

Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-437

Proposal Title: Preventing Legionnaires' Disease via Improved Drinking Water Management

Project Manager Information

Name: Timothy LaPara Organization: U of MN - College of Science and Engineering Office Telephone: (612) 624-6028 Email: lapar001@umn.edu

Project Basic Information

Project Summary: This project will investigate drinking water supplies for their ability to grow bacteria that cause Legionnaires' disease and development treatment strategies to mitigate the rise posed by these organisms.

ENRTF Funds Requested: \$925,000

Proposed Project Completion: June 30, 2029

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?

In the Future

Narrative

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

Legionnaires' disease is a severe form of pneumonia, caused by the bacterium Legionella pneumophila, which is fatal in about 10% of cases. Legionella naturally occur in soil and water and are commonly detected in drinking water. Unfortunately, there are occasional blooms of Legionella pneumophila in drinking water systems that lead to outbreaks of Legionnaires' disease, including a recent well-publicized outbreak in Grand Rapids, Minnesota involving 34 cases of the disease. Legionella levels in drinking water can be suppressed by maintaining a residual disinfectant (e.g., chlorine) but some public water supplies do not use any disinfectant (e.g., Grand Rapids prior to July 2024) and other public water supplies struggle to maintain a residual disinfectant throughout their water distribution systems. This research, therefore, will identify groundwaters and surface waters that contain sufficient "food" to support bacterial growth, as measured by the assimilable organic carbon (AOC) test. That is, this research will identify public water systems that are susceptible to outbreaks of Legionnaires' disease. In such cases where there is a higher susceptibility to growing Legionella, water utilities could treat their water to reduce AOC levels and/or ensure that a robust residual of disinfectant is maintained throughout their distribution systems.

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 a multi-faceted research project that will further our understanding of the frequency with which Legionella pneumophila is found in our drinking water systems, the factors that enable Legionella pneumophila to grow within our drinking water systems, and a practical approach to suppressing the growth of Legionella pneumophila in drinking water. One phase of this research project will be to survey public water systems within Minnesota for the presence of Legionella pneumophila (and associated/related organisms), the presence of residual disinfectant, and the concentration of AOC (the "food" in the water that enables Legionella pneumophila to grow). A second phase of the research project will focus on lab-scale experiments that explore the effects of different variables (temperature and AOC) that are pertinent for Legionella pneumophila growth in drinking water systems. The final phase of this research will determine the ability of various filtration technologies to reduce AOC levels in drinking water; we believe this is a potentially cost-effective technology for public water systems that are particularly susceptible to blooms of Legionella pneumophila in their water. This research project will significantly improve Minnesota's ability to prevent outbreaks of Legionnaire's disease attributed to its public water supplies.

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?

Surface water and groundwater are critically important sources of drinking water for all Minnesotans. Although public water systems are usually effective at preventing the spread of disease, cases of Legionnaire's disease caused by blooms of Legionella pneumophila have been increasing, including a high-profile outbreak in Grand Rapids, MN in 2023-2024. This research project will directly assess the susceptibility of dozens of Minnesota's public water systems to outbreaks of Legionnaire's disease. In addition, bench-scale experiments will further our understanding of the causes of blooms of Legionella pneumophila, which will further help reduce the risk of outbreaks of Legionnaire's disease.

Activities and Milestones

Activity 1: Quantify Legionella pneumophila, assimilable organic carbon, residual disinfectant, and other parameters in water samples from drinking water systems throughout Minnesota

Activity Budget: \$425,000

Activity Description:

Water and biofilm samples will be collected from approximately 20 non-disinfected community water systems (source = groundwater), 5 community water systems that use surface water as their source, and approximately 20 community water systems that use groundwater as their source and practice disinfection. Samples will be collected during the summer months (June-August) when water temperatures are the warmest. Water and biofilm samples will be collected from five locations within each system. Water samples (~1 L each) from each system will be collected at the treatment plant (i.e., source water and finished water) and from 3 different buildings in the distribution system. At each of these building sites, water will be collected from the building inlet and from a faucet within the building (likely a shower). A biofilm sample also will be collected by removing a shower head and swabbing the inside of the shower neck. Each system will be sampled up to three times (once per summer). We will quantify pertinent microorganisms by quantitative polymerase chain reaction (PCR) and by cultivation (Legiolert assay). We will also measure temperature, pH, chlorine concentration, total organic carbon concentrations, and assimilable organic carbon (AOC) concentrations for each water sample.

