WaterSense® Specification for Weather-Based Irrigation Controllers Supporting Statement

I. Introduction

Outdoor water use in the United States accounts for more than 7 billion gallons[1] of water each day, mainly for landscape irrigation. As much as half of this water is wasted due to evaporation, wind, or runoff often caused by improper irrigation system design, installation, maintenance or scheduling. In addition to working with irrigation professionals to increase water efficiency outdoors, the U.S. Environmental Protection Agency's (EPA's) WaterSense program is addressing irrigation scheduling by labeling efficient irrigation system control technologies. The *WaterSense Specification for Weather-Based Irrigation Controllers* (specification) is a significant step toward increasing water efficiency in landscape applications.

The release of this final specification is the result of more than four years of collaboration between EPA and controller manufacturers, water utilities, irrigation industry representatives, and other stakeholders. Since the release of a Notice of Intent in 2007, EPA has held various working groups, conducted independent research, and worked with numerous experts to determine the appropriate performance characteristics and testing protocols to ensure labeled products are capable of providing efficient irrigation. In November 2009, EPA released its initial draft specification for public comment. In January 2011, the program released a revised draft specification for additional stakeholder input. This final specification represents a culmination of research, collaboration, and compromise that balances the needs and interests of WaterSense and its stakeholders.

WaterSense developed this specification to promote and enhance the market for efficient irrigation controllers that create or modify irrigation schedules based on landscape attributes and real-time weather data, applying water only when the landscape needs it. The intent of this specification is to assist irrigation contractors and consumers in identifying and differentiating products that have been certified to meet EPA's criteria for water efficiency and performance.

II. Current Status of Weather-Based Irrigation Controllers

An estimated 13.5 million irrigation systems are currently installed in residential lawns across the United States[2], and an estimated one-third of new homes each year include an irrigation system[3]. Of the 13.5 million installed units, industry estimates that less than 10 percent use weather-based controllers to schedule irrigation.

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[1] Kenney, Joan F., et al. Estimated Use of Water in the United States in 2005. U.S. Geological Survey Circular 1344. Department of the Interior. Table 6, page 20.

[2] Results from the 2005 Residential Energy Consumption Survey Household Questionnaire. U.S. Department of Energy, Energy Information Office. 2008. http://www.eia.doe.gov/emeu/recs/recs2005/hc2005_tables/2005recshouseholdquex.pdf

[3] Units sold for new construction figure is based on 906,000 housing starts in 2008 as reported in the U.S. Census Bureau, *Housing Starts*, Construction Reports, Series C-20. Thirty-four percent of homes constructed between 2000 and 2005 had in-ground irrigation (based on the results from the 2005

The most common method used to schedule irrigation is a manually programmed clock timer that irrigates a specified amount on a preset schedule programmed by the user. In these systems, the responsibility of changing the irrigation schedule to meet landscape water needs lies with the end user or a hired irrigation professional. Clock timer controllers can be a significant source of wasted water because irrigation schedules are often set to water at the height of the growing season, and the homeowner may not adjust the schedule to reflect seasonal changes or changes in plant watering needs. For example, plant water requirements decrease in the fall, but many homeowners forget to reset their irrigation schedules to reflect this change (see Figure 1). Therefore, a homeowner may be watering in October as if it were July. As an alternative to a clock timer controller, weather-based irrigation controllers can make irrigation schedule adjustments automatically by tailoring the amount, frequency, and timing of irrigation events based on current weather data and landscape conditions.

