



Environment and Natural Resources Trust Fund

2025 Request for Proposal

General Information

Proposal ID: 2025-154

Proposal Title: Removing Mercury from Minnesota Waters

Project Manager Information

Name: Michael Smanski

Organization: U of MN - College of Biological Sciences

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Project Basic Information

Project Summary: We will test and refine a biotechnology approach to removing mercury from the food chain in Minnesota's lakes and rivers. If successful, this will make fish consumption in Minnesota safer.

ENRTF Funds Requested: \$247,000

Proposed Project Completion: May 31, 2027

LCCMR Funding Category: Small Projects (H)

Secondary Category: Methods to Protect or Restore Land, Water, and Habitat (F)

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?

In the Future

Narrative

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

Methyl-mercury (hereafter just referred to as mercury) is a major pollutant in Minnesota waters and a public health hazard. Mercury levels in the environment are increasing, primarily due to human activity including coal-powered energy generation, cement kilning, industrial production of chlorine-containing materials, and gold mining. Mercury is a potent neurotoxin in animals and is particularly hazardous during prenatal and postnatal neurological development. All lakes and rivers in Minnesota are polluted with mercury, resulting in limits on the number of fish that Minnesotans can safely eat to avoid mercury poisoning. This results in multiple deleterious consequences to the health, use, and viability of Minnesota's water resources. There is a feasible path to removing mercury from aquatic food chains by converting it to Hg(0), which would volatilize to the upper atmosphere. Remediating mercury from our waters would result in increased recreation and tourism for fishing, increased health of Minnesotans by allowing for the consumption of greater amounts of healthful fish, and would establish Minnesota as a global leader in innovative water resource remediation.

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.

Research that originated in our laboratory at the University of Minnesota recently demonstrated that bacterial genes can be introduced to baitfish, giving them the ability of detoxify mercury from their environment. The proof-of-concept was completed in zebrafish, which are convenient laboratory animals that originate from South Asia. However zebrafish are not a viable organism to remove mercury from Minnesota waters. We have recently introduced this technology to Fathead Minnows, the most abundant freshwater fish in the Central and Eastern US. We foresee a powerful bioremediation program where mercury-degrading minnows (which are simultaneously made (i) bright pink or green to encourage predation and (ii) sterile to prevent them from altering the genetics of native populations) are released to decrease levels of mercury in the fish we harvest for consumption.

In this project we will measure the ability of these mercury-detoxifying Fathead Minnows to remediate polluted waters using environmentally-representative aquaria. In parallel, we will perform stakeholder engagement work with the Minnesota Pollution Control agency and the Minnesota DNR to determine the best path towards field trials of these fish in severely impacted lakes.

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?

Successful completion of this project will result in a mature biotechnology with a feasible path forward through regulatory approval. The next steps after this funded project would be field trials in multiple lakes around the state and eventually deployment to remove methylmercury from Minnesota's edible fish population in a way that is safe and effective.

Activities and Milestones

Activity 1: Test and refine the mercury-degrading fathead minnows in secure laboratory environments.

Activity Budget: \$227,000

Activity Description:

We will test the ability of engineered fathead minnows to convert toxic methylmercury to Hg(0) which will leave aquatic ecosystems. We already have engineered fathead minnows in-hand, and a proof-of-concept has been successfully demonstrated in aquarium fish (zebrafish) by our collaborators. These preliminary results substantially de-risk this technical activity. In this activity, we will measure the efficiency of mercury bioremediation in a contained aquarium environment at the MAISRC Containment Laboratory. We will iterate on the design-build-test-learn engineering cycle until we have fish that will remove mercury from aquatic food chains with high efficiency. Lastly, we will use multi-trophic (food-chain) models of different MN lake and river systems to simulate the numbers of released fish needed to significantly reduce mercury levels in commonly consumed fish species. These models will be informed by laboratory experiments using co-housed fish species (i.e., feeding experiments) in the MAISRC Containment Laboratory.

Activity Milestones:

Description	Approximate Completion Date
Rate of methylmercury degradation by existing transgenic fish is quantified by mass spectrometry.	December 31, 2025
Rate of methylmercury volatilization is improved through iterative engineering.	December 31, 2026
Impact of methylmercury bioremediation through the food chain is modeled and quantified in laboratory experiments	May 31, 2027

Activity 2: Determine the pathway for field-trials and wide-spread mercury bioremediation by engaging with MN-DNR, MPCA, and other regulators.

Activity Budget: \$20,000

Activity Description:

Activity 2 is divided into two subtasks. Subtask 1 will be a series of individual stakeholder engagement meetings with individual agencies in MN and at the federal level. Meetings will be held in person (local) or virtually (federal). The first series of meetings is aimed to share the technology and current model for bringing it to the field with key stakeholders. This subtask will include building a comprehensive map of the stakeholders that will need to be congregated in Subtask 2. The second subtask will be to organize a full-day stakeholder meeting in St. Paul in summer 2026. Having all stakeholders together in one room will be important (funds in this Activity will cover travel of stakeholders to St Paul) to ensure that the key milestones for regulatory approval (local and federal) and field-testing are compatible and understood by all.