Activity Milestones:

Description	Approximate
	Completion Date
Sample collection and processing	August 31, 2028
Quantify Legionella pneumophila (cultivation), Assimilable Organic Carbon, measure chlorine,	August 31, 2028
temperature, and pH	
Quantification of Legionella pneumophila and other organisms by quantitative PCR	January 31, 2029
Data Analysis	May 31, 2029

Activity 2: Laboratory experiments to understand the factors (temperature and AOC) that affect the growth of Legionella pneumophila in drinking water

Activity Budget: \$250,000

Activity Description:

Legionella pneumophila is somewhat infamous for growing in water heaters operated at less than 115 degrees F, but our experience has demonstrated that this organism will also grow in the "cold" water lines within buildings. In addition, a relatively high concentration of Legionella pneumophila is needed to trigger a case of Legionnaire's disease. This Activity will therefore explore temperature and AOC as pertinent variables for growing Legionella pneumophila in drinking water. We will perform these experiments in CDC reactors that will be fed different concentrations of AOC (obtained from water systems studied in Activity 1) and operated at different temperatures (55, 70, 85, and 100 degrees F). Each of these CDC reactors has multiple "coupons" that will be removed and analyzed for Legionella pneumophila by quantitative PCR. These experiments will provide critically important information regarding the water temperatures and AOC concentrations at which Legionella pneumophila could become problematic. This information will be useful for identifying public water systems that are particularly susceptible to blooms of Legionella pneumophila capable of causing outbreaks of Legionnaire's disease.

Activity Milestones:

Description	Approximate Completion Date
Complete Laboratory Experiments at Different Concentrations of Assimilable Organic Carbon	October 31, 2027
Complete Laboratory Experiments at Different Temperatures	June 30, 2028
Quantification of Legionella pneumophila and other organisms by quantitative PCR	December 31, 2028
Data Analysis	May 31, 2029

Activity 3: Perform laboratory experiments to assess the ability of granular media filtration to reduce the concentrations of AOC in groundwater.

Activity Budget: \$250,000

Activity Description:

Granular media (e.g., sand, activated carbon) filtration is commonly used by water utilities to treat surface water supplies (i.e., lakes and rivers) but rarely to treat groundwater. We hypothesize that filtration using biologically-active filter media would be a cost-effective approach to reduce AOC in groundwater and limit the growth of bacteria that cause outbreaks of Legionnaire's disease. The basic concept is to allow bacteria to grow in filters within the treatment facility such that there is little or no "food" available to support their growth within the distribution system. We will collect water from a public water system with high AOC levels (identified during Activity 1) and feed this water to laboratory-scale columns packed with granular media (sand or activated carbon). Total organic carbon and AOC levels in the filtered water will be periodically measured. At the end of the experiment, filter media samples will be analyzed to quantify and characterize the microorganisms present. These experiments should demonstrate the ability of granular media filtration to effectively reduce AOC levels in groundwater. This would provide Minnesota's public water systems with another option, in addition to disinfection, to reduce the likelihood of outbreaks of Legionnaire's disease within their water system.

Activity Milestones:

Description	Approximate Completion Date
Complete laboratory-scale filtration experiments	December 31, 2027
Quantification of pertinent organisms on filter media by quantitative PCR	May 31, 2028
Data Analysis	December 31, 2028

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Raymond M. Hozalski	University of Minnesota	Co-project manager	Yes

