Water Conservation Management Case Studies From Southwest Golf Courses – Horticultural and Regulatory Challenges
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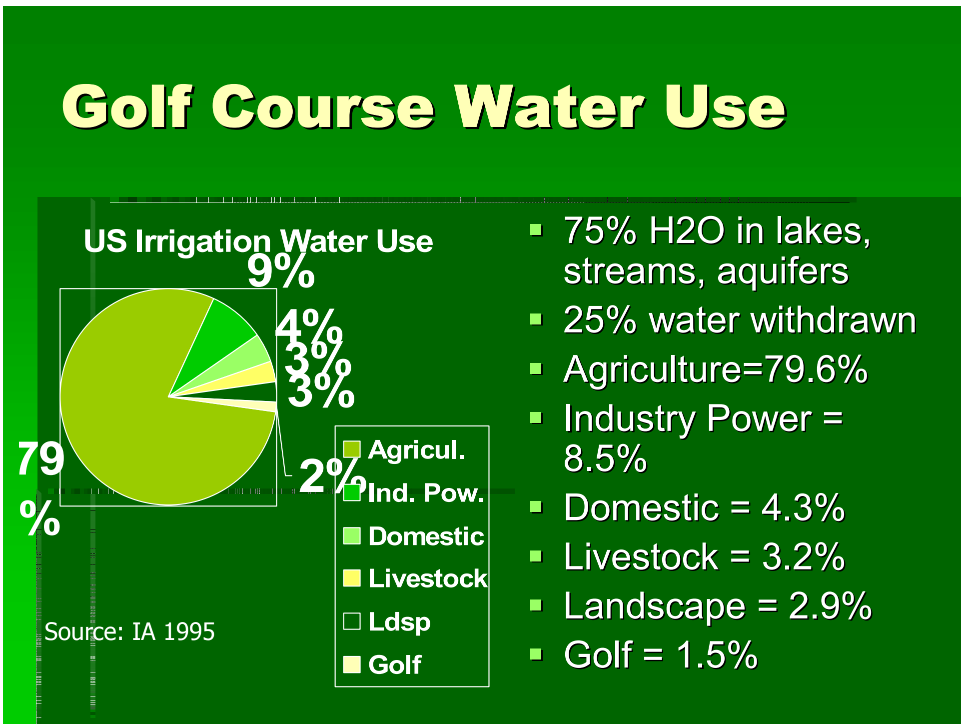
Overview - We have spent decades developing procedures for growing high quality turfgrass to meet the demands of discerning golfers. These skills include proper fertilization, mowing, grooming and cultivation, and of course irrigation water. Today due to drought conditions throughout the western United States regulatory agencies and golf courses managers are struggling to find ways to meet the sometimes competing goals of providing water for all users without making it impossible to irrigate golf courses. This paper will illustrate the regulatory and horticultural challenges and solutions seen in golf course irrigation.

Terminology - Based on surveys conducted by the Irrigation Association golf course turfgrass irrigation constitute the smallest portion of irrigation water used in the United States (i.e. 1.5% of the total compared to 79.6% of the total used for Agriculture).



Where do these numbers come from? How do they compare to the amount of water the turfgrass needs? What is the difference between the regulatory allotments for golf course turf and actual turf requirements?

Many states use Acre Feet (i.e. amount of water needed to cover 1 Acre (i.e. 43,560 square feet) 1 foot deep) measurements to calculate irrigation allotments. 1 Acre Foot = 32,585.78 gallons. Typical golf course irrigation systems will use 150,000 to 250,000 gallons of water per 24 hour period for 85 Acres of turf. Annual irrigation allotments are based on the square feet or acreage of irrigated turf. Using one 18 hole Arizona golf course with 147 irrigated acres (landscape and turfgrass) as an example, the Arizona Department of Water Resources (ADWR) allocates 690.68 Acre Feet of annual irrigation water, (i.e. 0.213 Acre Feet per Acre). Irrigation systems and ET calculations apply precipitation rates in inches. Pumps apply water in gallons.

Modern golf course irrigation systems use evapotranspirational (ET) models programmed into on site weather station integrated computers that regulate the amount of irrigation applied. The goal of these controllers is to provide only the amount of water needed by the plant to replace water lost the preceding 24 hour period by evaporation from the soil and by transpiration from the plant leaves. The water manager calculated the % of ET that will be used to apply water each night for maintaining plant health. The ET and pump models use gallons of water and inches of precipitation measurements to apply the irrigation water.

