CHAPTER EIGHT: UNDERGROUND WATER STORAGE, SAVINGS AND REPLENISHMENT

8.1 INTRODUCTION

The purpose of the Underground Water Storage, Savings & Replenishment (Recharge) Program is to encourage the development, delivery, use, and storage of renewable water supplies now and in the future. The Recharge Program, in combination with the *Fourth Management Plan for the Tucson Active Management Area* (4MP) conservation program efforts, is intended to support achievement of the safe-yield management goal for the Tucson Active Management Area (TAMA). Increasing the use of renewable water supplies, particularly Central Arizona Project (CAP) water and reclaimed[1] water in lieu of groundwater, is a key component of achieving safe-yield.

For the purposes of this chapter, "augmentation" means increasing the availability and use of renewable water supplies such as CAP water and reclaimed water in lieu of groundwater. "Recharge" means storage of excess water (non-groundwater) supplies for future use pursuant to the Underground Water Storage, Savings and Replenishment Act (A.R.S. § 45-801.01, *et seq*). Although the Arizona Department of Water Resources (ADWR) does not have the ability to implement an augmentation program, ADWR recognizes the need to continue to pursue and obtain additional water supplies into the future.

Although the TAMA groundwater management goal of safe-yield applies to the TAMA as a whole, the objectives of the Recharge Program in the fourth management period serve to enhance water resource management on a localized sub-TAMA scale. A TAMA-wide safe-yield balance between supply and demand of groundwater does not address local concerns regarding groundwater level declines and physical availability challenges. The 4MP recognizes these local challenges, taking these site-specific areas into consideration, and proposes possible solutions that can assist local stakeholders in addressing these challenges.

8.2 THE RECHARGE PROGRAM

The augmentation and recharge of renewable water resources is a principal mechanism by which the TAMA can reach both safe-yield and site-specific goals. During the fourth management period, ADWR will continue to encourage the development, efficient use, and recharge of renewable water supplies for the TAMA. Additionally, the Recharge Program is an effective tool to mitigate local water supply problems, depending where storage and recovery activities occur.

Recharge is an important water management tool in the TAMA 4MP. While the development and direct use of renewable water supplies is an important component of TAMA water management during the fourth management period, underground water storage provides a cost-effective means of utilizing available renewable water supplies that cannot currently be used directly.

8.2.1 Overview of Recharge and Recovery

Recharge statutes and 4MP provisions provide regulatory framework in which water may be stored and recovered. The statutes and the TAMA 4MP, when read together, establish a number of objectives. These objectives include:

- To protect the general economy and welfare of the state by encouraging the use of renewable water supplies instead of groundwater through a flexible and effective regulatory program for the underground storage, savings and replenishment of water;

[1] In the TAMA 4MP, the term "reclaimed water" has the same definition as effluent in A.R.S. § 45-101.

- To allow for the efficient and cost-effective management of water supplies by allowing the use of storage facilities for filtration and distribution of renewable water instead of constructing renewable water treatment plants and pipeline distribution systems;
- To reduce overdraft and achieve the management goals of the Active Management Areas (AMAs);
- To store water underground for seasonal peak demand use and for use during periods of shortage;
- To augment the local water supply to allow future growth and development.

Since the inception of the recharge and recovery program in Arizona in 1986, recharge and recovery have become increasingly flexible over time with regard to storage and recovery locations and the number and types of programs available. With the increased flexibility have come increased complexity and local water challenges. High or low water tables, water quality, physical availability and third party impacts are all challenges that can be affected positively or negatively by recharge and recovery facilities. Thus, the regulation of the program to maximize benefits and minimize harm is crucial to an effective program.

8.2.2 Primary Program Components

There are several key components of recharge and recovery. Rights to recover water may be exercised annually or long-term. Any recoverable water can be recovered within the same year in which it was stored. Stored water may also be credited to a long-term storage account, which allows the account holder to recover the water at any point in the future, if certain conditions are met. These conditions assist the achievement of water management goals by minimizing the potential negative impacts. The definition of "Water that cannot reasonably be used directly" contained in A.R.S. § 45-802.01(22) limits the types of stored water for which long-term storage credits may be earned.

No time limit exists on the right to recover long-term storage credits. Long-term storage credits may be assigned to another person if that person can meet the same provisions for earning credits as the storer. In addition, once the water is recovered, it retains the same legal characteristics it had before storage.

The Underground Water Storage (UWS) Program is also the mechanism by which the Central Arizona Groundwater Replenishment District (CAGRD) replenishes water on behalf of its members. The CAGRD may store water and accrue long-term storage credits or obtain credits already accrued. The CAGRD can request that ADWR transfer credits from the CAGRD's long-term storage account to its replenishment account, termed a "conservation district account" by statute, to offset the CAGRD replenishment obligations (A.R.S. § 45-859.01). Once the credits are transferred to the replenishment account, they may not be recovered, assigned or moved back to the long-term storage account.

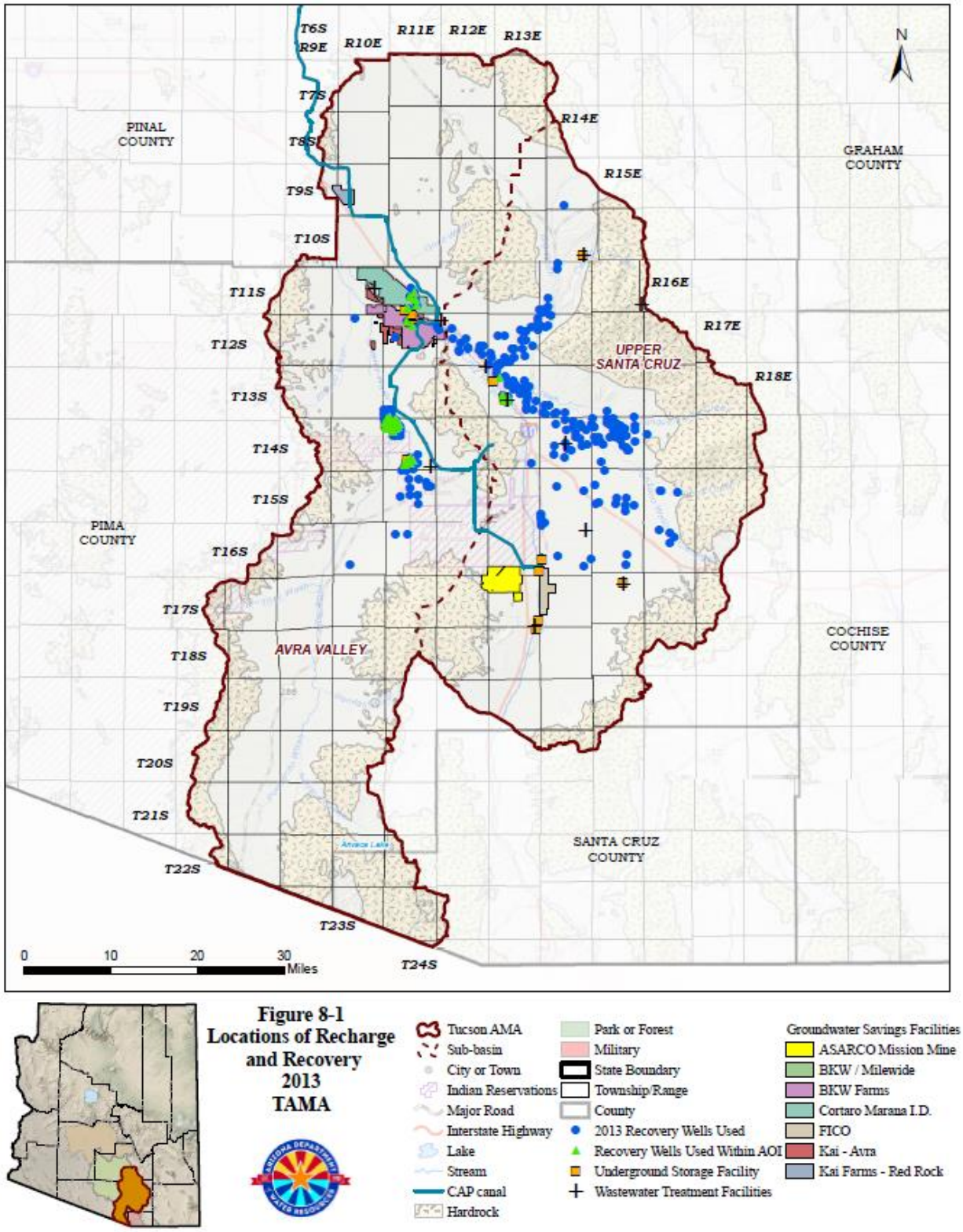
Finally, in many cases, a certain percentage of the volume of water stored is made non-recoverable by statute to benefit the aquifer. These required non-recoverable volumes are called "cuts to the aquifer." The cuts apply to the storage of certain types of water for long-term storage credits. They do not apply to water that is stored and recovered annually. In the TAMA, cuts to the aquifer totaled more than 202,000 ac-ft between 1986 and 2013 from storage of reclaimed water at managed facilities[2], CAP water at constructed facilities[3] and CAP water stored at Groundwater Savings Facilities (GSFs)[4].

[2] "Managed underground storage facility means a facility . . . that is designed and managed to utilize the natural channel of a stream to store water underground pursuant to permits issued under this chapter through artificial and controlled release of water other than surface water naturally present in the stream" (A.R.S. § 45-802.01(12)).

[3] "Constructed underground storage facility means a facility that . . . is designed and constructed to store water underground pursuant to permits issued under this chapter" (A.R.S. § 5-802.01(4)).

[4] "Groundwater savings facility means a facility . . . in an active management area or an irrigation non-expansion area at which groundwater withdrawals are eliminated or reduced by recipients who use in-lieu water on a gallon-for-gallon substitute basis for groundwater that otherwise would have been pumped from within that active management area or irrigation non-expansion area" (A.R.S. § 45-802.01(8)).

