Environment and Natural Resources Trust Fund
2019 Request for Proposals (RFP)

Project Title: **ENRTF ID: 219-F**

Use Floating Mini-Islands for Wetland Restoration

Category: F. Methods to Protect, Restore, and Enhance Land, Water, and Habitat

Sub-Category:

Total Project Budget: $ 312,228

Proposed Project Time Period for the Funding Requested: June 30, 2022 (3 yrs)

Summary:

We propose a new method of wetland restoration using floating mini-islands. We will deploy mini-islands to collect data, develop model to predict wetland growth, and demonstrate the strategy in practice.

Name: Lian Shen

Sponsoring Organization: U of MN

Title: Director and Professor

Department: St. Anthony Falls Laboratory

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Location

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Motivation: floating mini-islands can help rebuild ecosystem and restore wetland. Research tasks: we will conduct experiments, develop prediction model, and provide guideline on how to deploy mini-islands in practice.

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____%
____ If under $200,000, waive presentation?			

PROJECT TITLE: Use Floating Mini-Islands for Wetland Restoration

I. PROJECT STATEMENT

The objective of the proposed project is to develop a new nature-friendly strategy for wetland restoration by using floating mini-islands nearshore. The mini-islands have the size of three to five feet, made by wooden rafts filled with soils, floating at water surface, and anchored to the lake bottom nearshore to prevent them from drifting away. The soils inside the wooden rafts are seeded with native plants, and the mini-islands are environmentally friendly. Recent studies on the floating mini-islands have shown that they can bring multiple environmental benefits, including:

(1) Effectively reduce the wave energy impacting on the soils of the lake bank to stabilize the shoreline.
(2) Divert the water flow so that sediments and soils can accumulate between the floating mini-islands and shore, which helps the growth of aquatic vegetation for the restoration of wetlands.
(3) Provide habitats for wildlife, such as insects and waterfowl.

Using floating mini-islands nearshore is a cost-effective and nature-friendly approach for wetland restoration. What prevents us from taking further actions in using this method is the lack of data on how fast the aquatic vegetation grows between the floating mini-islands and lake bank, and how the growth rate is influenced by environmental factors such as temperature, wind, and water conditions. It is ineffective to simply introduce this new strategy to practice before more data and reliable prediction models are available to provide a comprehensive guideline on how, when, and where to deploy the floating mini-islands.

The proposed research includes: (1) conducting field experiments and simulations to collect data on the effectiveness of wetland restoration with various mini-island parameters, (2) developing computer software for predicting the wetland growth rate, (3) making an executable plan to apply the new strategy on lakes where wetland restoration is needed.

We will use the unique research resources in the St. Anthony Falls Lab (SAFL) at University of Minnesota to conduct field and numerical experiments to study the environmental flow around floating mini-islands and to develop a wetland restoration strategy. Based on the valuable measurement and simulation data, we will develop effective and accurate models to predict the habitat environment inside wetlands and the landscape evolution of around the mini-islands. We will also select a nearby lake with an urgent need for wetland restoration to measure the environmental conditions near its bank. We will deploy and maintain the mini-islands near the lake bank. We will then monitor the wetland growth of the selected lake, and promote the new strategy of wetland restoration for more lakes in Minnesota.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Collect flow data around mini-islands and monitor sediment and plant evolution.

We will build and deploy a floating mini-island in the stream at SAFL. The sediment deposition and wetland growth will be monitored with a self-timer camera. The data of temperature, wind speed, and water speed will be collected by the measurement devices installed. The measurement data will be incorporated into environmental flow software developed in house at SAFL to simulate the interactions among the mini-island, wind, water, and sediment.

ENRTF BUDGET: $ 90,625

Outcome	Completion Date
1. Build mini-islands and deploy them in the stream at SAFL	July 30, 2020
2. Monitor wetland growth around the mini-islands	Sept 30, 2021
3. Collect flow and temperature data around the mini-islands	Sept 30, 2021
4. Conduct simulation of air-water flow and sediment deposition near the mini-islands	Nov 30, 2021

Activity 2: Develop prediction model for wetland growth rate

We will leverage on the valuable data collected in activity #1 to develop a prediction model for measuring the effectiveness of wetland restoration. The model will be used to predict the growth rate of wetland with floating mini-islands of various sizes and distributions. A comprehensive guideline will then be provided to advice on how and where to deploy the floating mini-islands.

