We Did It – So Can You

How One Utility Met its Water-Use Restriction Goals

Ted McKim

Reedy Creek Improvement District (RCID) is the municipal entity that provides utility and other governmental services to the Walt Disney World Resort Complex in Central Florida. RCID began potable water service in October 1987, when it acquired and leased water-system assets from a private company. The water system is very simple because the source (the Floridan Aquifer) is of high quality and yield, requiring no treatment other than chlorination. The system consists of 12 main production wells, four pumping stations, and the distribution-system piping. The pumping stations contain ground storage reservoirs, the chlorination system (liquid sodium hypochlorite), and booster pumps. System capacity is 60 million gallons per day (MGD), and demand ranges between 10 and 30 MGD.

RCID began wastewater reuse efforts in 1971, by irrigating a 110-acre tree farm with secondary effluent. Efforts to improve and expand reuse of treated wastewater have been underway almost continuously since that time. Major improvements and expansion efforts completed in 1993 were the backbone of the current public-access reuse system. These included upgrading the treatment facility to achieve biological nutrient removal, adding deep-bed filtration and high-level disinfection, and installing a reuse distribution system complete with storage tanks and pumping station. In 1990, RCID employed the use of rapid-rate infiltration basins (RIBs) for wet-weather groundwater recharge.

Deficit rainfall from 1998 to 2001 resulted in the South Florida and St. Johns River Water Management Districts declaring water-use restrictions in January of 2001. These restrictions remain in force today for RCID. To illustrate the duration and severity of the current drought, **Figure 1** shows the cumulative rainfall deficit experienced at RCID from 1998 to 2002. Average rainfall was determined to be about 53 inches per year, based on the average of eight rainfall gauge stations located throughout RCID, with 30 years or more of historic record. As the figure illustrates, the rainfall deficit exceeded 80 inches in May of 2002 – over a year of average rainfall. But some recovery was observed in the latter months of 2002 as a result of above-average rainfall.

The water-use restrictions were aimed at reducing the demands on the Floridan Aquifer, the primary drinking-water source for most of Central Florida. Restrictions on the use of reclaimed water were not imposed, which led to a renewed interest in reclaimed water at RCID. The goal of the restrictions was to cut consumption by at least 15 percent compared to the prior year (calendar year 2000 was considered the base year against which comparisons were made).

The restrictions that were of highest concern to RCID included the ban on street and sidewalk cleaning with hoses, banning the use of non-recirculating decorative fountains, restricting irrigation to twice per week and to less than 0.75 inch per week, and reducing distribution-system pressure to 45 psi or less. With the exception of the latter restriction, reclaimed water played a significant role in helping RCID meet these restrictions and exceed the 15-percent reduction goal.

Complying with the Restrictions

The Role of Reclaimed Water

The major priority for RCID customers was to find a way to wash the streets and sidewalks of their theme parks without using potable water, which has been a nightly practice for the past 30+ years. While the restrictions allowed the use of high-pressure washers, these damaged baseboards and other "soft" surfaces and could remove paint and finishes, making their use undesirable. The obvious solution was to use reclaimed water, but the challenge was to find a suitable means of delivery, since three of the four theme parks were not equipped with their respective reclaimed-water distribution systems.

The solution was to build "filling stations" for a fleet of delivery vehicles, called "water buffaloes." The filling stations constructed were similar to the way a stream train takes on water and consisted of a 4-inch diameter line supported above grade, equipped with valves and flexible hoses. The water buffaloes consist of a trailer or truck-bed mounted storage tank, gasoline-powered pump, and hose. Storage-tank volumes ranged from 500 gallons to 3,000 gallons.

All street and sidewalk cleaning is done at night, after the theme parks close. The water buffaloes fill their tanks from the filling station and make five to six return trips per

