Mid-2021 Buckeye Lake Watershed Monitoring Summary Report

Prepared for Buckeye Lake for Tomorrow, Inc.

June 1st, 2021

Introduction

Buckeye Lake Watershed sampling began early June 2020 and continued every two weeks up to late May 2021. With one full year of monitoring complete, this summary report lists results for the following parameters in several of Buckeye Lake's tributaries: nitrates, phosphates, pH, temperature, dissolved oxygen, and conductivity. The monitoring equipment used included portable colorimeters for nitrates and phosphates and a YSI for the other parameters. Data has been continuously compiled in an Excel file, and a summarized version of results is presented here. Because pH, temperature, dissolved oxygen, and conductivity were all at expected levels throughout the sampling period, these summaries focus on the nutrients that more adversely affect Buckeye Lake's water.

Summaries

Honey Creek (HC104):

Nitrates tend to increase in warmer months at Honey Creek. Spring levels are the highest with a slight dip between September and February. The range for the year was 0.9 mg/L to 4.2 mg/L.

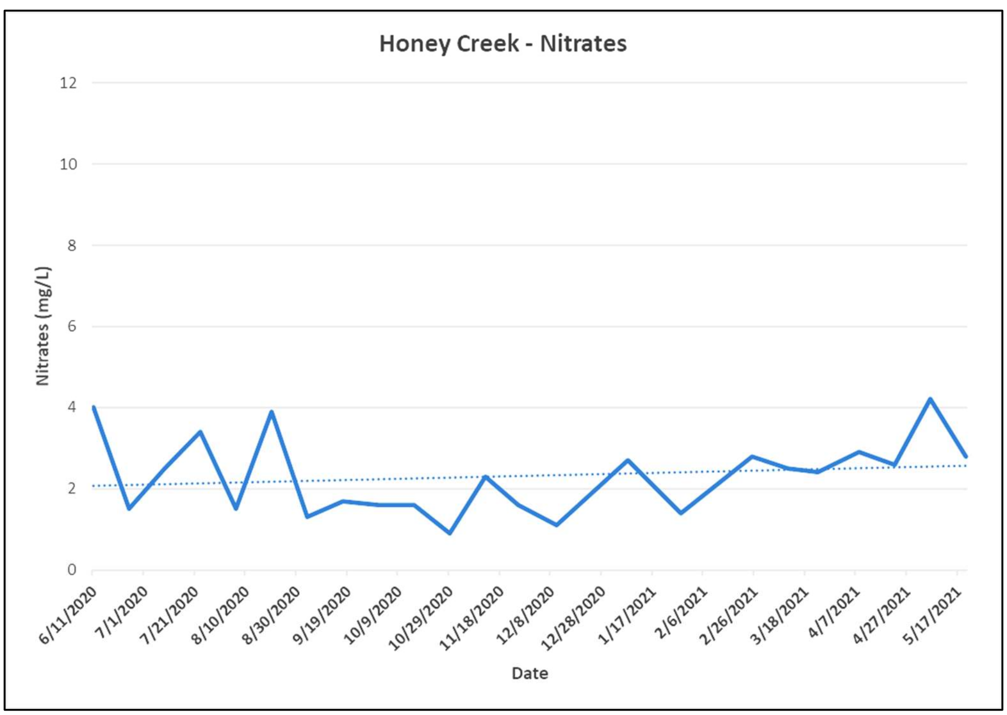

Figure 1. Nitrate concentrations at Honey Creek

Phosphates were at their highest during the fall before they dipped to their lowest during the winter. Concentrations gradually increased starting in spring and will likely continue throughout summer if last year is any indication. The range for this year was 0.04 mg/L to 1.18 mg/L.

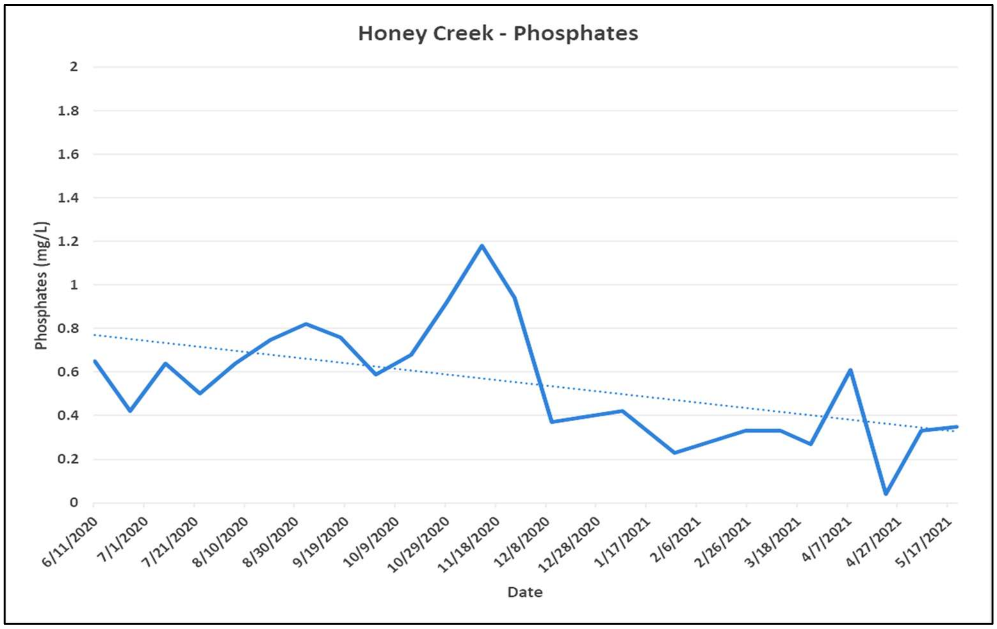

Figure 2. Phosphate concentrations at Honey Creek

Zartman Creek (ZC105):

Ignoring the September outlier, nitrates are steady throughout the year until spring when they begin to increase. The range for the year was 0 mg/L to 10.9 mg/L.

