

# Considerations in Retrofitting a Golf Course for Recycled Water Irrigation

Start thinking about preparing for the use of recycled water at your course.

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**W**ithin the United States as well as the rest of the world, the future of the golf industry is tied to water availability and price. Even in areas where water was once an unlimited resource, it is now viewed as limited and highly valuable, particularly in arid, semi-arid, and highly populated regions. The price of potable water rises with scarcity; both rising cost and the increased politicization of using a scarce resource for leisure and entertainment purposes put pressure on golf courses to use something other than potable water for irrigation.

In many locations, using recycled water (i.e., treated municipal sewage water, which may also be known as reclaimed or effluent water) for golf course irrigation is a viable strategy for coping with water shortages and the rising cost of fresh water. Some states, in fact, have already mandated recycled water irrigation on new golf courses and landscapes. Elsewhere, interest in recycled water irrigation continues to increase as more and better-quality recycled water becomes available for re-use.

Irrigating a golf course with recycled water poses unique challenges for a course superintendent. Whether a course is new and in the development phase or well established and switching to recycled water irrigation, issues arise in the areas of environmental stewardship, health, and agronomics. These issues are more easily addressed when a





course can be designed and built with recycled water irrigation in mind than when an established course decides to retrofit (or convert) to recycled water use. In both instances, however, a number of concerns are best handled during the planning phase; in fact, preparing for recycled water irrigation is almost always more efficient and effective than managing the potential negative effects of its misuse.

Resolution of the following infrastructure and management issues will ensure minimal negative impact of recycled water irrigation on the playability and agronomic health of a golf course. It will also ensure that legal and financial responsibilities are carefully considered and all parties are clear on their roles and responsibilities should problems arise. Most of these issues apply equally to courses under development and those being retrofitted for recycled water irrigation. Every site, however, will also be subject to specific health and environmental regulations which, due to the great variation between sites and communities, are not discussed here. Readers are therefore advised that the following discussion is not exhaustive with respect to such issues, complete evaluation of which should occur before contracts are signed.

## RECYCLED WATER TREATMENT PROCESS

Recycled water used for golf course irrigation must be at least secondary, and preferably tertiary, treated wastewater. Secondary treatment is a biological process in which complex organic matter is broken down to less complex organic material, then metabolized by simple organisms that are later removed from the wastewater. Secondary treatment can remove more than 90 percent of the organic matter in sewage. The secondary liquid effluent is always chlorinated or otherwise disinfected before release. Often, sewage treatment facilities associated with residential developments consist of aerated

lagoons, a less sophisticated secondary treatment process.

Advanced wastewater treatment consists of processes similar to potable water treatment, such as chemical coagulation and flocculation, sedimentation, filtration, or adsorption of compounds by a bed of activated charcoal. Because advanced treatment usually follows high-rate secondary treatments, it is



The issue of water availability continues to grow and impacts all industries. With rising costs of potable water, the use of recycled water is a viable strategy. Once the water arrives at the treatment facility, it must receive at least secondary, and preferably tertiary, treatment before it can be used on the golf course.

sometimes referred to as tertiary treatment. These processes can provide highly purified waters. Reverse osmosis, an advanced method of water treatment, can actually produce pure water; however, very high initial and operational costs and environmental problems related to disposal of reject saline brine limits the use of this process for golf course irrigation.

Generally, secondary and tertiary treated waters do not differ significantly chemically — i.e., in their dissolved salt content. However, due to the greatly reduced level of suspended (i.e., not dissolved) solids, tertiary waters are much more desirable for golf course irrigation. Suspended solids can plug irrigation heads and seal sand-based (USGA or California type) golf greens, thereby reducing drainage. Consequently, installing an efficient filtration system is essential when using recycled water for golf course irrigation, especially if the recycled water is only secondary treated effluent.

## AGRONOMIC AND MANAGEMENT CONSIDERATIONS FOR RETROFIT

There are unique challenges associated with using recycled water to irrigate golf courses originally designed for freshwater irrigation. Depending on the quality of the recycled water available, the costs of converting an irrigation

system and adapting course maintenance to the new irrigation can be substantial. The following items all bear careful consideration in planning for conversion of a course to recycled water irrigation. Most have both

cost and management consequences, although some are cost free. Some of the items may have already been addressed by local authorities — e.g., regulatory issues. Every effort is made to include all items of potential concern in this report; however, other, site-specific issues that are not apparent initially may come to light as the conversion project progresses.

