EXECUTIVE SUMMARY

Residential water demand in California accounts for 54% of total urban water demand and is forecasted to reach 58% by the year 2020 as a result of population growth, especially in the hotter, inland regions of the state. The 1999 AWWA *Residential End Uses of Water* study indicates that over half of residential water is used for irrigation. Because of the complexity and constant variability of factors required to irrigate efficiently (e.g., weather conditions, the growth cycles of plants, length of day), it has long been acknowledged that irrigation on residential landscapes is wasteful to some degree. Therefore, the potential for water savings by reducing residential irrigation could be significant.

The water agency solution to date has been to conduct residential audits, leaving the homeowner with a suggested watering schedule, hoping it would then be followed. These programs have had limited effect and a short-term impact. A preferred solution would be to install irrigation controllers that *automatically* adjust watering times based on local weather conditions. Unfortunately, until now these large landscape control systems have been far too complex and expensive for residential applications. This study tested a prototype controller that could provide weather-based irrigation adjustments via a broadcast signal at a reasonable cost, attractive to homeowners and water agencies.

The agencies participating in the study believed an "ET"[1] controller offered the potential to achieve sustained outdoor water savings in residential homes, on the order of or greater than that achieved by plumbing retrofits. As the study progressed, these agencies also recognized that this technology may offer the potential for reducing non-point source pollution caused by excessive run-off from residential sites and may provide a means to better manage peak system demands. A new study is now underway to measure that impact.

Study design

The field trials in this study were undertaken in Irvine, California in selected single-family homes served by the Irvine Ranch Water District (IRWD). The test controllers were off-the-shelf standard "Sterling" irrigation controllers modified specifically for this study to test the effectiveness of the broadcast technology. The test controllers were installed in 40 test homes. Each home's existing automatic irrigation controller was removed and replaced with the new test controller. The irrigation schedule for these homes was then controlled via a remote satellite signal. Changes in the irrigation schedule (if any were required), were made weekly, as determined by an irrigation professional based on local weather conditions and plant growth characteristics. In addition to the test homes, two other sets of households were included in the evaluation: a reference group to account for extraneous events (other than weather) which might effect customer water usage, and a "postcard" group. The postcard group consisted of homes that were periodically sent a postcard as the weather changed, suggesting what their irrigation schedule should be in number of days per week and minutes per day. The objective of the postcard group was to evaluate an alternative method of increasing household sensitivity to weather.

[1] ET refers to evapotranspiration, the rate at which plants lose water through evaporation and transpiration.

All three household study groups were selected from among high water users (top 23%) located in one of IRWD's development tracts, Westpark Village. Although the developer equipped all homes in this tract with an automatic controller, the study team did not know if all controllers were operational at the time of the study. Savings were estimated by comparing two years of pre- and one year of post-installation water consumption data. At the end of one year the test homes were also surveyed to obtain information about their satisfaction with their weather-based controller.

Program concept

In addition to evaluating water use, the study was designed to test an implementation method or program that could be easily and inexpensively implemented by water agencies. A pre-set base line irrigation schedule was programmed into each test controller using IRWD irrigation scheduling software rather than performing detailed reviews of each residence's landscape and irrigation systems (such as conducting catch-can tests). The base line schedules for station run time, cycle time and frequency were created using the same general scheduling parameters for each of the 40 test homes. These included sprinkler head type, plant palette, slope factor and root depth. For example, all homes using spray heads in a turf area received identical schedules. Irrigation schedules were then modified remotely by the weekly signal based on the previous week's actual ET value. This "hang it on the wall and walk away" approach greatly reduced time for controller installation.

Results

Potential vs. Actual Water Savings

Water savings were estimated through a statistical comparison of weather-normalized consumption before and after the controller retrofit. On an absolute basis, ET controllers were able to reduce total household water consumption by roughly 37 gallons per household per day, representing a 7% reduction in total household use, or 16% reduction in estimated outdoor use. But these results must be extrapolated with care because the retrofit group appears to have attracted households with lower levels of wasteful irrigation prior to the retrofit. In other words, we believe our retrofit households were already well disposed toward conservation, hardly surprising since participation in the study was voluntary.

Conservation potential is the difference between actual outdoor use and what *should have been* used taking weather into account. By way of example, if a home with one person replaces a 3.5-gallon toilet with a 1.6-gallon toilet and saves 1.9 gallons per flush, or 3,500 gallons per year, that home will have maximized the entire *potential* savings from toilet usage. By contrast, if a home with 5 people has a toilet dam in the tank, saving only 1 gallon per flush, that home may save over 9,125 gallons, but *could have* saved almost double by replacing the toilet. The second home had greater *absolute* savings, but the first home captured all of the *potential* savings.

Figure 1 displays the level of over-irrigation that was taking place in each of the three groups before and after the point in time that marks the beginning of our study. This chart shows that the postcard group had the most wasteful irrigation practices and the treatment group the least. Although both the controller retrofits and postcard reminders generated statistically significant savings, the ET controllers were able to convert roughly 85% of the pre-retrofit conservation potential into achieved savings, while postcard reminders were able to convert only about 30%. Nonetheless, it is worth noting that given the proper circumstances, such as an aggressive tiered rate structure and an effective customer outreach program, simple postcard reminders can produce meaningful reductions in water use. No statistically significant change was observed in the reference group.

