

**Environment and Natural Resources Trust Fund
2017 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 065-B

Enhancing DNRs Mineland Water Quality Impact Research, Hibbing

Category: B. Water Resources

Total Project Budget: \$ 442,346

Proposed Project Time Period for the Funding Requested: 3 years, July 2017 - June 2020

Summary:

The proposed research will guide mine regulatory decisions to protect state waters by providing valuable information on leachate from regional mine waste materials and improved local climate information.

Name: Megan Kelly

Sponsoring Organization: MN DNR

Address: 500 Lafayette Rd
St. Paul MN 55155

Telephone Number: (651) 259-5399

Email megan.j.kelly@state.mn.us

Web Address _____

Location

Region: Northeast

County Name: Itasca, Lake, St. Louis

City / Township:

Alternate Text for Visual:

The attached figure includes (A) a map of the Mesabi Iron Range of NE MN and associated mining features, (B) a map view of the DNR Mineland Environmental Research Site showing new experiment and monitoring well locations, and (C) a theoretical waste rock or tailings pile, showing factors addressed in this study that contribute to the quantity and quality of water leaving the pile.

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



PROJECT TITLE: Enhancing DNR’s Mineland Water Quality Impact Research, Hibbing

I. PROJECT STATEMENT

Northeastern Minnesota is home to an extensive taconite mining industry. A primary environmental topic associated with mining in this region is constituent release from tailings and waste rock produced during the mining process, potentially impacting downstream surface and groundwater. The Department of Natural Resources’ (DNR) mineland environmental research site, located in Hibbing, Minnesota, was constructed in the mid-1990s and has been operated using special project funds. The site was established to provide a space for research focused on the prediction, prevention, and control of contaminant release from locally produced mine waste. The discontinuation of several older projects provides an opportunity to redevelop the site and install new experiments that will ultimately help inform strategies to mitigate waste rock leachate and to protect water quality in downstream watersheds.

Two new experiments will be installed to address current gaps in knowledge about drainage quantity and quality through regional mine waste materials of northeastern Minnesota. One will involve initiating three field-scale weathering test piles for previously untested waste rock that is or could be generated in Minnesota. The waste rock material will be characterized and linked to the flow rate and composition of drainage from the piles (leachate) over time. The second new experiment will examine the infiltration and leaching characteristics of mine tailings by installing two lysimeter plots. When coupled with on-site weather data, lysimeters can be used to measure net infiltration through a material, the component of a water balance that is typically known with least certainty. Results from both experiments will help guide future mine and tailings basin hydrologic and geochemical investigations.

An additional goal of this project is to establish a specialized weather station at the Hibbing research site. Linking experimental data to on-site weather information better establishes accurate water balances, improving the ability to predict future drainage conditions at taconite pits and tailings basin sites. The Hibbing research site and associated laboratory will be equipped to collect and analyze water isotopes of precipitation, which are not consistently monitored or reported anywhere in Minnesota. Water isotopes have a number of valuable applications in hydrologic studies, such as characterizing different ground and surface water sources, estimating evaporation, and tracking seasonal and event specific infiltration. An in-house water isotope analyzer will allow timely, inexpensive, and unlimited analysis of various water sources (e.g. precipitation, mine waste drainage). The weather station will be closely monitored and data will be made readily available for use, providing a long term benefit not only to the DNR program but to other regional hydrologic studies as well.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Establish on-site weather and water isotope station

Budget: \$190,892

A research-grade weather station will be installed that is capable of measuring a standard suite of climate variables, along with a precipitation collection system for water isotope analysis. A liquid water isotope analyzer will be obtained and operated at the Hibbing lab. Weather station and isotope data will be made available on a DNR website.

