

Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-503

Proposal Title: Protecting Drinking Water from Nitrates in Southeast Minnesota

Project Manager Information

Name: David Mulla Organization: U of MN - College of Food, Agricultural and Natural Resource Sciences Office Telephone: (612) 625-6721 Email: mulla003@umn.edu

Project Basic Information

Project Summary: This project engages stakeholders in adopting alternative Continuous Living Cover (CLC) to protect groundwater from nitrate pollution. We will quantify the impact of CLC crops through environmental and economic modeling.

ENRTF Funds Requested: \$515,000

Proposed Project Completion: June 30, 2028

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? Region(s): SE

When will the work impact occur? During the Project and In the Future

1

Narrative

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

About 75% of Minnesotans source water from groundwater for drinking and crop irrigation (MPCA, 2025). Drinking water quality in Minnesota, in particular, Southeast Minnesota is increasingly threatened by nitrate contamination in private wells and public water supplies, primarily from row crops (MPCA, 2022). In Goodhue County, nitrate levels in groundwater frequently exceed the EPA's safe drinking water threshold of 10 mg/L, posing significant health risks, including methemoglobinemia (blue baby syndrome) (EPA, 2020), some cancers and thyroid diseases (Ward et al., 2018). The karst geology of the region exacerbates this issue– allowing surface pollutants such as nitrate to infiltrate groundwater more readily (MPCA, 2005).

Crop diversification using crops that provide Continuous Living Cover (CLC) significantly reduces nitrate leaching. (Leavitt & Teeter, 2024). These crops also enhance soil health, increase water retention, reduce soil erosion, and support biodiversity. Markets for these crops include sustainable aviation fuel (SAF), livestock feed, and potential carbon markets (Liu et al., 2018; FGI, 2025). However, widespread adoption remains limited due to gaps in scientific evidence, economic feasibility, and policy support (Jungers et al., 2022; Mulla et al., 2005; Ward et al., 2018).

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 aim of our project is to identify regional farm landscape and economy futures with farmers, community stakeholders, and researchers to find a viable path forward that improves water quality in the region with farmers, financing structures, and water quality and ecosystem benefits at the center.. We propose a science-driven, farmer- and community-informed process that creates an environment of readiness for rapid, risk-aware market-based expansion of Continuous Living Cover (CLC) crops such as winter camelina, winter barley, and hybrid winter rye. The result would include transformed regional agriculture practices that actually reduce, rather than contribute to, the pressing issue of nitrate contamination in drinking water in Goodhue County and other portions of the Cannon River watershed. These crops provide year-round soil coverage, minimizing nitrate leaching, also delivering several co-benefits, including reducing soil erosion, improving soil health, enhancing water retention, reducing emissions of nitrous oxide (N2O) from cropland, and supporting biodiversity. At the same time, these CLC can offer economic benefits to farmers through existing and new market opportunities in biofuels (SAF), livestock feed, and carbon credit programs. There is also great potential for new systems to reduce farmer risk and meet water quality needs (economic, policy, market-based solutions, etc.).

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?

This project engages stakeholders, especially farmers and other members of the private sector, agencies, and community groups , in developing alternative CLC scenarios and collaboratively designing sustainable futures for the Cannon River Watershed (Activity 1) that protect groundwater from nitrate pollution. We will develop geographically specific watershed models that quantify the impact of CLC crops (Activity 2), conduct environmental and economic modeling that assesses co-benefits of CLC including water retention, erosion control, biodiversity enhancement, and greenhouse gas fluxes (Activity 3); and use farm-level economic analysis to evaluate profitability, market opportunities, financial incentives, and to explore the potential for ecosystem service credits (Activity 4).

Activities and Milestones

Activity 1: Engaging with stakeholders to identify viable pathways for adoption of CLC alternatives that protect groundwater

Activity Budget: \$224,380

Activity Description:

Solving the Southeast Minnesota drinking water problem by diversification of regional agriculture requires design of concrete scenarios grounded in farmer and resident aspirations and realities, specifying which crops will be grown, where, by whom, and how these crops will contribute to profitable agricultural enterprises. Development of such scenarios must engage the range of stakeholders needed for their implementation, including established and emerging/marginalized farmers, agribusiness professionals, local and state agency personnel, non-governmental organizations, and non-farming residents,, among others. We will convene community-visioning sessions to identify future scenarios for diversified farming systems that meet economic needs, protect drinking water, and provide other environmental and social benefits. To initiate this activity, we will hold dialogue sessions with stakeholders, to learn from viewpoints on regional agricultural and environmental trends and on community development and growth. These and future sessions will provide guidance for modeling (Activities 2-4). Credible science-based information about economic and environmental impacts associated with various diversified farming systems will then guide development of community supported scenarios that improve drinking water and provide other benefits, and future pilot implementation of these scenarios that have staying power in the region.