## IRRIGATION SYSTEM ISSUES

- **Cross connection.** Protection of cross-connection systems may be necessary if the golf course irrigation system is connected to a potable water system or any dedicated fire line using potable water. In general, all physical connections between the recycled water irrigation system and the potable water system must be disconnected.
- **Lakes, wells, and creek protection.** On-site lakes, wells, and creeks whose water is used for potable purposes should be protected from overspray or runoff from recycled water irrigation. Drinking-water fountains on the property should also be protected from overspray. Local regulations may require modification or redesign of the



irrigation system to ensure these protections.

● **Quick couplers.** It may be necessary to tag or replace all quick couplers on the course with specialized couplers that prevent inadvertent drinking of recycled water by maintenance personnel or others.

● **Labeling, tagging, and painting.** On new golf courses, purple irrigation system components generally signify (and warn unsuspecting users of) the presence of recycled water. On existing golf courses, all buried components of the existing irrigation system are often “grandfathered in.” However, a golf course may be required to label all visible irrigation system components with purple tape, tags, paints, etc. It may also be necessary to install signs warning of recycled water use in more than just English (in most cases, warnings in Spanish are also mandatory) throughout the course, at the clubhouse and pro shop, and on scorecards. The cost of this “publicity” will depend on the type and magnitude of labeling a course chooses.

● **Pumping costs.** Depending on the pumping capacity and pressure requirements of the existing system, a booster pump and electricity for additional pumping may be required. The pressure provided by the treatment plant releasing the recycled water is often inadequate for irrigating a golf course.

● **Water storage facilities — construction and maintenance.** If recycled water cannot be stored in existing lakes on the course, additional storage facilities may be required. Covered storage tanks or “lined” ponds are options. The size and location of such storage facilities must be thoroughly evaluated in relation to environmental issues as well as for both fixed and operational costs. Note: Recycled water storage facilities require a high level of maintenance. Generally, covered (or buried) storage tanks require less maintenance than lakes, since the absence of light eliminates algae growth; on the other hand, settling of suspended matter

is a problem in tanks. With frequency depending on water quality, storage tanks must be periodically emptied and cleaned. The initial cost of constructing lined storage lakes may be less than that of installing covered tanks; however, the maintenance cost is generally higher. Due to elevated levels of nutrients such as nitrogen and phosphorus, algae and weed growth is a constant problem in storage lakes. Substantial labor and chemicals are often needed to keep pond water clean and suitable for irri-



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gation. Depending on the quality of the water, the cost of maintaining a storage pond for recycled water could be several times higher than maintenance costs for a pond of potable water (due primarily to algae and weed growth, and odor problems). If any existing lake at a course is converted for storage of recycled water, it may require lining to prevent potential groundwater contamination.

● **Irrigation water filtration.** Given the suspended matter content of recycled water, a dependable irrigation filtration system may be essential. Particularly if recycled water is stored in ponds, where algal bloom is a constant problem, filtration must be of high quality. If the existing filter system at a course is sub par, it must be replaced before beginning recycled water irrigation. Without effective filtration, algae and other suspended matter will plug irrigation nozzles, reducing irrigation efficiency and uniformity, and requiring

additional labor for repeatedly unplugging heads. In addition, without adequate filtration, the fine, suspended particles delivered in recycled water may plug pore spaces in the rootzone of sand-based golf greens, impeding both drainage and leaching — costly problems!

● **Irrigation water blending.** Recycled water may need to be blended with fresh water to reduce its salt content. If blending, often done in a storage tank or lake, is not possible, a course may be alternately irrigated with recycled and fresh water to leach salts (a process called “flushing”). Cost and logistics would determine which approach is used at a given golf course.

● **Adjacent properties.** Depending on local regulations, golf courses irrigated with recycled water may be required to protect adjacent properties from runoff or overspray from their irrigation. Compliance with such regulations may mean redesigning the irrigation system to allow irrigation of the perimeter with fresh water.

## AGRONOMIC ISSUES

● **Recycled water dissolved salts.** In most cases, recycled water will have a higher dissolved salt content than the water already being used for irrigation. In addition to salinity, other important chemical components of the recycled water are pH, sodium, calcium, magnesium, chloride, boron, bicarbonate, and residual chlorine. Depending on the levels of these chemical constituents, management practices on the course may need to change to counteract potential negative effects on soil, turf-grasses, and other plants. Such effects may range from slight to substantial. Without an analysis of the recycled water, it is impossible to predict the extent of its effect on management; however, any or all of the following may be needed:

1. Irrigation water blending (i.e., recycled with fresh).
2. Injection into the irrigation water of acids, gypsum, or other amendments.



