Environment and Natural Resources Trust Fund
2016 Request for Proposals (RFP)

Project Title: **ENRTF ID: 006-A**

Sentinel Lakes Monitoring and Data Synthesis

Category: A. Foundational Natural Resource Data and Information

Total Project Budget: $ 401,623

Proposed Project Time Period for the Funding Requested: 2 years, July 2016 to June 2018

Summary:

This project sustains intensive monitoring and multidisciplinary research on Minnesota's 25 Sentinel Lakes; data integration and synthesis will enhance understanding of how lakes respond to large-scale environmental stressors.

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Location

Region: NW, NE, SW, SE

County Name: Statewide

City / Township:

Alternate Text for Visual:

General monitoring program information, map of study sites and inset describing the role of data integration and data synthesis in this phase of the project

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

I. PROJECT STATEMENT

Continued monitoring of 25 Sentinel Lakes and the integration of data collected since the onset of the Sentinel Lakes Long-term Monitoring Program (previously funded by ENRTF as SLICE) will enable a fuller understanding of the key mechanistic and emergent properties of lakes affected by environmental stressors such as land use modification, invasive species, and climate change. Since 2008 DNR's Section of Fisheries, with funding from LCCMR, has coordinated the monitoring of biological, physical, and chemical attributes of 25 lakes and their watersheds. Our intent with the Sentinel Lakes Program is to continue monitoring these lakes and their watersheds, including water temperature, clarity, chemistry as well as biological monitoring to include fish, zooplankton and other invertebrates, and aquatic plants. We also propose the development of a state-wide water temperature monitoring network on Minnesota lakes that will complement our ongoing efforts on Sentinel Lakes and also enhance our understanding of the thermal dynamics on a wider variety of lakes. Integrating the vast amount of data collected in the last 8 years is now needed to allow managers, researchers, and policy makers a deeper understanding of the synergistic mechanisms within these systems and allow for the development of management strategies thereby ensuring the resiliency of desirable lake conditions. Our overall goal is to bridge baseline and future work on Sentinel Lakes by providing data integration and data synthesis to understand more fully mechanisms which promote healthy and resilient lakes (e.g., which factors promote high water quality, healthy aquatic plants and balanced fish communities). Ultimately we envision a better understanding of how and why lakes change due to environmental stressors and an ability to better predict and respond to lake changes, (e.g., what restoration efforts will work, and how predictable lake responses will be to management). Finally, these efforts will help the Sentinel Lakes Program identify knowledge gaps that will be considered in designing future monitoring and research efforts, thereby continuing Minnesota's reputation as a leader in the research, monitoring, and management of lakes.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Sentinel Lakes Data Integration and Synthesis. **Budget: $ 157,548**

By July of 2016 nearly 9 years of monitoring data will have been collected on the 25 Sentinel Lakes. While these efforts have produced tangible results for the management of fisheries and lakes in Minnesota (e.g., Cisco biology, sampling, and habitat needs) a great deal more can be done with proper integration of the wide range of data sets that have been established. We propose to hire a data expert who will assemble these data in a manner which will allow us to make comparisons between trophic levels, different taxa, and responses to experimental design factors such as ecoregion, nutrient levels, mixing status, land use and other features being inventoried in the Sentinel Lakes Program. These investigations will allow for the continued development of strategies which will allow managers to plan and adjust to the ecological changes occurring in our lakes. Finally, this will help us identify data gaps which will be integrated into future monitoring and research efforts.

Outcome	Completion Date
1. Gather and assemble data sets.	30 June 2018
2. Comprehensive analysis of data, identification of trends and empirical and mechanistic relationships.	30 June 2018
3. Identification of data gaps and recommendations for future monitoring efforts.	30 June 2018

Activity 2: Temperature, Biological and Water Chemistry Monitoring of Sentinel Lakes and Establishing a Supporting Network of Temperature Monitoring in Minnesota Lakes. **Budget: $244,075**

We propose to expand our water temperature monitoring in the Sentinel Lakes, covering a greater variety of habitats, as well as expanding our monitoring efforts to nearby and often connected bodies of water; thereby

enabling us to more fully understand landscape level effects on thermal habitat. We also propose to continue detailed water chemistry analyses on the 25 lakes as well as continuing to assist partners with sampling on an as needed basis.

