Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-209

Proposal Title: Assessing Salt Impact on Minnesota Lake Health

Project Manager Information

Name: Jeff Havig

Organization: U of MN - College of Biological Sciences

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Project Basic Information

Project Summary: The proposed work will characterize the chemistry, microbiology, and primary productivity of healthy lakes and compare them to 'at risk' and 'impacted' lakes to evaluate how salt effects lake health.

ENRTF Funds Requested: $651,000

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?

Region(s): Metro, Central, NW,

What is the best scale to describe the area impacted by your work?

Statewide

When will the work impact occur?

During the Project

Narrative

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

Recent research has shown that salt infiltrating into lakes can impact lake health, assessed by measuring chloride (Cl) concentration. Chloride a component in the ~400,000 tons of salt applied in the winter annually on Minnesota roads including sodium chloride (NaCl), calcium chloride (CaCl), and magnesium chloride (MgCl), as well as ~240,000 tons (annually) of the fertilizer potash – potassium chloride (KCl), and ~136,000 tons (annually) of NaCl used in domestic water softeners. Salt is transported in runoff to streams, rivers, and lakes, accumulating in the deep water - impacting lake health by inhibiting yearly turnover that brings oxygen to the deep water. Thus, anoxic (no oxygen) conditions in deep portions of lakes can make it uninhabitable for fish, and the insects on which they feed. While the Minnesota Pollution Control Agency (MPCA) works tirelessly monitoring Minnesota lakes, they don't have the resources to conduct an in-depth study on how salt in lakes impacts the microbial communities present – which are the key foundation of lake food webs. With a study that quantifies the impact of salt on the chemistry and microbiology of Minnesota lakes, we can better understand how continued salt inputs will impact lake health in the future.

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.

It is known that salt impacts lake health, but what is not fully understood is HOW. We propose to conduct a first of its kind in-depth chemical and microbiological study of 11 lakes in the Metro, Central, and Northwestern regions of Minnesota, focusing on characterizing healthy lakes, lakes that have been 'impacted' by salt, and lakes that are 'at risk' for salt impact (as defined by the MPCA). We will collect samples across all four seasons, analyzing the water and sediment chemistry as well as the microbial communities present. Furthermore, primary productivity by microbial communities will be measured at all lakes. With this comprehensive dataset, a full evaluation of the nutrients (like nitrogen and phosphorous) as well as the chemical makeup (including chloride concentration) for healthy versus 'at risk' and 'impacted' lakes can be compared to assess how the chemistry impacts the makeup and primary productivity of lake microbial communities – which are the foundation for lake ecosystems. This new knowledge will empower Minnesota stakeholders with better predictive capabilities for assessing impacts of salt on Minnesota lakes, which can help with guiding development of policies and best practices for reducing the impact of salt use on 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?

This project will provide a first of its kind comprehensive chemical and microbiological assessment of healthy, 'at risk', and 'impacted' Minnesota lakes with respect to salt input. Conservation, protection, preservation, and enhancement of Minnesota lakes, as with any natural resource, can only be fully realized with careful and in-depth study to allow evaluation of the impact of salt on lake health. With this information, Minnesota stakeholders can more accurately assess the effects of salt impact on lake health, better predict how lake health changes with increased salt, and explore and develop new strategies for mitigating salt impact.

Activities and Milestones

Activity 1: Collection and analysis of samples from 6 lakes (2 healthy, 2 'at risk', and 2 'impacted') in the Metro region.

Activity Budget: $216,121

Activity Description:
Objective: Assess the chemistry, microbiology, and primary productivity of lakes through sampling water and sediments and conducting primary productivity experiments to facilitate quantification and comparison of impact of salt on lake health in a high salt load region.

Tasks: Sample 2 healthy lakes (Square Lake and Lake Elmo), 2 'at risk' lakes (McCarrons and Medicine Lakes), and 2 'impacted' lakes (Gervais and Twin Lakes) across four seasons, collecting water and microbial samples. Conduct primary productivity experiments at each lake for each season. Collect lake sediment cores. Analyze chemistry of collected water, microbial biomass, and sediment samples. Extract DNA from microbial samples for microbial community composition sequencing.

