Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-162

Proposal Title: Before the Thaw: Winter Matters for Harmful Algae

Project Manager Information

Name: Hailey Sauer

Organization: Science Museum of Minnesota - St. Croix Watershed Research Station

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Project Basic Information

Project Summary: This project aims to identify and understand where and how harmful algae persist through winter, providing early-season information to support water quality improvement and bloom-risk reduction efforts.

ENRTF Funds Requested: $750,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Water (B)

Project Location

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

Region(s): Central, Metro,

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.

Harmful algal blooms (HABs) are an increasing challenge for Minnesota's lakes, degrading recreational use, drinking water quality, and fisheries. Current management responses are largely reactive and typically implemented only after blooms become visible. At that point, management options are limited, costs are higher, and impacts to water quality and public trust have already occurred. While summer conditions influencing blooms are relatively well studied, we know less about the processes that initiate blooms, particularly during winter when lakes are often assumed to be inactive.

Harmful algae do not disappear during cold months. Instead, they persist in specific lake zones where they tolerate adverse conditions and re-emerge when conditions become favorable. These winter "holdover" populations may strongly influence the timing, location, and severity of blooms later in the open-water season. However, we lack actionable information on where these populations persist, how consistent they are across years, and whether early-season actions could meaningfully reduce late season blooms.

In this work we will address HABs by expanding our understanding of the processes that occur outside traditional summer monitoring. By focusing on winter persistence and early-season dynamics, the work will provide the context needed to evaluate when and where management actions may be most effective.

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.

In this project we will address harmful algal blooms by expanding monitoring and analysis beyond the traditional summer season to better understand how blooms originate and develop. We will conduct coordinated late-fall, winter, and early-spring sampling in representative lakes to identify where harmful algae persist during cold months and the environmental conditions that support their survival. This work will determine whether "holdover" populations are consistent and predictable enough to warrant management attention.

At the same time, we will track the transition from winter to spring to evaluate how and when harmful algae re-enter the water column and proliferate. By documenting early-season recruitment patterns, our work will identify conditions and time periods that influence later bloom development.

Finally, we will integrate winter, spring, and summer observations to evaluate whether specific cold-season and early-season characteristics are linked to bloom timing and severity. We will use our results to develop practical indicators and guidance that help managers assess bloom risk earlier in the year.

Together, these activities will provide the evidence needed to determine whether winter processes represent a meaningful opportunity for prevention and early intervention, helping Minnesota invest in more effective, timely, and cost-efficient water quality protection strategies.

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?

Results will be implemented through integrated scientific, management, and public-facing products designed to support long-term water quality protection. Deliverables will include publicly accessible datasets, seasonal bloom and toxin risk screening tools, peer-reviewed publications, and technical summaries with recommendations based on this work for resource managers. Findings will be incorporated into educational initiatives, including the University of Minnesota Field Microbiology Program and Science Museum of Minnesota outreach activities ensuring broad dissemination to professional and public audiences.

Activities and Milestones

Activity 1: Identify Winter Harmful Algae Bloom Refuges and Toxin Risk

Activity Budget: $371,000

Activity Description:

This activity will establish a winter monitoring program in six representative Minnesota lakes to determine where harmful algae persist during cold months and what environmental conditions are associated with their survival and toxin-producing potential. We will collect water and sediment samples under ice and near ice-off from multiple lake zones, including nearshore areas, deep water, and bottom sediments. Measurements will include temperature structure, dissolved oxygen, conductivity, light availability, and nutrient concentrations.

We will collect and analyze biological samples to quantify harmful algal abundance, toxin-related genetic markers, and community composition. Sampling will be repeated across seasons and years at selected sites to evaluate whether winter "holdover" populations are consistent and predictable. At select locations, small-scale field manipulations will be used to examine how differences in snow cover, ice clarity, and temperature influence winter persistence and toxin-related indicators.

The results from this activity will be used to develop maps of high-probability overwintering zones and to identify winter conditions associated with elevated bloom and toxicity risk.

