Environment and Natural Resources Trust Fund
2014 Request for Proposals (RFP)

DRAFT
N

Project Title:

Silica/Frac Sand Mining Air/Water Quality Environmental Impacts

Category: E. Air Quality, Climate Change, and Renewable Energy

Total Project Budget: $ 607,924

Proposed Project Time Period for the Funding Requested: 3 Years, July 2014 - June 2017

Other Non-State Funds: $ 0

Summary:

This study will determine the environmental concentrations and compositions of airborne particulate matter generated by silica sand mining activities in Southeast Minnesota and evaluate related air and water quality impacts.

Name: George Hudak

Sponsoring Organization: U of MN - NRRI

Address: 5013 Miller Trunk Hwy
Duluth MN 55811

Telephone Number: (218) 720-4393

Email ghudak@nrri.umn.edu

Web Address http://www.nrri.umn.edu/default/about.htm

Location

Region: Metro, Southeast

County Name: Chisago, Dakota, Fillmore, Goodhue, Houston, Le Sueur, Olmsted, Wabasha, Washington, Winona

City / Township: Various SE MN and other reference locations

MP: 0613-2-243-proposa
Budget: 0613-2-243-bud
Qual: 0613-2-243-qualifi
Map: 0613-2-243-map-N
Resolution:
List:

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base	
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency	
Capacity	Readiness	Leverage	Employment	TOTAL

Environment and Natural Resources Trust Fund (ENRTF)
2014 Main Proposal
Project Title: *Silica/frac sand mining air/water quality environmental impacts*

PROJECT TITLE: S**ilica/frac sand mining air/water quality environmental impacts**

I. PROJECT STATEMENT

1. Background This study will produce essential environmental data about concentrations and compositions of airborne particulate matter (PM) generated by activities related to silica sand (frac sand) mining, production, and transport in SE Minnesota, and evaluate related air and potential water quality impacts. Airborne crystalline silica will be a major study focus, but diesel emissions will also be measured. Ambient air (e.g., community and background) and occupational (e.g., personal) sampling and analytical techniques will be employed. Potential impacts of airborne particulate matter (dust "fallout") on the region's water quality will also be addressed.

2. Justification On March 20, 2013, the Minnesota Environmental Quality Board (EQB) issued its *"Report on Silica Sand - Final Report"*. The EQB report addressed concerns about the impact of silica sand mining on Southeast Minnesota air quality, and identified the following as a priority area in need of attention/research:

- "*The Minnesota Department of Health (MDH) has little or no information on the levels of respirable silica generated by frac sand mining or processing. MDH has not been provided with any information on the ambient air levels of silica that result from frac sand mining operations*" (Pages 21-22 of EQB report).

Furthermore, increased truck traffic on unpaved roads and regional agricultural soils can contribute not only silica and diesel particulate, but other particulate matter to ditches, streams, rivers, and lakes. Fertilizers, pesticides, herbicides, and chemicals adsorbed on particulate matter surfaces can be re-deposited via erosion and aerosolization into local watersheds (e.g., dust fallout has been shown to stimulate algal blooms in water bodies). Therefore, the study will address these other inputs to the environment as well.

3. Materials and Methods Investigators from the Duluth (NRRI) and Twin Cities campuses of the University of Minnesota will conduct field and laboratory studies using much of the same equipment, environmental/ambient and personal/occupational sampling techniques, analytical protocols and methods, and interpretive skills they developed during the Minnesota Taconite Workers Health Study (MTWHS) to best characterize ambient airborne silica dust particulate matter levels in Southeast Minnesota (SE MN) air, and to assess other potential environmental, exposure, health, and water quality impacts. Methods include:

a) Geo-referenced sample collection: collect at locations impacted by potential silica dust-producing sources and activities (in communities potentially impacted by crystalline silica dust fallout; along haul routes from operating sand operations; and at background/baseline/silica sand sites).

b) Sample analysis: analyze for composition (airborne dust and diesel), size and weight distribution, morphology (shape), optical and electron microscopy, chemistry, and mineralogy, including measurements and particulate matter (PM) characterizations relevant to National Ambient Air Quality Standards (NAAQS) (i.e., PM_{10} and $PM_{2.5}$ standards) as well as for ***crystalline silica-specific PM_4***. PM_4 is an important metric specific to silica dust emission and exposure studies. A standardized monitoring method for **PM_4** has been identified as a data gap by the Minnesota Pollution Control Agency (MPCA) (Headman, J., MPCA, 2012).

