Financial and environmental returns crucial to water supply strategy

Fierce competition for water supplies will continue to mount as populations grow, standards of living improve, and energy demands rise. The result will be greater consideration of the source, degree of treatment, use, and reuse of water, according to **Jim Lauria** of Amiad Filtration Systems. Managing those variables will require consideration of both return on investment (ROI) and return on environment (ROE).

As the world's population heads toward nine billion and standards of living rise around the globe, nearly every sector of growth – from indoor plumbing to energy, heating and cooling, consumer goods, meat and vegetables – will directly exert pressure on water supplies.

In the near future, new sources of water will continually be explored, often starting with lower-quality supplies to slake the thirst of people, crops, and industry. Water will be allocated more carefully, flowing toward centers of economic or political influence rather than traditional outlets such as farms and ranches. Pressure – economic, political, and social – will be high to use water efficiently and to reuse again and perhaps for a second time.

Increasing scrutiny of water resources is already leading to a better understanding among the public of water's ties to energy. It takes energy to pump and treat water. In turn, water is required to extract, refine, and convert fossil fuels into power. Recognition of this energy-water nexus is helping to drive a greater appreciation for the idea that water must not only deliver a return on investment (ROI), but also a return on environment (ROE). Every drop of water must count in regards to economy and the environment given increasing water scarcity.

Targeted treatment

The first step in managing water for ROI and ROE is determining the most appropriate level of treatment. Today's best water managers – and all managers in the future – will consider the use of water, how it may be reused downstream, and what degree and technology of treatment will allow the water to achieve its optimum condition for those uses.

An example from Israel, arguably the most water-efficient nation on earth, illustrates the point. Approximately 75 percent of Israel's wastewater is treated and reused for irrigating crops and public spaces. Several years ago, farmers found that their treated wastewater contained three times the level of boron known to damage many crops. The Israeli government sat down with detergent manufacturers and worked out a plan to create and market boron-free detergents in the country. Boron levels in domestic wastewater dropped precipitously, laundry remains bright and clean, and treated wastewater now safely accounts for half of the nation's irrigation supply.

Israeli wastewater treatment experts recognize that over-treating wastewater needlessly generates high energy bills, elevates greenhouse gas emissions, and results in supplies of mineral waste that require costly disposal. Understanding the country's soils and the ions and nutrients that they can sustainably adsorb allows the water industry to optimize treatment. The same approach, looking upstream at supply and downstream at use, can be scaled down to an individual municipality, industrial site, or farm.

High-quality sources

This approach works with even the most optimal water supplies. A growing city in the western United States draws its municipal water from a pair of high-elevation lakes in the Rocky Mountains. Its pretreatment facility includes a rapid mix, flocculation, and plate-settling basin prior to a submerged PVDF micro-filtration membrane system.

Summer algal blooms can drive turbidity in the system as high as 50 NTUs. Protecting the membranes from algae, whose deformability and biological activity makes it an especially pernicious contaminant, is paramount. An Amiad EBS automatic self-cleaning screen filter provides a critical line of defense after the clarifier. The buildup of algae and sludge creates a pressure differential between the dirty and clean sides of the system, so a cleaning valve opens and the pressure differential back flushes the screen. Nozzles travel in a spiral pattern across the entire surface, focusing the back flush power onto 2.5 square centimeters of screen at a time for thorough, water-efficient cleaning.

The return on environment can be tallied many ways. Minimizing solids that must be captured by the membranes reduces the need for costly, chemical-intensive membrane cleanings. It improves the performance by the membrane, and can reduce the amount of pressure required to operate the system. The environmental benefit

Israel's wastewater reuse program considers source water quality and end uses for wastewater, and then treats the water appropriately to deliver economic and ecological returns. Photo by Amiad Filtration Systems

> **Water must show a return on investment and environment.**
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> Jim Lauria, Amiad Filtration Systems

can also be viewed directly in the wastewater capture tank at the water treatment plant. Only 0.1 percent of the system's total flow must be discharged as wastewater on an average day; the rest serves the community.

The same automatic self-cleaning screen filtration technology is in use around the world. In a small drinking water treatment plant along India's Cauvery River, four 25-micron automatic self-cleaning screen filters are followed by five two-micron Amiad automatic micro fiber (AMF) filtration systems, which capture solids in cassettes of tightly wound polyester threads. Like the screen units, the AMFs engage a self-cleaning cycle when a target pressure differential is reached. In the case of the AMF systems, a high-pressure stream of water is deflected off of a grooved plate in the core of each cassette, directing the water through the fibers to dislodge trapped solids.

The AMF technology delivers filtration fine enough to provide three-log (99.9 percent) removal of Giardia and Cryptosporidium cysts from the water supply without disposable cartridges or chemicals, saving significant economic and environmental costs. Minimizing solids reduces tie-up of chlorine and lowers the chance of creating disinfection byproducts (DBPs) during chlorination.

Removing solids prior to disinfection also delivers a positive ROI and ROE where filtration systems protect ozonation and ultraviolet (UV) systems. Like chlorine, energy-intensive ozone can be tied up by solids in water, and may produce DBPs in the presence of some organic contaminants. Suspended particles can reduce the absorption of germicidal wavelengths of UV light, scatter beams, or shield pathogens from the rays. According to one manufacturer of UV systems, performance of UV disinfection at 254 nm drops by one percent of transmittance for every 2 NTUs of turbidity.

Reaching farther

Approaches to reducing the economic and environmental cost of drinking water treatment come into sharper relief when the source water is of lower quality. For instance, to meet demands from an 18-percent growth spurt, a southwestern US city expanded its drinking water system to include a brackish well. The highly saline water was extremely challenging to treat with cartridge filters and skid-mounted membranes. Its silt density index measurement surpassed 3.0.

