Phosphorus Accumulation in the Gilbert Riparian Preserve Aquifer Recharge Ponds

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Objective

The objective of this project was to quantify the phosphorus budget of an aquifer recharge infiltration pond at the Gilbert Riparian Preserve and determine if those levels are cause for concern. These ponds are recharged with treated wastewater effluent from the City of Gilbert, and therefore contain elevated levels of phosphorus.

Fig. 1 North side of pond 7

Background

Managed Aquifer Recharge (MAR)

- Infiltration of water through spreading basins is a widely used method of MAR
- Regular maintenance needed to prevent buildup of contaminants/nutrients in soil

Phosphorus Accumulation

- High concentration of phosphorus often present in wastewater effluent
- May result in excessive algal growth and/or harmful algal blooms
- Can lead to clogging of pores and reduced infiltration into aquifers

Methodology

Water Sampling

1. Collect 2 wastewater effluent samples from splitter box
2. Collect 1 water sample from 4 locations around pond 7 (see map)
3. Repeat 3 times a week for 3 weeks
4. Send samples to ASU METALS facility for the following analyses
    i. Nitrate + Nitrite
    ii. Orthophosphate
    iii. Total Nitrogen
    iv. Total Phosphorus
5. Test samples for chlorophyll content using spectrophotometry

Soil Sampling (after pond is dried for maintenance)

- Collect soil samples from the center of pond 7 radiating out to the 4 water sampling locations at lease once

Legend:
- Pond 7 Sampling Locations

Fig. 3 Water sample bottles

Fig. 2 Map of Gilbert Riparian Preserve

Preliminary Results

Preliminary sampling event conducted in September of 2020 yielded the following results:

Sample	Phosphate Concentration (mg/L)	Total Phosphorus Concentration (mg/L)	% avail.
Wastewater Effluent	3.12	7.43	42%
Basin Water	0.17	9.60	1.7%
Groundwater	0.02	0.00	0%

- High available P (phosphate) to total P entering
- Less P available in basin water, close to zero in groundwater
- Suggests transformation to organic P that is likely building up in soil

Expected Results

- A high concentration of phosphorus present in the pond's soil due to accumulation since the start of operation
- Elevated chlorophyll presence in the pond water as a result of excess phosphorus (typically a limiting nutrient in freshwater)

Conclusion

- If results are as expected, the phosphorus in the MAR system may create an opportunity for recovery
- Additionally, phosphorus management should become a consideration for MAR management, especially in areas with higher connectivity to groundwater

Future Work

- Process water/soil samples and analyze data
- Estimate phosphorus budget over lifetime of MAR site (~30 yrs)
- Look at phosphorus stratification in soil
- Evaluate impact of basin tillage operations on phosphorus budget
- Depending on the results found by this study, facilities of this sort may be worth approaching as a source of phosphorus for crop fertilization in the future
    - Methods of phosphorus extraction from soil on a large scale could be explored for this application

References

"Phosphorus and Water." *USGS*, www.usgs.gov/special-topic/water-science- school/science/phosphorus-and-water.

Chavez-Guillen, R. 2003. From Chapter 6 of "Management of Aquifer Recharge and Subsurface Storage." NCC-IAH Publication. No. 4

Sen, Bulent, et al. "Relationship of Algae to Water Pollution and Wastewater Treatment." *Water Treatment*, 2013, doi:10.5772/51927.

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