Environment and Natural Resources Trust Fund (ENRTF)
M.L. 2016 Work Plan

Date of Report: May 29, 2016

Date of Next Status Update Report: November 30, 2016

Date of Work Plan Approval: June 7, 2016

Project Completion Date: June 30, 2019

Does this submission include an amendment request? No

PROJECT TITLE: Sentinel Lakes Monitoring and Data Synthesis – Phase III

Project Manager: Melissa K. Treml, Fisheries Research and Policy Manager

Organization: Minnesota Dept. Natural Resources, Division of Fish and Wildlife, Fisheries Research & Policy Unit

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Location: Statewide. See map in Section IX.

Total ENRTF Project Budget:		
	ENRTF Appropriation:	**$401,000**
	Amount Spent:	**$0**
	Balance:	**$401,000**

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 03g

Appropriation Language:
$401,000 the second year is from the trust fund to the commissioner of natural resources for the third and final phase of a monitoring and multidisciplinary research effort on 25 sentinel lakes in Minnesota, which will integrate and synthesize previously collected data to enhance understanding of how lakes respond to large-scale environmental stressors and provide for improved ability to predict and respond to lake changes for water and fisheries management. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

I. PROJECT TITLE: Sentinel Lakes Monitoring and Data Synthesis – Phase 3

II. 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 that 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 a better ability to 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.

III. OVERALL PROJECT STATUS UPDATES:

Project Status as of 11/30/2016:

Project Status as of 3/31/2017:

Project Status as of 9/30/2017:

Project Status as of 3/31/2018:

Project Status as of 9/30/2018:

Project Status as of 3/31/2019:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Sentinel Lakes Data Integration and Synthesis.

Description: 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.

Summary Budget Information for Activity 1:

ENRTF Budget: $ 157,562
Amount Spent: $ 0
Balance: $ 157,562

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 2019
3. *Identification of data gaps and recommendations for future monitoring efforts when fully funded by Section of Fisheries*	30 June 2019

Activity Status as of 11/30/2016:

Activity Status as of 3/31/2017:

Activity Status as of 9/30/2017:

Activity Status as of 3/31/2018:

Activity Status as of 9/30/2018:

Activity Status as of 3/31/2019:

Final Report Summary:

ACTIVITY 2: Temperature, Biological and Water Chemistry Monitoring of Sentinel Lakes and Establishing a Supporting Network of Temperature Monitoring in Minnesota Lakes.

Description: To date, most of our temperature monitoring has focused on the thermal habitat requirements of cold water species such as Cisco. We propose to expand our water temperature monitoring in the Sentinel Lakes to include the shallower, littoral areas of lakes. This added temperature monitoring will provide us insight into just how variable water temperatures in shallower areas might be and how that variability may affect cool and warm water fish species. 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.

Summary Budget Information for Activity 2:

ENRTF Budget: $ 243,438
Amount Spent: $ 0
Balance: $ 243,438

Outcome	Completion Date
1. *Expanded Temperature Monitoring of Sentinel Lakes*	30 June 2019
2. *Water Chemistry Analysis on Selected Sentinel Lakes*	30 June 2019
3. *Assist with Monitoring Biological Communities in Sentinel Lakes*	30 June 2019

Activity Status as of 11/30/2016:

Activity Status as of 3/31/2017:

Activity Status as of 9/30/2017:

Activity Status as of 3/31/2018:

Activity Status as of 9/30/2018:

Activity Status as of 3/31/2019:

Final Report Summary:

V. DISSEMINATION:
Description:
In addition to the scheduled status updates, and the Phase 2 final report due to LCCMR, we currently provide or envision:

1. An updated description of the overall long-term lake monitoring program will be available on MN DNR's public website at (http://www.dnr.state.mn.us/fisheries/slice/index.html). Basic "fact-sheets" and retrospective lake assessment reports on all 25 sentinel lakes are available on MN PCA's public website at (http://www.pca.state.mn.us/water/sentinel-lakes.html).
2. Development of data warehouse or "data mart" including download tools to obtain variables measured as part of the long-term lake monitoring program. Ultimately, we envision a scenario where graphs and data will be accessible for download shortly after data becomes available, typically within a few months after the field season.
3. Minimally, fish, zooplankton, aquatic plant, and water quality data will be housed in central databases and will be made available upon request.
4. Manuscripts will be developed by project staff and project partners (PCA, USGS, and university partners) and submitted to peer-reviewed journals.
5. Technical presentations and general program overviews will be given at state, regional, national, and potentially international symposia. Local outlets include MN chapter of the American Fisheries Society and organized lake groups.
6. Sentinel lakes data will be housed on a shared network drive that will be available to all internal DNR staff throughout the state.
7. A data sharing philosophy that encourages free access to comprehensive high quality data by outside researchers. The program and the state benefit greatly from analyses performed by outside researchers on raw datasets. These partnerships may bring in additional matching grants from outside funding sources.