Activity Milestones:

Description	Approximate Completion Date
Stakeholder interviews and focus group work to identify alternative CLC systems of interest	June 30, 2027
Build public-private partnerships to facilitate adoption of alternative CLC systems	June 30, 2028
Analysis and dissemination of promising pathways, scenarios, and markets for adoption of CLC	June 30, 2028
alternatives	

Activity 2: Assessing the effectiveness of winter annual crops to protect SE Minnesota drinking water from nitrate pollution

Activity Budget: \$99,736

Activity Description:

A crop modeling framework will be developed to identify the effectiveness of alternative CLC crops at reducing nitrate pollution in the Cannon River watershed. The model will be calibrated based on water quality monitoring data collected in fields throughout the Cannon River watershed that have adopted CLC cropping systems. This model will generate site-specific crop production and environmental projections for diversified farming systems (Wilson et al., 2023). Specifically, we will determine crop yield, water discharge and recharge, nitrate losses by leaching and tile drainage and co-benefits such as greenhouse gas fluxes, and soil runoff and erosion plus associated losses of phosphorus. Results will be summarized to determine how much land would need to be converted from the baseline corn-soybean rotation to an alternative CLC cropping system in order to achieve set reductions of 10, 20, 30, 40, and 50% in nitrate-N loads from the watershed compared to the baseline scenario. In addition, we will determine:

- What mix of annual and perennial crops should be planted?
- Where in the watershed should these crops be planted for maximum protection of groundwater?
- What are the environmental impacts of various spatial arrangements of these landscapes?

Activity Milestones:

Description	Approximate Completion Date
Modification of EPIC model to account for CLC crops of interest to stakeholders	December 31, 2027
Collection of nitrate losses from agricultural fields that have adopted CLC crops	June 30, 2028
EPIC simulations of nitrate leaching and co-benefits with and without CLC in Cannon River watershed	June 30, 2028

Activity 3: Evaluating environmental co-benefits of CLC adoption beyond nitrate reduction

Activity Budget: \$124,593

Activity Description:

This activity will evaluate the broader environmental benefits of Continuous Living Cover (CLC) crops, beyond their impact on drinking water in southeastern Minnesota (SE MN). While previous studies have highlighted CLC's potential for water quality improvements, this study will assess additional ecosystem co-benefits using the Integrated Valuation of Ecosystem Services and Tradeoffs (InVEST) model. InVEST is a tool for; (a) modelling nutrient and phosphorus runoff, groundwater recharge potential, and surface water quality impacts of CLC adoption in upper river reaches contributing nitrate loads to SE MN, (b) assessing local recharge potential of CLC, (c) evaluating soil erosion reduction and sediment export to the stream, and (d) assessing habitat quality and biodiversity benefits of different CLC cropping systems, particularly for pollinators. The results will present actionable insights to inform policy decisions on land use practices, ecosystem services, and the long-term sustainability of agricultural systems in the region. The InVEST model is one of the most widely used tools globally for assessing environmental co-benefits of various land-use management practices to enhance societal and ecological resilience.

Activity Milestones:

Description	Approximate		
	Completion Date		
Assessing co-benefits of water quality and recharge using InVEST Nutrient Delivery Model	June 30, 2027		
Assessing co-benefits of water retention/infiltration/recharge - using InVEST Seasonal Water Yield	June 30, 2027		
Model			
Assessing co-benefits of soil erosion control using InVEST Sediment Delivery Model and Daily Erosion	December 31, 2027		
Project			
Assessing co-benefits of biodiversity using InVEST pollinator model	June 30, 2028		

Activity 4: Farm Profitability of CLC Adoption: Current Status, Prospects, and Needs

Activity Budget: \$66,291

Activity Description:

Cropping rotations with continuous living cover (CLC) face challenges due to limited market opportunities and agronomic support compared to conventional crops like corn, soybeans, and wheat. Slow adoption is driven by profitability concerns, highlighting the need for more viable production systems and increased support for ecosystem services. This activity aims to assess the profitability of adding CLC crops to current rotations and identify necessary support for broader adoption.

