Water Window Efficiency

The New Way to Measure Golf Course Irrigation System Efficiency

BY **STUART HACKWELL**

THE EMPHASIS ON EFFICIENT WATER MANAGEMENT CONTINUES TO INCREASE IN IMPORTANCE FOR GOLF COURSE APPLICATIONS. IRRIGATION PROFESSIONALS ARE DEVELOPING NEW WAYS TO MEASURE THE EFFICIENCY OF AN EXISTING GOLF COURSE IRRIGATION SYSTEM.

One being used with great success is "Water Window Efficiency."

Water window efficiency (WWE) is a measure of how effective the irrigation system is at applying the desired amount of water in the shortest period of time during a nightly cycle. Experienced golf course maintenance personnel or irrigation professionals can easily measure the WWE.

It should be used as a tool to evaluate whether an existing irrigation system is being managed to optimum levels and it can be used as a measure of determining the operating efficiency of the irrigation system and whether the irrigation system should be upgraded or replaced.

A shorter water window has several benefits, including a better ability to manage turfgrass, reduced effects of evaporation due to wind, improved ability to manage disease, reduced electrical consumption, etc. If your golf course superintendent has not heard of this new method of measuring the efficiency of an irrigation system, please forward it to his attention.

Required Information: A few pieces of information easily obtained are required to measure WWE on a golf course.

The first piece is to determine the total amount of water being applied during a nightly irrigation cycle. Computerized central control systems can provide this information, usually in a "dry run" screen where projected nightly flow and run time are shown.

The second part also comes from the projected flow screen. This is the "total run time" that the system will operate that night.

The last two pieces of information are related to the pump station capacity. The first is the *design* (or "true") pump station capacity and the second is the *operated* "actual" pump station capacity. For most irrigation systems, these two values will be different.

CASE STUDY

A WWE calculation was recently performed at a golf course in the Midwest USA. The existing pump station was 10 years old and had an original "design" pump capacity of 1,300 GPM. The course superintendent was operating the system each night at a maximum of 1,100 GPM, the "operated" pump capacity. This reduced capacity of 200 GPM means that the pump station is not ever using 15 percent of its original design capacity.

Superintendents limit the pump station capacity to prevent issues like "low pressure shut-down" of the pump station. This happens when the pump station observes excess flow and it's not able to maintain pressure in the system. At this point, the pump station shuts down to prevent damage.

Excess flow is often observed in an irrigation system during sprinkler transitions, when one set of sprinklers takes too long to turn off after their cycle is completed. If too many sprinklers are operating, often because of excessively slow valve closing speed, excess flow is observed at the pump station. If the pump station cannot keep up with the demand from the sprinklers, it may shut down on low pressure. To prevent this from happening, superintendents artificially limit their pump station capacity to prevent low pressure shutdown.

WWE is calculated in two steps by the following method:

Step One: Calculate the shortest possible watering time.

$$\text{Shortest possible watering time} = \frac{\text{Total desired flow (gallons)}}{\text{Operating pump station capacity (GPM)}}$$

Step Two: Calculate the WWE.

$$\text{Water Window Efficiency (\%)} = \frac{\text{Shortest possible watering time (in minutes above)}}{\text{Actual irrigation event water time (mins)}}$$

The WWE shows how the system manages water to run a night's irrigation cycle compared to ideal results. The WWE can be calculated for the "design" pump station capacity and also for the "operating" pump station capacity. This will give the user a sense of how much they could improve their WWE by operating at closer to design pump capacity.

The Ideal Situation

The best result that golf course professionals can expect is that the irrigation system will operate at peak capacity for the entire cycle. As shown in the graph, the pump station starts at 10 p.m., operates at its desired capacity (1,200 gpm in the chart for the user) for the entire cycle and then shuts off at the end of

the cycle. Ideally the WWE should be above 90 percent based on user experience. In this chart, the WWE is 96 percent.

This level of performance can be achieved through daily programming that enables the pump station to operate at capacity throughout the irrigation cycle. This is easier to achieve with some control systems than other systems and also is influenced by the user training level and experience.

CASE STUDY RESULTS

In this case study, the nightly irrigation cycle required 147,097 gallons and took 3.5 hours (210 minutes) to complete with a 1,100 GPM operating capacity from the pump station.

