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

Project Title: **ENRTF ID:** **018-B**

Sulfate Release Rates from Specific Mine Waste Types

Topic Area: B. Forestry/Agriculture/Minerals

Total Project Budget: $ 200,000

Proposed Project Time Period for the Funding Requested: 2 yrs, July 2013 - June 2015

Other Non-State Funds: $ 0

Summary:

This project will measure sulfate release rates of specific mine waste types. These measurements will provide information that will improve the state's ability to conduct environmental review and mine permitting.

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Sponsoring Organization: MN DNR

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Location

Region: NE

County Name: Aitkin, Carlton, Itasca, St. Louis

City / Township:

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

PROJECT TITLE: Sulfate Release Rates from Specific Mine Waste Types

I. PROJECT STATEMENT

The Iron Range in northeastern Minnesota has a rich history of mining and has served as a critical source of iron for the United States. Over a century of mining has generated large volumes of a variety of mine wastes including tailings, waste rock, lean ore, and overburden. The compositions of these wastes vary across the Iron Range because of variable lithology, different mining strategies, and evolving mineral processing approaches. For example, the Lower Cherty unit is viewed as ore across the range, as is the Upper Cherty east of Hibbing; whereas the Lower Slaty is mined at only a few operations and considered waste rock at others. Additionally, the degree of metamorphism varies across the iron range which has resulted in changing the mineralogy of each unit. Because sulfate release depends on rock type, a wide range of release rates from different mine waste types is expected. Previous and on-going research projects on sulfate releases have focused mainly on watersheds downstream from mine land areas, quantifying bulk sulfate released and the resulting impact. This project moves upstream to the base of the mine wastes and will focus on capturing differences in sulfate release among the different mine waste types.

A major goal of this project is to provide sulfate release rates at the mine feature scale. This type of information is needed to enable assessment of specific mine waste contributions to total sulfate loads. This detailed approach is beyond the scope of previous and proposed research projects in this region and will require both field and laboratory studies. The field study will focus on specific mine land areas where rock mass and composition are known and drainage composition and flow rate can be effectively monitored. This will allow the amount of sulfate being released from a particular mine waste type to be determined. The laboratory portion of the project will quantify sulfate release rates as a function of rock type and sulfide mineralogy. Sulfide mineral reactivity is strongly related to mineral composition and degree of surface exposure and these features can vary within and among rock types. The Upper and Lower Slaty units of the Biwabik Iron Formation are thought to contain the majority of sulfide minerals so special emphasis will be placed on these rock types. Laboratory dissolution experiments on well-characterized rocks will allow quantification of release rates to determine differences in sulfide reactivity within and among rock types. Interpretation of differences in reactivity will be supported by mineralogic analysis of sulfides composition and exposure. The dissolution behaviors observed in the laboratory will then be used to interpret sulfate release rates determined in the field.

Increasing our understanding of sulfate release from individual mine waste components will substantially improve the state's ability to effectively conduct environmental review and permitting of existing and future mines.

II. DESCRIPTION OF PROJECT ACTIVITIES

Activity 1: Field Studies **Budget:** $98,000

The field study will include sampling and subsequent chemical analysis of drainage water from tailings and waste rock piles. These measurements will be collected approximately every month and will provide some of the most detailed information of sulfate release from mine wastes in Minnesota.

Outcome	Completion Date
1. Measure sulfate concentration and flow from specific mine waste drainage.	May 2015
2. Calculation of sulfate release from preexisting mine wastes.	May 2015
3. Preliminary Report of Field Investigation	July 2014

Activity 2: Laboratory Studies **Budget:** $95,000

Laboratory studies will include dissolution experiments and mineralogic analysis on a variety of mine waste samples. The dissolution experiments will provide detailed drainage fluid compositions that can be compared to determine differences in reactivity between rock types. Petrographic investigations will determine the shape and distribution of sulfide grains that will aid in defining relative rock reactivity.

