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

Date of Report: May 29, 2016

Date of Next Status Update Report: July 1, 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: Assessing the Increasing Harmful Algal Blooms in Minnesota Lakes

Project Manager: Miki Hondzo

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Location: St. Anthony Falls Laboratory (Hennepin County), Madison Lake (Blue Earth County), Peltier Lake (Anoka County), and South Center Lake (Chisago County)

		M.L. 2015, Chp. 76, Sec. 2, Subd. 10 Emerging Issues Account $	M.L. 2016, Chp. xx, Sec. xx, Subd. Work Plan $
Total ENRTF Project Budget:	**ENRTF Appropriation:**	**$71,000**	**$270,000**
	Amount Spent:	**$0**	**$0**
	Balance	**$71,000**	**$270,000**

Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 04b
M.L. 2015, Chp. 76, Sec. 2, Subd. 10

Appropriation Language:

M.L. 2016, Chp. 186, Sec. 2, Subd. 04b

$270,000 the second year is from the trust fund to the Board of Regents of the University of Minnesota for the Saint Anthony Falls Laboratory to investigate lake processes and meteorological conditions triggering algal blooms and toxin production, develop models for tracking blooms, and provide outreach on the prediction, detection, and impacts of mitigation of algal bloom events. This work must be done in cooperation with the St. Croix Watershed Research Station of the Science Museum of Minnesota and the Minnesota Pollution Control Agency. This appropriation is available until June 30, 2019, by which time the project must be completed and final products delivered.

M.L. 2015, Chp. 76, Sec. 2, Subd. 10

$1,000,000 the first year is from the trust fund to an emerging issues account authorized in Minnesota Statutes, section 116P.08, subdivision 4, paragraph (d).

Upon the recommendation of the Legislative-Citizen Commission on Minnesota Resources, the research teams of University of Minnesota (St. Anthony Falls Laboratory; Proposal 038-B) and the Science Museum of Minnesota (Proposal 037-B) had a meeting at the LCCMR office on November 10, 2015. In order to facilitate collaboration, eliminate duplicate efforts, and amplify synergistic discoveries related to harmful algal blooms, the researchers established a working agreement on where and when to sample harmful algae in Minnesota lakes.

I. PROJECT TITLE: Assessing the Increasing Harmful Algal Blooms in Minnesota Lakes

II. PROJECT STATEMENT:

Harmful algae including cyanobacteria are photosynthetic organisms that have been populating a growing number of freshwater ecosystems including lakes, rivers, wetlands, and stormwater ponds in Minnesota (Lindon and Heiskary, 2009). Change in land use and agricultural practices have been contributing to the degradation of water quality in Minnesota aquatic ecosystems. Such human-induced activities along with the increasing summer lake water temperatures have been establishing fertile environmental conditions for triggering harmful algal blooms.

The blooms are classified as harmful because the algae (e.g. *Microcystis*) release cyclic heptapeptide hepatoxins, called microcystins, which are harmful to wildlife and humans. Quantifying intra-cellular toxin production and extra-cellular toxin concentrations in Minnesota lakes, under variable meteorological and lake physical conditions, is crucial for understanding, predicting, and mitigating harmful algal blooms. The excessive growth of harmful algae and toxin production presents risk to public health (drinking water supply and recreational activity), has economic importance (water quality and transparency) and has ecologic significance (wildlife survival). The biological and chemical processes that trigger excessive growth of harmful algae have been studied extensively, but the meteorological conditions and corresponding lake physical processes that produce, sustain, and destroy algal growth and toxin production have received relatively little attention.