Task Execution: PI Havig and Co-I Hamilton will leverage their combined 40+ years of experience to mentor, train, and assist the postdoctoral researcher in collection of samples, and in analytical and data processing techniques. Postdoctoral researcher and undergraduate workers will prepare equipment for fieldwork, process samples following collection.

Outcomes: A fully integrated dataset for 6 lakes in the Metro Region, with lake water chemistry, microbial community composition, microbial primary productivity, and sediment chemistry across four seasons. Fully developed and honed protocols for conducting the sampling and analytical work to produce equivalent datasets for lakes.

Activity Milestones:

Description	Approximate Completion Date
Collect samples from 6 metro lakes to assess summer water chemistry, microbiology, and primary productivity	August 31, 2026
Collect samples from 6 metro lakes to assess fall water chemistry, microbiology, and primary productivity	October 31, 2026
Collect samples from 6 metro lakes to assess winter water chemistry, microbiology, and primary productivity	February 28, 2027
Collect samples from 6 metro lakes to assess spring water chemistry, microbiology, and primary productivity	May 31, 2027
Assess and modify sampling and analysis protocols based on lessons learned from Y1 sampling	June 30, 2027
Prepare/process and analyze water, microbial, sediment, and primary productivity samples from 6 metro lakes	July 31, 2027

Activity 2: Collection and analysis of samples from 5 lakes (2 healthy, 1 naturally non-mixing, 2 'at risk') in Central/Northwestern regions

Activity Budget: $215,038

Activity Description:
Objective: Assess the chemistry, microbiology, and primary productivity of lakes through sampling water and sediments and conducting primary productivity experiments to facilitate quantification and comparison of impact of salt on lake health in a lower salt load region.

Tasks: Sample 2 healthy lakes (Lake Itasca and Big Trout Lake), 2 'at risk' lakes (Lake Bemidji and Perch Lake), and 1 naturally non-mixing lake (Deming Lake) across four seasons, collecting water and microbial samples. Conduct primary productivity experiments at each lake for each season. Collect lake sediment cores. Analyze chemistry of collected water, microbial biomass, and sediment samples. Extract DNA from microbial samples for microbial community composition sequencing.

Task Execution: PI Havig and Co-I Hamilton will guide and assist the postdoctoral researcher in planning and execution of sampling trips. Postdoctoral researcher and undergraduate workers will prepare equipment for fieldwork, and process samples collected. Itasca Biological Field Station personnel will facilitate and assist with collection of samples from Lake Itasca and Deming Lake.

Outcomes: A fully integrated dataset for 5 lakes in the Central/NW regions, with lake water chemistry, microbial community composition, microbial primary productivity, and sediment chemistry across four seasons. Updated sampling and analysis protocols.

Activity Milestones:

Description	Approximate Completion Date
Collect samples from 5 Central/NW region lakes for summer water chemistry, microbiology, primary productivity	August 31, 2027
Collect samples from 5 Central/NW region lakes for fall water chemistry, microbiology, primary productivity	October 31, 2027
Collect samples from 5 Central/NW region lakes for winter water chemistry, microbiology, primary productivity	February 28, 2028
Collect samples from 5 Central/NW region lakes for spring water chemistry, microbiology, primary productivity	May 31, 2028
Assess and modify sampling and analysis protocols based on lessons learned from Y2 sampling	June 30, 2028
Process/analyze water, microbial, sediment, and primary productivity samples from 5 Central/NW region lakes	July 31, 2028

Activity 3: Evaluate and compile analytical results, select subset for metagenomic analyses, process and evaluate metagenomic data, interpret and disseminate project results

Activity Budget: $219,841

Activity Description:
Objective: Evaluate analytical results, conduct metagenomic analyses of samples representing key microbial communities identified, and compile, integrate, and interpret analytical results from the project to fully characterize, assess, and evaluate the impact of salt on the health of lakes in Minnesota.