Status as of 11/30/2016:

Status as of 3/31/2017:

Status as of 9/30/2017:

Status as of 3/31/2018:

Status as of 9/30/2018:

Status as of 3/31/2019:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:

A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:	$289,450	1 NR Specialist Data Manager (1 FTE) to assemble, manage, integrate, and analyze the wide range of data sets that have been collected in the Sentinel Lakes Program. 1 NR Specialist Long-Term Monitoring Biologist (1 FTE) to coordinate project surveys, train and lead field crews in data collection efforts, enter data into spreadsheets and databases, perform data QA/QC, and assist with reporting on status and trends for sentinel lakes. 3 Student Interns (0.33 FTE each, total 1 FTE), field data collection activities in support of project objectives.
Direct and Necessary Services:*	$28,187	Direct and Necessary Services for the Appropriation
Equipment/Tools/Supplies:	$48,363	Continuously-recording temperature sensors (100 to 140 loggers at ~$100 each), miscellaneous survey equipment, consumables, and repairs (~$3,800), and water chemistry analytical services (~$31,000) in support of long-term monitoring objectives outlined in the proposal.
Travel Expenses in MN:	$35,000	In support of project objectives, with approximate breakdown as follows: 60% for fleet for travel to study lakes to install equipment and conduct survey work, and to attend coordination meetings; 30% for hotels for overnight stays associated with lake survey work and project coordination; 10% for meal reimbursement in accordance with DNR travel guidelines, and meal reimbursement limits.
TOTAL ENRTF BUDGET:	**$401,000**	

* Direct and Necessary expenses include both Department Support Services and Division Support Services (Personnel support $5,820, Safety $1,372, Financial $5,219, Communication/IT $13,648, Planning $1,658 and Procurement $470). Department Support Services are described in agency Service Level Agreements, and billed internally to divisions based on indices that have been developed for each area of service. Department leadership (Commissioner's Office and Regional Directors) are not assessed. Division Support Services include costs associated with Division, business office and clerical support. Those elements of individual projects that put little or no demand on support services such as large single-source contracts, large land acquisitions, and funds that are passed-thru to other entities are not assessed Direct and Necessary costs for those activities.

Explanation of Use of Classified Staff: N/A

Explanation of Capital Expenditures Greater Than $5,000: N/A

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 6 FTE

Number of Full-time Equivalents (FTE) Estimated to Be Funded through Contracts with this ENRTF Appropriation: N/A

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
N/A	$0	$0	
State			
DNR Div. of Fish and Wildlife	$225,000	$0	In-kind match funding for new Sentinel Lakes Program coordinator position, as well as for program administration, fisheries field and technical support, and data management and analysis efforts by research and management staff
DNR Div. of EWR	$127,000	$0	In-kind match funding to support zooplankton and benthic invertebrate sampling and analysis, aquatic vegetation surveys, and lake level monitoring.
MPCA – Env. Anlys. & Outcomes	$75,000	$0	In-kind matching funds to support water quality assessments and analytical costs, sampling assistance, ground-water monitoring and volunteer coordination
TOTAL OTHER FUNDS:	**$427,000**	**$0**	

VII. PROJECT STRATEGY:

A. Project Partners:

1. DNR Division of Fish and Wildlife Section of Fisheries – Program administration, Fisheries technical and field support, data management, ($401,000 ENRTF + in-kind; Melissa Treml Project Manager).

Partners providing support but not receiving funds from the ENRTF:

2. DNR Division of Ecological and Water Resources – Zooplankton and benthic invertebrate sampling and analysis, aquatic vegetation surveys, and lake level monitoring (DNR Div. EWR, in-kind).
3. MPCA – Environmental Analysis and Outcomes Division – Water quality assessments, ground-water monitoring, volunteer coordination (in-kind).

