

SECTION FOUR

AVAILABLE WATER RESOURCES

This section provides an update on the three water sources physically available to Tucson Water and evaluates the constraints that may affect their use for supply. In addition, it includes a summary of ADWR's Assured Water Supply (AWS) Program which places restrictions on how water providers utilize their water resources to meet growing demand. Finally, this section discusses the potential opportunities to acquire or develop additional water resources. Supplemental information on the Utility's water resources portfolio and the AWS Program are provided in Chapter Four of *Water Plan: 2000-2050* and in Appendices C and D of this update.

GROUND WATER

Tucson Water will continue to rely on local ground-water resources and its well fields throughout and beyond the 50-year planning period. Ground water will remain an important supply source for the following reasons:

- To meet peak water demand during the hottest months;
- To meet projected annual potable demand when it exceeds the City of Tucson's annual Central Arizona Project allocation and if additional renewable supplies are not available;
- To provide emergency backup supply should there be a disruption in Colorado River water supply due to problems with the Central Arizona Project infrastructure or due to supply disruptions caused by system outages in Tucson Water's own system;
- To provide backup potable supply should a temporary shortage be declared on the Colorado River; and
- To provide longer-term back-up supply to help offset potential climate change impacts on Colorado River water availability.

Potential constraints on the use of ground water were discussed in *Water Plan: 2000-2050*. In general, the regional aquifer systems have stresses placed on them not only by Tucson Water but also by other water providers, industrial and agricultural operators, and numerous private well owners. Tucson Water remains the only local water provider that is not totally

dependent on “wet” ground water as its sole source for potable supply. Management decisions that will be made by Tucson Water to balance its use of this resource will take into account the current and projected actions of other ground-water users in the Long-Range Planning Area. One recent positive development is the passage of legislation that places constraints on the ability of private interests to drill “exempt” wells within the service area of a water provider that holds an AWS designation. This was an important step toward managing the proliferation of new “unregulated” demands on the local aquifers.

Over-pumping of these aquifers over many decades has resulted in significant water-level declines, measureable land surface subsidence, and loss of riparian habitat. In order for ground water to remain a viable resource for future use, Tucson Water has continued its efforts to reduce its ground-water use to approximate a hydrologically sustainable pumping rate. For the Utility’s efforts to be beneficial in the longer-term, other local ground-water users will also need to work cooperatively to ensure that the local regional aquifers will be able to provide sustainable supply to meet the water needs of the greater community.

The Utility has a finite volume of ground-water credits that it can pump over time under the AWS Program; this is referred to as “allowable” ground water. The Utility also has access to a small volume of annually accruing ground-water credits from “incidental” recharge (defined as aquifer recharge which occurs after the Utility accesses its water sources for supply) constituting four percent of Tucson Water’s annual total demand. In addition, Tucson Water has the ability to utilize up to 12,500 acre-feet of ground water per year that would be replenished through its contract with the Central Arizona Groundwater Replenishment District (CAGRDR). However, the bulk of Tucson Water’s ground-water pumping will debit against its allowable ground water account. Once these paper-water credits are exhausted, all ground water that is pumped in excess of incidental recharge must be replenished with a renewable water supply. Even if Tucson Water reduces its annual pumping and utilizes ground water at the hydrologically sustainable rate, the Utility will eventually deplete its allowable ground-water credit account. At some point in time, the credits remaining in this account will not be sufficient to renew the City of Tucson’s AWS designation. Despite these concerns, these credits will continue to be valuable because they provide planning flexibility and the legal means to transition to fully renewable water supplies.

Tucson Water’s use of its CAGRDR contract adds legal authority to pump ground water. Under current state law, the replenishment (i.e. recharge) activities of the CAGRDR are not required to occur in the same area as the ground-water pumping it seeks to offset. Thus CAGRDR replenishment does not necessarily address local ground water declines. Tucson Water will perform CAGRDR replenishment at its recharge and recovery facilities in order to maintain aquifer water levels within its projected service area and assist in achieving long term sustainability.