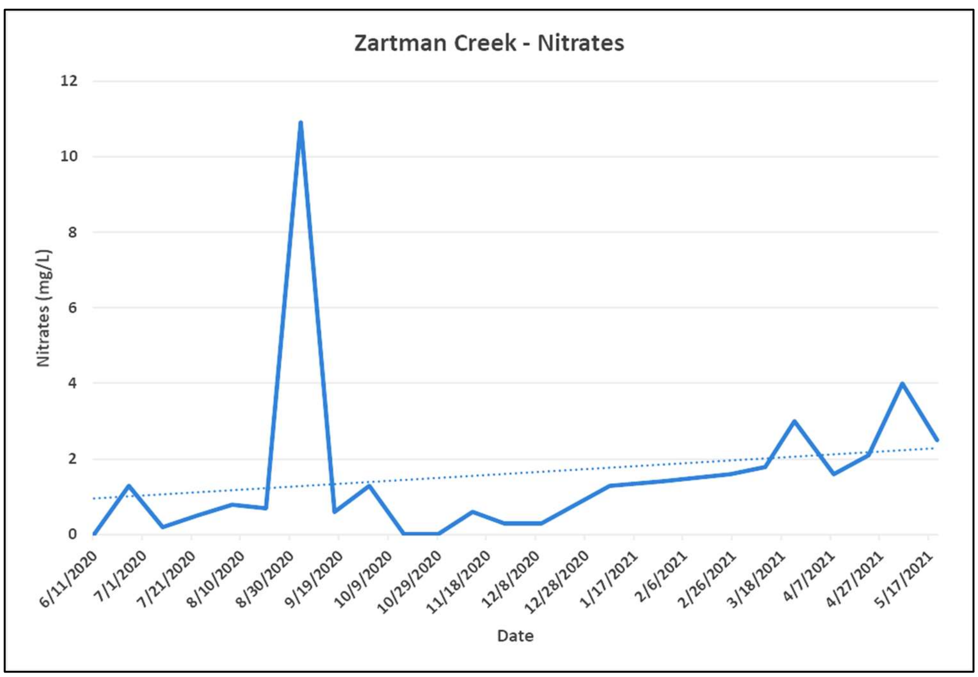

Figure 3. Nitrate concentrations at Zartman Creek

Phosphate concentrations were similar to Honey Creek: higher in the fall with a small spike in the spring. The range was 0.03 mg/L to 0.48 mg/L.

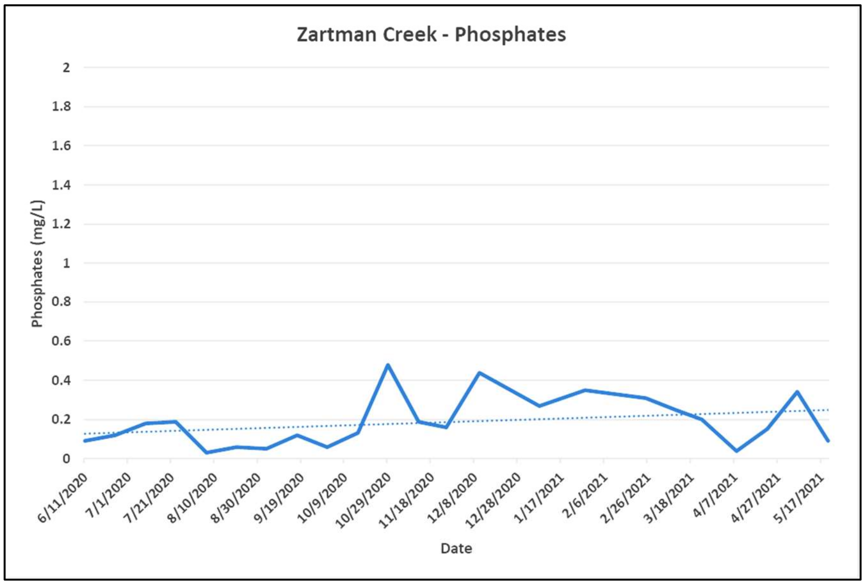

Figure 4. Phosphate concentrations at Zartman Creek

Murphy's Run (MR106):

Nitrates started to increase in late winter but recordings stopped at the beginning of March due to ODNR's wetland project at Brooks Park starting construction. Sampling will resume after construction is complete. One possible reason that nitrates increased so dramatically was a change in sampling location. We moved our collection point 200 feet upstream for easier access to the water during the winter. Murphy's Run will be a location to watch in the future after the new wetland is finished. The range for this year was 0 mg/L to 2.8 mg/L.

