Environment and Natural Resources Trust Fund

2026 Request for Proposal

General Information

Proposal ID: 2026-323

Proposal Title: Streambank Scour Effects of Reed Canary Grass

Project Manager Information

Name: Melissa Green

Organization: U of MN - St. Anthony Falls Laboratory

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Project Basic Information

Project Summary: Flume and field-scale experimental stream measurements will quantify effects of reed canary grass and other streambank vegetation on streamflow patterns and bank erosion to inform Minnesota stream and floodplain restoration.

ENRTF Funds Requested: $298,000

Proposed Project Completion: June 30, 2028

LCCMR Funding Category: Small Projects (G)
Secondary Category: Water (B)

Project Location

What is the best scale for describing where your work will take place?
Region(s): Metro

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.

Reed canary grass (RCG; Phalaris arundinacea) is an aggressive plant that can thrive along stream and river banks in Minnesota that have seen increased flooding and nutrient pollution in recent decades. Although native to MN, RCG often grows as a dense monoculture, outcompeting other native floodplain and streambank vegetation. Young maple and oak tree seedlings have trouble taking root in the floods, and the dense RCG root structure also works to restrict these and other plant species.

This grass monoculture has detrimental domino effects on Minnesota rivers and floodplains. The suppression of floodplain tree canopy is a documented loss of wildlife habitat, but it also decreases shading, increasing temperatures in soil and water systems. Streambank vegetation creates regions of water deceleration and recirculation in rivers and streams that can change scour and sediment deposition patterns, fundamentally changing the streambank shape.

While research exists on the biology of RCG, there is a need for a systematic study of how it interacts with water flow and streambank morphology.
- What streamflow patterns are associated with RCG monoculture vs. alternatives?
- How do these patterns affect erosion and streambank shape?
- How do these impacts affect restoration goals and vegetation management needs?

What is your proposed solution to the problem or opportunity discussed above? Introduce us to the work you are seeking funding to do. You will be asked to expand on this proposed solution in Activities & Milestones.

We will use both a flume model streambank and a field-scale experimental stream to measure water flow around RCG and other emergent vegetation. Flume experiments allow us to systematically change the flow rate, and the experimental model has been designed to study the effects of changing vegetation composition and bank angle. 2D flow fields will be measured along the bank or across the stream, revealing regions in which deceleration would allow for deposition, or recirculation could enhance scour effects and sharpen the bank angle over time. Changing vegetation characteristics of the model enables evaluation of how these patterns depend on vegetation size, density, and flexibility, which will correlate with known species observed in Minnesota floodplains and streambanks.

Flume model measurements will be augmented with measurements in SAFL's Outdoor StreamLab, in which patches of RCG have already grown. OSL measurements will include velocity and turbulence, and stream and channel morphology in patches of RCG and within the planted native vegetation under a range of flows from low flow to overbank floods. These measurements will validate the physical model being used in the water channel experiments using measurements around real vegetation, and guide future model upgrades.

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?

Major investments are being made for stream restoration projects across Minnesota and vegetation management is a critical component of many of these projects. While reed canary grass was previously planted widely for erosion control, the effect of RCG on streambank processes and instream habitat is not well documented. This project will provide critical information about the impact of reed canary grass flow and streambank shape (morphology) to help guide vegetation management in stream and floodplain restoration projects. We will share the project outcomes via peer reviewed publications, presentations, a public seminar, and a public website.

Activities and Milestones

Activity 1: Flow measurements around a laboratory streambank model

Activity Budget: $188,942

Activity Description:
As part of his senior Honors Capstone, a University of Minnesota student has designed a prototype of the experimental streambank and vegetation model. As shown in the attached figure, the student has built the model and installed it in a flume with plans for preliminary data collection in spring 2025. Relevant design parameters such as RCG stem diameter and spacing were collected from literature and previous field measurements. We will use particle image velocimetry (PIV) to measure 2D flow velocity fields both along and perpendicular to the stream direction. The necessary equipment for these measurements are available for use in this flume.

