ARIZONA WATER ATLAS
VOLUME 8 – ACTIVE MANAGEMENT AREA PLANNING AREA

Preface

Volume 8, the Active Management Area (AMA) Planning Area, is the eighth in a series of nine volumes that comprise the Arizona Water Atlas. The primary objectives in assembling the Atlas are to present an overview of water supply and demand conditions in Arizona, to provide water resource information for planning and resource development purposes and help to identify the needs of communities.

The Atlas divides Arizona into seven planning areas (Figure 8.0-1). There is a separate Atlas volume for each planning area, an introductory/executive summary volume and a resource evaluation volume that examines resource sustainability. "Planning areas" are an organizational concept that provide for a regional perspective on supply, demand and water resource issues. A complete discussion of Atlas organization, purpose and scope is found in Volume 1. Also included in Volume 1 is general background information for the state, a description of data sources and methods of analysis for the tables and maps presented in the Atlas, and appendices that provide information on water law, management and programs, and Indian water rights claims and settlements.

To the extent practical, the organization and content of this volume of the Atlas mirrors the six other planning areas. However, readers should be aware that the overall scope of this document differs in some important ways.

Five AMAs have been designated in the state as requiring specific, mandatory management practices to preserve and protect groundwater supplies for the future. Four AMAs - Phoenix, Pinal, Prescott and Tucson - were established in 1980 upon enactment of the Groundwater Code (Code) (A.R.S. §§ 45-401 et seq.). In 1994, the Arizona legislature established the Santa Cruz AMA, which had previously been the southeast portion of the Tucson AMA. This legislation recognized the international water management issues facing this area, and that its hydrology required coordinated management of surface water and groundwater.

The AMAs include most of the state's largest urbanized areas, and water use is subject to an extensive regulatory framework. As a result, water supply and demand data within AMAs is often more detailed and comprehensive than outside the AMAs, and unique legal and regulatory complexities exist. By adhering to the standardized Atlas format, Volume 8 provides an important overview of the AMAs and allows for direct comparison with the rest of the state. However, this volume does not include extensive data analysis and is not an exhaustive compilation of information relevant to the AMAs.

This volume of the Atlas is the first document of a larger AMA planning effort that includes an AMA Assessment and Fourth Management Plan for each AMA. The AMA Assessment includes a compilation of historic data, including detailed water budgets; future scenario development; and obstacles to achieving safe-yield, notably issues related to achievement of the statutory management goals for each AMA. The AMA Assessment is intended to provide an analytical foundation for the development and promulgation of Fourth Management Plans (A.R.S. §§ 45-561 et seq.). The management plans include mandatory regulatory provisions that apply to

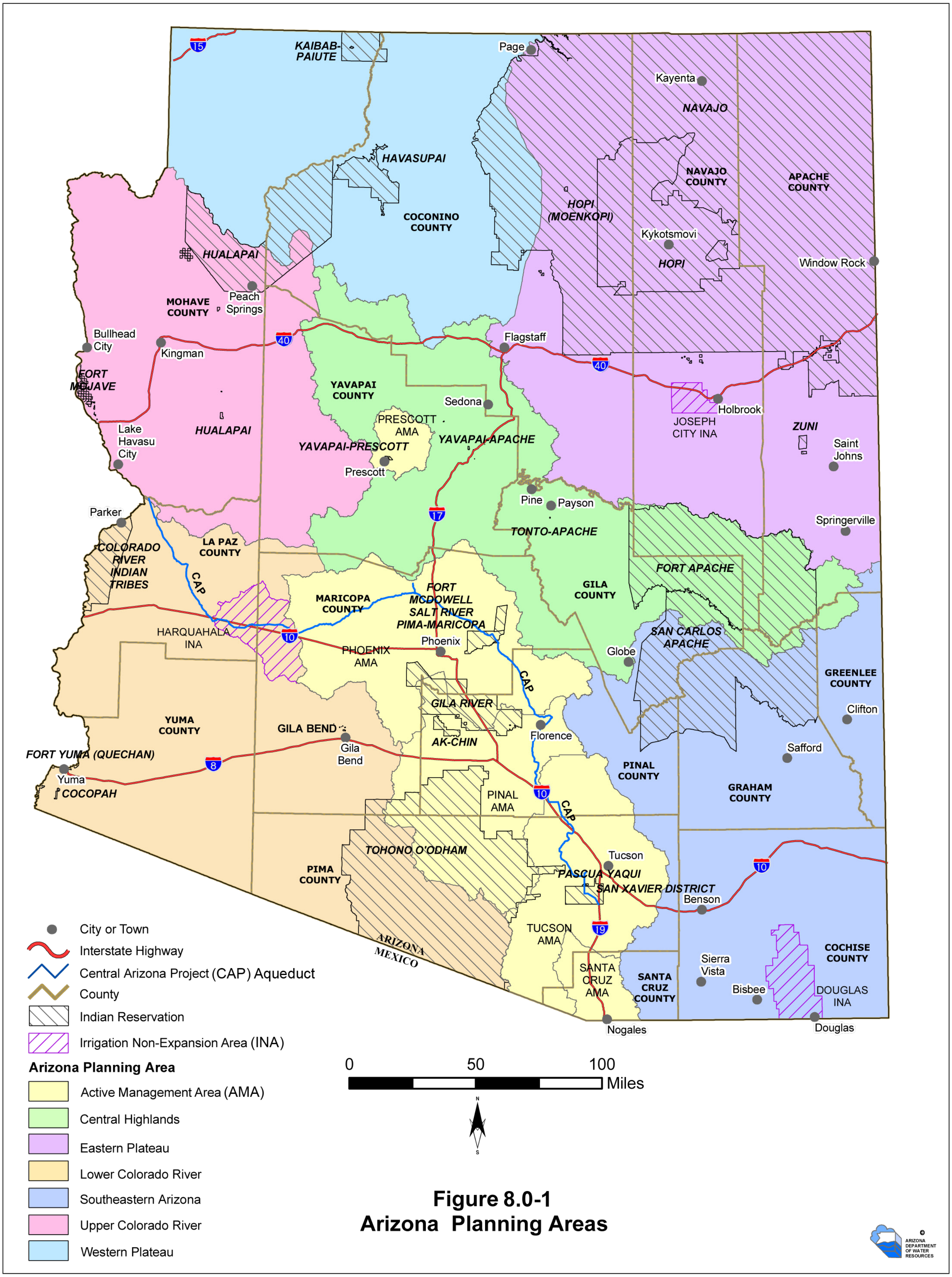


Figure 8.0-1
Arizona Planning Areas

each water use sector within an AMA. These provisions do not apply to tribal users.

More detailed data for the AMAs are also available by contacting the Arizona Department of Water Resources (Department).

8.0 Overview of the AMA Planning Area

The AMA Planning Area is composed of five groundwater basins located in the central and south central parts of the state. (Figure 8.0-2) The AMAs, established pursuant to the 1980 Groundwater Management Act, include the Santa Cruz AMA, the Tucson AMA, the Pinal AMA, the Phoenix AMA, and the Prescott AMA. The AMAs are located in portions of Santa Cruz, Pima, Pinal, and Maricopa counties as well as the central portion of Yavapai County. There are seven Indian reservations within the planning area including the Tohono O'odham (consisting of three reservations in the planning area), Pascua Yaqui, Ak-Chin, Gila River, Fort McDowell Yavapai, Salt River Pima-Maricopa and the Yavapai-Prescott.

Figure 8.0-2 Active Management Area Planning Area

In 2006, just over 82% of the state's 6.2 million inhabitants lived in the planning area. In 2005, AMA populations ranged from approximately 47,200 residents in the Santa Cruz AMA to over 3,650,000 residents in the Phoenix AMA. In 2006 the Arizona Department of Commerce estimated that the state's population would be approximately 10,348,000 by 2030 and would likely double by 2050 to over 12.8 million people. The majority of this growth will occur in the AMA Planning Area.

Between 2001-2005 an average of 3,659,480 acre-feet of water was used annually in the planning area for agricultural, municipal and industrial purposes (cultural water demand). Of this total demand, approximately 43% was met with groundwater supplies, 32% was met with Central Arizona Project (CAP) water, 21% was met with surface water and 4% was met with effluent or reclaimed water. During this time-period agriculture was the largest use sector in the planning area with an average annual demand of approximately 2,153,900 acre-feet or 59% of the total planning area demand. Municipal sector demand averaged about 1,273,100 acre-feet per year (AFA) (35%) and industrial sector demand averaged about 232,480 AFA (6%).

8.0.1 Geography

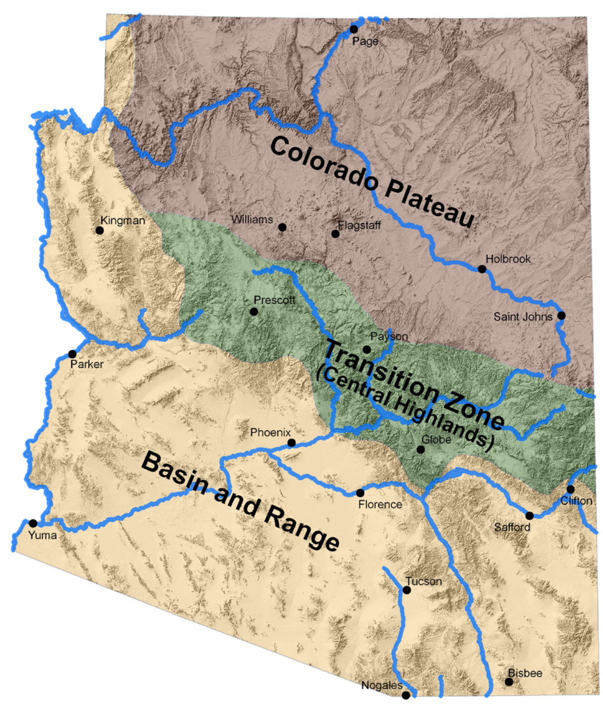
The AMA Planning Area covers approximately 14,700 square miles and stretches continuously from the international border through central Arizona to the northern boundary of Maricopa County. The most northern AMA, the Prescott AMA, is discontiguous from the other four AMAs (Figure 8.0-2) and is within the boundaries of the Central Highlands Planning Area, which borders the Phoenix AMA on the north. The planning area is located between the Southeastern Arizona Planning Area on the east and the Lower Colorado River Planning Area on the west and includes portions of six watersheds, which are discussed in section 8.0-2, Surface Water Hydrology.

Most of the AMA Planning Area is located in the Basin and Range physiographic province, which is characterized by broad, gently sloping alluvial basins separated by north to northwest trending fault-block mountains (Figure 8.0-3). The Prescott AMA and a small portion of the Phoenix AMA lie within the Central Highlands transition zone, which is characterized by a band of mountains of igneous, metamorphic, and sedimentary rocks. Because of its geographic extent and location in the state, the planning area exhibits a wide range of geographic features, from low elevation, broad, semi-arid Sonoran desert valleys to mountain ranges with summits over 9,000 feet. The topographic variability results in broad variations in the amount of precipitation, temperature range and vegetation type.

At approximately 485 square miles in area, the Prescott AMA is the smallest AMA basin and has the highest average elevation, ranging from 4,400 feet in the valleys to approximately 7,800 feet in the Bradshaw Mountains. The AMA is characterized by rolling topography, broad sloping alluvial basins and fault block mountains (see Figure 8.3-1). Streamflow in surface drainages are primarily ephemeral or intermittent.

The Santa Cruz AMA is approximately 716 square miles in area. It lies adjacent to the international border and its major drainage, the Santa Cruz River, flows from Mexico into the basin. The AMA is characterized by the relatively narrow river drainage flanked by hills and higher elevation mountains on its northern, eastern and western boundaries. Elevations range from 3,000 feet where the Santa Cruz River exits the basin to over 9,400 feet in the Santa Rita Mountains (see Figure 8.4-1).

Figure 8.0-3 Physiographic Regions of Arizona



Data source: Fenneman and Johnson, 1946

North and west of the Santa Cruz AMA, the Tucson AMA is approximately 3,866 square miles in area with two major, parallel alluvial valleys, the Upper Santa Cruz in the east and the Avra and Altar valleys in the west. The Santa Cruz River drains the Upper Santa Cruz Valley and is the major drainage in the AMA. Mountain ranges form the eastern and southern borders of the AMA. These “sky islands” are relatively isolated ranges separated by valleys that are part of a unique complex of mountains that are also found in northern Mexico and New Mexico (Warshall, 2006). The Tucson AMA has the widest elevational range of any of the AMAs with elevations ranging from 1,770 feet north of Picacho Peak, to over 9,400 feet in the Santa Rita Mountains (see Figure 8.5-1).

The Pinal AMA is located to the north and west of the Tucson AMA, and at 4,100 square miles in area, is the second largest basin in the planning area. It is characterized by broad, alluvial Sonoran desert valleys and mid-elevation north to northwest trending fault-block mountains. The Gila River flows east to west in the northern part of the basin while the Santa Cruz River enters the basin from the southeast, flowing primarily ephemerally toward the northwest. Elevations range from about 1,000 feet where the Gila River and Santa Cruz River exit the basin in the northwest to over 6,800 feet at Kitt Peak at the southern basin boundary (see Figure 8.2-1).

The Phoenix AMA is the largest AMA basin at approximately 5,646 square miles and is characterized by Sonoran desert valleys that are generally from 1,000 to 2,500 feet above mean sea level, surrounded by mid-elevation mountain ranges. The basin is drained by five major rivers, the Salt, Gila, Verde, Agua Fria and Hassayampa. The state’s most important water producing watersheds, the Salt and the Verde, converge in the Phoenix AMA, representing an important water supply for the area. Elevations range from 755 feet where the Gila River exits the basin to almost 5,900 feet in the New River Mountains on the northern basin boundary (see Figure 8.1-1).

8.0.2 Hydrology[1]

Groundwater Hydrology

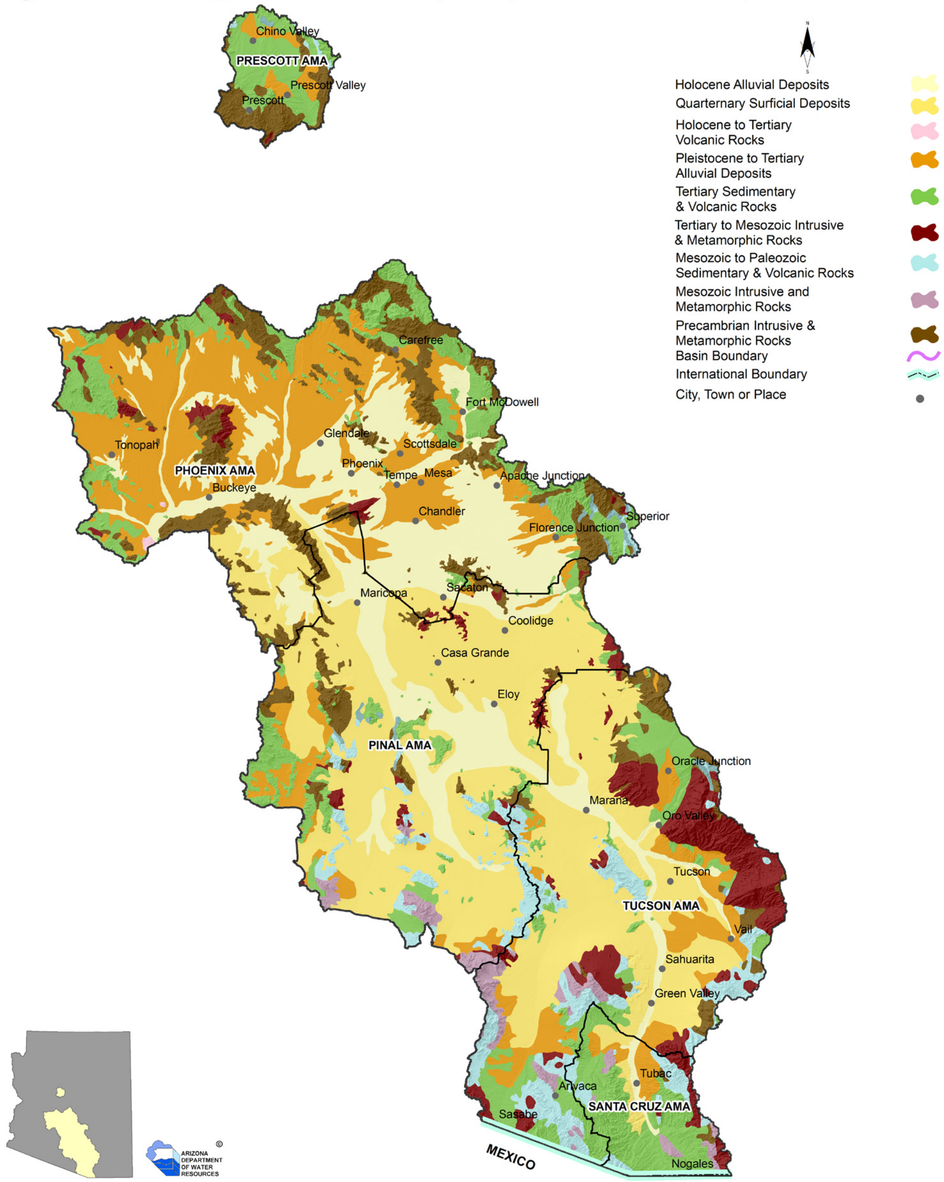
With the exception of the Prescott AMA, a large portion of the AMA planning area is located in what Anderson, and others (1992) categorized as the Central basins. Stream alluvial deposits and upper basin fill are the principal water bearing sediments in these basins (see Figure 8.0-4). The Central basins are characterized by relatively small to moderate amounts of mountain-front recharge, streamflow infiltration and significant underflow in and out of the basins. Groundwater flows tend to move inward from the edges of the basin and higher elevations and then downstream towards the outflow portion of the basin.

The Prescott AMA is located in what Anderson, and others (1992) categorized as the Highland basins. Highland basins consist of basin fill and alluvium deposits, similar to the Central basins; however, due to their discontinuous nature, relatively little or no underflow occurs between basins. As shown in Figure 8.0-4, much of this basin is covered by sedimentary and volcanic rocks. Recharge occurs from surrounding consolidated rock and inflow from stream infiltration.

The central AMAs (Phoenix, Pinal and Tucson) contain relatively deep alluvial aquifers and significant volumes of water in storage. However, since aquifer recharge rates are relatively low and pumping volumes large, the aquifers have been in an overdraft condition. Within an AMA, overdraft is defined as a condition where

[1] Except as noted, much of the information in this section is taken from the Arizona Water Resources Assessment, Volume II (ADWR, 1994) and the Third Management Plans (TMP) for the AMAs (ADWR, 1999a).

Figure 8.0-4 Surface Geology of the AMA Planning Area
(Based on Reynolds, 1988)



groundwater is pumped in excess of safe-yield. The definition of safe-yield is, "to achieve and thereafter maintain a long-term balance between the annual amount of groundwater withdrawn in an active management area and the annual amount of natural and artificial groundwater recharge in an active management area." A.R.S. § 45-561(12). The Prescott AMA aquifers are more discontinuous and less extensive than the large basin-fill aquifers of the central AMAs. As with the central AMAs, the Prescott AMA is in an overdraft condition. In the Santa Cruz AMA a close interrelationship exists between water levels in the stream alluvium along the Santa Cruz River, and precipitation and drought events. The Santa Cruz AMA is in a safe-yield condition. (Erwin, 2007)

All of the AMAs, with the exception of the Santa Cruz AMA, contain sub-basins: two in the Prescott AMA, seven in the Phoenix AMA, five in the Pinal AMA, and two in the Tucson AMA. Characteristics of each basin and sub-basin are described individually below.

<u>Central Basins</u>

Phoenix AMA

The primary source of groundwater in the Phoenix AMA is basin-fill sediments. Three distinct water bearing units are identified in most of the sub-basins in the AMA: an upper alluvial unit, a middle fine-grained unit, and a lower conglomerate unit. Although conditions and circumstances vary across the AMA, most groundwater is pumped from the middle unit. Bedrock, consisting of metamorphic and igneous rock, underlies the basin-fill sediments and is not considered an aquifer. Groundwater occurs under generally unconfined conditions throughout most of the AMA. Depth to water ranges from just below land surface (bls) to more than 800 feet bls.

There are seven groundwater sub-basins in the Phoenix AMA: East Salt River Valley (ESRV), West Salt River Valley (WSRV), Hassayampa, Rainbow Valley, Fountain Hills, Lake Pleasant, and Carefree. (Figure 8.1-6) Each sub-basin has its own unique hydrogeologic characteristics, discussed below.

Groundwater flow directions are shown on Figure 8.1-6. In several areas, historic flow directions have been altered by well pumping. Prior to extensive pumping, groundwater flowed primarily from the ESRV to the WSRV along or toward the Salt and Gila Rivers, exiting the AMA near Gillespie Dam. By 1964, a regional groundwater depression had formed in the WSRV sub-basin east of the White Tank Mountains, redirecting flow in the sub-basin to the depression (Rascona, 2005). By 1983, agricultural pumping had produced localized groundwater depressions throughout the AMA (Reeter and Remick, 1986). A groundwater divide now exists in the southwest quarter of Township 1N, Range 4E that severs the hydraulic connection between the ESRV and WSRV sub-basins (Corkhill and others, 1993). Groundwater flow patterns are discussed further in the sub-basin sections.

Gillespie Dam. Prior to extensive pumping, groundwater flowed primarily from the ESRV to the WSRV along or toward the Salt and Gila Rivers, exiting the AMA near Gillespie Dam. Flow shown here is primarily effluent from the Phoenix AMA.

Groundwater recharge is from mountain front and stream channel recharge. Groundwater inflow into the AMA occurs as groundwater flows north from the Pinal AMA into the ESRV, and from the north and east. Groundwater exits the basin at Gillespie Dam where the Gila River exits the AMA. In general, between 1991-’92 and 2002-’03, water levels rose in the eastern part of the AMA, declined in the central part and were stable or rose or declined slightly in the western part of the AMA (Figure 8.1-6). Well yields throughout the AMA are generally high, with median values of over 1,400 gpm reported (Table 8.1-6).

Groundwater quality is generally suitable for most uses, but 68 groundwater contamination sites associated with industrial and other activities have been identified in the AMA (Table 8.1-9, Figure 8.1-11). Volatile Organic Compounds (VOCs) are the most common contaminant at these sites. In addition, over 1,500 measurements have been made of parameter concentrations that have equaled or exceeded drinking water standards. Of these, nitrate, fluoride, arsenic, and organics are the most common. All water providers in Arizona that serve more than 25 people or having 15 or more connections are regulated under the Safe Drinking Water Act and treat water supplies to meet drinking water standards. Detailed information on groundwater quality in the Phoenix AMA is found in the 1999 Third Management Plan.

East Salt River Valley Sub-basin

The ESRV Sub-basin encompasses the eastern part of the AMA and includes a portion of the City of Phoenix, the cities of Scottsdale, Tempe, Mesa, and Chandler, and the towns of Superior, Apache Junction, Gilbert and Queen Creek. The thickness of basin-fill sediments range from less than 100 feet near the basin margins to over 10,000 feet southeast of Gilbert. The primary source of groundwater (49%) is from the lower basin fill, with another 40% withdrawn from the middle basin fill and only 11% withdrawn from the upper basin fill (Rascona, 2005).

Groundwater flows into the ESRV Sub-basin from the Lake Pleasant Sub-basin, the Eloy Sub-basin in the Pinal AMA, and between the Santan and Sacaton mountains in the southern part of the sub-basin. Groundwater also flows toward a cone of depression caused by groundwater pumping east of Chandler (see Figure 8.1-6). Natural groundwater recharge occurs along stream channels and from mountain front recharge. Other sources of recharge include infiltration of agricultural irrigation water, canal leakage and storage at underground storage facilities (USFs). From 1990 to 2002, groundwater recharge exceeded withdrawals by almost 2.7 million acre-feet (maf) (Rascona, 2005). Groundwater in storage to a depth of 1,000 feet bls is estimated at more than 68 maf in the ESRV and WSRV sub-basins (ADWR, 1998a).

Earth fissuring and subsidence have occurred in the ESRV sub-basin due to localized pumping. These occurrences are found near Apache Junction and in the vicinities of Queen Creek, North Scottsdale and Paradise Valley (Rascona, 2005).

Town of Superior, Phoenix AMA. The East Salt River Valley Sub-basin encompasses the eastern part of the AMA and includes a portion of the City of Phoenix, the cities of Scottsdale, Tempe, Mesa, and Chandler, and the towns of Superior, Apache Junction, Gilbert and Queen Creek.

Well yields commonly exceed 1,000 to 2,000 gpm (Figure 8.1-8). The median well yield reported for 2,397 large (10-inch) diameter wells is 1,280 gpm (Table 8.1-6). Substantial water level rises were measured between 1991-‘92 and 2002-‘03 in a number of wells in the sub-basin (see Figure 8.1-6A). Increases of over 60 feet were reported in some areas due to a combination of cessation of farming and associated reduction in pumping, and direct use and recharge of CAP water. Groundwater level depths measured during 2002-‘03 ranged from ten feet bls near Superior to over 800 feet bls south of Cave Creek. Locations of water quality exceedences are shown on Figure 8.1-10 and constituents exceeded are listed in Table 8.1-8.

West Salt River Valley Sub-basin

The WSRV Sub-basin includes the communities of Phoenix, Buckeye, Surprise, Glendale, Peoria, Goodyear, Tolleson and Avondale. It is a broad, gently-sloping alluvial plain bounded by hills and low-elevation mountains with a depth to bedrock of over 10,000 feet beneath the Luke Air Force Base area. A large salt body lies southeast of Luke Air Force Base at a depth of 880 feet to over 6,000 feet, which locally affects groundwater salinity. Groundwater in the sub-basin is obtained almost evenly between the upper, middle and lower basin fill (Rascona, 2005). The middle basin fill ranges in thickness from less than 100 feet to over 1,300 feet southwest of Glendale. Natural groundwater recharge occurs along stream channels and from mountain front recharge. Groundwater also enters the sub-basin from the Lake Pleasant, northern Hassayampa and ESRV sub-basins, and from the Maricopa-Stanfield Sub-basin in the Pinal AMA. Incidental recharge of agricultural irrigation water and effluent discharged from the City of Phoenix 23rd and 91st Avenue wastewater treatment plants also recharges the aquifer.

Groundwater flow historically was toward and along the Salt and Gila Rivers. As mentioned

City of Phoenix. The WSRV Sub-basin includes the communities of Phoenix, Buckeye, Surprise, Glendale, Peoria, Goodyear, Tolleson and Avondale.

previously, a regional groundwater depression has formed east of the White Tank Mountains in the vicinity of Sun City and Litchfield Park. Associated water level declines of more than 300 feet in the area of Luke Air Force Base resulted in surface subsidence of more than 18 feet by 1991 (see Figure 8.1-6) (Hipke and others, 1996). While groundwater levels rose in that part of the sub-basin between 1991-'92 and 2002-'03, they declined in the Glendale/Goodyear/Phoenix area. Depths to groundwater vary widely in the sub-basin with shallower levels present south of I-10 along the Salt and Gila River drainage (Figure 8.1-6D). Well yields commonly exceed 1,000 to 2,000 gpm (Figure 8.1-8). Locations of water quality exceedences in the sub-basin are shown on Figure 8.1-10 and constituents exceeded are listed in Table 8.1-8.

Hassayampa Sub-basin

The Hassayampa Sub-basin is bounded by hills and mountains and drained by the ephemeral Hassayampa River. The sub-basin consists of the largely undeveloped Hassayampa Plain in the north and the Lower Hassayampa Area in the south. Groundwater occurs in the basin-fill deposits primarily under unconfined conditions (Rascona, 2005). There are, however local occurrences of confined (artesian) or perched aquifer conditions in the Lower Hassayampa Area (Long, 1983).

Little groundwater development has occurred in the Hassayampa Plain so the basin-fill sequence is not well understood in that part of the sub-basin. Depths to bedrock beneath the Hassayampa Plain range from a few tens of feet near the basin margins to over 1,200 feet near the sub-basin center. In the Lower Hassayampa Area depths to bedrock exceed 1,200 feet in the central part of the Tonopah Desert and Centennial Wash area (Long, 1983).

Groundwater enters the Hassayampa Plain from the northeast and flows south toward the Gila River. Groundwater historically flowed into the sub-basin from the WSRV Sub-basin, but this no longer occurs due to groundwater pumping in that sub-basin. Sources of groundwater recharge include streambed (Gila and Hassayampa rivers) infiltration and mountain front recharge. Groundwater in storage is estimated at more than 12 maf for the area north of I-10 (ADWR, 2003).

Well yield data are available primarily in the Lower Hassayampa Area where yields may exceed 2,000 gpm (Figure 8.1-8). Groundwater pumpage has declined across the sub-basin compared to pumpage in the 1970s and 1980s, resulting in groundwater level rises in several areas. Groundwater depressions still exist in Tonopah and south of Tonopah in the Centennial Wash area (Rascona, 2005) (see Figure 8.1-6). Depths to groundwater ranges from about 20 feet bls in the southwest to over 600 feet bls in the northern part of the sub-basin (Figure 8.1-6B). Locations of water quality exceedences are shown on Figure 8.1-10 and constituents exceeded are listed in Table 8.1-8.

Rainbow Valley Sub-basin

The Rainbow Valley Sub-basin is a relatively undeveloped alluvial plain located in the southern part of the AMA and drained by Waterman Wash, an ephemeral stream that joins the Gila River near Buckeye. Depths to bedrock may reach nearly 10,000 feet in the center of the sub-basin. The basin-fill sediments consist of poorly sorted gravel, sand, silt and clay. Sources of groundwater recharge include streambed infiltration along Waterman Wash and mountain front recharge. Groundwater flow is from south to north and may have historically entered the sub-basin from the Maricopa-Stanfield Sub-basin in the Pinal AMA. Groundwater storage data are not available for the sub-basin.

Agricultural well pumpage in the sub-basin began in the 1940s and by 1952 a groundwater depression had developed in the northwest portion of the sub-basin. This depression is still evident (Rascona, 2005).

Well yield data are available primarily for the northern part of the sub-basin where yields may exceed 2,000 gpm (Figure 8.1-8). Groundwater levels generally declined between 1991-'92 and 2002-'03. Depths to groundwater measured in 2002-'03 ranged from 140 feet bls to almost 500 feet bls (Figure 8.1-6C). Fluoride is the water quality constituent most commonly exceeded in measured wells in the sub-basin (Figure 8.1-10, Table 8.1-8).

Fountain Hills Sub-basin

The Fountain Hills Sub-basin is a dissected alluvial plain bounded by mountains. It is drained by the lower Verde River, which is perennial along the axis of the sub-basin, and by the Salt River in the southern part of the sub-basin. The two rivers converge in the southern portion of the sub-basin.

The regional aquifer consists of older basin-fill sediments and more recent unconsolidated alluvium deposited by and hydraulically connected to the Verde River. The regional aquifer in the Fountain Hills Sub-basin may not be connected to adjacent sub-basins. The depth to bedrock may exceed 4,800 feet. A geologic cross-section through the Town of Fountain Hills indicates a lower confined aquifer system and more shallow alluvial aquifers along streams and washes around the Town and along the Verde River (HydroSystems, 1999).

The general direction of groundwater flow is from north to south, parallel to the sub-basin axis. A clay sequence forms a barrier to groundwater flow between the shallow alluvial aquifer along the Verde River and decomposed and fractured granites that exist north and east of the McDowell Mountains (ADWR, 2001). Groundwater recharge occurs through streambed (Verde and Salt rivers) infiltration and from mountain front recharge. Groundwater storage data are not available for the sub-basin.

Reported well yields are greatest in the southern part of the sub-basin where they may exceed 2,000 gpm (Figure 8.1-8). Groundwater levels rose in several wells in the sub-basin between 1991-'92 and 2002-'03 with depths to groundwater ranging from about 50 feet bls to over 500 feet bls (see Figure 8.1-6A). Arsenic and fluoride concentrations exceeded drinking water standards in several wells measured in the sub-basin (Figure 8.1-10, Table 8.1-8).

Lake Pleasant Sub-basin

The Lake Pleasant Sub-basin is a relatively small, gently sloping alluvial plain surrounded by hills and mountains in the northern part of the AMA. It is drained by the lower Agua Fria River, the New River and by Skunk Creek. Basin fill, interbedded with volcanics, intrusives and conglomerate make up the main water-producing aquifer (Clear Creek & Associates, 2003). Depth to bedrock exceeds 800 feet near the center of the sub-basin where reported well yields are generally between 100 and 500 gpm. In the New River area, the local aquifer consists of fractured schist and gneiss and the groundwater supply is drought-sensitive. Well yields in this area are relatively low.

Sources of groundwater recharge include streambed infiltration and mountain front recharge. Groundwater flow is generally from north to south and into the WSRV and ESRV sub-basins. Groundwater storage data are not available for the sub-basin. Groundwater levels were stable or rose in most measured wells between 1991-'92 and 2002-'03. Depth to water ranged from 17 feet bls to almost 300 feet bls in 2002-'03 (see Figure 8.1-6D). Fluoride was the most commonly measured constituent exceeding drinking water standards in wells in the sub-basin (Figure 8.1-10, Table 8.1-8).

Cave Creek Regional Park, Carefree Sub-basin. Photo courtesy of Maricopa County.

Carefree Sub-basin

The Carefree Sub-basin, located in the northeastern part of the AMA, is drained by Cave Creek, a relatively small ephemeral stream. A northwest-trending alluvial plain in the southern part of the sub-basin contains aquifers consisting of streambed alluvium and members of the Carefree Formation, the major water-producing unit (HydroSystems, 2000). The basin fill is up to 2,000 feet thick and composed of older, partially-consolidated to consolidated sedimentary rocks. The Carefree Formation consists of alluvial fan and playa deposits and is underlain by volcanic rocks. The Grapevine Member is the only significant source of groundwater in this formation and reaches a maximum thickness of 1,300 feet.

Historic groundwater pumping caused cones of depression to form near the Carefree Airport in the south-central part of the basin and in the northern part of the Town of Cave Creek. The cone near the Town is still well defined and draws in groundwater from the northwest and southeast (Rascona, 2005). Natural groundwater recharge is from mountain front recharge and infiltration of streamflow along Cave Creek. ADWR (1994) estimated that the volume of groundwater in storage in the Carefree Sub-basin was 570,000 acre-feet to a depth of 1,200 feet bls.

Well yields vary across the sub-basin, with the highest (>1,000 gpm) yields east of Carefree (Figure 8.1-8). Groundwater levels began declining in the early 1960s, but rose in several wells between 1991-'92 to 2002-'03 as many local golf courses converted from solely groundwater to a combination of CAP water, groundwater and effluent. Depth to water in wells measured in 2002-'03 ranged from 27 feet bls to 330 feet bls (Figure 8.1-6). Fluoride, arsenic and radionuclides were the parameters most commonly exceeding drinking water standards in wells in the sub-basin (Figure 8.1-10, Table 8.1-8).

Pinal AMA

The Pinal AMA consists of five sub-basins with unique groundwater recharge and storage characteristics. These sub-basins include the Maricopa-Stanfield, Eloy, Vekol Valley, Santa Rosa Valley, and Aguirre Valley (Figure 8.2-8). Sub-basin boundaries follow surface water topographic divides, and in the case of the Eloy and Maricopa-Stanfield sub-basins, a groundwater divide. Groundwater underflow between these two sub-basins is limited. Most groundwater development has occurred within the Maricopa-Stanfield and Eloy sub-basins while relatively little development and hydrologic information is available for the Vekol Valley, Santa Rosa Valley and Aguirre Valley sub-basins, which are primarily tribal lands.

The most productive groundwater-bearing units in the Maricopa-Stanfield and Eloy sub-basins consist of unconsolidated sands, gravels, silts, and clays that were deposited by the ancestral Gila and Santa Cruz rivers. Demand for water by irrigated agriculture has drained much of this upper alluvial unit in both sub-basins and changed the direction of groundwater flow between them.

Natural recharge is primarily from underflow into the basin and from streambed infiltration along the Gila and Santa Cruz rivers, which produce relatively large volumes of runoff from upstream basins outside the AMA following heavy rains. Lesser amounts of natural recharge occur from mountain fronts. The estimated groundwater in storage for the Maricopa-Stanfield, Eloy and Vekol Valley sub-basins is 35.2 maf to a depth of 1,000 feet bls. Median well yield in the AMA, reported from 1,582 large diameter (> 10-in.) wells, is 1,000 gpm (see Table 8.2-6). Water levels rose between 1993-'94 and 2003-'04 in many wells as shown on Figure 8.2-6, although areas of historic decline are found near Florence, Coolidge, southwest of Picacho and in the vicinity of Casa Grande.

Water quality in the Pinal AMA generally meets state and federal drinking water standards, however exceedences of nitrate, fluoride, arsenic and to a lesser extent, other constituents have been measured at some locations (see Table 8.2-8). Pesticide, jet-fuel and hydraulic fluid contamination has been reported at several contamination sites in the AMA (Table 8.2-9 and Figure 8.2-11).

Maricopa-Stanfield Sub-basin

Groundwater in storage is estimated at 8.6 maf in the Maricopa-Stanfield Sub-basin. Groundwater flow is north toward the Gila River and toward cones of depression that have formed west of the towns of Maricopa and Stanfield (see Figure 8.2-6). Groundwater levels have been recovering and rising in much of the sub-basin due to use of CAP water in lieu of groundwater pumping. Water level rises of more than 60 feet were observed in many wells between 1993-'94 and 2003-'04 (Figure 8.2-6). Recent depths to groundwater range from 51 feet bls near the Gila River in the north to more than 600 feet bls in the vicinity of Stanfield (Figure 8.2-6A). Well yields in excess of 1,000 gpm are common. Fluoride and arsenic were the most common constituents exceeding drinking water standards in wells measured in the sub-basin, with elevated TDS concentrations and nitrate exceedences also detected (Figure 8.2-10, Table 8.2-8).

