CHAPTER ELEVEN: PROJECTED BUDGET

11.1 INTRODUCTION

The management goal of the Tucson Active Management Area (TAMA) is safe-yield. Monitoring the cumulative impact of demand on the aquifer is critical in identifying the TAMA's success toward achieving this goal. The Arizona Department of Water Resources (ADWR) uses this information to evaluate whether additional tools are necessary to assist the TAMA in achieving its goal.

Water demand and supply projections as well as water budget scenarios are prepared based on many assumptions and are some of the tools used to evaluate whether the TAMA is meeting its goal. As discussed and described in Chapter 3, since the publication of the *Demand and Supply Assessment, Tucson Active Management Area* (Assessment) (ADWR, 2010), ADWR's Hydrology staff has developed revised historical natural recharge components and subsequently revamped the projected natural recharge components in the water budgets. In the Assessment, long-term averages of stream channel and mountain front recharge were used. This method masks the annual variability and uncertainty of net natural recharge, which is an important characteristic to understand in making water management decisions in the TAMA.

The projection years in the *Fourth Management Plan for Tucson Active Management Area* (4MP) are from 2014 through 2040, and incorporate the actual historical natural recharge components. The 4MP includes one scenario based on normal delivery of CAP water (Normal Delivery Scenario) and one scenario with a Tier 1 (320,000 acre-foot) shortage (Tier 1 Shortage Scenario) occurring almost every year in the projected period. In taking this approach, ADWR is not projecting nor predicting that there will be a Tier 1 shortage every year in the future, rather, it is intended as a conservative approach to evaluate shortage impacts on the TAMA. The probability of shortage depends on many factors, including the volume of Colorado River water used on-river, changes in CAP customer water ordering patterns, the availability of alternative water supplies, water conservation efforts, and the impact of rate increases (Central Arizona Project, 2015). Other factors can include climate variability and the timing, volume and location of precipitation. These factors are not constant, but vary every year and some are simply unknown. Additionally, the way these factors interact is not always clear. In addition, there may be other factors than these that have not yet been identified. All of these factors and conditions result in a multitude of probable volumes of available CAP water in the future.

It is important to note that the US Geological Survey (USGS) indicates that "a statement of probability is not a forecast," and describes probability as "analysis of the variability of a sample" (Luna B. Leopold, 1959). In 2014, the Arizona Water Banking Authority (AWBA), ADWR and the CAP published a joint plan for the recovery of AWBA long-term storage credits which could occur to help offset the impact of a CAP shortage (AWBA, ADWR and CAP, 2014). Charts indicating the range of the probability of CAP shortage are included in the plan, which show increasing uncertainty with time. In the book *The Signal and the Noise*, author Nate Silver describes uncertainty as "risk that is hard to measure," (Silver, 2012), and this description seems appropriate regarding water demand and supply projections. The Tier 1 Shortage scenario is included to give an idea of the potential impact of an extended shortage on groundwater overdraft, but is not intended as a prediction of shortage.

For the Normal Delivery Scenario, ADWR used the May 22, 2015 CAP Delivery Schedule through the year 2040 (See Appendix 11-1). For the Tier 1 Shortage scenario, ADWR subtracted 320,000 ac-ft from the volume projected to be delivered each year from the May 22, 2015 CAP Delivery Schedule in each year from 2015 through 2040. Although 2015 and 2016 will not be shortage years, ADWR has projected those years as shortage to illustrate the impact of a very long term Tier 1 shortage for comparison purposes with the Normal Delivery Scenario. For water management planning purposes, it may be helpful to explore additional scenarios during the fourth management period. Actual CAP deliveries during the projection period of 2014 through 2040 could be more or less than these assumptions.

Further, on April 22, 2015 ADWR hosted a Colorado River Shortage Preparedness Workshop. Information presented at that workshop can be found at: http://www.azwater.gov/azdwr/ColoradoRiverShortagePreparedness.htm. In planning for the uncertainty and range of probability of a CAP shortage, ADWR, the AWBA and the CAP are working together to help mitigate impacts of a potential shortage of CAP water on water users in the CAP service area and on water users on the Colorado River.

Population projections in the 4MP are based on Traffic Analysis Zone (TAZ) projections ADWR obtained from the Pima Association of Governments (PAG) and the Central Arizona Association of Governments (CAG) in the year 2014 for the Pima County and Pinal County portions of the TAMA which extend out to the year 2040. The small portion of the TAMA located within Santa Cruz County uses projections from the Arizona Department of Administration (ADOA). ADWR will update the planning water budgets on its website on a regular basis throughout the fourth management period. A summary of the projection assumptions describing ADWR's general approach is included in the section below, followed by tables showing the results of those assumptions.

The overdraft values shown in the 4MP water budget for each scenario represent TAMA-wide balances at given points in time. The fourth management period constitutes one 10-year increment of time. However both the management plan and the water budgets are affected by the Assured Water Supply (AWS) Program requirements and need to be understood in the context of the 100-year AWS planning time frame. Many of the decisions water providers and developers will make moving into the future will be made in the context of water management needs during this 100-year time frame. Likewise, decisions ADWR makes on water management policy are framed in this larger context, including the decision to allow a certain volume of groundwater mining by water providers.

