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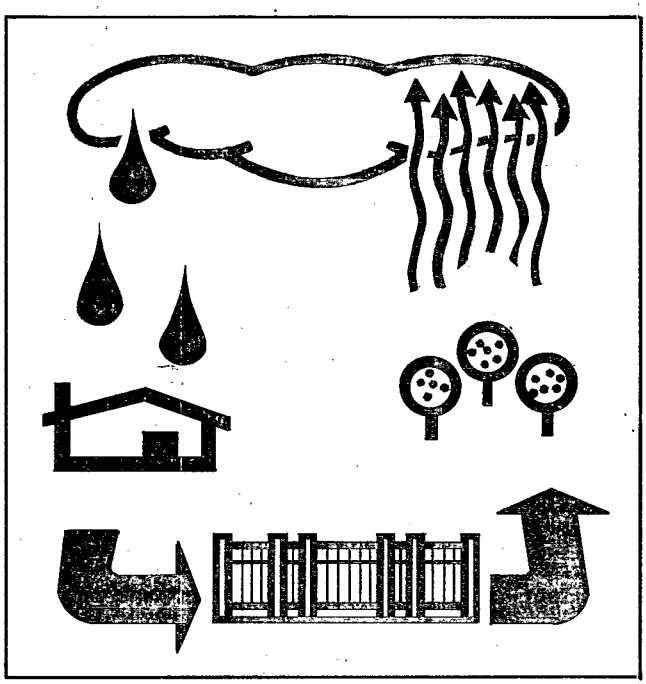
Water Reuse Via Dual Distribution Systems



Public Acceptance
Colorado Springs' non-potable irrigation system has a history of trouble-free operation with regard to community health. An extensive epidemiology study to assess the impacts of the system on community health has indicated that there are no apparent differences in gastrointestinal illness rates between users of parks irrigated with potable versus non-potable water. Public acceptance of reuse technology in general, and the existing irrigation system in particular, is high. Strong local participation in the Areawide Water Quality Management Plan (the 208 Plan) has resulted in repeated endorsement of wastewater reuse.

St. Petersburg, Florida

The city of St. Petersburg operates the largest effluent spray irrigation system in the United States. In response to PL 92-500 and a state legislative act that required either advanced treatment or zero discharge to Tampa Bay, the City Council adopted the concept of zero discharge through wastewater reuse in 1977.

Three of the City's four wastewater plants currently supply water to the effluent distribution system. When the fourth plant is tied to the system (scheduled for 1986), the recycled water potential will increase to 68.4 mgd. Although current demand requirements are less than 20 mgd, the City's program for extending the dual water system will continue to increase effluent usage. In addition, other nearby communities may eventually use the City's effluent.

System Design
Each of the four wastewater plants is a standard Complete Mix Activated Sludge plant without primary clarifiers. Complete Mix requires a shorter aeration detention time for treatment, and therefore, a smaller aeration basin. The shorter aeration period normally prevents nitrification. The nitrogen and phosphorus in the effluent reduce lawn fertilizer requirements - a good selling point. A treated wastewater main ties all four plants together in a complete loop, eliminating any problems in supply or pressure drops due to shut-down at any one plant.

Probably the most important process in meeting effluent quality restrictions is filtration. Pre-filter alum addition for enhanced solids capture is used at two of the plants. Sufficient chlorination after the filters is also important in disinfection and virus inactivation.

With the major percentage of reuse irrigation at night, a shift in effluent discharge from the normal daily flow is required. Four ground storage tanks (capacity 23

Water Reuse Via Dual Distrib

Introduction

Many communities are experiencing water supply shortages. In particular, communities with rapidly growing populations, in arid climates, or with partial water supply contamination, may have a demand for water that exceeds their supply. One remedy to this problem is development of a dual distribution water reuse system. Dual distribution water systems transport reclaimed water from treatment plants to irrigation or industrial sites. In many areas, development of a wastewater reuse system would provide reclaimed water at a lower cost than potable water. Substitution of reclaimed water for potable water can reduce demands on ground water supplies and can reduce or eliminate the amount of wastewater treatment plant effluent discharged to environmentally stressed surface waters (See Figure 1).

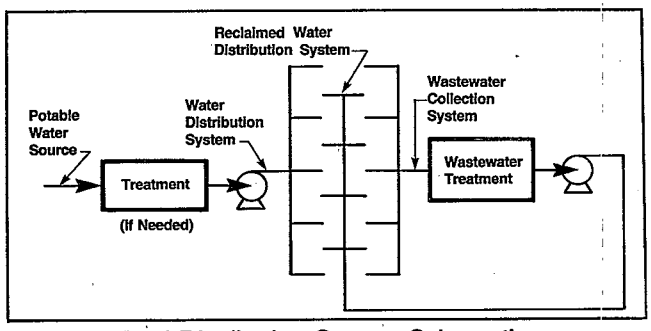


Figure 1. Dual Distribution System Schematic

A look at four operating dual distribution systems shows a cross-section of benefits available from operating a wastewater reuse system. The experiences of the wastewater reuse facilities in Irvine, CA; Tucson, AZ; Colorado Springs, CO; and St Petersburg, FL clearly demonstrate the benefits of utilizing this kind of wise management of a scarce and vital resource...our water.