We will conduct a cost-benefit analysis from three perspectives. First, we will use stakeholder input from Activity 1 and existing cost-return data (e.g., NASS, FINBIN) to evaluate profitability and risks in established grain, fuel, and feed markets. Second, we will factor in payments for ecosystem services (e.g., carbon crediting, EQIP) from Activity 2 and assess the incentive gap preventing adoption. Third, we will consider the full social value of CLC crops, incorporating ecosystem service benefits from Activity 3. These analyses will provide a comprehensive understanding of CLC adoption, the financial support required to achieve nitrate reduction goals, and how current incentives compare to these needs.

Activity Milestones:

Description	Approximate Completion Date
Analysis of profitability and risks of CLC production when current programs for ecosystem service payments	June 30, 2026
Analysis of profitability and risks of CLC production for current grain, fuel, and feed markets.	December 31, 2026
Analysis of social costs and benefits of CLC production when all known externalities and ecosystem	December 31, 2027

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Jennifer Tonko	Clean River Partners	Stakeholder engagement	Yes
Sam Grant	Rainbow Research	Recruiting stakeholders for engagement	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?

The results of this project will build concrete community supported pathways for adopting CLC to protect groundwater from nitrate pollution, based on estimates for how much land would need to be converted from row crops to CLC. Findings will be used to accelerate the adoption of Continuous Living Cover cropping systems to protect groundwater resources from nitrate pollution throughout Goodhue County, the Cannon River watershed and the entire region of southeastern Minnesota. This will be achieved through discussions with interested farming groups, local, county and state agencies, non-governmental organizations, and agribusiness companies. USDA-CIG funding will be sought to implement results.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Scaling a Market-Driven Water-Quality Solution for Row-Crop Farming	M.L. 2022, , Chp. 94, Art. , Sec. 2, Subd. 04n	\$476,000
Water Quality and Robots: Experientially Educating Minnesotan Youth	M.L. 2024, , Chp. 83, Art. , Sec. 2, Subd. 05s	\$353,000

Project Manager and Organization Qualifications

Project Manager Name: David Mulla

Job Title: Professor

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

Dr. Mulla is Professor and Larson Chair for Soil & Water Resources in the Dept. of Soil, Water, and Climate at the Univ. of Minnesota. Dr. Mulla's research emphasizes (1) the transport and modeling of water and nitrates to surface and ground water, (2) impacts of alternative crop production systems and (3) the measurement, modeling and management of soil erosion. In 2010 he led a study for the MN state legislature on nitrogen reduction strategies for protection of surface waters. He also has taken an active role in developing Minnesota's focus on using Continuous Living Cover (CLC) to attain goals for the Nutrient Reduction Strategy.

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

Organization Description:

The College of Food, Agricultural and Natural Resource Sciences (CFANS) at the University of Minnesota Twin Cities is a college focused on food, agriculture, and natural resources, offering 14 majors, 3 pre-majors, and 26 minors, with a strong emphasis on hands-on learning and real-world experience. When we envision a better tomorrow, it includes alternative crops, products that protect our health, groundwater that is healthy to drink, lakes free from invasive species, and so much more. We use science to find answers to the world's grand challenges and solve tomorrow's

problems. Few other public universities come close to the breadth of our expertise, allowing us to tackle challenges in novel ways. We develop leaders that see more possibilities and produce solutions that work for real people. This creates a powerful force for change.

