



Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-459

Proposal Title: Predicting BWCAW Landscape Damage: Extreme Rain/Runoff Thresholds

Project Manager Information

Name: Joe Magner

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

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Project Basic Information

Project Summary: Ely, MN area BWCAW is a fragile landscape that will unravel with extreme rain/runoff. Predicting the precipitation upon disturbed land will prevent water quality damage to lakes and rivers.

ENRTF Funds Requested: \$657,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Resiliency (A)

Project Location

What is the best scale for describing where your work will take place?

Region(s): NE

What is the best scale to describe the area impacted by your work?

Region(s): NE

When will the work impact occur?

During the Project and In the Future

Narrative

Describe the opportunity or problem your proposal seeks to address. Include any relevant background information.

Wilderness visitors spend roughly \$56 million directly in the private sector each year in the Ely gateway region. They come for the unique BWCAW experience of the natural beauty. Yet climate change threatens the region.

On June 19th, 2012, a mega storm hit northeastern Minnesota (MN) and caused damage to both natural and human infrastructure. Pollutants were dislodged and released into streams, wetlands, lakes and Lake Superior. Minnesota state climatology office shows a clear trend of increasing precipitation in northeastern MN over the last quarter century. Tree blow-down, forest fires, etc. have occurred in the BWCAW. Extreme climatic events in Minnesota have occurred more frequently over the past half century. To the naked eye, the landscape shows resiliency to climate induced impact. This landscape has shallow soil over hard bedrock. Its water quality threshold buffer capacity has been exceeded at selected locations. This can be observed physically (sediment deposition), chemically (exceedance of sulfate loads) and biologically (metals in fish tissue).

Proposed land use changes must consider large magnitude, intense rainfall and the concordant runoff to BWCAW waters. Considering the uncertainty of climate changes, a predictive tool is needed to help guide future development in areas adjacent to the BWCAW.

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

The State of Minnesota designates BWCAW as a Prohibited Outstanding Resource Value Water. Non-degradation of water quality is defined in Chapter 7050.0335. BWCAW is the only large-scale protected sub-boreal forest in the lower 48 states. Its interconnected, pristine waterways have very little natural buffering capacity against pollutants. The MPCA has conducted major watershed assessment at selected locations in the BWCAW for physical, chemical, and biological parameters.

But no entity has constructed a climate-precipitation tool for predicting the resiliency threshold that violates the state's water quality standards. The tool we are proposing to build will be statistically driven by historic rain/runoff response measurements using machine learning to adjust magnitude, intensity and duration for worst case scenarios. This climate model will be superimposed upon current natural landscape and projected estimates of human development.

We will validate the tool using selected lake cores to estimate the range of flood and drought conditions over the past 10,000 years. New sentinel biophysical stations will be established within the BWCAW to document water quality change and/or preservation over time. Modeling/data outputs and stakeholder events will be held to help non-scientific stakeholders understand the action necessary to retain a resilient landscape.

What are the specific project outcomes as they relate to the public purpose of protection, conservation, preservation, and enhancement of the state's natural resources?

- 1) Build a new AI machine learned modeling tool that accounts for extreme changes in climate with respect to land use.
- 2) An interactive GIS map that allows the public to select a location and apply the tool to estimate land use threshold resiliency.
- 3) The creation of sentinel data collection sites within BWCAW based on selected lake core logs to track selected water quality parameters over time.
- 4) Plan future land use scenarios and examine options that are... or aren't sustainable to the long-term water quality of the BWCAW.
- 5) Host two stakeholder meetings in 2028 and 2030.

Activities and Milestones

Activity 1: Build an AI machine learned modeling tool to predict the rain/runoff response to extreme events

Activity Budget: \$412,000

Activity Description:

UMN will hire a computer scientist postdoc trained in Monte-Carlo statistics to build an AI model that will predict the landscape response to varying precipitation events. Dr. Nieber will provide supervisory oversight to the postdoc and a graduate student working with artificial neural networks built upon past hydrologic models. Dr. Nieber has been working with NOAA to develop country-wide precipitation-flood prediction models. The team will conduct deep learning on historic data to provide the back drop for exploring landscape failure. Landscape failure is defined as damage to both the natural and built infrastructure. We will have limited ability to prevent events that cross resilient thresholds in wildland terrain. However, the model will have the ability to inform land use planners and managers on needed infrastructure strength to be sustainable for high magnitude and intense storms that have caused expensive infrastructure damage and irreversible water quality impact. Kerry Holmberg will provide day-to-day project management to insure actions are progressing as defined in a Gant chart. We anticipate the need of varying degrees of GIS expertise and plan to hire a temporary employee to guide UMN students building out the interactive map(s).

