TESTING THE EFFECTIVENESS OF RETENTION PONDS IN MILKHOUSE CREEK AT IMPROVING WATER QUALITY

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Retention ponds are designed to collect run-off from developed areas as well as provide pollutants such as sediment and organic compounds (like oil and grease) a chance to be removed from the water before joining waterways. Three ponds were chosen to be monitored in order to determine if the retention ponds draining into Milkhouse Creek are effective at improving water quality. These ponds were chosen at three different points in the creek, with samples taken from water in the pond and water that has recently left the pond. In addition to these samples, two more were taken: the first was located near the headwaters of Milkhouse Creek with no retention ponds flowing directly into it, and the second sample is located farther downstream after the sampled retention ponds have contributed to the water supply. Each sample was collected one day after a significant rainfall event in order to allow for pond collection and sediment sorting. After they were collected, the samples were tested for pH, alkalinity, total organic compounds, total suspended solids, and ammonia levels. This testing is intended to help in determining the effectiveness of current retention ponds and if tougher efficiency standards are needed.

Keywords: retention ponds-effectiveness, water quality, Milkhouse Creek

Introduction

Retention ponds are a crucial part of neighborhoods as well as other urbanized areas. They allow water a place to be absorbed into the ground where otherwise impermeable surfaces are located due to urbanization. Retention ponds also trap pollutants and prevent them from entering natural water bodies (University of Florida, 2004). Sediment is one of the most prevalent pollutants collected in the retention ponds. However, these ponds are designed to allow this sediment to filter out of the water and settle on the bottom of the pond. In residential areas in particular, other pollutants such as oils and grease from cars, fertilizers from lawns and gardens, as well as various chemicals can affect the water quality. These manufactured ponds can be attractive landscape features or even supplement natural wetlands while providing additional habitats for animals. If retention ponds are allowed to perform their function without disturbances such as removing the plant life that grow there, overall health of the retention ponds should increase (Garzon and Giraldo, 2005). Retention ponds are also useful for serving as nitrogen storage areas where wetlands were once present (Fleischer, et al., 1998). If these retention ponds are not as effective as they should be, harmful pollutants are able to leave the pond, and potentially contaminate the rest of the watershed.

Research Question

Are retention ponds effective at improving the water quality in Milkhouse Creek?

Methods

Before any tests were run, three retention ponds were chosen as well as sites upstream and downstream from these ponds. Site 1, the red circle in Figure 1, is the site chosen upstream from the retention ponds. Site 2, the purple circle in Figure 1, is a retention pond located in the Ashmoor Place neighborhood. Site 3, the orange circle in Figure 1, is the retention pond in Moss Creek Court. Site 4, the yellow circle in Figure 1, is a retention pond located at Brookside Retirement Village. Finally, Site 5, the green circle in Figure 1, is downstream from the retention ponds tested. After a rain event, I went to each of the testing sites and collected samples from both water in the retention pond, as well as water leaving the retention pond through pipes and concrete ditches.

A residential area may have various chemicals and products that affect the retention ponds around them. I