Outcome	Completion Date
1. Expanded Temperature Monitoring of Sentinel Lakes	30 June 2018
2. Water Chemistry Analysis on 25 Sentinel Lakes	30 June 2018
3. Establishment of a Temperature Monitoring Network of Minnesota Lakes	30 June 2018
4. Assisting with the Monitoring of Biological Communities in Sentinel Lakes	30 June 2018

III. PROJECT STRATEGY

A. Project Team/Partners

ENRTF support: **DNR Division of Fish and Wildlife, Section of Fisheries -** Program administration, fisheries field and technical support, data management ($401,623). Ms. Melissa Treml, (Fisheries Research Manager) Program Manager.

In-kind support: **DNR Division of Ecological and Water Resources -** Zooplankton and benthic invertebrate sampling and analysis, aquatic vegetation surveys, and lake level monitoring, **DNR Division of Parks and Trails -** Survey support and interpretive and outreach support, **DNR Division of Fish and Wildlife -** Fishery population and IBI assessments and fisheries research staff conducting associated research on Sentinel Lakes, **Minnesota Pollution Control Agency, Environmental Analysis and Outcomes Division -** Water quality assessments, sampling assistance, ground-water monitoring and volunteer coordination.

B. Project Impact and Long-Term Strategy

Since its inception, the strategy for the Sentinel Lakes Program has been that of implementing long-term ecological monitoring to provide managers, researchers, and policy makers with information needed to make informed decisions towards sustainable and resilient management of our lakes; that strategy still frames the program today. The DNR, along with partners such as PCA, have supplemented the generous support of the ENRTF by committing personnel and financial resources to establish a framework that will sustain the program long-term. For example, the DNR has dedicated two permanent staff, both Research Scientist II's, to currently oversee the Sentinel Lakes Program. However, due to the complexity of monitoring aquatic systems at the level currently being undertaken we anticipate occasional requests to LCCMR that will provide program continuity and continued ingenuity through supplemental research and monitoring which will allow the program to address specific, and often complex questions via the expertise of partners. For example, our past collaborations with U.S.G.S. Minnesota Water Science Center has led to a greater understanding of deep-water lake dynamics while our collaborative effort with the University of St. Thomas has provided insight into the shifts in food web and energy flow in lakes with zebra mussels. New questions and subsequent requests to ENRTF are likely to arise as monitoring efforts continue, however we anticipate the base monitoring framework to be fully funded by DNR in coming years.

C. Timeline Requirements

Work proposed here is expected to be completed within a 2-yr timeframe, including a partial first field season in 2016, an entire middle field season (2017), and a partial field season in 2018. Current ENRTF funding bridges the first part of the 2016 season (April-June), and DNR Fish and Game Funds will be used to fund core sampling activities scheduled after July 1, 2018. Data integration and synthesis work will involve previously collected data and will begin immediately on July 1, 2016 and continue throughout the 2-years of the study.