Budget Summary

Category / Name Subcategory Description Purpose or Type		Purpose	Gen. Ineli gible	% Bene fits	# FTE	Class ified Staff?	\$ Amount	
Personnel								
David Mulla/Principal Investigator		Manage Overall project and Lead Activity 2			36.6%	0.08		\$19,910
Nfamara Dampha/Researcher 6		Lead Activity 3 on InVEST modeling of ecosystem benefits of CLC			36.6%	50		\$80,499
Muhammad Tahir/Researcher 6		Lead crop simulation of continuous living cover and impacts on groundwater			36.6%	0.8		\$73,827
Nicholas Jordan/ Professor		Co-PI with responsibility for Activity 1 dealing with stakeholder engagement			36.6%	0.02		\$3,800
Colin Cureton/ Business development specialist	Colin Cureton/ Assist in identifying business implications of Business Continuous Living Cover alternatives development specialist			36.6%	0.02		\$3,286	
Nicholas Gallagher/Asst. Professor	las Lead Activity 4 dealing with farm scale economic gher/Asst. analysis of continuous living cover				36.6%	0.08		\$16,223
TBD/Half-Time Graduate Research Assistant	/Half-Time Assist with farm financial analysis of continuous living cover in Activity 4			23.2%	1		\$46,781	
Philip Adalikwu/postdoc		Responsible for InVEST modeling of ecosystem services associated with continuous living cover			25.9%	35		\$32,658
Steve Advise Activity 3 dealing with InVEST modeling Polasky/Regents Professor			36.6%	0.02		\$7,436		
Mitch Hunter/Asst. Professor		Advise Activity 1 stakeholders on agronomy of continuous living cover alternatives			36.6%	0.02		\$3,301
Andi Sutton/Executive Director RSDP		Lead RSDP and Extension efforts to engage stakeholders			36.6%	0.08		\$10,243
Danielle Piraino/Program Assistant		Engage with SE Minnesota stakeholders on continuous living cover alternatives			32.3%	0.34		\$31,513
							Sub Total	\$329,477

Contracts and							
Services							
Clean River Partners	Service	Facilitation and coordination of community-			2.4		\$123,300
	Contract	engaged processes: project management					
		between different team members: identification.					
		recruiting and relationshin-huilding with					
		stakeholders: connecting research team to					
		stakeholder input and stakeholders to research					
		results, and collecting water quality camples					
Deinker Deservel	Camilaa	Sum and collecting water quality samples.			0.1	!	ć 40.000
Rainbow Research	Service	Support development of, community			0.1		\$48,000
	Contract	engagement in, and facilitation support for a					
		watershed action research process that links					
		CRAC, CRP, SE RSDP, with diverse communities in					
		the region that will benefit from and offer					
		leadership for the health of the Cannon River					
		Watershed					
						Sub	\$171,300
						Total	
Equipment, Tools,							
and Supplies							
						Sub	-
						Total	
Capital							
Expenditures							
•						Sub	-
						Total	
Acquisitions and							
Stewardship							
•						Sub	-
						Total	
Travel In Minnesota						Total	
	Miles/Meals/	15 trips per year for two years combined for Nick	To attend stakeholder engagement				\$1,800
	Lodging	Is this per year for two years combined for Nick	mostings in SE MN				Ş1,800
	Louging	Conservation Agriculture Coordinator Fach trin					
		conservation Agriculture Coordinator. Each trip					
		averages 100 miles at a rate of \$60/day.					44.000
						Sub	\$1,800
				 		Total	
Travel Outside							
Minnesota							
						Sub	-
						Total	

Printing and Publication						
	Printing	1 four page handout per person for 10 persons in each of 15 stakeholder engagement meetings per year for two years	To orient stakeholders and provide background information for discussion.			\$300
	Publication	One scientific publication each year for two years.	Each publications concerns continuous living cover and its ability to protect groundwater from nitrate pollution and provide other ecosystem services			\$4,000
					Sub Total	\$4,300
Other Expenses						
		Room rental for each of 15 stakeholder engagement meetings per year for two years at \$70.77/meeting.	Meeting room rental			\$2,123
		Software licenses for computer simulations, geographic analysis and visualization of results at two licenses per year for two years.	For computer simulations, geographic analysis and visualization of results for continuous living cover impacts and how they vary with geographic location.			\$6,000
					Sub Total	\$8,123
					Grand Total	\$515,000

Classified Staff or Generally Ineligible Expenses

Category/Name Subcategory or Description Type	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: \$515,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component File: <u>1c315b08-cd1.pdf</u>

Alternate Text for Visual Component

Cannon River watershed map showing cultivated row crop areas (orange color) with opportunity for expansion of continuous living cover to reduce nitrate pollution....

Supplemental Attachments

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

Title	File
FP7267MullaLCCMRLOSSigned	<u>3c3f3712-c6c.pdf</u>

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?

No

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, Dept. Soil, Water & Climate, Univ. MN

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