CTRF Project Report: June, 2015

Project Title: The impact of golf courses on nutrient loss and overall pollutant export from developed areas

Principal Investigator: Dr. Chris Murray, Lakehead University

Summary:

This project is aimed at quantifying the effect golf course maintenance has on the quality of runoff and groundwater, especially where nutrients, volume of flow and sediment are concerned. As the project enters into the second growing season, the research team has begun testing of the effect of fertilizer and grass type on nutrient export. Experimental procedures have been finalized and over the next season measurements will be made regularly as a function of turf development and fertility regime. It is our hope to extend these plots to indoor tests again for the winter, so that while existing outdoor plots allow examination of winter melt, we can continue to probe the relationship between turf maintenance and its effect on water quality throughout the winter.

Personnel:

Ms. Amanda Grant continues her M.Sc. in Biology on this subject, and is beginning her third of six semesters in her program. Professor Nanda Kanavillil (Associate Professor of Biology, Lakehead University) is, along with Dr. Murray, advising Amanda and tracking her progress, and serves as co-supervisor for Amanda's M.Sc. project.

Progress since last report:

Since the winter of 2014/2015, plot design has been finalized and plots have been constructed for outdoor testing. The results of winter experiments in the laboratory allowed for determination of ideal plot design and preliminary testing of nutrient and sediment concentration. An experimental plan for the 2015 growing season was developed, which calls for examination of two types of turfgrass typical of golf courses, three regimes of nitrogen-based fertilization and the addition of phosphorus-containing fertilizer in the experimental plan. In all, including plots without any fertilizer and plots without any turf (to evaluate the nutrient export of bare soil) 26 plots are currently being studied (see Figure 1), divided equally between Kentucky Bluegrass and Creeping Bentgrass (provided by Mr. Ari Eckstein of Quality Seeds, Mississauga).

Figure 1.: Test plots approximately 1 week after seeding.

The apparatus being used (Figure 2), as described in greater detail in the last report, allows for the collection of both surface runoff and "leachate" that simulates the fraction of water expected to make its way into groundwater on a golf course. A vacuum extracts the sample from the groundwater reservoir located beneath each plot, and surface water is collected in a container adjacent to each test plot.

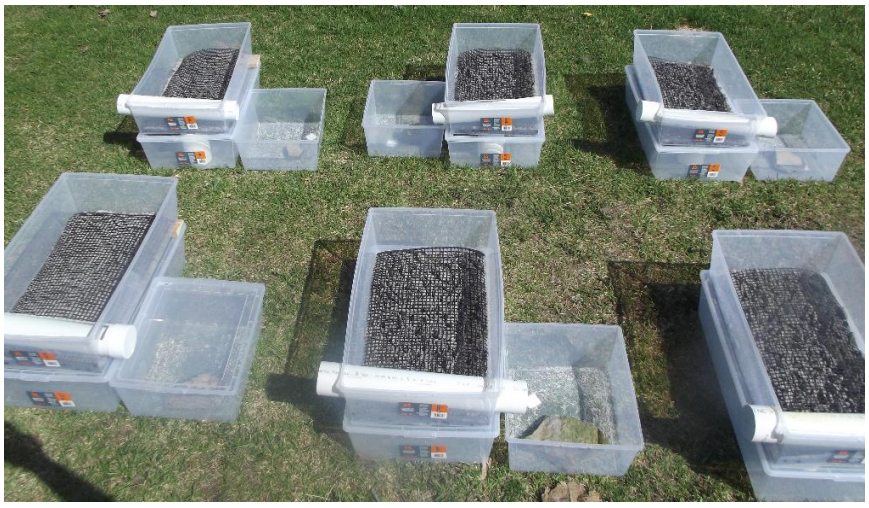

Figure 2 (right): plots before introduction of soil and seed, showing the drainage gravel and mesh which allows simulated groundwater to make its way to the lower chamber for collection. The troughs at the lower end of each plot direct runoff into another chamber.

Two types of simulated influent water are of interest in this round of testing: simulated rain or irrigation and simulated runoff from an adjacent area (such as a parking lot, other turfgrass, etc.). During a measurement of either simulated influent surface water or precipitation, water that will be applied to the plots is tested for nitrogen content, phosphorus content and total suspended solids before it is applied. The volume of water applied and the rate at which it is applied is noted, and the water is collected from both the surface water and groundwater reservoirs. The volume of water captured is noted and the fraction that remains in the turf/soil can thus be calculated. For both groundwater and surface water samples, nitrogen, phosphorus and TSS is measured. Each experimental condition is duplicated in two separate but nominally identical plots.

Throughout this season, measurements will be made as a function of turfgrass development (time since germination), turfgrass type, fertility regime and seeding density. A subset of plots receive no fertilizer and three subsets of plots (for each grass type) receive three levels of nitrogen-only fertilizer in a summer and fall application. Additionally, a subset of plots will receive phosphorus-containing fertilizer. A final subset of plots explores the effect of seeding density. Three levels of seed density were applied to duplicate plots, and shoot density counts will be made periodically to evaluate whether application of more or less seed had a noticeable effect on shoot density and associated water quality effect.

All of the current plots are sloped at 5%. A continuation of the 2014 study of the effect of slope and plot length will be undertaken with other plots, depending on space in a local greenhouse we may obtain.

Next steps:

To test additional parameters such as the effect of slope and plot length, and to continue testing of the effect of fertilizer during the winter months, space has been sought in a local greenhouse. The winter testing undertaken last season in Lakehead's laboratories was useful in establishing test procedures, but due to limited space only a small number of plots could be kept growing. The research team has been working with staff at Stayner Collegiate Institute, where a large greenhouse has been established for their new Environment and Green Industries programming, and we expect to begin turfgrass testing in this space once classes are ended later this month. Expanding into Stayner's space will not only allow our project to continue throughout the winter, it will also engage secondary school students in our work and demonstrate to them an aspect of environmental management they may not have been exposed to otherwise. Lakehead researchers will have a chance to work with these students and their teachers, and we hope the experiments we establish there will last for several years. Beginning this work in a large indoor space will allow simultaneous examination of several parameters simultaneously, including winter and summer-type experiments at the same time.