Mapping Land Use and Phosphorus Production within Tributaries of the Missisquoi Watershed

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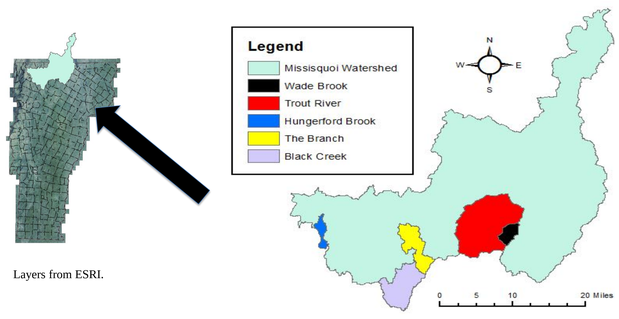
BACKGROUND

Lake Champlain, situated on the border of Vermont, New York State, and Québec, is subjected to large sediment and nutrient loadings originating throughout its 8,234 square mile watershed (LCBP, 2015). High concentrations of phosphorus can be observed all throughout the five regions of the entire lake (LCBP, 2012). This has a great potential to lead to increased algae blooms and excessive plant growth. This in return can cause harm to the local ecology and aquatic species, as well as limit the overall use of the lake (LCBP, 2015).

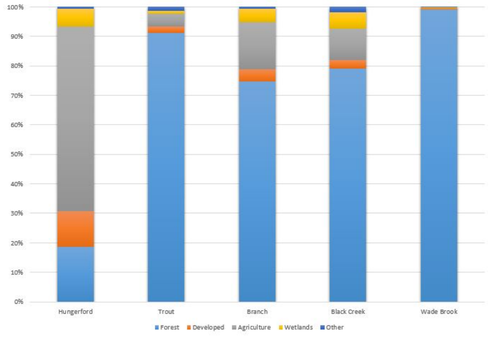
The Missisquoi Watershed drains approximately 1,200 square miles from five major subwatersheds located in northwestern Vermont and southern Quebec. The Missisquoi Bay, where the river empties into Lake Champlain, contains the highest concentration phosphorus and the community struggles to control its algae blooms. The Bay receives roughly one third of all the non-point source phosphorus in the lake (MRBAVT, 2015). This can be attributed to the different landuse practices within the watershed, in particularly, various types of agriculture. It is imperative for Vermont to better understand the particular areas in where sediment and nutrient production is the highest and began working on controlling the outflow into Lake Champlain.

MISSISQUOI WATERSHED AND STUDY SITES



Layers from ESRI.

LAND USE PERCENTAGES WITHIN EACH SUBWATERSHEDS



METHODS

Field Data Collection

- Five Philips samplers were deployed at five locations throughout Missisquoi Watershed – Hungerford Brook, Black Creek, Trout River, The Branch, and Wade Brook
- Each sampler was built to the specification designed by Philips et al 2000
- Samples were retrieved on approximately monthly intervals for analysis
- Due to initial unsafe, high flow conditions within the five streams, samplers were not deployed at the same time

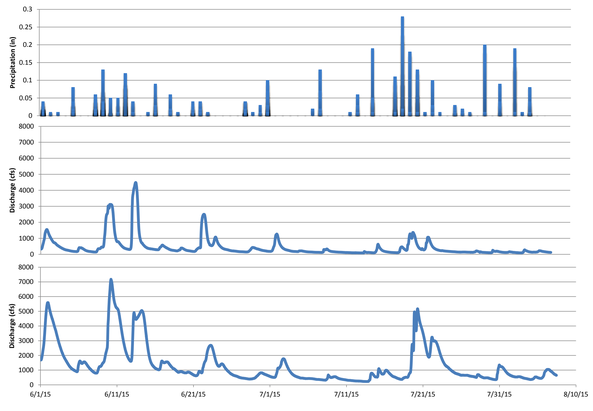
Laboratory Analysis:

