



Environment and Natural Resources Trust Fund

2023 Request for Proposal

General Information

Proposal ID: 2023-236

Proposal Title: Understanding and Improving Minnesota's Future Lake Water Quality

Project Manager Information

Name: Heidi Roop

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

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Project Basic Information

Project Summary: We will characterize how warming lakes across Minnesota might intensify or alter harmful algal blooms and share results and management strategies with the public using innovative tools and engagement strategies.

Funds Requested: \$492,000

Proposed Project Completion: June 30, 2025

LCCMR Funding Category: Water Resources (B)

Project Location

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

Statewide

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

Statewide

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.

Minnesota's lakes are critical to the state's public health, economy and culture: they provide recreation, sustenance, cultural value, and drinking water. However, these lakes are already warming and are expected to continue warming in the future, leading to degraded water quality and increasing risk of harmful algal blooms (HABs). Blooms can have severe ecological and economic consequences, leading to fish kills or costing millions of dollars in lost local tourism revenue. Certain freshwater HABs are expected to intensify because of increasing water temperatures alone, impacting wildlife and prohibiting recreation. Freshwater HABs are already a growing concern in the U.S. Midwest, particularly in Lake Erie and other Great Lakes, but anecdotal evidence suggests they are becoming more prevalent even in Minnesota's pristine northern lakes. These lakes are understudied despite the threat they face. Until recently, most studies on freshwater HABs have either focused on larger lakes or have required complex ecosystem models, and Minnesota's HAB efforts have been primarily reactive, not proactive. The threats posed by warmer climate conditions to Minnesota's freshwater resources necessitate a simple, forward-thinking approach that allows state agencies to get ahead of the problem and conserve water quality for future generations.

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.

We will estimate changes to HAB timing and intensity under different warming scenarios, engage with key stakeholders, and support a more proactive approach to lake management. From lake temperatures and temperature-based algal growth rates, we can estimate future HAB growth rates, compare them to historical rates, and project changes to when and where HABs will bloom in the future, i.e., at different times or in different lakes. This project leverages results from the state-funded Agricultural Weather Study, currently in progress at the University of Minnesota (UMN), which simulates future water temperatures in more than 70 of Minnesota's lakes that are not captured by existing computer simulations. The results will be incorporated into a climate visualization tool under development by the UMN Climate Extension Program, the Minnesota Climate Adaptation Partnership (MCAP). A community science monitoring program will demonstrate the application of these estimates to real-world problem solving. Through partnerships with statewide organizations and UMN Extension, we will (a) promote the data visualization tool and disseminate information about HABs to frontline communities; (b) solicit stakeholder feedback on a suite of data tools; and (c) design a community science program to monitor lake quality at a lake of cultural and ecological significance.

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?

This research will enable the conservation and preservation of water resources in Minnesota by identifying lakes with high HAB risk and demonstrating efficient monitoring efforts. Enhanced monitoring will reduce public HAB exposure and improve Minnesota's public water resources. With a focus on community engagement, this project will teach the public about HAB causes, impacts, and solutions, and will help protect future water quality across Minnesota's iconic, treasured lakes. To facilitate effective management of HABs, we will train managers from state, county, municipal, and Tribal entities in the use of the tool for assessing future HAB risk in nearby lakes.

Activities and Milestones

Activity 1: Use high-resolution computer models to project the effects of future warming on freshwater harmful algal blooms in lakes across Minnesota

Activity Budget: \$94,334

Activity Description:

We will use temperature projections for Minnesota's lakes with temperature-based growth rates for certain HAB species of concern to estimate HAB growth and timing for low-, medium- and high-emission scenarios at twenty-year increments from 2040 to 2099. These are the scenarios and time periods that MCAP's dynamically downscaled climate projections are currently simulating. We will calculate two indicators, bloom timing and bloom intensity. Bloom timing refers to the time of year when water temperatures are warm enough to cause rapid algal growth, and is defined by the week when growth reaches 75% of the maximum. Bloom intensity refers to the algal cell's potential growth at a particular point in time - higher potential growth suggests a more intense bloom. We will calculate these indicators from historical model simulations and first check the historical estimates against observations from the Sentinel Lakes program. We will then calculate the same indicators in the future and compare them to historical estimates to analyze how blooms might change. The results of this study will be published in an open access, peer-reviewed scientific journal and made available to the public on MCAP's website and through engagement activities outlined in Activities 2 and 3.

