LANDSCAPE IRRIGATION AUDITING: A MOBILE LABORATORY APPROACH FOR SMALL COMMUNITIES

K. A. Harrison[1], D. L. Thomas[2] and R. Reed[3]

AUTHORS: [1]Senior Public Service Associate, P.O. Box 1209, Tifton, GA 31793; [2]Professor, Biological and Agricultural Engineering Department (BAE), University of Georgia (UGA), College of Agricultural and Environmental Sciences (CAES) Tifton Campus, Tifton, GA 31794; and [3]Senior Public Service Associate and Extension Coordinator, Coffee County, GA.
REFERENCE: Proceedings of the 2003 Georgia Water Resources Conference, held April 23-24, 2003, at the University of Georgia. Kathryn J. Hatcher, editor, Institute of Ecology, The University of Georgia, Athens, Georgia.

Abstract. Landscape irrigation is one of the first water resource uses to be affected by designated drought or water restriction conditions. In large cities, personnel and funds may be allocated to help encourage improved approaches to outside water use. However, many small communities lack the funds to hire personnel to help with their outside water management and must revert to "system-wide bans". Obviously, outside watering bans have a direct and long-term potential impact on some of our most dynamic and thriving industries: landscape plant nurseries and turf/sod farms.

Landscape irrigation is notoriously inefficient because irrigation systems can rarely be designed, installed, and maintained at the highest level attainable (unless available funds are not limited and the owner is very conscientious and knowledgeable).

INTRODUCTION

The information provided in this paper is not new. In fact, any community that is interested in improving their landscape irrigation can find good resources to help manage their landscape water use, if they are willing to take the time and investigate alternatives. Unfortunately, many small (and large) communities may not be using the resources that are available. A large percentage of homeowners and business owners are unfamiliar with current landscape irrigation technologies and how they relate to water conservation. The need to provide a mechanism for direct investigation and education about good landscape irrigation practices is real. This paper presents an approach that could be implemented in smaller communities by extension service personnel or other groups for improving landscape irrigation efficiency, with direct alternatives that can potentially save water. Most of the ideas presented are being tested in South Georgia. Since Georgia is in the humid region, precipitation is an essential component of the water used by landscapes. In most years, precipitation is sufficient to supplement the irrigation required for landscape areas. Landscape irrigation is extensively used to keep turf green and provide supplemental water to landscape plants. For most areas, little effort has been spent to ensure "sustainable landscapes" or to maintain an efficient irrigation system. Within the past four years, drought conditions have caused severe water shortages across the state. In 2000, outside watering restrictions were implemented state-wide for the very first time. For many small communities with limited water supplies, their only alternative to meeting their water needs was to restrict outside watering (some were restricted 24 hours a day, seven days a week).

PROCEDURES

The steps indicated in this paper are those that are expected to be viable for Georgia communities. For areas where conditions are not similar, particular steps can be removed or changed to meet specific needs.

Overall Goal

The mobile laboratory approach was designed as a water conservation resource to small communities that could be moved into a community for a short period of time, do evaluations, make reports, and then move on to another community. The ability to have personnel "in a community" indicates the commitment of the sponsoring and funding organizations toward the needs of that community. The mobile laboratory approach (personnel and equipment) should logically be funded through some type of state appropriation. Specific recommendations that are tailored to a community can improve overall water use and provide incentive programs for the future.

Developing the Initial Team

For this particular effort (with a lack of substantial outside funding), it was essential to involve the County Extension Specialist from the community that is interested in water conservation. The knowledge of a local county extension specialist can include essential contacts and the potential for acceptance of the ideas (local politics). If a local extension specialist is unavailable, the Soil and Water Conservation Commission, Natural Resources Conservation Service, or a Rural Development Cooperative may be good alternatives. Having the mobile audit team in good communication with a local person is essential to "buy-in" and the potential for success of the effort. In addition, the participation of a local agency can create a local contact person who will be knowledgeable about landscape irrigation practices.

