

Environment and Natural Resources Trust Fund 2020 Request for Proposals (RFP)

Project Title:**ENRTF ID: 059-AH**

Enhanced Online Tool to Track Minnesota Lake Trends

Category: H. Proposals seeking \$200,000 or less in funding**Sub-Category:** A. Foundational Natural Resource Data and Information**Total Project Budget:** \$ 197,836**Proposed Project Time Period for the Funding Requested:** June 30, 2022 (2 yrs)**Summary:**

We propose to update and refine an existing online visualization tool and database to explore long-term water quality trends in Minnesota lakes to support natural resources decision-making and environmental education.

Name: Christopher Filstrup**Sponsoring Organization:** U of MN**Job Title:** Dr.**Department:** Natural Resources Research Institute**Address:** 5013 Miller Trunk Highway

Duluth MN 55811

Telephone Number: (218) 788-2764**Email:** filstrup@d.umn.edu**Web Address:** <https://www.nrri.umn.edu/faculty-staff/chris-filstrup>**Location:****Region:** Statewide**County Name:** Statewide**City / Township:****Alternate Text for Visual:**

Examples of existing and updated MN Lake Trends tool information for Mille Lacs, newly designed website, and improved navigation across existing online resources.

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



Environment and Natural Resources Trust Fund (ENRTF) 2020 Main Proposal

PROJECT TITLE: Enhanced online tool to track Minnesota lake trends

I. PROJECT STATEMENT

We propose to **update and refine an existing online visualization tool and database to explore long-term water quality trends in Minnesota lakes using existing lake water quality monitoring data.** This basic information is needed to help management agencies and lake associations effectively and economically manage these valuable freshwater resources. Our overall aim is to better support natural resources decision-making and environmental education. Specific objectives include:

1. incorporate more recent information into an enhanced MN Lake Trends database and online tool,
2. use new approaches to identify lake trends and water quality regions in MN, and
3. work with developers of existing tools (MN Natural Resources Atlas, MN Lake Browser) to ensure easy navigation across the tools (web linking) and conduct appropriate training for end users.

The current version of the MN Lake Trends tool (www.mnbeaches.org/gmap/trends/; last updated in 2010) shows whether water quality in lakes throughout MN is changing through time and how quickly. The database contains information on water quality variables commonly used by management agencies (nitrogen, phosphorus, water clarity, algae abundance, dissolved oxygen) for 638 lakes with at least 15 years of data. The tool is used as an informational resource by natural resources agencies (MPCA, US Forest Service), but suffers from some limitations. The database only contains information through 2007 (12 years ago) and looks at average straight-line trends across the entire time period but cannot look at trends across shorter time periods.

The enhanced version of the MN Lake Trends tool will include water quality information through 2020 (28+ years of data) for more lakes and be able to look at shorter term trends. For example, has water clarity gotten increasingly worse in Mille Lacs since 2010? The lake regions based on water quality trends will help agencies prioritize regions for management and protection by developing unique strategies tailored to individual regions. The redesigned website will be easier to use, will communicate information more clearly, and will be easier to find online. We will expand its use to lake associations and classrooms by working directly with these groups.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Update lake database and online visualization tool

ENRTF BUDGET: \$103,415

We will gather water quality information from state monitoring programs, such as MPCA, to update the existing MN Lake Trends database with data from 2008-2020. We will redesign the tool to incorporate new visualization approaches and make it so new information can easily be added in the future. Finally, we will redesign the website to make it easier to use for different user groups.

| Outcome | Completion Date |
|--|-----------------|
| 1. Add 2008-2020 water quality information to MN Lake Trends database. | April 30, 2021 |
| 2. Write computer code to add new features (trend analyses, visualization approaches). | April 30, 2021 |
| 3. Redesign existing online tool and website. | Dec. 31, 2021 |

Activity 2: Perform trend analyses and create supporting data products

ENRTF BUDGET: \$44,363

We will use new approaches to explore both near- and long-term trends in lake water quality in Minnesota. We will use spatial approaches to create water quality trend regions (clusters of lakes with increasing, decreasing, or no trend) and identify environmental factors contributing to trends across regions. MN DNR State Climatology Office will be consulted to ensure that we are using the newest climatology data and



