

**Environment and Natural Resources Trust Fund
2020 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 043-A

Fugitive Dust in Minnesota's Air: Why It Matters

Category: A. Foundational Natural Resource Data and Information

Sub-Category:

Total Project Budget: \$ 381,558

Proposed Project Time Period for the Funding Requested: June 30, 2023 (3 yrs)

Summary:

Guidance manual for sampling and analyzing geological materials throughout Minnesota having potential to generate fugitive dust and produce respirable elongate mineral particles (EMPs); integrated with NRRI's -Minnesota Natural Resources Atlas.

Name: Lawrence Zanko

Sponsoring Organization: U of MN - Duluth NRRI

Job Title: _____

Department: Natural Resources Research Institute (NRRI)

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Location:

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

The visual shows the project title, LCCMR regions map of Minnesota, descriptions of the project, fugitive dust sources, respirable particulate matter health effect examples, and an image of road dust.

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



Environment and Natural Resources Trust Fund (ENRTF) 2020 Main Proposal Template

PROJECT TITLE: Fugitive dust in Minnesota's air: why it matters

I. PROJECT STATEMENT

The project will produce:

- a manual for how to target, sample, prepare, analyze, and describe a suite of geological materials collected throughout the state of Minnesota that have potential to generate fugitive dust and produce respirable elongate mineral particles (EMPs); and
- a GIS map and database which will be integrated with the Natural Resources Research Institute's (NRRI's) Minnesota Natural Resources Atlas.

In doing so, the project will generate Foundational Natural Resource Data and Information related to air quality and mineral resources and, in-part, address LCCMR priorities to protect, conserve, preserve, and enhance Minnesota's air, water, land, fish, wildlife, and other natural resources.

Most fugitive dust studies focus on the "how much?" but often neglect to identify what that dust is actually composed of (chemically and mineralogically) and what shape (morphology) fugitive dust particulate matter (PM) have. **Obtaining more specific and detailed information relative to potential health impacts matters.**

What is an elongate mineral particle (EMP)? According to the National Institute of Occupational Safety and Health (NIOSH), an EMP is: *"Any mineral particle with a minimum aspect [length-to-width] ratio of 3:1."* With respect to fugitive dust, EMPs that are of inhalable, thoracic, or respirable size are of greatest interest. NIOSH has identified a strong need for research on fundamental mineralogical properties of respirable EMPs—relevant to toxicology, epidemiology, and exposure assessment—which can be used as a basis for exposure monitoring in the workplace or jobsite and ultimately protect worker health across the United States. The sampling and analytical methods developed by this project for Minnesota are intended to be used as a model that could be applied to the rest of the country.

Where does fugitive dust come from? The Western Regional Air Partnership (WRAP) has identified twelve major fugitive dust source categories: agricultural tilling, agricultural harvesting, construction and demolition, materials handling, paved roads, unpaved roads, mineral products industry, abrasive blasting, livestock husbandry, and windblown dust emissions from agricultural fields, material storage piles, and exposed open areas. The underlying sources for much of this fugitive dust are geological materials (rocks, soils, minerals, ores).

Therefore, the NRRI will produce a manual of standardized best practices for identifying, sampling, preparing, and analyzing geological materials that have potential to generate respirable EMPs when they are mined, processed, disturbed, and used. To create this manual, the NRRI will apply its geological expertise, its understanding of Minnesota's minerals industry, its knowledge of mineral processing, and its experience gained collecting and characterizing airborne mineral particulate matter (PM) during the Minnesota Taconite Workers Health Study. Project work will be conducted to provide geological, mineral resource, and geographical context for these materials, and to complement the interests of NIOSH.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Identify and collect bedrock, surficial, and historic/archived (e.g., drill core) samples from throughout Minnesota (~100 samples).

