



Environment and Natural Resources Trust Fund

2025 Request for Proposal

General Information

Proposal ID: 2025-193

Proposal Title: Healthy Native Prairie Microbiomes for Cleaner Water

Project Manager Information

Name: Brett Barney

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

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Project Basic Information

Project Summary: We will characterize and identify important microbes of the prairie microbiome that provide fixed-nitrogen through natural processes, and apply these to replace industrial fertilizers and prevent water contamination from nitrates.

ENRTF Funds Requested: \$508,000

Proposed Project Completion: June 30, 2028

LCCMR Funding Category: Water Resources (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?

During the Project and In the Future

Narrative

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

Native prairies represent an underappreciated legacy and resource that is relatively undisturbed as a result of the various conservationists across Minnesota who value and bring attention to these important ecosystems. These natural prairie biomes are able to support abundant plant and animal life without requiring industrial fertilizers. This is in contrast to modern agricultural processes for food and energy crops, where the targeted application of industrial nitrogen fertilizer has resulted in increased crop yields, while often overlooking the potential of native nitrogen-fixing microbes. Recent studies have uncovered many novel microbes from understudied plant microbiomes that enable other important plants to thrive without the requirements, impacts and related costs associated with application of industrial fertilizers. Additionally, these native prairies are often threatened by urban encroachment and a desire to repurpose lands for agriculture or the extraction of other natural resources. Our project will study a selection of pristine native prairie ecosystems with the assistance of important stakeholders with an established interest in the preservation of these sites. Through their guidance, we will sample and characterize the prairie microbiomes to identify important microbes that provide essential nutrients. We will then establish permanent stocks of these microbes to secure and meet future needs.

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.

The primary influx of nitrates and phosphates into ground and surface waters in Minnesota results from unintentional runoff from fertilizer application associated with agriculture. This loss of fertilizer results in both contaminated water systems and also represents an economic loss to farmers, who may be forced to reapply fertilizer to compensate for these losses, further compounding the problem. Native prairies in Minnesota are able to thrive without the requirement of external fertilizer inputs as a result of established beneficial partnerships between plants and the microbes that contribute to a healthy microbiome. The plant microbiomes from select prairies can be sampled with minimal disturbance to the environment when done through the auspices of suitable land stewards. In addition to characterizing important relationships for understudied plant species, this project will also allow us to identify novel strains and preserve stocks of important soil microbes. The proposed beneficial outcomes of this project would be twofold. First, we will characterize and report the core microbes that constitute healthy prairie plant microbiomes from Minnesota. Second, key microbes that sustain the nutrient requirements of the prairie microbiome will also be tested with various agricultural crops to determine if the benefits of these microbes can be expanded.

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?

We will generate important microbiome characteristics associated with beneficial microbes from Minnesota Native Prairies that contribute to a healthy ecosystem. We will further isolate important contributing microbes and deposit these microbes in managed strain collections in addition to maintaining our own strain collection. We will also study and characterize the nature of the beneficial association between these beneficial microbes and various plant species to develop a clearer picture of why specific microbes are beneficial and investigate the potential to further improve plant growth by providing microbes as part of the initial seed inoculum.

Activities and Milestones

Activity 1: Characterize Native Prairie Plant Microbiomes from Selected Sites across Minnesota

Activity Budget: \$280,000

Activity Description:

We will work with the Minnesota Driftless Chapter of the Prairie Enthusiasts and representatives from the Minnesota Division of Natural Resources who manage the Native Prairie Bank (NPB) easement sites to select and sample preserved and representative native prairie ecosystem sites across the state of Minnesota. Care will be taken to sample in a manner that does not significantly disrupt or harm these sites, by working under the careful supervision of specific stakeholders. We will sample the plant root rhizosphere (soils in immediate contact with roots) and the microbial diversity that makes up the root (surface and internal) microbiomes from key plants to identify the microbial composition for healthy native prairie sites. We will also enrich microbes that specifically fix nitrogen using natural processes to build a potential database and stock collection of these specific microbial contributors. Our goal will be to characterize the plant microbiomes of approximately twenty geographically diverse prairies sites across Minnesota to establish baseline data for these often overlooked and understudied ecosystems. The culminating results of these studies will be broadly shared through peer-reviewed scientific papers and through our outreach with various stakeholders and educators.

