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

Project Title: **ENRTF ID: 073-B**

Preventing Harmful Algal Blooms through Improved Stormwater Detention

Category: B. Water Resources

Sub-Category:

Total Project Budget: $ 619,031

Proposed Project Time Period for the Funding Requested: June 30, 2023 (3 yrs)

Summary:

Our project will identify assessment strategies for use in developing tools for pond management to limit nutrient release to be adopted by cities, counties, state agencies and watershed management organizations.

Name: John Gulliver

Sponsoring Organization: U of MN

Job Title: Professor

Department: St. Anthony Falls Laboratory

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Web Address:

Location:

Region: Statewide

County Name: Statewide

City / Township:

Alternate Text for Visual:

Nutrients may be released from sediments in old or failing ponds causing harmful algae blooms in ponds or lakes.

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

PROJECT TITLE: Preventing Harmful Algal Blooms through Improved Stormwater Detention

I. PROJECT STATEMENT

The goals of this project are (1) to identify detention ponds that are releasing the nutrients to surface waters that cause harmful algal blooms (HABs) and (2) to develop tools to assess performance of stormwater detention areas to avoid creation of harmful algal blooms in surface waters.

Why- Stormwater ponds, or settling basins, are one of the most commonly used stormwater practices in both rural and urban areas, designed to trap and hold pollutants. In fact, we estimate Minnesota has over 30,000 stormwater treatment ponds used to improve water quality in agricultural, suburban, and urban area. While these ponds are effective at retaining solids, metals, oils and hydrocarbons, there is increasing evidence that many of the older ponds are not working as intended, primarily with respect to retaining nutrients that are the primary cause of harmful algal blooms (HABs) in lakes and streams. It is estimated that approximately 40% of stormwater ponds are releasing nutrients to receiving waters and many of these ponds are likely producing HABs. Further, these ponds are often situated in suburban neighborhoods or rural areas where HABs pose a human, pet, and livestock health risk. Pond owners (state, county, city and private) currently have no means to accurately determine the risk that their pond is failing if the pond is contributing to local and downstream HABs, and how ponds should be maintained (e.g. by removing contaminated sediments) to ensure they are functioning as intended.

Background- Stormwater ponds are primarily designed to capture pollutants, particularly nutrients, in surface waters by settling suspended sediment and attached pollutants. The traditional paradigm is that once these pollutants settle to the pond sediments, they are permanently sequestered there. While this may be true for many pollutants such as heavy metals, recent studies have shown that many ponds have higher nutrient loads in outflows than in inflows, meaning that nutrient loads to downstream water bodies are being increased and contributing to the proliferation of HABs and eutrophication. These high levels of nutrients affect not only pond water quality, but also that of the lakes or streams receiving pond discharge, by causing eutrophication, fish kills, and degradation of lake and stream ecosystems. Stormwater ponds designed to permanently trap pollutants may be failing for several reasons including reduced storage capacity from accumulated sediment over time, sediment scour during floods, or frequent low oxygen conditions that leads to sediment nutrient release. For the communities that own and operate the ponds, tools to assess these conditions as well as potential maintenance strategies are lacking, but are necessary to improve water quality, and avoid harmful algal blooms in ponds, lakes and streams that pose a human, pet, and livestock health risk. Our project will identify assessment strategies for use in developing tools for pond management that can be adopted by cities, counties, state agencies and watershed management organizations.

II. PROJECT ACTIVITIES AND OUTCOMES

Activity 1: Identify factors causing failure of ponds for nutrient management **Budget: $223,968**

The goal of this activity will be to identify factors that lead to the release and export of nutrients from stormwater ponds including watershed, climate, and pond characteristics. This activity will also focus on factors that may describe the frequency and magnitude of HABs in stormwater ponds including toxin production to quantify human and animal risk. Physical characteristics and water chemistry will be sampled intensively in ten ponds, with inflow and outflow of three of the ponds monitored continuously. Water samples will be collected from an additional 20 ponds during dry and wet periods, including winter, to investigate variability among ponds and the influence of season, pond age and weather on nutrient release.