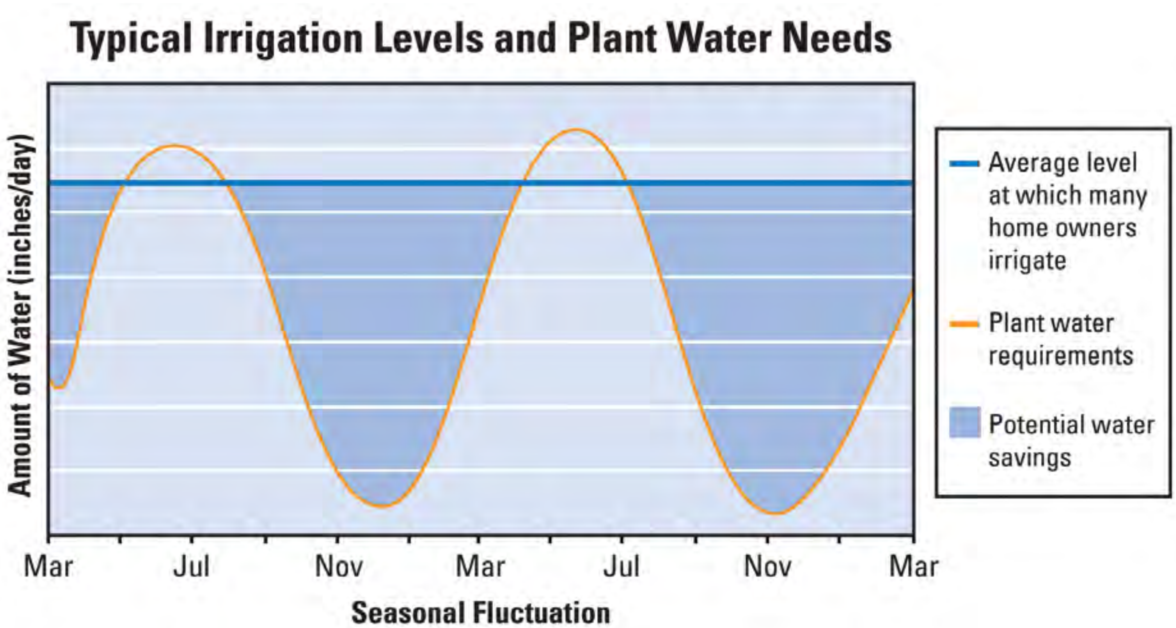

Figure 1. Potential Water Savings from Installing Weather-Based Irrigation Controllers

A voluntary effort called Smart Water Application Technologies™ (SWAT) was initiated in 2002 to test product performance and promote these technologies. Currently, no other performance standard or testing protocol exists for weather-based irrigation controllers. This national partnership, consisting of water purveyors, equipment manufacturers, and irrigation practitioners, recognized the need for irrigation technologies that create or adjust irrigation schedules based on plant needs. To identify high-performing products, SWAT developed the first test protocol for climatologically based controllers in 2003, and in 2008 published the eighth draft of the test protocol[4]. The protocol development process included multiple rounds of public

Residential Energy Consumption Survey Household Questionnaire, U.S. Department of Energy, Energy Information Office, 2008).
[4] http://www.irrigation.org/SWAT/Draft_Protocols/Climate-Based.aspx

comment, described on the SWAT website. As discussed below, the performance test identified in this final WaterSense specification is based on the SWAT protocol with modifications determined to be necessary by WaterSense and its stakeholders.

III. WaterSense Specification for Weather-Based Irrigation Controllers

Scope

This specification addresses weather-based irrigation controllers, including stand-alone controllers, add-on devices, and plug-in devices (collectively referred to in the specification as controllers) that use current weather data as a basis for scheduling irrigation.

For the purposes of this specification, a stand-alone controller is defined as a product in which weather-based control is an integrated capability. This includes a single controlling device (i.e., the irrigation controller) and all of the sensors and/or weather services that provide the weather data.

An add-on device is a product that modifies an existing system equipped with a standard clock timer controller to use current weather data as a basis for controlling the irrigation schedule. For the purposes of this specification, add-on devices are defined as those that are designed to work with any brand of base controller and may connect through a variety of ways.

A plug-in device is a product that also modifies an existing system equipped with a standard clock timer controller to use current weather data as a basis for controlling the irrigation schedule. For the purposes of this specification, plug-in devices are defined as those that are designed to work specifically with one brand of controller and may connect with the base controller through a variety of ways. Add-on and plug-in devices are included in this specification because they comprise a substantial portion of the weather-based irrigation controller market. In addition, these devices have been through SWAT testing and performed as well as the stand-alone controllers.

