



Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-358

Proposal Title: Oats and Water Quality: Potential for Nitrogen Preservation

Project Manager Information

Name: Anna Cates

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

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Project Basic Information

Project Summary: Quantify on-farm N losses in a novel corn-soy-oat/clover rotation, where we expect lower N fertilizer needs and nitrate losses across the rotation compared to corn/soy alone.

ENRTF Funds Requested: \$706,000

Proposed Project Completion: June 30, 2032

LCCMR Funding Category: Water (B)

Project Location

What is the best scale for describing where your work will take place?

Region(s): SE

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.

Oats are a promising new market for farmers in southern MN, but there's little understanding of how they will affect N dynamics in the area, with implications for on-farm economics and regional water quality. Nitrate levels in ground and surface water in southern Minnesota are a growing concern for environmental and public health, and need working lands solutions. Nitrate losses under oats have not been studied, but where small grains were grown in the Discovery Farms Tile Nitrate Monitoring project, tile nitrate concentrations were lower than under corn silage or corn grain. Lower N rates needed for oats (30-40 lbs N/acre instead of 150-200 lbs N/ac for corn) likely lead to lower tile N losses. In addition, oats grow faster earlier in the year when nitrate losses are high in warm-season annuals like corn and soybeans.

Oats may also lower N losses due to lower N fertilizer needs in the following year's corn. Growers with oats in rotation frequently underseed red clover in oats, which is anticipated to provide 30-60 lbs/ac N to the next year's corn. However, the N generated by clover and provided to the corn following it has not been specifically

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 propose to track the water quality effect of adding oats to a corn/soy rotation by monitoring nitrate in the tile drainage outlets of fields in Dodge and Olmsted counties and soil nitrate in oat growers' fields more broadly in the oat growing region. In addition, we will quantify the N needs in a subsequent corn year by conducting on-farm N rate trials and soil nitrate monitoring. Quantifying the N savings of including oat in rotation alongside a red clover cover crop helps de-risk farmer adoption, and our dissemination plan builds on existing farmer networks and local capacity to make sure the information is rapidly given to farmers and local policymakers to drive investment in systems that truly reduce nitrate in regional water systems.

Working with oat growers' networks, staff from the Green Acres milling facility, and local Soil and Water Conservation District staff, we will identify paired fields in either a 2-crop (corn-soybean) or 3-crop (corn-soybean-oats) rotation. Matching soil and landscape properties in each phase of the rotation, we will measure soil physical and biological properties, soil nitrate levels, and collect management data including N fertilizer application rate, timing and source to help explain variability in tile nitrate.

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 believe our data will show that nitrate in surface and groundwater can be lowered by including oats in rotation and crediting clover cover crops N to the following corn crop. This work will build on Cates' MDA-funded project performing an environmental and economic assessment of the Olmsted Groundwater Protection Program. Concrete data on water quality benefits of oat/clover in rotation strengthens the case for local and state government to provide cost share incentives. Given widespread interest in growing oats, this could lower nitrate losses and adverse health outcomes across southern MN.

Activities and Milestones

Activity 1: Establish a tile monitoring network to evaluate the nitrogen losses under corn-soy-oats compared to other crop rotations.

Activity Budget: \$247,420

Activity Description:

Recruitment will begin with farmers invested in contracting oats with Green Acres Milling. These fields will be paired with growers not using oats on similar soils in close vicinity. Growers will be paid a \$200/year fee and offered cost-share as eligible.

Staff at the Olmsted SWCD will sample tile water twice monthly during the growing season (April-Oct) and monthly depending on weather conditions in March, November, December.

To estimate annual soil nitrate load alongside the tile nitrate, resin lysimeters will be installed in a subset of 10-12 fields alongside tile sampling, as well as 10-12 fields where oats are grown without tile, to broaden the area of inference.

Three samples per field will be assessed for soil health and fertility, likely model covariates including soil structure, OM, P, and K, total organic C and water-extractable C and N, as well as the 24-hour mineralizable C (also used in the Haney Soil Health Test, which growers may have used).

Finally, management data will be collected including varieties used, dates of planting, tillage, spraying, fertilizer (rates, timing, placement, source of N, P, and K), any manure or livestock incorporation, and five years of cropping history, to complement interpretation of N outcomes.

Activity Milestones:

Description	Approximate Completion Date
Install lysimeters and remove lysimeters (annual)	November 30, 2026
Collect soil data (annual)	November 30, 2027
Collect management data (annual)	February 28, 2028
Recruit 30 fields for nitrate monitoring	July 31, 2028
Remove lysimeters after oat harvest	August 31, 2028

Activity 2: Evaluate the nitrate losses from fields in different cropping systems using a combination of monitoring and modeling approaches.