Outcome	Completion Date
1. Quantify nutrient loading to and from monitored ponds	*12/31/2021*
2. Identify relationships between pond nutrients and climate, season, pond size and age, and watershed factors	*6/30/2022*

Activity 2: Quantify nutrient release from stormwater pond sediments **Budget: $201,603**

Activity 2 will determine the conditions that facilitate sediment nutrient release and identify indicators of pond failure- threshold levels and appropriate mitigation strategies. Fifty intact sediment cores will be collected and used to measure sediment chemistry and nutrient release rates. Factors that control nutrient release will be altered to match field conditions observed in ponds. Indicators of pond failure by high rates of nutrient release will be identified and verified with the sediment cores.

Outcome	Completion Date
1. Quantify nutrient flux from different pond sediments under various conditions	*10/31/2022*
2. Identify sediment characteristics and factors affecting nutrient release/retention	*12/31/2022*

Activity 3: Develop tools and guidelines for maintaining stormwater ponds **Budget: $193,460**

The goal of this activity will be to develop a decision support tool based on a model that will predict the relationship between pond attributes like age, design and size, watershed variables, sediment chemistry, nutrient loading, and potential for nutrient release for ponds across Minnesota. The results can be used to determine which ponds are at risk for failure and to propose methods to control nutrient release from ponds.

Outcome	Completion Date
1. Develop and verify a predictive model that can estimate nutrient release potential for stormwater ponds in Minnesota	*4/30/2023*
2. Develop strategies for maintenance of stormwater ponds with a support tool	*6/30/2023*

III. PROJECT STRATEGY

A. Project Team/Partners

- Dr. John Gulliver, PI, Professor, Department of Civil, Environmental and Geo- Engineering, UMN-Twin Cities
- Dr. Jacques Finlay, co-PI, Associate Professor, Department of Ecology, Evolution, and Behavior, UMN-TC
- Joe Bischoff, co-PI, Principal Scientist, Wenck Associates, Inc.

Input and advice from several organizations will be utilized to ensure that the goals of this research are met, and that the findings are useful to, and shared with, decision-makers in Minnesota. We will partner with the Minnesota Pollution Control Agency (David Fairbairn), the Riley Purgatory Bluff Creek Watershed District and the City of Eden Prairie who performed initial research on stormwater pond nutrient concentrations. We will also partner with the City of Eagan who maintains over 1,300 stormwater basins and have on the ground experience with failing ponds. Finally, we will seek advice from the members of the Stormwater Research Council, who participate and are involved in much of the stormwater research in Minnesota.

B. Project Impact and Long-Term Strategy

This project will identify the human health risk of HABs in local stormwater ponds and improve water quality of Minnesota lakes, streams and ponds by providing guidance for pond maintenance, which requires improved understanding of factors and processes that influence nutrient release (or retention) from ponds. Understanding environmental conditions that influence nutrient release from pond sediments and HAB proliferation will be a major goal of the work.

An important outcome of the project is the development of maintenance guidelines that will minimize nutrient loading from ponds to other water bodies and reduce the magnitude and frequency of HABs. This includes developing tools that can predict the relationship between nutrient release and pond or watershed characteristics, and provide guidance on when ponds require maintenance. These tools will help communities prioritize sediment removal or other treatment options. The results will be valuable to a wide range of state, municipal and private entities managing stormwater ponds to improve lake and stream quality.

C. Timeline Requirements

Three years are needed to complete the project in order to capture seasonality and geographic variability in the field sampling, target specific questions in the laboratory, and analyze the range of processes involved.

Attachment A: Project Budget Spreadsheet
Environment and Natural Resources Trust Fund
M.L. 2020 Budget Spreadsheet
Legal Citation:
Project Manager: John Gulliver
Project Title: Preventing Harmful Algal Blooms in Lakes, Streams and Ponds
Organization: Regents of the University of Minnesota
Project Budget: $619,031
Project Length and Completion Date: 3 years; June 30, 2023
Today's Date: April 15, 2019

