Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-243

Proposal Title: Improving Year-Round Water Quality Downstream of Livestock Pastures

Project Manager Information

Name: Lindsay Pease

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

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Project Basic Information

Project Summary: This project will improve the year-round water quality of livestock runoff through an innovative filter strip design that better removes contaminants, particularly during winter and spring snowmelt events

ENRTF Funds Requested: $847,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Water (B)

Project Location

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

Region(s): NE, NW,

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.

Livestock is critical to Minnesota's economy, but it can also pose water quality concerns from contaminants including phosphorus, nitrate, and bacteria reaching freshwater streams, lakes, and groundwater. Minnesota's Agricultural Best Management Practice (BMP) Handbook (2017) recommends vegetative filter strips for livestock feedlot/wastewater control. Vegetative filter strips are highly effective during the summer months for reducing runoff (Young et al., 1980; Schmidtt et al., 1999). Yet Minnesota's harsh winters challenge the efficacy of vegetative filter strips. Minnesota's intense spring thaw period generates significant snowmelt flooding during a time when vegetation is dormant. Research from Manitoba found vegetative filter strips to be less effective during snowmelt events at reducing contaminants in runoff than during other times of the year (Vanrobaeys et al., 2019). This poses a substantial challenge for preventing and reducing water quality concerns in livestock runoff, particularly in Northern Minnesota. Phosphorus and nitrate loss to surface water threatens downstream ecosystems in Lake Superior and Lake Winnipeg, and bacterial contamination threatens human and animal health along the length of waterways. Livestock producers critically need low-cost, easily implemented solutions that reduce the risk of contaminant runoff from pastures during the spring snowmelt period.

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.

Livestock producers need practical solutions to filtering pasture runoff that are both low-cost and easily implemented. Filtration practices that can easily be deployed along pasture edges are critical for reducing contaminant transport in snowmelt and rainfall runoff. This project evaluates an innovative strategy for improving vegetative filter strip performance during spring snowmelt events: adding a fiber-based sediment barrier to the vegetative filter strip. Sediment barriers are recommended in the Minnesota Stormwater Manual for construction applications to slow water flow, encourage sedimentation, and filter contaminants in runoff water. However, fiber-based sediment barriers have never been evaluated for their ability to reduce contaminants resulting from Minnesota's livestock operations. This project will compare contaminant losses from livestock pastures under three conditions: 1) no-BMP control, 2) vegetative buffer strips alone, 3) vegetative buffer strips with a fiber-based sediment barrier placed in the fall. We hypothesize that adding fiber-based sediment barriers to vegetative buffers strips will improve contaminant reduction in pasture runoff. This project evaluates a practical solution to preventing and addressing contaminant runoff to Minnesota's water resources while demonstrating an innovative practice to reduce water pollution issues across Minnesota. This research provides actionable solutions to cooperatively engage with livestock producers on protecting natural resources.

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 aims to improve the year-round protection of Minnesota's water resources from detrimental effects of livestock production. Improvements in filter strip design will help us to achieve this goal through better contaminant removal in colder months and during snowmelt events. Specifically, this project will:

1) Research how different filter strip designs impact runoff and contaminants from livestock pastures on surface water quality

2) Establish practical, functional solutions that prevent or address impacts of livestock production on freshwater systems

3) Demonstrate how to implement improved filter designs to livestock producers across Minnesota

Activities and Milestones

Activity 1: Evaluate innovative filter strip designs for their impact on bacterial and nutrient loading from livestock pastures

Activity Budget: $838,536

Activity Description:
We will evaluate three filter strip conditions for runoff and contaminant load reduction in replicated pastures at the North Central Research & Outreach Center in Grand Rapids, MN: (1) no buffer or barrier (control treatment) (2) traditional vegetative buffer strips, and (3) vegetative buffer strips with fiber-based sediment barriers. Each treatment will be replicated four times. We will monitor the timing and intensity of surface runoff events by measuring water flow through a flume in each pen. We will also measure nutrient loads (nitrogen and phosphorus), water quality indicators (turbidity and total organic carbon) and bacterial populations (E. coli and high-priority pathogens) present in the runoff of each treatment. To understand barrier performance under different conditions, we will conduct sampling 3-4 times each spring. The project will be repeated for two years to ensure successful performance under varying weather conditions. Additionally, due to the unpredictability of weather from season to season, we will conduct a simulated rainfall experiment in Spring 2028 to ensure that we adequately evaluate practice performance during challenging spring conditions (i.e., rain on frozen ground).