Eloy Sub-basin

An estimated 22.6 maf of groundwater is in storage to a depth of 1,000 feet bls in the Eloy Sub-basin. Groundwater flow is generally to the north toward the Gila River and Phoenix AMA. Well yields in excess of 500 gpm to more than 2,000 gpm are common (Figure 8.2-8). Reductions in groundwater pumping and use of CAP water have contributed to recent rising water levels in several wells in this sub-basin. However, groundwater levels are also declining in the north due to dissipation of a groundwater mound formed after Gila River flooding; and in

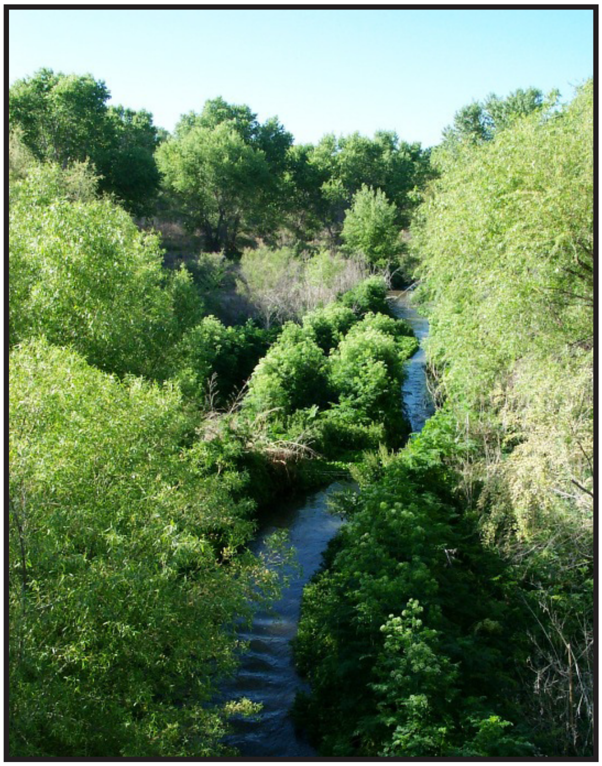
Irrigated farmland, Eloy Sub-basin. An estimated 22.6 maf of groundwater is in storage to a depth of 1,000 feet bls in the Eloy Sub-basin.

the south central sub-basin, probably from deep well pumping (see Figure 8.2-6). Recent depths to groundwater range from 53 feet bls in the northeast to over 400 feet bls near Picacho (Figure 8.2-6B). Concentrations of fluoride, arsenic, nitrates and other constituents have exceeded drinking water standards in wells throughout the sub-basin (Figure 8.2-10, Table 8.2-8).

Santa Cruz AMA

Basin-fill sediments along the Santa Cruz River from east and north of the City of Nogales to Amado form three named aquifer units. Listed in ascending order they are the Nogales Formation, Older Alluvium, and Younger Alluvium (also referred to as the stream alluvium). The alluvial units are generally unconfined and hydraulically connected, although the Older Alluvium aquifer exhibits semi-confined to confined conditions in some places, most notably in Potrero Creek. The Nogales Formation is not generally considered an important aquifer, although exceptions occur. The Older Alluvium varies in thickness from a few feet along the mountains to more than 1,000 feet in the north-central part of the basin. Well yields are often low in wells drilled in this aquifer. The Younger Alluvium forms the most productive and widely utilized aquifer in the AMA with well yields commonly in excess of 1,000 gpm. The Younger Alluvium ranges from about 40 to 150 feet thick, becoming thicker and wider to the north along the Santa Cruz River.

Groundwater enters the basin along the Santa Cruz River and west of Nogales. Groundwater flow is then generally from south to north. Natural groundwater recharge occurs from infiltration of Santa Cruz River channel flow and mountain front recharge. Groundwater storage in the Younger Alluvium has been estimated at about 160,000 acre-feet. The median well yield reported for 115 large (>10-inch) diameter wells is 800 gpm, with the highest yields located between Rio Rico and Tubac (Figure 8.4-8). Water levels have generally declined in wells measured between 1995 and 2004-'05 throughout the AMA, with most declines totaling from 1 to 15 feet (see Figure 8.4-6). However, a characteristic of the Younger Alluvium in the Santa Cruz AMA is the potential for rapid water level fluctuations resulting from river charge.



Santa Cruz River, Santa Cruz AMA. Basin-fill sediments along the Santa Cruz River from east and north of the City of Nogales to Amado form three named aquifer units.

Groundwater quality is generally good, although arsenic concentrations exceeding the drinking water standard have been measured at some wells in the basin (Table 8.4-7). In addition, there are two sites near Nogales with VOC and chromium contamination (Table 8.4-8 and Figure 8.4-10).

Tucson AMA

The Tucson AMA contains two parallel sub-basins: the Upper Santa Cruz Valley Sub-basin in the east half and the Avra Valley Sub-basin in the west half (Figure 8.5-6). The sub-basins consist of relatively deep alluvial basins filled with layers of sediments and bordered by mountains. The sediments contain substantial volumes of groundwater, but the composition and productivity of the sediment layers differ between the two sub-basins.

Groundwater enters the Tucson AMA from north from the Santa Cruz AMA and from bordering mountains and then flows to the north-northwest (Figure 8.5-6). Natural recharge also occurs along stream channels (primarily the Santa Cruz River). About 84% of the total net natural recharge in the basin is estimated to occur within the Upper Santa Cruz Valley Sub-basin. Groundwater storage in the AMA during predevelopment times is estimated to have ranged from 68 maf to 76 maf to a depth of 1,000 feet (ADWR, 2006a).

The median well yield reported for 1,063 large diameter (>10-inch) wells is 520 gpm. As shown in Figure 8.5-8, well yields in excess of 1,000 gpm are found in the vicinity of Sahuarita and Green Valley, near Marana and north of Three Points. During the period from 1994-'95 to 2004-'05 water level rises occurred in the northern half of the Avra Valley Sub-basin due to agricultural retirement, use of CAP water in lieu of groundwater pumping and groundwater recharge activities (see Figure 8.5-6). Similar widespread water level rises have not been noted in the Upper Santa Cruz Sub-basin with the exception of an area north of Sahuarita where CAP water is being recharged at the Pima Mine Road USF. Elsewhere in the sub-basin, water levels have generally decreased.

Rincon Mountain foothills, Tucson AMA. Natural recharge occurs along the mountain fronts and stream channel (primarily the Santa Cruz River) and via groundwater inflow from the Santa Cruz AMA.

Water quality in the Tucson AMA is suitable for most uses, although 26 groundwater contamination sites have been identified (Table 8.5-9). Volatile organic compounds (VOCs) associated with industrial and transportation activities are common at the contamination sites. In addition, elevated concentrations of certain natural constituents, including arsenic, fluoride and metals have been measured in wells. Elevated nitrate, sulfate and total dissolved solid concentrations have been detected in wells near mining and agricultural operations.

Upper Santa Cruz Sub-basin

The depth to bedrock in the center of the Upper Santa Cruz Sub-basin exceeds 11,000 feet. Sediments in this sub-basin have been divided into four hydrogeologic units that form the main regional aquifer and are hydrologically connected to varying degrees. In descending order these units are the recent alluvial deposits, Fort Lowell Formation, Tinaja Beds and Pantano Formation. A basement unit underlies the sediments and forms a relatively impermeable bedrock floor that extends to the surrounding mountains.

The recent alluvial deposits underlie streambed channels of the Santa Cruz River and its major tributaries and are generally less than 100 feet thick. The Fort Lowell Formation consists of unconsolidated to moderately consolidated sands and silts that are 300 to 400 feet thick throughout the sub-basin. The underlying Tinaja Beds are up to 5,000 feet thick in the center of the sub-basin and consist of sandstones, conglomerates, siltstones and mudstones. The Tinaja Beds have become the principal supply of groundwater in the Tucson AMA due to widespread dewatering of the overlying Fort Lowell Formation. Beneath the Tinaja Beds, the Pantano Formation, composed of consolidated sandstones, conglomerates and mudstones, is little used as a water supply because of its depth and relatively low well yields. Groundwater flow is from mountain fronts to the valley and from the south to the northwest (Figure 8.5-6). The pre-development groundwater in storage estimate for the sub-basin is 52 maf to a depth of 1,000 feet.

Well yields are generally between 100 to 1,000 gpm in the sub-basin with higher yields found in wells in the Sahuarita/Green Valley area and southwest of Marana. As mentioned previously and shown on Figure 8.5-6B, water levels in most measured wells in the sub-basin declined by more than 15 feet from 1994-'95 to 2004-'05. Locations of water quality exceedences are shown on Figure 8.5-10 and constituents exceeded are listed in Table 8.5-8. Concentrations of arsenic, metals, nitrate and other constituents that exceed drinking water standards have been measured in wells throughout the sub-basin.

Avra Valley Sub-basin
Sediments in the Avra Valley Sub-basin have been divided into upper and lower alluvial units. The upper unit is the primary water producer. Composed of silt and gravel, it includes streambed deposits along Altar and Brawley washes and ranges in thickness from less than 100 feet to more than 1,000 feet. The lower alluvial unit consists of gravel and conglomerates near the edges of the valley, grading to silts and mudstones along the central axis of the sub-basin. Groundwater flow is from the south to north. The pre-development groundwater in storage estimate for the sub-basin ranges from 17 to 24 maf to a depth of 1,000 feet.

Well yields are generally higher in the Avra Valley Sub-basin than in the Upper Santa Cruz Sub-basin (Figure 8.5-8) with measured yields often exceeding 1,000 gpm. As mentioned previously and shown on Figure 8.5-6A, water levels rose in the northern part of the sub-basin, in some wells by 30 feet or more, from 1994-'95 to 2004-'05. Constituents exceeding drinking water standards in the sub-basin are similar to those found in the Upper Santa Cruz Sub-basin (Table 8.5-8).

<u>Highlands Basins</u>

Prescott AMA

The Prescott AMA consists of two sub-basins, the Little Chino in the north and the Upper Agua Fria in the south (Figure 8.3-6). The sub-basins are separated by a surface drainage divide. Prescott AMA aquifers are discontinuous, with the major aquifer found in a deep structural trough that extends 25 miles from near Dewey-Humboldt to near Del Rio Springs. The trough appears to have formed from basin-and-range faulting and warping and filled with alluvial, sedimentary, and volcanic rocks of Quarternary to upper Tertiary age.

Three hydrogeologic units have been identified in the AMA. In ascending order they are named the Basement Unit, the Lower Volcanic Unit, and the Upper Alluvial Unit. The relatively impermeable Basement Unit consists of igneous and metamorphic rocks that form the floor and sides of the groundwater sub-basins and is exposed at land surface in the surrounding mountains. The Basement Unit has limited groundwater storage and production capacity and is not regarded as an aquifer except for domestic purposes.

The Lower Volcanic Unit overlies the Basement Unit across most of the Little Chino Sub-basin. It is composed of a relatively thick sequence of basaltic and andesitic lava flows interbedded with layers of pyroclastic and alluvial material. The Lower Volcanic Unit forms a highly productive confined (artesian) aquifer with discharge points northwest of and at Del Rio Springs. The most productive portion is estimated to range from less than 100 feet up to several hundred feet thick. Natural recharge occurs mainly through infiltration of runoff in ephemeral stream channels and along the mountain fronts of the Little Chino Sub-basin.

The Upper Alluvial Unit consists of relatively thick sedimentary and volcanic rocks that fill a structural trough that extends across both sub-basins. This unit constitutes the main, unconfined aquifer in the Prescott AMA. Natural recharge occurs from streambed infiltration and mountain front recharge. The thickness of the unit varies considerably. In the Upper Agua Fria Sub-basin it varies from 800-1,200 feet near Prescott Valley to 200-400 feet near Dewey-Humboldt. In the Little Chino Sub-basin, its thickness is difficult to determine but is estimated to be about 700 feet thick near Del Rio Springs with a median thickness of about 450 feet (Blasch and others, 2006). The combined thickness of the Upper Alluvial Unit and Lower Volcanic Unit is greatest in the central and southeastern portions of the Little Chino Sub-basin.

Groundwater flows generally from the mountain fronts toward the valleys, then north beneath the Little Chino Sub-basin and south beneath the Upper Agua Fria Sub-basin. ADWR (2005) estimated that there was 3.0 maf of groundwater in storage in the AMA; 2.1 maf in the Little Chino Sub-basin and 0.9 maf in the Upper Agua Fria Sub-basin. The median reported well yield for 78 large diameter (>10-inch) wells is 763 gpm (Table 8.3-6). Well yields are generally between 500 gpm and 1,000 gpm in wells near Chino Valley, and between 100 gpm to 500 gpm in the Upper Agua Fria Sub-basin. Between 1993-'94 and 2004, water levels declined in most measured wells (Figure 8.3-6). Recent depths to groundwater in wells ranged from 16 feet bls near Del Rio Springs to almost 500 feet bls in the east-central part of the basin.

Water quality is generally good; however arsenic, and to a lesser extent other constituents have been measured at concentrations exceeding water standards, at several locations (Table 8.3-8). Sites contaminated with hydrocarbons, lead, cyanide and other contaminants are found near Prescott, Chino Valley and Dewey-Humboldt (see Figure 8.3-11).

Surface Water Hydrology

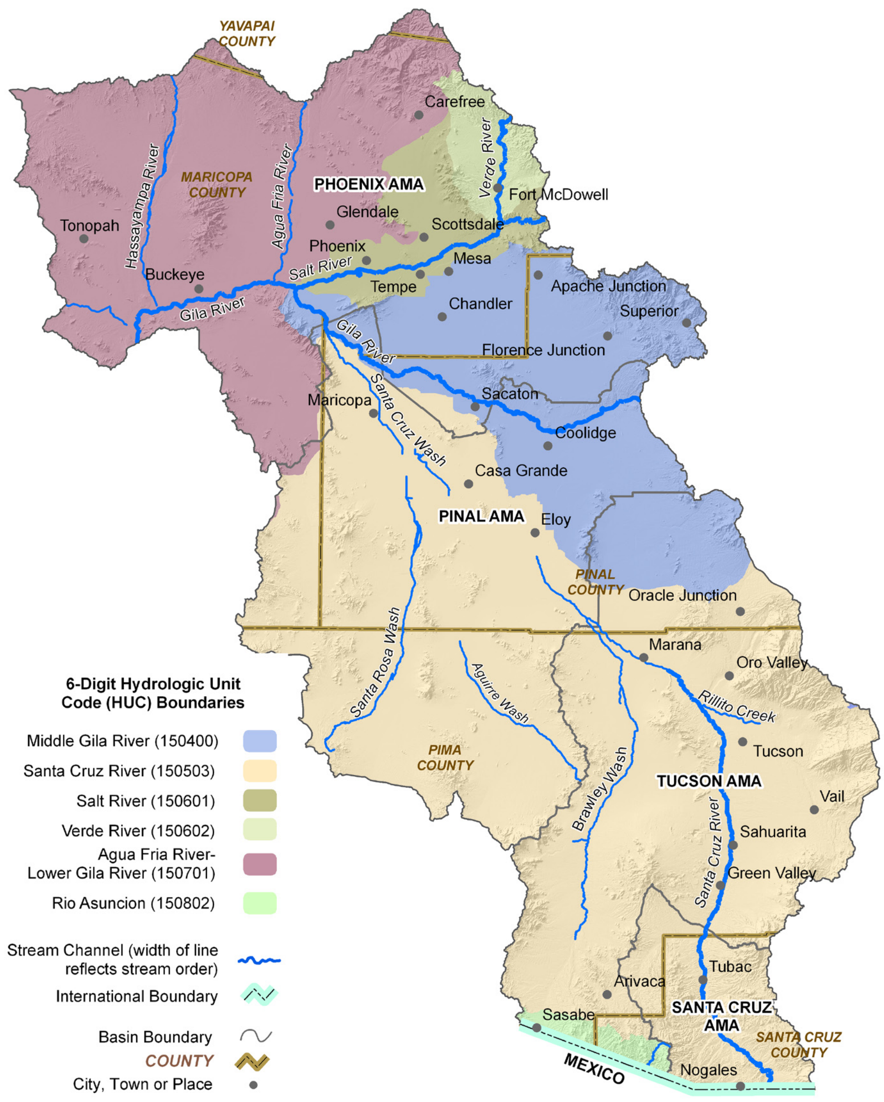
The U.S. Geological Survey (USGS) divides the United States into successively smaller hydrologic units based on hydrologic features. These units are classified into four descending levels. From largest to smallest they are: regions, subregions, accounting units and cataloging units. Each hydrologic unit is identified by a hydrologic unit code (HUC) consisting of two to eight digits depending on the unit level. A 6-digit code corresponds to accounting units, which are used by the USGS for designing and managing the National Water Data Network.

The AMA planning area encompasses portions of six watersheds at the accounting unit level. From north to south they are: the Verde River, the Agua Fria River-Lower Gila River, the Salt River, the Middle Gila River, the Santa Cruz River and the Rio Asuncion (Figure 8.0-5). More detailed information on stream flow gages, springs, reservoirs and general surface water characteristics are found in the individual AMA sections. An additional and comprehensive source of information on watersheds is Arizona NEMO (Non-point Education for Municipal Officials), which has produced watershed based plans for a number of Arizona watersheds including the Middle Gila, Salt, Santa Cruz, Upper Agua Fria and Verde watersheds. These plans characterize and classify watershed features with a focus on mitigation nonpoint source pollution. (Plans are available at http://www.srnr.arizona.edu/nemo/).

Verde River Watershed

The 6,100 square mile Verde River Watershed is located in north-central Arizona. A large part of the watershed is located in the Verde River groundwater basin (See Volume 5, Figure 5.0-5). The northern portion of the watershed begins near Seligman with tributaries of Big Chino Wash. The Verde River is perennial and almost 140 miles in length. Starting below Sullivan Lake Dam just north of the Prescott AMA it flows eastward to Perkinsville and southeastward to Fossil Creek, then passes southward

Figure 8.0-5 AMA USGS Watersheds
(USGS, 2005)



through two reservoirs (Horseshoe and Bartlett) before its confluence with the Salt River in the Fountain Hills Sub-basin of the Phoenix AMA. The last 25 miles of the river, and the southernmost part of the watershed are located in the Phoenix AMA.

The Verde River is impounded by Horseshoe Dam and Bartlett Dam outside the Phoenix AMA, both of which are part of the Salt River Project (SRP). SRP consists of two entities that provide water and power to the Phoenix metropolitan area. One of the entities, the Salt River Valley Water Users Association, is a private corporation that delivers nearly 1.0 maf of water annually to the Phoenix area through an extensive water delivery system that includes reservoirs, wells, canals and irrigation laterals.

The Little Chino Sub-basin in the northwestern portion of the Prescott AMA is also part of the Verde River watershed. Granite and Willow creeks are the major tributaries draining the Little Chino Sub-basin into the Verde River. An estimated 14% of the base flow in the upper Verde River comes from the Little Chino Sub-basin (Wirt and others, 2005). Dams constructed on Granite Creek and Willow Creek form Watson Lake and Willow Lake, respectively, and originally stored water for the Chino Valley Irrigation District (CVID). The lakes are now used by the City of Prescott for recreation and municipal water use. During major flood events water discharged from these lakes flows northward and joins the Verde River near Paulden outside the AMA (see Figure 8.3-4). Little Chino Creek and Big Draw Creek drain the northwestern part of the Little Chino Sub-basin. Little Chino Creek drains the CVID area and flows into the Del Rio Springs area where groundwater naturally discharges at the surface.

Granite Creek, Prescott AMA. Granite and Willow creeks are the major tributaries draining the Little Chino Sub-basin into the Verde River.

Del Rio Springs, located in the northern part of the Prescott AMA, is the only large spring in the AMA with a discharge of 874 gpm measured in 1999 (Table 8.3-5). Spring discharge maintains baseflow below the springs. The only other major spring in this part of the watershed is Camp Spring northeast of Carefree in the Phoenix AMA with a discharge of about 75 gpm. Sycamore Creek, a tributary of the Verde River, and Camp Creek northeast of Carefree, both have reaches with perennial flow (Figure 8.1-5).

Streamgages are located at Del Rio Springs, and along Granite and Willow creeks in the Prescott AMA, and on the Verde River in the Phoenix AMA. Mean flows measured at three Granite Creek streamgages have ranged between approximately 3,500 and 5,000 AFA. Flows on the Verde River in the Phoenix AMA are controlled by releases from Bartlett and Horseshoe dams. The highest reported annual flow at two Verde River gages was approximately 1.8 maf in 1993, while the median annual flow measured at these gages is approximately 298,000 acre-feet (Table 8.1-2).

<u>Agua Fria – Lower Gila River Watershed</u>

The Agua Fria – Lower Gila River Watershed begins near Prescott and extends south of Gila Bend in the Lower Colorado River Planning Area. Its major drainages include the Agua Fria River, the Lower Hassayampa River and the Gila River. Within the AMA planning area, this watershed encompasses the southeastern portion of the Prescott AMA as well as the western half of the Phoenix AMA.

Lake Pleasant, is impounded by New Waddell Dam at the northern boundary of the Lake Pleasant Sub-basin and only flows below the dam when water is released during major flood events.

In the Prescott AMA, the Agua Fria – Lower Gila River Watershed includes the Upper Agua Fria Sub-basin. Upper Lynx Creek, Lynx Creek and the Agua Fria River drain the sub-basin. Most of the runoff from Lynx Creek is impounded by a dam and used for recreation and industrial purposes. A short reach of the Agua Fria River becomes perennial before leaving the AMA and a portion of this reach receives effluent discharged from the Prescott Valley Wastewater Treatment Facility (Figure 8.3-10). All other flows in the Upper Agua Fria Sub-basin are ephemeral.

All or portions of five Phoenix AMA sub-basins lie within the Agua Fria – Lower Gila River Watershed including Carefree, Lake Pleasant, Hassayampa, West Salt River Valley and Rainbow Valley. The Agua Fria River enters the AMA approximately 20 miles north of Peoria, in the Lake Pleasant Sub-basin. The river is impounded by New Waddell Dam at the northern boundary of the sub-basin and only flows below the dam when water is released during major flood events. From there it flows south along the western edge of the Phoenix metropolitan area and joins the Gila River south of Avondale (Figure 8.1-4B). Downstream of the confluence of the Salt River, the Gila River flows year round due to effluent discharge from the City of Phoenix 23rd and 91st Avenue wastewater treatment plants into the Salt River, and from return flow from nearby agricultural areas. Some of this water is diverted for agricultural and industrial uses. This reach of the Gila River has been designated as impaired by the Arizona Department of Environmental Quality (ADEQ) due to pesticide concentrations that exceed the use standard (Figure 8.1-10A and Table 8.1-8B). The Gila River exits the Phoenix AMA at Gillespie Dam.

The Hassayampa River originates in the Bradshaw Mountains and flows through the Hassayampa Sub-basin before its confluence with the Gila River west of Buckeye (Figure 8.1-4B). It is an ephemeral stream within much of the AMA except for short perennial reaches where it enters the AMA and near its confluence with the Gila River. The Hassayampa River is impaired above the Gila River confluence due to elevated concentrations of selenium and boron (Table 8.1-8B and Figure 8.1-10A).

The only major spring in the watershed is Seven Springs north of Carefree with a discharge of about 75 gpm. Perennial reaches occur along Cave Creek and Seven Springs Wash northeast of Carefree (Figure 8.1-5).

Flow records from streamgages in the watershed are included in Tables 8.1-2 and 8.3-2. The annual median flow in the Agua Fria River near the Humboldt gage is about 3,400 acre-feet and the annual median flow on the Hassayampa River near Morristown is about 6,500 acre-feet. The highest annual flow measured in the watershed occurred at a gage on the Gila River (#9514100) where 6.1 maf was reported for 1993. The median flow at this gage is only about 12,000 AFA. (Table 8.1-2)

<u>Salt River Watershed</u>
Most of the Salt River Watershed is within the

Salt River, Phoenix AMA.

Salt River and Tonto Creek basins in the Central Highlands Planning Area. Its western edge extends into the Phoenix AMA and includes the confluence of the Salt and Gila rivers. The Salt River originates in eastern Arizona and drains approximately 6,000 square miles of the Mogollon Rim area in the east-central part of the State. Before entering the Phoenix AMA in the Fountain Hills Sub-basin, surface water from the Salt River Watershed passes through a series of four reservoirs: Roosevelt Lake, Apache Lake, Canyon Lake and Saguaro Lake. These reservoirs and associated dams are operated by SRP and used to supply water to the agricultural, municipal and industrial sectors in the Phoenix AMA.

The Salt River channel enters the AMA north of the Goldfield Mountains, flows southwest through the East Salt River Valley and West Salt River Valley sub-basins and the cities of Mesa, Tempe, Scottsdale and Phoenix, and then joins the Gila River near Laveen (Figure 8.1-4B). Downstream from the Granite Reef Diversion Dam located four miles below the confluence of the Salt and Verde rivers, the Salt River is ephemeral and only flows in response to flooding or reservoir releases. The Granite Reef Diversion Dam diverts flow to the Arizona Canal and the South Canal to serve municipal, agriculture and tribal uses. The Salt River becomes perennial further downstream due to effluent discharges from the 23rd Avenue and 91st Avenue WWTPs (Figure 8.1-5).

There are no major springs in the AMA portion of the watershed. Flow records from streamgages in the watershed are found in Table 8.1-2. Annual median flow on the Salt River below Stewart Mountain Dam is about 585,700 acre- feet with a maximum annual flow of over 3.2 maf in 1993. Further downstream near its confluence with the Gila River and below the Granite Reef Diversion Dam, annual median flows in the Salt River at 51st Avenue are about 4,300 acre-feet.

<u>Middle Gila River Watershed</u>

The Middle Gila River Watershed extends west from Coolidge Dam on the Gila River, located in the Southeastern Arizona Planning Area, to the confluence of the Gila and Salt rivers. The San Pedro and San Francisco rivers are major tributaries to the Gila River outside of the AMA Planning Area. Portions of the Phoenix AMA, Pinal AMA and Tucson AMA are located in this watershed. The Gila River enters the Pinal AMA in its northeastern corner and flows from east to west. Before development, the Gila River flowed year round through this area. Pre-development flows along the portion of the Gila River that passes through the Pinal AMA are estimated to have been about 500,000 AFA. The first records of San Carlos Irrigation Project (SCIP) diversions of Gila River water begin in 1930, although diversions by non-Indian farmers began much earlier. According to the Gila Water Commissioner's report annual diversions by SCIP at the Ashurst-Hayden Diversion Dam northeast of Florence in the Pinal AMA averaged 253,100 AFA between 2005 to 2008.

There are no major springs in this portion of the Middle Gila River Watershed. Short reaches of Queen Creek and Arnett Creek near Superior are perennial (Figure 8.1-5). Queen Creek has been designated as impaired from its headwaters to about nine miles downstream due to elevated copper concentrations from mining discharge (Table 8.1-8B and Figure 8.1-10A). Flow records from streamgages in the watershed are found in Tables 8.1-2 and 8.2-2. The annual median flow measured at the gage on Queen Creek below Whitlow Dam near Superior is about 1,600 acre-feet. Gages on the Gila River have either been discontinued or have only recent data. The Gila River gage near Laveen has the longest period of record (55 years) but was discontinued in 1994. The annual median flow at that gage was 9,420 acre-feet with a maximum annual flow of almost 1.2 maf in 1993.

<u>Santa Cruz River Watershed</u>

A large portion of the AMA Planning Area falls within the Santa Cruz River Watershed, including the Santa Cruz AMA and most of the Tucson and Pinal AMAs. The Santa Cruz River is the main surface water drainage in the Santa Cruz and Tucson AMAs. The river originates in the San Rafael Valley east of the planning area near the Mexican border and flows southward to Mexico before turning north and re-entering the U.S. east of Nogales. Within the planning area it flows from the international border northwestward to its confluence with the Gila River (where it is known as the Santa Cruz Wash) in the northern portion of the Pinal AMA. Major tributaries to the river in the Santa Cruz AMA are Nogales Wash, Sopori Wash and Sonoita Creek. Major tributaries to the Santa Cruz River in the Tucson AMA include Rillito Creek, Cañada del Oro Wash and Brawley Wash. Three smaller streams (Vekol Wash, Santa Rosa Wash and Aguirre Wash) drain the southern portion of the Pinal AMA and join Santa Cruz Wash upstream from its confluence with the Gila River.

Prior to development, the Santa Cruz River was locally perennial in its southernmost reach from its headwaters in the San Rafael Valley to near Tubac, forming a series of cienegas (marshes).

San Xavier del Bac, Tucson AMA. A few short perennial reaches existed including near the mission south of Tucson.

North of Tubac, a few relatively short perennial sections existed including reaches near the mission of San Xavier del Bac south of Tucson and at "A" Mountain near downtown Tucson. From the Nine-Mile water hole north of the confluence of the Santa Cruz River and the Rillito River in Tucson, to its confluence with the Gila River, the Santa Cruz River was historically dry except during floods. (Tellman and others, 1997)

Currently, two segments of the Santa Cruz River within the Tucson AMA and the Santa Cruz AMA flow year round downstream of wastewater discharges (Figures 8.4-11 and 8.5-12). In 2006, approximately 66,000 acre-feet was discharged at the Ina and Roger Road WWTPs by Pima County. In 2004, approximately 16,200 acre-feet of sewage was treated at the Nogales International WWTP, which treats sewage from both Nogales, Sonora and Nogales, Arizona prior to discharge to the river. Approximately 11,500 acre-feet of the influent was from Mexico. In the Pinal AMA, a portion of the Santa Cruz River currently receives wastewater discharge from the Casa Grande WWTP.

Perennial flows in the watershed include portions of Sabino, Romero, Cienega and Rincon creeks in the east central part of the Tucson AMA and Sonoita Creek in the Santa Cruz AMA (Figures 8.4-5 and 8.5-5). Nogales Wash, a tributary of the Santa Cruz River, originates about five miles south of the international border in Sonora and enters Arizona as a covered floodway. It joins the Santa Cruz River about 8 miles north of the border. Nogales Wash is the major drainage system for both Nogales, Arizona and Nogales, Sonora. (Varady and others, 1995) Springs create perennial flow in Nogales Wash near its headwaters in Mexico and below the springs, storm flows and uncontrolled sewage discharges also contribute to its flow (IBWC, 1998) (Figure 8.4-4). In the Santa Cruz AMA the Santa Cruz River and Nogales Wash have designated impaired reaches due to elevated levels of E. coli and other constituents (Figure 8.4-9 and Table 8.4-7).

Effluent dominated reach of the Santa Cruz River near Amado.

There are ten major springs in the watershed with locations near Arivaca, in mountains east of Tucson, and west of Amado in the Santa Cruz AMA. The spring with the largest discharge is Sopori, located west of Amado, with a discharge rate of 377 gpm measured in 1952 (see Tables 8.4-5 and 8.5-5).

Flow records from streamgages in the watershed are found in Tables 8.4-2 and 8.5-2. The annual median flow at the Santa Cruz River near Nogales is 14,013 acre-feet with a maximum annual flow of over 88,000 acre-feet in 1983. Downstream in the Tucson AMA the annual median flow at the gage on the Santa Cruz River at Cortaro is 38,655 acre-feet with a maximum annual flow in 1993 of over 182,000 acre-feet.

<u>Rio Asuncion Watershed</u>

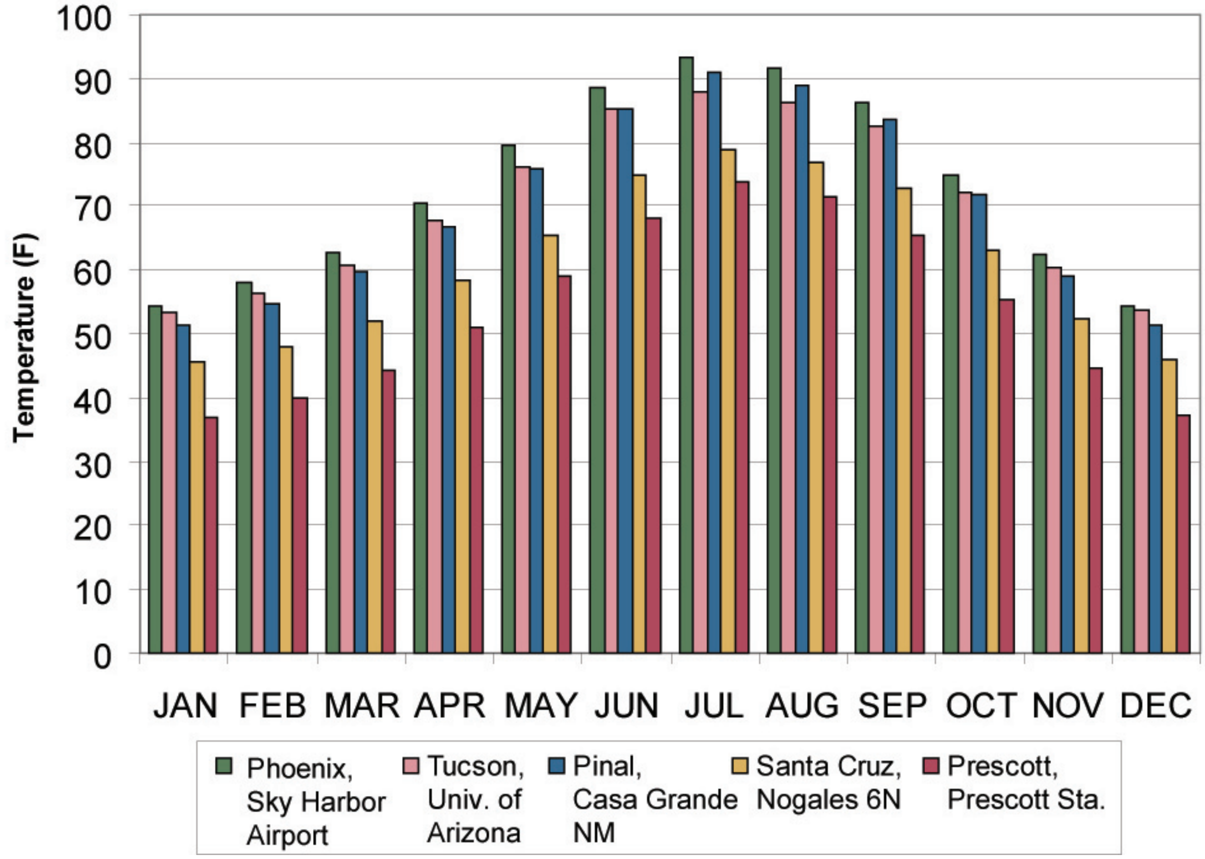
A small part of the Rio Asuncion Watershed is located at the base of the Tucson AMA along the international border. This watershed drains a large area of northwest Sonora, Mexico and discharges into the Sea of Cortez. Sycamore Creek, a perennial stream located in this watershed, flows south-southwest into Mexico. Due to its rich biological diversity, a portion of Sycamore Canyon has been designated as the Gooding Research Natural Area. There are no major springs identified in the U.S. portion of the watershed.

8.0.3 Climate

Climate in the AMA Planning Area varies widely due to its large geographic extent, with significant temperature and rainfall differences between some AMAs. Average annual temperatures range from 72.9°F in the Phoenix AMA to 53.3°F in the Prescott AMA compared to the statewide average of 59.5°F. Phoenix and Tucson climate stations report the warmest temperatures with the exception of the summer monsoon season when Tucson receives a significant amount of its annual rainfall and associated cooler temperatures (Figure 8.0-6).

Average annual precipitation (1971-2000) ranges from 8.3 inches at Phoenix Sky Harbor Airport to 18.7 inches at Nogales and Prescott. The AMA Planning Area exhibits a bi-modal precipitation seasonality that is characteristic of Arizona (Figure 8.0-7). During the winter and spring, frontal storm systems move west-to-east, guided by the jet stream. Summer monsoon thunderstorms also deliver significant amounts of precipitation, particularly in the Prescott and Santa Cruz AMAs. While precipitation amounts vary widely across the planning area, there are also strong year-to-year variations, due primarily to the influence of the El Nino-Southern Oscillation (ENSO), as well as long-term wet and dry periods that are linked to multi-decadal ocean variations.

