CITY OF BOWLING GREEN - OFFICE OF MUNICIPAL UTILITIES
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To Whom It May Concern,

The City of Bowling Green, Ohio draws water from the Maumee River into a holding reservoir prior to being processed to provide drinking water for the city. From late spring to early fall the Maumee River can have high levels of algae, cyanobacteria and nutrients, which at times can be drawn into the reservoir. The Bowling Green Reservoir has at times experienced Harmful Algae Blooms (HAB) due to the influence of the Maumee River as a source.

With the heightened awareness of HAB, the City of Bowling Green began to explore processes to reduce the occurrence of HAB in their reservoir. The reservoir is 25 acres in size and impounds approximately 170 million gallons or 30 day's supply of raw water. In the early 2000's a submersed aeration system was installed mainly to reduce short circuiting of the reservoir. This system included three one-inch air lines stretched ¾ across the width of the reservoir alternating from to side-to-side. Air was supplied by 1 hp air compressors at each line and provided a wall of bubbles that acted as a baffle for the reservoir. This system did work as a baffle system but was difficult to keep in operation. In 2016, we began to apply an algaecide along with the aeration and we were able to limit the occurrence of HAB's on the reservoir, having only five raw water detects in 2016. The Elisa method was used for monitoring bi-weekly for these detects. Hoping to further optimize our reservoir management to reduce the occurrence of HAB's we decided to install the Clean-flo aeration system in 2017. For the 2017 HAB season the Bowling Green reservoir had four detects in the raw source. BGWTP did use an algaecide during this season in conjunction with the aeration system. The 2018 HAB season saw better results with only three detects. These detects were caused by the BGWTP needing to fill the reservoir during a HAB event in the Maumee River. This event lasted one week in the reservoir after pumping. We also used an algaecide with the aeration during the 2018 season. It should be noted that cyanobacteria toxins were never detected in the BGWTP finished water. The BGWTP feels the installation of the Clean-flo system enhanced water quality and it is an important tool for its reservoir management.

Sincerely,
Daryl Stockburger

Asst. Director of Utilities
City of Bowling Green, Ohio

PS: SUPPORTING INFORMATION:

Data from the beginning of August 2016 illustrates the problem.

River 3rd Aug 2016			**Reservoir 1st Aug 2016**		
Total Phycological Count	**150,840**		**Total Phycological Count**	**123,950**	
Diatoms	3,555	2%	Diatoms	6,636	5%
Algae	44,538	30%	Algae	32,102	26%
Cyanobacteria	102,747	68%	Cyanobacteria	85,212	69%

The data shows that the total phycological count in the river was 150,840 cells per ml, and this was dominated by cyanobacteria, which made up 68%. Similarly, in the reservoir, the total phycological count was 123,950 cells per ml, and this was dominated by cyanobacteria, which made up 69%.

At the beginning of April 2017, technology supplied by Clean-Flo International was implemented in the reservoir. This aims to manage the phycological balance in favor of higher algae and diatom populations so that they can out compete the cyanobacteria and thus keep their populations under control.

Data from May 24th 2017, just 3 weeks after commissioning the Clean-Flo technology illustrates the extent to which the situation in the reservoir has been brought under control.

River 24th May 2017			**Reservoir 24th May 2017**		
Total Phycological Count	**34,208**		**Total Phycological Count**	**64,272**	
Diatoms	16,834	49%	Diatoms	50,000	78%
Algae	9,657	28%	Algae	13,167	20%
Cyanobacteria	7,717	23%	Cyanobacteria	1,102	2%

If we compare the data from the beginning of August in 2016:

River 3rd Aug 2016			**Reservoir 1st Aug 2016**		
Total Phycological Count	**150,840**		**Total Phycological Count**	**123,950**	
Diatoms	3,555	2%	Diatoms	6,636	5%
Algae	44,538	30%	Algae	32,102	26%
Cyanobacteria	102,747	68%	Cyanobacteria	85,212	69%

To the data from exactly one year later on July 31st 2017, the improvement in the water quality in the reservoir is clear.

River 31st Jul 2017			**Reservoir 31st Jul 2017**		
Total Phycological Count	**159,065**		**Total Phycological Count**	**41,645**	
Diatoms	46,000	29%	Diatoms	21,800	5%
Algae	45,745	28%	Algae	19,545	26%
Cyanobacteria	67,320	68%	Cyanobacteria	300	<1%

Data from July 31st 2018 provides evidence that this solution is sustainable.

River 31st Jul 2018

Total Phycological Count	**218,301**	
Diatoms	12,633	29%
Algae	23,543	11%
Cyanobacteria	182,125	83%

Reservoir 31st Jul 2018

Total Phycological Count	**63,738**	
Diatoms	9,846	15%
Algae	29,246	47%
Cyanobacteria	24,646	<1%