Activity Milestones:

Description	Completion Date
Project potential growth for HABs across the state in historical and future time periods	December 31, 2023
Estimate changes to bloom intensity and bloom timing	June 30, 2024
Publish results in an open access journal; post online at climate.umn.edu	December 31, 2024

Activity 2: Incorporate results into MCAP's data visualization tool from the Agricultural Weather Study

Activity Budget: \$221,833

Activity Description:

Working with geospatial data analysis and visualization experts at the University of Minnesota's U-Spatial, we will incorporate the results of Activity 1 into the Agricultural Weather Study's data visualization tool. We will engage stakeholders at every step of the process, from initial tool design to iterations on tool development and feedback on its usability. Users will be able to select the time period, emissions scenario, and HAB species they are interested in, and will have the option of viewing two map layers: one showing changes in bloom timing and another showing changes in bloom intensity. The state map will show the entire state divided into three regions - North, Central, and South - but users will also be able to zoom in to view specific lakes. Users will be able to download data as a map, as a graph, in GIS format, or as a CSV file for their own use.

Activity Milestones:

Description	Completion Date
Organize stakeholder meetings with partners to learn about data visualization needs	December 31, 2023
Work with U-Spatial to incorporate HAB projections into MCAP's climate tool	June 30, 2024
Follow up with stakeholders to get feedback on tool	September 30, 2024
Test tool's usability with interested stakeholders	December 31, 2024
Host data tool training workshops for the state and county and Tribal managers	June 30, 2025

Activity 3: Work with partners to enhance engagement, education and HAB monitoring efforts

Activity Budget: \$175,833

Activity Description:

Through partnerships with the 1854 Treaty Authority, University of Minnesota Water Resources Center, Minnesota Department of Natural Resources, Hennepin County, and Minnesota Lakes & Rivers Advocates, we will disseminate the study results, engage stakeholders to co-create a usable data visualization tool, and design the community science monitoring program. The Water Resources Center will integrate project results into existing Extension programming and disseminate information through Extension offices across the state. HAB projections for lakes in the Sentinel Lakes program will be shared with the Department of Natural Resources to inform future monitoring, while Minnesota Lakes & Rivers Advocates and Hennepin County will connect us with Minnesotans who use and care about the state's invaluable lakes. Finally, the 1854 Treaty Authority will co-lead a community science monitoring program to demonstrate the study's application in informing future monitoring efforts. With the Treaty Authority we will identify a lake of ecological and cultural importance, recruit and train volunteers, design a sampling scheme that covers the HAB growing season from May through September, and send samples for processing at the Natural Resources Research Institute. Results from the pilot monitoring program can be used to calibrate model estimates of bloom timing and growth, provided a bloom is observed.

Activity Milestones:

Description	Completion Date
Design monitoring program, including location, dates, and necessary equipment; recruit and train community scientists	June 30, 2024
With partners, identify additional stakeholders for outreach and engagement	September 30, 2024
Monitor HAB growth through the growing season (May - September)	October 31, 2024
Stakeholder engagement to share results of research and monitoring projects	June 30, 2025
Collect, synthesize and publish monitoring data	June 30, 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Heidi Roop	University of Minnesota	Principal Investigator: To oversee scientific analysis and engagement efforts; serve as primary point of contact for project	Yes
Suzi Clark	University of Minnesota	Co-PI: conduct scientific analysis; oversee data visualization development; lead communication and engagement efforts; support project partnerships and interactions	Yes
Brenda Hoppe	University of Minnesota	Research and Development: assist with communication and engagement with a focus on community health impacts and responses to HABs; assist with tool design and engagement development processes	Yes
Stefan Liess	University of Minnesota	Research: support data analysis and address technical issues with project partners	Yes
Data Visualization Specialist	University of Minnesota - U-Spatial	Communication: incorporate HAB projections into MCAP's climate visualization tool	Yes
Amanda Farris	University of Minnesota	Program management & evaluation; assist with project and budget management, coordinate stakeholder engagement, and conduct ongoing project evaluation related to project reach and impact	Yes
Catherine Burns	University of Minnesota	Communication: lead strategic communications plan development, assist with communications research and engagement	Yes
Graphic Designer	To be determined	Communication: develop communications materials to utilize during stakeholder engagement, such as handouts, guidebooks, email campaigns, and social media posts.	Yes
Christopher Filstrup	Natural Resources Research Institute, University of Minnesota - Duluth	Research, outreach and engagement: process samples from community science monitoring project	No
Hilarie Sorensen	1854 Treaty Authority	Outreach, engagement, and community science: Tribal liaison; help to identify lake of interest for pilot monitoring program; engage residents of the 1854 ceded territory in project; assist with dissemination of outreach and education materials	No
Joel Larson	University of Minnesota Extension - Water Resources Center	Outreach and engagement: Integrate results into existing Extension programming; help to establish relationships with community partners	No
Jeff Forester	Minnesota Lakes & Rivers Advocates	Outreach and engagement: connect with private landowners and lake users across the state for both information sharing and stakeholder engagement	No
Karen Galles	Hennepin County	Outreach and engagement: connect with local governments and lake associations to disseminate information and bring together stakeholders for training workshops	No