Continued on page 30

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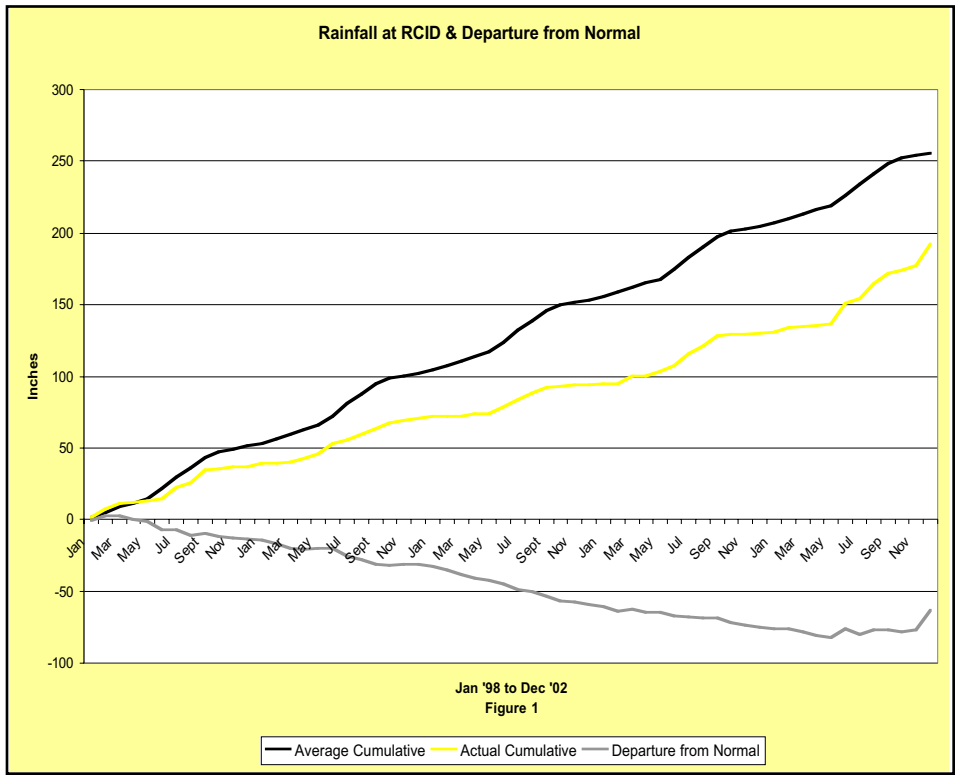

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night. The use of the water buffaloes and filling stations reduced the potable water demand by an estimated 300,000 gallons per day on average at the three theme parks.

A second priority for RCID customers was to convert irrigation uses from a potable-water source to reclaimed water. Landscaping plays an important role in the "show" and a huge investment exists in turf grass, trees, shrubs and annuals, requiring a reliable source of irrigation to protect that investment. Plans and construction for the conversions of three major and three minor customers were accelerated and completed in the spring of 2001. These conversions ranged from the installation of a few feet of pipe and meters to the extension of about 1,000 feet of 8-inch line for one customer. An estimated savings of 460,000 gallons per day of average demand was accomplished with these conversions.

A third area of conversion included cooling-tower makeup. RCID owns and operates some of the largest centralized chiller facilities in Florida to provide chilled water for air-conditioning needs. Also, numerous smaller cooling towers exist at many resorts within the RCID boundaries. These were evaluated and analyzed from a cost-effective viewpoint, and the lowest hanging fruit was chosen for conversion to reclaimed water. The main Central Energy Plant (18,000 tons of air conditioning capacity) and three smaller cooling towers at selected resorts were converted, resulting in an average potable water demand reduction of 350,000 gallons per day.

Conversion of the Central Energy Plant cooling towers required the installation of an on-line phosphorus analyzer in the reclaimed-water feed line to aid the operators in adjusting chemical feed rates for control of fouling in condenser tubes and cooling towers. A slight but insignificant increase in chemical expenditure for anti-foulants resulted from the conversion.

Lastly, about 10 acres of land irrigated for fire suppression purposes were converted to reclaimed water. This land was formerly wetted with potable water to preclude fire hazards. An estimated 100,000 gallons per day of potable water demand reduction was accomplished with this conversion.

Conservation Efforts

Conservation practices played a major role in reducing both reclaimed and potable water demands during the drought, and most of these practices will be continued into the future, regardless of the water-use restriction status. Most of the conservation efforts were for potable water, but some were practiced to conserve reclaimed water. Upon imposition of the water use restrictions, a decision was made to reduce reclaimed water used for irrigation by 10 percent, even though reclaimed water was not subject to restrictions.

Almost all irrigation systems within RCID are operated under the Rainbird Maxicon™ control system, which analyzes a number of soil, weather, and other variables to determine the optimum amount of irrigation required. These control devices were reprogrammed to reduce reclaimed water consumption by 10 percent at all reclaimed-water locations. Areas irrigated with potable water were likewise reprogrammed to restrict irrigation to the maximum application rate of 0.75 inches per week and no more than twice weekly. RCID sought and was granted an exemption from the restrictions on the days of the week that irrigation could be allowed, but this did not result in a net change in consumption or conservation.

