

**Environment and Natural Resources Trust Fund
2017 Request for Proposals (RFP)**

Project Title:

ENRTF ID: 069-B

Shrinking Lake Superior: Water Levels and Community Resilience

Category: B. Water Resources

Total Project Budget: \$ 324,425

Proposed Project Time Period for the Funding Requested: 3 years, July 2017 - June 2020

Summary:

Lake Superiors water level is critical to Minnesotas economy. We will provide science to make level predictions, determine critical knowledge gaps, and prepare communities and industries for water level change.

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Sponsoring Organization: U of MN - Duluth -Sea Grant Program

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Location

Region: Northeast

County Name: Aitkin, Carlton, Cook, Itasca, Koochiching, Lake, Pine, St. Louis

City / Township:

Alternate Text for Visual:

Fig. 1. Lake Superior lake levels since 1968

_____ Funding Priorities	_____ Multiple Benefits	_____ Outcomes	_____ Knowledge Base
_____ Extent of Impact	_____ Innovation	_____ Scientific/Tech Basis	_____ Urgency
_____ Capacity Readiness	_____ Leverage	_____ TOTAL	_____ %



PROJECT TITLE: Shrinking Lake Superior: water levels and community resilience

I. PROJECT STATEMENT

Lake Superior is changing rapidly as climate warms but its water budget is incompletely understood so science offers incomplete guidance about rates and amounts of lake level change or what this means for Minnesota’s economy. The purpose of this request is to gain a better understanding of the future trajectory of lake level change, define the science needed to improve forecasts of changes, and to work with Minnesota communities and businesses to prepare for climate-driven changes in the water level of Lake Superior.

Lake Superior represents 10% of Earth’s surface freshwater. It gives Minnesota the most inland seaport in the world and is only 15 days from European ports. It is warming faster than regional temperatures and has a major influence on regional climate and precipitation across the US⁵. Lake Superior’s Minnesota coastal counties generate \$77 billion in employment annually. Although the water budget of Lake Superior has unknown elements (e.g., groundwater), it is very sensitive to changes in air temperature and precipitation.

Our analyses (Fig. 1, below) show that Lake Superior’s level has fallen since 1968. The falling level (1” each 3-4 years) is >18-times the rate of sea level rise (0.4 mm/y). Declines in Lake Superior are accompanied by wide swings in level. Lowest lake levels now rival those of the dust bowl years. At this rate, costs will accrue to Minnesota communities long before 2100 when low waters will be 6 feet beneath those of 1968. By 2240 ship traverse of Sault Ste Marie may be impossible and by 2800 Lake Superior could cease to connect with the ocean. Minnesotans need to prepare for both low (due to climate change) and highly variable (due to intense storms) lake levels. The direction and amount of lake level change is of critical importance to Minnesota’s economy.

Activities in this proposal will provide (1) **research** to assemble current knowledge about the Lake Superior water budget and trends in the water level, (2) **expert panel** summaries of science needed to better define risks to water level, and (3) community and industry understanding of the **social and economic cost** of water level change, as well as guidance on measures needed.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Research on Lake Superior water budget and level

Budget: \$185,045

We will draw together all available data on surface fluxes and evaporation to determine how these variables are influenced by climate and weather. These analyses will be combined with ideas about likely groundwater contributions (Activity 2) and ongoing Minnesota research on climate change to leverage current data and models to make the best possible projections of water level change into the future.

Outcome	Completion Date
1. Collect all historical run-off data from gauged streams, analyze relation with climate, create report; analyze and report on historical weather and lake-level trends	June 2018
2. GIS of watersheds not consolidated by gauged streams, weight with run-off from gauged watersheds, combine with outcome 1 to discern historical trends in inputs and outputs	June 2019
3. Summarize historical evaporation data from meteorological stations around Lake Superior, relate to weather conditions, create report to combine with 1-2	June 2019
4. Combine surface flows with evaporation and groundwater status and climate projections from Activity 2 to project future water level trends	June 2020

Activity 2: Expert panels to define risks to water level from climate and groundwater

Budget: \$20,914

We will assemble an expert panel of 5 **hydrogeologists** with expertise in submarine groundwater flux. Submarine groundwater discharge on coasts can be similar to river discharge but have been ignored. This panel will meet annually to (year 1) evaluate the potential for groundwater inputs and outputs and define topics



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where published information needs summary, (year 2) evaluate the summarized information, and (year 3) create a document containing the best state of knowledge of potential fluxes to Lake Superior as well as define critical future research needs. Also, weak points in lake-level prediction are projected trends in precipitation, temperature, wind, ice-cover, and evaporation. We will assemble 5 **meteorologists, climate, and ice-scientists** to evaluate the current state of knowledge, summarize information, and define critical research needs.