Irvine, California

Nature intended this land to be brown; if you want it to be green, bring your own water.

So go the opening lines of a historical article about Southern California, where Orange County's Irvine Ranch Water District (IRWD) is located. Encompassing 70,000 acres, nearly one-sixth of the county, IRWD imports water from the Feather River in north-central California via the California Aqueduct and from the Colorado River via the Colorado River Aqueduct.

Public Acceptance

It would not have been possible for a project such as Tucson's to be constructed and institutionalized in such a short time without political leadership and widespread public acceptance. Public officials in Tucson are committed to managing the region's limited water supply. The reuse of reclaimed effluent is an important element in achieving the basinwide water balance mandated by state law.

Colorado Springs, Colorado

Colorado Springs has reclaimed wastewater for landscape irrigation since 1955. Secondary effluent from both an activated sludge treatment plant and a trickling filter plant is polished by seven gravity sand/anthracite dual media filters and stored in uncovered reservoirs prior to final chlorination and distribution. The system has a production capacity of 10 mgd. Non-potable irrigation water is delivered to users via a 13-mile distribution system. Average daily summer irrigation use is 5 mgd. Non-potable water is used to irrigate approximately 600 acres of landscaping in Colorado Springs including the wastewater treatment facility, municipal parks, golf courses, cemetaries, and private commercial establishments. Also, construction firms purchase non-potable water for construction purposes and dust control.

System Operation

The sand filtration operation is manned by wastewater treatment facility personnel, while the distribution-system and storage lakes are maintained by a single caretaker. Non-potable system customers own and operate the distribution system on their own sites in accordance with a Use Policy issued and enforced by the City Wastewater Division in accordance with guidelines from the Colorado Department of Health. The Wastewater Division conducts an extensive sampling program of the irrigation system to assure a high quality product.

Costs

The reclaimed wastewater portion of the irrigation system was put on line in 1955 and expanded in 1971. The system is financed entirely by user charges. The non-potable water rate is set at $.54 per hundred cubic feet as opposed to a potable water rate of $1.22 per hundred cubic feet. Since Colorado water law operates on the appropriations doctrine, the non-potable irrigation system is an important element in the plan for the beneficial use of Colorado Springs water resources. This indirect economic benefit of securing the city's water rights vastly outweighs the operating expenses of the irrigation system.

tion Systems

IRWD's Plan for Water Reclamation
Once imported, the water used and disposed of as sewage by the District's 35,000 customers is reclaimed. Reclaimed water, about 9 mgd in 1984, irrigates cropland, a regional park, school grounds, street medians and edgeways, golf courses, residential lawns, and greenbelt pathways. Wastewater is reclaimed and recycled by the District at the Michelson plant rather than disposed of into streams or the nearby Pacific Ocean. IRWD's Water Resources Master Plan of 1972 triggered the construction of suitable treatment facilities and the requirement that any new development include dual distribution facilities for potable and reclaimed water.

The Treatment Process
Sewage treatment at the Michelson plant is fairly typical, consisting of conventional primary and activated sludge treatment, with a capacity of 15 mgd. The reclaimed water facilities consist of the addition of coagulation chemicals, direct filtration (seven sand/fine carbon gravity filters), and two-hour chlorination.

All effluent leaving the plant must meet strict water quality criteria established by the California Department of Health Services. Stringent reliability features are included throughout the plant and storage ponds are available to contain, and return to treatment, any plant effluent not meeting the criteria.

Dual Distribution System
The dual distribution system includes an extensive array of storage reservoirs, pump stations, and a transmission/distribution piping system. Water in the dual distribution system is available upon demand by customers. It is delivered through regular service connections and meter facilities. In most cases use of reclaimed water for landscape irrigation must occur between the hours of 9 p.m. and 6 a.m. Automatic controllers are used throughout.

Reclaimed water is sold at 85% of the price of domestic water. The reduction in price is in recognition of the limitations upon use and as an incentive for choosing reclaimed water. The costs of reclamation and operation of a dual distribution system are high. Under 1984 conditions, the IRWD reclaimed-water system required a small payment in lieu of alternative disposal costs from the users of the sewerage system.

City of Tucson, Arizona

In Tucson, a Metropolitan Wastewater Reuse Assessment was completed in March of 1983 to assess the demand for reclaimed water for turf irrigation in the metropolitan area (See Figure 2). The results of this study were used to provide a basic plan for a reclaimed water system providing pretreatment by pressure filtration of 8.2 mgd (expandable to 25 mgd). The project was completely constructed with local funds and was designed and placed in operation in only eight months.