Potential Additional Sources of Ground Water

Substantial quantities of ground water might be available from less developed basins in western Arizona such as the Harquahala basin, McMullen Valley, and Butler Valley. Transfers of ground water from less populated areas of Arizona could yield additional water

supply in the future. These supplies could potentially be delivered to the Tucson area by utilizing existing excess capacity in the Central Arizona Project.

EFFLUENT

Municipal wastewater effluent is a renewable water supply that steadily grows along with the population. This recycled water supply is delivered through Tucson Water’s reclaimed water system and provides a sustainable alternative to mining ground water to satisfy irrigation demand. In addition, this water source will continue to be recharged thereby augmenting local aquifers.

In 2006, 69,067 acre-feet of effluent were produced from the metropolitan wastewater treatment plants in the Tucson area. As shown on Table 4-1, the City of Tucson had entitlement to a total of 31,536 acre-feet (46 percent) of this effluent. Of this total, 11,983 acre-feet were reused as reclaimed water within the Tucson Water service area while the remainder (19,553 acre-feet) was discharged to the Santa Cruz River. In contrast, all of the effluent annually entitled to the Secretary of the Interior (28,200 acre-feet) was discharged to the river and constitutes the majority of the perennial effluent flow observed in the Santa Cruz River.

Entity	AF/Year
Tucson	31,536
Secretary of the Interior	28,200
Pima County	4,087
Metropolitan Domestic Water Improvement District	2,890
Oro Valley	2,354
TOTAL (rounded)	69,067

Table 4-1: Local Effluent Entitlements in 2006.

Updated projections of wastewater generation through 2030 were developed in consultation with the Pima County Regional Wastewater Reclamation Department. These projections indicate that annual effluent availability within the Long-Range Planning Area could approach 118,900 acre-feet by 2030. Looking beyond, *Water Plan: 2000-2050* indicated wastewater availability could approach 128,000 acre-feet by 2050. The updated wastewater volumes were based on population growth projections and assumptions regarding per capita potable water usage, sewer return flow rates, and septic tank usage and are summarized in Appendix C. Of these totals, it is projected that the City of Tucson would have annual entitlement to approximately 61,000 acre-feet by 2030 and about 66,000 acre-feet by 2050.

The City’s reclaimed water system provides water of a quality appropriate for turf and ornamental landscaping, firefighting, toilet flushing, orchards, and the irrigation of some edible food crops. Tucson Water will continue to develop projects that will provide sufficient capacity to meet reclaimed water demand as the community continues to grow. A key long-term planning assumption is that the reclaimed water system will supply at least nine percent of Tucson Water’s projected total demand through 2050. Accordingly, reclaimed water

demand in the Tucson Water service area is projected to increase from 11,983 acre-feet per year in 2006 to approximately 24,000 acre-feet per year in 2050. In addition to serving customers in the Tucson Water service area, the reclaimed water system provides a regional service by treating and wheeling effluent supplies owned by other regional entities. In 2006, 2,186 acre-feet of reclaimed water were wheeled to Pima County facilities and to the Town of Oro Valley for distribution and use.

As the population increases and all other available potable water supplies become fully utilized, the need for reusing effluent as a critical supply source will also grow. Treated effluent will most likely be banked in local aquifers through a sequenced program of enhanced treatment and aquifer recharge. Tucson Water considers effluent to be a vital renewable water resource that will ensure supply sustainability and drought resistance in the long term.

Potential Changes to Effluent Availability

Tucson Water has entitlement to a large volume of municipal effluent and the Utility may be able to increase its usable share in the future. This could include agreements to lease or purchase the Secretary of the Interior's effluent entitlement as well as those of others. This would result in greater utilization of the only locally generated renewable supply that grows with the community.

The effluent that Tucson Water further treats for use in the Reclaimed Water System comes from the local wastewater treatment works owned and operated by Pima County. This arrangement is unique to this region; elsewhere in the State, municipalities provide both potable water delivery and municipal wastewater treatment.