- Water samples were given 24 hours to settle, before filtering the suspended sediment from the water. A dry mass was obtained after a period of 24 hours drying at 27 °C
- Phosphorus concentrations were then obtained from microwave-assisted nitric acid digest and ICP-MS system

Spatial Analysis:

- Basemaps and landuse data layers were downloaded from Vermont Center for Geographic Information (VCGI)
- USGS Streamstats was utilized to delineate and create shapefiles of the five upstream subwatersheds of each Philips sampler
- Landuses were grouped into five categories (agriculture, forest, developed, wetlands and other) and total percent contributions were calculated

RAINFALL AND HYDROGRAPHS DURING SAMPLE PERIOD



Data from USGS. Top Hydrograph and Hyetograph: North Troy. Bottom Hydrograph: East Berkshire

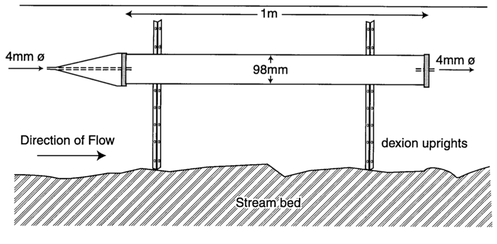
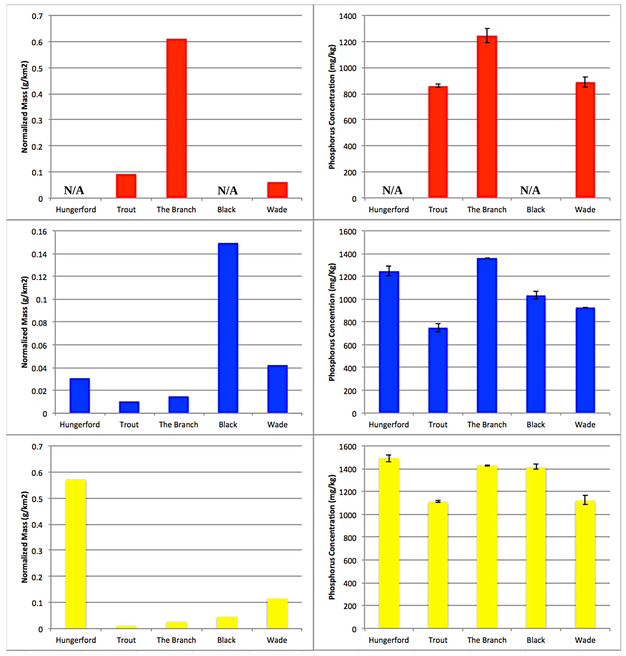


Figure (Left): Installation of Phillips Sampler at The Branch.
Figure (Right): Cross-sectional schematic of Philips sampler (Philips et al 2000).

SEDIMENT AND PHOSPHORUS DATA



CONCLUSIONS

The normalized mass, or the amount of suspended sediment collected by the Philips sampler divided by the subwatershed areas, shows one subwatershed producing significantly greater amount of sediment than others for each of the three sampling dates. This variance could be due to defects within the actual Philips samplers or else differing rainfall intensities within the Missisquoi Watershed. The phosphorus concentrations produce a constant trend of Hungerford Brook and The Branch having the largest values. This is to be expected due to the large percentage of agricultural land use within the subwatersheds. This, however, is not consistent between Wade Brook and Trout River, where Trout River has a higher percentage of agriculture, but a lower concentration of phosphorus. This irregularity could be due to human error within the methods or varying levels of phosphorus in Trout River.

REFERENCES

Lake Champlain Basin Program (LCBP). http://www.lcbp.org. 2015.
Lake Champlain Basin Program (LCBP). State of the Lake and Ecosystem Indicators Report. 2012.
Phillips, J. M., M. A. Russell, and D. E. Walling. Time-Integrated Sampling of Fluvial Suspended Sediment: A Simple Metholdolgy for Small Catchments. *Hydrological Processes* 14:2589-602. 2000.

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