In the TAMA 4MP, ADWR incorporated updated projections from those used in the Assessment and in the legislatively mandated Water Resource Development Commission (WRDC). Population projections generated by demographic agencies tend to mirror recent trends. When growth is strong, projections appear optimistic. In less robust economic times, when growth is slowed, projections tend to be lower. Planning water budgets can be found on ADWR's website: http://www.azwater.gov/azdwr/WaterManagement/AMAs/TucsonAMAFourthManagementPlan.htm.

11.2 WATER BUDGET COMPONENTS AND SECTOR ASSUMPTIONS

Demand and supply assumptions used in both the Normal Delivery Scenario and the Tier 1 Shortage Scenario for the TAMA 4MP are as follows:

Population projections

- Population projections prepared by other agencies were used to develop a total TAMA population projection. In Pima and Pinal counties, the regional associations of government (PAG, CAG) projections were used. For the Santa Cruz County portion of the TAMA, ADWR used the ADOA projections.
- Population projections by TAZ were disaggregated to water provider boundaries by comparing water distribution line location data, Certificate of Convenience and Necessity (CC&N) boundaries for private water companies, incorporated area boundaries or cities and towns, and issued determinations of AWS by provider to the TAZ boundary. TAZs with no current water provider service but significant population growth were assigned to the closest likely provider in most cases.

Where a TAZ included current population but no water provider, this population was assumed to be served via privately owned (exempt) wells. An assumption was made that this exempt well population component would not grow due to the greater likelihood that the majority of growth would be served by a central distribution system.

- Small provider population within a TAZ was generally held at the proportion of the TAZ population served by the small provider in 2010 unless ADWR had information that either 1) the small provider was not likely to grow (built out subdivision, mobile home parks that have not grown historically, etc.) or 2) the small provider had great potential to grow based on issued determinations of AWS.

Large Municipal Provider Demand and Supply

- Each large municipal provider's demand was based on an individual analysis of each provider's GPCD trend, whether reducing, increasing, or remaining constant, carried forward to 2040. A lower limit of 200 gallons per housing unit per day (GPHUD) was set; however, only one provider's calculated GPCD trend resulted in a GPHUD going below 200 GPHUD, and that provider's demand was then held at 200 GPHUD for the remainder of the projection period.
- Individual assumptions were made for each large municipal provider water supply based on historical supplies used. Not all municipal providers use the same water supplies. Each provider has their own unique pattern of water supply utilization. ADWR reviewed Designation of Assured Water Supply (DAWS) files and water rights information to project water supply utilization on a provider by provider, year by year basis. CAP water supplies available can include municipal and industrial subcontracts, leased CAP water, or NIA priority water *(See http://www.azwater.gov/AzDWR/PublicInformationOfficer/Non-IndianAgriculturalReallocationProcess.htm)*. In addition to the pending January 17, 2014 recommendation to the Secretary of the Interior to reallocate NIA priority water, there will be additional NIA priority reallocations during the projection period.

Small Municipal Provider Demand and Supply

- Small provider demand was projected using a trend line of the GPCD rate from 2005-2013.
- Small provider supply was all groundwater, except for a very small amount of surface water that has historically been used by one small provider, and which is assumed will continue.

Exempt Well Demand and Supply

- Exempt well demand was based on water use figures updated from the TAMA 3MP models for new single family homes (45 GPCD interior and 60 GPHUD exterior). The models were updated based on ADWR's review of reported water usage per lot for Central Arizona Groundwater Replenishment District (CAGRD) Member Lands and reported single family residential deliveries by month for CAGRD Member Service Areas.
- Exempt wells use all groundwater.

Industrial Demand and Supply Projections

- Industrial turf demand was projected using the log of 1985 through 2013 historical water use, and supplies would be used consistent with those used in the past.
- Mining demand was based on projections received from the Provider and Users Group of the Upper Santa Cruz Valley (PUG) and Freeport McMoRan[1] and the 1985 through 2013 historical supplies used.

[1] In October 2015 Freeport McMoRan announced extensive job cuts and a 50 percent reduction in the Sierrita mine production and evaluation of the economics of shutting down the Sierrita mine. Projected demand for mines in the 4MP is about 35,900 ac-ft per year. It is unclear at the time of publication what impacts this change in mining operation may have on the TAMA water use. Like the housing downturn in the economic recession in the 3MP, global commodity price fluctuations impact agricultural,

- Sand and gravel production water demand was projected to remain at the 1985 through 2013 historical average and supplies were projected to be used consistent with historical patterns over the same time span.
- Dairy use demand was held constant and supplies were presumed to be used consistent with the 1985 through 2013 historical patterns.
- Electrical power water demand was projected using the linear trend of the 1985 through 2013 historical water demand with supplies consistent with historical patterns over the same time period.
- “Other” industrial water demand was projected to remain at the historical average from 2004-2013 with water supplies consistent with the 2004 through 2013 historical pattern.

Agricultural Demand and Supply Projections

- Agricultural demand projections assumed
  - Extensive residential and commercial development will occur in the Marana area (Area of Similar Farming Condition No. 2) resulting in fewer irrigable acres;
  - Orchard crop acreage will be reduced;
  - Agricultural demand was projected based on information supplied by major producers using their own assumptions; information provided by the PUG, or ADWR staff using trend lines over the 1985 through 2013 period.
- Agricultural supply was projected using information about the current water portfolios for each irrigation district, large farm or other entity that was included in the analysis. In certain cases, knowledge regarding supply availability from sector professionals, especially large-scale producers, was used. CAP supplies were based on projected available CAP Agricultural pool volumes, recent use, projected demand, and planned expansions of delivery systems. The total CAP Agricultural pool water for all Active Management Areas (AMAs) will be reduced by 25 percent in 2017 and by an additional 25 percent in 2024, reducing to zero after 2030. For the purposes of these projections, reductions were applied proportionately to each allottee’s supply. GSF supply projections were based on current permits, and the projected amount of supplies available for storage. This supply is identified as in-lieu groundwater in the 4MP. Projected demands not met by CAP or in-lieu groundwater were assumed to be met by mined groundwater.

