IMPACTS TO SURFACEWATER FROM GOLF COURSES IN THE BAY AREA

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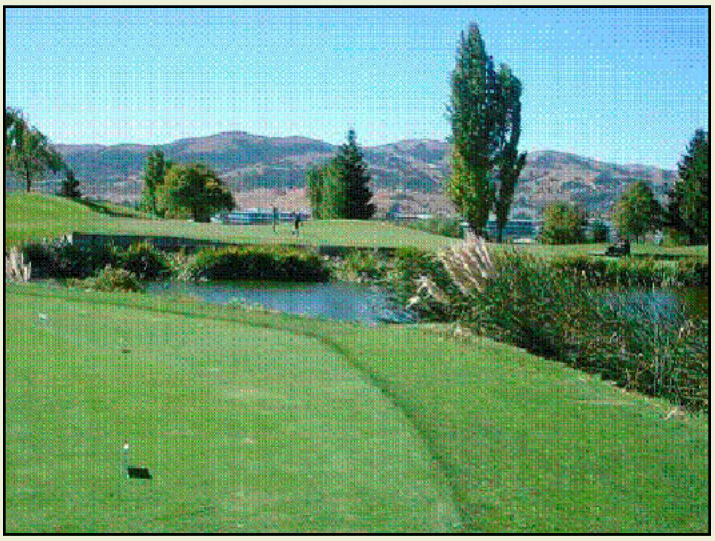
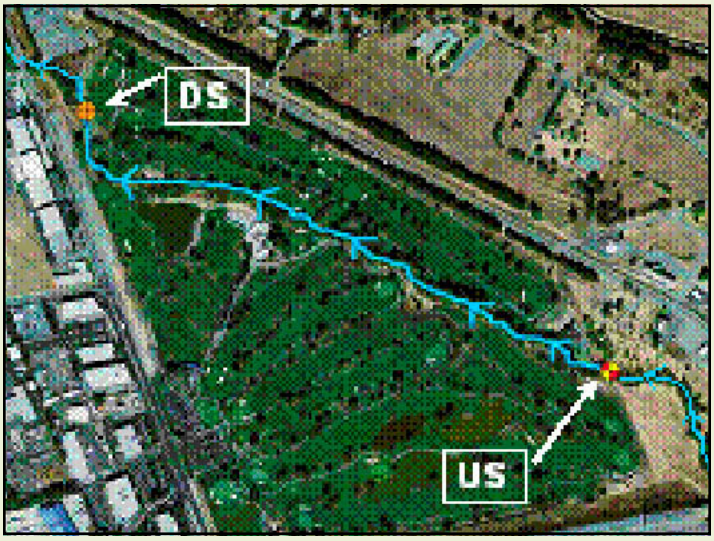
Over 150 courses are in the greater San Francisco Bay area. Virtually all of these courses have a creek, stream, drainage, pond or lake on or near the course. Significant regulatory pressure exists for municipalities to meet state and federal water quality regulations, including National Pollutant Discharge Elimination System (NPDES) stormwater rules. Regulatory agencies place particular emphasis on eutrophication, depletion of dissolved oxygen, and impacts from fertilizers and pesticides. Golf courses are widely perceived as contributing to these water quality problems.

A 6-year study was completed to address concerns over perceived negative impacts to surfacewater quality from golf course operations. Thirty golf courses in Contra Costa County where surface water passed through or adjacent to the course were screened for inclusion in this study. The study focused on differences in upstream vs. downstream surfacewater quality on "organic" vs. "traditionally" fertilized courses. From 2004 to 2006, year-round sampling was done, including 17 storm events. Forty six separate sampling events resulted in over 1,000 water quality measurements. Analyses were done for dissolved oxygen, specific conductivity and turbidity, ammonia, nitrate and phosphate, and toxicity to *Selenastrum capriconutum* (algae) and *Ceriodaphnia* (water flea). Data on agronomic practices such as fertilizer and irrigation water use, mowing frequency, etc. were collected at each course.



The results of the study suggest that impacts to surfacewater quality from golf courses, including nutrient input, were not occurring. Toxicity to water flea was not seen in any sample, suggesting that insecticides were not leaving any of the courses studied at concentrations adverse to this species. Algae populations were slightly reduced downstream of organic courses, suggesting that organic courses may be imparting some type of algae-limiting characteristic to surface water. Algae populations increased slightly downstream of traditional courses, suggesting that traditional courses may be contributing algae-enhancing nutrients to surface water. This later finding is at least in part due to the lack of a significant vegetative buffer use.



Courses showing a high frequency and magnitude of downstream algal growth generally had managed turf immediately adjacent to surfacewater with little or no buffer present. In contrast, courses showing the lowest frequency and magnitude of downstream algal enhancement had comparatively little managed turf directly adjacent to surface water. This finding supports the concept that vegetated buffers are effective at protecting surface water quality, regardless of the fertilizer type used.

The overall study-wide average magnitude of downstream algae growth was 3%, suggesting that golf course nutrient input may be occurring but is relatively small. In general, courses with vegetated buffers had better water quality, regardless of the type of fertilizer used. The study concluded that contrary to popular perception, golf course impacts to surfacewater do not appear significant.

Because no studies to date have been as focused, extensive or as scientifically robust, results of this ground breaking work can be used by parties interested in better understanding golf's relationship with water quality in adjacent streams and creeks.