Using Technology to Administer a Reclaimed Water Program

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Abstract

Administering annual backflow prevention assembly testing and reclaimed water site inspections can be challenging. Tucson Water has combined its backflow prevention and reclaimed water programs and is using technology to do more work with fewer people while providing excellent customer service.

Tucson Water recently implemented a new real-time web-based program management system (iBAK) that allows independent backflow testers (independent testers test all of the 20,000+ backflow assemblies in the Tucson Water service area) to directly enter the results of their customers' annual assembly test into the Tucson Water database. This database is also be used to track the initial and annual inspections, and other regulatory issues at reclaimed water sites.

The iBAK database is directly linked to the water billing system and is automatically updated daily as customer names and addresses change. Regulatory compliance reports and monthly statistics are available at the touch of a button.

The Tucson Water backflow prevention/reclaimed water inspectors are equipped with laptop computers and are able to access the iBAK database as well as an electronic data management system from the field, allowing them to use their vehicles as mobile offices and to respond more quickly to customers. Inspectors are able to download pictures from their digital cameras and e-mail them to Tucson Water Management allowing Management to have immediate access to unfolding situations.

The Role of Reclaimed Water in Tucson's Water Supply

Tucson's Regional Setting

The City of Tucson is located in the northern semi-arid reaches of the Sonoran Desert in eastern Pima County, Arizona and receives only about 11 inches of rain a year. Very few surface waterways contain perennial flow and most of these are effluent-dominated streams located downstream from municipal wastewater treatment plants. Until the early 1990s, the Tucson community relied almost exclusively on pumped groundwater to meet water demand. Due to rapid growth in population and associated water demand following

World War II, the groundwater system transitioned from an approximate state of equilibrium to one of accelerating depletion. Rapidly declining water levels in the metropolitan and surrounding areas had resulted in land subsidence, increased pumping costs, and the gradual loss of native riparian habitat. With the introduction of Colorado River water from the Central Arizona Project (CAP), the Tucson Water Service area has moved from pumping more groundwater than was replenished to delivering 4.5 times more CAP water than pumped groundwater.

The Tucson area is growing rapidly, at a rate of about 2 percent annually. The metropolitan area has a population of about 1,200,000 people. Potable water supplies are groundwater and Colorado River water from the Central Arizona Project that has been recharged and recovered. Non-potable water is provided through the reclaimed water system.

Tucson's reclaimed water system is unique in several ways. Rather than a means to dispose of treated wastewater, it is an important and growing water supply for this desert community. Wastewater is the only supply the community has that will continue to grow as the population increases. Therefore, reclaimed water plays an increasingly important role in the water supply picture. As part of its long-range water supply plan, the City has committed to the increasing the use of effluent for non-potable and possibly potable uses.

The City owns and operates a municipal water utility, Tucson Water, which provides potable and reclaimed water service in the Tucson metropolitan area. Tucson Water serves potable water to over 735,000 people, about 61 percent of the metropolitan population. In 2007 the utility delivered approximately 123,000 acre-feet of potable water and 15,203 acre-feet of reclaimed water.

Pima County owns and operates the regional wastewater collection system and treatment facilities. An intergovernmental agreement between the City and the County provides the City with the right to use about half of the 68,300 acre-feet of secondary effluent produced at the County's three metropolitan treatment plants. Today, some of this secondary effluent is used in the reclaimed system and the remainder is used to irrigate a city-owned golf or is discharged into the Santa Cruz River, where it recharges the aquifer.

Description of Tucson's Reclaimed Water System

Since the first customer (a golf course located at the end of a 10-mile pipeline) received reclaimed water in 1984, more than 160 more miles of pipe have been added to the system. Today, the reclaimed water system has more than 160 miles of pipeline and 15 million gallons of surface storage. The average day delivery is 13.6 million gallons and the summer peak day is approximately 30 million gallons. Unlike the potable water system that has a peak day of 1.65 times the average day, the reclaimed system's peak

day is 2.3 times the average day. The high peaking factor on the reclaimed system reflects the usage patterns of the irrigation customers; high usage during the hot months, low usage during the cool months. This pattern is also seen, to a lesser extent, on the potable system. In 2007, reclaimed water use accounted for 16.5 gallons per person per day (GPCD) that would otherwise have been potable water use.

Reclaimed water is produced in three ways: at a filtration plant for secondary effluent, at a tertiary wastewater treatment plant and through recharge and recovery. The filtration plant further treats secondary effluent from one of the County's wastewater plants and is permitted to produce up to 10 MGD. The tertiary wastewater treatment plant, also owned by the County, treats about 2.5 MGD of raw wastewater to reclaimed water standards This water is delivered directly into the reclaimed water system.