This specification applies to controllers that create or modify irrigation schedules based on evapotranspiration (ET) principles by:

- Storing historical crop evapotranspiration (ETc) data characteristics of the site and modifying these data with an onsite sensor;
- Using onsite weather sensors as a basis for calculating real time ETc;
- Using a central weather station as a basis for ETc calculations and transmitting the data to individual users from remote sites; or
- Using onsite weather sensors directly.

For the purpose of this specification, the onsite weather sensor requirement includes weather sensors such as temperature or solar radiation. Because rainfall devices do not modify ETc but interrupt or modify irrigation events based on rainfall, they do not meet this onsite weather sensor requirement when used as the sole method for modifying irrigation schedules.

Soil moisture sensors are not included in this specification because there is not currently an accepted test protocol for such products. SWAT has developed a test protocol for soil moisture sensors and EPA will consider developing a specification for this product category once the protocol has been fully reviewed and accepted.

This specification applies to controllers for use in residential or commercial landscape irrigation applications. Large commercial products such as central controllers are included in this specification because EPA determined these products could be adequately tested by the specification's performance test protocol. Including these products broadens the scope of the specification to more applications and increases the water savings potential from weather-based irrigation controllers used in commercial and institutional settings.

Water Efficiency and Performance Criteria

For weather-based irrigation controllers, the concepts of water efficiency and performance are interrelated and defined by the irrigation controllers' ability to deliver adequate water to meet landscape needs, without overwatering.

Test Protocol

The specification is based on SWAT's Climatologically Based Controller test protocol (protocol), which measures how well weather-based controllers can create or modify an irrigation schedule that delivers enough water to keep the landscape healthy while eliminating overwatering and minimizing runoff, two critical components for ensuring the efficiency and performance of these products. The SWAT protocol is based on input from a wide variety of stakeholders and aligns with the WaterSense requirement that performance-based testing differentiate products that can achieve water savings and performance from those that do not.

During the public comment period for the notice of intent (NOI) and first draft of the specification, stakeholders raised questions regarding the SWAT protocol's rigor and reproducibility of test results in dry versus rainy climates. As a result of the comments and concerns raised, WaterSense conducted research at the University of Florida from 2008 to 2010 to answer these outstanding questions. Detailed research reports are available on the WaterSense website at http://www.epa.gov/watersense/partners/controller_background.html. Based on the results of the research, WaterSense is using the SWAT protocol as the basis for the performance testing in this specification, but has included several modifications to address the issues identified.

Modifications to the SWAT protocol, as identified under Section 3.1 of the specification, include:

3.1.1 Minimum Runtimes: WaterSense included a minimum runtime requirement for product testing in this specification. All runtimes (irrigation cycles) that occur during the test period must be greater than 3 minutes in duration. The University of Florida research indicated that during testing, some controllers scheduled irrigation events with unrealistically short runtimes—in some cases, less than 2 minutes. Runtimes of this length may not fill the irrigation system and in the field would not deliver the intended water to the landscape. The current SWAT protocol does not have a minimum runtime, allowing these unrealistically short runtimes to occur during testing. Establishing a minimum runtime will help ensure that weather-based irrigation controllers schedule irrigation during testing that will mimic realistic schedules found in the field.

3.1.2 Missing Data: This specification provides direction to licensed certifying bodies on how to handle missing weather data. During the performance test training conducted in 2010 at the University of Florida for licensed certifying bodies interested in certifying these products, attendees questioned how to handle missing weather data (i.e., rainfall or ET) from the reference weather station and what level of missing data would be acceptable, items which are not currently addressed in the SWAT protocol. To eliminate confusion and strengthen the specification requirements, WaterSense determined that it needed to specify what action should be taken if the reference weather station did not record a day or more of data. To help WaterSense define this requirement, the University of Florida, as part of its research, evaluated whether performance scores were significantly impacted by various days of missing data. The research concluded that two consecutive days or three days in total of missing data during a single 30-day test period should not significantly impact performance scores.