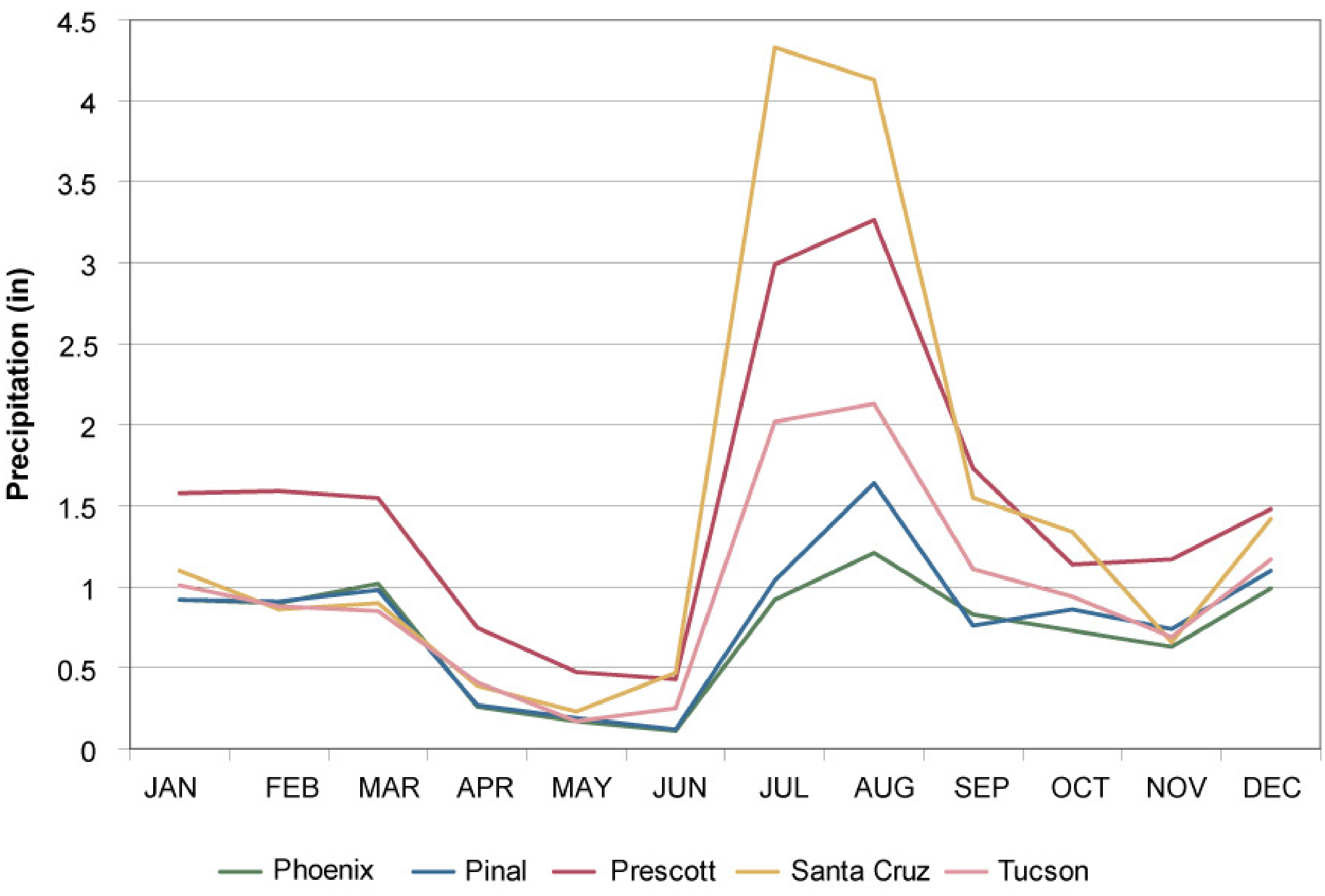
Figure 8.0-6 Average monthly temperature from 1952-2007 in the AMA Planning Area (Source: WRCC, 2008)



As shown in Figure 8.0-8, many of the wettest and driest periods since 1960 were synchronous throughout the AMAs with notable wet periods in the late 1970s, early 1980s and early 1990s. Notable dry periods were the early 1960s, the early 1970s and the period from 1996 through 2006. The greatest year-to-year precipitation variations during this period occurred in the Phoenix AMA and the least variation in the Prescott AMA, with the exception of 1965 when Prescott received almost double its annual rainfall.

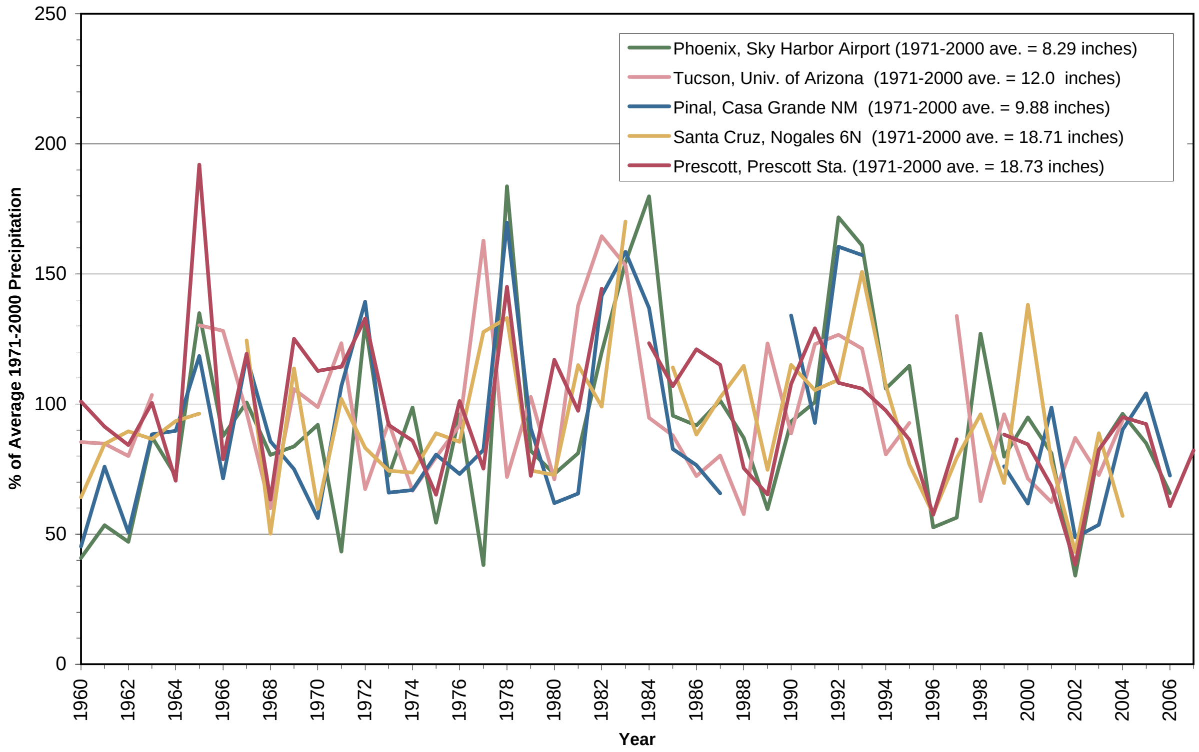
The planning area encompasses parts of five of Arizona's seven climate divisions. A climate division is a region within a state that is generally climatically homogenous. Long-term climate data for Arizona's climate divisions have been reconstructed from tree ring and instrumental data. These data show that since 1000 A.D., Climate Division 7 experienced more years (compared to the other planning area climate divisions) in which precipitation was less than that measured in 2002, one of the driest years in the instrumental record (CLIMAS, 2008).

Figure 8.0-7 Average monthly precipitation from 1948-1952 to 2006-2007 in the AMA Planning Area



Note: Data are from Phoenix, Sky Harbor Airport; Casa Grande NM; Prescott Sta.; Nogales 6N; and Univ. of Arizona WRCC Stations. Source: WRCC, 2008

Figure 8.0-8 Annual percent of average precipitation from 1960-2007 in the AMA Planning Area



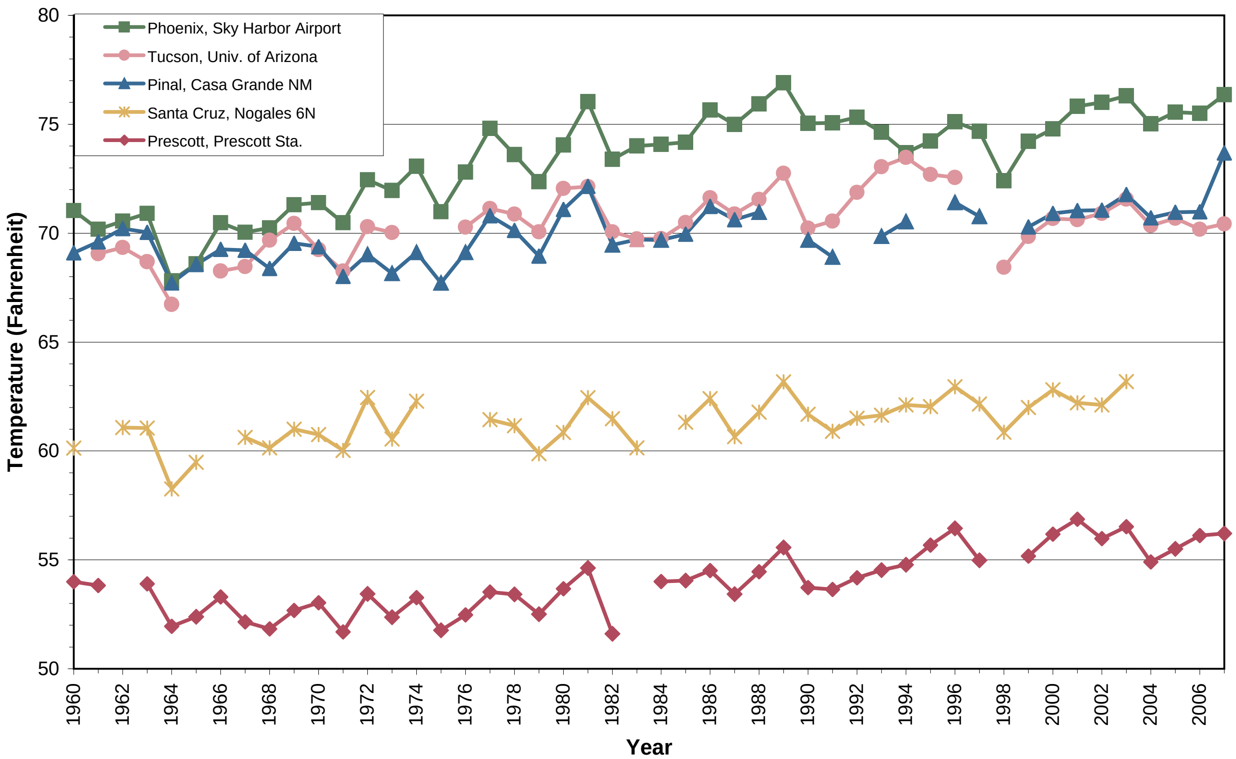
Years with more than five days of missing data in any month were omitted.
Source: WRCC, 2008

Climate Division 7 encompasses most of the Tucson AMA and all of the Santa Cruz AMA.

Average annual temperatures in the AMA Planning Area have been increasing since 1960, a phenomenon observed throughout the state. Figure 8.0-9 shows that all of the major urban locations in the AMAs have seen temperature increases, reflecting both a regional temperature trend and the influence of urban expansion and development. The effect of urban areas on temperature, precipitation and other climate phenomena is an important consideration in the planning area. Phoenix, for example, has experienced the greatest increase in temperatures during the time period shown. Figure 8.0-10 illustrates an increase in daily minimum temperatures during the summer months in Phoenix and Tucson, and is contrasted with modest increases measured at Casa Grande National Monument, a relatively non-urbanized area between the two cities.

Research on urbanization and warming in the Phoenix metropolitan area shows that, from 1948-2000, urbanization has increased the nighttime minimum temperature in central Phoenix (Sky Harbor Airport) by approximately 9° F and the average daily temperature by approximately 5.5° F (Baker and others, 2002). The number of days with temperatures between 59-100°F at Sky Harbor Airport has increased by about 30 days since 1948, most notably during the spring and fall. During the period 1990-2004, the Phoenix urban heat island expanded substantially, commensurate with increasing population and urban development. Recent research shows that temperatures in areas characterized by urban infill development, and areas in the core of the city were approximately 2° F and approximately

Figure 8.0-9 Average annual temperature measured between 1960 and 2007 in the AMA Planning Area



Source: WRCC, 2008

4° F warmer, respectively, than temperatures outside of urban areas (Brazel and others, 2007). Similarly, in central Phoenix the hours per day that exceed 100° F during the months of May through September have doubled since 1948 (Baker and others, 2002).

Tucson's urban heat island effect increased by approximately 5.5° F during the 20th century, with most of the warming since the late 1960s (Comrie, 2000). In the Tucson area, urban temperatures increased at almost 3 times the rate of rural temperatures. Temperature changes are not, however, uniform. Within the urban zone, variations in temperatures are caused by differences in housing density, the amount of green space, topography, and localized cold air flows downslope from mountains.

The impacts of urban warming are varied and include increases in energy consumption, predominantly from longer usage of air conditioning, and stress to animals and humans. Since 1948, the total number of cooling degree days (CDD) in Phoenix has increased by 569 while the heating degree days (HDD) has declined by 331 (Baker and others, 2002). The CDD and HDD are indices that reflect the demand for energy needed to cool or heat a structure, respectively. Research conducted in 2003 in Phoenix found that distinct neighborhoods experience up to 7° F difference in temperature.

Two studies suggest that urbanization and large irrigated areas in the Phoenix metro area increase precipitation to the northeast of the city (Diem and Brown, 2003; Shepherd, 2006). Average precipitation in the northeastern suburbs and exurbs of metropolitan Phoenix has increased by 12-14%, from the first half of the 20th century (Shepherd, 2006). The study suggests that urban heating, from built surfaces and buildings, affects upward motion in the atmosphere and can increase storminess beyond the urban area. Irrigation increases local water vapor in the atmosphere, and probably contributes to the increased precipitation (Diem and Brown, 2003).

8.0.4 Environmental Conditions

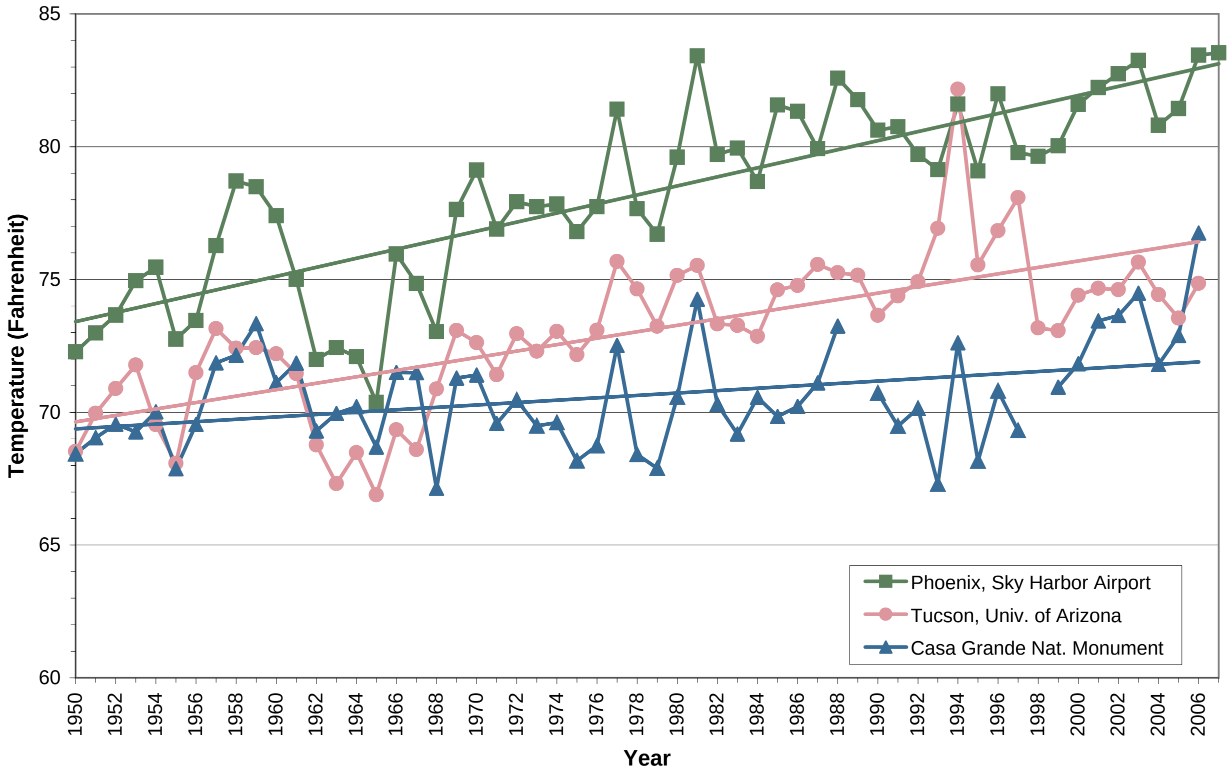
Vegetation

Information on ecoregions and biotic (vegetative) communities in the AMA Planning Area is shown on Figure 8.0-11. The planning area contains five of the six ecoregions found in Arizona, most of which is within the Sonoran Desert ecoregion. The Tucson and Santa Cruz AMAs also contain Chihuahuan desert with "sky islands" of Sierra Madre Occidental pine-oak forest. The northeastern portion of the Phoenix AMA and most of the Prescott AMA are within the Arizona Mountains Forests region, and the northern portion of the Prescott AMA includes part of the Colorado Plateau shrublands region.

Biotic communities range from Lower Colorado River Valley Sonoran desertscrub to Rocky Mountain (Petran) and Madrean montane conifer forest. Most of the planning area is covered by Lower Colorado River Valley and Arizona Uplands Sonoran desertscrub biotic communities.

Rocky Mountain and Madrean montane conifer forests occur at the highest elevations of the Tucson AMA in the Santa Catalina and Rincon

Figure 8.0-10 Average Daily Minimum June, July and August temperature measured between 1960 and 2007 in the AMA Planning Area



Years with more than five days of missing data in any month were omitted.
Source: WRCC, 2008

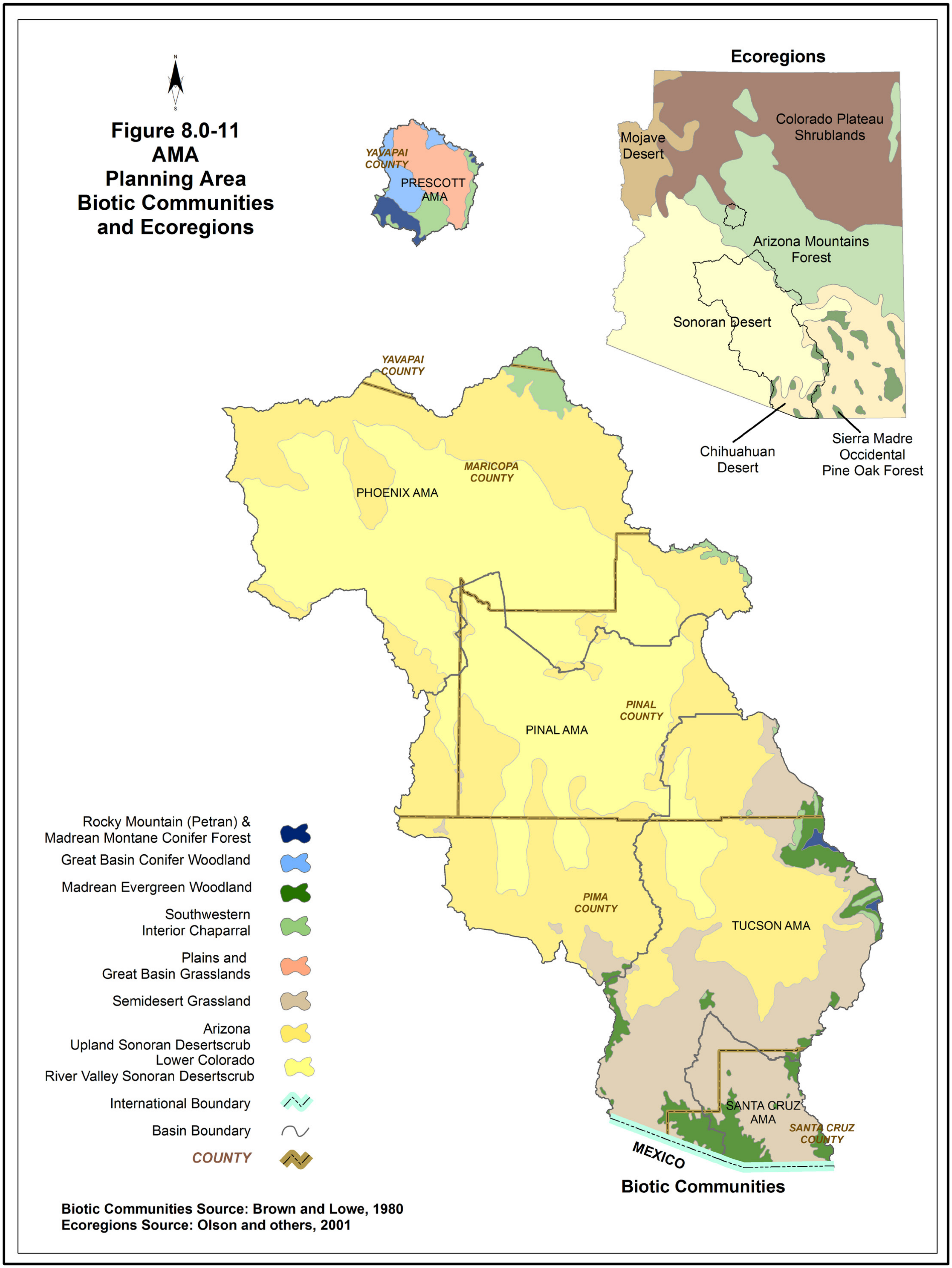


Figure 8.0-11
AMA
Planning Area
Biotic Communities
and Ecoregions
YAVAPAI COUNTY
PRESCOTT AMA
Ecoregions
Colorado Plateau Shrublands
Mojave Desert
Arizona Mountains Forest
Sonoran Desert
Chihuahuan Desert
Sierra Madre Occidental Pine Oak Forest
YAVAPAI COUNTY
MARICOPA COUNTY
PHOENIX AMA
PINAL COUNTY
PINAL AMA
PIMA COUNTY
TUCSON AMA
SANTA CRUZ AMA
SANTA CRUZ COUNTY
MEXICO
Biotic Communities
Rocky Mountain (Petran) & Madrean Montane Conifer Forest
Great Basin Conifer Woodland
Madrean Evergreen Woodland
Southwestern Interior Chaparral
Plains and Great Basin Grasslands
Semidesert Grassland
Arizona Upland Sonoran Desertscrub
Lower Colorado River Valley Sonoran Desertscrub
International Boundary
Basin Boundary
COUNTY
Biotic Communities Source: Brown and Lowe, 1980
Ecoregions Source: Olson and others, 2001

mountains and in the Prescott AMA in the Bradshaw Mountains. These forests commonly occur between about 7,200 to 8,700 feet. Above 8,000 feet, in areas that receive from 25 to 30 inches of annual rainfall, the forest contains a mix of conifers that may include Douglas and White fir, Limber Pine, Blue Spruce, and White Pine, with Ponderosa Pine on warmer slopes. Aspen and Gambel Oak are prominent in these forests following disturbances. Below 8,000 feet, in areas that receive about 18 to 26 inches of annual precipitation, the mix of species gives way to almost pure stands of Ponderosa Pine. About half of the precipitation occurs during the growing season, which permits forests to exist on less than 25 inches of annual rainfall, making them some of the driest forests in North America (Brown, 1982). Bark beetle infestations have killed large areas of Ponderosa Pine in the Prescott AMA within and in the vicinity of the City of Prescott.

Higher elevations in the Prescott AMA contain areas of Great Plains grassland and Great Basin conifer woodland not found in the other four AMAs. Great Basin conifer (piñon-juniper) woodlands are found at elevations between about 5,000 and 7,500 feet that receive about 10 to 20 inches of annual precipitation. One of the most extensive vegetation types in the southwest, it is characterized by juniper and piñon pine trees. Plains and Great Plain grasslands, primarily composed of mixed or short-grass communities, are located in the center of the AMA at elevations above about 4,000 feet that receive between 11 and 18 inches of annual precipitation. (Brown, 1982).

Madrean evergreen woodlands are found at higher elevations in the Tucson and Santa Cruz AMAs. This community occurs in the Santa Catalina, Baboquivari and Santa Rita Mountains and in the mountain ranges along the U.S.-Mexico border where the mean annual precipitation exceeds 16 inches. The woodland consists of evergreen oaks, Alligator Bark and One-seed Junipers, and Mexican Pinyon Pine, and transitions to semidesert grassland at lower elevations. Cacti of the semidesert grassland may extend into the woodland. (Brown, 1982)

Semi-desert grasslands occur predominantly in the Santa Cruz and Tucson AMAs with smaller areas in the Pinal AMA. These grasslands occur at elevations between 3,500 and 5,000 feet that receive annual precipitation of 10 to 17 inches. The grasslands were originally covered with perennial bunch grasses with intervening areas of bare ground. Where heavily grazed, these grasses have shifted to annual species where summer rainfall is low, or to low growing sod grasses where rainfall is moderate to

Rose Canyon Lake, Tucson AMA. Madrean evergreen woodlands are found at higher elevations in the Tucson and Santa Cruz AMAs.

heavy. Shrubs, cacti and herbaceous plants are commonly found in the semi-desert grassland community. (Brown, 1982)

Southwest interior chaparral occupies mid-elevation foothill and mountain slopes in the Santa Rita Mountains in the Tucson AMA, the Superstition Mountains in the Phoenix AMA and the Bradshaw Mountains in the Phoenix and Prescott AMAs. Southwest interior chaparral occurs in areas between about 3,500 and 6,000 feet that receive 15 to 25 inches of annual precipitation (Brown, 1982). Typical shrubby species are mountain mahogany, shrub live oak, and manzanita. Chaparral plants are well adapted to drought conditions.

Two subdivisions of the Sonoran desertscrub region, the Lower Colorado River Valley subdivision and the Arizona Upland subdivision, dominate all but the Prescott AMA. The Lower Colorado River Valley subdivision is the hottest and driest of the two. There is intense competition for water, with plants widely spaced and more concentrated along drainage channels. Characteristic plants include creosote bush, bursage, saltbush, and mixed, more diverse vegetation along washes and other areas with more water. These areas may include blue palo verde, ironwood and jojoba. Also commonly found in the subdivision are several types of cholla and other cacti. (Brown, 1982)

The Arizona Upland subdivision borders the Lower Colorado River Valley subdivision and occurs primarily on slopes and sloping plains at elevations of 980 to over 3,000 feet where it merges with interior chaparral or semi-desert grassland. This subdivision receives more precipitation than the other Sonoran desertscrub subdivisions with average annual precipitation between 8 to 16 inches. Vegetation is scrubland or low woodland in appearance with blue and foothill palo verde, ironwood, mesquite and cat-claw acacia as common tree species. Cacti

Lower Colorado River Valley desertscrub in the Phoenix AMA.

are extremely important in this subdivision including saguaro, organ pipe, cholla and barrel cacti. (Brown, 1982)

The occurrence and composition of riparian vegetation has changed along many of the watercourses in the AMA Planning Area, including the Santa Cruz River in the Santa Cruz and Tucson AMAs, the Gila River in the Pinal and Phoenix AMAs, and the Salt and Verde rivers in the Phoenix AMA.

Along the Santa Cruz River riparian vegetation has increased in most reaches upstream from Tucson that have perennial flow from either base flow or sewage effluent, while it has been largely eliminated within Tucson. North of Nogales below the International WWTP the Santa Cruz River is line with Cottonwood and Willow. In the late 1990s and early 2000s, die-off of riparian trees occurred at Nogales and near Rio Rico respectively, and may be related in part to groundwater pumping. North of Tucson, effluent discharge supports a relatively newly established riparian ecosystem. North of Marana, the Santa Cruz River is ephemeral and there is little historic evidence of riparian vegetation with the exception of tamarisk. Tamarisk density may be increasing at some locations. (Webb and others, 2007)

Riparian vegetation along the Gila River has significantly declined between Florence in the Pinal AMA and its confluence with the Salt River in the Phoenix AMA due to surface water diversion and groundwater pumpage. This reach historically supported lush, woody riparian vegetation, but now mostly tamarisk and mesquite are found. However, cottonwood has returned along the Gila River near its confluence with the Salt River due to rising groundwater levels and changes in the flow regime of the Salt River. Current groundwater levels are high at the confluence and support a cottonwood-willow forest surrounded by "a sea of tamarisk" (Webb and others, 2007). Effluent discharge from the City of Phoenix and agricultural return flow have created perennial flow and also increased riparian vegetation below the confluence, where vegetation is primarily tamarisk and mesquite with small stands of cottonwood-willow (AZGF, 1993).

The reservoir system on the Salt River has largely stabilized the channel in the Phoenix AMA below the dams (except during large flood events) and allowed establishment of native and nonnative (primarily tamarisk) riparian vegetation. Below its confluence with the Verde River and Granite Reef Dam, most surface flow in the Salt River is diverted, and the riparian vegetation declines and disappears downstream to the effluent-dependent section near the confluence of the Salt and Gila rivers. Downstream of Bartlett Dam, native and nonnative riparian vegetation has increased along the Verde River due to relatively steady release of water. (Webb and others, 2007) Vegetation includes cottonwood-willow, tamarisk and mesquite (AZGF, 1993).

Concerns about receding riparian areas at some locations have resulted in restoration projects in the Phoenix and Tucson metropolitan areas, including the Rio Salado project in downtown Phoenix in the Phoenix AMA; and the San Xavier Riparian Restoration project on the Tohono O'odham Reservation, south of Tucson in the Tucson AMA.

Many of the natural biotic communities in the planning area are threatened by invasive species that interfere with ecosystem function through altering natural fire, nutrient flow and flooding regimes. The most problematic invasive species include buffel grass, fountain grass, natal grass, onionweed, Sahara mustard and tamarisk. Numerous agencies and interest groups throughout the planning area are cooperating to control the spread of these species where feasible, and to educate the public about the threat of these species to ecosystem function. (ASDM, 2008)

Although not necessarily caused or exacerbated by invasive species, several major wildfires occurred in the AMA Planning Area during the drought years between 2002-2006 (see Figure 8.0-12). The 2003 Aspen fire in the Tucson AMA burned 85,000 acres in the Santa Catalina Mountains, including much of the Town of Summerhaven. The 2005 Cave Creek Complex fire, of which a portion is located in the Phoenix AMA, burned 243,950 acres and is the second largest fire in Arizona to date. Both of these fires occurred in areas with perennial streams and have documented impacts on peak-flow events. Rainfall two months after the Aspen fire caused

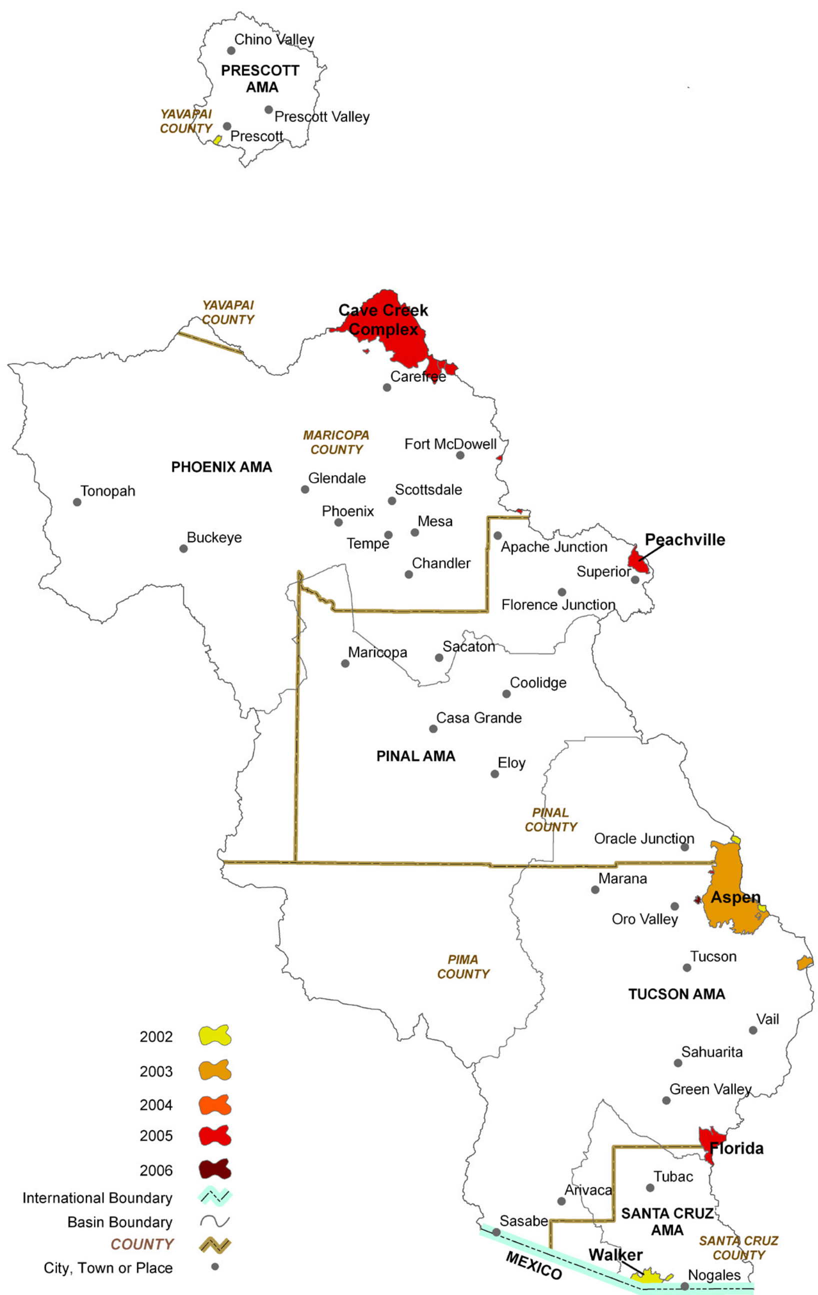
Rio Salado Project, Phoenix AMA. Photo courtesy of Maricopa County.

runoff to increase three-fold over pre-burn runoff in the Sabino Creek watershed. (Reed and Schaffner, 2007) Increased peak flows can degrade stream channels and make them unstable, increase sediment production, and cause flood damage (Neary and others, 2003).

Arizona Water Protection Fund Programs

The objective of the Arizona Water Protection Fund (AWPF) program is to provide grants for the protection and restoration of Arizona's rivers and streams and associated riparian habitats. Thirty-nine restoration projects in the AMA Planning Area had been funded by the AWPF through FY 2008. Six projects were funded in the Phoenix AMA for wetland construction, exotic species control, revegetation and general research. One habitat protection project was funded in the Pinal AMA. Seven grants in the Prescott AMA funded feasibility studies, general research and stream restoration. In the Tucson AMA nineteen projects, including general research, habitat restoration and exotic species control, were funded. Finally, six research, revegetation and habitat protection projects were funded in the Santa Cruz AMA. A list of AWPF projects and project types funded in the AMA Planning Area through 2008 is found in Appendix A. A description of the program, a complete listing of all projects funded, and a reference map are found in Volume 1.

Figure 8.0-12 Location of Major Wildfires in the AMA Planning Area 2002-2006 (USFS 2007)



Instream Flow Claims

An instream flow water right is a non-diversionary appropriation of surface water for recreation and wildlife use. Fifteen applications for instream flow claims have been filed in the AMA Planning Area. The applications are listed in Table 8.0-1 and locations are shown on Figure 8.0-13. Applications have been filed in three of the five AMAs, including Phoenix, Tucson and Santa Cruz; and seven certificates have been issued, six in the Phoenix AMA and one in the Tucson AMA. Certificates have been issued for claims on Arnett Creek, Camp Creek, Cave Creek, Cienega Creek, Hassayampa River, Seven Springs Wash and Sycamore Creek. Applications are pending for reaches of Cave Creek, Queen Creek Wash, Rincon Creek, Sabino Creek and Sonoita Creek.

Threatened and Endangered Species

Several listed threatened and endangered species may be present in the AMA Planning Area. Those listed by the U.S. Fish and Wildlife Service (USFWS) as of January 2008 are shown in Table 8.0-2.[2] Presence of a listed species may be a critical consideration in water resource management and supply development in a particular area. The USFWS should be contacted for details regarding the Endangered Species Act (ESA), designated critical habitat, and current listings.

As shown on Table 8.0-2 the number and type of endangered or threatened species vary by AMA, with only one in the Prescott AMA and 13 in the Tucson AMA. Habitat encroachment by development and growth in the Tucson AMA, primarily in Pima County, required Pima County

Sabino Creek, Tucson AMA. Three instream flow claims have been filed on this stream in the Tucson AMA.

