Department of Biosystems and Agricultural Engineering
MICHIGAN STATE UNIVERSITY

BE 487 - Spring 2025
Biosystems Design Projects

Prevention of Harmful Algal Bloom Events in Soldan Dog Park Pond

Ella Harrell, Janie Cooper, Dov Myers, Amari Selby

Client: Ingham County Faculty Advisor: Dr. Dawn Dechand

INGHAM COUNTY PARKS

Background

Soldan Dog Park in Lansing, Michigan has closed frequently in recent years due to harmful algal bloom (HAB) events. Dog owners have expressed concern about the safety of their dogs due to this. HAB events are caused by excess phosphorus (Janke, 2023). The project aims to prevent HAB events from occurring at Soldan Dog Park by controlling nutrient levels. Figure 1 shows the important focus areas of water testing and the solution implementation area.

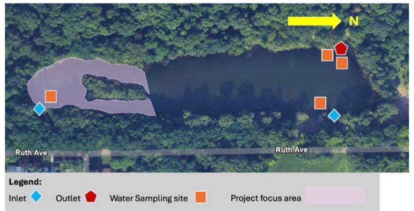

Figure 1. Aerial view of Soldan Dog Park Pond.

Water testing of the total phosphorus concentrations were done across four days, with the results are shown in Table 1.

Table 1. Water Sampling results over a three-day period

Date	Outlet	SE Inlet	NE Inlet
Oct. 24	0.02	0.03	-
	0.04	-	-
Oct. 29	0.02	0.03	-
Nov. 8	0.02	0.01	0.03
	0.05	0.03	0.03
	0.16	0.21	0.29
	0.03	0.04	0.06
Nov. 15	0.11	0.02	0.03
	0.30	0.05	0.72
	-	0.22	0.30
	-	0.02	0.31

Objectives & Constraints

Objectives
- Fully operational by May 2026
- Reduce HAB events by 50% compared to previous two years
- Maintenance four times annually
- Annual maintenance cost of $1,000

Constraints
- Nitrogen concentration of 10 mg/L
- Phosphorus concentration of 0.1 μg/L

Water Control Structure

The final design chosen is a water control structure attached to the existing stormwater system. The stormwater will flow into the water control structure and through the phosphorus removal media, Alcan, held in barrels. The structure integrates an overflow outlet to prevent backups in the system.

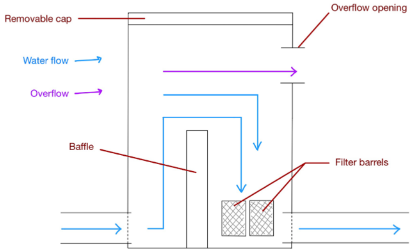

Figure 2. Proposed water control structure with removable filter barrels.

OpenHydroQual Modeling

OpenHydroQual was used to assess the effectiveness of the water control structure at decreasing phosphorus levels in the pond. The whole system included the watershed, filter materials (sand/Alcan), Soldan Dog Park Pond, and Sycamore Creek. Two equations were used to model sorption and desorption that occur.

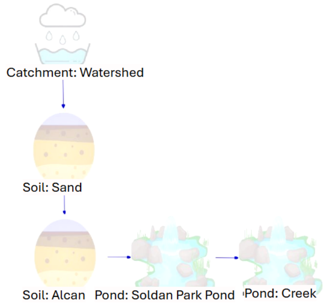

Figure 3. OpenHydroQual graphics showing the blocks used to model the overall stormwater system.

OpenHydroQual Modeling continued

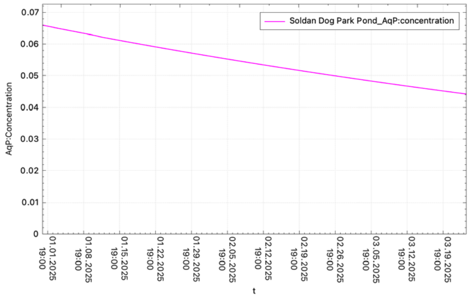

Figure 4. Aqueous phosphorus concentration (g/m^3) in the pond over time.