Environment and Natural Resources Trust Fund (ENRTF)
2020 Main Proposal

interpreting it accurately. We will use these trends and regions to develop various decision support map layers, such as state-wide surface water nutrient trends and distinct water quality regions, to be incorporated within the MN Natural Resources Atlas.

| Outcome | Completion Date |
|--|-----------------|
| 1. Perform analyses to identify water quality trends in individual lakes. | Dec. 31, 2021 |
| 2. Create lake trend regions (groups of lakes with similar trends) using spatial approaches to help identify regions to prioritize for lake management, restoration, and protection. | March 31, 2022 |
| 3. Create map layers for the MN Natural Resources Atlas to aid in decision support. | March 31, 2022 |

Activity 3: Better tool navigation and training for end users

ENRTF BUDGET: \$50,058

We will work with developers of existing online resources (MN Natural Resources Atlas, MN Lake Browser) to improve navigation across all resources. With the help of MN Sea Grant, we will work with management agencies, lake associations, and educators (high school) to beta-test and improve the website, demonstrate the capabilities of the MN Lake Trends tool, and train end users on its use. We will meet with management agency personnel, such as MPCA and US Forest Service, and representatives from lake associations to ensure that the tool meets their needs. We will lead a hands-on training workshop in conjunction with an appropriate statewide meeting, such as the MN Lakes and Rivers Advocates, to demonstrate how lake associations and concerned citizens can use the MN Lake Trends tool to compare the health of their lake to surrounding lakes. Finally, we will hold an educators' workshop (10 teachers) to train high school teachers on use of the online tool and its capabilities.

| Outcome | Completion Date |
|---|-----------------|
| 1. Improve navigation across existing online resources. | June 30, 2022 |
| 2. Present findings and introduce the online tool at agency and lake association meetings. | May 31, 2022 |
| 3. Host educators' workshop to train teachers on use of tool to be used in classroom exercises. | June 30, 2022 |

III. PROJECT PARTNERS AND COLLABORATORS:

- Dr. Jacques Finlay, Professor, U. of Minnesota Twin Cities. PI of "Assessment of Surface Water Quality with Satellite Sensors", LCCMR 2016-2019.
- Cynthia Hagley, Environmental Quality Extension Educator, Minnesota Sea Grant.

IV. LONG-TERM IMPLEMENTATION AND FUNDING:

When developing and updating the new website and underlying MN Lake Trends database, we will design the website code and database so that it can easily incorporate future water quality information (beyond 2020) and different types of information that may be added to monitoring programs in the future (new variables or measurements). While incorporating new information into the database will require some user entry, this effort and associated costs will be minimal. We will leverage compiled MN water quality data from the NSF-funded LAGOS database team (www.lagoslakes.org), of which PI Filstrup is Senior Personnel. We will seek small amounts of funding from state agencies and user groups to update, maintain, and enhance the new MN Lake Trends tool in the future.

Attachment A: Project Budget Spreadsheet
 Environment and Natural Resources Trust Fund
 M.L. 2020 Budget Spreadsheet

Legal Citation:

