

# Particulate Health Risks from Sand Mining & Processing

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# Overview of Health Risks

- Waterborne pollutants that can be ingested.
- **Airborne pollutants that can be inhaled.**
- Noise pollution that can be heard.
- Light pollution that can be seen.
- Wetland loss that affects local water quality.
- Truck traffic that affects road safety.
- Greenhouse gas generation that increases climate change.

# Chemicals of Concern: Particulate Matter (PM)

- Increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing, for example;
- Decreased lung function;
- Aggravated asthma;
- Development of chronic bronchitis;
- Irregular heartbeat;
- Nonfatal heart attacks; and
- Premature death in people with heart or lung disease.

# Particle Size is Important

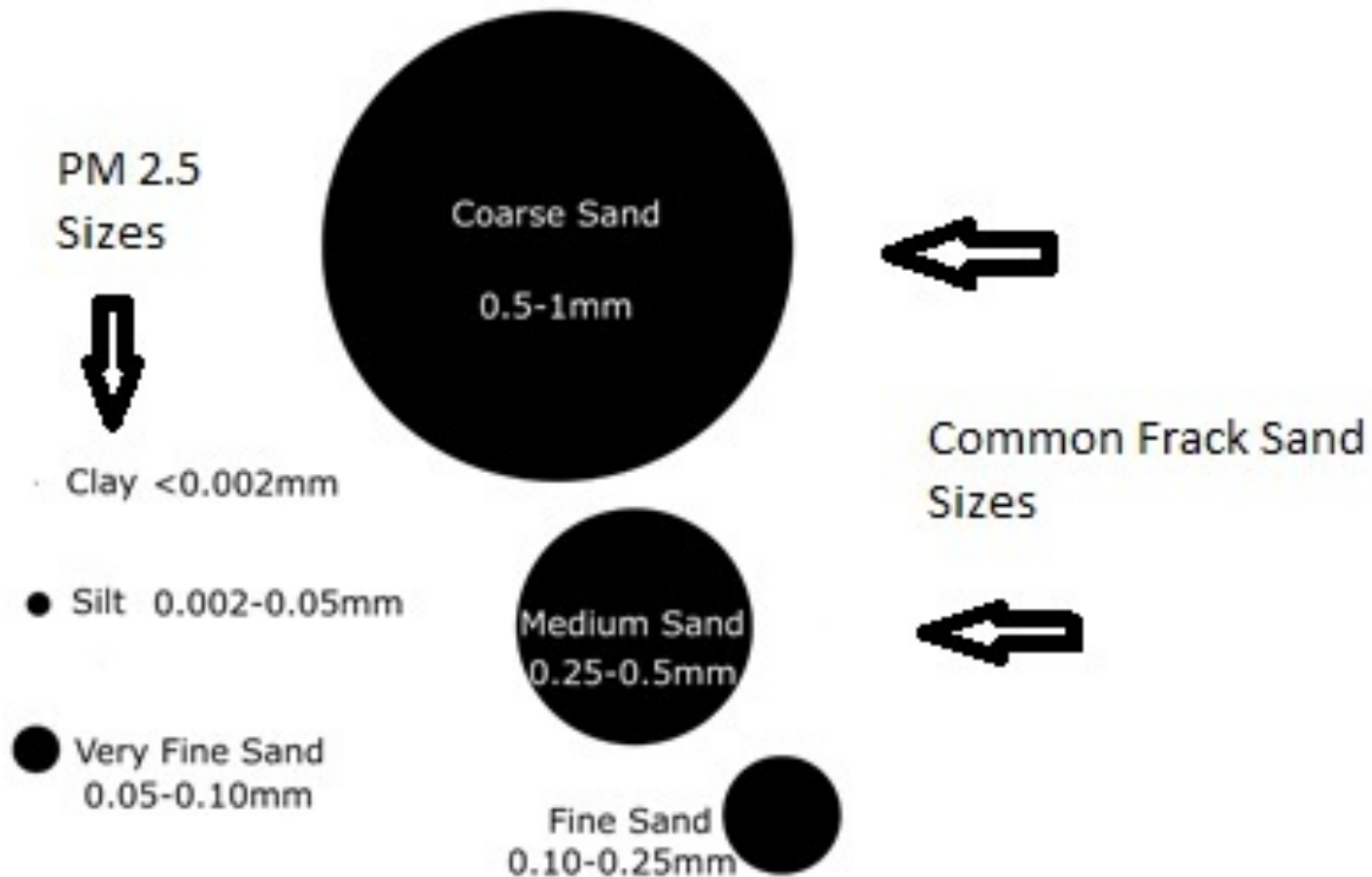


Image: Modified from <http://www.riverpartners.org>



# Chemicals of Concern: Crystalline Silica

**NIOSH**

United States Department of Labor  
**MSHA**  
Mine Safety and Health Administration



