Environment and Natural Resources Trust Fund

2023 Request for Proposal

General Information

Proposal ID: 2023-061

Proposal Title: Minnesota Million: Seedlings for Reforestation and CO2 Sequestration

Project Manager Information

Name: Julie Etterson

Organization: U of MN - Duluth

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Project Basic Information

Project Summary: A grower network will raise tree seedlings so that we have enough to conduct widespread reforestation in Minnesota to improve carbon sequestration, wildlife habitat, watershed resilience, and create economic opportunity.

Funds Requested: $1,012,000

Proposed Project Completion: June 30, 2025

LCCMR Funding Category: Methods to Protect, Restore, and Enhance Land, Water, and Habitat (F)

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?

In the Future

Narrative

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

Reforestation is a natural climate solution. Trees uptake CO2 from the atmosphere and store carbon. By reforesting one million acres in Minnesota, we could draw down 1.6 million tons of CO2 annually—the emissions equivalent to 348,000 average passenger vehicles. Reforestation also benefits water resources, habitat, and resilience to extreme events such as intense rainfall and heatwaves. So, why don't we do it? A major obstacle is that we do not grow enough conservation-grade tree seedlings to meet reforestation demand. Consequently, even if we had the will to plant enough trees to reabsorb carbon emissions, we would not have the way. This project aims to remedy this problem by increasing the capacity of farmers and tree nurseries to produce tree seedlings and, in turn, scale up forest restoration potential across the state. In order to ramp up tree seedling production so that we can meet our ambitious goal of reforesting one million acres by 2045, we would need to grow seven times more seedlings than we do right now, from 6.1 million to ~42 million tree seedlings per year. This level of seedling production would allow reforestation on ⅓ of the land available for restoration in Minnesota (figure).

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.

We will mobilize people across Minnesota to engage in all aspects of climate-resilient forest restoration through a new initiative called the Minnesota Million: from seed collection, to seedling production, purchasing, and planting. Through a successful pilot project, we have field-tested each of these steps (figure). In 2020-2021, we collected wild seeds (six species, 36 sites) that were grown by 14 farmers yielding 10,000 trees that were large enough to sell. These seedlings are currently being planted into 14 reforestation sites. In 2022, we added three new members to our farmer coalition, and are currently planning a broader fall 2022 seed collection. Here we identify key LCCMR investments that will solidify and grow the project with the ultimate goal of becoming self-sufficient. Specifically, we are requesting funding for:

-training, salary, and travel for wild seed collectors

-outreach to engage more farmers and growers, especially Indigenous nurseries and foresters

-training, equipment, and technical support for growers

-funds to track survival and establishment of seedlings from specific species/population seed sources, and

-educational programming for diverse Minnesotan populations including urban and Tribal youth.

This two-year investment will fuel the momentum of this promising program and heighten public awareness about natural climate solutions.

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?

Train community members in best practices for seed collection in collaboration with the state nursery, Tribal Nation, academic, and extension partners. Seed collectors will learn how to select locations, species, populations, and conduct seed collection and cleaning to retain valuable genetic diversity.

Establish a larger network of tree growers across the state by engaging farmers and tribal, commercial and state nurseries to increase the supply of climate-adapted seed and seedlings.

Equip and train growers to successfully germinate seeds, raise and overwinter seedlings to meet industry standards, and sell them.

Direct benefits to Minnesotans who are most impacted by forest losses

Activities and Milestones

Activity 1: MN Million public outreach to expand our network: training, equipment, and continuing education for seed collectors and tree seedling growers