3. Application of gypsum, sulfur, and other amendments to the soil.

4. Additional core aerating to reduce soil impermeability caused by elevated sodium levels.

5. Installation of additional drainage lines in low-lying areas to remove leached salts.

6. Application of additional herbicides and fungicides to combat weed and disease problems if existing grasses are stressed by the presence of salt.

7. Application of more water than is currently applied to leach salt below the grass rootzone (leaching requirement).

8. Regular and more frequent soil and water testing. Twice a year, soils must be lab tested to identify potential salinity problems. Soil samples should be taken from representative greens, tees, fairways, roughs, and general landscaped areas. Recycled water must be lab tested at least quarterly to determine the level and fluctuation of dissolved salts.

● **Trees, shrubs, and other non-turf plants.** Depending on the recycled water's salt content as well as the sensitivity of the course's trees, shrubs, and other plants, remedial actions may be required to prevent plant injury. The most common remedial practice is modification of the irrigation system so that water from sprinklers does not wet plant leaves. Although trees and shrubs may tolerate certain levels of salt accumulation in the soil, they can exhibit injury from saline water sprayed on their foliage.

● **Consultant fees.** Agronomic issues relating to recycled water can be complex, requiring the input of consulting specialists. Most golf course superintendents work closely with a turfgrass water quality consultant. The cost of such service, as well as lab test fees, is a consistent recurring cost associated with recycled water irrigation, and it should be added to the management budget.

## ENVIRONMENTAL AND MANAGEMENT ISSUES

● **Groundwater monitoring.** If a golf course is located above a drinking

water aquifer, a comprehensive ground-water quality monitoring program may be required if the course is irrigated with recycled water. At issue is whether the golf course or the sewage treatment plant is responsible for mounting and paying for such a program.

● **Odor problems.** Depending on the level of treatment, recycled water irrigation may cause an odor problem. It should be decided in advance who will be responsible for correcting the situation.



This special design protects the water fountain from being struck by recycled irrigation water.

● **Liability issues.** Although extremely rare, human health problems, adjacent property contamination, and other negative impacts may result from recycled water irrigation. It is highly advisable to determine ahead of time whether the golf course or the sewage treatment plant, or both, will take responsibility for such outcomes.

● **Equipment deterioration.** Turfgrass maintenance equipment rusts and deteriorates in other ways more quickly when exposed to saline irrigation water. How big a problem this may be at a given golf course will depend on the salinity of the recycled water.

● **Golf course superintendent compensation.** Switching from fresh to recycled irrigation water will add to the responsibilities (and therefore on-the-job time) of the golf course superintendent. In addition to extra agronomic tasks that the use of recycled water imposes, the superintendent will spend more time inspecting, keeping records, preparing reports, and filing documents with environmental and regulatory agencies. He will also have

to spend more time with regulators, community representatives, consultants, laboratories, and vendors providing goods or services related to recycled water. Total labor needs on the course, including that of the superintendent, often rise 10-20% when recycled water irrigation replaces freshwater irrigation, the actual figure depending on the quality of water used.

## ADVANTAGES OF RECYCLED WATER

### ● **Conservation and availability.**

Using recycled water is an excellent means of conserving fresh water. Water availability, especially during a drought or other water shortages, is almost guaranteed when using recycled water.

● **Cost.** Recycled water is almost always less expensive for golf course irrigation than fresh water.

● **Nutrient Content.** All recycled waters contain nutrients required by turf plants (e.g., nitrogen, phosphorus, and potassium). The quantities of nutrients available at a given site and their impact can only be evaluated after recycled water becomes available and can be tested for nutrient content. This limitation notwithstanding, most recycled waters contain enough nutrients to completely eliminate fertilization of roughs and even fairways, and to substantially reduce the fertilizer required by greens and tees.

## AUTHOR'S NOTE

Use of recycled water for irrigation is rapidly spreading worldwide. The author is interested in staying abreast of issues arising from recycled water irrigation on golf courses in regions with varying social, environmental, political, and climatic conditions. Readers are encouraged to communicate issues related to recycled water irrigation that are not covered in this article. The author will compile and periodically cover these issues in new publications. The author may be reached at: [maharivandi@ucdavis.edu](mailto:maharivandi@ucdavis.edu).

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