4. Tasks and Goals Design project, define sample collection and analytical protocols, collect and analyze samples, and provide high-quality data needed to better assess the potential air quality, health, and related environmental impacts of silica sand mining activities in SE Minnesota. These data can be used for making better environmental (and occupational health) risk assessments, will be interpreted by project scientists, and provided to stakeholders: the public, government officials, regulatory agencies, and scientists. Importantly, the study will act as a model – applicable to any location in Minnesota – that can be used in advance of (and during) resource development situations requiring similar environmental data.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: *Year 1-Project Design and Initial Sampling and Testing Results:* Project planning meetings, experimental design, equipment acquisition, initial sampling, testing, & analysis **Budget: $240,100**

Outcome	Completion Date
1. Collect background/historical information (literature and technical data search)	August, 2014
2. Develop methodologies, quality assurance/quality control/procedures for entire project	October, 2014

3. Develop and incorporate environmental and occupational health components and sampling protocols, based on consultation with state agencies (e.g., MPCA, MDH, MnDOT)	November, 2014
4. Consult with potential silica sand mining localities, community representatives, state agencies, and industry, and select five (5) representative community and background locations for collecting silica dust, diesel, and other particulate matter	December, 2014
4. With U of M Mechanical Engineering scientists and U of M School of Public Health, choose, acquire, and field-test particulate matter counting and/or sampling devices	March, 2015
5. Perform initial field sampling and analytical work (~170 samples); assess results; modify procedures as-needed. Use as guide to Activity 2	June, 2015
6. Present and discuss preliminary findings with decision-makers, regulators, etc.	June, 2015

Activity 2: *Years 2-3 Quantify, Assess & Report Key Impacts*: collect, analyze, and characterize airborne particulate matter (crystalline silica, diesel, etc.) from all potential sources, including sand mining/processing operations, material handling, transportation activities, and agricultural lands. Assess and report potential environmental, personal/occupational impacts and exposures. Publish and present findings. **Budget: $367,824**

Outcome	**Completion Date**
1. Sample collection per established procedures (est'd 540 samples)	December, 2015
2. Sample analysis: particulate size/weight distribution, chemistry, mineralogy, morphology	March, 2016
3. Assess potential environmental & personal/occupational health exposures and impacts	June, 2016
4. Present final project findings to public, decision-makers, regulators, etc.	September, 2016
5. Published final report, including manuscript submittals to peer-review scientific journals	June, 2017

III. PROJECT STRATEGY

A. Project Team/Partners (NOTE: NRRI staff is grant-supported, i.e., not state employees)

NRRI-UMD Team (LCCMR funding): PI: George Hudak, PhD (Project design and management); **Co-PIs:** Stephen Monson Geerts (Project Design and Particulate Team Leader); Larry Zanko (Project design and coordination); Bryan Bandli (optical and electron microscopy); **Anticipated NRRI Technical Staff:** Julie Oreskovich (GIS); John Heine (Geologist); Craig Maly and Sara Post (Field Scientists); Steve Hauck (technical report review)

UM Team (LCCMR Funding)*:*

- **UM Mechanical Engineering (ME): Co-PI:** Bernard Olson, PhD (Air Sampling System Development/Quality Control); Virgil Marple, PhD, Professor Emeritus - Consultant (Air Sampling/Quality); and UM ME student(s)**.**
- **UM Division of Environmental Health Sciences, School of Public Health (SPH): Co-PI:** Gurumurthy Ramachandran, PhD, CIH (Environmental and Occupational exposures); SPH grad student

Potential Agency Collaborators/Advisors: Minnesota Pollution Control Agency (MPCA); Minnesota Departments of Health (MDH) and Transportation (MnDOT)

B. Timeline Requirements: 3 years (Year 1 for initial work and interim results; Year 2 for completion of major project work; Year 3 for data compilation, presentation of findings, and report publication).

