

How Can Floating Gardens Mitigate Agricultural Runoff in Ponds and Lakes in Waynesville, Ohio?

BY AJ BRYANT

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Faculty Advisor: Stevie Famulari

Bachelors of Science in Horticulture

University of Cincinnati College of Design,

Art, Architecture, and Planning

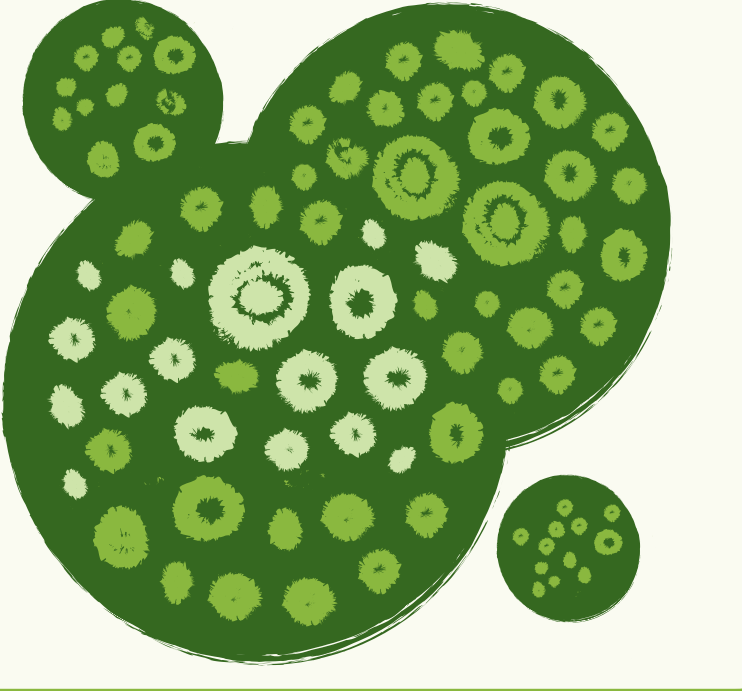
Solution

Floating Treatment Wetlands (FTWs) create an ecosystem that efficiently digests agricultural runoff. The plants inhabiting an FTW use the existing nutrients to grow and serve as a host for microbial life. FTWs attract and host microorganisms that generate biofilm, a colony of bacteria that sticks to surfaces from roots to polymers, with the goal of metabolic cooperation, which digests more than twice as many nutrients as plants (Kania, 2018). These microorganisms feed on macronutrients often associated with agriculture and nursery production, specifically nitrogen and phosphorus. FTWs provide an accessible and aesthetically pleasing solution to agricultural and nursery runoff. They passively fight harmful algal blooms induced by nutrient-rich aquatic environments by hydroponically growing plants and rebuilding the food web instead of destroying it with chemical treatments or mechanical removal.

FLOATING TREATMENT WETLANDS

ALGAE

Is responsible for anoxic conditions in the water, fueled by too many nutrients.

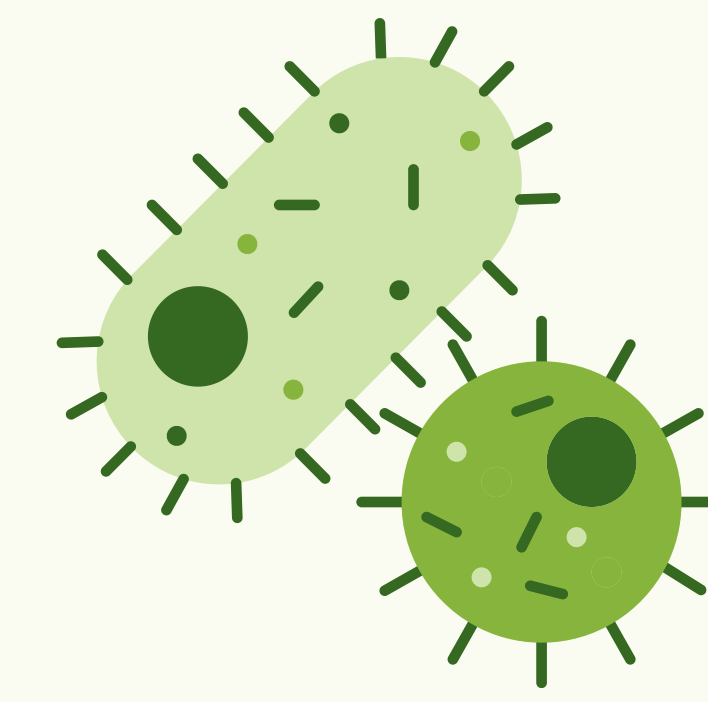


PLANTS

Use nutrients to grow and create a habitat with the substrate for biofilm to thrive.