Activity Milestones:

Description	Approximate Completion Date
Identify and select initial native prairies sites across Minnesota for pilot studies.	August 31, 2025
Apply modern community genomic sequencing techniques to characterize the plant microbiomes of five initial sites.	December 31, 2025
Enrich specific microbes that contribute nitrogen in healthy prairie ecosystems and prepare for long-term storage.	March 31, 2026
Expand initial community genomic studies to an additional fifteen sites for a comprehensive sample set.	August 31, 2026
Develop educational resources related to our project effort to share with educators.	March 31, 2028
Prepare manuscripts characterizing the native prairie ecosystems of Minnesota for publication in peer-reviewed scientific journals.	April 30, 2028

Activity 2: Study the Potential of Beneficial Microbes from Native Prairies to Minimize Industrial Fertilizer Requirements in Additional Minnesota Plant Systems

Activity Budget: \$228,000

Activity Description:

In addition to sampling the plant microbiomes associated with native prairies, we will also work with specific stakeholders to identify key agricultural crops with high-nitrogen requirements that represent ideal targets for improved plant growth through applications of natural nitrogen-fixing microbes. The microbiomes of several key agricultural crops from across Minnesota will also be collected, compared and contrasted with what we find for the microbiomes in our native prairies. Microbes with ideal characteristics will be further sequenced to better understand the beneficial nature of the associations with these plants, and specific microbes will be selected for greenhouse and field studies to determine the potential to lower industrial nitrogen fertilizer requirements. Because these microbes will be fixing nitrogen either within the plant tissues or in the direct vicinity of the plant root system, fixed nitrogen will be delivered directly to these plants. This will result in a lower requirement for applied industrial fertilizer, and assure that less nitrogen results in nitrates that contaminate groundwater and rainwater runoff. This aspect of our study also has the

potential to lower the economic burdens and costs to both farmers and consumers to support a sustainable food and bioenergy system.

Activity Milestones:

Description	Approximate Completion Date
Identify and select specific crops across Minnesota for application of prairie microbiome microbes.	August 31, 2025
Identify specific microbes with demonstrable benefits for selected crop targets.	September 30, 2027
Scale cultures for potential greenhouse and field plot demonstration within Minnesota.	January 31, 2028
Publish results of studies as a potential tool and education component for Minnesota farmers.	June 30, 2028

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Neil Olszewski	University of Minnesota	co-PI	Yes
Devanshi Khokhani	University of Minnesota	co-PI	Yes
Gabe Ericksen	Minnesota Driftless Chapter of The Prairie Enthusiasts	Chapter Chair	No

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 will seek further funding through additional state and federal funding sources including the United States Department of Agriculture, the United States Environmental Protection Agency and the National Science Foundation.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Transformation of Plastic Waste into Valued Resource	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 04j	\$225,000

Project Manager and Organization Qualifications

Project Manager Name: Brett Barney

Job Title: Professor

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

Dr. Brett Barney (Project Manager) received his PhD in 2003. Prior to his PhD work, he spent six years in the medical device manufacturing sector. Following his PhD, he spent six years as a postdoctoral fellow and project manager. He has been a professor with the Department of Bioproducts and Biosystems Engineering and a member of the Biotechnology Institute at the University of Minnesota since 2009. He was the Director of the Microbial and Plant Genomics Institute from 2020 to 2022. The Bioproducts and Biosystems Engineering Department serves as a core department combining Agricultural Engineering, Biological Engineering and Environmental and Ecological Engineering. The University of Minnesota provides a range of facilities and sufficient laboratory space to perform each of the activities described in this proposal. Additionally, controlled environments including greenhouse space sufficient for this work is conveniently located in close proximity to Dr. Barney's laboratory space.

Dr. Barney's laboratory is focused on minimizing the environmental impacts associated with biofuels and agriculture, and finding innovative methods to remove contaminants from water and wastewater. Dr. Barney has 30 years of experience in both basic and applied research in both academia and industry, including experience managing projects and laboratories in a range of settings. Previous research funding has come from the National Science Foundation (NSF), the United States Department of Agriculture (USDA), the United States Department of Energy (DOE), the Defense Advanced Research Projects Agency (DARPA), the Legislative-Citizen Commission on Minnesota Resources (LCCMR),

Minnesota's Discover, Research and Innovation Economy (MnDRIVE) and the Initiative for Renewable Energy and the Environment (IREE).

