Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-465

Proposal Title: Managing Climate using Inverse Modeling: Central Sands Aquifer

Project Manager Information

Name: Kerry Holmberg

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Office Telephone: (651) 429-3127

Email: holmberg@umn.edu

Project Basic Information

Project Summary: Past climate can be estimated using lake-bed coring. SWAT and MODFLOW Models have been developed with ENRTF. Engage tribes, industry & local government using inverse modeling to seek win-win solutions.

ENRTF Funds Requested: $884,000

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): Central

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

Region(s): Central

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.

Minnesota has seen enormous growth in irrigated agriculture in its Central Sands region, with little attention paid to aggregate water quality and quantity impacts to groundwater and surface water. New data has been gathered to illustrate unsustainable land use change coupled with a changing climate. Excessive nutrients, loss of habitat, increased invasive species, along with the loss of diverse landscape perennial plants have led to a loss of ecosystem resiliency.
In 2021, summer drought impacted indigenous and local communities with water levels dropping, along with an influx of private well interference complaints. Beginning in 2023, both surface and groundwater models have been developed by the UMN. These models were built with ENRTF. The models will be ready for use in stakeholder meetings to not only engage tribal communities and the Irrigators Association of MN (IAM) but help forge water protection strategies and ultimately water policy for irrigated agriculture in Minnesota's Central Sands given a changing climate.
With uncertainty about both wet and dry conditions going forward, we believe lake coring will provide a window to the future by dissection of past centuries of climate. We believe now is the time to engage all to find a win-win long-term land-use.

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.

Previous project monitoring and modeling show the impact of long-term changes in human groundwater consumption in the critical Central Sands zones including patterns and pathways of water and chemical flow and solute/chemical loading to surface water resources. The calibrated regional models now make it possible for future scenario-based simulations that can be communicated to help government and citizens plan a sustainable irrigation policy and plan.
Lake cores make it possible to estimate the range of flood and drought conditions over the past 10,000 years. This information will be integrated into zone and regional scenarios. The White Earth Nation will lead this effort and the UMN team will develop modeling outputs and lead stakeholder events to help non-scientific stakeholders understand how to plan for a resilient landscape given a changing climate.

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?

Collect and analyze critical lake core samples for past climate evidence.
Gather hydrologic and water quality data from established locations to improve model calibration.
Integrate lake core data into ground and surface water models, updating calibrations with new information.
Develop sustainable land use scenarios.
Share modeling results with MNDNR, MNDA, and MPCA for irrigation permitting and impaired waters evaluation.
Host 3 stakeholder meetings in 2027-2028 to educate and engage native and nonnative local communities, farmers, IAM, and NGOs on inverse modeling PEST+++-driven land management options.
Ensure informed decision-making by providing critical data for sustainable resource management.

Activities and Milestones

Activity 1: Conduct Lake Coring

Activity Budget: $244,360

Activity Description:
How have land use changes (specifically conversion of land to agriculture and use of surface- and groundwater for irrigation) affected hydrology and the environmental conditions for wild rice health from pre-1850s to the present? What were environmental conditions around and before 1850, immediately prior to the signing of the 1855 Treaty of Washington in which the lands were ceded, and how have those conditions changed as land use has changed in the time since then? To answer these questions, we will estimate sediment accumulation rates (lead-210), sediment composition (LOI), wild rice presence (sediment DNA - specific primer), and hydrology (oxygen stable isotopes of chironomid/midge head capsules).

Activity Milestones:

Description	Approximate Completion Date
Select lakes for historic climate coring	November 30, 2026
Collect data, and send material to labs	January 31, 2027
Analyze data and prepare a report	December 31, 2027

Activity 2: Data gathering, integration and inverse modeling

Activity Budget: $492,602

Activity Description:
Continue gathering flow, stage and chemical samples from 10-15 river sites, lakes, and groundwater wells. Integrate the new data into existing models. Then conduct inverse modeling to run scenarios assessing changes in ground and surface water quantity, patterns and pathways of water and chemical flow and solute/chemical loading to surface and groundwater resources. The inverse modeling will take a given output from a given location and work in reverse to estimate the land use management associated with the surface and groundwater conditions shown by the model

Activity Milestones:

Description	Approximate Completion Date
Data collection, analysis, integration	January 31, 2028
Develop inverse modeling runs	May 31, 2028
After stakeholder input prepare a report	June 30, 2029

Activity 3: Stakeholder communication

Activity Budget: $147,038

Activity Description:
In concert with the Minnesota Departments of Natural Resources, Agriculture, Pollution Control Agency and the White Earth Nation Department of Natural Resources, share and discuss inverse modeling outputs. Then beginning in December 2027, host 3 public stakeholder meetings that include citizens, industry groups and NGOs.