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?

This project will benefit from long-term partnerships and ongoing programming supported by MCAP through Extension.

The research component will be implemented by MCAP scientists and is fully funded by the budget described below. The visualization tool and communications materials will be created by the University of Minnesota's U-Spatial, graphic designers, and Extension Educators and are funded by this proposal. Stakeholder and community engagement will build on MCAP's extensive network of partners across the state, will be funded through this project and partners' budgets, and will be executed together with state agencies, UMN Extension, Tribal partners, non-governmental organizations, and municipal governments.

Project Manager and Organization Qualifications

Project Manager Name: Heidi Roop

Job Title: Assistant Professor

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

Principal Investigator Heidi Roop is a trained climate scientist and science communicator, with years of experience developing innovative ways to build bridges between the theory and practice of science communication. Dr. Roop's research focuses on developing communications tools and methods for connecting climate science to decision-making. Dr. Roop holds appointments in the University of Minnesota Extension and College of Food, Agricultural and Natural Resource Sciences, is Director of the Minnesota Climate Adaptation Partnership (MCAP), and was formerly the Lead Scientist for Science Communication at the University of Washington Climate Impacts Group. In two short years at UMN she has grown MCAP from a volunteer-run annual conference to a university-funded organization with more than ten scientists, staff, and interns. Her expertise in climate science, communication, and stakeholder engagement give her the skills to lead this project. She has experience in climate research across the globe, from Antarctica to Greenland to Minnesota, and her knowledge of climate models and climate data will inform Activity 1. Dr. Roop is also currently the principal investigator of MCAP's Agricultural Weather Study, which gives her intimate knowledge of MCAP's new climate data visualization tool for Activity 2. Finally, as a result of her research at the University of Minnesota and elsewhere, she is experienced in stakeholder engagement and science communication, which will enable her to lead Activity 3.

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

Organization Description:

The mission of the Department of Soil, Water, and Climate is to advance the understanding of Earth system processes and the interaction among land, atmosphere, and water. Through research, teaching, and outreach it seeks to: (1) improve and protect the quality of soil, air, and water resources in natural and managed ecosystems; (2) enhance agricultural and forest productivity and sustainability; (3) predict and mitigate impacts of environmental change on ecosystems and society; and (4) provide science based knowledge for improved decision making and a better informed citizenry.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Principal Investigator		to oversee scientific analysis and engagement efforts; serve as primary point of contact for project			33.5%	0.2		\$26,169
Co-Principal Investigator		to conduct scientific analysis; oversee data visualization development; lead communication and engagement efforts; support project partnerships and interactions			20.9%	2		\$146,162
Researcher		to assist with communication and engagement with a focus on community health impacts and responses to HABs; assist with tool design and engagement development processes			33.5%	0.4		\$36,675
Climate Modeler		to support data analysis and address technical issues with project partners			33.5%	0.4		\$30,303
Data Visualization Specialist		to incorporate HAB projections into MCAP's climate visualization tool			33.5%	1		\$115,958
Professional Administrator		to assist with project and budget management, coordinate stakeholder engagement, and conduct ongoing project evaluation related to project reach and impact			33.5%	0.4		\$29,799
Postdoctoral Associate		to lead strategic communications plan development, assist with communications research and engagement			20.9%	0.6		\$33,580
							Sub Total	\$418,646
Contracts and Services								
TBD	Professional or Technical Service Contract	to develop communications materials to utilize during stakeholder engagement				0.4		\$20,000
TBD	Professional or Technical Service Contract	Community scientists will attend a day-long training and collect samples throughout the HAB season (May-September). They will be responsible for transporting samples to the lab at the Natural Resources Research Institute for training.				0.1		\$6,000