Table 8.0-1 Instream flow claims in the AMA Planning Area as of 12/2008

Map Key	Stream	Applicant	Application No.	Permit	Certificate No.	Filing Date
1	Arnett Creek	Tonto National Forest	33-96235.0	96235	96235	10/20/1992
2	Camp Creek	Tonto National Forest	33-96693.0	96693	96693	7/5/2001
3	Cave Creek	Tonto National Forest	33-96302.0	96302	96302	9/27/1993
4	Cave Creek	Desert Foothills Land Trust	33-96255.0	Pending	Pending	3/25/1993
5	Cienega Creek	Pima County	33-89090.0	89090	89090	8/31/1983
6	Hassayampa River	Nature Conservancy	33-92304.0	92304	92304	1/20/1987
7	Queen Creek	Boyce Thompson Arboretum	33-92298.0	Pending	Pending	1/20/1987
8	Rincon Creek	Saguaro National Park	33-96733.0	Pending	Pending	12/10/2002
9	Sabino Creek	Sierra Club, et al	33-93232.0	Pending	Pending	7/28/1987
10	Sabino Creek	Hidden Valley HOA	33-96551.0	Pending	Pending	5/5/1997
11	Sabino Creek	Joeseph and Lynette Marco	33-87168.1	Pending	Pending	4/17/2001
12	Seven Springs Wash	Tonto National Forest	33-96303.0	96303	96303	9/27/1993
13	Sonoita Creek	AZ State Parks Board	33-96709.0	Pending	Pending	2/14/2002
14	Sonoita Creek	AZ State Land Department	33-93287.0	Pending	Pending	8/7/1987
15	Sycamore Creek	Tonto National Forest	33-96509.0	96509	96509	5/15/1996

[2] An "endangered species" is defined by the USFWS as "an animal or plant species in danger of extinction throughout all or a significant portion of its range," while a "threatened species" is "an animal or plant species likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

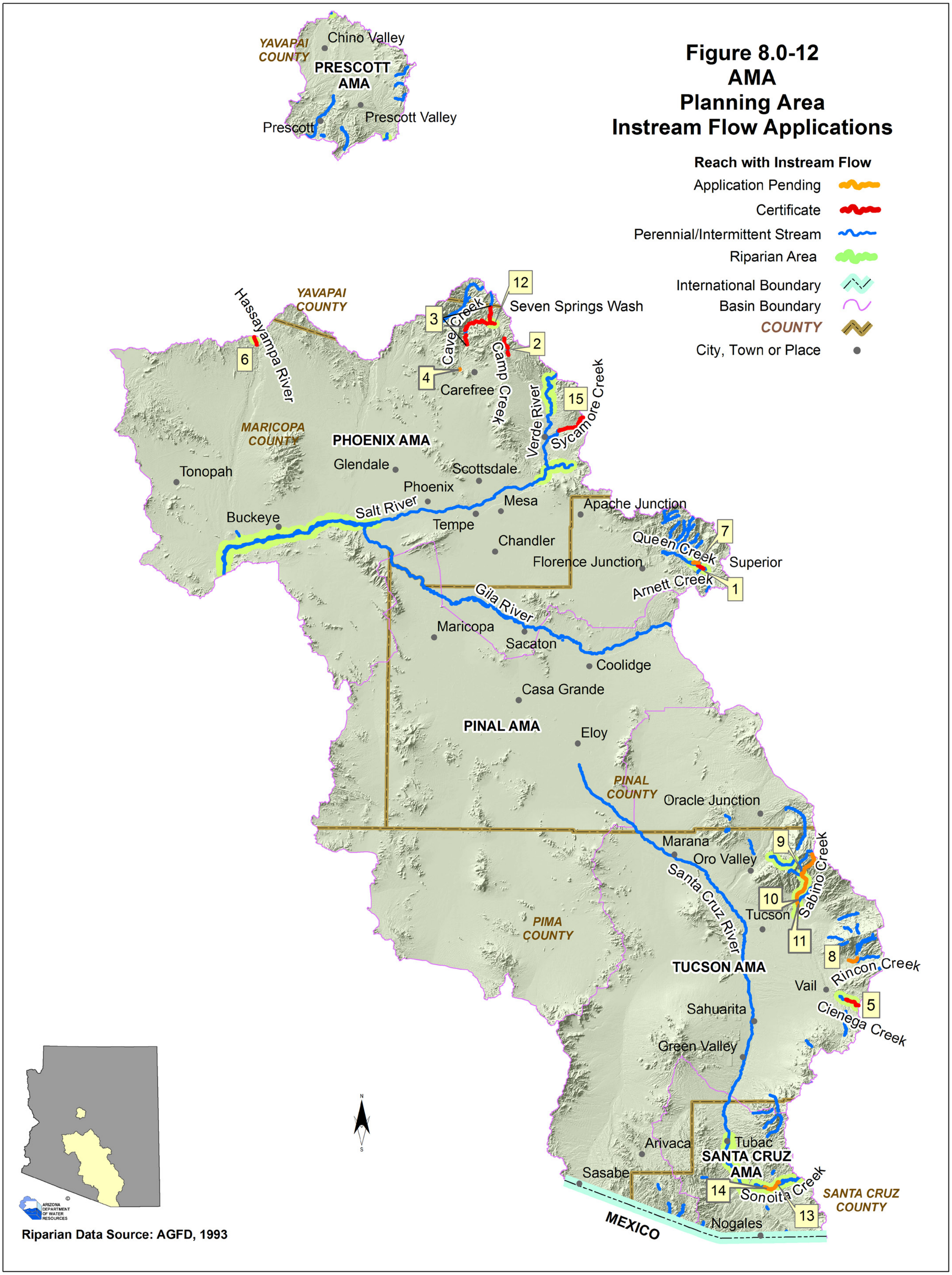


Figure 8.0-12
AMA
Planning Area
Instream Flow Applications
Reach with Instream Flow
Application Pending
Certificate
Perennial/Intermittent Stream
Riparian Area
International Boundary
Basin Boundary
COUNTY
City, Town or Place
YAVAPAI COUNTY
Chino Valley
PRESCOTT AMA
Prescott
Prescott Valley
YAVAPAI COUNTY
Hassayampa River
6
3
Cave Creek
12
Seven Springs Wash
2
Camp Creek
4
Carefree
Verde River
15
Sycamore Creek
MARICOPA COUNTY
PHOENIX AMA
Tonopah
Glendale
Scottsdale
Phoenix
Salt River
Mesa
Buckeye
Tempe
Apache Junction
Chandler
Queen Creek
7
Superior
Florence Junction
Arnett Creek
1
Gila River
Maricopa
Sacaton
Coolidge
Casa Grande
PINAL AMA
Eloy
PINAL COUNTY
Oracle Junction
Marana
9
Oro Valley
Sabino Creek
Santa Cruz River
10
Tucson
11
PIMA COUNTY
8
Rincon Creek
TUCSON AMA
Vail
5
Cienega Creek
Sahuarita
Green Valley
Arivaca
Tubac
SANTA CRUZ AMA
Sasabe
14
Sonoita Creek
13
SANTA CRUZ COUNTY
Nogales
MEXICO
N
S
ARIZONA DEPARTMENT OF WATER RESOURCES
Riparian Data Source: AGFD, 1993

Table 8.0-2 Listed threatened and endangered species in the AMA Planning Area

Common Name	AMA	Threatened	Endangered	Elevation/Habitat
Arizona Agave	PHX		X	3,000 ft./Steep, rocky granite slopes, or level hilltops, near chaparral; New River and Sierra Ancha Mountains.
Arizona Cliff Rose	PRE		X	<4,000 ft./White soils of Tertiary limestone lakebed deposits.
Chiricahua Leopard Frog	TUC, SAN	X		3,300-8,900 ft./Streams, rivers, backwaters, ponds stock tanks.
Desert Pupfish	TUC, PHX		X	<5,000 ft./Shallow springs, small streams and marshes. Tolerates saline and warm water.
Gila Topminnow	TUC, PHX		X	<4,500 ft./Small streams, springs, cienegas and vegetated shallows.
Huachuca Water-umbel	TUC		X	2,000 - 6,000 ft./Cienegas or marshy wetlands within Sonoran desertscrub, grassland or oak woodland, and conifer forest.
Jaguar	TUC		X	Approx > 5,000 ft./Lowland wet habitats and oak-pine woodland.
Kearny's Blue Star	TUC		X	3,685 - 4,500 ft./Canyon bottoms and sides in oak woodlands.
Lesser Long-Nosed Bat	SAN, TUC, PHX		X	1,190 - 7,320 ft./Desert grassland and shrubland up to oak transition.
Masked Bobwhite Quail	TUC		X	3,090 - 3,720 ft. /Broad valley desert grassland.
Mexican Spotted Owl	TUC, SAN	X		4,100-9,000 ft./Canyons, dense forests with multi-layered foliage structure.
Nichol's Turk's Head Cactus	PIN, TUC		X	2,400-4,100 ft./Sonoran desertscrub.
Ocelot	TUC, SAN		X	<4,000 ft./Subtropical thorn forest, thorn scrub and dense brushy thickets, often in riparian bottomland.
Pima Pineapple Cactus	TUC, SAN		X	2,300 - 5,000 ft./Ridges in semidesert grassland and alluvial fans in Sonoran desertscrub.
Razorback Sucker	PHX		X	<6,000 ft./Riverine and lacustrine areas, not in fast moving water.
Sonora Chub	TUC	X		<1,000 - 4,000 ft./Large, deep and most permanent pools in Sycamore Creek.
Southwestern Willow Flycatcher	PHX, SAN		X	<8,500 ft./Cottonwood-willow and tamarisk along rivers and streams.
Yuma Clapper Rail	PHX, PIN		X	<4,500 ft./Fresh water and brackish marshes.

Source: AZGF 2008, USFWS 2007

to develop a Multiple-Species Conservation Plan (MSCP). No such plans affect the other AMAs.

The Pima County MSCP was created to comply with the "take" provisions of the ESA.[3] Incidental take of a listed species, as the result of carrying out an otherwise lawful activity, is not allowed without a permit from the USFWS.[4] The final Pima County MSCP was released in December 2009 and was submitted to the USFWS for a 30-year Section 10 permit. The permit will provide mitigation to impacts on 49 species and approximately 36,000 acres. For the 36,000 impacted acres, Pima County proposes to acquire and protect about 125,000 acres of land by the end of the permit period. By 2009, the county had acquired over 71,000 acres of fee lands and was managing over 130,000 acres of State Trust Lands. (Pima County, 2009a)

The Pima County MSCP is part of a larger planning effort known as the Sonoran Desert Conservation Plan (SDCP), which covers 5.9 million acres in Pima County and is focused on six elements: habitat, corridors, cultural resources, mountain parks, ranch conservation and riparian protection. The SDCP planning process began in 1998 as a way to create a science-based conservation plan, update the county's comprehensive land use plan, and comply with the ESA. The plan directs growth to areas with the least natural, historic, and cultural resource values as well as sets aside sensitive habitat through land acquisitions. (Pima County, 2009b)

National Parks, Monuments, Wildlife Refuges and Wilderness Areas

The AMA Planning Area contains 11 wilderness areas administered by the Bureau of Land Management (BLM), five by the United States Forest Service (USFS) and one administered by the National Park Service. The Planning Area also includes one National Wildlife Refuge (NWR), one National Park and four National Monuments (Figure 8.0-14). The national park and one of the national monuments also contain wilderness areas. In total there are over 823,000 acres of protected federal lands in the planning area, accounting for approximately 9% of the land area. The Tucson AMA contains the largest amount of protected areas with almost 372,000 acres.

Southwestern willow flycatcher, one of the 49 species included in the Pima County MSCP. Photo courtesy of USFWS.

Nine wilderness areas are entirely within the planning area as well as parts of eight others. Wilderness Areas are designated under the 1964 Wilderness Act to preserve and protect the designated area in its natural condition. Designated wilderness areas, their size, AMA location and a brief description are listed in Table 8.0-3.

The largest protected area in the planning area consists of approximately 259,000 acres of the 496,000-acre Sonoran Desert National Monument. The monument, located in the

[3] As defined by the ESA, to take means to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in other conduct" (16 U.S.C. section 1531 [18]).
[4] "Incidental take" is defined by the ESA as a take that is "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity" (50 C.F.R. section 17.22 and 17.32)

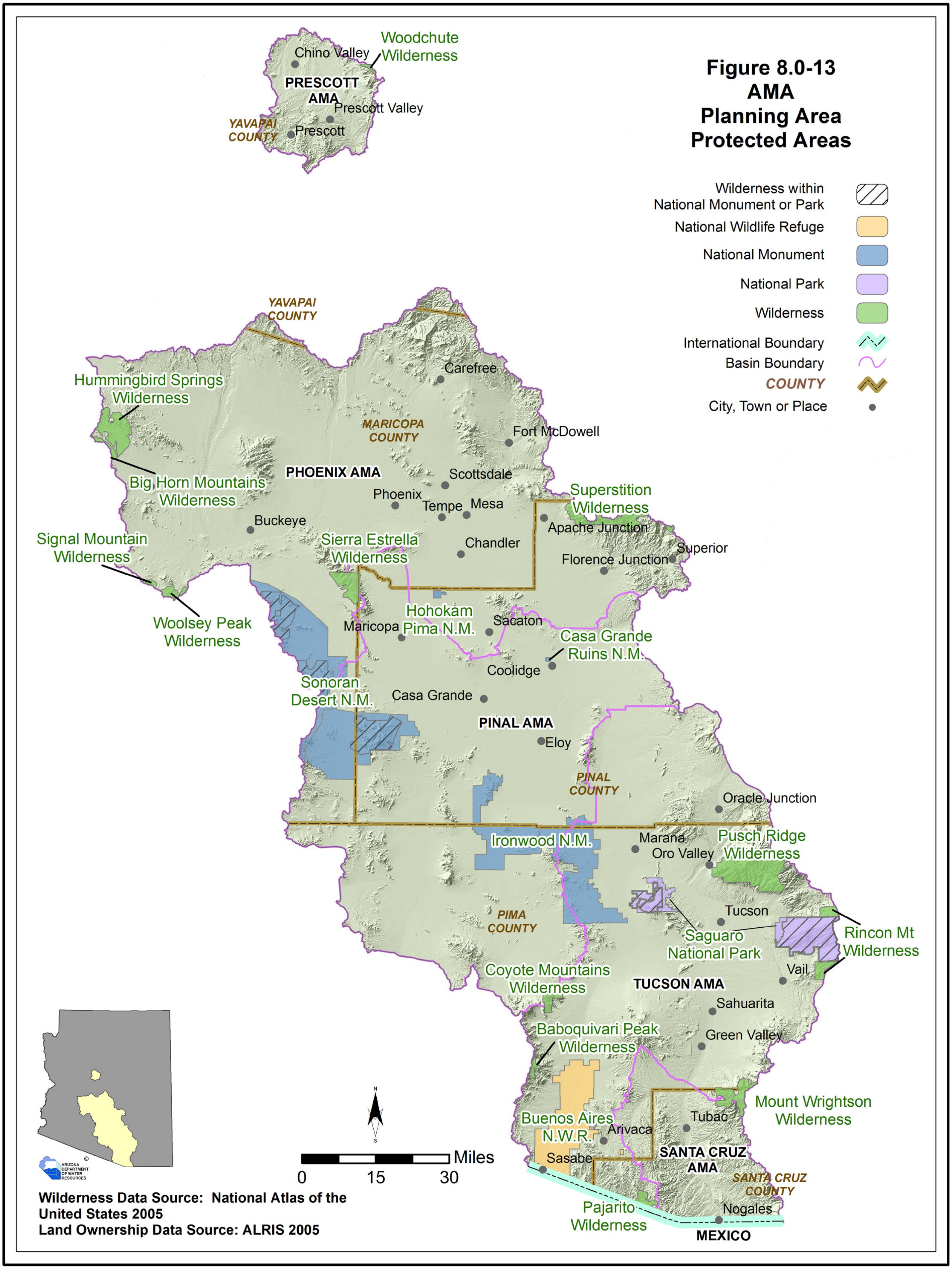


Figure 8.0-13
AMA
Planning Area
Protected Areas

Wilderness Data Source: National Atlas of the United States 2005
Land Ownership Data Source: ALRIS 2005

Phoenix and Pinal AMAs and extending into the Lower Colorado River Planning Area, was established by executive proclamation in 2001 and contains extensive areas of saguaro cactus forest and archeological and historic sites. Two wilderness areas, North and South Maricopa Mountains, are contained within the monument boundaries. (BLM, 2008)

The Ironwood Forest National Monument, located in the center of the planning area in the Tucson and Pinal AMAs, includes over 129,000 acres. An additional 60,000 acres of state trust land and private inholdings are contained within the boundary of the monument but do not have national monument status. Designated in 2000, several endangered and threatened species are found in the monument as well as more than 200 sites dating from the Hohokam period (600 A.D. to 1440 A.D). (BLM, 2008)

Other national monuments in the AMA Planning Area include the Hohokam Pima National Monument in the Phoenix AMA, and the Casa Grande Ruins National Monument in the Pinal AMA. Both national monuments protect ancient Hohokam ruins. The village at the Hohokam Pima National Monument, located on the Gila River Indian Community reservation, was re-covered with earth in the 1960s and is not open to the public (NPS, 2008a). Casa Grande Ruins National Monument was created as the nation's first archeological reserve in 1892 and was declared a national monument in 1918. The monument preserves the ancient farming community and the "Great House" (NPS, 2008b). Tumacácori National Historical Park, located in the Santa Cruz AMA, protects three Spanish colonial mission ruins: Tumacácori, Guevavi, and Calabazas, located at three separate sites. Mission San Jose de Tumácacori was established in 1691 and is the main site, located on 310 acres at the town of Tumacácori south of Tubac.

Cacti in the Sonoran Desert National Monument, Pinal AMA.

The only national park in the planning area, Saguaro National Park, preserves over 83,000 acres in two distinct districts, the Rincon Mountain District and the Tucson Mountain District, located on the east and west sides of Tucson in the Tucson AMA. Saguaro National Park may contain ten species of threatened, endangered, or sensitive plants. Seventy-five percent of the park is designated as wilderness. (NPS, 2008c)

The Buenos Aires National Wildlife Refuge, located in the Tucson AMA, contains over 118,000 acres of habitat for threatened and endangered plants and animals including reintroduced populations of masked bobwhite quail and pronghorn antelope. Concerns about public safety have caused managers to close approximately 3,500 acres of the refuge to the public along the U.S./Mexico border. (USFWS, 2008)

8.0.5 Population

Arizona was the second fastest growing state from 2000 to 2006, with a 20.2% statewide population increase (4% annually). However, from 2006 to 2009 the statewide annual growth rate slowed to about 2% due to the national recession. Population in the planning area increased by 25% between 2000 and 2006 and

Table 8.0-3 Wilderness areas in the AMA Planning Area

Wilderness Area	Acres in the Planning Area	AMA	Description
Baboquivari Peak	2,738	Tucson	Includes Baboquivari Peak; oak, walnut, and pinyon at higher elevations and saguaro, paloverde, and chaparral at lower elevations.
Big Horn Mountains	3,082 (Partial)	Phoenix	Desert plain escarpments, hills, fissures, chimneys and narrow canyons.
Coyote Mountains	4,483	Tucson	Rugged peaks, rounded bluffs, sheer cliff faces and large open canyons with paloverde, saguaro, chaparral, and oak woodlands.
	1,309	Pinal	
Hummingbird Springs	24,453 (Partial)	Phoenix	Includes Sugarloaf Mountain which rises steeply from the Tonopah Desert plains.
Mount Wrightson	10,322	Tucson	Deep canyons, ridges and peaks surrounded by semiarid hills and sloping grasslands. Ponderosa pine, douglas-fir and montane Mexican plants that grow nowhere else north of the border.
	5,542	Santa Cruz	
North Maricopa Mountains*	24,353 (Partial)	Phoenix	Low-elevation Sonoran Desert mountain range and extensive surrounding desert plains.
Pajarito	7,553	Tucson	Includes Sycamore Canyon and Sycamore Creek with rolling hills and oak woodlands.
Pusch Ridge	56,769	Tucson	Pine, fir, aspen, and maple forests; elevation ranging from 2,800 feet to over 9,100 feet.
Rincon Mountain	11,127	Tucson	Desert grasses at lower elevations and steep hillsides of pinyon, juniper, and oak above deep canyons at higher elevations.
Saguaro*	68,399	Tucson	Vegetation varies with elevation and includes desert scrub, desert grassland, oak woodland, pine-oak woodland, pine forest and mixed conifer forest.
Sierra Estrella	11,715	Phoenix	Steep slopes and rocky canyons with diverse plant communities.
	3,041	Pinal	
Signal Mountain	1,830 (Partial)	Phoenix	Sharp volcanic peaks, steep-walled canyons, arroyos, craggy ridges and outwash plains.
South Maricopa Mountains*	21,331 (Partial)	Phoenix	Low-elevation Sonoran Desert mountain range and extensive surrounding desert plains.
Superstition	22,179 (Partial)	Phoenix	Rugged mountains, rock formations, large vegetation range, prehistoric dwellings, riparian habitat.
Table Top	34,715	Pinal	Includes Table Top Mountain with a 40-acre summit of desert grassland, narrow ridges, wide canyons, lava flows, and washes lined with mesquite and ironwood.
Woodchute	1,411 (Partial)	Prescott	Views, ponderosa pine, pinyon and juniper.
Woolsey Peak	4,913 (Partial)	Phoenix	Sloping lava flows, basalt mesas, rugged peaks and ridges.
Total	**321,539**		

Source: BLM 2008, USFS 2008, NPS 2008
* Wilderness areas are within the boundaries of a National Monument or National Park.

Table 8.0-4 2000 Census population of AMAs and Indian reservations

AMA/Reservation	2000 Census Population
Phoenix AMA	3,056,706
Gila River	*7,855*
Fort McDowell Yavapai	*929*
Salt River Pima-Maricopa	*6,243*
Tucson AMA	811,307
Pascua Yaqui	*3,315*
Tohono O'odham	*2,034*
Pinal AMA	93,580
Ak-Chin	*752*
Gila River	*3,435*
Tohono O'odham	*3,016*
Prescott AMA	85,742
Yavapai-Prescott	*183*
Santa Cruz AMA	35,579
Total	***4,082,914***

by 38% between 1990 and 2000. Census data for 2000 show a population of approximately 4.1 million residents and projections by the Arizona Department of Commerce and Councils of Government suggest that the planning area population will more than double by 2030 to over 9.1 million. Historic, current and projected AMA populations are shown in the cultural water demand tables for each AMA in Sections 8.1 - 8.5.

The Phoenix AMA is the most populous AMA with approximately 75% of the total planning area population in 2000. The Tucson AMA has the second largest percentage of population in the planning area with 20% in 2000. The 2000 Census populations for each AMA and Indian reservations are shown in Table 8.0-4.

Almost all AMAs experienced growth rates in excess of the state average from 2000 to 2006. During this time-period Prescott AMA population increased by 32%, Phoenix AMA population increased by 22% and the Pinal AMA population grew by 61%. The Tucson AMA population increased at a lower rate of 17% during this period. In the Santa Cruz AMA, population increased by 34%, mostly in unincorporated areas where the combined population exceeded that of the City of Nogales for the first time in 2006.

Listed in Table 8.0-5 are communities in the planning area with 2000 Census populations greater than 1,000 persons and growth rates for two time-periods: 1990-2000 and 2000-2006. As listed, there were a number of rapidly growing communities in the planning area. The community of Maricopa in the Pinal AMA grew 1,643% between 2000 and 2006. The community of Marana in the Tucson AMA grew 520% between the years 1990 and 2000 and an additional 125% from 2000 to 2006. Many other communities in the planning area grew by several hundred percent during one or both time periods. Gilbert, Surprise and Goodyear, all in the Phoenix AMA, grew by more than 200% between 1990 and 2000. The Town of Prescott Valley in the Prescott AMA grew by 164% in the same time-period.

Population Growth and Water Use

A variety of regulatory programs and local initiatives address water use in conjunction with growth within the AMAs. Three examples at the state level that affect multiple AMAs include the Assured Water Supply Program, Growing Smarter legislation, and Community Water System Planning. Locally, communities and counties may have programs or requirements that address growth and water use through impact fees, zoning, planning guidelines and ordinances. Ordinances may include water conservation features in new construction and landscape restrictions. Information on these ordinances may be obtained by contacting local planning and zoning departments.

Table 8.0-5 Communities in AMAs with a census population greater than 1,000 (listed by 2000 population)

Communities	AMA	1990 Census Pop.	2000 Census Pop.	Percent Change 1990-2000	2006 Pop. Estimate	Percent Change 2000-2006	Projected 2030 Pop.
Phoenix	Phoenix	983,392	1,321,045	34%	1,505,265	14%	2,201,843
Tucson	Tucson	405,371	486,699	20%	534,685	10%	671,225
Mesa	Phoenix	288,104	396,375	38%	451,360	14%	584,866
Glendale	Phoenix	147,864	218,812	48%	243,540	11%	322,062
Scottsdale	Phoenix	130,075	202,705	56%	237,120	17%	286,020
Chandler	Phoenix	89,862	176,581	97%	235,450	33%	283,792
Tempe	Phoenix	141,993	158,625	12%	165,890	5%	197,970
Gilbert	Phoenix	29,122	109,697	277%	185,030	69%	300,295
Peoria	Phoenix	50,675	108,364	114%	145,135	34%	306,070
Avondale	Phoenix	16,169	35,883	122%	72,210	101%	123,265
Prescott	Prescott	26,592	33,938	28%	42,085	24%	68,099
Apache Junction	Phoenix	18,092	31,814	76%	35,685	12%	113,928
Surprise	Phoenix	7,122	30,848	333%	98,140	218%	401,458
Oro Valley	Tucson	6,670	29,700	345%	40,215	35%	60,344
Casa Grande	Pinal	19,076	25,224	32%	38,455	52%	114,613
Prescott Valley	Prescott	8,904	23,535	164%	35,740	52%	73,737
Nogales	Santa Cruz	19,489	20,878	7%	21,765	4%	26,356
Fountain Hills	Phoenix	10,030	20,235	102%	24,990	23%	33,810
Goodyear	Phoenix	6,258	18,911	202%	49,720	163%	299,397
Florence	Pinal	7,321	14,466	98%	21,295	47%	63,791
Paradise Valley	Phoenix	11,773	13,664	16%	14,000	2%	15,352
Marana	Tucson	2,187	13,556	520%	30,435	125%	89,761
Eloy	Pinal	7,211	10,375	44%	11,535	11%	40,571
Buckeye	Phoenix	4,436	8,497	92%	31,745	274%	419,146
Chino Valley	Prescott	4,837	7,835	62%	12,700	62%	30,286
Coolidge	Pinal	6,934	7,786	12%	9,950	28%	37,609
El Mirage	Phoenix	5,001	7,609	52%	32,605	329%	38,717
South Tucson	Tucson	5,171	5,490	6%	5,805	6%	5,675
Guadalupe	Phoenix	5,458	5,228	-4%	5,570	7%	5,983
Tolleson	Phoenix	4,434	4,974	12%	6,520	31%	10,193
Queen Creek	Phoenix	2,667	4,316	62%	18,690	333%	72,947
Litchfield Park	Phoenix	3,303	3,810	15%	4,890	28%	10,510
Cave Creek	Phoenix	2,925	3,728	27%	4,865	30%	9,656
Superior	Phoenix	3,468	3,254	-6%	3,325	2%	4,249
Sahuarita	Tucson	1,629	3,242	99%	18,035	456%	84,714
Youngtown	Phoenix	2,542	3,010	18%	6,320	110%	7,359
Carefree	Phoenix	1,657	2,927	77%	3,785	29%	6,097
Maricopa	Pinal	-	1,482	N/A	25,830	1643%	90,521
Dewey - Humboldt	Prescott	-	-	N/A	4,230	N/A	6,082
Total > 1,000		2,487,814	3,575,118	44%	4,434,610	24%	7,518,369
Other		466,829	507,796	9%	667,592	31%	1,646,811
Total		**2,954,643**	**4,082,914**	38%	**5,102,202**	25%	**9,165,180**

Source: DES 2005, US Census Bureau 2006

Assured Water Supply Program

The Department's Assured Water Supply (AWS) program, created as part of the 1980 Groundwater Management Code, is designed to preserve groundwater resources and to promote long-term water supply planning in the AMAs. This is accomplished through regulations that limit the use of groundwater by new subdivisions that require a "Certificate" of AWS and by "Designated" Water Providers that have demonstrated an AWS for their entire service area.

Every developer proposing to build a new subdivision is required to demonstrate an AWS that will be physically, legally, and continuously available for the next 100 years before the developer can record plats or sell parcels. The Arizona Department of Real Estate will not issue a Public Report, which allows the developer to sell lots, without a demonstration of an AWS.

In 1995, the Department adopted AWS Rules to implement the AWS statutes. An important component of the AWS Rules is the requirement to demonstrate that renewable water supplies will be used rather than mined groundwater. This requirement did not apply to the Prescott AMA until 1999 when the AMA was declared to no longer be in a safe-yield condition.

The Santa Cruz AMA was established July 1, 1994 near the end of the period when the AWS Rules were being drafted. Consequently, it was not possible to include rule provisions that applied to the management goal of the Santa Cruz AMA at that time since goal criteria had not been developed. Although the general provisions apply, the Department is still developing specific AWS Rules for the Santa Cruz AMA where relatively limited groundwater storage capacity directly influences the availability of water supplies and where the hydrologic situation may affect the course of population growth in this AMA.

Following adoption of the AWS Rules, rapid population growth in the Pinal AMA led to modification of the AMA's AWS Rules in order to reduce the over allocation of unreplenished groundwater supplies. This rule change, which took effect on October 1, 2007, substantially reduced the volume of groundwater that can be used without replenishment by new developments, from close to 100% under the old rules to as little as 10% under the new rules.

Under the AWS Rules, developers can prove a 100-year water supply by satisfying the requirements to obtain a Certificate of AWS or by a written commitment of service from a provider with a Designation of AWS. The AWS Rules list in detail what an applicant for a Certificate of AWS or a Designation of AWS must demonstrate. In addition to securing a water supply that is physically, legally, and continuously available for the next 100 years, to obtain a Certificate the developer must prove that the supply is of sufficient quality and is consistent with the AMA management goal and management plan. Finally, the developer must demonstrate the financial capability to construct any necessary water storage, treatment, and delivery systems. Water providers seeking a Designation of AWS must demonstrate a 100-year water supply for their entire service area for both current and committed demand, as well as projected demand. A list of Designated water providers in the planning area can be found in Table 8.0-6.

Before the AWS program was created in 1980, the Adequate Water Supply program was effective statewide. This program was created in 1973 as a consumer protection program and is still in effect outside the AMAs. If a developer can successfully demonstrate that water of sufficient quality will be physically, legally and continuously available for the next hundred years, the Department will issue a Water Adequacy Report with a determination that the water supply is adequate. If the Department determines that there is an inadequate water supply, the developer can still sell the lots in most areas but must disclose this fact to potential buyers.[5] Because the Adequate Water Supply program was in effect in the planning area prior to 1980, some Water Adequacy Reports issued for older developments in the AMAs exist.

Prior to obtaining a Certificate of AWS, developers also have the option to obtain an Analysis of AWS (Analysis). An Analysis is generally used to prove that water will be physically available for master planned communities but may be used to demonstrate other criteria required for a Certificate of AWS. An applicant for an Analysis must demonstrate that one or

Table 8.0-6 Designated water providers in the AMA Planning Area as of 12/2008

Water Provider	AMA	County	Designation No.	Date Application Received	Date Designation Issued	Projected Annual or Estimated Demand (af/yr)	Year of Projected Annual or Estimated Demand
Apache Junction Water Facilities Dist.	Phoenix	Pinal	26-400989.0000	06/09/03	02/01/05	2,769	2011
Baca Float Water Company, Inc.	Santa Cruz	Santa Cruz	26-400800.0000	08/13/02	11/17/04	333	2011
Chaparral City Water Co	Phoenix	Maricopa	26-401242.0000	02/11/04	04/07/04	8,000	2014
City of Avondale	Phoenix	Maricopa	86-002003.0001	06/11/07	02/04/08	21,186	2010
City of Casa Grande	Pinal	Pinal	26-400728.0000	05/06/02	07/21/03	4,113	2013
City of Chandler	Phoenix	Maricopa	26-002009.0000	02/15/95	12/31/97	63,615	2010
City of El Mirage	Phoenix	Maricopa	26-400054.0000	03/22/99	11/02/99	7,695	2010
City of Eloy	Pinal	Pinal	26-402148.0000	05/10/06	02/20/07	49,159	2015
City of Glendale	Phoenix	Maricopa	26-002018.0000	03/15/95	09/25/97	57,074	2010
City of Goodyear	Phoenix	Maricopa	26-402090.0000	04/07/06	01/27/08	15,940	2010
City of Mesa	Phoenix	Maricopa	26-002023.0000	05/28/96	09/19/97	105,061	2010
City of Nogales	Santa Cruz	Santa Cruz	26-401358.0000	05/14/04	04/19/05	6,322	2009
City of Peoria	Phoenix	Maricopa	26-400679.0000	01/18/02	10/17/02	39,325	2010
City of Phoenix	Phoenix	Maricopa	26-002030.0000	10/11/96	12/31/97	356,521	2010
City of Prescott	Prescott	Yavapai	26-401501.0000	09/02/04	09/16/05	14,350	2014
City of Scottsdale	Phoenix	Maricopa	26-400619.0000	10/11/01	04/25/02	105,986	2008
City of Surprise	Phoenix	Maricopa	26-300431.0000	11/11/97	09/07/99	20,334	2010
City of Tempe	Phoenix	Maricopa	26-002043.0000	03/27/97	12/31/97	70,462	2010
City of Tucson	Tucson	Pima	26-400957.0000	04/29/03	06/12/07	183,956	2015
Johnson Utilities Company - Phoenix AMA	Phoenix	Pinal	26-400665.0000	12/26/01	08/12/03	5,633	2011
Johnson Utilities Company - Pinal AMA	Pinal	Pinal	26-401382.0000	05/26/04	10/14/05	551	2007
Marana Municipal Water System	Tucson	Pima	26-402254.0000	07/31/06	05/07/07	7,580	2017
Metropolitan Domestic Water Imp. Dist. - West	Tucson	Pima	26-401922.0000	10/20/05	09/25/06	1,014	2016
Metropolitan Domestic Water Improvement District	Tucson	Pima	26-401062.0000	09/02/03	07/31/06	13,302	2016
Rancho Sahuarita Water Company	Tucson	Pima	26-401203.0000	01/06/04	12/01/04	2,578	2014
Santa Cruz Water Company	Pinal	Pinal	26-402008.0000	01/24/06	12/27/07	23,979	2013
Spanish Trail WC	Tucson	Pima	26-000170.0000	07/18/97	04/16/96	1,843	2005
Town of Florence	Pinal	Pinal	26-401284.0000	03/12/04	01/25/05	12,310	2014
Town of Gilbert	Phoenix	Maricopa	26-402208.0000	06/19/06	10/30/07	70,954	2010
Town of Oro Valley	Tucson	Pima	26-400765.0000	07/01/02	06/26/03	15,049	2013
Vail Water Company	Tucson	Pima	26-401752.0000	05/03/05	11/10/05	3,749	2015
Willow Springs Utilities Company	Tucson	Pinal	26-402225.0000	07/06/06	04/15/08	2,635	2017

more of the requirements for an AWS are met, but need not demonstrate that all have been met. If an Analysis is issued for groundwater, it reserves a specific volume of water for 10 years for the specific property that is the subject of the Analysis. However, an Analysis cannot be used to obtain a Public Report and must be followed by a complete demonstration of all the criteria to obtain a Certificate of AWS.

A summary of the planning area's AWS determinations through 2008, including AWS Certificates (27's), Analysis of AWS (28's), Water Adequacy Reports (53's) and AWS Designations (26's) can be found in Table 8.0-7. Detailed information on individual determinations are found in the AMA Assured Water Supply sections, 8.1.9 - 8.5.9. Up to date information on certificate and designation applications and issuances are found on the Department's website.

Growing Smarter

Four out of the five counties in the planning area have requirements under the Growing Smarter Plus Act of 2000 (GSP Act). The GSP Act requires that counties with a population greater than 125,000 (2000 Census) include planning for water resources in their Comprehensive Plans. Counties in the planning area that must meet this requirement are Maricopa, Pinal, Pima and Yavapai. Santa Cruz is the only county in the planning area with a population less than 125,000 residents.

The GSP Act also requires that 30 communities in the AMAs include a water resources element in their general plan. These communities are:

Phoenix AMA:
- Apache Junction
- Fountain Hills
- Peoria
- Avondale
- Gilbert
- Phoenix
- Buckeye
- Glendale
- Queen Creek
- Cave Creek
- Goodyear
- Scottsdale
- Chandler
- Mesa
- Surprise
- El Mirage
- Paradise Valley
- Tempe

Pinal AMA:
- Casa Grande
- Florence
- Eloy
- Maricopa

Prescott AMA:
- Chino Valley
- Prescott Valley
- Prescott

Santa Cruz AMA:
- Nogales

Tucson AMA:
- Marana
- Sahuarita
- Oro Valley
- Tucson

All communities have complied with the general plan requirement. Plans must consider water demand and water resource availability in conjunction with growth, land use and infrastructure. These plans may contain useful water resource information.

Table 8.0-7 Assured Water Supply determinations in the AMA Planning Area as of 06/2008

	AWS Certificates	Analyses of AWS	Water Adequacy Reports	AWS Designations
Phoenix AMA	1118	61	208	15
Pinal AMA	214	19	16	5
Prescott AMA	104	2	8	1
Santa Cruz AMA	34	6	32	2
Tucson AMA	230	16	90	9
Total	**1700**	**104**	**354**	**32**

Note: Lot count totals may over estimate actual platted lots due to database accounting, changes in file numbering methodology and subsequent development plan changes.

[5] Legislation adopted in 2007 allows counties, cities or towns to require a demonstration of adequate water supply before a final plat can be approved.

Community Water System Planning

Beginning in 2007, all community water systems in the state were required to submit annual water use reports and system water plans to the Department. The reports and plans are intended to reduce system vulnerability to drought, and to promote water resource planning to ensure that water providers are prepared to respond to water shortage conditions. Most community water systems located within the AMA Planning Area were already reporting their annual water use to the Department and have been regulated under the Department's mandatory municipal conservation program since the early 1980s. The other, "non-regulated" AMA community water systems must now also submit annual water use reports to the Department and all systems in the AMAs are now subject to the system water plan requirements. However, exemptions from some components of the plans may apply for large municipal providers, as well as providers with an AWS designation.

Local Drought Impact Groups (LDIGs) are county-level voluntary groups created to coordinate drought public awareness, provide impact assessment information to local and state leaders, and implement and initiate local drought mitigation and response actions. These groups are coordinated by local representatives of Arizona Cooperative Extension and County Emergency Management and supported by ADWR's Statewide Drought Program. By the end of 2009 LDIG groups had been formed in Yavapai, Pinal, Pima and Santa Cruz counties.