The WWE based on *operating* pump station capacity is calculated as:

Step One: Shortest Possible Time =

147,097 gallons

1,100 GPM

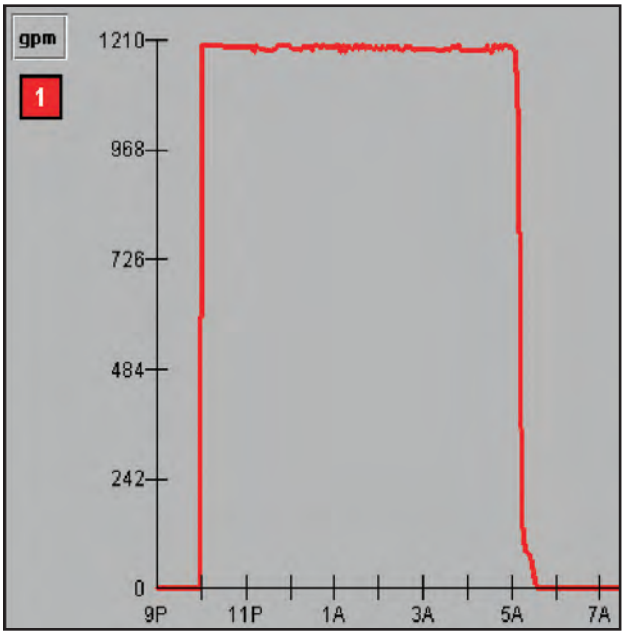
Step Two: WWE (operating) =

133 minutes (shortest time)

210 minutes (actual time)

In the next graph is the actual flow graph from the course evaluated in the case study. This is a consultant designed and programmed irrigation system.

The user found that, when making daily changes to the sprinkler run times, it was difficult to achieve operation at peak capacity.



This is because programs had to be re-written and it was difficult to flow manage the system to achieve maximum pump capacity.

Typically an irrigation consultant can achieve high WWE in their initial programming, but for some control systems, when the user makes daily changes, it is difficult, if not impossible to replicate the high efficiency on a long-term basis.

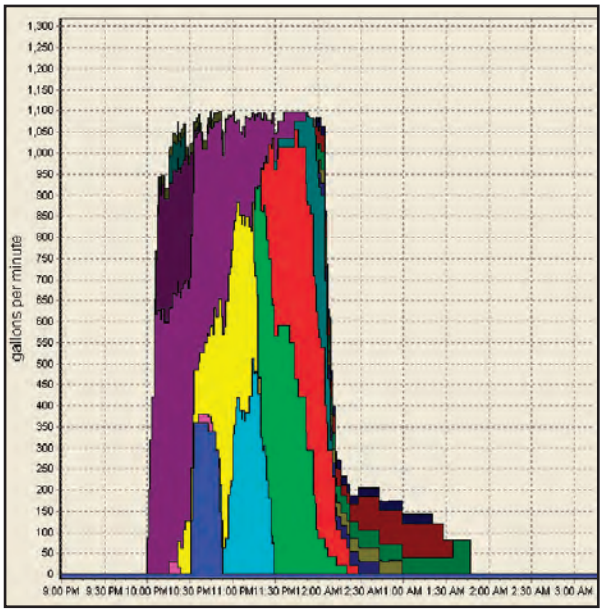
In this example, if the WWE is re-calculated using the "design' pump station capacity of 1,300 GPM, the WWE is reduced to 54 percent.

Achieving "Design" Pump Station Capacity: Establishing communication between the irrigation system computer and the pump station control panel is another way to improve WWE.

This enables specialized computer software to actively manage irrigation flow based on the actual pump station flow. As a result, the computer turns stations on and off based on the actual flow demand that is experienced by the pump station not the theoretical values in the software.

It can manage and respond to sprinklers turning off slowly and can also identify mainline pipe breaks and shut down the pump station before serious damage occurs.

Water window efficiency is a new term used by industry professionals to measure how efficiently the system is being operated



during a nightly irrigation cycle. Increasing the WWE provides many benefits to the golf course, including reduced watering time and being able to run the pump station at design capacity. It's reasonable to expect that a golf course with a modern irrigation system should be able to achieve a WWE of 90 percent or greater.

Please contact your local irrigation professional for additional information or to help measure your system water window efficiency. **BR**

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