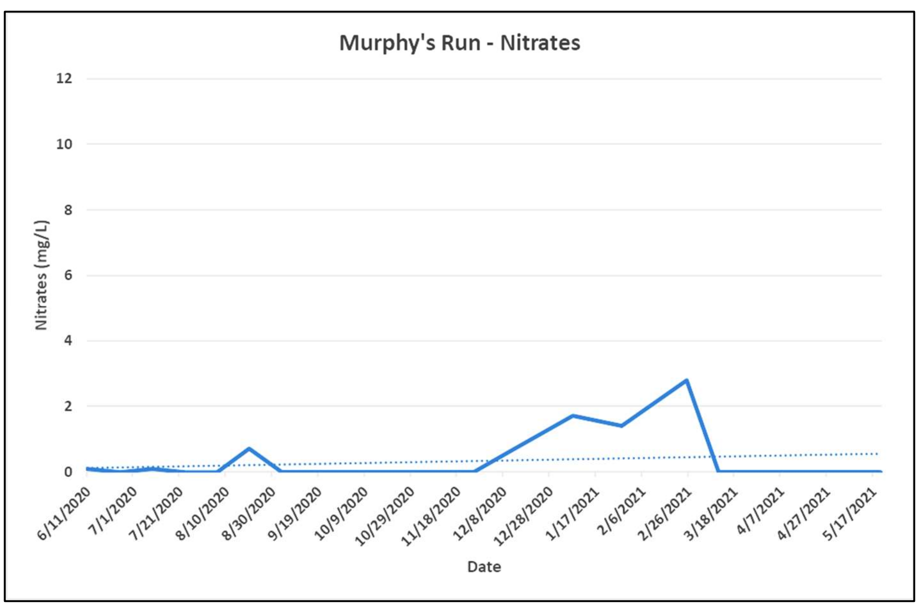

Figure 5. Nitrate concentrations at Murphy's Run

Phosphates also increased at the same time that the nitrates did. Again, this could be due to changing the sampling location. The range for the year was 0 mg/L to 0.54 mg/L.

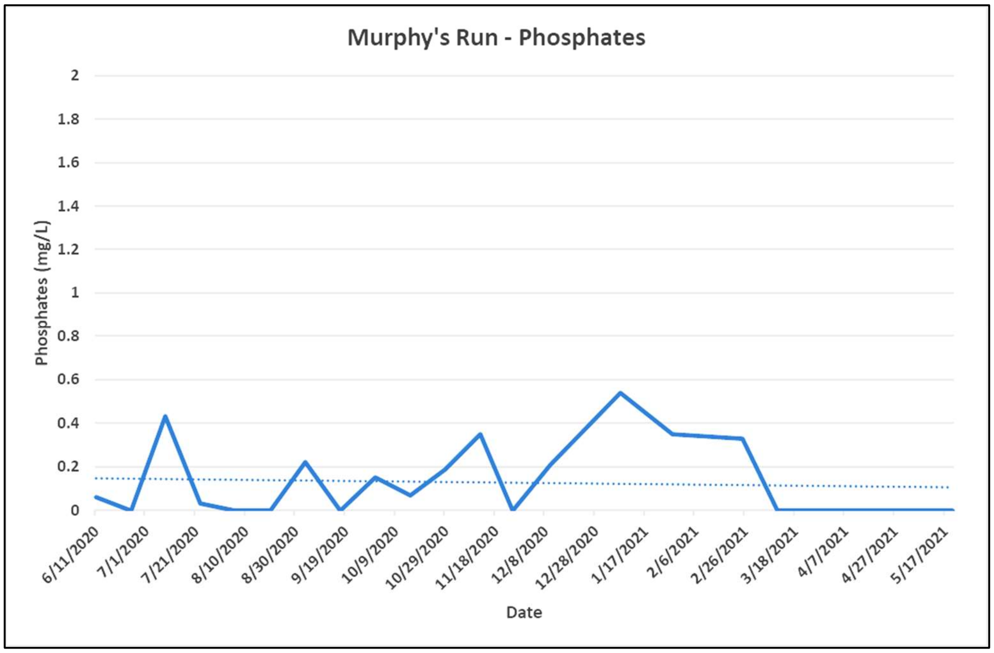

Figure 6. Phosphate concentrations at Murphy's Run

The Feeder Channel:

Nitrates increased substantially at the start of winter and have continued their upward trend throughout the spring. Further testing will be needed to determine if late summer/fall is commonly a time for low nitrates. The range for the year was 0 mg/L to 5.9 mg/L.