This platform has been designed to enable variations in two parameters:
1. A mechanism to vary bank angle: flow will be measured around model streams of different shapes, and around bank shapes that may emerge due to observed scour or deposition.
2. Vegetation models of different size, material, and spacing: uniformly spaced RCG monoculture patterns (shown in figure) will be used as baseline. By the end of the project we will swap in polyculture models (different grasses, some larger diameter tree models) for a direct comparison with the flow patterns that would have dominated before invasive RCG patches

Activity Milestones:

Description	Approximate Completion Date
Platform update design and construction	October 31, 2026
Flow around Reed canary grass-like vegetation	February 28, 2027
Flow around flexible vegetation model	August 31, 2027
Flow around polyculture-like vegetation	June 30, 2028

Activity 2: Outdoor StreamLab bank measurements

Activity Budget: $100,340

Activity Description:
In activity 2, researchers will collect flow and turbulence measurements around RCG and other native streambank vegetation in the Outdoor StreamLab (OSL) at St. Anthony Falls Laboratory. This unique experimental stream and floodplain allows for controlled flooding experiments in a natural environment. We will use an acoustic Doppler velocimeter (ADV) to measure flows around well established vegetation at a range of flows from baseflow to overbank floods.

This information will be used to:
1. Verify water channel observations with real vegetation,
2. Relate flow and erosion processes to vegetation characteristics (stem density, stem diameter, stem shape and stem flexibility), and
3. Relate flow and turbulence characteristics to channel and bank morphology (shape).

We will map water surface elevation and bed and bank topography with cm-resolution in areas with different types of vegetation using a specialized computer controlled carriage and will relate the current topography to past topographic data (collected in 2009, 2010, 2011, 2016, 2019) to quantify bank migration rates. Together, these data will provide

critical information on the influence of RCG on streambank erosion, stream and bank morphology, and in-stream habitat across a range of flows to support decision making on vegetation management plans for stream restoration.

Activity Milestones:

Description	Approximate Completion Date
Flow measurements around Reed canary grass	August 31, 2027
Flow measurements around other streambank vegetation	September 30, 2027
Bank and stream morphology with different vegetation	October 31, 2027

Activity 3: Results dissemination and communication

Activity Budget: $8,718

Activity Description:
Funds are requested to support travel for two project participants to the Minnesota Water Resources Conference each year to present project methods, results, and recommendations. Project participants will also attend the Upper Midwest Stream Restoration Symposium in spring 2027, of which co-PI Kozarek is an organizer (and therefore registration costs are assumed to be waived). In addition, we plan to engage the local community via the SAFL seminars and workshops. In particular, we will work with SAFL staff to have student participants present at its “Tiny Lunch Talks” series, and to host a talk to which representatives from MN DNR and watershed organizations, as well as local consultants, will be invited.

For wider distribution, the materials generated as part of the proposed work will be organized and formatted for a descriptive public-facing web page that will be hosted on University of Minnesota servers. These materials will include results and figures, summarized and contextualized with respect to ongoing restoration efforts. Raw data and engineering designs of the model platform will also be available and linked to via that site.

Activity Milestones:

Description	Approximate Completion Date
Leverage SAFL seminar series to present results to broader audience	June 30, 2028
Creation of public-facing website describing experiments and findings	June 30, 2028

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Jessica Kozarek	U of MN - St. Anthony Falls Laboratory	Manage Outdoor StreamLab experiments and co-advise students	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 proposed work is an extension of a UMN Honors Capstone project co-advised by PIs Green and Kozarek that yielded an experimental platform designed to model the size and density of RCG on Minnesota streambanks. No additional funds will be needed for the completion of the proposed work: using the platform to detail interactions among flow, vegetation, and streambank morphology at lab scale and in the field-scale OSL. This emerging collaboration, however, is expected to facilitate future projects motivated by similar questions. Where possible, the built platform will be available for new projects on different vegetation types and streambank shapes.

Project Manager and Organization Qualifications

Project Manager Name: Melissa Green

Job Title: Associate Professor

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

PI Melissa Green is an Associate Professor in Aerospace Engineering & Mechanics at the University of Minnesota, and an Affiliated Faculty of SAFL. She joined UMN in the fall of 2021, after starting her faculty career in Mechanical & Aerospace Engineering at Syracuse University in 2012. Prior to that, she received her PhD in Mechanical & Aerospace Engineering at Princeton and was an NAS/NRC Postdoctoral Research Associate at the Naval Research Laboratory. She received the Air Force Office of Scientific Research Young Investigator Award in 2014, and was selected as an Associate Fellow of AIAA in 2020. She won her department's teaching award in 2015 and 2020, and the Dean's Award for Excellence in Engineering Education in 2016.

Green's research interests are in the field of experimental fluid dynamics, particularly in vortex-dominated and bio-inspired applications. Her research group has expertise in water tunnel experiments, and they study problems where large-scale flow separation and vortex dynamics are strongly correlated with engineering characteristics such as power, efficiency, mixing, and noise. Her research group has a reputation of synthesizing many different sources and types of data for deeper physical understanding of unsteady fluid dynamics phenomena. Their work has been published in the Journal of Fluid Mechanics, Chaos, Experiments in Fluids, Marine Technology Society Journal, AIAA Journal, Physical Review Fluids, and the Journal of Geophysical Research: Oceans.