Activity Milestones:

Description	Approximate Completion Date
Conduct 1st winter sampling in selected lakes across designated lake zones.	March 31, 2028
Quantify harmful algal abundance and toxin-related genetic markers from 1st winter water and sediment	June 30, 2028
Conduct 2nd winter sampling in selected lakes across designated lake zones	March 31, 2029
Quantify harmful algal abundance and toxin-related genetic markers from 2nd winter water and sediment	June 30, 2029
Conduct small-scale winter light and temperature experiments to assess effects on algal and toxin persistence	August 31, 2029
Conduct 3rd winter sampling in selected lakes across designated lake zones.	March 31, 2030
Quantify harmful algal abundance and toxin-related genetic markers from 3rd winter water and sediment	June 30, 2030
Map spatial distribution of overwintering populations and identify reoccurring high-probability refuge zones across lakes	June 30, 2030

Activity 2: Track Early-Season Recruitment and Toxin Development

Activity Budget: $319,200

Activity Description:

This activity will focus on the period between ice-off and early summer, when harmful algae re-enter the water column and begin to proliferate. Following winter sampling, lakes will be monitored at regular intervals to measure changes in algal abundance, toxin-related indicators, community structure, and environmental conditions. The sampling will emphasize areas identified in Activity 1 as potential recruitment sources.

We will combine our field observations with laboratory incubation analyses to evaluate whether early-season populations resemble winter communities or represent new growth from other sources. Physical and chemical conditions including oxygen, nutrients, and light availability, will be measured to identify factors associated with rapid early-season expansion and increased toxin potential.

By documenting recruitment patterns across multiple lakes and seasons, this activity will establish timelines for bloom and toxicity development and clarify how winter persistence influences early-season risk.

Activity Milestones:

Description	Approximate Completion Date
Collect water samples (yr1) from ice-out through summer to track algal abundance and toxin-related indicators	September 30, 2028
Collect water samples (yr2) from ice-out through summer to track algal abundance and toxin-related indicators	September 30, 2029
Compare early-season algal communities to winter populations to assess recruitment pathways	March 31, 2030
Identify environmental conditions associated with rapid early-season algal expansion and increasing toxin potential	June 30, 2030
Develop lake-specific timelines describing bloom and toxicity progression from winter through early summer	June 30, 2030

Activity 3: Synthesize Data, Develop Indicators, and Engage the Public

Activity Budget: $59,800

Activity Description:

Finally, we will guide future harmful algal bloom monitoring and prevention efforts by synthesizing project findings into practical tools and accessible resources. The data we generate through winter, spring, and summer monitoring will be integrated to identify seasonal patterns associated with bloom development and toxin risk. We will share our results through scientific publications, publicly available datasets, visual summaries, and screening tools designed to support early-season risk assessment.

Additionally, we will communicate our findings through presentations at regional and statewide water resource meetings and through targeted outreach materials. We will make our project datasets and analytical products openly accessible to support transparency and continued use beyond the project period.

To strengthen education and workforce development, we will incorporate our project activities into the University of Minnesota's Field Microbiology Program (June '29-'30), providing students with hands-on experience in bloom monitoring and microbial analysis. And, at the Science Museum of Minnesota, we will develop interactive public-facing learning experiences that highlight seasonal bloom dynamics, water quality protection, and public health relevance. Ultimately, through coordinated synthesis, dissemination, and education, this final activity will ensure that project investments translate into informed and lasting stewardship of Minnesota's lakes.

Activity Milestones:

Description	Approximate Completion Date
Present findings with professional colleagues	June 30, 2030
Deliver instruction to undergraduate and graduate students on methodologies and techniques related to the proposal	June 30, 2030
Share findings and engage the general public through museum-based outreach	June 30, 2030
Deliver summary analysis describing relationship between winter persistence, bloom intensity, and toxin potential	June 30, 2030

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.
Project results will be shared with scientific, management, and public audiences to ensure findings support improved harmful algal bloom monitoring, water quality management, and public awareness in Minnesota.

Scientific Publications and Professional Presentations
We will prepare peer-reviewed publications describing winter persistence of harmful algae, recruitment dynamics, and bloom risk indicators. Findings will also be presented at professional meetings such as the Minnesota Water Resources Conference and other regional scientific conferences. These venues ensure that researchers, lake managers, and water resource professionals can incorporate project findings into monitoring and management programs.

Data Products and Management Applications
Project datasets, including seasonal monitoring data, genomic results, and environmental measurements, will be made publicly available through appropriate data repositories and institutional archives. Technical summaries and screening tools describing seasonal bloom risk indicators will be shared with local and state agencies and organizations responsible for lake management. These products will support incorporation of winter and early-season indicators into existing water quality monitoring programs.