Activity Budget: $703,182

Activity Description:
Each time we present about the Minnesota Million in a public forum, people eagerly ask how they can get involved! This movement will capitalize on Minnesotan's enthusiasm for improving the environment and embracing natural climate solutions. We will spread our message broadly to public, Tribal, private, student, professional, and community groups with a special emphasis on educational programming for Tribal and urban youth. Participants will be trained and supported in their roles. Seed collectors will learn how to identify species, find populations, collect genetically diverse samples, and maintain detailed records on the origin of the seed. Undergraduates will gain research experience assessing seed viability, determining optimal germination and growth conditions and assessing survival at restoration sites. Growers will receive a farm visit and will be provided with training, basic supplies, and native seed for planting. Throughout the year, growers will also have opportunities to participate in virtual workshops for technical guidance and group problem solving about seed germination, plant growth, overwintering, and seedling preparation for sale, including quality inspections from the MN Department of Agriculture. Collectively, these efforts will help expand seedling production which is currently only 14% of the level needed to reach our long-term reforestation goal.

Activity Milestones:

Description	Completion Date
Two-day meeting in Duluth to introduce MN Million to tribal leaders, nursery personnel, and foresters	November 30, 2023
In-person grower visits to consult on infrastructure, set-up, supplies, and procedures in winter 2023	February 28, 2024
Virtual and in-person workshops with potential farmers/commercial growers winter 2023 and 2024	November 30, 2024
In-person grower visits to consult on infrastructure, set-up, supplies, and over-winter seedling storage in 2023	June 30, 2025
Outreach to tribal and urban youth	June 30, 2025

Activity 2: Capturing species and genetic diversity in our seed collections and tracking their success from germination to survival at reforestation sites

Activity Budget: $258,872

Activity Description:
Biological diversity is the cornerstone of ecological stability. This fundamental concept holds at the macro level of species diversity and at the micro level of genetic diversity. Biodiversity at both scales contributes to ecosystem function and long-term community resilience. Our seed collection strategy is designed to enhance diversity at both levels by selecting species that will thrive into the future and by collecting seeds in a way that maximizes genetic diversity. Importantly, we will also track the success of restoration plantings that are based on specific species/populations to assure that we are meeting our goals. To select species, we will use tools now available from the Forest Service and others that predict the species that will thrive into the future in different forest types in Minnesota. For these species, we will collect seeds from numerous populations and from 20-50 mother trees per population to assure that we are capturing genetic diversity. Seed collections will be maintained separately through seed processing and delivery to seed growers so that we can track the success of our specific collections as measured by percentage germination, the number of seedlings successfully raised/sold by the grower and, ultimately, tree establishment at the restoration site.

Activity Milestones:

Description	Completion Date

Virtual training and three in-person workshops for seed collectors in 2023-2024	November 30, 2024
Planning and coordination of seed collection in 2023-2024	December 31, 2024
Tracking seedling survival and growth per species/population collection at the production sites	March 31, 2025
Outreach to community seed collectors for recruitment into MN Million	June 30, 2025
Tracking tree survival and growth per species/population collection at the reforestation sites	June 30, 2025

Activity 3: Research to optimize seed germination, seedling growth, and tree survival at the restoration site, especially with respect to mycorrhizal amendments

Activity Budget: $49,946

Activity Description:

Recent popular books such as the Pulitzer Prize winner “The Overstory: A Novel'' (Powers, 2018) and the New York Times bestseller “Finding the Mother Tree: Discovering the Wisdom of the Forest” (Simard 2021) have captured the public imagination and helped people realize that trees require community partners to thrive. One of the most important partners is the mycorrhizal fungi. These organisms grow a fine web of threads that extend widely into the soil and deliver water and dissolved nutrients to the tree roots, as much as 80% of the required nitrogen and phosphorus for plant growth. In exchange, the fungi obtain sugars from the tree. These below-ground partners have been shown to play a key role in seed germination, plant growth, and survival. Despite their importance, they have not been studied extensively in the context of reforestation. Here, we will test whether the addition of natural or commercially obtained mycorrhizal inoculants promote seedling germination and growth better than fertilizers. Few studies have examined this, and none have followed the trees through the phases of seedling production and into the restoration site. With this information, we will provide valuable recommendations to growers that will increase seedling yield and promote reforestation success.