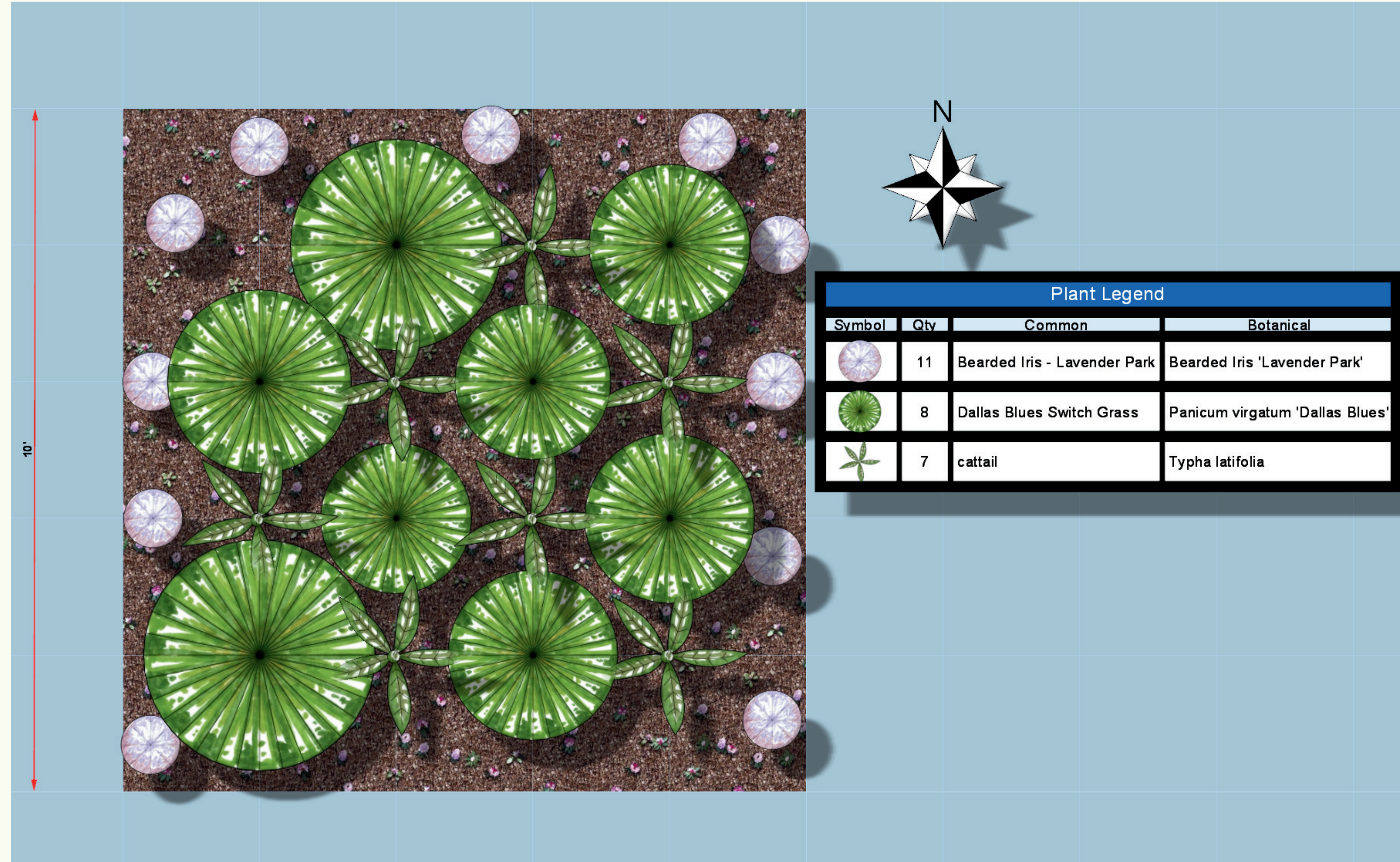
WATER

Feeds the plants, carries the nutrients, and creates a habitat for bacteria to live.