Average monthly rainfall minus the potential Turf ET surplus or deficit*

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
PHX, AZ	0	-0.4	-1.8	-3.8	-6.3	-8.2	-9.1	-7.4	-5.9	-3.5	-1.3	-0.2	-47.9
LAX, CA	2.3	2.4	0.5	-1.5	-3.8	-4.9	-6.1	-5.6	-4.3	-2.5	-0.6	2.0	-22.1
SFO, CA	3.3	2.7	0.9	-1.2	-3.1	-4.3	-5.0	-4.5	-3.7	-1.9	0.2	3.0	-13.6
DEN, CO	0.5	0.6	1.0	0.7	0.3	-1.8	-2.7	-2.3	-1.3	-0.3	0.6	0.5	-4.2
LVG, NV	0	-0.3	-1.5	-3.2	-5.4	-7.4	-8.8	-7.6	-5.4	-2.9	-1.0	-0.2	-43.5
ABQ, NM	0	-0.2	-1.0	-2.3	-4.0	-5.7	-5.7	-4.8	-3.2	-1.7	-0.6	0	-29.2
PDX, OR	7.3	5.5	4.6	1.1	-0.6	-2.0	-4.7	-3.9	-1.5	2.9	6.4	8.1	23.2
SLC, UT	1.6	1.2	0.8	-0.2	-2.0	-4.0	-6.3	-5.2	-3.0	-0.5	0.8	1.3	-15.5
SEA, WA	5.2	3.9	2.8	0.4	-1.4	-2.4	-4.1	-3.4	-1.1	2.3	4.8	5.8	12.8

Source: Rainfall-ET Data. The Toro Co. Minneapolis, MN, USA. 1966, 63 pp.
*Potential turf ET rate calculated from modified Blaney-Criddle formula.

Irrigation application uniformity (Coefficient of Uniformity or CU) is calculated to determine the precision of the water distribution (based on nozzle performance, sprinkler spacing, pipe and head pressure, sprinkler turning speed, etc.). Using the golf course example above, CU is calculated yearly and ranges from 77% to 85%.

Best Management Practices – Now that we have covered terminology we can look at specific case histories from golf courses and regulatory agencies to see how these factors function in the real world.

- Increasing the CU is the best way to reduce water usage by reducing waste water and increasing precision of irrigation application. The catch can test is the best way to accomplish this. (Cite water savings studies Center for Irrigation Technology, CSU Fresno).
- Individual head control (VIH) provides increased precision compared to block controlled sprinklers (i.e. 2 to 10 sprinklers controlled concurrently per station). Comparing VIH sprinkler irrigation to block systems shows 7,458,885 gallons of used Jan-Jul with VIH compared to 10,382,399 gallons used Jan-Jul with block system controls (i.e. Block control sprinklers used 2,923,514 gallons more in the same time within the same city, a 28.16% water savings). Individual sprinkler control also provides better turf quality with firmer playing conditions.
- Ensuring sprinkler spacing, head pressure, and nozzle performance is consistent with design specifications is another way to ensure precision application.
- Installation of part circle sprinklers to reduce excess irrigation of naturalized areas can save significant irrigation water and improve turf quality. (Desert Forest e.g.).
- Golf courses in Arizona, California, and Nevada are not overseeding to save water. The city of Phoenix golf courses stopped overseeding last year and golf courses in Las Vegas are considering it due to water allocation restrictions.
- Golf courses throughout Colorado were required to stop irrigation all together due to three years of successive drought and low snow fall levels. (E.g. City of Denver, City of Aurora, City of Pueblo, City of Golden)
- Use of drought tolerant turf reduces water requirements. Perennial ryegrass requires more irrigation water to stay green compared to bermudagrass in a warm season climate. (i.e. Comparison of ET°)
- E.g. of core aeration, wetting agents, sand topdressing, pre-wetting, turf growth regulators, mowing height, composting as water conservation procedures.
- Salt affected turf management issues – TDS, bicarbonates, sodium. Leaching requires 5 to 15% more water to grow healthy turf. The advantages and disadvantages of effluent reclaimed compared to well or potable water.
- Regulatory Updates: Las Vegas (NDWR), Arizona (ADWR), California (CDWR).

Conclusion – Based on observations from golf course irrigation throughout the west there are serious future challenges ahead. Regulatory agencies and golf course turf managers need to collaborate and learn about each other's goals, needs and perspectives to develop workable plans for the future. Planning agencies, reclaimed and water resource managers need to work with industry to develop realistic management guidelines. Research must continue to help us find the water and cultural limits for turf management and find ways to maintain optimum precision and water conservation from our irrigation systems.