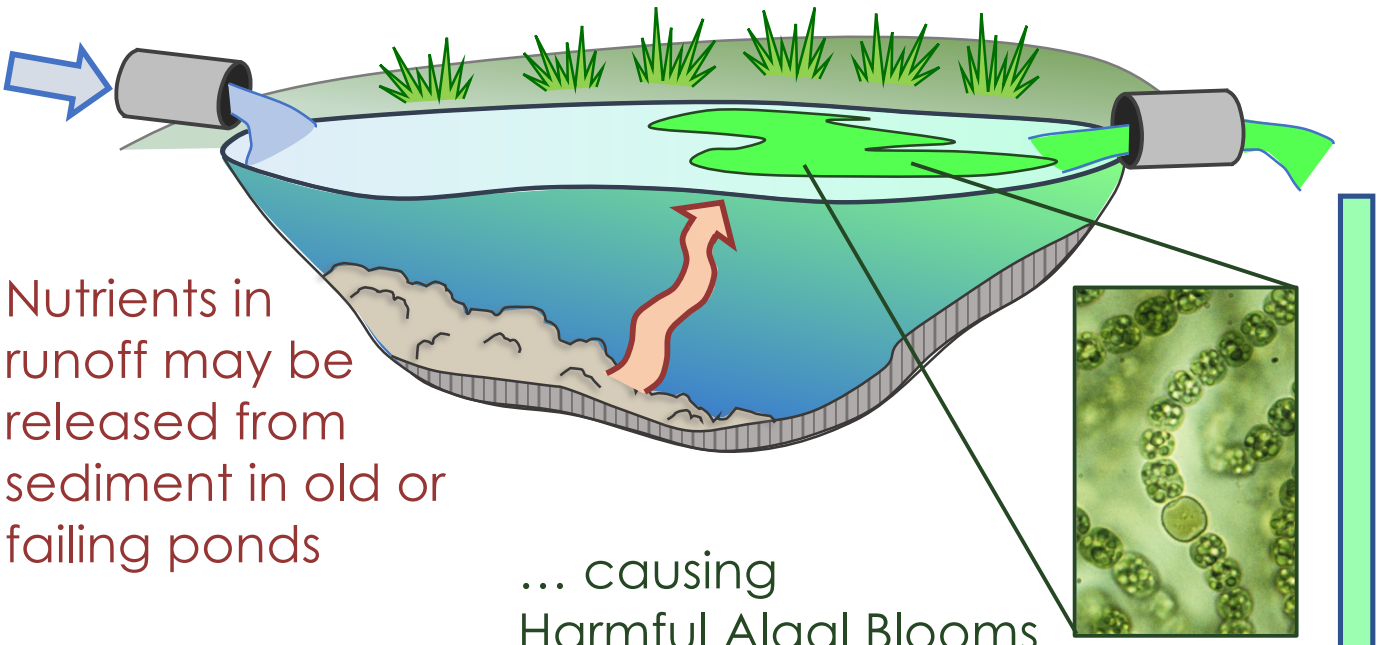
ENVIRONMENT AND NATURAL RESOURCES TRUST FUND BUDGET	Budget	Amount Spent	Balance
BUDGET ITEM			
Personnel (Wages and Benefits)	$ 408,031	$ -	$ 408,031
Professor (J. Gulliver), Supervisory and Analysis, 4% time, 74% salary, 26% benefits, 3 years ($27,454).			
Professor (J. Finlay), Supervisory and Analysis, 4% time, 74% salary, 26% benefits, 3 years ($19,302).			
Research Associate (B. Janke), Field sampling and monitoring, data collection and analysis, 40% time, 74% salary, 26% benefits, 3 years ($106,719).			
Research Associate (P. Natarajan), Field sample collection, laboratory experiments, data collection and analysis, 20% time, 74% salary, 26% benefits, 3 years ($49,323).			
Graduate Student, Laboratory experiments, sample analysis, and data analysis, 25% appointment, 58% salary, 42% benefits, 3 years ($76,961).			
Junior Scientist (A. Ketchmark), Field sample collection and experimental apparatus, 3% time, 77% salary, 23% benefits, 3 years ($6,174).			
Junior Scientist (S. Rorer), Laboratory sample analysis, 32% time, 77% salary, 23% benefits, 3 years ($64,076).			
Junior Engineer Trainees/Undergraduate Research Assistants, Field sample collection and laboratory sample analysis, 75% time, 100% salary, 3 years ($58,022).			
Professional/Technical/Service Contracts			
Wenck Associates Inc. will provide environmental engineering, water quality modeling, analytical analyses, and project reporting. They will participate in all aspects of the project, which will allow us to combine our expertise.	$ 178,000	$ -	$ 178,000
Equipment/Tools/Supplies	$ 28,240	$ -	$ 28,240
Analytical laboratory services for gas, water and sediment analysis ($8,000)			
Supplies for field monitoring, sample collection, laboratory experiments, and sample analysis ($20,000).			
Cellular data for remote data collection at field monitoring sites ($240)			
Capital Expenditures Over $5,000			
	$ -	$ -	$ -
Fee Title Acquisition			
	$ -	$ -	$ -
Easement Acquisition			
	$ -	$ -	$ -
Professional Services for Acquisition			
	$ -	$ -	$ -
Printing			
Printing and duplicating project reports ($120)	$ 120	$ -	$ 120
Travel expenses in Minnesota			
Travel: To sites to collect samples. 8000 miles @ $0.58/mi ($4,640)	$ 4,640	$ -	$ 4,640
Other			
	$ -	$ -	$ -
COLUMN TOTAL	$ 619,031	$ -	$ 619,031