3.1.3 Rainfall Requirement: WaterSense is requiring that a 30-day test period include at least four individual days that receive at least 0.10 inches of rain. This does not increase the SWAT protocol rain requirement of at least 0.40 inches in total, but requires that the controller encounter at least 4 days with rainfall to achieve this total. From the beginning of the weather-based irrigation controller specification development process, stakeholders have questioned the transferability of performance scores from one climate region to another, specifically if controllers tested in a dry climate would perform well when installed in a rainy climate. The University of Florida research conducted from 2008 through 2010 aimed to examine these concerns. The results from testing the controllers during a rainy period indicated that performance scores are not transferable from dry to wet climates. As a result, EPA added this requirement to test a controller’s ability to handle rainfall.

3.1.4 Order of Operations: The final specification changed the order of operations implemented during the SWAT protocol daily water balance calculation to be ET first, then irrigation, then rainfall, rather than rainfall occurring first, as designated by the SWAT protocol. In the early stages of specification development, some stakeholders were concerned that the order of operations in the SWAT protocol moisture balance unfairly penalized controllers for not being able to predict rainfall. The University of Florida research examined this concern under periods of heavy rain and concluded that the order of operations did impact performance scores; therefore, WaterSense made this modification to the protocol.

Performance Levels

The SWAT protocol establishes the method by which controllers are tested and provides two output measures of performance: irrigation adequacy and irrigation excess. According to the protocol, irrigation adequacy is a measure of how well the plant’s or landscape’s consumptive water needs are met. Irrigation excess is a measure of water applied in excess of the plant’s or landscape’s consumptive needs.

The SWAT protocol does not establish specific targets for irrigation adequacy and irrigation excess that define an efficient, high-performing weather-based irrigation controller. Therefore, in the specification, WaterSense has set specific performance levels for these output measures. To meet this specification’s performance criteria, products must score greater than or equal to 80 percent irrigation adequacy for each zone. The 80 percent is based on well documented research that indicates that the appearance of warm and cool season turfgrass does not significantly differ when irrigated between 80 and 100 percent of their specific evapotranspiration rates.[5] Products must score less than or equal to 10 percent irrigation excess for each zone. In addition, the average of the irrigation excess scores calculated across the six zones shall be less than or equal to 5 percent. This level allows for a reasonable amount of variation in controller scheduling, but prevents excessive overwatering.

Supplemental Capability Requirements

During the NOI phase of specification development, water utility stakeholders indicated that weather-based controllers need to have additional features to maintain their performance and intended long-term water savings. A working group consisting of utility and manufacturer representatives met multiple times over a period of months to produce the list of supplemental capability requirements described in Section 4.0 of this specification. These requirements were refined over time based on comments submitted under the initial and revised draft specifications. The controller, as configured for testing in accordance with Appendix A of the specification, shall have the following supplemental capabilities in both smart mode and standard mode:

- The controller shall have non-volatile memory to ensure that information regarding the irrigation program and settings are retained when the power source is lost and no back-up battery is available.

- The controller shall have zone-by-zone control to successfully manage landscapes that have multiple areas with various watering requirements that need to be managed separately.

- The controller shall be able to notify the user if it is not operating in smart mode (e.g., if there is a problem with the signal or local sensor input that is prohibiting it from automatically adjusting irrigation).

- The controller shall be able to connect to a rainfall device. Rainfall devices are an important component of an efficient irrigation system in many climate regions. Multiple states have mandated the inclusion of these devices by law.

- The controller shall be able to accommodate watering restrictions. With the existence of utility-imposed watering restrictions, it is important that weather-based controllers are capable of watering efficiently, while complying with these restrictions.

- The controller shall include a percent adjust (water budget) feature. This feature allows end users to adjust water applied to the landscape without changing the detailed settings in the controller's program.

[5] Beard, 1993; Brauen, 1989; Danielson et al., 1981; Feldhake et al., 1984; Gibeault et. al, 1991; Gibeault et. al, 1985; Meyer and Gibeault, 1986; Minner, 1984; University of California, 2002; and Zazueta et. al, 2000.