Reclaimed water is also produced at two recharge and recovery facilities: the Sweetwater Recharge and Recovery Facility located south of the filtration plant and the Santa Cruz River. The Sweetwater facility consists of eight constructed basins which are used to recharge secondary effluent. It is operated under an aquifer protection permit that allows 13,000 acre-feet/year of treated wastewater to be recharged and recovered annually. A constructed wetlands is also part of the Sweetwater facility. The wetlands were designed to treat the backwash water from the filters and are used as a public environmental amenity.

The Santa Cruz River facility is a "managed in-channel" project. Secondary effluent produced at the County's wastewater treatment plants is discharged into the river and "stored water credits' earned. These credits are then used to recover effluent from wells which pipe water into the reclaimed system. The recovered water is a very good quality, less than one NTU turbidity with nitrogen levels below the 10mg/L drinking water standard. This low nitrogen level is significant because the secondary effluent produced by the County is not denitrified and is typically in the 28mg/L range. Recovered water from the recharge facilities is blended with water produced at the filtration plant to produce water that meets Tucson's Reuse Permit requirements. The amount of recovered water blended with water produced at the filtration plant varies daily based on total system demand and the quality of the filtered water. On an annual basis, the blend is about 50 percent filtered water and 50 percent recovered water.

Tucson's Reclaimed Water Customer Characteristics

In 2007, the utility delivered approximately 15, 203 acre-feet of reclaimed water to over 900 customers. Fifty seven percent of this water was delivered to eighteen golf courses. Another 17 percent was delivered to parks. The remainder was delivered to schools (8 percent), other water providers (8 percent and other (single family, agriculture, commercial, multi-family, and street landscape (10 percent).

Although reclaimed water deliveries have increased by more than 50 percent since 1995, the percentage of deliveries in each customer category has remained relatively constant.

Re-engineering the Reclaimed Water Program

Before Re-engineering

In 2004, the Backflow Prevention Office began a re-engineering process that resulted in the creation of the Backflow Prevention/Reclaimed Water Section. In 2004, the need to "re-engineer" the office was obvious. An off the shelf database was being used to track over 30,000 backflow prevention assemblies (BPA) and more than 600 sites with reclaimed water. Data queries and the production of regulatory compliance reports was time consuming and complicated. As many as four letters, two of them certified, were being sent to customers reminding them of the annual BPA test requirement. The Backflow Prevention Office had nearly two FTEs dedicated to entering BPA test reports into the database and answering customer phone calls. And the information for the reclaimed water sites was disorganized and incomplete.

The Re-engineering Process

Several key retirements in the Backflow Office provided the opportunity to make changes. Strong commitment of the remaining existing personnel to work with the new management to improve all aspects of the Office's work was critical and ultimately was the single most important factor in the success of the re-engineering. The re-engineering followed the six step process shown in Figure 1:

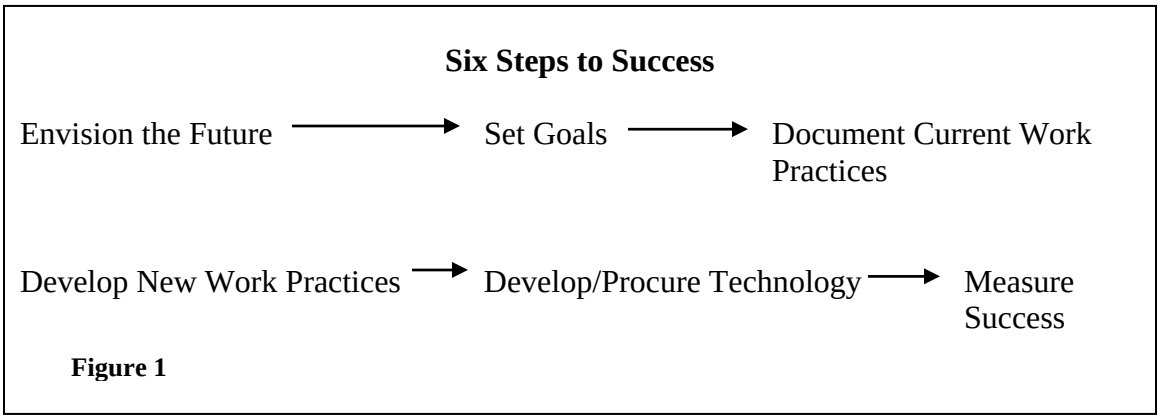

Figure 1

Envision the Future

The Backflow Office began meeting at least twice a week for a minimum of 2 hours at a time. This meeting schedule was maintained for the first year of the re-engineering process. Beginning in the second year, the meetings were reduced to once a week. By the third year, the weekly meetings only required an hour.