At first, the system's one-micron cartridge filters required replacement every 10 days, stacking up high material, labor, and disposal costs. Protecting those filters with a battery of five-micron cartridges extended the change-out interval to 30 days, but costs remained high.

The city then installed an EBS automatic self-cleaning screen filter as well as a sulfuric acid/sodium hydroxide treatment system. Drinking water recovery increased to 80 percent from 70 percent, five-micron cartridges need be replaced only every six months, and one-micron cartridges are now replaced once a year. That represents a tremendous reduction in solid waste, cost, and labor. The efficiency of back flush from the screens – which consume 75 percent less water during flushing than sand media filters do – minimizes the amount of water waste that must be pumped down a nearby dry well for disposal.

Desalination plants of all types, from brackish groundwater to seawater, have been designed with multi-stage filtration systems to lower costs and improve efficiency. According to The World's Water 2006-2007, membrane replacement accounts for five percent of the cost of desalination plant operation, labor represents four percent, and consumables – such as filter cartridges, media, coagulants and other products – cost three percent. Reducing fouling, removing larger solids without using costly, finer filters, and extending the interval between cleaning cycles help save significant amounts of money in desalination.

There are also strong indicators that minimizing back flush in desalination plant filtration systems will also be important in the years to come. Existing and planned plants in markets such as California have encountered spirited opposition to their plans for discharging wastewater.

Rainwater

Arid and crowded regions of the world are also looking to another underutilized water source that will become increasingly important in the years to come -- rainwater. Already a small-scale staple at homes and farms throughout Australia, the Middle East, Africa, and Latin America, harvested rainwater will be a vital tool at every level and location.

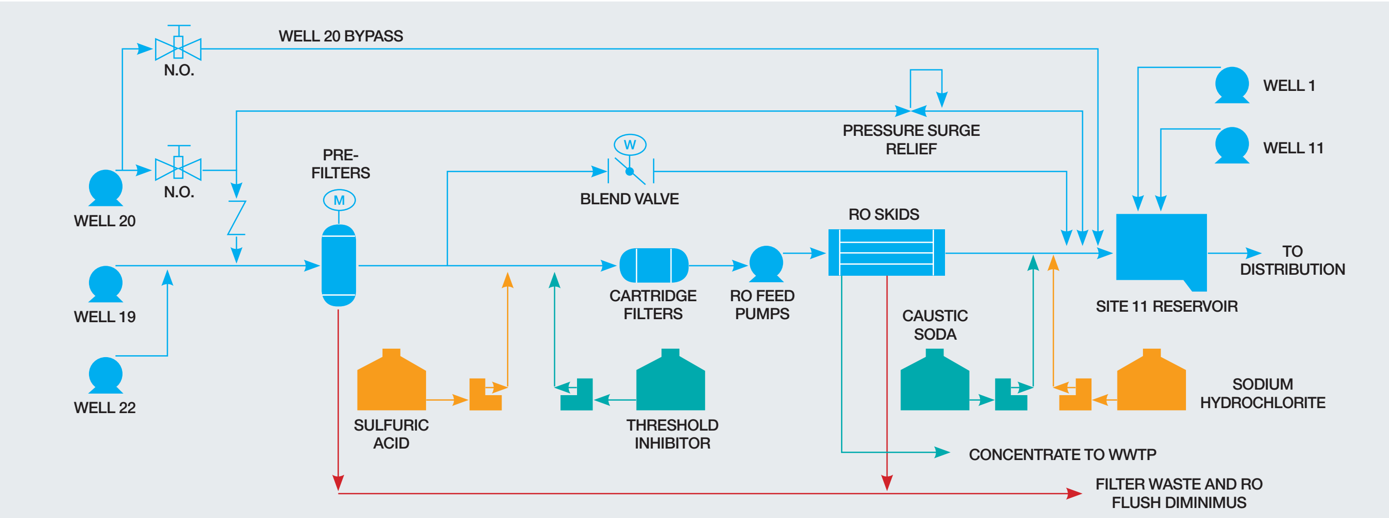
The potential is huge. A 2,000-square-foot roof in Mexico City, which receives an average of 61 cm of rain per year, can capture more than 109,000 liters of water. With little or no treatment, that captured water can be used to irrigate gardens, service cooling and heating systems, and flush toilets. Proper filtration and disinfection, which does not have to be complicated, can treat rainwater for drinking.

The concept is also being successfully scaled up in innovative projects around the world, including the Bank of America building in New York City. The 58-story office tower features filtration and disinfection stations on four levels and a 1.1-million-liter rainwater storage system in its basement. The treated water is currently used to flush toilets and irrigate rooftop and indoor gardens. By capturing rainwater and cycling it onsite, Bank of America also reduces the burden on New York City's stormwater system, which is subject to combined sewage overflows during storm events – a challenge faced by cities of all sizes and locations.

As cities grow, industry builds, farms struggle to keep up with a hungry world, power plants burn through the days and nights, and drinking and wastewater systems become increasingly overextended, achieving both return on investment (ROI) and return on environment (ROE) from every drop of water will become ever more critical.

Author's Note

Jim Lauria is vice president of sales and marketing for Amiad Filtration Systems, a manufacturer of clean technology water filtration systems for agricultural, industrial and municipal applications. He earned a Bachelor of Chemical Engineering degree from Manhattan College and has over twenty years of global experience in the water treatment and process industries.



A southwestern US city improved the efficiency and cost-effectiveness of its drinking water desalination system with multi-stage filtration and acid pre-treatment. Illustration by Amiad Filtration Systems