C. Long-Term Strategy and Future Funding Needs

The expertise developed and demonstrated by the study team during the Minnesota Taconite Workers Health Study will allow them to conduct the study efficiently, precisely, and accurately. ***The end-result will be improved instrumentation, sampling, analytical protocols, and interpretation methods that will more effectively generate datasets required by regulatory agencies and health professionals for environmental and health-based risk assessments – not only for crystalline silica dust – but for other particulate matter/fugitive mineral dust situations.*** This project would also lay the groundwork for conducting similar future statewide environmental studies and surveys (e.g., a dust "atlas") by improving the ability to sample and characterize ambient particulate matter in a variety of settings and situations. This outcome would have a significant impact on the ability to secure future state and federal funding, as well as develop expanded collaborative partnerships in the coming years.

2014 Detailed Project Budget

Project Title: *Silica/frac sand mining air/water quality environmental impacts*

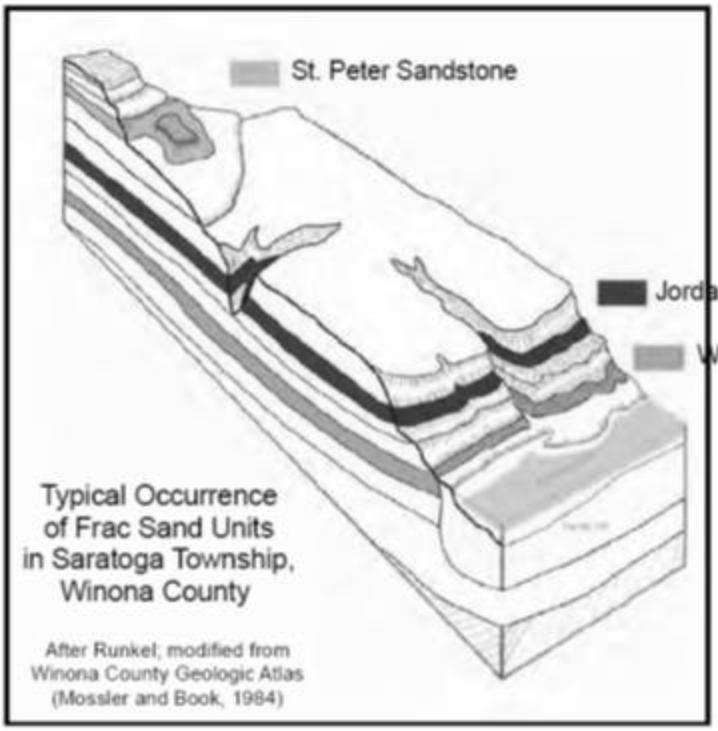
IV. TOTAL ENRTF REQUEST BUDGET 3 years

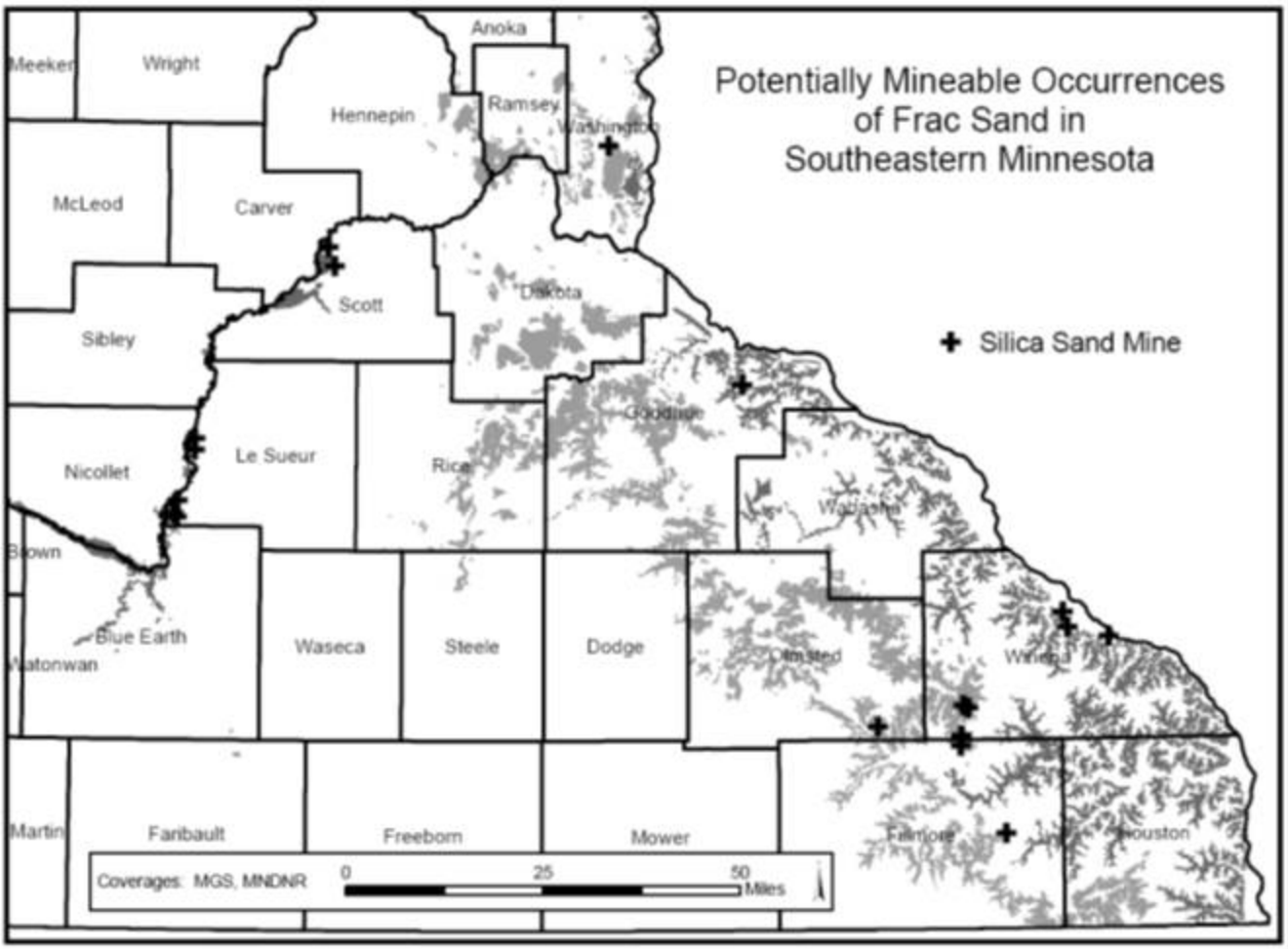
BUDGET ITEM	AMOUNT
Personnel: Natural Resources Research Institute (NRRI) Particulate Team: Project Manager and Principal Investigator; Technical Personnel: Co-Investigators (2) and scientific support staff (5): project design and coordination, technical supervision, field and lab studies, air sampling, particulate characterization analysis, GIS, reporting, meetings, presentations (combined average 100% FTE/yr: 74% salary, 26% fringe)	$ 278,646
Personnel: UM-Mechanical Engineering (UMME) Co-Investigator (average 12% FTE/yr: 75% salary, 25% fringe); and undergrad student(s): (average 25.6% FTE/yr: 100% salary, 0% fringe): air quality (sampling, program design, equipment selection, lab and field testing, reporting. (combined 113% FTE)	$ 74,090