Tribal Demand and Supply Projections

- Tribal demand projections were focused on increased demands in tribal agriculture. Generally, demand was projected based on evaluating trends in the available historical data, or reasonable assumptions regarding use, based on the Southern Arizona Water Rights Settlement Act (SAWRSA) settlement documents. Tribal municipal demand was increased based on the on-reservation population growth between 2000 and 2010 and an assumed overall GPCD rate of 57 GPCD. For the 4MP tribal agricultural demand projection, a trendline based on the 2000 through 2013 tribal agricultural use was used. Supply is assumed to be CAP water for tribal agricultural use and groundwater for tribal municipal use.

11.3 ADDITIONAL SUPPLY ASSUMPTIONS

The volume of groundwater projected to be used is equal to the remainder of the projected demand after renewable supplies are subtracted. Generally, ADWR assumed that CAP subcontract utilization would increase over time, that excess CAP would correspondingly decrease over time, and that any excess CAP water would either be replenished each year by the Central Arizona Groundwater Replenishment District

industrial and mining activities making specific long-term use projections difficult.

(CAGRD), or stored by the Arizona Water Banking Authority (AWBA), or other excess users. Utilization of reclaimed water is assumed to increase throughout the projection period.

ADWR also assumed that additional artificial recharge would occur. In the TAMA, the majority of recharge activity consists of CAP storage at Underground Storage Facilities (USFs). Some CAP is stored at Groundwater Savings Facilities (GSFs), although the number of agricultural acres in production with direct access to CAP supplies limits the volume of storage. The amount of GSF storage is driven by the available storage capacity, the water available to store, and historical patterns of GSF storage.

Reclaimed water storage was also projected to increase, since projected reclaimed uses keep pace with the rate of increase in reclaimed water production, and there is currently unused capacity in the TAMA's permitted reclaimed water storage facilities.

Natural components that result in net natural recharge used in the 4MP are different from those used in the Assessment, which assumed a long-term average of stream channel recharge. This may give the false impression that stream channel recharge is a long-term reliable supply. Arizona's arid climate is such that stream channel recharge is variable and can have significant peaks and periods of little or zero flow. To help simulate these naturally occurring conditions for the 4MP budgets, ADWR Hydrology staff examined the historical period of flow for the Santa Cruz and Rillito Rivers and the Tanque Verde Creek and used the 1999 through 2013 historical record as generally representative of "normal" conditions. In the Assessment, net natural recharge assumptions had remained at a constant long-term average in both the "normal" and "shortage" scenarios. Riparian transpiration also varies. Riparian transpiration tracks with stream channel recharge, groundwater inflow and outflow, and lagged agricultural incidental recharge.

11.4 DIFFERENCES BETWEEN THE NORMAL DELIVERY SCENARIO AND THE TIER 1 SHORTAGE SCENARIO ASSUMPTIONS

Both scenarios consider the projected direct use of CAP water as well as projected storage of CAP water among the three CAP AMAs. If the difference between the projected supply and the projected use (including storage) of CAP water in any year is a positive number, the remaining amount is distributed among the three AMAs proportionately based on the total agricultural sector demand, and assumed to be stored. If the result is a negative number, it is first subtracted from any unused CAP supplies, beginning with the lowest priority users.

The CAP agricultural pool has the lowest priority and was designed to be declining over time, until the pool does not exist by 2030, based on the idea that CAP use in the early years would be in the agricultural sector and developing into the municipal and tribal sectors in later years. In the Tier 1 Shortage Scenario, the 320,000 acre-foot shortage cuts into the CAP agricultural pool each year of shortage, beginning in the first projected shortage year, 2015 through 2040. After 2030, with no CAP agricultural pool, shortage volumes will come out of any unused CAP supplies and the next highest pool of water, which is called the Non-Indian Agricultural (NIA) priority pool (which actually supplies municipal and tribal uses), if needed. This scenario, with a Tier 1 shortage of 320,000 ac-ft, shows results that the NIA priority pool will not be impacted through 2040. However, in reality additional shortage tiers and river conditions could occur and could bring shortages of larger volumes. These deeper shortages, combined with increasing demands in the other, higher priority CAP Municipal and Industrial (M&I) pool and the CAP Indian pool, could impact all of these pools in later years.