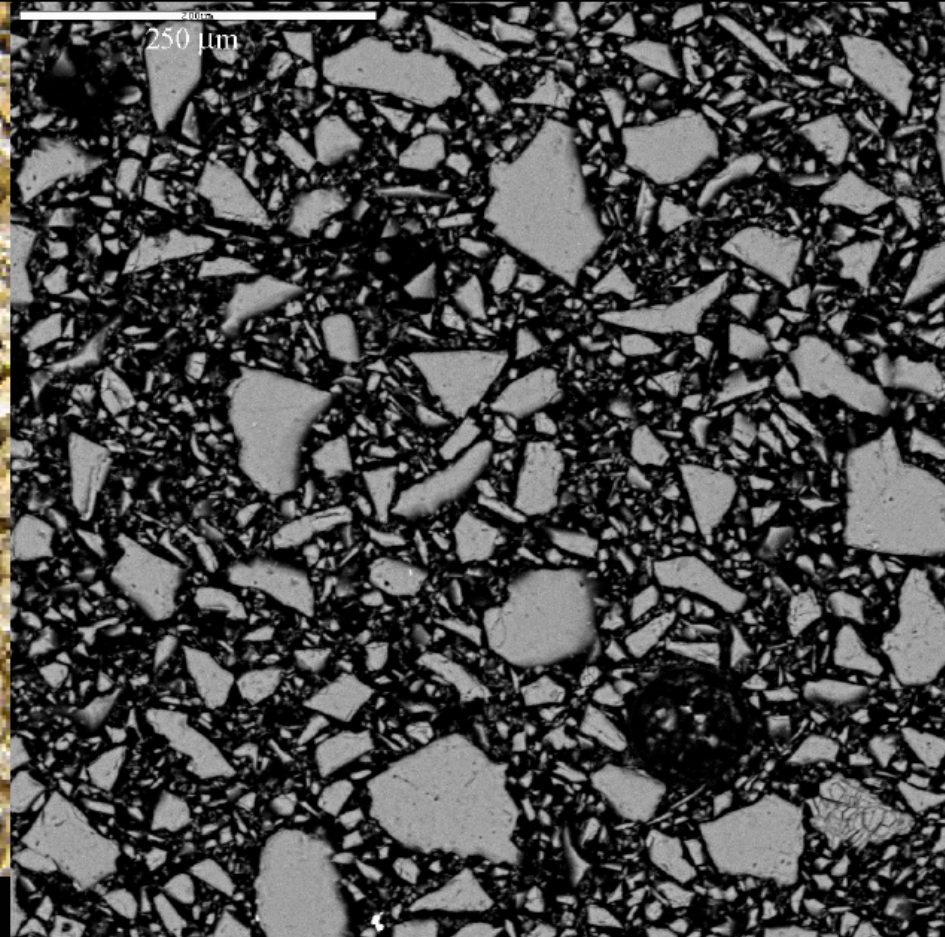
**AMERICAN LUNG ASSOCIATION**

**OSTIA**

## Sand



## Respirable Silica (Quartz)




SEM image courtesy: Geoff Plumlee, Ph.D., Heather Lowers, MS, USGS 2011

# Health Effects

- Silicosis –a fibrosis (scarring) of the lungs. Silicosis is progressive and leads to disability and death.
- About 200 people in the US will die this year due to workplace exposure to silica (NIOSH 2008).
- Between 8-18 people are expected to die in Wisconsin from workplace silicosis in 2012.