SOURCE AND USE OF OTHER FUNDS CONTRIBUTED TO THE PROJECT	Status (secured or pending)	Budget	Spent	Balance
Non-State:		$ -	$ -	$ -
State:		$ -	$ -	$ -
In kind: The University of Minnesota does not charge the State of Minnesota its typical overhead rate of 54% of the total modified direct costs.	secured	$ 320,932	$ -	$ 320,932

Other ENRTF APPROPRIATIONS AWARDED IN THE LAST SIX YEARS	Amount legally obligated but not yet spent	Budget	Spent	Balance
		$ -	$ -	$ -

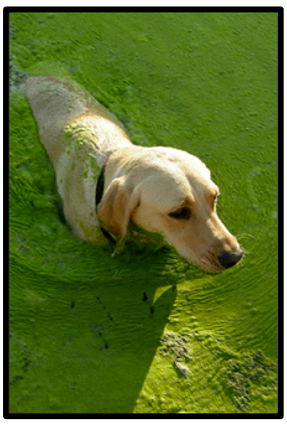
Preventing Harmful Algal Blooms in Lakes and Streams

We will develop tools to assess, maintain, and ***improve stormwater management practices to prevent Harmful Algal Blooms*** *in ponds, lakes and streams*



Nutrients in runoff may be released from sediment in old or failing ponds

… causing Harmful Algal Blooms in ponds and lakes



Harmful algal blooms can be toxic to humans, and fatal to pets and aquatic life

Project Manager Qualifications & Organization Description

Dr. John S. Gulliver

Professor, Department of Civil, Environmental and Geo- Engineering, University of Minnesota

B.S. 1974	University of California, Santa Barbara (Chemical Engineering)
M.S. 1977	University of Minnesota (Civil Engineering)
Ph.D. 1980	University of Minnesota (Civil Engineering)

John Gulliver is a professor of civil, environmental and geo- engineering, performing his research at the St. Anthony Falls Laboratory. Much of his research, in conjunction with other faculty, involves the development of new technology for stormwater treatment and assessment of field performance of stormwater treatment practices, including the SAFL Baffle, which converts any sump into an effective sediment settling device, the Iron-Enhanced Sand Filter, which removes dissolved, as well as particulate phosphorus, and the MPD Infiltrometer, which can measure infiltration into soil accurately and effectively with minimal volume of water. He has investigated the retention of metals by bioretention media, the infiltration rates of various stormwater treatment practices, the impact of various types of impervious areas on runoff, and the impact of climate change on stormwater infrastructure. He is a co-author of the book, Optimizing Stormwater Treatment Practices: A Handbook of Assessment and Maintenance, published by Springer.
Gulliver has expanding his interdisciplinary research activities related to managing and treating urban runoff and publication of the practitioner-oriented newsletter, Stormwater Updates.

The St. Anthony Falls Laboratory (SAFL), an interdisciplinary fluids research and educational facility of the College of Science and Engineering at the University of Minnesota. SAFLs research is focused at the intersection of fluid dynamics with major societal challenges in energy, environment and health. SAFL integrates experiments in the laboratory and field with advanced computational tools and theory to obtain innovative, science-based solutions to real-world fluid-flow problems. SAFL serves as a resource for departments across the Twin Cities campus, the statewide University system, and the broader research community. The connections and collaborations reach across the country and all over the world, and SAFL partners with local, state and federal agencies; private consulting firms; businesses of many kinds; technical associations; and other educational institutions to expand knowledge and solve problems.