Project Manager: Christopher Filstrup

Project Title: Enhanced online tool to track Minnesota lake trends

Organization: Natural Resources Research Institute

Project Budget: \$197,836

Project Length and Completion Date: 2 Years; 6/30/2022

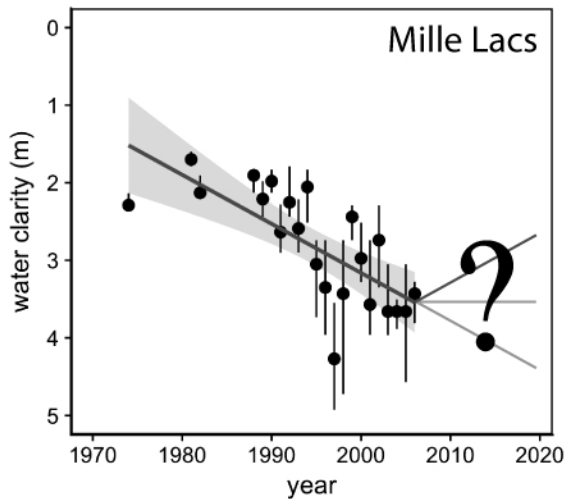
Today's Date: 4/9/2019



| ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET | | Budget | Amount Spent | Balance |
|---|--|------------|--------------|------------|
| BUDGET ITEM | | | | |
| Personnel (Wages and Benefits) | | \$ 183,963 | \$ - | \$ 183,963 |
| Chris Filstrup/Principal Investigator; \$20,500 (74% salary, 26% benefits); FTE: Year 1 = 10%, Year 2 = 10% | | | | |
| Will Bartsch/Co-Investigator; \$25,465 (74% salary, 26% benefits); FTE: Year 1 = 20%, Year 2 = 10% | | | | |
| Lucinda Johnson/Co-Investigator; \$4,736 (74% salary, 26% benefits); FTE: Year 1 = 1%, Year 2 = 1% | | | | |
| Norm Will/Programmer; \$56,452 (77% salary, 23% benefits); FTE: Year 1 = 20%, Year 2 = 40% | | | | |
| Jane Reed/Web Programmer; \$4,112 (77% salary, 23% benefits); FTE: Year 1 = 2%, Year 2 = 3.5% | | | | |
| Elaine Ruzycski/Scientist; \$45,242 (74% salary, 26% benefits); FTE: Year 1 = 40%, Year 2 = 10% | | | | |
| Cindy Hagley/Extension Educator; \$27,456 (74% salary, 26% benefits); FTE: Year 1 = 7%, Year 2 = 15%. | | | | |
| <i>*Note: NRRI research staff salaries are largely sponsored by external funders.</i> | | | | |
| Professional/Technical/Service Contracts | | \$ - | \$ - | \$ - |
| Equipment/Tools/Supplies | | \$ 2,350 | \$ - | \$ 2,350 |
| Computer software necessary for project: \$500 | | | | |
| GIS computer lab fees: \$800 (45 hours in Year 1 and 100 hours in Year 2 @ \$5.52 per hour) | | | | |
| Water sampling kits for teachers: \$1050 (10 kits @ \$105 each (\$60 transparency tubes + \$15 pH test strips + \$15 alkalinity test strips + \$15 hardness test strips)) | | | | |
| Capital Expenditures Over \$5,000 | | \$ - | \$ - | \$ - |
| Fee Title Acquisition | | \$ - | \$ - | \$ - |
| Easement Acquisition | | \$ - | \$ - | \$ - |
| Professional Services for Acquisition | | \$ - | \$ - | \$ - |
| Printing | | \$ - | \$ - | \$ - |
| Travel expenses in Minnesota | | \$ 2,023 | \$ - | \$ 2,023 |
| Present findings to resource managers at Water Resources Conference in Year 2: \$887 (1 person, 2 nights @ \$165 per night lodging + 3 days per diem (\$48 + \$64 + \$48) + 340 miles @ \$0.58 per mile + \$200 registration fee) | | | | |
| Meetings with agencies in St. Paul: \$788 (2 trips per year for 2 years each of 340 miles @ \$0.58 per mile) | | | | |
| 3 outreach meetings in Year 2: \$348 (3 trips of 200 miles on average @ \$0.58 per mile) | | | | |
| <i>*Note: All travel amounts follow University of Minnesota travel reimbursement policy guidelines.</i> | | | | |
| Other | | \$ 9,500 | \$ - | \$ 9,500 |
| Teacher Training Workshop: \$5750 (10 teachers, 2 days @ \$150 daily stipend each + \$275 each for travel and lodging). Costs are based on Cindy Hagley's experience organizing numerous teacher training workshops for the past two decades. | | | | |
| Website registration and hosting services: \$750 (5 years registration @ \$15 per year + 5 years hosting @ \$135 per year) | | | | |
| Cost to host server through U of MN: \$3000 (2 years @ \$1500 per year) | | | | |
| COLUMN TOTAL | | \$ 197,836 | \$ - | \$ 197,836 |
| SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT | | | | |
| | Status (secured or pending) | Budget | Spent | Balance |
| Non-State: | | \$ - | \$ - | \$ - |
| State: | | \$ - | \$ - | \$ - |
| In kind: Unrecovered F&A @ 54% MTDC | Secured | \$ 103,726 | \$ - | \$ 103,726 |
| Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS | Amount legally obligated but not yet spent | Budget | Spent | Balance |
| | | \$ - | \$ - | \$ - |