SOURCE: National Center for Health Statistics multiple cause of death data. Population estimates from U.S. Bureau of the Census, <http://www.cdc.gov/niosh/docs/96-134/pdfs/96-134e.pdf>

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- Lung Cancer – Crystalline silica (quartz) is classified as a human carcinogen by the following regulatory agencies:
    - **International Agency for Research on Cancer (IARC)**
    - **National Toxicology Program**
    - **California Proposition 65**
    - **American Conference of Governmental Industrial Hygienists**
    - **Occupational Safety and Health Administration - Potential Cancer Hazard**
    - **National Institute for Occupational Safety and Health (NIOSH) – Potential Cancer Hazard**



# Sand Mining and Processing Generate PM and Silica



Image: [upstreamonline.com](http://upstreamonline.com)

- Frac sand mining and processing generate PM and silica through blasting, loading, and hauling; processing activities such as crushing; and transporting frac sand and “waste sand.”

# Particulates and Silica From Sand Plants



Photos taken of the silica sand mine and processing site at CTH DD and STH 64 in the Town of Auburn on October 7, 2011 by James Torseth. Note visible emissions from sand piles. Photographer noted *"Upwind of the site the sky was clear. Downwind of the site there was a whitish gray haze extending for a mile or more."*

# Regulation

- Five states (but not Wisconsin) are now regulating crystalline silica exposure: the State of California OEHHS has done a careful job of establishing a non-cancer risk threshold of 3  $\mu\text{g}/\text{m}^3$  to protect the public from silicosis (Myers 2010).

# Research at UW-Eau Claire



- Review previous research and exposure standards for exposure to particulate matter (PM<sub>10</sub>, PM<sub>4</sub>, PM<sub>2.5</sub>, and “respirable” dust particles), and crystalline silica (quartz).



- Record GPS coordinates, wind speed and direction, particulate matter concentrations and crystalline silica concentrations surrounding the EOG Resources Chippewa Falls sand processing plant before and during operation.



# EOG Chippewa Falls Sand Plant



# Sources of Data: MSHA

Mine Safety and Health Administration (MSHA) monitoring of 41 sand mines and processing plants in Wisconsin.

## EOG Resources, Chippewa Falls, WI

Date	Location	Job	Contaminant	Concentration	PEL	PPE	Contractor ID	Action
6/2012	S - General	Electrician	Quartz, respirable, >1% Qtz	0.13	0.56	Y		
27/2012	M - Washing & Screening	Washer Operator	Noise dosimeter, 80dBA threshold dose	52.40	50.00	Y		E
27/2012	M - Washing & Screening	Washer Operator	Noise dosimeter, 90dBA threshold dose	37.46	100.00	Y		
27/2012	S - General	Electrician	Noise dosimeter, 80dBA threshold dose	32.85	50.00	Y		
27/2012	S - General	Electrician	Noise dosimeter, 90dBA threshold dose	19.96	100.00	Y		
27/2012	Laboratory	Lab Technician	Quartz, respirable, >1% Qtz	0.23	0.40	Y		
27/2012	M - Washing & Screening	Washer Operator	Quartz, respirable, >1% Qtz	0.60	0.53	Y		L
27/2012	S - General	Electrician	Quartz, respirable, >1% Qtz	0.82	0.57	Y		C
4/2012	S - Ore Processing	Building Repair/Maint.	Quartz, respirable, >1% Qtz	0.47	0.60	N		
4/2012	S - Ore Processing	Building Repair/Maint.	Quartz, respirable, >1% Qtz	0.70	0.74	N		
4/2012	S - Ore Processing	Washer Operator	Quartz, respirable, >1% Qtz	0.54	0.69	N		