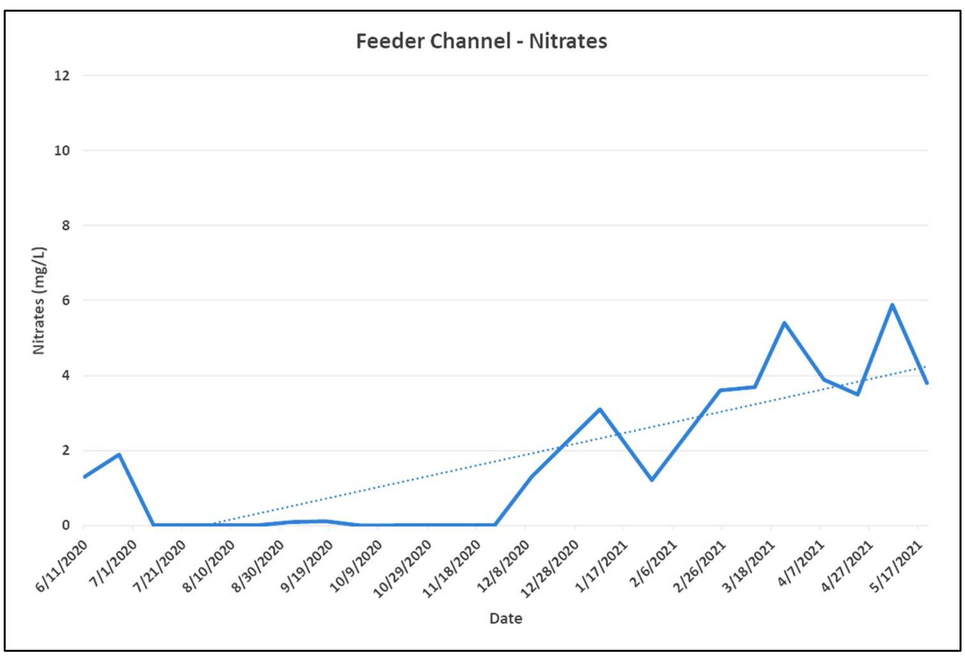

Figure 7. Nitrate concentrations at the Feeder channel

Phosphates behaved erratically and did not show the steady winter/spring rise that nitrates did. The range was 0.03 mg/L to 0.61 mg/L.

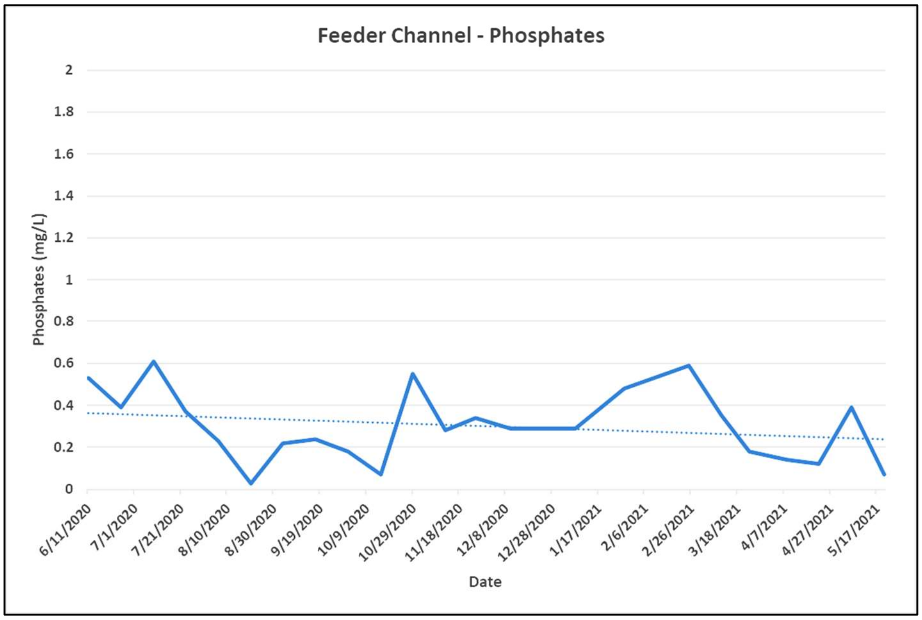

Figure 8. Phosphate concentrations at the Feeder channel

Grosse Property Ditch (GB103):

The Grosse property had the highest nitrates in the watershed. Spring time saw some massive jumps in nitrate concentrations after a very low summer/fall. Further testing will determine whether these high results fall back down regularly during the summer. The range was 0 mg/L to 11.8 mg/L.

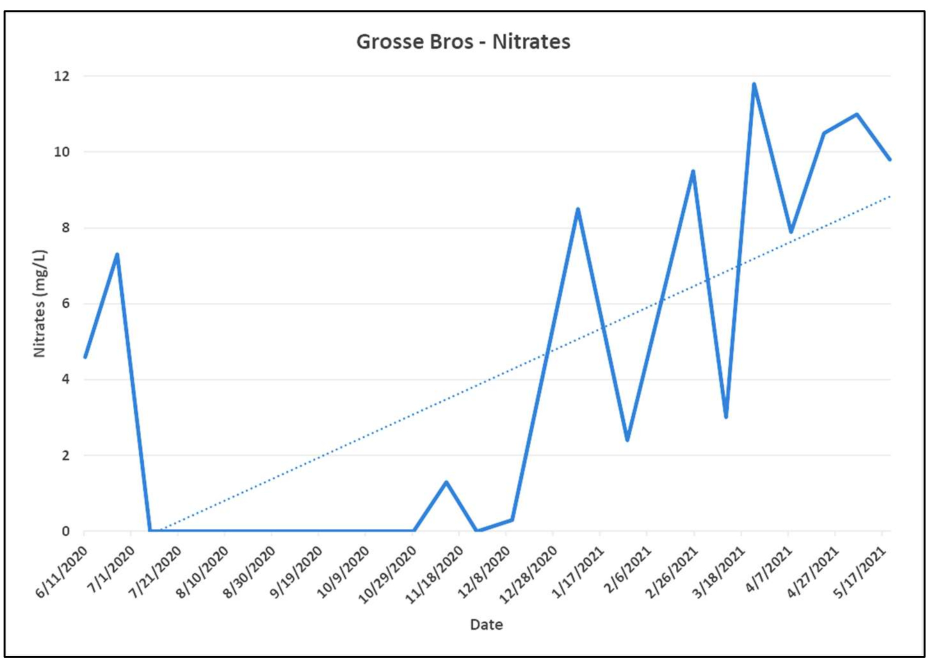

Figure 9. Nitrate concentrations at the Grosse property

Phosphates did not rise in the way nitrates did. Outside the peak in late fall, phosphates followed roughly the same pattern as rainfall. The range was 0 mg/L to 0.84 mg/L.

