

**Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 181-E

Fugitive Mineral Dust Baseline Air Quality Project

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

Sub-Category:

Total Project Budget: \$ 600,000

Proposed Project Time Period for the Funding Requested: June 30, 2022 (3 yrs)

Summary:

Better baseline air quality data are needed for projects that generate fugitive dust. Lake sediment and air will be sampled and characterized at locations representing past, present and future impacts.

Name: Stephen Monson Geerts

Sponsoring Organization: U of MN - Duluth

Title: _____

Department: Natural Resources Research Institute

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Duluth MN 55811-1442

Telephone Number: (218) 788-2608

Email sgeerts@d.umn.edu

Web Address _____

Location

Region: Metro, Northeast, Southeast

County Name: Hennepin, Ramsey, St. Louis, Winona

City / Township: _____

Alternate Text for Visual:

Person collecting lake sediment core and aerosol equipment used to collect fractionated particulate matter. Both methods will be used for creating better baseline air quality data.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity	_____ Readiness	_____ Leverage	_____ TOTAL _____%
_____ If under \$200,000, waive presentation?			



Environment and Natural Resources Trust Fund (ENRTF) 2019 Main Proposal

PROJECT TITLE: Fugitive Mineral Dust Baseline Air Quality Project

I. PROJECT STATEMENT

Better baseline/background air quality data are needed in advance of (or to assess retrospectively) projects that generate (or generated) fugitive mineral dust, such as mining and mineral product processing. To address this need, the project will take a case study approach and sample and characterize lake sediment and air in ways that can: A) more accurately reflect pre-development (baseline/background) air quality; and B) be used as a reference for past and present dust-generating activities. To do so, the project will apply aspects of aerosol science, paleolimnology (paleolimnology is the study of the older environments of inland bodies of water), geology, mineralogy, and geochemistry, and will focus on three Minnesota test case locations:

- **Twin Cities Metro:** Collect and characterize lake sediment (core) downwind of a known (**past**) human impact, in the vicinity of an industrial site where asbestos-contaminated insulation products were manufactured. The distinctive nature of the asbestos minerals will provide a definitive way to confirm how lake sediments can be used for assessing past environmental air quality impacts.
- **Northeastern Minnesota:** Collect and characterize aerosol samples downwind of potential (**future**) non-ferrous copper-nickel mining. Before mining and mineral processing activities begin, detailed foundational information and data are needed to better define the baseline/background concentrations and physical, chemical, and mineralogical characteristics of airborne mineral particulate matter (PM).
- **Southeastern Minnesota:** Collect and characterize aerosol PM samples from an active (**present**) sand mine in S. MN, to evaluate any ongoing impacts, using comprehensive characterization techniques.

Baseline/background air quality data will be generated about mineral particulate matter (PM) for each test case location, via air sampling (for a prospective/future and current outstate mining location) and via lake sediment sampling (for a Metro Area location), followed by detailed characterization of the collected PM. But how can lake sediment be used to obtain baseline air quality data? Recent NRRI work has shown that atmospheric deposition of airborne particulate matter such as fugitive dust from activities like mining and mineral processing can contribute to sediment that accumulates at the bottom of a lake. Because of this phenomenon, lake sediment is a sampling medium that can act as an air quality sample archive and time capsule and allow investigators to assess what mineral particles were present in the air – *pre-settlement/pre-industrialization* – before a dust-generating activity even started. This is especially valuable for establishing better baselines and for conducting retrospective environmental assessments – which are key objectives and long-term benefits of this project.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Case Study 1 – Metro Area lake sediment as a potential indicator of past asbestos contamination

Collect and age-date sediment core(s) from a suitable lake (e.g., Walsh Lake), ~2.5 miles downwind of the former Western Mineral Products plant, which produced Zonolite® (Libby, MT) between 1938 and 1989. Process age-dated core intervals to isolate inhalable/respirable particles and analyze for asbestos minerals at Pace Labs using electron microscopy (TEM). If present, the asbestos can be shown to document the time frame of the environmental impact, as well as preserving and translating the aerosol concentrations of the deposition.