Outcome	Completion Date
1. Evaluate the current state of knowledge on submarine groundwater flux (SGF) and meteorological projections of climate change	June 2018
2. Summarize current information on SGF and climate projections germane to Lake Superior	June 2019
3. Define critical research needs on SGF and climate projections for Lake Superior	June 2020

Activity 3: Community and industry outreach to determine water level impacts

Budget: \$118,316

Minnesota stakeholder groups will identify social, economic and environmental impacts from lake level change. Stakeholder groups will include: shipping, business owners (i.e. marinas, recreation and tourism), land owners, parks, resource managers, local governments, conservation districts, city/county staff, and tribal (i.e., Grand Portage and Fond du Lac). Stakeholders will participate in a workshop (year 1) to learn about Lake Superior water budget/lake level change and identify potential impacts to their business or community. Photos will be used to visualize areas vulnerable to lake level change as it applies to their communities. Stakeholders will then participate in a scenario-planning workshop (year 2) to visualize future impacts under different water level scenarios. Scenarios will be developed for each stakeholder group. Finally, stakeholders will participate in a socio-economic analysis (year 3) of the costs/benefits of the various lake level change scenarios, and identify priority actions for reducing their vulnerability to these changes.

Outcome	Completion Date
1. Conduct needs assessment and photo inventory telling the story of lake level change impacts to North Shore of Lake Superior community stakeholders	June 2018
2. Scenario planning with Minnesota stakeholders for water level change. Three scenarios will be developed with each stakeholder group	June 2019
3. Socio-economic analysis of lake level scenario impacts and identification of priority adaptation strategies to increase resilience	June 2020

III. PROJECT STRATEGY

A. Project Team/Partners

This project will be performed and coordinated by the Minnesota Sea Grant College Program (MNSG), Duluth, MN. The project manager will be Dr. John A. Downing, Director of MNSG. Jesse Schomberg and Hilarie Sorensen will be outreach leads. Dr. Christopher Filstrup will lead the science and expert panel activities.

B. Project Impact and Long-Term Strategy

The project will work with communities to come to grips with future lake level changes resulting from Minnesota’s changing climate, using the best available information. We will define the most important knowledge gaps to fill to help Minnesota’s coastal communities deal effectively with lake-level changes. Future proposals may deal with filling knowledge gaps in groundwater flux and climate projection.

C. Timeline Requirements

The project will be finished within three years following the deliverables noted above. We hope to work on the project in July 2017 and will keep to the tabular schedule above. This project is not part of a larger program.

2017 Detailed Project Budget

Project Title: *Shrinking Lake Superior: water levels and community resilience*

INSTRUCTIONS AND TEMPLATE (1 PAGE LIMIT)

Attach budget, in MS-EXCEL format, to your "2017 LCCMR Proposal Submission Form".

(1-page limit, single-sided, 10 pt. font minimum. Retain bold text and DELETE all instructions typed in italics. ADD OR DELETE ROWS AS NECESSARY. If budget item row is not applicable put "N/A" or delete it. All of "Other Funds" section must be filled out.)

IV. TOTAL ENRTF REQUEST BUDGET 3 years

BUDGET ITEM (See "Guidance on Allowable Expenses", p. 13)	AMOUNT
Personnel:	\$ -
John Downing, Project Manager (75% salary, 25% benefits); 1% FTE for years 1-3	\$ 8,224
Jesse Schomberg, Associate Extension Professor (75% salary, 25% benefits) 15% FTE for years 1-3	\$ 40,677
Hilarie Sorensen, Extension Educator (75% salary, 25% benefits); 30% FTE for years 1-3	\$ 56,624
Chris Filstrup, Post Doc (75% salary, 25% benefits); 100% FTE for years 1-3	\$ 185,045
Professional/Technical/Service Contracts:	NA
Equipment/Tools/Supplies:	\$ -
Folders & printed materials for meetings	\$ 150
Refreshments for meetings (\$25/person x 10 = \$250) x10 x 3 years	\$ 7,500
Acquisition (Fee Title or Permanent Easements):	NA
Travel: All travel is in state	\$ -
Grand Marais, (110 miles x 2 x \$.54 = \$119)+ (per diem \$23 x 2 people = \$46) x 3 years)	\$ 495
Silver Bay, (56 miles x 2 x \$.54 = \$60) + (per diem \$23 x 2 people = \$46) x 3 years)	\$ 318
Two Harbors, ((27 miles x 2 x \$.54) + (per diem \$23 x 2 people = \$46) x 3 years)	\$ 228
	\$ 4,212
Water Resource meeting (((hotel \$210) + (per diem \$96) + (150 miles x 2 x \$.54 = \$162) x 3 people) x 3 years)	\$ 4,212
Stakeholder Travel ((463 miles x \$.54 = \$250) x 3 years) travel to and between meetings to gather data from stake holders	\$ 750
Participant travel: Hydrology meeting, (((hotel \$213) + (per diem \$48) + (150 miles x 2 x \$.54 = \$162) x 5 participants) x 3 years)	\$ 6,345
Participant travel: Climate science meeting, (((hotel \$213) + (per diem \$48) + (150 miles x 2 x \$.54 = \$162) x 5 participants) x 3 years)	\$ 6,345
Additional Budget Items:	\$ -
Conference registration fees ((((\$150 x 3 people = \$450) x 2 conferences per year) x 3 years)	\$ 2,700
Facility Rental (\$100 a year x 3 years)	\$ 300
Printing (5 posters x \$20 = \$100) x 3 years	\$ 300
TOTAL Shrinking Lake Superior: water levels and community resilience \$ REQUEST =	\$ 324,425

