



Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-462

Proposal Title: Ice Thickness Monitoring Sensor

Project Manager Information

Name: Thomas Rodengen

Organization: Creative Scientific

Office Telephone: (651) 497-4820

Email: tommy@creative-scientiic.com

Project Basic Information

Project Summary: Lake ice thickness monitoring sensors will be developed, tested and deployed in the 25 Sentinel Lakes of Minnesota. The sensors will collect and record hourly ice thickness data.

ENRTF Funds Requested: \$60,000

Proposed Project Completion: July 31, 2028

LCCMR Funding Category: Small Projects (G)

Secondary Category: Water (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.

The Minnesota Department of Natural Resources manages citizen science ice-in and ice-out reports. Citizen scientists do not report the ice thickness. How ice forms on a lake is driven primarily by heat transfer between the water and environment. This project aims to track how ice thickness is impacted by environmental conditions including temperatures, wind, cloud cover and precipitation. By simultaneously monitoring ice thickness with data from weather stations we will have the opportunity to identify the combined role of environmental factors. Advanced understanding of the variables that control the evolution of lake ice will lead to safer ice travel and winter recreation as well as adding to the scientific understanding on a complicated natural phenomenon.

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 propose deploying ice thickness monitoring sensors late fall 2027 on Sentinel Lakes in Minnesota. The ice thickness monitoring sensors will transmit daily ice depth in the winter season of 2027/2028. Ice thickness formation and extirpation data will be correlated with surface water quality monitoring data and meteorological data.

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?

Outcomes include a peer-reviewed journal publication of correlations and submission of the ice thickness dataset to the Minnesota Pollution Control Agency. The data may also allow for information related to ice safety to be shared with the MN DNR.

Activities and Milestones

Activity 1: Ice Thickness Monitoring Sensor Development

Activity Budget: \$17,000

Activity Description:

Dr. Shepard, a mechanical engineering professor, will work with an undergraduate engineering research assistant to develop a functional ice thickness measurement system. This work will expand on a currently existing prototype which will be refined and assessed in a controlled lab environment. Multiple units of the final design will be run through rigorous reliability testing to gain confidence in the device for long-term deployment and determine measurement uncertainty. Specific tasks for these activities include assembling the prototypes, microprocessor coding, sensor calibration, battery life validation and troubleshooting instrument malfunctions.

Activity Milestones:

Description	Approximate Completion Date
Working Prototype with Data Transmission	October 31, 2027

Activity 2: Ice Thickness Monitoring Sensor Assembly

Activity Budget: \$15,000

Activity Description:

Assembling the 25 monitoring sensors modeled after the prototype. Each ice thickness monitoring sensor will be calibrated and confirmed to make accurate measurements prior to deployment to the sentinel lakes.

Activity Milestones:

Description	Approximate Completion Date
Sentinel Lake Location Ascertained	November 30, 2027
Ice Thickness Monitoring Sensor Assembled	November 30, 2027

Activity 3: Ice Thickness Monitoring Sensor Deployment

Activity Budget: \$15,000

Activity Description:

Deploying and testing the sensors in sentinel lakes. This will be done at each lake once the ice thickness is appropriately thick to walk on. The installation will involve drilling a small hole in the ice, manually measuring the ice thickness, installing the ice thickness measurement system and confirming that it is correctly measuring the ice thickness. The installation will be done when environmental conditions will allow the system to be frozen into place, for example when temperatures are below freezing and forecast to be below freezing for an extended period.

Activity Milestones:

Description	Approximate Completion Date
Deployment and in-field Testing of Ice Monitoring Sensors	January 31, 2028
Field Check of Ice Monitoring Sensors	February 28, 2028

Activity 4: Acquisition and Statistical Analysis

Activity Budget: \$13,000

Activity Description:

The ice thickness monitoring sensors will be retrieved before the ice thickness has become too thin for safe travel. The time history of the ice thickness at each location will be compared with environmental data from corresponding environmental measurement stations. Statistical analyses, such as linear regression analyses, will be conducted to determine the impact of various meteorologic conditions on ice thickness measurements at the sentinel lakes. Additionally, ice thickness data will be uploaded to sentinel lakes repository which may be of use should future ice measurements be taken. The data will then be organized into a peer-reviewed article.

Activity Milestones:

Description	Approximate Completion Date
Deployment of Ice Thickness Monitoring Sensors	December 31, 2027
Recovery of Ice Thickness Monitoring Sensors	March 31, 2028
Data Analysis	June 30, 2028
Draft technical paper	July 31, 2028

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Thomas Shepard	University of St. Thomas	Project Partner	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.

Submission of findings to an open access peer reviewed journal. Upload of data to the EQuIS system of the Minnesota Pollution Control Agency.

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?

After publication and upload of the 2027/2028 dataset, ongoing efforts will be determined by the University of St. Thomas' partner.

Project Manager and Organization Qualifications

Project Manager Name: Thomas Rodengen

Job Title: Project Manager

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

PhD in Resource and Environmental Management

Organization: Creative Scientific

Organization Description:

Environmental Consultancy that performs Paleolimnological Services of a Watershed

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Dr. Thomas Shepard		Project Partner			7.23%	0.08		\$14,349
Undergraduate Researcher		Undergraduate Lab and Field Assistance			5.2%	0.25		\$8,930
Dr. Thomas Rodengen		Project Lead			0%	0.25		\$15,000
Field Assistant		Assist in field deployment, checking, and recovery of sensors.			0%	0.25		\$5,000
							Sub Total	\$43,279
Contracts and Services								
							Sub Total	-
Equipment, Tools, and Supplies								
	Tools and Supplies	Ice Travel Personal Protective Equipment (PPE)	Safely deploy and recover ice thickness monitoring sensors					\$182
	Tools and Supplies	Ice Thickness Monitoring Sensors - materials to construct 28 devices	Parts and batteries for Ice Thickness Monitoring Sensors					\$10,000
	Tools and Supplies	Field Kit to repair failing ice thickness monitoring sensors	Backup parts of 1 sensor plus tool kit to use in the field					\$347
							Sub Total	\$10,529
Capital Equipment								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								

	Miles/ Meals/ Lodging	3 round trips to sentinel lakes. Each Trip is 714 miles (POV @0.725/mi). 3 people per trip (per diem@127).	Ice Thickness Monitoring Sensor deployment, check, and recovery.					\$4,566
							Sub Total	\$4,566
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Publication	Peer-reviewed scientific journal submission	Publishing fees of open access journal publication					\$1,626
							Sub Total	\$1,626
Other Expenses								
							Sub Total	-
							Grand Total	\$60,000

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: \$60,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [aff2232b-bd1.pdf](#)

Alternate Text for Visual Component

Visual of Ice Thickness Monitoring Sensor Prototype...

Financial Capacity

Title	File
Financial Capacity Note	d4b399cf-010.pdf

Supplemental Attachments

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

Title	File
UST Sponsored Program Approval	ba724b26-a8a.docx
Letter of Authorization	9301c2f6-2b3.pdf
Budget Supplement	3fb53e90-d52.xlsx

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:

Dr. Thomas Rodengen of Creative Scientific and Dr. Thomas Shepard of the University of St. Thomas

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