About 3.7 million ac-ft of recovery occurs in the Normal Delivery scenario in the TAMA between 2014 and 2040; however, about 3.0 million ac-ft of the water projected to be stored in the TAMA during the projection period remains in storage under the assumptions described above. Under the Tier 1 Shortage

Scenario, almost the same volume of recovery takes place, but the volume remaining in storage in the TAMA is less than half that in the Normal Delivery Scenario, only about 1.4 million ac-ft. For more detail on supply assumptions used in these projections, please refer to ADWR's website:
http://www.azwater.gov/azdwr/WaterManagement/AMAs/TucsonAMAFourthManagementPlan.htm

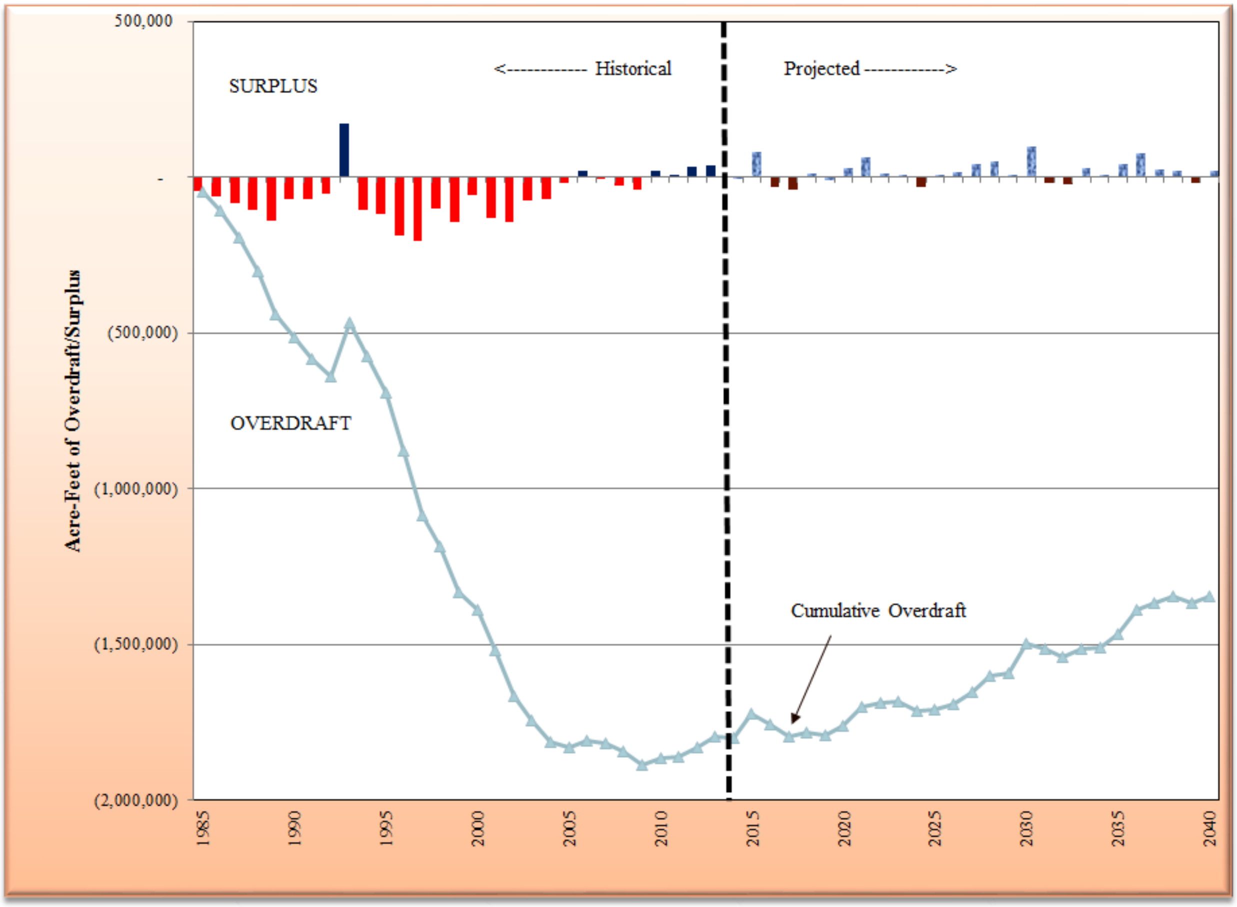
11.5 RESULTS OF WATER BUDGET ANALYSES

Figure 11-1 illustrates historical and projected overdraft or surplus in the Normal Delivery Scenario in the TAMA from 2014 through 2040, given the actual historical and assumed projected demands, supplies utilized, and natural supply availability. In Figure 11-1 the historical overdraft is shown with red bars. For the historical period of 1985 through 2013, there were a few years where the water supply, based on net natural recharge into the TAMA, exceeded the volume of pumping (surplus years). Those years are shown in dark blue bars prior to the year 2014.

Figure 11-2 shows the water budget for the projected years, with both scenarios, CAP Normal Delivery and CAP Tier 1 Shortage, combined. Over the long-term, the Tier 1 Shortage Scenario results in less progress towards safe-yield, however on an annual basis, the Tier 1 Shortage Scenario is not very different from the CAP Normal Delivery Scenario. This is because the Tier 1 Shortage only affects the agricultural CAP pool availability and excess CAP water storage. The majority of CAP users in the TAMA are municipal and industrial, who are unaffected in the Tier 1 Shortage Scenario. In other AMAs where there is significantly greater agricultural CAP pool use and significantly greater excess CAP storage, the difference between the two scenarios is greater. In some years, under the Tier 1 Shortage Scenario there could be surplus. It then follows that additional surplus would be available under the Normal Delivery Scenario. Likewise, under the Normal Delivery Scenario, there could be years with overdraft, and in those years, additional overdraft in the Tier 1 Shortage Scenario occurs. These results are shown as stacked bars. There is also one bar for a single year in which the projections resulted in a surplus under the Normal Delivery Scenario, but showed very minimal overdraft in the Tier 1 Shortage Scenario (in the year 2034), which is so slight (about 550 ac-ft) as to be hardly visible in the chart.