Activity Milestones:

Description	Approximate Completion Date
Establish experimental site with buffer treatments and water quality monitoring systems	October 31, 2027
Rainfall simulation experiment	May 31, 2028
Evaluate performance of different buffer designs	June 30, 2030

Activity 2: Conduct education and outreach on BMPs for reducing contaminants in livestock pasture runoff

Activity Budget: $8,464

Activity Description:
This activity will support outreach & extension efforts for the livestock industry and individual producers. To increase adoption of water quality BMPs in livestock systems, we will use multiple channels for outreach and education:
1. Field day and workshop: During the project, we will highlight the trial and its findings at a field day each summer to demonstrate the technologies and benefits of water conservation practices for livestock production. We will also organize a workshop each winter to provide hands-on training for extension educators, SWCD staff, consultants and others who directly train or help farmers in their management.
2. Extension publications: Extension bulletins, factsheets and blogs will be developed to reach a large audience of growers, consultants, extension educators, general public, state and federal agency personnel.
3. Conferences and other events: We will also demonstrate the outcomes of the project at other local field days, workshops, and conferences around the state (e.g., UMN Extension and the Minnesota Agricultural Water Resource Center's Nutrient Management Conference).
4. Two peer reviewed publications (one focused on nutrient loss reduction and one focused on biological contaminants) based on project findings and results

Activity Milestones:

Description	Approximate Completion Date

Train farmers / local government (SWCDs) in Ag Water Quality BMPs for livestock systems (Year 1)	March 31, 2028
Field Day Demonstration of BMP Design (Year 2)	August 31, 2028
Train farmers / local government (SWCDs) in Ag Water Quality BMPs for livestock systems (Year 2)	March 31, 2029
Field Day Demonstration of BMP Design (Year 3)	August 31, 2029
Train farmers / local government (SWCDs) in Ag Water Quality BMPs for livestock systems (Year 3)	March 31, 2030
Published educational material and design guidance for Extension Educators, SWCDs, and NRCS staff	June 30, 2030
Two peer-reviewed publications on project findings and results	June 30, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Eric Mousel	U of MN	Collaborator	Yes
Gillian Tarr	U of MN	Collaborator	Yes
Yoshika Crider	U of MN	Collaborator	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.
Dissemination of project findings and recommendations is a major goal of this project. Project personnel Dr. Lindsay Pease and Dr. Eric Mousel hold UMN Extension appointments and are located at UMN Research and Outreach Centers. Lindsay Pease is a Nutrient and Water Management Specialist in the Department of Soil, Water, and Climate. Her extension programming engages more than 750 stakeholders annually on nitrogen and phosphorus water quality issues in agriculture. Eric Mousel is a Beef Systems Management Specialist in the Department of Animal Sciences. He organizes several statewide educational programs including Cow Calf Days, the Minnesota Grazing School, and the Fall Beef Roundup. This project will leverage the resources and reach of UMN Extension to disseminate project results through traditional and online platforms.

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?
Results will be implemented through Dr. Pease and Dr. Mousel's UMN Extension Appointments. The UMN Extension platform will provide long-term access to project findings, results, and recommendations. Materials focused on practice implementation will be developed during this project which will continue to be available after the end of this project. Findings and recommendations could also be incorporated into future editions of the Minnesota Agricultural BMP handbook for further reach and impact.