Education and Public Engagement
Findings will also be shared with the public through outreach programs at the Science Museum of Minnesota and through educational activities connected to the University of Minnesota Field Microbiology Program. These efforts will translate project findings into accessible learning experiences that highlight seasonal lake processes, bloom development, and actions that support water quality protection.

Data Longevity and Collections
All environmental samples, analytical results, and associated metadata generated through the project will be archived through the St. Croix Watershed Research Station to ensure long-term availability for future research and management applications.

Acknowledgment of ENRTF Support
All publications, presentations, reports, educational materials, and digital media produced through this project will acknowledge support from the Environment and Natural Resources Trust Fund and the Legislative-Citizen Commission on Minnesota Resources using the required attribution language and logo in accordance with ENRTF Acknowledgment Guidelines.

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?
We will implement project findings through collaboration with lake managers, state agencies, and monitoring programs to incorporate winter and early-season indicators into harmful algal bloom risk assessment. Our data products, seasonal bloom-risk screening tools, and technical summaries will be shared with partners including state agencies, watershed districts, and lake associations. Our public datasets and peer-reviewed publications will ensure long-term accessibility

and scientific impact. We will pursue means to continued monitoring and refinement of predictive indicators through future state and federal research proposal so that we can incorporate winter bloom dynamics into long-term water quality management strategies.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Uncovering the Past to Protect Minnesota's Walleye Fisheries	M.L. 2024, , Chp. 83, Art. , Sec. 2, Subd. 04m	$1,121,000
Superior Shores: Protecting Our Great Lakes Coastal Habitats	M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 03ff	$675,000

Project Manager and Organization Qualifications

Project Manager Name: Hailey Sauer

Job Title: Assistant Scientist

Provide description of the project manager's qualifications to manage the proposed project.
Dr. Hailey Sauer has a comprehensive and specialized academic background. She holds bachelor's degrees in Education, Environmental Science, and Geographical Information Science, along with a Ph.D. in Microbial Biology. Her research focuses on the microbial and biogeochemical processes that shape freshwater ecosystem function, with particular emphasis on harmful algal blooms, nutrient cycling, and microbial community dynamics in lakes.
Hailey's work integrates field observations, molecular techniques, and environmental data analysis to better understand how microbial communities respond to environmental change. Her research has advanced understanding of bloom formation, toxin production, and microbial interactions across seasons, including under-ice and early-season conditions that are often overlooked in lake monitoring programs. This makes her well-suited for leading efforts to investigate how harmful algae persist through winter and how those populations contribute to bloom formation in the following open-water season, the main goal of Before the Thaw.
Hailey's dedication to education and outreach, highlighted by her education degree and her participation in various initiatives, will support the project's objectives to educate the public on freshwater ecosystem health. Her leadership is expected to promote scientific progress and increase awareness and care for Minnesota's waters.
Hailey Sauer's blend of scientific and educational expertise makes her an excellent choice for Project Manager of the "Before the Thaw" project. She will lead a team that includes experts in microbial genomics (Hamilton), lake biogeochemistry and sediment processes (Havig), limnological modeling and lake monitoring (Heathcote), and additional research staff supporting field and laboratory work. Together, this team brings complementary expertise in microbial ecology, lake chemistry, sediment processes, and environmental monitoring needed to address winter bloom dynamics across Minnesota lakes.

Organization: Science Museum of Minnesota - St. Croix Watershed Research Station

Organization Description:
The Science Museum of Minnesota (SMM) is a private, non-profit 501(c)3 institution dedicated to encouraging public understanding of science through research and education. The St. Croix Watershed Research Station is the environmental research center of the SMM with the mission "we do the science that helps make our rivers and lakes clean" through research and outreach. The SCWRS supports an active year-round program in environmental research and graduate-student training, guided by a dedicated in-house research staff with direct ties to area universities and colleges. It collaborates closely with federal, state, and local agencies with responsibility for managing the St. Croix and upper Mississippi rivers and is a full partner with the National Park Service for resource management in parks of the western Great Lakes region. Its research has played a central role in setting management policy for the state and tribal