Tasks: Compile water, biomass, and sediment chemistry analytical results. Calculate primary productivity rates. Process and analyze DNA sequencing results. Select subset of microbial samples for metagenomic sequencing, and process and analyze results. Generate sampling, processing, and analysis protocols. Write a comprehensive scientific report to be given to Minnesota stakeholders. Write three manuscripts on Y1 results, Y2 results, and then integration of the complete dataset for submission to peer-review scientific journals.

Task execution: The postdoctoral researcher, with guidance from PI Havig and Co-I Hamilton, will lead the effort to select and analyze metagenomic samples with assistance from undergraduate workers, compile and integrate analytical results, write protocols, and prepare the comprehensive report and scientific journal article manuscripts.

Outcomes: The most comprehensive chemical and microbiological lake dataset ever generated for Minnesota lakes to date evaluating the impact of salt on lake health. A comprehensive scientific report on the protocols and results of the project for Minnesota stakeholders. Three peer review scientific journals.

Activity Milestones:

Description	Approximate Completion Date
Prepare manuscript from Y1 results to be submitted to a peer-reviewed scientific journal	October 31, 2027
Assess microbial results, select subset for metagenomic analyses, process and evaluate results	September 30, 2028
Compile/integrate water, microbial, and sediment chemical analytical, microbial sequencing, and primary productivity results	October 31, 2028
Prepare manuscript from Y2 results to be submitted to a peer-reviewed scientific journal	December 31, 2028
Prepare report detailing protocols developed, analytical results, and interpretations from project for Minnesota stakeholders	May 31, 2029
Prepare overview manuscript on project results to be submitted to a peer-reviewed scientific journal	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Trinity Hamilton	University of Minnesota	Primary expert in microbiology and genomic sample collection, analysis/analytical techniques, and interpretation. Hamilton will provide lab space and equipment necessary for completion of the sequencing component of the proposed work, mentor the postdoctoral researcher and undergraduate workers in microbial techniques, and assist in sample collection.	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?

Results of the proposed research will be compiled into a report to be provided Minnesota stakeholders involved with lake health management, and will be published in peer-reviewed journal articles to make the data and results readily available to government agencies as well as the greater research community. As this project will generate foundational science, we predict that the results of the proposed work will be invaluable for future research projects to build upon to further our understanding of the impact of salt on lake health, providing critical data to be used for developing new research/grant proposals.

Project Manager and Organization Qualifications

Project Manager Name: Jeff Havig

Job Title: Research Associate

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

Havig has successfully led multi-collaborator, multi-institution, and international research projects over a 26 year career as an aqueous geochemist and geobiologist, working with experts across multiple fields including microbiology, geology, limnology, ecology, environmental science, and chemistry. The results of Havig's work include 10 first author and 35 coauthored peer-reviewed scientific journal publications enhancing our understanding of fundamental water-rock-life interactions at locations that include lakes, hot springs, glaciers, and acid mine drainage sites. Havig's training includes a B.S. in Chemistry specializing in Environmental Chemistry, a M.S. in Geology specializing in Groundwater Studies, and a Ph.D. in Geological Sciences specializing in Aqueous Geochemistry. Havig has successfully led or participated in fieldwork involved with the research projects he has participated in, building a reputation for generating a safe and professional work environment where high quality samples are properly collected according to field leading best practices for analysis to generate high quality data. Havig's work highlights his ability to work with professionals across disciplines to integrate large and complex datasets in order to answer challenging questions. Havig has assisted in mentoring PhD and postdoctoral researchers at UMN and previous institutions he has worked at. Havig has experience with using a wide range of analytical techniques, including all of the geochemical and imaging techniques requested for this project submission. Havig's work experience includes the tools and techniques critical for completion of this proposed work, including a study characterizing the water chemistry of naturally meromictic Fayetteville Green Lake (NY) resulting in 4 peer-reviewed scientific journal papers (2 first author, 2 co-author), and a collaborative project with proposal Co-I Hamilton characterizing the water chemistry, sediment chemistry, and microbiology of lakes in Ohio and Indiana impacted by harmful algal blooms and invasive muscles resulting in a co-authored peer-review scientific journal paper.