Outcome	Completion Date
1. Install meteorological station outfitted with water isotope sampling cup	August 2017
2. Obtain and install water isotope analyzer and accessories	October 2017
3. Establish online database and begin reporting weather and isotope data	December 2017



Environment and Natural Resources Trust Fund (ENRTF)

2017 Main Proposal

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Activity 2: Design experiments, prepare site, and install field-scale experiments **Budget: \$123,417**

The Hibbing research site is equipped with infrastructure to accommodate three new field-scale (~50 ton) rock weathering tests. Source material would be chosen from Iron Formation layers based on availability and data needs. Two lysimeter plots will be constructed from large, conical storage tanks placed below the ground surface and filled with selected tailings material. The lysimeters will be equipped with water content and temperature sensors at various depths. Groundwater elevation has declined in the area since the research site was developed. To continue monitoring for potential groundwater contamination from field experiments, existing monitoring wells will be replaced by deeper wells up to 170 ft.

Outcome	Completion Date
1. Installation of four replacement monitoring wells to 170 ft. depth	September 2017
2. Secure sulfide-bearing waste rock sources and tailings for experiment installation	December 2017
3. Design and install field experiments	June 2018

Activity 3: Two-year data collection period and report generation **Budget: \$128,037**

Waste rock and tailings material will be characterized by measurement of particle size distribution, sulfur content, and mineralogy. The composition of leachate from both experiments will be evaluated over a two year period and linked to on-site climate information (Activity 1). Leachate will be analyzed on a weekly or bi-weekly basis during the warm season (approximately March through November) for a standard suite of chemical parameters as well as water isotopes. Results will be summarized in reports specific to each experiment.

Outcome	Completion Date
1. Characterize waste rock material (solid phase)	December 2019
2. Complete two-year (warm season) leachate chemistry analysis period	December 2019
3. Evaluate results and generate reports for each experiment	June 2020

III. PROJECT STRATEGY

A. Project Team/Partners

Megan Kelly, Research Scientist II with the DNR Lands and Minerals Division, will act as project lead and oversee activities carried out by Steven Koski (Research Scientist I) and a new Chemist I position. DNR Lands and Minerals maintenance staff will assist with installations during year one of the study, covered by other state funds. Additional in-kind time contributions from DNR staff experts are expected.

B. Project Impact and Long-Term Strategy

The advanced research proposed for the Hibbing research site will generate previously unavailable scientific information relating to the quantity and quality of leachate from regional mine waste materials. This information will improve the accuracy of models and predictions used to guide decisions during environmental review and permitting. Ultimately, results from this work will be used to protect and conserve state water resources by ensuring appropriate mine waste management is employed to limit or prevent impacts from mining activities. Furthermore, the weather station and precipitation water isotope reporting provides a valuable resource for researchers across northeastern Minnesota. Monitoring and isotope analysis have the potential to continue beyond the proposal timeline.

C. Timeline Requirements

The proposed work is designed to take place over a three-year period (July 2017 through June 2020). The first year will largely be dedicated to planning and installations at the field site, while years two and three will focus on data collection, evaluation, and reporting. All listed outcomes will be reached by the end of June 2020.

