Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-565

Proposal Title: Lake Impacts from Road Salt and Climate Change

Project Manager Information

Name: Andy Erickson

Organization: U of MN - St. Anthony Falls Laboratory

Office Telephone: (612) 239-2046

Email: eric0706@umn.edu

Project Basic Information

Project Summary: This project will develop a tool to assess the risk of lake habitat loss due to climate change and road salt usage that can be extrapolated to Minnesota Lakes statewide.

ENRTF Funds Requested: $516,000

Proposed Project Completion: June 30, 2029

LCCMR Funding Category: Fish and Wildlife (D)

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.

Some research has demonstrated the potential impact to lakes of temperature increase due to climate change, while other research has shown the potential impact of road salt on lake ecosystems. Road salt concentrations (i.e., chloride) in many lakes in developed areas like Powers Lake in Woodbury, have increased 3-fold since the early 2000's, raising concern about toxicity to aquatic life and reduction to lake mixing and ecology . In addition, the current criterion for listing lakes as chloride impaired is based on a minimum number of measurements above a certain concentration. This method is appropriate for acute toxicity but is less appropriate for chronic physiological stress and effects on mixing. Climate change-induced increases in average air temperature can elevate water temperatures near the lake's surface. Water temperature and salt concentration both change the density of water, causing cold salty water to be trapped at the bottom of a lake and prevent the lake from mixing. This research improves our understanding of the combined effects of climate change and increasing road salt levels on the amount of habitat for fish and other aquatic species in Minnesota lakes and will help inform how lakes are classified as impacted.

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.

This proposal focuses on developing and implementing methodologies to identify Minnesota lakes at risk of habitat loss, generating information products to communicate the level of risk, and describing options for practitioners to avoid and mitigate the effects of climate change and road salt. We plan to rank and map cold-water, cool-water, and warm-water lakes in Minnesota of a specific size (e.g., greater than 10 acres) by low, medium, or high risk based on the susceptibility of fish and aquatic life habitat degradation to combined impacts of climate change and increasing road salt levels . We can understand how chloride and rising water temperatures affect lakes by analyzing monitoring data provided by the MPCA (https://webapp.pca.state.mn.us/surface-water/search) and others and using one or more computer models (e.g., MINLAKE, GLM-AED). We can then develop predictive methods based on model results to categorize habitat risk, even for lakes that are less monitored (e.g., only one parameter) or not monitored. We will use the results to assess and describe the vulnerability of Minnesota Lakes to habitat loss due to climate change and road salt usage.

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?

The primary project outcome is the opportunity to develop more durable lake management strategies and projects to protect, conserve, preserve and enhance Minnesota's lakes. The outcomes include: 1) basic research to understand how both climate change and road salt use affect our lakes; 2) using the research results to categorize lake vulnerability to climate change and road salt use; and 3) creating information products for use by planning agencies and local governments to focus implementation efforts to achieve great public benefit. Informing decision-makers will result in better resource management through prioritized protection and mitigation efforts.

Activities and Milestones

Activity 1: Define Parameters for Classifying Fish and Aquatic Life Habitat Requirements in Cold-Water, Cool-Water and Warm-Water Lakes

Activity Budget: $21,289

Activity Description:
The activity's objective is to define the water temperature, dissolved oxygen, water clarity, and chloride requirements to classify risk of fish and aquatic life habitat degradation as 'low,' 'medium,' and 'high' risk for use in estimating the amount of healthy habitat for fish and other aquatic species (i.e., aquatic life) in Minnesota's cold-water, cool-water, and warm-water lakes (i.e., lake type). The temperature and oxygen habitat needs will be correlated with salt levels that impact aquatic life, using the acute and chronic water quality criteria for chloride specified in Minnesota's water quality regulations. We intend to examine the science supporting the chloride criteria to ensure they reflect the species found in each lake type. We can then define habitat as low, medium, or high risk using the requirements to estimate the quality and amount of aquatic habitat. The ranges in surface water temperature, dissolved oxygen, water clarity, and chloride concentrations that characterize low, medium, or high risk of habitat degradation in Minnesota's cold-water, cool-water, and warm-water lakes will be summarized in a table and used to categorize habitat quality.

Activity Milestones:

Description	Approximate Completion Date
Define Habitat Requirements for Cold-Water, Cool-Water and Warm-Water Lakes	February 28, 2027

Activity 2: Develop Groups of Each Lake Type (Cold-Water, Cool-Water and Warm-Water) and Analyze Water Quality Trends Including Chloride Levels

Activity Budget: $221,837

Activity Description:
The activity's objective is to identify and select specific Minnesota Lakes subject to changing chloride levels that can be used to create groups to represent each lake type (e.g., cold-water, cool-water and warm-water) based on prior research (e.g., Jacobson et al., 2016, A Fish Habitat Conservation Framework for Minnesota Lakes; Ladwig et al., 2021, Impact of salinization on lake stratification and spring mixing). We intend to divide each lake type into two subgroups (small and large) based on physical attributes such as watershed area and lake size, depth, and volume, because these will likely determine responses to climate and salinity changes. Urban, suburban, age of development, trends in land use change, and other watershed variables are likely important predictive variables. We plan to use MNDNR geographic information system data as a starting point to classify lakes. Our proposed work will build on previous work funded by LCCMR (e.g., M.L. 2022, Chp. 94, Sec. 2, Subd. 04l, Edlund 2022, Salt Threatens Minnesota Water Quality and Fisheries) to develop a tool that can be used to assess vulnerability to climate change and road salt usage that can be applied to other Minnesota Lakes.

