INVESTIGATION OF TSS CONCENTRATION AT A VARIETY OF FLOW RATES

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INTRODUCTION

First flush stormwater is commonly described as having a disproportionately high concentration of pollutants in the rising limb of the hydrograph (SOURCE). The water often contains a high total suspended solids (TSS). Levels of TSS present in first flush water are a strong indicator of total stormwater quality (Gupta and Saul 1996). TSS measurements in first flush samples may reflect both the pollutant load the storm water picked up and may also reflect the flow rate generated from the event. Testing the strength of the correlation between TSS and peak flow will clarify this relationship.

HYPOTHESES:

1.There is a strong correlation between the max TSS and peak flow rate.

2.The max TSS and peak flow rate occur at the same spot on the hydrograph.

MATERIALS & METHODS:

GENERAL: Stormwater inflow samples were collected from a rain garden adjacent to a parking lot located on the University of Vermont campus in Burlington. ISCO sampling captured 24 distinct inflow water samples during each storm event. After rain events, each ISCO bottle was labeled for cell number, position (in/out), position (1-24) and date. Twelve storm events were sampled between 5/17/2014 and 6/20/2014.

TOTAL SUSPENDED SOLIDS: Glass-fiber filters were placed on aluminum weigh boats and then weighed. Each filter was put onto the vacuum plate and rinsed with 5ml of DDI water. 200-250 mL of sample water was placed in a large beaker on the stir plate with a stir bar. 25mL of sample water was pipetted onto the filter while the vacuum was still on. This was done in 5 sets of 5 mL pipets. The filters were left to dry for 24 hours. The weigh boats were re-weighed and recorded in the data sheet.

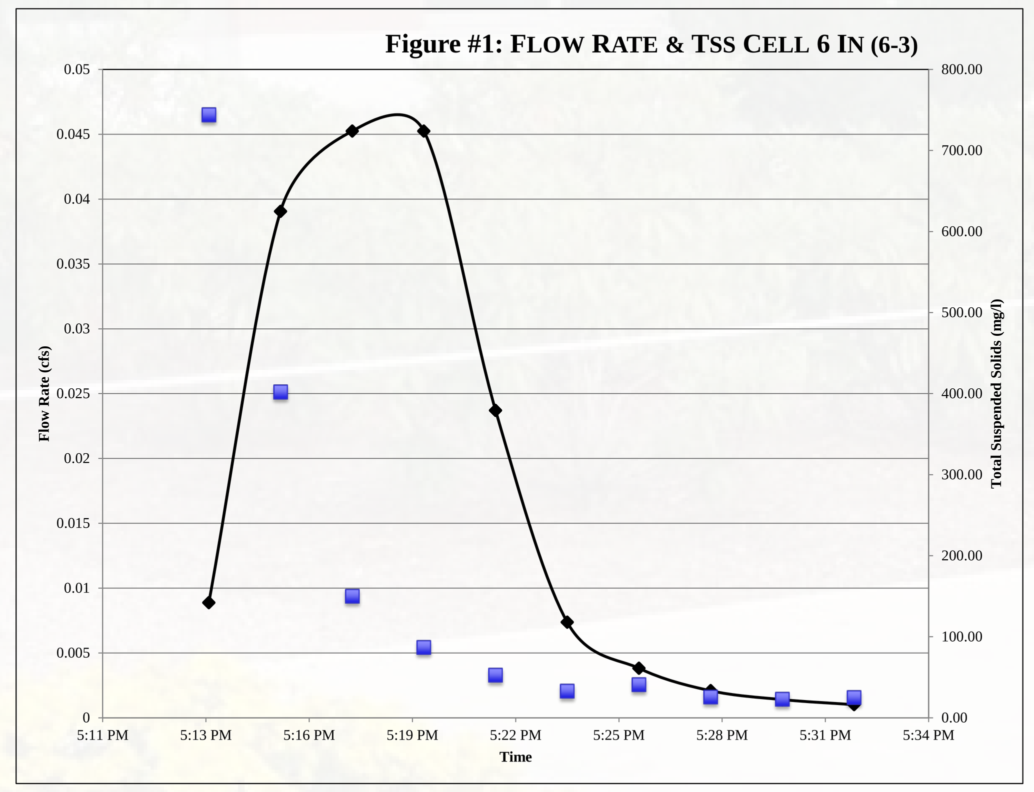
CALCULATION: mg total suspended solids/L – [(A-B) x 1000]/(sample volume, mL) was applied to the data.

WHERE:

A = weight of filter + dried residue, mg, and

B = weight of filter, mg.

RESULTS



There is not a simple relationship between TSS and flow rate. Comparing flow rate and TSS measurements across all twelve storm events yields no correlation between flow rate and TSS (Figure 1). Analysis of the hydrographs from individual storm events yielded ___ storms showing a pattern of decreasing TSS from first sample to last regardless of flow rate (Figure 2). In contrast several other hydrographs had a contrasting pattern of low TSS levels in early samples followed by a sharp increase and a steady decline (Figure 3).

