A Comparison of Storm Events and Total Phosphorus Discharge in a High Elevation Forested Stream and a Low Elevation Agricultural Stream in Vermont

Stowe High School Team — Annika Norden and Natalie Herwood — Teacher Advisor: Don McDowell

Abstract

In this study we were investigating the effect of major storm events on phosphorous discharge levels in Vermont. We hypothesized that climate change and storms events are increasing and may be leading to higher phosphorous discharge levels in Vermont streams. This was done by looking at two streams, Goldbrook and Pond Brook, and comparing their phosphorous discharge levels both before and after large storm events. We found there was a correlation between large storm events and phosphorous discharge in both streams. Goldbrook's phosphorous loading increased 100% while Pond Brook's phosphorous discharge increased 400%. Pond Brook's drainage is mostly agricultural while Goldbrook is mostly forested. This suggested that the more pristine streams have less phosphorous discharge.

Phosphorus as a Nutrient

Phosphorus is a required nutrient of plants. In many cases, phosphorus could be considered a "limiting factor", meaning that it limits the population growth of species in a certain environment. Because it is often a limited nutrient, many farmers typically add phosphates to help grow their crops.

A Gloomy Fate

This becomes a problem when there is an extreme amount of rain. Fresh water ecosystems are often limited in the amount of phosphorus. Adding more phosphorous to aquatic environments through runoff from fertilized areas can cause eutrophication (excessive nutrient input). This leads to excessive growth and domination of certain plant species. In the case of Lake Champlain, it leads to algal blooms. During the storms, the sides of the bank will start to erode allowing even more nutrients to enter the river. Over the past summer there were numerous storm events. The increased frequency of storms may be a result of climate change. Typically these storms increase the likelihood of eutrophication.

With this understanding, we hypothesized that climate change and storm events lead to higher phosphorus discharge levels in Vermont streams.

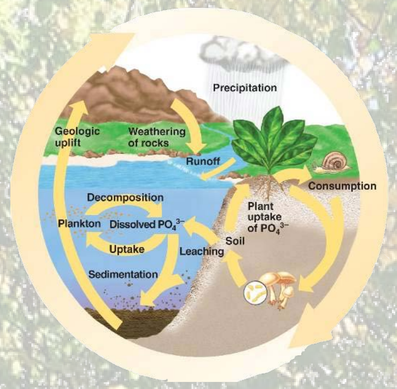
Our Study

To begin the study, streams with the necessary criteria were found. These were stream sites with total phosphorus, stage sensor, and discharge data. The study then became limited to three sites. Each site had the stage and nutrient data for the appropriate dates. Only two sites used the procedure to find discharge data.

With these two sites, total phosphorous discharge levels were then calculated from the total phosphorus and discharge values, using the conversion shown below. However, total phosphorus levels were not simple to interpret as minimum detection levels (MDL) limited the certainty of the amounts recorded. Therefore, some of the values used did not pass 95% confidence, but were interpreted in this study as accurate. Two storm event were then found on July 23rd and August 13th, 2014.

Using the sensor depth data from the stage sensors and the total phosphorus discharge calculated, the factors could be compared to relate storm events to total phosphorus discharge.

Total Phosphorus µg / L	x	Discharge m^3 / sec	x	Conversion 1000 L / m^3	=	Total Phosphorus Discharge µg / sec

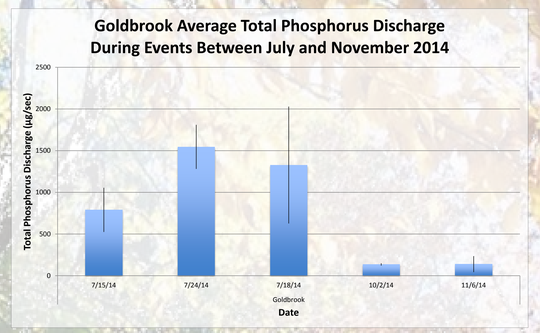


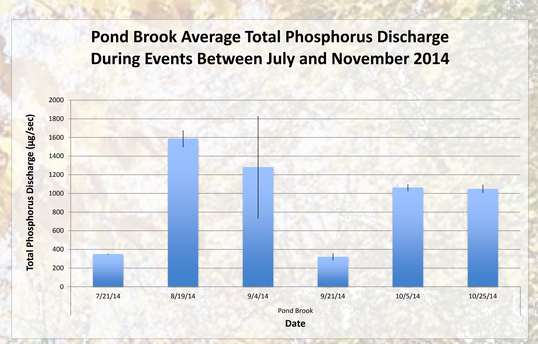
The Habitat Assessment of Goldbrook and Pond Brook

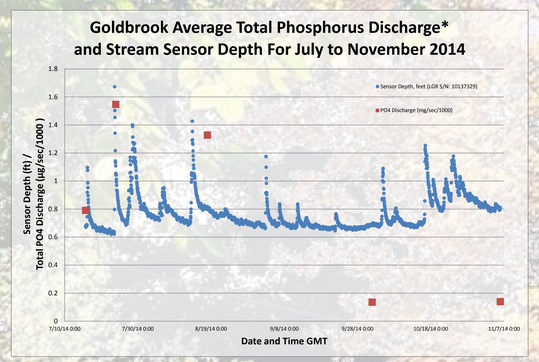
Site Code	Location	Elevation	Percent Catchment Agricultural	Percent Catchment Urban	Percent Catchment Forested
WR_GoldBrk_952	Stowe, VT	952 ft.	1%	1%	98%
LCD_PndBrk_179	Colchester, VT	179 ft.	17%	4%	66%

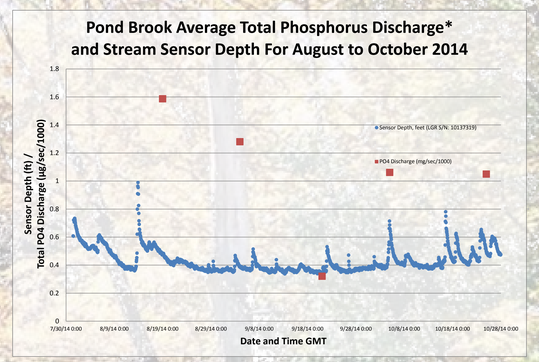
Aerial Photo of Goldbrook Sampling Site

Aerial Photo of Pond Brook Sampling Site









Climatological Data for Stowe, VT July 2014 (US Climate Data)

Date	Precipitation
7/22/14	0.01
7/23/14	**1.02**
7/24/14	0.15
7/25/14	0

Climatological Data for Burlington Area, VT August 2014 (NOAA Online Weather Data)

Date	Precipitation
8/12/14	0.01
8/13/14	**1.19**
8/14/14	0.06

Conclusion

This study supported our hypothesis and suggested that storm events do increase phosphorous discharge. The data shows a correlation between the storm events and an increase of phosphorous discharge at both streams. Goldbrook's phosphorous loading increased 100% but not significantly as shown by overlapping standard error bars. Meanwhile Pond Brook's phosphorous loading increased 400% which is very significant. We found that when looking at the two streams qualitatively and quantitatively, Goldbrook is mostly forested and Pond Brook is mostly agricultural. Pond Brook is surrounded by farms including a llama farm, while Goldbrook is surrounded by forests. We suggest that because Pond Brook has more agricultural impact than Goldbrook the higher phosphorus levels come from the fertilizer which typically is found in excess around agricultural practices. During a large storm event, the phosphorous trickles into the river causing the phosphorus levels to increase. This could even cause eutrophication. Goldbrook is forested so it doesn't have as great a fertilizer run off. Our data concludes that more pristine streams have less phosphorous loading.

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