Activity Milestones:

Description	Completion Date
Greenhouse experiments testing the value of mycorrhizal and other soil amendments on germination, survival, and growth.	October 31, 2024
Germination tests in the lab and at grower sites in 2023-2025 to optimize seedling yield	June 30, 2025
Experiments testing the value of mycorrhizal/soil amendments on tree establishment at restoration sites	June 30, 2025

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dr. Meredith Cornett	The Nature Conservancy in MN/ND/SD	co Principal Investigator	No
David Abazs	U of MN Northeast Sustainable Development Partnership	co Principal Investigator	Yes
Mary Hammes	The Nature Conservancy in MN/ND/SD	Serve as primary contact for TNC's involvement in the overall project, including coordination with diverse partners engaged in the Minnesota Million, Minnesota's statewide initiative to reforest 1-million acres by 2045.	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 piloted the grower's network with $50,000 from the Institute on the Environment and successfully: 1) collected wild seed, 2) recruited/trained farmers who grew the seed, and 3) sold seedlings to conservation organizations for spring 2022 planting. We request a ~one-million-dollar LCCMR investment to improve and expand our operations to include Tribes, urban populations, and commercial nurseries. We will continue to raise funds for MN Million to support seed collection and seedling production, for example, through a USDA Partnerships for Climate -Smart Commodities proposal that is supporting "innovative, scalable approaches to carbon sequestration that also benefit the economy."

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Conserving and Monitoring of Minnesota's Rare Arctic Plants	M.L. 2019, First Special Session, Chp. 4, Art. 2, Sec. 2, Subd. 08d	$135,000

Project Manager and Organization Qualifications

Project Manager Name: Julie Etterson

Job Title: Distinguished McKnight Professor, Head, Department of Biology, UMD; Director, Institute on the Environment - Duluth

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

This work will be co-managed by a three-person team that has successfully collaborated previously. Our diverse and complementary backgrounds in academics, extension, and nonprofit organizations collectively provide the expertise to achieve our project objectives.

ETTERSON is Head of the Department of Biology. Her research focuses on understanding plant response to climate change and taking action to restore healthy natural communities. Over the last decade, she collaborated with TNC to test adaptive forest management methods with funds from Wildlife Conservation Society (WCS, Cornett) and the MN Lake Superior Coastal Program (Etterson). This work has already influenced public policy on seed sourcing for forest restoration. Etterson served as the lead on the small pilot project from the Institute on the Environment that preceded this proposal. Etterson established and currently manages a $1.3 million research seed bank, Project Baseline, that was

funded by the National Science Foundation and will provide research materials to scientists nationwide over the upcoming 50 years.

CORNETT is Climate Change Director for TNC in Minnesota, North Dakota and South Dakota. In addition to her TNC position, Cornett is an adjunct member of the graduate faculty at the University of Minnesota's Conservation Sciences Program and Forest Resources Department. She holds an MS and PhD in Forestry from the University of Minnesota, and a BA in Biology from Oberlin College. Cornett is the Project Manager for a WCS-funded mainstreaming project for MN Million.

ABAZS is the Executive Director of the UM Extension Northeast Regional Sustainable Development Partnership. He leads the community/University work around sustainability relative to these focus areas - natural resources, agriculture and food systems, resilient communities, and clean energy. As part of the MN Million, he has served as the primary liaison with the seedling grower network and is responsible is for development, training, and sales.

Organization: U of MN - Duluth

Organization Description:
This project represents a unique collaboration between academic, extension, and nonprofit organizations.

ACADEMIC - The University of Minnesota Duluth is a public university that offers 16 bachelor's degrees in 88 majors, graduate programs in 25 different fields. Dr. Etterson is the Head of the largest department on campus that is highly research active (~700 undergraduates; 75 graduate students). Etterson, alone, has raised $3.7 million external funds, and advised 17 graduate students and >60 independent undergraduate research projects.