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:	NA	<i>Indicate:</i>
Other State \$ To Be Applied To Project During Project Period:	NA	<i>Indicate:</i>
In-kind Services To Be Applied To Project During Project Period: Foregone Facilities and Administrative costs at 33% of modified total direct costs of \$310,985.	\$ 102,625	<i>Secured</i>
Funding History:	NA	
Remaining \$ From Current ENRTF Appropriation:	NA	<i>Indicate:</i>

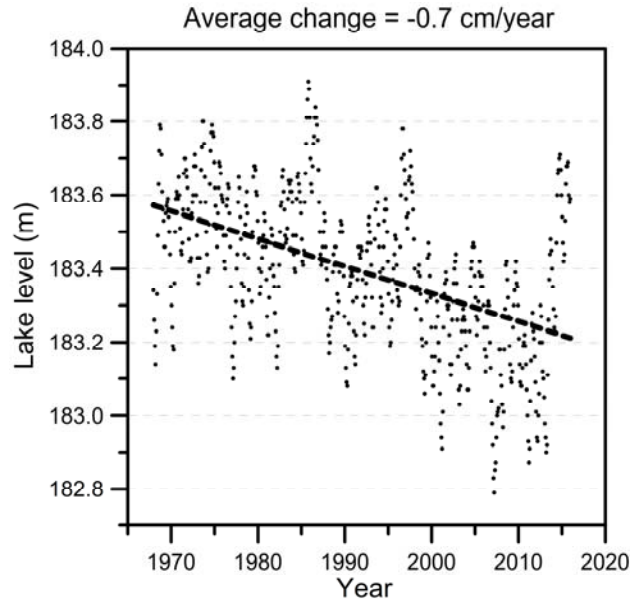


Fig. 1. Lake Superior lake levels since 1968. Data are from <http://www.glerl.noaa.gov/data/>. The dark dashed line is a linear regression analysis ($r^2=0.24$).

Project Manager Description

Project Manager Qualifications and Responsibilities

John A. Downing will manage this project. He has 40 years of experience in aquatic research and community outreach. He is currently the Director of the Minnesota Sea Grant College Program, a research scientist at the Large Lakes Observatory, and a tenured Professor in the Department of Biology at the University of Minnesota Duluth. Although he has life-long roots in Minnesota, he was formerly a Regent's Excellence Professor of Ecology, Evolution, & Organismal Biology and Agricultural & Biosystems Engineering at Iowa State University and ran one of the best-funded and long-standing research operations at that institution. His 150+ peer-reviewed books and journal articles cover diverse topics in limnology, marine science, environmental economics, and terrestrial ecology. His leadership experience has been as the Director of the Laurentian Biological Station (Montreal, Quebec), the co-founder of the Inter-University Limnological Research Group (Montreal, Quebec), Director of the Iowa State University Limnology Laboratory (Ames, Iowa), Chair of the Environmental Science Interdepartmental Graduate Program (Ames, Iowa), President of the Association for the Sciences of Limnology and Oceanography, and Chair of the Council of Scientific Society Presidents (Washington, DC). Recent outreach programs have assisted citizens in agricultural regions to understand and mitigate nutrient pollution and helped citizens and industries in northern Minnesota combat eutrophication and avoid lake degradation from aquatic invasive species.

Organization Description

Minnesota Sea Grant is part of the National Oceanic and Atmospheric Administration's (NOAA) Sea Grant Program, which supports 33 similar programs in coastal states throughout the United States and Puerto Rico. Our mission is to facilitate interaction among the public and scientists to enhance communities, the environment and economies along Lake Superior and Minnesota's inland waters by identifying information needs, fostering research and communicating results. Minnesota Sea Grant concentrates on research, outreach, and education in four focus areas: Healthy coastal ecosystems, sustainable fisheries and aquaculture, resilient communities and economies, environmental literacy and workforce development.