MN Lake Trends Tool

1. Updated MN Lake Trends tool with recent data (2008 - 2020).

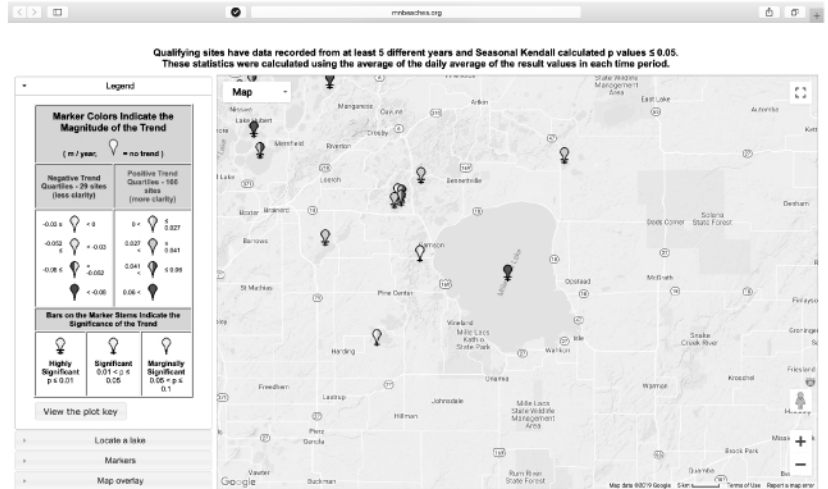


2. Newly designed online user interface & increased functionality.

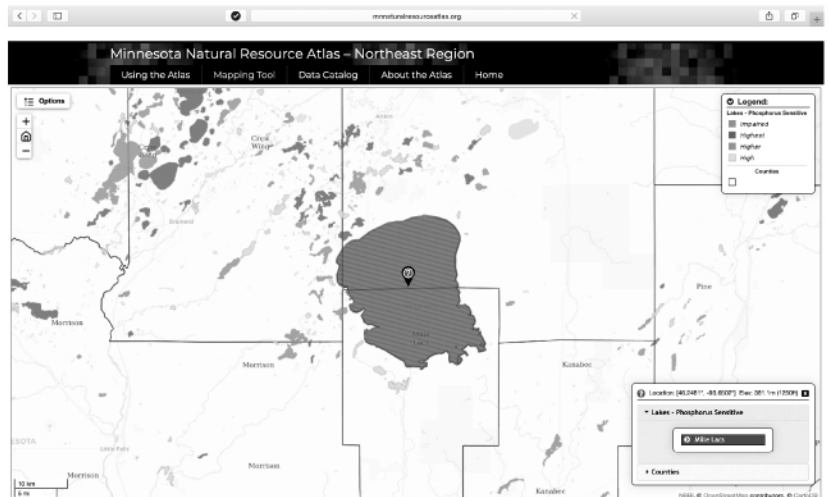


3. Improved navigation across existing online water quality resources.

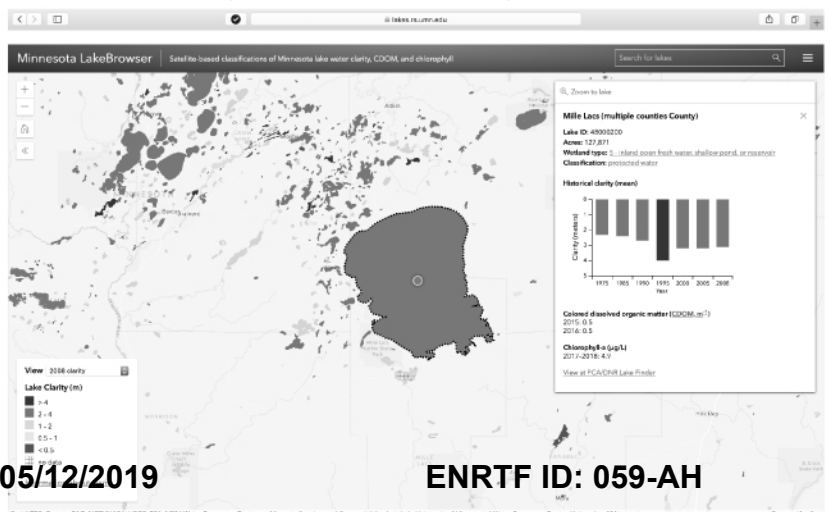
MN Lake Trends (www.mnbeaches.org)