2017 Detailed Project Budget

Project Title: Enhancing DNR's Mineland Water Quality Impact Research, Hibbing

IV. TOTAL ENRTF REQUEST BUDGET: 3 years

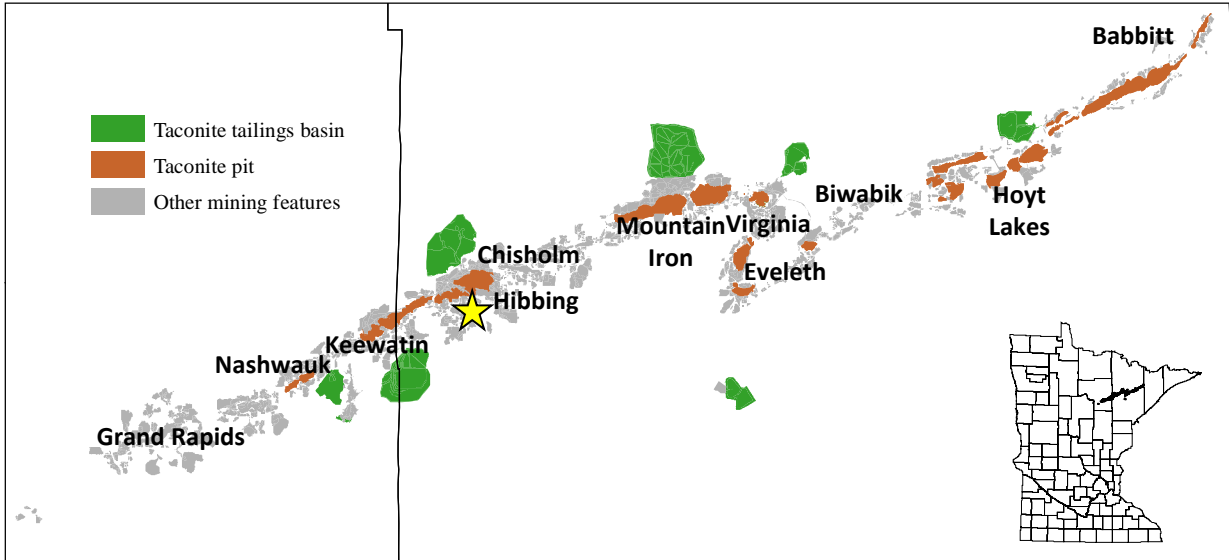
<u>BUDGET ITEM</u>	<u>AMOUNT</u>
Personnel: 1.0 to 1.5 FTE per year for classified and unclassified staff paid almost exclusively through special project funds, including ~15-20% fringe benefits as per state union contracts. A. Research Scientist II/project manager: 0.5 FTE yrs. 1 and 3, 0.25 FTE yr. 2 (\$101,000) B. Research Scientist I: 0.5 FTE yrs. 1 and 3, 0.25 FTE yr. 2 (\$74,000) C. Chemist I, new unclassified: 0.5 FTE yrs. 2 and 3 (\$44,000)	\$ 219,000
Professional/Technical/Service Contracts: Water chemical analysis (\$15,000) Mineralogical analysis (\$10,000) Sulfur content and particle size distribution (\$5,000)	\$ 30,000
Equipment/Tools/Supplies: Activities 1 and 2, on-site installations: A. Experiment installation and supplies (conveyor rental, pumps, flow meters, tipping buckets, sumps, PVC pipes, tubing, datalogger, water content and temperature sensors): \$33,000 B. Research grade weather station and datalogger: \$15,000 C. Liquid water isotope analyzer, plus accessories and standards: \$90,000 D. Installation of four new observations wells down to bedrock, 170 ft. depth (through DNR EWR Division): \$17,000	\$ 155,000
Equipment/Tools/Supplies: Activity 3, two-year data collection period: General sampling and laboratory supplies (including bottles, vials, filters, gloves, chemicals/reagents): \$6,000	\$ 6,000
Travel: MN DNR research staff travel from St. Paul to and from Hibbing, MN field site, including overnight lodging and meal costs as per state contracts	\$ 7,000
Additional Budget Items: Direct and necessary costs to cover: People Support (\$5,178), Safety Support (\$1,450), Financial Support (\$5,838), Communication Support (\$1,316), IT Support (\$10,454), Planning Support (\$912), and Procurement Support (\$197) necessary to accomplishing funded programs/projects.	\$ 25,346
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND \$ REQUEST =	\$ 442,346

