Environment and Natural Resources Trust Fund
2012-2013 Request for Proposals (RFP)

Project Title: **ENRTF ID:** **014-B**

Understanding Environmental/Economic Consequences of Frac Sand Mining

Topic Area: B. Forestry/Agriculture/Minerals

Total Project Budget: $ 1,185,260

Proposed Project Time Period for the Funding Requested: 3 yrs, July 2013 - June 2016

Other Non-State Funds: $ 0

Summary:

An interdisciplinary-based planning tool and scientific investigation of frac sand mining's benefits/impacts to communities, waters, ecology, air quality, and aesthetics for facilitating local understanding and responsible stewardship in policy/decision making.

Name: Donald Fosnacht

Sponsoring Organization: U of MN - Duluth NRRI

Address: 5013 Miller Trunk Hwy
Duluth MN 55811

Telephone Number: (218) 720-4282

Email dfosnach@nrri.umn.edu

Web Address http://www.nrri.umn.edu

Location

Region: SE

County Name: Blue Earth, Dakota, Fillmore, Goodhue, Houston, Le Sueur, Olmsted, Rice, Scott, Wabasha, Washington, Winona

City / Township:

_____ 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)
2012-2013 Main Proposal

PROJECT TITLE: Understanding Environmental/Economic Consequences of Frac Sand Mining

I. PROJECT STATEMENT

Bluffs, trout streams, wetlands, drinking water and **clean air** are just some of the natural resources that will be impacted by frac sand mining in SE Minnesota. While promising a much-needed economic boost to the region, citizens' concerns on environmental issues have led to moratoriums on frac sand mining in several counties. Frac sand is sand used by the petroleum industry to prop open fractures created in shale rock to allow oil/gas flow. SE Minnesota, NE Iowa and western Wisconsin host large deposits of high quality frac sand in three easily accessible layers: the **St. Peter, Jordan and Wonewoc sandstones**, which are also **aquifers**. To reap the economic benefit while practicing environmental stewardship, quality information and tools will be needed for sound decision-making. Therefore, this project proposes to:

1. Conduct an **interdisciplinary scientific investigation** addressing the following local concerns: **respirable dust, water quality, native species, landscape/views and community impacts.**
2. Produce a **"best practices"** planning tool to facilitate mine permitting at the local level.

Drawing upon previous work of the county geologic atlases, this project comprises 5 components:

1. **Geology/Mining** - map mineable sand occurrences in detail; collect and analyze sands of each unit; simulate a typical mining scenario in each; expand mines in size/complexity over time;
2. **Air Quality** – use multiple sampling equipment/methods simultaneously to collect air samples per EPA/other standards upwind/downwind/along haul route from operating sand operations; analyze for particle size/weight distribution, chemistry and mineralogy;
3. **Hydrology** – Compile regional and site specific hydrologic data, model regional flow, and conduct analyses of impacts to water resources from sand mining/processing operations, including flocculant use (flocculants are chemicals added to settling ponds to clump the fines);
4. **Ecology/Landscape** – Assess regional /site specific impacts of frac sand mining on physiography, characteristic plant communities, and dominant human land use; conduct viewshed (visible landscape) analyses; model impacts and remediation/restoration opportunities; and
5. **Economic Impacts** – Analyze the economic impacts of frac sand mining on communities of the region per the 3 simulated mining scenarios developed above; model for increased mine size and complexity; model for price range/value estimation of Minnesota frac sand.

