Surface and Subsurface Water Quality Data Collection and Model Development for a Watershed Scale Turfgrass System

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Objectives:

1. Collect, evaluate, and quantify surface and lateral water quality (i.e., nitrate N, ammonium N, phosphorus) from a golf course using a watershed approach.
2. Evaluate the water quality impact of transitioning from potable to reclaimed water for golf course irrigation.
3. Develop a computer model designed specifically for turfgrass systems based on an existing watershed scale water quality model.

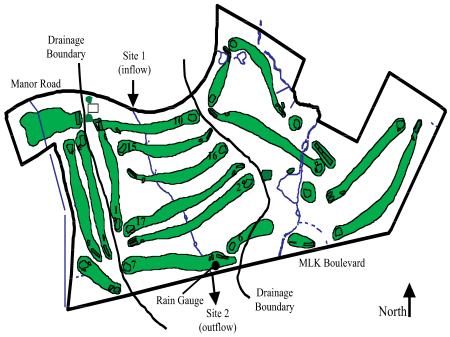
Start Date: 2000
Project Duration: 3 years
Total Funding: $74,800

A watershed-scale water quality monitoring and analysis program was initiated in the spring of 1998 to quantify the amount and quality of water exiting a golf course in central Texas. A section of Morris Williams Municipal Golf Course in Austin, TX, managed by the City of Austin Parks and Recreation Department (PARD), was selected as the study site for the project. The selected section of the course is ideal for studying surface water as the section has only one inlet and one outlet for runoff, thus the boundary conditions are easily monitored.

The topography is such that the contributing area (71.7 acres) contains 10 greens (1.8 acres), 7 fairways (20.3 acres) and 7 tees (0.7 acres). The managed areas (greens, fairways, and tees) represent 32% of the total area and are managed at a moderate level, typical of most municipal courses in the U.S. The contributing area also contains approximately 16.1 acres of reduced-management rough, with the remainder comprised of unmanaged trees and shrubs.

Baseflow water samples are collected on a near weekly basis, while storm flow samples are collected during high flow. Lateral flow samples from a green/fairway drain and a fairway drain are collected on a daily basis, while weekly samples are collected from a spring that flows into the stream. Current collected data from this research site suggest significant contributions of nitrate in the surface runoff from this course. The system contributed statistically significant ($p<0.05$) increases in median NO_3+NO_2-N concentrations (+0.16 mg L^{-1}) and PO_4-P concentrations (+0.02 mg L^{-1}), and decreases in NH_4-N concentrations (-0.01 mg L^{-1}) from storm water.

The golf course contributes a significant increase in median concentration of NO_3+NO_2-N (+0.63 mg L^{-1}), reduced NH_4-N concentrations (-0.07 mg L^{-1}), and no significant effect on PO_4-P concentrations to base flow. Lateral flow from the green/fairway drain indicates average concentration of NO_3+NO_2-N at 1.40 mg L^{-1}, NH_4-N at 0.05 mg L^{-1}, and PO_4-P at 0.13 mg L^{-1} while analysis from the fairway drain indicate average concentrations of NO_3+NO_2-N at 0.54 mg L^{-1}, NH_4-N at 0.04 mg L^{-1}, and PO_4-P at 0.09 mg L^{-1}. Data from the spring indicates average concentrations of NO_3+NO_2-N at 2.28 mg L^{-1}, NH_4-N at 0.02 mg L^{-1}, and PO_4-P at 0.10 mg L^{-1} entering the surface stream.



Layout of study area at Morris Williams Golf Course in Austin, TX.

Advances in model development for turfgrass include the ability to simulate: 1) hydrology on a sub-daily time-step, 2) slow-release fertilizers, 3) thatch growth and decay, 4) reclaimed water as irrigation, and 5) automated mowing.

Storm Flow Concentrations (mg L^{-1})

	NO_3 + NO_2-N		NH_4-N		PO_4-P	
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Mean	0.30	0.48	0.11	0.09	0.13	0.15
Median	0.24 a	0.40 b	0.05 a	0.04 b	0.11 a	0.13 b
Maximum	2.25	3.52	4.04	3.23	0.90	0.99

Baseflow Concentrations (mg L^{-1})

	NO_3 + NO_2-N		NH_4-N		PO_4-P	
	Site 1	Site 2	Site 1	Site 2	Site 1	Site 2
Mean	0.29	0.89	0.10	0.03	0.11	0.10
Median	0.24 a	0.87 b	0.09 a	0.02 b	0.10 a	0.10 a
Maximum	1.84	2.35	0.69	0.17	0.37	0.20

Mean, median and maximum storm flow and baseflow concentrations of nitrate + nitrite nitrogen, ammonium nitrogen, and phosphate phosphorus from inflow (Site 1) and outflow (Site 2) of Morris Williams Municipal Golf Course.

Summary Points

- Significant contributions of nitrite and nitrate have been measured in storm flow, base flow, lateral flow, and return flow.
- Concentrations of ammonium nitrogen are reduced through the course while phosphorus is generally not affected.
- Advances in simulation technology are continuing as well as the validation of the model based on the first four years of collected data.
- Evaluation of transition to using effluent for irrigation should begin soon.