



Environment and Natural Resources Trust Fund

2027 Request for Proposal

General Information

Proposal ID: 2027-400

Proposal Title: Investigating Big Waves' Impacts on Native Aquatic Plants

Project Manager Information

Name: Jake Walsh

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

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Project Basic Information

Project Summary: We will investigate the impacts of wakeboat waves on aquatic plants in Minnesota lakes, performing experiments to quantify thresholds for plant damage and mortality under different ecological and boating scenarios.

ENRTF Funds Requested: \$664,000

Proposed Project Completion: June 30, 2030

LCCMR Funding Category: Fish and Wildlife (D)

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?

During the Project

Narrative

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

Native aquatic plants support healthy Minnesota lakes by providing habitat for insects and fish, clearer water, and lower nutrient pollution and are themselves a major component of the state's biodiversity. Aquatic plants also absorb energy created by storm waves, boat wakes, and natural currents, shielding the lake bottom and shorelines. However, if these forces are too large, plants can be damaged or destroyed, removing this shielding capacity and other plant services. These damage thresholds are not well understood. As a result, stakeholders cannot account for the potential risk to plant services alongside recreational benefits of boating activities as they make lake management decisions.

Potentially damaging "big waves" in Minnesota lakes are increasing due to both natural (e.g., more wind gusts) and human-driven processes (e.g., more recreational activity and more powerful boats). Due to their power and mode of operation, increasingly popular wakesurf boats are especially likely to increase wave and propeller wash energy and the depths these forces penetrate. The University of Minnesota (ENRTF-funded) has documented the complete uprooting of plants by wakesurfing at greater depths than non-wakesurf boats. Quantifying the potential for big waves to damage plants is necessary to protect Minnesota lakes' biodiversity and ecosystem services.

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 collect some of the first-of-its-kind data on the interactions between native aquatic plants and natural and recreational waves and wash. We will quantify the damage to plants caused by big waves and the ameliorating role that plants play in energy dissipation that protects shorelines and lake bottoms. Crucially, the project will identify boating conditions and operations that lead to damage and mortality of aquatic plants, giving lake managers, boaters, policymakers, and other stakeholders the information they need to balance recreational interests with the need to protect our valuable waters.

Through careful in-lake experimentation and observation, we will document the physical properties of different plant species (e.g., distribution, growth form, life stage, stem and root size, strength, and flexibility), measure the natural and recreational waves entering the site (e.g., height, energy, and velocity), and measure how plants dissipate wave energy through sensors and cameras. To understand damages by big waves, we will inventory and mark plants before and after experimental pass-overs by different boat types and modes of operation. This will allow us to quantify damage and mortality, identify which species are most vulnerable to waves' impacts, and relate differences to plant traits.

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 will co-develop new informational products and guidance for Minnesota citizens that use and manage lakes. The research will contribute:

- Awareness of important native aquatic plants, what they look like, where they are typically found, and how they benefit lakes,
- Underwater videos showing how waves and currents move and interact with plants,
- Accessible media on how plants protect shorelines and the lakebed by absorbing energy from waves,
- Documentation of what conditions lead to "big waves" that damage aquatic plants, and
- Guidelines for recreational use that minimizes harm and supports healthy aquatic vegetation.

Activities and Milestones

Activity 1: Co-develop research plans and select field sites

Activity Budget: \$180,721

Activity Description:

We will select our study lake based on its aquatic plant community, management and monitoring history, recreational activities, and potential to provide multiple informative study sites. After selecting our study lake, we will identify local managers to co-develop relevant research approaches and products. With local partner guidance, we will conduct field reconnaissance to finalize field sites. Selection will also be based on criteria defined by the team including aquatic plant management history, shoreline slope, lakebed material, site access, plant community composition, and how recreational activities are conducted on the lake. We will scout field sites with meandering rake toss surveys to identify plants and characterize their distribution and Ekman grabs for sediment characterization.

Over the winter months, the team will develop instrumentation pads to deploy during testing that include wave monitoring, bottom substrate sampling, nearbed velocity measurements and underwater cameras. The systems will be ready to deploy at the beginning of Activity 2. We will also hold regular meetings with project external advisors and local partners to develop the research, plan ongoing outreach with the local community, and finalize research products and dissemination efforts for Activities 2 and 3.