# NIOSH (National Institute for Occupational Safety and Health)

**NIOSH** OIL & GAS EXTRACTION  
SAFETY & HEALTH RESEARCH

## NIOSH Field Effort to Assess Chemical Exposures in Oil and Gas Workers: Health Hazards in Hydraulic Fracturing

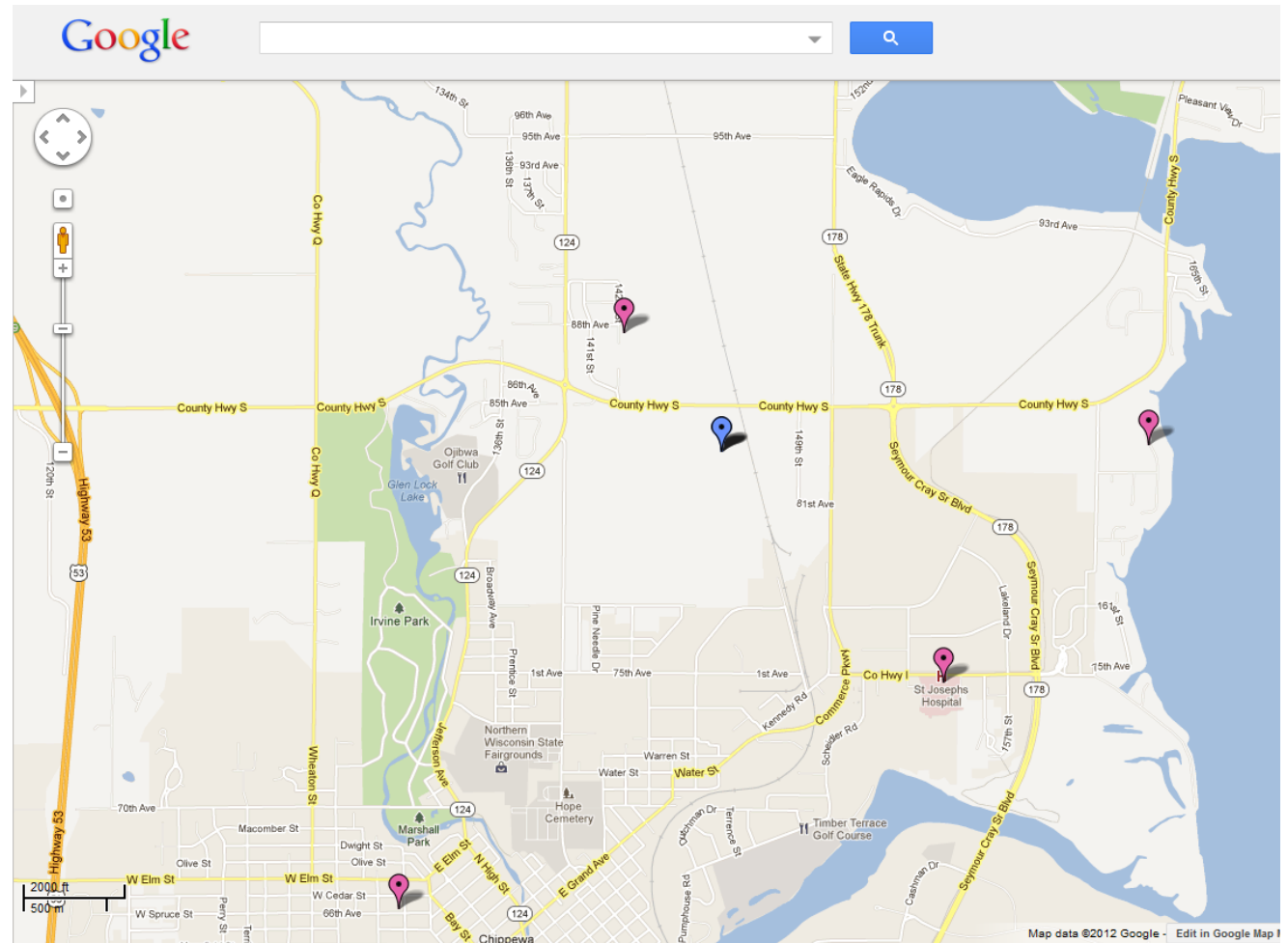
Eric J. Esswein  
Michael Breitenstein  
John Snawder

**Disclaimer:** The findings and conclusions in this presentation have not been formally disseminated by NIOSH and should not be construed to represent any agency determination or policy.



# Jeff Falk Analysis

Used differences in Dylos readings up- and down-wind of the EOG sand plant.