Activity Milestones:

Description	Approximate Completion Date
Define Groups of Lakes in Study Geographic Area	March 31, 2027
Create Lake Classes Based on Morphometric & Drainage Area Characteristics	August 31, 2027
Analyze Lake Monitoring Data - Trends for Lake Classes	February 28, 2028

Activity 3: Develop Climate Change Scenarios – Assemble and Integrate Data Needed for Modeling Analysis

Activity Budget: $32,080

Activity Description:
The activity's objective is to develop climate change scenarios describing the amount of energy from the sun, air temperature, and precipitation, which can be compared to trends in chloride levels (from Activity 2), to characterize the effects of climate change and road salt usage on Minnesota Lakes. Two future climate change scenarios for the next 30 years can be defined by downloading and scaling the results of global climate change models for two distinct emissions predictions from the Minnesota Climate Mapping and Analysis Tool and comparing it to 30 years of historical climate. The likely changes in average air temperature and precipitation depth brought on by the rise in greenhouse gases are reflected in each scenario. The lake model (see Activity 4) uses daily average solar radiation, wind speed, and air temperature. We can downscale the monthly averages to daily averages using typical climate patterns. Three climatic scenarios—one for the historic climate and two for the future— will be compared to chloride trends and used to complete our analyses.

Activity Milestones:

Description	Approximate Completion Date
Confirm Analysis Time Frame For Scenarios	October 31, 2026
Define Scenarios for Climate Change and Road Salt Usage	January 31, 2028
Extract and Downscale Climate Change Data	February 28, 2028

Activity 4: Describe Impacts of Climate Change and Increasing Chloride Levels on the Amount of Habitat in Cold-Water, Cool-Water and Lake Mixing

Activity Budget: $168,468

Activity Description:
The activity's objective is describing the combined effects of climate change and changing chloride levels for each lake type and size subclass. A literature review will identify model tools, methods, and data sources. We can assess the effects by simulating the parameters describing habitat quality (see Activity 1) for each lake type and subgroup and scenario. The model will be informed by the physical, chemical and biological characteristics of the lakes within each type and subgroup will be described by completing statistical analyses and trend analyses. MINLAKE is an example of a model that can simulate water temperature, how deep and often lakes mix, water clarity, and dissolved oxygen and chloride concentrations. The Generalized Lake Model with Aquatic EcoDynamics (GLM-AED) is another model that has the advantage of also simulating ecological & biogeochemical parameters (e.g., duration of hypoxia). We plan to develop and calibrate a model for each lake type and subgroup and then simulate a total of 6 scenarios representing simultaneous changes in climate and chloride levels. Using the model results we can compare the volumes of low, medium, or high aquatic habitat degradation for each scenario for each lake type and subgroup.

Activity Milestones:

Description	Approximate Completion Date
Develop Input Data for Model (current condition and 4 scenarios)	April 30, 2028
Check & Confirm Model Version & Accuracy	May 31, 2028
Run Model; Analyze and Summarize Results	January 31, 2029
Complete Sensitivity Analysis	March 31, 2029

Activity 5: Describe Strategies to Mitigate Impacts, Inform Practitioners and Complete Report

Activity Budget: $72,326

Activity Description:

The activity's goal is to establish solutions for mitigating habitat loss and then communicate the study findings and strategies to Resource Managers and transportation authorities to reduce future lake impacts, utilizing SAFL's existing Stormwater Education Program. We will create communication products and propose remedies to improve or protect critical habitat. Remedies can be focused on the most vulnerable lakes and may include using alternative deicing agents, strategic use of salt to reduce use, installing stormwater facilities and using methods to increase oxygen levels. We can advise Resource Managers and transportation authorities about the particular chloride levels that will cause habitat loss as climate changes, as well as strategies for mitigating the impacts. Resource Managers can utilize maps to prioritize lake conservation and restoration measures based on the vulnerability of cold-water, cool-water, and warm-water lakes to habitat loss caused by the combined effects of climate change and road salt use. The findings summarized in the final report can be used to draft and submit peer-reviewed papers.