- The controller shall be able to rely on a conservative watering schedule if the product loses real-time weather input or a weather signal. This can be either a proxy of historical weather data or a percent adjust (water budget) features.

- The controller shall be capable of automatically returning to smart mode if switched to manual mode. Often controllers are turned to manual mode for troubleshooting or other reasons and not returned to smart mode. This requirement ensures the controller will automatically return to smart mode within a specified time period as designated by the manufacturer.

Packaging and Product Documentation Requirements

To ensure that controllers, as sold, have the capability to provide water efficiency and performance, EPA is specifying packaging and product documentation requirements as part of the criteria for products to earn the WaterSense label. Specifically, the controller, as packaged, shall include the same components (excluding the base controller for add-on or plug-in devices) or attributes with which it was tested to meet the specification requirements. For controllers with weather stations, sensors, or rainfall devices this includes all components tested with the controller. For example, if a controller is tested with a rainfall device, it must be packaged with the rainfall device. For signal-based controllers, this includes instructions on acquiring the proper weather signal.

Although add-on or plug-in devices are not required to be packaged with the base controller(s) with which they were tested to meet the requirements of this specification, the product documentation for the device must provide this list of base controllers. For these products, the documentation must also contain a statement to the effect that the device is only WaterSense labeled when used in combination with a base controller on the provided list. This will allow the consumer to identify both pieces of technology that can be used together to provide water efficiency and performance.

In addition, the specification requires that the product packaging include an instruction manual that lists the settings and specific parts used during the performance test. The licensed certifying body will program the controllers for the performance test according to the settings and instructions included in this manual. WaterSense included this requirement to because the licensed certifying body can only use the material included in the product packaging to program the controller. The specification also requires that the instruction manual include the maximum number of stations the product can operate. This serves as the mechanism for WaterSense to include this information on its website.

The specification also requires that the product not be packaged or marked to encourage operation of the controller in standard mode. Any instruction related to the maintenance of the product must direct the user on how to return the controller to smart mode. The intent of this requirement is to encourage the use of the controller in smart mode and is consistent with requirements for other WaterSense product specifications.

Potential Water Savings

Note: Refer to Appendix A for the assumptions and calculations used to derive these estimates.

Weather-based irrigation controllers have the potential to save significant amounts of water both individually and at the national level. Assuming that a household lawn with a weather-based irrigation controller installed uses 15 percent less water than one with a standard clock timer controller, a household could save 8,700 gallons per year based on an average seasonal outdoor water use of 58,000 gallons per year.

EPA received data from the 2005 Residential Energy Consumption Survey conducted by the Energy Information Administration (EIA) that 13.5 million single-family detached homes have automatic irrigation systems, or about 19 percent of all single-family detached homes. Assuming that 95 percent of these are candidates for installing a weather-based irrigation controller, 12.8 million households could be candidates for a weather-based irrigation controller. If all 12.8 million households installed weather-based irrigation controllers, the measure could save households a combined total of more than 110 billion gallons of water and $410 million per year.

Energy savings realized by water utilities will accompany any national water savings. If all candidate households install weather-based irrigation controllers, it could reduce energy consumption of water utilities by 112 million kilowatt-hours (kWh) of electricity.

Cost Effectiveness

Note: Refer to Appendix A for the assumptions and calculations used to derive these estimates.

A homeowner installing a WaterSense labeled weather-based controller in place of a standard clock timer controller and achieving 8,700 gallons of water savings would realize an accompanying annual water cost savings of $32 due to reduced irrigation water use.

EPA estimates the average cost of a weather-based irrigation controller is approximately $240, based on available market and cost data. Using this estimate, the average payback period for installing a weather-based irrigation controller would be approximately 7 years. The payback period would decrease on residential properties that use more water than the estimated 58,000 gallons per year and/or install a lower cost option that still effectively saves water. For example, a residence that applies 100,000 gallons of irrigation water per year and purchases a WaterSense labeled weather-based controller that costs less than $150 could realize a payback period of less than 3 years.