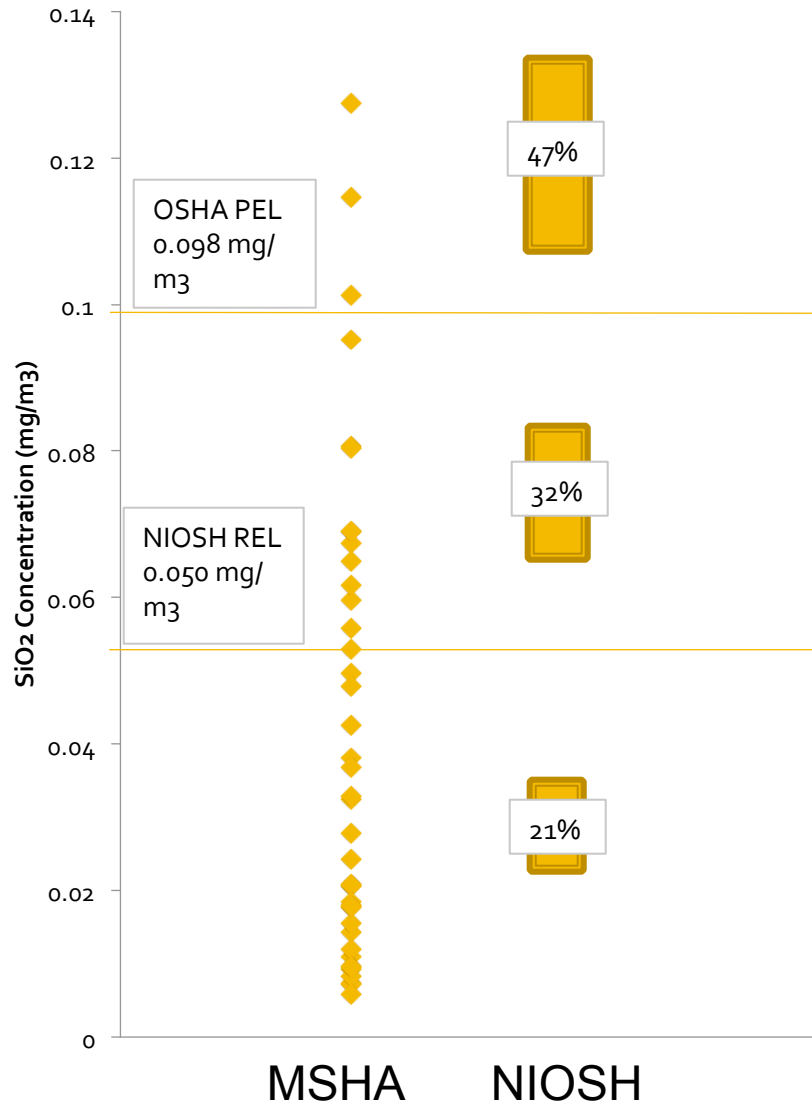




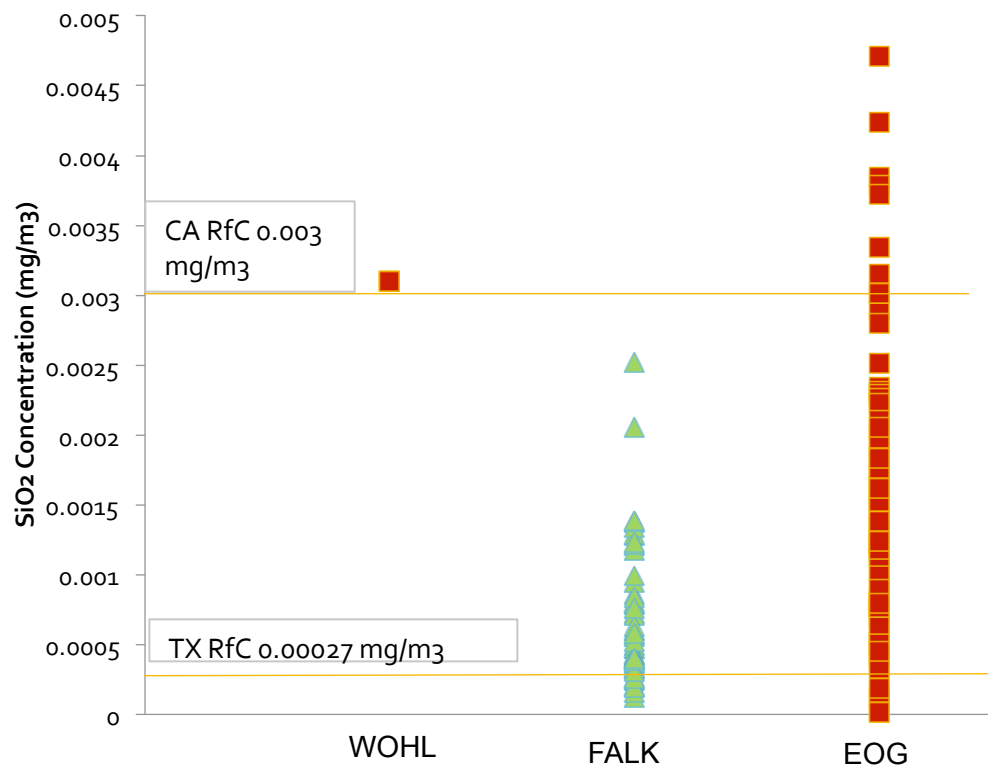
# EOG PM 10 Monitor

- A DNR-required monitor operated by EOG measures PM 10 and is located in