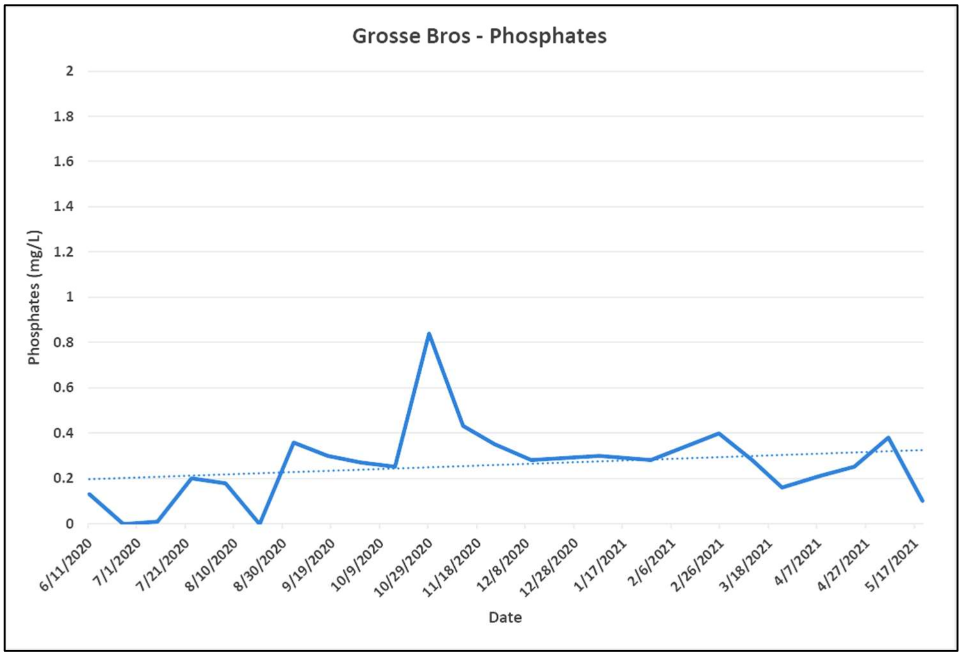

Figure 10. Phosphate concentrations at the Grosse property

Heron Bay:

Despite the fact that Heron Bay will no longer house an aerating unit in the canal, the site still reflected higher nutrient flows in the spring. Heron Bay lacked detectable nitrates until early spring when it peaked at 1 mg/L in March and May.

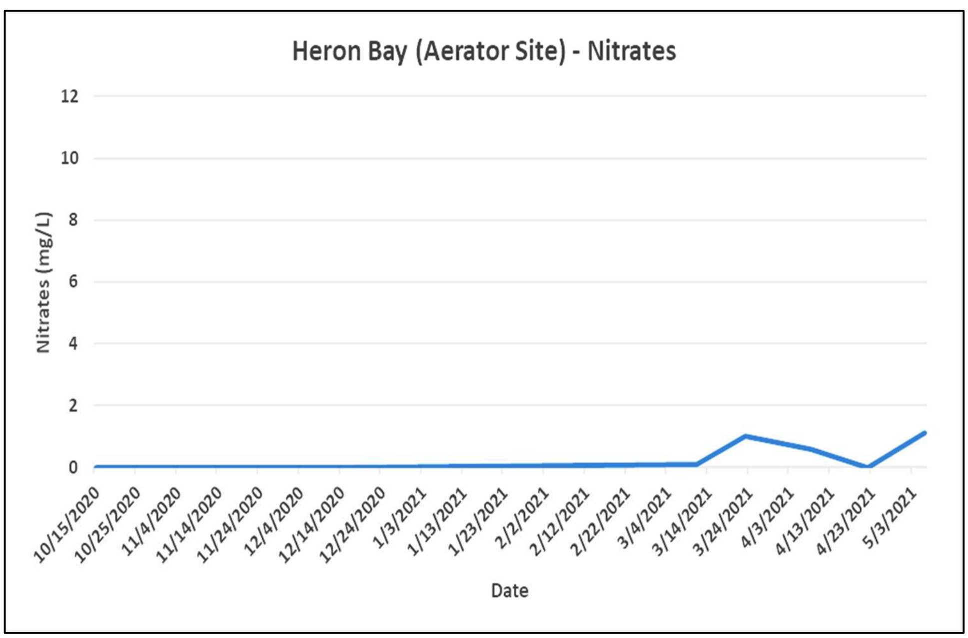

Figure 11. Nitrate concentrations at Heron Bay

Phosphates were generally even, though they also trended upward slightly in the spring.