V. OTHER FUNDS

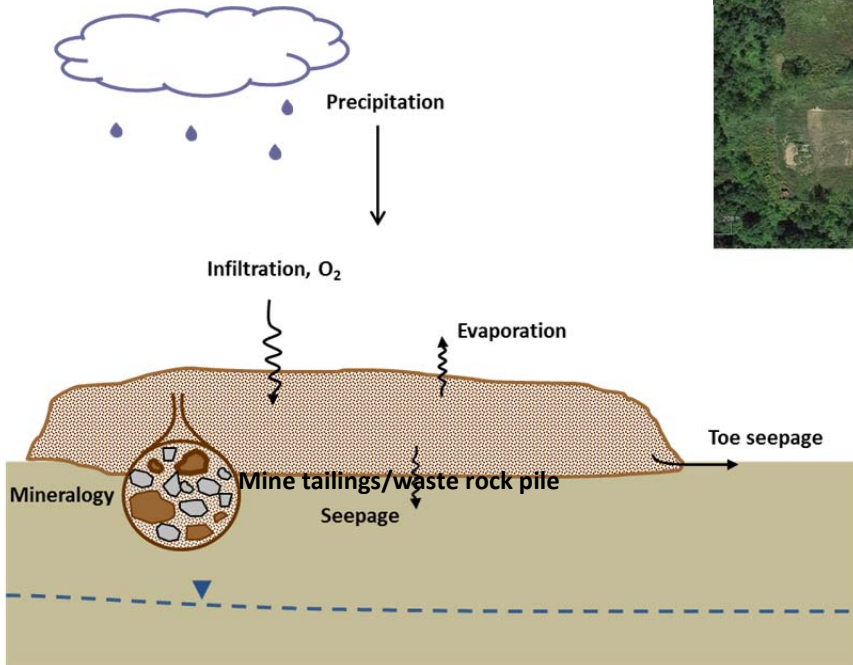
<u>SOURCE OF FUNDS</u>	<u>AMOUNT</u>	<u>Status</u>
Other Non-State \$ To Be Applied To Project During Project Period:	N/A	N/A
Other State \$ To Be Applied To Project During Project Period: Up to 0.25 FTE salary + fringe for maintenance staff assistance, yr. 1 of project	\$ 11,000	secured
In-kind Services To Be Applied To Project During Project Period: Additional DNR Lands and Minerals staff contributions, salary + fringe, total of 0.25 FTE during yrs. 1 and 3 of project.	\$ 50,000	pending
Funding History: Includes construction and continued operation of the Hibbing research site since 1995. Contributing funding sources include General Fund, Iron Ore Cooperative Research, Cooperative Environmental Research, Minerals Coordinating Committee, and industry match funds. The cost of running past and ongoing field experiments at the site is not included here.	\$ 540,000	spent
Remaining \$ From Current ENRTF Appropriation:	N/A	N/A

Environment and Natural Resources Trust Fund (ENRTF) 2017 Proposal Figure
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A. The Mesabi Iron Range of NE MN and associated mining features. The yellow star marks the approximate location of the DNR Mineland Environmental Research Site in Hibbing, Minnesota.



B. Map view of the DNR Mineland Environmental Research Site. Installation locations for the new experiments are circled in yellow. Approximate monitoring well locations are indicated by small blue circles.



C. Theoretical waste rock or tailings pile, showing factors addressed in this study that contribute to the quantity and quality of water leaving the pile.

Environment and Natural Resources Trust Fund (ENRTF) 2017 Project Proposal
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Project Manager Qualifications

Project Manager: Megan Kelly, Research Scientist II
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Email: megan.j.kelly@state.mn.us

Megan Kelly has been working as a Research Scientist II with the DNR Division of Lands and Minerals since 2012. Megan received her B.A. in Geology and Environmental Studies from Macalester College in St. Paul (2000), and her Ph.D. from the University of Minnesota Geology Department (2010), where she specialized in isotope geochemistry. Her current research focuses on the sources and fate of mine-derived sulfate in NE Minnesota. Megan has authored or coauthored numerous publications, and has presented her work in a variety of settings. In her role as RS-II, Megan has demonstrated her ability to coordinate collaborative research projects, develop and maintain relationships with research partners and contracted laboratories, oversee DNR laboratory facilities and protocol training, manage project budgets, and produce final project reports.

Organization Description:

The Department of Natural Resource's mission is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life. Within the organization, the role of the Division of Lands and Minerals is to, in part, manage the state's mineral resources for the benefit of all Minnesotans, and to ensure that mineral development is environmentally sound, and mined areas are reclaimed to be safe, free of pollution, and suitable for future use.