CENTRAL ARIZONA SALINITY STUDY

PHASE I EXECUTIVE SUMMARY

Salinity is increasingly becoming a key consideration in municipal water supply and infrastructure planning. Higher concentrations of salinity - also referred to as salts or "total dissolved solids"(TDS) - are progressively accumulating in the soils and water supplies of regions throughout the United States. This is particularly evident in portions of the arid Southwest where the collective impact of irrigation, urban growth, low rainfall and the high mineral content of geologic features exacerbate the problem. It is important to note that traditional water treatment practices do not remove salinity.

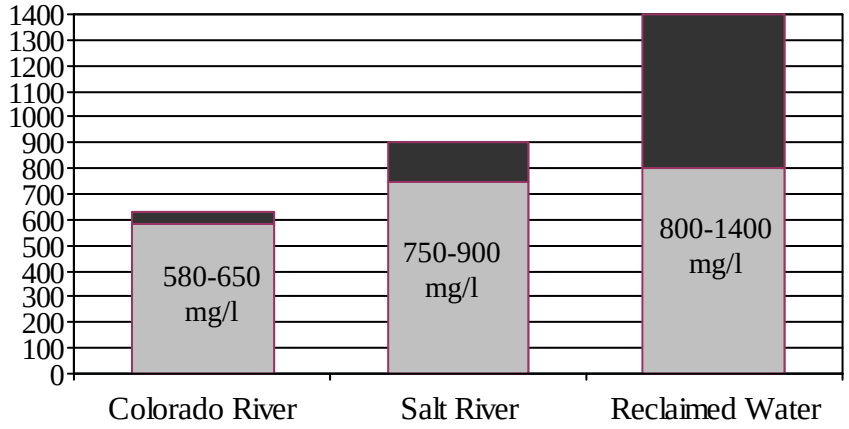
For decades, it has been acknowledged that the importation of high-salinity source waters for urban and agricultural uses could pose significant consequences. A 1948 planning report for the Central Arizona Project (CAP) indicated that *"…eventually it will become necessary to release salt-laden water from the Maricopa and Pinal units to maintain a salt balance in those areas"*(U.S. Bureau of Reclamation, 1948). With the CAP now delivering its full 1.5 million acre-feet capacity annually to central Arizona, along with 1.35 million tons of salt, it was felt that a comprehensive study of the impacts of those salts, and salts from other sources, was both timely and necessary. The "Central Arizona Salinity Study" was thus initiated in late 2001 as a means to evaluate these impacts, and to identify potential mitigation opportunities.

Study Background

The primary sponsors of the Central Arizona Salinity Study (CASS) are the five cities comprising the Sub-Regional Operating Group (SROG) in partnership with the Bureau of Reclamation. SROG consists of the Cities of Phoenix, Tempe, Mesa, Glendale and Scottsdale, who jointly own the 91st Avenue Wastewater Treatment Plant. In recent years, SROG has noted an upward trend in the salinity of effluent generated at that plant – a supply which is currently used for agricultural and industrial purposes. CASS was envisioned as a means to broadly evaluate and eventually curtail the impacts of high-salinity source waters on consumers, industry, infrastructure, water resources and the environment in a geographic area roughly approximating the CAP service area. A similar study in Southern California, conducted by the Bureau of Reclamation and the Metropolitan Water District in 1999, served as a model for CASS (Bookman-Edmonston, 1999)

The TDS content of surface water sources and reclaimed water is indicated in Figure 1. TDS in area groundwater ranges widely from as little as 200 milligrams per liter (mg/L) to well over 2,500 mg/L in

Figure 1. Comparison of Recent TDS Levels in Select Phoenix-Area Sources (Top bar reflects typical range)



the West Salt River Valley. The Environmental Protection Agency has established a secondary (non-enforceable) standard for salinity at 500 mg/L. This standard generally reflects a threshold associated with aesthetics.

CASS was envisioned as a two-part process with each phase comprising two years. The first phase (the subject of this report), focuses on characterizing the nature of the salinity problem (i.e. where the salts come from, where they end up, and both short and long term impacts). Phase 2 is expected to identify and evaluate solutions for managing salinity contributions from a variety of sources, and managing the brine "concentrate" from treatment processes. It is expected that the results of Phase 2 will then be utilized by area utilities (individually or through collaborative efforts) to assess the feasibility of constructing facilities or participating in other salinity management efforts.

A key objective of the Phase 1 process has been to engage other municipalities, private water companies, government agencies and other entities impacted by salinity. To date, the cities of Chandler, Goodyear, Peoria, Surprise, and Tucson, the towns of Buckeye and Gilbert, the Arizona-American Water Company, Arizona Water Company, and the Queen Creek Water Company have all joined the CASS study and financially contribute to the effort. Several other entities participate in CASS discussions. The project is funded on a 50/50 cost share basis between the participating entities and the Bureau.