EXTENSION - The Northeast Regional Sustainable Development Partnership, of UM Extension, has been serving northeast Minnesota for a quarter century by advancing environmental, economic and social sustainability through authentic community-University partnerships that co-create innovative solutions and fulfill the University's land-grant mission. This organization engages graduate and undergraduate students, citizen boards, and partner organizations to advance natural resource management, agriculture and food systems, resilient communities, and clean energy.

NONPROFIT - The Nature Conservancy is a nonprofit organization whose mission is to conserve the lands and waters on which all life depends. Our vision is a world where the diversity of life thrives, and people act to conserve nature for its own sake and its ability to fulfill our needs and enrich our lives.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Julie Etterson		PI: Supervise and manage all aspects of the project with collaborators Cornett and Abazs			25.1%	0.08		$15,107
GRA Jessy Carlson		MS Graduate Student: Develop programming for youth with a special emphasis on Tribal and urban populations, conduct original research testing the value of mycorrhizal additions for germination and seedling growth.			49.1%	0.5		$44,681
Summer GRAs, Y2, Jessy Carlson, Austen Hilding		MS Graduate Students: Deliver youth programming which will include tree growth and planting, conduct original research testing the carryover value at the restoration site of mycorrhizal inoculation and other soil amendments that were applied during seedling growth in the greenhouse.			19.1%	0.25		$14,466
Research 2a		Seed Collection Manager: Finding seed source locations and obtaining collecting permits, recruiting and training seed collectors, web site development for data management, supervising seed processing and viability testing, germination, seed delivery to seedling growers, germination training			22.3%	2		$156,293
Research 2b		Farmer/Nursery Manager: outreach to new participants, site visits to consult on infrastructure, individual grower training, monthly group training workshops to discuss issues related to germination, growth conditions, overwintering and general trouble shooting, coordinate MN Department of Agriculture quality inspections, manage seedling marketing and sales.			22.3%	2		$156,293
Undergraduate Research Assistants		Undergraduates: Process and package seeds for farmers, test percent germination, conduct independent research on optimal conditions for germination and early growth in conjunction with UMD undergraduate research programs; March - May, 10 people, 10 hours per week, 5 weeks			0%	0.48		$14,194

Seed Collectors Temp/Casual		Work with Seed Collection Manager to learn how to find sources populations, identify species, and make genetically diverse seed collections, monitor seed maturation, collect seeds according MN Million protocols, record basic site information, enter data. Citizen scientists - 10 people, 20 hours per week, 8 weeks			7%	1.52		$68,794
Production Coordinator Temp/Casual		Americorps Interns: Work with the David Abazs and the Farmer/Nursery Project Manager to facilitate communication with seedling growers, conduct sites visits for trouble shooting.			7%	0.38		$12,878
							Sub Total	**$482,706**
Contracts and Services								
							Sub Total	**-**
Equipment, Tools, and Supplies								
	Tools and Supplies	Seed cleaning non-capital equipment	Tumblers and threshers for the cones, screened trays for drying cones.					$30,000
	Tools and Supplies	Nursery start up and scale up funding	Funds for ~40 individuals to establish and/or expand tree nursery production. Personal site visits and training will identify the specific needs to assure successful growth operations.					$198,835
	Equipment	Two Farmstead 150HD Seed Cleaner/Grain Cleaners Two Seed cleaning machines	Seed/Grain Cleaners: two Seed cleaning machines needed to clean tree seeds					$10,000
							Sub Total	**$238,835**
Capital Expenditures								
		Seedling Storage and overwintering	Two solar powered tree seedling storage refrigeration units, of adequate size, to allow for optimal temperature storage and assure both the grower and the planting organizations, good winter survival					$210,000