The objective of this study is to determine how lake physical processes and meteorological conditions control *Microcystis* growth and toxin production in Minnesota lakes. Quantifying intra-cellular toxin production and extra-cellular toxin concentrations under variable meteorological and lake physical conditions is very important for understanding, predicting, and responding to *Microcystis* blooms in Minnesota lakes. In collaboration with the Minnesota Pollution Control Agency and the Science Museum of Minnesota, we propose laboratory and field investigations on harmful algal blooms to 1) develop and deploy a cyanobacterial profiler with wireless data transfer and real-time data assessment over the Internet; 2) asses *Microcystis* and toxin concentration levels in Minnesota lakes before, after, and during blooms, 3) reproduce in the laboratory lake physical and meteorological conditions able to generate high *Microcystis* growth and toxin concentrations, 4) develop predictive models based on field and laboratory measurements, and 5) establish state-wide education outreach and training programs.

Lindon M., and S. Heiskary (2009). Blue-green algal toxin (microcystin) levels in Minnesota lakes, *Lake and Reservoir Management*, 25, 240-252.

III. OVERALL PROJECT STATUS UPDATES:

Project Status of July 1, 2016:

Project Status as of January 1, 2017:

Project Status as of July 1, 2017:

Project Status as of January 1, 2018:

Project Status as of July 1, 2018:

Project Status as of January 1, 2019:

Overall Project Outcomes and Results:

IV. PROJECT ACTIVITIES AND OUTCOMES:

ACTIVITY 1: Develop and deploy a cyanobacterial profiler
Description:
Harmful algal blooms and related toxic conditions are highly variable in both space and time. Quantifying and understanding them requires novel measurement technologies and monitoring systems not commonly available. Based on our long-term proven experience in the area of lake water quality monitoring, we will develop a unique and robust cyanobacterial and water quality profiler for continuous monitoring of harmful algal blooms in Minnesota lakes.

The profiler will have wireless data transfer and real-time data assessment over the Internet. The sampling sensors will generate data over the lake depth including cyanobacterial concentration, temperature, pH, dissolved oxygen, depth, and photosynthetically active radiation. Sampling times and depths will be adjustable over the Internet. The data will provide a virtual field laboratory for research and educational outreach.

During the period Feb-Apr, 2016, the instrumentation will be developed and laboratory tested at SAFL so that the field monitoring program, scheduled to begin in April, 2016, can commence without delay. The profiler will generate three years of harmful algal blooms monitoring during the "open water", or "ice-free" season (Apr-Oct, 2016-18). During these periods, we will measure the water quality and meteorological parameters responsible for triggering harmful algal blooms in Minnesota lakes.

Summary Budget Information for Activity 1:

ENRTF Budget: $ 71,000
Amount Spent: $ 0
Balance: $ 71,000

Outcome	Completion Date
1. Cyanobacterial and water *quality profiler development, construction and verification at the St. Anthony Falls Laboratory*	April 1, 2016
2. Cyanobacterial profiler deployment in *Madison Lake (Blue Earth County; ID 07-0044). Data acquisition, wireless transfer, and display over the Internet*	June 30, 2016

Activity Status as of July 1, 2016:

Final Report Summary:

ACTIVITY 2: Investigate lake processes and meteorological conditions triggering harmful algal blooms and toxin production
Description:
The proposed activity will determine how lake physical processes and meteorological conditions control *Microcystis* bloom and toxin production in Minnesota lakes. In collaboration with the Science Museum of Minnesota and the Minnesota Pollution Control Agency (MPCA), the following lakes are selected for field

measurements: Madison Lake (Blue Earth County; ID 07-0044), Peltier Lake (Anoka County; ID 02-0004), and South Center Lake (Chisago County; ID 13-0027) (please see SECTION IX: Visual Component). The selected lakes are part of the MPCA long-term monitoring program. The lakes are eutrophic with documented HABs in the past. The morphometry data of selected lakes (maximum depth and lake surface area) indicate that the selected lakes are dimictic (Madison Lake and South Center Lake) and polymictic (Peltier Lake). The proposed cyanobacterial profiler (Activity 1) will be deployed during the "open water" season in Madison Lake (Apr-Oct, 2016), Peltier Lake (Apr-Oct, 2017), and South Center Lake (Apr-Oct, 2018). During these periods, we will measure the water quality and meteorological parameters responsible for triggering harmful algal bloom and toxin production in Minnesota lakes.