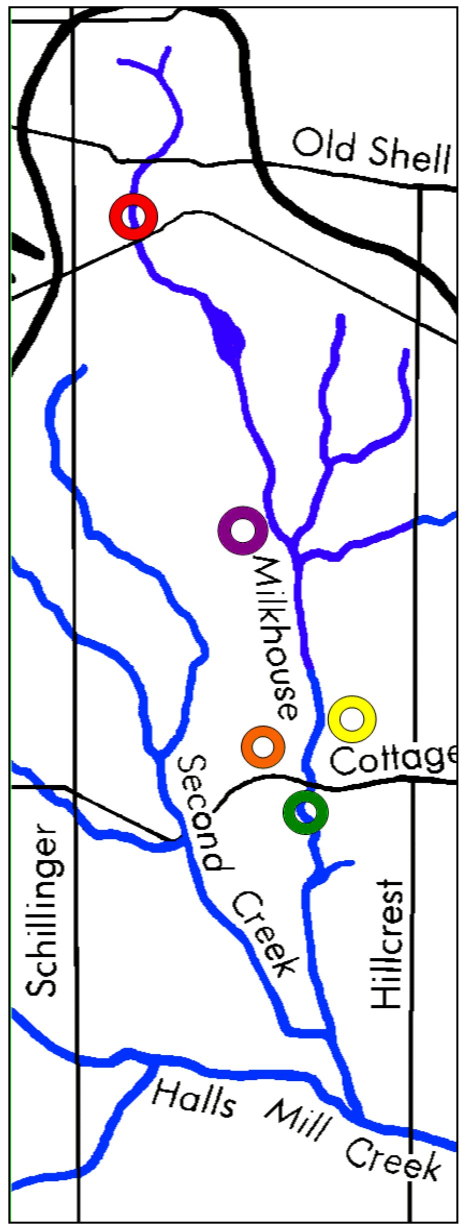

Figure 1: Location of test sites in Milkhouse Creek.

suspected that run-off from the lots in these neighborhoods would have a negative effect on the water quality of the retention ponds, and eventually the streams into which they drain. Tests were then conducted in order to give us an idea as to whether or not the retention ponds were being an effective site for the removal of various pollutants. One measurement that proved helpful is to test all samples for pH. This helped determine if the retention pond has any affect on pH by comparing the pond results to the outlet as well as upstream to downstream. PH is an important characteristic of water quality as many plants and animals are sensitive to severe pH levels. A Fisher Scientific Accumet pH meter, Figure 2, was used to measure pH levels. Alkalinity measurements were also taken from the samples. The alkalinity of a body of water can make changes in pH more difficult, so it is important to check for both factors. Alkalinity has also been shown to be associated with a higher level of pollutants (Brandes and Kney, 2007). Alkalinity was tested using the La Mott Water Quality kit.

Figure 2: Fisher Scientific Accumet pH meter.

The third measurement that was taken from both samples is that of turbidity. Turbidity is the cloudiness of water due to suspended matter. This proved useful to see how dirty the water in the retention ponds is, when compared to the water leaving them (AWW, 2006). To determine turbidity, a Total Suspended Solids tests was performed in order to determine the amount of sediment in the samples. The level of total suspended solids is usually higher during the mid-day range (Garcia, et al.; 2006), however the samples used for these tests were gathered during the morning and evening time. Tests were also conducted in order to test for total organic compounds in the water samples. This helped determine the amount of oils, greases, and solvents being added to the retention pond, and how effective the ponds are at removing them. This was done by using a Shimadzu Corporation Total Organic Compound Analyzer. Finally, ammonia levels were tested. Ammonia levels are evidence of over-fertilization, and can ultimately distress wildlife in the watershed if it is not removed from runoff at the retention pond (AWW, 2006). Ammonia levels were tested using the Ion Selective Probe Method.

Results and Discussion

Samples were collected on three different days: March 16, 2007; April 2, 2007; and April 4, 2007. March 15th had approximately 3 inches of rain, April 1 had just over 4 inches of rain, and April 3 had about 1 inch of rain (Weather Underground, 2007). The results for pH, proved to be within a margin of 0.4 of 7.0, which is neutral and a healthy level (Figure 3).

PH levels were within the "neutral" category. This is excellent news for the water quality because if high acid rain were being added to these ponds, it could potentially kill plants and animals that depend on it.

