

Extending the Nation's Water Supply

Treated Wastewater Is a Valuable Resource

by Caigan M. McKenzie
NESCS Staff Writer

Droughts and explosive population growth in arid parts of the country have come close to drying up many water sources. But some communities across the nation have found an alternative water supply in wastewater reuse to help them meet existing and future needs. Wastewater reuse not only conserves highly treated, expensive drinking water supplies, it reduces the release of nutrient-rich wastewater into environmentally stressed streams and rivers, providing an economical way to meet increasingly more stringent discharge standards.

What is wastewater reuse?

The U.S. Environmental Protection Agency (EPA) defines wastewater reuse as, "using wastewater or reclaimed water from one application for another application. The deliberate use of reclaimed water or wastewater must be in compliance with applicable rules for a beneficial purpose (landscape irrigation, agricultural irrigation, aesthetic uses, ground water recharge, industrial uses, and fire protection)." Although not everyone agrees, the term wastewater reuse is often used synonymously with the terms wastewater recycling and wastewater reclamation.



How can wastewater be reused?

Wastewater reuse can be grouped into the following categories:

- Urban reuse—the irrigation of public parks, school yards, highway medians, and residential landscapes, as well as for fire protection and toilet flushing in commercial and industrial buildings.
- Agricultural reuse—irrigation of nonfood crops, such as fodder and fiber, commercial nurseries, and pasture lands. High-quality reclaimed water is used to irrigate food crops.
- Recreational impoundments—such as ponds and lakes.
- Environmental reuse—creating artificial wetlands, enhancing natural wetlands, and sustaining stream flows.
- Industrial reuse—process or makeup water and cooling tower water.

Irrigation is the most common application of wastewater reuse.

"In North Carolina, we have about 50 golf course irrigation projects approved in the state," says Robert Rubin, professor emeritus, North Carolina State University, and senior environmental scientist, McKim and Creed, Raleigh, North Carolina. "We used advanced treatment, dual disinfection, filtration, and then irrigation. If we don't need to use the water on a particular day, we store it. But beginning with the middle of summer, just one of our golf courses will use between a half million to a million gallons of water a day."

Reuse Use and Technology

According to EPA, the U.S. reuses an estimated 1.7 billion gallons of wastewater each day with Florida and California leading the nation by reusing an average of 500 million gallons per day (mgd).

Nationally, the estimate is that six percent of wastewater collected and treated by organized wastewater utilities is distributed and beneficially reused. "The amount of intentional reuse varies from zero in many states to 52 percent of the reclaimed water being reused in Florida," says Don Vandertulip, chair, Water Environment Federation Water Reuse Committee. "I say intentionally because most of the wastewater discharged to a surface water flows downstream and at some point, the creek or river or lake, the water is withdrawn and used for irrigation or as source water for a water treatment plant providing potable water for the public in another community."

The technology selected for reuse depends upon the specific treatment goals. "You always start at a baseline, and for reuse, the baseline is contact water quality," says Anish Jantrania, technical director of NCS Wastewater Solutions. "At this base level, you need to start with aerobic treatment followed by at least one level of disinfection, such as ultraviolet or chlorine, so that the pathogens, BOD [biochemical oxygen demand], and suspended solids can be removed. This is the basic goal of treatment, and there are quite a few technologies that will get you there."

"You can start with a recirculating media filter, for instance, such as a sand filter, textile filter, or peat filter," Jantrania continues. "When these filters are properly sized and followed by an ultraviolet disinfection, you should get contact water quality; this assumes, of course, that the system is properly maintained and managed. This quality of water can definitely be used for agriculture, home garden or ground irrigation, and it is beneficial because it still contains its nutrients while being stripped of its organic and bacteriological contamination. Water treated at this level of treatment can also be used for toilet flushing."

"The high end of the technology typically works with membrane bioreactors (MBR)," he says. "Basically what MBRs do is allow you to focus on nutrient reduction. An example would be urban reuse where you have a large quantity of sewage coming into the water and you want to clean the water and reuse it in people's homes."

Reuse at the Heart of “Triple Bottom Line” Concept

Developers in Victoria, British Columbia, turned a brownfield into a mixed commercial and residential development named Docksider Green. Its sustainable design boasts an on-site sewage treatment plant that will process 100 per cent of its sewage, satisfying the water needs for toilet flushing, landscape irrigation, green roof watering, and an onsite natural stream channel and pond complex. Compared to similar developments, its annual water usage savings is more than 84 million gallons; its annual potable water consumption savings is 66.5 per cent, and its annual energy savings is 49 per cent.

Docksider Green was designed using the triple bottom line approach, which integrates equally into the design process the economic, social, and environmental responsibilities of a corporation, explains Patrick Lucey, president and senior aquatic ecologist, Aqua-Tex Consulting, Ltd., Victoria, British Columbia.