Findings from the 5 components will be used to generate a **best practices standard** for local government use in permitting frac sand and other mines/operations. **Visual models (3-D, animations, other)** will be generated from acquired data to facilitate public understanding of the benefits and impacts involved**.**

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Geology/Mining: mapping; sample collection/characterization; GIS (Geographic Info. Systems) database; GIS-based site selections for 3 mine simulations; mine simulation/modeling. **Budget: $263,000**

Outcome	Completion Date
1. Frac sand outcrop/subcrop map of SE Minnesota	June, 2014
2. GIS-based mine site selection; 3 mining simulations (1 per sandstone unit)	June, 2014
3. Sand characterization-physical properties (base data for air quality study)	June, 2015

Activity 2: 12-Cty regional/local analysis of economic impacts from frac sand mining. **Budget: $25,000**

Outcome	Completion Date
1. Direct/indirect/induced economic impacts based on 3 mining simulations, including wages, jobs, sales, etc.	June, 2015
2. Mine-scaled/time-sequenced model of impacts; econocentric price model	June, 2016

Activity 3: Regional/site specific characterization of surface and ground water through data compilation/field determination; risk analyses of sand mining/processing impacts (including flocculant use – polyacrylamide) to drinking water, trout streams, wetlands, other. **Budget: $161,000**

Outcome	Completion Date
1. Simulate regional flow	June, 2015
2. Risk analysis of mining/flocculants on drinking water, trout streams, etc.	June, 2015
3. Mine-scaled/time-sequenced modeling of impacts to surf./ground water	June, 2016

Activity 4: Characterization of ecological/visual impacts to surrounding landscape/viewshed, including physiography, native plant communities, and dominant human land use. **Budget:** $**69,000**

Outcome	Completion Date
1. Assessment of site specific and regional ecological impacts	June, 2015
2. Viewshed analysis to incorporate all areas within viewing distance of sites	June, 2015
3. Time-sequenced animations of impacts/remediation/restoration options	June, 2016

Activity 5: Characterization of fugitive dust emissions from sand mining/processing operations and truck haul via simultaneous use of multiple air sampling units/methods per EPA/MSHA (Mine Safety & Health Admin.) standards; 3 sampling events/site, summer/winter; particulate analysis. **Budget: $456,000**

Outcome	Completion Date
1. Sample collection per EPA/MSHA standard air sampling procedures	June, 2015
2. Analysis of particle size/weight distribution, chemistry, mineralogy	Dec., 2015
3. Mine-scaled/time-sequenced modeling of air quality impacts	June, 2016

Activity 6: Development of planning tool; presentation of findings **Budget: $211,260**

Outcome	Completion Date
1. "Best Practices" tool for environmentally sensitive frac sand mining	June, 2016
2. Community outreach to present findings.	June, 2016

III. PROJECT STRATEGY

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

NRRI Team (LCCMR funding):

PI: Donald Fosnacht, PhD, Director NRRI-CARTD (Project Manager); **Co-PIs:** George Hudak, PhD (Mineralogical Analysis); George Host, PhD (Landscape Ecology); Terry Brown, PhD (Modeling); Julie Oreskovich (GIS/Project Coordinator); **Technical Staff:** Larry Zanko (Mine Modeling); John Heine (Geologist); Stephen Monson Geerts (Particulate Analysis); Paul Meysembourg (GIS); Craig Maly (Field Technician); Steve Hauck (Technical Review)

Partners (LCCMR Funding):

UMD Civil Engineering: Rebecca Teasley, PhD (**Co-PI**, Water Resources); associated graduate and undergraduate students.

UMD Labovitz School of Bus. and Econ., Bureau of Business and Economic Research: Co-PIs: James Skurla, Director; Chris McIntosh, PhD; Neil Wilmot, PhD; associated undergraduate student.

UMD Geological Sciences: Bryan Bandli (Particulate Characterization)

UM Mechanical Engineering: Bernard Olson, PhD (**Co-PI**, Air Sampling/Quality); Virgil Marple, PhD, Consultant (Air Sampling/Quality)

Minnesota Geological Survey (MGS): Tony Runkel, Chief Geologist (Geological mapping)

B. Timeline Requirements: Three years to accommodate two field seasons.

C. Long-Term Strategy and Future Funding Needs

This project will be the first multi-disciplinary best practices analysis of the effects of frac sand mining in Minnesota. It can serve as a model for future mineral and aggregate industry developments statewide, thereby ensuring that similar assessment projects are effectively and efficiently funded.