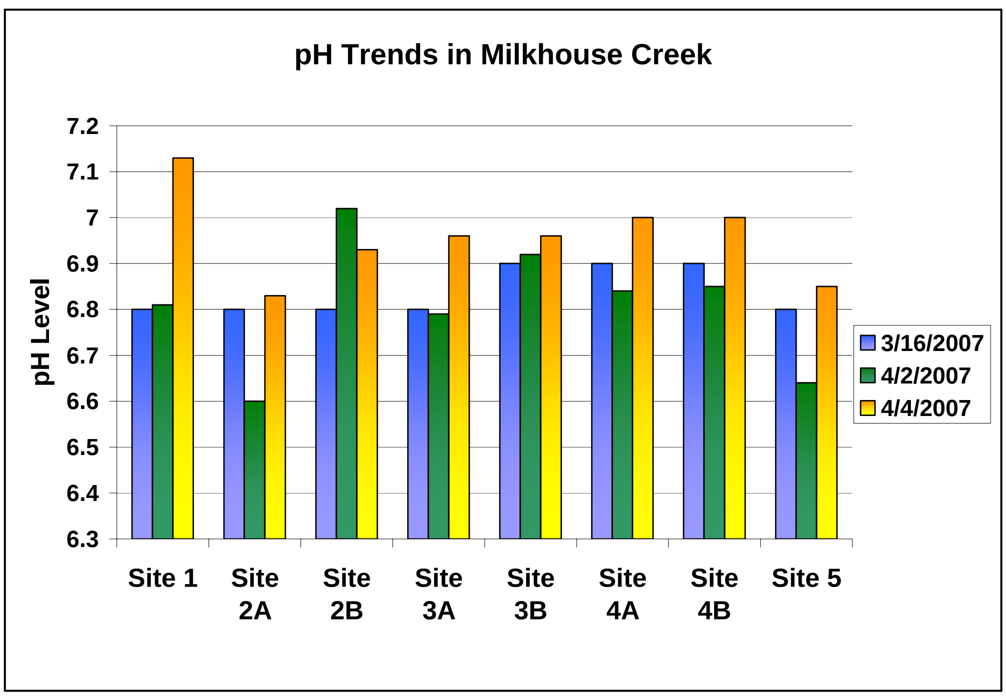

Figure 3: pH Trends in Test Sites.

Alkalinity results were very different from the pH result, with high levels of fluctuation (Figure 4). Alkalinity levels were much lower at Sites 4 and 5. This could be due to the limestone rocks surrounding both the Site 4 retention pond and outlet pipe. Notable differences between Site 1 and Site 5 are apparent.