Activity Milestones:

Description	Approximate Completion Date
Select study lake and identify local partners	August 31, 2027
Scout and characterize field sites	October 31, 2027
Develop instrumentation	March 31, 2028
Meet with partners and advisors to co-develop relevant research products	March 31, 2028

Activity 2: Quantifying energy absorption services of aquatic plants

Activity Budget: \$238,401

Activity Description:

The first field season will focus on interactions between water motion and native aquatic plants over a range of depths, sediments, and plant communities and densities. This activity will focus on interactions that are below the threshold for damage to aquatic plants. Aquatic plant patches will be studied at three depths extending roughly perpendicular from shoreline. Data will be collected using velocity sensors near the lakebed and underwater cameras. A surface mast will record wave height and wave period. Divers will document plant species, density, and physical properties. In general, we will seek to document wave energy and quantify how energy is damped, velocities reduced, and lakebed sediments and shorelines shielded as waves move through each of the aquatic plant patches. We will quantify the energy absorption services of plants for an open-access, peer-reviewed journal article that we will disseminate through partner meetings and Minnesota lake conferences.

Activity Milestones:

Description	Approximate Completion Date
Field tests of plant energy absorption	October 31, 2028
Data analysis and manuscript drafting	March 31, 2029
Dissemination to partners and Minnesota lake communities	March 31, 2029

Activity 3: Quantifying thresholds of big wave damage to aquatic plants

Activity Budget: \$244,878

Activity Description:

The second field season will focus on studying big waves and force thresholds that cause damage to aquatic plants. First, we will finalize our study sites for boat pass-over trials in 5, 10, 15, and 20 feet of water. Using diving and snorkeling surveys, we will fully characterize the sediments and plant communities of these sites, including counting and marking rooted plants. Re-surveying and counting marked plants after boat pass-over trials will allow us to determine which species and what plant traits are most vulnerable to big waves. During these trials, we will use sensors to measure hydrodynamics and an underwater remotely operated vehicle (MAISRC, free to use for LCCMR projects) and stationary cameras to further document plant damage and mortality. We will quantify plant mortality and relate it to big wave force and plant characteristics for an open-access, peer-reviewed journal article that we will disseminate through partner meetings and Minnesota lake conferences.

Activity Milestones:

Description	Approximate Completion Date
Site characterization	July 31, 2029
Boat pass-over trials	October 31, 2029
Data analysis and article writing	March 31, 2030
Dissemination with partners and Minnesota lake communities	June 30, 2030

Project Partners and Collaborators

Name	Organization	Role	Receiving Funds
Dan Larkin	UMN Dept. of Fisheries, Wildlife, and Conservation Biology	co-PI	Yes
Naomi Blinick	UMN Dept. of Fisheries, Wildlife, and Conservation Biology	Dive team lead, field support	Yes
Jeff Marr	UMN St. Anthony Falls Laboratory	co-PI	Yes
Andrew Riesgraf	UMN St. Anthony Falls Laboratory	co-PI	Yes
Judy Yang	UMN St. Anthony Falls Laboratory	Faculty Advisor	Yes
Chris Milliren	UMN St. Anthony Falls Laboratory	Engineer	Yes
Madigan Rios	UMN St. Anthony Falls Laboratory	Engineer	Yes
Ben Erickson	UMN St. Anthony Falls Laboratory	Technician	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.

All data and manuscripts will be co-developed with local and State partners and published in publicly available data repositories and open access journals.

We will present at annual lake management conferences in the off seasons of 2028-2029 and 2029-2030. Minnesota has several practitioner-focused conferences where SAFL has presented the early phases of this work to inform managers, citizens, and applied researchers. The PhD student will present at one of these conferences, and PI Walsh will present results at multiple others.

With input from our local partners and external advisors, we will identify valuable products and design accessible media (e.g., project webpage, handouts, short informational videos or longer-format recorded webinars) to disseminate results regarding the importance of aquatic plants and research-based strategies to protect them, especially as they relate to safe boating behaviors. SAFL has already worked with the MNDNR to inform safe boating behaviors in the Boat and Water Safety education course.

ENRTF will be acknowledged in all dissemination activities and products as per the ENRTF Acknowledgement Guidelines.

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 will partner with local lake managers and citizen groups to co-develop research products that directly serve decision-making that balances recreation and lake protection. We will build these partnerships as we select our research study site. In addition to informing recreational activity on lakes, these products will also support shoreline management in Minnesota.

Managing the increasing number and effect of big waves is not unique to Minnesota, and we will continue collaboration with Upper Midwest managers and researchers to explore federal funding sources to study the effects and management of big waves at the regional or national scale.

