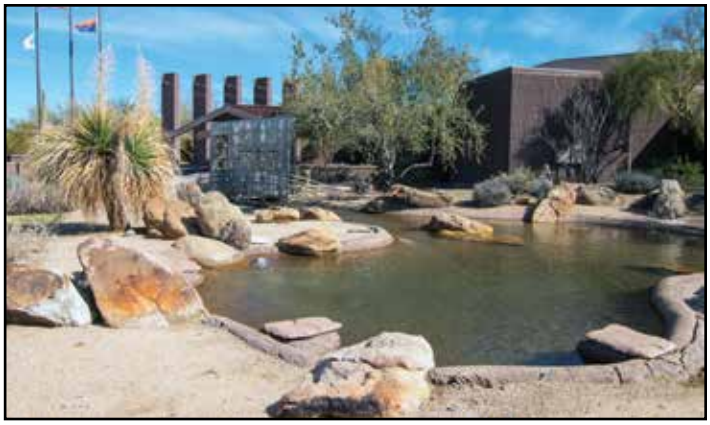
Reusing Water for 90 Years

By Guy W. Carpenter



Scottsdale's water campus produces different qualities of recycled water, tailored for a variety of intended uses.

INTRODUCTION

In 1926, Grand Canyon Village developed the first dual distribution system in the United States. The term *dual distribution* refers to the distribution of potable water through one dedicated delivery system and nonpotable effluent water from sewage treatment through a separate delivery system. For Grand Canyon Village, the water was considered highly treated even by today's standards, undergoing conventional activated sludge, rapid sand filtration, and disinfection with chlorination. Water from the dual distribution system was pumped for 2 miles and used for toilet flushing at the El Tovar Hotel, boiler feed, stationary engines in the power generating plant, and make-up water for steam locomotives.

Today, Arizona derives water from four sources: the Gila River and its tributaries, the Colorado River, groundwater, and reclaimed water. Arizona has invested significant public and private funds in constructing dams and reservoirs, canals, aqueducts, wells, groundwater replenishment projects, and treatment plants to develop and deploy these resources. Although it is difficult to quantify the actual percentage of water recycled in Arizona because of the way reuse applications are permitted, an estimated 90 percent of wastewater in the state is reclaimed and intentionally reused. Thus, Arizona serves as an example of a state that has honored its water sources in the best way possible, through conservation and reuse.

THE EARLY YEARS

Before significant population expansion in the 1980s and 1990s, the beneficial use of effluent was limited to agricultural irrigation and make-up water for cooling towers—primarily for the Palo Verde Nuclear Generating Station (PVNGS).

Beginning in the 1930s, Arizona began the irrigation of nonconsumptive agricultural crops, such as cotton and corn, and fodder crops, such as alfalfa, with treated and disinfected effluent. Today, approximately 20 percent of the Phoenix Active Management Area's agricultural water demand is met with reclaimed water. In the city of Phoenix, a portion of the treated effluent from its two wastewater treatment plants is used for crop irrigation, and Phoenix benefits from exchanges of surface water that can then be treated for drinking water purposes.

Beginning in the 1970s, the PVNGS has used approximately 75,000 acre-feet per year of effluent from three municipal-owned reclamation facilities. Arizona Public Service, the operating entity for the PVNGS, owns a 30-mile pipeline to deliver the effluent to a water reclamation plant that further treats the water to reduce ammonia and hardness. The reclaimed water is then used as cooling tower make-up water for the largest nuclear generating station in the United States, which is capable of producing 4,000 megawatts of energy.

POLICIES AND CASE LAW PROVIDE FRAMEWORK FOR WATER REUSE

In the 1980s and 1990s, Arizona's significant increases in population resulted in rapid urbanization. Concurrently, Arizona developed policies that incentivized water reuse. The first policy was the 1980 Groundwater Management Act (GMA). Essentially, this policy limited groundwater consumption and incentivized the use of reclaimed water to meet long-term demands. The second policy was established by the Arizona Supreme Court case, *Arizona Public Service Company v. John F. Long*, which changed the way effluent was regulated.

The GMA had three primary goals: control severe overdraft throughout Arizona, allocate the state's limited groundwater resources to meet its changing needs, and augment the state's groundwater through water supply development. To accomplish these goals, the GMA instituted a comprehensive management framework and established the Arizona Department of Water Resources (ADWR) to administer the GMA's provisions. The GMA established three levels of water management to respond to various groundwater conditions. The lowest level of management included general statewide provisions; the second level applied to irrigation nonexpansion areas; and the highest level, with the most provisions, applied to active management areas, where groundwater overdraft is most severe.