Samples will target geological materials associated with known or prospective mineral deposit types from Minnesota, including surficial materials (soils). Samples will be prepared (split, with ½ of sample retained and archived), with the other half used for preparing and processing samples for microscopic, mineralogical, and particulate (EMP) analysis. Supplemental data will also be assembled from studies that have focused on geological materials. Cataloguing and archiving of samples is critical for conducting any follow-up or comparative analyses that might be required. All sample locations will be georeferenced.



**Environment and Natural Resources Trust Fund (ENRTF)
2020 Main Proposal Template**

ENRTF BUDGET: \$135,000

Outcome	Completion Date
1. Field work and completion of sample and data collection activities (100 samples).	Dec 31, 2020
2. Creation of a “library” of archived, documented, and georeferenced geological samples.	Feb 28, 2021
3. Samples prepared for Activity 2 characterization and analysis	Apr 30, 2021

Activity 2: Laboratory analysis of geological samples.

Samples from Activity 1 will be studied and characterized using microscopic, geochemical, mineralogical, and particulate isolation and analysis methods.

ENRTF BUDGET: \$206,000

Outcome	Completion Date
1. Petrographic (optical microscopy) analysis to identify and document major mineral types	6/2021
2. Geochemical analyses for the creation of geochemistry database	9/2021
3. Mineralogical analysis by X-ray diffraction (XRD) and electron microprobe analysis for the creation of mineralogy database	12/2021
4. EMPs isolated, counted, and analyzed/characterized using transmission electron microscopy (TEM) and electron microprobe analysis	3/2022

Activity 3: Data review, compilation, and statistical analysis of analytical results

Results from Activity 2 will be used to create a geological sample database, which will be integrated into a geologically-based EMP potential map of the state of Minnesota, using the NRRRI’s Natural Resource Atlas tool.

ENRTF BUDGET: \$40,558

Outcome	Completion Date
1. Sample characterization database and GIS map, integrated into Natural Resource Atlas	6/2022
2. Presentation of results at one or more in-state conferences	9/2022
3. EMP sampling and characterization manual; final project report; end of project seminar	12/2022

III. PROJECT PARTNERS:

Centers for Disease Control and Prevention/National Institute of Occupational Safety and Health (CDC/NIOSH)

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

The project will provide additional geological, mineralogical, and analytical context in a comprehensive and integrated fashion for the state of Minnesota, and will be an important reference for those involved with protecting worker and public health, and act as a model for establishing methodologies and protocols for what could be done nationwide. This project will generate impact by improving knowledge of the fundamental nature of EMPs generated by various geological materials. It is always best to be anticipatory and obtain and generate foundational natural resource and environmental data proactively rather than reactively. The project will contribute to and complement what CDC/NIOSH intends to apply nationwide over the next several years. There is excellent potential for follow-up collaboration and funding support from CDC/NIOSH.

V. TIME LINE REQUIREMENTS:

The project duration would require 2.5 years of ENRTF funding, from 7/1/2020 to 12/31/2022.

Attachment A: Project Budget Spreadsheet
 Environment and Natural Resources Trust Fund
 M.L. 2020 Budget Spreadsheet



Legal Citation:
 Project Manager: Lawrence M. Zanko
 Project Title: Fugitive dust in Minnesota's air: why it matters
 Organization: University of Minnesota Duluth
 Project Budget: \$381,558
 Project Length and Completion Date: 2.5 years; December 31, 2022
 Today's Date: April 10, 2019