2012-2013 Detailed Project Budget

PROJECT TITLE: Understanding Environmental/Economic Consequences of Frac Sand Mining

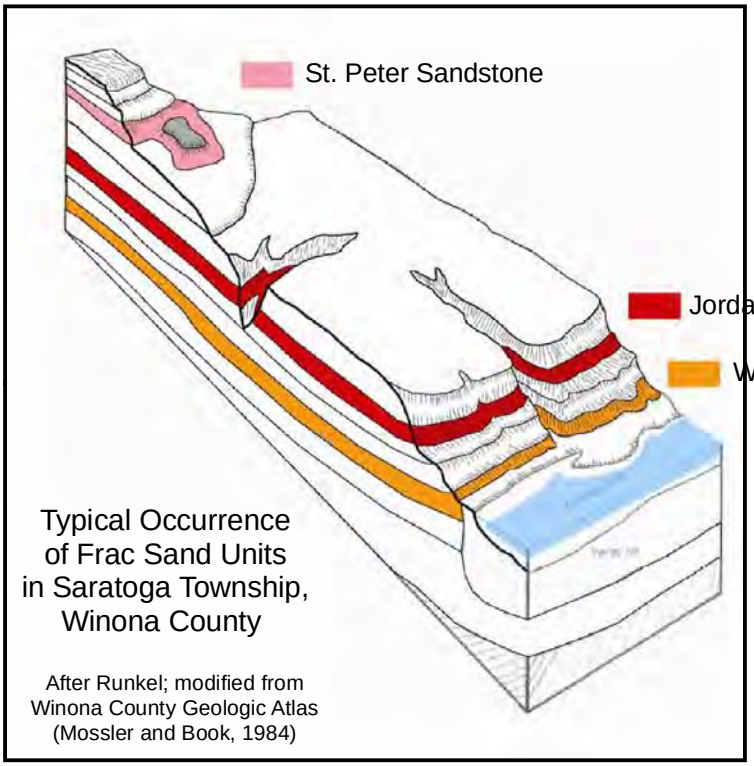
IV. TOTAL ENRTF REQUEST BUDGET 3 (three) years

