Characterization of total suspended solids and total phosphorus in urban stormwater runoff at the UVM Bioretention Laboratory

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Introduction

•Stormwater pollution is one of the major contributing factors of receiving-water deterioration (Lee et. al, 2000)

•Total Suspended Solids (TSS) accumulate on impervious surfaces from traffic , atmospheric deposition, etc.

•Phosphorus is the limiting nutrient in Lake Champlain and works to accelerate eutrophication (Meals and Budd, 1998)

•Hypotheses:
1) TSS (mg/L) in outflow < inflow
2) Total phosphorus highly correlates with TSS in stormwater runoff

Materials and methods

- Stormwater was collected from eight bioretention cells constructed in November 2012 at the UVM Bioretention Laboratory

- Teledyne ISCO automated water samplers, pressure transducers and 90º v-notched weirs were placed at the inflow and outflow of each cell
- 12 to 24 one-liter samples were collected by each ISCO
- Each sample was passed through a previously weighed 47 mm glass microfiber filter, dried and reweighed to determine TSS (mg/L)
- Samples were digested before being analyzed for Total Phosphorus (TP) with a Lachat flow injection analysis system
- Samples were filtered through a 0.45 µm nylon syringe filter and analyzed for Soluble Reactive Phosphorus (SRP) using the Lachat

Results

- Through regression analysis, a weak correlation of 24% was observed between TSS and TP across all inflows, with a p-value of 2.53E-05 (Figure 1)
- The Event Mean Concentrations (EMC) of TSS from the five storms observed were 38.08 mg/L and 8.13 mg/L for all inflows and outflows respectively. The overall removal rate of TSS was 78.66% (Figure 2)
- The percent of TP that was found to be SRP was 45.6% across all inflows
- Nearly 96% of all phosphorus leaving the bioretention cells was in the form of SRP
- Insoluble (particulate) phosphorus was calculated by using the equation: TP-SRP = Insoluble P (Figure 3)
- A correlation of 61% was observed between TSS and insoluble P, with a p-value of 4.66E-15 (Figure 3)

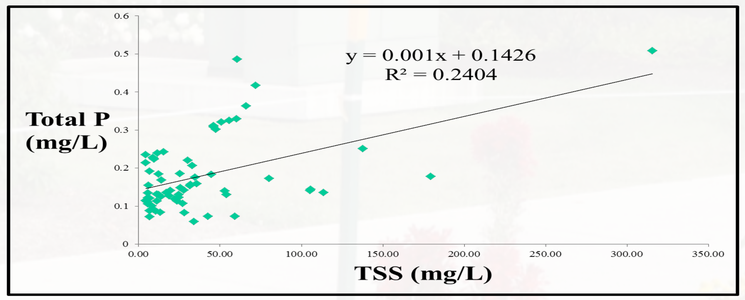

Figure 1: Scatter plot of TSS and TP for all inflow data from 6/23/13 to 8/1/13

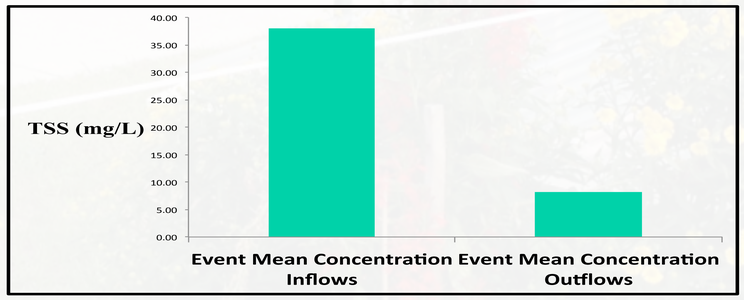

Figure 2: Event Mean Concentrations from five storms 6/23/13 to 8/1/13

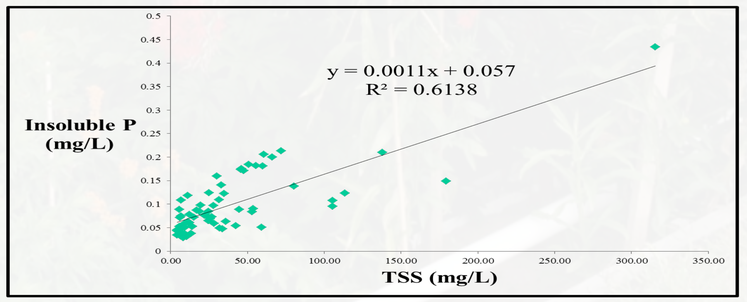

Figure 3: Scatter plot of TSS and Insoluble P (TP-SRP = Insoluble P) for all inflow data from 6/23/13 to 8/1/13

Discussion and conclusions

- TP inflow totals did not strongly correlate with TSS inflow totals in stormwater runoff due to the high proportion of SRP in the inflow. However, insoluble phosphorus did correlate with TSS across all inflow data
- Correlation of insoluble phosphorus with TSS suggests that insoluble phosphorus was sorbed onto TSS. This is consistent with the results of Hsieh et al. (2007)
- TSS in the outflow was found to be less than the inflow with a removal rate of 78.7% for five storms from 6/23/13 to 8/1/13
- TSS removal rates were consistent with studies conducted by Davis et al. (1998) and Hsieh and Davis (2005) at 81% and 72-99% respectively

Literature cited

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Acknowledgments

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Further information on the Bioretention Project at UVM can be found at:

http://www.uvm.edu/~pss/?Page=bioretentionproject.html

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