Both scenarios show more years of surplus than overdraft, although the Tier 1 Shortage Scenario in every year shows less surplus than the Normal Delivery Scenario. Much of the surplus is attributable to the assumptions for net natural recharge. The period of record used for net natural recharge included several years of typical flood flows on the Santa Cruz River and its tributaries in the TAMA, rather than prolonged drought conditions. Historical and projected net natural recharge, which includes streambed recharge as a primary component, is listed in Table 11-1. The conditions from 1999 through 2013 were repeated for the projection period of 2014 through 2040.

FIGURE 11-1
HISTORICAL AND PROJECTED WATER BUDGET
NORMAL CAP DELIVERY SCENARIO, 1985 – 2040, TAMA

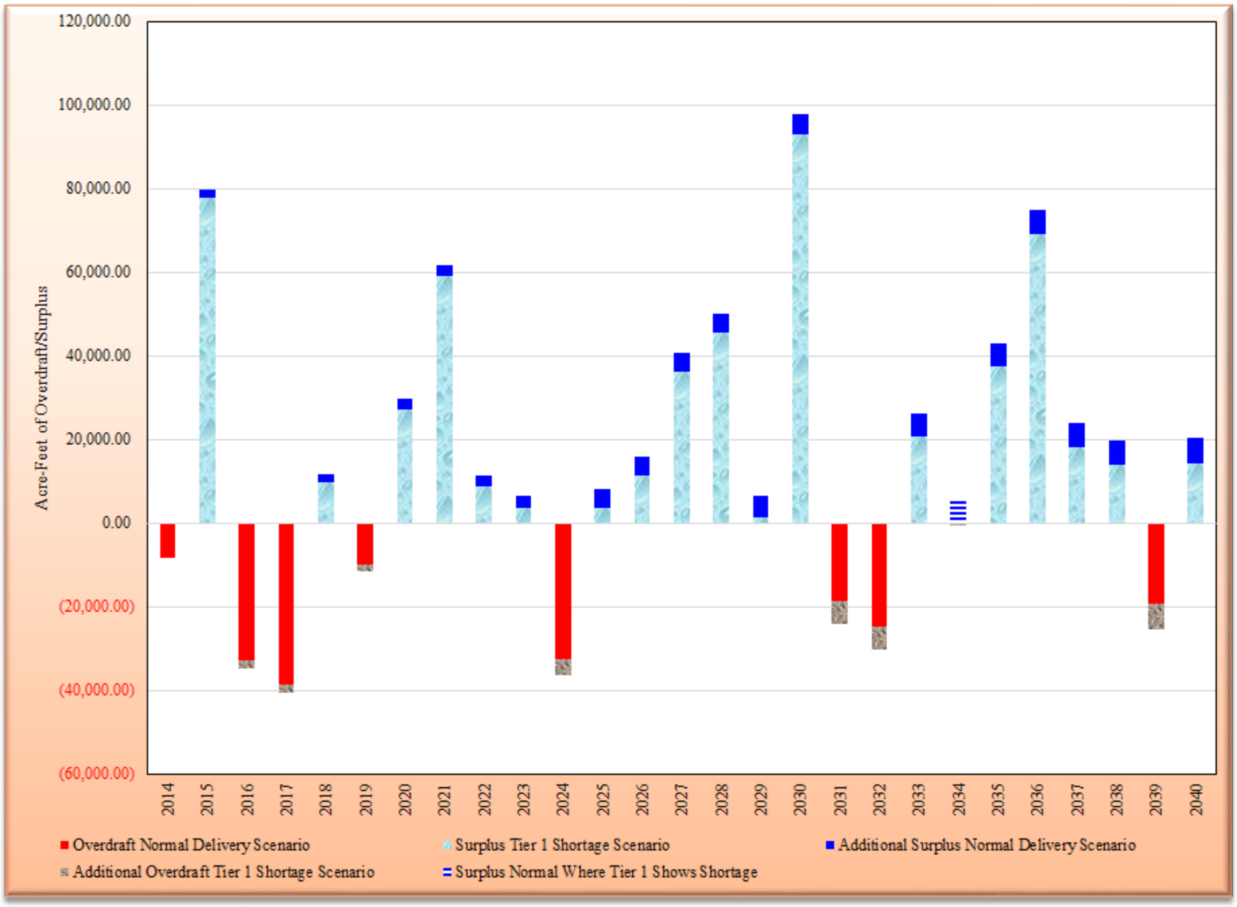


The Tier 1 Shortage Scenario impacts the CAP agricultural pool, but does not affect municipal and industrial or Indian CAP water uses during the projection period. In the municipal sector, providers held sufficient long term storage (LTS) credits to maintain their DAWS requirement of consistency with the management goal. ADWR did not assume any AWBA credit recovery in the Tier 1 Shortage Scenario.

The projection assumptions are based on fairly low TAMA population growth along with an overall AMA municipal provider GPCD rate, including large and small providers, that declines by 14 percent, or about 0.5% per year, (from 149 GPCD to about 128 GPCD) from 2013 to 2040. The scenarios also assume that use of CAP water increases over time by subcontract holders, but not all subcontract holders use their CAP water during the projection period. In addition, it is presumed that NIA priority CAP reallocation water will be available for use beginning in the year 2017, and will be fully utilized in the TAMA when available.