Outcome	Completion Date
1. Characterization of Upper and Lower Slaty drainage composition.	May 2015
2. Characterization of sulfide mineralogy for Upper and Lower Slaty rock types.	February 2014
3. Preliminary Report of Laboratory Investigation	July 2014

Activity 3: Project Report **Budget:** $7,000

Results from the field and laboratory studies will be presented in a detailed report that will inform policy makers, state agencies, and industry on managing sulfate release from mine wastes.

Outcome	Completion Date
1. A project report which will include data interpretation and recommendations for managing sulfate release from mine wastes.	June 2015

III. PROJECT STRATEGY

A. Project Team/Partners

Dr. Zach Wenz is an Environmental Research Scientist with the Minnesota Department of Natural Resources (MN DNR) Division of Lands and Minerals. He will be the project manager and oversee the project activities completed by the Chemist 1 and Research Scientist 2 and be in charge of contracting and writing the reports.

B. Timeline Requirements

Project Task	Completion Date
Sample selection and mineralogic analysis	October 2013
Field Sampling	May 2015
Laboratory Experiment	May 2015
Data Interpretation	May 2015
Develop recommendations and complete report of Investigation	June 2015

C. Long-Term Strategy and Future Funding Needs

This project is an extension of previous regional scope sulfate projects conducted by the MN DNR Division of Lands and Minerals. This project supports the mission of the Lands and Minerals Division to ensure that mineral development is environmentally sound, and mined areas are reclaimed to be safe, free of pollution, and suitable for future use. Results from this study will increase our effectiveness in environmental review and permitting of mines in Minnesota.

2012-2013 Detailed Project Budget

IV. TOTAL ENRTF REQUEST BUDGET [2 years]

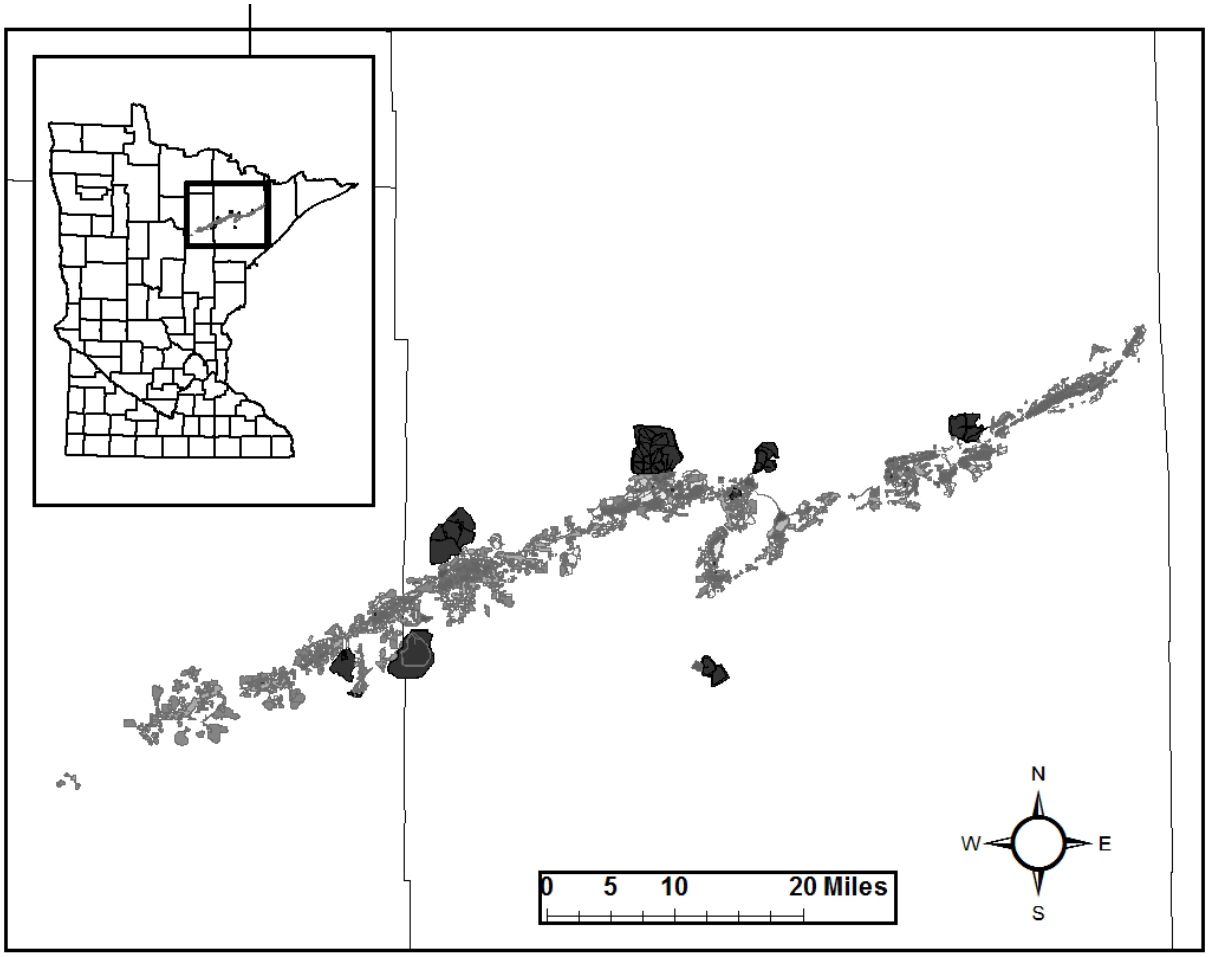
BUDGET ITEM	AMOUNT
Personnel:	
Zach Wenz, Environmental Research Scientist, 10% time, 2 years (back filled)	$ 12,000
Research Scientist II, 50% time, 2 years	$ 55,000
Chemist I, 50% time, 2 years	$ 41,000
Contracts:	
Rock and water chemical analysis	$ 32,000
Mineralogic analysis	$ 20,000
Sulfur and Oxygen isotope analysis	$ 8,500
Flow Measurements	$ 10,000
Equipment/Tools/Supplies:	
Laboratory supplies (humidity cell materials, sample bottles, etc.)	$ 3,000
Field supplies (sample bottles, safety gloves, chemicals, etc.)	$ 1,500
Acquisition (Fee Title or Permanent Easements):	
Travel:	
Travel to field sites	$ 4,000
Additional Budget Items: Direct Support Services (DNR used a rate of 6.5% to calculate costs for direct support services, which are DNR's direct and necessary business services required to support this proposal.)	$ 13,000
=	$ 200,000