Other ENRTF Appropriations Awarded in the Last Six Years

Name	Appropriation	Amount Awarded
Wind Wave and Boating Impacts on Inland Lakes	M.L. 2023, , Chp. 60, Art. 2, Sec. 2, Subd. 04c	\$415,000
Operationalizing State Zooplankton Data to Support Lake Health	M.L. 2025, First Special Session, Chp. 1, Art. 2, Sec. 2, Subd. 03dd	\$423,000

Project Manager and Organization Qualifications

Project Manager Name: Jake Walsh

Job Title: Assistant Professor

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

Dr. Jake Walsh is an assistant professor in the Department of Fisheries, Wildlife, and Conservation Biology at the University of Minnesota. Dr. Walsh has been studying lake ecology and stewardship for 16 years with two dozen peer-reviewed publications and several white paper reports for partnership organizations. His lab focuses on lake ecology and management in partnership with the State of Minnesota, Tribes, local governments, and lake organizations, especially in support of aquatic invasive species (AIS) and water quality management. He leads projects (totaling \$1.1M) focused on understanding and evaluating lake responses to aquatic plant management and common carp removal, often by pairing statewide and local datasets on lake water quality, aquatic plants, watershed land use, fishes, and zooplankton. His lab is developing new methods to understand changes in lakes through rapid collection of zooplankton community data through an ongoing LCCMR project. Prior to joining UMN, he spent three years as the MN DNR AIS Research & Grants Coordinator where he built relationships across the State with DNR and local managers and citizen groups that form the foundation of his research today.

Dr. Walsh specializes in partner-driven research focused on data synthesis and co-designing monitoring and analytical frameworks that address both research and management questions. His perspective working with lake groups and local managers to monitor lake water quality and aquatic plants will complement the skillsets of St. Anthony Falls Laboratory co-PIs in designing careful field experiments grounded in physical limnology and engineering.

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

Organization Description:

This work will be conducted in the UMN College of Food, Agricultural, and Natural Resources Sciences (CFANS)

Department of Fisheries, Wildlife, and Conservation Biology (FWCB) and the UMN College of Science and Engineering (CSE) St. Anthony Falls Laboratory (SAFL). CFANS works to advance Minnesota as a global leader in food, agriculture, and natural resources management through extraordinary education, science-based solutions, and dynamic public engagement that nourishes people and enhances the environment in which we live. FWCB provides multidisciplinary research to advance informed natural resources decision-making about animal populations and the habitats and landscapes they depend on. CSE is uniquely positioned to provide the vision, leadership, and intellectual capital that underwrite progress in the 21st Century. SAFL supports innovative solutions to the world's most critical environmental and engineering challenges through careful experimentation and computation that transforms the complexity of natural environments into accessible research.

Budget Summary

Category / Name	Subcategory or Type	Description	Purpose	Gen. Ineligible	% Benefits	# FTE	Classified Staff?	\$ Amount
Personnel								
Jake Walsh (lead PI)		Project management, supervise Blinick, and advise PhD student			36.6%	0.24		\$48,015
Daniel Larkin (co-PI)		Advise on research			36.6%	0.12		\$31,068
PhD Student		Design PhD thesis around project activities, co-lead field program with SAFL staff			24.2%	3		\$178,133
Naomi Blinick (Dive Team Lead)		Dive team lead, field and project support			36.6%	0.9		\$107,238
FWCB Undergraduate Technician		Support Blinick, PhD student, and SAFL team in summer field seasons			0%	0.54		\$36,000
Jeff Marr (co-PI)		Research team member leading hydrodynamic measurement within aquatic plants, data analysis			36.6%	0.18		\$32,482
Andrew Riesgraf (co-PI)		Scientist performing underwater assessment, site selection, data processing			36.6%	0.78		\$92,431
Chris Milliren (Engineer)		Engineer supporting drone technology and environmental monitoring systems, GPS and app-based boat tracking analysis			36.6%	0.15		\$17,355
Judy Yang		Faculty advising on in-situ velocity and wave measurements and data processing			36.6%	0.12		\$25,484
Madigan Rios		Engineer supporting field data collection and preliminary analysis.			32.3%	0.06		\$4,411
Ben Erickson (Technician)		Technician and safety officer supporting field gear preparation, safety training, and field coordination for Activity 1 field deployments.			32.3%	0.12		\$13,579
							Sub Total	\$586,196
Contracts and Services								
Adventure Scuba and Travel	Service Contract	Pool rental for 2.5 training days at \$400 per day				0		\$1,000
Renter to be determined	Service Contract	We will rent a wakeboat for Activities 2 and 3. \$200-300 per hour, 20 hours in '28, 40 hours in '29.				-		\$18,000