							Sub Total	\$26,000
Equipment, Tools, and Supplies								
	Tools and Supplies	General operating supplies, including workshop materials (flip charts and travel case, markers, tubs and totes to move materials, travel easel and case, power cords, markers, etc.), and printing and project promotion materials	To facilitate stakeholder engagement through workshops and training sessions					\$4,000
	Tools and Supplies	Sampling supplies (288 samples, \$10 per sample) and extraneous sampling materials (gloves, markers, travel cases, coolers, packing supplies))	These supplies will enable monitoring during the pilot community science monitoring program.					\$5,000
	Tools and Supplies	Two years of Matlab license	The Matlab license will enable data analysis as part of Activity 1					\$4,400
	Tools and Supplies	Adobe Illustrator License for two years	This license will enable the production of communications materials as part of Activity 3					\$954
							Sub Total	\$14,354
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	12 trips per year within Minnesota	Exact locations of engagement and dates of travel will be determined through the project process and interaction with our stakeholder groups. Trip costs are expected to be approximately \$500 each, with variability based on the distance traveled. We anticipate 12 trips each year of the following approximate distances and durations: average mileage will be 500 miles/round trip at					\$12,000

			0.585/mile for a total of \$293 per trip. Average per diem, based on GSA rates, is expected to be \$97 per night for accommodation and approximately \$55 each day for two days for food and incidentals.					
	Miles/ Meals/ Lodging	48 maximum trips from Duluth to Lake Vermilion and back	The distance round-trip is 180 miles, at a reimbursement rate of \$0.585/mile, and an estimated 48 maximum trips to the lake to monitor during the growing season (180 x 48 x 0.585 = \$5,050). \$5,000 is requested to meet these approximate costs for Minnesota-based travel.					\$5,000
							Sub Total	\$17,000
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
		Sample processing	A maximum of 288 samples will be processed at the Natural Resources Research Institute, at a cost of \$45 per sample					\$13,000
		Room rentals and fees	This funding will support room rentals and associated fees for in-person community scientist training and data visualization tool training					\$3,000
							Sub Total	\$16,000
							Grand Total	\$492,000

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	-

Attachments

Required Attachments

Visual Component

File: [c4fa5175-ebb.pdf](#)

Alternate Text for Visual Component

The first image shows wintertime lake temperature at Red Lake, which has warmed 0.28 degrees Fahrenheit per decade since 1895. The next two images show the model's lakes and a HAB growth curve (growth vs. temperature). The final two images show outreach efforts: community scientists and workshops.....

Optional Attachments

Support Letter or Other

Title	File
UMN Letter of Support	c6fe2268-433.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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

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

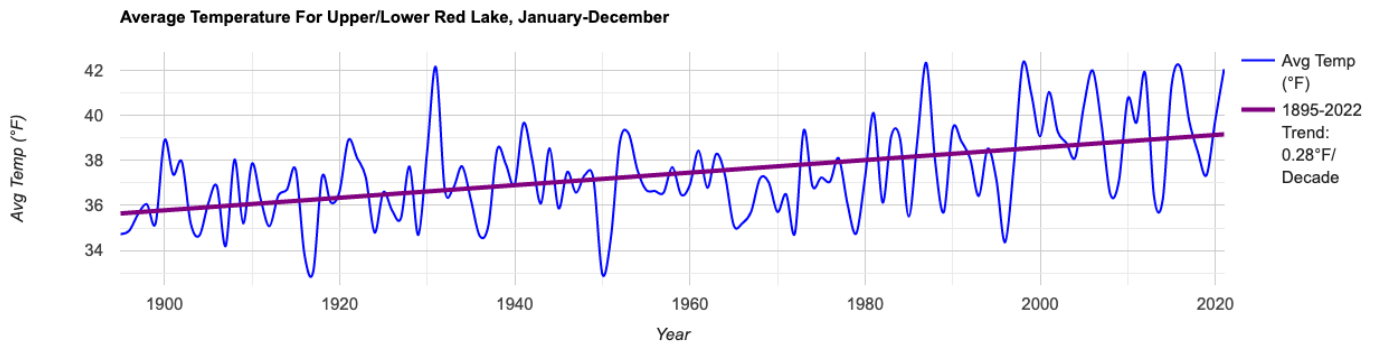
Does your project include original, hypothesis-driven research?