BUDGET ITEM	AMOUNT
Personnel: D. Fosnacht, Director, NRRI Center for Applied Research and Technology Development (NRRI-CARTD): Project Manager and Principal Investigator (5% FTE: 64% salary, 36% fringe; 3 years): Overall project management.	$ 34,276
Personnel: NRRI-CARTD Economic Geology Group Technical Personnel (Geologic Program) (17.7% FTE: 71.3% salary, 28.7% fringe; 3 years): co-Investigators and scientists; project coordination, geologic field studies, sample collection and analysis, mining simulations, GIS, reporting, presentations.	$ 253,826
Personnel: NRRI-CARTD Economic Geology Group Technical Personnel (Air Quality Program) (24.4% FTE: 73.5% salary, 26.5% fringe; 2 years): co-Investigators and scientists: technical supervision, air quality study, air sampling, particulate characterization analysis and modeling, reporting, presentations; 100% FTE graduate student.	$ 210,861
Personnel: NRRI Center for Water and the Environment (NRRI-CWE) Technical Personnel (Ecology/Landscape Program) (7.3% FTE: 73.5% salary, 26.5% fringe; 3 years): co-Investigators and scientists: landscape ecology, viewshed analysis, GIS, spatial modeling/simulation, reporting.	$ 70,581
Personnel: UMD-Civil Eng. Technical Personnel/Faculty (Hydrology Program) (25% FTE: 58.6% salary, 41.4% fringe; 3 years): co-Investigator/scientist: surface and ground water resource field studies, data analysis, risk analyses, GIS, spatial modeling, reporting; 39% FTE combined graduate and undergraduate students.	$ 175,076
Personnel: UM-Mech Eng. Technical Personnel (30% FTE: 64% salary, 36% fringe; 2 years): co-Investigator/scientist: air quality lead, sampling program design/protocols, reporting.	$ 88,819
Personnel: UMD-Labovitz Sch. Of Bus. And Econ. Technical Personnel/Faculty (Economic Program) (3.7% FTE: 73.5% salary, 26.5% fringe; 3 years): co-Investigators, economic impacts, price modeling, reporting.	$ 32,029
Personnel: UMD-Geol Sciences Technical Personnel (10 % FTE: 58.7% salary, 41.3% fringe; 2 years): scientist, particulate characterization, reporting.	$ 17,190
Personnel: MN Geological Survey (MGS) Technical Personnel (15% FTE: 58.7% salary, 41.3 % fringe; 1 year): scientist, sand resource mapping, consultant.	$ 15,595
Contracts #1: Virgil Marple, Ph.D., Consultant (Retired UMn Prof.-air quality specialist) 25 days @$125/hr ($1,000/day)	$ 25,000
Contracts #2: External lab analyses (air filters: 166 @$115, 172 @$115, 252 @$60).	$ 53,990
Equipment/Tools/Supplies: Field supplies (Air Quality) Pumps, housings, filters, grease	$ 21,157
Equipment/Tools/Supplies: Field supplies (Geol, Hydro, Landscape) Smp bags, water cont., etc.	$ 5,453
Equipment/Tools/Supplies: Modeling Software-various disciplines (Geol, Landscape, Econ)	$ 3,930
Equipment/Tools/Supplies: Software upgrade to automate current Scanning Electron Microscope system at UMD SEM lab (savings of up to 5x over using external lab for analyses)	$ 20,000
Travel: Mileage (Duluth to SE MN) and per diem (lodging and meals) for in-state field work, meetings, outreach (3 years) Air:42smpling events@4days*4people; Geol: 10 10-days*2; more	$ 91,990
Additional Budget Items: UMD SEM Lab analyses (456 samples, 23 duplicates, 12 blanks @ standard SEM lab hourly rate); physical/chem characterization of the air particulate.	$ 65,487
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 1,185,260

V. OTHER FUNDS

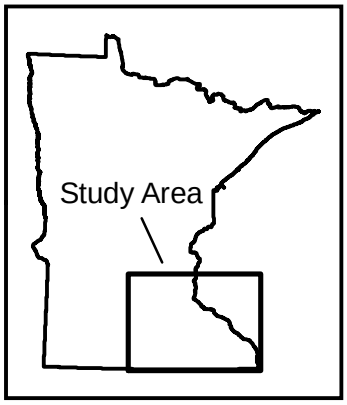
SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ Being Applied to Project During Project Period:	$ -	NA
Other State $ Being Applied to Project During Project Period:	$ -	NA
In-kind Services During Project Period:	$ -	NA
Remaining $ from Current ENRTF Appropriation (if applicable):	$ -	NA
Funding History:	$ -	NA