			rates and high quality stock for planting.					
		Seed cleaning equipment	Acquire seed cleaning equipment that will be temporarily housed at UMD but will ultimately be moved to a permanent seed cleaning facility					$10,000
							Sub Total	**$220,000**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	10 rooms @$125 each, 2 nights	Tribal leaders, nursery personnel, and foresters will meet in Duluth to discuss the goals of the project and Tribal engagement.					$2,500
	Miles/ Meals/ Lodging	300 miles per person, 10 people, @$0.585 per mile	Support the travel of tribal leaders, nursery personnel, and foresters to Duluth for MN Million meeting.					$1,755
	Miles/ Meals/ Lodging	Rent the Biology "Turtle" passenger van to visit sites, $90 per day for three days, $0.54 per mile, 200 miles	Participants will visit one of the MN Million farms that is already participating in the program.					$387
	Miles/ Meals/ Lodging	10 travelers to Duluth and 10 Duluth participants @ Per diem rate for MN = $79 per day	Travel support for Tribal leaders, nursery personnel, and foresters who will meet to discuss the goals of the project and Tribal engagement.					$3,160
	Miles/ Meals/ Lodging	Numerous trips to centralized locations for trainings and site visits to farmers and nurseries. Mileage and per diem	Farmer/Nursery Manager and the Americorps intern (Production Manager) will travel for workshops and trainings.					$18,000
	Miles/ Meals/ Lodging	Seed Collection travel for citizen scientists - 10 people, 2000 miles each, $0.585 per mile	Mileage to collect seeds					$23,400
	Miles/ Meals/ Lodging	Farmer/Nursery Manager and Production Coordinator training travel - 3 trips to grower sites, 300 miles per grower on average, $0.585 per mile	Mileage to three sites for on-site regional trainings					$1,052
	Miles/ Meals/ Lodging	MS Graduate Student outreach travel - 10 trips, 300 miles per trip, $0.585	Mileage for 10 educational sessions					$3,510
	Miles/ Meals/ Lodging	Farmer/Nursery Manager and Production Coordinator travel for site visits- 30 trips to grower	Mileage to travel to growers for on-site consultation					$10,530

		sites, 300 miles per grower on average, $0.585 per mile						
	Miles/ Meals/ Lodging	MS Graduate Student research travel - 6 trips to 5 sites, 300 miles per trip on average, $0.585 per mile	Mileage to restoration to assess tree seedling survival and growth depending upon soil amendment treatments					$5,265
							Sub Total	**$69,559**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
							Sub Total	**-**
Other Expenses								
		ST Lease - Building	Conference Room rental for Tribal meeting					$500
		Professional services	MDA Nursery License for seedling quality control inspection					$400
							Sub Total	**$900**
							Grand Total	**$1,012,000**

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	**-**

Attachments

Required Attachments

Visual Component

File: 14ffa428-e35.pdf

Alternate Text for Visual Component

PROJECT FLOW CHART: Collect seeds->Grow seedlings on farms/nurseries->Sell trees and reinvest->Plant trees for reforestation and carbon sequestration. BOTTOM: Map of reforestation opportunities and 2021-2022 pilot project accomplishments. Seed collected from 11 species->60,000 trees grown by 14 farmers->10,000 trees sold->14 restoration plantings....

Optional Attachments

Support Letter or Other

Title	File
Etterson et al. 2020. Using assisted migration to detect adaptation lags in two major North American tree species in response to global climate change	4958a54a-6f9.pdf
Etterson et al. 2018. Embedding research into restoration: A case study illustrating the value of applied-academic partnerships.	bcc9cbb9-3af.pdf
Letter of Support from the Rutabaga Project, a shared initiative between the Arrowhead Economic Opportunity Agency and the Iron Range Partnership for Sustainability	1f3a4225-6c3.pdf
Letter of Support from the Iron Range Partnership for Sustainability	304d9f3e-5d7.pdf
Minnesota Million - Media Attention	433b5631-539.pdf
Letter of Support from Lake Superior Sustainable Farming Association	8b934312-568.pdf
Transmittal Letter	ce86d4eb-674.docx

Administrative Use

Does your project include restoration or acquisition of land rights?

No

Does your project have potential for royalties, copyrights, patents, or sale of products and assets?

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?