University of Minnesota Research Analytical Laboratory	Service Contract	Water and soil analysis				-		\$3,000
Contractor to be determined	Service Contract	Year 2 and 3 Sensor and Equipment Maintenance				0		\$2,000
Contractor to be determined	Service Contract	FWCB pontoon maintenance and repair				-		\$1,000
Contractor to be determined	Service Contract	Dive kit service and maintenance for three at \$200/year/kit				-		\$1,800
Contractor to be determined	Service Contract	Air tank service fee for three at \$25/tank/year				-		\$225
							Sub Total	\$27,025
Equipment, Tools, and Supplies								
	Tools and Supplies	FWCB pontoon gas	Walsh/Hansen Lab Research Pontoon will be used for all FWCB field activities.					\$500
	Equipment	Dive equipment (flippers, masks, snorkels)	For three divers @ \$500 each					\$1,500
	Equipment	DAN oxygen kit rental	Safety and first-aid for emergency situations					\$200
	Tools and Supplies	Air fills	6 tanks per day for a team of 2, \$11 per tank to fill, 10 days in '27, 15 days in '28, and 25 days in '29					\$3,300
	Tools and Supplies	Supplies for SAFL research work boat	Outfit the work boat for project activities					\$1,000
	Equipment	Survey equipment	anchors, lines, and buoys for survey work					\$1,206
	Tools and Supplies	SAFL research boat gas	The SAFL research work boat will be used for project activities					\$200
	Equipment	Wave sensor system	Used to observe wave energy, height, length					\$2,000
	Equipment	Velocity sensors	Measure wave velocity and energy					\$2,000
	Equipment	Mounting for velocity sensors	Used to place velocity sensors in the water					\$1,500
	Tools and Supplies	Turbidity meter supplies	Maintenance and use costs for turbidity meter					\$300
	Equipment	Radios	Onwater communication between FWCB and SAFL boats					\$250

	Tools and Supplies	General field supplies	field note books, labels, sample bags, storage bins					\$400
							Sub Total	\$14,356
Capital Equipment								
		Nortek Vector + ADV	High-accuracy single-point current meter that is capable of acquiring 3D velocity in a very small volume at rates up to 64 Hz	X				\$25,000
							Sub Total	\$25,000
Acquisitions and Stewardship								
							Sub Total	-
Travel In Minnesota								
	Miles/ Meals/ Lodging	SAFL travel for research	Local travel to study lake (~50 mi round trip), roughly 3 field days per week over 12 weeks in June, July, August each year; 0.725/mi					\$3,915
	Miles/ Meals/ Lodging	FWCB travel for research	Local travel to study lake (~50 mi round trip), roughly 3 field days per week over 12 weeks in June, July, August each year; 0.725/mi					\$3,915
	Conference Registration Miles/ Meals/ Lodging	Conference travel for PhD student.	Disseminate results. Conference registration, lodging, and travel for NALMS (ex: Duluth, MN). \$550 registration. Three nights lodging at \$220 per night (\$660). Per diem (First and last day $64.5 \times 2 + 86 = \$215$). Mileage 0.725×300 miles (\$217.5).					\$1,643
	Other	Dive certification training for 3 at \$650 each	Initial dive certification training for dive team, Blinick will lead scientific diving training					\$1,950
							Sub Total	\$11,423
Travel Outside Minnesota								

							Sub Total	-
Printing and Publication								
							Sub Total	-
Other Expenses								
							Sub Total	-
							Grand Total	\$664,000

Classified Staff or Generally Ineligible Expenses

Category/Name	Subcategory or Type	Description	Justification Ineligible Expense or Classified Staff Request
Capital Equipment		Nortek Vector + ADV	SAFL needs one additional ADV to conduct the work in Activities 2 and 3. Additional Explanation : This is an additional sensor to increase SAFL capacity for Activities 2 and 3, and for SAFL research beyond this project.

Non ENRTF Funds

Category	Specific Source	Use	Status	Amount
State				
			State Sub Total	-
Non-State				
In-Kind	University of Minnesota foregone indirect costs (54% MTDC)	Administrative costs associated with support of research activities including payroll and human resources, finance, facilities, and IT. If this award is reduced from the requested amount, the proposed cost sharing will be reduced proportionately.	Secured	\$310,765
			Non State Sub Total	\$310,765
			Funds Total	\$310,765

Total Project Cost: \$974,765

This amount accurately reflects total project cost?

Yes

Attachments

Required Attachments

Visual Component

File: [c2e3916b-55c.pdf](#)

Alternate Text for Visual Component

Top-left photo: boat wake labeled "big waves". Top-right photo: sensor on a lake bottom labeled "bed disruption". Bottom-left photo: same sensor clouded by suspended sediment and broken plant fragments labeled "vegetation disruption". Bottom-right photo: a diver completing a native plant survey labeled "investigate the impacts on native aquatic plants"....

Supplemental Attachments

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

Title	File
Letter_MLR_JeffForester	332f463b-386.pdf
Letter_UMN-SPA	3517d63e-41c.pdf
Letter_ThreeRivers_BrianVlach	0898b0e1-839.pdf
Letter_MNCOLA_JoeShneider	56b8a465-464.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:

Jake Walsh, Jeff Marr, Andy Riesgraf, Daniel Larkin, Jared Langer (all University of Minnesota)

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