It took a number of meetings to find the common vision of the future. When it did emerge, it was simple and powerful:

- Empowered field inspectors
- No ringing phone
- No customers at the walk-in counter
- No paper handling

Set Goals

The goals reflect the Backflow Office's knowledge of its regulatory requirements and what it would take to ensure that they were consistently met. Ideas for changes were evaluated for their consistency with the goals. The following goals were used to guide all of the re-engineering work:

- To protect public health and comply with State and City regulations
- To improve service with internal and external customers
- To utilize technology to increase efficiency and save money
- To have a nationally-recognized program

Document Current Work Practices

This was the critical step in the process and took the most time. It was also the most revealing. The Office began by going through the City's Backflow Prevention Ordinance line by line. This process opened the door for discussions about not only how the ordinance was being enforced, but also changes that could be made that would improve the process for both customers and the Office. From there, Office and field inspector procedures, including everything from the content of the letters sent to customers advising them of their annual BPA requirements, to the envelopes, to the use of certified mail, to the notification procedure for the discontinuance of water service, to the adequacy of the database were reviewed and discussed.

Develop New Work Practices

When the re-engineering process began, the Office was focused primarily on backflow prevention with reclaimed water being a secondary function. While documenting the current work practices, it became obvious that many of the systems and procedures used for backflow prevention could be easily adapted for use in the reclaimed water system. For example, the process for sending letters to customers notifying them of their annual BPA test requirement could be modified and used to notify reclaimed water customers of their required annual site inspection (becomes effective in 2010) requirement. The annual test/inspection dates for a site could be coordinated and the personalized backflow test form could be modified as a reclaimed water site inspection form.

During the development of the new work practices, representatives from the Tucson Water Information Technology Section and the consultant who would be developing the new program management system were encouraged to attend the meetings.

This ultimately saved time as the feasibility of information technology ideas could be reworked or rejected early in the process.

Not all of the new work practices worked out as well as anticipated. When something wasn't working, the Office re-evaluated, made changes, and moved on.

One of the most significant new work practices was the reorganization of the Backflow Prevention Office to the Backflow Prevention/Reclaimed Water Section (Figure 2). This reorganization recognized the importance of reclaimed water and the natural relationship between it and backflow prevention. It was also significant because as a result of the efficiencies created through the new work practices, two positions were able to be dropped from the Section even though additional responsibilities were taken on. Additionally, two customer service representative positions were reclassified to administrative assistants reflecting the change in the type of work the positions performed.