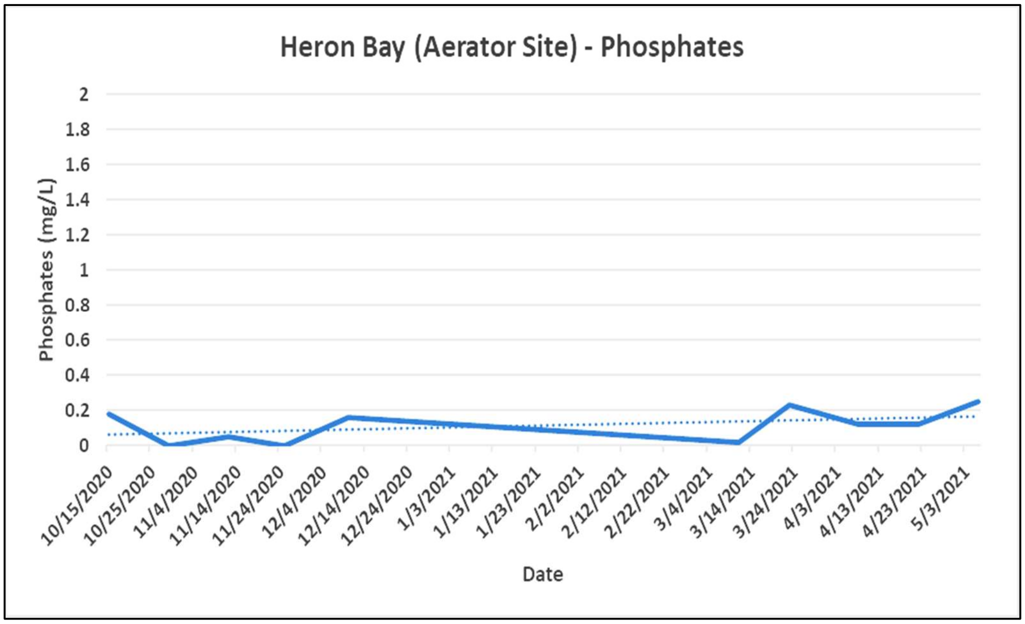

Figure 12. Phosphate concentrations at Heron Bay

The Heron Bay control site showed this slight upward trend for nitrates as well.

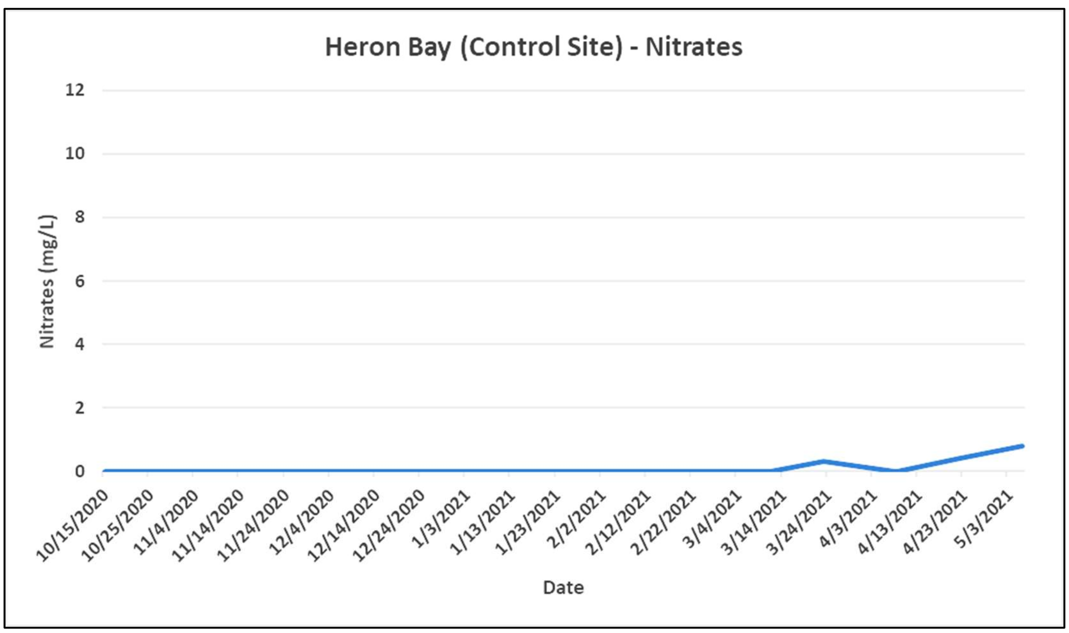

Figure 13. Nitrate concentrations at the Heron Bay control location

Phosphate levels, however, were more or less even.