Figure 2 illustrates a pattern of highest TSS levels in early stormwater samples with a declining TSS rate in later samples. There were ___ other storm hydrographs with a similar pattern.

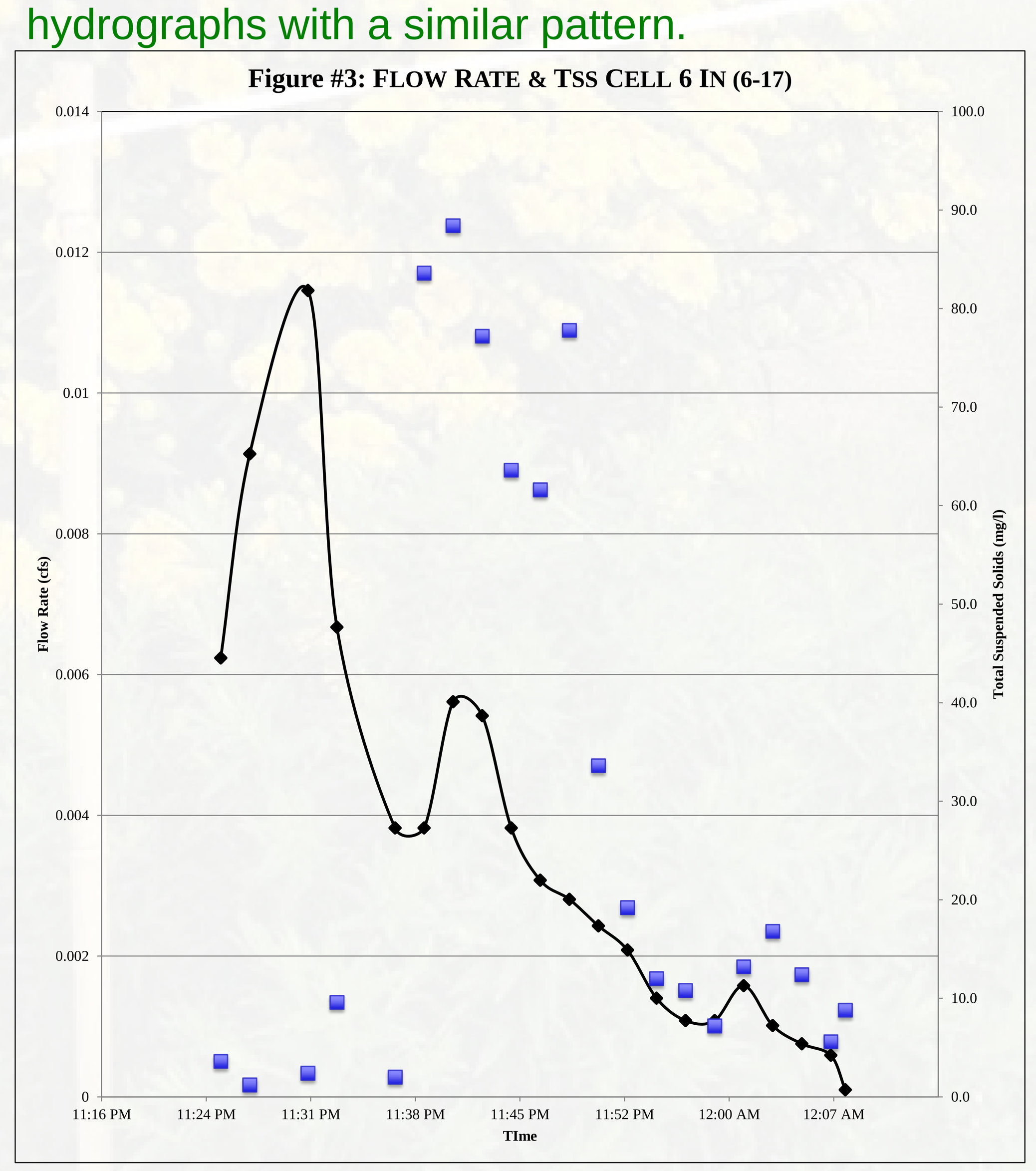


Figure #3 illustrates a more erratic TSS sampling result. TSS samples were lowest for the first samples collected, followed by a spike in TSS and then a declining rate until the end of the storm event. This storm event is also distinct from the 6/3 event in Figure 2 in having a stronger flow of water and a second spike in water velocity midway through the sampling period. There were ___ other hydrographs with similarly erratic TSS sample results.