the SW (upwind) corner of the facility.

# Results: Onsite Silica Above Limits



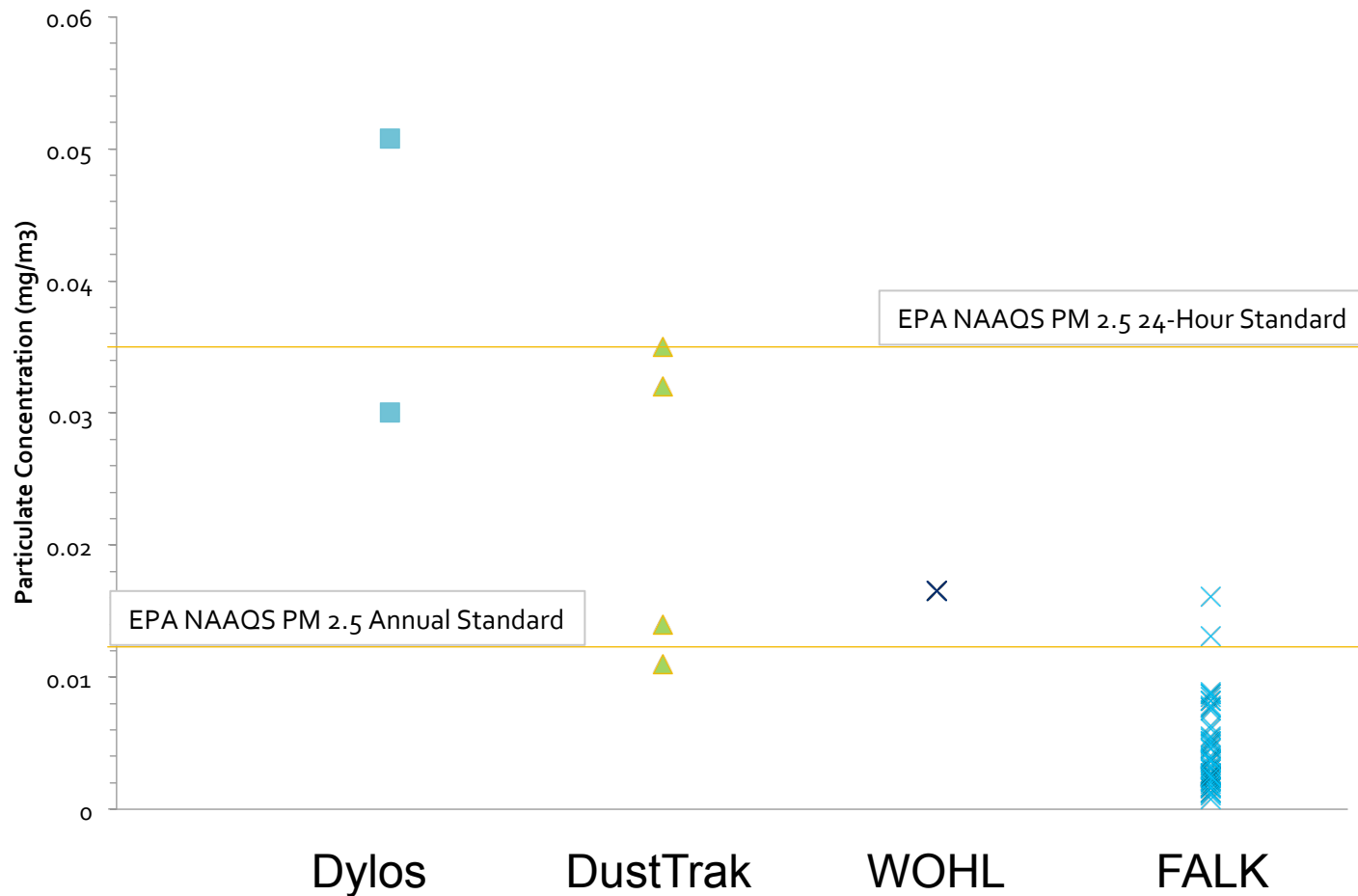
# Ambient Silica is At or Near Standards from Other States



