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Attn: Noah Czech, City of St. Cloud
From: Stormwater Research Group, St. Anthony Falls Laboratory, University of Minnesota
Re: Summary of Collected Data from Pond 52 in St. Cloud, Minnesota
Date: January 6th, 2020

The following is a summary and brief analysis of the collected data from Pond 52 in St. Cloud, Minnesota that the stormwater Research Group (PI: John Gulliver) has examined.

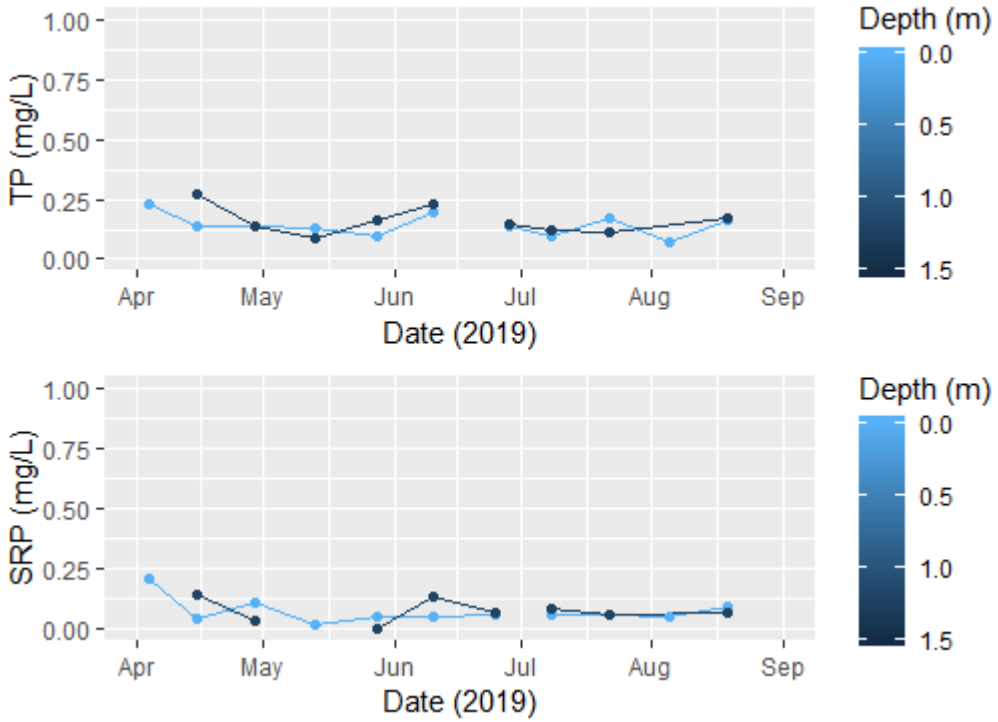

Figure 1. Concentrations of total phosphorus (TP) and soluble reactive phosphorus (SRP) were relatively constant throughout the 2019 monitoring season with minimal observed seasonal variations. Differences between epilimnion (water surface) and hypolimnion (deep water) samples were not substantial.