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 have been investigating the presence of Legionella pneumophila in drinking water for about a decade funded by two different water utilities, the Minnesota Department of Health, the Minnesota Environment and Natural Resources Trust Fund, and the US Environmental Protection Agency. As such, we are well positioned to disseminate our research conclusions to key stakeholders and then seek funding for subsequent research. In particular, we envision personnel at the National Science Foundation and the National Institutes of Health to be particularly interested in funding our future research.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount
		Awarded
Evaluating Coronavirus And Other Microbiological	-	-
Contamination Of Drinking Water Sources From		
Wastewater		
Monitoring Emerging Viruses in Minnesota's Urban	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2,	\$416,000
Water Cycles	Subd. 04c	
Evaluating Coronavirus And Other Microbiological	M.L. 2021, First Special Session, Chp. 6, Art. 6, Sec. 2,	\$594,000
Contamination Of Drinking Water Sources From	Subd. 04g	
Wastewater		
High Temperature Anaerobic Digestion of Sewage	M.L. 2022, , Chp. 94, Art. , Sec. 2, Subd. 04b	\$208,000
Sludge		
Enhancing Wastewater Treatment through Genetic	M.L. 2024, , Chp. 83, Art. , Sec. 2, Subd. 04d	\$553,000
Sequencing		

Project Manager and Organization Qualifications

Project Manager Name: Timothy LaPara

Job Title: Professor

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

Professor LaPara has worked at the University of Minnesota in the Department of Civil, Environmental, and Geo-Engineering since August 2000. He has worked on numerous research projects funded the Minnesota Environment and Natural Resources Trust Fund, the National Science Foundation, the National Institutes of Health, the Environmental Protection Agency, and other city, state, and federal agencies. His research has resulted in countless presentations at scientific conferences and more than 90 publications in the peer-reviewed literature. According to Web of Science, his research has been cited more than 3000 times.

Organization: U of MN - College of Science and Engineering

Organization Description:

The University of Minnesota is one of the largest, most comprehensive, and most prestigious public universities in the

United States (http://www1.umn.edu/twincities/01_about.php). The laboratories directed by the project manager contains the majority of the equipment needed to perform the proposed project, including centrifuges, pumps, water meters, analytical balances, and a real-time PCR machine. The University of Minnesota also has "core facilities" that offer additional equipment, which can be used by University researchers "at cost." For this project, the core facility that is most germane is the University of Minnesota Genomics Center (UMGC; http://genomics.umn.edu). UMGC offers state-of-the-art DNA sequencing capabilities, numerous real-time PCR machines, digital PCR machines, and experts available for consultation on an as-needed basis.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineli	% Bene	# FTE	Class ified	\$ Amount
				gible	fits		Staff?	
Personnel								
Timothy		Project Manager			26.9%	0.36		\$97,364
LaPara								
Raymond		Co-Project Manager			26.9%	0.36		\$105,412
Hozalski								
TBD		Post-doctoral research associate			20.6%	3		\$268,348
TBD		Graduate Research Associate			43.2%	150		\$179,716
TBD		Undergraduate Research Assistants			0%	2.13		\$80,660
							Sub Total	\$731,500
Contracts and Services								
University of	Internal	UMGC provides at-cost services for University of				-		\$10,000
Minnesota	services or	Minnesota personnel. For this project, this would						
Genomics	fees	enable us to characterize complex microbial						
Center	(uncommon)	communities by sequencing PCR-amplified 16S rRNA						
(UMGC)		genes and/or proximity-ligation metagenomic						
Oissen	Comico	sequence analysis.				0		¢22.000
Qiagen	Contract	to extract (nurify DNA from complex and to quantify				0		\$33,000
	Contract	specific gape targets. These equipment items are						
		very expensive and critical to the success of our						
		project. We will purchase a service contract to						
		ensure that these items function properly during our						
		project.						
							Sub Total	\$43,000
Equipment,								
Tools, and								
Supplies								
	Tools and	DNA extraction kits (Quantity = 17 extraction kits;	Extract and purify DNA from drinking					\$25,500
	Supplies	\$1500 for a kit that performs 100 extractions)	water, biofilms, and granular media					
	Tools and	Supplies for Legiolert Assay (1000 assay; i.e., \$25 per	Quantify Legionella pneumophila by					\$25,000
	Supplies	assay)	cultivation in drinking water samples					4.5.5.5
	Tools and	Trays for Digital Polymerase Chain Reaction (dPCR)	Quantity specific genes (linked to					\$3,000
1	Supplies	(Quantity = 20 trays)	organisms of interest) by digital PCR	1		1	1	1

