Tracking E. coli, Phosphorus, and Nitrate Pollution in an Urban-Rural Watershed

Introduction

Water quality is an extremely pressing issue in the state of Iowa. In 2018, The Iowa Department of Natural Resources (DNR) classified 58% of assessed rivers and streams and 57% of assessed lakes and reservoirs in Iowa as impaired. In streams and rivers, the primary cause of surface water impairment is bacteria. In lakes and reservoirs, the greatest source of impairment is algal growth from excess concentrations of nitrates and phosphorus.

This research project examines water quality - with a specific interest in E. coli and phosphorus pollution - in South Worrell Creek, which is a small and rapidly urbanizing rural watershed on the south side of Ames. This research is part of a broader project within the University Translational Research Network (U-TuRN) at Iowa State University that seeks to promote citizen engagement and foster collaboration among stakeholders in the South Worrell Creek watershed. This research supports the U-TuRN project objectives by improving the understanding of pollutant dynamics and pollutant sources in the watershed. Eight sites within the watershed have been sampled on a monthly basis since March 2018 and volunteers from Iowa State and the Ames community have been recruited to assist in data collection (see photos linked).

Phosphorus

Phosphorus occurs naturally in water bodies in dissolved forms or as forms that are attached to soil particles. Dissolved phosphorus (orthophosphate) is an important biological nutrient for photosynthesis and cellular growth and reproduction, so plant and microbial growth is often limited by its presence. Elevated concentrations of phosphorus, often from human sources such as sewage leaks, fertilizer runoff, agricultural practices, and urban construction, can promote excessive algal growth.

Study Site

We established eight sample locations along the South branch of Worrell Creek (Fig. 2). These sample locations were selected for ease of access to the streams and also to allow for the collection of data at key locations of flow attenuation and hydraulic/kinetic processes in the watershed. These sites capture water entering data collected by the Squaw Creek Watershed Coalition since 2006. Monthly sampling at eight locations has occurred from March 2016 through April 2018. The watershed is a rapidly urbanizing area featuring new developments, apartments, and businesses have moved into the area. The Tedesco Environmental Learning Corridor, a 4.5-mile linear green infrastructure in the watershed, is being developed by Story County Conservation as a new public park and feature stream restoration project.

Results

E. Coli By Date

- Mean E. coli was above the EPA surface water quality standard for most of the year.
- Mean E. coli varied seasonally, with most of the high values occurring during summer (Fig. 4).

Ortho-P By Date

- Spikes in Orthophosphate levels occurred throughout the watershed following a large rain event on 6/14/2018 and snow melt on 3/14/2019 (Fig. 5).

Spatial Patterns of Nutrient Pollution

- E. coli was highest in the north fork sites at the Ringgenberg stormwater retention ponds (Fig. 6).
- Ortho-P varied by site and was greatest at north fork sites (Fig. 7).
- Nitrate levels varied by site and were the highest downstream of the south fork (Fig. 8).

Conclusions

From the results of this research, several conclusions can be drawn:

1. South Worrell Creek is highly impaired with E. coli and phosphorus nearly year-round.
2. Nitrate concentrations in the watershed are not as concerning as E. coli and phosphorus.
3. Stormwater retention ponds play an important role in sequestering phosphorus before it flows downstream.

Further research steps:

- Identify the sources of pollution in the watershed
- Examine the impact of land cover and record water quality change over time
- Use citizen engagement and stakeholder collaboration as tools to improve water quality

References

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