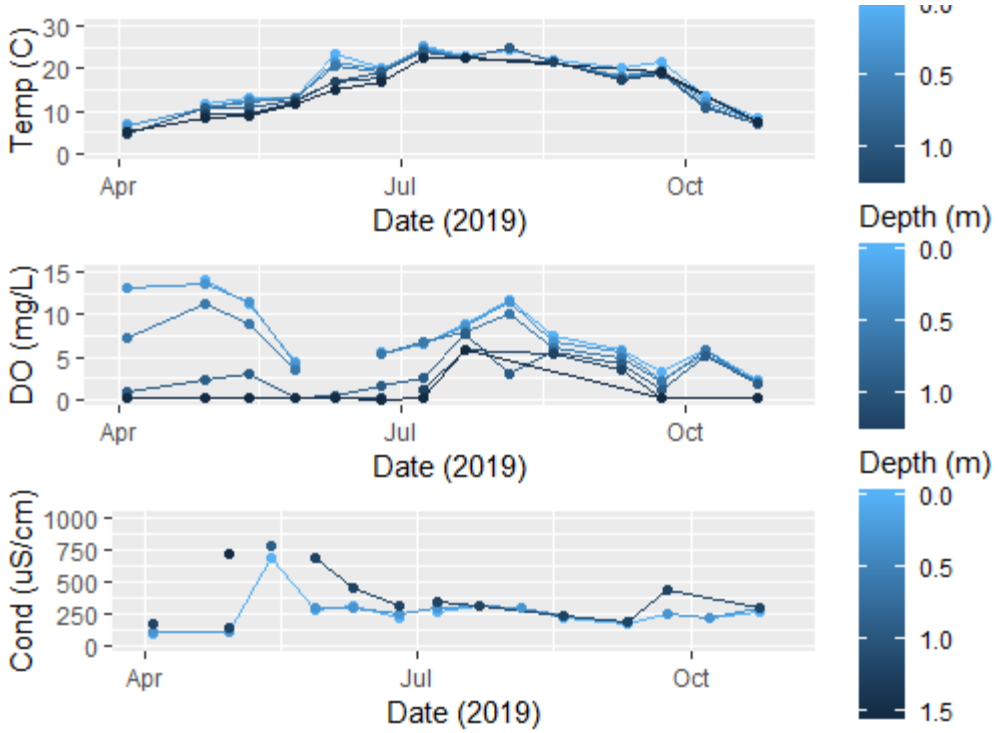

Figure 2. Temperature differences across water depths were minor. Still, weak thermal stratification throughout much of the year, along with chemostratification indicated by a large gradient in specific electrical conductivity at the beginning of the year, appeared to be sufficient to depress dissolved oxygen (DO) concentrations at the pond bottom. After chloride had flushed out of the pond (indicated by a decrease in conductivity levels) and temperatures began to equilibrate at the end of the summer, benthic (water above the sediment) DO levels appeared to increase.

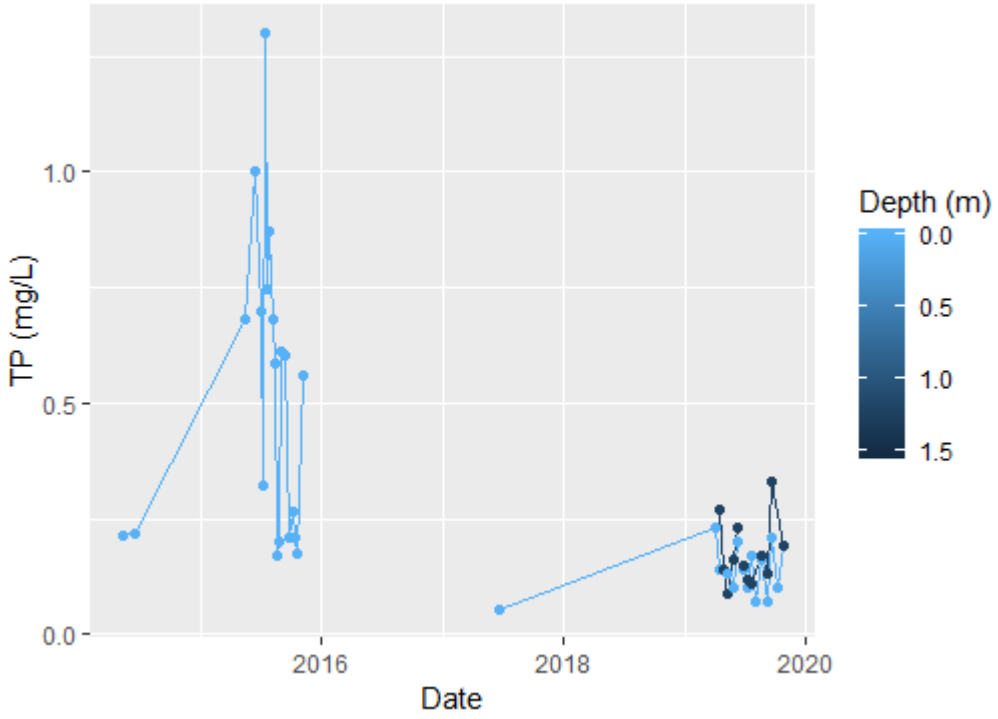

Figure 3. A record of periodic total phosphorus (TP) concentration measurements from the water surface of pond 52 dates back at least to 2014. TP concentrations fluctuated greatly in 2015, reaching concentrations in excess of 1.5 mg/L, but no data exist for 2016. In 2017, a single water quality sample collected by the SAFL Stormwater Research Group measured a low TP concentration, but a single sample is not representative of overall trends as any number of factors could have led to a brief jump or drop in TP concentration (weather conditions, time of year, time since last precipitation, magnitude of last precipitation, etc.). Again, no data exist for 2019, but regular water quality monitoring was initiated by the City of St. Cloud in 2019 following the dredging of the pond and an application of iron filings to the pond sediments.

