Irvine Ranch Water District's application of signal paging to ET controllers for medium size commercial landscapes

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Introduction

Over the last 5 years, the Irvine Ranch Water District has joined with the irrigation industry, wholesale water suppliers, environmental groups and other government agencies to develop proper water management through weather based controllers. The results of IRWD's weather based irrigation management studies point to an impressive effective on irrigation water management. While past District efforts have focused on market forces to modify irrigation practices, the ET controller studies switched focus to providing the tools for water management.

In the Residential Run-off Reduction (R3) study, the District replaced 112 residential irrigation controllers with a weather based controller that used a combination of local (at the controller) programming and weekly schedule adjustments based on the change in evapotranspiration (ET). A remote operator adjusted the schedule by sending a paging signal. The controller's design allowed the irrigation to adjust for rain, heat, cloud cover and high wind conditions without requiring a landscaper's physical presence at the controller.

While the focus of the R3 study was conservation and run-off reduction in a residential setting, which included parks, streetscapes and condo associations. These landscapes are typically viewed as commercial sites or medium sized landscapes (MSL). A MSL for this article is 0.14 acres to 2 acres of actual landscape. The study team has concluded that MSL provides for the most effective water conservation and the team believes that most of the run-off reduction can be attributed to controllers in the 17 meters

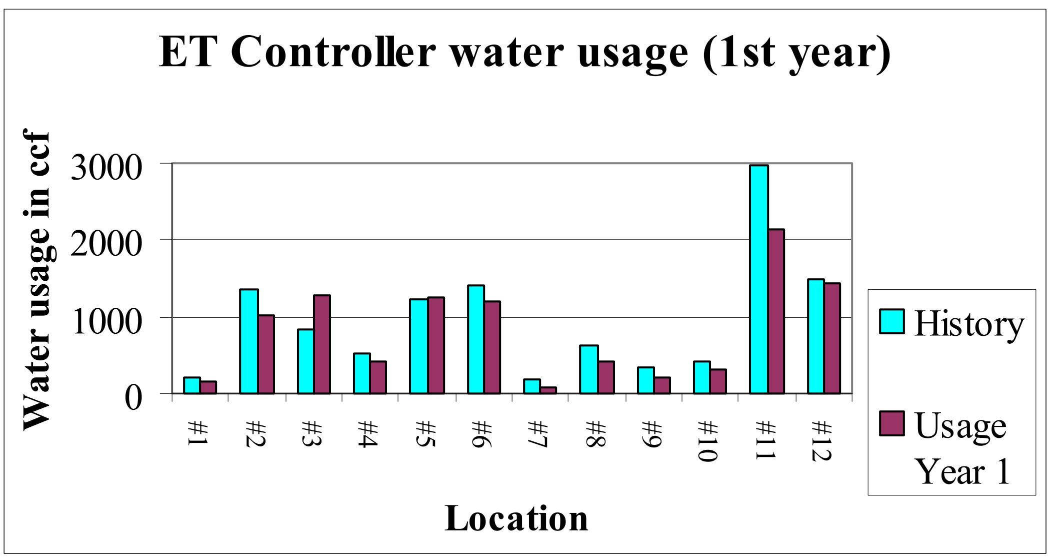
1st year of Water Savings

The R3 study consisted of 12 city streetscapes, 1 city park, 2 condo landscapes and 3 landscapes in a Home Owner Association (HOA). After the success of these larger landscapes, the District expanded the concept of using this type of controller to other MSL sites. IRWD installed ET controllers at manufacturing plants, offices building, and warehouses.

From a water district perspective, the critical question is water conservation. The chart, shown below, lists the historical usage of the individual meter associated with the City of Irvine landscapes along the street or in the street median and the city sites were well managed. This is reflected by comparison between the *Historical average* column to the *ET Year 1* and the *ET Year 2* columns. The ET is calculated by the IRWD weather station for 100% cool season turfgrass. Thus, the ET column contains the maximum water requirements for each site.

A discernable pattern occurs, the City landscape lead operators maintain the water usage with in 20% of the ideal water usage for 10 of the 12 sites. This is a tribute to the City of Irvine but only 4 of the 12 were below the ET usage. Prior to the installation of the paging ET controller, the City demonstrated a clear effort to manage the water and was fairly successful in the efforts. The 12 landscapes were just 3% over the expected water consumption for 100% turfgrass. The controllers were in installed at the 12 sites in the belief that weekly adjustments would result in more effective water usage. The lead operators could reprogram every city valve on a weekly basis but this would be costly.

The controllers were installed in the City landscapes. The results during the first year were impressive. 10 of the 12 landscapes were below the ET and 8 of the 12 used 85% of the measured ET or less. The total water usage on the sites was 14.5% less than the ET measured and 17.5% less than the historical average of the combined 12 sites. Equally important is the water usage after the first year.