In the Normal Delivery Scenario more than five million ac-ft of CAP water is stored at USFs, more than one million ac-ft of CAP water is stored at GSFs, and over 830,000 ac-ft of reclaimed water is stored at USFs in sum for the 26 year projection period from 2014 through the year 2040. *(See Figure 11-3.)* These figures are based on current permit limits and ADWR AWS determinations and legal authorities and policies currently in place. The budgets are based on approximate conservation and augmentation goals and are not intended to suggest limitations on individual water users or sectors.

FIGURE 11-2
COMBINED SCENARIO PROJECTED WATER BUDGET, 1985 – 2040, TAMA



Storage of CAP water is much less in the Tier 1 Shortage Scenario. In this scenario, only about 4.4 million ac-ft of CAP is stored at USFs, and less than 825,000 ac-ft of CAP is stored at GSFs. (Storage of reclaimed water is identical to the Normal Delivery Scenario.)

In the projection years, 2014 through 2040, overdraft and surplus vary year to year depending on the fluctuating natural condition assumptions, but the low growth and declining GPCD rates allow the TAMA to remain near a safe-yield condition based on these assumptions. Allowable growth in the municipal and industrial sectors will eventually result in an increase overdraft in the TAMA.

Depending on the volume of groundwater pumping in the TAMA, net natural recharge will be a greater or lesser determinant of whether the TAMA is in safe-yield or not on an annual basis.

Because the water table is greatly affected by localized recharge and withdrawal, achieving safe-yield TAMA-wide does not ensure that all local areas of the TAMA will attain a balance of supply and demand. There may be areas within the TAMA where localized groundwater declines will result in land subsidence, wells going dry, increased pumping costs, and water quality changes. Conversely, the benefits of recharge may be confined to areas where recharge basins and stream channels are located. Addressing the impacts of local water level declines and recoveries in subareas of the TAMA will be an ongoing issue for water management as the fourth management period proceeds.

TABLE 11-1
HISTORICAL AND PROJECTED NET NATURAL RECHARGE, 1985 – 2040, TAMA

Year	Net Natural Recharge	Mountain Front	Streambed	Groundwater Inflow	Groundwater Outflow
1985	173,730	28,100	137,479	29,443	21,292
1986	148,892	28,100	113,599	29,790	22,597
1987	130,741	28,100	94,235	30,472	22,066
1988	114,065	28,100	75,898	29,838	19,771
1989	102,088	28,100	62,248	30,351	18,611
1990	132,386	28,100	94,773	30,757	21,244
1991	150,065	28,100	108,114	32,126	18,275
1992	154,131	28,100	113,067	31,503	18,539
1993	357,551	28,100	320,201	30,367	21,117
1994	131,277	28,100	91,285	32,012	20,120
1995	148,152	28,100	106,598	32,789	19,335
1996	103,083	28,100	61,162	32,320	18,499
1997	91,612	28,100	47,992	32,472	16,952
1998	162,821	28,100	118,228	32,291	15,798
1999	126,483	28,100	80,899	32,597	15,113
2000	217,133	28,100	171,267	31,399	13,633
2001	97,934	28,100	53,711	31,702	15,579
2002	90,523	28,100	46,386	32,109	16,072
2003	139,307	28,100	96,683	29,862	15,338
2004	118,167	28,100	75,049	29,806	14,788
2005	156,121	28,100	112,548	30,830	15,357
2006	188,194	28,100	144,088	31,865	15,859
2007	136,151	28,100	92,204	31,902	16,055
2008	133,331	28,100	87,745	32,028	14,542
2009	88,632	28,100	47,730	30,955	18,153
2010	129,716	28,100	87,766	31,885	18,035
2011	132,367	28,100	90,807	30,595	17,135
2012	155,788	28,100	114,848	30,400	17,560
2013	166,202	28,100	125,987	30,145	18,030
2014	*121,769*	*28,100*	*80,899*	*31,270*	*18,500*
2015	*212,137*	*28,100*	*171,267*	*31,270*	*18,500*
2016	*94,581*	*28,100*	*53,711*	*31,270*	*18,500*
2017	*87,256*	*28,100*	*46,386*	*31,270*	*18,500*
2018	*137,553*	*28,100*	*96,683*	*31,270*	*18,500*
2019	*115,919*	*28,100*	*75,049*	*31,270*	*18,500*

Year	Net Natural Recharge	Mountain Front	Streambed	Groundwater Inflow	Groundwater Outflow
2020	*153,418*	*28,100*	*112,548*	*31,270*	*18,500*
2021	*184,958*	*28,100*	*144,088*	*31,270*	*18,500*
2022	*133,074*	*28,100*	*92,204*	*31,270*	*18,500*
2023	*128,615*	*28,100*	*87,745*	*31,270*	*18,500*
2024	*88,600*	*28,100*	*47,730*	*31,270*	*18,500*
2025	*128,636*	*28,100*	*87,766*	*31,270*	*18,500*
2026	*131,677*	*28,100*	*90,807*	*31,270*	*18,500*
2027	*155,718*	*28,100*	*114,848*	*31,270*	*18,500*
2028	*166,857*	*28,100*	*125,987*	*31,270*	*18,500*
2029	*121,769*	*28,100*	*80,899*	*31,270*	*18,500*
2030	*212,137*	*28,100*	*171,267*	*31,270*	*18,500*
2031	*94,581*	*28,100*	*53,711*	*31,270*	*18,500*
2032	*87,256*	*28,100*	*46,386*	*31,270*	*18,500*
2033	*137,553*	*28,100*	*96,683*	*31,270*	*18,500*
2034	*115,919*	*28,100*	*75,049*	*31,270*	*18,500*
2035	*153,418*	*28,100*	*112,548*	*31,270*	*18,500*
2036	*184,958*	*28,100*	*144,088*	*31,270*	*18,500*
2037	*133,074*	*28,100*	*92,204*	*31,270*	*18,500*
2038	*128,615*	*28,100*	*87,745*	*31,270*	*18,500*
2039	*88,600*	*28,100*	*47,730*	*31,270*	*18,500*
2040	*128,636*	*28,100*	*87,766*	*31,270*	*18,500*