Local Initiatives

A number of local initiatives address water use and growth in the AMAs. Citizen-based advocacy groups, and government-sponsored advisory groups, provide input into the growth and water use decision-making process within the AMA Planning Area. These groups may include municipal and regional water users associations; watershed groups; county water advisory councils; non-profit conservation groups; water augmentation authorities; and county associations of government.

In the Tucson AMA, the Sonoran Desert Conservation Plan was initiated by Pima County in 1998 in response to conservation needs of rare species, and as an effort to balance growth and environmental concerns. The plan covers 59 million acres within Pima County. The SDCP was incorporated into Pima County's comprehensive land use plan in 2001 and addresses issues such as land use and water availability.

The Groundwater Code established a five-member Groundwater Users Advisory Council (GUAC) within each AMA (A.R.S. § 45-420). Members of the councils are appointed by the governor to represent the users of groundwater in the AMA, and on the basis of their knowledge, interest, and experience with problems relating to the development, use and conservation of water. The GUACs provide recommendations on groundwater management programs and policies to the AMA Director, and to the Director of the Department.

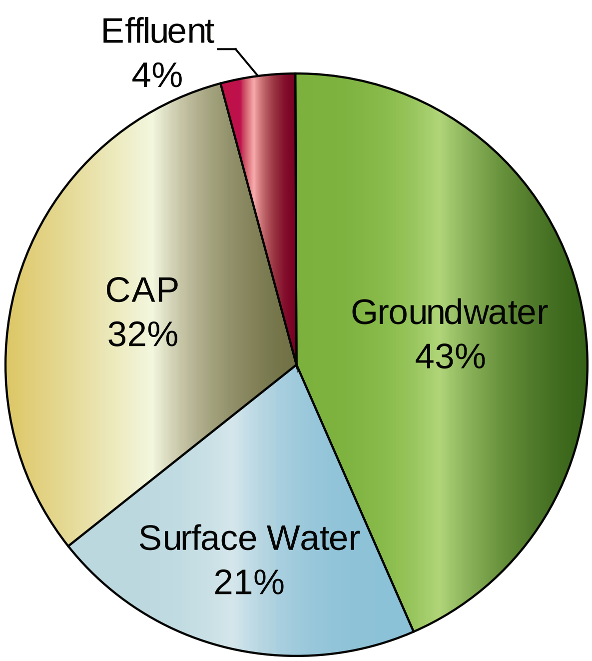
View of Scottsdale, Phoenix AMA. Scottsdale is one of 30 communities in the AMA Planning Area that have a water resource element in the general plan.

8.0.6 Water Supply

Water supplies in the AMA Planning Area include Central Arizona Project (CAP) water, surface water, groundwater and effluent. As shown in Figure 8.0-15, on average more than half of the annual water demand in the planning area from 2001-2005 was met with non-groundwater supplies. These non-groundwater or renewable supplies are primarily comprised of CAP water and surface water diverted from the Salt, Verde, Gila, Agua Fria or Santa Cruz rivers. Effluent is a smaller but growing non-groundwater source used in the planning area.

Non-groundwater supplies were the primary water supply in the Pinal and Phoenix AMAs during 2001-2005. In the Pinal AMA, 53% of the average annual water demand between 2001-2005 was met with a non-groundwater source and 47% of the demand was met with groundwater. The Phoenix AMA also relies heavily on non-groundwater sources; 64% of the average annual demand in 2001-2005 was met with non-groundwater sources and 36% of its demand was met with groundwater. (See Figure 8.0-20)

Figure 8.0-15 Average Annual Water Supply Utilized in the AMA Planning Area 2001-2005



During 2001-2005 the Prescott AMA used primarily groundwater supplies with approximately 19% of demand met by effluent and surface water. The Santa Cruz AMA uses a combination of groundwater and surface water from the younger alluvium that is withdrawn from wells and collectively considered groundwater. Between 2001 and 2005, the Tucson AMA used approximately 74% groundwater and 26% non-groundwater supplies to meet demands. However, the percentage of non-groundwater sources, primarily CAP, used in the Tucson AMA has increased rapidly since 2001 due to increased recharge and recovery capacity in the municipal sector.

Central Arizona Project Water

The primary non-groundwater supply in the planning area is CAP water. The CAP was constructed to annually deliver 1.5 maf of Arizona's allocation of Colorado River water to Maricopa, Pima and Pinal and counties through a series of canals and pumping stations (Figure 8.0-16). The delivery system is 336 miles long and lifts Colorado River water 2,400 feet to its terminus just south of the City of Tucson. Water is withdrawn at Lake Havasu at the Mark Wilmer Pumping Plant. It then crosses the Parker, Ranegras Plain and Harquahala basins in the Lower Colorado River Planning Area via the Hayden-Rhodes Aqueduct to the CAP service area in central and southern Arizona.

The CAP canal enters the planning area on the western side of the Phoenix AMA and runs toward the east and southeast across much of the AMA. A significant portion of CAP water is stored in Lake Pleasant behind New Waddell

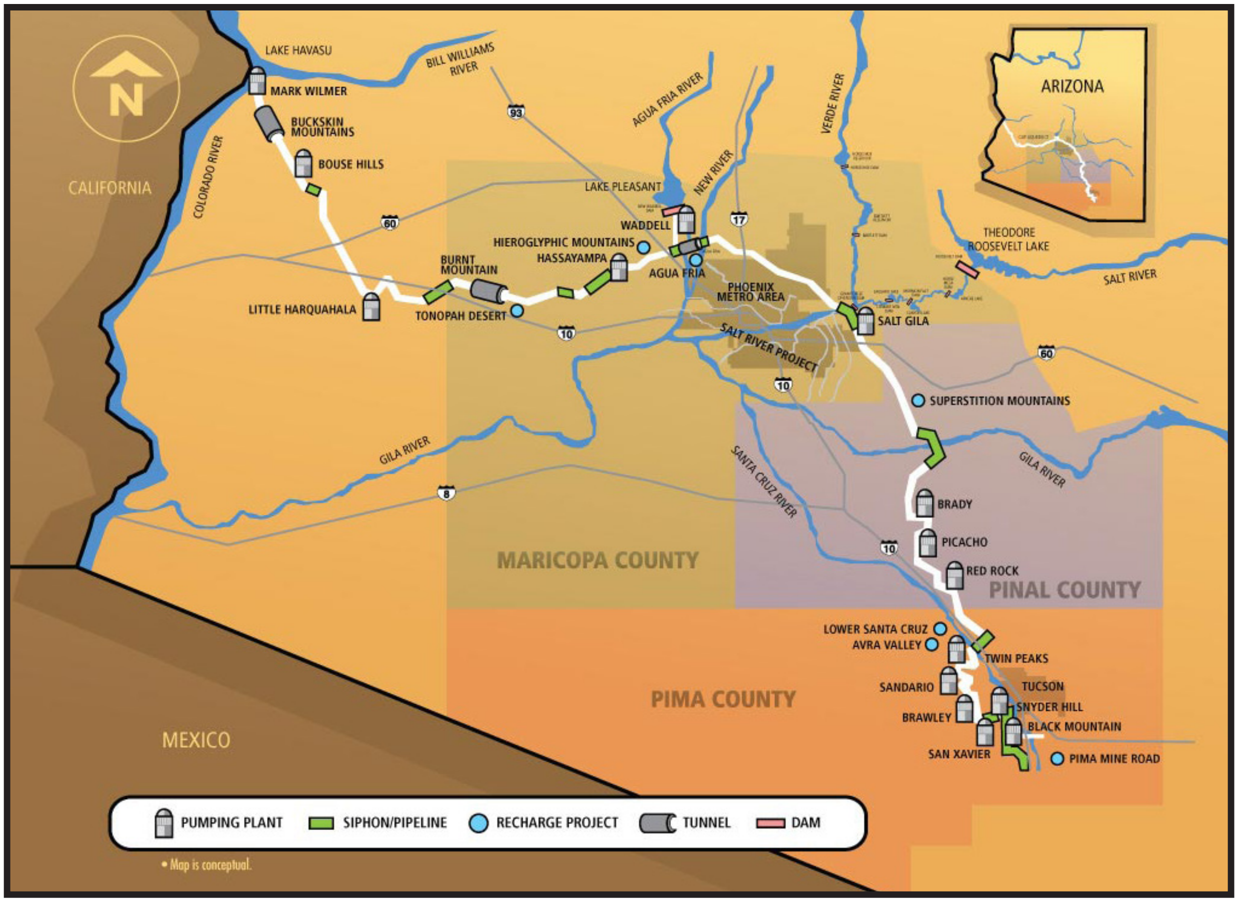
Dam, completed in 1992, at the northern edge of the Phoenix AMA. It then travels in a southerly direction and enters the Pinal AMA north of Florence, crosses the northeastern portion of the AMA and enters the Tucson AMA near Picacho Peak. The CAP canal terminates at Pima Mine Road in the Tucson AMA just south of the San Xavier District of the Tohono O'odham Nation. Turnouts from the CAP aqueduct connect it to municipal water treatment plants and irrigation district canals for distribution. CAP water is used both directly and indirectly through the Department's recharge program (described below) in the Phoenix, Pinal and Tucson AMAs. CAP water was first used in the planning area in 1985.

There are three main CAP contract categories: non-Indian municipal and industrial (M&I), non-Indian agricultural and Indian. Almost all non-Indian agricultural subcontracts have been declined or terminated and CAP water is used pursuant to the Department's recharge program. The status of CAP subcontracts as of October, 2009 is found in Appendix B. According to the status report, subcontract totals were:

M&I Subcontracts	620,678 acre-feet
Indian Contracts	555,806 acre-feet
Non-Indian Agricultural Subcontracts	9,026 acre-feet
Currently Uncontracted Water	155,787 acre-feet
Other Project Water Under Contract	73,703 acre-feet

To encourage the direct use of renewable water supplies, the recharge program restricts the type of water that may be stored long-term to renewable water supplies that cannot be used

Figure 8.0-16 Central Arizona Project System Map



Source: CAP, 2009

directly. Persons who wish to store water through the recharge program must apply to the Department for permits. There are two types of facilities and associated permits; Underground Storage Facility (USF) Permits and Groundwater Savings Facility (GSF) Permits. In addition, a Water Storage (WS) Permit (A.R.S. § 45-831.01) allows the permit holder to store water at a USF or a GSF and a Recovery Well (RW) Permit (A.R.S. § 45-834.01) allows the permit holder to recover long-term storage credits or to recover stored water annually.

Some CAP water use on non-Indian agricultural land is pursuant to GSF Permits (A.R.S. § 45-812.01), which allows the permit holder to deliver a renewable water supply, called "in lieu" water, to a recipient (farm) who agrees to replace groundwater pumping with in lieu water, thus creating a groundwater savings. The permit holder accrues recharge credits which can be recovered later from a well elsewhere in the AMA (or INA). When withdrawn, the water retains the character of the water that was recharged at the GSF.

A USF Permit (A.R.S. § 45-811.01) allows the permit holder to operate a facility that stores water in the aquifer in one of two ways. A *constructed* underground storage permit allows water to be stored by using some type of constructed device, such as an injection well or percolation basin. A *managed* underground storage facility permit allows water to be discharged to a naturally water-transmissive area such as a streambed where the water percolates into the aquifer without the assistance of a constructed device. Not all the water stored at a USF is recoverable. The recharge statutes require that a certain percentage of the recharged volume be made non-recoverable to benefit the aquifer. These non-recoverable volumes are called cuts to the aquifer. CAP water stored at constructed facilities carries a 5% cut to the aquifer; effluent stored at constructed facilities carries no cut

Avra Valley Underground Storage Facility, Tucson AMA.

to the aquifer; and effluent stored at managed facilities carries a 50% cut to the aquifer.

Most of the water delivered to recharge facilities in the AMA Planning Area is CAP water with lesser amounts of effluent and surface water. In 2005, over 423,000 acre-feet of CAP water, 91,600 acre-feet of effluent and 11,400 acre-feet of surface water were delivered to USFs and GSFs, for a total of over 526,000 acre-feet delivered. By the end of 2008, more than 3.3 maf of long term storage credits had been accrued in the AMA Planning Area. The location of GSF and USF sites and facility information are shown on maps and tables in the groundwater conditions section for each AMA.

Surface Water

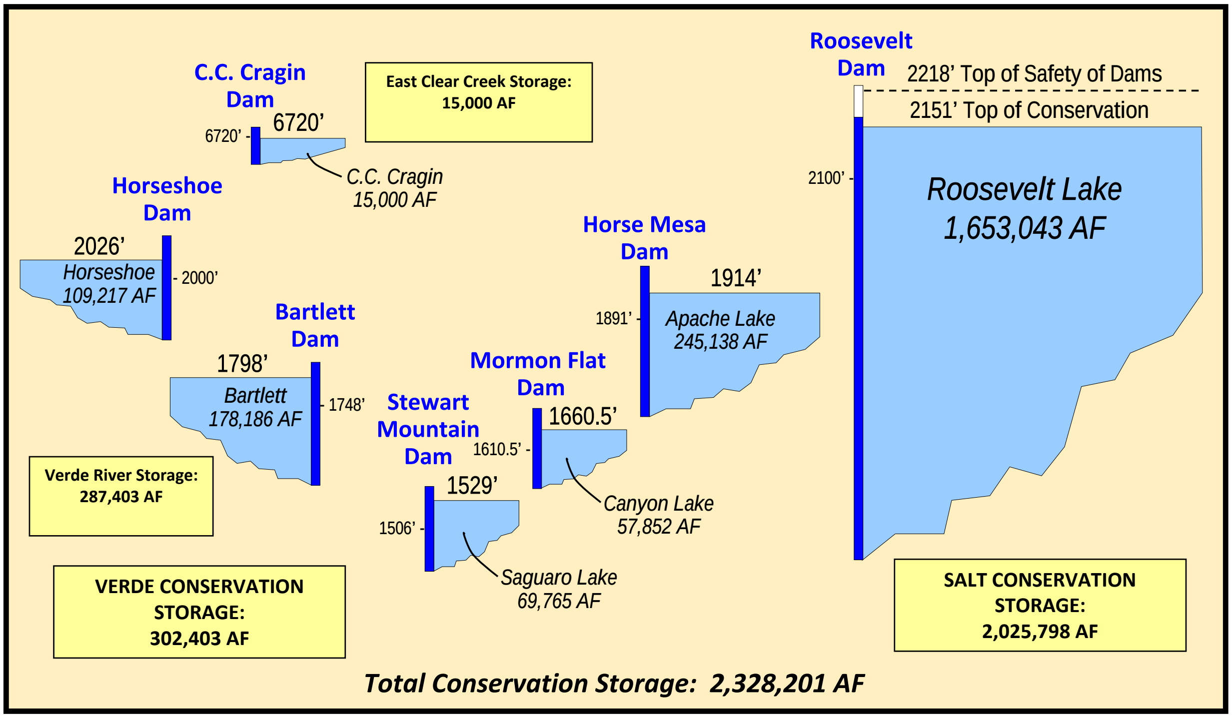
Physical Supplies

In addition to CAP water, other major sources of surface water in the planning area are the Salt and Verde rivers, which supply the Phoenix AMA and the Gila River; supplying the Phoenix and Pinal AMAs.

The dams and reservoirs on the Salt and Verde rivers, located in the Central Highlands Planning Area and operated by the Salt River Valley Water Users Association, or SRP, store and release water for the benefit of agricultural, municipal and industrial users in the Phoenix metropolitan area. SRP was established in 1903 as the nation's first multipurpose reclamation project. It is the nation's third largest public power utility and one of the state's largest water suppliers. Working with other agencies, the SRP manages or assists with the management of seven dams; the six shown in Figure 8.0-17. Water stored in C.C. Cragin Dam, located in the Eastern Plateau Planning Area, may be pumped into the East Verde River for use in the Phoenix AMA. This reservoir system is utilized in conjunction with about 250 groundwater wells to provide water through 131 miles of canal to a 2,900 square mile service area that delivers more than 1.0 maf of water annually to its customers. The service area encompasses portions of the East Salt River Valley and West Salt River Valley sub-basins in the Phoenix AMA, including portions of Chandler, Gilbert Glendale, Mesa, Peoria, Phoenix, Scottsdale, Tempe and Tolleson. (SRP, 2008) Historically, SRP water was primarily used for agricultural irrigation; now a large portion of the project's service area is urbanized. In addition to SRP, the Roosevelt Water Conservation District and the Buckeye Water Conservation District use surface water from the Salt and Verde rivers.

The total capacity of the SRP reservoir system and maxiumum storage elevations are shown in Figure 8.0-17. Capacity on the Salt River system is over 2.0 maf, primarily at Roosevelt Lake. The capacity of the reservoir was increased by 20% with completion of a 77-foot dam heightening project in 1996. The new conservation space between 2,151 feet and the pre-modification elevation of 2,136 feet is available to six valley cities. Flood control storage is between elevations 2,151 and 2,175 feet. The space between 2,175 feet and the maximum storage elevation of 2,218 feet is called safety of dam space. By comparison, the Verde River system reservoirs are considerably smaller with a storage capacity of over 302,000 acre-feet and average annual inflows exceeding

Figure 8.0-17 Profile View of SRP Salt and Verde Reservoir System



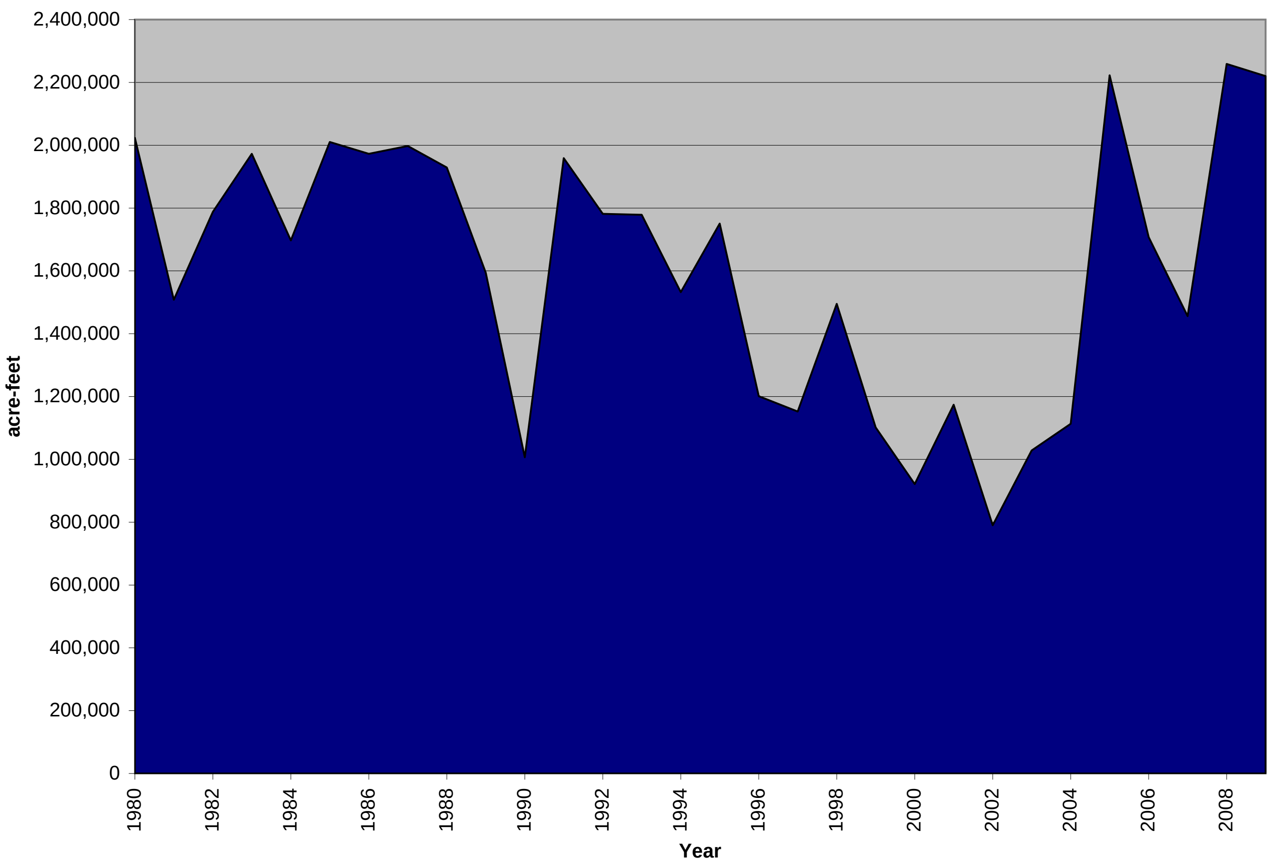
Source: SRP 2010

storage capacity. Consequently, the Verde River reservoirs are managed to minimize the potential for spill during the winter months, with releases of water during the fall, winter and spring (Ester and Reigle, 2001).

As shown in Figure 8.0-18, storage in SRP dams fluctuates as water is collected and then released to meet water demands. The impact of drought conditions can be observed during 1989 and again beginning in the mid 1990s. Substantial storage recovery is seen in 2005 and 2008 following wet winters. As of February 1, 2010, storage in the Salt River system was 95% of capacity after a series of strong winter storms. Just a month before, on January 1, 2010, storage was 79% of capacity. Storage volumes in the Verde River reservoirs, particularly Horseshoe Lake, have been reduced to almost zero at times during recent drought years. On June 1, 2007, storage in the total Verde system had been reduced to 27% of capacity but by June 1, 2009 had increased to 63% of capacity. By February 1, 2010, the storage volume had increased to 83% of capacity. (CAP, 2010)

Water from the Gila River is used primarily for agricultural irrigation. The primary storage and flood control facility on the Gila River is Coolidge Dam located in the Southeastern Arizona Planning Area about 30 miles southeast of Globe. The dam is part of the San Carlos Irrigation Project (SCIP). Water is diverted in the Pinal AMA for the SCIP at Ashurst-Hayden Diversion Dam located 12 miles east of Florence. The dam, completed in 1922, consists of diversion works and is not a storage or flood control facility. Diverted water is conveyed to

Figure 8.0-18 Water Stored on May 1st in SRP Reservoirs on the Verde and Salt Rivers, 1980-2009



Source: Compilation of data from CLIMAS Drought Monitor and GRIC Settlement Technical Assessment (ADWR 2006b) the San Carlos Irrigation and Drainage District (SCIDD), located in the Pinal AMA, consisting of approximately 200 miles of unlined main and lateral canals and 40 miles of canals owned jointly with the SCIP (ADWR, 1998b). In addition to agricultural uses, SCIDD delivers Gila River water mixed with groundwater for landscape irrigation to subdivisions, schools and parks in Casa Grande, Coolidge and Florence (ADWR, 1999b). The SCIP also delivers Gila River water to tribal lands within the Gila River Indian Community located in the Phoenix and Pinal AMAs. The Buckeye Water Conservation and Drainage District in the West Salt River Sub-basin of the Phoenix AMA also uses Gila River water as part of its water supply.

Maricopa Water District (MWD) in the West Salt River Valley Sub-basin uses a combination of CAP and Agua Fria River water stored in Lake Pleasant behind New Waddell Dam. This water is delivered to the MWD service area via the 33-mile Beardsley Canal. MWD owned and operated Waddell Dam, the original storage and flood control structure on the Agua Fria River, which was later inundated by the enlarged Lake Pleasant. (ADWR, 1998b)

A few other sources of surface water are utilized in the planning area. When available, Santa Cruz River water is diverted for agricultural irrigation by some growers in the Central Arizona Irrigation and Drainage District in the Eloy Sub-basin of the Pinal AMA (ADWR 1998b). In the Tucson AMA, surface water diverted from Cienega Creek is used for turf irrigation at Del Lago Golf Course at Vail and springs are the water supply for the community of Summerhaven, located in the Santa Catalina Mountains.

In the Prescott AMA, the City of Prescott has acquired rights to water stored in Watson Lake and Willow Creek reservoirs from the Chino Valley Irrigation District (CVID). Under an

Ashurst-Hayden Diversion Dam, Pinal AMA. The dam, completed in 1922, consists of diversion works and is not a storage or flood control facility.

agreement with CVID, the City maintains the lakes for recreational purposes and releases approximately 1,500 AFA for recharge, which it recovers on an annual basis. In return the City provides up to 1,500 acre-feet annually of recovered effluent credits to CVID members for irrigation. While the City also holds rights to water stored in Lynx and Upper Goldwater reservoirs, this water is not used as a water supply.

<u>Legal Availability</u>
State statutes, ongoing water rights adjudications, court decrees and settlements all affect the use of surface water supplies in the planning area and are discussed below. In addition, environmental laws, instream flow rights and environmental protection designations assign surface water supplies to environmental purposes. These are discussed further in Section 8.0-4 and include the Endangered Species Act and associated habitat conservation plans.

Rights to surface water in Arizona are subject to the doctrine of prior appropriation, which is based on the tenet “first in time, first in right”. This means that the person who first put the water to a beneficial use acquires a right that is superior to all other surface water rights with a later priority date. Under the Public Water Code, beneficial use is the basis, measure and limit to the use of water. The surface water rights system is further discussed in a later sub-section.

Arizona has two general stream adjudications in progress to determine the nature, extent and priority of water rights across the entire Gila River and Little Colorado River systems. The adjudications will recognize existing water right decrees and settlements (discussed below) and adjudicate all remaining water rights claims in the river systems. Pertinent to the AMA Planning Area, the Gila River Adjudication is being conducted in the Superior Court of Arizona in Maricopa County. The Gila Adjudication was initiated by petitions filed by several parties in the 1970's, including Salt River Project, Phelps Dodge Corporation and the Buckeye Irrigation Company. The petitions were consolidated in 1981 into a single proceeding. The Gila Adjudication includes seven adjudication watersheds - Upper Salt, San Pedro, Agua Fria, Upper Gila, Lower Gila, Verde, and Upper Santa Cruz. Most of the Upper Santa Cruz and parts of the Agua Fria, Lower Gila, Upper Salt and Verde adjudication watersheds are within the planning area boundaries. These watersheds do not coincide with the 6-digit HUC watersheds discussed previously and shown in Figure 8.0-5. The entire Gila Adjudication includes over 24,000 parties.

Court determinations that currently affect the distribution of surface water supplies in the planning area including the Kent and Benson-Allison decrees. The Kent Decree (1910) determined that almost 240,000 irrigable acres in the Salt River Valley had a right to water diverted from the Salt and Verde rivers for agricultural purposes and determined which lands were entitled to receive water from Roosevelt Lake. The Salt River Valley Water Users Association is responsible for the proper accounting and delivery of water pursuant to the decree. The Kent Decree also increased and decreed Salt River Indian Reservation rights and recognized Fort McDowell Indian Reservation water users. Further, it established the concept of normal flow rights whereby the land on which water was first used had first right to water normally flowing in the river, and water other than normal flow (stored and developed water) was to be shared equally on lands within a water users association. The Benson-Allison Decree (1917) addressed irrigation lands in the Phoenix AMA that are entitled to divert water from the Salt, Agua Fria and Gila rivers. Most of the rights in a prior decree, the Haggard Decree, were encompassed in this decree.

The 2004 Arizona Water Settlements Act (Act) allocates over 700,000 AFA to the Gila River Indian Community (GRIC) and the Tohono O'odham Nation (TON) (Bark, 2009). Title I of the Act settled the Central Arizona Project debt repayment obligation at $1.65 billion and reallocated CAP water between federal (Indian) and state (non-Indian) uses including the reallocation of high priority uncontracted CAP water to cities.

Title II of the Act allocates 653,500 AFA to the GRIC who have signed a number of water leases and exchanges that provide water to municipalities. The GRIC water entitlement includes water from the CAP, SRP, groundwater and a reclaimed water exchange with the cities of Mesa and Chandler. This exchange provides treated effluent for part of the tribe's CAP water on a 5 to 4 ratio and allows the cities to use potable water for municipal uses and the tribe receives treated effluent for agricultural use. (Smith and Colby, 2007)

In addition, Title II includes agreements by parties not to drill new wells near the reservation boundary, or to limit pumping. (ADWR, 2006b)

C.C. Cragin Reservoir, formerly referred to as Blue Ridge Reservoir, located approximately 25 miles north of Payson, was acquired by SRP from Phelps Dodge Corporation in February 2005 as part of the Arizona Water Settlement Act. The reservoir satisfies obligations to the Gila River Indian Community in the Phoenix AMA and will be used to supplement SRP's water supply via diversions from the reservoir into the East Verde River. The Act also allocated 3,500 AFA from the reservoir to northern Gila County, of which 3,000 AFA will be used by Payson. (SRP, 2007)

Title III of the Act, the Southern Arizona Water Rights Settlement Act (SAWRSA) settled litigation concerning the 1982 SAWRSA settlement. It allocated 79,200 acre-feet of water per year to the San Xavier and eastern Schuk Toak Districts of the TON within the Tucson AMA. The allocated rights include: 13,200 AFA of "underground water"; 37,800 AFA of currently contracted CAP Indian Priority Water; and 28,200 AFA of new CAP Non-Indian Agricultural Priority Water. The Act also allows limited off-reservation water leasing. Implementation of SAWRSA includes a special management zone adjacent to and outside the reservation boundaries, the San Xavier Buffer Zone, in which the drilling of non-exempt new wells is restricted.

Surface Water Right System

The legal framework and process under which surface water right filings are administered is complex. Each type of surface water right filing is assigned a unique number with a prefix as explained in Appendix C and listed in Table 8.0-8. All parties who use water or claim to have a water right within the two adjudication areas are required to file a statement of claimant or SOC (39) in the adjudication, or risk loss of their right. This includes reserved water rights for public lands and Indian reservations, of which only some have been quantified or prioritized. Other surface water right filings are discussed below.

A Certificate of Water Right (CWR) may be issued if the terms of the permit to appropriate water (3R, 4A or 33, and in certain cases, 38) are met. CWRs retain the original permit application number. Statements of claim of right to use public waters (36) have also been filed, but their filing does not in itself create a water right. Surface water rights can also be determined through judicial action in state or federal court in which the court process establishes or confirms the validity of the rights and claims and ranks them according to priority. Court decreed rights are considered the most certain surface water right.

Table 8.0-8 summarizes the number of surface water right and adjudication filings in the planning area. The methodology used to query the Department's surface water right and SOC registries is described in Appendix C. Of the 35,417 filings that specify surface water diversion points and places of use in the planning area, 3,184 CWRs have been issued to date. Figure 8.0-19 shows the location of surface water diversion points listed in the Department's surface water rights registry. The numerous points reflect the large number of stockponds and reservoirs that have been constructed in the planning area as well as diversions from streams and springs. Locations of registered wells, many of which are referenced as the basis of claim in SOCs are also shown in Figure 8.0-19.

Results from the Department's investigation of surface water right and adjudication filings are presented in Hydrographic Survey Reports (HSRs) and other adjudications-related reports. Within the AMA Planning Area, two preliminary HSRs were published for the Gila River Indian Reservation (1996 and 1999) and one draft HSR for the Upper Salt River (1992). Technical assessments of water right settlements for several Indian tribes including the Salt River Pima-Maricopa Indian Community (1991); Fort McDowell Indian Community (1993); San

Table 8.0-8 Inventory of surface water right and adjudication filings in the AMA Planning Area[1]

AMA	Type of Filing							Total
	BB[2]	3R[3]	4A[3]	33[3]	36[4]	38[5]	39[6]	
Phoenix	0	51	103	113	1,455	682	9,694	**12,098**
Pinal	0	20	48	63	313	290	2,724	**3,458**
Prescott	0	7	26	70	347	207	6,142	**6,799**
Santa Cruz	0	13	14	75	448	442	1,673	**2,665**
Tucson	1	178	150	366	1,509	1,292	6,901	**10,397**
Total	**1**	**269**	**341**	**687**	**4,072**	**2,913**	**27,134**	**35,417**

Notes:

[1] Based on a query of ADWR's surface water right and adjudication registries in February 2009. A file is only counted in this table if it provides sufficient information to allow a Point of Diversion (POD) to be mapped within the basin. If a file lists more than one POD in a given basin, it is only counted once in the table for that basin. Several surface water right and adjudication filings are not counted here due to unsufficient locational information. However, multiple filings for the same POD are counted.

[2] Court decreed rights; not all of these rights have been identified and/or entered into ADWR's surface water rights registry.

[3] Application to construct a reservoir, filed before 1972 (3R); application to appropriate surface water, filed before 1972 (4A); and application for permit to appropriate public water or construct a reservoir, filed after 1972 (33).

[4] Statement of claimant of rights to use public waters of the state, filed pursuant to the Water Rights Registration Act of 1974.

[5] Claim of water right for a stockpond and application for certification, filed pursuant to the Stockpond Registration Act of 1977.

[6] Statement of claimant, filed in the Gila or LCR General Stream Adjudications.

Carlos Apache Tribe (1999); Gila River Indian Community (2006); and Tohono O'odham Nation (2006).

The location of surface water resources are shown on surface water condition maps and maps showing perennial and intermittent streams and major springs for each basin IN SECTIONS 8.1-8.5. Tables also list data on streamflow, flood ALERT equipment, reservoirs, stockponds and springs in the sections for each basin.

Groundwater

Groundwater is an essential water supply in the planning area. It is the primary water source in the Prescott and Santa Cruz AMAs, as these AMAs lack access to CAP water. Water supplies are managed jointly as "groundwater" in the Santa Cruz AMA due to the close hydrologic relationship of surface water, groundwater and effluent. Until relatively recently, the Tucson AMA also relied primarily on groundwater to meet demand, and it still made up 74% of its water supply during 2001-2005. Groundwater is also a vital water supply for the Phoenix and Pinal AMAs, although currently, surface water supplies surpass groundwater supplies in both AMAs. Groundwater is a relatively abundant water supply with the median of reported well yields exceeding 1,000 gpm in the Phoenix and Pinal AMAs and exceeding 600 gpm in the other AMAs.

As a result of long term groundwater pumping in the AMAs, moderate to severe regional and localized water level declines have occurred. Over time, groundwater declines can lead to increased pumping costs, decrease in water quality, riparian damage, land subsidence and land fissuring and permanent compaction of the aquifer, all of which have occurred in the planning area. Localized groundwater level rises have also occurred in the last two decades at

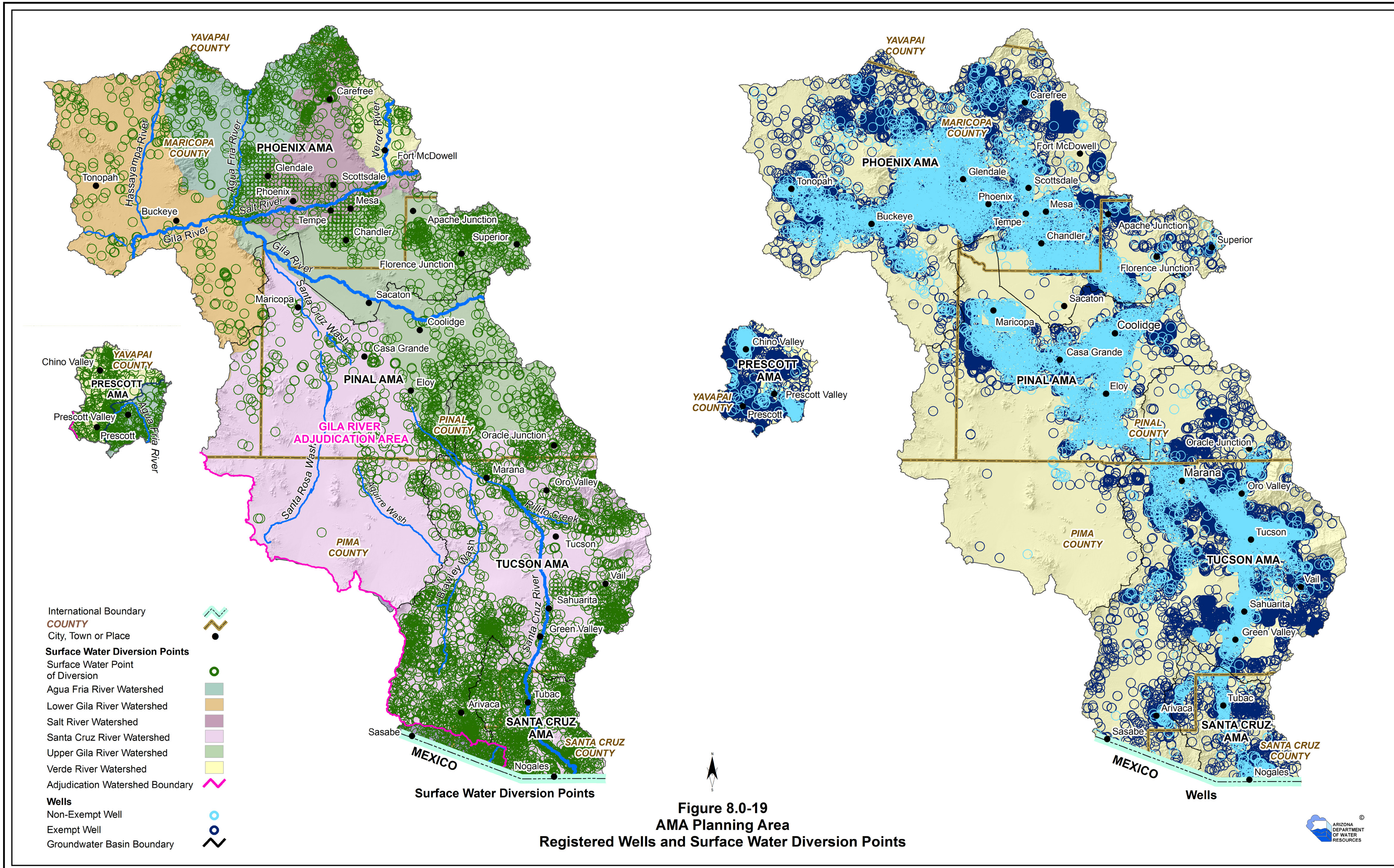


Figure 8.0-19
AMA Planning Area
Registered Wells and Surface Water Diversion Points

some locations, due to retirement of agricultural lands, use of CAP water in lieu of groundwater and a growing number of underground storage projects.