Controlled laboratory measurements will be conducted at the St. Anthony Falls Laboratory, University of Minnesota, where we have developed experimental bioreactors and flumes to study *Microcystis* physiology under controlled temperature, light, nutrient, and turbulence conditions. The laboratory experiments will be guided by field measurements in the selected lakes. In the laboratory bioreactors, we will replicate the field conditions and systematically change fluid flow variables (4-5 turbulence levels) and nutrient concentrations (high and low phosphate and nitrate), while monitoring *Microcystis* growth and toxin production. The proposed toxin measurements will be quantified at the Center for Drug Design, University of Minnesota. The combination of proposed field and laboratory observations will be used to develop methods and tools for detecting and predicting harmful algal blooms and toxin production in Minnesota lakes.

Summary Budget Information for Activity 2:

ENRTF Budget: $ 193,922
Amount Spent: $ 0
Balance: $ 193,922

Outcome	Completion Date
1. *Quantify meteorological conditions (temperature, wind), lake physical variables (temperature, velocities, light) and nutrient concentrations (nitrate and phosphate) that trigger Microcystis bloom and toxin production in Madison Lake (2016), Peltier Lake (2017), and South Center Lake (2018)*	December 31, 2016 (Madison Lake) December 31, 2017 (Peltier Lake) December 31, 2018 (South Center Lake)
2. Quantify physical variables and nutrient concentrations that trigger high *Microcystis* biomass and Microcystin concentration generation in bioreactors at the St. Anthony Falls Laboratory. The laboratory bioreactors will be populated by the field species of *Microcystis* (Madison Lake, 2016; Peltier Lake, 2017; South Center Lake, 2018)	June 30, 2017 June 30, 2018
3. *Determine a combination of meteorological-physical-chemical conditions that maximizes intra-cellular and extra-cellular toxin production*	December 31, 2018

Activity Status as of January 1, 2017:

Activity Status as of July 1, 2017:

Activity Status as of January 1, 2018:

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

ACTIVITY 3: Develop models for alerting and reporting harmful algal blooms
Description:
Monitoring harmful algal blooms is difficult because of their patchy and transient distribution in lakes. In addition, toxin detection and harmful algal bloom identification usually take several days after the collection of samples. For the development of predictive models, we thus plan to use identified and verified proxies emerging from the proposed laboratory and field measurements (outcomes of Activity 1 and Activity 2). We will identify statistically significant variables that explain the presence of high *Microcystis* biomass and toxin concentrations. The variables will be grouped and implanted in the prediction models of *Microcystis* biomass and toxin production. A guiding principle will be to investigate real-time available data including air and water temperatures, wind speed, as well as lake specific variables such as lake morphometry, stability, and stratification. An overall objective is to develop simple prediction models, which use the readily available proxies, for alerting and predicting harmful algal blooms and toxin production in Minnesota lakes.

Summary Budget Information for Activity 3:

ENRTF Budget: $ 35,557
Amount Spent: $ 0
Balance: $ 35,557

Outcome	Completion Date
1. Develop scaling relationships for assessing HABs and toxin production in MN lakes	March 30, 2018
2. Develop models for predicting HABs and toxin production in MN lakes	December 31, 2018