Activity Milestones:

Description	Approximate Completion Date
Interactive GIS map that allows the public to select a location and apply the tool	June 30, 2030
Predict sustainable long-term water quality of the BWCAW modeling different land uses.	June 30, 2030
Define the needed infrastructure resiliency to withstand extreme events	June 30, 2030

Activity 2: Creation of sentinel data collection sites within BWCAW

Activity Budget: \$195,000

Activity Description:

The creation of sentinel water quality data collection sites within BWCAW will be based on selected lake core logs to track indicator water quality parameters over time. Lake cores will help guide historical understanding of past climate extremes. Based on lake core data sentinel water quality stations can be established and operated by NMW to detect changes over time. NMW will contract with Mud Enviro to collect three lake cores and perform analysis of sediment constituents. We anticipate sediment layers will reveal periods of drought and extreme wetness with associated sediment deposition. The core data will help to constrain the uncertainty of the AI modeling tool. NMW will also purchase water quality equipment to measure and analysis both organic and non-organic constituents.

Activity Milestones:

Description	Approximate Completion Date
Select lakes for mud coring with contractor	December 31, 2027
Purchase needed equipment	December 31, 2027
Conduct lake coring	January 31, 2028
Interpret lake core data	June 30, 2028
Select sentinel monitoring sites	October 31, 2028
Gather water quality data at sentinel sites and interpret the results	June 30, 2030

Activity 3: Host two stakeholder meetings to educate and engage regional native and non-native local communities, and others interested parties.

Activity Budget: \$50,000

Activity Description:

Many people across the USA have an interest in the BWCAW environment. The folks include both native Americans who are concerned about the 1854 Treaty Rights of hunting, fishing and gathering, and those who seek a pristine wilderness experience. Dr. Magner has been working with the White Earth Nation for the past 4 years to examine how land use can impact wild rice production. Because the MPCA sulfate water quality standard has been exceeded in the Ely area, we anticipate finding higher sulfide values at selected locations and possibly other pollutants where a TMDL has not been resolved. Dr. Magner will lead stakeholder meetings and translate complex science into understandable information. Meetings will be planned for the summer months of 2029 and June of 2030.

Activity Milestones:

Description	Approximate Completion Date
Reach out to native Americans in the region	June 30, 2028
Communicate with folks concerns about pollutants of concern	June 30, 2029
Host communication events with citizens to translate information learned.	June 30, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Northeastern Minnesotans for Wilderness	NGO	Establish and collect water quality data in the BWCAW to provide long-term sentinel information about changes to the terrestrial and aquatic environment.	Yes

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.

NMW will provide the long-term dissemination of the project results

Long-Term Implementation and Funding

Describe how the results will be implemented and how any ongoing effort will be funded. If not already addressed as part of the project, how will findings, results, and products developed be implemented after project completion? If additional work is needed, how will this work be funded?

Beyond 6-30-30, work will continue with Northeastern Minnesotans for Wilderness (NMW). NMW is an established NGO in Ely MN that has been engaged in monitoring of the BWCAW for over a decade. The organization is supported by citizens in Minnesota and across the country. People who are passionate about wilderness canoeing. The science staff will be trained by Dr. Magner and his team to use both modeling and monitoring data to track and predict the future water quality of the BWCAW.

Project Manager and Organization Qualifications

Project Manager Name: Joe Magner

Job Title: Research Professor

Provide description of the project manager's qualifications to manage the proposed project.

Dr. Joe Magner is a professor with the Department of Bioproducts and Biosystems Engineering at UMN, teaching students water quality, hydrology, ecological engineering and watershed management. Joe has successfully advised over 50 graduate students along with 130+ publications. Joe is a co-author of the 4th edition of Hydrology and the Management of Watersheds published by Wiley-Blackwell (2013) – a book that is ranked in the upper 2% by ResearchGate of worldwide publications in hydrology.