ENRTF BUDGET: \$225,000

Outcome	Completion Date
1. Two sediment cores collected from target lake (in winter), and 1 cm intervals freeze-dried and prepared for age-dating and characterization.	3/2021
2. Sediment intervals age-dated using ^{210}Pb (or ^{137}Cs if necessary).	6/2021
3. 36 lake sediment intervals analyzed for mineral particulate matter and presence of asbestos following isolation of inhalable and respirable particles; including microscopic, geochemical, and mineralogical analyses; database and journal-ready report produced.	6/2022



**Environment and Natural Resources Trust Fund (ENRTF)
2019 Main Proposal**

Activity 2: Case Study 2 – Northeastern MN prospective Cu-Ni mining operation: aerosol sampling to establish baseline/background levels and composition of particulate matter (PM) prior to development

Collect and perform comprehensive characterization of aerosol PM downwind of a potential copper-nickel mining operation, including asbestos mineral identification at Pace Labs using TEM. Baseline data collected during this LCCMR project will be compiled, and samples will be archived. If mining commences, these baseline data can be compared to follow-up air sampling, making possible a “total net air quality impact” assessment.

ENRTF BUDGET: \$187,500

Outcome	Completion Date
1. Background/baseline PM physical properties, concentrations, mineralogy, chemistry determined from aerosol sampling performed prior to potential mining impacts.	6/2021
2. If no mining in 2021, additional baseline PM data produced. Otherwise, operating mine data will be produced. 1 & 2 compared; database and journal-ready report produced.	6/2022

Activity 3: Case Study 3 – SE Minnesota active sand mine: aerosol sampling to establish baseline/background levels and composition of particulate matter (PM) to evaluate any current impacts

Collect aerosol both upwind and downwind and characterize similar to “Activity 2.” Upwind (background) data compared with downwind data, with the explicit purpose of identifying any air quality impact(s). Downwind sampling will occur at several increasing distances to determine the extent of impacts.

ENRTF BUDGET: \$187,500

Outcome	Completion Date
1. Air quality impacts of operating sand mine determined, at increasing distances downwind from mine (minus background). Database and journal-ready report produced.	6/2022

III. PROJECT PARTNERS:

A. Partners receiving ENRTF funding

Name	Title	Affiliation	Role
Bernard Olson	Researcher 6	UM Dept. of Mech. Eng.	Aerosol collaborator

B. Partners NOT receiving ENRTF funding N/A

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

This project is part of a larger effort to use detailed science to better understand past and potential future environmental (air quality) impacts. We believe the “baseline” data and techniques used by this study will be invaluable and adopted by researchers and regulatory scientists to improve future air quality assessments.

V. TIME LINE REQUIREMENTS:

The project duration would require three years of ENRTF funding from 7/1/2019 to 6/30/2022. All three activities are ready to be implemented with existing equipment and facilities, with minor supply purchases.

VI. SEE ADDITIONAL PROPOSAL COMPONENTS:

- A. Proposal Budget Spreadsheet
- B. Visual Component or Map
- C. Parcel List Spreadsheet
- D. Acquisition, Easements, and Restoration Requirements
- E. Research Addendum (not required at proposal stage)
- F. Project Manager Qualifications and Organization Description
- G. Letter or Resolution
- H. Certified Audit or 990 Tax Information

