2010 Smart Controller Evaluation Methodology

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Methodology Introduction

Controller performance will be evaluated against multiple points of comparison. The basic models will be comparing the "Total Applied Irrigation" of each controller station to the total ETo of the study period, a simple ETc Model and the irrigation recommendation produced by the TexasET Network. These models and their calculation criteria are described below. Other models may be developed as the study progresses such as a comparison to a conventional "time-based" irrigation controller or a simple soil moisture balance.

Controller Irrigated Volume (Total Applied Irrigation)

Each controller is connected to a datalogger through a set of relays (simulated valves). Controller stations' start and stop times are recorded in the datalogger. This data is imported into a database and an irrigation event runtime is calculated. Runtimes for each station will be totaled during and at the end of the evaluation and multiplied by the programmed precipitation rate of the station as defined in Table 1. This value will be known as the "Total Applied Irrigation" by each station for the evaluation program.

ETo, ETc and Recommended Irrigation

ETo will be computed from weather parameters measured at the Texas A&M University Golf Course in College Station, TX. The weather parameters are measured with a standard agricultural weather station which records temperature, solar radiation, wind and relative humidity, as well as rainfall. ETo was computed using the standardized Penman-Monteith method. This data and ETo calculation can be viewed from the Texas ET Network Website (http://TexasET.tamu.edu).

ETc Model

To determine the plant water requirements of a particular station, a simple ETc Model will be used. This model is defined in Equation 1:

$$ETc = (ETo \times Kc \times Af) - Re \qquad \text{(Equation 1)}$$

where: ETc = irrigation requirement

ETo = reference evapotranspiration

Kc = crop coefficient

Af = adjustment factor

Re = effective rainfall

Table 1 shows the corresponding crop coefficients and adjustment factors used within Equation 1. The crop coefficient is a single value that will be utilized during the effective growing season and evaluation period. The adjustment factor is used to adjust the Kc value to reflect desired plant quality and microclimate conditions.

Table 1. The virtual landscapes as defined by Representative Texas Landscapes

	Station 1	**Station 2**	**Station 3**	**Station 4**	**Station 5**	**Station 6**
Plant Type	Flowers	Turf	Turf	Groundcover	Small Shrubs	Large Shrubs
Plant Coefficient (Kc)	.8	.6	.6	.5	.5	.3
Root Zone Depth (in)	3	4	4	6	12	20
Soil Type	Sand	Loam	Clay	Sand	Loam	Clay
MAD (%)	50	50	50	50	50	50
Adjustment Factor (Af)	1	.8	.6	.5	.7	.5
Precipitation Rate (in/hr)	.2	.85	1.4	.5	.35	1.25
Slope (%)	0-1	0-1	0-1	0-1	0-1	0-1

The following Soil Water Holding Capacities in will be used when evaluating the controller using the Texas Common Landscape

Table 2. Water Holding Capacity of Soils given in Inches of Water per Foot of Soil (in/ft)		
Soil Texture	**Available Moisture**	**Available Moisture at MAD (50%)***
Sands	0.9	0.45
Loams	1.7	0.85
Clays	2.1	1.05

TexasET and the Plant Water Requirement Calculator

In this report, smart controllers irrigation results will be compared to the recommendations of the TexasET Network and Website generated using the Landscape Plant Water Requirement Calculator (http://TexasET.tamu.edu) based on a weekly water balance. This is the method that is used in the weekly irrigation recommendations generated by TexasET for users that sign-up for automatic emails. The calculation uses Equation 1.

Recommended Kc for warm season turf is 0.6 and cool season 0.8. Due to the lack of scientifically derived crop coefficients for most landscape plants, we suggest that users classify plants into one of three categories based on their need for or ability to survive with frequent watering, occasional watering and natural rainfall. Suggested crop coefficients for each are shown in Table 3.

Table 3. Landscape Plant Water Requirements Calculator Coefficients		
Plant Coefficients		**Plant Types**
Warm Season Turf	0.6	Bermuda, St Augustine, Buffalo, Zoysia, etc.
Cool Season Turf	0.8	Fescue, Rye, etc.
Frequent Watering	0.8	Annual Flowers
Occasional Watering	0.5	Perennial Flowers, Groundcover, Tender Woody Shrubs and Vines
Natural Rainfall	0.3	Tough Woody Shrubs and Vines and non-fruit Trees

In addition to using a Plant Coefficient, users have the option of applying an Adjustment Factor. This can be used to adjust the crop coefficient for various site specific factors such as microclimates, allowable stress, or desired plant quality. For most home sites, a Normal Adjustment Factor (0.6) is recommended in order to promote water conservation, while an adjustment factor of 1.0 is recommended for sports athletic turf. Table 4 gives the adjustment factor in terms of a plant quality factor. Effective rainfall was calculated using the relationships shown in Table 5.

Table 4. Adjustment Factors in terms of "Plant Quality Factors."	
Maximum	1.0
High	0.8
Normal	0.6
Low	0.5
Minimum	0.4

Table 5. TexasET Effective Rainfall Calculator	
Rainfall Increment	**% Effective**
0.0" to 0.1"	0%
0.1" to 1.0"	100%
1.0" to 2.0"	67%
Greater than 2"	0%

For the Smart Controller Evaluation Program, a weekly irrigation recommendation was produced using equation (1) following the methodology discussed above. A range of TexasET irrigation recommendations will be reported corresponding to an adjustment factor (Af) ranging from 0.6 to 1.0.