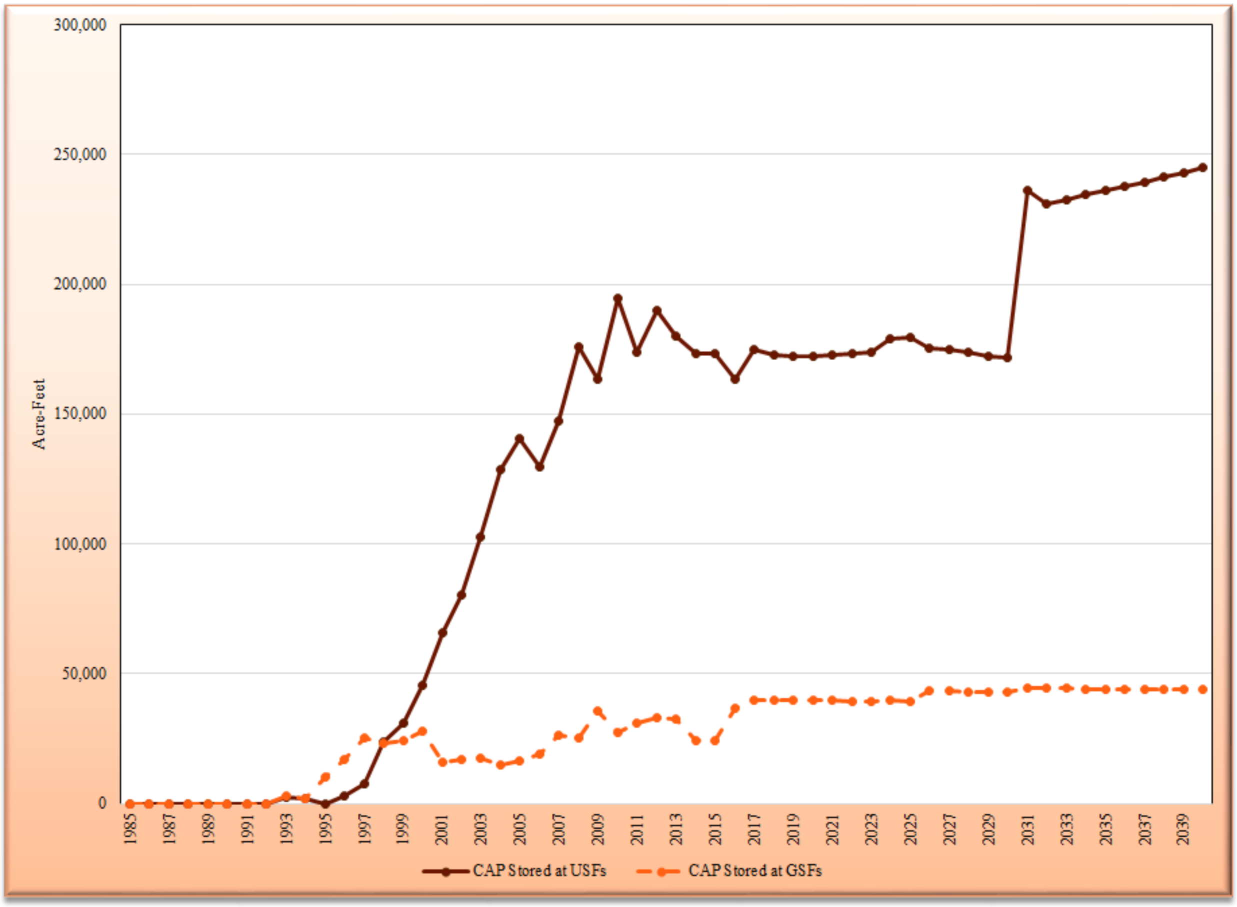
11.5.1 Determining Factors

Many of the 1980 Groundwater Code (Code) provisions are designed to assist the TAMA in achieving safe-yield. These include mandatory conservation requirements, the AWS Program, AWBA excess CAP water storage, and incentives for use of renewable supplies. There are a number of factors that affect safe-yield that are not under ADWR's control. Many of these factors relate to under-utilization of CAP water while others relate to water pricing, municipal growth, changes in land utilization, and industrial demand.

ADWR will evaluate whether there is potential for additional conservation measures for inclusion in the Fifth Management Plan. Regardless of the stringency of conservation requirements, some volume of groundwater will need to be pumped on an ongoing basis to meet the municipal demand for users who are not required to meet AWS criteria. Additionally, groundwater will continue to be pumped to meet the demand associated with grandfathered rights under the Code. These continued uses of groundwater could result in further depletion of groundwater supplies.

The AWBA has stored a significant volume of excess CAP water, which will be made available to municipal and industrial (M&I) priority subcontractors and fourth priority on-river M&I users during declared shortages on the Colorado River. During the fourth management period, the AWBA may recharge CAP and extinguish the associated credits to provide water to the aquifer itself. Another possible future strategy could be to increase the groundwater withdrawal fees, which could be used to purchase and recharge CAP water and extinguish the credits.