For active management areas, the GMA required that any entity offering subdivided land for sale or lease demonstrate

an assured supply of water to the ADWR before marketing land to the public. This means that the Arizona Department of Real Estate cannot record a subdivision plat without the applicant demonstrating a 100-year assured water supply. Alternatively, the developer can locate the proposed development within the service area of a city, town, or private water company with a designation of assured water supply from the ADWR, which demonstrates a 100-year assured water supply for an associated projected population. In this case, the developer needs only a written commitment of service from the water provider.

In 1986, two legislative acts significantly incentivized the expanded use of reclaimed water: the Lakes Bill and the Underground Water Storage Act. The Lakes Bill prohibits the construction of new private bodies of water larger than 12,320 square feet used primarily for landscape, scenic, or recreational purposes within an active management area. In the same year, the legislature passed the Underground Water Storage Act, which provided a regulatory framework to allow nongroundwater supplies to be stored in underground aquifers and recovered later through recovery wells, while not being accounted for as groundwater.

The other major policy to influence widespread practice of water reuse is the Arizona Supreme Court case, *Arizona Public Service Company v. John F. Long* (1989). According to this case, effluent is not to be regulated as either surface water or groundwater until the legislature declares otherwise. Until effluent is discharged into a surface water channel, it is owned by the entity that generates it. While finding beneficial uses for effluent, as opposed merely discharging to the environment, had been practiced for years before this case, it is often referred to when determining whether an entity has a right to put reclaimed water to beneficial use.

ARIZONA REUSE PRACTICES TODAY

After the GMA was enacted, and as cities grew and their demands exceeded their legally and physically projected available supplies, effluent was recognized as the only locally available and locally controllable water supply that would increase in volume as the population grew. To help demonstrate a rolling 100-year assured water supply for projected populations, municipal utilities began to invest in water reuse programs that included direct deliveries (purple pipe, or nonpotable, systems) to meet nonpotable demands such as turf irrigation, ornamental lake make-up water, and industrial needs. Through aquifer protection permits issued by the Arizona Department of Environmental Quality and water storage and underground storage facility permits issued by the ADWR, municipal utilities also began developing groundwater replenishment projects to accumulate credits derived from recharging aquifers with reclaimed water. With these measures, many Arizona municipalities achieved nearly 100 percent water reuse, with reclaimed water constituting as much as 30 percent or more of current and future water resource portfolios for some designated water providers.

Snowmaking with recycled water in Flagstaff, Arizona.

CITY OF FLAGSTAFF

Although Flagstaff is not in an active management area, it has a limited availability of groundwater and surface water. As a result, the city began reusing water nearly 45 years ago by delivering effluent to the Continental Country Club. Today, approximately 20 percent of all water used in Flagstaff is direct-delivered reclaimed water, with the remaining reclaimed water used to unintentionally recharge the local aquifers. Reclaimed water is applied to industrial use, toilet flushing, residential lawn and garden watering, snowmaking, park and golf course irrigation, and habitat replenishment along the Rio de Flag. In fact, Arizona is the only state with a ski resort using 100 percent reclaimed water for snowmaking, using water provided by Flagstaff.

CITY OF GOODYEAR

Like many growing cities in the Phoenix metropolitan area, Goodyear initially constructed a purple pipe reclaimed water distribution system to meet nonpotable demands from common areas in residential subdivisions and turf irrigation for golf courses. Since then, the city has faced significant limitations on the long-term availability of groundwater and surface water supplies. In response, Goodyear changed its policy on the availability of reclaimed water for nonpotable demands, deciding to recharge the regional aquifer with all available reclaimed water. Goodyear coupled this policy change with an aggressive water conservation program that aims to ensure the highest and best use of available water supplies for the community's benefit. By recharging available reclaimed water, Goodyear is accumulating groundwater credits that can be pledged toward its 100-year assured water supply.

CITY OF SCOTTSDALE

Since the early 1990s, Scottsdale has provided nonpotable water to 23 golf courses in north Scottsdale through a public-private partnership known as the Reclaimed Water Distribution System (RWDS). When the RWDS was first established, Scottsdale pumped untreated surface water from the Central Arizona Project (CAP) canal to member courses. When the city's water reclamation plant came

online in 1998, the courses began to receive a combination of untreated CAP water and tertiary-treated effluent.