Approaching the Water System Purveyor

The organization that is involved in distributing the water to customers is an essential component to the success of a landscape auditing program in a small community. Since their direct revenues are usually associated with the amount of water being distributed, the idea of "reducing" that water is not always met with a positive reaction. It is important to assure the local water system purveyor that recommendations will include approaches to maintaining their economic viability while reducing overall water use.

Approaching the Water Users

If a community has separate water meters for outside landscape irrigation, it may be very easy to approach those who can benefit from irrigation conservation alternatives. In the pilot study in Coffee County, Georgia, that was the case. A letter was sent to each individual with an outside water meter indicating the opportunity to receive an audit of their landscape irrigation system. This letter contained information about the program, who was doing the activity, what would be expected of the participants, and what they would receive in return.

For each potential water user, their personal audit information was to be maintained as confidential. However, a community report would be created that consolidated information from all the individual reports. None of the information in that report was to be identified with any individual audit.

If a community does not have separate water meters for outside irrigation, the initial contact with potential participants is very critical and essential. A community- or county-based meeting is a recommended approach to initiate the audit program. Typical and innovative contact approaches (mass media) are essential to good participation in such meetings. "Incentives" could be provided by the water system purveyor to help encourage community attendance at the meeting. "Incentives" can be both positive and negative. We have encouraged positive approaches to participation, but the typical response of a community may require negative incentives. Examples of positive incentives for attending the first meeting include a small water rebate for a coming month, a coupon to be used with excessive future water bills, raingages to help determine water use. The raingages could be provided by a local irrigation dealer who is also interested in water conservation in landscape systems. Brochures about landscape water use, landscape planting (Xeriscaping, etc.) could also be available at this initial meeting. Potential negative incentives could be an added charge to a water bill if participants with outside irrigation do not attend the meeting.

The Audit

After a time was scheduled for the team to meet the water user, the audit team visited the irrigation system directly. During the audit, the system was operated through each of the different zones. One member of the team recorded the zone information (sprinkler types, number of sprinklers, nozzles, areas covered, i.e., full circle and part circle) while another team member observed individual sprinklers on zones for off-site applications, other maintenance problems, and pressure conditions at near and far sprinklers. A third team member usually asked questions to the water user while recording information on the time clock. In most cases, digital pictures were obtained to help illustrate problems or good characteristics of the irrigation system. These images would be essential to helping explain particular characteristics to the water user in their report.

The water user was requested to be present during the audit (turn system on and answer questions). Many of the observed problems with the system could be discussed directly with the water user. In most cases, the water user was armed with sufficient information to make some initial changes for direct water saving and to improve water use efficiency, prior to submitting a formal report.

Uniformity Analysis

A uniformity analysis (can test) was performed on a selected number of irrigation audit sites. The uniformity was of main concern for irrigation applications from rotating sprinklers in turf areas. If the water user indicated the presence of “wet” or “dry” spots during irrigation, a uniformity analysis was useful for visual and quantitative analysis of the problems. In most cases, a uniformity analysis was not required.

Reports

An individual report was prepared for each audit site. This report contained general information that relates to most irrigation systems, as well as, specific information on the system being audited. For example, some water saving technologies were illustrated (rainfall cut-off switches). Particular off-site application or maintenance problems were also identified. Specific recommendations for the irrigation system (nozzle changes, time of application within a zone, etc.) were described for calculating direct water savings. These potential water savings were reported to the water user as a way to encourage changes in the system.

A community report was also prepared to illustrate the overall water savings that could be expected by instituting water saving alternatives. Most results were reported in percentages with direct reference to potential gallons saved during a period of time. The opportunity to save water was indicated in combination with alternatives to maintain income for the water purveyor. Incentive programs are essential to the potential buy-in by the water purveyor and the customers. Recommendations for nozzles to be available for retrofitting rotating sprinklers, raingages to help keep track of current conditions, and other water saving practices were provided in the community report.

COMMUNITY CONDITIONS

The pilot study in the Douglas community in Coffee County Georgia was the initial location for implementing this mobile landscape auditing program. Douglas is located at about 31° 31' N and 82° 50' W in South Georgia. Ground water is the primary source for the drinking and landscape water supply. Water is supplied from Upper Floridan aquifer wells. Douglas has about 186 separate meters for outside watering systems. Total city water use (excluding industry) is about 2 million gallons per day (mgd).