	Tools and Supplies	Supplies for measuring assimilable organic carbon (AOC)	Quantify the amount of nutrients in water that can potentially grow			\$12,500
	Tools and	Disc filters (Quantity = 1500)	Legionella pneumophila Concentrate biomass from drinking			\$2,000
	Table and		analyzed by PCR			¢10.000
	Supplies	PCR reagents	(Legionella pneumophila, etc) of interest by PCR			\$10,000
	Tools and Supplies	Hach Colorimeter (Quantity = 1)	Quantify the concentrations of disinfectant (chlorine, chloramine) in drinking water			\$1,000
	Tools and Supplies	CDC reactors and supplies (Quantity = 4)	Lab-scale experiments on the potential for growing Legionella pneumophila in drinking water			\$18,500
	Tools and Supplies	Glass Reservoirs (quantity = 24)	These will hold/store drinking water during laboratory experiments growing biofilms (Activity 2) and removing AOC (Activity 3)			\$12,000
	Tools and Supplies	Peristaltic Pumps/Pump Heads (Quantity = 4 pumps)	These will be used to feed drinking water into either CDC reactors (Activity 2) or to filtration columns (Activity 3)			\$6,000
	Tools and Supplies	Filter Columns (quantity = 9)	Perform experiments in granular media filtration to reduce AOC levels in drinking water			\$9,000
	Tools and Supplies	Miscellaneous Supplies	Small items but numerous items that are needed for analyzing drinking water, CDC reactors, and performing filtration experiments			\$6,000
					Sub Total	\$130,500
Capital Expenditures						
					Sub Total	-
Acquisitions and Stewardship						
					Sub Total	-
Travel In Minnesota						

	Miles/ Meals/ Lodging	Most trips will involve two people, who will potentially need to stay in a hotel. This will involve the use of either personal vehicles or U of MN fleet	To collect samples and water from water utilities throughout the State of Minnesota		\$10,000
		services vehicles (whichever is cheaper). We envision as many as 150 of these trips.			
	Conference Registration Miles/ Meals/ Lodging	We would like to present our results at state-level conferences and to personnel at participating water utilities, if needed. We envision two conference presentations (MN AWWA meeting in September of each year) and as many presentations at participating water utilities as feasible.	Disseminate our research results to stakeholders		\$5,000
				Sub Total	\$15,000
Travel Outside Minnesota					
				Sub Total	-
Printing and Publication					
	Publication	Open access publishing costs	This would allow us to publish our work but retain the copyright so that we and LCCMR staff can promote our research to the fullest extent.		\$4,500
	Printing	Presenting our research results in poster-format	Sometimes, research conferences invite us to present our work in poster form. This involves printing costs.		\$500
				Sub Total	\$5,000
Other Expenses					
				Sub Total	-
				Grand Total	\$925,000

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	University of MInnesota	Indirect Costs that are not allowed to be charged to LCCMR/ENTRF	Secured	\$484,559
			Non State	\$484,559
			Sub Total	
			Funds	\$484,559
			Total	

Total Project Cost: \$1,409,559

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component File: <u>6221f02d-702.pdf</u>

Alternate Text for Visual Component

Panel #1 shows screenshots from various media outlets discussing outbreaks of Legionnaires' disease in Maple Grove, Albert Lea, and Grand Rapids. Panel#2 shows project personnel collecting water samples from Grand Rapids. Panel#3 shows a positive Legiolert assay collected from Grand Rapids during their Legionnaires' disease outbreak....

Supplemental Attachments

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

Title	File
Letter of Support from Minnesota Department of Health	7845af6d-61c.pdf
Board Resolution Letter	<u>c29b66d9-643.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?

Yes, I understand the UMN Policy on travel 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?

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:

Enoch Pan, University of Minnesota, Department of Civil, Environmental, and Geo- Engineering

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