Potable water conservation measures were generally in compliance with the water-use restriction guidelines. These included distribution-system pressure reduction in most buildings to 45 psi or less at the most remote plumbing fixtures. Fortunately for RCID, most buildings and customers have separate fire and domestic-service lines and the latter are equipped with pressure-reducing valves

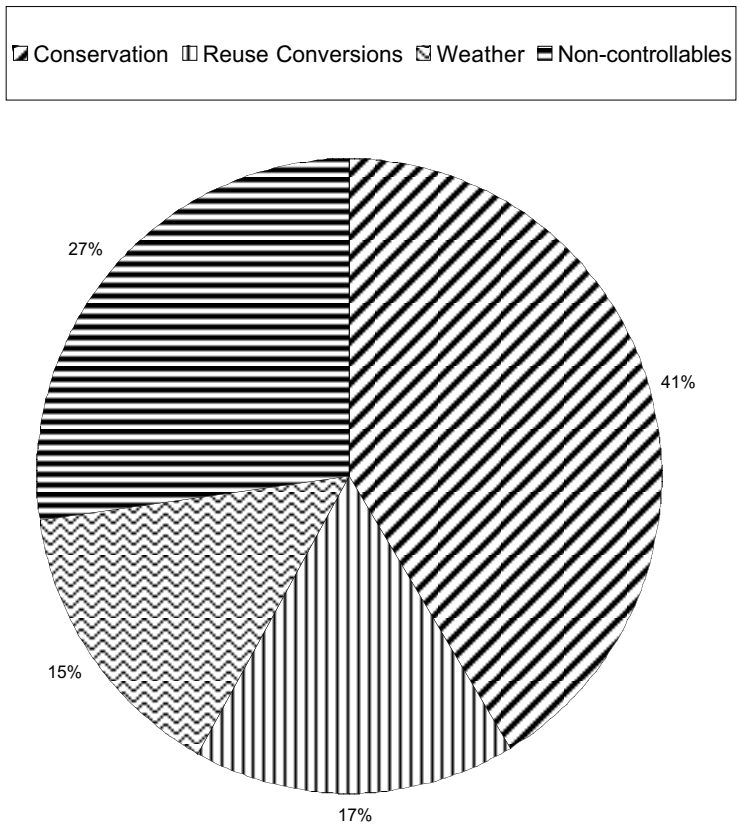
(PRVs); therefore, it was a relatively simple task to reset the PRVs at the buildings to achieve the 45 psi pressure at the top floor in the most remote fixture. The few buildings that were not equipped with PRVs were retrofitted.

The separation of the fire and domestic-service lines allowed the distribution system to maintain its normal pressure level for fire demand and allowed full compliance with the pressure-reduction requirements. Maintaining fire-system pressure was an important consideration in the success of the conservation efforts. If the pressure were lowered significantly, some systems would suffer from inadequate coverage of the sprinklers and others would require alarm settings to be reprogrammed; therefore, maintaining the pressure at normal levels was a prime consideration in maintaining the safety and protection of the building occupants.

Many of the decorative fountains within RCID re-circulate their contents and therefore were not subject to the restrictions. But a few did not and operated as once-through systems. To meet the restrictions, these fountains were discontinued. A few have since been converted to re-circulate their contents, and one was converted to reclaimed water. Fountains that were guest-interactive and non-recirculating were also shut–down. These fountains played a small role in the overall conservation effort, but made a major visual impact and served as a constant reminder to employees and guests about the severity and duration of the drought and the need to conserve.

Additional aesthetic uses of water were also halted. These typically involved the use of water to create a mist or fog-like look for a special effect. While these uses were small and relatively insignificant from a consumption standpoint, their message played an important role in reminding employees and guests of the presence of the restrictions.

Conservation Elements - Represents 4.024 Billion Gallons
Figure 2



Supplemental Sources

In calendar years 2000 through 2002, RCID utilized approximately 60 percent of its total wastewater effluent volume for reuse purposes. The balance was used for groundwater recharge via rapid infiltration basins. Approximately 6.1 MGD, on average, was used by the reuse system in calendar years 2000 through 2002. This represents about 30 percent of the total water resource needs within RCID.

To achieve high effluent utilization rates in the reuse system, supplemental sources of water are typically needed to meet extended-duration peak demands. RCID was no exception to this requirement. When reuse system demands started to exceed 50 percent of the available effluent volume on an annual average basis, mining of the existing storage reservoirs was observed during peak-demand periods. Some irrigation customers with surface-water backup systems were advised to temporarily return to these sources to help meet the supply shortage.