Co-PI Jessica Kozarek is a research associate and manager of the Outdoor StreamLab at the University of Minnesota at SAFL since 2010. She received a BS in chemical engineering from Penn State, and MS and PhD degrees in biological systems engineering from Virginia Tech. Dr. Kozarek's primary research interests are in the areas of stream restoration and management; ecohydraulics; interactions between flow, sediment, and aquatic biota and vegetation.

Organization: U of MN - St. Anthony Falls Laboratory

Organization Description:

The St. Anthony Falls Laboratory (SAFL) is an interdisciplinary research lab and educational facility under the College of

Science and Engineering at the University of Minnesota. The lab provides facilities, technical support, and community connection for researchers tackling questions with past and potential impact on policy and infrastructure at state, federal, and global levels.

SAFL Associated Faculty come from departments across UMN, and their research interests span fundamental fluid mechanics, hydrology, granular media, geomorphology, ecology, and climate. SAFL maintains an Applied Research & Engineering team who support their own projects and clients while also assisting faculty research.

SAFL is able to divert Mississippi River water from above the falls into the building's experimental facilities. There are several channels and flumes and a full machine shop. The Outdoor StreamLab (OSL) is a stream channel and floodplain system developed by SAFL and the National Center for Earth-surface Dynamics that offers laboratory-quality measurements and control in a field-scale setting. Water flows in from the Mississippi at rates up to 1,200 liters per second, through the OSL channel and floodplain, a sediment settling basin, and back into the River. It enables research opportunities such as channel & floodplain interactions, vegetation & channel dynamics, and biogeochemical processes.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	$ Amount
Personnel								
Melissa Green		PI and project manager. Advising graduate and undergraduate students.			36.6%	22		$45,700
Jess Kozarek		Co-PI and manager of Outdoor StreamLab measurements. Co-advising graduate and undergraduate studnents.			36.6%	44		$60,386
Dick Christopher		Engineering support for Outdoor Streamlab experiments			36.6%	0.6		$7,114
Erik Steen		Engineering support for Outdoor StreamLab experiments			36.6%	0.6		$8,165
Chris Milliren		Instrumentation support for Outdoor StreamLab measurements			36.6%	0.9		$6,729
Jim Tucker		SAFL engineering technician			32.3%	0.5		$7,571
Graduate Student		Perform flume measurements, data analysis, and communication			36.6%	1		$119,205
Undergraduate Students		Support both flume experiments and Outdoor StreamLab measurements. Data and communication materials organized for public website.			0%	0.9		$28,560
							Sub Total	**$283,430**
Contracts and Services								
							Sub Total	**-**
Equipment, Tools, and Supplies								
	Tools and Supplies	Supplies for flume and field-scale measurements.	Large scale equipment is already available, but funds are requested for to purchase parts to build, augment, or maintain lab and field experiments					$7,254
							Sub Total	**$7,254**
Capital Expenditures								

							Sub Total	**-**
Acquisitions and Stewardship								
							Sub Total	**-**
Travel In Minnesota								
	Miles/ Meals/ Lodging	Travel for one local conference per year: the Minnesota Water Resources Conference. Funds requested to support 2 people attending the meeting, including registration ($500 ea.) and meals and incidentals for 2 days. Current Saint Paul per diem M&I rate used ($79/day).	Communication of project methods and results.					$2,316
							Sub Total	**$2,316**
Travel Outside Minnesota								
							Sub Total	**-**
Printing and Publication								
	Publication	Publication fees	Funds requested to support open access publication of 1 archival journal paper per year from this project. Cost of $2500 based on previous expenses from related publishers.					$5,000
							Sub Total	**$5,000**
Other Expenses								
							Sub Total	**-**
							Grand Total	**$298,000**

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: $298,000

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: b6939954-106.pdf

Alternate Text for Visual Component

Top left: Representative photos of reed canary grass from Shoreview, MN. Top right: photo of Outdoor StreamLab. Bottom left: schematics of vegetation and different streambank shapes. Bottom center: engineering drawings of experimental platform. Bottom right: photo of platform installed in water channel facility....

Supplemental Attachments

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

Title	File
LCCRM UMN Letter of Intent	dad3167d-7b4.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:

Jessica Kozarek, Angela Boutch, UMN St. Anthony Falls Laboratory

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

N/A