



Environment and Natural Resources Trust Fund

M.L. 2025 Approved Work Plan

General Information

ID Number: 2025-193

Staff Lead: Noah Fribley

Date this document submitted to LCCMR: June 4, 2025

Project Title: Healthy Native Prairie Microbiomes for Cleaner Water

Project Budget: \$468,000

Project Manager Information

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Project Reporting

Date Work Plan Approved by LCCMR: June 24, 2025

Reporting Schedule: March 1 / September 1 of each year.

Project Completion: June 30, 2028

Final Report Due Date: August 14, 2028

Legal Information

Legal Citation: M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 04q

Appropriation Language: \$468,000 the first year is from the trust fund to the Board of Regents of the University of Minnesota to identify and characterize prairie plant microbiomes and study the potential of native prairie microbes to provide nitrogen for agricultural crops and reduce industrial fertilizer use and nitrate contamination of water.

Appropriation End Date: June 30, 2028

Narrative

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.

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.

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

Activities and Milestones

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

Activity Budget: \$258,000

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: \$210,000

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

Dissemination

Describe your plans for dissemination, presentation, documentation, or sharing of data, results, samples, physical collections, and other products and how they will follow ENRTF Acknowledgement Requirements and Guidelines.

We have multiple audiences that will benefit from this work. As this project has a basic research component, we will be publishing reports that will be peer-reviewed and published in open-access journals to provide a comprehensive report to the broader research community. This information can be used by microbiologists, plant scientists and ecologists to better understand how to manage our native prairies in the future. We aim to identify new microbial associations that are important to maintaining a healthy prairie ecosystem, and potentially apply these microbes to other applications, where they can benefit agriculture from an economic standpoint, but also benefit the general public by lowering the amounts of nitrogen that are applied in agricultural settings.

Our other audience is the general public. We will be maintaining a website associated with this project, and will be presenting the findings of this project to both the scientific community, and also to the citizens of Minnesota, by presenting our research work to various organizations. We will also be working to expand our efforts with specific stakeholders that have an interest in maintaining Minnesota's native prairies.

The Environmental and Natural Resources Trust Fund will be acknowledged through attribution in the acknowledgements section of any peer reviewed research. The use of the trust fund logo will be used in any presentation or electronic media, publications and signage as detailed in the ENRTF Acknowledgement Guidelines.

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

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		\$24,000
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		\$160,000
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		\$55,000
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		\$14,000
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		\$20,000
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		\$138,000

		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	\$411,000
Contracts and Services								
DNA Sequencing Laboratory Services (Internal and External)	Service Contract	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.				0		\$18,000
							Sub Total	\$18,000
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
							Sub Total	\$36,000
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	\$468,000

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: \$468,000

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
2025-193 Research Addendum revised_Final	9b6f6d2e-e02.docx

Difference between Proposal and Work Plan

Describe changes from Proposal to Work Plan Stage

We made some minor changes to the budget to accommodate the lowered recommended amount of funding that was approved. We still believe we can address most of the goals of this project with the slight cut to our budget. We also moved DNA sequencing services from laboratory supplies to laboratory services. Finally, we added the required statement acknowledging ENRTF funding under dissemination. We did not make any substantial changes to the work plan based on the reviews. We did make some minor changes to the peer-reviewed document, which will be used as a roadmap as we address our research aims. We believe we have addressed all the requested changes.

Additional Acknowledgements and Conditions:

The following are acknowledgements and conditions beyond those already included in the above workplan:

Do you understand and acknowledge the ENRTF repayment requirements if the use of capital equipment changes?

N/A

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?

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 project:

None

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