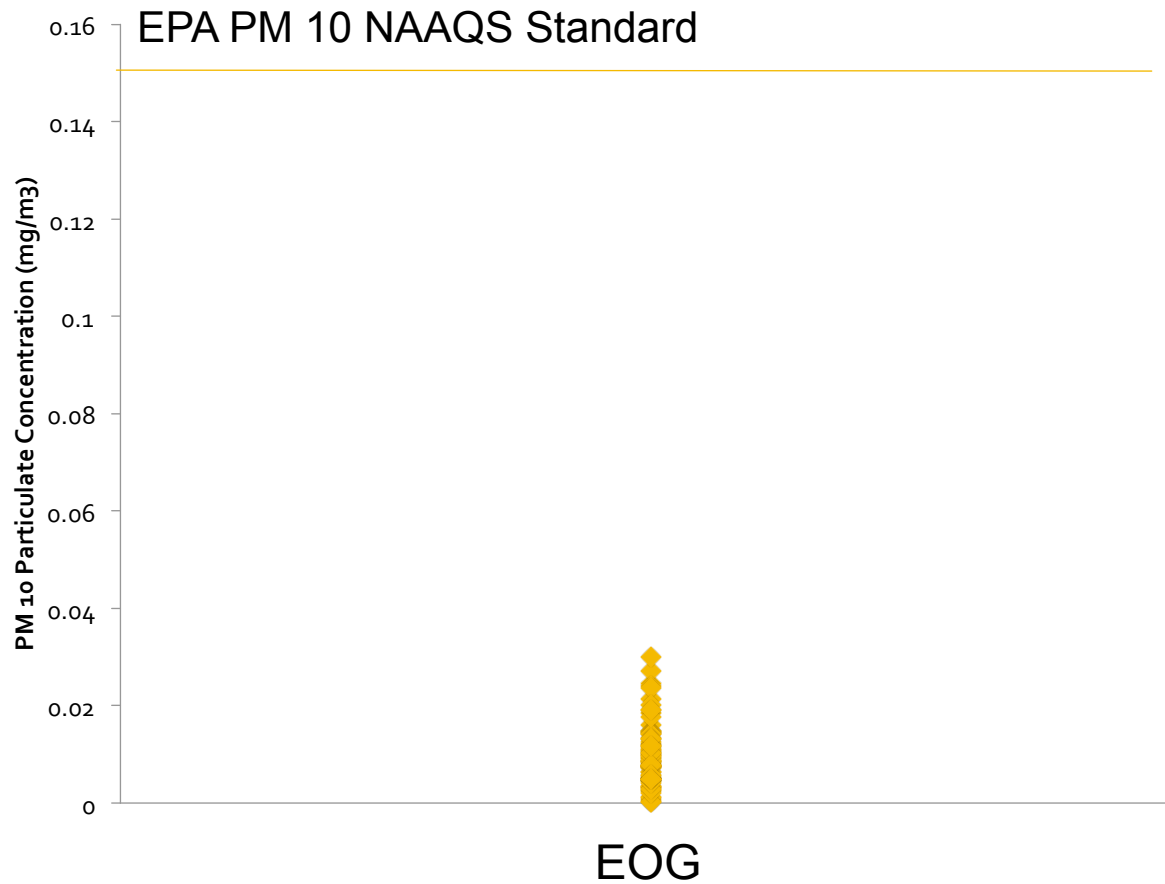
Preliminary PM 4 silica data from an industry-sponsored study (John Richards, PhD) has measured the presence of silica at EOG (and the Towns of Howard and Cooks Valley mines) at around 0.0005—0.001 mg/m<sup>3</sup>).



# Ambient PM 2.5/4 Particulates are At or Near EPA Standards



# EOG PM 10 Monitor Shows Low Levels



# Other Considerations (Pilar Gerasimo)

- “Two years ago, Wisconsin had five frac sand mines and five processing facilities. Now it has 63 mines and 36 processing facilities.”