Personnel: UM Division of Environmental Health Sciences, School of Public Health (SPH) Co-Investigator (10% FTE/yr: 75% salary, 25% fringe; Years 1&2; 5%FTE Year 3): Grad student (25% FTE in Year 2 only)	$ 83,363
Personnel: UMD-Geol Sciences Technical Personnel (average 10% FTE/yr: 73% salary, 27% fringe): scientist, optical and electron microscopy particulate characterization, reporting.	$ 24,626
Contract #1: Virgil Marple, Ph.D., Consultant (Retired UMn Prof.-air quality specialist) 15 days @$125/hr ($1,000/day)	$ 12,500
Contracts #2: External lab analyses School of Public Health samples: silica and diesel (200 @$85; 200 @$57).	$ 28,400
Contracts #3: External analyses Natural Resources Research Institute samples: particle chemistry (400 @$80); geological materials (20@$125); water sample chemical analysis (50@$100)	$ 39,500
Equipment/Tools/Supplies: Pump for Micro-Orifice Uniform Deposit Impactor (MOUDI) ($4,000); compressor ($500); portable generator for remote site power ($2,500); GPS units for personal/occupational location tracking (10@$125); Field-capable laptop for data and comminications ($1500)	$ 9,750
Equipment/Tools/Supplies: General laboratory supplies (consumable laboratory supplies such as sample filters and substrates for particulate collection, glassware, aerosol standards, metal for equipment fabrication, etc.)	$ 2,500
Travel: Vehicle Mileage (NRRI, UMD, UM ME, UM SPH) to SE MN and meetings; 2013 GSA rate=$0.565/mile x 21,750 miles)	$ 12,289
Travel: 120 person-days (total) for in-state air sampling field work, potential travel to Wisconsin frac sand mining sites, meetings, outreach; typically a team of 2 to 3 people (2013 GSA per-diem of $77 lodging and $46 meals)	$ 14,760
Additional Budget Items: NRRI Machine Shop - equipment housing fabrication (100 hrs @$25/hr)	$ 2,500
Additional Budget Items: UMD SEM Lab analyses (40 samples @ $125/sample); mineralogical and electron microscope characterization of air particulate.	$ 5,000
Additional Budget Items: Software upgrade of scanning electron microscope to automate particle counts and analysis (significantly lower cost than manual analysis)	$ 20,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 607,924

