 2nd high 24-hour TSP concentration does not exceed 150 µg/m^3
Operational Considerations: Collocated monitor required at one sampling site	**Annual MAAQS**: Annual average TSP concentration does not exceed 60 µg/m^3

Inhalable particulate (PM_{10})

High-volume PM_{10} monitor (top); semi-continuous PM_{10} monitor (bottom)

Inhalable particles (PM_{10}) are very small particles less than 10 micrometers in diameter. Sources of PM_{10} include crushing and grinding operations, natural (crustal) and road dust, and biological sources. Scientific studies have linked short term exposure to elevated PM_{10} concentrations to decreased lung function, increased respiratory symptoms in children, increased doctor's visits and hospital admissions, and premature death in people with heart or lung disease.

In Minnesota, PM_{10} is regulated through national and state ambient air quality standards including a daily (24-hour) and annual standard. To meet the daily PM_{10} National Ambient Air Quality Standard (NAAQS) the 3-year average of the annual count of 24-hour PM_{10} concentrations greater than 150 $\mu g/m^3$ site must be less than or equal to 1. To meet the annual PM_{10} MAAQS, the annual average PM_{10} concentration must not exceed 50 $\mu g/m^3$.

The Code of Federal regulations requires that any monitor operated for the purpose of comparison of NAAQS must have a Federal Reference or Equivalent Method Designation, except as otherwise provided in Appendix C of 40 Code of Federal Regulations 40, Part 58. A complete list of acceptable monitors can be found in the 40 CFR, Part 53, Sections 53.2 and 53.3.

There are several PM_{10} monitoring methods included among the EPA certified monitors. The three most common monitoring methods used for measuring PM_{10} concentrations include high volume and low volume monitors that collect a 24-hour mass sample on a filter and semi-continuous monitors that collect hourly PM_{10} measurements on an auto-advancing filter tape. There are advantages and disadvantages for each of these monitor types. Choosing the best monitor for the monitoring study will depend on the monitoring objective.

To assess the PM_{10} impacts of silica sand mining operations in a community, the MPCA recommends utilizing a semi-continuous PM_{10} monitor. When paired with hourly meteorological or site activity data, hourly PM_{10} concentration data can be used to identify PM_{10} sources. Additionally, the semi-continuous monitor requires less frequent site operator visits than the high-volume sampler. The average cost of a semi-continuous PM_{10} monitor, including the monitor enclosure is $30,000. Because the semi-continuous PM_{10} monitors do not collect the PM_{10} sample on a retrievable filter, crystalline silica analysis cannot be performed with this collection method.

PM_{10} Summary Information	**Regulatory Standards**
Equipment Cost: **High-volume filter:** \$10,000 **Low-volume filter:** \$12,500 **Semi-continuous:** \$28,000 **O&M Cost**: \$5,000/monitor	**Daily NAAQS:** 3-year average of the annual count of 24-hour PM_{10} concentrations greater than 150 $\mu g/m^3$ must be less than or equal to 1 **Annual MAAQS**: Annual average PM_{10} concentration does not exceed 50 $\mu g/m^3$

Fine particles ($PM_{2.5}$)

Fine particles such as those found in smoke and haze are 2.5 micrometers in diameter and smaller. Fine particles can be emitted directly from combustion activities or the can form in the air when other pollutant gases react in the air. Fine particles are created through most combustion activities, but the most common sources of fine particle pollution includes power plants, industries, automobiles, and fires.

Due to their very small size, fine particles can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked fine particle exposure to respiratory discomfort, decreased lung function, aggravated asthma, irregular heartbeat and heart attacks, increased doctor's visits and hospitalizations, and premature death in people with heart or lung disease.

Low-volume $PM_{2.5}$ filter monitor

Fine particle pollution is regulated through two national ambient air quality standards including a daily (24-hour) and annual standard. To meet the daily $PM_{2.5}$ standard, the 3-year average of the annual 98th percentile 24-hour $PM_{2.5}$ concentration must not exceed 35.4 $\mu g/m^3$. To meet the annual $PM_{2.5}$ standard, the 3-year average of the annual average $PM_{2.5}$ concentration must not exceed 12.0 $\mu g/m^3$.

The Code of Federal regulations requires that any monitor operated for the purpose of comparison of NAAQS must have a Federal Reference or Equivalent Method Designation. Except as otherwise provided in 40 CFR, Part 58, Appendix C. A complete list of acceptable monitors can be found in the 40 CFR, Part 53, Sections 53.2 and 53.3.