Activity Milestones:

Description	Approximate Completion Date
Meet with Minnesota state agencies and White Earth Nation August 2027 through December 31, 2027	December 31, 2027
Hold 3 public stakeholder meeting in northwestern Minnesota December 2027 through May 30, 2028	May 31, 2028
Prepare the project final report	June 30, 2029

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dustin Roy Team	White Earth Nation	Tribal data collection, Treaty Rights and Indian Law (Activity 2 and 3)	Yes
Amy Myrbo	Amible Consulting	Lead the lake coring collect, analyses, and data interpretation (Activity 1)	Yes
Professor John Nieber	Department of Bioproducts and Biosystems Engineering, University of Minnesota	Provide guidance on the inverse modeling of groundwater and surface water with post doc (Activity 2)	Yes
Research Professor Joe Magner	Department of Bioproducts & Biosystems Engineering. University of Minnesota	Provide advice to field technicians and to graduate students on the setup of data acquisition systems and provide advice on the analysis of the data acquired during the project period. (Activity 2 and 3)	Yes
Della Young	YECG	Provide detailed project management and co-lead stakeholder meetings with tribal, state, industry and NGOs (Activity 3)	Yes
Kerry Holmberg	Department of Bioproducts & Biosystems Engineering. University of Minnesota	Overall Project Management and coordinator.	Yes
Post Doctoral (TBD)	Department of Bioproducts & Biosystems Engineering. University of Minnesota	Specialized modeling expert who will perform the inverse modeling to develop future land use scenarios. (Activity 2)	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?

Once data and modeling outputs are made publicly available and shared with native and non-native government officials, they can be integrated into existing permitting policies/assessments, proposed policy reforms and future scientific research as needed. The inverse model outputs will also be available for use in other Central Sands locations to better predict impacts to individual water resource areas for specific locations.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Protecting Minnesota's Headwaters of the Mississippi/Pineland Sands	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 04m	$1,693,000

Project Manager and Organization Qualifications

Project Manager Name: Kerry Holmberg

Job Title: Reseacher

Provide description of the project manager's qualifications to manage the proposed project.
Ms. Holmberg has over 25 years of experience in water resources research. For the past 10 years, she has collaborated with Joe Magner and John Nieber on five different ENRTF projects. Her extensive research background has equipped her with the skills needed to help plan, implement, and complete complex research projects.
She currently plays a critical role in the ENRTF project Protecting Minnesota's Headwaters of the Mississippi/Pineland Sands, where her responsibilities include:

- Coordinating with project partners and collaborators to ensure tasks are completed effectively.
- Researching and developing methods to achieve project objectives within budget.
- Managing worker schedules, resource allocation, and task execution.
- Overseeing laboratory equipment use and functionality.
- Supervising data collection, compilation, and analysis.
- Contributing to data interpretation, report writing, and project documentation.
- Presenting findings at professional conferences.

Ms. Holmberg's extensive experience with ENRTF projects, along with her deep involvement in the predecessor project, makes her an outstanding candidate for the proposed initiative.

Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences

Organization Description:
The Department of Bioproducts and Biosystems Engineering (BBE) is jointly affiliated with the University of Minnesota College of Science and Engineering and the College of Food, Agricultural and Natural Resource Sciences. BBE brings together science, engineering, business and technology to prepare students to solve real-world problems. Our graduates enter the workforce with an understanding of the interconnected systems that impact everything from renewable energy to food security and environmental protection so they can advance and engineer a more sustainable future.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Project Manager Kerry Holmberg - FTE dependent on grant funding		Overall Project management			32.3%	1.5		$144,545
Postdoc		Build inverse model and scenarios			25.9%	3		$246,960
Co-PI's Nieber and Magner		Guide postdoc & lead Stakeholders			36.6%	0.33		$85,281
Undergrad students		Sample/data collection			0%	0.09		$3,000
Technician		conduct specific experiments			7.4%	0.18		$11,814
							Sub Total	**$491,600**
Contracts and Services								
Amiable Consulting	Service Contract	lake coring collect, analyses, and data interpretation				0.75		$180,000
Della Young YEC G	Subaward	Provide detailed project management and co-lead stakeholder meetings with tribal, state, industry and NGOs				0.3		$70,000
White Earth Nation Trib al	Subaward	data collection, Treaty Rights and Indian Law				0.3		$40,000
tbd	Service Contract	lab analysis of lake cores				-		$64,360
							Sub Total	**$354,360**
Equipment, Tools, and Supplies								

	Tools and Supplies	Lab and Field Supplies; major cations and anions, experiment supplies, gloves, cleaners, etc	Lab work, Materials and supplies for setting up and maintaining field data systems					$6,040
							Sub Total	**$6,040**
Capital Expenditures								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Miles/ Meals/ Lodging & stakeholder rentals MN conferences ~250 miles/12 trips/year for 3 years at $0.70/mile; 35 nights/year @ $110/night with 70 travel days @$51 per diem; 25 days meals/year @ $45/day	To travel to field sites for collection of data & meetings with partners, & stakeholders					$32,000
							Sub Total	**$32,000**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$884,000**

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: $884,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 7ad9ca31-e49.pdf

Alternate Text for Visual Component

Map of the Study Area...

Supplemental Attachments

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

Title	File
Letter of Authorization to Submit	af8fae97-149.pdf
Audit	579307a1-125.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:

Dr. Joe Magner and Wendy Moylan UMN Department of Bioproducts and Biosystems 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