

Create an Optimum Irrigation Schedule

By Don Clark

Every contractor knows that the primary purpose of an automated landscape irrigation system is to augment rainfall in order to re-supply the soil with enough available water to keep turf and plants looking their best. However, how do you establish the best possible irrigation schedule for each customer's property? With varying soil types, sun exposure and terrain, it's definitely a challenge to determine precise watering schedules that avoid wasting water while still keeping landscapes healthy.



The best way to develop an optimum irrigation schedule is to first gain a firm understanding of the four scheduling variables listed below. Although few contractors have the time to calculate all of these variables for each irrigation site, it's a good idea to understand them and consider how they affect watering schedules.

1) Reference Evapotranspiration Rate (ET_o). This rate is used as a baseline to which a landscape coefficient / factor is applied to determine the number of inches of water lost over a period of time (usually on a daily or weekly basis). The amount of water lost to the atmosphere is due to the combination of evaporation from the soil surface and transpiration (sweat) from the plant foliage -- otherwise known as evapotranspiration (ET).

A site's ET rate is influenced by a combination of solar radiation, temperature, wind speed and relative humidity. Higher solar radiation, temperature and wind speed values cause water to evaporate faster, resulting in a higher ET rate. On the other hand, higher relative humidity values will result in a lower ET rate. Actual daily Reference Evapotranspiration Rates can often be found online at local water utility, university or municipal airport Web sites.

2) Effective Rainfall. Obviously, not all rain can be used by plants and turf. If rain is falling too quickly for the soil to absorb it, it simply runs off the soil and down the street into the gutter. Or, if rain happens to fall immediately after irrigation has already taken place, soil and root zone reservoirs may already be full. It's safe to assume that only 30 to 50 percent of annual rainfall is actually effective. On sites without a Smart controller, it is highly recommended that a rain shut-off sensor be installed that will suspend irrigation during a rainfall event. Based on the user-adjusted settings on the shut-off device, the controller will suspend irrigation for a prescribed period of time for approximately one to two days after a rain event. The duration of the suspension (rain delay) depends on the amount of rain that occurred along with any sensor or controller settings that have a programmable "rain delay" feature.

3) Landscape Coefficient. In almost all cases, the plants in each irrigation zone will have an actual ET rate that is lower than the sites Reference Evapotranspiration Rate. To find the actual ET rate for the zone, you have to first take three zone-specific factors into consideration -- the plant species within the zone, the denseness of the plantings and the amount of sun or shade the zone experiences. These factors are used to create a Landscape Coefficient, which is then multiplied by the Reference Evapotranspiration Rate to determine how much water a specific zones landscape actually needs.

4) Zone Net Application Rate. A zone's Net Application Rate is used to determine the actual amount of irrigation water that is being applied to the zone by the sprinklers. It is used when calculating the actual irrigation schedule run time for each zone to replace the water that is lost from evapotranspiration. The Zone Net Application Rate is determined by multiplying the Zone Precipitation Rate times the Zone System Efficiency.

Zone Precipitation Rate -- Too often, precipitation rate information from an irrigation manufacturer's catalog does not closely match actual site conditions. In many cases, sprinkler spacing is tighter and/or water pressure at the sprinkler is significantly higher than that shown in the catalog. Reduced (tighter) sprinkler spacing or higher pressure at the nozzle will increase the actual precipitation rate significantly above what's mentioned in the catalog.

The most practical way to determine the actual precipitation rate of a zone is to determine the flow rate (gallons per minute) from the water meter and to measure the area (square feet). Then insert this information into the following industry standard precipitation rate formula:

$$\text{Precipitation Rate} = 96.3 \times \text{Flow (GPM)} / \text{Area (Square Feet)}$$

Zone 1 Example: Flow = 15.2 GPM; Area = 650 Sq. Ft. Square Feet

Precipitation Rate = $96.3 \times 15.2 / 650 = 2.25$ inches per hour. The catalog precipitation rate for a 15H Spray Nozzle is 1.58 inches per hour, which is approximately 40% lower than the actual site precipitation rate. If the catalog precipitation rate was used, it would result in over-irrigating the zone by 40 percent.

Zone System Efficiency -- No irrigation zone is completely efficient. The water being applied over each zone varies based on the nozzle design, sprinkler spacing and pressure at the nozzle. Partially clogged nozzles, sprinklers that are not plumb or plants that block or disrupt spray patterns can also have an adverse effect on efficiency. The system efficiency for a sprinkler system can range from 50 to 85 percent, dependent on the nozzle distribution uniformity and the factors mentioned above.

The Monthly Watering Index method of irrigation scheduling

To maintain healthy plant material and conserve water, the new water requirement resulting from the changing weather conditions would need to be calculated on a weekly or monthly basis and the zones run times adjusted accordingly. This can be a very time-consuming process, and let's face it -- not all of us are mathematicians or statisticians. Fortunately, we have the option of using the "Monthly Watering Index" method of scheduling irrigation -- a much easier and less time-consuming way to manage watering schedules.

This method is a practical approach to quickly and easily apply a "Water Index" to the "Water Budget" feature of the controller. Once a month, the user simply moves the dial to the Water Budget position and adjusts the value to the current month's pre-determined water index and each zone's run time is automatically adjusted based on historical weather patterns.

Rain Bird has made it easy for you to develop a recommended irrigation schedule for the hottest month of the year as well as provide Monthly Water Index values for any site located in the United States. Simply visit www.rainbird.com/homeowner/index.htm# and enter the site's ZIP code. After entering the ZIP code for the site, simply select the menu option for the sprinkler type, plant type, plant density, sun factor, soil type and slope for each zone. The scheduling tool will produce both 1) a Recommended Irrigation Schedule for the hottest month and 2) a Monthly Water Index Table.

On most time-based controllers, the dial is moved to the “Water Budget” position at the beginning of the month, and the water index value for the current month is entered. The run times that were originally programmed in the controller for the hottest month will be adjusted downward based on the water index value. More advanced controllers allow the user to pre-enter each monthly water index value for the entire year and on the first day of each month, each zone’s run time is adjusted automatically based on the previously entered water index values.

For example, the Water Index from the table below is 64 percent for March, so zone 1 -- which was programmed to run 12 minutes per cycle, 2 cycles per day for a total of 24 during the hottest month (100 percent Water Index) -- will be adjusted to run 15.4 minutes per cycle, 2 cycles per day for a total of 30.8 minutes during the month of March.

Monthly Seasonal Adjust Setting

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
36%	46%	64%	83%	86%	95%	100%	94%	74%	52%	38%	32%

Benefits of a Smart controller compared to a time-based controller

To save time and simplify the process, “smart” controllers make these zone-by-zone schedule adjustments on a regular basis (usually daily) based on changes in the season and the associated weather conditions. More sophisticated smart controllers such as the Rain Bird ESP-SMT and ESP-LXM plus ET Cartridge make irrigation schedule adjustments regarding the irrigation frequency and amount based on daily weather information. These schedule adjustments maintain optimum soil moisture balance in the plants root zone and prevent wasteful, damaging runoff.