FIGURE 8-1
TUCSON AMA RECHARGE SITES & RECOVERY LOCATIONS



Persons who elect to undertake recharge-related activities must obtain the necessary permits from ADWR. There are three recharge-related permit categories: (1) storage facility permits, composed of constructed or managed Underground Storage Facility (USF) permits and Groundwater Savings Facility (GSF) permits; (2) Water Storage (WS) permits; and (3) Recovery Well (RW) permits. For a detailed description of each of these permits, please see the *Demand and Supply Assessment 1985-2025, Tucson Active Management Area* (Assessment) on ADWR's website: *http://www.azwater.gov/AzDWR/WaterManagement/Assessments/documents/FINALTAMAASSESSMENT.pdf*.

8.3 PHYSICAL ASSESSMENT OF THE TUCSON AMA

Attaining safe-yield may not eliminate potential water supply challenges facing the TAMA water users such as high water tables in recharge areas, and land subsidence and earth fissuring in areas of groundwater level decline. There is a need to develop additional aquifer management strategies during the fourth management period to address the impacts of these varied local groundwater declines and physical availability challenges. Because of possible CAP water shortages projected by the US Bureau of Reclamation, continued drought contingency planning is important as well. In 2013, about 35 percent of water recovered as either annual or long-term storage credits was recovered within one mile of a USF or GSF where the recovered water was stored, minimizing the potential impacts of localized water level declines. Further data analysis is needed to quantify how much individual storers are recovering within the area of impact of storage. In 2013, the volume of water recovered within the area of impact in the TAMA was approximately 41,000 ac-ft out of 117,000 ac-ft of total water recovered in the TAMA.

8.3.1 Groundwater Overdraft

Total 2013 water demand in the TAMA was approximately 343,000 ac-ft. About 48 percent of this demand, 163,000 ac-ft, was met by groundwater. Groundwater overdraft in the TAMA has been declining due to the increased use of renewable supplies primarily by TAMA municipal water providers and the use of USFs and GSFs by other TAMA water use sectors, including the Arizona Water Banking Authority (AWBA). The cut to the aquifer for stored water helps to offset overdraft. In addition, net natural and incidental recharge offset overdraft. Between 1985 and 2013 there were 12 years where more than 100,000 ac-ft of annual stream channel recharge is estimated to have occurred.

Despite the TAMA population nearly doubling from 1985 to 2013, groundwater demand has decreased due to increased direct use and recharge and recovery of renewable water supplies. The statutory goal of reaching safe-yield by 2025 appears achievable in the TAMA with continued water conservation, supply augmentation and careful water management.

8.3.2 Consequences of Groundwater Overdraft

Although water users in the TAMA have made significant strides to reduce groundwater dependency, remaining groundwater pumping in the TAMA could still negatively impact the AMA's aquifers, particularly at the local level for areas with greater hydrologic sensitivity. Lower groundwater levels could reduce well productivity and increase pumping costs. Lower groundwater levels may increase land subsidence, reducing the aquifer's ability to store water introduced either naturally or artificially through recharge. As shown in Chapter 2 of this plan, land subsidence has already occurred in the TAMA due to groundwater overdraft. Continued lowering of water levels could potentially result in additional land subsidence. Because there is potential for damage due to land subsidence in the TAMA, reduction of groundwater overdraft and increased recharge in sub-regional areas of the TAMA could benefit the TAMA. The depletion of the groundwater supplies in local areas within the TAMA may also reduce the groundwater supply physically available for demonstration of an Assured Water Supply (AWS).

As described in Chapter 2 of this plan, groundwater overdraft results in groundwater level declines. During the period 1940 to 2010, maximum water level declines between 100 and 250 feet in total were observed in the TAMA. Figure 2-8 in Chapter 2 of this plan shows historical water level changes between 2000 and 2010. Since the year 2000, water levels in the City of Tucson's (Tucson Water's) central wellfield, which historically experienced significant water level declines, appear to have stabilized and in some cases even risen due to Tucson Water's increased storage of CAP water and shifting its pumpage closer to the area of storage in the Avra Valley area. Table 8-1 below summarizes the water storage and recovery through the year 2013 at the AMA level and for each of the two groundwater sub-basins in the TAMA.

TABLE 8-1
TUCSON AMA WATER STORAGE & RECOVERY SUMMARY, 1986-2013 (ac-ft)

	Sub-basin	Avra Valley*	Upper Santa Cruz	AMA TOTAL
Delivered to be Stored through 2013	USF CAP	1,669,023	305,302	1,974,325
	USF Reclaimed	214,959	214,108	429,067
	USF Surface Water	957	0	957
	USF TOTAL	*1,884,939*	*519,410*	*2,404,349*
	GSF (CAP) TOTAL	*401,889*	*41,078*	*442,967*
	TOTAL DELIVERED TO BE STORED	**2,286,828**	**560,488**	**2,847,316**
Recovered through 2013	CAP	584,820	506,356	1,091,176
	Reclaimed	0	128,992	128,992
	Surface Water	870	0	870
	TOTAL RECOVERED	**585,690**	**635,348**	**1,221,038**
Recovered Water in 2013	CAP	67,061	41,942	109,003
	Reclaimed	0	8,018	8,018
	Surface Water	0	0	0
	Total	67,061	49,960	117,021
	Within 1 mile of any storage location	**34,949**	**5,814**	**40,763**
Recovered Water in 2005	CAP	24,617	46,344	70,960
	Reclaimed	0	5,358	5,358
	Surface Water	149	0	149
	Total	24,766	51,702	76,467
	Within 1 mile of any storage location	**7,372**	**4,655**	**12,027**

*Includes recharge projects that span both sub-basins.

8.3.2.1 Avra Valley Sub-basin

The Avra Valley Sub-basin has historically been dominated by agricultural water demand. In recent years, a significant volume of artificial recharge has occurred in this sub-basin. As of 2013, over two million ac-ft of water had been delivered for storage in the Avra Valley Sub-basin. Of this volume, 1.6 million ac-ft was CAP water delivered for storage at USFs, and more than 400,000 ac-ft of CAP was delivered to GSFs, primarily in the Avra Valley Area of Similar Farming Condition (ASFC). Most of the water stored in this sub-basin has been CAP water stored at USFs by Tucson Water. In addition to CAP water, there was nearly 215,000 ac-ft of reclaimed water stored in this sub-basin at USF facilities. A small volume of non-CAP surface water was stored as well.

About 48 percent of total TAMA recovered annual and long-term storage credits have been recovered in the Avra Valley Sub-basin to date, mostly by Tucson Water. Nearly all the water recovered in the Avra Valley Sub-basin has been CAP water.

8.3.2.2 Upper Santa Cruz Sub-basin

Historically, municipal demand has usually been concentrated in the Upper Santa Cruz (USC) Sub-basin in the TAMA. Over 93 percent of the TAMA population resides in this sub-basin, and accounts for the vast majority of municipal demand. There is significant agricultural demand in this sub-basin as well. About 47 percent of agricultural groundwater withdrawals in the TAMA in the year 2013 occurred in the USC Sub-basin.

By the end of 2013, more than 300,000 ac-ft of CAP water and more than 214,000 ac-ft of reclaimed water were stored in the USC Sub-basin. More than 635,000 ac-ft of this stored water has been recovered either annually or as long-term storage credits in this sub-basin. Of the water recovered in the USC Sub-basin, 506,000 ac-ft was recovered CAP water. The remainder of the water recovered in this sub-basin (approximately 129,000 ac-ft) was reclaimed water. Of the total volume of reclaimed water recovered, 93 percent was reclaimed water recovered within the area of hydrologic impact of where the water was stored. Under the management plan provisions, reclaimed water recovered within the area of impact of storage is considered "direct use" reclaimed water for purposes of determining compliance with conservation requirements.

The primary storer of water in the USC Sub-basin has been Tucson Water.

8.4 ALTERNATIVE WATER SUPPLIES ASSESSMENT

The primary renewable supplies in the TAMA are CAP water and reclaimed water, and are the primary alternative to groundwater use in the TAMA. Lack of surface water storage means that non-CAP surface water resources in the TAMA are a less significant renewable supply. The following section describes the major water supplies and how they are currently used in the TAMA. For a broader discussion of renewable supplies in the TAMA, see Chapter 2, section 2.9.

8.4.1 Colorado River Water and the Central Arizona Project

The CAP canal delivers Colorado River water to Pima, Pinal, and Maricopa Counties. Figure 8-1 shows the location of the CAP canal and terminal pipeline within the TAMA. The following sections describe the TAMA's CAP water supply, current use by water use sectors, and supply reliability challenges related to allocation priorities, Tucson's location at the end of the CAP line and water user needs. Additional discussion of CAP water use challenges may be found in Chapters 2, 5 and 6 and in Appendix 8.

8.4.1.1 Central Arizona Project Water Supply

The CAP is the largest source of renewable water supply available in the TAMA. Annual CAP water allocations for the TAMA total 263,298 ac-ft per year. Of this total, approximately 66,500 ac-ft per year are currently subcontracted to the Tohono O'odham Nation and Pascua Yaqui Tribe. The remaining 196,798 ac-ft per year consists mostly of municipal subcontracts. Additional CAP water may be allocated as a result of the Southern Arizona Water Rights Settlement Act and Non-Indian Agriculture (NIA) Priority CAP water reallocations.