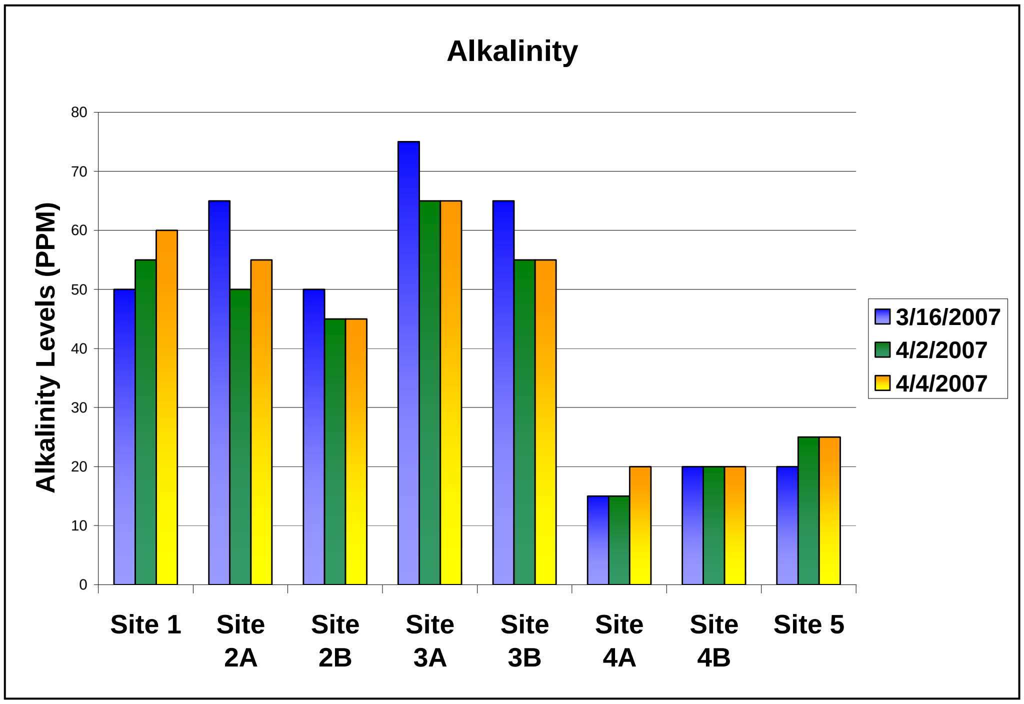

Figure 4: Alkalinity Trends in Test Sites

The total suspended solids (TSS) test resulted in low numbers, with the exception of Site 3 (Figure 5). Most of the total suspended solids tests came back with fairly low results, however, Site 3's pond had over 300 times more than the other sites. This pond never had as much water flowing through it as the other sites did. This might have contributed to the TSS being so high. Despite the pond having so much more sediments in it, the outlet had levels similar to other ponds showing just how effective this pond is at removing the sediment.

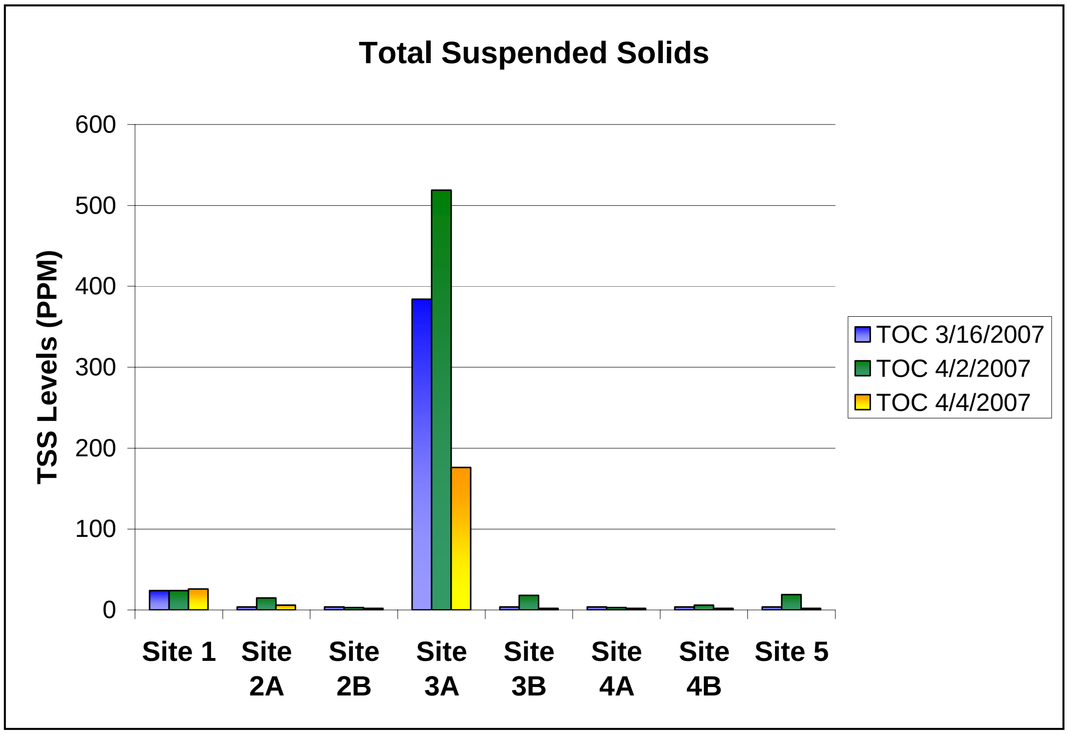

Figure 5: Total Suspended Solids Results.

Total organic compounds such as oils and grease, were similar to the alkalinity in that there were high levels of fluctuation in test results, see Figure 6. Total organic compounds also had some interesting results. Site 1, the upstream location, had a consistently high level of TOC's, most likely due to several car dealerships being located nearby. The rain washes any fluids lost by these cars off the parking lots and directly into Milkhouse Creek. Site 3 had high TOC levels both in the pond and in the outlet, however there is no apparent reason for this deviation. At the other end of the scale, Site 4 had low TOC's in the pond and outlet, most likely due to the small amount of cars in combination with the previously mentioned limestone rocks.