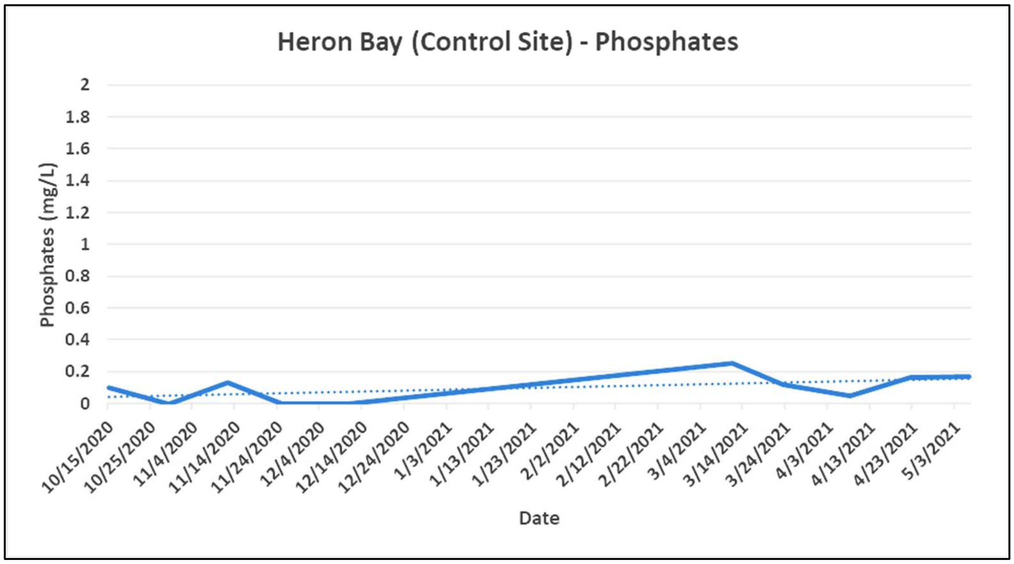

Figure 14. Phosphate concentrations at the Heron Bay control location

Rainfall

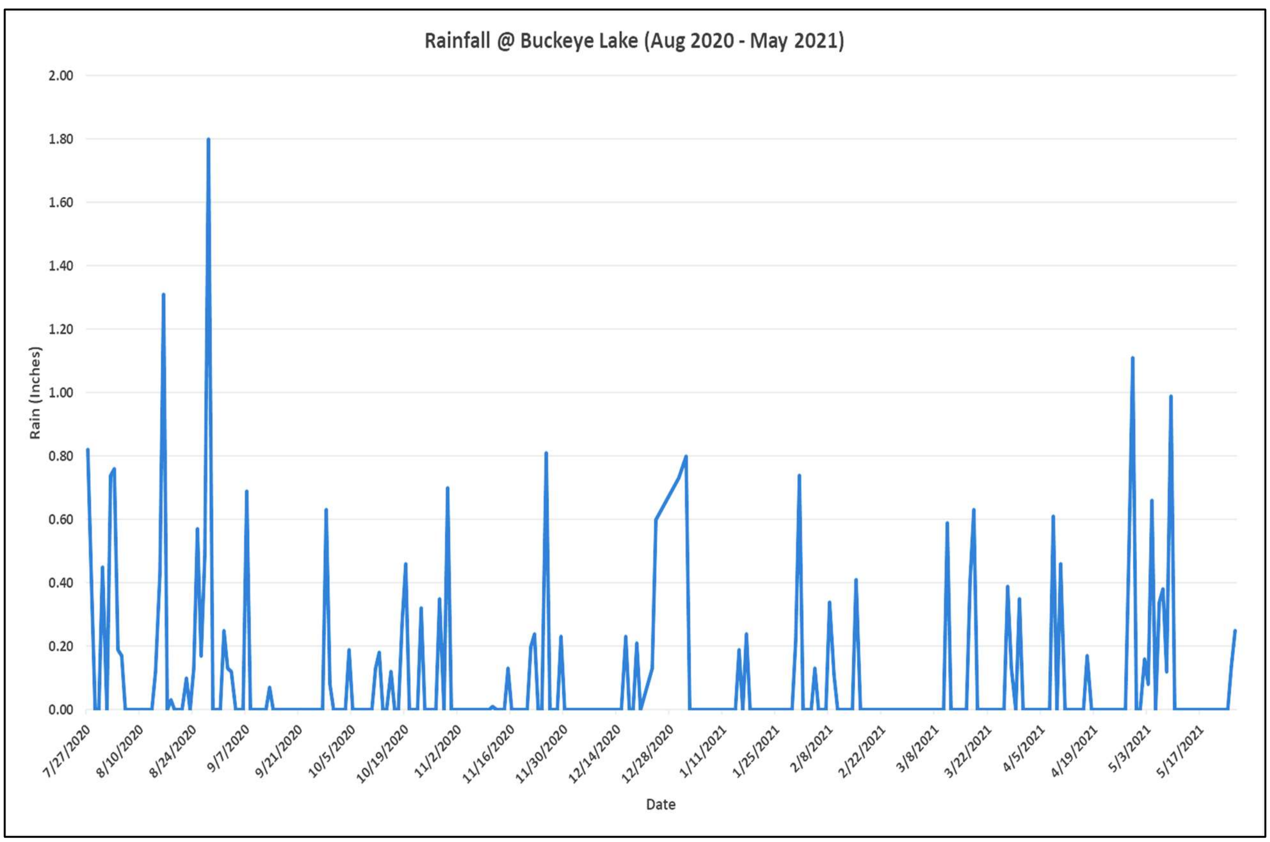

Figure 15. Rainfall for 2020-2021

Rainfall at Buckeye Lake was highest toward the end of the summer, with occasional high events in the autumn and winter months. Spring rains were elevated but not as much as some of the summer events. These periods of heavier rain match observed nitrate and phosphate spikes at several of the sampling locations.

Algae Testing

Algae testing began in late October at locations expected to receive bubbling aerators: Millersport Canal, Buckeye Beach Park, and Heron Bay. A second sample was taken at Heron Bay at the control site. Lab analysis was conducted by Alloway. Although the aerator at Heron Bay was removed after its initial installation, the results for algae tests are still presented here.

Millersport Canal		
Analytical Method	*Results: 10/27/2020*	*Results: 3/23/2021*
Cyanobacteria, Total (16S)	4040 gene copies/uL	4330 gene copies/uL
Microcystins, Nodularin	<0.180 gene copies/uL	<0.180 gene copies/uL
Cylindrospermopsin	<0.180 gene copies/uL	<0.180 gene copies/uL
Saxitoxin	3.75 gene copies/uL	1.21 gene copies/uL

Table 1. Algae results for Millersport Canal

Buckeye Beach Park		
Analytical Method	*Results: 10/27/2020*	*Results: 3/23/2021*
Cyanobacteria, Total (16S)	4930 gene copies/uL	2910 gene copies/uL
Microcystins, Nodularin	<0.180 gene copies/uL	<0.180 gene copies/uL
Cylindrospermopsin	<0.180 gene copies/uL	<0.180 gene copies/uL
Saxitoxin	<0.180 gene copies/uL	<0.180 gene copies/uL