BIOFILM

Is responsible for digesting most of the nitrogen and phosphorus, preventing harmful algal blooms.



Plan View of my FTW planting (Bryant, 2023)

Concept Description

This FTW design utilizes the top three most efficient plants at uptaking nitrogen and phosphorus. Switchgrass, Iris, and cattail. Switchgrass is the best overall at uptaking nitrogen and phosphorus, and it has a lengthy root system. Iris is an aesthetically pleasing hard worker, which placed second in the Virginia Tech study. Lastly, cattail can phytoaccumulate lots of phosphorus in the root system and can be easily propagated on-site (IISD).

Treatment	Cumulative removal after 8 weeks			
	P (g) ¹	(%)	N (g) ¹	N (%)
Trial 1				
<i>Agrostis alba</i>	2.18 ^{cd}	29.8	10.6 ^d	41.5
<i>Canna × generalis</i> 'Firebird'	1.92 ^d	26.1	11.2 ^d	43.7
<i>Carex stricta</i>	2.09 ^d	28.3	10.0 ^d	38.9
Control	1.59 ^d	21.9	1.21 ^e	4.8
<i>Iris ensata</i> 'Rising Sun'	3.57 ^b	48.6	12.9 ^{cd}	50.4
Mixed: all plants	3.28 ^{bc}	44.2	16.3 ^{bc}	63.4
Mixed: partial ²	3.27 ^{bc}	44.2	17.4 ^b	67.7
<i>Panicum virgatum</i>	4.88 ^a	64.7	21.6 ^a	82.4
ANOVA F ratio, p value	20.5, <0.0001		47.6, <0.0001	
Trial 2				
<i>Agrostis alba</i>	2.00 ^b	26.8	3.44 ^b	12.9
<i>Canna × generalis</i> 'Firebird'	2.75 ^b	37.1	7.74 ^b	29.2
<i>Carex stricta</i>	2.24 ^b	29.6	7.09 ^b	26.2
Control	2.53 ^b	34.6	3.77 ^b	14.4
<i>Iris ensata</i> 'Rising Sun'	3.19 ^b	42.9	5.84 ^b	22.0
Mixed: all plants	2.50 ^b	33.3	7.01 ^b	26.1
Mixed: partial ²	2.65 ^b	35.1	9.64 ^b	35.8
<i>Panicum virgatum</i>	4.86 ^a	63.2	16.3 ^a	59.6
ANOVA F ratio, p value	11.70, <0.0001		8.84, <0.0001	

¹ Means with different letters differ significantly from other means with for the same trial at $p < 0.05$
² Partial mixed treatments included *Agrostis alba*, *Carex stricta*, and *Panicum virgatum*

Data from V.T. FTW plant trials (Spangler et. al., 2019)

Case Studies Supporting FTW's:

1. Virginia Tech Hampton Roads Agriculture Research and Extension Center

A study replicated agricultural and nursery runoff conditions in small "mesocosms" or aquariums. A floating treatment wetland (FTW) was placed on top of the water, covering 80% of the surface area. It found that FTWs comprised of switchgrass could remove up to 60-80% of nitrogen and phosphorus after 8 weeks.

2. Wiconisco Township Wastewater Treatment Plant, Floating Island International

Floating Island International is the world's largest commercial FTW producer and research organization. In early 2006, it implemented one of its first iterations of BioHaven, its FTW system. The system covered 2% of the surface area. A control and FTW lagoon were tested and compared after four years of treatment. The FTW lagoon removed 17% more nitrates than the control and improved phosphorus removal by 3%.



BIOHAVEN FLOATING WETLAND

terrestrial habitat creation

erosion control

aquatic habitat creation

water quality treatment

BioHaven Floating Island (FI.I.)