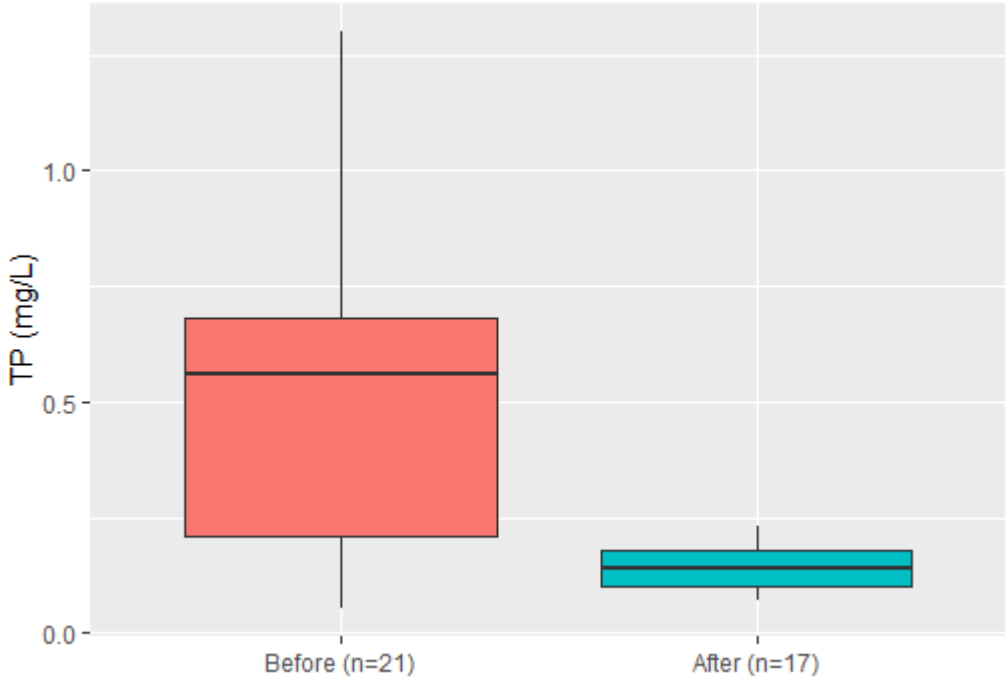

Figure 4. Box plot comparing the range of surface water quality TP concentrations from all data prior to and following the dredging and iron filings application illustrates markedly lower concentrations following iron treatment. The absence of a robust sampling dataset immediately leading up to the dredging and iron dosing of the pond in 2019 makes it impossible to determine whether reductions in TP concentration were a result of the treatment or merely coincident with naturally improving water quality due to other factors. Assuming the treatment is responsible for the apparent sudden improvement in water quality (given the available data), the concurrent timing of the two treatments makes it difficult to determine whether the improvement was achieved by dredging or the iron filings dosing.