Installation effort per year

During the 1st year, the controller required a higher degree of effort to install and maintain. The controller operated on a series of sequential calculations. This is the common method used through out the irrigation industry. The equations include the maximum runtime for sprinkler without run-off; the water holding capability of the soil to determine the number of irrigation days needs per week; to calculate the precipitation rate; calcualte a precise total runtime on any given irrigation day. This method of water management is a half-century old and applied by all educated irrigators through out the world. However, in the landscape industry, the level of education varies from college education to field worker that set controllers based on observation of other field worker with no background in landscape irrigation science.

In order for the controller to function, the controller is programmed with a series of factors that are specific to each valve. This includes the type of plant material, the slope factor, soil type and the sunlight exposure. However, the two most important factors are the precipitation rate and the root depth.

The root depth can vary from one area of the landscape to another. The operator could increase the number of irrigation days per week to adjust the root depth valve to accommodate the shortest plant root depth. This adjustment changes the schedule to assist the landscapers with brown spots caused by inefficient irrigation systems. Yet, the increase in the number of irrigation days does not increase the total volume of water applied during a day. The soil holding capacity calculations, which were performed by the controller, reduced the volume of water applied each day. Thus the total volume of watered applied during the week remained the same.

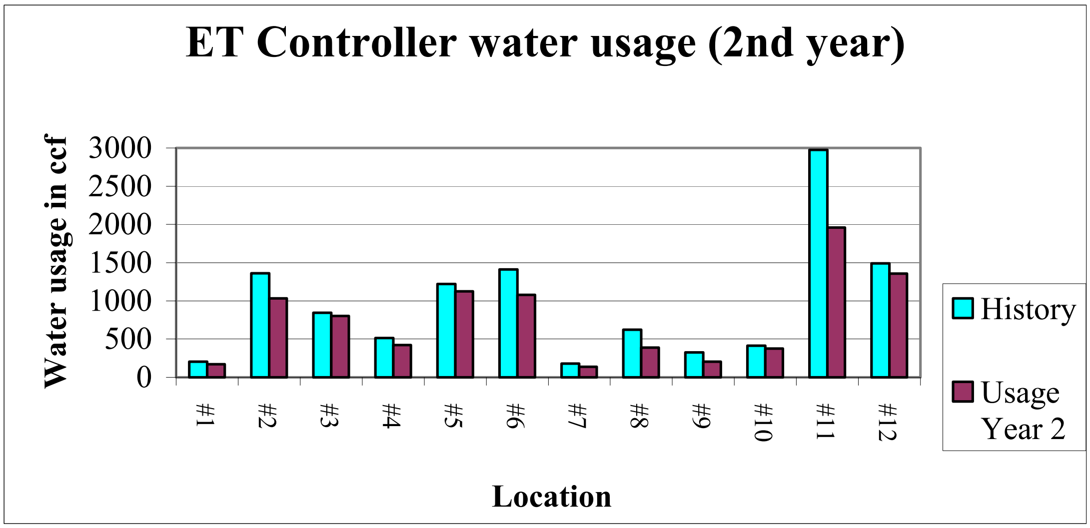
The second factor used to adjust the controller was the precipitation rate. The initial measurement of the precipitation rate was accomplished by an area/flow measurement. This provides the general range of the precipitation rate but the landscape has to be monitored. The monitoring allows the factors to be adjusted to improve the irrigation performance and deliver a proper irrigation volume to all parts of the individual landscape areas. This monitoring was time intensive during the installation period and continued for most of the first year to correct for the first generation controller used by the study. The landscapes were inspected on a weekly basis and the meters of each landscape were read to spot any hardware problems. This routine was significantly reduced after the first year.

At the end of the first year, two patterns emerged. The ET controller could be more successful with monitoring of the MSL than with the single family. Second, the consistently highly maintained landscapes of the City of Irvine do not completely reflect the water saving potential of the interactive weather based controllers. Therefore, IRWD installed additional ET controllers on other MSL landscapes. At the time of this report, 8 commercial location have completed a single year of continuous operation.

2nd year for City sites and the 1st year for commercial sites

The second year result was an improvement on the first year’s accomplishment. All 12 sites were under the ET value for turfgrass. This is not surprising since all of the sites have a mixed use of warm season turfgrass and either trees or shrubs. 11 of the 12 sites had water usage below 75% of the ET value as measured by the IRWD weather station.

Additionally, during the second year of operations, the study group reduced the number of site visits. Both the City and IRWD noticed marked improvement in the performance of the controllers. The precipitation rate and root depth factors were fine tuned to the equations established by the controller's programming. The schedules adjusted according the ET signal with very little manipulation. When problems did occur in the landscapes, the majority of problems could be traced to physical problems with the hardware of the irrigation system and not with the irrigation schedule. The 2nd year demonstrated improved labor cost, greater efficiency and increased water savings.