A "Train Wreck in Slow Motion"

A regional "salt balance" developed as part of Phase 1 concludes that the Phoenix region imports approximately 1.5 million tons of salt per year. Most of this salt arrives via two major surface water supplies - the Colorado River and the Salt River. The Colorado River picks up its salts from several sources including agricultural return flows, salt springs, natural run off from range land and effluent from communities located along the river. Salinity in the Salt River is primarily due to natural salt springs in the watershed. Salt contributions to wastewater systems (for example from food waste and water softeners) and from fertilizers used in agriculture are also included in the 1.5 million tons of imported salt. Since only about 400,000 tons leave the area, approximately 1.1 million tons (almost three-fourths) remain.

Preliminary estimates indicate that about 39 percent of the salts entering the Phoenix metropolitan area end up in the groundwater through recharge and agricultural irrigation. Approximately 22 percent of the salts become trapped in the vadose zone through urban irrigation of parks, golf courses and other landscaping. Over a long period, it is possible that some of these salts residing in the vadose zone will migrate to the groundwater table. About 8 percent of the salts end up in sinks such as evaporation ponds, golf course lakes and other water bodies. The evaporation ponds associated with Arizona Public Service's Palo Verde Nuclear Generation Facility (which uses effluent from the 91st Avenue Plant for cooling) are the largest salt sinks in the region. The remaining 31 percent of the salts end up in consumer and industrial appliances, water supply infrastructure, evaporative coolers, cooling towers and wherever water evaporation is taking place.

A similar salt balance for the Tucson area indicates a net accumulation of 100,000 tons per year – a figure that is expected to double in the near term as the importation of CAP supplies increases to replace the lower-TDS groundwater currently used in the area. The predominately agricultural areas of Pinal County and the Harquahala Basin have over the past decade supplemented local water sources with CAP. Aquifers in these agricultural areas are continuing to degrade both due to the high-TDS source water and from fertilizer applications.

Economic and Other Impacts

Water with a high TDS concentration impacts virtually all sectors of society - residential, commercial, industrial, and agricultural. For the homeowner, salinity reduces the useful life of household appliances, such as water heaters, evaporative coolers, faucets, garbage disposals, clothes washers and dishwashers. Homeowners also incur salinity "avoidance costs" such as buying bottled drinking water and installing water softening systems. The commercial sector (schools, hospitals, retail stores, etc.) encounters impacts similar to homeowners with water-intensive operations bearing higher costs. Some industries in central Arizona (such as food and beverage manufacturers and semiconductor manufacturing) require de-mineralized water, other industries require water softening. In such cases, relative costs are directly tied to the TDS content of the water they receive from potable systems.

The effect of salinity on crops has been well documented. Worldwide, millions of acres of land - in some cases dating back to ancient civilizations - have been rendered unproductive due to salt loading. The present day agricultural sector experiences economic losses as high TDS water reduces crop yields, requires additional fertilizers and soil additives, and results in a need to apply supplemental water to flush salts downward away from the root zone. Increasing salinity content of groundwater has left supplies in certain areas unusable for expanding urban growth without some form of treatment.

The overall impact is even more significant when considering increased urban and agricultural reliance on reclaimed wastewater. Because wastewater streams include significant salt contributions from commercial, residential and industrial uses, this added salt can render reclaimed water less desirable or even unusable for certain purposes. Furthermore, irrigation with reclaimed water amplifies the salt-loading problem in groundwater.

Though economic impact of high-TDS water in central Arizona is significant, it has not yet substantively affected economic development of the region. The economic impacts of salinity are very subtle, and are widely spread among the sectors previously indicated. CASS Phase I economic modeling equated a 100 mg/L TDS variation of the two primary surface water sources (the Salt River and Colorado River) with approximately $30 million in damages. About 93 percent of those damages are associated with the Phoenix Metropolitan area. However, given that the gross domestic product (GDP) for Maricopa County is about $93.6 billion, the relative impact at present is minor. However, the economic impacts are expected to increase substantially in the future with the compound affects of continued salt importation via the rivers and additional salt loading as the population grows.

Next Steps

CASS Phase 2 will evaluate a wide range of potential solutions to address the continued buildup of salts in the study area, and will describe the consequences of a "no action" alternative. The key focus areas are likely to include: 1) removal of salt (or prevention of entry) in watersheds; 2) salt removal at water and wastewater plants; 3) limiting salt contributions to wastewater systems through regulations or incentives; 4) concentrate management; and 5) preventing further salt loading of soils and aquifers. Phase 2 will also explore the feasibility of developing brackish groundwater in the area as a supplemental source. The results of Phase 2 will form a basis for future funding decisions with regard to salinity management practices and infrastructure needs to both protect and enhance our water supplies.