IV. Certification and Labeling

WaterSense has established an independent third-party product certification process, described on the WaterSense website at www.epa.gov/watersense/specs/certification.htm. Under this process, products are certified to conform to applicable WaterSense specifications by accredited third-party licensed certifying bodies. Manufacturers are then authorized to use the WaterSense label in conjunction with certified products.

It is important to recognize that the WaterSense Product Certification System is independent of ongoing SWAT testing conducted at the Center for Irrigation Technology (CIT) in Fresno, California. Products may still undergo SWAT testing, but in order to earn the WaterSense label, they must be tested and certified by a WaterSense licensed certifying body in accordance with the specification. Licensed certifying bodies will not publish test results or disclose them to WaterSense. Previous SWAT test scores or data will not factor into the WaterSense product certification process.

Manufacturers are currently permitted to set up their products for SWAT testing at CIT; however, under the WaterSense Product Certification System, the licensed certifying body will be responsible for product set-up based on instructions included in product documentation (e.g., user manual) as provided by the manufacturer.

To facilitate the certification and labeling process for controllers, EPA has developed *Supplemental Guidance for WaterSense® Certification and Labeling of Weather-Based Irrigation Controllers* available on the WaterSense website, [http://www.epa.gov/watersense/partners/controller_final.html]. This guidance walks manufacturers through the certification process, providing specific information and instructions on how to apply for certification with a licensed certifying body, what is involved in the initial testing and evaluation, what to expect during ongoing surveillance, and how to get products listed on the WaterSense labeled product registry.

V. Other Issues

While weather-based irrigation controllers have been shown to save significant amounts of water—upwards of 50 percent in certain applications—there are numerous outside factors that must be considered and addressed in order to achieve the intended savings. First, it is important to acknowledge that the weather-based irrigation controller is part of the irrigation system and can only perform as intended if the system is properly designed, installed, and maintained. Second, the weather-based irrigation controller must be installed and programmed properly. Third, since weather-based irrigation controller requires a weather input, it must maintain contact with its weather data source to properly schedule irrigation.

WaterSense plans to address these issues with a two-pronged marketing and outreach approach with our stakeholders, as well as our national network of irrigation partners. Marketing and outreach strategies will be used to help consumers and utilities make informed purchasing decisions and necessary irrigation system improvements before installing these technologies. EPA also recommends that purchasers of these products utilize the services of irrigation professionals who have been certified through a WaterSense labeled program that focuses on water efficiency and innovative technologies.

Additionally, it is important to acknowledge that weather-based controllers are designed to deliver a targeted amount of water required by the landscape (usually 100 percent of ETo (reference evapotranspiration)). In some areas of the country where water conservation is promoted, consumers are practicing deficit irrigation, which is watering at less than 100 percent of ETo. If a weather-based controller is installed as part of a landscape irrigation system where the user was previously deficit watering, and the newly installed weather-based controller is programmed to water at 100 percent of ETo, the water use in that landscape may increase as a result of installing the controller.

This phenomenon was demonstrated in the recent evaluation of a weather-based irrigation controller program in California (Aquacraft 2009), where many of the homes increased water use after installation. The report suggested that this increase in water use was due to previous good watering habits that were altered when the new weather-based controller was installed and not properly programmed. Irrigation professionals or a savvy end user with experience in these technologies will be able to address this issue in the field through features such as the percent adjust supplemental capability that is required by this specification. While it is true that these technologies can save water if programmed correctly, the report also provides an important lesson to utilities, suggesting that rebate or giveaway programs should first target high water users to achieve the greatest savings.

VI. References

AquaConserve, 2002. Residential Landscape Irrigation Study Using Aqua ET Controllers. Prepared for Denver Water, Denver, Colorado; city of Sonoma, California; and Valley of the Moon Water District, California.

Aquacraft, Inc., Water Engineering and Management. 2003. Report on Performance of ET Based Irrigation Controller. Prepared for the Cities of Boulder, Greeley, and Longmont, Colorado. Analysis of Operation of WeatherTRAK™ Controller in Field Conditions during 2002.