Several $PM_{2.5}$ monitoring methods are included among the EPA certified monitors. The most common monitoring methods used for measuring $PM_{2.5}$ concentrations include low-volume monitors that collect a 24-hour mass sample on a filter and semi-continuous monitors that collect hourly $PM_{2.5}$ measurements on an auto-advancing filter tape. There are advantages and disadvantages for each of these monitor types. Choosing the best monitor for the monitoring study will depend on the monitoring objective.

To assess PM2.5 impacts of silica sand mining operation in a community the MPCA recommends utilizing a semi-continuous PM2.5 monitor. When paired with hourly meteorological or site activity data, hourly $PM_{2.5}$ concentration data can be used to identify $PM_{2.5}$ sources. Additionally, the semi-continuous monitor requires less frequent site operator visits than the filter based sampler. The average cost of a semi-continuous $PM_{2.5}$ monitor, including the monitor enclosure is $30,000.

$PM_{2.5}$ Summary Information	Regulatory Standards
Equipment Cost: **Low-volume filter:** $12,500 **Semi-continuous:** $30,000	**Daily NAAQS:** 3-year average of the annual 98^{th} percentile 24-hour $PM_{2.5}$ concentration does not exceed 35.4 $\mu g/m^3$
O&M Cost: $5,000/monitor	**Annual NAAQS:** 3-year average of the annual average $PM_{2.5}$ concentration does not exceed 12.0 $\mu g/m^3$
Operational Considerations: Collocated monitor required at one sampling site	

Crystalline silica

Respirable crystalline silica is a dust-sized particle invisible to the naked eye that when inhaled is deposited deep within the lungs. Crystalline silica is a very common component of soil and well-known occupational hazard in certain trades. Activities such as mining for crystalline silica and other natural resources, as well as construction activities related to cutting and sawing of common materials such as concrete, create respirable crystalline silica particles.. People who work in the hydraulic fracturing or frac sand mining industries are most at risk for exposure to elevated levels of respirable crystalline silica, but people living downwind of silica sand mining, processing, or hauling operations could also be exposed to respirable crystalline silica. Due to the greater risk for exposure in the occupational environment, respirable crystalline silica is routinely measured in the workplace. However, levels of respirable crystalline silica in ambient (outdoor) air are rarely determined. Diseases associated with chronic exposure to respirable crystalline silica over many years include: silicosis, emphysema, chronic obstructive pulmonary disease, tuberculosis, lung cancer, and immune system diseases.

There are no federal or state standards for respirable crystalline silica in ambient air. However, the MPCA uses a risk guideline value developed by the MDH to assess the risk of adverse health effects from exposure to measured levels of respirable crystalline silica in the air. In July 2013, the MDH established a chronic Health Based Value for respirable crystalline silica of 3 $\mu g/m^3$ in ambient air for non-occupational exposures occurring in the general population. The MPCA compares annual average monitoring results to the chronic health based value to assess the health

risk associated with respirable crystalline silica concentrations in the air. Quantitative health based guidance for shorter duration exposures to respirable crystalline silica were not developed because data are lacking and the extremely high levels of respirable crystalline silica required to cause short-term health effects in occupationally-exposed individuals are far beyond the scope of ambient exposure scenarios the general public would be expected to encounter. The Minnesota Department of Health's chronic Health Based Value for respirable crystalline silica of 3 $\mu g/m^3$ is very conservative and highly protective guidance. Short-term increases in ambient levels of respirable crystalline silica in excess of the chronic Health Based Value do not necessitate an immediate cause for concern. Therefore measured 24-hour average concentrations of respirable crystalline silica in ambient air will be used to calculate the 95% upper confidence limit of an annual mean concentration and compared to the chronic Health Based Value of 3 $\mu g/m^3$
The EPA has not established a standard method for measuring crystalline silica in ambient air. The MPCA recommends utilizing a modified low-volume particulate sampler to collect 24-hour mass samples of PM_4 on a 47 mm mixed ester sample filter. Following sample collection, the loaded filter should be sent to a certified laboratory for crystalline silica analysis using the National Institute for Occupation Safety and Health (NIOSH) Method 7500 or NIOSH Method 7602. The average cost of the low-volume particulate sampler is $12,500. The estimated annual cost of analysis of 60 crystalline silica samples from a certified laboratory is $25,000.