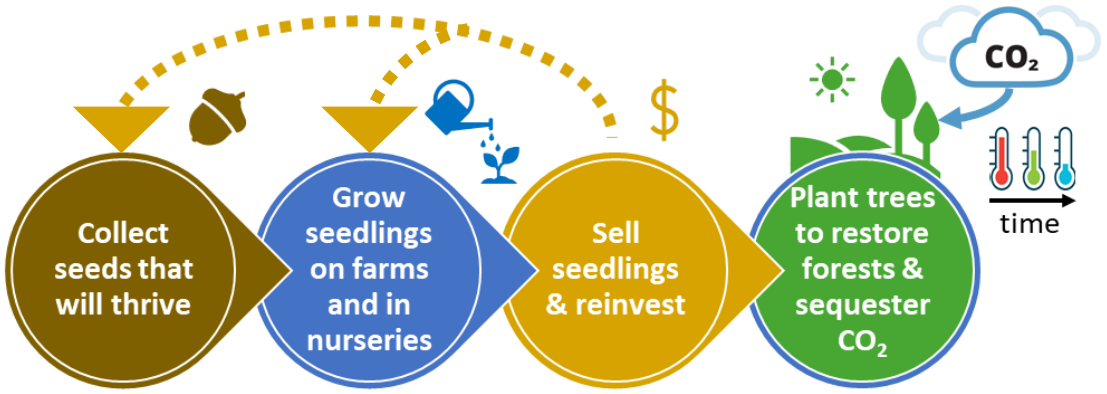
Yes

Does the organization have a fiscal agent for this project?

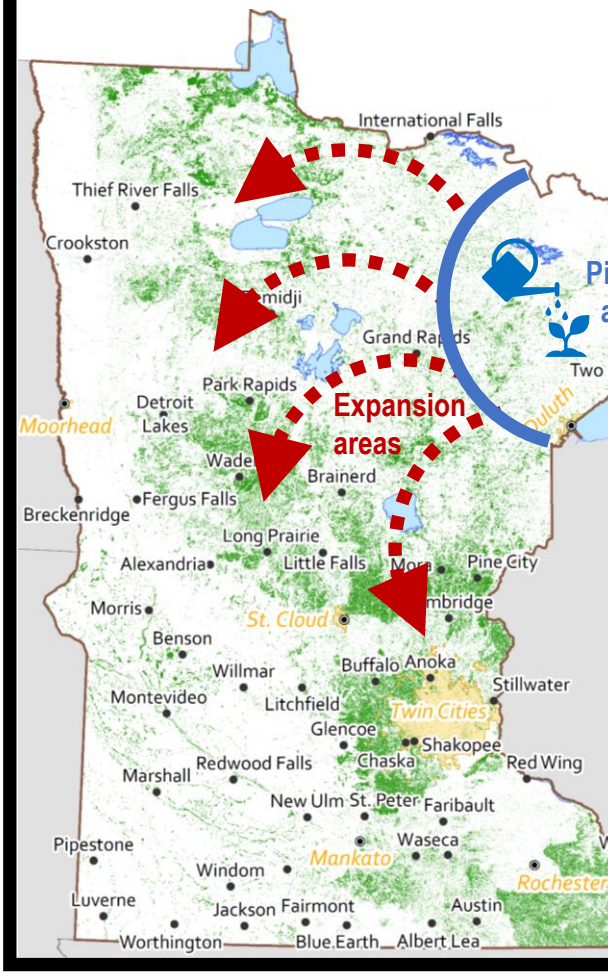
Yes, Sponsored Projects Administration (UMD)

MN Million: Tree seedlings for reforestation and carbon sequestration

2023-2025 Project Flow Diagram



2021-2022 Pilot Project Accomplishments



Seed collected from 11 species in fall 2020 and 2021

60,000 trees grown by 14 farmers in 2021; + 3 farmers in 2022

~10,000 trees were large enough to sell in spring 2022

Trees planted into 14 restoration sites