Table 2. Algae results for Buckeye Beach Park

Heron Bay 1		
Analytical Method	*Results: 10/27/2020*	*Results: 3/23/2021*
Cyanobacteria, Total (16S)	5400 gene copies/uL	1160 gene copies/uL
Microcystins, Nodularin	0.224 gene copies/uL	<0.180 gene copies/uL
Cylindrospermopsin	<0.180 gene copies/uL	<0.180 gene copies/uL
Saxitoxin	<0.180 gene copies/uL	<0.180 gene copies/uL

Table 3. Algae results for Heron Bay 1

Heron Bay 2 (Control Site)		
Analytical Method	*Results: 10/27/2020*	*Results: 3/23/2021*
Cyanobacteria, Total (16S)	3160 gene copies/uL	974 gene copies/uL
Microcystins, Nodularin	<0.180 gene copies/uL	<0.180 gene copies/uL
Cylindrospermopsin	<0.180 gene copies/uL	<0.180 gene copies/uL
Saxitoxin	<0.180 gene copies/uL	<0.180 gene copies/uL

Table 4. Algae results for Heron Bay 2

Gene copies per microliter are units that measure strands of DNA in a sample but is not a number that can be converted to PPM or mg/L. A representative from Alloway provided the following explanation:

> “Cyanobacteria screening is quite a bit different than most analytical methods, there is no way to convert it to ppm. Gene Copies per microliter (gc/uL) means how many strands of DNA per microliter are in the sample. The DNA strands are capable of producing toxins but it does not guarantee they are. The Ohio EPA has set action levels at 5.0 gc/uL for Cylindrospermopsin, Microcystins, and Saxitoxin. When the source water reaches 5.0 gc/uL they begin monitoring for the toxins themselves. The 16S (total cyanobacteria) does not have an action level. There are over a 100 of variations of cyanobacteria and not all of them are toxic, this number is used to look at trends for a body of water and look for indicators of an upcoming bloom.”

By these definitions, all locations are beneath the threshold of 5.0 gene copies per microliter and do not warrant immediate action. Millersport Canal is the only location that has detectable levels of saxitoxins.

About the Results

The US EPA is currently revising Ambient Water Quality Recommendations for Lakes, which help states set limits for nitrate and phosphate loads in lake waters. The last update happened 20 years ago. In the meantime, the State of Delaware has set water quality thresholds that help make sense of these nitrate and phosphate recordings. According to their calculations, phosphates should ideally be less than 0.03 ppm (mg/L) because <0.03 ppm supports aquatic vegetation. 0.05 ppm (mg/L) and higher begins to negatively affect fish and macroinvertebrates. Exceeding 0.10 ppm activates explosive algae growth. Nitrates activate algal blooms at 3 ppm (mg/L) or higher. 10 ppm is the limit for drinking water and 20 ppm starts to kill off aquatic life.

Most sites sampled had nitrate readings below 3 mg/L. The exceptions are Honey Creek, Zartman Creek during the September spike and during the spring, the Feeder channel during the spring, and the Grosse property. Among these, Honey Creek and the Grosse property pose the most threat of consistently introducing algae-causing nitrates to Buckeye Lake. A careful eye will have to be kept on the Feeder Channel too, with the way nitrates have been rising as spring ends.

Phosphates, on the other hand, generally exceeded the State of Delaware’s <0.05 mg/L recommendation for algae prevention. The sites in frequent violation were Honey Creek, the Feeder, and the Grosse property. Spikes also occurred regularly at Zartman Creek and Murphy’s Run.

One more thing worth mentioning in comparison to the previous report is the absence of site UT101, an unnamed tributary to the Feeder. Due to a downed power line in the water and general tree debris preventing access to the site, the location was removed from the sampling routine. In the future, further sites will be added at Buckeye Lake canals where residents are interested in installing aerators.

Conclusions

Seasonal fluctuations appear to affect nitrates more than phosphates at Buckeye Lake. Increased rainfall may account for higher springtime readings, but nitrates at the Feeder Channel and the Grosse property increased substantially, suggesting that there is higher nutrient runoff happening at these locations than is normal. Honey Creek remained consistent throughout the year, with a dip in nitrates during the fall, but should also be addressed due to its baseline being relatively high. Murphy’s Run also showed elevated readings compared to 2020 data, but a true picture of the stream will have to wait until after things have settled down with Brooks Park construction. In general, spring and summer are high points for nutrient concentrations, with fall being the low point, although large spikes can still occur during this time. With baseline data now in place, sampling will continue. The data presented here will aid us in determining how high flow events impact the watershed and how effective nutrient reduction and streambank stabilization projects will be at mitigating these concentrations.

References

Background Information for Interpreting Water Quality Monitoring Results.

http://www.dnrec.delaware.gov/fw/Education/Documents/AREC/Water%20quality%20interpretation%20guides.pdf

Draft Ambient Water Quality Criteria Recommendations for Lakes and Reservoirs of the Conterminous United States: Information Supporting the Development of Numeric Nutrient Criteria

https://www.epa.gov/sites/production/files/2020-05/documents/draft-ambient-wqc-recommendations-lakes-2020.pdf

Understanding Units of Measurement.

https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.files/fileid/14285#:~:text=For%20water%2C%201%20ppm%20%3D%20approximately,equal%20to%206%2C000%20ug%2FL.