Project Manager and Organization Qualifications

Project Manager Name: Lindsay Pease

Job Title: Associate Professor & Extension Specialist

Provide description of the project manager's qualifications to manage the proposed project.
Dr. Pease is an Associate Professor in the Department of Soil, Water, and Climate at the University of Minnesota Twin Cities. She also holds an Extension appointment as a State Specialist in Nutrient and Water Management. She is stationed at the Northwest Research & Outreach Center in Crookston, MN. She holds a PhD in Agricultural Engineering from The Ohio State University. She is an agricultural water quality expert with 10 years of experience measuring nitrogen and phosphorus loss in surface runoff and subsurface drainage discharge. Dr. Pease's research and extension programming focuses on improving agricultural water quality by adapting best management practices to the unique agricultural systems and climate conditions in Northern Minnesota. Her previous research projects include: adapting cover crops and strip-tillage to sugarbeet fields, using 4R nutrient management to improve agricultural water quality, and evaluating changes in nutrient cycling and water quality following a new subsurface drainage installation in Northwest Minnesota. She is well-qualified to manage the proposed project having successfully led teams to complete both federal- (USDA-NIFA) and state-funded (MDA) projects.

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

Organization Description:
UMN-CFANS is Minnesota's flagship educational institution, with vast expertise for carrying out and promoting research in applied settings. Within CFANS, the Department of Soil, Water, and Climate has a long history of collaboration with greater Minnesota to address agricultural challenges.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Lindsay Pease		PI: Oversee the overall project, buffer strip design, and monitoring layout, and conduct Extension and outreach efforts.			26.8%	0.12		$25,772
Gillian Tarr		Co-PI: Oversee analysis of microbiological samples and statistical analysis of effect; develop qPCR protocol and statistical analysis plan			26.8%	0.15		$31,968
Yoshika Crider		Co-PI: Oversee collection, processing, and evaluation of microbiological samples; develop protocols for these activities			26.8%	0.15		$27,996
Water Quality Researcher		Design water monitoring and sampling set-up, collect water samples during runoff events, and conduct data analysis on nutrient losses			26.8%	0.6		$63,334
Graduate Research Assistant		Collect microbiological samples, evaluate samples for turbidity and E. coli count, conduct qPCR for specific targets of interest, conduct statistical analysis			45%	1.5		$187,890
Undergraduate Research Assistant		Assist with various aspects of data collection, site set-up, and general maintenance			0%	0.36		$15,455
NWROC Research Technician (Pease)		Install water monitoring set-up, collect water samples during runoff events, and conduct laboratory analysis of water samples for nitrogen and phosphorus			24.4%	1.2		$102,232
2 NCROC Research Technicians (Mousel)		Oversee the day-to-day operation of livestock, install buffers, conduct pasture/buffer maintenance, assist with data collection			24.4%	1.5		$122,680
NCROC Farm Animal Attendants		General care and handling of livestock			24.4%	1.05		$107,171
							Sub Total	**$684,498**
Contracts and Services								

CFANS Research Analytical Lab	Internal services or fees (uncommon)	Analysis of water samples for Total Organic Carbon (192 samples/year x $14 each x 4 sets/year + $30 set up fee x 2 years)				0		$5,616
Livestock Yardage at North Central Research & Outreach Center	Internal services or fees (uncommon)	Non-feed costs per head per day associated with operating a cattle feeding facility and caring for cattle (120 head x $1 per day for 240 days per year x 2 years)				-		$60,000
TBD	Service Contract	Event rentals (tents, tables, chairs, etc.) for Extension field day				-		$2,000
							Sub Total	**$67,616**
Equipment, Tools, and Supplies								
	Tools and Supplies	48 surface runoff flumes	Materials and supplies for constructing surface runoff collection flumes (e.g., plastic flume material, nalgene bottles): 4 flumes/livestock pen x 12 pens x $50 ea.					$2,400
	Tools and Supplies	24 lysimeters	Lysimeters for pore water sampling: 2 lysimeters per pen x 12 pens x $100 ea.					$2,400
	Tools and Supplies	24 water table well monitors	Water table wells and pressure transducers for groundwater monitoring and sampling: 2 wells per pen x 12 pens x $550 ea.					$13,200
	Tools and Supplies	Soil sampling supplies	Consumables for soil sampling (e.g., bags, labels, probe tips): $500/yr x 2 years					$1,000
	Tools and Supplies	Buffer strip and fiber barrier materials	Materials and supplies for constructing buffer strips and fiber barriers (e.g., seed, bale wrap): $9,000/yr x 2 yrs					$18,000
	Tools and Supplies	Water sampling supplies for nitrogen and phosphorus	Consumables for soil and water sampling in Pease lab for nitrogen and phosphorus (e.g., filters, gloves, reagents, vials): 1368 samples x $3/sample					$4,104
	Tools and Supplies	Water sampling supplies for bacteria	Consumables for bacteria sampling in Tarr/Crider Lab (e.g., nalgene bottles,					$11,269

