**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**

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| **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.  **ENRTF BUDGET: $135,000** |  |
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| **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 NRRI’s Natural Resource Atlas tool.  **ENRTF BUDGET: $40,558** | | |  |

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| **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/NIODH 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.