B. Project Impact and Long-term Strategy:

Healthy lakes are an important aspect of Minnesota's cultural heritage. While losses to lake health have already undoubtedly occurred in many areas, numerous high-quality lakes still exist throughout the state, yet all lakes remain vulnerable to a myriad of threats (excess nutrients from land use and human populations, climate changes, and invasive species, to name a few). Lakes are especially vulnerable as lakes collect and integrate the surface waters that move across the landscape (and thus strongly reflect human modifications within watersheds), and lakes are also sensitive integrators of climatic conditions. For these reasons, timing is urgent for effective monitoring and protection tools not only to prevent further and possibly irreversible damage, but also to document lake improvements to our actions. Foremost, we hope to offer lake managers, conservation planners, lakeshore residents, fishers, other recreational users, and the Minnesota public a better understanding of the factors past, present, and future influencing lake conditions. Our monitoring and modeling efforts will not only help reveal the cause-effect mechanisms affecting lake status, but will also help lead us to the most appropriate indicators to track the status of our state's lakes. Detailed assessment and modeling of lake conditions will inform revisions to lake monitoring programs, provide an empirical foundation for understanding impacts of state's varied land uses and watershed restoration programs, and help inform climate change

adaptation policies related to lake management. Understanding the myriad of factors driving changes to lake habitats is one our main project goals, and critical to the societal, economic, and ecological well-being of our state.

Our long-term strategy is to establish a fully integrated lake monitoring program that combines and focuses the activities of key, collaborative management agencies (e.g. DNR and MPCA) and our partners (e.g., universities, USGS, St. Croix Watershed Research Station). Such a system will greatly increase our understanding of how these lakes change, and what management actions are most likely to provide cleaner water and healthier fish populations. Following this final ENRTF funding request for program development and implementation, our hope is to fully incorporate the Sentinel Lake Long-Term Monitoring Program into the regular activities of both agencies. New questions and subsequent requests to ENRTF are likely to arise as monitoring efforts continue, but we expect these requests to take the form of specific research projects conducted by or in collaboration with our partners. Such projects are likely to be outside the scope of routine monitoring activities and our expertise. We emphasize that we intend to cover future routine monitoring work with regular agency funding sources.

C. Funding History:

Funding Source and Use of Funds	Funding Timeframe	$ Amount
ENRTF (SLICE Phase 1)	M.L. 2009	$825,000
ENRTF (SLICE Phase 2)	M.L. 2013	$1,200,000
In-kind support originating from the Game and Fish Fund, USGS cooperative funds, US Forest Service operating budgets, PCA operating budgets and Clean Water Legacy. FY12-16 includes equipment purchases for the SLICE Phase 2 project and 50% salary for project coordinators, Jeff Reed and Brian Herwig, to finish the SLICE Phase 1 project and to design, coordinate, and implement the SLICE Phase 2 project.	FY10-FY16	$991,000
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.	FY09-FY13	$595,873

VIII. FEE TITLE ACQUISITION/CONSERVATION EASEMENT/RESTORATION REQUIREMENTS: N/A

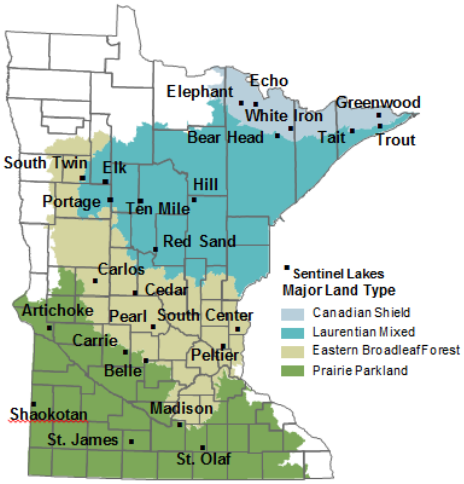
IX. VISUAL COMPONENT or MAP(S):

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?

MNDNR

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

X. RESEARCH ADDENDUM: Peer reviewed in Phase I.

XI. REPORTING REQUIREMENTS: Periodic work plan status update reports will be submitted no later than 11/30/2016, 3/31/2017, 9/30/2017, 3/31/2018, 9/30/2018, and 3/31/2019. A final report and associated products will be submitted between June 30 and August 15, 2019.