The city of Douglas uses a decreasing block rate structure for their water users. The decreasing block rate structure does not specifically encourage water savings since the cost per 1,000 gal. decreases with increased gallons used. For example, a 1/3 acre (14,500 ft^2, or 1,350 m^2) irrigation area that is irrigated 1.5 inches (38 mm) per week would result in about 53,500 gallons used in a month. The water bill would be about $59.00 for that month. The potential to address income questions is a reality if water audit results are to have an effect on total water use.

Audits were performed on 14 different systems in the community (>7% sample). The selection was based entirely based on those who requested an audit after receiving a notice in the mail. Half of the audits were on commercial or municipal sites, the rest were residential customers.

The state guidelines followed by the Douglas community is an odd/even watering restriction (based on address). That means that water users may irrigate every other day. There is also a 6+-hour time restriction during allowable irrigation days (4 p.m. to 10 p.m.) that has been initiated in many locations across the state. In practically all sites analyzed in this pilot study, the time-clocks were set to allow irrigation during early morning hours, thus reducing losses due to evaporation. Unfortunately, early morning hours (12 a.m. to 5 a.m.) creates the largest potential for other losses. Offsite applications, maintenance problems (broken sprinklers), and small leaks (if the evidence of the leak is not substantial) are not easily observed during those hours of operation.

Water Saving Opportunities

The largest potential to save water observed within the audits was *selection of nozzles in rotating sprinklers*. Rotating sprinklers were defined as gear-driven or impact sprinklers that “rotated” across the area of irrigation need. Regardless of whether sprinklers were old or new, nozzles were not sized according to the area of coverage by the rotating sprinklers. For sprinklers that were operating over part circles, the same nozzles were typically used as compared to full circle sprinklers. This is not a problem if all full circle sprinklers are on the same zone, all part circle sprinklers are on a different zone, and the operating times are adjusted accordingly. Results from the Douglas community tests indicate that about 24% of the water used on rotating sprinklers could be saved by using the proper nozzles (based on those systems tested, with no other changes in operating schedules). This percentage translates into nearly 40,000 gallons of water per week that could be saved on the 14 systems tested, by using proper nozzles. For the individual systems tested, the water savings due to nozzle changes ranged from 0 to 45%.

Operating time was the next concern/potential illustrated from the irrigation audit results. In most cases, spray heads tend to put out three to five times the water application rate on a given area as compared to drip or rotating sprinklers. If the time is not adjusted accordingly for zones with spray heads, those areas will receive a much higher application of water. For those systems with spray head problems (60% of those systems with spray heads), about 19% of the water used through spray heads could be saved by adjusting the time to conform to a "recommended" amount that was consistent with the rotating sprinkler amounts. Turf needs about 1.25 in. (32 mm) per week during peak water demand periods (Tyson and Harrison, 1995; Wade et al., 2000). This water savings percentage translated into over 5,000 gallons of water saved per week for the systems tested.

On one single system, the operating time per irrigation was 180 minutes (with rotors). If this system is operated on an odd/even irrigation schedule, the application amount per week is nearly 2.0 inches (50 mm). By reducing the zone time to 120 minutes per irrigation, over 4,700 gallons per week could be saved on this system alone.

Off-site applications were a real problem in some areas. Spray heads and rotating sprinklers were observed putting water in roads, sidewalks, driveways, and parking lots; hitting nearby bushes and trees (significantly affecting the pattern); and even putting water into a swimming pool. Recommendations to save water were provided based on converting some full circle rotating sprinklers to part circle. Water savings based on off-site applications are "real" based on any application scenario because this water is not being used for any beneficial plant response. Off-site applications did represent a relatively small percentage of the overall water use. For one system tested, changing a full circle sprinkler to a 270 degree coverage would save about 210 gallons per week. For another system, changing a full circle sprinkler to a half circle sprinkler amounted to about 100 gallons per week in water savings. This was based on the current operating time that was set to provide 0.5 inches (12.7 mm) of water per week. All of the above savings were based on the current irrigation schedule (time of application in a zone) and the particular nozzles being used.

