

How Much Water Does Golf Use and Where Does It Come From?

Gregory T. Lyman, Environmental Programs Director
Golf Course Superintendent Association of America

The Golf Course Environmental Profile conducted by the GCSAA is a project dedicated to collecting data from the United States on the property features, management practices and inputs associated with golf courses. This article features information on irrigation water use patterns, water sources, costs, conservation practices and irrigation system infrastructure. Future water use trends and recommendations also are discussed. This project was funded through support from the Environmental Institute for Golf.

The information presented for the USGA Water Summit is provided through GCSAA’s Golf Course Environmental Profile, a series of surveys to collect data on golf courses throughout the United States. The Profile reports provide insight and perspective into the property features, management practices and inputs associated with U.S. golf courses.

Water Use and Conservation Practices on U.S. Golf Courses is the second report produced from the project. It provides an accurate portrayal of water use, costs, sources and conservation practices on golf courses in the United States. It also establishes a baseline that will be compared to data from future surveys to identify change over time. All reports from the project are available at www.gcsaa.org.

The objectives of the water use and conservation survey were to measure:

- Number of irrigated turfgrass acres for the U.S. and in agronomic regions
- Total water use in the U.S. and in agronomic regions
- Water cost averages for the U.S. and in agronomic regions
- Water sources used for irrigation
- Recycled water use in the U.S. and in agronomic regions
- Water quality
- Irrigation system characteristics
- Water management and conservation practices.

Superintendents at all golf facilities in the U.S. (16,797) were invited to participate in the survey. A total of 2,548

golf facilities participated in the survey, accounting for 15 percent of the nation’s facilities.

Report Highlights:

There are an estimated 1,504,210 acres of main-maintained turfgrass (greens, tees, fairways, rough) on golf facilities in the U.S. An estimated 1,198,381 acres or 80 percent of maintained turfgrass are irrigated. Approximately 80 acres of an average 18-hole golf course’s 100 acres of maintained turfgrass are irrigated. From 2001–2005, an estimated total of 31,877 acres of irrigated turfgrass were added to existing golf facilities in the U.S. The greatest net gain in irrigated acreage occurred in the North Central and Northeast regions, where 13,513 and 8,442 new acres were irrigated, respectively. The Southwest region had an estimated net decrease of 12 acres.

Table 1. Number of irrigated acres and percentage of total irrigated acres by golf course component for an average 18-hole golf facility in the USA.

Component	Irrigated acres	% total irrigated acres
Greens	3.7	4.6
Tees	3.4	4.2
Fairways	30.7	38.0
Rough	33.8	41.9
Practice area	5.6	6.9
Clubhouse grounds	3.5	4.3
Total	80.7	99.9

From 2003–2005, the average water use for golf course irrigation in the U.S. was estimated to be 2,312,701 acrefeet per year. That equates to approximately 2.08 billion gallons of water per day for golf course irrigation in the U.S. According to the U.S. Geological Survey’s “Estimated Use of Water in the United States in 2000” report, approximately 408 billion gallons of water per day are withdrawn in the U.S. Golf course irrigation accounts for 0.5 percent of this total.

Water use varies significantly by agronomic region. An average 18-hole golf facility in the Southwest region uses an average of 4 acre-feet of water per irrigated acre per year. An average 18-hole golf facility in the Northeast region uses an average of 0.8 acre-feet of water per irrigated acre per year.

Annual irrigation water cost also varies significantly by agronomic region. Golf course facilities in the Southwest region had the highest water costs – approximately \$107,800 per year for an average 18-hole golf course. Golf facilities in the North Central, Northeast and Transition regions had the lowest water costs, paying \$4,700, \$6,300 and \$6,900 per year, respectively.

Multiple sources are utilized for irrigation water and many golf facilities have more than one source available for irrigation. Most 18-hole golf facilities utilize surface waters (ponds, lakes) or on-site irrigation wells. Approximately 14 percent of golf facilities use water from a public municipal source and approximately 12 percent use recycled water as a source for irrigation. Specific water sources for 18-hole courses as indicated by participants are noted below:

- 52 percent use water from ponds or lakes.
- 46 percent use water from on-site wells.
- 17 percent use water from rivers, streams and creeks.
- 14 percent use water from municipal water systems.
- 12 percent use recycled water for irrigation.

As previously noted, 12 percent of 18-hole courses use recycled water for irrigation. The most common reason cited for not using it was a lack of an available source for recycled water as indicated by 53 percent of respondents.

In general, irrigation water quality is acceptable or better in all agronomic regions, although there are golf

Table 2. Irrigated turfgrass acres, water use, and water use per irrigated turfgrass acre on an average 18-hole golf facility by agronomic region.

	Agronomic region ^x						
	NE	NC	Trans	SE	SW	UW/Mtn	Pac
Irrigated turfgrass (acres)^y	54f	66e	74d	100b	115a	103b	84c
Water use (acre-feet)^y	42.4f	76.7e	78.9e	241.8c	459.0a	300.4b	158.0d
Water use (acre-feet) / irrigated turfgrass acre	0.8	1.2	1.1	2.4	4.0	2.9	1.9
Water use (inches) / irrigated turfgrass acre	9.4	13.9	12.8	29.0	47.9	35.0	22.6

^x Agronomic regions: NE = Northeast; NC = North Central; Trans = Transition; SE = Southeast; SW = Southwest; UW/Mtn = Upper West/Mountain; Pac = Pacific.

^y Within a row, values followed by the same letter are not significantly different from one another. Letters denote significance at the 90% confidence level.

facilities in all agronomic regions that face significant agronomic challenges due to the quality of their irrigation water.

Approximately 46 percent of 18-hole golf facilities treat their irrigation water or distribute products via the irrigation system. The most common products distributed through the irrigation system are wetting agents and fertilizers.

Nearly all 18-hole golf facilities use multiple irrigation scheduling techniques to aid in making water application decisions. Most facilities utilize direct observations of turfgrass and soil conditions to aid in irrigation scheduling decisions. Approximately 35 percent routinely utilize evapotranspiration data and approximately 3 percent use soil moisture sensors to aid in irrigation scheduling.

Superintendents at 18-hole golf facilities utilize numerous methods to conserve water. The top three conservation methods and the percent of golf facilities utilizing that method are: wetting agents (92%); hand watering (78%); and keeping turfgrass drier (69%).

An estimated 25 percent of 18-hole golf facilities are subjected to recurring annual water allocations. Facilities in the Southwest (40%), Upper West/Mountain (39%) and Southeast (36%) are most likely to be subjected to a recurring annual irrigation water allocation. From 2001 to 2005, 16 percent of 18-hole golf facilities in the U.S. were subjected to mandatory irrigation water restrictions more stringent than the normal recurring annual irrigation water allocation for at least one year. Facilities in the Northeast and Upper West/ Mountain agronomic regions were more likely to experience more stringent restrictions. Approximately 28 percent of 18-hole golf facilities in the Northeast agronomic region have written drought management plans, more than any other agronomic region.