A list of existing CAP water allocations/contracts for the TAMA is presented in Table 8-2. Agricultural and mining water users originally declined CAP water subcontracts; however, both Rosemont Copper and Freeport McMoRan Sierrita Inc. have applied for volumes of reallocated NIA Priority CAP water. TAMA

TABLE 8-2
TUCSON AMA CAP SUBCONTRACTS AND ALLOCATIONS

	Entity	Allocation (ac-ft)	Previous Allocation (ac-ft)
Municipal Subcontracts	City of Tucson	144,172	138,920
	Arizona State Land Department*	14,000	14,000
	Metropolitan Domestic Water Improvement District	13,460	8,858
	Flowing Wells Irrigation District	2,873	4,354
	Spanish Trail Water Company	3,037	3,037
	Green Valley Water Company	1,900	1,900
	Town of Oro Valley	10,305	2,294
	Avra Water Co-Op	808	0
	Midvale Farms	0	1,500
	Community Water Company of Green Valley	2,858	1,337
	Vail Water Company (formerly Del Lago Water Company)	1,857	786
	Town of Marana	1,528	47
Tribal Subcontracts	San Xavier (Tohono O'odham)	50,000	27,000
	Schuk Toak (Tohono O'odham)	16,000	10,800
	Pascua Yaqui	500	500
	TOTAL MUNICIPAL & TRIBAL SUBCONTRACTS	**263,298**	**215,333**
	(Other) ASARCO-Ray Mine	21,000	

*Per the Subcontract Among the United States, the Central Arizona Water Conservation District, and the State of Arizona by the Arizona State Land Department Providing for Water Service, dated July 13, 2007, in Appendix A of Addendum A.

agricultural CAP water use began in 2004 and has declined since 2006. Most agricultural CAP water use has been in-lieu CAP water delivered to GSFs. Overall, agricultural water use in the TAMA is likely to decline with urbanization.

Excess CAP water from unused entitlements and surplus Colorado River supplies have historically provided an opportunity to bring additional CAP water supplies into the TAMA beyond existing allocations. The volume of excess CAP water fluctuates depending on the use of CAP subcontracts and allocations and the availability of the overall CAP supply. Based on projections by the US Bureau of Reclamation, there is a probability that CAP shortages may occur in the future. Lower than average precipitation on the Colorado River watershed may increase the likelihood of these shortages occurring. Because CAP delivers mostly lower priority Colorado River water, Colorado River supplies for the CAP (and certain on-river/mainstem users) have a junior priority compared with other on-river/mainstem users. Colorado River supplies for the CAP will be reduced in times of a declared shortage in the Lower Colorado River Basin. As insurance

against the impacts of future shortages, unused CAP supplies have been recharged by individual entities within the TAMA holding water storage permits.

In addition to long-term storage and recovery, CAP water is also stored and recovered annually. This mechanism, although it involves recharge, is analogous to direct use because no long-term storage credits are generated.

Central Arizona Project Water Supply Reliability

The reliability of CAP water supplies and delivery scheduling has implications for the use of CAP water by municipal water providers within the TAMA. Arizona's CAP water holds a junior priority water entitlement to the Colorado River among the Lower Colorado River Basin States. It, and other junior priority uses in Arizona and Nevada, may be subject to reductions during times of shortage. However, projected shortages are not expected to impact CAP's high priority Municipal and Industrial (M&I) subcontractors. The CAP water supply reliability and scheduling is important to the TAMA due to its lack of other available surface water supplies.

Municipal Use of Central Arizona Project Water

The municipal sector has the largest allocations of CAP water in the TAMA. The City of Tucson is the largest provider in the TAMA, serves 75 percent of the population in the TAMA, and holds the largest municipal CAP water contract in the state (144,172 ac-ft).

Several municipal providers have been storing water at the TAMA's recharge facilities since 1993. Table 8-3 shows the volume of water stored by entity since 1993 and the portion of that volume that has been stored from 2000 through 2013. Not all the water stored is recoverable. As discussed in section 8.2.2 of this chapter, water stored by the CAGRD is to offset groundwater pumping associated with post-1995 subdivisions that are enrolled as member lands in the CAGRD and for municipal water providers who are member service areas in the CAGRD.

See Chapters 2, 3 and 5 of the plan for additional information on CAP water use by municipal providers. See Chapter 7 for additional information on water quality challenges.

Figure 8-1 shows the locations of recharge sites. Table 8-4 lists the facilities, permitted storage volumes, and volume stored as of 2013. A total of 410,733 ac-ft were delivered to be stored at GSF's in the TAMA between inception of the program and the end of 2013.

Agricultural Use of CAP Water

While a small portion of agricultural demand is met with CAP agricultural pool water, additional CAP water has been made available to farmers in the TAMA through the institution of ADWR's GSF Program, which allows a water storer to earn storage credits for providing an alternative water supply to a water user who otherwise would have used groundwater. The cost of CAP water to a farmer operating a GSF varies depending on the CAP water provider and specific conditions of the storage agreement. However, GSF storage agreements typically provide CAP water to farmers at a cost lower than any other water source available to them. In such instances, there is an economic incentive for the farmer to use CAP water instead of groundwater. The entities supplying CAP water earn long-term storage credits. Because much of the agricultural land in the TAMA is close to the CAP canal, CAP water distribution costs are minimized.

TABLE 8-3
TUCSON AMA WATER STORED BY ENTITY (ac-ft)

Entity	Stored 2000 - 2013	Stored 1993 - 2013
Tucson Water	1,372,537	1,470,761
Arizona Water Banking Authority	703,396	739,974
Metropolitan Domestic Water Improvement District	138,328	156,128
US Bureau of Reclamation	104,372	104,372
Tohono O'odham Nation	97,628	97,628
Town of Oro Valley	53,216	58,018
Augusta Resource (Arizona) Corporation	45,000	45,000
Central Arizona Water Conservation District	2,478	8,840
CAWCD – CAGRD Sub-Account	8,840	8,904
CAGRD – Conservation District Account	3,910	3,910
CAGRD - Replenishment Reserve Account	17,297	17,297
Town of Marana	23,031	23,078
Robson Ranch Quail Creek LLC	16,323	16,323
Vail Water Company	16,272	16,272
Spanish Trail Water Company	11,130	42,877
Flowing Wells Irrigation District	10,590	10,590
Pima County Regional Wastewater Reclamation Department	7,987	7,987
Green Valley Domestic Water Improvement District	4,825	5,325
Town of Sahuarita	3,642	3,642
Aqua Capital Management LP	3,000	3,000
Pascua Yaqui Tribe	3,433	3,433
Robson Communities Inc.	1,000	1,000
Cortaro Marana Irrigation District	957	957
Community Water Company of Green Valley	0	2,000
TOTAL DELIVERED TO BE STORED	**2,649,192**	**2,847,316**

Agricultural use of in-lieu CAP water in the TAMA peaked in the year 2000 at 27,973 ac-ft. Since then, the volume has fluctuated. In the year 2013, in-lieu CAP was 25,356 ac-ft. Although agricultural use in the TAMA has fluctuated historically, it does not show a trend of reduction as growth has occurred in the municipal sector. See Chapter 4 for further discussion of agricultural CAP water use.

Direct use of CAP water for agricultural purposes historically has not been economically advantageous to various agricultural entities in the TAMA. The Cortaro Marana Irrigation District (CMID), Avra Valley Irrigation District (AVID) and Farmers Investment Company (FICO), declined their CAP water allocations in the 1980s, primarily due to CAP water costs. In the case of AVID and FICO, infrastructure cost for the conveyance of CAP water to their farms was also a challenge. Thus, historical use of CAP agricultural pool water in the TAMA in most years has been less than 3,000 ac-ft per year.

Tribal Use of Central Arizona Project Water

Tribal use of CAP water in the TAMA began in the year 2000 and has ranged from 10,000 to more than 21,000 ac-ft per year from 2002 through 2013. This CAP water is used entirely for agricultural irrigation on tribal land.

Industrial Use of Central Arizona Project Water

Most industrial users in the TAMA have chosen not to pursue CAP water supplies. Historically, the cost of CAP water compared to groundwater, lack of physical access to the CAP water supply, and infrastructure cost has constrained the use of CAP water by industry. Mines are the largest-volume industrial water user group in the TAMA. In-lieu use of CAP water by the mining sector began in 2007 and has increased to more than 6,500 ac-ft per year since 2009. The mining industry has been increasing their use of renewable CAP supplies by the use of recharge and recovery for current and future uses. Two mines have long-term storage accounts and water storage permits and one has been storing CAP water. See Chapter 6 for further discussion of current and potential CAP water use by industrial users.

TABLE 8-4
TUCSON AMA WATER STORAGE FACILITIES

Facility Name	Permit Volume (ac-ft/year)	Source water	Amount Stored (ac-ft)
ASARCO Facility	10,000	CAP	41,078
Avra Valley USF	11,000	CAP	100,510
BKW Farms GSF	14,317	CAP	143,976
BKW Milewide GSF	613	CAP	5,045
Black Wash USF	4,480	Reclaimed	0
CAVSARP USF	100,000	CAP	835,315
Corona De Tucson WRF	2,240	Reclaimed	1,313
Cortaro Marana Irrigation District GSF	20,000	CAP, Reclaimed	113,869
Farmers Investment Company GSF	22,000	CAP	0
Herb Kai - Avra Facility	12,513	CAP	0
Kai Farms GSF (Red Rock)	11,231	CAP	138,999
Lower Santa Cruz Replenishment Project USF	50,000	CAP	425,949
Lower Santa Cruz River Managed USF	43,000	Reclaimed	212,065
Marana High Plains USF	600	Reclaimed, Surface	3,851
Pima Mine Road USF	30,000	CAP	301,331
Project Renews USF	3,000	CAP	0
Robson Ranch Quail Creek USF	2,240	Reclaimed	16,323
Saddlebrooke Water Reclamation Plan USF	2,090	Reclaimed	0
Santa Cruz River Managed USF	9,307	Reclaimed	84,591
SAVSRP USF	60,000	CAP	307,250
Sweetwater USF	13,000	Reclaimed	108,239
Town of Sahuarita	896	Reclaimed	3,642
Tucson Water Injection Projects	NA	CAP	3,971
TOTAL	**422,527**		**2,847,317**

8.4.2 Reclaimed Water

In 2013, Pima County Regional Wastewater facilities produced 64,354 ac-ft of reclaimed water (Pima County Regional Wastewater Reclamation Department, 2013). ADWR annual report records indicate that about 15,400 ac-ft, or 24 percent of the volume of reclaimed water produced was directly reused on turf facilities or delivered to agricultural users. As a result of recent upgrades to wastewater reclamation facilities, there has been a reported increase in the rate of in-channel recharge. About 26,000 ac-ft, or 40 percent of the reclaimed water produced was stored at managed or constructed recharge facilities in the TAMA. Reclaimed water discharges to the Santa Cruz River have benefited riparian habitat, which provides

ancillary benefits including recreational opportunities. However, reclaimed water also provides an important component of the total water supply available to the TAMA.