“The triple bottom line is where you begin with a regenerative design that restores the ecosystem function and natural capital, and then build in the social equity as part of the design process,” Lucey says. “Those societies that are able to adopt a regenerative adaptive design process will be the ones that will be the most flexible and the most able to meet a changing environment.”

Lucey explains that shifting to a sustainability by design model of development requires that we look at nature’s two key design principles: nature has no waste, only resources, and nature uses a closed-looped design process, not an open one where wastes are discarded.

“So, the type of design process we are talking about is where you shift from waste management to resource recovery,” Lucey says. “That immediately places you in a valuation economic mode. Then you need to ask what is the highest and best use for that particular resource. So, instead of a sewage treatment plant, for instance, you go to a water and energy recovery cell so you can recover all of the solids, which are full of energy, and recover all of the water, which can be used for reclaim purposes. And you are probably going to adopt a decentralized system since it makes resource recovery easier than with a large centralized system.”

Learn more about Docksider Green at www.docksidergreen.com.

Barriers to Wastewater Reuse

EPA sees reuse as a local/regional issue, so reuse regulation is highly decentralized, with each state formulating its own regulations. “Regulatory agencies allow and even promote reuse for traditional, outside uses, but they become nervous about using this water indoors,” says Rubin. “In North Carolina, some reclaimed water projects have been approved for indoor use for toilet flushing.”

Wastewater professionals agree that the primary barrier to reuse is an uninformed public’s perception of the quality of the reused water. “This has been discussed as the ‘yuck’ factor,” says Vandertulip. “The facts are that an organized utility can collect and treat the wastewater generated in a community to a higher quality than waters in most natural water bodies in the local area.”

Rubin points out that many professional wastewater associations, colleges, universities, and the U.S. Department of Agriculture are working through educational efforts to dispel the myths and to encourage reuse.

A second barrier is regulatory, Vandertulip explains. While many states allow water reuse, not all of them do; and the type of reuse allowed in some states may not be allowed in other states. “Water rights regulations and permits also restrict the ability to reuse water as some withdrawal permits require return of a specified percentage of the water. In some cases, water could be used in an adjoining community, but that community is in another river basin and state laws do not allow inter-basin transfer of the water.”

Vandertulip says a third barrier was recently introduced in Florida. “The state decided that reclaimed water overspray and runoff contributes to nutrient loadings and must be considered in TMDL total nutrient loadings. This seems to be an extension of doing all that can be done beyond limits of technology on point sources and not being willing to control nonpoint sources. This interpretation will likely cause a lot of work for property owners and utilities to eliminate overspray and runoff and could influence some property owners to not use reclaimed water.”

Yelm, Washington

One community that has successfully implemented a reuse program is Yelm, Washington. In 1994, the city constructed a sewer system; but because it discharged treated wastewater into the river, wastewater managers were politically pressured to find another use for the water. So, in 2001, the city built an \$11 million water reclamation facility rated for one million gpd; currently it recycles 350,000 gpd.



“Our collection system consists of septic tanks with pumps in them, and, instead of drainfields, the effluent is pumped to a pressure main, which goes to the facility here,” says Jim Doty, plant manager. “After the water reaches the facility, it goes to a sequencing batch reactor; we have two of them with one in reserve. The water then flows into an equalization basin, which is basically a pond; and it is pumped from the pond through sand filters that are continuous cleaning, so they don’t have to be backwashed. Finally, the water gets chlorinated, then it goes out for reuse. The facility produces Class A reclaimed water, and it has won statewide recognition and numerous awards.

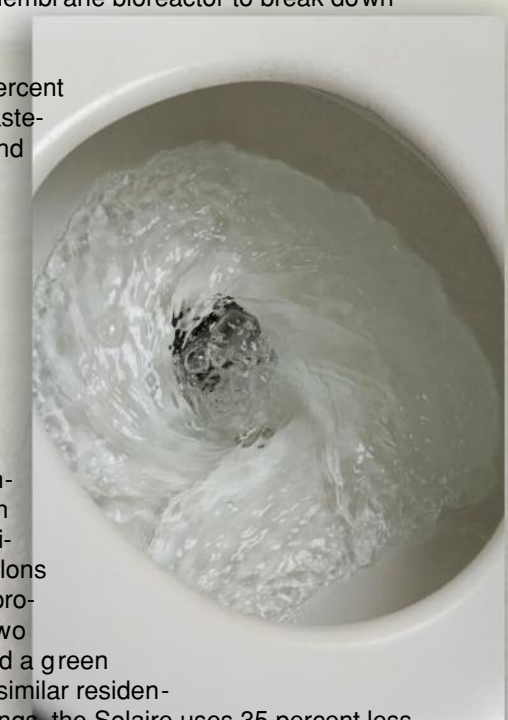
“We reuse the water to irrigate school playgrounds, ball fields, and city parks, and we have never had an illness related to its use.”

