

Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-507

Proposal Title: Innovative Pollutant Sensors for Surface Water Monitoring

Project Manager Information

Name: John Sartori Organization: U of MN - College of Science and Engineering Office Telephone: (612) 625-0811 Email: jsartori@umn.edu

Project Basic Information

Project Summary: Minnesota's waters face pollution threats missed by current monitoring. Our team develops low-cost, AI-powered sensor networks for real-time water quality insights, aiding agencies, businesses, and communities in proactive environmental protection

ENRTF Funds Requested: \$496,000

Proposed Project Completion: June 30, 2028

LCCMR Funding 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.

Water quality management is limited by outdated, costly, and inefficient monitoring methods that rely on periodic manual sampling, leading to delayed and sparse data. This lack of real-time insights hinders our ability to predict and respond to pollution events, especially as Minnesota's waters face increasing challenges from climate change, including altered precipitation patterns and flooding. Current methods fail to capture water quality dynamics at the necessary scale, leaving communities, regulators, and researchers without timely, actionable information.

Our innovative in-situ sensor networks provide continuous, real-time water quality data using a low-cost, distributed system. Integrating AI-powered analytics, Big Data management, and geospatial visualization, this system enhances data accessibility, usability, and security. The sensors measure key water quality parameters, such as pH, dissolved oxygen, temperature, and conductivity, while incorporating publicly available data from state and local agencies. AI models will leverage this data to generate fine-scale water quality predictions, similar to our prior work in air quality modeling.

By bridging gaps in water quality monitoring, our technology will empower stakeholders—including underserved communities, municipalities, policymakers, and environmental organizations—to make informed decisions. This innovation will enhance environmental health, support sustainable water management, and drive data-driven policy development to protect Minnesota's waters.

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.

Our next-generation in-situ water quality sensing system combines advanced sensor technology, AI-driven analytics, and Big Data management to enable real-time, continuous water quality monitoring. Unlike traditional methods that rely on infrequent, labor-intensive sampling, our system deploys cloud-connected sensor nodes to provide high-resolution, real-time data on key water metrics, including nitrate and phosphate—major contributors to water contamination and harmful algal blooms.

The collected data is securely stored and processed in our Big Data platform, which integrates AI-powered analytics to detect trends, forecast pollution risks, and deliver actionable insights through an interactive dashboard. With experience in AI-powered Big Data platforms for traffic and air quality sensors, we will now apply our expertise to water management.

With funding, we will:

- Deploy sensor networks across Minnesota's watersheds, including urban and rural areas.
- Enhance AI and Big Data capabilities for predictive modeling and user-friendly visualization.
- Collaborate with stakeholders to ensure accessible, equitable data use.
- Optimize sensor performance for long-term deployment in diverse environments.
- Expand educational support to train communities on data-driven water management.

This initiative will transform water quality management, equipping communities and decision-makers with critical tools to protect Minnesota's water resources and public health.

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?

Our water quality sensing system advances the protection, conservation, preservation, and enhancement of Minnesota's natural resources through real-time monitoring, pollution prevention, and data-driven conservation efforts. It enables early pollution detection, supporting policymakers and conservation groups in protecting lakes, rivers, and wetlands. The project reduces costs and environmental impact by replacing traditional monitoring with advanced sensor

networks. High-resolution datasets aid long-term water resource management, ensuring clean water for future generations. Public engagement is strengthened through education, accessible data dashboards, and citizen science initiatives. By integrating AI, Big Data, and IoT, our system enhances Minnesota's water quality management and sustainability.

Activities and Milestones

Activity 1: Initial IoT Sensor and Data Platform Pilot Deployment for Water Quality Monitoring

Activity Budget: \$246,000

Activity Description:

Establish a functional pilot system in selected watersheds. Install IoT sensors, develop a data platform, and validate AI models for predictive analytics. This activity focuses on testing and refining the core technologies to ensure accuracy and reliability before wider deployment. Tasks include sensor installation, data platform development, and AI model training and validation.

Activity Milestones:

Description	Approximate Completion Date
Install sensors in selected watersheds	September 30, 2026
Data Platform Prototype Ready	December 31, 2026
Al Model Validation Complete	March 31, 2027
Pilot System Performance Report	June 30, 2027

Activity 2: Expand Sensor Network and Enhance AI Models for Comprehensive Regional Coverage

Activity Budget: \$250,000

Activity Description:

Scale the successful pilot system by deploying sensors across multiple regions. Enhance AI models with additional environmental data to improve predictive capabilities. This activity will broaden the system's reach and accuracy. Tasks include regional sensor deployment, integrating external environmental data, and refining AI algorithms.

Activity Milestones:

Description	Approximate Completion Date
Regional Deployment Plan Finalized	September 30, 2027
Expanded Sensor Network	December 31, 2027
Al Model Integration of External Data	March 31, 2028
Regional System Performance Analysis	June 30, 2028

Project Partners and Collaborators

Name	Organization	Role	Receiving
			Funds
John Sartori	University of	Embedded Systems Engineering	Yes
	Minnesota,		
	College of		
	Science and		
	Engineering		
Cara Santelli	University of	Environmental Engineering	Yes
	Minnesota,		
	College of		
	Science and		
	Engineering		
Yao-Yi Chiang	University of	Data Science, Machine Learning, and Spatial Science	Yes
	Minnesota,		
	College of		
	Science and		
	Engineering		
Change Ge	University of	Big Data Science and Engineering	Yes
	Minnesota,		
	College of		
	Science and		
	Engineering		
Maggie Sartori	Quantum Shift	Project Management	No
	Strategies		

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?