There are several benefits to increasing use of reclaimed water. The primary benefit is reserving high quality groundwater for potable use. Other benefits include the following:

- Use of reclaimed water for turf irrigation offsets the use of groundwater or other renewable supplies
- Land subsidence caused by over-pumping of groundwater can be partially reduced by reclaimed water use/recharge
- Reclaimed water may also be recharged or directly used in areas with severe groundwater water level declines

Management of the reclaimed water supply is complicated by the decisions and policies of the jurisdictions controlling the supply. These decisions and policies regarding the distribution of reclaimed water will continue to affect the use of reclaimed water during the fourth management period. However, any and all use of reclaimed water either directly replaces current or future groundwater demand, or replaces CAP use, which then can replace current or future groundwater demand.

Pima County owns and operates the largest wastewater system in the TAMA but controls little of the reclaimed water produced. Under an agreement related to the Southern Arizona Water Rights Settlement Act (SAWRSA), the Secretary of the Interior is assigned 28,200 ac-ft per year of the reclaimed water discharged from Pima County's metropolitan wastewater treatment facilities. The City of Tucson controls 90 percent of the remaining reclaimed water produced by County facilities under a 1979 intergovernmental agreement (IGA), and ten percent is controlled by Pima County. Of the 90 percent of reclaimed water controlled by the City of Tucson, five other water providers (Metro Water District, Town of Oro Valley, Town of Marana, Flowing Wells Irrigation District and Spanish Trail Water Company) have signed IGAs with the City of Tucson and are entitled to reclaimed water generated from their service areas.

The City of Tucson owns and operates a distribution system for reclaimed water (post-secondary-treated wastewater). The reclaimed system is primarily used for turf irrigation. The Sweetwater Recharge Facility provides temporary underground storage and recovery to meet seasonal demands of the reclaimed water system. The facility uses spreading basins to recharge excess reclaimed water during the winter. The reclaimed water can be later recovered via on-site recovery wells for use in the hotter months when irrigation demands are higher. The Santa Cruz River Managed and Lower Santa Cruz River Managed Recharge Facilities are in-channel reclaimed water storage and recovery projects that have increased the volume of water that can be delivered through the reclaimed system.

Although the supply of reclaimed water offers opportunities for augmenting the water supply, the following factors could affect reclaimed water use in the TAMA:

- Expanding the City of Tucson's reclaimed water distribution system would be costly.
- There is currently no distribution system that could make reclaimed water available to many of the large agricultural users such as BKW Farms, AVID, and FICO.
- Chemical incompatibility of reclaimed water with metallurgical processes can make the use of reclaimed water in mining operations problematic.

There has been public interest within the TAMA in continuing discharges to the Santa Cruz River for purposes such as maintaining riparian vegetation. The Sonoran Institute's Living River program has created

an initiative which monitors river flow rates, water quality and related factors such as existence of aquatic wildlife and social/recreational impacts.

Cooperative regional planning can help address some of the institutional, financial and regulatory barriers to efficient reclaimed water supply management and reclaimed water use. In 2011 the US Bureau of Reclamation published a report that discusses the potential to enhance reclaimed water recharge rates in the TAMA. The study found that, while costly, recharge at the Santa Cruz River Managed Recharge Project can be enhanced by diverting the reclaimed water to be stored into adjacent dry channels.

8.4.3 Surface Water

In the upper stream reaches in the Santa Catalina Mountains and a few other areas in the TAMA, surface water often flows year-round. Because the surface water eventually percolates to the groundwater aquifer as mountain front and stream bed recharge, this surface water is not a potential new source of renewable supply.

Most of the intermittent run-off in the TAMA recharges naturally along the mountain fronts and in the washes of the TAMA, and is not a source of renewable supply. In order to accrue recharge credits for recharge of storm water, one must demonstrate that the water stored would not have been naturally recharged within the TAMA (A.R.S. §§ 45-831.01(D)(1) and 45-852.01).

Changing the distribution of storm-water recharge in the basin may help meet local water management objectives. Large-scale recharge projects designed solely to recharge storm water are often not cost-effective due to the small number of days of flow during each year. Some small-scale, multiple-use projects incorporating storm-water recharge have been proposed in the TAMA. A large number of households retaining storm water by harvesting runoff in swales, micro-catchments and tanks could cumulatively result in reductions in municipal demand for outdoor use. Retaining storm water in the soil and applying tank-stored storm water to landscaping reduces the need to use groundwater, imported CAP water or reclaimed water to meet this demand.

8.4.4 Cooperative Efforts to Produce Water Management Solutions

Entities in the TAMA have worked cooperatively to create initiatives and projects that enhance augmentation and recharge in the AMA. The TAMA community encourages innovative programs that contribute positively to local achievement of water management goals, while fostering educational, recreational and tourism opportunities.

ADWR staff works in concert with the Safe Yield Task Force (SYTF), a technical working group that informs the Tucson Groundwater Users Advisory Council (GUAC). The SYTF is an ad-hoc group with participants from all water use sectors within the TAMA. An ongoing effort of the SYTF is the examination of different regions of the TAMA that have particular challenges such as local water level declines. During the fourth management period, ADWR, the GUAC and the SYTF will continue to identify and examine challenges within the TAMA and work to establish effective water management solutions.

8.5 TAMA 4MP AUGMENTATION & RECHARGE PROGRAM GOALS AND OBJECTIVES

This Recharge Program chapter has thus far highlighted the physical groundwater supply conditions in various locations throughout the TAMA, the availability of renewable water supplies, the successes and shortcomings of the Recharge Program during the third management period in the TAMA and the water management challenges facing the TAMA during the fourth management period. ADWR has developed the goals and objectives of the Recharge Program for the fourth management period based upon these

TAMA considerations. The Recharge Program for the fourth management period is intended to move the TAMA toward its goal of safe-yield and to begin to address sensitive areas by emphasizing the following primary objectives:

- Encourage and facilitate the replacement of groundwater use with the efficient use of renewable supplies throughout the TAMA.
- Improve or maintain groundwater conditions in areas of the TAMA experiencing or projected to experience impacts due to water level declines.
- Explore options for managing local aquifer areas.
- Maximize storage of CAP water to offset future shortages.

During the fourth management period ADWR will work to:

- Maximize the beneficial use of Colorado River water and reclaimed water to reduce groundwater overdraft and ensure a safe, long-term, reliable water supply.
- Support efforts to utilize the CAP canal system to the fullest extent possible, to deliver excess Colorado River water and other water to the TAMA while these supplies are available.
- Support development of local water management, supply augmentation and recharge plans consistent with groundwater management objectives.
- Develop groundwater monitoring programs, improve databases and expand public information programs to support planning and management activities.
- Coordinate groundwater replenishment, AWBA activities, AWS activities and related activities to facilitate achievement of groundwater management goals. These goals include ensuring that recharge activities protect the quality and storage capacity of the aquifer and that facilities are sited in a manner that maximizes benefits and provides for future recovery as required.
- Support comprehensive regional water management efforts, including the development and beneficial use of alternative supplies.
- Develop incentives for augmentation of water supplies, including incentives that promote efficient use of renewable supplies.
- Identify and assess feasibility of potential future water supply augmentation measures.
- Facilitate the settlement of Tribal water rights claims in the TAMA.

The possibilities and need for augmentation during the fourth management period differ substantially among the five AMAs. ADWR will continue to assist water users in developing additional water supplies and maximizing the use of existing alternative water supplies in meeting the TAMA water management goal. To accomplish this, ADWR will first seek to identify all potential measures available to the TAMA. Proposed measures will be evaluated based on their cost and physical practicality in implementation. The amount of information available for water management has already increased through the development of groundwater and surface water monitoring programs by ADWR to facilitate effective implementation of water augmentation and recharge plans.

8.6 TAMA 4MP RECHARGE PROGRAM

ADWR is required to include in the 4MP "if feasible, a program for additional augmentation of the water supply of the active management area, including incentives for artificial groundwater recharge" (A.R.S. § 45-567(A)(5)). Pursuant to A.R.S. § 45-561(2), "Augmentation means to supplement the water supply of an active management area and may include the importation of water into the active management area, storage of water or storage of water pursuant to chapter 3.1 of this title." The Recharge Program must be consistent with this statute, but, as described in the introduction, for purposes of this chapter *augmentation*

means increasing the availability and use of renewable supplies such as reclaimed water in lieu of groundwater and *recharge* means storage of water pursuant to Title 45, Chapter 3.1, the Underground Water Storage, Savings and Replenishment Act. The Recharge Program, therefore, includes provisions for maximizing the use of renewable supplies and for storage of renewable water.

The principal responsibility for developing water supplies and for storing that water for future uses lies with the TAMA's water users. ADWR's responsibility under A.R.S. § 45-567(A)(5) is to design a program that encourages and facilitates the efforts of those water users. The program should particularly encourage augmentation and storage of water where groundwater supplies are limited. The Recharge Program also strives to avoid aggravating existing local water supply problems.

The Recharge Program for the 4MP includes the statutory requirements for storing and recovering water within an AMA. The key statutory provisions for storage facilities relate to hydrologic feasibility (A.R.S. § 45-811.01(C)(2)); protection of land and other water users from unreasonable harm (A.R.S. § 45-811.01(C)(3)); and avoidance of water quality impacts (A.R.S. § 45-811.01(C)(5)). The Underground Water Storage, Savings and Replenishment Act requires certain types of storage and recovery to be found consistent with the management plan and management goal for the AMA. The provision that governs non-recoverable storage includes a requirement that non-recoverable water storage must be consistent with the AMA's Recharge Program (A.R.S. § 45-833.01(A)). Provisions governing recovery allow stored water to be recovered outside the area of impact of the stored water only if certain conditions are met (A.R.S. § 45-834.01). One of the conditions is that the Director must determine that recovery at the proposed location is consistent with the management plan and management goal of the AMA (A.R.S. § 45-834.01(A)(2)(b)(ii)).