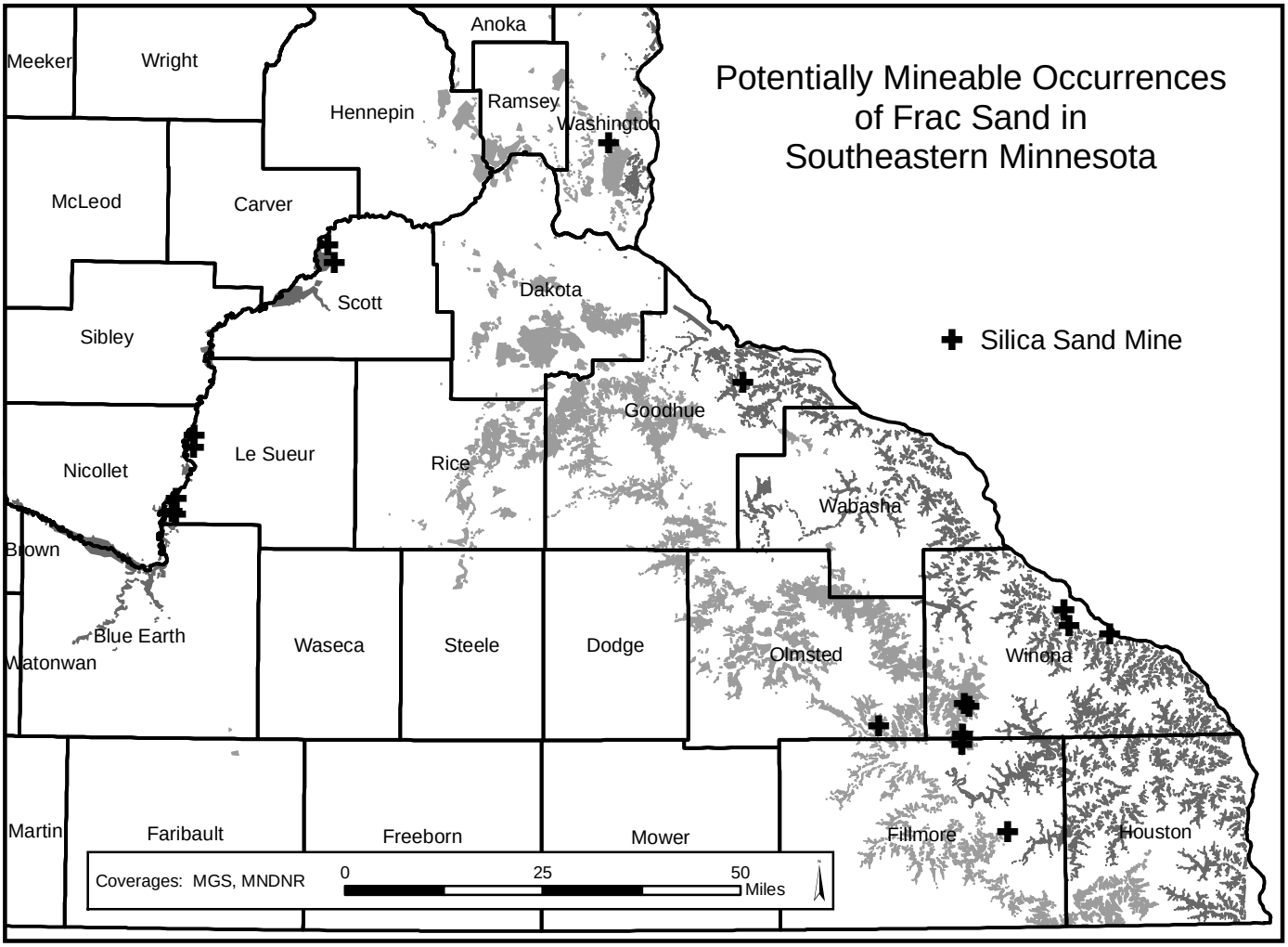
Understanding Environmental/Economic Consequences of Frac Sand Mining



Typical Occurrence of Frac Sand Units in Saratoga Township, Winona County

After Runkel; modified from Winona County Geologic Atlas (Mossler and Book, 1984)





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Project Manager Qualifications

Donald Fosnacht, Ph.D.

Dr. Fosnacht is Director of the Center for Applied Research and Technology Development (CARTD) at the University of Minnesota Duluth's Natural Resources Research Institute. A Ph.D. in metallurgical engineering, he has over twenty years of experience in managing and directing research programs and technology development, coupled with broad experience in minerals, metallurgy and analytical chemistry. At NRRI, Dr. Fosnacht has overseen large multi-agency/entity interdisciplinary projects. A recent example is the Pumped Hydro Energy Storage project consisting of environmental, geotechnical, facilities, engineering, and policy teams. Teams included scientists, engineers, and experts from NRRI, UMD-Civil Engineering, UMTC's St. Anthony Falls Laboratory, the Humphrey School of Public Affairs, Minnesota Power, Great River Energy, and Barr Engineering.

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.