Our project results will be implemented through scalable sensor networks and an AI-powered platform, providing realtime water quality data to policymakers, agencies, and communities. We will integrate findings with state water management frameworks, ensure public data accessibility, and offer stakeholder training.

Ongoing funding will come from NSF, EPA, and state grants, partnerships with municipalities and industries, and potential commercialization. Community-driven monitoring will further sustain efforts. These strategies ensure long-term adoption, empowering stakeholders with actionable insights to protect Minnesota's water resources.

Project Manager and Organization Qualifications

Project Manager Name: John Sartori

Job Title: Professor, Department of Electrical and Computer Engineering

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

Dr. John Sartori, Professor of Electrical and Computer Engineering at the University of Minnesota, is well-qualified to lead the development of innovative remote sensor systems for water quality monitoring. His extensive experience in designing and deploying advanced sensing technologies makes him uniquely positioned to manage this project effectively.

Dr. Sartori's research focuses on the intersection of sensor networks, data acquisition, and signal processing, with a specific emphasis on environmental monitoring applications. He has a proven track record of developing and

implementing remote sensing systems, including those deployed in challenging field environments. His expertise encompasses the entire sensor system lifecycle, from initial design and prototyping to data analysis and interpretation.

His work includes significant experience with IoT-based sensor platforms, wireless communication protocols, and embedded systems, all critical components of modern remote monitoring systems. Dr. Sartori's deep understanding of these technologies, coupled with his ability to translate scientific concepts into practical engineering solutions, ensures the project's technical success.

Furthermore, Dr. Sartori has a strong history of leading interdisciplinary research teams, fostering collaboration between engineers, scientists, and stakeholders. His experience in securing and managing grant funding demonstrates his ability to oversee complex projects and deliver results within budget and timeline constraints. His commitment to advancing environmental monitoring through technological innovation makes him a capable leader for this critical project.

Organization: U of MN - College of Science and Engineering

Organization Description:

The University of Minnesota's College of Science and Engineering (CSE) is a premier institution dedicated to advancing scientific discovery and engineering innovation. With a commitment to interdisciplinary research and education, CSE tackles critical environmental and natural resource challenges facing Minnesota and beyond. Our faculty, researchers, and students possess expertise in areas such as water resources, sustainable energy, ecological modeling, and environmental sensing. CSE leverages state-of-the-art facilities and strong industry partnerships to develop practical solutions for environmental stewardship. We are committed to translating research into actionable strategies, empowering communities, and informing policy decisions that protect and enhance Minnesota's natural resources for future generations. CSE's collaborative approach ensures that our research directly addresses the state's environmental priorities.

Budget Summary

Category /	Subcategory	Description	Purpose	Gen.	%	#	Class	\$ Amount
Name	or Type			Ineli	Bene	FTE	ified	
				gible	fits		Staff?	
Personnel								
John Sartori		Embedded Systems Engineering Project Leadership			36%	0.5		\$54,000
Embedded		Development and testing of remote sensor systems			23%	0.5		\$60,000
Systems								
Engineering								
Research								
Assistant								
Cara Santelli		Environmental Engineering Project Leadership			36%	0.5		\$46,000
Environmental		Deployment and science for watershed monitoring			23%	0.5		\$60,000
Engineering								
Research								
Assistant								
Yao-Yi Chiang		Data Science, Machine Learning, Spatial Science			36%	0.5		\$58,000
		Leadership						
Data Science		Development of water quality monitoring and			23%	0.5		\$60,000
and Machine		forecasting models						
Learning								
Research								
Assistant								
Chang Ge		Big Data Science Leadership			36%	0.5		\$49,000
Big Data		Development of data systems for data collection and			23%	0.5		\$60,000
Research		dissemination						
Assistant								
							Sub	\$447,000
							Total	
Contracts and								
Services						-		
							Sub	-
							Total	
Equipment,								
Tools, and								
Supplies	Tables		To be used for some 1 11 1 1 1					¢40.000
	Tools and	Electronic supplies	To be used for constructing embedded					\$10,000
	Supplies		sensor systems					<u> </u>
	I ools and	Sensors	To be used in sensor systems to					\$33,000
1	Supplies		monitor water quality metrics	1	1	1	1	1

	Tools and Supplies	Lab supplies	To be used for laboratory testing of water samples			\$4,000
	Tools and Supplies	Field Supplies	To be used for deployment of sensor systems			\$2,000
					Sub Total	\$49,000
Capital Expenditures						
					Sub Total	-
Acquisitions and Stewardship						
					Sub Total	-
Travel In Minnesota						
					Sub Total	-
Travel Outside Minnesota						
					Sub Total	-
Printing and Publication						
					Sub Total	-
Other Expenses						
					Sub Total	-
					Grand Total	\$496,000

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: \$496,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component File: 2d20b1b2-6d7.pdf

Alternate Text for Visual Component

The proposed water sensor networks track water quality throughout a watershed and provide advanced real-time data analytics through a feature-rich, accessible app that can alert users and the public about pollution levels so that timely and informed decisions can be made to protect water resources....

Supplemental Attachments

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

Title	File
UMN SPA Letter	<u>4bf74535-4e4.pdf</u>

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?

N/A

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

Yes

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

Yes

Do you wish to request reinvestment of any revenues into your project instead of returning revenue to the ENRTF? If so, describe here (1) the source and estimated amounts of any revenue and (2) how you propose to use those revenues:

Yes, It is possible that we may generate funds from sale of sensor systems, but it is unlikely within this initial project period. If revenue is generated, we request to reinvest into the project to increase the scope of watershed monitoring and data sharing possible.

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:

John Sartori - UMN CSE Cara Santelli - UMN CSE Yao-Yi Chiang - UMN CSE Chang Ge - UMN CSE

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