Organization: U of MN - College of Biological Sciences

Organization Description:

PI Havig and Co-I Hamilton are affiliated with the Department of Plant and Microbial Biology, a unit within the College of Biological Sciences at the University of Minnesota, Twin Cities.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Research Associate		Project Leader			26.79%	0.51		$70,064
Professor		Leader of Microbiological Research, Postdoctoral Mentor			26.8%	0.24		$60,064
Postdoctoral Researcher		Primary sampling, analysis, data integration coordinator and manuscript writer			20.6%	3		$255,456
Undergrad		field sampling			0%	5.55		$61,440
							Sub Total	**$447,024**
Contracts and Services								
Quantitative Bio-element Imaging Center (QBIC) at Northwestern University	Service Contract	anion, cation, trace element analyses				0.04		$23,000
Stable Isotope Facility, University of California, Davis	Service Contract	water isotope, dissolved inorganic carbon, biomass and sediment C and N, sediment carbonate C analyses				0.04		$12,976
Jan Veizer Lab, University of Ottawa	Service Contract	dissolved organic carbon analyses				0.04		$12,000
University of Minnesota Genomics Center	Internal services or fees (uncommon)	DNA 16S and metagenomic sequencing				0.18		$80,000
							Sub Total	**$127,976**

Equipment, Tools, and Supplies								
	Tools and Supplies	Equipment and supplies include nucleic acid extraction kits, DNA quality reagents, a Hach portable spectrophotometer, probes for the Sonde and pH meters, filter pipette tips and lab consumables, probes and reagents for assessing water quality, tubes, bottles, chemicals for cleaning and preparing sampling bottles/equipment, and filters for collecting water and microbial samples.	Funds to support lab and field costs associated with sampling water and sediments and conducting primary productivity experiments in lakes.					$39,000
							Sub Total	**$39,000**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Funds in Years 1 and 2 of the project to support field sampling trips for Hamilton, Havig, the postdoc, and an undergraduate research assistant. Trips in Y1 will require rental vehicle and meals, Trips in Y2 will require vehicle rental, lodging, and meals. Lodging and meals for Y2 will include stays at the UMN Itasca Biological Field station at institutional rates. Vehicles will be rented and fueled through UMN motor pool at institutional rates.	Field sampling					$28,000
							Sub Total	**$28,000**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								

	Publication	publications	publish research result and findings					$9,000
							Sub Total	**$9,000**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$651,000**

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				
In-Kind	The University of Minnesota is not allowed to charge the State of Minnesota its typical overhead rate of 54% of the total modified direct costs. We are listing our unrecoverable indirect cost as in-kind contribution.	in-kind contribution of F&A	Secured	$351,540
			Non State Sub Total	**$351,540**
			Funds Total	**$351,540**

Total Project Cost: $1,002,540

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 85a2cadc-ec8.pdf

Alternate Text for Visual Component

Figure shows we don't understand how salt inputs into Minnesota waterways, including ~136,000 tons/yr (water softeners), ~240,000 tons/yr (fertilizer), and ~400,000 tons (road salt/brines), impacts lake health, with maps indicating the locations of the 11 lakes selected for sampling across Minnesota....

Supplemental Attachments

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

Title	File
Letter of Support - Minnesota Pollution Control Agency	8bbc38f9-358.pdf
UMN submission approval	7584075c-47b.pdf
Letter of Support - Itasca Biological Field Station	a22aded9-95d.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 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:

Dr. Trinity Hamilton (Co-Investigator, Dept. of Plant and Microbial Biology, University of Minnesota); Lori Nicol (CBS Financial Cluster Accountant, College of Biological Sciences, University of Minnesota)

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