Changes were also recommended *based on the season*. In the majority of the audits no direct effort was identified by the water user to reduce water applications during the fall, winter or spring. In some cases the timing was modified if areas were observed to be too wet. Rarely were the seasonal adjust features (water budgeting) utilized on time clocks. The potential for educational efforts to help water users more effectively use their time clocks, was evident in almost all audit situations. However, it should be noted that most of the sites had controller settings (zone operating time) that applied LESS water than recommended for plant growth and vigor.

Efficiency improvements, but more water needed

In some cases, water application recommendations were provided to help meet potential plant water needs. Most irrigation systems were not providing sufficient water to meet plant water requirements at peak summer conditions. Recommendations that increase the amount of water to be applied to a particular area would result in increased efficiency, but also increased water use. Obviously, if the water user is satisfied with the condition of the turf and landscape plants, these recommendations should not be implemented (indicated in their report). Schools represent one type of irrigation system that may not need as much water during the summer. Most schools are not in session during the summer. Maintenance during the summer is desired to be low and visual appearance may not be as important (low application amounts may be acceptable). Unfortunately, the southern climate will encourage the encroachment of drought tolerant weeds if sufficient water is not available to the turf.

Application amounts for rotors seemed to be low for a large percentage of the systems evaluated (50%). These systems were putting out less than 0.6 in. (15 mm) in a week (based on an application "every other day"). These application amounts may need to be adjusted based on the stresses observed on turf and landscape plants. The amount applied can easily be corrected by adjusting operating time(s) per zone. However, this would result in increased water use (gallons) for those particular systems.

SUMMARY

A new mobile landscape irrigation auditing program for small communities was developed and tested in a pilot study in Douglas, Georgia. At least 14 individual systems were audited (>7% of outside water meters). Fifty percent of the audit sites were municipal or commercial sites, the rest were residential. For the audited systems, at least 250,000 gallons per week were estimated to be used if all systems were operating on an "every other day" irrigation schedule. If all recommendations for water savings were implemented on these systems, nearly 50,000 gallons per week (about 20%) would be saved. All potential water savings were based on adjusting irrigation schedules to apply less water if they were currently exceeding recommended amounts (per week).

Some audited sites were applying less water than is recommended for turf and landscape plants (during the hot part of the summer). Irrigation efficiencies, and possibly health of turf and landscape plants could improve by applying more water.

In practically all irrigation audit situations, no seasonal adjustments were being made to reduce water applications during the fall, winter, and spring. The need for improved education on irrigation and operating system alternatives was obvious.

The audit program represents a real and potentially viable method of improving water conservation for small communities. The potential to use water more efficiently and save water under drought conditions is necessary to the future viability of the landscape and turf industries, and the quality of life and beauty we expect from our landscapes.

REFERENCES

ASAE Standard. 1994. ASAE Standard No. S436. Test procedure for determining the uniformity of water distribution of center pivot, corner pivot, and moving lateral irrigation machines equipped with spray or sprinkler nozzles. ASAE, St. Joseph, MI.

Harrison, K. A. 2002. Irrigation system analysis and computation (ISAAC). University of Georgia. Cooperative Extension Service, Athens, GA. Public Software.

Keller, J. and R. D. Bliesner. 1990. Sprinkle and Trickle Irrigation. Van Nostrand Reinhold Publishers.

Tyson, A. W. and K. A. Harrison. 1995. Irrigation for Lawns and gardens. University of Georgia, Cooperative Extension Service Bulletin. http://www.ces.uga.edu/pubcd/b894-w.html

Wade, G. L., J. T. Midcap, K. D. Coder, A. W. Tyson. and N. Weatherly, Jr. 1992. Xeriscape™: A guide to developing a water-wise landscape. University of Georgia, Cooperative Extension Service Bulletin. http://www.ces.uga.edu/pubcd/B1073.htm