Respirable Crystalline Silica Summary Information

Equipment Cost:	**No regulatory standard**
$12,500/monitor	**Chronic health based value:** 3.0 $\mu g/m^3$
O&M Cost:	See MDH Silica Health Based Value Summary at:
$25,000/monitor	http://www.health.state.mn.us/divs/eh/risk/guidance/air/silicasumm.pdf

Diesel exhaust

The exhaust from diesel engines contains a complex mixture of air pollutants including gases and particles. Major chemical components of diesel exhaust include carbon dioxide, carbon monoxide, nitrogen dioxide, nitric oxide, particles (coarse, fine, and ultra-fine), black carbon, and sulfur dioxide. Diesel exhaust also contains air toxic pollutants such as acrolein, benzene, formaldehyde and polycyclic aromatic hydrocarbons (PAHs).

The majority of scientific studies conducted to measure the health risks associated with exposure to diesel exhaust focus on the particle components of the exhaust. Similar to the health effects associated with fine particle pollution, exposure to diesel particles can cause adverse respiratory and cardiovascular health effects including decreased lung function, aggravated asthma, irregular heartbeat and heart attacks, increased doctor's visits and hospitalizations, and premature death in people with heart or lung disease. The U.S. EPA has also classified diesel exhaust as a likely carcinogen due to increased risk for lung cancer resulting from long term exposure.

There is no ambient air standard for diesel exhaust. The MPCA uses a health based value to assess the risk of adverse health effects from exposure to diesel particulate. The chronic non-cancer health risk value for diesel particulate is 5 $\mu g/m^3$.

Methods do not currently exist to measure the amount of diesel exhaust in ambient air directly. Instead, researchers typically monitor other pollutants that may be signatures of diesel exhaust. These pollutants include fine particles, ultra-fine particles (particle diameter less than 1 micrometer), elemental carbon, and nitrogen oxides. Utilizing surrogate pollutants to assess the amount of diesel exhaust in the air has significant limitations, as the relationship between the surrogate pollutant and the amount of diesel exhaust in the air varies geographically and by the characteristics of the emissions source.

If surrogate monitoring is conducted to assess diesel exhaust concentrations, the MPCA recommends establishing an upwind (non-impacted) and downwind (impacted) monitoring site. Comparing the result from these monitors may help identify the relative impact of increased diesel exhaust emissions if other pollutant emissions are relatively uniform between the two monitors. While either hourly $PM_{2.5}$ or nitrogen oxides can be used as a surrogate for diesel exhaust, the MPCA recommends utilizing hourly measurements of $PM_{2.5}$.

Due to the difficulties associated with measuring diesel exhaust through air monitoring, the MPCA assesses the health risks associated with diesel exhaust emissions through air dispersion modeling. Air dispersion models integrate information on emission sources and local geography and meteorology to estimate pollution concentrations in the air. To assess the increased health risks associated with diesel exhaust emissions from silica sand mining operations, information on diesel emission sources should be gathered. This may include information on the engine type, size, and age; fuel type; and in the case of on-road diesel engines, the number of vehicles and miles traveled on a roadway.

Diesel Exhaust Summary Information

No direct monitoring methods

Surrogate measurements:
- **Fine particles**: $30,000
- **Nitrogen dioxide:** $12,000

O&M Cost: $5,000/monitor

No regulatory standard

Chronic non-cancer health based value: 5 $\mu g/m^3$ diesel particulate

Summary of estimated air monitoring site capital and annual operation costs in 2013 dollars

All monitoring sites must meet the guidelines described in 40 CFR Part 58 Appendix E.

Site infrastructure		
	Rooftop site	$6,000
	Ground-level site (no shelter)	$10,000
	Shelter/trailer site (with HVAC)	$32,000
Pollutant monitors		
	Semi-continuous $PM_{2.5}$ (with environmental shelter, but without HVAC)	$30,000
	Semi-continuous PM_{10} ((with environmental shelter, but without HVAC)	$28,000
	High-volume TSP	$8,000
	Low-volume PM_4	$12,500
	Nitrogen oxides	$12,000
Supporting equipment		
	Data logger/wireless telemetry	$9,000
	Meteorological sensors and tripod	$3,500
	Laptop and uninterruptable power supply	$4,500
	Certified meters and devices for calibration and QA/QC	$2,500
	Dynamic Dilution Calibrator with gas phase titration chamber (GPT)	$21,000
	NO2 Calibration gas cylinder and regulators	$1,000
Sample analysis		
	TSP sample prep and post-weigh analysis	$5,000/year
	Low-volume PM_4 sample silica analysis (60 samples)	$25,000/year
	Data processing and analysis for $PM_{2.5}$, PM_{10}, and nitrogen oxides	$5,000/year
Operations and maintenance		
	Weekly site operations and maintenance	$20,000/year
	Project administration, contract management, site construction, procurement, QA/QC audits, data management, analysis and reporting	$10,000/year
	Consumable field supplies and hardware	$1,000/year