Joe after 4 decades of service to Minnesota and worldwide, was presented a life-time achievement (Dave Ford Award) by the 2024 Water Resources Conference Planning Committee.

Joe has been engaged with northeastern Minnesota hydrology and water quality for over 4 decades – via MPCA and UMN. For the past 7 years, Joe has been working with Save the Boundary Waters Campaign to help citizens better understand the landscape fragility, water quality, and the dynamic of surface and subsurface hydrology.

Joe has researched climate change in Minnesota – with a particular emphasis on precipitation changes. He was the PI for the 2020 Quantifying New Urban Precipitation and Water Quality. He has published several papers on precipitation change and the concordant landscape response.

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Organization Description:

UMN-TC is a world class university. Graduate programs in natural resources and the environment are top ranked worldwide. Dr. Magner is an advisor in the NRSM, WRS, and BBSEM graduate programs.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
PI		Lead the project work			36.6%	0.3		\$34,113
Co-PI		Lead for AI model development			36.6%	0.15		\$12,793
Post doc		Chief builder of the AI model			26.1%	1.5		\$134,417
Research Assistant		Graduate student			24.2%	1		\$114,457
Activity Manager		Overall project management and administration			32.3%	1.5		\$144,546
Undergraduate		Provide labor to developers			0%	0.15		\$3,000
Non-student assistance		Causal/Temp labor			8%	0.15		\$3,480
							Sub Total	\$446,806
Contracts and Services								
NMW	Subaward	This subaward will provide NMW funds to conduct lake coring and establish sentinel monitoring sites in the BWCAW region.				3		\$175,000
							Sub Total	\$175,000
Equipment, Tools, and Supplies								
	Equipment	WQ Sonde + replacement sensors, and batteries	The WQ sonde provides the most basic WQ information and will be used daily across all data collection sites to define current WQ conditions.					\$20,000
							Sub Total	\$20,000
Capital Equipment								
							Sub Total	-
Acquisitions and Stewardship								

							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	Estimated 10 trips, 500 mile/trip, 2-5 individuals	2-3 UMN individuals traveling from St. Paul to Ely over the length of the project to work with NMW staff, meet with native and non-native Americans and conduct stakeholder meetings.					\$15,194
							Sub Total	\$15,194
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
							Sub Total	-
							Grand Total	\$657,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
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Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
			Non State Sub Total	-
			Funds Total	-

Total Project Cost: \$657,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [41242cd6-bdf.pdf](#)

Alternate Text for Visual Component

Most everyone knows where the BWCAW is located, the figure shows the powerful impact of a rain drop hitting the ground surface. This image reflects the key focus of this project....

Supplemental Attachments

Capital Project Questionnaire, Budget Supplements, Support Letter, Photos, Media, Other

Title	File
Proposal Letter FP - 14754	fc0c2d8e-8af.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Do you understand that travel expenses are only approved if they follow the "Commissioner's Plan" promulgated by the Commissioner of Management of Budget or, for University of Minnesota projects, the University of Minnesota plan?

Yes, I understand the UMN Policy on travel applies.

Does your project have potential for royalties, copyrights, patents, sale of products and assets, or revenue generation?

No

Do you understand and acknowledge IP and revenue-return and sharing requirements in 116P.10?

N/A

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF?

N/A

Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

Yes, Sponsored Projects Administration

Does your project include the pre-design, design, construction, or renovation of a building, trail, campground, or other fixed capital asset costing \$10,000 or more or large-scale stream or wetland restoration?

No

Do you propose using an appropriation from the Environment and Natural Resources Trust Fund to conduct a project that provides children's services (as defined in Minnesota Statutes section 299C.61 Subd.7 as "the provision of care, treatment, education, training, instruction, or recreation to children")?

No

Provide the name(s) and organization(s) of additional individuals assisting in the completion of this proposal:

Kerry Holmberg, UMN

Do you understand that a named service contract does not constitute a funder-designated subrecipient or approval of a sole-source contract? In other words, a service contract entity is only approved if it has been selected according to the contracting rules identified in state law and policy for organizations that receive ENRTF funds through direct appropriations, or in the DNR's reimbursement manual for non-state organizations. These rules may include competitive bidding and prevailing wage requirements

N/A