2019 Proposal Budget Spreadsheet

Project Title: Fugitive Mineral Dust Baseline Air Quality Project

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM	AMOUNT
Personnel: <i>(personnel below are non-faculty, 12-month appointment positions)</i>	\$ 470,160
Steve Monson Geerts, Principal Investigator: \$135,913 (fringe rate 33.5%); 45% FTE each year	
Euan Reavie, Co-Investigator: \$70,238 (fringe rate 33.5%); 15% FTE each year	
Larry Zanko, Co-Investigator: \$123,878 (fringe rate 33.5%); 32% FTE each year	
Lab Technicians (2): \$20,859 (fringe rate 27.2%); 25% FTE in Y1, 10% FTE in Y2	
Andy Bramburger, Researcher: \$10,422 (fringe rate 33.5%); 5% FTE in Y1 & Y2	
Bernard Olson, Mechanical Engineer: \$44,249 (fringe rate 33.5%); 10% FTE each year	
Assistant Scientist (Field/Lab work): \$35,920 (fringe rate 7.7%); 26% FTE each year	
Statistician: \$28,681 (fringe rate 33.5%); 10% FTE each year for 3 years	
Professional/Technical/Service Contracts:	\$ 74,040
Scientific Services - Lab Analyses (\$74,040): - St. Croix Watershed Research Station service contract (\$6,000): \$3,000 x 2 cores for core dating - Pace Analytical (\$48,000): MDH 851, Transmission Electron Microscope analysis to identify elongate mineral particles (EMPs) from lake sediments: 36 samples @\$500/sample; MDH 852, Transmission Electron Microscope analysis to identify elongate mineral particles (EMPs) from aerosol samples: 60 samples @\$500/sample - Elemental Analysis, Inc. (\$11,040): Proton Induced X-Ray Emission (PIXE) chemical analysis of particulate matter from lake sed and aerosol: 96 samples @\$115/sample - Maxxam Analytical (\$9,000): X-ray Diffraction to identify/quantify Respirable silica analysis: 60 samples @ \$150/sample	
Equipment/Tools/Supplies:	\$ 7,650
Field supplies (\$2,000): safety gear and first-aid supplies, extension cords for powering sample collection instrumentation and support instruments/equipment, battery power backups for air sampling instrumentation	
Lab supplies (\$2,000): air sampling filter substrates (polycarbonate, mixed cellulose ester, foil, teflon), flexible tubing for pumps and MOUDIs, lubricant, reagents, cutting tools, gloves, glassware, cleaning supplies, thermometer.	
Davis weather station (\$650): for collecting/recording weather conditions during air sampling	
Vacuum Pumps (\$3,000): 3 x \$1,000 each for providing air flow for ambient air sampling.	
Acquisition (Fee Title or Permanent Easements):	\$ -
Travel:	\$ 21,900
Mileage (~16,500 miles reimbursed at \$0.545/mi), lodging, and meals for travel between NRRI, sampling/field sites; and to Twin Cities for meetings/consultations/laboratory visits; in-state conferences to present results of project. Travel will be reimbursed per University policy.	
Additional Budget Items:	\$ 26,250
UMD Instrumentation Laboratory (\$5,000): Fees for use of scanning electron microscope (SEM) and X-ray diffractometer; for mineral particle analysis	
UM Twin Cities Characterization Facility (\$5,000): Fees for use of transmission electron microscope for supplemental mineral particle analysis	
UM Dept. of Mechanical Engineering (\$15,000): Expenses/fees related to experimental design consultation and air collection instrumentation operation, calibration, and testing	
Shipping/mailing (\$1,250): Delivery of samples to analytical labs, and return of samples	
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 600,000

V. OTHER FUNDS

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State \$ To Be Applied To Project During Project Period:	\$ -	N/A
Other State \$ To Be Applied To Project During Project Period:	\$ -	N/A
In-kind Services To Be Applied To Project During Project Period:	\$ -	N/A
Unrecovered indirect: 54% on total direct costs (\$600,000 base)	\$ 324,000	Secured
Past and Current ENRTF Appropriation:	\$ -	N/A
Other Funding History:	\$ 1,610,000	Spent
\$810,000: State of MN - Minnesota Taconite Workers Health Study (MTWHS) 2008-2013		
\$800,000: Permanent University Trust Fund (Match to MTWHS) 2008-2016		

Fugitive Mineral Dust Baseline Air Quality Project

ACTIVITY 1 Lake Sediment Sampling



Lake sediment can act as an air quality archive and time capsule, and allow us to assess what was in the air years ago.