Yes

Does the organization have a fiscal agent for this project?

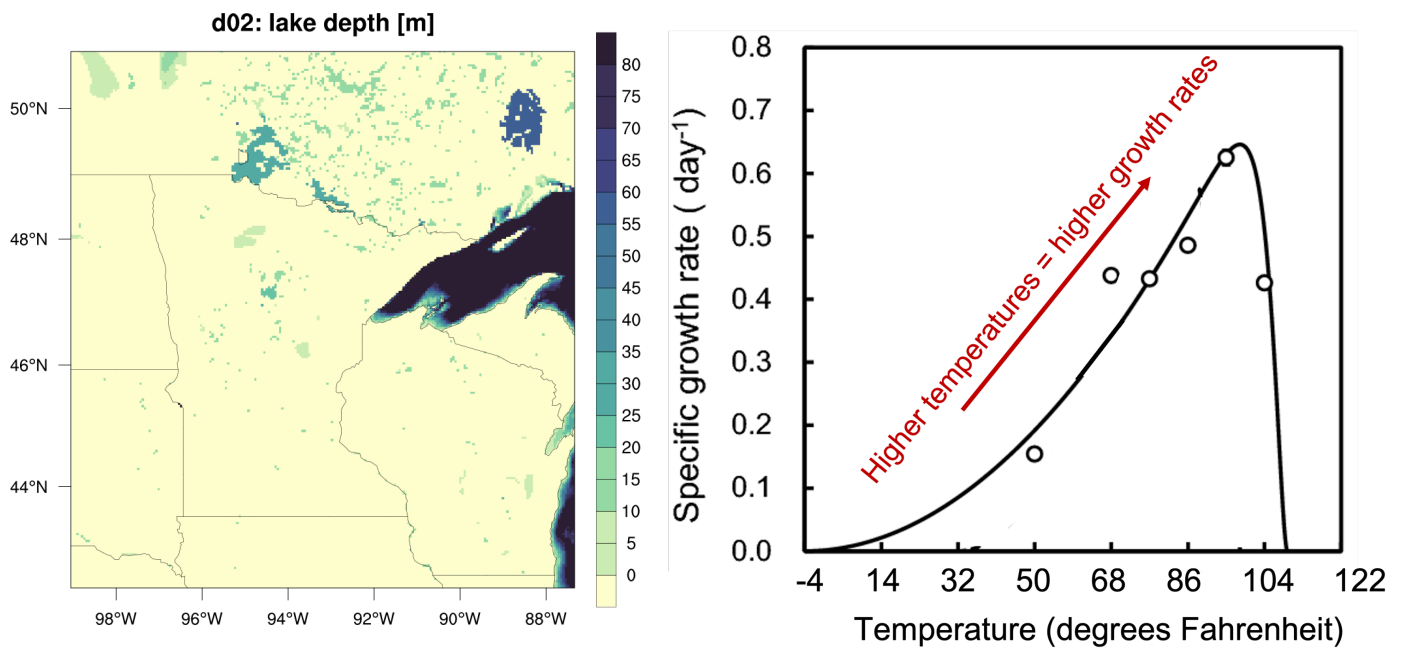
Yes, Sponsored Projects Administration

1. Warming lake temperatures in Minnesota can degrade water quality and cause HABs.



[Source: Minnesota Department of Natural Resources]

2. Using computer simulations and HAB growth based on temperature, we will project how HAB bloom intensity and timing will change in lakes across the state.



[Sources: Liess 2022 (left); Li et al., 2022 (right)]

3. We will share results with people across Minnesota through our partnerships and an online data visualization tool.



[Source: UMN Extension]

