The Effects of Fertilizer Application on Soil Moisture, Groundwater, and Surface Water

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Background

- Nitrates and phosphates, particularly from fertilizers, make their way into streams, rivers, lakes, and oceans. When these nutrients get into aquatic systems, blooms of algae occur that ultimately deplete oxygen in the water, resulting in vast “dead zones” that are low in oxygen and acidic (Galloway et al. 2003). Anaerobic bacteria are the only organisms that can survive in these types of conditions which causes huge problems and decreases the biodiversity of an area.
- Sulfur is an important micro nutrient for plant growth and crop production. Sulfur is essential for chlorophyll formation and the synthesis of oils. Most of the sulfur found in soils is found in the organic matter. Microbes convert the sulfur into a sulfate form that is readily available to plants through a process known as mineralization (Kivi and Bailey 2017). However, if sulfate concentrations in the soil are too high then the soil moisture and groundwater can increase in salinity. An increase in salinity can hinder crop production and water quality, as well as cause toxic conditions for many fish, fungi, and microbes (Meiling et al. 2016).
- **The objective of this study was to determine if nitrate, phosphate, and sulfate from fertilizer move into and through the soil in an agricultural field and appear in the nearby stream water. This study specifically looked at nitrates, phosphates, and sulfates in soil moisture, and in nearby stream water. The study took place in an agricultural field and small creek in a large ravine along Reed Hill Rd in Campbell, New York.**

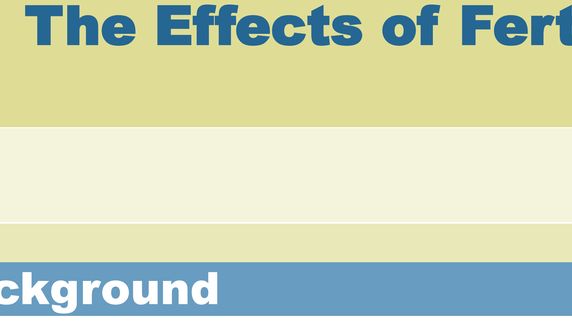
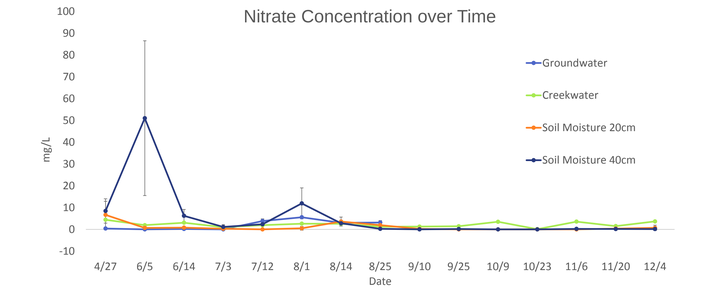


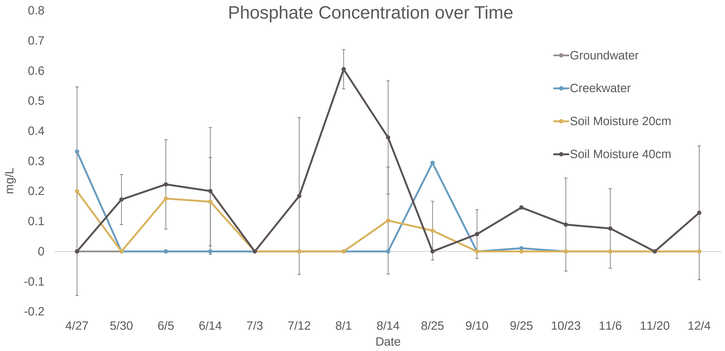
Figure 1: Map of Field of Study in Campbell, New York. (Google Earth)

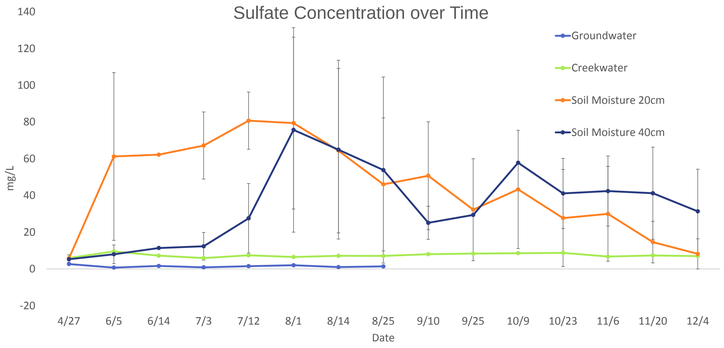
Methods

- 6 soil moisture collectors (Soil Moisture Corp. Model 1900L) were installed on the edge of the agricultural field.
- The collectors were installed in pairs at each location. One collector was installed to sample moisture at 20cm depth and the other at 40cm depth.
- In the small stream within the ravine, a metal pipe was inserted in the stream bed to collect groundwater flowing into the stream. Surface water and groundwater samples were collected from the same location.
- A funnel and bottle precipitation collector were also installed to measure and collect precipitation falling on the agricultural field.
- Samples of soil moisture, groundwater, surface water, and precipitation were collected every 2 weeks from May 2017 through December 2017. Samples were analyzed for nitrates, phosphates, and sulfates using an ion chromatograph (Thermo Scientific Dionix ICS-1100).

Results







- Throughout approximately 7 months of sampling, nitrate concentrations in the groundwater, surface water, and soil moisture changed very little.
- Likewise, phosphate concentrations in the groundwater, surface water, and soil moisture changed very little.
- Concentrations of sulfate remain fairly constant within the groundwater and surface water, however, concentrations vary greatly within the soil moisture.

Discussion

- Nitrates and phosphates from fertilizer application peaked in the early spring when the fertilizer was first applied to the study field. However, throughout the summer and into early fall, both nitrate and phosphate concentration decreased and remained at considerably low levels.
- The timothy and alfalfa that were planted in the study field readily took up the nitrates and phosphates from the fertilizer that was applied. As a result, nitrates and phosphates from fertilizer did not move through the soil zone and end up in the groundwater or creek water.
- Sulfates from fertilizer application peaked in the 20cm depth soil moisture in late spring, early summer (late June-early July). Sulfates then peaked again in the 40cm depth soil moisture in late summer (August) while the sulfates in the 20cm depth soil moisture decreased, indicating it took approximately 1 month to move 20cm in depth.
- Sulfates from fertilizer application in the field of study were not readily taken up by the timothy and alfalfa. Instead, sulfates moved down through the soil moisture.
- This suggests that sulfates from fertilizer application could in fact move down through the soil moisture and into the groundwater, which would then allow a pathway of travel into the creek water.

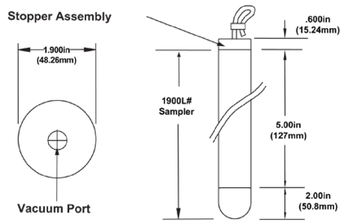


Figure 2: Soil Moisture collectors used in Campbell Field Site (Soil Moisture Corp. Model 1900L).

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