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PROJECT RESULTS and BENEFITS

- **Better baseline air quality data**
- **Accurate characterization at the particle-scale**
- **Can be used by researchers and regulatory scientists to improve future air quality assessments**

05/08/2018

ACTIVITIES 2 & 3 Fractionated Aerosol Sampling



This type of air sampling separates airborne particles by size for characterization, and retains an archive of those particles for future evaluation.

ENRTE ID: 181-E



Environment and Natural Resources Trust Fund (ENRTF)
2019 Project Manager Qualifications and Organization Description

PROJECT TITLE: Fugitive Mineral Dust Baseline Air Quality Project

STEPHEN MONSON GEERTS, Natural Resources Research Institute, University of Minnesota Duluth

Key Qualifications: Stephen Monson Geerts is a Geologist/Researcher 6 for the Minerals, Metallurgy and Mining (M³) Program at NRRI-UMD. Mr. Monson Geerts has over 35 years of experience as a geologist/ 22 years of research experience with a focus on mineral characterization. **Education:** **M.S. Geology**, University of Minnesota Duluth. **Thesis:** Petrography and Geochemistry of a Platinum Group Element-Bearing Mineralized Horizon in the Dunka Road Prospect (Keweenaw) Duluth Complex, Northeastern Minnesota. **B.S. Geology**, University of Minnesota Duluth. **NRRI Research:** Petrographic and aerosol mineral characterization. Principal and co-principal investigator, project coordination, manuscript/technical report preparation and presenter. Over 50 peer-reviewed and technical reports.

EUAN D. REAVIE, Natural Resources Research Institute, University of Minnesota Duluth

Key Qualifications: Dr. Reavie is a Senior Research Associate with specialties in the aquatic sciences at NRRI-UMD. He is an aquatic ecologist with particular expertise in paleoecology, describing the environmental histories of lakes to help define management and remedial protocols. His research focuses on the use of modern and historical biological indicators that inform on the effects of stressors such as nutrient loads, harmful algal blooms and atmospheric warming. Reavie will be supported by Dr. Lucinda Johnson, an expert in forecasting fish habitat conditions due to stressors; Dr. Valerie Brady, an expert in the use of aquatic insects to indicate aquatic habitat condition; Dr. Bill Herb, an expert in aquatic habitat modeling and forecasting; and Mr. Peter Jacobson, MN DNR Fisheries Research, who has worked extensively with coldwater fish and stressor impacts in Minnesota.

LAWRENCE ZANKO, Natural Resources Research Institute, University of Minnesota Duluth

Key Qualifications: Mr. Zanko is a Senior Research Program Manager (Researcher 7) for By-Product Reuse and Remediation within the Minerals, Metallurgy and Mining (M3) Program at NRRI-UMD. He has participated in or led a broad spectrum of geological, mineral resource and minerals industry-related applied research for most of his 30+ year professional career at the NRRI. **Education:** Master of Geological Engineering, University of Minnesota, Twin Cities (UMTC). Bachelor degrees in Geological Engineering and Microbiology (UMTC). **NRRI Research:** A large part of Mr. Zanko's work since 2001 has focused on NRRI's efforts to research, characterize, and expand the use of taconite mining byproducts for construction aggregate purposes within and beyond Minnesota. 1 patent (co-inventor), 4 peer-reviewed professional publications, and over 40 publicly available technical reports.

ORGANIZATION DESCRIPTION

The Natural Resources Research Institute is a University of Minnesota Duluth applied research organization. NRRI's mission is to deliver research solutions to balance Minnesota's economy, resources and environment for resilient communities.