Pima County is presently engaged in its Regional Optimization Master Plan (ROMP) which will define the effluent quality and quantities that will be produced at the Roger Road Wastewater Treatment Plant and the Ina Road Water Pollution Control Facility. The outcome of the ROMP is critical to the future direction of the City's Reclaimed Water System since at the present time, most of the reclaimed supply is derived from the County's Roger Road Plant. Changes in where the effluent is produced as well as its resultant water quality may impact Tucson Water's ability to produce additional reclaimed water to meet increasing non-potable water demand. For a more detailed discussion of effluent ownership in the Tucson region and the near-term future of the Reclaimed Water System, refer to the *Reclaimed Water System – Status Report 2007* (City of Tucson Water Department, 2007a).

COLORADO RIVER WATER

The Colorado River is a major source of water supply, power generation, recreation, and environmental habitat in the western United States. It is a major part of Arizona's water supply portfolio providing more than one-third of all water used in the State (Central Arizona Project, 2007a). More than half of Arizona's annual water supply is delivered to central Arizona via the Central Arizona Project. The Colorado River is the largest renewable supply

source available to Tucson Water. This section provides an update on the status of Tucson Water’s allocation of Colorado River water, information related to future shortage issues associated with drought, and the potential implications of climate change.

Colorado River water is delivered to the greater Tucson area via the Central Arizona Project which conveys water from Lake Havasu to its terminus located southwest of Tucson. The City of Tucson has rights to the largest municipal allocation of Central Arizona Project water in the State—currently 135,966 acre-feet per year. For planning purposes, however, the City’s allocation is expected to reach a total of 144,191 acre-feet per year in the near future. This anticipated increase in the City’s allocation is due to the recently finalized Arizona Water Settlements Act (an addition of 8,206 acre-feet per year) and a pending allocation transfer from the Flowing Wells Irrigation District (19 acre-feet per year).

Clearwater Program and the Blend

Tucson Water’s efforts to fully utilize its Central Arizona Project allocation are managed under its Clearwater Program. Through the process of recharge and subsequent pumping (recovery), Colorado River water mixes with native ground water to produce a blended water supply. The Central Avra Valley Storage and Recovery Project (CAVSARP), the Hayden-Udall Treatment Plant, and the 60-million gallon Clearwell Reservoir in the Tucson Mountains currently constitute the core infrastructure of the Clearwater Program. CAVSARP is permitted to annually recharge up to 80,000 acre-feet of Colorado River water. Recovery components are currently being upgraded to increase the facility’s recovery capacity to about 70,000 acre-feet per year. The core facilities are currently sized to utilize about 50 percent of the City of Tucson’s annual Central Arizona Project allocation and make it available for potable supply in Tucson Water’s service area.



Figure 4-1: Aerial View of CAVSARP Taken January 2008.

Phase II of the Clearwater Program, the Southern Avra Valley Storage and Recovery Project (SAVSARP), is currently under construction. Deliveries of Colorado River water for recharge at SAVSARP will begin in spring 2008 to the first three recharge basins. When construction of the balance of the facility is completed by the end of 2008, SAVSARP is expected to have about 60,000 acre-feet of annual recharge capacity. Recovery will initially be conducted through an existing well field that will be expanded over time. Upon completion of additional wells, pipelines, a reservoir/booster station, and a large-diameter recovered water transmission main, the annual recovery capacity at SAVSARP will be approximately 60,000 acre-feet.

Since issuance of *Water Plan: 2000-2050*, Tucson Water has evaluated how the Pima Mine Road Recharge Project might be more fully utilized. The Utility owns a 50 percent share of the facility which is located near the Central Arizona Project terminus at I-19. Tucson Water's Santa Cruz Well Field is located adjacent to the Pima Mine Road Recharge Project, and water levels in the vicinity of the well field benefit from its recharge activities. Tucson Water plans to continue recharging a portion of its Central Arizona Project allocation at Pima Mine Road and to recover all or part through the Santa Cruz Well Field. This well field will be expanded with additional wells and pipelines in the future.

Between CAVSARP, SAVSARP, and the Pima Mine Road Recharge Project/Santa Cruz Well Field, Tucson Water will have sufficient capacity to recharge and recover its entire Central Arizona Project allocation. The Utility currently plans to begin purchasing its full allocation in July 2008. The collective recovery capacities of these facilities will expand over time as infrastructure projects are completed and as potable water demand increases. By 2012, the vast majority of Tucson Water's service area will be served a renewable water supply through Clearwater Program facilities.