<http://minnesota.publicradio.org/display/web/2012/05/18/environment/frac-sand-sediment-saint-croix-spill/> DNR's Tom Woletz.

# Traditional gravel and sand pits

- Average size 5 to 10 acres
- Low-intensity ops, gradual expansion
- Used for local projects
- Geographically dispersed, located near where used
- Generally do not use flocculant chemicals\*



*Wisconsin Towns Association Frac-Sand Conference, Eau Claire, WI, Jan. 2012*  
*\* Dan Masterpole, Department of Land Conservation, Chippewa County*



# Industrial frac-sand mines

- Heavy industry, intense, 24/7 ops
- Can be very large (1,200+ acres)
- May expand continually
- Often located close together
- Shipped to other states or countries
- Typically rely on flocculants\*



*Wisconsin Towns Association Frac-Sand Conference, Eau Claire, WI, Jan. 2012,  
\* Dan Masterpole, Department of Land Conservation, Chippewa County. Photo: Jim Tittle*

# Quality of Life

- Level of noise
- Dark, starry nights
- Traffic
- Landscape
- Agricultural character
- Well water
- Creek flow

# Water Depletion/Degradation

- High capacity wells can draw 1 to 2 million gallons a day (multiply by number of wells in region)
- Blasting, digging and declining water levels can release natural and agricultural contaminants\*
- 6+ sand-industry spills in 12 months

Wisconsin Towns Association Frac Sand Conference, Jan. 2012

\*DNR Magazine

<http://dnr.wi.gov/wnrmag/html/supps/2006/apr06/threats.htm#sub8>





Polluted water flows to beaver dam, then to St. Croix River

Sediment-filled water overflows holding pond and flows downhill to creek

**This photo shows the area where the sediment overflowed, said Wisconsin DNR storm water specialist Ruth King. The photo, taken April 26, 2012, shows the cream-colored sediment spilling over the holding pond's left side. The sediment traveled down the hill to a creek and into a beaver dam, seen at the top of the photo, before continuing to the St. Croix River. (Photo courtesy Wisconsin DNR)**

**CLOSE X**



# Positive impacts are best publicized

- 40-60 Jobs commonly planned at large mine
- 12-20 Jobs (max) commonly produced\*
- Historic mining regions:  
Appalachia, Ozarks, Upper Peninsula, Iron Range



*“Frac-Sand Mining and Community Economic Development” UW Madison Dept. of Agriculture and Applied Economics Staff Paper, May 2012; \*Mining presentation by Bruce Brown, WTA Frac-Sand Mining Conference, Wisconsin Geological and Natural History Survey, Madison, UW Extension*

# Conclusions

- Sand mining, transportation and processing releases particles including crystalline silica into the ambient air.
- MSHA found silica in all 41 samples from WI sand plants and mines; 3 samples exceeded the safety standard.
- Limited ambient sampling found silica and particulates at or near public health standards.

# QUESTIONS?

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- Department of Public Health Professions
- 244 Nursing
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- Eau Claire, WI 54702-4004
- (715) 836-5589
- <http://www.uwec.edu/piercech>
- Video:  
[http://desi.uwec.edu/PIERCECH/Sand\\_Mining\\_1024.asx](http://desi.uwec.edu/PIERCECH/Sand_Mining_1024.asx)

# Emission Violations

RE: Initial Air Emissions Compliance  
Testing Performed April 3-5, 2012  
Preferred Sands Wisconsin, LLC  
Blair Facility  
WDNR EI Facility No: 662028620

## **POI Sand Dryer Particulate Matter (PM) Limits**

Condition I.A.1.a.(1) of the permit requires PM emissions to not exceed 8.75 pounds per hour. April 2012 testing resulted in an average of 13.97 pounds per hour.

## **POI Sand Dryer Carbon Monoxide (CO) Limit**

Condition I.A.4.a.(1) of the permit requires CO emissions to not exceed 1.21 pounds per hour. April 2012 testing resulted in an average of 3.15 pounds per hour.

## **P04 Dry Plant Dust Collector PM Limit**

Condition I.D.1.a.(1) of the permit requires PM emissions not exceed 0.1 pounds per hour. April 2012 testing resulted in an average of 0.49 pounds per hour.