ADWR has developed the Recharge Program for the 4MP to address the goals and objectives identified in the previous section. The program components are discussed in the following sections.

8.6.1 Arizona Water Banking Authority

The AWBA was established in 1996 to: 1) protect municipal and industrial (M&I) users of CAP water from shortages or disruptions to the CAP system, 2) assist in meeting the management objectives of the state's Groundwater Code (Code), 3) assist in the settlement of Tribal water rights claims, 4) exchange water to assist Arizona's Colorado River communities and 5) explore opportunities for interstate water banking with Nevada and California. To this end, the AWBA has recharged nearly 4.2 million ac-ft (MAF) of excess CAP water within the Central Arizona Water Conservation District's (CAWCD) service area through 2014. Long-term storage credits (credits) accrued from this storage total 3.97 MAF and include 3.36 MAF for Arizona uses and 0.6 MAF for interstate storage, specifically, the Southern Nevada Water Authority (SNWA).

As shown in Table 8-5, the AWBA has accrued 736,238 ac-ft of credits in the TAMA, of which 109,791 ac-ft are for SNWA. The highest percentage of credits that have been accrued at CAWCD's Lower Santa Cruz Recharge Project (43 percent), followed by CAWCD's Pima Mine Road Recharge Project (18 percent). The combined storage at Tucson Water's Central and Southern Avra Valley Storage and Recovery Projects accounts for 27 percent of total credits accrued by the AWBA in the TAMA.

The AWBA is authorized to use four main revenue sources to accomplish its objectives:

- General Fund appropriations received at the discretion of the Legislature;
- Groundwater Withdrawal Fees of $2.50 per ac-ft collected in the Tucson, Phoenix and Pinal AMAs collected by ADWR;

- An *ad valorem* property tax (4¢ tax) levied and collected by CAWCD in its three-county CAP service area; and
- Monies received for interstate banking

While the AWBA is authorized to use these funding sources, the revenues available from each source vary both on an annual basis and by the amounts collected within each AMA or County. There are also limitations on how each fund may be utilized by the AWBA to achieve its various goals.[5] The availability and use of funds for any given year are described in the AWBA's Annual Plan of Operation.

In addition to its primary funding sources, the AWBA also received funds from two other sources: shortage reparations and water storage capital charges assessed by CAWCD in Pima County. Under the Arizona-Nevada Shortage-Sharing Agreement executed on February 9, 2007, SNWA agreed to provide $8 million to the AWBA to assist Arizona in offsetting impacts from any shortages during the "Interim Period".[6] These funds have been used by the AWBA to accrue credits in each of the three AMAs. Any credits not utilized during the Interim Period will continue to be available to the AWBA for future firming purposes. In 2004, the AWBA also began using monies from the water storage capital charges collected at CAWCD storage facilities in the TAMA. These revenues ($9/ac-ft) are deposited into CAWCD's 4¢ *ad valorem* tax fund for Pima County, where they are made available to the AWBA for M&I firming purposes. Revenues from the capital charge through 2014 total over $2.25 million.

TABLE 8-5
TUCSON AMA AWBA CREDITS ACCRUED & LOCATION THROUGH 2014

		AWBA Long-term Storage Credits (ac-ft)		
	Storage Facility	**Intrastate**	**Interstate**	**Total**
USF	Avra Valley Recharge Project	60,175	1,315	61,490
	Central Avra Valley Storage & Recovery Project (CAVSARP)	90,444	4,717	95,161
	Lower Santa Cruz Recharge Project	242,683	73,930	316,613
	Pima Mine Road Recharge Project	101,072	29,828	130,900
	Southern Avra Valley Storage & Recovery Project (SAVSARP)	103,607	0	103,607
	Subtotal	**597,980**	**109,791**	**707,772**
GSF	BKW Farms	1,641	0	1,641
	Cortaro Marana Irrigation District	12,257	0	12,257
	Kai Farms-Red Rock	14,336	0	14,336
	ASARCO-Mission Mine Complex*	234	0	234
	Subtotal	**28,467**	**0**	**28,467**
	Total	**626,447**	**109,791**	**736,238**

*Long-term storage credits purchased from the Tohono O'odham Nation pursuant to § 45-841.01
NOTE: Totals may not add due to rounding.

[5] A.R.S. § 45-2425 describes how revenues are made available to the Arizona Water Banking Fund and A.R.S. § 45-2457 describes how these revenues may be used.
[6] The Interim Period is the period beginning on the date the US Secretary of the Interior issued the Colorado River Interim Guidelines for the Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead, December 13, 2007, and ending on December 31, 2025 (through preparation of the 2026 Annual Operating Plan).

Table 8-6 below identifies the volume of credits the AWBA has accrued in the TAMA for each funding source. The majority of the credits accrued (57 percent) are from use of the 4¢ *ad valorem* tax monies and represent 49 percent of the TAMA M&I firming goal of 864,000 ac-ft.

TABLE 8-6
TUCSON AMA AWBA CREDITS ACCRUED
PER FUNDING SOURCE THROUGH 2014*

Funding Source	Long-term Storage Credits (ac-ft)
Groundwater Withdrawal Fees*	103,306
Four-cent *Ad valorem* Tax	422,292
General Fund	54,546
Appropriation for Indian Firming	28,481
Shortage Reparation	17,822
Interstate Banking - Nevada	109,791
Total	736,238

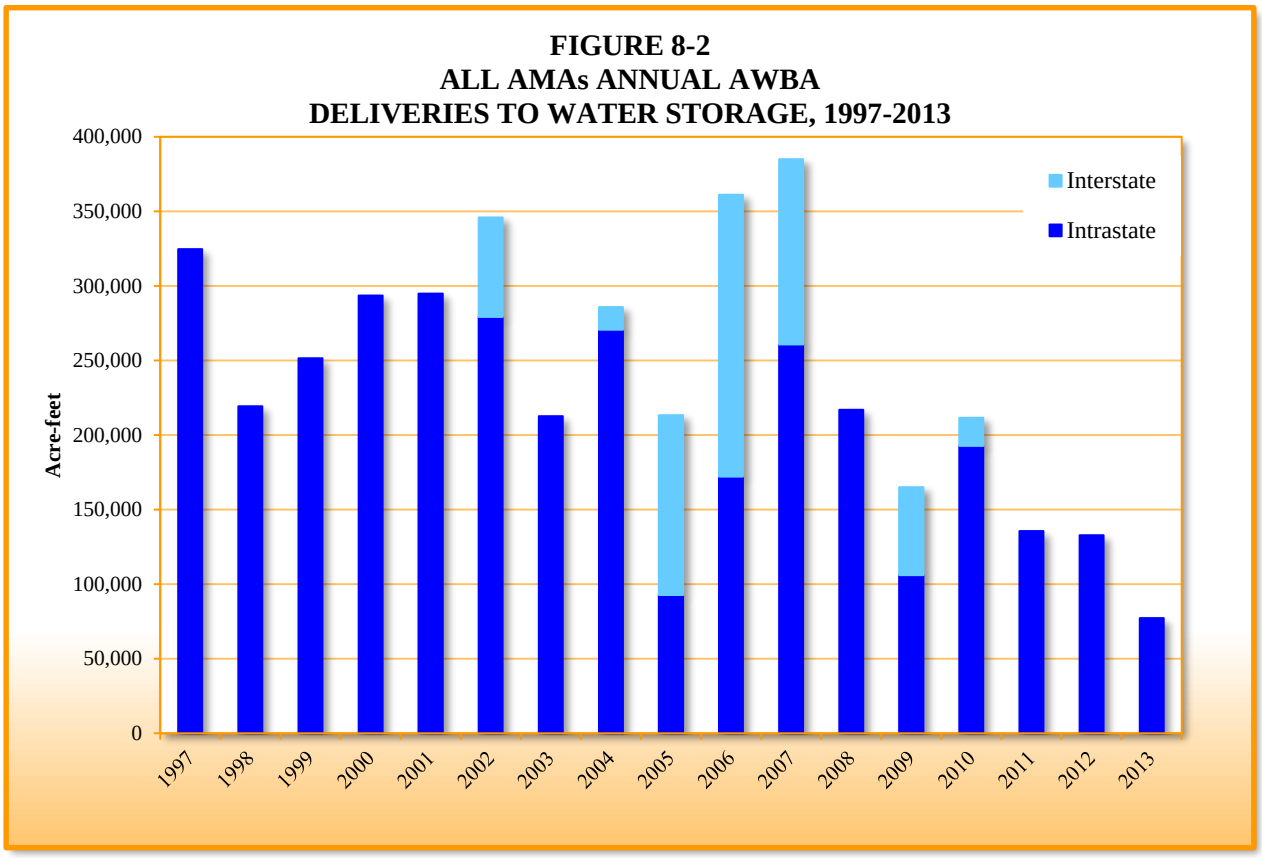
*Includes 234 ac-ft of credits purchased from the Tohono O'odham Nation pursuant to § 45-841.01

As illustrated in Figure 8-2, the volume of Excess CAP water available to the AWBA has historically been over 200,000 ac-ft per year with volumes peaking in 2006 and 2007 at 361,220 ac-ft and 384,890 ac-ft, respectively. This trend began to shift in 2008 due to an increase in use by higher priority CAP water users, which decreased the amount of water available to the excess pool. The volumes available to the AWBA within the excess pool also decreased, fueled primarily by a decrease in the rate for incentive-priced recharge water. While it has always been anticipated that the amount of excess CAP water available to the AWBA would decrease over time, these decreases occurred earlier than expected.