ENRTF BUDGET: $ 153,417

Outcome	Completion Date
1. Analyze the data collected in activity #1 to develop a model for predicting the growth rate of wetland.	Dec 31, 2021
2. Provide guideline on the floating mini-island deployment.	June 30, 2022

Activity 3: Deploy mini-islands near a selected lake bank for further monitoring

We will select a lake for which wetland restoration is urgently needed to deploy mini-island prototypes near its bank. We will measure the environmental conditions near the bank, including the bank topography, wind condition, and current speed. These data will be imported into the model developed in Activity #2 to make an executable plan for deploying and maintaining the mini-islands near the bank. We will monitor the wetland near the mini-islands, and conduct simulations to further improve the wetland restoration strategy.

ENRTF BUDGET: $ 68,186

Outcome	Completion Date
1. Measure environmental conditions of a selected lake bank	June 30, 2021
2. Deploy mini-islands near the selected lake bank	July 30, 2021
3. Monitor the wetland growth around the mini-islands	June 30, 2022

III. PROJECT PARTNERS:

B. Partners NOT receiving ENRTF funding

Name	Title	Affiliation	Role
Chin Wu	Professor	Univ. of Wisconsin	Collect field data in Wisconsin

IV. LONG-TERM- IMPLEMENTATION AND FUNDING:

Minnesota has 11,842 lakes more than 10 acres in size. It has 10.6 million acres of wetlands, an essential part of the state's natural ecosystem and water resources. Wetlands have enormous ecologic and environmental benefits. In 1991, Minnesota passed the Wetlands Conservation Act, which states that there should be no loss in the quantity, quality, and biological diversity of the existing wetlands. Due to the serious situation in bank erosion, it is becoming increasingly urgent to restore wetlands with an effective method. Unfortunately, our knowledge of the habit environment inside wetlands is far from satisfactory, and executable guidance on wetland restoration is insufficient. The long-term impact of this project will be significant. It will overcome the technical barriers to the wide use of planting vegetation on ground and floating platforms in a cost effective way, and thus substantially improve the technology for wetland restoration. The long term strategy of the project is to ensure that the data, design, and model of this project will be provided to state agencies including MPCA, BWSR, and DNR. The results will also be shared with water quality and lake/wetland managers, land owners, and concerned citizens.

V. TIME LINE REQUIREMENTS:

This project is planned for 3 years starting from July 1, 2019 and ending on June 30, 2022.

VI. SEE ADDITIONAL PROPOSAL COMPONENTS:

A. Proposal Budget Spreadsheet
B. Visual Component or Map
F. Project Manager Qualifications and Organization Description

2019 Proposal Budget Spreadsheet

Project Title: Use floating mini-islands for wetland restoration

IV. TOTAL ENRTF REQUEST BUDGET: 3 years

BUDGET ITEM	AMOUNT
Personnel:	$ 295,728
Prof. Lian Shen, project manager (75% salary, 25% benefit); 6.25% FTE (i.e., 0.75 month of summer salary) for each of 3 years. ($48,697)	
Postdoctoral Associate, experiment and modeling research (82% salary, 18% benefit); 100% FTE for each of 3 years. ($191,368)	
IT Research Staff, data analysis and model development (75% salary, 25% benefit); 15% FTE for each of 3 years. ($41,263)	
Undergraduate Assistant, measurement and data analysis (100% salary); 3 months for each of 3 years. ($14,400)	
Professional/Technical/Service Contracts: N/A	$ -
Equipment/Tools/Supplies: Cost of setting up of mini-island models to test in the lab ($3,000), setting up of mini-island models to deploy in lakes ($2,000), setup of water wave model in the lab water channel ($3,500), and the purchasing of velocimetry ($4,500) and wave sensors ($2,000) for the water flow measurement in this project.	$ 15,000
Acquisition (Fee Title or Permanent Easements): N/A	$ -
Travel: Tranportation within Minnesota state for data collection and research meetings with other researchers in the state. Estimation of cost for 3 years: Mileage $0.545/mile x 1000 miles =$545; Incidental expense during travel $200; Lodging $755.	$ 1,500
Additional Budget Items: N/A	$ -
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 312,228