V. OTHER FUNDS

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

Project Map

The small state map shows the location of the Iron Range in northeastern Minnesota. The larger scale Iron Range map shows the location of mine pits and mine waste (light gray) and the taconite tailing basins (dark gray). The proposed study will focus on specific mine waste piles and tailing basins where the rock mass and composition is known and drainage flow can be measured.



Project Manager Qualifications/ Organizational Description

Project Manager: Zachary J Wenz, PhD

Dr. Wenz will be responsible for planning and overseeing field and laboratory studies performed by the Research Scientist 2 and Chemist 1. Dr. Wenz will also write the preliminary and final project reports and present details of the project to the public and state officials as necessary.

Qualifications:

Education:
2011—University of Missouri, PhD Geology
2004—University of Alaska Fairbanks, MS Geology
2002—University of Minnesota Duluth, BS Geology

Work Experience:
2011- present—Environmental Research Scientist, Minnesota Department of Natural Resources Division of Land and Minerals
Duties- Perform Environmental Review, Analyze Laboratory Dissolution Experiment Data and Write Reports

2011-2007—Research/ Teaching Assistant, University of Missouri
Duties- Teach Mineralogy, Petrology, and Principles of Geology Courses, Design Experiments and Perform Mass Spectrometry Analysis and X-Ray Spectrometry Analysis of Fluids and Minerals

2006-2007—Research Technician, Kansas Geological Survey
Duties- Laboratory Development, Design New Material Analysis Techniques

Organizational Description:

The Minnesota Department of Natural Resources, Lands and Minerals Division is responsible for ensuring that mineral development in the state is environmentally sound, and mined areas are reclaimed to be safe, free of pollution, and suitable for future use.