Annual AWBA water storage in the TAMA are quantified in Figure 8-3 below. Though slow-paced at first, AWBA storage gradually increased as more recharge capacity became available within the TAMA. The AWBA further increased its storage opportunities in 2010, when it developed a pricing policy for GSFs that encouraged storage partnerships. Through 2014, nearly 780,500 ac-ft of water has been delivered for AWBA storage in the TAMA. By bringing additional CAP water into the AMA, the AWBA has played an important water management role in the TAMA. AWBA storage accounts for nearly 40,000 ac-ft of water provided as a benefit to the aquifer (5 percent cut). Because the AWBA is still behind in meeting its M&I firming goals for the TAMA, the AWBA has focused heavily in recent years on storage in the TAMA to make further progress on its M&I firming goal while Excess CAP supplies are still available for its use.

The location of AWBA storage is also an important factor for meeting water management objectives, particularly when that storage is for M&I firming because the stored water must also be recovered. This is of particular importance in the TAMA considering that CAP subcontractors use their entitlements primarily through annual storage and recovery. While there was emphasis historically on the AWBA's use of CAP demonstration projects, the AWBA, working with Tucson interests, has developed a priority system that focuses storage first at USFs with existing or future planned recovery wells (e.g. CAVSRP/SAVSRP, Pima Mine Road, and Avra Valley Recharge Projects), second at GSFs and third at the Lower Santa Cruz Recharge Project.

FIGURE 8-2
ALL AMAs ANNUAL AWBA
DELIVERIES TO WATER STORAGE, 1997-2013



NOTE: Storage in 2004 and 2009 included 10,000 ac-ft and 51,387 ac-ft, respectively, of Nevada's unused Colorado River apportionment stored on behalf of SNWA.

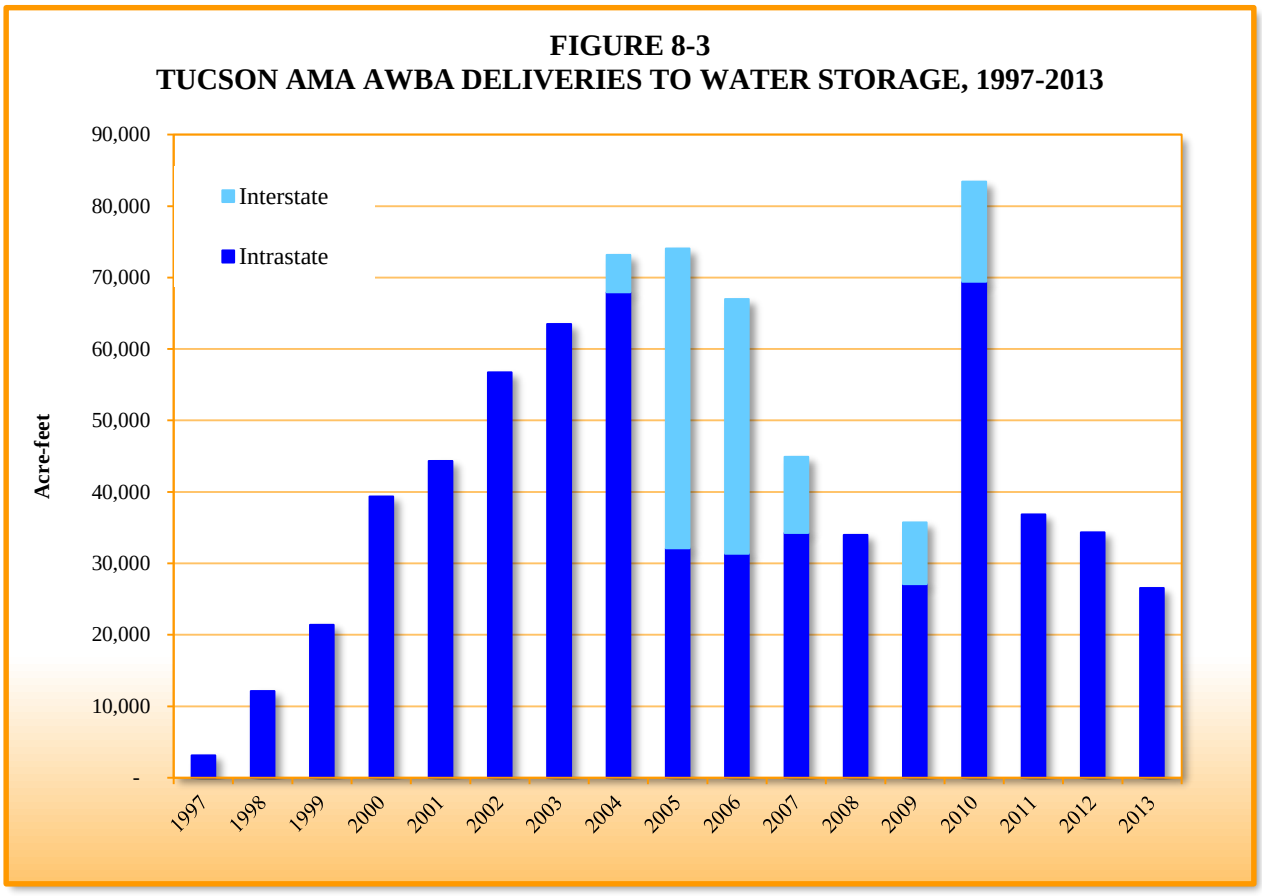
In April 2014, Metro DWID's Board of Directors directed Metro DWID staff to plan, design and construct an annual recharge and recovery project called CAP Recharge, Recovery and Delivery System for Metropolitan DWID Main System. MDWID purchased the Avra Valley Recharge Project from CAWCD in December 2010. A pipeline routing study and property acquisition have taken place, with construction currently planned for 2019.

Although much progress has been made toward the development of new recharge facilities in TAMA, a proposed recharge site located in the Sahuarita/Green Valley area that was recommended for AWBA storage was not realized during the third management period. Future facilities at or near this location could also benefit from AWBA storage.

8.6.1.1 Interstate Water Banking in the TAMA

The AWBA began storing water pursuant to its interstate water banking program in 2002. As illustrated in Figure 8-3, storage for interstate purposes in the TAMA began in 2004. The AWBA has since stored nearly 110,000 ac-ft of water in the TAMA on behalf of SNWA. Benefits from interstate storage in the TAMA are two-fold. First, there is a short-term benefit of additional water supplies imported into the TAMA in advance of when those supplies will be needed for interstate use. Second, as previously discussed, capital charges paid for interstate storage are subsequently deposited into CAWCD's 4-cent *ad valorem* tax fund for Pima County. Capital charges for interstate storage have increased the amount of funds available for M&I firming in the TAMA by nearly $1 million ($999,855).

FIGURE 8-3
TUCSON AMA AWBA DELIVERIES TO WATER STORAGE, 1997-2013



8.6.1.2 Assistance in Settlement of Tribal Water Rights Claims

The Arizona Water Settlements Act (AWSA) P.L. 108-451, which settles longtime claims to water by the Gila River Indian Community (Community) and the Tohono O'odham Nation (Nation), was enacted in December of 2004. The State, under Section 105(b)(2) of the AWSA, is required to: 1) firm 15,000 ac-ft of non-Indian agricultural (NIA) priority CAP water re-allocated to the Community, 2) firm 8,724 ac-ft of NIA priority CAP water re-allocated in the future to Arizona Tribes and 3) assist the US Secretary of the Interior (Secretary) in its firming requirement for the Nation by providing $3 million in cash or in-kind goods or services, including water, to the Secretary. For a 100-year period and during times of shortage, the AWSA requires the State to firm delivery of CAP water to certain Arizona Tribes with NIA priority water to the same level of priority the State would likewise firm delivery of CAP water to M&I priority users. The Indian Firming Study Commission, created by the Arizona State Legislature (Legislature) to evaluate the potential alternatives for meeting the State's obligations under the AWSA, concluded that the AWBA is the most appropriate entity to fulfill the State's firming obligations. The AWBA was subsequently given this authority pursuant to A.R.S. § 45-2491.

On November 15, 2007, the AWBA and the Secretary entered into an agreement that defines the AWBA's obligation to firm water during times of shortage. The agreement also allows the AWBA to enter into separate agreements with tribal communities to develop firming plans that will be used to meet its obligations. In the TAMA, the AWBA's settlement obligation involves assisting the Secretary in meeting its firming obligation to the Nation as described above. Under its agreement with the Secretary, the AWBA agreed to provide the $3 million in assistance by accruing an equivalent amount of long-term storage credits and to distribute those credits to the Secretary when a firming need arises. The AWBA fulfilled this

obligation in 2009, accruing over 34,000 ac-ft of credits for this purpose. With enforceability of the AWSA in December of 2007, the AWBA has a firming responsibility through 2107.

8.6.1.3 Distribution and Recovery of AWBA Long-term Storage Credits in the TAMA

Based on current modeling projections, the AWBA does not anticipate the need to firm on-River or CAP M&I priority supplies before 2025.[7] While there is a chance (< 30 percent) that the AWBA will need to firm NIA priority supplies during this time as required under the AWSA, this firming requirement would only affect the Phoenix and Pinal AMAs. However, in its requirement to firm NIA priority supplies for the Nation, the Secretary could request that the AWBA distribute credits it has accrued in the TAMA for this purpose. The AWBA is not responsible for the recovery of those credits. Recovery for the development of Intentionally Created Unused Apportionment (ICUA) for Nevada is also not projected to occur until sometime after 2025.

To prepare for meeting future firming requirements and for the development of ICUA, the AWBA, CAWCD and ADWR, in cooperation with stakeholders, developed a recovery plan that provides a framework for how the AWBA's credits will be recovered in the future.[8] The recovery plan identifies various methods that can be used for recovering AWBA credits such as direct recovery by CAWCD, indirect recovery with third parties, and credit exchanges with recovery partners. The recovery plan also makes recommendations on opportunities for recovery within each AMA. In the TAMA, these recommendations are predominantly for the use of credit exchanges between CAWCD and CAP M&I subcontractors due to the nature of how these water providers utilize their entitlements. Direct recovery facilities in the vicinity of the Kai Farms Red Rock GSF and the Lower Santa Cruz Recharge Project will also be considered. By defining the location of future recovery sites, the recovery plan will also assist the AWBA in making future storage decisions.