Aquacraft, Inc., Water Engineering and Management, Caldwell, E., Miller, T., and Bickel. J. 2009. Evaluation of California Weather-Based “Smart” Irrigation Controller Programs. Facilitated by California Urban Water Conservaton Council. Located at http://www.cuwcc.org/uploadedFiles/Resource_Center/Products/WBIC/Smart-Controller-Programs-Final-Report-07-01-09.pdf.

Beard, J.B. 1993. The Xeriscaping Concept: What About Turfgrasses. International Turfgrass Society Research Journal 7. R.N. Carrow, N.E. Christians, R.C. Shearman (Eds.) Intertec Publishing Corp., Overland Park, Kansas. P. 87-98.

Brauen, S. 1989. Turfgrass Water Consumption in the Northwest. How Do We Compare to Other Regions? 43rd Northwest Turfgrass Conference, Sheraton-Tacoma Hotel, Tacoma, Washington, September 18-21, 1989.

Carlos, W.J., W.W. Miller, D. A. Devitt, and G.J. Fernandez. 2001. Globalization and Water Resources Management: The Changing Value of Water. Water Conservation Using Satellite Technology for Irrigation Scheduling. August 6-8 AWRA/IWLRI- University of Dundee International Specialty Conference.

Danielson, R.E., C.M. Feldhake, and W.E. Hart. 1981. Urban Lawn Irrigation and Management Practices for Water Saving with Minimum Effect on Lawn Quality. Completion Report to OWRT Project No. H-043-Colorado. 120p.

Devitt, D.A, K. Carstensen, and R.L. Morris. 2008. Journal of Irrigation and Drainage Engineering. Residential Water Savings Associated with Satellite-Based ET Irrigation Controllers. Jan-Feb: 74-82.

Feldhake, C.M., R.E. Danielson, and J.D. Butler. 1984. Turfgrass Evapotranspiration. II. Responses to Deficit Irrigation. Agronomy Journal. 76, Jan-Feb: 85-89.

Gibeault, V.A., J. Meyer, M.A. Harivandi, M. Henry, and S. Cockerham. Managing Turfgrass During Drought. Cooperative Extension University of California Division of Agriculture and Natural Resources Leaflet 21499.

Gibeault, V.A., J.L Meyer, V.B. Younger, and S.T. Cockerham. 1985. Irrigation of Turfgrass Below Replacement of Evapotranspiration as a Means of Water Conservation: Performance of Commonly Used Turfgrasses. P. 340-356. In F. Lemaire (Ed) Proc. 5th Int. Turfgrass Res. Conf., Avignon, France. 1-5 July, 1985. INRA Publ., Versailles, France.

Irving Ranch Water District (IRWD). 2001. Residential Weather-Based Irrigation Scheduling: Evidence from the Irvine "ET Controller" Study.

Los Angeles Department of Water and Power (LADWP). 2004. LADWP Weather-Based Irrigation Controller Pilot Study. A Report Submitted to the Los Angeles Department of Water and Power.

Metropolitan Water District of Southern California. 2004. Weather-Based Controller Bench Test Report.

Meyer, J.L. and V.A. Gibeault. 1986. Turfgrass Performance Under Reduced Irrigation. Calif. Agric. 40(7,8):19-20.

Minner, D.D. 1984. Cool Season Turfgrass Quality as Related to Evapotranspiration and Drought. PhD. Diss., Colorado State University, Fort Collins, Colorado.

Santa Barbara County Water District. 2003. Santa Barbara County ET Controller Distribution and Installation Program. Final Report.

Saving Water Partnership. 2003. Water Efficient Irrigation Study Final Report.

University of Arizona Cooperative Extension. 2006. Basics of Evaporation and Evapotranspiration. Turf Irrigation Management Series Number 1:1-4.

University of California, Riverside Turfgrass Research Program Newsletter, January 2002. Buffalograss and Zoysiagrass: Hot Picks for Functional, Low Input Sites.

Zazueta, F.S., G.L. Miller, and W. Zhang. 2000. Reduced Irrigation of St. Augustinegrass Turfgrass in the Tampa Bay Area. University of Florida Extension Institute of Food and Agricultural Sciences AE-264.