V. OTHER FUNDS *(This entire section must be filled out. Do not delete rows. Indicate "N/A" if row is not applicable.)*

SOURCE OF FUNDS	AMOUNT	Status
Other Non-State $ To Be Applied To Project During Project Period: This project will be performed in collaboration with Professor Chin Wu at University of Wisconsin, Madison, who is supported by the Wisconsin side of funding agency and will not be part of the budget of our project. Prof. Wu's research is funded by Wisconsin Department of Natural Resources and the Dane County Land and Water Resources Department.	$ 300,000	Secured
Other State $ To Be Applied To Project During Project Period: N/A	$ -	N/A
In-kind Services To Be Applied To Project During Project Period: The University of Minnesota does not charge the State of Minnesota its typical overhead rate of 54% of the total modified direct costs (graduate tuition and equipment are excluded).	$ 168,603	Secured
Past and Current ENRTF Appropriation:	$ -	N/A
Other Funding History: N/A	$ -	N/A


Motivation
Mini-islands Deployed
Wave impact on shore reduced
Floating Mini Island
Diminished waves
Sediments and soil
Wetland Restored
How?


Research Plan
How to Deploy Floating Islands?
Guidelines
Data Collection
Model Development
Apply in Practice

PROJECT MANAGER QUALIFICATIONS

This project will be led by Professor Lian Shen as program manager. Prof. Shen is the Director of the St. Anthony Falls Laboratory and a Professor in the Department of Mechanical Engineering at University of Minnesota, Twin Cities. He earned his Doctor of Science degree from Massachusetts Institute of Technology (MIT) in 2001. After three years of postdoctoral training at MIT, he joined the faculty of Johns Hopkins University (JHU) in 2004. At JHU, he performed extensive research on environmental water and air flows. In 2012, he was recruited by University of Minnesota to join its faculty.

Prof. Shen is a world expert on the study of environmental fluid flows. He is currently serving on the national committee of ASCE Environmental & Water Resources Institute on CFD Applications in Water and Wastewater Treatment. He is also on the editorial boards of the International Journal of Computational Methods and the Ocean Systems Engineering journal. Prof. Shen has also been active in professional societies, including American Geophysical Union, American Society of Civil Engineers, American Society of Mechanical Engineers, and Association of Environmental Engineering and Science Professors. He has organized many national and international conferences and symposiums.

ORGANIZATION DESCRIPTION

This project will be performed at the St. Anthony Falls Laboratory (SAFL, http://www.safl.umn.edu) at University of Minnesota. SAFL is an interdisciplinary fluid mechanics research and educational institution. It has 21 faculty members and 37 research and administrative staff members. SAFL is a world-renowned research laboratory specialized in environmental and engineering fluid mechanics. SAFL researchers have been performing many innovative environmental studies for the state of Minnesota. Some of the projects were/are funded by the Minnesota Environment and Natural Resources Trust Fund.

The proposed research leverages on the unique and advanced capability of measuring environmental flows at SAFL, which has 16,000 ft^2 of research space dedicated to physical modeling and experimentation. The facility, which has recently been upgraded with a $16M renovation, has 15 general purpose flumes, tanks, and channels readily configurable to the needs of projects. The primary water source is the Mississippi River. SAFL's maximum flow capacity is 300 ft^3/s (8.5 m^3/s), which can be sustained indefinitely, allowing long-duration experiments. This project will utilize the main channel, SAFL's largest research channel, which is a straight, concrete channel capable of nearly 300 ft^3/s flow rates of river water. The channel is equipped with a wave generator, sediment flux monitoring and recirculation system, and a data acquisition carriage. The channel can be run in flow-through mode or as a ponded system.

The proposed project will also use the Outdoor StreamLab (OSL), which is a premier research facility developed at SAFL. The OSL is an experimental stream channel system designed to host experiments on the interactions between physical, chemical, and biological processes with water diverted from the Mississippi River. The OSL is equipped to: a) quantify environmental fluid flow processes from microscopic to reach scales with high-resolution laboratory-quality measurements; b) conduct hydrological and ecological field-scale experiments under controlled conditions; and c) impose and repeat steady and unsteady inlet hydrographs, including floods. Located across the Mississippi River from downtown Minneapolis, OSL is frequently visited by the public. The proposed project will provide an excellent opportunity for public education and outreach.