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

ACTIVITY 4: Education and public outreach: Detection, prediction, impact mitigation
Description:
Education and Public Outreach **(EPO)** activity will promote and enhance education and communication on harmful algal blooms in Minnesota lakes. The audience will be water quality managers, lake management associations, public and government agencies, and drinking water utilities. We will identify and form 3 to 5 focus groups (state agencies, watershed managers, public, high school students, graduate students) and asses public awareness and interest on harmful algal blooms. A designated website (hab.safl.umn.edu) will be established and used to conduct the proposed EPO. The educational modules will developed based on the assessment of public awareness, peer-reviewed publications, and our laboratory and field measurement in Minnesota lakes. The educational modules will include 1) field detection (biomass quantification, and toxin evaluation); 2) online reporting; 3) prediction (biomass and toxin concentrations); and 4) mitigation strategies. Selected data and procedures will be available on the website to further promote scientific collaboration with other universities and research groups. A regional workshop is planned to present and provide overview of (1) algae, their identification, and harmful algal blooms, (2) toxin generation and detection, (3) risk to public health and wildlife survival, and (4) prediction and impact mitigation of harmful algal blooms. The workshop will be conducted in December, 2018, at the St. Anthony Falls Laboratory, University of Minnesota. The training portions of workshop will be recorded for future reference.

Summary Budget Information for Activity 4:

ENRTF Budget: $ 40,520
Amount Spent: $ 0
Balance: $ 40,520

Outcome	Completion Date

1. Assess public awareness, establish focus groups, establish project website (hab.safl.umn.edu)	December 31, 2017
2. *Compile a list of available freshwater HAB educational materials (work other researchers & agencies), including web accessible outreach materials*	May 31, 2018
3. *Establishment of educational modules on harmful algal blooms, video development, and online placement (* hab.safl.umn.edu*)*	Jun 31, 2018
4. *Demonstration and training on detection, prediction, and impact mitigation techniques*	December 31, 2018
5. Regional workshop at the University of MN: Harmful algal blooms detection, prediction, and mitigation	December 31, 2018

Activity Status as of January 1, 2018:

Activity Status as of July 1, 2018:

Activity Status as of January 1, 2019:

Final Report Summary:

V. DISSEMINATION:

Description:
During the duration of project, major research findings will be submitted to peer-reviewed publications, regional and national conferences with emphasis on harmful algal blooms. The proposed EPO activity will be administrated through the designated website hab.safl.umn.edu. A short 3 minute video will be developed to introduce and promote the project, disseminate awareness on the potential impact of harmful algal blooms, and advocate early detection and mitigation strategies. The video will be posted on the project website (hab.safl.umn.edu, social media) and will be publicly available. The video will be intended for general public with interest in the project. It can also be used as an introduction of the project at City Council, County Commissioners lake associations, or any other agencies or organizational meetings.

Status as of July 1, 2018:

Status as of January 1, 2019:

Final Report Summary:

VI. PROJECT BUDGET SUMMARY:
A. ENRTF Budget Overview:

Budget Category	$ Amount	Overview Explanation
Personnel:	$255,661	Hondzo project manager at 10% FTE year 1 and 5% FTE for year 2 and year 3 ($39,786); Guala, experimental fluid mechanics, at 5% FTE each year for 3 years ($20,225); Salomon, toxin measurements, at 3% FTE ($13,296); Missaghi, education outreach, at 10% FTE for year 2 and year 3 ($16,442). 1 graduate student (59% salary, 41% fringe) during year 1 and year 2 for 12 months and year 3 for 3 months ($98,249). 1 undergraduate student (100% salary) 3 months for year 1, 2 months for year 2, and 2