Appendix A: Calculations and Key Assumptions

Potential Water Savings

Assumptions:

- A study of 14 cities and more than 1,200 homes stated that average outdoor usage is approximately 58,000 gallons of water annually.[6]
- 13,500,000 detached single family homes have automatic irrigation systems.[7]-
- 95 percent of irrigation systems are candidates for replacement.[8]
- WaterSense has gathered a number of studies conducted by a variety of entities that cover numerous controller brands.[9] Results from these studies indicate a range of overall savings from 6 to 30 percent. Individual site savings can vary beyond these overall numbers, depending on the watering habits prior to installing the weather-based irrigation controller. In some cases, site water use can increase if the owner was practicing deficit irrigation before installing a weather-based irrigation controller.

  In a recent comprehensive study, Evaluation of California Weather-Based "Smart" Irrigation Controller Programs,[10] first year savings were shown to be approximately 6 percent. For a limited subset of controllers in this study that were tracked for 3 years, overall savings were shown to be 16 percent in year 3 after installation.

  In full consideration of the findings of these numerous studies, WaterSense anticipates seeing overall water savings of approximately 15 percent after installation of weather-based irrigation controllers.

Calculation 1. Annual Individual Water Savings from Installing a Weather-Based Irrigation Controller
(58,000 gallons per year) x (15 percent reduction) = 8,700 gallons per year

Calculation 2. Number of Candidates for Installation
(13,500,000 households with irrigation systems) x (95 percent) = 12,825,000 candidates for installation

Calculation 3. Annual National Water Savings
(12,825,000 households) x (8,700 gallons per year) = 111.6 billion gallons per year

Calculation 4. Annual National Cost Savings
(111.6 billion gallons per year) x ($3.68 per Kgal) =$410.6 million per year

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[6] Mayer, Peter W. and William B. DeOreo. Residential End Uses of Water. Aquacraft, Inc. Water Engineering and Management. American Water Works Association. 1998. Table 5.14
[7] Residential Energy Consumption Survey, 2005.
[8] Program assumption based on market research.
[9] AquaConserve, 2002; Aquacraft, Inc., 2003; Aquacraft Inc., 2009; Carlos et al., 2001; Devitt, 2008; IRWD, 2001; LADWP, 2004; MWDOC, 2004; Santa Barbara County Water District, 2003; Saving Water Partnership, 2003; University of Arizona, 2006
[10] Aquacraft, Inc., 2009

Potential Energy Savings

Assumptions:

- 1,500 kWh required to deliver 1,000,000 gallons to residences from public supply.[11]

Calculation 5. Energy Savings Realized by Water Utilities
(111.6 billion gallons per year) x (1,500 kWh of electricity/ 1,000,000 gallons of water) = 167.4 million kWh of electricity

Cost Effectiveness Calculations

Assumptions:

- $3.68 per kilo-gallon of water (marginal cost)[12]
- 15-year product lifetime for weather-based irrigation controllers.[13]

Calculation 6. Estimated Annual Water Cost Savings From Installing a Weather-Based Irrigation Controller

(8,700 gallons per year) x ($3.68 per Kgal) = $32.02 per year

Calculation 7. Estimated Payback Period for Average Cost of a Weather-Based Irrigation Controller

($236) ÷ ($32.02 per year) = 7.4 years

Calculation 8. Estimated Payback Period for Low-Cost Option Weather-Based Irrigation Controller and Higher Water Use

(100,000 gallons per year x 15 percent savings estimate) x ($3.68 per Kgal) = $55.20

($150) ÷ (55.20 per year) = 2.7 years

Unit Abbreviations:
gal = gallon
kgal = kilo-gallons
kWh = kilowatt-hour

[11] Goldstein, R. & W. Smith. 2002. Water & Sustainability Volume 4: U.S. Electricity Consumption for Water Treatment & Supply—the Next Half Century. Electric Power Research Institute, March 2002. Table 1-2
[12] Raftelis Financial Consulting. Water and Wastewater Rate Survey. American Water Works Association. 2010.
[13] Program assumption based on market research.