To avoid this condition and plan for the future, RCID looked at possible alternatives that could serve the entire reuse system, rather than rely on selected customers to bear the load. This was accomplished with the conversion of two idle, formerly potable water wells (Wells 13 and 14), to serve as supplemental sources of water to the reclaimed-water system. The wells were equipped with new pumps and motors and piped to the reuse system.

In 2001 and 2002, operation of Well 14 successfully enabled RCID to meet the extended-duration peak demands. Approximately 15 million gallons were pumped from Well 14 in 2001 and 38.8 million gallons in 2002 to supplement the reclaimed water supply. Well 13 has not been required, to date. While the consumption of water from these wells slightly increases RCID's consumptive use withdrawal, their use allows more reclaimed-water customers to be reliably served and thereby reduces the total consumption of water from the Floridan Aquifer.

At RCID, where the major use of reclaimed water is for irrigation, the peak demands must also be met within an eight-hour window, typically between 11 p.m. and 7 a.m. RCID's customers demand that their irrigation systems operate when most people are sleeping. This factor requires significant storage and booster pumping station capacity to meet the daily peak. To meet this need, a third ground storage reservoir of 5 million gallons capacity was added to the existing 10 million gallons of capacity. The reservoir was completed in May 2002. A fourth reservoir is planned for the future.

Assessing the Impacts to the Water Resources

For calendar year 2000, the average daily potable water demand at RCID was 19.95 MGD. For 2001, the demand dropped to 14.57 MGD; for 2002 the demand averaged 14.32 MGD and has remained in this range for 2003. These correspond to 26-percent and 27-percent reductions in demand for CY 2001 and 2002 respectively, when compared to CY 2000 demands. The total annual difference in demand between 2000 and 2001 was 1.969 billion gallons; and 2.055 billion gallons for 2002, with the total reduction just over 4 billion gallons (CY 2000 is considered the base year or year in which comparisons on demand reductions are to be judged, per direction from the SFWMD).

Four major factors are believed to contribute to the demand reduction: conservation practices of potable water, increased use of reclaimed water, differences in

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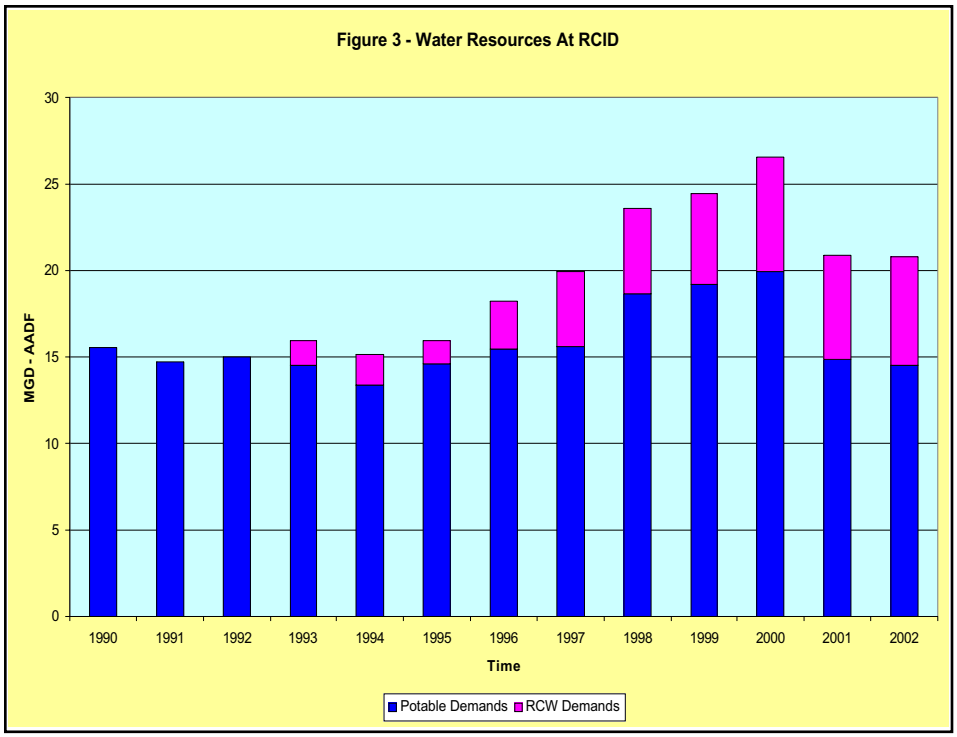

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weather/rainfall, and non-controllable factors such as the general economy and its relationship to the number of guests and employees using the facilities within RCID. Quantifying these differences proved to be relatively simple for the weather and reclaimed-water uses, but were more challenging to measure for conservation and the non-controllable factors.