Doty explains that when the plant was being designed, they worked with the high school drama department to put on a play about reclaimed water to educate the public. They also did other outreach activities, such as community meetings, but mostly worked with elementary schools. “Our thinking was that the way to get acceptance is to work with the young kids, and, hopefully, they will turn their parents around.”

Doty explains that using reclaimed water in the home, such as for toilet flushing, is prohibited in Washington, and he points out that it would be cost prohibitive to hook up homeowners anyway because they would use such a small amount of the water, primarily for watering lawns and gardens.

Another example of reuse, but on an urban scale, is the Solaire, a residential high-rise located in lower Manhattan, hailed as the first green, environmentally friendly apartment building in the U.S. The high-rise houses its own onsite wastewater treatment and reuse system, which relies on a membrane bioreactor to break down the waste.

One hundred percent of the building’s wastewater is recycled and used for HVAC cooling and toilet flushing. In addition, 5,000 gallons per day of the recycled wastewater provides subsurface irrigation to an adjacent public park. A stormwater catchment system, which will capture approximately 170,000 gallons of water per year, provides irrigation to two rooftop gardens and a green roof. Compared to similar residential, high-rise buildings, the Solaire uses 35 percent less energy and 50 percent less potable water.



Wastewater Reuse Advantages and Disadvantages

Advantages

- This technology reduces the demands on potable sources of freshwater.
- It may reduce the need for large wastewater treatment systems, if significant portions of the waste stream are reused or recycled.
- The technology may diminish the volume of wastewater discharged, resulting in a beneficial impact on the aquatic environment.
- Capital costs are low to medium for most systems and are recoverable in a very short time; this excludes systems designed for direct reuse of sewage water.
- Operation and maintenance are relatively simple except in direct reuse systems where more extensive technology and quality control are required.
- Provision of nutrient-rich wastewaters can increase agricultural production in water-poor areas.
- Pollution of rivers and groundwaters may be reduced.
- Lawn maintenance and golf course irrigation is facilitated in resort areas.
- In most cases, the quality of the wastewater, as an irrigation water supply, is superior to that of well water.

Disadvantages

- If implemented on a large scale, revenues to water supply and wastewater utilities may fall as the demand for potable water for non-potable uses and the discharge of wastewaters is reduced.
- Reuse of wastewater may be seasonal in nature, resulting in the overloading of treatment and disposal facilities during the rainy season; if the wet season is of long duration and/or high intensity, the seasonal discharge of raw wastewaters may occur.
- Health problems, such as water-borne diseases and skin irritations, may occur in people coming into direct contact with reused wastewater.
- Gases, such as sulfuric acid, produced during the treatment process can result in chronic health problems.
- In some cases, reuse of wastewater is not economically feasible because of the requirement for an additional distribution system.
- Application of untreated wastewater as irrigation water or as injected recharge water may result in groundwater contamination.

Source: Organization of American States. *Water Reuse*.

What's the future of reuse?

"Water reuse is the future of the water industry," says Rubin. "It is a finite resource that has recycled itself through the water cycle for billions of years, and all we are doing is capitalizing on that by using current technology to speed up the natural process."

"In the next 15 years or so, the population in the U.S. is expected to increase by 25 percent, and if you believe anything about climate change (not the same as global warming), the frequency and intensity of rainfall events are going to change, requiring us to find better ways of managing water resources. In short, reuse can satisfy a significant water demand, and the supplanted demand is particularly significant in water short areas."

"But it's not just about managing water resources; it's about managing all of our resources. In California, for instance, 20 percent of the state's electrical energy is used for moving water from one place to another. Nationwide, depending on where you are, it's between five to 10 percent to move water. As we look at improving our water management strategies, which includes reuse, the amount of energy we need to transport water is going to be reduced."

References

Doty, Jim; Anish Jantrania; Patrick Lucey; Robert Rubin; and Don Vandertulip. Interviews with author, February 2010.

U.S. Environmental Protection Agency. 2004. *Guidelines for Water Reuse*. Accessed at <http://epa.gov/nrmrl/pubs/625r04108/625r04108chap4.pdf>

For More Information

The WaterReuse Foundation has developed a comprehensive database of nationwide reuse programs and facilities that can be used by agencies, utilities, consultants, and reuse water customers to advance the practice of water reuse at the local, regional, state, and national levels. Visit their website at: www.watereuse.org/files/s/docs/02-004-01.pdf

The U.S. Environmental Protection Agency's *Guidelines for Water Reuse* summarize water reuse for utilities and regulatory agencies. It covers water reclamation for nonpotable urban, industrial, and agricultural reuse as well as augmentation of potable water supplies through indirect reuse. Technical, regulatory, legal, funding, and public involvement issues related to water reuse are discussed. These guidelines can be downloaded at: www.epa.gov/ORD/NRMRL/pubs/625r04108/625r04108.htm.