Pursuant to A.R.S. § 45-553, groundwater may be withdrawn from the Butler Valley Basin and transferred to an initial AMA. There are no limits on the volume of groundwater that may be transported from this basin.

A.R.S. § 45-552 allows groundwater in the Harquahala Basin pumped from historically irrigated acres owned by a political subdivision of the state to be transported for use in an AMA or use by the Arizona Water Banking Authority (AWBA).[6] The volumetric limit is six acre-feet per acre per year or 30 acre-feet per acre for any ten year period. The director of ADWR may establish an alternative volume as long as it will not unreasonably increase damage to basin residents and other water users. The groundwater may not be withdrawn below 1,000 feet below bls nor at a rate that causes declines of more than an average of ten feet per year during the 100 year evaluation period. The City of Scottsdale has applied to the Department to transport 3,645 acre-feet of groundwater per year from historically irrigated acres in the Harquahala Basin to the Phoenix AMA. This application is currently still under review.

Groundwater may also be withdrawn from historically irrigated acres in the McMullen Valley Basin that were owned by a city or person prior to January 1, 1988 and transported to the Phoenix AMA. (A.R.S. § 45-552). Qualified groundwater importers include cities, towns, private water companies and replenishment districts for their use or use by the AWBA. The City of Phoenix owns 14,000 acres of agricultural land in the McMullen Valley Basin allowing it to transport a total of 6 maf of groundwater into the Phoenix AMA. The annual volume that may be withdrawn is limited to an average of 3 acre-feet per irrigated acre. If this water is used for an assured water supply demonstration in the AMA, only water withdrawn above 1,000 feet bls at a rate not to exceed 10 feet per year over the 100 year period will be considered.

McMullen Valley. Groundwater may be withdrawn from historically irrigated lands in the McMullen Valley Basin that were owned by a city or person prior to January 1, 1988 and transported to the Phoenix AMA.

Under A.R.S. 45-555(E), the City of Prescott can withdraw and transport an amount of groundwater not to exceed 14,000 AFA from the Big Chino Sub-basin into the Prescott AMA. The actual volume that can be transported during a year depends on several factors listed in the statute. In 2007, the City of Prescott applied for Modification of Designation of Assured Water Supply to include transportation of Big Chino Sub-basin groundwater. In November 2008 the Director of ADWR issued his decision that the City was entitled to transport 8,076.4 AFA of groundwater from the Big Chino Sub-basin and that this volume should be added to Prescott's designation provided that a pipeline to transport the groundwater is constructed by December 31, 2019.

The City of Prescott appealed the Director's decision to the Office of Administrative Hearings, claiming it was entitled to transport a

[6] The AWBA stores unused Colorado River water to be used in times of shortage to secure (or firm) water supplies for Arizona.

larger volume. Subsequently, an Administrative Law Judge (ALJ) recommended the volume be increased by 500 AFA to replace the Yavapai-Prescott Indian Tribe's CAP allocation that was sold to Scottsdale. A number of residents of the Prescott AMA also appealed the Directors' decision, contending that pumping by Prescott in the Big Chino Sub-basin would reduce the flows of the Verde River, causing negative impacts to endangered species and surface water users. In a November 20, 2009 decision, the Director accepted the ALJ's recommendation to grant Prescott's application, but upheld his previous decision, determining that Prescott was not entitled to transport the additional 500 AFA from the Big Chino Sub-basin.

In addition to the groundwater the City of Prescott is allowed to transport under A.R.S. § 45-555(E), cities and towns in the Prescott AMA are allowed to withdraw groundwater associated with historically irrigated acres in the Big Chino Sub-basin and transport the groundwater into the Prescott AMA. (A.R.S. §45-555 (A) through (D)) The Department will make a determination regarding the volume of groundwater that a city or town can transport from historically irrigated acres lands after it has finalized Administrative Rules for this process. The allotment associated with historically irrigated acres is three acre-feet per acre per year.

Automated Well in the Prescott AMA. As of December 2009, ADWR monitored a total of 72 Index and Automated wells in this planning area.

The Department's Groundwater Site Inventory (GWSI) database, the main repository for statewide well data, is available on the Department's website. The GWSI database consists of records for over 42,000 wells and over 210,000 water level measurements. GWSI includes spatial and geographical data, owner information, well construction and geologic data, and historic water level, water quality, well lift and pumpage records. Also included are hydrographs for Index Wells and Automated Groundwater Monitoring Sites (Automated Wells), which can be searched and downloaded for planning, drought mitigation and other purposes.

Approximately 1,700 GWSI sites are designated as Index Wells (GWSI sites are primarily wells but include other types of sites such as springs and drains). Typically, Index Wells are visited once each year by Department field staff to obtain a long-term record of groundwater level fluctuations. Approximately 200 GWSI sites are designated as Automated Wells. In these wells water levels are measured four times daily and the data stored electronically. Automated Wells were established to better understand the water supply situation in critical areas of the state. These devices are located in areas of growth, subsidence, along river/stream channels, and in areas affected by water contamination or drought.

Volume 1 of the Atlas shows the location of Index Wells and Automated Wells. As of December 2009 there were 72 of these wells in the planning area: 35 in the Phoenix AMA; 16 in the Prescott AMA; 11 in the Tucson AMA; six in the Santa Cruz AMA; and four in the Pinal AMA. Updated maps showing the location of Index and Automated wells (including automated wells operated by non-ADWR entities) may be viewed at the Department's website.

Information on major aquifers, well yields, estimated natural recharge, aquifer flow direction, and water level changes are found in groundwater data tables, groundwater condition maps, hydrographs and well yield maps for each AMA in Sections 8.1.6, 8.2.6, 8.3.6, 8.4.6. and 8.5.6.

Effluent

Effluent, also referred to as reclaimed water, is a growing water supply in the AMA Planning Area, meeting approximately 4% of the annual supply during the 2001-2005 time-period. Since effluent production is tied directly to population, population growth generally leads to increased effluent supply. However, lack of infrastructure to deliver effluent to potential users is often a limiting factor. The Phoenix and Tucson AMAs generate the majority of the effluent in the planning area, which is used by agricultural, municipal and industrial sectors.

Many municipalities and private entities in the planning area recharge effluent in permitted basins and streambeds. This storage earns recharge credits that can either be pumped from the ground through a permitted recovery well, or used towards assured water supply certificates or designations. The recharge option is often favored as a way of using effluent if direct use is not possible due to lack of a distribution system.

There is increasing interest in effluent as a water supply as population growth continues and other renewable water sources become more extensively used. Some communities, for example Tucson, Phoenix, Prescott and Scottsdale, have made substantial investments in effluent reuse. Global Water Resources, a private water and wastewater utility, is promoting reuse technology at a new development in Maricopa where its water center uses non-potable water for irrigation and toilet flushing.

Effluent recharge at the Avondale Wetlands, Phoenix AMA. Many municipalities and private entities in the planning area recharge effluent in permitted basins and streambeds.

Most effluent in the Phoenix AMA is generated at the 91st Avenue WWTP. In 2004 the treatment plant processed approximately 139,000 acre-feet of wastewater from Glendale, Mesa, Phoenix, Scottsdale, and Tempe, who co-own the facility as part of a multi-city partnership known as SROG, the Sub-regional Operating Group. A large portion of this effluent is used at the Palo Verde Nuclear Generating Station for cooling purposes. The unused effluent is discharged into the Salt and Gila rivers, supporting perennial flow and flows out of the AMA. Effluent is also a water supply for agricultural irrigation. Effluent generated from Phoenix's 23rd Avenue WWTP is used to irrigate crops in the Roosevelt Irrigation District and effluent from Chandler and Mesa are used for irrigation on the Gila River Indian Reservation. Major cities in the Phoenix AMA also use effluent for landscape and golf course watering.

In the Pinal AMA, Casa Grande, Coolidge, Eloy and Florence all have municipal WWTPs. These plants deliver treated effluent for a variety of purposes, including agricultural irrigation, golf course watering, and power generation. Florence and Eloy also have permitted underground storage facilities for recharging effluent. The City of Maricopa's wastewater needs are handled by a private utility (Global Water Resources) and the effluent is used for watering turf and filling subdivision lakes. There are several other WWTPs in the AMA serving unincorporated communities. Effluent from these facilities is used for golf course watering, and in some cases the excess is recharged at underground storage facilities (see Table 8.2-7).

Effluent is an important water supply in the Tucson AMA where it met approximately 3.7% of the total AMA water demand during 2001-2005. Since the early 1980s the City of Tucson has operated a reclaimed water system. The system now consists of almost 160 miles of pipe, 33 mgd of production capacity, 15 million gallons of storage capacity and four supply sources including the Tucson Water Reclaimed Water Treatment Plant, a treatment wetlands and a managed underground storage facility. The system extends throughout the Tucson water service area and extends into northeast Marana near the Tortolita Mountains and interconnects to the Oro Valley system where it is used for golf course irrigation in the Town of Oro Valley. (City of Tucson, 2007) Reclaimed water is delivered to approximately 900 sites in the Tucson Water service area including 14 golf courses, 35 parks, 47 schools and more than 700 single family homes (Tucson Water, 2009).

Three communities in the Prescott AMA have permitted recharge facilities that store effluent: the City of Prescott, the Town of Prescott Valley and the Town of Chino Valley. Effluent availability in the Town of Chino Valley is currently limited as the Town is largely unsewered; however, it is in the process of constructing a centralized sewer system to serve new and existing developments. Effluent is a water supply both directly and through recharge and recovery for three golf courses, a community park, and a sand and gravel operation in Prescott, as well as for a golf course at Prescott Valley. Effluent stored by the City of Prescott is recovered by CVID for agricultural irrigation and by the City of Prescott. As of 2008 effluent stored by Prescott Valley has not been recovered.

Effluent use at Tubac Golf Resort, Santa Cruz AMA. Effluent accounted for 4% of the annual supply for the AMA Planning Area during 2001-2005.

The Nogales International Wastewater Treatment Plant (NIWWTP) is the primary treatment facility in the Santa Cruz AMA. It treats over 16,000 acre-feet of sewage from both Nogales, Arizona and Nogales, Sonora, and discharges the effluent to the Santa Cruz River where it supports riparian vegetation. Several smaller "package" treatment plants provide treatment to developments within the AMA, but with the exception of the Tubac Golf Resort do not provide reused effluent.

Contamination Sites

Environmental contamination impacts the use of some water supplies in the AMAs. An inventory of Department of Defense (DOD), Resource Conservation and Recovery Act (RCRA), Superfund, Water Quality Assurance Revolving Fund (WQARF), Voluntary Remediation Program (VRP) and Leaking Underground Storage Tank (LUST) sites was conducted for the planning area. Table 8.0-9 provides a summary of active contamination sites, by cleanup program, in each AMA. Tables listing the contaminant and affected media as well as maps showing the location of all contamination sites can be found in the AMA Water Quality sections.

In the AMA Planning Area there are 61 active VRP sites. The majority (39) of these sites are located in the Phoenix AMA. The VRP is a state administered and funded voluntary cleanup program. Any site that has soil and/or groundwater contamination, provided that the site is not subject to an enforcement action by another program, is eligible to participate. To encourage participation, ADEQ provides an expedited process and a single point of contact for projects that involve more than one regulatory program (Environmental Law Institute, 2002).

There are 13 RCRA sites in the AMA Planning Area, including nine in the Phoenix AMA, two in the Tucson AMA and one each in the Pinal and Santa Cruz AMAs. The RCRA program regulates the management of hazardous waste handlers which includes generators, transporters and facilities for treatment, storage and disposal (ADEQ, 2002). The 13 RCRA sites are corrective action sites where contamination of groundwater and/or soil has occurred due to improper handling of hazardous waste.

Two DOD sites are located in the AMA Planning Area; the 161st Air National Guard site in the Phoenix AMA and the Davis-Monthan Air Force Base site in the Tucson AMA. Both contamination sites are located at active duty bases.

There are 19 WQARF sites and nine Superfund sites in the Phoenix, Tucson and Prescott AMAs. WQARF is a state administered funding mechanism created to support hazardous substance cleanup efforts. Superfund is the federal government's program, administered by the Environmental Protection Agency (EPA), to clean up the most contaminated hazardous waste sites across the country. (ADEQ, 2008a) Almost all WQARF and Superfund sites in the planning area involve Trichloroethylene (TCE) and/or Tetrachloroethene (PCE) contamination. One Superfund site, the 19th Avenue Landfill in the Phoenix AMA, was removed from the National Priorities List (NPL) of Superfund sites in 2006 after the EPA and ADEQ determined that no further cleanup activities were necessary (ADEQ, 2006). There is one Superfund site in the Prescott AMA; the Iron King Mine and Humboldt Smelter, a site contaminated with arsenic and lead.

Leaking underground storage tanks can pose a significant threat to groundwater quality and therefore to drinking water supplies. Regulations require that underground storage tanks be protected from spills, overfills, and corrosion. In 2008, there were 5,697 active LUST sites in the planning area. Seventy-one percent of these sites are located in the Phoenix AMA and 20% are located in the Tucson AMA.

Table 8.0-9 Active contamination sites in the AMA Planning Area

AMA	Leaking Underground Storage Tanks	Voluntary Remediation Program	Resource Conservation and Recovery Act	Department of Defense	Water Quality Assurance Revolving Fund	Superfund
Phoenix	4,042	39	9	1	12	7
Pinal	292	3	1	NA	NA	NA
Prescott	180	3	NA	NA	NA	1
Santa Cruz	26	1	1	NA	NA	NA
Tucson	1,157	15	2	1	7	1
Total	**5,697**	**61**	**13**	**2**	**19**	**9**

8.0.7 Cultural Water Demand

Total cultural water demand (Indian and non-Indian) in the AMA Planning Area averaged approximately 3,659,480 AFA during the 2001-2005 time-period; approximately 49% of the total demand in Arizona. Total non-Indian and Indian demand, by water source and water demand sector for each AMA, is shown in Figure 8.0-20 and Table 8.0-10. Tribal demand and non-Indian municipal, agricultural and industrial sector demand are discussed later in this section. Tribal and non-tribal demands are discussed separately because non-Indian water use in AMAs is regulated under the Groundwater Code, which requires annual reporting of water use by all groundwater rightholders, compliance with mandatory conservation requirements, and other regulations. As a consequence, these data are generally reported in Departmental and other publications.

As shown in Figure 8.0-20, cultural water demand varies widely between the AMAs due to differences in geographic area, population, land use and available water supplies. Total cultural water demand was the highest in the Phoenix AMA and lowest in the Santa Cruz AMA with an average annual total demand of 2,253,500 acre-feet and 22,300 acre-feet, respectively, during the 2001-2005 time-period.

Municipal demand accounted for 35% of the cultural water demand in the planning area with approximately 1,273,100 acre-feet of average annual demand during the 2001-2005 time-period. Municipal demand includes water delivered by a water provider and water withdrawn from domestic (exempt) wells. As would be expected, the Phoenix AMA accounted for the largest (81%) of the total municipal demand in the planning area. Across the AMAs, 63% of the municipal demand was met with "renewable" water supplies; CAP, surface water and effluent. The Phoenix AMA met over 72% of its municipal demand with CAP, surface water and effluent supplies while the other AMAs used primarily groundwater.

The agricultural sector was the highest demand sector in the AMA planning area with 2,153,900 acre-feet or approximately 59% of the average annual cultural demand between 2001-2005. Agricultural demand exists within all AMAs but the volumes vary significantly. The largest annual average agricultural demand was in the Phoenix AMA at 1,052,600 acre-feet (47% of total Phoenix AMA demand) and the smallest was in the Prescott AMA with 5,300 acre-feet (22% of total Prescott AMA demand). The sources of water used to this meet demand also vary between the AMAs. Agricultural demand in the Prescott AMA was met with groundwater and recovered effluent credits; surface water use ceased in 2003. In the Phoenix and Pinal AMAs, 59% and 55% respectively, of the agricultural demand was met with CAP, surface water and effluent supplies. In the Tucson AMA, approximately 30% of the agricultural demand was met with CAP water and the remainder by groundwater during 2001-2005.

Sun Lakes, Phoenix AMA. Municipal demand accounted for 35% of the cultural water demand in the planning area with an average of approximately 1,273,100 acre-feet of annual demand during the 2001-2005.

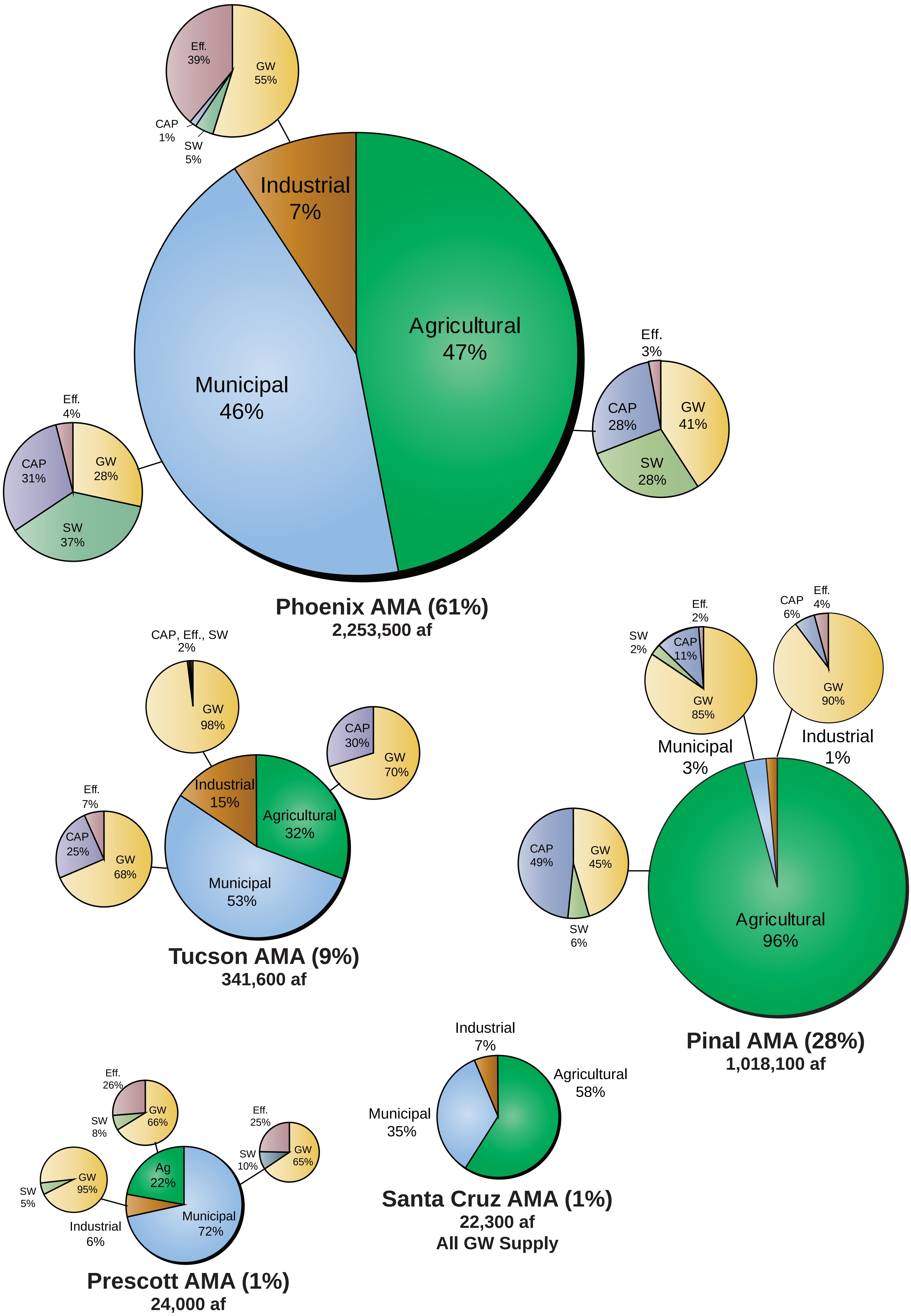


Figure 8.0-20
Average AMA Water Demand by Sector and Water Source During 2001-2005

Table 8.0-10 Average AMA water demand by sector and water source (Indian and Non-Indian) during 2001-2005 in acre-feet

Phoenix AMA

	Groundwater	Surface Water	CAP	Effluent	Total
Municipal					
Non-Indian	287,700	383,900	317,200	41,600	**1,030,400**
Indian	7,900	200	0	0	**8,100**
Total	**295,600**	**384,100**	**317,200**	**41,600**	**1,038,500**
Industrial					**0**
Non-Indian	88,800	7,900	2,400	63,300	**162,400**
Total	**88,800**	**7,900**	**2,400**	**63,300**	**162,400**
Agricultural					**0**
Non-Indian	354,500	183,100	272,900	28,200	**890,200**
Indian	75,400	115,600	22,900	0	**213,900**
Total	**429,900**	**298,700**	**295,800**	**28,200**	**1,052,600**
Grand Total	**814,300**	**690,700**	**615,400**	**133,100**	**2,253,500**

Prescott AMA

	Groundwater	Surface Water	Effluent	Total
Municipal	14,600	800	1,800	**17,200**
Industrial	1,400	80	0	**1,480**
Agricultural	3,500	400	1,400	**5,300**
Grand Total	**19,500**	**1,280**	**3,200**	**23,980**

Santa Cruz AMA

	Groundwater
Municipal	7,800
Industrial	1,500
Agricultural	13,000
Grand Total	**22,300**

Pinal AMA

	Groundwater	Surface Water	CAP	Effluent	Total
Municipal					
Non-Indian	23,900	600	3,100	500	**28,100**
Indian	800	0	0	0	**800**
Total	**24,700**	**600**	**3,100**	**500**	**28,900**
Industrial					
Non-Indian	13,200	0	900	600	**14,700**
Total	**13,200**	**0**	**900**	**600**	**14,700**
Agricultural					
Non-Indian	379,400	60,300	391,700	1,700	**833,100**
Indian	60,200	7,600	73,600	0	**141,400**
Total	**439,600**	**67,900**	**465,300**	**1,700**	**974,500**
Grand Total	**477,500**	**68,500**	**469,300**	**2,800**	**1,018,100**

Tucson AMA

	Groundwater	Surface Water	CAP	Effluent	Total
Municipal					
Non-Indian	123,900	100	44,300	12,200	**180,500**
Indian	200	0	0	0	**200**
Total	**124,100**	**100**	**44,300**	**12,200**	**180,700**
Industrial					
Non-Indian	50,100	200	400	400	**51,100**
Indian	1,300	0	0	0	**1,300**
Total	**51,400**	**200**	**400**	**400**	**52,400**
Agricultural					
Non-Indian	76,400	0	20,200	0	**96,600**
Indian	0	0	11,900	0	**11,900**
Total	**76,400**	**0**	**32,100**	**0**	**108,500**
Grand Total	**251,900**	**300**	**76,800**	**12,600**	**341,600**

Total All AMAs

	Groundwater	Surface Water	CAP	Effluent	Total
Municipal					
Non-Indian	457,900	385,400	364,600	56,100	**1,264,000**
Indian	8,900	200	0	0	**9,100**
Total	466,800	385,600	364,600	56,100	**1,273,100**
Industrial					
Non-Indian	155,000	8,180	3,700	64,300	**231,180**
Indian	1,300	0	0	0	**1,300**
Total	156,300	8,180	3,700	64,300	**232,480**
Agriculture					
Non-Indian	826,800	243,800	684,800	31,300	**1,786,700**
Indian	135,600	123,200	108,400	0	**367,200**
Total	962,400	367,000	793,200	31,300	**2,153,900**
Grand Total	**1,585,500**	**760,780**	**1,161,500**	**151,700**	**3,659,480**

Industrial demand accounted for the remaining 6% of the annual cultural water demand within the planning area for the 2001-2005 time-period. Although groundwater was the predominant water supply for industrial uses in all AMAs, a significant volume of effluent, 63,300 AFA, was used in the Phoenix AMA. The nature of the industrial demand differs between the AMAs. Water use by turf-related facilities was the largest industrial demand in the Santa Cruz and Prescott AMAs. In the Phoenix AMA, power plant use (65,600 AFA) slightly exceeded turf-related facility use (62,900 AFA) during the period. In the Tucson AMA, mining accounted for 69% (35,200 AFA) of the industrial demand. In the Pinal AMA, dairies and feedlots were the largest industrial demand category, accounting for 49% (7,200 AFA) of the industrial total. (See table 8.0-17)

Tribal Water Demand

With the exception of the Santa Cruz AMA, there are tribal lands within all AMAs. The locations of tribal communities are shown on Figure 8.0-1 and on the land ownership maps in the AMA sections. Tribal communities, in alphabetical order, are: Ak-Chin Indian Community (Pinal AMA); Fort McDowell Yavapai Nation (Phoenix AMA); Gila River Indian Community (Phoenix and Pinal AMAs); Pascua Yaqui Tribe (Phoenix, Pinal and Tucson AMAs); Salt River Pima-Maricopa Indian Community (Phoenix AMA); Tohono O'odham Nation (Pinal and Tucson AMAs); and Yavapai-Prescott Indian Tribe (Prescott AMA). Tribal demand averaged approximately 377,600 AFA during 2001-2005. Estimated water demand, irrigated acres, CAP allocation volumes and other information are listed in Table 8.0-11. Ninety seven percent of tribal demand is agricultural irrigation. Groundwater met about 38% of all tribal demand with large proportions of surface water (33%) and CAP water (29%) also utilized (Table 8.0-10).

Agriculture in the Phoenix AMA. The agricultural sector was the highest demand sector in the AMA Planning Area with 2,153,900 acre-feet or approximately 59% of the annual cultural demand between 2001-2005.

Ak-Chin Indian Community

The Ak-Chin Indian Community is a 21,480-acre area located entirely within the Pinal AMA in northwest Pinal County approximately 50 miles south of the Phoenix metropolitan area. The community consists of approximately 750 tribal members comprised of both the Tohono O'odham and Pima people (2000 Census). The community includes a 109-acre industrial park and 15,000 acres of irrigated fields (ITCA, 2008). Harrah's Phoenix Ak-Chin Casino is located within the community.

The Ak-Chin Indian Community was originally allocated 58,300 AFA of CAP water in 1983. Pursuant to the community's water rights settlement in 1984, it is entitled to 75,000 acre-feet of Colorado River water in a normal year, 85,000 acre-feet in a surplus year and not less than 72,000 acre-feet in a shortage year. The intended use of the CAP water is irrigation (CAP, 2008). During 2001-2005, an average of approximately 69,200 AFA of CAP water was used for irrigation. In 2009, approximately 83,700 acre-feet was used by the Ak-Chin Farms. In addition to on-reservation use of CAP water, the Ak-Chin Indian Community has entered into long-term CAP lease agreements, primarily with Anthem, north of Phoenix. In

Table 8.0-11 Tribal water supply and demand in the Active Management Areas

Tribe	AMA	Size (acres)	Population (2000 Census)	Current Water Supply	Ave. Annual Water Demand (2001-2005) acre-feet	Irrigated Acres	CAP Allocation (AFA)
Ak-Chin Indian Community	Pinal	21,480	750	CAP	69,300	15,000	72,000 - 85,000
Fort McDowell Yavapai Nation	Phoenix	25,000	900	SRP/GW	11,700	2,000	18,233
Gila River Indian Community	Pinal/Phoenix	373,000	14,000	SW/GW/ CAP/EFF	183,200	37,000	311,800
Pascua Yaqui Tribe	Tucson/Phoenix/Pinal	1,150+	7,700	City of Tucson	unk	0	500
Salt River Pima-Maricopa Indian Community	Phoenix	56,000	6,200	SW/GW/ CAP	86,600	13,000	13,300
Tohono O'odham Nation	Tucson/Pinal	1,191,000	5,000	GW/CAP	26,830	5,900	74,000
Yavapai-Prescott Indian Tribe	Prescott	1,400	180	City of Prescott	unk	0	none
TOTAL			**34,730**		**377,600**	**72,900**	

ADWR, 2008; CAP, 2008; ITCA, 2008
unk = unknown
EFF= effluent

2009, approximately 6,300 acre-feet of CAP lease water was used by off-reservation users (CAP, 2010).

Fort McDowell Yavapai Nation

The almost 25,000-acre Fort McDowell Yavapai reservation is located in northeastern Maricopa County approximately 23 miles northwest of Phoenix. The reservation is bisected by the Verde River and is located entirely within the Phoenix AMA. The Nation has slightly more than 900 members comprised of the Yavapai and Apache people (2000 Census). During 2001-2005 an average of approximately 11,700 acre-feet was used annually. Water supplies are primarily SRP water and groundwater.

There are a number of commercial operations within the reservation. The Fort McDowell Casino is a gaming facility located adjacent to a 247-room resort and conference center and the 18-hole We-Ko-Pa Golf Club. A sand and gravel facility, Fort McDowell Yavapai Materials, has been in operation since 1980. Recreational activities associated with the Verde River and Fort McDowell Adventures are other tribal enterprises (NAU, 2008; ITCA, 2008). The Fort McDowell Tribal Farm includes 2,000 irrigated acres of alfalfa, pecans and citrus.

The Fort McDowell Yavapai Nation was originally allocated 4,300 AFA of CAP water in 1983. Pursuant to the tribe's water rights settlement in 1990, the nation now has a 18,233 AFA CAP allocation with the intended use identified as tribal homeland (CAP, 2008). In 2007, the City of Phoenix executed a long-term lease of 4,300 AFA of this allocation and used all of it in 2009 (CAP, 2010).

Gila River Indian Community (GRIC)

The 373,000-acre Gila River Indian reservation straddles the Phoenix and Pinal AMAs, occupying lands on both sides of the Gila River south of Phoenix, Tempe, and Chandler. It is inhabited by approximately 14,000 members of the Pima and Maricopa tribes (ITCA, 2008). During 2001-2005, the GRIC used an average of approximately 183,200 AFA. Industrial parks, gaming facilities and agriculture are the primary demand sectors. There are three industrial parks and a business park that occupy more than 800 acres. The agricultural industry brings more than $25 million of annual income to the GRIC from the irrigation of 15,000 acres of GRIC farms and 22,000 independently farmed acres that produce cotton, wheat, millet, alfalfa, barley, melons, pistachios, olives, citrus and vegetables (ITCA, 2008). Wild Horse Pass, Vee Quiva and Lone Butte collectively form the Gila River Casinos. Wild Horse Pass Resort and Spa includes a 17,500 square foot spa, two 18-hole golf courses, an equestrian center, and a 2½ mile long replica of the Gila River (NAU, 2008; ITCA, 2008). The 18-hole Toka Sticks Golf Course (formerly the Williams Air Force Base Golf Course) is also located on the reservation.

The GRIC was originally allocated 173,100 AFA of CAP water for irrigation purposes in 1983. An additional 138,700 AFA were allocated to the GRIC pursuant to the Arizona Water Settlement Act (Act) bringing their total CAP allocation to 311,800 AFA (CAP, 2008). The settlement agreement specifies the water rights assigned to the GRIC. The GRIC have rights to 13 categories of water including CAP, surface water, effluent and groundwater. In addition to CAP water, supplies include 125,000 AFA of Globe Equity Decree Water (Gila River water) and 156,700 AFA of groundwater. In total, the GRIC are entitled to an estimated average of 653,500 AFA for any period of ten consecutive years. Approximately ninety-eight percent of the water demand is for agriculture. (ADWR, 2006b) The Community is in the planning stages of a large irrigation project with plans to establish an irrigation system to deliver water to 146,300 acres of land in seven reservation districts (GRIC, 2008). Up to 41,000 AFA of Indian priority CAP water has been approved for lease to Phoenix AMA cities by the Tribal Council. A lease has been executed with the City of Phoenix, which used 15,000 acre-feet in 2009 (CAP, 2010). In 2009 the GRIC reported 322,514 acre-feet of water use including CAP, surface water, groundwater and effluent.

Pascua Yaqui Tribe

The Pascua Yaqui Tribe is composed of nine communities located in the Tucson, Phoenix and Pinal AMAs. The largest in terms of population is New Pascua, consisting of 1,152 acres of trust land located about 15 miles southwest of Tucson. New Pascua is recognized as the Pascua Yaqui reservation. The second largest community is Guadalupe located in the Town of Guadalupe southeast of Phoenix. Other communities in the Tucson AMA are: Old Pascua near downtown Tucson; Barrio Libre in the Town of South Tucson and Yome Pueblo in Marana. Other communities in the Phoenix AMA are Penjamo in Scottsdale and High Town in Chandler. Pinal AMA communities are located at Coolidge and Eloy (Pascua Yaqui Tribe, 2005).

There are 3,315 members of the Pascua Yaqui tribe at New Pascua (2000 Census), but many tribal members live off reservation in other communities in the planning area and also outside of Arizona. According to the Pascua Yaqui Tribe (2005), in July 2005 there were almost 7,700 tribal members in the nine communities with a total Arizona population of approximately 13,100. There is no irrigated acreage on the Pascua Yaqui Tribe reservation and land dedicated there for an industrial park currently remains vacant (NAU, 2008). There are two gaming facilities on the reservation and the 4,400 seat Anselmo Valencia Tori Amphitheater is southern Arizona's largest concert venue. The Pascua Yaqui tribe holds a CAP allocation for tribal homeland uses of 500 AFA (CAP, 2008).

Salt River Pima-Maricopa Indian Community (SRPMIC)

The Salt River Pima-Maricopa Indian reservation is located within the Phoenix AMA adjacent to the cities of Scottsdale, Fountain Hills, Mesa, Tempe and Phoenix. Lands within the 56,000-acre reservation are allocated for agriculture, industrial and commercial use, recreation, housing and desert preservation (NAU, 2008). The population of the reservation exceeds 6,200 and consists of members of the Pima and Maricopa tribes (2000 Census). There are 13,000 acres of irrigated lands with cotton, melons, potatoes, onions and carrots the primary crops. Commercial lands are largely located along Pima Road and the primary use is the 140-acre retail center, "The Pavilions". Other industrial uses include Cypress Golf Course (two nine-hole courses), Talking Stick Golf Club (a 36-hole course), a sand and gravel operation and a 200-acre landfill. There are two gaming facilities on the reservation, Casino Arizona at McKellips and Casino Arizona at Talking Stick.

The community holds a CAP allocation for irrigation use of 13,300 AFA (CAP, 2008). The SRPMIC has executed long-term leases of CAP water to the cities of Gilbert (4,088 AFA), Chandler (2,586 AFA), Glendale (1,814 AFA), Mesa (1,669 AFA), Scottsdale (60 AFA) and Tempe (60 AFA). Total average annual water demand was 86,600 AFA during 2001-2005.

<u>Tohono O'odham Nation</u>

The 2.8 million acre Tohono O'odham Nation is comprised of four separate reservations, with over 1.1 million acres within the planning area. There are 11 tribal districts within the reservations. The largest reservation, Tohono O'odham, is located across portions of the Pinal and Tucson AMAs as well as outside the AMAs. Tribal lands also extend south into Mexico. The Gila Bend Reservation (San Lucy District) is outside of the planning area in the Gila Bend Basin. The 71,095-acre San Xavier Reservation is located south of Tucson within the Tucson AMA. Its boundaries are coincident with the those of the San Xavier District. The smallest reservation is the 20-acre Florence Village located 2 miles west of Florence in the Pinal AMA.

There are almost 24,000 members of the Nation with just over 5,000 members residing within the planning area. Estimated annual water demand during 2001-2005 was approximately 26,800 acre-feet (ADWR, 2008). Industrial uses within the Nation include a 120-acre industrial park located within the San Xavier Reservation. The Nation operates two casinos in the planning area, both located south of Tucson; the Desert Diamond I-19 Casino and the Desert Diamond Casino.

Agriculture near San Xavier del Bac, Tucson AMA. The 71,095-acre San Xavier Reservation is located south of Tucson within the Tucson AMA.

The entire Tohono O'odham Nation holds a 74,000 acre-foot CAP allocation. The Southern Arizona Water Rights Settlement Act (SAWRSA) of 2004 (Title III of the Arizona Water Settlement Act) and the associated settlement agreement specified that the Nation was entitled to 79,200 acre-feet of water rights within the Tucson AMA for use on the San Xavier Reservation and the Eastern Schuk Toak District of the Tohono O'odham reservation. Of this total, 66,000 acre-feet is CAP water and 13,200 acre-feet is groundwater. The Nation may lease up to 15,000 acre-feet of CAP water to off-reservation users.

The Nation historically supplied groundwater from three wells to ASARCO's Mission Mine facility, which straddles the reservation boundary (see Figure 8.5-12). During 2001-2005 approximately 1,300 AFA was pumped from on-reservation wells and 5,000 acre-feet was pumped from off-reservation wells to serve the mine (ADWR, 2006c). Through SAWARSA, ASARCO agreed to decrease groundwater use and use up to 10,000 acre-feet of the Nation's CAP allotment. By 2009 almost 8,100 acre-feet of CAP water was delivered to the mine in lieu of groundwater pumping (CAP, 2010). The Nation accrues credits for the CAP water used at the Mission mine.