Activity Budget: \$216,480

Activity Description:

Of the fields recruited for the nitrate monitoring project, we will identify which are most suitable for more detailed characterization based on watershed properties and farmer input (to determine the extent of existing tile drainage networks). This information will be used to delineate catchment areas for the fields of interest as well as the immediate watershed. Nitrate monitoring of these fields will be augmented with discharge or flow measurements, and resulting water yield data at the field-scale will be compared against nearby available gauge data to develop field-scale estimates for drainage and nitrate loading. Watershed-scale models will also be developed for the study fields and watersheds as a means to provide context and help understand the mechanisms behind observed nitrate data. Finally, an in-situ monitoring approach will be used to make spatial maps of water quality data. Using a raft equipped with continuous monitoring devices, we will visit relevant waterways ~15 times per year to estimate nitrate concentration through real time and space. These data will help to determine how field-scale influences on water quality may be realized at points further downstream.

Activity Milestones:

Description	Approximate Completion Date
Identify which monitoring fields are best-suited for more detailed monitoring and characterization	November 30, 2028
Delineate study watersheds that encompass targeted fields and relevant upstream areas.	July 31, 2029
Conduct Lagrangian in-ditch sampling campaigns to develop spatial maps of stream nitrate (2029-30)	September 30, 2030
Develop and apply small watershed-scale simulation models that represent lysimeter, tile, and ditch monitoring data.	November 30, 2030

Activity 3: Measure nitrogen fertilizer offsets and leaching reductions from oat-clover intercropping

Activity Budget: \$126,835

Activity Description:

Reducing nitrogen fertilization of corn can drastically reduce nitrate leaching to groundwater. Legume crops like clover fix nitrogen, and when grown with a grain crop like oats, can provide enough nitrogen to offset fertilizer needs, thus increasing farmer profitability. Moreover, the nitrogen provided by clover is “slow release” compared to synthetic fertilizers, and thus can provide nitrogen credits to crops (like corn) in subsequent years. For this reason, more than 4000 acres of oats were grown with a clover intercrop in 2024, but the subsequent corn crop on these acres was still fertilized with a broad range of rates. Repeatedly, farmers have asked for information on the N credit of clover so they can reduce fertilizer inputs to their following corn crop with less risk. By working with three farmers to conduct an on-farm trial, we will fertilize corn at different rates in fields following oat monocultures and oat-clover intercrops. We will measure corn yields and soil water nitrate using lysimeters. The experiment will occur in two consecutive years in different fields. Results will support farmers in reducing potential nitrate leaching and N fertilizer inputs without risk to yield, based on locally relevant research.

Activity Milestones:

Description	Approximate Completion Date
Select fields for N rate trials	November 30, 2027
Conduct year 1 N rate trials in corn, analyze samples	December 31, 2028
Conduct year 2 N rate trials in corn, analyze samples	December 31, 2029
Analyze all data and summarize in Extension publications and presentations	August 31, 2030

Activity 4: Disseminate research findings to growers and other stakeholders via field days and workshops. Increase awareness of sustainable oat production practices

Activity Budget: \$115,265

Activity Description:

LSP and UMN will collaborate on at least one winter event per year, and field events as needed to highlight both research in this project and related efforts to manage N in a corn-soy-oat rotation. Content will be coordinated by UMN and LSP annually, based on data generated in Activities 1-3 and feedback from LSP soil health hubs and the Byron Area Farmers in Olmsted County. These events will prioritize time for peer-to-peer learning among the farming community, and bring in relevant speakers from MN and region to cover regional best practices in nutrient management, public health, and water quality. Our efforts build on existing successful programming led by both LSP and UMN Extension, and aim to expand to support new oat growers and meet new challenges as they arise. Informal opportunities to share research information will be facilitated within LSP’s soil health hubs and UMN Extension local and regional programming on cover crops and water quality (i.e. UMN Cover Crop Academy, the Great Lakes Cover Crops Project, UMN Soil Management Summit, Cates’ participation in Midwest Cover Crops Council, UMN Institute for Ag Professionals Summer Field School and Crop Pest Management Short Course, Nutrient Management and Nitrogen Conferences).