waters, for establishing water-quality standards for Minnesota lakes, and for developing long-term monitoring plans for the National Park Service.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Hailey Sauer		Project Management, Fieldwork, Genomics, Analysis, Reporting and Outreach			22.5%	1.26		$120,000
Adam Heathcote		Assisting Project Management, Fieldwork, Sediment Analysis, Reporting and Outreach			22.5%	0.09		$14,168
Postdoctoral Fellow		Fieldwork, Water & Sediment Analysis, Reporting and outreach			26%	2.01		$170,300
Lab Technician		Fieldwork, water and sediment analysis			22.5%	0.99		$59,600
							Sub Total	**$364,068**
Contracts and Services								
SCWRS - Analytical Lab	Internal services or fees (uncommon)	Water quality analytical costs, 600 water and ice samples, analysis for TN/TP, DIN/SRP, DSi, DOC, DIC, Chl-a @ $195 per sample				-		$117,000
SCWRS - Analytical Lab	Internal services or fees (uncommon)	Cyanotoxin (Microcystin & Anatoxin) analysis for subset of 200 water and ice samples @ $85 per sample				-		$17,000
UC Davis or Competitive Bid	Service Contract	Carbon and nitrogen isotopic analysis for 600 water/ice, and 132 composite sediment samples @ $16 per sample				-		$11,700
Northwestern University or Competitive Bid	Service Contract	ICP-OES for Trace Element Analysis, 600 water and ice samples and 132 composite sediment samples @ $40 per water/ice sample and $33 per sediment sample				-		$28,356
University of Minnesota Genomics Center or Competitive Bid	Service Contract	Dual indexed (16S/18S) and sequencing for 600 water/ice and 30 composite sediment samples: 732 samples @ $18				-		$13,176
University of Minnesota Genomic	Service Contract	Metagenome sequening for subset of water, ice, and sediment samples: 5 lanes for 250 samples				-		$5,500

Center or Competitive Bid								
University of Auburn or Competitive Bid	Service Contract	Sediment cyanotoxin analsysis for a subset 132 composite sediment samples @ $50 per sample				-		$6,600
University of Minnesota - Hamilton & Havig	Subaward	Assisting in project management, genomics, fieldwork, water and sediment analysis, reporting and outreach				0.78		$94,500
							Sub Total	**$293,832**
Equipment, Tools, and Supplies								
	Tools and Supplies	Fieldwork and Sampling Supplies	Bottles/vials, reagents, preservatives, consumables for the collection and analysis of water, ice, and sediment samples.					$7,000
	Tools and Supplies	DNA Extraction & Toxin Gene Quantification Supplies	DNA extraction kits and consumables related to the quantification of toxin gene markers as well as storage and preservation of ice, water, and sediment samples.					$25,000
	Equipment	Monitoring Buoy Supplies	Includes component sensors, rope, and anchors to construct and install 6 monitoring buoys on lakes					$24,000
							Sub Total	**$56,000**
Capital Equipment								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								

	Miles/ Meals/ Lodging	14 Trips (2 days, 1 night - 4 persons) - 650 miles/trip, $60/day per diem, $0.725/mile, $225/night lodging	Fieldwork to complete activity 1					$19,600
	Miles/ Meals/ Lodging	10 Trips (2 days, 1 night - 4 persons) - 650 miles/trip, $60/day per diem, $0.725/mile, $225/night lodging	Fieldwork to complete activity 2					$14,000
							Sub Total	**$33,600**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	Publication page charges	Activity 3 milestone, dissemination and outreach					$2,500
							Sub Total	**$2,500**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$750,000**

Classified Staff or Generally Ineligible Expenses

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

Non ENRTF Funds

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

Total Project Cost: $750,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: e477fbf2-53d.pdf

Alternate Text for Visual Component

Three panels show a winter ice shoreline, microscopic algae with dormant cell in spring, and a green summer bloom. Arrows connect seasons, illustrating research to identify winter persistence zones, track spring recruitment, and evaluate links between overwintering algae populations and harmful summer blooms....

Supplemental Attachments

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

Title	File
Scope of Work - University of Minnesota	ccf696e1-b17.docx
Letter of Intent - University of Minnesota	8b8405e5-4ce.pdf
Audit for Fiscal Year 20024 - Science Museum of Minnesota	60bc380b-e73.pdf
990 for Fiscal Year 2024 - Science Museum of Minnesota	aa5d9ba3-b54.pdf
Proof of Good Standing - Science Museum of Minnesota	8cf6bd06-f04.pdf
Letter of Support - Science Museum of Minnesota	d64f9e25-585.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 Commissioner's Plan 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?

No

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:

Trinity Hamilton - University of Minnesota; Jeff Havig - University of Minnesota; Adam Heathcote - St. Croix Watershed Research Station

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

Yes, I understand