8.6.1.4 Recommendations to the Arizona Water Banking Authority

One of the stated purposes of the legislation creating the AWBA is to "store water brought into this state through the CAP to fulfill the water management objectives of this state set forth in chapter 2 of this title" (A.R.S. § 45-2401(H)(3)). The AWBA is required to coordinate with the Director of ADWR, who serves as chair of the AWBA Commission, in the "storage of water and distribution and extinguishment of long-term storage credits . . . in accordance with the water management objectives set forth in chapter 2 of this title [the Code]" (A.R.S. § 45-2423(A)(3)). To meet these statutory requirements, ADWR must provide specific advice to the AWBA as to how to incorporate such objectives into the AWBA's activities. Specifically, the Groundwater Code requires that ADWR include recommendations to the AWBA in the 4MP regarding the following three questions: 1) whether additional water storage in the AMA would help to achieve the management goals of the AMA, 2) where the additional water storage would be most useful in achieving the management goal and 3) whether the extinguishment of credits would assist in achieving the management goal. ADWR provides the following recommendations to the AWBA for water storage in the AMA.

Advice to the AWBA on Additional Water Storage in the TAMA

It is clear that water storage by the AWBA helps to meet the water management objectives of the TAMA. Because the AWBA is behind in meeting its M&I firming goal in the TAMA, ADWR recommends that the AWBA continue to prioritize storage for the TAMA, including the storage of additional supplies that may become available during the year, so that further progress can be made on achieving this goal. To ensure

[7] Arizona Water Banking Authority 2014 Annual Report.

[8] The Preface to the *Recovery of Water Stored by the Arizona Water Banking Authority – A Joint Plan by AWBA, ADWR and CAP* that acknowledges the plan advances the objectives of the Intergovernmental Agreement among the Parties, was executed on May 6, 2014.

the storage of these additional supplies, ADWR also recommends that the AWBA work with storage facility operators to seek opportunities for additional storage capacity, particularly at facilities that have future recovery capabilities.

Advice to the AWBA on the Location of Water Storage in the TAMA

It is anticipated that most of the water that is stored by the AWBA in the TAMA will need to be recovered to firm CAP M&I subcontract supplies during future shortages or outages of the CAP. To better manage local aquifers, ADWR recommends that the AWBA continue to work with CAWCD and Tucson interests to select sites for recharge that are also expected to have future recovery capabilities such as at the Avra Valley Recharge Project. ADWR also recommends that the AWBA seek opportunities to store water in the Sahuarita/Green Valley area should storage facilities become available in this area in the future.

Advice to the AWBA on Water Storage Credit Extinguishment

While the extinguishment of withdrawal fee credits to provide water management benefits is always desirable, recognizing that the AWBA is behind in reaching its firming goal for the TAMA and that the AWBA may use withdrawal fee credits for this purpose, ADWR recommends that the AWBA hold these credits in reserve at this time. Additionally, ADWR recommends that the AWBA be conservative in how it distributes credits during times of shortage and only distribute credits to mitigate shortages for direct use demands, including demands that are met through annual storage and recovery. If withdrawal fee credits were to become available for extinguishment ADWR recommends that the AWBA develop a program in cooperation with TAMA water users and interested parties to extinguish storage credits in areas that best meet the TAMA's water management needs, such as in areas of ongoing overdraft.

8.6.2 Storage and Recovery Siting Criteria

Recharge Program water management benefits are dependent upon the location of storage and recovery. Because recovery outside the area of impact must be consistent with the TAMA's management plan and management goal, the locations of storage and recovery of water are inherently linked. Both must be considered when determining whether the future recovery of stored water meets the requirement for consistency with the management plan and management goal of the TAMA. Water management benefits to the TAMA would depend greatly on whether water recovered from an existing recovery well was stored in a remote area of the TAMA or in a large pumping center of the TAMA. Therefore, the criteria to determine whether the recovery location is consistent with the management plan and goal for the TAMA must also consider where water was stored.

The locations of storage and recovery are also important factors in addressing local and regional supply problems, particularly in areas experiencing severe water level declines, land subsidence, or other aquifer management challenges and in attempting to balance the TAMA's supplies during the fourth management period. For example, these locations are also crucial because future TAMA water supplies may be diminished if water storage occurs in a remote location with no future demand for the stored water and recovery occurs in an area experiencing water level declines. On the other hand, if storage occurs in an area experiencing high water levels and recovery occurs away from the area of impact, the water storage will contribute to those high water levels. If dewatering is required as a *direct* result of water storage or savings, either the storage facility's operational plan should be adjusted to minimize impacts, which may include strategic recovery locations to mitigate impacts, or the storer may not be issued credits.

Pursuant to A.A.C. R12-15-716(B)(3)(c)(ii), the AWS Program protects the estimated water demand of AWS determinations, including groundwater and stored water to be recovered outside the area of impact, from being considered physically available to subsequent AWS applicants.

The Recharge Program criteria also link future use benefits to determinations under the AWS Program. If the recovery will occur outside the area of impact of storage, but the storage contributed to groundwater supplies that have been committed to establish an AWS determination[9], the recovery is deemed to be consistent with the management plan and achievement of the management goal. If recovery is to take place outside the area of impact, but is not contributing to groundwater supplies of an AWS determination, the recovery may still be consistent with the management plan and achievement of the management goal if the storage contributes to groundwater supplies accessible to current groundwater users, is a component of a remedial action project, or is otherwise determined by the Director to have contributed to the objectives of this chapter or achievement of the management goal. If a storage facility is found not to meet these criteria, the permit will include a notice to potential water storers that recovery of the stored water will be allowed only within the area of impact of storage until such time that the Director determines there is a demand for groundwater within the area of impact of the storage.

The requirement that recovery outside the area of impact of storage must be consistent with the TAMA's management plan and management goal continues to be a requirement even after the recovery well permit has been issued. Thus, previously permitted recovery wells are subject to the criteria of the 4MP and future management plans.

8.6.3 Criteria for Storage of Non-Recoverable Water

Pursuant to A.R.S. § 45-833.01(A):

> "At the request of the applicant, the Director may designate a water storage permit as storing non-recoverable water. If the water storage occurs within an active management area, the water storage permit may be designated in this manner only if the storage is consistent with the active management area's augmentation program."

This designation has only been applicable in a few instances. In the second management period, non-recoverable storage occurred in association with certain augmentation grants that included storage of water to test the hydrologic feasibility of a recharge site. Under the 4MP, non-recoverable water storage may also occur as a result of an enforcement action associated with non-compliance of conservation requirements *(See Chapter 10)*. For example, an entity out of compliance with its conservation requirements may agree to store water and extinguish any credits from that storage that might have otherwise accrued in the entity's long-term storage account of an equal volume to the volume of groundwater used in excess of the conservation requirement.

Water that is stored under a permit with this designation may not be recovered on an annual basis, may not be credited to a long-term storage account, and may not be used for replenishment purposes associated with a groundwater replenishment district. The same criteria for recovery and storage locations in the previous section exist for siting non-recoverable storage.

8.7 REGULATORY INCENTIVES

Provisions established in the Agricultural, Municipal and Industrial Conservation Programs of this management plan provide incentives for water users to utilize renewable resources. The programs to increase the use of renewable water supplies are not alternatives to conservation. All water use should be as efficient as possible.

[9] Such as a Designation, Certificate, or Analysis of AWS.

Shortages are anticipated on the Colorado River system in the coming years. The Code (particularly through the AWS provisions) and the management plans require a long-term perspective on supply and demand. In the long-term, efficient use of *all* water supplies is necessary.

Achievement of water management goals over the long-term is only possible in the context of serious, long-term conservation efforts and increased utilization of renewable supplies. The focus should not be a debate between conservation and augmentation, but rather, efficiently using water. Matching the water resources to the most appropriate demand will continue to require sophisticated management of groundwater, surface water and reclaimed water.

Incentives should be limited to applications where the desired response, such as substitution of use of renewable supplies for groundwater use or improved water conservation, would not otherwise have happened without the incentive.

Table 8-7 lists the 4MP incentives to use alternative supplies. Some of these incentives were established in the Second Management Plan. Because many of these incentives encourage use of alternative supplies at the expense of conservation, the augmentation incentives may need to be scaled back in the future in order to achieve safe-yield.

TABLE 8-7
TUCSON AMA RENEWABLE WATER SUPPLY UTILIZATION INCENTIVES

Sector	Incentive
Municipal	Delivery of reclaimed water by a municipal water provider does not count against the gallons per capita per day (GPCD) requirement, unless it is reclaimed water that is stored in one location and recovered outside the area of impact. This is an incentive for municipal providers to invest in reclaimed water systems (Chapter 5, section 5-703.A).
Industrial	Reclaimed water use is discounted when calculating compliance with the annual allotment for a turf-related facility. For the 4MP, ADWR has retained the 30 percent discount that was included in the 3MP for the TAMA (Chapter 6, section 6-1604.A).
Industrial	Cooling towers that beneficially reuse 100 percent of their blowdown water are exempt from meeting the blowdown concentration requirements (Chapter 6, section 6-2002.B). Cooling towers that convert to at least 50 percent reclaimed water are exempt from the blowdown concentration requirements for one full year. If it is shown that they cannot meet the requirements, amended blowdown concentration levels may be applied (Chapter 6, section 6-2002.B.2).
Industrial	Large-scale power plants that recycle 100 percent of their blowdown water are exempt from meeting the blowdown concentration requirements (Chapter 6, section 6-1902.C and 6-1903.B).
Agricultural	Pursuant to A.R.S. § 45- 467, reclaimed water use cannot contribute to a farm exceeding its allotment in any year. In determining whether a farm exceeds its maximum annual groundwater allotment for a year, total water use, including groundwater, reclaimed water, and surface water, is counted and any reclaimed water used that year is subtracted from the amount of groundwater that otherwise would have exceeded the farm's allotment.
Recharge	Reclaimed water stored at a constructed USF or a GSF does not have a cut to the aquifer requirement.