Activity Milestones:

Description	Approximate Completion Date
1 event highlighting research efforts alongside peer-to-peer learning and regional context	July 31, 2028
1 event highlighting research efforts alongside peer-to-peer learning and regional context	July 31, 2029
1 event highlighting research efforts alongside peer-to-peer learning and regional context	July 31, 2030
1 event highlighting research efforts alongside peer-to-peer learning and regional context	July 31, 2031
1 event highlighting research efforts alongside peer-to-peer learning and regional context	June 30, 2032

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Jeff Coulter	University of Minnesota	Professor, assist with data interpretation and Extension in Activity 3	Yes
Jessica Gutknecht	University of Minnesota	Associate Professor, lysimeter lead	Yes
Jacob Jungers	University of Minnesota	Associate Professor, lead on Activity 3, coordinating and analyzing data on N credits from clover	Yes
Anna Cates	University of Minnesota	Associate Professor, Project lead	Yes
Kat LaBine	University of Minnesota	Researcher	Yes
Leah Hallett	University of Minnesota	Researcher	Yes
Jesse Bealsburg	University of Minnesota	Researcher	Yes
Brent Dalzell	USDA-ARS	Lead of Activity 2, coordinating collection and analysis of data characterizing watershed-scale nitrate losses	No
Jeff Strock	University of Minnesota	Professor, data interpretation and outreach	No
Shona Langseth	Olmsted SWCD	Assist with tile nitrate sampling in Activity 1 and 2	Yes
Shae-Lynn Ramthun	Land Stewardship Project	Assist with outreach in Activity 4	Yes
Mary Nesberg	University of Minnesota Extension	Extension Educator, Olmsted county, assist with outreach in Activity 4	Yes

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.

Research objectives 1-3 have all been developed alongside relevant stakeholders, in particular farmers growing oats in southern Minnesota. At a March 2026 event, more than 36-40% of over 100 farmer attendees asked for more programming on small grains before corn, interseeding clover in small grains, and N credits from clover. This data can be immediately incorporated in Extension documents by Coulter and the team, which are in turn referenced by state agencies such as MDA looking for lists of agricultural best management practices.

Water quality is also of high interest to this group, as shown by their willingness to participate in existing, smaller-scale tile line sampling in Olmsted county and their approaching Cates to ask for this study. Cates' role includes regular collaboration with NRCS, BWSR and SWCD staff around the state, including consultation on changing programs to include new practices or adjust incentives to promote practices most beneficial in a region. Therefore, the water quality information will immediately get to people who can apply it to manage watersheds across the region.

The farmer-facing events funded by this effort are well-positioned to succeed because they build on existing successful programming led by both LSP and UMN Extension. Both groups prioritize farmer networking alongside research-based information that farmers can use. The funds don't go toward one-off events with no follow up and continuation; instead, this funding supports and expands existing capacity to bring farmers together for honest, practical conversation about agricultural practices that protect water quality and keep farms economically viable.

Long-term, this effort will build into Extension programming for all project personnel and regional NGO partners. We are well-positioned to continue to use and share this information after the project ends, ensuring that the funds invested continue to provide relevant information to key stakeholders and landowners.

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?

Findings will be used by conservation districts, watershed districts, and perhaps state agencies to build policy to support lower nitrate losses from agricultural lands in the Mississippi Basin. Based on Cates' ongoing collaboration with conservation districts and state agencies, we will have many opportunities to communicate project results formally and informally. Extension personnel will highlight the clover N credit recommendations in many farmer-facing events and communications. However, we will seek additional funding from the LCCMR, state agencies, and national grant programs to continue monitoring for at least five more years to estimate of tile nitrate losses during different weather years.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Soil Health Management for Water Storage	M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 04h	\$454,000

Project Manager and Organization Qualifications

Project Manager Name: Anna Cates

Job Title: Associate Professor and Soil Health Specialist

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

Cates' lab runs various projects with a total annual budget of over ~1M. She works with collaborators in NGOs and government units to accomplish research and outreach goals around increasing adoption of soil health practices across the state. Her team, including lab manager Kat LaBine, is used to maintaining safe lab and field conditions, handling large volumes of samples, protecting data privacy and quality, and communicating with research collaborators. Dr. Cates has a Research and Extension appointment, gives ~20 farmer-facing talks per year, and delivers training to conservation professionals across Minnesota in the Minnesota Cover Crop Academy and other formats. Cates' research program focuses on measuring agronomic and environmental outcomes of soil health practices in row crop agriculture. She enjoys research based on farmer-inspired questions which answers real questions.