Many additional potential Clearwater Program elements are described in *Water Plan: 2000-2050*. Newer initiatives under consideration include additional expansions of the recharge and recovery capabilities of CAVSARP. An application to expand its recharge capacity to 100,000 acre-feet per year was filed with the State in January 2008; the Utility may receive its permit before the end of the year. In the longer term, the CAVSARP and SAVSARP facilities could potentially be expanded beyond 100,000 and 60,000 acre-feet per year as additional renewable water supplies are brought into service.

Shortage on the Colorado River

The primary uncertainty related to Tucson's use of Colorado River water is the future impacts of potential shortage conditions. There are several factors that could individually or in combination result in a declaration of shortage on the Colorado River. In preparation, Tucson Water has developed supply-and-demand response contingencies to augment the institutional protections already in place to help offset the impacts of eventual shortages.

Factors Contributing to Shortage

Three critical factors that could drive a future declaration of shortage on the Colorado River are as follows:

- Annual allocations to Colorado River water exceed the actual long-term average yield of the Colorado River;
- Effects of extended drought conditions on water availability; and
- Potential ramifications of long-term climate change.

It is widely recognized that the annual average yield of the Colorado River was over-estimated in the 1920s. When compared to information collected and analyzed in subsequent years, it is clear that the annual average yield is significantly lower. As a result, the magnitude of flows in the Colorado River will not always be sufficient to fulfill all of the annual Central Arizona Project allocations.

Water users in the Colorado River basin have also experienced droughts which are intermittent periods of below normal water availability; these periods can sometimes last decades. Because of the current severity of drought conditions within the Colorado River Watershed, the first shortage declaration on the Colorado River may be just years away.

The probability of shortage in the longer term may increase based on current climate change projections for the Southwest. These projections, largely based on climate modeling simulations, generally agree that a gradual long-term warming trend is likely. These projections also suggest that there will be a decrease in annual precipitation in the Southwest (Christensen et al., 2007; Lenart et al., 2007; and Overpeck; 2007). The effects of climate change could be significant with regard to the long-term yield of the Colorado River.

Regardless of the factors that result in an eventual shortage declaration on the Colorado River, the potential effects on Tucson Water and the Utility's planned responses are similar. The Utility continues to prepare for periods of time when access to Colorado River water will be reduced. In order to prepare for eventual shortages, Tucson Water has taken several proactive steps with regards to both supply and demand.

Preparations for Shortage

The Utility has participated in state-wide planning efforts to protect Arizona's renewable water resources, cooperated with the Arizona Water Banking Authority (AWBA) to store excess Central Arizona Project water in the near-term for eventual recovery during times of shortage, and developed infrastructure that will remain viable when the supply of Colorado River water is reduced. In addition, the Utility will seek to acquire and develop additional, higher-priority sources of renewable water supply such as main-stem (non-Central Arizona Project) Colorado River water as well as locally-generated effluent; these potential supplies

are particularly attractive since they will not be curtailed except during the most extreme shortages and therefore offer greater resource and supply reliability.

An important institutional buffer is the high priority of the City's annual allotment within the Central Arizona Project's hierarchical allocation structure. The City of Tucson's allocation is for municipal and industrial (M&I) use which would only be impacted after shortages have become severe. To ensure full benefit its M&I allocation, Tucson Water must fully utilize its entire annual allotment no later than the year before a shortage is declared. According to the Central Arizona Project (2007b), the current worst-case estimate of when a shortage on the Colorado River might be declared is 2011. To prepare for this possibility, the City plans to fully utilize its entire allocation beginning in 2009.

When a shortage affects M&I usage of Central Arizona Project water, providers in the Central Arizona Project's three-county service area will have access to water that has been banked in long-term storage facilities through the AWBA. Plans to recover this banked water have not yet been finalized but the Central Arizona Project is in the process of developing conceptual plans to recover the stored water (Central Arizona Water Conservation District, 2007). Tucson Water has already provided the AWBA storage capacity at its recharge facilities. The water stored in these facilities can readily be recovered during times of shortage and brought into service; however, this represents only a small part of the AWBA water that would be required in a multi-year shortage.