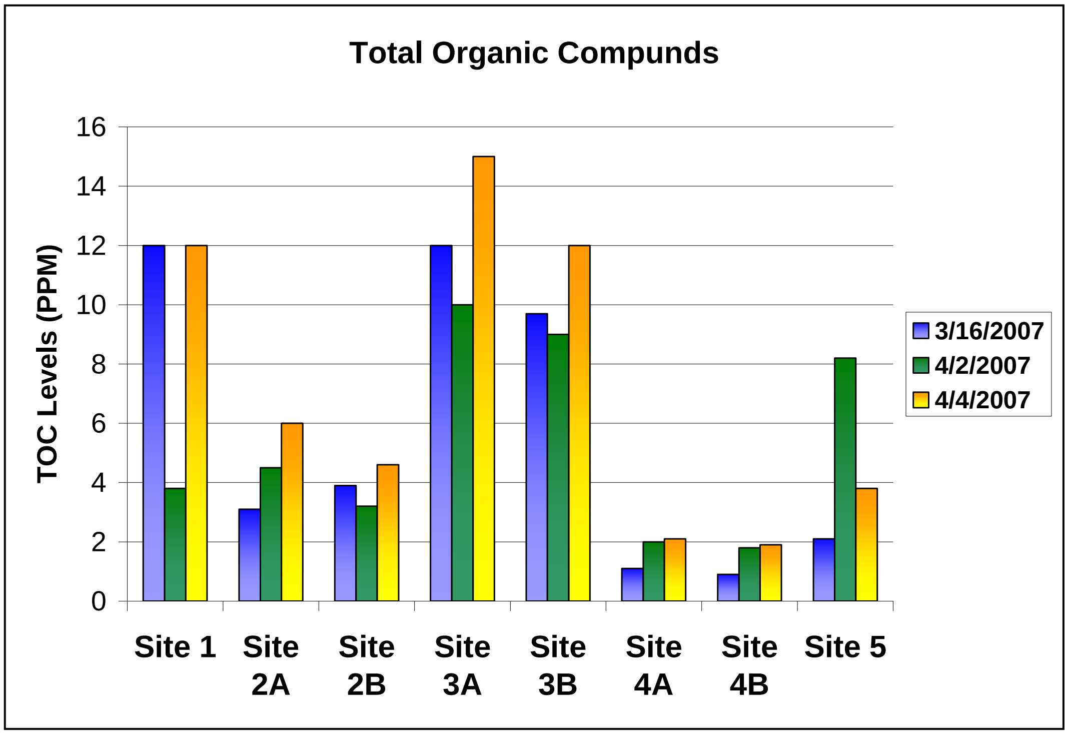

Figure 6: Total Organic Compounds Results.

Finally, the ammonia levels were, for the most part low, however, there were either high or very low levels present, with not much middle-range (Figure 7). Ammonia was consistently found at Site 1, with the other sites only having significant amounts on only one or two of the sampling dates. Site 3, the location with the highest TOC and TSS results, had no significant amount of ammonia on any sampling date. Site 5, the location downstream had the same results. The lack of ammonia in Site 5 is evidence that the ponds were successful in removing the pollutant.