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET		Budget	Amount Spent	Balance	
BUDGET ITEM					
Personnel (Wages and Benefits)*		\$ 286,508	\$ -	\$ 286,508	
Larry Zanko, Principal Investigator: \$55,410 (sal. 74%; fringe 26%); 15% FTE annually for 2.5 years					
George Hudak, Co-Investigator: \$46,788 (sal. 74%; fringe 26%); 10% FTE each year for 2.5 years					
Dean Peterson, Co-Investigator: \$75,776 (sal. 74%; fringe 26%); 20 % FTE each year for 2.5 years					
Stephen Monson Geerts: Co-Investigator: \$51,355 (sal. 74%; fringe 26%); 20 % FTE each year for 2.5					
Sara Post (Researcher 5): \$27,737 (sal. 77%; fringe 23%); 20% FTE each year for 2.5 years					
Will Bartsch (Researcher 5): \$10,615 (sal. 74%; fringe 26%) 5% FTE each year for 2.5 years					
Kristina Nixon (Research Scientist): \$9,094 (sal. 77%; fringe 23%); 5% FTE each year for 2.5 years					
Shima Hosseinpour (Proj. Admin.): \$6,850 (sal. 74%; fringe 26%); 2.5% FTE annually for 2.5 years					
* NOTE: NRRI research staff salaries are largely sponsored by external funds					
Professional/Technical/Service Contracts					
Equipment/Tools/Supplies					
Desktop Computer dedicated to project's extensive data processing & graphic needs	\$4,500	\$ 13,890	\$ -	\$ 13,890	
Large format plotter supplies for map-making (paper and ink): 20 @ \$100 per	\$2,000				
Rock drill for collecting outcrop (rock) samples at field locations	\$3,500				
Particulate laboratory supplies (peristaltic pumps, balance maintenance)	\$3,000				
Bottles and hoses for water-isolated EMP samples (25 samples)	\$300				
Field supplies (pens, paper, sample tags: \$200; and 100 sample bags: \$150)	\$350				
External hard disks for data backup and archiving (2 at \$120 each)	\$240				
Travel expenses in Minnesota					
Statewide Travel (\$9,720): mileage at 12,000 miles x \$0.58 per mile (\$6,960) and lodging and meals estimated at \$150 per night x 40 person-nights (\$6,000) NOTE: Travel will be reimbursed per established University policy		\$ 12,960	\$ -	\$ 12,960	
Other					
<i>External analytical services and shipping</i>		\$ 68,200	\$ -	\$ 68,200	
Polished thin section prep for microscopic work (100 at \$50/sample)	\$5,000				
Geochemistry: (100 geological samples at \$200/sample)	\$20,000				
Microprobe analysis of EMPs to confirm composition (50 at \$250/sample)	\$12,500				
Transmission Electron Microscope (TEM) analysis of EMPs (25 at \$500 each)	\$12,500				
X-ray diffraction analysis of samples to identify mineralogy (100 at \$150)	\$15,000				
Particle size distribution of crushed geochemistry samples (100 at \$15 per)	\$1,500				
Sample shipping to laboratories and archiving location (100 samples)	\$2,000				
COLUMN TOTAL		\$ 381,558	\$ -	\$ 381,558	
SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT		Status (secured or pending)	Budget	Spent	Balance
Non-State:			\$ -	\$ -	\$ -
State:			\$ -	\$ -	\$ -
In kind: Unrecovered indirect: 54% on modified total direct cost (\$381,558 base)		Secured	\$ 206,041	\$ -	\$ 206,041
Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS		Amount legally obligated but not yet spent	Budget	Spent	Balance
			\$ -	\$ -	\$ -

Fugitive dust in Minnesota's air: why it matters

Statewide Project



This project will produce a manual for how to target, sample, prepare, analyze, and describe a suite of geological materials collected throughout the state of Minnesota that have potential to generate fugitive dust and produce respirable elongate mineral particles (EMPs), and integrate it with the NRRI's Minnesota Natural Resources Atlas.

Airborne dust from roads and open surfaces, called fugitive dust, is a form of air pollution (MPCA, 2013). Common sources of fugitive dust include unpaved roads, agricultural tilling operations, mining and mineral production, aggregate storage piles, and heavy construction operations. The commonality is geology.