Tucson Water's reliance on recharge and recovery as the means to bring its Colorado River water into use will also mitigate shortage impacts. A benefit of recharge over the use of a conventional water treatment plant is that recovery wells associated with a recharge facility can continue to operate for a period of time even when the availability of the source water is reduced. In contrast, a surface water treatment plant can only produce water as long as the source water is available.

An additional contingency is the Utility's diversified water-supply portfolio. As Tucson Water further expands and diversifies its portfolio, impacts to any particular water supply can be offset by relying on other available supply sources including the City's effluent resource. Access to locally-generated effluent is not subject to curtailment due to drought, Central Arizona Project infrastructure outages, or climate change. If this resource were used to augment the regional aquifers within the Utility's service area, it would provide the community with greater supply reliability during times of shortage.

The demand-management recommendations of Tucson Water's Community Conservation Task Force could generate long-term water savings. These savings could reduce the overall strain on the Utility's available water supplies and as such can become a significant part of Tucson Water's management strategy to prepare for shortages on the Colorado River. The Utility also developed a comprehensive Drought Preparedness and Response Plan to control demand in such times of need. These and other demand-management initiatives are more fully discussed in Section Three.

As the ultimate backstop, Tucson Water also possesses extensive ground-water production facilities which tap into the large regional aquifers in both the Tucson basin and Avra Valley. While the Utility is increasingly shifting its reliance to renewable water resources, the local regional aquifers have a very large volume of ground water in storage. Under the AWS rules, there is provision to allow ground-water pumping without debiting the Utility's credit accounts during shortages. This non-renewable supply source can be used for an extended period of time to satisfy customer demand.

Acquiring Additional Sources of Colorado River Water

The City of Tucson will continue efforts to increase its Central Arizona Project allocation and to access additional Colorado River water. This may be accomplished through reallocation, lease, and/or transfer and these options are discussed in detail in Chapter Four of *Water Plan: 2000-2050*.

Another potential mechanism to acquire additional Colorado River water is to participate in an "exchange" program by providing an alternate water supply. An option under state-wide consideration is to invest in a seawater desalination facility in partnership with a coastal community in the United States or Mexico that has higher-priority rights to Colorado River water. Under such a potential agreement, Tucson could, in partnership with others, provide funding to the coastal community to desalinate seawater for use in that location in exchange for more Colorado River water to import to the Tucson area via the Central Arizona Project. If this type of arrangement were to occur, it would likely be many decades out. Tucson Water plans to participate in these discussions in order to take advantage of this potential opportunity if and when it occurs.

ASSURED WATER SUPPLY PROGRAM

Under the current AWS Designation issued in 2007, the City of Tucson's 100-year supply of water that meets all of the AWS criteria is 185,688 acre-feet per year. However, Tucson's AWS designation is currently capped at 183,956 acre-feet which was the projected demand volume for 2015 at the time of the AWS application. The City's current water supply portfolio is based on its physically available ground water, Colorado River water and effluent supplies. The controlling factor in determining this total volume is the "Consistency with Management Goal" criteria (i.e. Safe Yield).

The current AWS designation contains a sufficient volume of approved water resources to meet projected growth through 2016. To maintain the designation without interruption, the Utility will need to re-apply to extend the designation order at least two years before this demand volume is reached. Based on current projections of the Utility's available water supplies, water credit balances, and future demands, Tucson Water expects to extend its AWS designation from 2016 to about 2025. There will be subsequent extensions to the AWS designation.

Under the AWS Program, all ground-water withdrawals are debited from several potential sources of water credits. This program places a finite cap on the amount of ground water that can be pumped by Tucson Water without incurring a replenishment obligation. This is referred to as allowable ground water. Since *Water Plan: 2000-2050* was issued in 2004, Tucson Water has continued to debit its allowable ground water credit account although the annual rate of ground-water use has steadily declined as use of renewable supplies has increased. Reliance on renewable supplies would allow for sustainable growth over the longer term.