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

Organization Description:

University of Minnesota is a research and education institution.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Jeff Coulter, faculty		Communicate clover N credits to corn via Extension media and events			36.6%	0.05		\$14,532
Jake Jungers, faculty		Lead Activity 3 field trials and data interpretation			36.6%	0.1		\$24,516
Jessica Gutknecht, faculty		Lead lysimeter analysis and data interpretation			36.6%	0.1		\$22,180
Anna Cates, faculty		Project lead, coordinate all activities and outreach			36.6%	0.2		\$38,201
Eduardo Garay, project manager		Coordinate nitrate data collection			36.6%	0.5		\$59,243
Post-doctoral researcher		Lead field data collection in Activity 2, assist with data analysis in Activity 1			26.1%	2		\$159,304
Undergrad assistants		Field work and sample processing for Activities 1,2, and 3			0%	0.7		\$20,800
Kat Labine, Research Assistant		coordinate field and lab activities in Activities 1 and 2			32.3%	0.25		\$20,575
Leah Hallett, Researcher		Lead lysimeter analysis in Activities 1, 2, 3			32.3%	0.3		\$24,006
Jesse Bealsburg, Researcher		Manage field trials in Activity 2			32.3%	0.3		\$26,689
							Sub Total	\$410,046
Contracts and Services								
Gutknecht Lab	Service Contract	Nitrate samples from lysimeters and tile outflows MN for Activities 1 and 2, \$8/sample, 30 sites x 2 samples/month x 8 months, \$3840/year in years 2-5, \$1920 in year 1 (half a growing season). For Activity 3, 180 samples/year, in years 1 and 3m \$2880				0		\$23,040

Research and Analytical Lab	Service Contract	To assess water-extractable organic C and N for Activities 1 and 2, extracts would be analyzed at the Research and Analytical lab at UMN, \$20/sample for 3 samples/field for 30 fields, total \$1800/year.				0		\$9,000
Research and Analytical Lab	Service Contract	To assess standard fertility (OM, pH, Bray-P, K) for Activities 1 and 2 at the Research and Analytical Lab we budget \$17.60/sample x 90 samples/year, total \$1584/year.				0		\$7,920
Land Stewardship Project	Subaward	To host, plan, and publicize events with farmers and stakeholders, the Land Stewardship project will be subcontracted for staff time.				0.3		\$65,957
Olmsted SWCD	Service Contract	Staff at the Olmsted SWCD would be contracted to physically collect all nitrate samples from selected tile lines in the region. Their time and mileage are charged at \$80/hr, assuming 3 days/month for 8 months is \$15360/year.				0.75		\$76,800
Farmer cooperators	Service Contract	Farmers will be paid an annual stipend to acknowledge the time taken to communicate with research staff about tile locations and management information, \$200/field for 30 fields, \$6000/year for Activities 1 and 2, and 3 farmers paid \$2000/year for N rate trials in Activity 3, \$6000/year for				-		\$48,000
							Sub Total	\$230,717
Equipment, Tools, and Supplies								
	Tools and Supplies	Bottles for samples will be purchased primarily at the outset, approximately 6 bottles/site for 180 bottles at \$900, with another \$60/year for bottle replacements in subsequent years. Materials for lysimeters in Activities 1 and 2 are anticipated to cost \$600/year, materials for lysimeters in Activity 3 will be \$1150 in years 1 and 3, and other lab supplies for soil health analyses \$200/year.	Supplies will be used to collect samples and perform sample analysis.					\$7,440
	Tools and Supplies	Supplies for outreach events including chair or tent rental, food, and printing, for winter meetings and field events, \$8000/year. In years 1-4, \$7759 in year 5.	Space and chair rental, food, speaker travel funds and displays will be used to create events where farmers and other stakeholders can learn about events.					\$39,759
							Sub Total	\$47,199

Capital Equipment								
							Sub Total	-
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	8 trips from St. Paul for scoping sites and installing lysimeters in year 1, 6 trips for site checks and lysimeter install/removal in following years (Activities 1 and 2). 6 trips/year for Activity 3 in Years 1-3. 15 trips/year in years 1 and 2 for raft monitoring activities. Assuming trips are ~300 miles and mileage at \$0.725/mile.	Trips will include sample collection and communication with farmer cooperators.					\$18,038
							Sub Total	\$18,038
Travel Outside Minnesota								
							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
							Sub Total	-
							Grand Total	\$706,000

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: \$706,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [ac089d04-548.pdf](#)

Alternate Text for Visual Component

File shows higher N inputs and losses in corn-soy rotations compared to corn-soy-oat rotations...

Supplemental Attachments

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

Title	File
Letter from Regents, approval to submit	205afc5e-da7.pdf
Letter of Support- Byron Area Farmers	cc97a983-1f5.pdf
Letter of Support- Olmsted county	3b28bba7-96d.pdf
Letter of Support- Green Acres	20138e7b-1a4.pdf
Letter of Support- Forever Green	37d0ec53-493.docx

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:

Sue Kilber, UMN

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