		months for year 3 ($11,360). 1 instrumentation engineer at 15% FTE in year 1 (14,355), 1 machinist at 1% FTE in year 1 ($668), 1 engineer at 4% FTE in year 1 ($3,033), 1 technician at 20% FTE each year for 3 years for detecting microcystis concentrations in field and laboratory water samples, and 1 IT technician at 2% FTE for year 2 and year 3 for designing the proposed project website.
Professional/Technical/Service Contracts:	$	Na
Equipment/Tools/Supplies:	$49,000	General supplies for laboratory and field analyses are quantified based on previous experience. Year 1 ($21,00) includes laboratory supplies and material needed for the construction of profiler ($11,000). The supplies for profiler will include the construction of floating raft, temperature sensors, mechanisms for traversing the cyanobacterial profiler, data acquisition boards, wind speed anemometer and wireless data transfer communication supplies. The remaining supplies ($10,000) for year 1, $10,000 for year 2, and $8,000 for year 3 will include 1) optical components for PIV/PTV experiments (one fixed focal macro lens, laser mirrors and mounting posts), 2) chemical components for *Microcystis* laboratory experiments (BG-11 medium, *Microcystis* culture, nitrogen gas, carbon dioxide gas, acetone, reagents for nutrient analysis, microcystin detection), and 3) parts and labor for laboratory bioreactor modifications and field deployments. Additional supplies and tools will be utilized for the proposed education and public outreach ($5,000 year 1 and $5,000 year 2). The supplies will include assessment laboratory kits for microcystin detection, chlorophyll detection kits, assessment survey materials, supplies for the proposed workshop.
Capital Expenditures over $5,000:	$19,714	Laboratory fluorometer (Turner Design, chlorophyll, nitrate, and phosphate detection, $8,792). Cyanobacterial water quality profiler for measuring algal concentration, temperature, oxygen, pH, and underwater light intensity at specified times and water depth increments which are adjustable over the Internet (OTT Hydromet, $10,922).
Printing:	$ 1,000	Printing expenses will include the proposed assessment surveys, educational summary cards, and the handouts of proposed workshop.
Travel Expenses in MN:	$ $13,825	Travel expenses will include travel to 3 designated field sites for profiler deployment

		and subsequent monitoring efforts ($2,800 for year 1 (10 daily field visits from Apr-Oct, including expenses for university truck and millage ($120/day), meal for 4 researchers ($50/day person)), $1500 for year 2 (5 daily visits), and $900 for year 3 (4 daily visits). Additional travel expenses for the proposed education and public outreach ($4,310 for year 2 (15 daily trips) and $4,315 for year 3 (15 daily trips)). The proposed education and public outreach include: assessment surveys for 3 focus groups, curriculum development, onsite training, and attending state conference to present research outcomes.
Other:	$ 1,800	Wireless data download from the proposed field sites to designated project website (hab.safl.umn.edu) at the University of Minnesota.
TOTAL ENRTF BUDGET:	**$ 341,000**	

Explanation of Use of Classified Staff:

Explanation of Capital Expenditures Greater Than $5,000:
A laboratory fluorometer will be used for the proposed analysis of chlorophyll, nitrate and phosphate concentrations in the laboratory and field samples. The cost of equipment with an educational discount is $8,792 (Turner Designs). A Cyanobacterial autonomous profiler will be used in the field . The profiler can provide cyanobacterial concentration profiles over the lake depth and it will have adjustable sampling times and depths over the Internet. The profiler will have a wireless data transfer with display over the Internet. The cost of profiler with an educational discount is $10,922 (OTT Hydromet).

Number of Full-time Equivalents (FTE) Directly Funded with this ENRTF Appropriation: 1.5

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

B. Other Funds:

Source of Funds	$ Amount Proposed	$ Amount Spent	Use of Other Funds
Non-state			
	$	$	
State			
	$	$	
TOTAL OTHER FUNDS:	**$**	**$**	

VII. PROJECT STRATEGY:
A. Project Partners:
The project team consists of the Principal Investigator (PI) Prof. Miki Hondzo (University of Minnesota) and Co-PIs Prof. Michele Guala, Prof. Christine Salomon, and Dr. Shahram Missaghi. Project Partner not receiving funds: Steven Heiskary (Minnesota Pollution Control Agency). This proposed project will be conducted in collaboration with the St. Croix Watershed Station of the Science Museum of Minnesota.