In addition to this in lieu CAP use, the Nation stored 15,000 acre-feet of its CAP allotment at the Pima Mine Road Recharge Facility in 2009 (CAP, 2010).

Approximately 2,900 acres of active farmland are irrigated on Tohono O'odham lands in the Tucson AMA including a 2,000-acre farm on the Eastern Schuk Toak District and a rehabilitated 880-acre San Xavier Cooperative farm (Edwards, 2008). In 2005, approximately 13,300 acre-feet of CAP water was used for agricultural irrigation on Tucson AMA tribal lands (ADWR, 2006c), but by 2009, this had increased to approximately 21,200 acre-feet on expanded irrigation projects on the San Xavier and Schuk Toak Districts. Another approximately 13,000 AFA of CAP water was used in the Chuichu and Vaiva Vo farming areas in the Pinal AMA during 2001-2005.

Yavapai-Prescott Indian Tribe

The Yavapai-Prescott Indian reservation covers approximately 1,400 acres and is located within the City of Prescott in the Prescott AMA. The tribe has approximately 180 members (2000 Census). Historical land uses included timber, mining and ranching, however, current tribal uses are business oriented. The tribe operates the 12-acre Sundog Industrial Park and the 250-acre Frontier Village shopping center. There are also two gaming facilities on the reservation; the Yavapai Bingo and Gaming Center and Bucky's Casino with the adjacent 160-room Prescott Resort and Conference Center (ITCA, 2008; NAU, 2008).

The Yavapai-Prescott Tribe received an original allocation of 500 acre-feet of CAP water that was relinquished in 1994 pursuant to a water rights settlement and acquired by the City of Scottdale in 1996 (CAP, 2008). Currently, the tribe is provided water by the City of Prescott, although they retain up to 1,000 acre-feet of annual surface water rights from Granite Creek.

Municipal Demand

Municipal, non-Indian demand is summarized by AMA and water supply in Table 8.0-12. Average annual demand during the 2001-2005 time-period was almost 1,264,000 acre-feet. Throughout the planning area, approximately 36% of the municipal demand was met with groundwater, 31% with surface water, 29% with CAP water and 4% with effluent (see Table 8.0-12) although the type of supplies utilized varies substantially among the AMAs. The Phoenix AMA is unique in that it meets the majority of its municipal demand with surface water from the CAP and the Salt and Verde river systems. Groundwater is the primary municipal water supply in the Pinal and Tucson AMAs. Effluent meets almost 7% of the Tucson AMA municipal demand; the largest percentage of any AMA.

Municipal supplies in the Prescott AMA are primarily groundwater, with smaller volumes of effluent and surface water also used. All of the municipal water supplies in the Santa Cruz AMA are considered groundwater.

A total of 55 water providers within the planning area each served more than 1,000 acre-feet of water, excluding effluent, in 2005 (see Table 8.0-13). Of these largest water providers, 34 are located in the Phoenix AMA and met 88% of

Table 8.0-12 Average annual municipal water demand in the AMA Planning Area in acre-feet (2001-2005)

Basin	Groundwater	Surface Water	CAP	Effluent	Total
Phoenix AMA	287,700	383,900	317,200	41,600	1,030,400
Pinal AMA	23,900	600	3,100	500	28,100
Prescott AMA	14,600	800	0	1,800	17,200
Santa Cruz AMA	7,800	0	0	0	7,800
Tucson AMA	123,900	100	44,300	12,200	180,500
Total Municipal	**457,900**	**385,400**	**364,600**	**56,100**	**1,264,000**

Notes: Does not include Indian municipal use

Within the Santa Cruz AMA, water is not separately defined as surface water or groundwater, therefore all volumes are reported as groundwater.

the Phoenix AMA potable municipal demand. The 12 largest water providers in the Tucson AMA met 96% of the AMA's potable municipal demand. In the other AMAs, the largest water providers met about three-fourths of the AMA's potable municipal demand in 2005.

Water providers fall primarily into two categories: private water companies and public water systems. Private water companies are regulated by the Arizona Corporation Commission (ACC), which oversees setting water rates in these service areas. Publicly owned systems are not regulated by the ACC and have the authority to enact water conservation ordinances and establish water rates as approved by the appropriate governing body. This authority may provide greater flexibility to manage water resources within their water service areas. Another type of water provider is a Domestic Water Improvement District (DWID), a county improvement district formed for the purpose of constructing or improving a domestic water delivery system or purchasing an existing domestic water delivery system. DWID's are governed by elected boards that have a variety of powers including setting fees, selling bonds and acquiring waterworks, but cannot enact ordinances.

There are regulatory requirements for all water providers within AMAs. Under the conservation programs in the AMA Management Plans, ADWR regulates water providers that annually serve more than 250 acre-feet of water for non-irrigation use as large municipal water providers. The Groundwater Code mandates that these conservation programs require reasonable reductions in per capita water use through time or implementation of conservation measures designed to reduce water use within the service area. The Code also requires that reasonable conservation requirements be established for small municipal water providers.

Golf Course Demand

Pursuant to the Groundwater Code, water provided directly to a golf course by a water provider is categorized as municipal use and is calculated as part of the overall municipal demand. Groundwater that is withdrawn by the facility itself, through its own wells, is categorized as industrial use. Data from both municipal and industrial golf courses are shown in Table 8.0-14. Golf courses used approximately 129,900 acre-feet of water in 2006. Each AMA within the planning area has golf course demand; however, there are significant differences in the number of golf courses within each AMA and the sources of water used to supply them.

Some golf courses receive effluent, surface water and CAP water either through direct delivery or via recovery of stored water, and these volumes may or may not be calculated within

Table 8.0-13 Water providers serving a minimum of 1,000 acre-feet of water annually (excluding effluent) in the AMA Planning Area

AMA	Water Provider	1990 (AF)	2000 (AF)	2005 (AF)
Phoenix	City of Phoenix	268,598	304,293	285,301
Phoenix	City of Mesa	71,023	101,359	89,614
Phoenix	City of Scottsdale	43,317	79,479	77,018
Phoenix	City of Chandler	24,433	49,371	53,294
Phoenix	City of Glendale	33,484	49,382	47,590
Phoenix	City of Tempe	50,748	62,977	45,789
Phoenix	Town of Gilbert	7,838	30,029	36,929
Phoenix	City of Peoria	10,691	23,514	22,485
Phoenix	Arizona-American Water Co. - Sun City System	13,271	13,076	14,128
Phoenix	Arizona Water Co. - Apache Junction System	3,725	10,627	11,396
Phoenix	Arizona-American Water Co. - Paradise Valley System	8,369	11,069	10,901
Phoenix	Arizona-American Water Co. - Agua Fria System	841	4,952	10,517
Phoenix	City of Avondale	3,072	5,653	9,893
Phoenix	Litchfield Park Service Company	1,940	3,982	8,651
Phoenix	Chaparral City Water Company	2,716	6,363	7,248
Phoenix	Johnson Utilities Company	N/A	N/A	6,168
Phoenix	Pima Utilities Company	3,274	5,526	6,055
Phoenix	Queen Creek Water Company	669	2,063	5,369
Phoenix	Arizona-American Water Co. - Sun City West System	4,269	6,250	5,336
Phoenix	City of El Mirage	1,686	3,360	5,312
Phoenix	City of Surprise	N/A	821	4,696
Phoenix	City of Goodyear	1,030	2,570	4,384
Phoenix	City of Tolleson	1,477	2,920	3,269
Phoenix	Rio Verde Utilities, Inc.	1,173	2,711	2,915
Phoenix	H2O Water Company	N/A	417	2,000
Phoenix	New River Utility Company	7	983	1,877
Phoenix	Apache Junction Facilities District	761	1,611	1,732
Phoenix	Luke Air Force Base	1,622	1,701	1,549
Phoenix	Cave Creek Water Company	736	1,406	1,482
Phoenix	Rose Valley Water Company	114	915	1,426
Phoenix	Berneil Water Company	729	1,194	1,216
Phoenix	Valencia Water Company	N/A	315	1,032
Phoenix	Carefree Water Company	1,281	1,000	1,022
Phoenix	Sunrise Water Company	N/A	709	1,020
Pinal	Arizona Water Co. - Casa Grande System	7,381	10,411	14,903
Pinal	City of Eloy	2,223	2,211	2,037
Pinal	Santa Cruz Water Company	N/A	N/A	1,977
Pinal	Arizona Water Co. - Coolidge System	1,305	1,646	1,678
Pinal	Town of Florence	797	1,999	1,606
Prescott	City of Prescott	5,014	7,339	7,862
Prescott	Prescott Valley Water District	1,795	3,895	4,945
Santa Cruz	City of Nogales	4,529	4,375	4,666
Santa Cruz	Rio Rico Utilities	678	1,756	2,377
Tucson	City of Tucson	95,519	117,656	123,456
Tucson	Town of Oro Valley[1]	2,731	9,085	10,468
Tucson	Metro Domestic Water Improvement District	7,190	8,642	8,713
Tucson	Green Valley Domestic Water Improvement District[2]	1,918	2,225	3,227
Tucson	Flowing Wells Irrigation District	2,646	2,879	2,901
Tucson	Community Water Co. of Green Valley	1,713	2,448	2,854
Tucson	Lago Del Oro Water Co.	422	2,220	2,702
Tucson	Town of Marana	N/A	544	1,670
Tucson	Davis-Monthan Air Force Base	1,755	1,423	1,370
Tucson	University of Arizona	1,631	1,516	1,350
Tucson	Avra Water Co-op	534	1,027	1,097
Tucson	Metro Water District-Hub	872	1,105	1,054

[1] formerly Canada Hills Water Company

[2] formerly Green Valley Water Company

a water provider's deliveries. Other unique situations also exist. For example, in the Santa Cruz AMA, the Palo Duro Golf Course receives water from municipal wells but it also receives remediated poor-quality water from the United Musical Instruments RCRA remediation site.

Phoenix AMA

For the 2001-2005 time-period, the annual municipal demand in the Phoenix AMA, excluding Indian demand, averaged 1,030,400 acre-feet. Municipal water demand has become the AMA's major non-Indian demand sector and is steadily growing. Approximately 59% of the potable municipal demand is located within the cities of Phoenix, Mesa, Scottsdale, Chandler, Glendale and Tempe.

In addition to public and private water companies, water for municipal use, including urban irrigation, is provided by water districts and water users associations. A number of systems are defined as "untreated water providers" in the Phoenix AMA. As shown in Table 8.0-15 the largest of these systems include SRP, Roosevelt Water Conservation District (RWCD) and Queen Creek Water Company. During the 2001-2005 time-period these systems provided an average of 135,800 acre-feet of water per year for urban irrigation.

The largest untreated water provider by far is SRP, which operates an extensive water delivery system that includes portions of Glendale, Peoria, Phoenix, Scottsdale, Tempe, Chandler, Gilbert and Mesa. Its eight canals deliver Salt and Verde river water, supplemented by groundwater, to municipal and agricultural users. It also wheels other types of water, including CAP water, through its system. In addition to providing untreated water for urban irrigation, the SRP system is connected to eight municipal water treatment plants for delivery of potable water through municipal water systems.

The largest water provider in the Phoenix AMA is the City of Phoenix, which delivered 285,301 acre-feet of water in 2005. Its service area covers more than 500 square miles and serves a population in excess of 1.5 million (2006 estimate). The City of Phoenix water system also provides water to a portion of the Town of Paradise Valley. The water system for the City of Phoenix includes four primary sources of supply: surface water from the Salt and Verde river systems provided by the SRP (54%); CAP water (36%); groundwater (3%); and effluent (7%) from three treatment facilities. The total potable system capacity is currently more

Table 8.0-14 Water use by golf courses in 2006[1]

AMA	# of Golf Courses	# of Holes	# Acres	Water Demand (AF)	Water Supply
Phoenix	184	3,533	18,946	99,000	Groundwater (45%)
					Surface water (18%)
					CAP (14%)
					Effluent (23%)
Pinal	12	180	N/A	4,900[1]	Groundwater (31%)
					CAP (25%)
					Effluent (21%)
Prescott	6	108	N/A	3,000	Groundwater (30%)
					Effluent (70%)
Santa Cruz	4	72	535	2,000	Groundwater (97%)[2]
					Remediated water (3%)
Tucson	43	838	4,312	21,000	Groundwater (47%)
					Surface water (2%)
					CAP (3%)
					Effluent (48%)

[1]Golf course water demand includes both industrial courses and those served by municipal providers.

[2] Within the Santa Cruz AMA water is not separately defined as surface water or groundwater so all volumes are reported as groundwater.

than 780,000 acre-feet with a planned expansion to 1.2 maf. Major system components include five surface water treatment plants (Verde River, 24th Street, Deer Valley, Valley Vista and Union Hills); the Granite Reef Diversion Dam interconnect facility; a groundwater well system that includes 30 active wells; and more than 6,000 miles of water mains (City of Phoenix, 2005).

The City of Phoenix utilizes reclaimed water from the Cave Creek Water Reclamation Plant to irrigate turf in northeast Phoenix and provides reclaimed water from the 91st Avenue WWTP, through the Tres Rios Wetlands Project, to the Buckeye Irrigation Company and the Palo Verde Nuclear Generating Station for cooling purposes. The City also provides reclaimed water from the 23rd Avenue WWTP to the Roosevelt Irrigation District for agricultural irrigation. The volume of reclaimed water available exceeds demand and the City is developing ways to fully utilize this water source. (City of Phoenix, 2005)

The cities of Mesa, Scottsdale, Chandler and Tempe, all located in the East Salt River Valley Sub-basin and Glendale in the West Salt River Valley Sub-basin, each served over 45,000 acre-feet of water in 2005 (see Table 8.0-13). The City of Mesa was the second largest provider in the AMA, serving over 89,000 acre-feet of water in 2005. The western part of the Mesa service area is within the SRP and RWCD boundaries and receives Salt and Verde river water. Approximately half of Mesa's demand is supplied by SRP and 11% by RWCD. Mesa utilizes a variety of other water supplies including groundwater, CAP water, SRPMIC lease water and effluent (City of Mesa, 2004).

Table 8.0-15 Large untreated water providers in the Active Management Areas

AMA/Water Provider	2000 (acre-feet)	2003 (acre-feet)	2005 (acre-feet)
Phoenix AMA			
Salt River Project	110,454	90,630	108,839
Roosevelt Water Conservation District	9,815	48,253	12,702
Queen Creek Water Company	1,494	2,345	3,619
Arcadia Water Company	3,859	3,619	3,404
Turner Ranches Water and Sanit. Co	2,764	2,689	3,342
Chandler Heights Citrus Irr Dist	4,196	4,868	3,224
Roosevelt Irrigation District	2,138	2,035	3,086
Peninisula Ditch Co	10,775	8,773	2,222
Sunburst Farms Irrigation Dist	2,269	2,142	1,861
Clearwater Farms	1,338	225	1,437
Ranchos Jardines Irr/Del/Dist	925	1,074	1,193
Sunburst Farms East	583	598	654
Western Meadows Irrigation	419	372	391
Mc Cormick Ranch Prop Own Assn	424	356	385
Maricopa Water District	705	311	311
Sunburst Farms West Mutual Wtr	411	313	282
Orangewood Farms	177	409	213
Gila Buttes Water Users Assoc.	184	211	212
McDowell Water Co	219	155	146
AMA TOTAL	**153,149**	**169,379**	**147,525**
Pinal AMA			
San Carlos Irrigation and Drainage District	262	243	599
Evergreen Irrigation District	115	127	108
AMA TOTAL	**377**	**369**	**708**

City of Phoenix, Phoenix AMA. The largest water provider in the Phoenix AMA is the City of Phoenix, which delivered 285,301 acre-feet of water in 2005.

The City of Scottsdale delivered approximately 77,000 acre-feet of water in 2005. About 48% of the City's demand is met with CAP water and 47% by groundwater. Less than 5% of its water supply is SRP surface water. Scottsdale operates the Scottsdale Water Campus that treats wastewater and CAP water. Wastewater is treated to irrigation standards for use at golf courses, and when irrigation needs are reduced in the winter, the wastewater is treated to drinking water standards and recharged to the aquifer via injection wells. (City of Scottsdale, 2007 and ADEQ, 2008b)

The City of Chandler was the fourth largest water provider in the Phoenix AMA in 2005; delivering over 58,000 acre-feet of water. Chandler's municipal water system serves more than 75,000 commercial, institutional and residential customers. In 2005 water supplies include Salt and Verde river water delivered by SRP and RWCD, CAP water, groundwater and effluent. The proportion of water pumped or received from other systems was 67% SRP, 14% CAP and 18% groundwater. At build-out, Chandler predicts that supplies will consist of: 65% SRP, 2% storage, 27% CAP and 6% groundwater. (City of Chandler, 2008). Chandler delivered approximately 3,900 acre-feet of effluent to turf facilities in 2006 and recharged another 7,500 acre-feet.

The City of Glendale was the fifth largest water provider in the Phoenix AMA in 2005; serving approximately 47,600 acre-feet of water. In that year, approximately 56% of the supply was SRP surface water, 43% CAP water and 1.5% groundwater. Part of Glendale's CAP supply is SRPMIC settlement water including a 99-year lease for 1,800 acre-feet. In addition, approximately 3,000 acre-feet of effluent was delivered to turf facilities and 9,400 acre-feet of effluent was recharged. Chandler also stores CAP water. Approximately 76% of deliveries are to residential customers.

The City of Tempe delivered approximately 45,800 acre-feet of water to customers in 2005. Most of its water supply is surface water from the SRP. Groundwater provides from 1% to 7% of the total supply depending on surface water availability. In 2005, about 7% of Tempe's water demand was met by groundwater. (City of Tempe, 2006)

Pinal AMA

For the 2001-2005 time-period, the average annual municipal demand in the Pinal AMA, excluding Indian demand, was 28,100 acre-feet. Average annual municipal demand has increased 29% over the 1995-2000 time-period spurred by a population that grew by 65% from 2000-2006. However, municipal demand is still a relatively small percentage of demand, accounting for less than 3% of the AMA non-Indian demand during 2001-2005.

There are five population centers within the Pinal AMA: Casa Grande, Coolidge, Eloy, Florence and Maricopa. The fastest population growth occurred in the Casa Grande area where more than half of the municipal demand is located. Approximately 85% of the municipal demand is met with groundwater, although four water providers serving these population centers hold CAP allocations sufficient to meet almost 50% of the 2006 municipal demand. The lack of water treatment facilities to treat CAP water for potable use is currently a limiting factor to utilization of this supply (City of Casa Grande, 2001).

The largest water provider in the Pinal AMA is a private water company, Arizona Water Company - Casa Grande System (AWCCG), that supplied 14,900 acre-feet of water to Casa Grande and the surrounding area in 2005. The AWCCG service area is about 140 square miles with a distribution system consisting of approximately 466 miles of pipes. The primary source of supply used by the AWCCG is groundwater withdrawn from 15 active wells. The AWCCG also provides untreated CAP water to two private golf courses and an electric power plant within its service area. In addition, the City of Casa Grande WWTP delivers effluent to the power plant and the City's municipal golf course. The treatment plant produces approximately 2,800 acre-feet of effluent per year.

The City of Eloy pumps groundwater and receives CAP water to serve its customers. In 2005 the utility delivered approximately 570 acre-feet of CAP water to turf-related facilities, 1,000 acre-feet of groundwater to residential customers and 500 acre-feet of groundwater to non-residential customers of which 360 acre-feet was effluent. The Santa Cruz Water Company serves most of the Town of Maricopa. In 2005 it served 1,200 acre-feet of groundwater to over 6,000 single family units, 300 acre-feet to commercial/construction and 500 acre-feet to landscape irrigation. By 2008, service area water use had more than doubled to over 5,000 acre-feet including 3,600 acre-feet to 16,000 single family units. In that year, almost 1,800 acre-feet of effluent was received from the Palo Verde WWTF, almost all of which was used for landscape irrigation. The Arizona Water Company Coolidge System pumped almost 1,700 acre-feet of groundwater in 2005 to serve primarily residential customers (1,115 acre-feet). The Town of Florence serves groundwater to over 3,600 residential units, three Arizona State Prison facilities and other non-residential uses. More than 78% of its deliveries are typically to non-residential customers. In 2005 pumpage was 1,606 acre-feet.

Prescott AMA

For the 2001-2005 time-period, the average annual municipal demand in the Prescott AMA was 17,200 acre-feet. This includes Indian demand as the Yavapai-Prescott Indian Tribe currently receives potable water from the City of Prescott. The Prescott AMA continues to experience an increase in municipal water use and a decrease in agricultural demand.

Casa Grande City Hall, Pinal AMA. The largest water provider in the Pinal AMA is a private water company, Arizona Water Company - Casa Grande System (AWCCG), that supplied 14,900 acre-feet of water to Casa Grande and the surrounding area in 2005.

Municipal demand accounted for 72% of water use within the AMA and demand is met primarily with groundwater, comprising 85% of the supply. Effluent met 10% and surface water 5% of the demand during 2001-2005.

The "tri-cities" of Prescott, Prescott Valley and Chino Valley are the population centers of the Prescott AMA, with Prescott and Prescott Valley accounting for nearly 75% of the municipal deliveries. The largest water provider in the Prescott AMA is the City of Prescott, which supplied almost 7,900 acre-feet of groundwater in 2005 to a service area that covers approximately 50 square miles. Although groundwater is the primary source of water used to meet municipal demand, the City also holds surface water rights, including recently purchased rights to surface water stored in Watson and Willow lakes. Due to the lack of a surface water treatment facility, any use of surface water is conducted through underground recharge and recovery. In 2005, the City of Prescott recovered 1,547 acre-feet of surface water and 23 acre-feet of effluent storage credits and delivered approximately 1,400 acre-feet of effluent to primarily turf facilities. In addition, it accrued over 2,900 acre-feet of effluent storage credits that year.

The second largest water provider in the Prescott AMA is the Prescott Valley Water District, which supplied more than 4,400 acre-feet of groundwater in 2005. In 2005, the District delivered over 300 acre-feet of effluent for golf course use and accrued approximately 1,090 acre-feet of effluent storage credits at the Agua Fria Recharge Facility. The Town of Chino Valley and the newly incorporated town of Dewey-Humboldt meet most of their municipal demand through small private domestic (exempt) wells.

Santa Cruz AMA

For the 2001-2005 time-period, the average annual municipal demand in the Santa Cruz AMA was 7,800 AFA. There is no Indian

City of Prescott, Prescott AMA. The largest water provider in the Prescott AMA is the City of Prescott, which supplied almost 7,900 acre-feet of groundwater in 2005 to a service area that covers approximately 50 square miles.

demand within this AMA. Similar to the other AMAs, the Santa Cruz AMA is experiencing an increase in municipal demand; however, it is still secondary to agricultural demand. Municipal demand accounted for 35% of the total demand with the two primary demand centers served by the City of Nogales and Rio Rico Utilities.

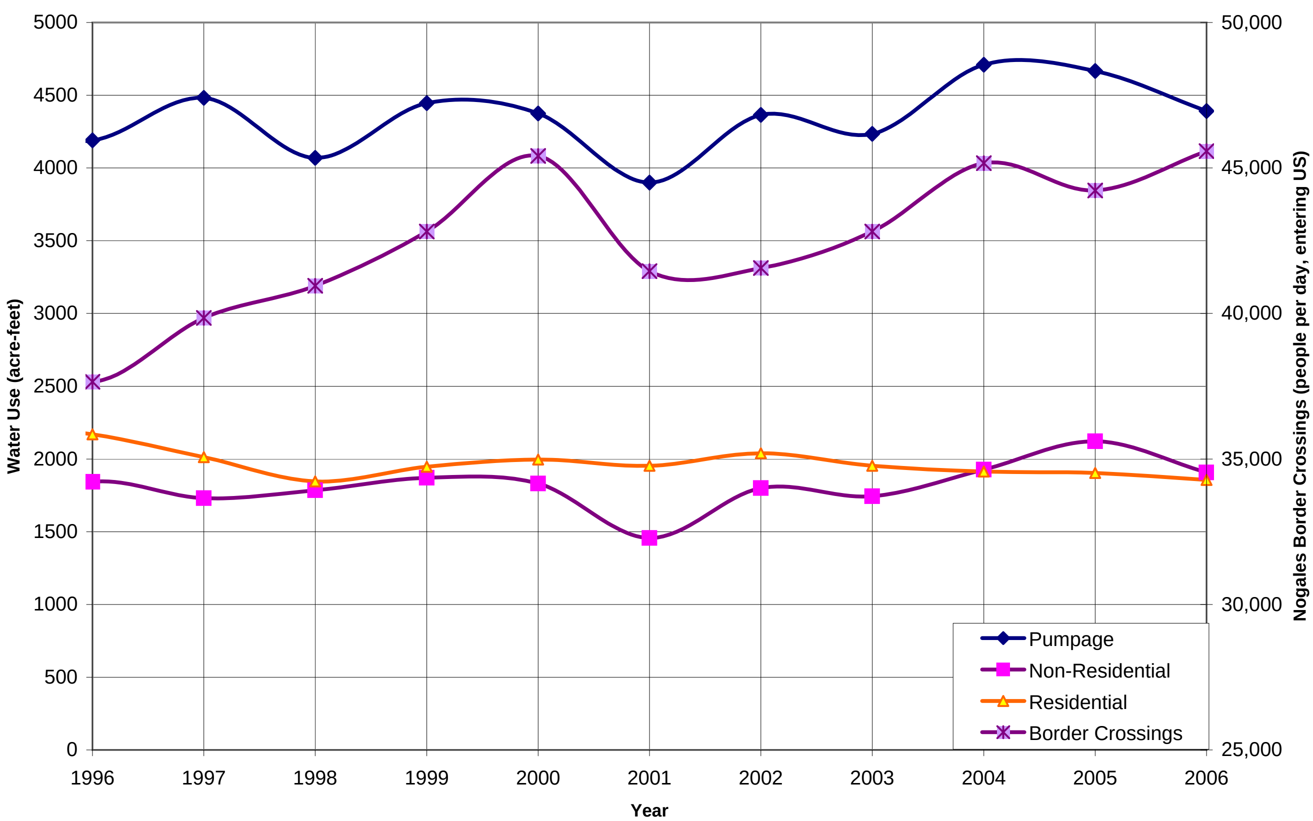
The City of Nogales is the largest water provider and withdrew almost 4,700 acre-feet to serve its customers in 2005. Its service area is located along the international border both east and west of Interstate 19, encompasses approximately 20 square miles, and includes areas both inside and outside the city limits. Nogales currently has a Designation of AWS, with an aggregate volume of 6,322 AFA in normal years, and 5,473 AFA in a drought year. Total pumpage by Nogales has fluctuated, with a slight increase during the period 1996-2006 (Figure 8.0-21). Fluctuations can be related to a number of factors including: the number of border crossings, weather conditions, distribution system problems, and record-keeping changes. Nogales withdrew water from 14 wells in 2005, including an infiltration gallery along the Santa Cruz River and the Potrero well field located west of Nogales.

Municipal water uses consist of residential demand, produce storage and processing, tourist service use, and light manufacturing. Two turf-related facilities, Palo Duro and Kino Springs golf courses, use water supplied by the City of Nogales. Residential demand has slightly decreased, while non-residential demand has increased since 1996. Nogales has a relatively high gallon per capita per day (GPCD) rate due in part to the greater proportion of non-residential water demand (approximately 1:1 with residential use). Part of this non-residential demand is due to water uses associated with the large number of people who cross the border from Nogales, Sonora into Nogales, Arizona each day. Annual non-residential demand trends closely track the number of border crossings reported by U.S. Customs and Border Patrol; in particular, a reduction in crossings due to increased border security measures implemented in 2001 corresponds to a steep drop in demand. Overall, the number of border crossings into Arizona at the Nogales ports of entry rose 21% from 1996-2006 (see Figure 8.0-21).

Tucson AMA

For the 2001-2005 time-period, the total annual municipal demand in the Tucson AMA averaged 180,500 acre-feet, excluding Indian demand. Municipal demand accounted for 55% of the total non-Indian demand during that period, approximately 69% of which was met with groundwater supplies. Generally, surface water sources are limited within the Tucson AMA and CAP water is the most abundant renewable supply available. While a number of large providers in the Tucson AMA have a CAP allocation (see Appendix B), many do not have physical access to the supply and currently none are serving it directly. A growing number of providers are using all or a portion of their CAP allocations through storage and recovery. These include City of Tucson (Tucson Water), Metropolitan Domestic Water Improvement District, Town of

Figure 8.0-21 City of Nogales, Arizona Water Use and Border Crossings, 1996-2006



Source: Kilb, 2008

Oro Valley, Green Valley Domestic Water Improvement District and Vail Water Company.

With the exception of Tucson Water, municipal providers in the Tucson AMA that are designated as having an assured water supply rely to a significant extent on the Central Arizona Groundwater Replenishment District (CAGRD) to recharge CAP water to offset groundwater pumping. This allows designated providers to meet the AWS requirement that water use be consistent with the safe-yield goal of the AMA.

Average annual effluent demand in the AMA averaged approximately 12,200 acre-feet during the 2001-2005 time-period. In 2006, golf courses in the City of Tucson and Oro Valley area consumed approximately 10,000 acre-feet of the 16,830 acre-feet of reclaimed water that was used directly (see Table 8.0-14). The remainder was served to parks, schools and individual homeowners (City of Tucson Water Department, 2007).

Population centers in the AMA include the central Tucson area, north Tucson/Oro Valley, Marana and the Sahuarita/Green Valley area. The central Tucson area is the largest demand center, accounting for approximately 77% of the Tucson AMA municipal demand. This area is served primarily by the City of Tucson Water Department, the largest municipal water provider in the AMA. In 2005 it served over 123,400 acre-feet of water to its customers within a service area approximately 300 square miles in size. The City's system includes both a potable and non-potable (reclaimed) system. (City of Tucson, 2004) In 2006, Tucson Water's demand was met with 47% groundwater, 43% CAP water and 10% effluent.

Until the 1990s, Tucson Water relied solely on groundwater and a relatively small volume of effluent for its supply, although it currently has a CAP allotment of 144,000 acre-feet. In 1992,

Sweetwater Recharge Facility, Tucson AMA. In addition to direct delivery of reclaimed water deliveries through the non-potable system, the City of Tucson recharges a portion of its effluent.

Tucson Water began direct delivery of CAP water to residential customers. Those deliveries were discontinued in 1994 due to aesthetic issues and delivery problems. In 1995, a voter-approved initiative restricted Tucson Water from delivering treated CAP water directly. In response to this initiative, Tucson Water chose to recharge the CAP water and then deliver the recovered water to customers. In 1996, Tucson Water began operation of the Central Avra Valley Storage and Recovery Project (CAVSRP) permitted to store 100,000 acre-feet of water per year. In 2008, a second recharge facility, the 60,000 acre-foot Southern Avra Valley Storage and Recovery Project (SAVSRP), was completed (see Figure 8.5-9). A series of recovery wells has been constructed in conjunction with each of these recharge sites with the anticipation that Tucson Water will eventually be able to store and recover its entire CAP allocation.

Tucson Water also relies on effluent to meet demand and offset the use of groundwater. In 2000, reclaimed water use accounted for 8% of Tucson Water's total demand (City of Tucson, 2004). By 2005 effluent accounted for almost 10% of demand. By 2009, 17,249 acre-feet of effluent was delivered to customers including 18 golf courses, 39 parks, 52 schools and 700 single-family homes for landscaping (Tucson Water, 2009). In addition to direct delivery of reclaimed water through the non-potable system, the City of Tucson recharges a portion of its effluent.

In addition to Tucson Water, 11 water providers in the Tucson AMA each served over 1,000 acre-feet of water in 2005. North and northwest of the Tucson Water service area the largest providers are the Town of Oro Valley, which served approximately 10,500 acre-feet in 2005, and Metropolitan Domestic Water Improvement District's main system (Metro-Main), which served over 8,700 acre-feet in the same year. The Town of Oro Valley is the second largest municipal provider in the AMA based on the amount of water served. In 2005, it accounted for almost 6% of the municipal demand. Historically, the Town of Oro Valley relied exclusively on groundwater. In 2005, it added CAP water to its supply and began using reclaimed effluent to serve golf courses. In 2005, it served 473 acre-feet of recovered CAP and delivered 184 acre-feet of effluent. Metro-Main is the third largest provider in the AMA, accounting for almost 5% of the municipal demand in 2006. Metro-Main has used a high percentage of CAP water since 2003. By 2006, 98% of Metro-Main's demand was met with recovered CAP water.

Northwest of Tucson, the rapidly growing Marana area is primarily served by the Town of Marana Municipal Water System (MWS). Part of the Town of Marana is also served by the Tucson Water system. In 2005 Marana MWS withdrew 944 acre-feet of groundwater and received 737 acre-feet of groundwater and surface water from the Cortaro Water Users Association. West of Marana, the Avra Water Coop served almost 1,100 acre-feet to customers north of Saguaro National Park West in 2005.

In the Sahuarita/Green Valley area the two largest providers have historically been the Green Valley Domestic Water Improvement District (Green Valley DWID) and the Community Water Company of Green Valley. These two providers served a total of 6,081 acre-feet of primarily groundwater to customers in 2005. In 2005, Green Valley DWID indirectly used 565 acre-feet of untreated CAP water for golf course irrigation through recovery of storage credits.

Agricultural Demand

The planning area includes AMAs where agriculture is the predominant demand sector, as well as AMAs with relatively little agricultural use. Total annual average non-Indian agricultural demand for the 2001-2005 time-period was 1,786,800 acre-feet (see Table 8.0-16). Agricultural demand is highest in the Phoenix and Pinal AMAs where it recently accounted for almost 44% and 95%, respectively, of the total non-Indian demand.

Agricultural water use within AMAs is subject to Groundwater Code regulations that limit groundwater use for irrigation purposes in several ways. Within the AMAs, there is a prohibition on new irrigated lands, and management plan conservation requirements set maximum annual groundwater allotments. The maximum annual groundwater allotment for an irrigation right is determined by multiplying the irrigation water duty by the farm acres. The irrigation water duty is the annual amount of water (in acre-feet per acre) that is reasonable to apply to land to produce the crops historically grown (during the years 1975 to 1980) divided by an assigned irrigation efficiency. To be in compliance with management plans, irrigation efficiency must improve through time. Under the management plans, agricultural water users may participate in alternative conservation programs such as the historic cropping program or a best management practices (BMP) program. All agricultural conservation programs are required to use water efficiently.

Due to the AMA regulations that restrict new irrigated acres and require improved efficiencies, agricultural demand should not significantly increase within the AMAs as may occur in non-AMA planning areas. Additionally, as the AMA population centers grow, urbanization is expected to result in a decrease in agricultural demand over time. This decrease is evident in the Phoenix AMA where over 130,000 acres of agricultural land have been urbanized since 1984.