To quantify reclaimed-water use differences between CY 2000 and 2001 & 2002, the meter readings of the customers converted to reclaimed water were examined and tabulated. Some of the data was adjusted and annualized if the conversion took place after January 1, 2001. This value totaled over 670 million gallons for the two-year period, or 0.92 MGD, on average.

To quantify weather-related differences, two values were evaluated: differences in annual average rainfall and the area irrigated with potable water. The former value amounted to 17.1 inches of rainfall for 2001 and 23.0 inches for 2002. There were 17.1 fewer inches of rainfall in CY 2000 than in CY 2001, and 23.0 fewer inches of rainfall in 2000 than in 2002. These differences are based on the average of eight rainfall gauges throughout RCID.

The latter value (the number of acres of property irrigated with potable water) was determined from aerial photo interpretation using GIS to calculate the areas. This totaled approximately 541.5 acres. The assumption was then made that the irrigation-control systems would account for the rainfall differences and would deliver equivalent volumes of water to any given acre of land (i.e., the rainfall deficit would be made up by the irrigation-control system). The difference in rainfall times the irrigated area therefore accounted for about 590 million gallons of water over the two-year period.

Because of multiple factors influencing potable water consumption, the consumptive differences between 2000 and 2001 & 2002 relating to the changes in business activity (non-controllables) could not be readily calculated; therefore; a different approach was taken. Wastewater records were examined for the two periods and the difference in wastewater volume was assumed to be proportionate to the change in business activity. A 75-percent return factor of wastewater generated from potable water consumed was assumed, based on historic data. From the differences in wastewater volumes and using the assumed return factor, a value was calculated. Non-controllable factors were estimated to account for a potable-water demand reduction of about 1,100 million gallons over the two-year period.

The value attributed to demand reduction from actual conservation practices was assumed to be the difference between the total conservation effort (4,024 MG) and the sum of the above three components (670 + 590 + 1,100 MG). Actual conservation practices therefore amounted to an estimated 1,664 million gallons over the two-year period. **Figure 2** (page 31) is a pie chart that shows the relative contribution of the four components to the total water conservation picture. Customer conversions to reclaimed water accounted for about 17 percent of the total and conservation efforts accounted for about 41 percent of the total. Weather accounted for about 15 percent and non-controllable factors accounted for the balance.

Consumptive Use Ramifications

Like most utilities in Central and South Florida, RCID has a Water Use Permit or Consumptive Use Permit (CUP) that limits the amounts of water used for reasonable, beneficial purposes. The past and current source for the majority of this water for RCID has been the Floridan Aquifer. And like most utilities, obtaining significant additional volumes of groundwater from the Floridan Aquifer is an unlikely prospect for the future. This once-abundant source has reached (some claim exceeded) its sustainable yield, and alternative sources must be sought. Alternative water sources for RCID are few. There are no high-quality, perennial surface waters within a reasonable distance of RCID, the shallow groundwater is of poor quality and yield, and desalination seems unlikely for a utility that is 50 miles from coastal sources; therefore, maximizing the use of reclaimed water and water conservation are the obvious choices for RCID to meet its future consumptive needs, and remain within its CUP limits.

The important and growing role of conservation and reclaimed water in meeting the water-resource needs of RCID is illustrated in **Figure 3**, a bar graph showing historic potable-water consumption since 1990. Stacked on top of the potable consumption is the volume of reclaimed water. The sum is representative of the total water-resource demands within RCID. The graph clearly illustrates the growing role reclaimed water has played in RCID's water resources and shows the dramatic decrease in potable-water consumption for CY2001 and 2002, after implementation of water conservation measures. Without reclaimed water, RCID could have exceeded its CUP limitation (about 23.4 MGD AADF) in 1998, 1999 and 2000. Continued expansion of the reclaimed-water distribution system and continuation of water conservation efforts are expected to enable RCID to remain within its CUP limit well into the future.

Summary

The drought condition from 1998 to 2002 has had a bright side at RCID and resulted in a renewed awareness and appreciation for water, both reclaimed and from the Floridan Aquifer. The expanded and increasing role of reclaimed water in meeting the water-resource needs of RCID has changed preconceptions about its value and utility. Without conservation and reclaimed water, RCID could be facing a serious water crisis in the near future. With reclaimed water and continuing conservation, RCID is looking to effectively and reliably meets its customers' needs for many years.