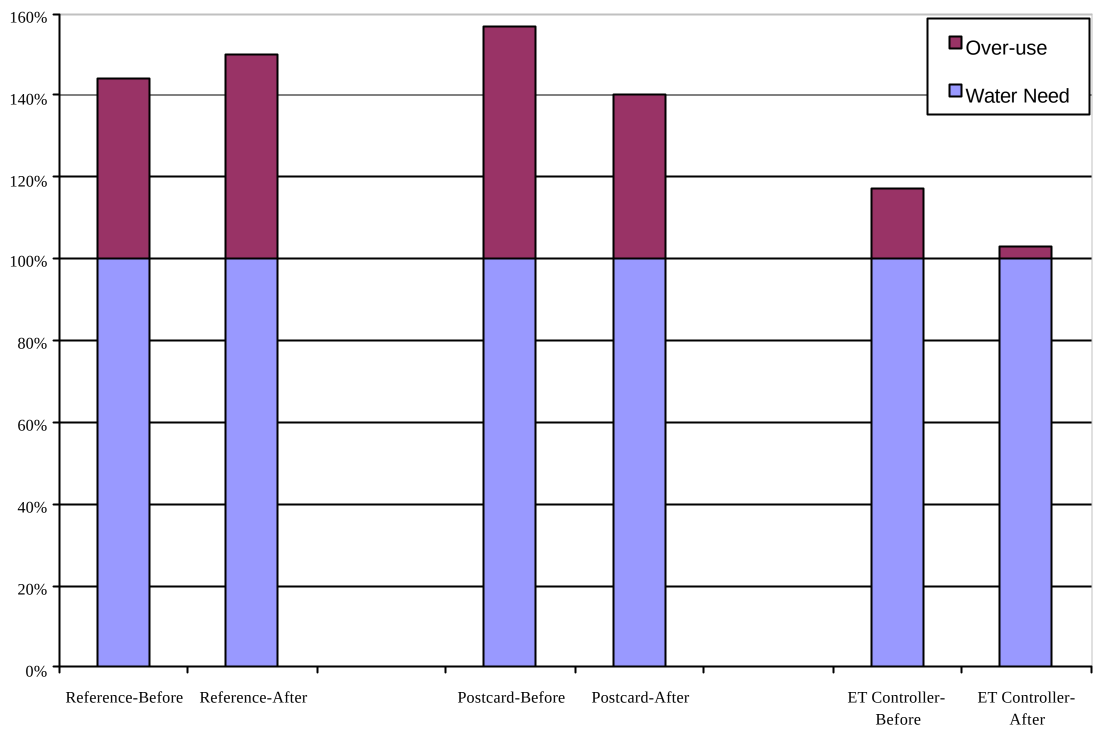

Figure 1 Estimated Outdoor Usage Relative to ETo-Based Water Budget

Extending the analysis to IRWD's service area

An additional analysis was undertaken to estimate the possible level of savings from a larger and more representative sample of high water-using single-family homes within IRWD. This analysis suggests that by targeting roughly the top third of homes in terms of water use (approximately 10,000 homes) ET controllers might be expected to save roughly 57 gallons per household per day, a reduction of 10% in total water use, or 24% in outdoor use. Combined, these 10,000 single-family homes would be projected to save over 200,000,000 gallons (614 acre feet) per year.

Study results were extrapolated to a larger set of single-family households for illustration purposes only. Without further study of water savings in different communities with different rate structures, different levels of customer education, and different ET requirements, it would be inappropriate to consider 57 gallons per day as a regional savings value.

Customer satisfaction

Results of the post-treatment survey showed almost 97% of the ET controller participants reported either improvement or no change in the appearance of their landscapes and **all** found the ET controller convenient. However, in the course of the study customers often mistakenly attributed problems with their landscapes to the ET controller, suggesting that future programs must devote some attention and resources to customer post-installation education and assistance.

Cost-effectiveness

ET controllers, when available, are expected to cost approximately $100 per unit, installation an additional $75, with an ET signal fee of $4 per month. The signal fee is expected to include the cost of customer service. The useful life is expected to be between 10 and 15 years.

Using 57 gallons savings per home per month as an assumption, the value of saved water to the customer and agency *combined* exceeded the all associated costs of the controller. However, since the customer *alone* did not have enough water savings to counterbalance the costs, one solution might be for the water agency to subsidize the customer's costs in some manner, such as by offering a rebate.

However, if the convenience and other benefits (besides water savings) associated with ET controllers are valued sufficiently, customers may be willing to opt for this technology, *with no additional incentive from the water agency*, especially since the signal fee is not a large up-front cost but spread out over the entire life of the controller. During the pre-test survey, over 66% of the test households appeared willing to pay up to $125 for the controller and up to $4 per month for the signal fee.