Estimated one-time capital expenses per monitoring site*: $19,000 - $142,000**
Estimated annual expenses per monitoring site*: $12,000*- $56,000

*Post-construction upwind/downwind monitoring will require at least two monitoring sites

**Low-end of range based on a single rooftop monitoring site measuring TSP and meteorological parameters only.

c. Recommendations, Standards, Criteria, Considerations

The proposed standards, criteria, and considerations are informed by both the processes within the proposed silica sand project and the geographic location of the project.. The monitoring plan for a silica sand project should include the following:

What to monitor:

- Every silica sand project involving a mine of any size should conduct monitoring for Total Suspended Particulate, PM_4-silica, and meteorological data.
- Every silica sand project involving processing should monitor for PM_{10}, PM_4-silica, and meteorological data; the term 'processing' means washing, cleaning, screening, crushing, filtering, sorting, stockpiling, and storing silica sand.
- Every silica sand project involving over-the-road transportation should monitor for $PM_{2.5}$, PM_4-silica, and meteorological data at each site where silica sand is either loaded or unloaded from a transportation carrier (e.g. truck, rail, barge).

Note that if a silica sand project involves one or more of the above activities, then the monitoring plan should reflect all of the indicated monitors (e.g. a project that encompasses a mine, processing facility, and over-the-road transportation should monitor for TSP, PM_{10}, $PM_{2.5}$, and PM_4-silica).

When to monitor:

- All silica sand projects should conduct ambient monitoring prior to startup of the project. The pre-construction monitoring period should continue until at least one year of valid data is collected.
- All silica sand projects should conduct ambient monitoring after startup of the project. The post-construction monitoring period should continue until at least three (3) years of valid data are collected.

How often to monitor:

- Each TSP sampler should run for a 24-hour midnight-to-midnight period once every six days on the schedule found here: http://www.epa.gov/ttnamti1/calendar.html
- Each PM_{10} analyzer should run on a semi continuous (hourly) basis
- Each $PM_{2.5}$ analyzer should run on a semi continuous (hourly) basis
- Each PM_4 sampler should run for a 24-hour midnight-to-midnight period once every six days on the schedule found here: http://www.epa.gov/ttnamti1/calendar.html

Which monitor and test method should be used:

- Each TSP, PM_{10}, and $PM_{2.5}$ monitor should be one that has been designated as a Federal Reference Method (FRM) or as a Federal Equivalent Method (FEM); an electronic list of monitors that hold this designation is available at http://www.epa.gov/ttnamti1/files/ambient/criteria/reference-equivalent-methods-list.pdf
- Each PM_4 monitor should be approved by the MPCA on a case-by-case basis. The silica test method should be NIOSH 7500.

Monitor Siting

- Historical wind patterns (direction, intensity) from nearby meteorological stations and the on-site meteorological station should be compiled to inform the siting conditions in order to construct 'upwind / downwind' monitor placement. The monitors should be placed as close to the facility as possible while remaining in ambient air. This is typically the fence line of the facility.
- Monitor sites should meet criteria laid out at 40 CFR pt. 58, Appendix E. This appendix contains information such as vertical and horizontal placement, spacing, distance from obstructions, and more.

Data Reporting

- All data should be sent to the MPCA and the LGU
- TSP, PM_{10}, $PM_{2.5}$, and Crystalline Silica data should be reported on a quarterly basis no later than one month following the end of each quarter.
- Data may be provided in a written report but most also be provided in an electronic format that can be directly read into a spreadsheet or database
- For parameters that are measured hourly or sub-hourly, electronic data submissions should include hourly averaged data
- The silica sand project proposer should notify both the MPCA and the LGU within 24 hours of receiving sample results exceeding ambient standards. The notification should include the date of the exceedance, the concentration of the sample, and a summary of the measures taken by the proposer to reduce emissions at the silica sand project.

A.2. Dust Control & Containment of Sand

a. Description of Silica Sand Project Concerns

Virtually all stages of silica sand mining, processing, and transportation may emit particulate matter, which is commonly known as dust. The control strategies share a common feature: they are designed to minimize the interaction between wind and silica sand. In general, all processes after the mining process should be enclosed. Those portions of the process that cannot be enclosed (i.e. roads) should utilize alternative methods such as watering and sweeping in order to suppress the movement of particulate matter.