# Water Spreading in the Desert

***Mario R. Lluria*** *– HydroSystems Inc.*

In the late 1980s, the portion of the Central Arizona Project (CAP) aqueduct that conveys water from the Colorado River to Phoenix was completed. At the time, the Salt River Valley lacked sufficient surface storage capacity for Arizona's unused portion of CAP water, and storage in the distant reservoirs of the Salt and Verde rivers was prohibitively expensive. Consequently, the Salt River Project (SRP) and several municipalities agreed to develop a large underground water storage facility. A study funded by the Arizona Municipal Water User Association (AMWUA) identified favorable sites in the Salt and Agua Fria rivers for in-channel groundwater recharge, a method successfully used for many years in the Los Angeles Basin to store water in the underlying alluvial aquifer.

## The First Facility: GRUSP

In 1986, the City of Mesa and SRP initiated work on a large water-spreading recharge facility in the East Salt River Valley. Based on the AMWUA study, SRP evaluated a 7-mile-long reach of the lower Salt River immediately downstream of Granite Reef Dam, and found favorable hydrogeologic conditions with no environmental constraints.

Four potential sites were selected, all near the SRP water delivery system and its large-capacity wells, providing the necessary supporting infrastructure. In 1987, Phoenix-area municipalities joined with SRP to select a site, acquire the land, and design, permit, construct, and operate the regional Granite Reef Underground Storage Project (GRUSP). More than 90 percent of the site would be within the Salt River Pima-Maricopa Indian Reservation. Negotiations with the tribal government concluded in 1992 with the leasing of a 350-acre parcel for a period of twenty years. Every five years the land is re-appraised and the rent adjusted according to current value. The main determinant is the value of the land's sand and gravel, which is in high demand. Thus, a steady, substantial rent increase has affected the unit cost of recharge at GRUSP.

The permit process for GRUSP commenced in 1987 and was completed in 1992. Two federal permits were required under the Clean Water Act, one each from the U.S. Environmental Protection Agency and the Army Corps of Engineers. State permits were issued by the Arizona Department of Water Resources (for underground storage) and the Arizona Department of Environmental Quality (for aquifer protection).

## Construction and Operation

In 1994, four recharge basins with a total area of 174 acres were completed. Two more added in 1999 increased the area to 225 acres. Originally, CAP water and water from the Salt and Verde rivers were used for recharge; in 2007 reclaimed water was added. The waters are mixed before entering the recharge basins.

One of the most important factors in GRUSP's successful operation is the site's favorable hydrogeologic characteristics. On the periphery of the large Salt River Valley tectonic basin, the site's coarse-grained unconsolidated sands and gravels have high permeability and water storage capacity, producing recharge rates of 2 to 7 feet per day. The storage capacity of the area of hydrologic impact exceeds one million acre-feet. Over 920,000 acre-feet of water have been stored in GRUSP, both short-term and long-term, over its 13 years of operation (Lluria, 1998).

*View of the Granite Reef Underground Storage facility in 1995, showing canals transporting CAP water to the facility in the Salt River Valley.*

The cost of construction of the GRUSP facility was $1.2 million, with a total project cost at the start in May 1994 of $2.2 million. Ownership of GRUSP is held by SRP and the cities of Chandler, Gilbert, Mesa, Phoenix, Scottsdale, and Tempe. The recharge capacity for each city is based on entitlement, with recharge rights based on percent ownership. Other entities have also used GRUSP; of these, the Arizona Water Banking Authority has accumulated the most water storage credits.

## Challenges and Solutions

GRUSP has faced some challenges. All delivery and recharge facilities are constructed of river bed material and are subject to damage during stormwater releases from Granite Reef Dam. Damage caused by such releases are of primary concern because of reconstruction costs, but only three flood events, in the winters of 1995, 2005, and 2008, have occurred so far. Successful mitigation measures have included breaching some of the structures to route flows and minimize erosion.

In 1994, a sanitary landfill was completed one mile north of the GRUSP site. Groundwater mounding under the landfill is controlled by regulating inflow, rotating the operating recharge basins, and increasing the hydraulic gradient away from the landfill by pumping. Evapotranspiration losses are minimized by controlling the vegetation in the delivery and recharge units of the facility.

## Benefits Accruing

The principal benefit of GRUSP has been replenishment of the aquifer beneath the East Salt River Valley. The equivalent of 40 percent of the total water storage capacity of SRP's reservoir system for the Salt and Verde rivers has been added to the aquifer for future recovery. As the first ASR project in the Phoenix area, GRUSP was able to store a large volume of CAP water which otherwise would have gone to California. The recharge operation has also improved the quality of groundwater near the site by reducing arsenic and nitrate concentrations. Finally, GRUSP has improved SRP's operational flexibility and the water management practices of several municipalities.

## On the West Side: NAUSP

To provide aquifer storage services to the western Phoenix metropolitan area, SRP constructed the New River Agua Fria Underground Storage Project (NAUSP) with four partnering municipalities. Agricultural land was purchased on the eastern bank of the Agua Fria River in its ancestral fluvial system, where favorable hydrogeologic characteristics existed for direct surface groundwater recharge (Paski and Lluria, 2005). The site is on the periphery of a large cone of depression, where considerable land subsidence has occurred and aquifer replenishment is urgently needed (Lluria, 1995).

*GRUSP was able to store a large volume of CAP water which otherwise would have gone to California.*

NAUSP was completed in March 2007 and stored 21,000 acre-feet of water last year, achieving recharge rates of 1 to 3 feet per day. The facility consists of six off-channel basins with a 126-acre infiltration area. A seventh in-channel basin of 65 acres will be added in 2008. The facility receives water from CAP and the Salt and Verde rivers, plus a small volume of reclaimed water. The waters are blended before recharging. The NAUSP facility is permitted for a maximum volume of 75,000 acre-feet per year, 40 percent of the permit capacity of GRUSP.

During facility development, a few difficulties had to be resolved. The original site in the Agua Fria River channel was abandoned because of its proximity to future gravel mining operations. Topsoil from the agricultural fields had to be removed for construction of the off-channel basins to ensure adequate infiltration rates and eliminate potential agriculture contaminants. The cost of land was high because of its proximity to the recently completed City of Glendale sports center.

NAUSP will provide a much-needed underground storage facility for the area, particularly for the temporary storage of reclaimed water. It will capture flows in the tail end of the SRP system that might otherwise go unused. The recharge activity will improve groundwater quality near the site by diluting the high nitrate concentrations caused by decades of agriculture. Having two recharge facilities, one located near the head of the water delivery system, the other near its terminus, considerably increases the operational flexibility of SRP's water resources management system.

*Contact Mario Lluria at mario@hydrosystems-inc.com.*

## References

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