Total water usage for a year in ccf

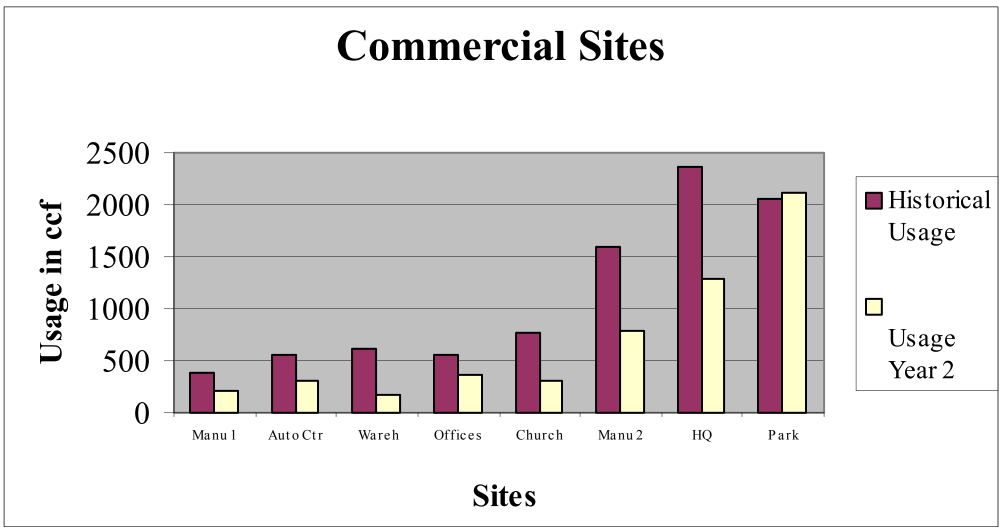
	Historical Average	ET Year 1	Usage Year 1	ET Year 2	Usage Year 2
Site #1	207	221	164	233	171
Site #2	1364	1484	1005	1561	1030
Site #3	845	1014	1269	1074	802
Site #4	512	559	407	590	424
Site #5	1219	1413	1244	1545	1122
Site #6	1414	1139	1201	1209	1080
Site #7	180	361	82	355	138
Site #8	624	557	414	590	387
Site #9	328	298	217	317	203
Site #10	413	588	316	624	376
Site #11	2976	2530	2139	2661	1958
Site #12	1492	1738	1437	1843	1357

Commercial Sites

Because the success of the controllers in city landscapes was greater than expected, the study team believed that 1 acre or less commercial property would benefit from this method of water management. Since the city site were regularly monitored by the city lead operators who had water management knowledge and irrigation education, the effect on sites that often are tended to by landscape crew without any irrigation experience or education should produce similar results.

The installation utilized the same audit system as the city sites. The installation team surveyed the individual valve. This included a valve-by-valve measurement of the landscape area and the flow rate. The precipitation rate was the controlling factor for water savings and improving the general appearance of the landscape.

Prior to the installation of the ET controller, only 2 sites of the 8 total sites in the study used a volume of water that was less than the ET volume measured by the local weather station. After the installation of the ET controller, only 1 site exceeded the ET volume. Even this site showed a reduction from previous years water usage. Notice that the park water usage increased from the historical 3-year average to the 2nd year controller water usage. However, when the ET for the historical years are factored into the equation, the park actually saved water.



		Prior to Installation			After Installation				
Location	Acres	ET Historical	Historical Usage	Differential in ccf	ET Year 2	Usage Year 2	Differential in ccf	Net Change in ccf	Percent Change Usage
Manufacturer 1	0.17	297	392	94	288	218	-70	-164	-54%
Auto Center	0.22	274	561	288	258	307	49	-239	-82%
Warehouse	0.23	389	624	235	379	176	-203	-437	-109%
Offices	0.24	412	549	137	401	356	-45	-182	-40%
Church	0.34	578	764	186	574	309	-266	-452	-84%
Manufacturer 2	0.52	890	1597	707	831	794	-38	-744	-62%
Headquarters	1.55	2640	2373	-267	2117	1296	-822	-555	-30%
City Park	1.91	2607	2060	-547	3016	2117	-899	-352	-17%
Totals	5.18	8087	8919	832	7864	5572	-2293	-3125	-43%

Conclusion

The most important conclusion is that residential ET controllers, the City of Irvine ET controllers and the commercial ET controllers is that the weather based scheduling must include precipitation rate, internal calculation for run-off reduction and actual schedule adjustments from a signaled ET value or rain pause. The method of the signal is less important than the ability to change the irrigation schedule without the need for a person to be present at the site.

Second, the potential for water savings in the commercial setting and the corresponding run-off reduction is high. The single controller covers 0.17 to 1.91 acres as compared to a residential controller that manages the water for just 0.04 acres. The potential for saving water through water management is greatest for the large landscapes. The residential water users do not incur a high enough volume of water to justify the expense of a full-time water management operator.

Finally, the comparison of the first year after the installation to the second year after the installation indicates that the water savings continues. The second year may prove to increase the savings with less attention. Once the program is adjusted for the various anomalies in the irrigation system, the regular ET signal serves to maintain the water management without a need for manual overrides. This should result is cost saving to the customer for reduced water charges and reduced labor charges.