Environment and Natural Resources Trust Fund
M.L. 2016 Project Budget

Project Title: Sentinel Lakes Monitoring and Data Synthesis – Phase III
Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 03g
Project Manager: Melissa Treml
Organization: Minnesota Department of Natural Resources
M.L. 2016 ENRTF Appropriation: $401,000
Project Length and Completion Date: 2 years, June 30, 2018
Date of Report: May 29, 2016

ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Activity 1 Budget	Amount Spent	Activity 1 Balance	Activity 2 Budget	Amount Spent	Activity 2 Balance	TOTAL BUDGET	TOTAL BALANCE
BUDGET ITEM	***Sentinel Lakes Data Integration and Synthesis***			***Temperature, Biological and Water Chemistry Monitoring of Sentinel Lakes***				
Personnel (Wages and Benefits) - Overall	$129,375		$129,375	$160,075		$160,075	$289,450	$289,450
1 NR Specialist Data Manager: $129,375 (77% salary, 23% benefits); 1 FTE for 2 years								
1 NR Specialist Long-Term Monitoring Biologist: $116,875 (77% salary, 23% benefits); 1 FTE for 2 years								
3 Student Interns: $43,200 (100% salary); 1 FTE for 12 weeks in FY17, 5 weeks in FY18								
Professional/Technical/Service Contracts								
Direct and Necessary Services for the Appropriation	$28,187		$28,187				$28,187	$28,187
Equipment/Tools/Supplies (estimates, actual costs may vary slightly)								
Temperature loggers, 100 to 140 @ ~ $100/ea				$13,500		$13,500	$13,500	$13,500
Water chemistry analytical services , $31,000				$31,000		$31,000	$31,000	$31,000
Miscellaneous survey equipment, consumables, and repairs				$3,863		$3,863	$3,863	$3,863
Travel expenses in Minnesota								
For DNR field staff to conduct regular bi-monthly sampling to all study lakes, and specialized seasonal sampling at study lakes, and to attend coordination meetings (hotels, fleet costs, meals)				$35,000		$35,000	$35,000	$35,000
COLUMN TOTAL	**$157,562**	**$0**	**$157,562**	**$243,438**	**$0**	**$83,363**	**$401,000**	**$401,000**

Sentinel Lakes Monitoring & Data Synthesis

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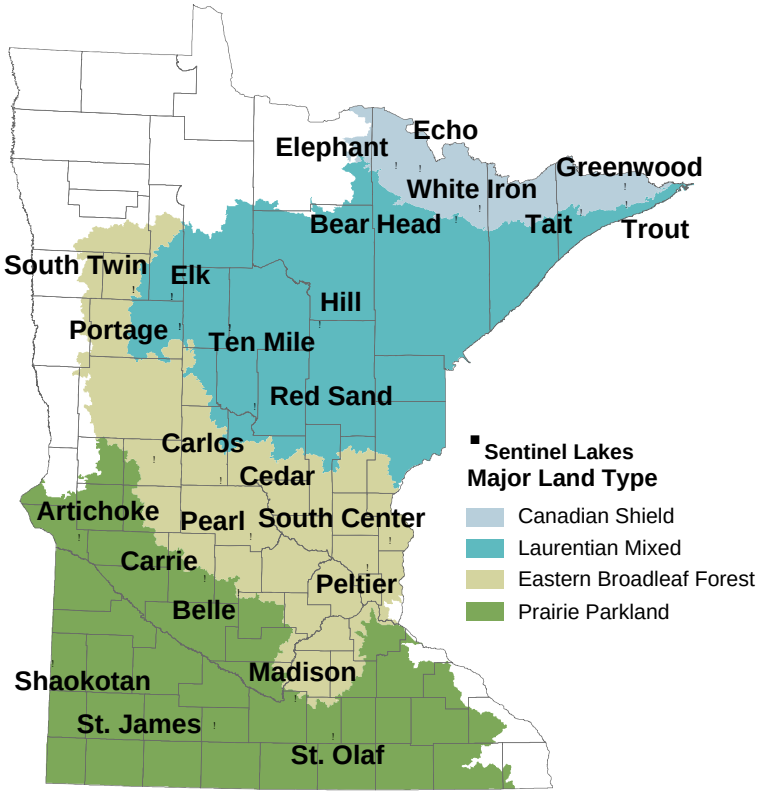

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