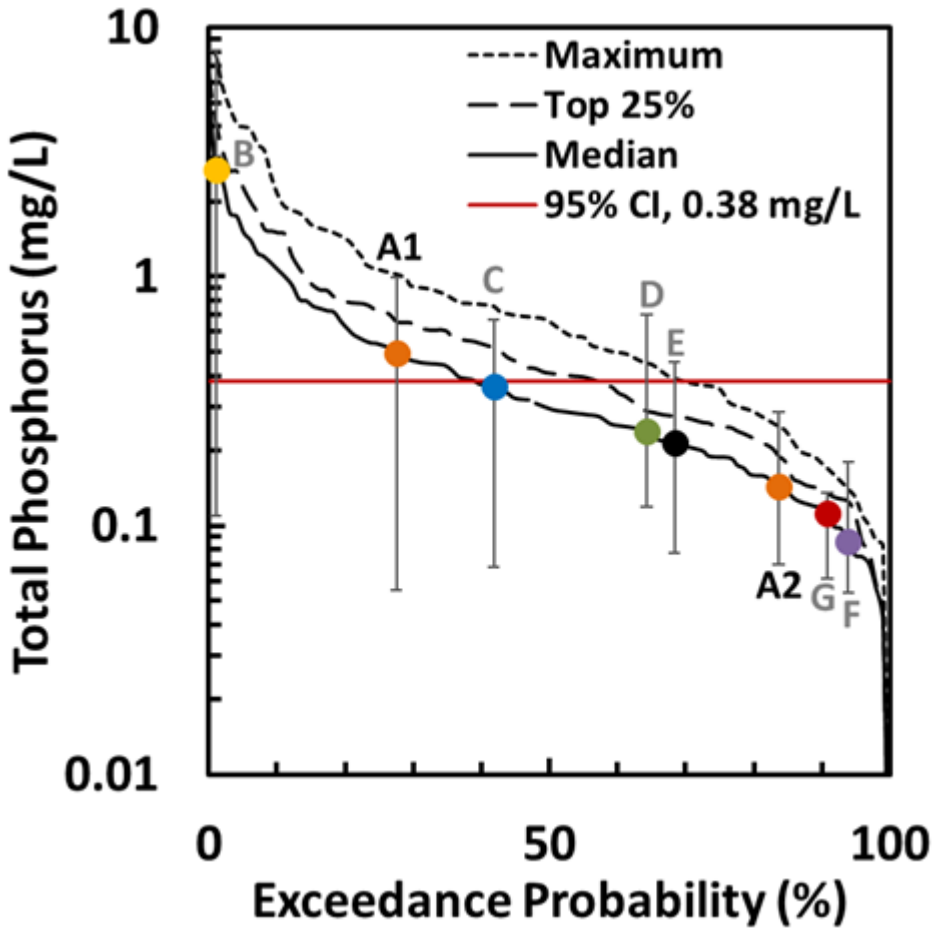

Figure 5. This figure depicts a percent exceedance plot of TP concentrations from surface grab samples collected from 98 ponds within the Riley Purgatory Bluff Creek Watershed District (RPBCWD) in the Twin Cities metropolitan area of Minnesota. The red line represents the upper 95% confidence interval for TP concentrations from a study that characterized stormwater runoff in the Twin Cities (Janke et al. 2007). Pond 52 is plotted against the 98-pond dataset along with six other ponds that have been monitored. The points represent the average of all surface TP data for each pond, with A1 being pond 52 prior to dredging and A2 being pond 52 post dredging. The error bars represent the minimum and maximum TP concentrations for each pond. Prior to dredging and treatment with iron filings, the average TP concentration for pond 52 was in excess of the upper 95% confidence interval threshold, and this was no longer the case after the dredging and iron filings treatment.

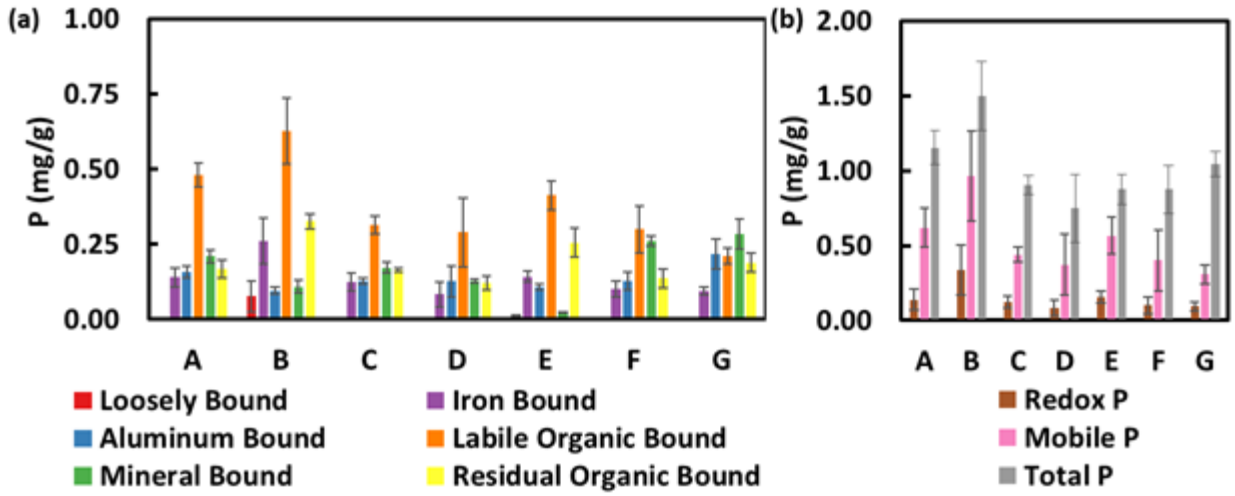

Figure 6. The Stormwater Research Group has conducted sequential phosphorus fractionation extraction analyses on sediment cores retrieved from each of the seven monitored ponds. Compared to others, pond 52 (pond A) had relatively high labile organic-bound phosphorus and iron-bound phosphorus fractions, which are each part of mobile phosphorus (mobile P). Mobile P represents forms of phosphorus that can be mobilized under specific conditions, potentially including low DO conditions at the sediment-water surface.

The sediment cores used in the sediment analysis were extracted from pond 52 in 2018, before dredging of the pond and application of iron filings to the pond sediments. Sediment cores have not been collected after dredging and treatment with iron filings. If additional cores are retrieved following the treatments, it may be possible to infer whether reductions in pond TP levels are solely due to dredging as well as assess what role the iron filings treatment could be playing. During dredging, the sediments sampled by the sediment cores were presumably removed and new cores would examine the sediments that currently from the bottom of the pond. The relative distribution of different phosphorus fractions is uncertain since they probably represent soil that was present prior to the construction of pond 52. Any phosphorus captured by the iron filings would become a part of the iron-bound phosphorus fraction, so its magnitude relative to other fractions and pre-treatment levels could be evidence of the effectiveness of the iron filings treatment. Similarly, lower magnitudes of labile organic-bound phosphorus and total sediment phosphorus could be evidence of the effectiveness of the dredging treatment.