			ice packs, gloves, petri dishes, funnels, vials)					
	Equipment	1 vacuum manifold	Manifold for vacuum filtering water samples prior to bacterial analysis					$3,056
	Equipment	1 vacuum pump for membrane filtration	Vaccum pump for vacuum filtrating water samples prior to bacterial analysis					$1,300
	Tools and Supplies	Quantitative polymerase chain reaction sampling materials	Materials and supplies to conduct quantitative polymerase chain reaction (qPCR) analysis to detect DNA in water samples: (96 above-strip samples/year + ~50% of below-strip samples) x 8 targets x 2 technical replicates: $6713/yr x 2 years					$13,426
	Equipment	1 Turbidity meter, cuvettes, and standards	Turbidity meter to detect clarity of surface runoff water					$1,663
	Equipment	2 Micropipettes	Micropipettes for water sampling in the Tarr/Crider lab (2 x $500 ea.)					$1,000
	Tools and Supplies	Materials and supplies for hosting extension events	Materials and supplies to improve the overall quality and educational outcomes of extension events (e.g., AV supplies, printed educational materials)					$4,000
	Tools and Supplies	Postage	Postage and sample shipment between locations: $750/yr x 2 years					$1,500
							Sub Total	**$78,318**
Capital Equipment								
							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	320 mi/trip x $0.725/mi x 4 trips/yr x 2 yr	Mileage for one vehicle to travel from Crookston to Grand Rapids for water sampling by Pease's team four times per year for two years					$1,856

	Miles/ Meals/ Lodging	1 person x $147/night x 4 nights/yr x 2 years	Lodging for one person per year for two years from Pease's research team to conduct water quality sampling in Grand Rapids					$1,176
	Miles/ Meals/ Lodging	360 mi/trip x $0.725/mi x 4 trips/yr x 2 yr	Mileage for one vehicle to travel from St Paul to Grand Rapids for water sampling by Tarr and Crider's team four times per year for two years					$2,088
	Miles/ Meals/ Lodging	2 people x $147/night x 4 nights/yr x 2 years	Lodging for two people per year for two years from Tarr and Crider's research team to conduct water quality sampling in Grand Rapids					$2,352
	Miles/ Meals/ Lodging	2 people x $51/day x 8 days/yr x 2 years	Meals and incidental expenses for two people per year for two years from Tarr and Crider's research team to conduct water quality sampling in Grand Rapids					$1,632
	Miles/ Meals/ Lodging	320 mi/trip x $0.725/mi x 2 trips = $464	Mileage within Minnesota for Pease to attend extension/outreach events in Grand Rapids (one trip per year for two years)					$464
							Sub Total	**$9,568**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	2 peer-reviewed manuscripts	Publication fees and page charges for two peer-reviewed manucripts (2 x $3500 each)					$7,000
							Sub Total	**$7,000**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$847,000**

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	**-**

Total Project Cost: $847,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: 889c4efb-2b3.pdf

Alternate Text for Visual Component

An aerial image of the livestock pasture and water sampling layout including proposed locations of fiber barriers and vegetative filter strips....

Supplemental Attachments

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

Title	File
Letter from UMN Sponsored Projects Administration	eb3e460a-d76.pdf

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:

N/A

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