An equation was derived from this graph of aqueous phosphorus concentration in the dog park pond:

$$[AqP]= -2.6201E-4t+0.066$$

Using this equation, it would take 176 days to get below the 0.02 g/m^3 threshold for which HAB events are caused by excess phosphorus (Liao et al., 2023).

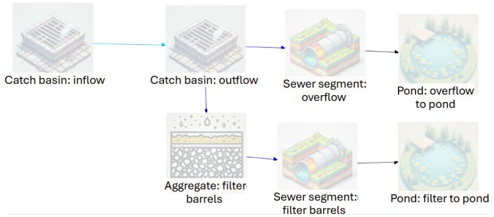

Figure 5. OpenHydroQual graphics showing the blocks used to model the water control structure.

OpenHydroQual was used to adjust the dimensions of the control structure. This was to minimize the use of the overflow outlet caused by increased hydraulic residence time from the filter media.

Prototype

Mesh densities were tested at 250 μm, 110 μm, and 35 μm. Alcan dosage was set at 3 g/L (Kumari & Dong, 2024). After testing for water retention, media containment, and durability, the optimal liner was found to be 250 μm mesh.

Figure 6. BayFilter™ 545 cartridges supplied by Advanced Drainage Systems Inc.

Overall Schematic

Final design drawings were done by Advanced Concrete Products Co. The 8’x8’x9’ structure has a grate on top that allows for removal of barrels.

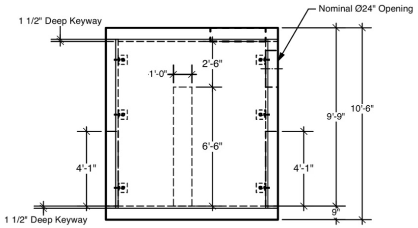

Figure 7. Design drawing showing side view of control structure.

Excavation is required to replace existing pipe with 36” concrete pipes. Riprap will allow for a waterfall effect as water exits control structure.

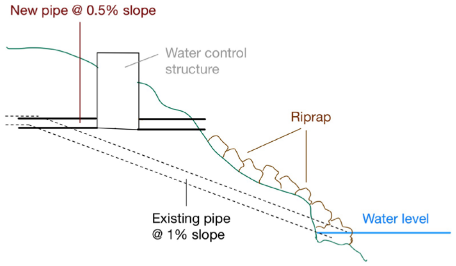

Figure 8. Overall design schematic sketch, showing required excavation and recommended additions.

Economics

One objective that was not achieved in this project is the maintenance cost of the project being less than $1,000 annually. As shown in Table 2, the filter media costs $1,500 to replace annually, which is slightly over budget. The park brings in $150,000 in revenue over the same period, which could be used to offset the cost of the project.

Table 2. The first 10-years cost of implementing the design.

Item	Cost	Frequency	Total cost
Concrete control structure	$22,100	Once (up front)	$22,100
New concrete pipe	$10,000	Once (up front)	$10,000
Filter cartridges	$1,000	Once (up front)	$1,000
Filter media	$1,500	Annual	$15,000
Excavation	$48,000	Once (up front)	$48,000
Park revenue	-$15,000	Annual	-$150,000
Sum of project expenses			**-$53,900**

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This project would not have been possible without Brian Collins, Cristina Estrada, and Brett Kaschinske from Ingham County. We also want to thank our faculty advisor, Dr. Dechand for her inputs and for providing a great sounding board for our group as we made decisions. Michelle Crook and Eric Iverson from the industry advisory board were kind enough to meet with us and give us direction to focus our efforts from their experience. Phil Hill helped with the construction of our prototype. Soni Kumari collaborated with us to provide lab space for our prototype testing. Finally, Dr. Reese and Dr. Jeong provided a lot of guidance as the leaders of senior design and gave us consistent feedback that served as a backbone for our project.

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