Health Effects Exposures to particulate matter (PM), particularly fine particles referred to as $PM_{2.5}$, can cause harmful effects on the cardiovascular system including heart attacks and strokes (EPA, 2018)

<https://gispub.epa.gov/air/trendsreport/2018/#effects>

fects

Most fugitive dust studies focus on the "how much?"

This project will focus on the dust's composition and its potential for generating EMPs

05/12/2019



Dust from unpaved road

ENRTF ID: 043-A



**Environment and Natural Resources Trust Fund (ENRTF)
2020 Project Manager Qualifications and Organization Description**

PROJECT TITLE: Fugitive dust in Minnesota's air - why it matters

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) Initiative at the UMD – NRRI.

Since his start with NRRI in 1988, he has participated in or led a broad spectrum of research projects dealing with non-ferrous minerals, ferrous minerals, industrial minerals (with a focus on construction aggregates), contaminated sediment remediation and reuse, resource modeling and estimation, and related policy issues.

Education: Master of Geological Engineering, University of Minnesota, Twin Cities (UMTC); Bachelor of Geological Engineering; and B.S. Microbiology (UMTC). **NRRI Research:** 4 peer-reviewed professional publications, and over 40 publicly available technical reports. Transportation Research Board (TRB) of the National Academies: Aggregates (AFP70) and Resource Conservation and Recovery (ADC60) committees.

GEORGE HUDAK: Natural Resources Research Institute, University of Minnesota Duluth

Key Qualifications: Dr. Hudak is Initiative Director for Minerals, Metallurgy and Mining. As Initiative Director, he is responsible for overseeing both the Minerals Laboratory in Coleraine, Minn., and the Duluth Minerals Group. He guides the overall strategic plan for the Initiative. **Education:** Post-Doctoral Research Fellowship, University of Minnesota Duluth, 1997-1998; Ph. D in Geology, University of Minnesota, 1996; MS in Geology, University of Minnesota Duluth, 1989; BA in Geology, Carleton College, 1984 **NRRI Research:** Dr. Hudak has been the Group Leader for the Particle and Materials Characterization Group. He is also the Associate Director of NRRI's Precambrian Research Center. He is a Registered Professional Geologist (P.G) in Minnesota and Wisconsin, and holds a Professional Geoscientist License (P.Geo.) License in Ontario.

DEAN PETERSON Natural Resources Research Institute, University of Minnesota Duluth

Key Qualifications: Dr. Peterson is the Program Manager of the Economic Geology Group within M³ at the Natural Resources Research Institute (NRRI), University of Minnesota Duluth. He had served as the Senior Vice President of Exploration at Duluth Metals Limited from 2008 to 2015 and as a Senior Research Associate of the NRRI since 1999. Dr. Peterson has 33 years' experience in mineral exploration, geological consulting, and developing economic geology research programs for a wide variety of deposit types including gold and VMS deposits; Duluth Complex Cu-Ni-PGE deposits; high-grade Cu-PGE vein systems; and Cu-Au-Mo porphyry deposits. **Education:** Ph.D. in Economic Geology and Geographic Information System Modeling from the University of Minnesota **NRRI Research:** Economic geology and mineral potential modeling of Minnesota, Natural Resource Atlas of Northern Minnesota, Soudan underground mine geobiology, acid rock drainage modeling of northern Minnesota, Duluth Complex Cu-Ni-PGE deposits of Minnesota, comprehensive GIS assembly of geologic data for Minnesota

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

Key Qualifications: Stephen Monson Geerts is a Senior Geologist/Researcher 6 for the Minerals, Metallurgy and Mining (M³) Program at the UMD - NRRI. 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 w/ Minor Hydrogeology.** University of Minnesota - Duluth. **B.S. Geology.** University of Minnesota - Duluth. **NRRI Research:** Principal and co-principal investigator, project coordination and management, manuscript/technical report preparation and presenter. Primarily minerals and materials characterization with emphasis on igneous intrusives and aerosol particulate matter, respectively, includes 3 peer-reviewed and 45+ 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.