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

Organization Description:

In the College of Food, Agricultural and Natural Resources Sciences (CFANS) at the University of Minnesota, we look at the bigger picture. When we envision a better tomorrow, it includes disease-resistant crops, products that protect our health, lakes free from invasive species, and so much more. We use science to find answers to Minnesota and the world's grand challenges and solve tomorrow's problems. Almost 93 percent of students who earn CFANS undergraduate degrees find jobs in their career field or enter graduate school within six months of graduation.

The Department of Bioproducts and Biosystems Engineering, in CFANS, discovers and teaches solutions for the sustainable use of renewable resources and the enhancement of the environment. We discover innovative solutions to address challenges in the sustainable production and consumption of food, feed, fiber, materials, and chemicals by integrating engineering, science, technology, and management into all degree programs.

We have a public impact through community engagement and extension efforts. We develop and deliver high quality, regionally and nationally-recognized research-based programs to meet current and emerging needs of industry and communities. We also have a long-standing tradition of close partnerships with alumni, industry professionals, organizations, government agencies,

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Lead Principal Investigator		Oversee all aspects of project, supervise students and researchers, plan monthly meeting with entire research group and quarterly meetings with broader group of stakeholders. These funds represent partial summer support for the lead Principal Investigator.			37.1%	0.12		\$26,000
Graduate Student Research Assistant		Conduct laboratory and field experiments, train and educate undergraduate students in field and laboratory research. Write research papers related to project finding and share results with the broader research community through presentations. These funds represent support throughout the duration of the grant period of one graduate student.			45.8%	3		\$174,000
Undergraduate Research Assistants (2-3)		Collect data, assist graduate students and learn about laboratory and field research. These funds represent summer support and part-time support during the academic year for two or three undergrads throughout the duration of the grant period.			0%	2.01		\$64,000
Co-Principal Investigator		Oversee experiments and analysis associated with plant and microbe interactions. Supervise Graduate Students and Post-Doctoral Research Associates. These funds represent partial summer support for the Co-Principal Investigator.			37.1%	0.06		\$15,000
Co-Principal Investigator		Contribute expertise and oversee aspects of the research associated with beneficial fungi that support the plant microbiome. Supervise Graduate Students and Post-Doctoral Research Associates. These funds represent partial summer support for the Co-Principal Investigator.			37.1%	0.12		\$22,000
Post-Doctoral Associate		Design and supervise experiments, manage undergraduate students, work with stakeholders and act as point person to manage experiments and assure that routine experimental procedures are properly performed. Assist with completion of			27.1%	2		\$150,000

		project reports and lead efforts to complete peer-reviewed research papers related to the project. These funds represent full-time support for on post-doctoral associate for two years of the grant period.						
							Sub Total	\$451,000
Contracts and Services								
							Sub Total	-
Equipment, Tools, and Supplies								
	Tools and Supplies	Lab Supplies	Laboratory Supplies: General Laboratory Chemicals, Media, Reagents and Safety Materials for students, including gloves (\$200 per month) and Kits for Performing Routine Molecular Biology (\$200 per kit), Analytical Reagents (\$300 per month), Liquid Nitrogen for Strain Storage (\$400 per year).					\$36,000
	Tools and Supplies	DNA Sequencing Costs	External costs to contract laboratories to perform sequencing runs to identify microbiomes and specific microbes. Anticipating two runs per year, \$3000 per run, for all three years. Projections are based on historical costs for similar projects.					\$18,000
							Sub Total	\$54,000
Capital Expenditures								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								

	Other	Travel to various sampling sites to meet with stakeholders and collect prairie microbiome samples. Approximately three day trips per year, with a combined travel of under 200 miles per trip, including two or more persons.	Collect prairie microbiome samples during the duration of the grant					\$3,000
							Sub Total	\$3,000
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
							Sub Total	-
							Grand Total	\$508,000

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				
			Non State Sub Total	-
			Funds Total	-

Total Project Cost: \$508,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [f28021b3-aff.pdf](#)

Alternate Text for Visual Component

Graphic showing Native Prairie Plants and Agricultural Crops, and how what is learned from our studies could be applied to Agricultural Crops while also benefiting our understanding of what is required to maintain healthy Native Prairie Ecosystems....

Supplemental Attachments

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

Title	File
Letter of Authorization to Approve	6c62974c-2f0.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?

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:

None