FIGURE 11-3
PROJECTED ANNUAL CAP WATER DELIVERED TO BE STORED, TAMA



The ultimate capacity for CAP recharge in the TAMA depends on multiple physical, economic, and political variables. Pricing of CAP water is controlled by the Central Arizona Water Conservation District (CAWCD) and is slated to increase with time. The volume of available CAP water either for direct use or for recharge and recovery depends upon whether the Secretary of the Interior declares a shortage on the Colorado River, per the 2007 Record of Decision on the Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead.

Other diverse factors will affect the TAMA water use in the future. The price of potable water is controlled by water providers and the Arizona Corporation Commission, and is affected by the cost of energy, infrastructure needs, and other factors. Population growth can lead to replacement of agricultural land with housing. However, population growth can also result in higher water demand to support increased industrial and municipal demand. Ongoing mining demand and future growth of the golf industry can result in increasing water demand by the industrial sector.

Beyond the year 2025 and into the latter part of the next century, it is anticipated that some general trends in water supply and demand could appear. Agricultural production is likely to continue to decrease but may not disappear since some farmlands are in the floodplain and may never be developed. Mining could increase or decrease depending on the price of global commodities. Water use by other industries served by grandfathered groundwater rights and permits could increase in the long run. However, Pima County's prohibition on new golf courses using groundwater to meet turf demands partially limits the potential for increased Type 1 and Type 2 Grandfathered Groundwater Right withdrawals. Municipal water use is likely to continue to increase throughout the next century, further increasing the need for renewable water supplies in the TAMA. Maximizing the use of reclaimed water is a water management strategy for the fourth management period. In the long-term, increased direct use of reclaimed water could occur if it were treated to potable standards and delivered for direct potable use. The obstacles in terms of public acceptance of this strategy would likely be substantial.

Long-term water use decisions made by municipal water providers who hold a DAWS will be driven by the need to meet AWS Program requirements. These decisions relate to the use of allowable mined groundwater, recharge and recovery of CAP water, recharge and recovery of reclaimed water, and possible acquisition of additional CAP allocations. The physical availability of groundwater may increasingly affect water management decisions in the future. Declining groundwater levels could make recovery of CAP or effluent credits through groundwater pumping difficult or impossible in some areas of the basin. ADWR's computer model will be a valuable tool for evaluating the possible effects of various recharge and pumping scenarios inside the TAMA.

11.6 CONCLUSIONS

During the third management period water users in the TAMA made considerable efforts to reduce groundwater withdrawals and increase artificial recharge of CAP and reclaimed water, particularly in the municipal sector. The result of these efforts was that annual groundwater use in the TAMA was reduced by almost half between 1996 and 2013, from nearly 320,000 ac-ft of groundwater in 1996 to about 163,000 ac-ft in 2013.

The water budgets presented here indicate that given these assumptions and recent population projections, safe-yield by 2025 appears to be an achievable goal in TAMA, provided that the commitment to water conservation, reduction in groundwater dependency, and increased utilization of renewable supplies, particularly reclaimed water, continues during the fourth and fifth management periods. A variety of factors will affect whether safe-yield is achieved, including CAP and reclaimed water recharge and recovery strategies selected by municipal water providers; strategies for the use of allowable mined groundwater; changes in population; agricultural acreage retirement; changes in mine production; changes in demand for other industries; and changes in the available CAP supply.

Water budgets are useful planning tools when viewed in the long-term planning context. Water management decisions made in the next 10 years should increasingly reflect the need to balance current demands with the anticipated needs of future water users. The TAMA historical water budget will continue to be updated throughout the fourth management period as new data and water use plans become available. Water budget updates will be coordinated with ADWR's hydrologic modeling efforts so that changes in supply and demand can be understood in terms of their impacts on water levels in the TAMA. In this way the historical water budget will continue to be a key tool in understanding the progress the TAMA is making toward reaching and maintaining a balance in its groundwater supplies.

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APPENDIX 11-1

Year	CAP Delivery Supply (includes P4 and P3 (68,400))	Tier 1 Shortage Supply
2014	*1,500,000*	*1,500,000*
2015	*1,500,000*	*1,180,000*
2016	1,538,785	1,218,785
2017	1,537,841	1,217,841
2018	1,536,912	1,216,912
2019	1,535,999	1,215,999
2020	1,529,508	1,209,508
2021	1,528,372	1,208,372
2022	1,527,251	1,207,251
2023	1,526,148	1,206,148
2024	1,525,059	1,205,059
2025	1,523,988	1,203,988
2026	1,522,934	1,202,934
2027	1,521,898	1,201,898
2028	1,520,880	1,200,880
2029	1,519,882	1,199,882
2030	1,518,999	1,198,999
2031	1,518,290	1,198,290
2032	1,517,592	1,197,592
2033	1,516,907	1,196,907
2034	1,516,236	1,196,236
2035	1,515,579	1,195,579
2036	1,514,937	1,194,937
2037	1,514,308	1,194,308
2038	1,513,690	1,193,690
2039	1,513,086	1,193,086
2040	1,512,491	1,192,491

NOTE: For 2014 and 2015, ADWR assumed 1,500,000 would be the delivery supply. No shortage was taken from 2014. The first shortage year in the scenario is 2015.