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period:	$ -	N/A
Other State $ Being Applied to Project During Project Period:	$ -	N/A
In-kind Services During Project Period: NRRI has three MOUDI aerosol/particulate sampling devices and housings that will be used for ambient air sampling; SPH has one more. If they had to be purchased for the project, each unit would cost approximately $30,000	$ 120,000	Secured
Remaining $ from Current ENRTF Appropriation (if applicable):	$ -	N/A
Funding History: Minnesota Taconite Workers Health Study (Source: MN Legislature; SPH and NRRI) Total appropriation was ~$5 million for the 5-year study period (2008-2013)	$ 5,000,000	Secured

Silica/frac sand mining air/water quality environmental impacts





Project Title: Silica/frac sand mining air/water quality environmental impacts

Project Manager Qualifications

George Hudak is the Director of the Minerals Division in the Center for Applied Research and Technology Development (CARTD) at the University of Minnesota Duluth's Natural Resources Research Institute. Dr. Hudak has a Ph. D. in Geology, and has managed the NRRI Environmental Study of Airborne Particulate Matter on the Mesabi Iron Range, collaborating with scientists from the University of Minnesota School of Public Health on the Minnesota Taconite Workers Health Study. Prior to his appointment at the NRRI, Dr. Hudak spent nearly five years working as a hydrogeologist /project manager for environmental consulting/remediation firms, and spent 11 years conducting government- and industry-funded research on base- and precious metals mineral deposits while he served as an Associate Professor of Geology at the University of Wisconsin Oshkosh. Dr. Hudak is a Licensed Professional Geologist (P. G.) in Minnesota and Wisconsin, and is a Professional Geoscientist (P. Geo.) in the Province of Ontario. He is also the Associate Director of the Precambrian Research Center at the University of Minnesota Duluth, an Adjunct Assistant Professor of Geology at the University of Minnesota Duluth, a Mentor for the Society of Economic Geologists, and a Director of the Minnesota Center for Mineral Resource Education.

Organization Description

UMD's Natural Resources Research Institute (NRRI) is a research facility charged with the mission to foster economic development of Minnesota's natural resources in an environmentally sound manner to promote private sector development. NRRI's mission is carried out through its three major divisions: Center for Applied Research and Technology Development (Forest Products, Forestry, Minerals, Peat and Chemical Extractives), Center for Water and the Environment (Land Resources, Water Resources, Land/Water Interactions, Environmental Chemistry and Public Outreach/Education) and Center for Economic Development.