Although there may be a need to include specialized incentives to address sub-regional water declines, currently the only regulatory tool available to address these localized declines is to limit the recovery of recharged water in those areas, if it is recovered outside the area of impact of the stored water. Additional water management tools may need to be developed to help address this challenge in the future. The requirements described in Table 8-7 are designed to encourage direct use of reclaimed water rather than storage and recovery of reclaimed water.

ADWR has received requests from parties within the TAMA to consider the permitting of groundwater savings facilities for certain non-agricultural uses of reclaimed water, in order to expand the use of the supply of reclaimed water. ADWR will meet with stakeholders to explore this concept.

Additional incentives to encourage use of remediated groundwater in lieu of high quality supplies are provided in the AWS Rules and through legislative requirements in the Water Quality Assurance Revolving Fund (WQARF Program) *(See Chapter 7).*

8.7.1 Other Strategies to Address Water Management Challenges

As described in Chapter 2 and summarized in the physical assessment section of this chapter, certain areas within the TAMA are experiencing localized groundwater declines. These areas could continue to experience local declines even if safe-yield is achieved on an AMA-wide basis. A more localized approach to water management to address these areas could help offset these conditions. Therefore, ADWR will work to develop strategies to address the problems. Working cooperatively with stakeholders, ADWR's efforts may include: 1) developing local/state partnerships; 2) identifying areas of concern; 3) conducting hydrogeologic investigations as necessary; 4) examining new legislation and/or local ordinances; 5) developing programs and 6) creating incentives that discourage or mitigate local water level declines.

8.8 CONCLUSION

There are a number of challenges that will have to be addressed in order to facilitate achievement of safe-yield and other objectives discussed in this chapter. There is a growing recognition that the regulatory and non-regulatory tools that are available may not be sufficient to meet the TAMA management objectives. As has been discussed, there are numerous factors that impact water use patterns, many of which are not regulated by ADWR. Although some Code provisions are directly linked to achieving the management goal, there are many ways in which water management tools could be improved. An evaluation of the roles and responsibilities of all groundwater users in reducing groundwater mining will be initiated as described in Chapter 12. A key consideration in evaluating the need for stronger regulatory programs is whether economic conditions alone can substantially reduce groundwater use across all sectors. If all sectors reduce their groundwater pumpage substantially, the need to offset their groundwater pumpage will diminish

Multiple strategies will continue to be considered during the fourth management period to attempt to not only achieve the AMA-wide goal of safe-yield but to address water management challenges in specific geographic areas of the TAMA as the need arises. Many of these efforts will need to be undertaken in a cooperative approach with local stakeholders. Potential challenges associated with groundwater pumping, such as large cones of depression, land subsidence, earth fissures, reduction in aquifer storage capacity, and the reduced physical availability of supplies may manifest themselves. The efforts to address these challenges will require partnerships with TAMA entities that are willing to make necessary changes, and support efforts to improve groundwater conditions.

8.9 AUGMENTATION AND RECHARGE REQUIREMENTS

8-901. Storage and Recovery Siting Criteria

During the fourth management period, for the purposes of A.R.S. § 45-834.01(A)(2), recovery of stored water at a location is consistent with the management plan and achievement of the management goal for the active management area:

A. If recovery will occur within the area of impact of the stored water, regardless of whether the recovery well permit applicant was the storer of the water; or

B. If recovery will occur outside of the area of impact of the stored water, all of the following three criteria are met:

1. The water storage that resulted in the right to recover water:

a. Is contributing to groundwater supplies that are accessible to current groundwater users or that have been committed to establish a Designation, Certificate, or Analysis of Assured Water Supply pursuant to A.R.S. § 45-576 or rules adopted thereunder so long as the areas in which water is stored are not experiencing problems associated with shallow depth to water; or

b. Is a component of a remedial action project under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) or Title 49, Arizona Revised Statutes, except projects for which groundwater is withdrawn to provide an alternative water supply pursuant to A.R.S. § 49-282.03, and the Director has determined that the remedial action will contribute to the objectives of this chapter or the achievement of the management goal for the active management area; or

c. Is otherwise determined by the Director to have contributed to the objectives of this chapter or the achievement of the management goal for the active management area.

2. Either:

a. At the time of the application, the maximum projected depth to water at the location of the recovery well after 100 years does not exceed the general 100-year depth-to-static water level for the active management area specified by A.A.C. R12-15-716 after considering: (1) the maximum proposed withdrawals from the recovery well; (2) withdrawals for current, committed, and projected demands associated with determinations made under A.R.S. § 45-576 that are reliant on the water which the recovery well will withdraw; and (3) withdrawals for other current or projected demands that are reliant on the water which the recovery well will withdraw; or

b. The recovery will be undertaken within the applicant's service area and the applicant is a municipal provider designated as having an assured water supply.

3. The recovery well is:

a. Located in an area experiencing an average annual rate of decline that is less than 4.0 feet per year; or

b. A component of a remedial action project under CERCLA or Title 49, Arizona Revised Statutes, except projects for which groundwater is withdrawn to provide an alternative water supply pursuant to A.R.S. § 49-282.03, and the Director has determined that the remedial action will contribute to the objectives of this chapter or the achievement of the management goal for the active management area; or

c. Likely to contribute to the water management objectives of the geographic area in which the well is located, as determined by the Director.

8-902. Storage of Non-Recoverable Water

During the fourth management period, water storage that is designated as non-recoverable is consistent with the active management area's Recharge Program if one of the following criteria is met:

The water storage:

1. Is contributing to groundwater supplies that are accessible to current groundwater users or that have been committed to establish a Designation, Certificate, or Analysis of Assured Water Supply pursuant to A.R.S. § 45-576 or rules adopted thereunder so long as the areas in which water is stored are not experiencing problems associated with shallow depth to water; or

2. Is a component of a remedial action project under CERCLA or Title 49, Arizona Revised Statutes, except projects for which groundwater is withdrawn to provide an alternative water supply pursuant to A.R.S. § 49-282.03, and the Director has determined that the remedial action will contribute to the objectives of this chapter or the achievement of the management goal for the active management area; or

3. Is otherwise determined by the Director to contribute to the objectives of this chapter or the achievement of the management goal for the active management area.

APPENDIX 8A
DECLINE RATE METHODOLOGY

In evaluating an application for a proposed recovery well permit, ADWR considers many factors in determining consistency with the average water level decline rate siting criteria. The time frame for which the average is calculated may vary based on data availability and the hydrologic characteristics of the area. Major trends in precipitation, water supply utilization over time, hydrogeologic data and the modeling of projected impacts may be factors in evaluating this rate. Other considerations may also be appropriate depending on the location of the proposed recovery well.

Typically, ADWR examines the historic static water level data for the period of record for wells located in the section in which the proposed recovery well is located and in the eight sections that surround the section where the proposed well is located. The specific area examined depends on the availability and quality of water level data and the hydrogeology of the area. Bedrock outcrops, large pumping centers, and other features may affect the determination of pertinent data. Generally, wells that are screened in the aquifer of concern and regularly monitored using consistent methods for static water level data are good reference points (such as ADWR's statewide monitoring or index wells). ADWR examines the well hydrographs (graphs of static water levels over time) and evaluates the slope of the curve for the period of interest. The slope indicates whether the static water level in the monitoring well has risen or fallen over time. A horizontal line on the hydrograph indicates that water levels remained stable over time. ADWR identifies what activities may have caused the groundwater changes over time to see whether the activity still exists or has been reduced, eliminated, or increased over time.

This approach provides more flexibility and protection of the groundwater resource than would be provided by a simplistic evaluation of decline rates calculated for all water level data within a set radius and during the entire period of record. For example, if a recovery well is proposed for an area which historically had a rapid decline in groundwater levels due to activities that no longer exist (e.g., retirement of agriculture after heavy agricultural use in the 1940s and 1950s), and if the proposed area is not at high risk for subsidence, the proposed recovery well might be deemed consistent with the average decline rate criteria by looking at the period of time after the historic change in use. Similarly, if water levels in the vicinity of the proposed recovery well were stable for decades, but recently a new use caused rapid rates of decline, the proposed recovery well may be deemed inconsistent with the criteria.

ADWR's groundwater models may be used to project future water levels and decline rates on a regional basis. Modeling may assist the permittee in evaluating recovery options. Where there are sufficient data, a model may give an indication of how long recovery within a region may remain permitted based on the current average decline rate criteria.

The most current procedures for establishing the average groundwater level decline rate in the vicinity of a proposed recovery well will be published in ADWR's Recovery Well Application Packet, however the general procedure is described below.

Decline Rate Procedure Description
To evaluate the four-foot decline criteria, ADWR will review water level data from all available, reliable sources of water level data in the vicinity of the proposed recovery well. Some sources include the ADWR Groundwater Site Inventory (GWSI) database, water levels submitted with the recovery well application from the applicant, or other water level data available.

The entire period of record for each well in the vicinity of the proposed recovery well is plotted on a hydrograph. The entire period of record of measurements is often used in the evaluation; however,

sometimes the hydrograph reveals a pronounced inflection in average slope of the hydrograph, indicating that the entire period of record may not be representative of current conditions. The inflection may be attributed to conditions such as urbanization of previously irrigated acreage or the introduction of a new water source. The latest portion of the hydrograph that is most representative of current conditions, and will likely continue in the future, is then used in the analysis.

The average annual rate of decline for a given well is calculated by dividing the total change in water level for the selected period of record by the period of record, in years. The water level change for each well is averaged to arrive at an average water level change in the vicinity of the proposed recovery well. Care is taken to select wells for averaging near the proposed recovery well that are representative of nearby aquifer conditions.

Bibliography

Pima County Regional Wastewater Reclamation Department. (2013). *Effluent Generation and Utilization Report, 2013.* Tucson: Pima County.