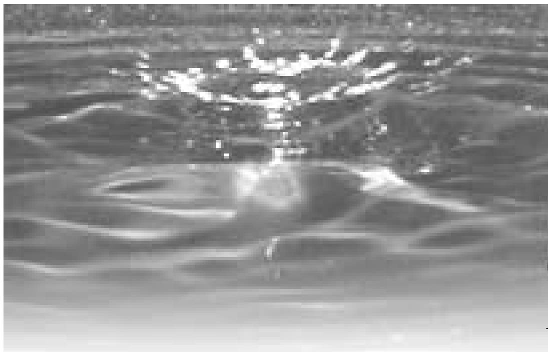

Desalination of Inland Brackish Water:

Issues and Concerns

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According to the World Water Development Report (United Nations, 2003), by 2025, more than 50 percent of the nations in the world will face water stress or water shortages. As in so much of the world, access to fresh water is an increasingly critical issue in the southwestern United States. Growth in the Southwest has led to increased demand for water and to unsustainable water management practices, resulting in falling water tables with ground subsidence and associated building and utility damage, and reductions in surface water and groundwater quality and availability.

In the search to address these challenges, one area that can no longer be overlooked for increasing water supplies is the application of desalination technologies to treat brackish surface and groundwater resources. Much of the United States, including the Southwest, contains extensive brackish groundwater resources (Krieger et al., 1957). Since much of this supply underlies more easily accessible and higher-quality fresh water resources, it has remained primarily untapped. As fresh water supplies become more limited, however, desalination of these brackish water resources will become more common.

Desalination Trends in the Southwest

From Virginia and Florida to New Mexico and California, desalination plants are being installed across the country in an effort to supplement fresh water supplies for a wide range of industrial and domestic needs. The growing interest in the Southwest and other inland areas in applying desalination includes:

- Enhancing domestic water supplies. Many southwestern water districts are evaluating brackish groundwater desalination to supplement limited fresh water supplies and provide water for a wide range of industrial and municipal uses.
- Fossil energy production. Large volumes of saline or brackish water are commonly co-produced in oil and gas production. Using desalination technologies to treat this water may offer oil-producing areas a beneficial use for this water.
- Treatment of impaired surface water. Many of the river systems in the Southwest suffer from salt buildup caused by surface runoff, agricultural irrigation practices, urban uses, and evaporation. Desalination of these impaired rivers will become increasingly important to meet more stringent water quality standards for domestic and ecological-based total maximum daily load requirements.
- Industrial and domestic water pretreatment and reuse. As water conservation and reuse become increasingly important, desalination-based water- and waste-water treatment technologies could meet water quality standards for water reuse in various applications.

The many applications of desalination are being evaluated and pursued by municipalities and industries across the Southwest. El Paso, Las Vegas, Phoenix, and Tucson all are considering desalination plant options to supplement or improve water supplies. Cities such as Scottsdale, Ariz. and Ft. Stockton, Texas have already built and are operating desalination facilities. Even mid-sized cities like Alamogordo, N.M., with a population around 30,000, is planning to construct an approximately 10 million gallon-per-day (mgd) desalination plant to help supplement its fresh surface and groundwater resources to meet future growth. Pat McCourt, City Manager for Alamogordo suggests, "The cost of acquiring new fresh water supplies has increased to a level that desalination of local brackish water is now competitive with developing and bringing in fresh water from remote locations." As an example of other desalination applications, oil companies, in cooperation with federal and state resource management agencies in New Mexico, Colorado, and Texas, are evaluating the treatment and desalination of oil- and gas-produced water for supplementing river flows during drought, rehabilitating rangeland, and cooling water for power plants.

Inland Desalination Concerns

Desalination research and development efforts since the mid-1960s have led to improvements in the performance and costs of brackish and sea water desalination, but additional progress is still needed. By the late 1990s, there were more than 12,500 desalination plants in operation in the world, generating more than six billion gallons of fresh water per day and accounting for about one percent of the world's daily production of drinking water (Martin-Lagardette, 2001). Many of these systems have been built in coastal areas for sea water desalination. Desalination in inland areas, like the Southwest, has lagged behind coastal desalination applications. Most water professionals agree there are three major concerns critical to the wider use of desalination in inland areas. These include addressing the environmental issues of concentrate and salt disposal, improving desalination efficiency, and reducing the costs of inland desalination.

There are several concentrate disposal methods practiced today: surface water discharge, discharge to sewers, deep well injection, land application, evaporation ponds/salt processing, and brine concentration. The feasibility of each disposal option depends primarily on location and desired efficiency. Surface water discharge is used extensively in coastal applications where coastal water can be used to dilute the concentrate, providing an inexpensive and often environmentally benign disposal option.

The other methods, while viable, have disadvantages. In inland areas, concentrate disposal options, including surface water discharge, sewer discharge, and land application, can increase the salt load in the receiving waters and soils, which contaminates water resources and reduces soil fertility. Evaporation ponds often require large land areas and are appropriate only in arid climates with low land values. Like other brine concentration techniques, they typically require impervious disposal areas to prevent contamination of fresh water supplies and soils. Deep well injection is not permitted in many states, but those that do allow it, including Texas and New Mexico, require permits, monitoring wells, and completions in deep contained aquifers to ensure that fresh water supplies are not contaminated.

Concentrate disposal may be the biggest roadblock to widespread inland desalination. Mike Gritzuk, Director of the Phoenix Water Services Department, likens the potential accumulation of salts and the possible long-term negative environmental impacts from inland desalination as “a train wreck in slow motion.” New research into areas such as concentrate reuse and salt sequestration technologies is needed to address the environmental issues with inland desalination concentrate disposal.

Desalination efficiency is also an important issue for the Southwest, according to Bruce Johnson, Assistant Director of the Tucson Water Department. Today, common desalination systems have recovery efficiencies of 60 to 85 percent for brackish water desalination (U.S. Bureau of Reclamation, 2002). Unfortunately, this means that 15 to 40 percent of the available water is not used and often must be disposed, wasting potentially valuable water resources and requiring additional pumping. Improving recovery efficiencies to 90 or 95 percent could significantly reduce concentrate disposal volumes, extend the supply of brackish resources, and potentially reduce overall desalination costs.

To reduce costs, many coastal desalination plants are designed to treat large volumes of water, often 50 mgd or greater, and are co-located with coastal power plants to take advantage of common intake and outfall structures and less expensive power. These strategies enable coastal facilities, such as the Tampa Bay Desalination Facility, to maintain desalination costs as low as $2.00-$2.50 per 1000 gallons of water produced. Similar facilities in inland areas may cost twice as much to operate because of smaller plant sizes, higher concentrate disposal costs, higher water pumping costs, and higher energy costs (U.S. Bureau of Reclamation, 2002).

While there have been significant strides in desalination over the past several decades, additional improvements in desalination efficiency, cost effectiveness, and concentrate disposal are still needed for desalination to become widely used as a long-term, environmentally friendly enhancement for fresh water supplies in inland areas. The recently completed “Desalination and Water Purification Technology Roadmap,” coordinated by Sandia National Laboratories and the U.S. Department of the Interior, Bureau of Reclamation (2003) identified the requirements needed to direct future desalination research in the United States (see pages 22-24). This roadmap should help ensure that the concerns above will be addressed, which will accelerate the use of desalination and supplement our limited fresh water resources to help meet the growing demands for water in the Southwest.

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Waste ponds at the Yuma Desalting Plant