B. Project Impact and Long-term Strategy:

Harmful algal blooms, including the toxin-producing cyanobacterium *Microcystis* are a global environmental concern worldwide. A key question in the proposed study is: What combination of environmental non-biological conditions enhances the blooms of *Microcystis* and toxin production in Minnesota lakes? Predictive models of *Microcystis* growth and toxin production in lakes, integrated with the readily available variables including air and water temperatures, wind speed, lake morphometry, lake stability, and stratification meteorological conditions, will be the core of research strategy. The long-term goal will be to build a computational framework over the Internet for alerting and predicting harmful algal blooms and toxin production in Minnesota lakes (*algae tracker*). A similar approach has been used to alert and forecast pollen concentration (*allergy tracker*) by the Internet-based weather prediction models. The proposed website will be developed to interface with existing resources (LakeFinder from DNR, or MPCA lake website) to assist water quality managers, public, government agencies, and drinking water utilities in the prediction and management of the detrimental impacts of harmful algal blooms in Minnesota lakes.

C. Funding History:

Anne Wilkinson, the National Science Foundation Fellow, has been funded for three years (Sep 2013 to August 2016) to conduct laboratory and field measurements with focus on *Microcystis* bloom in Minnesota lakes. That funding provided a basis for the proposed research. The proposed project will provide 50% research assistantship for Ms. Wilkinson for year 1 and year 2 of project. Anne's PhD thesis is focused on cyanobacterial blooms and microcystin production in Minnesota lakes.

Funding Source and Use of Funds	Funding Timeframe	$ Amount
Funding History: salary and tuition of NSF-funded student Anne Wilkinson that is currently investigating algal blooms for her PhD thesis. The total, for the period prior to the project start date September 2013 to February 2016, is based on the 51,500 yearly NSF contribution	Sep 2013-August 2016	$154,500

