**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**

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| **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.

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| **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* |

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| **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.

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| **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* |

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| **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.

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| **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.