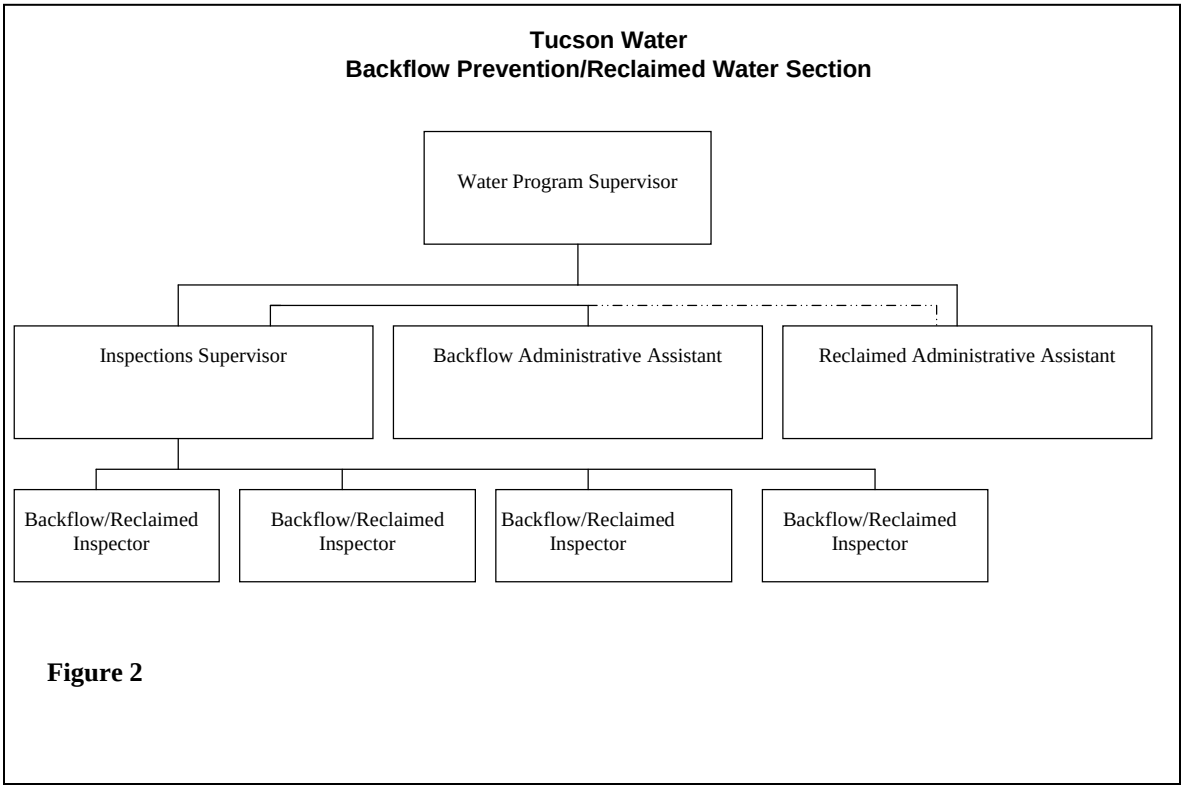

Figure 2

Develop/Procure Technology

The "Develop New Work Practices" step of the re-engineering process identified two major technology applications that would be required for the new Backflow Prevention/Reclaimed Water Section: a program management system that included a database and a document management system. Since the off the shelf backflow prevention database program Tucson Water was using had been unsatisfactory, it was

decided early in the process that a consultant would be retained to develop a program management system to meet the needs of the backflow prevention/reclaimed water programs. Working very closely with the consultant, it took almost three years for the basic program management system (iBAK) to be ready for use. iBAK has now been in full operation for more than a year and there is an annual maintenance contract with the consultant for system improvements and resolution of problems.

iBAK is a program management system that includes a database. It is designed to track backflow prevention assemblies and reclaimed water sites. It is being used to send notification letters to customers, schedule and track the work of the backflow/reclaimed water inspectors, and to generate regulatory compliance and other informational reports.

iBAK allows independent backflow testers (independent testers test all of the 20,000+ backflow assemblies in the Tucson Water service area) to directly enter the results of their customers' annual assembly test into the Tucson Water database. The iBAK database is directly linked to the water billing system and is automatically updated daily as customer names and addresses change. All iBAK information is available in real time.

The iBAK database is designed using a 'thin client' architecture, which means that the application is available to authorized users via the internet or an intranet. This allows users to access the database from the field, a customer location or the users own office. The database employs standard web application technologies including HTML, DHTML, CSS and javascript. The application has no client side (browser) plug ins or special hardware or software requirements (the external facilities provided by the application are accessible from all major browsers). The server side components execute in a Windows Server environment under IIS. They are written in VB/ASP and employ either an Oracle or MS SQL database backend. No server side components or other proprietary software is required to run the application.

The volume of paper generated by the backflow/reclaimed water program had become overwhelming. The state regulatory agency required that backflow test forms be retained for three years; reclaimed water applications and user agreements for every site were maintained permanently. The solution was an electronic document management system. Prior to proceeding, the State granted permission for the test forms to be maintained in electronic form. An off the shelf data management program, Hummingbird, was selected for use. Now all test forms and reclaimed water site information is scanned into the database as PFDs which can be retrieved by anyone with computer access to the directory in which they are stored.

Laptop computers with internet access, vehicles with built-in computer stands, GPS equipment, online access to valve maps (emap), and digital cameras were also identified

and budgeted as equipment required for the inspectors. Tucson Water has an emap system that allows employees with internet access to view the utility's valve maps. This feature is regularly used by the Backflow Prevention/Reclaimed Water inspectors to locate meters, property lines, easements, and other information they need while working in the field.

All backflow prevention assemblies and reclaimed water meters are located by GPS and the coordinates are entered into the database, enabling anyone to quickly find the equipment.

Each of the inspectors carries a digital camera. This enables them to keep a photographic record of site conditions. It also allow for pictures of situations where there are questions or incidents like main breaks to be e-mailed immediately to Tucson Water management.

Measure Success

There are many ways to measure success. In terms of cost savings, the re-engineering process and use of technology resulted in the reduction of two positions, a reduction in paper, printing, and mailing costs, and a reduction in the number of claims paid to customers resulting from staff errors.

Success can be measured in terms of the future. With the new program management system in place, no new staff is anticipated to be needed for the foreseeable future even though the number of BPAs and reclaimed water sites in the service area is growing and the Section has taken on additional responsibilities.

Success can be measured in terms of customer satisfaction. Since completing the implementation of the major changes in policy and procedures, customer complaints and claims have dwindled to almost none. Phone calls have been reduced by more than half as a result of providing more customer friendly information.

Success can also be measured in terms of the "green" factor. More than 20,000 fewer letter a year mailed to customers, information and forms available on the internet, and the ability for backflow testers and reclaimed water site inspectors to enter the results of their test online saves trees and reduces the carbon footprint of the program.

Conclusion

The iBAK program management system and other technological and organizational changes to Tucson Water's reclaimed water and backflow prevention program discussed

in this paper came about through a multi-year process of re-engineering. This process, though time consuming, resulted in substantive positive changes and cost efficiencies in the way business is done. The vision set forth at the beginning of the process is now a reality and each of the four goals have been realized.