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

A. Parcel List: NA

B. Acquisition/Restoration Information: NA

IX. VISUAL COMPONENT or MAP(S):

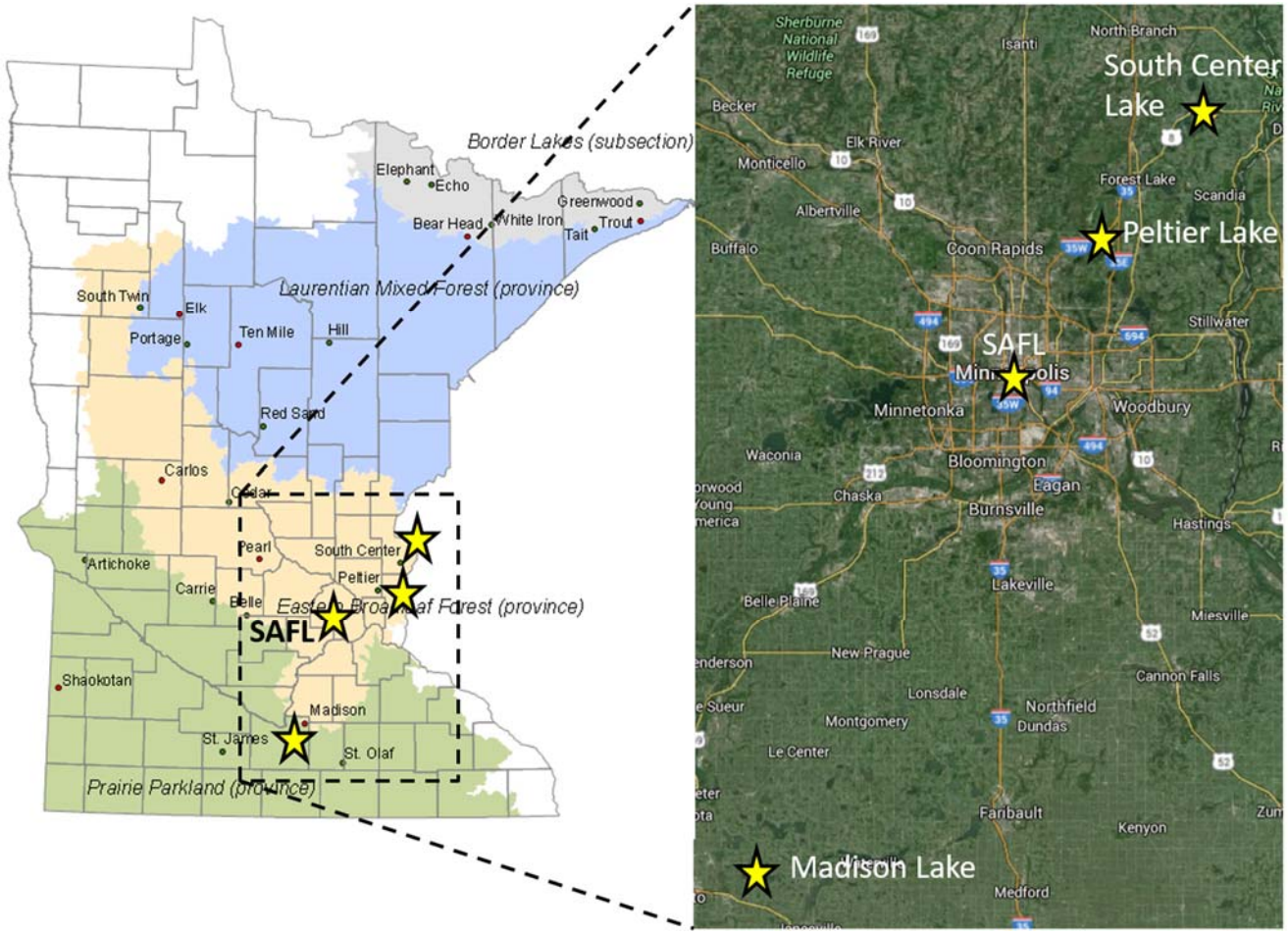

Figure 1. Geographic locations of selected lakes for field measurements (star symbols) and laboratory measurements (SAFL) at the University of Minnesota.

X. RESEARCH ADDENDUM: N/A

XI. REPORTING REQUIREMENTS:

Periodic work plan status update reports will be submitted no later than July 1, 2016, January 1, 2017, July 1, 2017, January 1, 2018, July 1, 2018, and January 1, 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: Assessing the Increasing Harmful Algal Blooms in Minnesota Lakes
Legal Citation: M.L. 2016, Chp. 186, Sec. 2, Subd. 04b
Project Manager: Miki Hondzo
Organization: St. Anthony Falls Laboratory, University of Minnesota
M.L. 2015, Chp. 76, Sec. 2, Subd. 10 Emerging Issues - Activity 1 - $71,000
M.L. 2016 ENRTF Appropriation: $ *341,000*
Project Length and Completion Date: 3.5 years, *June 30, 2019*
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	Activity 3 Budget	Amount Spent	Activity 3 Balance	Activity 4 Budget	Amount Spent
BUDGET ITEM	*M.L. 2015, Chp. 76, Sec. 2, Subd. 10 Emerging Issues - Develop and deploy cyanobacterial profiler*			*Assess algal bloom and toxin production in Minnesota Lakes*			*Develop models for algal blooms and toxin production*			*Education and public outreach*	
Personnel (Wages and Benefits)	$25,686	$0	$25,686	$173,522	$0	$173,522	$35,557	$0	$35,557	$20,895	$0
Miki Hondzo, Project Manager: $39,786 (75% salary, 25% benefits); 10% FTE year 1, 5% FTE year 2, and 5% FTE year 3											
Michele Guala, Co-PI: $20,225 (75% salary, 25%benefits); 5% FTE each year for 3 years											
Christine Salomon, Co-PI: $13,296 (75% salary, 25% benefits); 3% FTE each year for 3 years											
Shahram Missaghi, Co-PI: $16,442 (75% salary, 25% benefits); 10% FTE year 2, and 10% FTE year 3											
IT Technician: $2,453 (78% salary, 22% fringe): 2% FTE year 2, and 2% FTE year 3											
Christopher Ellis, data acquisition engineer: $14,355 (78% salary, 22% fringe); 15% FTE year 1											
Benjamin Ericon, field engineer: $3,033 (78% salary, 22% fringe); 4% FTE year 1											
Lab Technician: $35,792 (78% salary, 22% fringe): 20% FTE each year for 3 years											
Eric Steen, machinist: $668 (78% salary, 22% fringe); 1% FTE year 1											
Graduate student: $98,249 (59% salary, 41% fringe): 50% FTE year 1 and year 2, and 12.5 % FTE year 3											
Undergraduate student (100% salary): $11,360: 25% FTE year 1, 17% FTE year 2, and 17% FTE year 3											
Professional/Technical/Service Contracts											
NA											
Equipment/Tools/Supplies											