2016 Detailed Project Budget

Project Title: Sentinel Lakes Monitoring and Data Synthesis

IV. TOTAL ENRTF REQUEST BUDGET 2 years

BUDGET ITEM *(See "Guidance on Allowable Expenses", p. 13)*	**AMOUNT**
Personnel: 1 NR Specialist Senior - data manager to assemble, analyze, and distribute via a web portal the wide-ranging, non-centralized data sets collected over the past 9 years and during 2016-2018 (100% FTE, $64,687.50/yr includes fringe) 1 NR Specialist Intermediate - monitoring specialist to coordinate project surveys, train and lead field crews in data collection efforts during 2016-18, and assist with reporting on status and trends for sentinel lakes located across MN's major aquatic ecoregions (100% FTE, $58,437.50/yr includes fringe) 3 Student Interns - field data collection activities in support of project objectives (each 0.25 FTE, $21,600/yr)	$ 289,450
Professional/Technical/Service Contracts: N/A	$ -
***Direct and Necessary expenses:** Direct and Necessary expenses include: Human Resources ($8,003), IT Support ($11,176), Safety ($1,887), Financial Support ($4,808), Communications Support ($1,236), Planning Support ($829), and Procurement Support ($235) necessary to accomplishing funded programs.	$ 28,173
Equipment/Tools/Supplies: Temperature loggers, water chemistry analytical services, and miscellaneous equipment (consumables, equipement repairs) in support long-term monitoring objectives	$ 49,000
Travel: In support of project objectives, with approximate breakdown as follows: 40% for fleet for travel to study lakes to install sensors and conduct survey work, and to attend coordination meetings; 40% for hotels for overnight stays associated with lake survey work and project coordination, 20% for meal reimbursement in accordance to DNR travel guidelines, and meal reimbursement limits.	$ 35,000
TOTAL ENVIRONMENT AND NATURAL RESOURCES TRUST FUND $ REQUEST =	$ 401,623

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

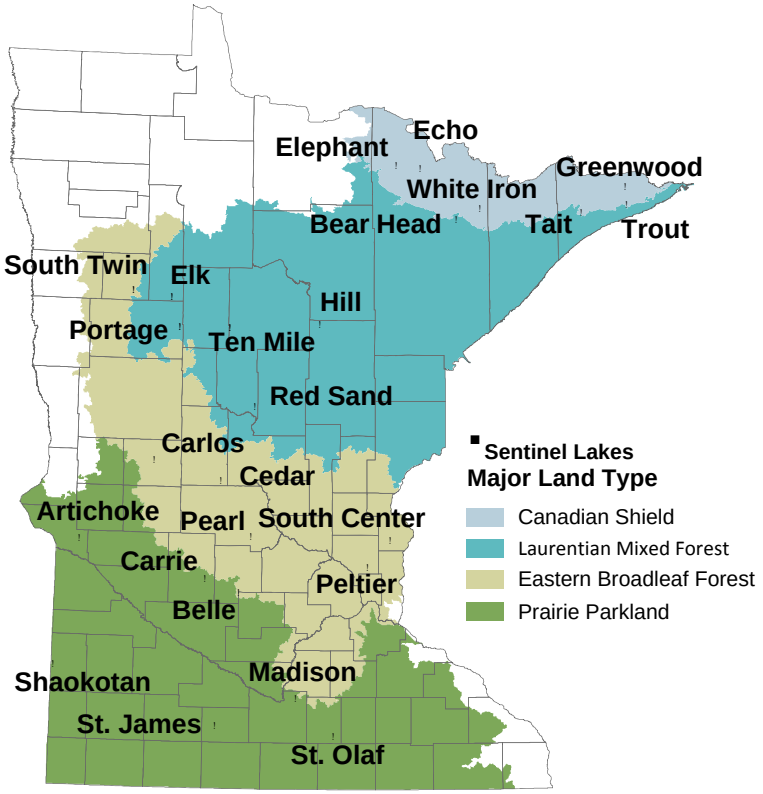
SOURCE OF FUNDS	**AMOUNT**	**Status**
Other Non-State $ To Be Applied To Project During Project Period: N/A	$ -	
Other State $ To Be Applied To Project During Project Period: DNR Div. of Fish and Wildlife, in-kind match funding for 2 project coordinators and various other Fisheries staff involved in field data collection and data analysis efforts ($460,000) DNR Div. of EWR, in-kind match funding to support monthly zooplankton and annual benthic invertebrate sampling and sample processing costs. Support for development of emergent mapping and score-the-shore methodologies, and point-intercept sampling of submerged aquatic plants in Sentinel Lakes ($167,500) MPCA – Env. Anlys. & Outcomes, in-kind matching funds to support water quality sampling and analytic costs ($110,000). In-kind labor provided by citizen lake monitoring volunteers (not quantified).	$ 737,500	
In-kind Services To Be Applied To Project During Project Period: *N/A*	$ -	
Funding History: FY13 (M.L. 2012): ENTRF, ML 2013, Chp. 52, Sec. 2, Subd. 05a. - Sustaining Lakes in a Changing Environment - Phase II. $1,200,000 FY10 (M.L. 2009): ENTRF, ML 2009, Chap. 143, Sec. 2, Subd. 5C. - Assessing the consequences of ecological drivers of change on water quality and habitat dynamics of deep-water lakes with coldwater fish populations. $825,000 FY09-FY12: DJ Study 605 - Designing a long-term monitoring program to track the status of fish communities and their habitats in Minnesota lakes, identify efficient indicators, and evaluate mechanisms. $595,873	$ 2,620,873	
Remaining $ From Current ENRTF Appropriation: as of 1 April 2015	$ 517,798	