Activity Milestones:

Description	Approximate Completion Date
Stakeholder identification and one-on-one stakeholder engagement to familiarize them with the emerging technology	February 28, 2026
Multi-stakeholder in-person workshop to establish pathway to regulatory approval and deployment in MN.	August 31, 2026

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?

There are two major implementation possibilities, both of which will be on the table to discuss during our stakeholder engagement (Activity 2 below). One route is commercializing this technology through a start-up company that will be paid to remediate mercury on a lake-by-lake basis. The second is to partner with local government agencies (MN DNR or Pollution Control Agency) for a government-funded remediation program. These two paths may differ in which lakes would be cleaned up first, with social-justice implications (e.g., route one will prioritize lake associations willing to pay for the technology).

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Building Knowledge and Capacity to Solve AIS Problems	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 06a	\$4,000,000
Building Knowledge And Capacity For AIS Solutions	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2, Subd. 06e	\$3,750,000

Project Manager and Organization Qualifications

Project Manager Name: Michael Smanski

Job Title: Associate Professor; Department of Biochemistry, Molecular Biology, and Biophysics and Biotechnology Institute

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

Michael Smanski has a Bachelor's Degree in Biochemistry from UC-San Diego, a PhD in Microbiology from U-Wisconsin, and did postdoctoral training at Massachusetts Institute of Technology. He has run a productive research lab at the University of Minnesota since 2014. His lab specializes in leveraging the latest advancements in precision genetic engineering to create biotechnologies that address problems in human health, medicine, agriculture, and the environment. In recent years, his lab has pioneered the translation of genetic engineering into non-laboratory organisms, including native and invasive fish species. The proposed project is an extension of a currently ongoing research project in his lab. His group has already demonstrated the ability to genetically modify fathead minnows and to introduce genes for mercury bioremediation. This project seeks to characterize the performance of these bioremediation agents and to tune them to enhance the rates of mercury remediation. In recent years, Dr. Smanski has led several stakeholder engagement workshops through his role as a PI at the University of Minnesota and through his role as Deputy CTO and Technology Fellow at a national manufacturing innovation institute called BioMADE. This has given him the network and experience to lead the stakeholder engagement aspects of this project.

Organization: U of MN - College of Biological Sciences

Organization Description:

The University of Minnesota Biotechnology Institute is located on the St Paul campus and is comprised of 45 faculty whose labs focus on diverse applications of biology to address societal problems. The Institute provides ample access to lab space to perform the research described in this proposal. It also provides administrative support including, but not limited to, Human Resources, Accounting/Finance, and General Administration. Researchers working on this project will be situated in a great environment where they will be routinely exposed to the latest advancements in the field of biotechnology.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Professor		PI			27.06%	0.4		\$20,078
Researcher 5 academic lab staff		To conduct analysis			27.06%	2		\$166,165
							Sub Total	\$186,243
Contracts and Services								
							Sub Total	-
Equipment, Tools, and Supplies								
	Tools and Supplies	Consumable and supplies: \$12,000 for year 1, \$12,240 for year 2;	This will cover fish husbandry materials (food, cleaners, etc.) and genetic engineering reagents (DNA, enzymes, lab consumables, etc.) for constructing and characterizing transgenic fish					\$24,240
							Sub Total	\$24,240
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Conference Registration Miles/ Meals/ Lodging	This will cover travel costs and room rental associated with hosting the multi-stakeholder meetings in summer of 2026	Convene ~20 stakeholders from across the state to determine a pathway to field release.					\$5,000

							Sub Total	\$5,000
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
	Publication	Publication of results describing fathead minnow bioremediation of mercury in high-visibility science journal	Communication of results to the broader science and regulatory community					\$3,000
							Sub Total	\$3,000
Other Expenses								
		Laboratory services related to research and development (Activity 1)	\$13,000 in year 1 and \$13,260 in year two to cover fees associated with DNA sequencing, Mass Spectroscopy, and service fees for the MAISRC Containment Lab. \$237 added as rounding to make sum total round to a thousand.					\$26,497
		Repairs and maintenance	\$1000 in year one and \$1020 in year two to cover minor costs associated with routine repair and maintenance of equipment used in R&D efforts					\$2,020
							Sub Total	\$28,517
							Grand Total	\$247,000

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				
In-Kind	Indirect costs for this proposal, though not allowed, are listed as in-kind contribution of 55% MTDC which is the Federally Negotiated rate with the U of MN. The indirect is proportionate to the awarded funds at a rate 55% so if the award is reduced the F&A would be reduced.	To pay for administrative and facility expenses for this project	Secured	\$135,720
			Non State Sub Total	\$135,720
			Funds Total	\$135,720

Total Project Cost: \$382,720

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [f7d7d199-b30.pdf](#)

Alternate Text for Visual Component

Our visual component contains an infographic describing how the methylmercury degrading baitfish will lower mercury levels in the aquatic food chain. We also show photographs of our current fathead minnows engineered to degrade methylmercury, which are also made bright pink to make them more attractive to predator fish....

Supplemental Attachments

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

Title	File
SPA_submission_letter_Smanski	23769c1f-439.pdf

Administrative Use

Does your project include restoration or acquisition of land rights?

No

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?

No

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:

Lori Nicol, University of Minnesota