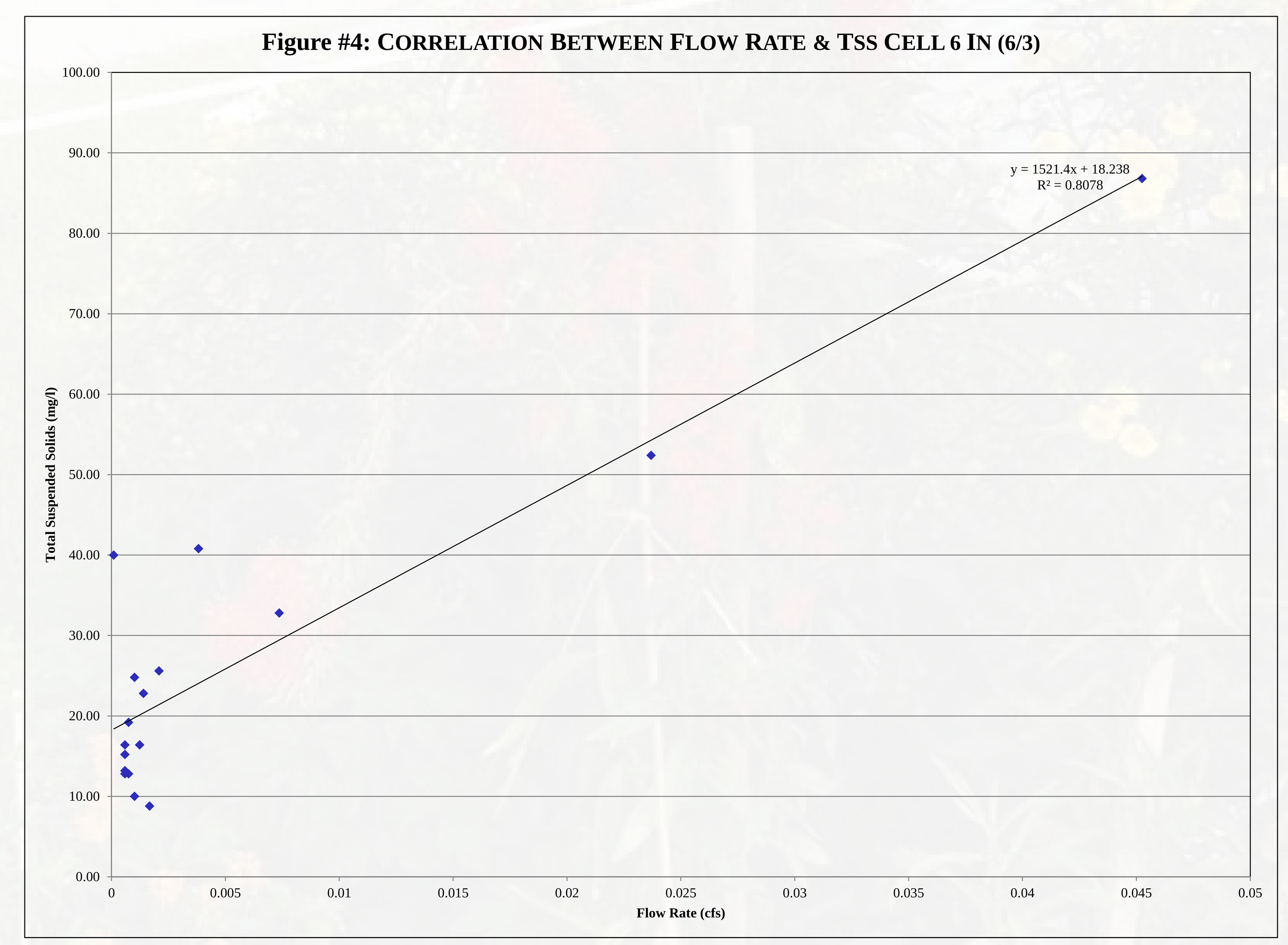


Figure #4 shows the glass-fiber filters placed on aluminum weigh boats. The darker filter in the top left hand corner is from the inflow TSS. The filter on the bottom left hand corner shows the outflow TSS.

DISCUSSION & CONCLUSION

The lack of correlation between strength of flow and TSS levels has several potential explanations. One may be that rain events are highly variable precipitation rate and wind patterns that may influence how quickly pollutants are mixed with and carried by stormwater. It is harder to explain why the pattern of TSS reduction over time of sample collection is not consistent. The differences between the pattern of TSS decline during the rain event of 6/3 (Figure 2) and the more fluctuating TSS levels of 6/17 shown in Figure 3 might have several explanations. The delay in high TSS expected during first flush may be due to particle size distribution during the event (Characlis and Wiesnet 1997). The energy of water required to carry the TSS particles may vary. At very high water flows, it may be that TSS constituents cannot drop into sampling bottles as water flows by them. It is also possible that a sampling error may have been introduced by failing to fully clear old water from the wier boxes prior to each new rain event. If relatively clean water were still present in the box, this would explain why the first samples taken from the 6/17 event had lower TSS levels. Further experimentation and sampling is needed to explain the results. Careful review of wier box processes could address the potential of sampling error. A laboratory sample of known pollutant load could be used to determine if particle size and water speed influences how much TSS is measured per sample.

LITERATURE CITED

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