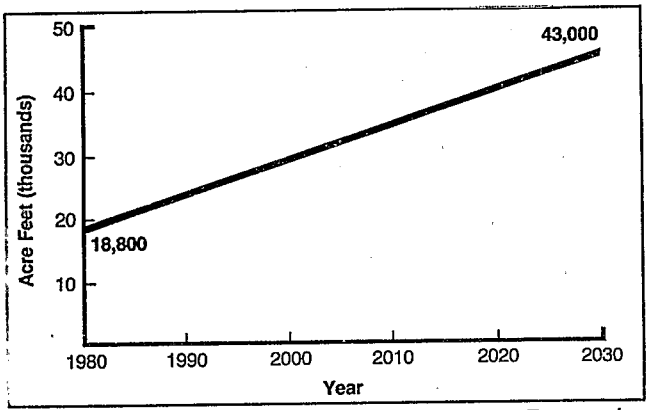


Figure 2. Projected Annual Reclaimed Water Demand for Turf Irrigation

A demonstration recharge project is being constructed to store up to 1.5 mgd of reclaimed water underground during low demand winter months which will be pumped to the system during peak summer demand. The Recharge Project will be studied to evaluate the treatment provided by the vadose (unsaturated soils) zone to assess the potential application of this treatment for future recharge projects.

Costs

A 10-year capital program is in place to provide 24,000 acre-feet per year of reclaimed water to identified users at a cost of $39 million. Operating and maintenance costs are projected to be $70 per acre-foot which includes $24 per acre-foot for pumping. Users of the reclaimed water pay 80% of the applicable potable water rate, presently $348 per acre-foot.

Effects on Potable Water System

As turf irrigation users shift from the potable system to reclaimed water, overall utility revenues will decline somewhat. This loss of revenue is generally offset by the reduced need for well capacity. More importantly, the reclaimed water system allows high quality, potable ground water to be reserved for future use by Tucson's growing population.

million gallons) provide the reservoir for nighttime pumping. The closed storage tanks eliminate algae problems, as well as mosquitoes, bird contamination, etc.

Effluent Disposal System

Effluent disposal is accomplished through spray irrigation or deep-well injection. The spray irrigation system consists of a complete secondary water main of 100 miles, carrying effluent to the four quadrants of the City. Branches of the water main supply both large water users - golf courses, parks, school grounds - and also the critical water quality (CWQ) areas. CWQ areas (generally residential users) are areas where wells produce salt water, which is unacceptable for irrigation and would therefore require potable water for irrigation.

Excess effluent not used for irrigation is injected via deep wells into a brine zone a thousand feet below the ground. An impermeable layer of rock and clay over-laying the brine zone prevents vertical migration of the effluent, eliminating the possibility of contaminating ground water.

Reclaimed Water Use

Since the program was initiated in 1977, the City has experienced a substantial decline in the increasing rate of potable water consumption and attributes this decline to the introduction of the Reclaimed Water System (See Figure 3). Reclaimed water, on a limited scale, is

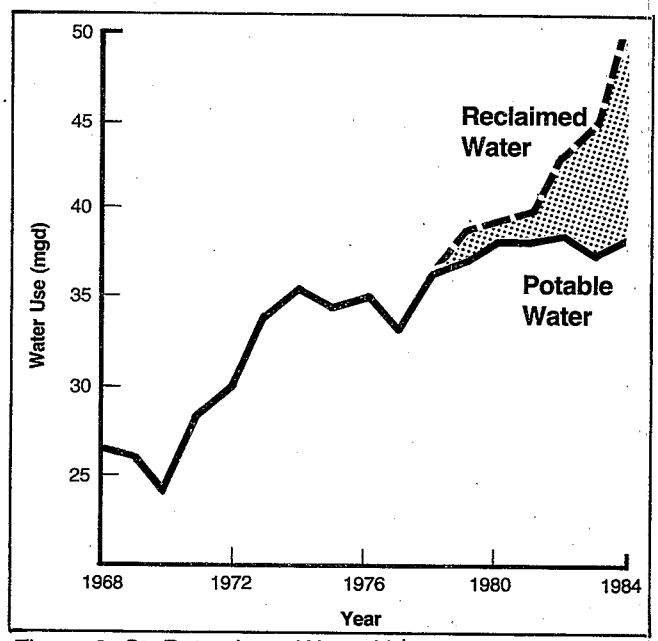


Figure 3. St. Petersburg Water Usage

available throughout the current system for fire protection. The City is also engaged in a pilot program utilizing the reclaimed water as make-up water for cooling towers, illustrating the flexibility of the system.

Charges for reclaimed water are based on the area to be served, not on water volume. Currently, charges for the first acre or less are $6.00 per month for unrestricted use. Large users pay an additional $1.20 per half acre irrigated. These sites are not metered. The exception to this is the industrial user, where the water is used for boiler make-up or cooling water, etc. The charge for metered industrial users is 25 cents per thousand gallons.

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