Because of the salt content of the source water and additional discharges of salt from water softeners, the reclaimed water delivered to the golf courses had high salt content, which created challenges with turf germination. In response, the RWDS courses worked out an agreement with Scottsdale to blend a portion of ultrapure water from the city's advanced water treatment facility with the CAP water and effluent to significantly reduce the levels of total dissolved solids (primarily sodium) in the delivered water. To accommodate the additional water, the RWDS golf courses purchased capacity in the advanced water treatment facility, ultimately paying an additional $22.5 million to expand the facility's capacity from 14 million gallons a day to its current capacity of 20 million gallons a day.

In addition to reducing salt concentrations in water delivered to golf courses, the advanced water treatment facility treats effluent from the city's water reclamation plant to ultrapure levels utilizing ozonation, microfiltration, reverse osmosis, and ultraviolet disinfection before recharging the local aquifer through injection wells.

CITY OF TUCSON

Since 1984, Tucson has produced and delivered reclaimed water to nearly 1,000 sites, including 18 golf courses, 50 parks, 65 schools (including the University of Arizona and Pima Community College), and more than 700 single-family homes. Recycled water is one of two renewable water resources (the Colorado River is the other). Producing and using reclaimed water for irrigation saves groundwater and Colorado River water for drinking.

In 2013, Tucson Water completed a recycled water master plan, which resulted in a recycled water implementation plan that consists of public outreach, scoping an indirect potable reuse project, and researching and designing an indirect potable reuse demonstration facility. Although Tucson may not need potable reuse for decades, steady progress of public outreach and the research of evolving treatment technologies are essential to plan for a safe, reliable, and assured water supply.

THE ROLE OF RECLAIMED WATER IN MEETING GROUNDWATER REPLENISHMENT OBLIGATIONS

In 1993, the Arizona legislature created a groundwater replenishment authority that would be operated by the Central Arizona Groundwater Replenishment District (CAGRD). The CAGRD's purpose is to provide a mechanism for landowners and water providers that do not have direct access to the CAP canal, or do not otherwise have sufficient water supplies, to demonstrate an assured water supply. Essentially, landowners and water providers enrolled in the CAGRD can pump and use groundwater, which the CAGRD replenishes on their behalf.

Historically, to replenish the aquifer on behalf of its members, the CAGRD used CAP water that subcontractors did not use. However, as subcontractors grew into their available subcontract volumes, less excess CAP water became available, forcing the CAGRD to seek and acquire other water resources, such as reclaimed water, to meet the replenishment obligations.

Currently, the state's first-ever public-private reclaimed water recharge facility is being built through a partnership between the CAGRD and Liberty Utilities, an investor-owned utility. The new recharge facility will be located in the city of Goodyear, where Liberty Utilities has 12 wells that pump from the same aquifer that this project will recharge. At the recharge facility, water will be delivered to large, shallow basins where it will percolate into the aquifer. This will also help the CAGRD meet its replenishment obligations through an arrangement that lets CAGRD own the stored water. The water supply will come from Liberty Utilities' Palm Valley Water Reclamation Plant, which produces approximately 3.5 million gallons per day of A+ reclaimed water. It is also anticipated that additional similar partnerships and arrangements will be developed with other investor-owned and public utilities in the future.

THE FUTURE OF WATER REUSE IN ARIZONA

Reusing water in Arizona for groundwater replenishment and to meet nonpotable demands will continue. However, as people become more confident in the use of reclaimed water for potable purposes, and as demands consume other cost-effective supplies, growing cities will be expected to turn to potable reuse as a realistic water management solution. Recent public policy reports have been explicit about the need for increased water reuse, including for potable purposes. In February 2016, the Arizona Department of Environmental Quality initiated the process of updating Arizona's water reuse rules, which will likely include rules for direct potable reuse.

While there is no reported demand for potable reuse rules that would allow a utility to proceed with a potable reuse project, developing a regulatory framework now that fits into Arizona's other water quality and water resource management regulations and rules is prudent. Arizona has a long and proud history of planning for reliable water supply in its semiarid climate. Planning for the safe and reliable use of reclaimed water as a source of supply for the production of drinking water is one of the next steps in continuing that history.

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