The AMA Planning Area includes two of the largest agricultural areas in Arizona, Pinal and Maricopa counties, located in the Pinal and Phoenix AMAs, respectively. Only Yuma County is larger in terms of agricultural production and water use. Crops grown in Maricopa County include (in order of harvested acres for 2003) alfalfa hay, upland cotton, wheat, principal vegetables (includes lettuce, broccoli, cauliflower, onion, and melons), barley, citrus, other hay and corn for grain. Annual agricultural sales in Maricopa County were over $740 million in 2003. In Pinal County, the crops grown include (in order of harvested acres for 2003) upland cotton, alfalfa hay, durum wheat, barley, corn for grain, other hay, and Pima cotton. Annual agricultural sales in Pinal County were over $424 million in 2003. (NASS, 2008)

Table 8.0-16 Average annual agricultural demand in the AMA Planning Area (excluding Indian demand)

	1991-1995 (acre-feet)	1996-2000 (acre-feet)	2001-2005 (acre-feet)
Phoenix AMA			
Groundwater	437,100	447,000	354,500
Surface Water	467,700	275,000	183,100
CAP	121,000	293,700	273,000
Effluent	30,000	28,200	28,200
Total	**1,055,800**	**1,043,900**	**838,800**
Pinal AMA			
Groundwater	299,100	398,600	379,400
Surface Water	162,600	99,900	60,300
CAP	269,600	373,800	391,700
Effluent	2,800	1,500	1,700
Total	**734,100**	**873,800**	**833,100**
Prescott AMA			
Groundwater	5,600	5,400	3,500
Surface Water	9,500	3,100	400
Effluent	0	200	1,400
Total	**15,100**	**8,700**	**5,300**
Santa Cruz AMA			
Groundwater	11,400	13,500	13,000
Total	**11,400**	**13,500**	**13,000**
Tucson AMA			
Groundwater	85,000	82,300	76,400
CAP	3,000	23,400	20,200
Effluent	2,600	1,400	0
Total	90,600	**107,100**	**96,600**
Total All AMAs	**1,907,000**	**2,047,000**	**1,786,800**

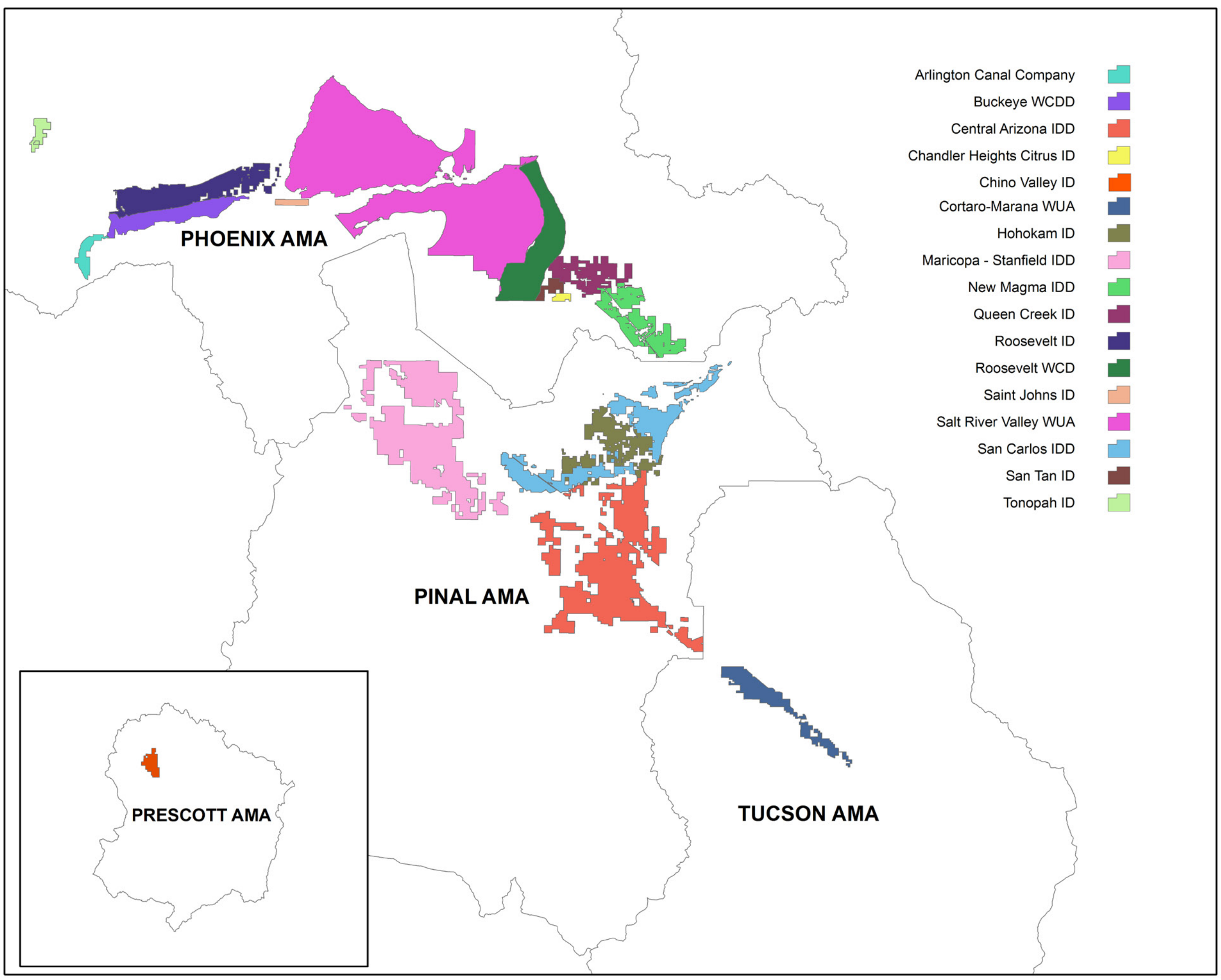
Notes:
Within the Santa Cruz AMA water is not separately defined as surface water or groundwater, therefore all volumes are reported as groundwater.

There are currently 39 irrigation districts within four of the AMAs: Phoenix AMA (33); Pinal AMA (4); Prescott AMA (1); and Tucson AMA (1). Figure 8.0-22 shows the general location of the largest irrigation districts.

The sources of water used for irrigation differ widely across the planning area. Due to regulations on agricultural water use within the AMAs as well as supply cost and availability, some irrigation districts utilize different water sources to ensure that they remain in compliance with conservation requirements. Overall, the sources of water available for irrigation are groundwater, CAP water, effluent, surface water, tailwater and in lieu water.

In lieu water is a renewable water supply, typically CAP water, that is delivered by a water storer to a groundwater savings facility (GSF), often a farm or irrigation district, pursuant to permits issued under A.R.S. § 45-812.01. The in lieu water is used in an AMA or an irrigation non-expansion area (INA) by the recipient (agricultural water user) on a gallon-for-gallon substitute basis for groundwater that otherwise would have been pumped from within that AMA or INA. In lieu water is included as CAP water demand in the Atlas. Water supplies used by the AMA agricultural sector are shown in Figure 8.0-23. During the period 2001-2005, approximately 46% of the agricultural demand in the AMAs was met by groundwater, 38% by CAP water, 14% by surface water and 2% by effluent.

Figure 8.0-22 Large Irrigation Districts in the AMA Planning Area

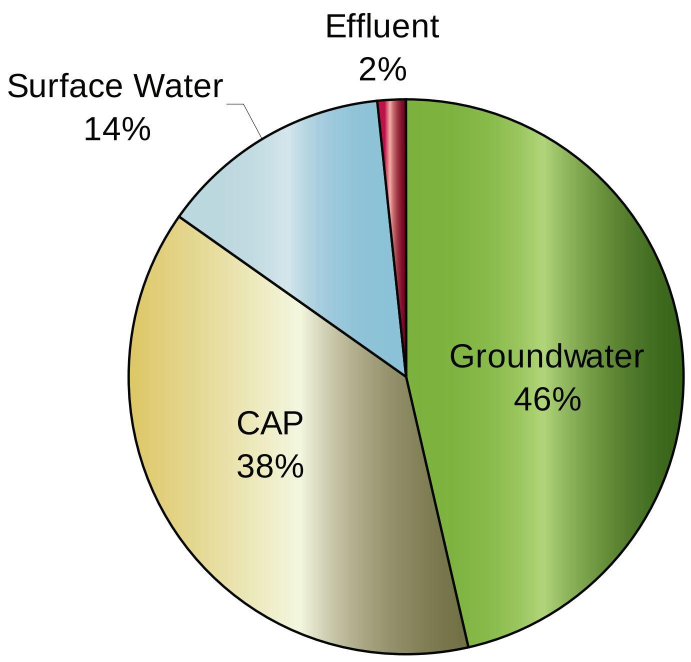


Water that runs off the end of the field after irrigation is called tailwater and is used most frequently in the Phoenix AMA. Irrigators benefit by capturing and reusing this runoff because while the first application of water is counted within the allotment given to agricultural rightholders, if tailwater can be collected and re-used in any way, the second (and subsequent) applications of water do not count against the allotment. Use of tailwater is a component of the Agricultural BMP conservation program previously mentioned.

Phoenix AMA

Average non-Indian agricultural demand in the Phoenix AMA for the 2001-2005 time-period was 890,200 AFA, or 50% of the total non-indian agricultural demand in the planning area. Agricultural water demand decreased over the last decade. The majority (approximately 80%) of this demand is associated with seven of the largest irrigation districts: Salt River Valley WUA (or SRP), Roosevelt Irrigation District (RID), Roosevelt Water Conservation District (RWCD), Buckeye Water Conservation and Drainage District (Buckeye), New Magma Irrigation and Drainage District (NMIDD), Maricopa Water District and Queen Creek Irrigation District. Most irrigated lands are located in the central and south-central portions of the AMA (see Figure 8.0-22). Water supplies used to meet agricultural demand include groundwater, CAP water (including in leiu), surface water and effluent. All seven of the largest irrigation districts utilize at least three different water supplies. The largest irrigation district within the Phoenix AMA is SRP.

Figure 8.0-23 Average Agricultural Water Supplies Used in the AMA Planning Area 2001-2005



Analysis of agricultural water demand trends of five Phoenix AMA irrigation districts shows an overall decrease in water use of approximately 11,500 AFA between 1984 and 2002. This decrease has varied spatially due to the proximity of agricultural lands to urban areas and the availability and cost of water supplies. Agricultural lands in the SRP service area decreased by more than 50% from 1984 to 2002 with an associated reduction in demand of approximately 9,800 AFA. RWCD, also located near the Phoenix metropolitan area, experienced similar declines, though not as pronounced as SRP. Demand within the RID, located on the western edge of the Phoenix metropolitan area, has been stable, likely due to increased utilization of effluent and changes in crop type. Buckeye, located south of and adjacent to RID, is in a waterlogged area and requires pumping and disposal of excess water. Water demand has increased within RID, likely due to increased farming to offset reductions in production in other parts of the AMA. Similarly, demand increased within the NMIDD, located in the southeastern part of the AMA. The increase is likely related to the availability of Colorado River water and, like RID, increased farming to offset reductions in production due to urbanization. (Hetrick and Roberts, 2004)

Pinal AMA

Non-Indian agricultural demand in the Pinal AMA for the 2001-2005 time-period averaged approximately 833,100 AFA, or 46.6% of the total agricultural demand in the planning area. Agricultural water demand has remained relatively constant in the Pinal AMA with a 15-year average water use of approximately 778,000 AFA. However, there has been a significant shift in the source of supply (see Table 8.0-16). Prior to CAP water availability in the AMA (approximately 1987) almost all agricultural demand was met with groundwater or surface water supplies from the Gila River. During 2001-2005, approximately 391,700 acre-feet of CAP water was used to meet demand.

The majority (approximately 87%) of agricultural demand in the AMA is associated with four large irrigation districts: Central Arizona Irrigation and Drainage District (CAIDD), Maricopa-Stanfield Irrigation and Drainage District (MSIDD), Hohokam Irrigation and Drainage District (HIDD), and San Carlos Irrigation and Drainage District (SCIDD). Most irrigated lands are located in the northern half of the AMA (see Figure 8.0-22). Groundwater is pumped to supplement CAP deliveries in CAIDD, MSIDD and HIDD and surface water in SCIDD, up to the total amount of water allotted annually to the farms in each district. SCIDD receives and distributes surface water from the Gila River pursuant to the Globe-Equity Decree.

The largest irrigation district within the Pinal AMA is MSIDD. The MSIDD was organized in 1962 to obtain supplemental water from the CAP. Construction of all CAP facilities in the district was completed in 1989. The district operates the Santa Rosa Canal, 78 miles of main conveyance canals, 116 miles of lateral canals and pipelines and 484 irrigation wells. MSIDD does not own the individual irrigation wells but leases them from the landowners; only 80 are directly connected to MSIDD's distribution system. District boundaries encompass approximately 148,000 acres, 89,000 acres of which have a recent history of irrigation.

Pecan orchard in the Pinal AMA. Non-Indian agricultural demand in the AMA during 2001-2005 averaged approximately 833,100 AFA, or 46.6% of the total agricultural demand in the planning area.

Prescott AMA

Average annual agricultural demand in the Prescott AMA for the 2001-2005 time-period was 5,300 acre-feet, or 0.7% of the total agricultural demand in the AMA Planning Area. There has been a significant decrease (approximately 60%) in agricultural water use within the AMA over the past two decades. Agricultural demand is now approximately 22% of the total Prescott AMA demand. Historically, both groundwater and surface water supplies were utilized to meet agricultural demand; however, there has been a shift to greater utilization of groundwater and recovery of effluent credits due to transfer of Chino Valley Irrigation District (CVID) surface water rights to the City of Prescott.

Most of the irrigated lands are located in the northern part of the AMA near the Town of Chino Valley where groundwater and recovered effluent are used. Additional acres are irrigated with groundwater in the southern portion of the AMA along the Agua Fria River (see Figure 8.3-12). From 2001 to 2005 the number of irrigated acres declined from 5,175 acres to 1,546 acres.

The only irrigation district within the Prescott AMA is CVID, located in the Little Chino Sub-basin. CVID originated at around the turn of the 20th century as the Arizona Land and Irrigation Company and was incorporated as CVID in 1926. Historically, the CVID was entirely a surface water provider that supplied water to slightly more than 2,500 acres of irrigated lands (Gookin, 1977). Surface water was diverted from two reservoirs, Watson Lake and Willow Lake, which are connected by a cross-cut canal constructed in 1965. In 1998, CVID entered into an intergovernmental agreement (IGA) with the City of Prescott in which CVID's surface water rights were relinquished to the City. Pursuant to the IGA, all CVID deliveries from Prescott are now effluent through recovery of long-term storage credits; however, CVID retained a small commitment to serve surface water to three CVID properties (< 30 acre-feet). The maximum annual recovery limit under the IGA is 1,500 acre-feet until a total of 33,000 acre-feet have been recovered. As of 2007, CVID contained approximately 480 irrigated acres and had ceased delivery of surface water.

<u>Santa Cruz AMA</u>

Agricultural demand in the Santa Cruz AMA for the 2001-2005 time-period averaged 13,000 AFA, or 0.7% of the total agricultural demand in the planning area. Agricultural demand has remained relatively stable in the AMA, which has no organized irrigation districts. The predominant agricultural use is pasture land and one irrigation right holder accounts for 33-50% of all agricultural use in the AMA.

<u>Tucson AMA</u>

Non-Indian agricultural demand in the Tucson AMA for the 2001-2005 time-period averaged 96,600 AFA, or approximately 5.4% of the total agricultural demand in the planning area. Agricultural demand has remained relatively constant and accounts for approximately 29% of the Tucson AMA non-Indian water demand. Groundwater is the primary agricultural water supply. During 2001-2005, in lieu CAP water was also used, meeting about 26% of the agricultural demand. There are two primary agricultural centers: Avra Valley near the town of Marana, and Green Valley/Sahuarita along the Santa Cruz River (see Figure 8.5-12).

The only irrigation district in the AMA with a consolidated distribution system is the Cortaro-Marana Irrigation District (CMID). Located in the Avra Valley/Marana area, CMID is an arm of the Cortaro Water Users' Association, formed in 1948. CMID pumps water from wells to serve its customers. It has several surface water rights and claims wells as points of diversion; however, the Department accounts for this water as groundwater in its water budget. CMID operates a delivery system that provides water to about 11,000 irrigated acres. The system consists of almost 54 miles of concrete lined canals, eight miles of pipeline and 45 irrigation wells. In 2007, CMID pumped approximately 31,800 acre-feet of water and received 2,500 acre-feet of in lieu CAP and 2,000 acre-feet of CAP water.

Other farming operations in the Avra Valley include those within the Avra Valley Irrigation

Agriculture in the Tucson AMA. Non-Indian agricultural demand in this AMA during 2001-2005 averaged 96,600 AFA, or approximately 5.4% of the total agricultural demand in the AMA Planning Area.

District (which does not operate a consolidated distribution system), BKW Farms, and other irrigators. Both groundwater and CAP water are used to irrigate crops, which are predominantly cotton in this area. In 2006 approximately 7,800 acre-feet of groundwater was used, along with approximately 7,000 acre-feet of in lieu CAP.

A relatively large agricultural operation, Farmers Investment Company (FICO), is located in the Sahuarita – Green Valley area and predominantly grows pecans. FICO is separated into two operating areas: the northern section has approximately 4,000 acres and the southern section approximately 1,800 acres. FICO used approximately 29,700 acre-feet of groundwater in 2006. Although FICO is currently permitted to receive in-lieu CAP, the physical infrastructure necessary to deliver CAP does not yet exist.

Another relatively large farming operation is located in the northern part of the AMA near Red Rock. Kai Farms-Red Rock grows predominantly row crops and has recently planted pecans. In lieu CAP water and groundwater are used for irrigation. In 2006, 9,709 acre-feet of in lieu CAP was used to meet demand.

Industrial Demand

Industrial demand in the AMA Planning Area averaged approximately 231,200 acre-feet annually between 2001 and 2005. This demand accounted for 9.5% of the total non-Indian water demand in the planning area during the time-period.

While the composition of industrial demand differs among the AMAs, as shown in Table 8.0-17, turf demand has been the highest demand sector overall, followed by power plants and mining. Industrial demand is greatest in the Phoenix AMA with 70% of the total in the planning area followed by the Tucson AMA with 22% of the total.

Within the AMAs, industrial water use is specified in non-irrigation groundwater rights or permits. Water supplied by municipal providers for industrial or commercial use is not reflected within the industrial demand sector but rather within AMA municipal demand. Based on this definition of industrial use, the predominant source of supply in the planning area is groundwater; however, some CAP water and effluent is also used. All industrial users classified within the AMAs have general conservation requirements under the AMA management plans. Additional conservation requirements exist for turf-related facilities, power plants, metal mines, sand and gravel operations, dairies, feedlots, large cooling facilities, new large landscape users and new large industrial users. "Other" industrial users listed in Table 8.0-17 are those subject to the general requirements that apply to all industrial users, as well as large cooling facilities, new large landscape users and new large industrial users.

<u>Phoenix AMA</u>
Industrial demand in the Phoenix AMA averaged 162,400 AFA during 2001-2005; 8% of the Phoenix AMA non-Indian demand. Although the total annual demand in the AMA has been

Feedlot in the Pinal AMA near Maricopa. The largest industrial water use category in the AMA is dairies and feedlots. Seventeen new, large-scale dairies were constructed in the Pinal AMA during 2000 to 2006, bringing the total number to 28.

Table 8.0-17 Average annual industrial demand in the AMA Planning Area (excluding Indian demand)

Type/*AMA*	1991-1995	1996-2000	2001-2005
	Water Use (acre-feet)		
Power Plant Total	**52,200**	**61,700**	**69,410**
Phoenix AMA	50,400	58,700	65,600
Pinal AMA	0	0	10
Tucson AMA	1,800	3,000	3,800
Turf Total[1]	**53,300**	**70,100**	**77,800**
Phoenix AMA	42,900	58,000	62,900
Pinal AMA	1,900	2,500	4,800
Prescott AMA	400	500	800
Santa Cruz AMA	1,000	1,100	1,100
Tucson AMA	7,100	8,000	8,200
Dairy/Feedlot Total	**10,370**	**13,600**	**19,200**
Phoenix AMA	7,800	9,700	11,900
Pinal AMA	2,500	3,800	7,200
Tucson AMA	70	100	100
Mining Total[2]	**54,900**	**53,700**	**45,800**
Phoenix AMA	9,600	8,500	9,200
Pinal AMA	400	400	1,200
Prescott AMA	200	200	100
Santa Cruz AMA	200	200	100
Tucson AMA	44,500	44,400	35,200
Other Total[3]	**16,900**	**18,000**	**21,620**
Phoenix AMA	12,000	11,700	15,300
Pinal AMA	700	1,500	1,500
Prescott AMA	100	500	600
Santa Cruz AMA	200	200	220
Tucson AMA	3,900	4,100	4,000

Source: ADWR 2008

[1] Turf-related facilities include golf courses, schools, parks, cemeteries and common areas of subdivisions

[2] Mining uses include both hard rock mines and sand and gravel operations

[3] Other category includeslarge cooling facilities, new large landscape and other industrial users.

increasing, the portion attributed to industrial use has remained fairly stable. The largest industrial use category during that period were power plants. There are nine relatively large powerplants in the AMA but the largest by far is the Palo Verde Nuclear Generating Facility. Palo Verde used over 64,000 acre-feet in 2005, a majority of which was effluent. All powerplants use some groundwater with the exception of Redhawk which uses 100% effluent. The SRP Kyrene and San Tan plants use some CAP water.

The next largest industrial use in the Phoenix AMA are turf related facilities, primarily golf courses, which accounted for 39% of the industrial use in 2005.

Though dairy operations have been relocated from the Phoenix AMA to the Pinal AMA and rural Arizona, there were still 81 large-scale dairy operations and 8 large-scale feedlots in the AMA during 2005, representing 7% of the total industrial demand. Sand and gravel operations are a fairly stable demand within the Phoenix AMA with approximately 6% of the total industrial demand. Approximately 9% of the industrial demand is by "other" industrial users such as small-scale dairies, industrial facilities and high water use landscape areas less than ten acres in size.

Pinal AMA

Industrial demand in the Pinal AMA during 2001-2005 averaged approximately 14,700 acre-feet, or 6% of the total industrial demand in the planning area and less than 2% of the Pinal AMA non-Indian demand. The largest industrial water use in the AMA is dairies and feedlots. Seventeen large-scale dairies were constructed in the Pinal AMA from 2000 to 2006, bringing the total number to 28. Many of these were dairies relocated from the Phoenix AMA due to urbanization. The number of new dairies in the

AMA has leveled off, with only three starting operations after January 2004 and another in the planning stage. The additional dairies have increased the acreage of forage crops in the AMA and also impacted agricultural demand.

Water for turf irrigation, primarily golf courses, has been steadily increasing and was the second largest industrial user in the AMA during 2001-2005 averaging 4,800 AFA.

Prescott AMA

Industrial water demand within the Prescott AMA is limited to two golf courses (Prescott Country Club and Quailwood), sand and gravel operations and other industrial uses. Groundwater is the only water supply used for this demand. The average annual demand during 2001-2005 was approximately 1,500 acre-feet, or 6% of the Prescott AMA demand and less than 1% of the total industrial demand in the planning area.

Santa Cruz AMA

Approximately 1,500 acre-feet (7%) of the average 2001-2005 total water demand in the Santa Cruz AMA was industrial. Most of this demand occurred at two industrial golf courses and other turf-related facilities. As shown on Table 8.0-17, relatively small amounts of water were also used by sand and gravel operations and by other industrial users.

Tucson AMA

Industrial water demand in the Tucson AMA during 2001-2005 averaged 51,100 AFA, or 22% of the total industrial demand in the planning area. This accounted for 16% of the total Tucson AMA demand; the largest percentage of any AMA, and was primarily met with groundwater.

Water for the mining sector was almost 69% of the industrial demand in the AMA and 77% of the total mining demand in the planning area.

Aerial view of copper mines in the Green Valley area, Tucson AMA. Historically, mine water was supplied by groundwater.

Most of this demand came from three active copper mines, all located west of the Sahuarita/Green Valley area (Figure 8.5-12). Water use at the Mission, Silver Bell and Sierrita mines has fluctuated through time, reaching a peak in the mid 1990s when almost 50,000 acre-feet of water was used. By 2002, water use fell by almost half due to low copper prices. More recently, with the price of copper reaching historic highs, mining water use is again on the rise. Historically, all mine water was supplied by groundwater. Begining in 2007 approximately 1,000 acre-feet of CAP water was used at the Mission mine and that volume increased to over 8,100 acre-feet in 2009.

In addition to the copper mines, other industrial users in the Tucson AMA include sand and gravel operations, turf facilities, electric power plants, a dairy and other types of industrial users. As listed in Table 8.0-17, industrial turf facilities were the second largest industrial water uses averaging of 8,200 AFA during 2001-2005. The two power plants in the AMA, TEP-Wilson Sundt Generating Station (formerly Irvington Station) and APS Saguaro Station, used an average of 3,800 AFA during 2001-2005.

8.0.8 Water Resource Issues in the AMA Planning Area

A number of water resource issues exist in the AMA Planning Area. These issues have been identified by the Department through its management plans, stakeholder processes, a Governor's Commission, an Arizona Town Hall, and numerous community water resource groups. Groundwater pumping, achievement of management goals, access to renewable water supplies, legal differences between groundwater and non-groundwater, environmental protection, local area management and increasing salinity are some of the important considerations in the planning area. Discussed below are issues that have been identified in the past decade and are common to multiple AMAs. These and other AMA issues will be evaluated in detail in the Department's AMA Fourth Management Plans.

Residual (Allowable) Groundwater Pumping and Management Goals

Groundwater withdrawals allowed under the Groundwater Code, management plans and Assured Water Supply (AWS) Rules through groundwater rights, groundwater permits, and certificates and designations of AWS are a significant obstacle towards achieving AMA management goals. Four of the five AMAs have safe-yield as a component of their goal. The definition of safe-yield is, "to achieve and thereafter maintain a long-term balance between the annual amount of groundwater withdrawn in an active management area and the annual amount of natural and artificial groundwater in an active management area." A.R.S. § 45-561(12). Groundwater pumped in excess of safe-yield is termed groundwater "mining" or overdraft.

The safe-yield AMAs (Phoenix, Prescott, Santa Cruz and Tucson) have made progress toward achieving their management goals through recharge, replenishment, retirement of agricultural land and conservation, but challenges remain. As allowed by the Code, AWS Rules and the management plans, the responsibility to reduce mined groundwater pumping may not apply proportionately or equitably to all water-using sectors. For example, although water providers designated as having an AWS are required to use renewable supplies, they can continue to use a limited amount of groundwater. Industrial and agricultural users have management plan incentives to use renewable water supplies, but there are no mandatory requirements. In some AMAs the allowable pumping volume may be a large proportion of the overdraft.

Use of domestic/exempt wells is not subject to groundwater replenishment nor management plan requirements. Exempt well pumpage can represent a significant percentage of water demand in some AMAs. For example, over 9,000 exempt wells are estimated to be in use in the Prescott AMA and may account for as much as 25 percent of the AMA municipal water use. (Since exempt wells are exempt from the Department's reporting requirements, the actual amount of water use is unknown). The number of exempt wells is expected to increase through parcel splits and dry lot developments, where each lot owner drills their own well due to the lack of a centralized water service.

Access to Renewable Water Supplies

Utilization of renewable supplies has increased over the past 20 years, facilitated by the construction of surface water treatment plants and completion of the CAP, allowing use of Colorado River water either directly or indirectly through artificial recharge and recovery projects. Several issues are associated with using CAP water. These issues include: limited CAP supplies; the need to construct new infrastructure to permit full utilization of supplies; financing of infrastructure; and the roles of the Central Arizona Groundwater Replenishment District (CAGRD) and the Arizona Water Banking Authority (AWBA) to ensure long-term availability of renewable supplies for the AMAs.

As groundwater supplies diminish and more developments require groundwater replenishment or direct use of non-groundwater supplies pursuant to the AWS Rules, competition for renewable water supplies will increase. The debate on the reallocation of CAP Non-Indian Agricultural water is indicative of the level of interest in acquiring renewable supplies, even where they may be relatively expensive, subject to shortages, or available in small volumes.

Many CAP Municipal and Industrial (M&I) subcontractors lack direct access to CAP water and must utilize the resource indirectly through underground storage facilities, or groundwater savings facilities, located in close proximity to the CAP infrastructure. Because recovery is not required to occur in the area of replenishment, some areas may experience local water level declines and encounter physical availability limitations in the future. Funding for extension of the CAP canal in the Tucson AMA, as well as for water treatment and secondary infrastructure in all AMAs, limits direct renewable supply utilization in some areas.

Developers and water providers contract with the CAGRD to replenish groundwater withdrawals as required by the AWS Rules. To meet its replenishment obligations to member lands and service areas the CAGRD competes for renewable water supplies with other users in the Phoenix, Tucson and Pinal AMAs. If the CAGRD cannot meet its obligations, its plan of operation is considered inconsistent with the AMA management goal, which could impact approval of AWS Certificates and jeopardize the status of AWS Designations.

Central Arizona Project Canal. Utilization of renewable supplies has increased over the past 20 years, facilitated by the construction of surface water treatment plants and completion of the CAP, allowing use of Colorado River water either directly or indirectly through artificial recharge and recovery projects.

AMAs without access to CAP water (Prescott and Santa Cruz AMAs) must look to other water supplies in order to meet their management goals. For the Prescott AMA, transporting alternative long-term supplies into the AMA is critical to achieving safe-yield in this groundwater-dependent AMA. The only alternative supplies currently available are a limited amount of effluent, and groundwater transported from the adjacent Big Chino Sub-basin pursuant to A.R.S. § 45-555. In the Santa Cruz AMA access to both renewable and groundwater supplies is influenced by water demand in the large upstream community of Nogales, Sonora. Some of this demand is offset by delivery and treatment of effluent generated in Mexico at the Nogales, Arizona, International Wastewater Treatment Plant (IWWTP), which discharges treated effluent to the Santa Cruz River near Rio Rico. However, there are currently no treaties or legal agreements regarding rights to the treated effluent nor for continued delivery and treatment of Mexican effluent at the IWWTP.

Effluent is a growing renewable resource in all AMAs, but physical distance between the location where the effluent is generated and the location of potential users, and lack of delivery infrastructure, limit its direct use in some areas. As with CAP water, recharge and recovery is utilized with similar concerns about the spatial disconnect between storage and pumping.

Legal Differences Between Groundwater and Non-Groundwater

Groundwater and surface water are managed under different statutes with limited integration and consistency in approach. In the rapidly growing AMAs with multiple water sources, the statutory limitations on management of non-groundwater supplies may be problematic. Water management efforts are currently fragmented because effluent, CAP water, surface water and groundwater are all regulated differently and in many cases owned or controlled by different entities. An exception to fragmented water management is the Santa Cruz AMA, where legislation creating the AMA expressly addressed its unique hydrogeology and the inter-connection of surface and groundwater supplies. Its management goal requires coordinated management of surface water and groundwater supplies to address seasonal and drought-sensitive conditions along the Santa Cruz River.

Environmental Protection

Restoration and preservation of riparian areas is a high priority in some AMAs. Potential effects on these areas from ongoing groundwater pumping and surface water diversions are a concern. These riparian areas function as natural recharge zones through streambed infiltration and can beneficially serve both environmental and water management objectives if managed appropriately.

Local (Critical) Area Management

Management goals and programs currently apply to entire AMAs regardless of local conditions. However, areas within AMAs may have specific critical concerns. For example, hydrologic conditions can vary widely, from waterlogged areas to areas with severe groundwater overdraft that may result in land subsidence, earth fissures, and aquifer compaction. Overdraft may affect water supply reliability for local groundwater users who lack access to renewable water supplies.

Nogales, Arizona, International Wastewater Treatment Plant. Photo courtesy of the International Boundary and Water Commission

Salinity

The concentration of total dissolved solid (TDS) levels in CAP water, surface water and effluent can exceed that in native groundwater. Typical TDS levels in Phoenix area reclaimed water range from 800 to 1400 mg/l compared to a range of 580 to 650 mg/l found in CAP water. Groundwater in the Phoenix area ranges from 200 to 5,000 mg/l (City of Phoenix, 2008). As these renewable supplies are increasingly utilized in the planning area, salinity levels will increase in both soil and groundwater. Studies suggest there is an annual net gain of approximately 1.1 million tons of salts in the Phoenix area and about 100,000 tons in the Tucson area. (USBOR, 2003)

High salinity levels in water reduce its suitability for some uses, or may necessitate additional treatment. Salinity reduces the life of household appliances, may require water softening for some purposes, and can reduce crop yields. Salt accumulation in agricultural area soils requires supplemental water to flush salts below plant root zones. Because salts become concentrated in wastewater, irrigation with reclaimed water may be problematic and its disposal increases salt-loading in groundwater.

8.0.9 AMA Water Resource Characteristics

Sections 8.1 through 8.5 present data and maps on water resource characteristics of the groundwater basins in the AMA Planning Area. A description of the data sources and methods used to derive this information is found in Section 1.3 of Volume 1 of the Atlas. This section briefly describes general information that applies to all of the basins and the purpose of the information. This information is organized in the order in which the characteristics are discussed in Sections 8.1 through 8.5.

Geographic Features
Geographic features maps are included to present a general orientation to principal land features, roads, counties and cities, towns and places in the groundwater basin.

Land Ownership
The distribution and type of land ownership in a basin have implications for land and water use. Large amounts of private land typically translate into opportunities for land development and associated water demand, whereas Federal lands are typically maintained for a public purpose with relatively little associated water use. State-owned land may be sold or traded, and is often leased for grazing and farming. The extent of State-owned lands is due to a number of legislative actions. The State Enabling Act of 1910 and the Act that established the Territory of Arizona in 1863 set aside sections 2, 16, 32 and 36 in each township to be held in trust by the State for educational purposes. Other legislation authorized additional State Trust Lands for specified purposes, which are identified for each basin (ASLD, 2006).

Climate
Climate data including temperature, rainfall, evaporation rates and snowfall are critical components of water resource planning and management. Averages and variability, seasonality of precipitation and long term climate trends are all important factors in demand and supply planning. Important in the AMA Planning Area is the heat island effect, which is affecting climate in major metropolitan areas.

Surface Water Conditions
Depending on physical and legal availability, surface water may be a potential supply in a basin. Stream gage, flood gage, reservoir, stockpond and runoff contour data provide information on physical availability of this supply. Seasonal flow information is relevant to seasonal supply availability. Annual flow volumes provide an indication of potential volumetric availability.

Surface water maps display runoff contours and the location of reservoirs and gages. Also shown are 1st and 2nd order streams, and 3rd order streams with gages. The stream order used is the Cartographic order, similar to “stream level” used by the USGS to categorize streams in its National Hydrography Dataset (NHD). This method assigns Level 1 to the principal stream in a drainage area, major tributaries are assigned Level 2, minor tributaries are assigned Level 3, etc.

Criteria for including stream gage stations in the AMA tables are that there is at least one year of record, and annual streamflow statistics are included only if there are at least three years of record. There are different types of stations and those that only serve repeater functions were not included.

Flood gage information is presented to direct the reader to sources of additional precipitation and flow information that can be used in water resource planning. Large reservoir storage information provides data on the amount of water stored in the basin, its uses, and ownership. Because of the large number of small reservoirs, and less reliable data, individual small reservoir data is not provided. The number of stockponds is a general indicator of small-scale surface water capture and livestock demand. Runoff contours reflect the average annual runoff in tributary streams. They provide a generalized indication of the amount of runoff that can be expected at a particular geographic location.

<u>Perennial and Intermittent Streams and Major Springs</u>

A map of perennial and intermittent streams is provided for each AMA. For some AMAs, more than one source of information was used. Stream designations may not accurately reflect current conditions in some cases. Spring data was compiled from a number of sources in an effort to develop as comprehensive a list as possible. Spring data is important to many researchers and to the environmental community due to their importance in maintaining habitat, even from small discharges.

<u>Groundwater Conditions</u>

Several indicators of groundwater conditions are presented for each AMA. Aquifer type can be a general indicator of aquifer storage potential, accessibility of the supply, aquifer productivity, water quality and aquifer flux. Well yield information for large diameter wells is provided and is generally measured when the well is drilled and tested and is reported on completion reports. It was assumed that large diameter wells were drilled to produce a maximum amount of water and, therefore, their reported pump capacities are indicative of the aquifer's potential to yield water to a well. However, many factors can affect well yields including well design, pump size and condition and the age of the well. Reported well yields are only a general indicator of aquifer productivity and specific information is available from well measurements conducted as part of basin investigations. Natural recharge is often one of the least well known component of a water budget. Recharge estimates are generally from hydrologic studies conducted within the AMA.

Water level data are from measured wells, usually collected during the period when the wells were not actively being pumped or only minimally pumped. Shown are water level changes over an approximately ten-year period. Depth to water measurements are shown on mapped wells for the most recent measurement. The basin hydrographs show water-level trends for selected wells, typically over a 30-year period from 1975 to the year of most recent measurement, which varies between AMAs.

The flow directions that are shown generally reflect long-term, regional aquifer flow in the basin and are not meant to depict temporary or local-scale conditions. However, flow directions in some AMAs indicate how localized pumping has altered regional flow patterns.

Groundwater recharge is an important water management program in the AMAs and has had significant effects on groundwater levels at a number of locations. Permit information and the location of underground storage facilities and groundwater savings facilities where CAP water, effluent and surface water are stored for later recovery are shown on maps and tables.

<u>Water Quality</u>

Water quality conditions impact the suitability of water supplies for certain uses. Water providers serving more than 25 people or having 15 or more connections are regulated under the Safe Drinking Water Act and treat water supplies to meet drinking water standards (for more information see www.azdeq.gov). Water quality data were compiled from a variety of sources as described in Volume 1. The data indicate areas where water quality exceedences have previously occurred, however additional areas of concern may currently exist where water quality samples have not been collected or sample results were not reviewed by the Department (e.g. samples collected in conjunction with the ADEQ Aquifer Protection Permit programs). It is important to note also that the exceedences presented may or may not reflect current aquifer or surface water conditions. Due to a high density of measured sites in the Phoenix, Pinal, Santa Cruz and Tucson AMAs, most sites within 0.75 miles of one another share a common map key. Also shown are contamination sites including DOD, RCRA, Superfund, WQARF, VRP and LUST sites including location, affected media and specific contaminant.

Cultural Water Demand

Cultural water demand, defined in the Atlas as municipal, industrial and agricultural water demand, is an important component of a water budget. Mandatory metering and reporting of water use in the AMAs has resulted in the collection of extensive and relatively accurate demand data. Municipal demand includes water company and domestic (self-supplied) demand estimates. AMA demand information is compiled from several sources in order to prepare as accurate an estimate as possible. Annual demand estimates have been averaged over a specific time-period. This provides general trend information without focusing on potentially inaccurate annual demand estimates due to incomplete data or anomalous weather conditions in a single year.

Locations of major cultural water uses are primarily from a 2004 USGS land cover study using older satellite imagery that may not represent recent changes. The cultural demand maps provide only general information about the location of water users.

Effluent generation data were compiled from several sources to provide an estimate of how much of this renewable resource might be available for use. However, effluent reuse is often difficult to determine both logistically and economically since a potential user may be far from the wastewater treatment plant.

Assured Water Supply

Detailed information on Assured Water Supply (AWS) determinations for subdivisions, master planned communities and service areas are shown on maps and tables. Also shown are Water Adequacy Reports which were issued prior to enactment of the Groundwater Code in 1980. Change of ownership of a previously issued determination is not counted in the totals shown on tables and maps.

Developers of subdivisions within AMAs are required to obtain a determination of whether there is sufficient water of adequate quality available for 100 years and that the development is consistent with the management plan and management goal of the AMA. In addition to these subdivision determinations for which a Certificate of AWS is issued, water providers may apply for assured water supply designations for their entire service area. If a subdivision is to be served water from a designated service area, then a separate Certificate of AWS is not required (See Section 8.0-5).

Developers also have the option to obtain an Analysis of AWS, which is generally used to prove that water will be physically available for master planned communities and are issued based on a development plan or plat. If an Analysis is issued for groundwater, it reserves a specific volume of water for 10 years (for purposes of further assured water supply reviews) only for the specific property that is the subject of the Analysis of AWS.

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