MN Natural Resource Atlas (www.mnnaturalresourceatlas.org)



MN Lake Browser (www.lakes.rs.umn.edu)





Environment and Natural Resources Trust Fund (ENRTF) 2020 Project Manager Qualifications and Organization Description

PROJECT TITLE: Enhanced online tool to track Minnesota lake trends

Dr. Christopher Filstrup, Natural Resources Research Institute (NRRI), University of Minnesota Duluth (UMD)

Dr. Filstrup is a Research Associate and Director of the Central Analytical Laboratory at NRRI at UMD. For the past two decades, he has been conducting and specializing in research involving large-scale water quality analyses, biogeochemical nutrient cycling, phytoplankton ecology (harmful algal blooms), and freshwater resources management. He has published 26 peer-reviewed articles that have been cited over 750 times, as well as 9 technical reports for previously funded projects. Chris has secured approximately \$1.76 million in funding for research projects that he led during his previous appointment at Iowa State University (ISU). While in this post, he also managed several federally-sponsored projects (National Science Foundation) for the ISU Limnology Lab. He is currently collaborating as senior personnel on a National Science Foundation Macrosystems Biology Project investigating water quality relationships across the continental United States.

EDUCATION

Ph.D. (2009). Biology – Department of Biology, Baylor University.

B.Sc. (1998). Biology – College of Natural Sciences, University of Texas at Austin.

SELECTED PUBLICATIONS

Filstrup, CT, T Wagner, SK Oliver, CA Stow, KE Webster, EH Stanley, & JA Downing. 2018. Evidence for regional nitrogen stress on chlorophyll *a* in lakes across large landscape and climate gradients. *Limnology and Oceanography* 63: S324-S339.

Filstrup, CT, & JA Downing. 2017. Relationship of chlorophyll to phosphorus and nitrogen in nutrient-rich lakes. *Inland Waters* 7:385-400.

Filstrup, CT, H Hillebrand, AJ Heathcote, WS Harpole, & JA Downing. 2014. Cyanobacteria dominance influences resource use efficiency and community turnover in phytoplankton and zooplankton communities. *Ecology Letters* 17:464-474.

Filstrup, CT, T Wagner, PA Soranno, EH Stanley, CA Stow, KE Webster, & JA Downing. 2014. Regional variability among nonlinear chlorophyll-phosphorus relationships in lakes. *Limnology and Oceanography* 59:1691-1703.

In addition to Chris, our multi-disciplinary research team consists of Will Bartsch (Senior Research Scientist, NRRI; specializing in GIS tool development and statistical analysis), Dr. Rich Axler (Emeritus, NRRI; specializing in limnology and water quality management), Elaine Ruzycki (Senior Research Scientist, NRRI; specializing in water quality data management and quality assurance), Norm Will (IT Specialist, NRRI; specializing in data visualization and user-interface development), Cynthia Hagley (Extension Educator, MN Sea Grant; specializing in environmental education and discussion facilitation), and Dr. Lucinda Johnson (NRRI Associate Director / Initiative Director for Water, NRRI; specializing in stressors of aquatic communities and climate change impacts).

ORGANIZATION DESCRIPTION

The Natural Resources Research Institute is a University of Minnesota Duluth applied research organization. NRRI's mission is to deliver research solutions to balance Minnesota's economy, resources and environment for resilient communities. NRRI has the technical capabilities and experience necessary to develop interactive, online natural resources mapping applications. It has a fully-equipped Geographic Information Systems (GIS) Laboratory with ArcGIS software licenses (Environmental Systems Research Institute, Redlands, CA) and the data servers, databases, and software required for this project.