Activity Milestones:

Description	Approximate Completion Date
Describe Road Salt Use Implications and Develop Mitigation Recommendations	March 31, 2029
Prepare Report Including Recommendations	May 31, 2029
Conduct Workshop for Road Salt Authorities Describing Results & Impact Mitigation	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Gaston Small	University of St. Thomas	Gaston Small is a lake modeling and ecology expert and will contribute expertise to the project and advise on the use of the GLM-AED model.	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 can be implemented using current local, state, and federal watershed planning (e.g., One Watershed, One Plan), resource management planning processes, and project implementation processes. We want to generate maps and other geospatial products in standard formats, which will then be advertised, hosted, and distributed to practitioners. One example dissemination route is MNIT through the MN Geospatial Commons. Public transportation agencies such as MnDOT, counties, and municipalities can use the research findings to identify lake basins where reducing road salt sources can maintain and improve lake water quality as well as aquatic habitat.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Removing CECs from Stormwater with Biofiltration	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 04j	$641,000

Project Manager and Organization Qualifications

Project Manager Name: Andy Erickson

Job Title: Research Manager

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

Dr. Andy Erickson is a researcher and engineer at the University of Minnesota's St. Anthony Falls Laboratory. He studies water quality in urban watersheds, develops stormwater assessment and maintenance best practices, and designs innovative stormwater treatment technologies. In leadership roles, Andy is co-director of the Cold Climate Center of Excellence for Stormwater Infrastructure Technologies, the Chair of the ASTM International E64 Committee on Stormwater Control Measures, and the Chair for the University of Minnesota's Water Council. As a research manager, Dr. Erickson is the principal investigator and leads a team of senior research fellows, research scientists, graduate students, and undergraduates to complete numerous research projects. Dr. Erickson also serves on the St. Anthony Falls Lab Executive Committee, as a Fellow at the University of Minnesota's Institute on the Environment, and as a scholar for the Center for Transportation Studies. He is a member of the Civil, Environmental, and Geo-Engineering Graduate Faculty, Water Resources Science Graduate Faculty, and a member of the Environment and Energy in Transportation Research Council. Dr. Erickson is dedicated to outreach through frequent presentations, workshops, and hosting the popular Minnesota Stormwater Seminar Series. In addition to numerous scientific reports and peer-reviewed publications, he is the editor of the University of Minnesota stormwater newsletter "UPDATES," and author of "Optimizing Stormwater Treatment Practices: A Handbook of Assessment and Maintenance."

Organization: U of MN - St. Anthony Falls Laboratory

Organization Description:

The St. Anthony Falls Laboratory (SAFL) is an interdisciplinary fluid mechanics research lab and educational facility under the College of Science and Engineering at the University of Minnesota. We are engineers and scientists who collaborate

across disciplines to solve fluids-related problems in the Earth-surface environment. Our vision encompasses both science and practice, beginning with basic research and moving through application, decision-making, and management. SAFL integrates cutting-edge experimental work at laboratory and field scales with advanced computational tools and theory to obtain innovative, science-based solutions to fluid-flow challenges. Located on Hennepin Island in the Mississippi River in the heart of Minneapolis, SAFL serves as a resource for departments across the Twin Cities campus, the statewide University system, and the broader research community. We partner with local, state and federal agencies; private consulting firms; businesses of many kinds; technical associations; and other educational institutions to expand knowledge and solve problems.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Andy Erickson, Principal Investigator		Project Manager; responsible for all deliverables			27%	0.3		$50,951
Jacques Finlay, co-Principal Investigator		Limnologist, aquatic ecologist and nutrient dynamics expert. Will advise on all tasks and deliverables.			27%	0.12		$32,140
William Herb		Lake modeling and trend analysis expert; will advise on all model and data analysis tasks.			27%	0.3		$37,307
Mark Deutschman, co-Principle Investigator		Lake modeling, nutrient dynamics, and ecosystems expert. Will advise on all tasks and deliverables.			7%	0.75		$128,015
Post Doctoral Scholar		Literature review, data management, modeling, writing, and communicating on all tasks and deliverables.			21%	3		$244,531
							Sub Total	**$492,944**
Contracts and Services								
University of St. Thomas (Gaston Small)	Service Contract	Gaston Small is a lake modeling and ecology expert and will contribute expertise to the project and advise on the use of the GLM-AED model.				0.12		$19,445
							Sub Total	**$19,445**
Equipment, Tools, and Supplies								
	Tools and Supplies	Interim report printing and supplies, software for computer modeling.	Printing as necessary to complete the tasks; software fees to ensure functional computer modelling.					$767
							Sub Total	**$767**

Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Conference Registration Miles/ Meals/ Lodging	Registration ($400) and Parking ($30/day x2 days = $60) = $460 per person x 2 attendees = $920 in Year 1. Assuming 3% increase in fees per year; total = $948 in Yr 2 & $976 in Yr 3. Total for three years = $2844.	Registration and parking for two people to attend both days of the MN Water Resources Conference (October 2026, October 2027, and October 2028), specifically to present on the results of the project and expand its reach.					$2,844
							Sub Total	**$2,844**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$516,000**

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				
			Non State Sub Total	**-**
			Funds Total	**-**

Total Project Cost: $516,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 96a2d526-74a.docx

Alternate Text for Visual Component

Visual depiction of lakes that are unimpacted by temperature and road salt increase (mixed) compared to lakes that are impacted by temperature and road salt increase (unmixed)....

Supplemental Attachments

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

Title	File
Sponsored Projects Administration Approval to Submit	3690b5e6-5e8.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?

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:

Andy Erickson, U of M; Mark Deutschman, U of M; Jacques Finlay, U of M, William Herb, U of M; Gaston Small, University of St. Thomas; Angela Boutch, U of M; Victoria Troxler, U of M.

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