General supplies for laboratory and field analyses are quantified based on previous experience. Year 1 ($21,00) includes laboratory supplies and material needed for the construction of profiler ($11,000). The supplies for profiler will include the construction of floating raft, temperature sensors, mechanisms for traversing the cyanobacterial profiler, data acquisition boards, wind speed anemometer and wireless data transfer communication supplies. The remaining supplies ($10,000) for year 1, $10,000 for year 2, and $8,000 for year 3 will include 1) optical components for PIV/PTV experiments (one fixed focal macro lens, laser mirrors and mounting posts), 2) chemical components for Microcystis laboratory experiments (BG-11 medium, Microcystis culture, nitrogen gas, carbon dioxide gas, acetone, reagents for nutrient analysis, microcystin detection), and 3) parts and labor for laboratory bioreactor modifications and field deployments. Additional supplies and tools will be utilized for the proposed education and public outreach ($5,000 year 1 and $5,000 year 2). The supplies will include assessment laboratory kits for microcystin detection, chlorophyll detection kits, assessment survey materials, supplies for the proposed workshop	$21,000	$0	$21,000	$18,000	$0	$18,000				$10,000	$0
Capital Expenditures Over $5,000											
Laboratory fluorometer (Turner Design, chlorophyll, nitrate, and phosphate detection, $8,792). Cyanobacterial water quality profiler for measuring algal concentration, temperature, oxygen, pH, and underwater light intensity at specified times and water depth increments which are adjustable over the Internet (OTT Hydromet, $10,922)	$19,714	$0	$19,714								
Fee Title Acquisition											
NA											
Easement Acquisition											
NA											
Professional Services for Acquisition											
List costs associated with fee title and easement acquisition transactions. Indicate expected number of transactions and average costs per transaction.											
Printing											
Printing coasts are associated with Activity 4 (Education and Public Outreach) including assesment survey handouts, educational summary cards, and the handouts of proposed workshop										$1,000	$0
Travel expenses in Minnesota											

Travel expenses will include travel to 3 designated field sites for profiler deployment and subsequent monitoring efforts ($2,800 for year 1 (10 daily field visits from Apr-Oct, including expenses for university truck and millage ($120/day), meal for 4 researchers ($50/day person)), $1500 for year 2 (5 daily visits), and $900 for year 3 (4 daily visits). Additional travel expenses for the proposed education and public outreach ($4,310 for year 2 (15 daily trips) and $4,315 for year 3 (15 daily trips)). The proposed education and public outreach include: assessment surveys for 3 focus groups, curriculum development, onsite training, and attending state conference to present research outcomes.	$2,800	$0	$2,800	$2,400	$0	$2,400			$8,625		$0
Other											
Wireless data download from the proposed field sites to designated project website (hab.safl.umn.edu) at the University of Minnesota.	$1,800		$1,800								
COLUMN TOTAL	**$71,000**	**$0**	**$71,000**	**$193,922**	**$0**	**$193,922**	**$35,557**	**$0**	**$35,557**	**$40,520**	**$0**