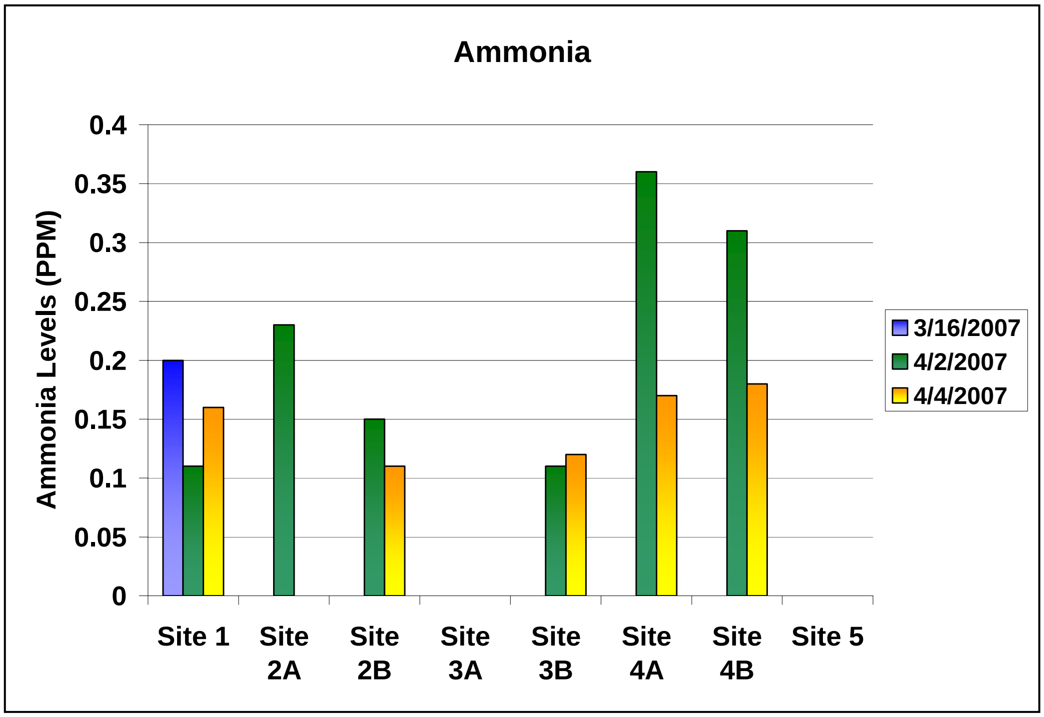

Figure 7: Ammonia Test Results.

Discussion and Conclusion

These tests showed that the retention ponds improved the water quality of the run-off from the surrounding urban areas for most of the factors tested. The downstream site showed higher levels of total organic compounds than several of the ponds however. This might be contributed to the large amount of TOC from Site 3. Also, ammonia test results were inconsistent with the outcome. Some ponds had less ammonia than was found in the outlet source of the pond water.

To improve the filtration of these dangerous compounds, more vegetation and limestone rocks could be used. Vegetation will remove ammonia by using the nutrients to grow and become more healthy. This vegetation, in combination with limestone, will help to take hold on the organic compounds and absorb them from the water.

Works Cited

Alabama Water Watch. 2006. “Alabama Water Watch: Water Chemistry Monitoring”. Pp. 42-57.

Brandes, David; Arthur D. Kney. “A Graphical Screening Method for Assessing Stream Water Quality Using Specific Conductivity and Alkalinity Data”. *Journal of Environmental Management.* Volume 82. Issue 4. March 2007. Pages 1202-1214.

Fleischer, S.; A. Gustafson, A. Joelsson. 1998. “Decreased leaching and increased retention potential co-operative measures to reduce diffuse nitrogen load on a watershed level”. *Water Science and Technology*.

Garcia, J.; B.F. Green; T. Lundquist; R. Mujeriego; M. Hernandez-Marine; W.J. Oswald. “Long Term Diurnal Variations in Contaminant Removal in High Rate Ponds Treating Urban Wastewater”. *Bioresource Technology*. Volume 97. Issue 14. September 2006. Pages 1709-1715.

Garzon, A.; Giraldo, E. 2005. “The Potential for Water Hyacinth to Improve the Quality of the Bogota River Water in the Muna Reservoir”. *Water Science and Technology*.

University of Florida. 2004. “Plant Management in Florida Waters”. Available: http://plants.ifas.ufl.edu/guide/aquascape.html#retpond. Accessed: February 19, 2007.

Weather Underground. 2007. Available: http://www.wunderground.com/. Accessed: April 10, 2007.