Sentinel Lakes Monitoring & Data Synthesis

The Sentinel Lakes include 25 lakes which encompass 4 ecoregions and represent a wide variety of fish community- and lake-types that are essential to our way of life in Minnesota

- Long-term monitoring provides a strong historical basis for almost all fisheries management activities
- Lake habitat conservation is often the most difficult and complex part of fish management
- Sentinel Lakes Monitoring is about collecting information to better conserve critical fisheries habitats

Minnesota's Sentinel Lakes:



Data integration and data synthesis is now needed, this will allow us to bridge baseline and future work on Sentinel Lakes to more fully understand mechanisms which promote healthy and resilient lakes (e.g., which factors promote high water quality, healthy aquatic plants and balanced fish communities). Some questions being examined:

How do invasive species affect lakes?	How do changes in the watershed affect lakes?
What happens to lakes when water quality changes?	What changes are occurring to aquatic communities?

The long-term collection of data from these 25 lakes will provide managers with an abundance of information to better manage all of Minnesota's 10,000 lakes

Project Manager: Melissa K. Treml, is the Fisheries Research and Policy Manager for the DNR. She obtained her B.S. in Fisheries and Wildlife from Michigan State University in 1989. She also holds an M.S. from Michigan State University in Fisheries Science which was awarded in 1992. In her 25 years of experience in fisheries and aquatic sciences she has been a leader in the development of an index of biotic integrity (IBI) for inland lakes as well as fishery population modeling and centrarchid biology. She was hired as the Fisheries Research and Policy Manager in March of 2014 and currently oversees a staff consisting of 18 research biologists and scientists and 3 Research Supervisors.

Organization Description: The Minnesota Department of Natural Resources works to integrate and sustain the interdependent values of a healthy environment, a sustainable economy, and livable communities. DNR's integrated resource management strategy shares stewardship responsibility with citizens and partners to manage for multiple interests. DNR protects the state's natural heritage by conserving the diversity of natural lands, waters, and fish and wildlife that provide the foundation for Minnesota's recreational and natural resource-based economy (M.S. 84, M.S. 97A). DNR manages natural lands such as forests, wetlands, and native prairies; maintains healthy populations of fish and wildlife; and protects rare plant and animal communities throughout the state. DNR manages the state's water resources, sustaining healthy waterways and ground water resources. DNR provides access to enrich public outdoor recreational opportunities, such as hunting, fishing, wildlife-watching, camping, skiing, hiking, biking, motorized recreation, and conservation education through a state outdoor recreation system that includes parks, trails, wildlife management areas, scientific and natural areas, water trails, and other facilities (M.S. 86A). DNR supports natural resource-based economies, managing state forest lands for multiple forest values (M.S. 89), ensuring the maximum long-term economic return from school trust lands (M.S. 127A), and providing other economic opportunities in a manner consistent with sound natural resource conservation and management principles. The mission of the Minnesota Department of Natural Resources is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life.